JOINT NATURE CONSERVATION COMMITTEE

Coasts and seas of the United Kingdom

Region 13 Northern Irish Sea
Colwyn Bay to Stranraer, including the Isle of Man

edited by
J.H. Barne, C.F. Robson, S.S. Kaznowska, J.P. Doody & N.C. Davidson

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This volume has been produced by the Coastal Directories Project of the JNCC
on behalf of the project Steering Group,
with sponsorship from the Ministry of Agriculture, Fisheries & Food.

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Recommended citation for this volume:

Barne, J.H., Robson, C.F., Kaznowska, S.S., Doody, J.P., & Davidson, N.C., *eds*. 1996. C*oasts and seas of the United Kingdom. Region 13 Northern Irish Sea: Colwyn Bay to Stranraer, including the Isle of Man.* Peterborough, Joint Nature Conservation Committee.

Recommended citation for a chapter in this volume (example):

Davidson, N.C. 1996. Chapter 4.1 Estuaries. *In: Coasts and seas of the United Kingdom. Region 13 Northern Irish Sea: Colwyn Bay to Stranraer, including the Isle of Man,* ed. by J.H. Barne, C.F. Robson, S.S. Kaznowska, J.P. Doody, & N.C. Davidson, 63-66. Peterborough, Joint Nature Conservation Committee.

Region 1: ISBN 1 873701 75 6
Region 2: ISBN 1 873701 76 4
Region 3: ISBN 1 873701 77 2
Region 4: ISBN 1 873701 78 0
Region 5: ISBN 1 873701 79 9
Region 6: ISBN 1 873701 80 2
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Region 12: ISBN 1 873701 86 1
Region 13: ISBN 1 873701 87 x
Region 14: ISBN 1 873701 88 8
Region 15/16: ISBN 1 873701 89 6
Region 17: ISBN 1 873701 92 6

Set of 17 regions: ISBN 1 873701 91 8

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Foreword

Information is vital for sound policy formulation. Decision makers at national and local level need to know more than just the scale, location and importance of natural resources that are of value to humans. They have to understand how human activities affect the value of those resources and how to conduct those activities in an environmentally sustainable way. This is true for virtually every activity that impinges on the natural environment. In the coastal zone the complexity of the relationships between the physical and biological systems adds another dimension to the problems of formulating management policy.

I am pleased, therefore, to be introducing the *Coasts and seas of the United Kingdom* series. The Coastal Directories project, of which this series of seventeen regional reports, covering the whole of the UK coast, is an important product, has brought together an encyclopaedic range of information on our coastal resources and the human activities that are associated with them. Amongst the topics covered are the basic geology of the coasts around the United Kingdom and measures taken for coast defence and sea protection, the distribution and importance of the wildlife and habitats of our coasts and seas, including fish and fisheries, and the climate and sea level changes to which they all are subject.

In addition to the value of the information itself, the way the project has been run and the data collected has made an important contribution to the quality of the product. A wide range of individuals and organisations concerned with the conservation and use of the coastal margin have collaborated in collating the information, their variety reflecting the extent of the interplay between the coastal environment and human activities. These organisations included the Ministry of Agriculture, Fisheries and Food, the Scottish Office Agriculture, Environment and Fisheries Department, the National Rivers Authority, the Countryside Commission, the Scottish Office, the Welsh Office, the Department of the Environment, the Sea Fisheries Committees, English Nature, Scottish Natural Heritage and the Countryside Council for Wales, together with local authorities, voluntary conservation organisations and private companies (notably those in the oil industry, through the UK Offshore Operators Association). I am also pleased to be able to acknowledge the contribution made by the staff of the Joint Nature Conservation Committee. As the work has evolved since the first meetings of the Steering Group in 1990, the value of involving such a broad span of interests has been highlighted by the extent to which it has allowed new approaches and information sources to be identified.

The regional reports will be of value to all who live and work in the maritime areas of the UK, where informed management is the key to the sustainable use of resources. The reports should become indispensable reference sources for organisations shouldering new or expanded responsibilities for the management of marine Special Areas of Conservation under the EC Habitats Directive. In addition, the reports will make an important contribution to the implementation of the UK Biodiversity Action Plan. The notes that follow provide some general guidance about finding and interpreting the information in this book.

The Earl of Selborne
Chairman, Joint Nature Conservation Committee

How to use this book

Structure

The book is divided into ten chapters, each split into sections containing summary data on the topics shown in the Contents list. Chapter 2 provides an overview of the general physical background to the region. Sections in Chapters 3, 4 and 5 have been compiled to the following standard format:

- **Introduction**: presents the important features of the topic as it relates to the region and sets the region in a national context.
- **Important locations and species**: gives more detail on the region's features in relation to the topic.
- **Human activities**: describes management and other activities that can have an effect on the resource in the region.
- **Information sources used**: describes the sources of information, including surveys, on which the section is based, and notes any limitations on their use or interpretation.
- **Acknowledgements**
- **Further sources of information**: lists references cited, recommended further reading, and names, addresses and telephone numbers of contacts able to give more detailed information.

Sections in the remaining chapters all have the last three subsections and follow the other elements as closely as practicable, given their subject nature.

At the end of the book there is a list of the addresses and telephone numbers of organisations most frequently cited as contacts, as well as a core reading list of books that cover the region or the subject matter particularly well. Finally there is a full list of authors' names and addresses.

Definitions and contexts

The word 'region' (as in 'Region 13') is used throughout this book to refer to the coastal and nearshore zone, broadly defined, between the two points given in the title of this book. The area covered varies between chapter sections, depending on the form in which data is available. Coverage is usually either coastal 10 km squares, sites within one kilometre of Mean High Water Mark, or an offshore area that may extend out to the median line between the UK and neighbouring states. Inland areas of the counties concerned are not included unless specifically stated.

'Britain' here means Great Britain, i.e. including only England, Scotland and Wales. 'United Kingdom' also includes Northern Ireland.

The term 'North Sea Coast', as used here, means the coast of Britain covered by *The directory of the North Sea coastal margin* (Doody, Johnston & Smith 1993): that is, from Cape Wrath (longitude 5°W) along the east and south coasts of Britain to Falmouth (again longitude 5°W), and including Orkney and Shetland.

The 'West Coast', as used here, normally includes the coast and seas from Falmouth to Cape Wrath along the west coast of Britain. Only where explicitly stated have data for the Isle of Man and/or Northern Ireland been included in West Coast descriptions.

Sites within each chapter section are described in clockwise order around the coast, incorporating islands within the sequence. Maps and tables are numbered sequentially within their chapter section; for example in section 5.4, Map 5.4.1 is the first map referred to and Table 5.4.2 is the second table.

Throughout the book, the information given is a summary of the best available knowledge. The sites mentioned as important, the numbers and distributions of species, archaeological features discovered and information on all the other elements of the natural and man-made environment are as known at December 1994, unless otherwise stated. The fact that no information is presented about a topic in relation to a locality should not be taken to mean that there are no features of interest there, and fuller details should be sought from the further sources of information listed at the end of each section. Note, however, that under the Environmental Information Regulations (1992; Statutory Instrument No. 3240) you may be asked to pay for information provided by organisations.

Acknowledgements

This regional report is one of a series of products from the Coastal Directories Project of the JNCC. The compilation and publication of the series has been made possible by generous contributions from the members of the Coastal Directories Funding Consortium listed below:

Arco British Ltd [1]
Avon County Council
Banff and Buchan District Council
BHP Petroleum Ltd [1]
Ceredigion District Council
Cheshire County Council
Chevron UK Ltd [1]
Cleveland County Council
Clwyd County Council
Clyde River Purification Board
Colwyn Borough Council
Copeland Borough Council
Countryside Commission
Countryside Council For Wales
Cumbria County Council
Cunninghame District Council
Delyn Borough Council
Department of the Environment
Department of the Environment for Northern Ireland
Devon County Council
Dorset County Council
Dumfries and Galloway Regional Council
Dyfed County Council
Eastbourne Borough Council
English Nature
Fife Regional Council
Forest of Dean District Council
Gwynedd County Council
Hampshire County Council
Highland River Purification Board
Humber Forum
Isle of Man Government, Department of Transport
Isle of Man Government, Department of Industry
Isle of Man Government, Department of Local Government and the Environment
Kyle and Carrick District Council
Lancashire County Council
Lincolnshire County Council
Marathon Oil UK Ltd [1]
Ministry of Agriculture, Fisheries and Food: Directorate of Fisheries Research
National Rivers Authority
Neath Borough Council
Norfolk County Council
North Cornwall District Council
North East Fife Regional Council
Nuclear Electric plc
Preseli Pembrokeshire District Council
Restormel Borough Council
Scottish Natural Heritage
Scottish Office Agriculture, Environment and Fisheries Department
Scottish Salmon Growers Association Ltd
Sefton Borough Council
Shepway District Council
Solway River Purification Board
Somerset County Council
South Pembrokeshire District Council
Standing Conference on Regional Policy in South Wales
Stroud District Council
Tayside Regional Council
Torridge District Council
UK Offshore Operators Association [2]
Vale of Glamorgan Borough Council
Water Services Association
Welsh Office
World Wide Fund for Nature (UK)

Notes

[1] Funding from these companies was given to the Cardigan Bay Forum to fund the supply of information to the Project.

[2] The UK Offshore Operators Association is the representative organisation for the British offshore oil and gas industry. Its 34 members are the companies licensed by HM Government to explore for and produce oil and gas in UK waters.

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This collaborative project involves many other branches of JNCC in addition to the project team listed on page 2. These are: Marine Conservation Branch (Keith Hiscock, Tim Hill, Bill Sanderson, Colin McLeod), Vertebrate Ecology and Conservation Branch (Deirdre Craddock, David Stroud, Steve Gibson), Species Conservation Branch (Nick Hodgetts, Deborah Procter, Martin Wigginton), and Seabirds and Cetaceans Branch (Mark Tasker, Paul Walsh, Andy Webb). We thank them all for their help and support.

The project has also received widespread support from the country conservation agencies: Countryside Council for Wales, English Nature, Scottish Natural Heritage and the Department of the Environment (Northern Ireland). We are grateful to the many regional and headquarters staff listed below as well as the representatives on the Core Steering Group.

The editors would also like to thank the many people who have provided information for the project or gave their time to comment on drafts, as well as those who gave editorial assistance:

Jim Andrews, EN; Miran Aprahamian, NRA; Steve Atkins, SNH; Roger Bamber, Fawley Aquatic Research Laboratories Ltd.; Gordon Barclay, Historic Scotland; T.J.C. Beebee, University of Sussex Brighton; Tricia Bradley, RSPB; Andrew Burr, Department of Transport; Keith Corbett, Herpetological Conservation Trust; Dominic Counsell, SNH; Rogey Covey, JNCC; Martyn Cox, The Crown Estate; Peter Cranswick, The Wildfowl and Wetlands Trust; Martin Dodds, Cumbria County Council; Isobel Drummond-Murray, Scottish Office; Kathy Duncan, SNH; David Dunlop, Lancashire Wildlife Trust; Joan Edwards, Devon Wildlife Trust; Matthew Ellis, CCW; Ben Ferrari, National Monuments Records Centre; Jackie Galley, SNH; Mike Gash, CCW; Tony Gent, EN; David George, Natural History Museum; Wells Grogan, Marathon Oil, Paul Harding, Institute of Terrestrial Ecology; David Harpley, Cumbria Wildlife Trust; John Hartley, AMOCO (UK); Stephen Hawkins, University of Southampton; M. Haworth, IoM Department of Transport; Duncan Huggett, RSPB; E. Hutchinson, Dumfries and Galloway Regional Council; Alan Jemmet, EN; Ceri Jones, Metropolitan Borough of Sefton; Graham King, National Coasts and Estuaries Advisory Group; Fiona Lee, SNH; Ben Leyshon, SNH; Chris Lumb, EN; Colin Macduff-Duncan, ESSO; Scot Mathieson, SNH; Tony Murray, The Crown Estate; Diana Murray, Royal Commission on the Ancient and Historical Monuments of Scotland; R. Elwyn Owen, Wales Tourist Board; Frank Parrish, The Crown Estate; Lindsay Pickles, NRA; Iowerth Rees, CCW; Ivor Rees, University of Wales Bangor; Guy Richardson, Cumbria County Council; Mike Roberts, Department of the Environment; Chris Rollie, RSPB; Paul Rooney, Metropolitan Borough of Sefton; Pat Sargeant, EN; Andrea Sharp, Cumbria Wildlife Trust; Duncan Shaw, Irish Sea Forum; Pauline Simpson, Institute of Oceanographic Sciences; Sarah Soffe, CCW; Alastair Somerville, SWT; P.M. Stainer, NRA; Chris Stroud, Whale and Dolphin Conservation Society; Stephanie Tyler, RSPB; Chris Vivian, MAFF; M. Watkins, Hampshire County Council; Sarah Welton, Marine Conservation Society; Janette Williams, Isle of Man Department of Industry and Ray Woolmore, Countryside Commission.

Where appropriate, individual acknowledgements are given also at the end of each section.

Chapter 1 Overview

1.1 The Coastal Directories Project

Dr J.P. Doody

1.1.1 Introduction

Developing policies for coastal environmental management depends on wide ranging contextual information being available. Collecting such information is always time-consuming and difficult, especially ensuring that all relevant aspects are covered.

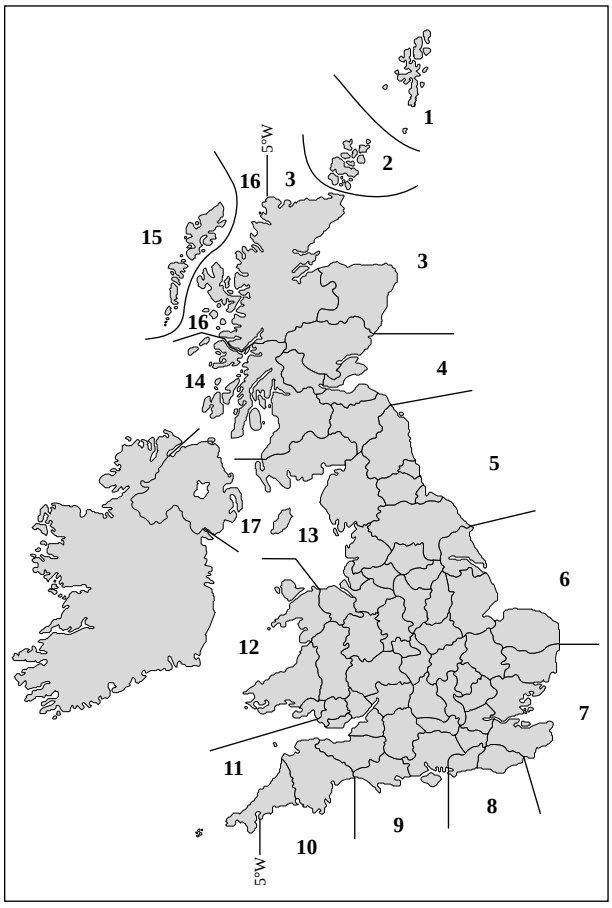
This problem is widely recognised. Nevertheless the solution - amassing the encycopaedic knowledge required, collating it in useable form and disseminating it to potential users while the information is still current - has until recently been too daunting a project for any single organisation to tackle. However, with the help of sponsorship from a large number of organisations and support and practical help from many bodies, ranging from government departments to voluntary organisations, and using numerous experts as writers and consultees, the Joint Nature Conservation Committee has undertaken to prepare such a compendium of information for the coast of the whole United Kingdom.

This undertaking - the Coastal Directories Project - collates existing information on the United Kingdom and Isle of Man coastal zone to provide national and regional overviews of its natural resources and human activities, and indexes more detailed sources of information. The project uses a broad definition of the coastal margin that encompasses all the main habitats from offshore waters through to dry land, including any habitat forming part of the functioning coastal system; in addition areas of former tidal land now enclosed from the sea and lowland wet grassland alongside tidal rivers are included. At times it can be either unhelpful or impossible to set precise limits on the geographic areas that need to be covered, for example in the marine environment, such as when discussing fisheries or sources of contamination. However, where possible, coverage is of coastal 10 km squares, or sites within one kilometre of Mean High Water Mark, or (for marine topics) from the landward limit of high tides out to the median line between the UK and neighbouring states. Inland areas are not included unless specifically stated.

The relationships between the many and varied components of the coastal zone, that is, between the physical functioning of the zone, its biological components and the human activities that take place there, are complex. With this in mind, a wide-ranging approach to collating coastal information has been adopted in the project; information has been drawn from many sources, from national databases and nation-wide published surveys to the personal observations of field specialists and the newsletters of amateur societies. The approach has also served to highlight the interactions and interdependence between the environmental components (and between the various bodies and individuals) involved. This should help to ensure that users of the information develop policies and adopt strategies that secure the integrated, sustainable use and management of the coastal zone while maintaining biological diversity - a key element of Agenda 21 of the Rio Earth Summit in 1992.

1.1.2 Origins and early development of the project

The concept of providing integrated coastal information took a long time to evolve into the Coastal Directories Project. As early as 1984, the need for such data was acknowledged at the first International Conference on the Protection of the North Sea. In 1987, recognising the significant gaps that existed in the scientific understanding



Map 1.1.1 Regions in the series. Region names are given in Table 1.1.2.

of the North Sea, the Second International Conference on Protection of the North Sea established the North Sea Task Force (NSTF). Under the guidance of the International Council for the Exploration of the Sea (ICES) and the Oslo and Paris Commissions, the NSTF organised a programme of study with the primary aim of producing a (mainly marine) assessment of the North Sea (the *North Sea Quality Status Report* (QSR)) by 1993.

At the second meeting of the NSTF, in 1989, the UK suggested that the North Sea QSR should include consideration of terrestrial habitats and species. This was to involve the collection of information dealing with the coastal margin of the North Sea (defined as being east of longitude 5° West - i.e. from Cape Wrath in northern Scotland around the North Sea and the English Channel coasts to the Fal Estuary in Cornwall) and the collation of this information into book form. A project was set up by the Nature Conservancy Council (NCC) and, after 1991, the Joint Nature Conservation Committee (JNCC), to produce this information, with part funding from the Department of the Environment (DoE). A small group was invited to steer the project and to help identify information sources, including the Department of the Environment (DoE), the Ministry of Agriculture, Fisheries and Food (MAFF), the National Rivers Authority (NRA), the Countryside Commission (CC), the Scottish Office (SO), the Welsh Office (WO) and the country conservation agencies (English Nature, Scottish Natural Heritage, Countryside Council for Wales). With its help, a draft text was prepared in 1990-91; the resulting *Directory of the North Sea coastal margin* - the first product of the Coastal Directories Project, as it was to become - was presented to Ministers at the Intermediate Ministerial Meeting on the North Sea held in Denmark in December 1993 (Doody *et al.* 1993).

The principal aims of the *Directory* were to produce "a comprehensive description of the North Sea coastal margin, its habitats, species and human activities, as an example to other North Sea states" (North Sea Task Force 1993), and thus to help to ensure that terrestrial habitats and species were considered in the QSR. In this it succeeded, and the QSR, also published in 1993, included descriptions of terrestrial habitats and species in several of the sub-regional reports, together with comments on the human impacts on the ecosystems.

The North Sea Task Force was wound up in December 1993, following completion of the *North Sea QSR*, and its work is now carried on by a new Assessment and Monitoring Committee (ASMO), under the 1992 Convention for the Protection of the Marine Environment of the North East Atlantic (the OSPAR Convention). This convention requires that assessments similar to the North Sea QSR be produced for all the constituent parts of the north-east Atlantic, and for that area as a whole, by the year 2000. The Celtic Seas, including the Irish Sea and the west coast of Britain, are one of the first areas to be subject to assessment.

In the UK during the period 1990 - 1993 there was a considerable upsurge of interest in the principles of coastal management. For example, between November 1991 and February 1992 the House of Commons Environment Committee examined the issues for England; their report on *Coastal zone protection and planning* was published in March 1992 (House of Commons Environment Committee 1992). This report, together with initiatives at UK and European levels, encourages a more integrated, local approach to management issues. At the same time, as the work on the *Directory of the North Sea coastal margin* proceeded, the emphasis of the approach changed. The main aim had been the collection of information, but gradually the process of working with people to gather the data threw the spotlight more on the benefits of a partnership approach and its value for promoting coastal zone management, with which the Coastal Directories Project became more directly linked.

1.1.3 Recent developments

These developments in coastal management fostered interest in the Coastal Directories Project and increased demand for information at a regional level, as well as at the level of whole seaboards (the approach adopted for the *Directory of the North Sea coastal margin*). Between 1992 and 1993, it was decided, therefore, to produce a *West Coast Directory* to cover the remainder of the coast of Great Britain and the Isle of Man and, by later agreement, Northern Ireland, as well as a series of regional volumes to cover the whole coast of the United Kingdom. Regions were defined, wherever possible, by the current local or national government coastal boundaries that most closely approximated to the limits of major coastal process cells (see section 2.4), to ensure that pragmatic management requirements were matched by an ecologically coherent information base. Seventeen regional volumes have been or are being prepared: the areas that they cover are shown in Map 1.1.1. Regions 1 - 10 cover the area of the *Directory of the North Sea coastal margin*; Regions 11 - 17 deal with the area of the *West Coast Directory*. These regional volumes provide a more detailed level of information than the *Directory of the North Sea coastal margin*, to help set each region in a national context and facilitate the preparation of regional plans. Discussions in the main steering group (see below) in January 1994 resulted in early completion of the

Table 1.1.1 Coastal Directories project management structure

Group	*Role*	*Undertaken by*
JNCC Coastal Conservation Branch (CCB)	Day to day management	Head of CCB, project coordinators
Project management board	Liaison & executive decisions	Country conservation agencies (English Nature, Scottish Natural Heritage, Countryside Council for Wales), JNCC Coastal Conservation Branch
Core steering group	Steer work, provide information and support	See page 2
Main steering group (includes all funding consortium members, amongst others)	Review progress, consider new developments, provide expert advice and act as consultees	All members, through an annual steering group seminar and individually

regional volumes, rather than the overview *West Coast Directory*, becoming the priority.

Whereas work for the *Directory of the North Sea coastal margin* was funded principally by the DoE and the NCC/JNCC, it was decided to seek funding for the extended project from a consortium of private organisations and public bodies, including the original steering group members, as well as coastal local authorities (see page 7). In the event more than 200 organisations, from government departments and oil, water and power companies to nature conservation organisations, both statutory and voluntary, have contributed either money or information or both to the project; further participants are still coming forward. Those organisations that contributed money - the funding consortium - and a number of others comprised the main steering group, and from this group a smaller number were identified to form the core steering group (Table 1.1.1).

Interest in the project has been reflected in the level of sponsorship that the project has received and in the commitment shown by members of the steering groups, which meet regularly. The main steering group meets annually for a seminar: so far it has considered the *Role of the Directories in the development of coastal zone management* (January 1994), and the *Use of electronic storage and retrieval mechanisms for data publication* (February 1995); the core steering group also meets at least annually.

1.1.4 The contribution of the project to coastal management

At the outset it was agreed that the work should involve as many as possible of the individuals and organisations concerned with the use of the coastal margin, to reflect the complex nature of the habitats and species and the wide-ranging influence of human activities. As the project evolved, the value of this approach has been highlighted by the extent to which new approaches and information sources have been identified. The dialogue between the Coastal Directories Project funding consortium members has confirmed the importance of the project in providing basic resource information to support new approaches to coastal management.

Increasingly, the regional volumes are seen as providing essential information to inform the development of coastal zone management policy at a national level. They provide information that complements the approach currently being promoted by a range of government reports. These include PPG 20: *Planning Policy Guidelines: coastal planning* (DoE/Welsh Office 1992), the *Policy guidelines for the coast* (DoE 1995) and the two consultation documents that followed up the House of Commons Environment Committee report: *Development below low water mark* (DoE/Welsh Office 1993) and *Managing the coast* (DoE/Welsh Office 1993) (note that these reports do not cover Scotland, Northern Ireland or the Isle of Man). MAFF too has promoted the setting up of flood and coastal defence 'coastal cell groups', to encourage sustainable shoreline management.

It has also been recognised that the summary information in the regional volumes is valuable in preparing and assessing applications for oil and gas licensing around the coastal margin. An injection of funds from the United Kingdom Offshore Operators Association (UKOOA) made possible the early production of draft regional reports for most of the potential licensing areas in the 16th Offshore Oil and Gas Licensing Round in 1994.

Table 1.1.2 (Provisional) titles and publication dates of products of the Coastal Directories Project

Product	*Publication date*
Book editions	
Directory of the North Sea coastal margin	1993
Region 1. Shetland	Due 1997
Region 2. Orkney	Due 1997
Region 3. North-east Scotland: Cape Wrath to St. Cyrus	Due 1996
Region 4. South-east Scotland: Montrose to Eyemouth	Due 1997
Region 5. North-east England: Berwick-on-Tweed to Filey Bay	1995
Region 6. Eastern England: Flamborough Head to Great Yarmouth	1995
Region 7. South-east England: Lowestoft to Dungeness	Due 1997
Region 8. Sussex: Rye Bay to Chichester Harbour	Due 1997
Region 9. Southern England: Hayling Island to Lyme Regis	Due 1996
Region 10. South-west England: Seaton to Falmouth Bay	Due 1996
Region 11. The Western Appproaches: Falmouth Bay to Kenfig	Due 1996
Region 12. Wales: Margam to Little Orme	1995
Region 13. Northern Irish Sea: Colwyn Bay to Stranraer including the Isle of Man	1996
Region 14. South-west Scotland: Ballantrae to Mull	Due 1996
Region 15.* The Outer Hebrides	Due 1996
Region 16.* North-west Scotland: Loch Linnhe to Cape Wrath	Due 1996
Region 17. Northern Ireland	Due 1996
West Coast Directory	Planned for 1996
Electronic editions	
Coastal and marine UKDMAP datasets: Version 1	1994
Region 12	1996
Other regions	Following book publication

Key: *note that book editions for Regions 15 and 16 will be bound as a single volume.

1.1.5 Outputs

The regional volumes are being published as hardback books. In addition a first release of coastal conservation data, covering national surveys of terrestrial habitats and coastal Sites of Special Scientific Interest (SSSIs), and a second release of marine conservation data, covering marine benthic surveys, have been published in electronic format (Barne *et al*. 1994) compatible with UKDMAP, the electronic atlas developed by the British Oceanographic Data Centre, Birkenhead (BODC 1992). Other forms of electronic publication are now being evaluated, and an electronic edition of the published Region 12 volume will be launched early in 1996. The current position on the publication of book and electronic editions is shown in Table 1.1.2.

1.1.6 Further sources of information

A. References cited

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House of Commons Environment Committee. 1992. *Coastal zone protection and planning. Second Report*. 2 volumes. London, HMSO.

North Sea Task Force. 1993. *North Sea quality status report*. London, Oslo and Paris Commissions.

B. Further reading

Bird, E.C.F. 1984. *Coasts - an introduction to coastal geomorphology*. 3rd ed. Oxford, Blackwell.

Department of the Environment. 1995. *Policy guidelines for the coast*. London, HMSO.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Information about the Coastal Directories Project and UKDMAP version; sales of electronic editions of the regional volumes	*Project Co-ordinator, Coastal Conservation Branch, JNCC, Peterborough, tel: 01733 62626
Sales outlet for book editions of the regional volumes, the Directory of the North Sea coastal margin, and other JNCC publications	Natural History Book Service Ltd, 2-3 Wills Road, Totnes, Devon TQ9 5XN, tel: 01803 865913

* Starred contact addresses are given in full in the Appendix.

Region 13 is characterised by its sheltered, accreting shores and many estuaries, among them some of the largest in the UK. Unlike those in the south of the region, the Cumbrian estuaries (such as the Duddon, pictured here) are backed mostly by undeveloped countryside and mountains - part of the Lake District National Park. Photo: Peter Wakely, English Nature.

1.2 Introduction to the region

Dr J.P. Doody

1.2.1 Introduction

This section gives a brief introduction to the character of the region, its wildlife and the extent of its human use and development, synthesising information presented in Chapters 2 - 10. The main coastal locations are shown on Map 1.2.1. Map 1.2.2 shows the coastal 10 km squares in the region.

Region 13 covers the major part of the British coastline bordering the Irish Sea. It includes the north Wales coast eastwards from the Clwyd county boundary, Liverpool Bay, Morecambe Bay, the coast of Cumbria, the south coast of Dumfries & Galloway (including the Solway Firth) and the Isle of Man. The coastline is 1,191 km long, which is 6.3% of the Great Britain total (JNCC Coastal Resources Database). Much of the area from Liverpool Bay to the Solway Firth is low-lying and includes several of the most important estuaries in the UK. These have extensive areas of saltmarsh and sand/mud flats, together with other associated habitats including sand dunes, as on the Sefton coast. This landscape is broken in a few places by cliffs, as at St. Bees Head in Cumbria. On the southern Scottish shore, the outer Solway Firth and the coastline running west to the Mull of Galloway are rocky, though only at the Mull of Galloway are there substantial cliffs. The Isle of Man has a generally rocky coast in the south, which rises steeply from the shore. Glacial deposits of sand and gravel dominate in the north.

Around the estuaries in the south of the region are major infrastructure developments. These include the city of Liverpool and the extensive industry and port facilities on the Wirral and the industry at the head of the Dee. With the resorts of north Wales, Southport and Blackpool, this is one of the most built up stretches of coast anywhere in Great Britain. The north is, by contrast, much more rural, with the hinterland mostly in agricultural use.

Map 1.2.3 shows the boundaries of the administrative units used to delimit Region 13 in relation to the proposed new unitary authority boundaries agreed in 1994.

1.2.2 Structure and landscape

The solid geology of the region comprises rocks of the Permo-Triassic Period (248 - 286 million years old). These are, however, obscured throughout most of the area by thick deposits of glacial drift left when the area was covered with ice. These deposits range in age from Pleistocene (up to 1.6 million years ago) to younger Holocene (deriving from the last glacial period, which ended only 10,000 years ago). Exposures of rock do occur, as for example at St. Bees Head in Cumbria (Sandstone of Permo-Triassic age) and the south-west coast of Scotland, where there is a complex assortment of older rocks. In addition the region contains, around the northern end of Morecambe Bay, all the coastal occurrences of limestone pavement in Great Britain.

The region can be considered in two broad areas: the rocky shores and cliffs of the outer, westernmost coast and the soft-coast low-lying areas in between and further east. The continuous movement of post-glacial sediments by geomorphological processes is a particular feature of the region, and longshore drift is an important component of the development of the systems. These natural systems have been greatly modified, especially around the estuaries of the Dee, Mersey, Morecambe Bay and the Duddon, by human intervention occurring since Roman times.

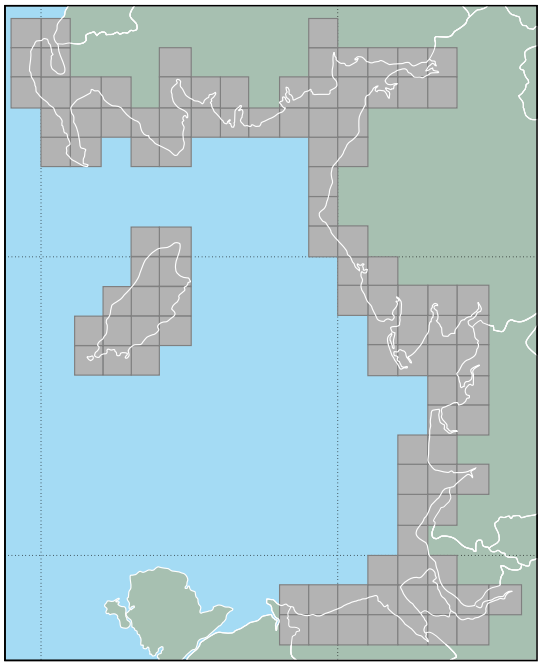
The coast is relatively sheltered from winter storms, as the prevailing winds from the south-west and the waves that are generated by them are reduced by the land mass of Ireland. Offshore the land shelves gently and water depths seldom reach more than 40 m, except off the north coast of Anglesey, Calf of Man and the Mull of Galloway. The exception is the Lune Deeps at the entrance to Morecambe Bay, where depths of up to 86 m occur. Unlike the rest of the eastern Irish Sea, the Deeps channel, which was cut in glacial times, has not been infilled by the more recent Holocene sediments. Over much of the rest of the region's sea bed Permo-Triassic sediments several kilometres deep cover older geological strata.

1.2.3 The natural environment

The main conservation interest of this region lies in its estuarine habitats, seas and sea bed, and the species they support. Overall, Region 13's estuaries represent almost a quarter of the total UK estuarine area, more than half of the estuarine area on the British West Coast and 7.5% of that in north-west Europe (Davidson *et al.* 1991). Many have large intertidal and saltmarsh areas, of which the region has even larger percentages of the national resource: a third of the UK and almost two thirds of the British West Coast resource of each. The major estuaries include important examples of all the main structural features and habitats typical of soft coasts, though mudflats and saltmarshes predominate. Much of the estuarine coast in the south has been highly modified by human use where there are extensive built up areas. 60% of the Welsh coast of the region but only 35% of the region's English coast is protected against flooding. The terraced nature of the low-lying coasts around the Solway Firth, in part the result of long-term uplift, make these coasts less prone to major flooding than the coasts along the southern shores of the region. However, overall the proportion of modified shoreline is much lower in this region than in counties bordering the southern North Sea (Regions 6 and 7), the other part of Britain with major estuarine systems. This is a reflection both of the fact that the extent of enclosure for agriculture or industrial development is less from the Duddon Estuary northwards than elsewhere in low-lying coastal plains, and of the relatively static sea level over the same stretch of the region's coast, posing few threats of erosion or flooding.

There are also a number of nationally important limestone pavements (a priority habitat under the EC Habitats and Species Directive) that lie adjacent to the coast of Morecambe Bay, as at Gait Barrows (Lancashire) and Arnside Knot (Cumbria). Whilst not being strictly coastal, such areas have a rich flora and invertebrate fauna. Only 3% of the limestone pavement existing 50 years ago survives

Map 1.2.1 Rivers, major towns and other coastal locations in the region



Map 1.2.2 National Grid 10 km by 10 km squares included as 'coastal' for this region

Map 1.2.3 New local authority areas in Region 13. Merseyside is administered by four borough Councils and one city council, three of which are coastal: Wirral Borough Council, Liverpool City Council and Sefton Borough Council.

undamaged, and all of Great Britain's coastal occurrences of this habitat are found in this region. Ancient semi-natural woodland on steep limestone slopes also survives, with one of the most inaccessible (and thus lease modified by human use) being at Humphrey Head, on the north shore of Morecambe Bay.

There are also significant sections of coast with shingle shores, a landform that is important for both its geomorphological and its biological interest. Examples include the western side of Walney Island, Cumbria, which is a Geological Conservation Review (GCR) site of national importance.

Because of the variety of habitats present, the region has a wide range of rare and scarce plants, both lower plants (mosses, lichens, fungi and stoneworts) and higher plants (flowering plants and ferns). Several of the larger sites in the region are of national, or even international, importance for their lower plants. About half of Britain's bryophyte flora and about two fifths of its stonewort flora occur in the region. Historically, the region's dune systems included some of the most important dunes for lower plants in Britain, but many are now badly damaged by commercial and tourist developments, particularly in the Merseyside/Lancashire area. The region is the world stronghold of the Isle of Man cabbage *Coincya monensis* subsp. *monensis*, a (higher plant) subspecies endemic to dunes on the west coast of Britain. The remaining more-or-less intact mires around the Solway Firth are nationally important for their extent and for their bryophyte flora. Some of the limestone pavements in the Silverdale area of Lancashire are important for lower plants. Three of the key localities for higher plants - around Colwyn Bay, Morecambe Bay and parts of the Solway Firth - also owe much of their interest to the exposure of carboniferous limestone at the coast. The rocky coasts of south-western Scotland are among the richest in the UK (and Europe) for coastal lichens.

For amphibians and reptiles, the region is probably the most important area in Great Britain, after the south coast. It supports populations of all nine of the more widespread species and in addition has the much rarer natterjack toad *Bufo calamita* and the sand lizard *Lacerta agilis*. Both of these occur mainly among sand dunes, especially on the Sefton coast, where the sand lizard is present in some numbers (8% of the national total). The natterjack toad is also found at the margins of saltmarshes, especially in the Solway and the Ravenglass and Duddon Estuaries.

Overall the region is nationally important for many coastal invertebrate species. However, it is not so significant for terrestrial mammals, athough the red squirrel is found in south Cumbria and areas of Dumfries & Galloway and in the conifer plantations on the Sefton Coast. The otter is also present throughout the region, though nowhere is it common. Eight species of protected bats are also present in the region.

The region is of major national and international importance for its bird life. Seabird communities in the region are dominated by birds requiring largely estuarine habitats for nesting, hence the presence of internationally important concentrations of several gulls and terns, and all the estuaries are also of major importance for wintering waterfowl.

The region's most significant and characteristic habitats and their associated wildlife are further described below.

The sea and sea bed

Parts of the sea bed in this region are of exceptional interest for their rare and scarce marine benthic (sea-bed) species. This is especially true where rocky substrate predominates. Eleven rare and ten scarce non-exploited marine benthic species have been recorded in the region, many around the coast of the Isle of Man (see section 5.4). The south-west corner of the island is particularly rich, with all but one of

these rare and scarce marine species being found there. Nationally rare species that occur in the region tend to be representative of a Mediterranean-Atlantic group at the margins of their distributions. Many of these species are considered to be extremely vulnerable. Of the exploited species, scallops and queen scallops are widely distributed in offshore gravelly areas between Galloway and north-west Wales, particularly around the Isle of Man, and brown crabs and lobsters occur in exploitable numbers along the more exposed parts of the region's coastline.

Elsewhere, where soft sediments dominate the surface of the sea bed, nationally important populations of a limited range of species occur, especially exploited species such as brown shrimp *Crangon crangon*, cockles *Cerastoderma edule* and mussels *Mytilus edulis,* as for instance in the Dee Estuary, the Solway and, particularly, Morecambe Bay. *Nephrops* occur in the muddy-bottomed deeper zones to the east and west of the Isle of Man. There are important nursery areas for plaice, herring and bass in the region, amongst them Morecambe Bay (for flatfish and sea bass).

The three diadromous fish species widespread in British waters, the Atlantic salmon, sea trout and eel, are all present in this region. Basking sharks *Cetorhinus maximus,* the world's second biggest fish, are regularly sighted in the Irish Sea. During the summer they are common migrants to Manx waters, where they are protected under the Manx Wildlife Act 1980.

During late winter, seaduck and divers occur in significant numbers in Liverpool Bay and the south-east part of the Irish Sea. Both grey and common seals occur in the region, though only grey seals occur in any numbers. Between 300 and 350 grey seals regularly use the outer Dee Estuary for feeding and haul out at low tide near Hilbre Island. Only three species of cetaceans (the harbour porpoise, bottlenose dolphin and common dolphin) regularly occur in the region throughout the year or are seen annually - many fewer than further north. Numbers of individuals and species appear to have declined in recent years: records suggest that the harbour porpoise was present in large schools in Liverpool Bay at the turn of the century, but by the 1950s the species was rarely seen, and since 1957 only three sightings of live animals have been reported.

Estuarine shores

There are fourteen estuaries identified in this region by the Nature Conservancy Council's Estuaries Review (Davidson *et al.* 1991), representing 25% of the national estuary resource and 7.5% of that in north-west Europe. All except one of the estuaries are larger than 5,000 ha: Morecambe Bay has the largest area of intertidal mud and sand of any site in the UK, and Morecambe Bay and the Solway Firth are the largest estuaries in the UK, after the Wash (Region 6).

Estuarine sedimentary habitats in the region support communities characteristic of the north-east Irish Sea. These typically have low species diversity and high biomass, particularly including polychaete worms and bivalve molluscs, which in their turn provide food for huge populations of wintering waterfowl. All the estuaries are of major importance for wintering waterfowl, feeding and roosting on the full range of estuarine habitats. In mid-winter the region holds 21 species occurring at levels of international importance on at least one site. The Mersey, Ribble Estuary, Morecambe Bay, Dee Estuary, Duddon Estuary and Solway Firth are all internationally important sites for wintering waterfowl. Morecambe Bay, for example, supports ten species that occur in internationally important numbers, notably pintail, curlew, bar-tailed godwit, oystercatcher and knot. It is second only to the Wash (Region 6) for the total numbers (regularly more than 180,000) of waterfowl it supports in winter. The Solway Firth also regularly supports more than 80,000 waders, with six species of international importance, and a further 30,000 wildfowl, with four species of international significance, including barnacle goose and pink-footed goose. The Solway saltmarshes are the sole wintering grounds for the entire population of the Svalbard race of barnacle geese. Grazing marshes on the Ribble Estuary and elsewhere are important high tide roosts for wintering waterfowl. In addition, colonies of a wide range of bird species breed on the Solway saltmarshes, including lapwing, redshank, dunlin, black-headed gull, lesser black-backed gull and common tern.

Many of the saltmarshes have increased in area in recent years, as the pioneer saltmarsh plant common cord-grass has expanded rapidly over the tidal flats. Unlike on the south coast, where its rapid expansion at the expense of the tidal flats was followed by an almost equally rapid decline (die-back), here the expansion phase continues apace in the majority of the estuaries of the region. The saltmarshes in this region are noted for their-lawn like structure. Heavy grazing by sheep and, in the case of Morecambe Bay and the Duddon, turf cutting have reduced the vegetation to a short grass sward. The palatable common saltmarsh grass and red fescue, which dominate under these intensive regimes, provide important winter grazing for a large number of ducks and geese.

Enclosure of saltmarsh has occurred around most of the estuaries of this region, although this has not been on such a large scale as in the south and east of England. In the Solway, in particular, where there has been relatively little saltmarsh enclosure for agriculture, important transitions to wet grassland occur. These are some of the few remaining extensive areas of natural transitional grasslands, now represented elsewhere in Great Britain mainly by enclosed but unimproved grazing marshes. The upper saltmarsh plants, which survive in the absence of enclosure, particularly where there are transitions to grassland, are especially favoured by rare invertebrates. There is relatively little surviving coastal grazing marsh (enclosed improved saltmarsh), most having been converted to more intensive forms of agricultural use or for industry, as around the Dee and Mersey Estuaries. Unenclosed saltmarshes and grazing marshes, where they do survive, are also important for breeding birds; the Ribble saltmarshes hold more than 20,000 pairs of black-headed gull.

The saltmarshes of the Solway hold a particularly important place in the geography of vegetation types. The flora includes a number of major components of saltmarshes that are both dominant in, and characteristic of, saltmarshes of the south and south-east. Here many of them reach their northern limit in Great Britain; further north, where they are absent, the character of the saltmarsh changes. Sea-purslane, sea wormwood, two species of sea-lavender, *Limonium humile* and *L. vulgaris,* and sea couch are all major and characteristic components of saltmarshes in England and Wales (and therefore this region) that are absent throughout much of Scotland.

Sand and shingle shores

The region includes only a moderate proportion of the total area of sand dune in Great Britain (8%). The most important and extensive sand dunes are on the Sefton coast, where there are more than 3,000 ha of blown sand. The remaining undeveloped dunes are still extensive and important on a national scale. Among the other important sites is Torrs Warren (Luce Bay) in the south-west of Scotland, where extensive areas of dune heath occur. This site is used by the Ministry of Defence.

The Sefton coast sand dunes have been extensively modified by human activity, including golf course development and afforestation, and the building of the resort of Southport and its associated recreational facilities. Elsewhere the other dunes are relatively free from human modification. Change through scrub growth is a problem at several sites, partly because of the reduction of grazing on many. This is particularly acute on the Eskmeals Ranges, where extensive patches of sea buckthorn have obliterated extensive area of open dune. Sea buckthorn is rare as a native species, in which character it occurs only on the east coast of Britain; in this region it is an invasive alien.

Many dune sites include important animal populations, which range from nesting seabirds to rare amphibians and reptiles. The dry, open and warm aspect of the dune ridges and the wetter dune slacks support some of the most important colonies of natterjack toad anywhere in the UK. The sand dunes of the Sefton Coast and the Esk Estuary have nationally important invertebrate faunas. Many of these rely on specific association with plants that are restricted to particular habitats. These dunes also have significant numbers of breeding pairs of shelduck. The dunes of south Walney support >30,000 pairs of lesser black-backed gull and 16,000 pairs of herring gull respectively. On the dunes at Ravenglass an extensive colony of gulls and other colonial nesting seabirds occurs; it was the basis for some classic studies in animal behaviour (Tinbergen 1974). This colony, which then included 10-15,000 black-headed gulls and was thought to be the largest in Europe, now no longer exists.

The coastal plains also include a number of other wetlands that are today not directly in contact with the sea. Prominent amongst these are mosses around the inner reaches of estuaries on the Cumbrian coast and the shores of the Solway, including the RSPB reserve at Leighton Moss - a peat bog drained for agricultural use and now reverted to reed swamp - Wedholme Flow SSSI, an extensive cut-over raised mire to the south of Moricambe Bay, and Glasson Moss National Nature Reserve, on the south Solway Plain, a largely intact peatland that has developed over a terrace of estuarine sediment.

The area has a considerable amount of shingle, with extensive areas along the north coast of Wales and north and west of Morecambe Bay, where Foulney Island and the barrier island of Walney have recurved spits of sand and shingle that support important plant communities. The raised beaches of the north shore of the Solway are also important, and the presence of prostrate scrub and, at Rascarrel Bay, woodland is particularly unusual in a Great Britain context. Nowhere is the vegetation as significant as on the other major shingle structures in Great Britain (e.g. Dungeness in Region 7 or Chesil Beach in Region 9); however, the intermixture of these areas with sand and saltmarsh create some important transitional vegetation. The north shore of the Solway is an important geographical divide for shingle plants. It contains the most southerly recent location for some northern shingle species (e.g. oyster-plant, which has been recorded there during the last decade) and the most northerly sites for some southern species (e.g. yellow horned-poppy).

Sea cliffs

There are few cliffs in the region, but they are diverse in form, although most are not sheer. The most impressive examples are at Humphrey Head and St. Bees Head (Cumbria), the south-west coast of the Isle of Man and along most of the west coast of the Rhinns of Galloway (Dumfries & Galloway). St. Bees Head supports the only English breeding colony of black guillemots. Offshore there are only limited numbers of cliff-nesting birds, which feed, except in the north, near the seabird colony on Ailsa Craig (Region 14).

1.2.4 Landscape and nature conservation

The value of the region for landscape and nature conservation is reflected in the number and combined extent of sites afforded official protection, especially designations reflecting national or international importance These include 80 Sites of Special Scientific Interest and seven coastal National Nature Reserves, plus six Special Protection Areas and five designated Ramsar sites, a relatively high number when compared with most other regions. The total number of sites and total areas of the main designations are given in Table 1.2.1.

1.2.5 Human activities, past and present

The region is rich in archaeological remains. Evidence of human occupation dates back 200,000 years; these remains are some of the earliest in northern Britain to have escaped destruction by subsequent glaciation.

The Isle of Man is particularly important for the great range and richness of its archaeological remains and landscapes. Some 4,500 archaeological sites have been identified to date. On the Isle of Man there was no Roman or Norman occupation; there is, however, an extensive early Christian archaeological heritage dating from the 6th century onwards. While the mainland was experiencing the Norman conquest and development of medieval culture, the Isle of Man was undergoing a succession of Norse invasions, now recalled by the numerous impressive burial mounds, including ship burials, that occur on the island.

At the end of the last glaciation the mainland extended a considerable distance seawards; the Merseyside coastline was some 15 km west of its current location. Rising sea level has covered large areas of ancient landscapes, but prehistoric sites and artefacts are being discovered in the intertidal zone. In the Roman period, the Iron Age port of Meols became secondary to the legionary base and river port of Chester. Other ports supplied the frontier zone around the Solway Firth at the western end of Hadrian's Wall. Trade remained important throughout the Middle

Table 1.2.1 Main landscape and nature conservation designations in Region 13

Designation	*No. sites in region*	*Total area in this region (ha)*	*Regional % of area/length on GB coast so designated*
Biosphere Reserves	1	5,469	20.1
Ramsar sites	6	56,410	20.4
Environmentally Sensitive Areas (ESAs)	2.5+	433,900+	31.0
Special Protection Areas (SPAs)	7	55,239	19.1
National Nature Reserves (NNRs)	7	13,420	15.5
Sites of Special Scientific Interest (SSSIs)	80	122,547	17.5
Limestone Pavement Orders	17	1,022	100.0
Local Nature Reserves (LNRs)	8	832	6.3
National Trust sites	12	767	1.2
Wildlife Trust sites	26	1,605	6.9
RSPB reserves	9	8,115	21.0
National Parks	1	229,200	30.8
Wildfowl and Wetlands Trust sites	1	726	45.8

Key: +one site lies partly within Region 14; half the area has been included in the total.

Ages. Liverpool had by 1699 become the third largest trading port in England. In the following centuries Whitehaven, Maryport and Workington prospered as exporters of coal. To the south the sheltered waters of the Dee and the Mersey provided the focus for industrial and commercial development, which greatly reduced the areas of intertidal land within these estuaries.

The major docks on Merseyside are still important in a national context, and Liverpool/Birkenhead is one of the largest ports in the UK. The oil refinery and chemical complexes are also amongst the largest, and Merseyside and the other conurbations make the shores of the Mersey amongst the most built-up industrial coasts in Great Britain. At the same time, other conurbations, notably the resorts of Sefton and Blackpool, have altered the landscape of the south central part of the region. Substantial areas of land, especially in the south, are threatened by flooding, and there are long stretches of artificial shoreline. Outside the conurbations, much of the region, particularly in the north, is in agricultural use for both arable and other crop production and livestock.

This region is very important nationally for leisure activities and tourism. The north Wales and Lancashire coast are dominated by traditional seaside resorts, while Cumbria and Dumfries & Galloway are important for more active leisure pursuits. Blackpool is the premier regional tourist centre and is the largest coastal resort in the UK, with over 17 million visitors each year. Tourism provides significant income for the region.

Poor water quality is a persistent problem for much of the region's coast, especially its estuaries. A legacy of centuries of disposal of industrial and human effluent into nearshore waters, often with little or no treatment, has rendered some stretches of coast (for example parts of the Mersey Estuary) a hostile environment for marine life, and most (65%) of the region's bathing beaches fail to comply with mandatory EC bathing water standards. Added to these pollutants is the recent increase in the use and hence run-off of agricultural chemicals and slurry into surface waters, and their ultimate destination, the sea. There is a major sewage sludge disposal site in Liverpool Bay. Water companies are making large investments to improve water quality.

Aggregate dredging occurs in only two locations, and quantities removed represent only 1% of the total extracted from British waters in 1994 (no marine aggregates are dredged off Scotland). Because the region's shores are generally accreting, dredging is widespread and comparatively large amounts of dredged material (from capital and maintenance dredging) are dumped at sea in the region (13% of the GB total).

Quarrying is a significant activity throughout the region, except in Merseyside. Nearly a quarter of the limestone produced in Great Britain is quarried in the north and south of Region 13, and Cheshire is an important source of sand and gravel, producing 2.6 million tonnes in 1991, more than half of the region's output. Lancashire produces large quantities of sandstone, in a national context (1.4 million tonnes - nearly 11% of the GB total in 1991).

Recently there has been increasing interest in oil and gas exploration in the region. The Morecambe Bay gas field was a significant discovery - production began in 1985 - and the gas terminal at Barrow is the second largest in Europe.

There are a number of large fishing ports in the region, all except Fleetwood being on the Isle of Man. Fleetwood has a fleet of over 50 vessels greater than 10 m in length that fish predominantly in the Irish Sea. The shellfish industry is the most important aspect of the fisheries of the region; species such as scallops, queen scallops, *Nephrops*, brown shrimp, cockles and mussels are targeted. Three quarters of the queen scallops landed to British ports are landed on the Isle of Man. Only a small amount of pelagic and demersal fish are landed in the region, compared with the rest of Britain. Shellfish mariculture takes place in the region in Morecambe Bay, Luce Bay and on the Isle of Man.

The Isle of Man was the centre for the Irish Sea herring fishery for over a century, although catches fluctuated widely. Despite the recent decline in the importance of herring, fishing is still one of the most important industries there. Since 1939 most of the fishing effort has been concentrated on the scallop and the queen scallop. The fishing industry in the Isle of Man has undergone a decline over the last 20 years or so; herring landings by the Manx fleet are now minimal, most Manx landings being by boats from Northern Ireland, and kippering has declined markedly.

There are many groups in the region that aim to improve the sustainable management of the coast, and many initiatives, both locally and nationally generated, are working to this end. Amongst these are the North Wales Coastal Forum, the Irish Sea Forum, the North West Coastal Network, Liverpool Bay (Llandudno to Merseyside) Coastal Group, Tidal Dee Users Group, Sefton Coast Management Scheme, North Western Coastal Group, Fylde Forum, Morecambe Bay Forum, Solway Firth Partnership and many others.

1.2.6 Further sources of information

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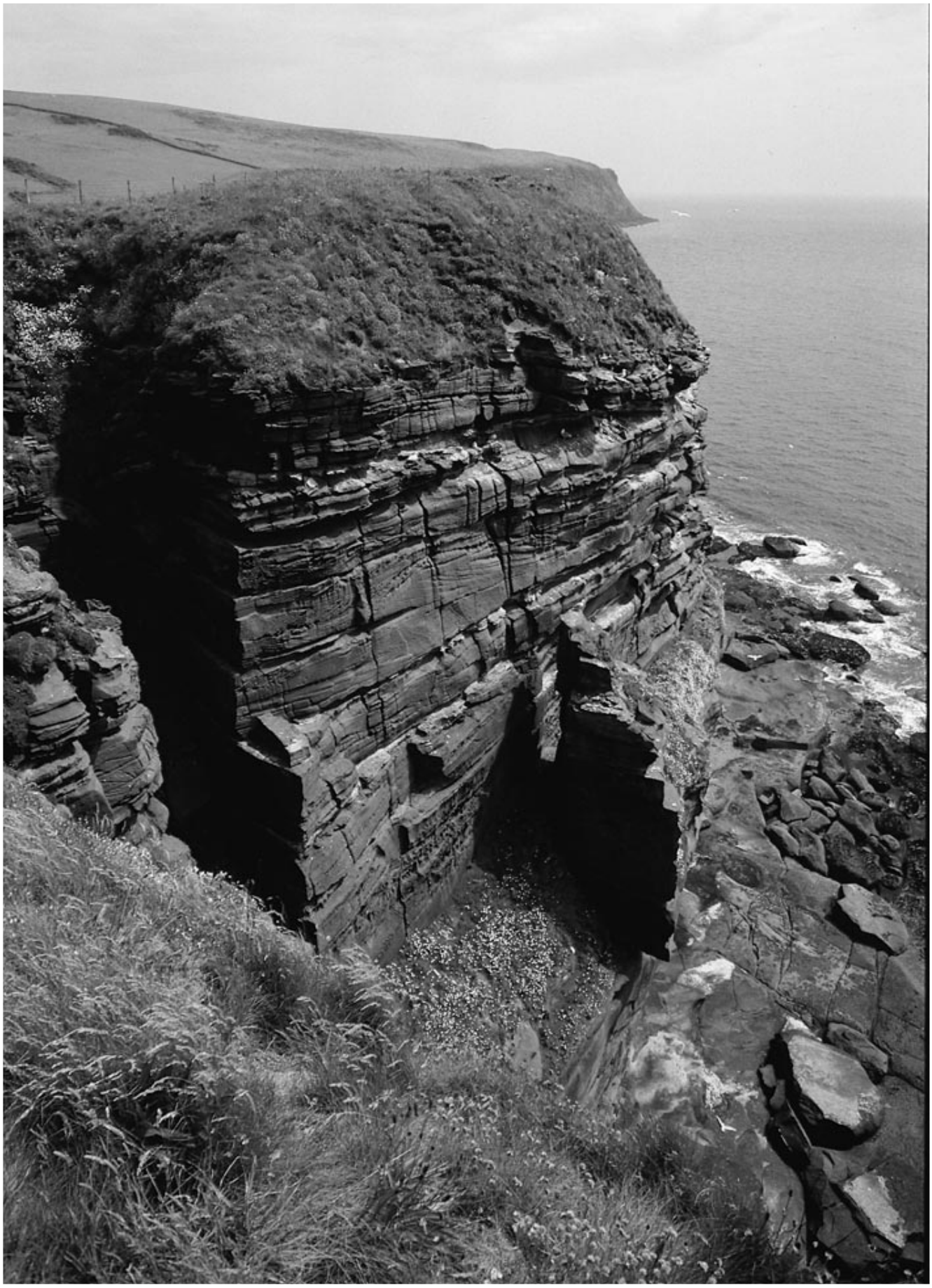


Few parts of the coast of this region are cliffed. At St Bees Head, Cumbria, red sandstone outcrops as steep cliffs up to 100 m high. They are the only English breeding site of the black guillemot and form a striking feature of this Heritage Coast. Photo: Peter Wakely, English Nature.

Chapter 2 Geology and physical environment

2.1 Coastal geology

British Geological Survey

2.1.1 Introduction

The northern Irish Sea is the site of a number of sedimentary basins infilled with thick sequences of Permo-Triassic sediments and, in places, Jurassic sediments (see section 2.2.3). Locally, thin spreads of these sediments extend onshore to cover the older Palaeozoic rocks, which form the coastal lowlands (Map 2.1.1 and Table 2.1.1).

2.1.2 Stratigraphy

Great Orme — Mersey Estuary

The Great Orme in the south-western part of the area is an impressive headland of Carboniferous Limestone, containing locally-worked veins of lead and copper. The same rocks form smaller headlands around Colwyn Bay, but to the east the coast is low-lying and formed of soft Permian sandstones overlain by till and extensive Holocene deposits. Outcrops of yellow and red Triassic sandstones form Hilbre Island and Perch Rock, and similar isolated outcrops are found along the shores of the Mersey Estuary.

Mersey Estuary — Duddon Estuary

Sand dunes backed by peat form the coast around Formby; northwards to the Ribble Estuary and Fleetwood, alluvium and till are more extensive. All along this coast the nearest outcrops of bedrock are many miles from the sea. The Permo-Triassic bedrock does not outcrop along the southern borders of Morecambe Bay; however, the more rugged northern shores of the bay are formed of folded and faulted Carboniferous and Silurian rocks. Along these shores, Cartmel and Milnthorpe Sands (within the estuaries of the Leven and Kent respectively) are infilled with Holocene alluvium, though the bedrock reaches the coast in places. The Duddon Estuary on the western facing coast of the Lake District has St. Bees Sandstone of Permo-Triassic age along its coastal fringe, but inland the estuary cuts through Carboniferous Limestone and Silurian slates and volcanic rocks. These estuaries occupy part of the radial drainage system of the southern Lake District, which was overdeepened by valley glaciers during the late Pleistocene.

Duddon Estuary — River Eden

Between the northern shores of the Duddon Estuary and St. Bees Head a coastal strip of Permo-Triassic sediments laps onto the flanks of the Lake District massif, which is formed of Lower Palaeozoic slates and volcanic rocks with acid and basic igneous intrusions. Along much of the coast the Permo-Triassic bedrock is covered by thick and complex glacial till sequences, but extensive sections of the bedrock are exposed in the cliffs at St. Bees Head. Here pre-Permian rocks, which are generally reddened, are overlain by a basal (bottom-level) Permian breccia followed by evaporites such as anhydrite. Shales and sandstones overlie the evaporites and the base of the Triassic is arbitrarily fixed at the base of the sandstone. The succession changes rapidly to the east, with the replacement of all these lithologies by a basal breccia unit. In contrast the succession thickens seaward towards the centre of the depositional basin. North of St. Bees locally-reddened Westphalian shales, sandstones and coals are exposed along a narrow coastal strip, but inland these are overlain by an almost complete till cover. This area once supported a significant coal mining industry.

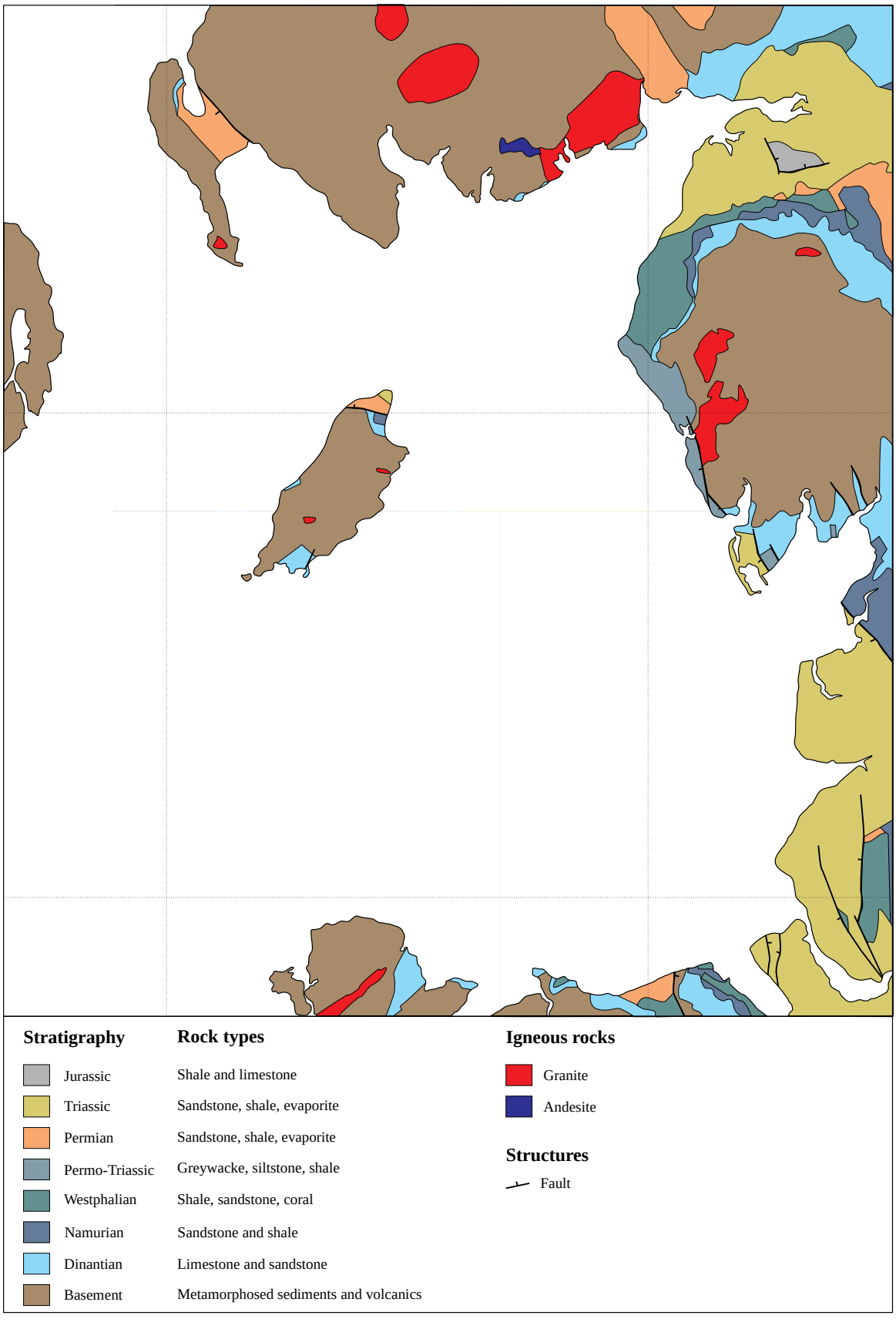
A major NE-SW fault at Maryport separates Carboniferous rocks to the south from Triassic rocks to the north. The change in lithology produces a change in the form of the coast, with that to the north of the fault being low-lying. Permo-Triassic rocks underlie much of the Solway Firth but the area is largely devoid of exposed bedrock.

Dumfries & Galloway and Isle of Man

Along the Scottish shores of the region the Permo-Triassic rocks generally do not extend onshore, except to the east of Annan and in Luce Bay. Along the northern shores of the Solway Firth the Calciferous Sandstone Measures (of Carboniferous age) form a narrow strip of coarse-grained sandstones with conglomerates and some limestones. Their contact landward with the Silurian rocks is commonly faulted. The batholith (igneous intrusion) of the Dalbeattie granodiorite generally lies inland but it reaches the shore at Auchencairn Bay and in bays to the east.

Between Abbey Head and Loch Ryan the coast is formed almost exclusively of structurally complex, medium-to-thick bedded Ordovician and Silurian greywacke, with sandstones and some volcanic units. Dyke swarms of Devonian and Tertiary age are represented along this coast but their continuation inland is uncertain.

A thin sequence of Carboniferous Millstone Grit (with lavas) followed by Permo-Triassic rocks underlie Luce Bay, Loch Ryan and the low ground in between. The Permo-Triassic sediments are conglomeratic (known as Brockram) and well exposed, but the overlying finer sediments to the



Map 2.1.1 Onshore coastal geology. Source: British Geological Survey (1991).

Table 2.1.1 Geological column

Era	*Period*	*Epoch*	*Age of start (million yrs)*	*Stratigraphic units mentioned in the text*	*Significant geological events*
Cenozoic	Quaternary	Holocene	0.01		Rapid sea-level rise
		Pleistocene			Max. advance of last glaciation
			1.6		Earlier glaciations
	Tertiary (Neogene)	Pliocene	5.1		
		Miocene	25		
	Tertiary (Palaeogene)	Oligocene	38		
		Eocene	55		Emplacement of dykes
		Palaeocene	65		
Mesozoic	Cretaceous		144		Uplift of sedimentary basins
	Jurassic		213		Deposition in the Irish Sea basins
	Triassic		248	St. Bees Sandstone Mercia Mudstone Group	Deposition in the Irish Sea basins
Palaeozoic (Upper)	Permian		286	Brockram	Deposition in the Irish Sea basins Emplacement of dykes
	Carboniferous	Stephanian Westphalian Namurian		Coal Measures Millstone Grit	Emplacement of dykes
		Dinantian	360	Calciferous Sandstone	
	Devonian		408		Intrusion of Dalbeattie batholith
Palaeozoic (Lower)	Silurian		438		Caledonian earth movements
	Ordovician		505		Emplacement of igneous bodies in Isle of Man and Lake District
	Cambrian		590		
	Precambrian				

Note: Shaded boxes show ages of rocks with important or extensive exposures in the region.

east are covered by Holocene raised beach deposits.

The Isle of Man, to the south of an east-west line that reaches the east coast near Ramsey, is made up primarily of Manx Slate, which locally contains conglomerate and sandstone horizons. The series is intruded by dykes, and minor granites are exposed inland. Carboniferous Limestone, with a basal conglomeratic unit, forms Castletown Bay. North-west of Ramsey, faulted blocks of Carboniferous Limestone and Namurian rocks overlie the slates. The northernmost part of the island is formed of Permian marls and breccia overlain by Triassic St. Bees Sandstone and salt-bearing red marls. These rocks have been proved only in boreholes and are not exposed at outcrop.

2.1.3 Structure

The gross structural form of the region is controlled by the major NE-SW trending Caledonian fault system. These faults were reactivated during the Permo-Triassic when parts of the region suffered crustal stretching, and the subsequent subsidence led to the formation of basins in which over 4 km of sediments have accumulated. Uplift of these basins during the late Mesozoic and Tertiary led to the removal of up to 2 km of sediments and the exposure of older rocks along the basin margins.

2.1.4 Further sources of information

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B. Further reading

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Kidson, C., & Tooley, M.J., *eds*. 1977. The Quaternary history of the Irish Sea. *Geological Journal Special Issue No. 7.*

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Geological information for Region 13 and the whole of Britain; 1:50,000 scale map sheets	Coastal Geology Group, British Geological Survey, Keyworth, Nottingham NG12 5GG, tel: 0115 936 3100
Geological Conservation Review (GCR) sites in Clwyd	*CCW North-East Area Office, Mold, tel: 01352 754000
GCR sites in Lancashire, Merseyside, coastal districts of Cheshire	*EN North West Local Area Team, Wigan, tel: 01942 820342
GCR sites in Cumbria	*EN Cumbria Local Area Team, Bowness-on-Windermere, tel: 015394 45286
GCR sites in Dumfries & Galloway	*SNH Dumfries & Galloway Area Office, Dumfries, tel: 01387 247010

* Starred contact addresses are given in full in the Appendix.

2.2 Offshore geology

British Geological Survey

This section deals briefly with the geology of the rocks and sediments at and below the sea bed. The bulk of the information is shown on the maps, with some additional explanation provided by the text.

2.2.1 Holocene sea-bed sediments

The sea bed of the region is covered by a wide range of mobile sediments (see Map 2.2.1), the grade of which is controlled largely by the speed of the local tidal streams and the effects of the rise in sea level during the early Holocene. Much of Liverpool Bay is covered with sand and gravel, and some of the banks off the north Wales coast are worked for aggregate; muddier sediment is found in the estuaries entering the bay. The tidal currents decrease in speed to the north, and the sea-bed sediments become muddier: a well-defined mud belt occurs off the south-west Cumbria coast. The sea bed between Anglesey and the Isle of Man, and northwards to the entrance to Luce Bay, is largely covered with a lag gravel overlying till or glacial sediments (lag deposits are formed by currents winnowing out finer grains from the underlying material to leave a coarser layer on the sea bed). The strong tidal currents north-west of the Isle of Man have led to the formation of a number of tidal banks, the tops of which reach to within 10 m of the sea surface.

The North Channel, between Northern Ireland and the Scottish coast, is floored by thin sand and gravel, with extensive areas of bedrock exposed at the sea bed. Tidal current speeds decrease rapidly to the south and an extensive mud belt has accumulated off the County Down coast. To the south the mud gives way to a sandy sea bed, formed into a major sand wave field, and further south into a gravelly sea bed.

2.2.2 Pleistocene geology

The region was one of extensive deposition during the last (Devensian or Weichselian) Pleistocene glaciation, and there is evidence of deposition from an earlier (Saalian) glaciation in parts of the region (Map 2.2.2). During the last glaciation an ice sheet flowed down the western Irish Sea and spilt over eastwards into the shallower, eastern part. This ice sheet interfingered with the ice sheets flowing off the surrounding massifs to deposit a complex sequence of sediments across coastal fringes of the region.

Much of the north-eastern Irish Sea is underlain by till, which may be over 100 m thick in the over-deepened valleys off the Cumbrian coast. Off the coast of Lancashire and Cumbria, muds of variable thickness, formed during the melting of the ice sheet, overlie the till. Thick muds also overlie till to the west of the Isle of Man and Anglesey. These muds were deposited soon after the retreat of the ice sheet from the region, when turbid water from a distant, melting ice sheet entered the area. The variations in sea level across the region since the glacial maximum are complex, owing to the combination of a global rise in sea level and more local isostatic changes. The latter are due to the depression and subsequent uplift of the land as a result of the changing load imposed by the ice sheet.

2.2.3 Solid (pre-Quaternary) geology

The north-eastern Irish Sea is the site of the East Irish Sea and the Solway Firth Basins, which are separated by a narrow ridge of older sedimentary rocks stretching between the Lake District and the Isle of Man (Map 2.2.3). The East Irish Sea basin is made up of eight or more half-grabens (faulted basins), the deepest of which contains up to 4.25 km of Triassic sediments. The Permo-Triassic sediments infilling the basins extend as thin marginal sequences onto the older rocks of the surrounding coastal lowlands. The Mercia Mudstone Group (Triassic) within the basins contains five major halite (salt) units, some of which have become deformed as a result of salt tectonics. Extensive parts of the basins overlie Carboniferous rocks, including Westphalian Coal Measures, and the deep burial of these rocks has led to the generation of gas and oil. The hydrocarbons migrated upwards into reservoir rocks in the overlying Triassic sandstones and, where trapped, have produced economic accumulations of gas (for example the Morecambe Bay gas field) (see also section 9.5). Lias sediments (Lower Jurassic) up to 500 m thick have been proved in one of the half-grabens. Similar rocks are preserved in the Carlisle Basin east of the Solway Firth and in the Cheshire Basin.

Uplift during the late Cretaceous led to the removal of up to 2 km thickness of sediment from the basin deposits. During the early Tertiary an *en-echelon* dyke swarm (the Fleetwood Dyke Group) intruded into the Triassic sediments, and smaller dyke swarms of the same age occur onshore across the region.

The Solway Firth Basin, which occupies an NE-SW syncline, is infilled largely with Permo-Triassic sediments and is less well known than the intensively-investigated East Irish Sea Basin. The Carboniferous rocks west of the Isle of Man are many kilometres thick. They have yet to be investigated in detail and are the subject of some interest for their hydrocarbons.

2.2.4 Further sources of information

A. Maps

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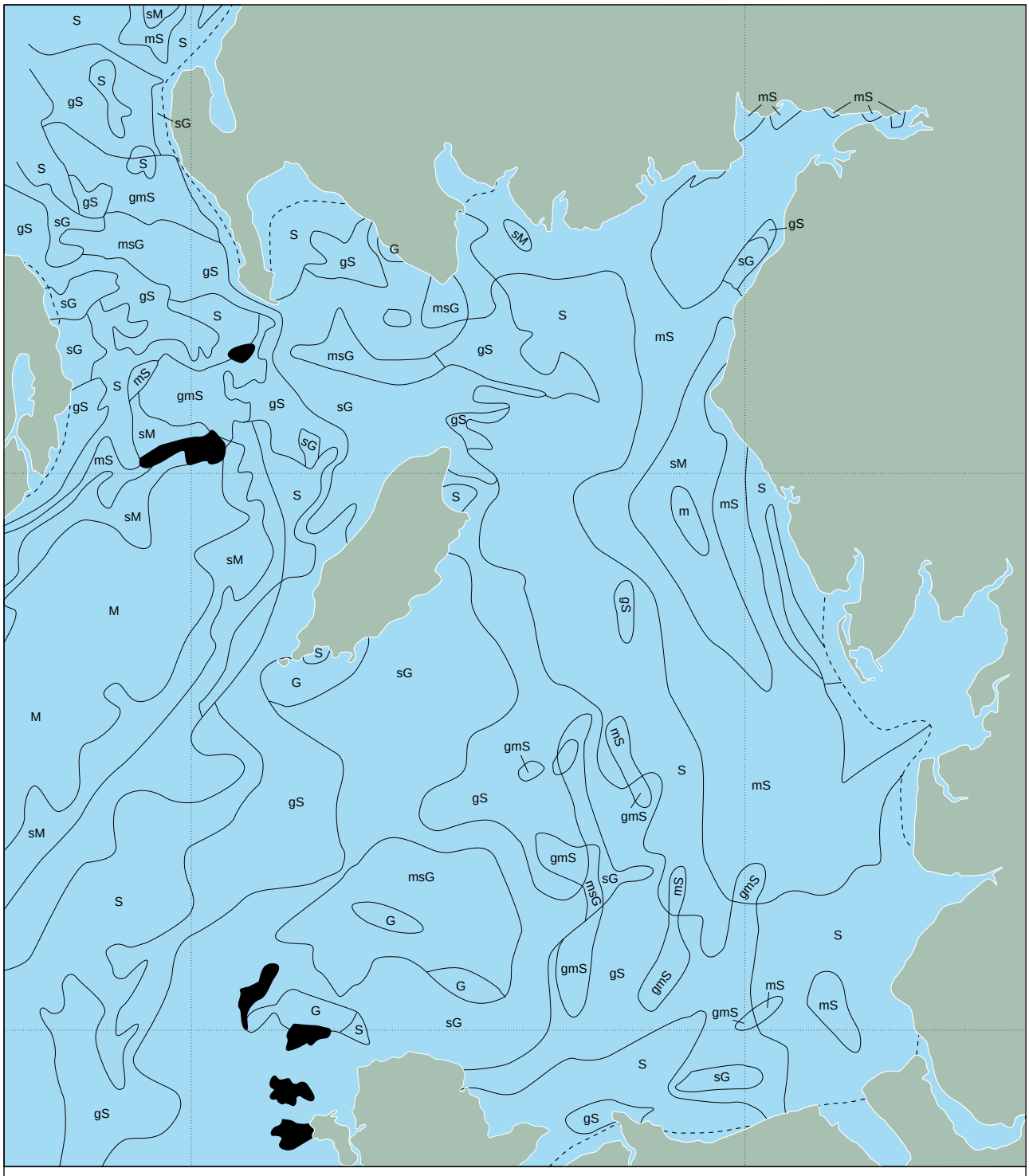
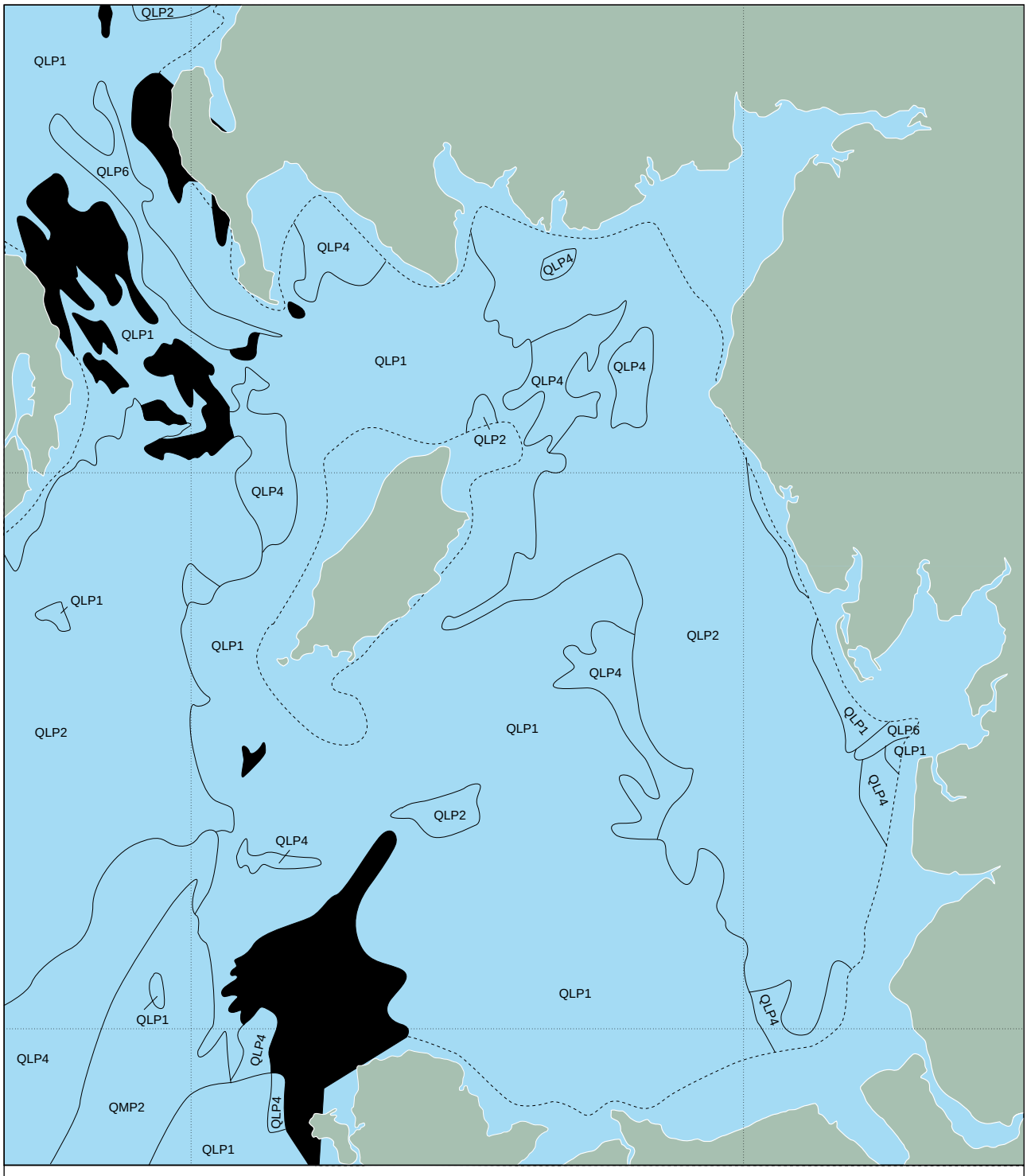


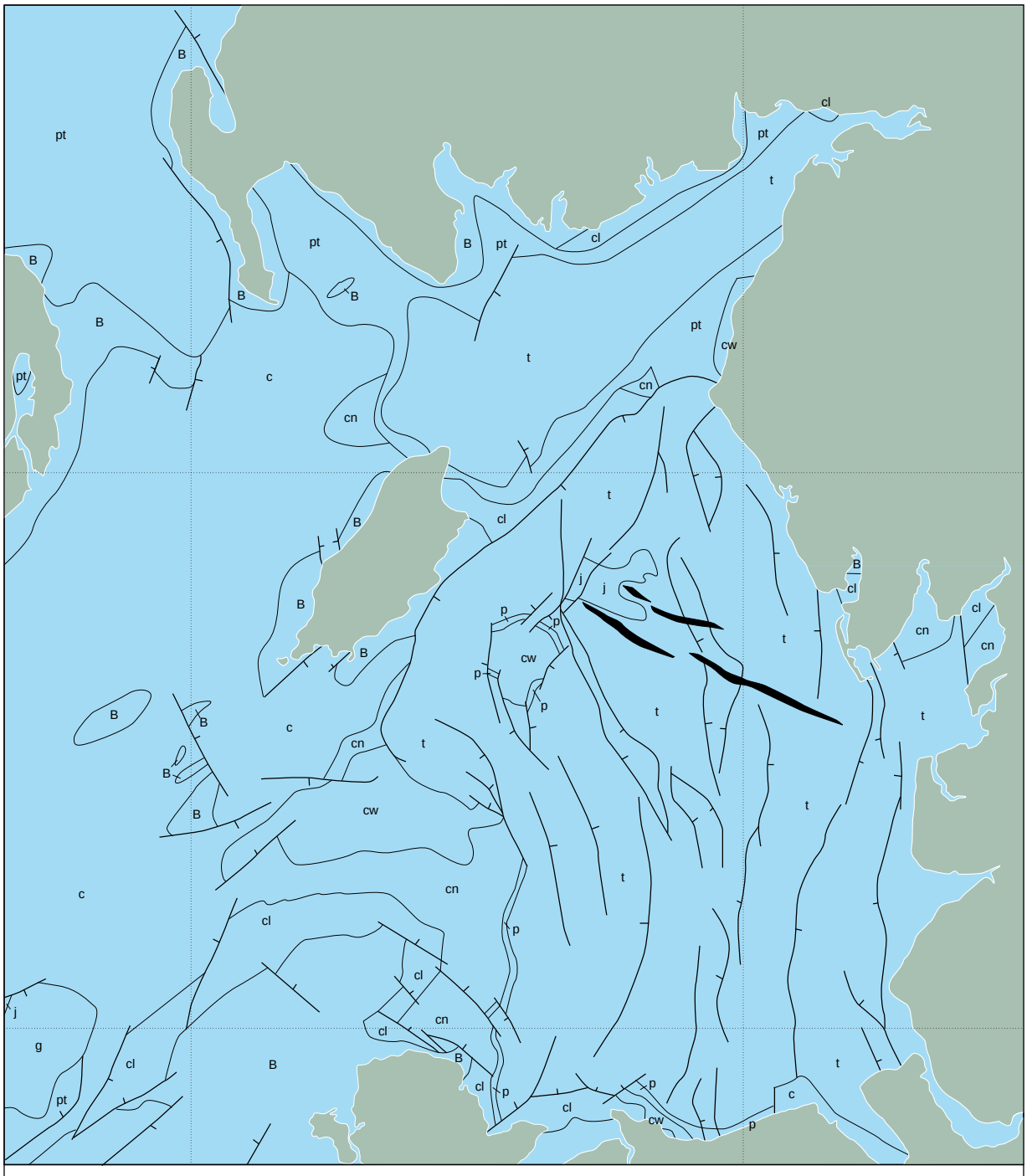
Map 2.2.1 Sea-bed sediments. Source: British Geological Survey (1991); sediment classification modified after Folk (1954).



Key to symbols

QLP	Late Pleistocene to Early Holocene	1	Predominantly till
QMP	Middle Pleistocene	2	Predominantly mud
	No data, broken line shows seaward limit	4	Predominantly sand
	No significant Pleistocene cover	6	Predominantly incision and channel deposits

Map 2.2.2 Offshore Pleistocene deposits. Source: British Geological Survey (1994).



Map 2.2.3 Offshore pre-Quaternary geology. Source: British Geological Survey (1991).

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B. Further reading

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Geological information for region and the whole of Britain	Coastal Geology Group, British Geological Survey, Keyworth, Nottingham NG12 5GG tel: 0115 936 3100
UKDMAP 1992. Version 2. United Kingdom digital marine atlas. Oceanographic maps	British Oceanographic Data Centre, Proudman Oceanographic Laboratory, Bidston Observatory, Birkenhead, Merseyside L43 7RA, tel: 0151 652 3950

2.3 Wind and water

British Geological Survey

2.3.1 Wind

The northern Irish Sea is relatively land-locked and the exposure of coasts to winds is variable (see Maps 2.3.1 and 2.3.2). For instance, the Clwyd coast is protected from the area's dominant westerly winds but is open to winds from the north-western sector. Along the coast of the region the mean wind speed is less than or equal to 3.5 m/sec (7 knots, or barely Force 3) for 25% of the time and exceeds 18 m/sec (36 knots or Force 8) for only 0.1% of the time. These values are speeds maintained for at least an hour; for shorter time intervals speeds can be considerably greater. Factors such as local topography and wind direction are important in determining local conditions and extreme speeds. The information on wind directions for Birkenhead and Holyhead (Figure 2.3.1) has been taken from the Admiralty Pilot and is taken to be representative of the whole area. The figure shows that the dominant winds are from the westerly quadrant.

2.3.2 Water depth

The offshore part of the region may be divided in two along a line running approximately from Anglesey northwards along the west coast of the Isle of Man to the Mull of Galloway. The seas to the east of this line are generally shallow and form the north-east Irish Sea; the north-west Irish Sea to the west, linking the St. George's Channel with the North Channel, is deeper (Map 2.3.3).

The north-east Irish Sea is a shallow embayment, generally less than 40 m deep, within which Liverpool Bay and the inner Solway Firth have especially gently shelving

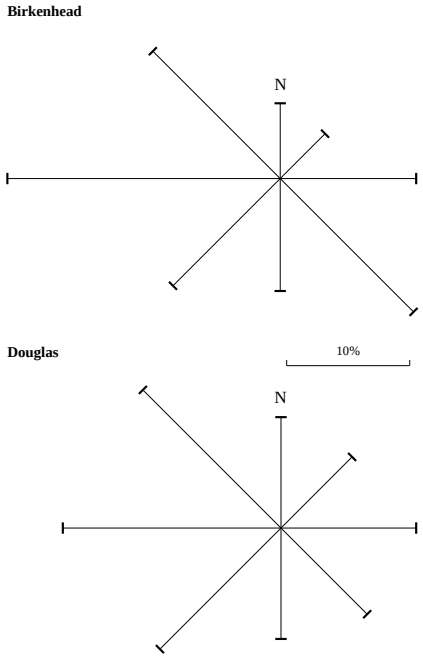
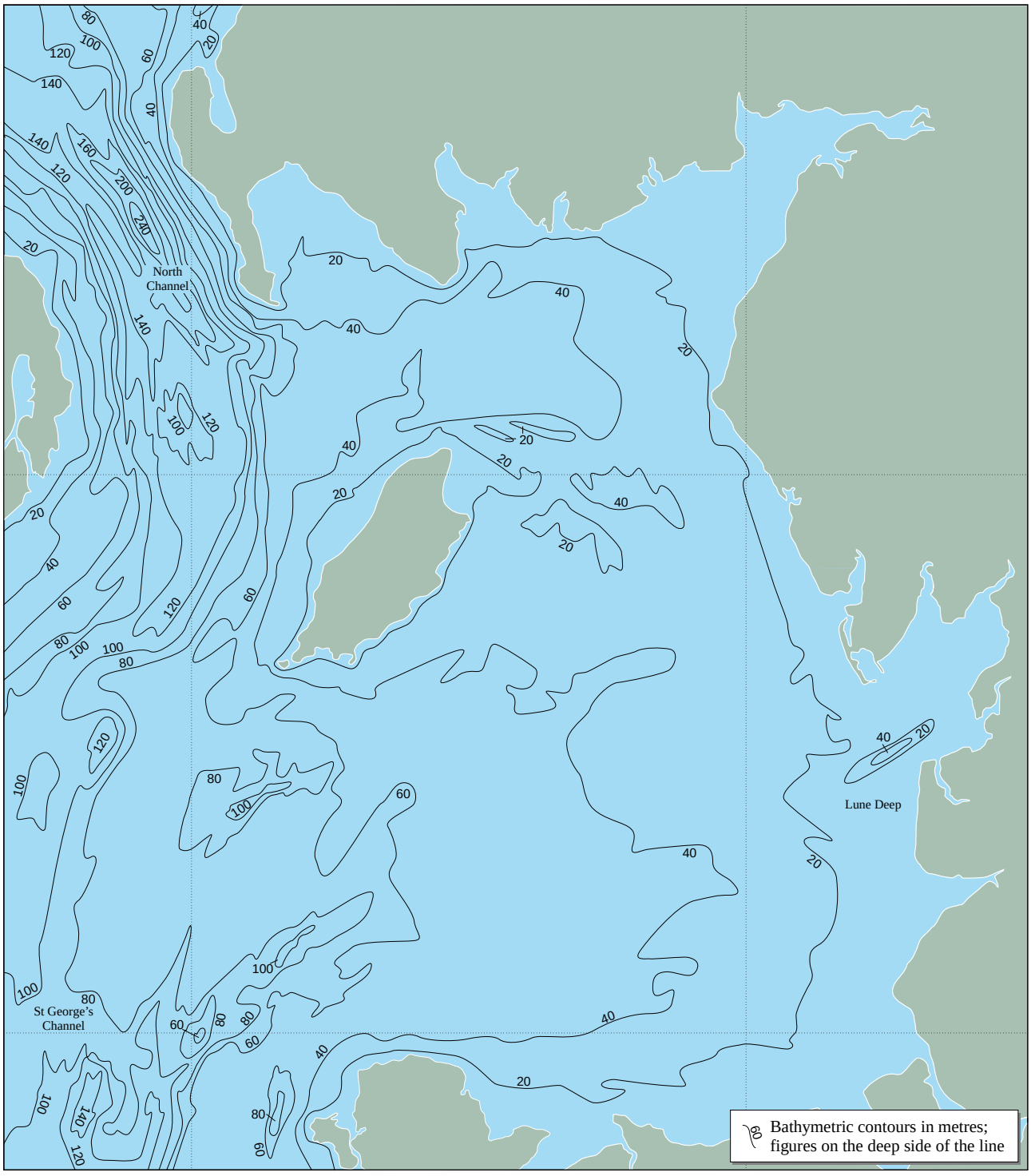


Fig 2.3.1 Wind directions at Birkenhead and Douglas shown as % of observations through the years 1913 - 1950. Source: Hydrographic Department (1960).

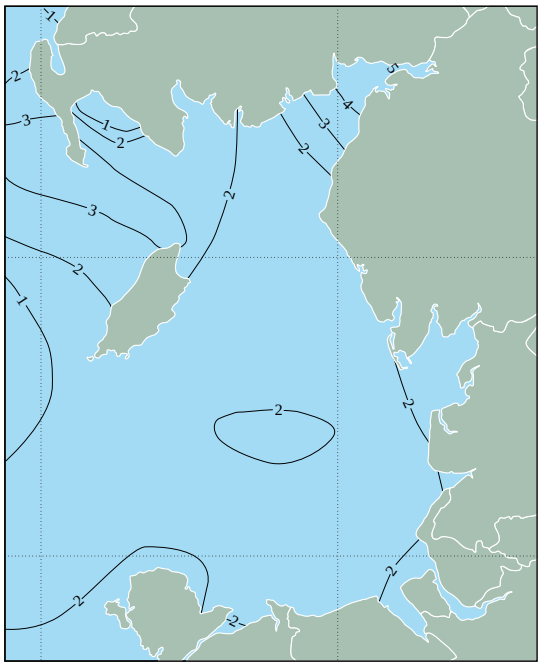
Map 2.3.1 Hourly mean windspeed (in m/s) exceeded for 75% of the time. Source: Caton (1976).

coastal zones. Deeper water approaches the coast only off the north coast of Anglesey, the Calf of Man and the Mull of Galloway. Of note is the over-deepened Lune Deep at the entrance to Morecambe Bay, which reaches a maximum depth of 86 m. This is a glacially-incised feature - a kettlehole - which has not been infilled by Holocene sediments. The series of sand banks off the north-eastern coast of the Isle of Man is the result of strong tidal currents

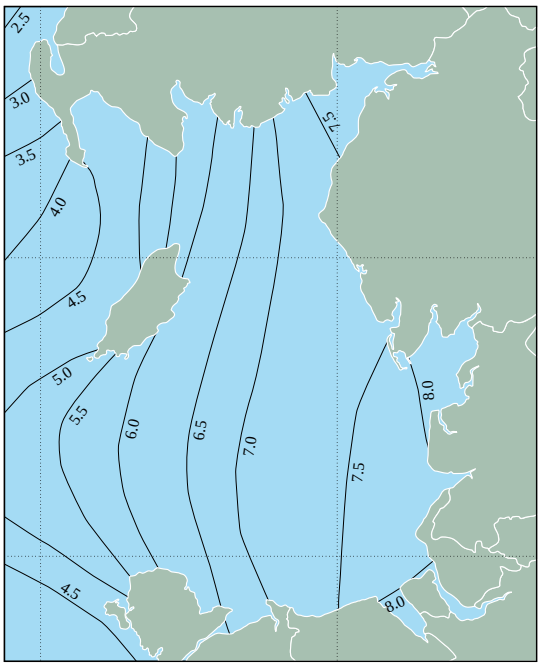
Map 2.3.2 Hourly mean windspeed (in m/s) exceeded for 0.1% of the time. Source: Caton (1976).



Map 2.3.3 Bathymetry. Source: British Geological Survey (1987).



Map 2.3.4 Maximum tidal current speed (in m/s) at mean spring tides. Source: Sager & Sammler (1968).



Map 2.3.5 Tidal range (m) at mean spring tides. Source: Lee & Ramster (1981). © Crown copyright.

in this area and an abundant supply of sand.

West of the Isle of Man is the continuation of the deep channel that extends from St. George's Channel northwards to the North Channel. The channel has a minimum depth of 110 m west of the Isle of Man but deepens northwards to over 240 m. An ice sheet flowing down the Irish Sea deepened the channel during the last glaciation, although it must have been a major topographic feature even before that. The overdeepening is most pronounced in the North Channel.

2.3.3 Tidal currents

Tidal currents in the region are generally weak (see Map 2.3.4), exceeding 2 m/sec only within the inner Solway Firth and between the northern tip of the Isle of Man and the Mull of Galloway. The strong currents, and therefore the predominantly sandy natures, of the inner Solway Firth and the Mersey Estuary adjacent to the Wirral are due to their funnel-like shapes. Strong currents have led to the formation of a series of linear sand banks off the northern tip of the Isle of Man. Low tidal currents off St. Bees Head have allowed mud belts to accumulate off this coast. Here a large tidal range is associated with low tidal current speeds.

2.3.4 Tidal range

The maximum tidal range across the region is high, ranging from about 3 m west of the Mull of Galloway and increasing uniformly eastwards to over 8 m in the Mersey Estuary and Morecambe Bay (Map 2.3.5). The range may at times be influenced by tidal surges, which are produced by rapidly-moving atmospheric depressions that increase the flow of water into the Irish Sea from the Atlantic. The predicted elevation of the 50-year storm surge is 2 m along the Lancashire and south Cumbria coast. The flooding at Towyn, Clwyd, in February 1990 resulted from the conjunction of a storm surge of about 1.3 m elevation, a high tide, and higher than normal wave heights (see also section 2.5.2). Significant advances have been made over the last decade using computer models to predict the height and timing of storm surges in the Irish Sea.

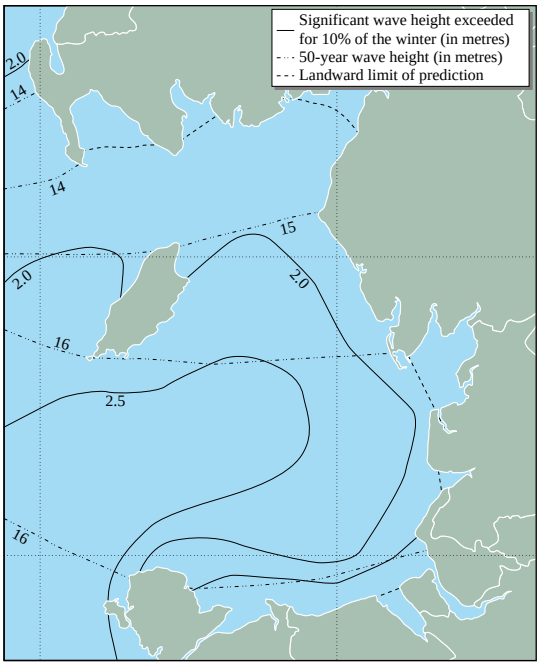
2.3.5 Wave exposure and sea state

The north Irish Sea is semi-enclosed and the significant wave heights exceeded for 10% of the time are generally low compared with those on the more exposed western coasts of the British Isles. In addition the differences between summer and winter wave heights are generally less than on these more exposed coasts (see Map 2.3.6). Offshore, the height of the 50-year wave in the area is about 14 m in the northern and 16 m in the southern part of the region. During these events, wave heights at the coast are less than this: during the 1990 storm that led to the flooding at Towyn, waves of over 4.5 m were recorded at the beach during high water.

2.3.6 Water characteristics

Water temperature

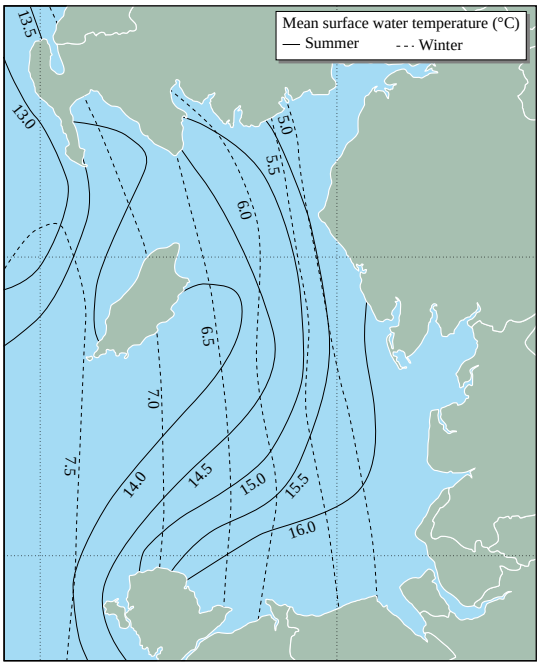
The surface temperature of the sea water varies with the seasons, being coldest in winter (February/March), when it varies from 5°C to 7.5°C, and warmest in summer (August/September) when it varies from 13°C to 16°C (Map 2.3.7). This variation is greater in coastal waters (12°C) compared with offshore waters (6.5°C). In winter coastal waters are cooler than those offshore, and in summer they are warmer. Shallow water in the estuaries may reach considerably higher temperatures than these.



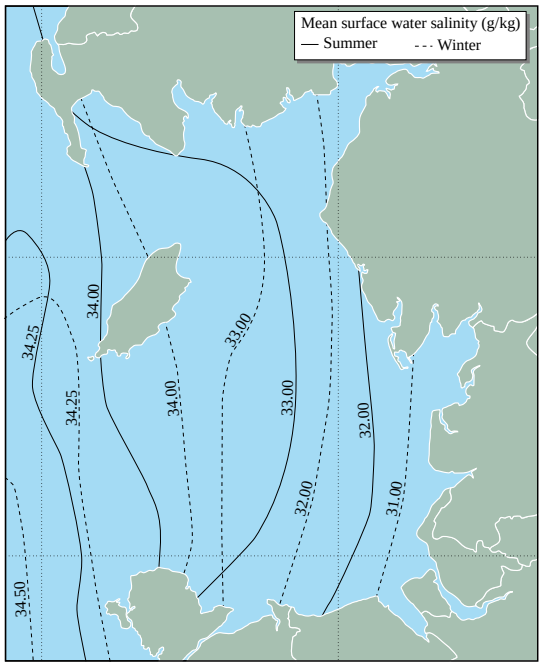
Map 2.3.6 Significant wave height (m) exceeded for 10% of the winter and 50-year wave height. Source: Draper (1992).

Salinity

The salinity of the sea water of the region decreases eastwards, owing to the increased river water input (Map 2.3.8) and is lower in summer than in winter for the same reason. The salinity of coastal waters may fluctuate considerably through the year with variations in river flow.



Map 2.3.7 Mean surface water temperature in summer and winter (°C). Source: Lee & Ramster (1981). © Crown copyright.



Map 2.3.8 Mean surface salinity of seawater in summer and winter in g/kg of total dissolved salt. Source: Lee & Ramster (1981). © Crown copyright.

Water flow

Averaged water flow through the Irish Sea is northward from St. George's Channel to the North Channel, though there are variations due to storm events. The northward flow is weak and averages about 2 to 8 km/day on an annual basis. Thus discharges into the Irish Sea move out into the North Channel, and Liverpool Bay tends to form a backwater where residence time is increased, possibly by more than a year.

2.3.7 Further information

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
UKDMAP (United Kingdom digital marine atlas) Version 2. Oceanographic maps.	British Oceanographic Data Centre, Proudman Oceanographic Laboratory, Bidston Observatory, Birkenhead, Merseyside L43 7RA, tel: 0151 652 3950
Monthly, seasonal and annual windroses	J. Hammond, Meteorological Office Marine Enquiry Service, Johnstone House, London Road, Bracknell RG12 2SY, tel: 01344 854979

2.4 Sediment transport

British Geological Survey

2.4.1 Description

Sediment transport is described within the context of coastal cells and sub-cells. These divide the coastline into sections within which sediment erosion and accretion are inter-related and largely independent of other cells (Motyka & Brampton 1993). Sub-cells are described below and shown on Map 2.4.1. Note that the sediment transport shown is of sand and gravel 'bed load', not suspended sediments.

The varied tidal regime of the northern Irish Sea and the orientation of the coastline relative to the prevailing winds results in complex sediment circulation along the coasts of the region. Motyka & Brampton (1993) include the English and Welsh coasts of the region in a single coastal cell embracing five sub-cells. An equivalent analysis is underway, covering the Scottish coasts.

Within sub-cell 11a, from the Great Orme to the Mersey, there is a moderate to high transport rate for sand, and a low transport rate for shingle; both move eastward. Tidal currents transport sediment, predominantly fine sand and silt grade, into the Dee and Mersey Estuaries. Sediment transport around these estuaries, both on the offshore banks and along the coast, is extremely complex.

In sub-cell 11b, along the coast from the Mersey to Fleetwood, there is a high rate of northerly sand transport and onshore movement of fine sand and silt into the estuaries. Canalization of the outer Mersey has led to major changes in the transport and distribution of sediment within the inner part of Liverpool Bay. South of Blackpool, shingle travels south along the coast into the Ribble Estuary, but to the north of the town, shingle movement is northwards towards Fleetwood (Steers 1969).

The northerly drift continues into the southern part of Morecambe Bay (sub-cell 11c), but the general movement of sediment in the bay is low. On the open coast to the south of St. Bees Head (sub-cell 11d) longshore drift moves the nearshore sediment southwards while the headland itself marks a major divide in sediment transport direction. To the north (sub-cell 11e), tidal currents and waves generated by the prevailing westerly winds move sediments into the Solway Firth, but transport rates are low north of Silloth. Sediment is transported into the minor estuaries along the Cumbrian coast.

Along the north coast of the Solway Firth (Scottish coastal cell 7) sediment transport is to the east. The infill of sand in Wigtown Bay and the sand dunes at the head of Luce Bay indicate that sediment transport is northwards into these bays, being driven largely by wave rather than tidal transport. To the west of the Mull of Galloway, in Scottish sub-cell 6d, there is little sign of any net drift direction.

2.4.2 Coastal erosion

Extensive protection measures exist along much of the coast from Llandudno eastwards to the Mersey and northwards to Walney Island (see also section 8.4). These measures restrict erosion of the backshore, though they may increase erosion on the lower foreshore by restricting the supply of eroded sediment from elsewhere.

The natural defences of the coast are being eroded, with sand dunes along the Formby coast retreating at up to 4 m/year. Along the western shores of Morecambe Bay and Walney Island the cliffs, which are formed of glacial deposits, are being eroded. Of particular interest is the erosion of the cliffs that protect the railway line between Seascale and St. Bees. Erosion is widespread on the artificially augmented beaches at Whitehaven, Workington and Maryport, on the southern shores of the Solway Firth. Here the decline in heavy industry has reduced the volume of industrial material being dumped onto the foreshore. Along this section of coast the north-eastward longshore drift of sediment is leading to local erosion at the mouths of the small coastal harbours.

The Solway Firth contains areas of both erosion and accretion, and its natural development has been modified by land claim in parts of the coastal zone. As the longshore drift of sediment is into the estuary, accretion in general is probably greater in volume than erosion. Locally, however, there may be significant erosion. Around Luce Bay, local erosion of the narrow raised beach threatens roads and defences have been constructed in places (see section 8.4). The dunes in the bay are suffering continual erosion. There is localised erosion in Loch Ryan to the north of Stranraer and on the western coastline of The Rhinns (HR Wallingford 1995).

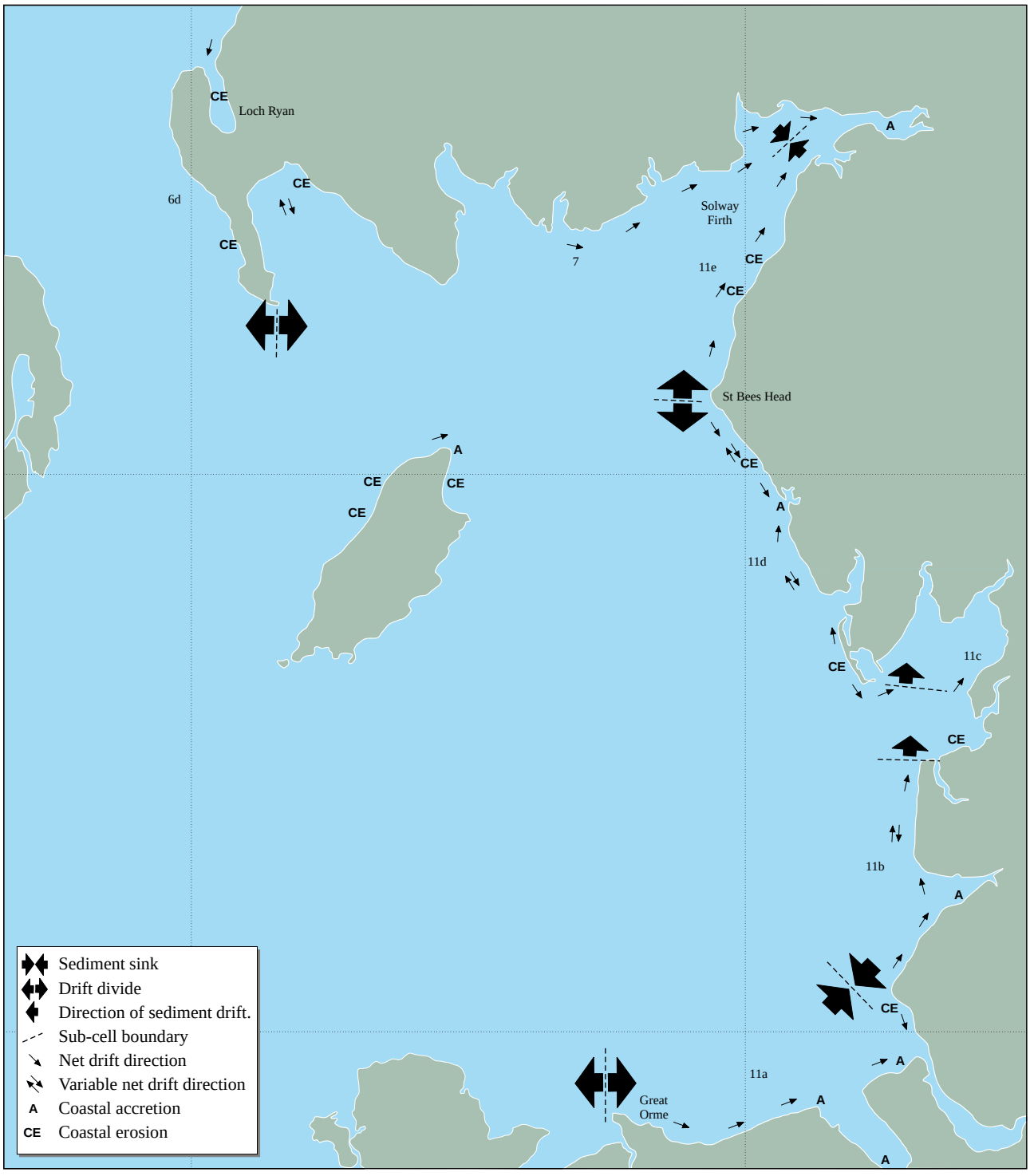
The northern and western parts of the Isle of Man have suffered severe coastal erosion in the last 100 years (Joliffe 1981), with more than 100 m of erosion in the vicinity of Jurby Head.

2.4.3 Accretion

In the south and east of the region, open coasts tend to be eroding while the sediment is accreting in the adjoining estuaries. The Dee Estuary has suffered substantial infill in historic times, and in the Mersey, accretion is taking place next to the training walls. The sand spits off the Point of Ayr and East Hoyle Bank are also accreting. Similar accretion and saltmarsh development is taking place in the Ribble Estuary and Morecambe Bay. To the north, the sand dunes at Haverigg Point, the Esk Estuary and Drigg Point are accreting. The sediments of these estuaries and most of the region contain radioactivity originating from Sellafield, and this provides a means of assessing accretion rates over the past four decades. The Solway Firth acts as a sediment sink, and coal from the coastal dumping to the south-west, along with waste from the nuclear plant at Sellafield, is accumulating within the estuary.

Wigtown Bay and Kirkcudbright Bay are almost infilled with sediment, but Luce Bay, to the west, remains open, though the northern shores of the bay are backed by extensive sand dunes.

The mobility of the northern part of the Isle of Man coastline in the last 100 years has resulted in areas of net accretion around the Point of Ayre (Joliffe 1981).



Map 2.4.1 Sediment transport and coastal cells. Source: Motyka & Brampton (1993). Adapted with permission from MAFF Flood and Coastal Defence Division. Scottish information is from HR Wallingford (1995).

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Steers, J.A. 1973. *The coastline of Scotland*. Cambridge, Cambridge University Press.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Coast protection policy; coast protection survey of England; sediment cells	*Ministry of Agriculture, Fisheries and Food (MAFF), Flood and Coastal Defence Division, London, tel: 0171 238 3000
Review of erosion, deposition and flooding in Great Britain (maps and database)	Minerals Division, Room C15/19, Department of the Environment, 2 Marsham Street, London SW1P 3EB, tel: 0171 276 0900
Sediment cells	HR Wallingford Ltd., Howbury Park, Wallingford, Oxfordshire OX10 8BA, tel: 01491 835381
Sediment transport and wave climate in Region 13	Department of Civil Engineering, Liverpool University, PO Box 147, Brownlow Street, Liverpool L69 3BX, tel: 0151 794 5231

*Starred contact addresses are given in full in the Appendix.

2.5 Sea-level rise and flooding

British Geological Survey

2.5.1 Sea-level changes in the region

Long-term sea-level change across the region is a function of both the global change in sea level, estimated as rising between 1.5 mm to 2 mm/year, and the local change in land levels. Data are available on modern sea-level change from tide gauges at Liverpool, Heysham, Douglas and Portpatrick (Flather 1992). These data show considerable year-to-year variation and also variation between gauges, and the global average quoted above probably represents a reliable estimate of sea-level change across the region in the medium term. The examination of tide gauge data across the region by Emery & Aubrey (1985) confirmed that absolute sea levels were rising by between 0 to 2 mm/year, with the higher value in the southern part of the region.

Shennan (1989) deduced from the measurement of Holocene peat levels that the British Isles was slowly tilting, with northern Britain rising and southern Britain subsiding. The line of zero change runs from the Tees Estuary, through the mouth of the Mersey and westwards across the Lleyn Peninsula. The tilting increases northwards across the region to be between 0.5 to 1 mm/year along the Scottish coast of the Irish Sea (Map 2.5.1). The tilting is a function of isostatic uplift of the earth's crust following its depression under the weight of the last major ice sheet.

The combined effects of the tilting and sea-level change will be slightly greater along the southern coasts of the region and least along the northern coasts, where the uplift of the land will offset some of the rise in sea level.

Map 2.5.1 Areas below 5 m above OD and thus susceptible to flooding; area flooded in 1990. Source: estimated rates of crustal uplift (mm/yr) after Shennan (1989).

2.5.2 Flooding risk in the region

Flooding is an important issue across those parts of the region where the coasts are low-lying. Extensive stretches of these coasts are protected by man-made defences: a third to a half of the coast between Liverpool and Carlisle is provided with man-made defences. The flooding at Towyn in 1990 illustrated the consequences of having inadequate or no defences. Similar previous incidents are reported by Crellin & Diamond (1993) for elsewhere along the coast. Examination of historic records suggests that these flooding events are becoming more frequent, but the causes of the change - possibly sea level rise and/or a more stormy climate - are unclear.

Flooding across the region is most likely when a high tide coincides with a storm surge that overtops or breaches defences. The height of storm surges across the area increases from west to east, with the estimated height of the 50-year storm surge being in excess of 2 m along most of the eastern coasts of the region, decreasing to about 1.5 m along the more western coasts (Flather 1992) (see also section 2.3.4). Thus the magnitude of the isolated storm surge is more important than any global sea-level rise itself in determining possible flooding events in the region over the medium term.

The areas described below as being susceptible to flooding (see Map 2.5.1) along the Welsh and English coasts of the region are taken from Motyka & Brampton (1993).

The description is rather generalised, being based on historic data and a visual examination of the area rather than any specific land contour or tidal water level.

Along the north Wales coast the section susceptible to flooding extends from Abergele to the Dee Estuary. Along the Lancashire coast the section susceptible to flooding covers the entrance to the River Alt, from Southport to Hesketh and from Cleveleys to Fleetwood. Much of the shore of the Lune Estuary and Morecambe Bay to the north is at risk. Flooding risk is minimal along the coast from Walney Island to St. Bees Head and northwards into the Solway Firth. The terraced nature of the low-lying coasts around the Solway Firth, in part the result of long-term uplift, make these coasts (with the exception of the shores of Moricambe Bay) less prone to major flooding than coasts along the southern shores of the region.

The Isle of Man has no extensive areas susceptible to flooding, the southern coasts of the island being predominantly rocky and the northern coasts mostly low cliffs of Quaternary deposits.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Flood defence - Wales	*National Rivers Authority - Welsh Region, Cardiff, tel: 01222 770088
Flood defence - north-west England	*National Rivers Authority - North West Region, Warrington, tel: 01925 653999
Flood and coastal defence policy (see also section 8.4)	*Ministry of Agriculture, Fisheries and Food (MAFF), Flood and Coastal Defence Division, London, tel: 0171 238 3000
Review of erosion, deposition and flooding in Great Britain (maps and database)	Minerals Division, Room C15/19, Department of the Environment, 2 Marsham Street, London SW1P 3EB, tel: 0171 276 0900
Tide gauge data	British Oceanographic Data Centre, Proudman Oceanographic Laboratory, Bidston Observatory, Birkenhead, Merseyside L43 7RA, tel: 0151 652 3950

* Starred contact addresses are given in full in the Appendix.

2.6 Coastal landforms

British Geological Survey

2.6.1 Description

Clwyd eastwards to the Dee Estuary

The coast east from Llandudno Bay to Llandulas comprises a series of rocky headlands separated by open bays and backed by sand and shingle beaches (Map 2.6.1). Much of the lower ground to landward is covered by till, the local erosion of which produces the beach sediments. From Llandulas to the Point of Ayr the coast is formed of shingle and sand beaches backed by sand dunes, alluvium or, locally, peat. The extensive alluvial deposits within the Vale of Clwyd overlie Permo-Triassic sediments, which are softer than the bedrock which forms the coast on either side. Much of this coast is protected by sea walls and groyne systems built to restrict the easterly movement of beach sediment. Similarly, extensive sand dunes backed by alluvium occur along the north coast of the Wirral peninsula between the Dee and Mersey Estuaries. Local early Holocene peat deposits are exposed along the Wirral foreshore, and these give an indication of sea-level changes in the area over the last few thousand years (see also section 6.1.2).

The Dee Estuary to the Mersey Estuary

The estuary of the Dee is almost infilled with sediment and the western shores are fronted by extensive salt marsh. Ports in the upper reaches of the estuary have silted up in historic times. The funnel shape of the estuary encourages siltation: in contrast the Mersey Estuary is constricted near its mouth, which leads to local tidal scour. The banks of the Mersey are formed of low till slopes with a few outcrops of bedrock. Saltmarsh is extensive along the southern shores east of Ellesmere Port, and across the river, east of Liverpool Airport, is an extensive sheet of older Holocene blown sand (the Shirdley Hill Sands). Much of the Dee, Wirral and Mersey coastline is protected and natural coastal processes have been considerably modified as a result.

The Mersey to Morecambe Bay

From the northern outskirts of Liverpool to Southport, a distance of about 25 km, the coast is backed by an extensive sand dune system, forming a belt up to 5 km wide and 25 m high. The high tidal range along this coast leads to a wide intertidal foreshore formed of gently undulating sand. The dune system has shown significant growth in historic times, possibly influenced by the man-made defences in the Mersey and Ribble Estuaries. However, parts of the dune system are now eroding, indicating that their development may fluctuate in response to subtle variations in climate and sediment supply. The dunes rest on peat up to 2 m thick, which comes to the surface inland. The lower part of the Ribble Estuary, where dunes are absent, is covered with the same peat unit; modern estuarine clays overlie the peat in the outer parts of the estuary. Sea walls protect much of the lower Ribble Estuary, and saltmarsh is accumulating seaward of these structures.

The sand dune system on the Fylde coast, north of the Ribble, is well developed northwards to Blackpool and at the mouth of the Wyre Estuary. North of Blackpool the coast consists mainly of low cliffs cut into till. However, nearly all of this coast is modified by coast protection measures, which limit erosion and longshore drift of sand and shingle.

Morecambe Bay to Walney Island

The northern shores of Morecambe Bay are steep and limestone outcrops in places, as at Arnside. In contrast the southern coast is topographically lower and more extensively modified by coast protection schemes. Much conversion of marshland has occurred along the southern margin of the bay. The broad sand flats exposed at low tide were once used as a route for crossing the bay, but their ever-changing form makes the crossing a hazardous venture.

Walney Island, at the northern entrance to the bay, is formed of till and alluvium and has been extended northwards and southwards by recurved shingle spits. A shingle beach fronts the seaward coast of the island, and the eastern sheltered coast is formed of marsh.

Walney Island to Maryport

The coast northwards to St. Bees Head is straight, formed for much of its length of low till cliffs fronted by a shingle storm beach and a sandy foreshore. Spits divert southwards some of the small rivers entering the sea, and the coast at and south of Seascale has a fringing sand dune system of variable width. The 300 m high stretch of Triassic sandstone cliffs at St. Bees Head is the most prominent and significant landform on this stretch of coast.

From St. Bees Head to Maryport the coast is formed of till cliffs fronted by a boulder-rich beach. Spoil from the mining and iron industries has introduced much waste material onto these beaches and longshore drift moves the material north-eastwards.

Solway Firth

The coasts of the Solway Firth are made up of terraced alluvium, overlain locally by peat bogs. The intertidal part of the estuary is a complex of low, largely mobile sand banks separated by winding channels. Isolated shingle areas associated with the banks are the result of the winnowing of coarser material out of the underlying till. Saltmarshes line the intertidal areas which pass landward into a series of Holocene terraces formed of sandy loam. The terraces have been raised into position by the rebound of the earth's crust following the melting of the last ice sheet.

Auchencairn Bay and Rough Firth to the west are infilled with sand, but much of the coast westward to the Mull of Galloway is rocky and cliffed, with the only low-lying sectors being at the heads of Wigtown Bay and Luce

Map 2.6.1 Major coastal landforms

Bay. In places a narrow coastal strip of raised beach is preserved, commonly used by the coastal roads of the region. Sand banks occupy the outer part of Wigtown Bay and pass landward into saltmarsh and then terrace alluvium. The Moss of Cree is an extensive area of peat, which has accumulated on top of the alluvium.

No major rivers enter Luce Bay, which is separated from Loch Ryan to the north by low ground covered by glacial meltwater deposits. The bay is backed by extensive sand dunes (Torrs Warren), landward of which lies Holocene peat or alluvium. The western coast of the Mull of Galloway is smooth in gross plan, but minor irregularities and small bays are common, owing to variations in the response of the rocks to marine erosion. Caves and fossil cliff lines occur along parts of this coast.

Isle of Man

The coasts of the southern parts of the Isle of Man are generally cliffed, though sand-fronted bays occur at Douglas and Port Erin. North of Ramsey the island is low-lying, formed of glacial sands and gravels with till and raised beach deposits.

2.6.2 Further sources of information

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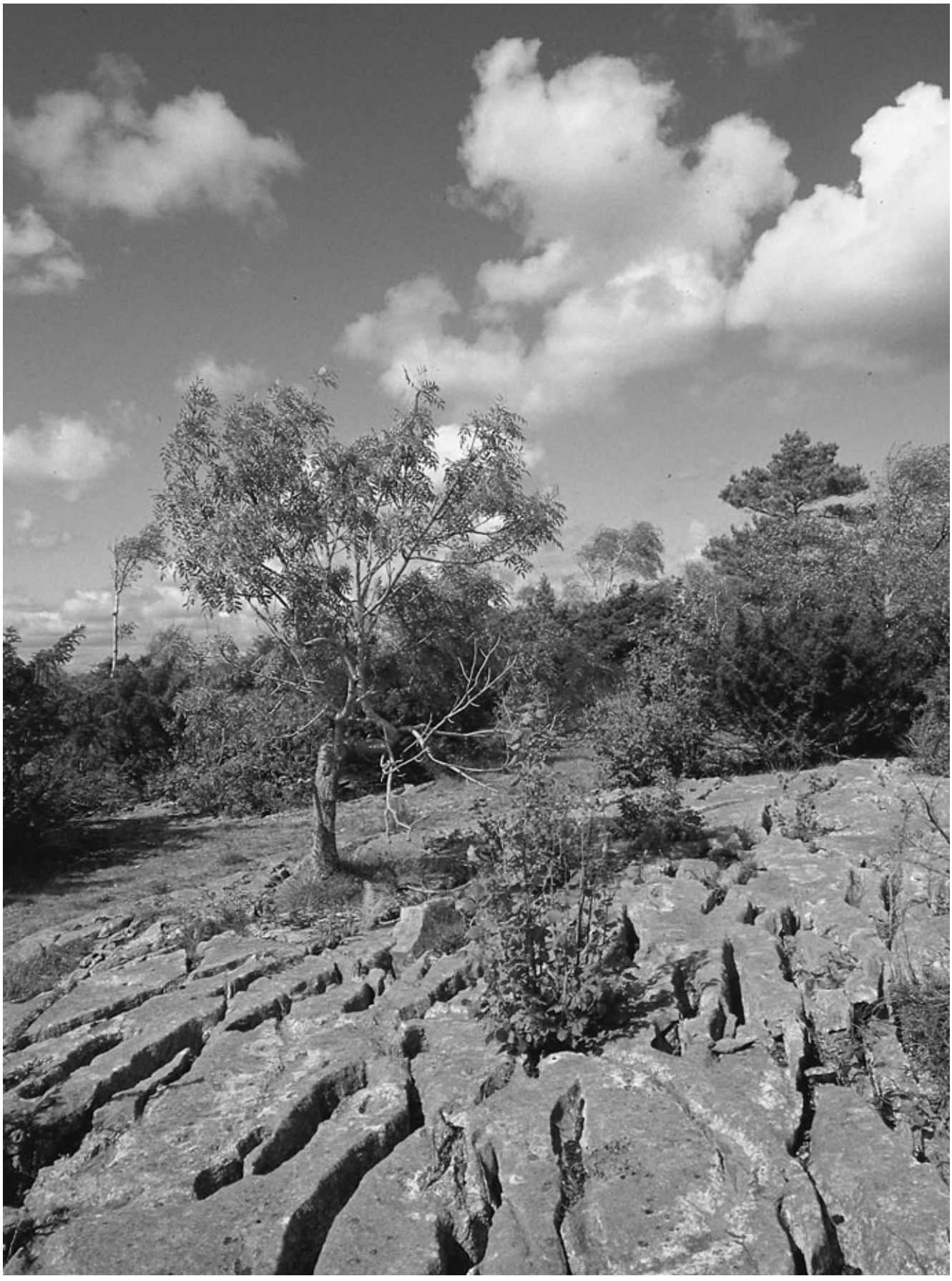
B. Contact names and addresses

Type of information	*Contact address and telephone no.*
Coastal protection	*Ministry of Agriculture, Fisheries and Food, Flood and Coastal Defence Division, London, tel: 0171 238 3000
Coastal geomorphology; 1:50,000 scale 'solid' and 'drift' maps	Coastal Geology Group, British Geological Survey, Keyworth, Nottingham NG12 5GG, tel: 0115 936 3100

* Starred contact addresses are given in full in the Appendix.



Gait Barrows National Nature Reserve, Lancashire, on the northern side of Morecambe Bay, is renowned for its limestone pavements. This rare and fascinating habitat consists of a checkerboard of stone blocks, furrowed by deep solution cracks, in which warmth-loving tender plants and invertebrates have their home. All the coastal limestone pavement in the UK is found in this region, at only a handful of sites.
Photo: Peter Wakely, English Nature.

Chapter 3 Terrestrial coastal habitats

This chapter covers terrestrial habitats that are maritime influenced, i.e. are distinctive because of their association with the coast and coastal processes. Adjacent to some parts of the coast there are other semi-natural habitats of importance that are not directly influenced by the sea, including for example lowland heathland, woodland and dry grassland (other than that on typically coastal substrates - sand, shingle or cliff). In this region, there are a number of important areas of non-maritime habitat close to the coast, principally limestone pavement and associated calcareous grassland, and lowland peatlands.

There are a number of nationally important limestone pavements that lie adjacent to the coast in Region 13, as at Gait Barrows National Nature Reserve (NNR), Lancashire, and Arnside Knot, Cumbria. This habitat has a rich and distinctive flora and invertebrate fauna (see sections 5.1, 5.2 and 5.3) and is of great geological, geomorphological and landscape interest and value. All of Great Britain's coastal occurrences of limestone pavement are found in this region. The region is of national importance for this habitat, which is a priority habitat under the EC Habitats and Species Directive (see section 7.2.4); the Morecambe Bay Limestone Pavements are a candidate Special Area of Conservation under this Directive. Limestone pavements are increasingly under threat as demand for limestone for rockeries and gardens has increased. Only 3% of the limestone pavement existing in Great Britain 50 years ago survives undamaged. All pristine examples of limestone pavement in England and Wales therefore have either been recommended for protection or are already statutorily protected by Limestone Pavement Orders made under the Wildlife and Countryside Act 1981, and many are notified as Sites of Special Scientific Interest (SSSIs). There are seventeen coastal (i.e. within 1 km of the shore) Limestone Pavement Orders (1,022 ha) in Region 13, representing 100% of the coastal Orders in Great Britain (see section 7.3.9).

Lowland peatlands lying within 10 km coastal squares are distributed throughout the region, although this habitat too has been severely depleted in areas of urban development or agricultural improvement. Undamaged examples survive mainly around north Morecambe Bay and the inner reaches of estuaries on the Cumbrian coast and the shores of the Solway, and many have been notified as Sites of Special Scientific Interest (SSSIs) or declared as National Nature Reserves (NNRs). Important sites include the RSPB reserve at Leighton Moss - a peat bog drained for agricultural use and now reverted to reed swamp; Wedholme Flow SSSI, an extensive cut-over raised mire to the south of Moricambe Bay (Solway); and Glasson Moss NNR, on the south Solway Plain, a largely intact peatland that has developed over a terrace of estuarine sediment.

In only a very few places in England does the natural transition of the range of habitats, from marine to terrestrial, occur unmodified by man. At Roudsea Woods and Mosses National Nature Reserve, Cumbria, the whole span from the intertidal mud of Morecambe Bay to climax woodland can be seen in one view, with coastal limestone exposures as a bonus in the foreground. Photo: Peter Wakely, English Nature.

3.1 Cliffs and cliff-top vegetation

Dr T.C.D. Dargie

3.1.1 Introduction

The coast between Clwyd and Loch Ryan (Dumfries & Galloway) contains only a moderate length of cliff and restricted amounts of cliff-top habitat, whereas cliffs comprise over 80% of the Isle of Man coastline. The region has a total cliff length of 258 km (Table 3.1.1, Map 3.1.1), representing 6% of the British resource, and is therefore of modest importance for cliffs in the national context.

Geology and geological structure, together with past environmental history (marine erosion past and present, and glacial processes), determine cliff form. The most distinctive cliff types are consolidated (hard cliffs developed from resistant bedrock) and unconsolidated (soft cliffs developed in easily-eroded materials, including unconsolidated Jurassic shales and Quaternary deposits).

Cliffs in the region exhibit good diversity in form. Their lithologies are very varied, ranging from granite and other hard intrusive types to limestone, sandstone and soft marls, pebble beds and boulder clay. Non-vertical forms are dominant (Table 3.1.2), the most impressive examples being at Humphrey Head and St. Bees Head (Cumbria), the south-west coast of the Isle of Man and along most of the west coast of the Rhinns of Galloway (Dumfries & Galloway). Cliffs rise to 100 m in height close to St. Bees Head, and to 110 m at Dunman, north-west of the Mull of Galloway. Elsewhere cliffed sectors are short and, in the south of the region, very rare.

The soils and vegetation of cliffs and cliff-tops are closely related to slope angle, soil type and salt spray deposition, with much local variability possible with changing exposure around headlands. The major natural and semi-natural cliff and cliff-top habitats in Great Britain are bare ground, spray-zone lichen-covered rock, rock crevice, cliff-ledge, sea-bird colony, perched saltmarsh, maritime grassland and maritime heath. Very sheltered cliffs and cliff-top sectors that receive little salt spray input are not here treated as coastal habitats. Soft cliffs on sheltered coasts are rare in the region and undercliff vegetation is probably absent. The full

Map 3.1.1 Sea cliffs. Source: JNCC Coastal Database and OS Landranger maps. © Crown copyright.

regional extent of cliff-top habitat has not been surveyed but the exposure of the coast to westerly winds and heavy spray deposition allows maritime cliff grassland to develop extensively in Cumbria and it is probably moderately common in Dumfries and Galloway also. Such grassland is restricted to hard cliffs and these more exposed cliff and cliff-top habitats are probably very limited in extent elsewhere in the region. There are estimated to be around 109 ha of maritime cliff grassland in the English counties in the region - 6% of the England total - and 56 ha on the Isle of Man (Table 3.1.1), but there is no equivalent information for Scotland or Wales.

The scenic contribution of cliffs within the region is

Table 3.1.1 Cliff and maritime cliff grassland resource[a] in context

	Soft cliffs		*All cliffs*		*Maritime cliff grassland*	
Area	*Total length (km)*	*% of total in Region 13*	*Total length (km)*	*% of total in Region 13*	*Area (ha)*	*% of total in Region 13*
Clwyd	unknown	-	0.5	-	unknown	-
Merseyside	2.5	-	8.5	-	0	-
Lancashire	0.3	-	3.0	-	3.0	-
Cumbria	8.3	-	25.5	-	106.1	-
Dumfries & Galloway	unknown	-	108.5	-	unknown	-
Isle of Man	18	-	112.0	-	55.8	-
Region 13	***unknown***	-	***258.5***	-	***unknown***	-
England	256.0	4*	1,164.5	3*	1,894.8	6*
Scotland	unknown	unknown	2,372.5	5	unknown	unknown
Wales	unknown	unknown	522.5	0.1	unknown	unknown
West Coast	unknown	unknown	2,271.5	6*	unknown	unknown
GB	unknown	unknown	4,171.0	4*	unknown	unknown

Source: Pye & French (1993). Key: *excluding the Isle of Man; [a]all figures have been rounded to the nearest whole km.

Table 3.1.2 Lengths (km)[a] of cliff types

Area	Vertical >20 m high		Vertical <20 m high		Non-vertical >20 m high		Non-vertical <20 m high	
	Length (km)	% of total length in Region 13	Length (km)	% of total length in Region 13	Length (km)	% of total length in Region 13	Length (km)	% of total length in Region 13
Clwyd	0.5	-	0	-	0	-	0	-
Merseyside	0	-	0	-	3.0	-	5.5	-
Lancashire	0	-	3.0	-	0	-	0	-
Cumbria	7.5	-	5.5	-	11.0	-	1.5	-
Dumfries & Galloway	8.0	-	3.0	-	92.0	-	5.5	-
Isle of Man	unknown	-	unknown	-	unknown	-	unknown	-
Region 13*	***16.0***	**-**	***11.5***	**-**	***106.0***	**-**	***12.5***	**-**
England*	320.0	2.3	49.0	17.3	628.5	2.2	167.0	4.2
Scotland	676.6	1.2	723.5	0.4	633.0	14.5	339.5	1.6
Wales	328.5	0.2	45.5	0	109.5	0	38.5	0
West Coast*	724.5	2.2	438.5	2.6	812.5	13.0	284.0	4.4
Great Britain*	1,325.1	1.2	818.0	1.4	1,371.0	7.7	545.0	2.3

Source: JNCC Coastal Resources Database (cliff height and angle categories). Key: * excluding the Isle of Man; [a]all figures have been rounded to the nearest whole km.

outstanding only at Humphrey Head and St. Bees Head (Cumbria), the Isle of Man and between the Mull of Galloway and Milleur Point (Dumfries & Galloway). St. Bees Head is a Heritage Coast (Cumbria County Council pers. comm.) (see also section 7.4). In this region no Areas of Outstanding Natural Beauty or National Scenic Areas (Scotland) are associated with cliffs (Gubbay 1988; Heritage Coast Forum 1993).

3.1.2 Important locations and species

Of the twelve National Vegetation Classification (NVC) maritime cliff vegetation communities in the UK (Rodwell in prep.), ten are recorded from England, the remaining two being confined to Scotland. No cliff habitat in the region has been mapped using the NVC system, but available survey information suggests that the Dumfries & Galloway coast has the widest range of NVC communities (eight out of the twelve), with Cumbria and the Isle of Man having only two each (Rodwell in prep.). However, neither of these areas has been comprehensively surveyed, so other communities are likely to be present. Maritime heath is an important national feature of cliff-top habitat and is probably moderately extensive on the west coast of the Rhinns of Galloway and parts of the northern Solway Firth coast and Isle of Man.

In Great Britain nine nationally rare and four nationally scarce species or subspecies of higher plant are found mainly or exclusively on cliffs. Most are restricted to cliff habitats in the south and west of Britain. Goldilocks *Aster linosyris* is a national rarity present on Humphrey Head (Cumbria), and four nationally scarce species are present in the region: maidenhair fern *Adiantum capillus-veneris*, red broomrape *Orobanche alba*, Isle of Man cabbage *Coincya monensis*, and yellow vetch *Vicia lutea*. Other nationally rare and scarce species more typical of other habitats also occur on cliffs. Present in the region are one such nationally rare species (small restharrow *Ononis reclinata*) and eight nationally scarce species (wild cabbage *Brassica oleracea*, sea kale *Crambe maritima*, hoary rock-rose *Helianthemum canum*, golden samphire *Inula crithmoides*, rock sea lavender *Limonium binervosum*, vernal sandwort *Minuartia verna*, sea radish *Raphanus maritimus* and Nottingham catchfly *Silene nutans*). No lichen heath of national or regional importance is recorded for the region's cliffs (Fletcher *et al*. 1984). The nationally scarce lichen *Lecania aipospila* occurs on cliffs on the southern edge of Morecambe Bay.

The regional bird fauna is good but no cliff site warrants Special Protection Area status (Stroud *et al.* 1990) under the EC Birds Directive, though several high cliffs support regionally important numbers of breeding seabirds. Grazed maritime turf is important for foraging choughs, and controlled grazing by sheep is vital to the maintenance of the invertebrate populations on which choughs depend. The Isle of Man has the densest recorded population of choughs in north-west Europe (Cullen & Jennings 1986) (see also section 5.11). No systematic survey of invertebrates in cliff and cliff-top habitats has been carried out, but these environments have a rich habitat diversity and thus support large numbers of species (Mitchley & Malloch 1991). A few cliffs in the region have good invertebrate lists, with some notable and Red Data Book (threatened, see footnote to Table 5.3.1) species: Humphrey Head and St. Bees Head (Cumbria) are regionally important cliff locations in the JNCC's Invertebrate Site Register (see also section 5.3). Langness on the Isle of Man supports the only colony of the lesser mottled grasshopper *Stenobothrus stigmaticus* in the British Isles.

The glacial soft rock cliffs around the northern coast of the Isle of Man are of major importance for beetle conservation in the British Isles (Boyce & Fowles 1989). The 5 km stretch of exposures, which rise to 50 m on the north-east coast, have been described as some of the finest of their kind in Europe for beetles (Garrad 1972). Whilst the cliffs are of limited botanical importance, the mosaic of actively eroding to well-vegetated, dry to saturated microhabitats is of considerable importance for invertebrates, slopes that are flushed by surface water being the richest. The flushing of the soft substrates causes considerable slumping of the cliffs, and there is a well developed talus zone (debris heap) beneath them, which can be rich in invertebrates. A certain amount of disturbance through erosion can benefit many of

the invertebrates of such cliffs.

Several coastal cliffs support woodland, as for example on limestone cliffs at Arnside, Cumbria, and on the Isle of Man the woodland is thought to be descended from native stock (Garrad 1972).

Although localised problems occur on the raised cliffs around Galloway, the most significant cliff recession occurs on the Cumbrian coastline. The low cliffs formed in clayey till between Seascale and St Bees are particularly prone to erosion, and the 100 m high sandstone cliffs between St Bees and Maryport are susceptible to rockfalls. Much of the Cumbrian coastline is undeveloped and hence erosion does not create major problems, although it releases significant quantities of shingle, which is transported northwards (Jones & Lee 1994).

3.1.3 Human activities

Cliffs are among the least modified of terrestrial habitats, although nationally the cliff-top zone, especially its inner sectors, has been affected by a variety of human impacts, sometimes leading to major habitat loss. At a national scale the most extensive influences on hard cliff vegetation are grazing and burning, the major management techniques for cliff-top habitat (Mitchley & Malloch 1991). Little is known of their role in the region, though grazing is locally common in Cumbria and Dumfries & Galloway. In general, on the cliffs of this region, visitor erosion and residential development have caused very little local habitat loss and vegetation disturbance. However, footpaths have heavy usage in some parts of the region (particularly Cumbria, and a short stretch of the Southern Upland way in the Rhinns of Galloway) and local erosion is present. Most of the cliffed coast is largely undeveloped, the major exceptions being housing close to one coastal settlement (Portpatrick, Dumfries & Galloway). There is little caravan park development close to cliffs and there are few car parks.

Very little of the region's cliffed coast has had the base protected by coastal defences, and natural coastal erosion is prevalent. Slumped material is common on the small extents of soft cliff in Merseyside and Lancashire and on the Isle of Man.

3.1.4 Information sources used

Detailed NVC survey based on mapping has not been carried out in the region, and existing information is insufficient to detail the regional extent of individual cliff and cliff-top habitats, apart from maritime cliff grassland in England and the Isle of Man.

3.1.5 Acknowledgements

Special thanks are due to John Lamb, Manx Nature Conservation Trust, for providing information on cliffs and cliff-top habitat on the Isle of Man. Thanks go to Rendel Geotechnics for information on landsliding and cliff erosion. The figure for the area of maritime cliff grassland on the Isle of Man was provided by courtesy of the Department of Agriculture, Fisheries and Forestry.

3.1.6 Further sources of information

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B. Further reading

Further details of coastal habitat sites, including cliffs, are available on the *Coastal & marine UKDMAP datasets* module disseminated by JNCC Coastal Conservation Branch, Peterborough.

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Steers, J.A. 1964. *The coastline of England and Wales*. Cambridge, Cambridge University Press.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Flora, fauna, habitat information, location of site reports, site management - England	*Coastal Ecologist, English Nature HQ, Peterborough, tel: 01733 340345
Flora, fauna, habitat information, location of site reports, site management - Scotland	*Coastal Ecologist, Scottish Natural Heritage HQ, Edinburgh , tel: 0131 447 4784
Flora, fauna, habitat information, location of site reports, site management - Wales	*Coastal Ecologist, Countryside Council for Wales HQ, Bangor, tel: 01248 370444
Flora, fauna, habitat information, site management - Isle of Man	*Biological Records Officer, Manx National Heritage, Douglas, tel: 01624 675522
Advice on national and international policy and cliff conservation	*Coastal Conservation Branch, JNCC, Peterborough, tel: 01733 62626
National Landslide Databank	Rendel Geotechnics, Norfolk House, Smallbrook Queensway, Birmingham B5 4LJ, tel: 0121 627 1777
Invertebrate fauna	*Invertebrate Site Register, Species Conservation Branch, JNCC, Peterborough, tel: 01733 62626

* Starred contact addresses are given in full in the Appendix.

3.2 Sand dunes

Dr T.C.D. Dargie

3.2.1 Introduction

The Irish Sea coastline of the region contains a moderately large number of sand dune systems associated with bays and estuaries. The exact extent of vegetated sand dune in Dumfries & Galloway is uncertain but the overall distribution in the region is shown in Map 3.2.1, with major concentrations in north Wales, the Sefton Coast, west Cumbria and Luce Bay. In the English counties of the region there are at least 3,170 ha of sand that is vegetated or has some other land cover. This represents 34% of the dune resource in England. The total area of vegetated sand dunes in the region (at least 4,205 ha) represents more than 8% of the resource in Great Britain; the region is therefore of moderate importance in the national context (Table 3.2.1).

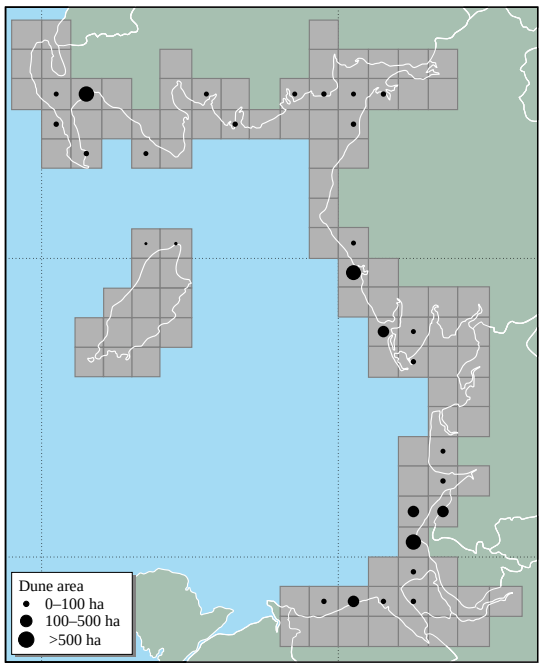
90 National Vegetation Classification (NVC) communities (Radley 1994) have been recorded for all England, Scotland and Wales, with a total of 156 types for communities and sub-communities combined, not all of them exclusive to dunes. The region is notable for extensive mobile dunes (SD6 marram *Ammophila arenaria* community), semi-fixed dunes (SD7 marram *Ammophila arenaria* - red fescue *Festuca rubra* community) and most dune slack communities and sub-communities (SD13 creeping willow *Salix repens* - moss *Bryum pseudotriquetrum*, SD14 creeping willow *Salix repens* - moss *Campylium stellatum*, SD15 creeping willow *Salix repens* - moss *Calliergon cuspidatum*, SD16 creeping willow *Salix repens* - Yorkshire-fog *Holcus lanatus* and SD17 silverweed *Potentilla anserina* - common sedge *Carex nigra* types). The diversity of vegetation in the dune slacks is particularly important in the context of English dunes. The extent of NVC dune vegetation types occurring in the region, including other land cover (e.g. bare ground, car park, caravan park), is given in Table 3.2.2.

The moderately large extent and diverse range of habitats make the sand dunes of the region of great interest. This is reflected in 24 SSSI designations, three NNRs and five LNRs. Several sites also fall within an Area of Outstanding Natural Beauty or the Lake District National Park. Hoylake Dunes are part of the Mersey Estuary Ramsar Site and Special Protection Area for birds (Stroud, Mudge & Pienkowski 1990), and other sites are of equivalent importance.

Table 3.2.1 Region 13 vegetated dune resource[a] in context

	Total area (ha)	*% of total in Region 13*
Clwyd	266	-
Merseyside	1,686	-
Lancashire	42	-
Cumbria	1,442	-
Isle of Man	70	-
Dumfries & Galloway	699	-
Region 13	***4,205***	***100***
England	9,282	34
Scotland	31,540	2
Wales	8,483	3
West Coast	31,308	13
GB	50,200	8

Sources: Dargie (1993), Dargie (1995), DAFF (1995), Radley (1994), JNCC Coastal Resources Database. Key: [a]all figures have been rounded to the nearest whole hectare. Note: Country totals for Scotland (and therefore Great Britain) are provisional estimates.



Map 3.2.1 Areas of sand dune by coastal 10 km square. Source: JNCC Coastal Database.

3.2.2 Important locations and species

There are 31 sand dune sites in the region (Table 3.2.3; Map 3.2.2). The largest dunes are hindshore types, which develop above beaches with a good sand supply and an onshore prevailing wind, which drives sand inland as a series of dune ridges or mobile parabolic dunes. Hindshore systems are found in the most exposed sectors of the Irish Sea coastline, e.g. at the Wirral Coast, all of the Sefton Coast from Hightown (site 6) to Southport Dunes (site 14), and Torrs Warren (site 29). Torrs Warren is an unusual example of the type, in that it lies at the head of Luce Bay, but its relatively wind-sheltered position is compensated for by the fact that it has a long fetch (unbroken stretch of sea before the waves deposit their load of sand) southwards towards the Merseyside coast. Ness or foreland dunes develop on shores with sand supply from two directions and gradually extend (prograde) seawards. This type is restricted in the region to Haverigg Haws and Sandscale Haws in the Duddon Estuary. Spit dunes (e.g. Drigg Dunes, Eskmeals, North Walney, Gronant to Talacre) develop at the mouths of estuaries and depend strongly on river sediment for their sand supply. Bay dunes are infrequent in the region because the shoreline exposed to prevailing winds has few headlands to trap sand; they are commonest in the area around Silloth and Maryport. Climbing dunes are sand blown up on to terrain inland of the main dune system, but

Table 3.2.2 Areas of dune vegetation types (ha)[a]

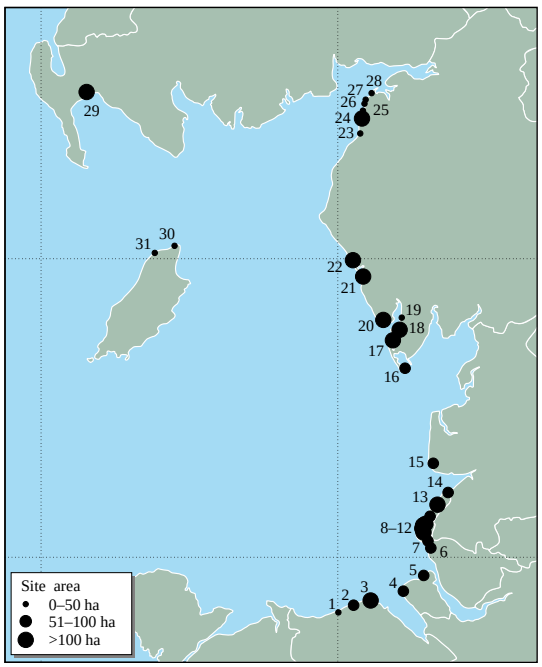
	Strand and embryo dune	*Mobile and semi-fixed dune*	*Acidic fixed grassland*	*Neutral calcareous fixed dune grassland*	*Dune heath and bracken*	*Dune slack*	*Other dune wetland*	*Dune woodland and scrub*	*Trans-itions to saltmarsh*	*Trans-itions to maritime cliff*	*Other land cover*
Clwyd	6	78	1	111	0	1	13	20	10	0	26
Merseyside	11	679	100	217	14	181	0	324	0	0	159
Lancashire	1	30	0	1	0	6	0	1	0	0	3
Cumbria	19	496	199	410	53	62	43	67	8	0	85
Dumfries & Galloway	2	32	253	37	192	2	133	38	3	0	9
Isle of Man	0	70	0	0	0	0	0	0	0	0	0
Region 13	***39***	***1,384***	***552***	***777***	***259***	***253***	***189***	***448***	***20***	***0***	***282***
England	179	2,484	671	2,710	197	487	150	1,189	141	30	1,044
Scotland	61	4,059	4,125	10,513	2,113	1,095	3,817	5,500	217	41	587
Wales	136	1,961	162	2,034	136	614	221	2,364	59	21	775
West Coast	-	-	-	-	-	-	-	-	-	-	-
Great Britain	340	8,574	4,953	15,228	2,615	2,175	4,114	8,965	836	64	2,406

Sources: Dargie (1993), Dargie (1995), DAFF (1995), Radley (1994), JNCC Coastal Resources Database. Key: [a]all figures have been rounded to the nearest whole hectare. Note: Country totals for Scotland (and therefore Great Britain) are provisional estimates.

this type is rare. In this region it is restricted to Drigg in Cumbria, where sand covers glacial drift north of the main spit, and on the raised beach at the Ayres in the Isle of Man (Dackombe & Smith 1988), which has not been properly surveyed.

The larger dune systems in the region develop a fresh (rarely brackish) watertable which influences the vegetation of depressions, forming a distinctive and nationally rare type of wetland termed dune slack. This habitat is common on hindshore dunes and the larger ness/foreland and spit dune types. It is rare or absent from most bay and climbing dunes. The Sefton Coast sites have a particularly fine set of such slacks.

In Great Britain five nationally rare and twelve nationally scarce higher plants are found mainly or exclusively on dunes. One nationally scarce variety, dune helleborine *Epipactis leptochila* var. *dunensis*, is present in the region. Variegated horsetail *Equisetum variegatum*, sea stork's bill *Erodium maritimum*, Portland spurge *Euphorbia portlandica*, sea spurge *E. paralias*, seaside centaury *Centaurium littorale*, Baltic rush *Juncus balticus*, dune fescue *Vulpia membranacea* and grey hair-grass *Corynephorus canescens* are nationally scarce dune plants found in the region. The Ayres in the Isle of Man is the only British site outside Ireland for dense-flowered orchid *Neotinea maculata*. The nationally scarce dune species sea buckthorn *Hippophae rhamnoides* is common but introduced in the region. Other nationally rare and scarce species more typical of other habitats also occur on regional dunes. The only such national rarity is sharp club-rush *Schoenoplectus pungens*, but its status is uncertain (Atkinson & Houston 1993). Nationally scarce species include Azores adder's-tongue fern *Ophioglossum azoricum*, sea kale *Crambe maritima*, brackish water-crowfoot *Ranunculus baudotii*, Isle of Man cabbage *Coincya monensis* subsp. *monensis*, coralroot orchid *Corallorhiza trifida*, pendulous-flowered helleborine *Epipactis phyllanthes*, bird's-foot clover *Trifolium ornithopoides*, Ray's knotgrass *Polygonum oxyspermum* subsp. *raii*, larger wintergreen *Pyrola rotundifolia*, yellow bartsia *Parentucellia viscosa* and slender spike-rush *Eleocharis acicularis* (see also Section 5.2). Rare bryophytes also occur in the region (e.g. *Bryum mamillatum* and *Petalophyllum ralfsii*). (see also Section 5.1).



Map 3.2.2 Sand dune sites. Numbers refer to Table 3.2.3. Source: JNCC Coastal Database.

Hoylake Dunes are within an area of international importance for birds, and natterjack toad *Bufo calamita* and sand lizard *Lacerta agilis* have their northern limit in Britain here, although numbers appear to be in decline (Atkinson & Houston 1993). Sand dune and saltmarsh habitats are particularly important for natterjack toads, with 95% of the British population found in five of the region's estuaries (Alt, Ribble, Duddon, Irt-Esk and Solway). The JNCC's Invertebrate Site Register summarises the invertebrate characteristics of the region's coast, and locations containing fifteen dune sites emerge as outstanding in terms of notable, rare and Red Data Book (threatened, see footnote to Table 5.3.1) species. These are: Gronant Dunes, North Wirral Foreshore, Ainsdale Sand Dunes, Southport Sand Dunes, Formby Sand Dunes, Lytham St. Anne's Dunes, South

Walney, North Walney, Sandscale Haws, Eskmeals Dunes, Drigg Coast, Silloth Dunes, Ravenglass Dunes, Torrs Warren - Luce Sands and The Ayres (see also section 5.3).

3.2.3 Human activities

In general, sand dunes are among the least heavily modified of terrestrial habitats. However, the inner edge of many sand dune sites in the region has been strongly affected by a variety of human impacts, sometimes leading to major habitat loss or conversion to vegetation that is common and lacks typical dune species (Doody 1989). The most notable cases are the loss of large dune areas to residential development and conifer afforestation on the Sefton Coast (Jones *et al.* 1993). Residential and recreational development has encroached on many sites. Car parks, caravan and camp sites and golf courses are very common on and adjacent to many sites. Military use is present on several sites (notably Eskmeals and Torrs Warren), but the total area of impact and damage is slight.

Conservation is now a major aim in many locations, with many sites having one or more designations or forms of planning control (Table 3.2.3) (Dargie 1993, 1995; Radley 1994). Conservation management is common on many sites. Damage from recreational use is controlled by the provision of car parking space and hardened paths and boardwalk to reduce path erosion. Several sites have required scrub removal (notably of sea buckthorn *Hippophae rhamnoides*), and grazing using sheep has been reintroduced at a number of sites. Coastal erosion is a problem in many sites, with a majority showing erosion rather than accretion over most of their beach frontage (Radley 1994; Rouse 1990). Which sectors are eroding has changed significantly over time on the Sefton Coast and occasional storm surges can cause major losses to the foredune sector of beaches (Plater *et al.* 1993; Rouse 1990). A Coast Management Plan has been developed for the Sefton Coast, involving Sefton Borough Council, English Nature and the National Trust, providing strategies for managing and monitoring dunes, woodland

Table 3.2.3 Sand dune sites in region[a]

Code	*Name*	*Grid ref*	*Area (ha)*	*Dune type*	*Conservation status*
	Clwyd				
1	Kinmel Bay	SH988806	13	spit	
2	Rhyl to Prestatyn	SJ042830	54	bay	
3	Gronant to Talacre	SJ096844	200	spit	SSSI
	Merseyside				
4	Hoylake Dunes	SJ207873	74	bay	Ramsar, SPA, SSSI
5	Wirral Coast and Wallasey Golf Course	SJ277927	83	bay	SSSI
6	Seaforth to Hightown	SD297018	155	hindshore	WT, SSSI
	Lancashire				
7	Altcar Firing Range	SD288042	98	hindshore	
8	Cabin Hill to Lifeboat Road	SD275070	237	hindshore	NNR, NT, SSSI
9	Formby Point	SD282091	178	hindshore	SSSI
10	Formby Golf Course to Woodvale Aerodrome	SD282099	303	hindshore	SSSI
11	Ainsdale NNR	SD286109	343	hindshore	NNR, SSSI
12	Ainsdale LNR	SD298129	111	hindshore	LNR, SSSI
13	Birkdale Hills	SD320164	418	hindshore	LNR, SSSI
14	Southport Dunes	SD354207	78	hindshore	SSSI
15	Fylde Coast Dunes	SD310303	57	bay	
	Cumbria				
16	South Walney	SD213622	81	spit	WT, SSSI
17	North Walney	SD172718	142	spit	NNR, SSSI
18	Sandscale Haws	SD192753	199	ness/foreland, spit	NT, SSSI
19	Dunnerholme to Askham in Furness	SD212788	0	bay	SSSI
20	Haverigg Haws	SD143783	130	ness/foreland, spit	SSSI
21	Eskmeals Dunes	SD077939	227	spit, bay	WT, LNR, NP, SSSI
22	Seascale to Drigg	SD052992	345	spit, climbing, bay	LNR, NP, SSSI
23	Silloth/Maryport Allonby to Maryport	NY074409	0	bay	AONB
24	Silloth/Maryport Mawbray Banks South	NY080466	322	bay	AONB, SSSI
25	Silloth/Maryport Mawbray Banks North	NY086483	0	bay	AONB, SSSI
26	Silloth/Maryport - Wolsty Bank	NY097517	0	bay	AONB, SSSI
27	Silloth/Maryport Silloth Golf Course	NY103525	0	bay	AONB, SSSI
28	Grune Point	NY136565	55	spit	AONB, SPA, SSSI
	Dumfries & Galloway				
29	Torrs Warren	NX148550	699	bay, hindshore	SSSI
	Isle of Man				
30	The Ayres	NX430037	34	hindshore	MNH
31	Blue Point to Sartfield	NX371011	36	hindshore	WT

Source: Dargie (1993); Dargie (1995); Radley (1994); DAFF (1995). Key: Code refers to mapped site location (see Map 3.2.2); AONB = Area of Outstanding Natural Beauty; WT = County Wildlife Trust reserve; LNR = Local Nature Reserve; NNR = National Nature Reserve; NP = National Park; NT = National Trust; Ramsar = wetland of international importance (Ramsar site); SPA = Special Protection Area; SSSI = Site of Special Scientific Interest (biological); MNH = Manx National Heritage; [a]all figures have been rounded to the nearest whole hectare.

and vegetation, and for species conservation, education and recreation, via co-ordinated site and local authority subject management plans (Wheeler *et al.* 1993). This area is probably the most experienced and progressive in Britain for such initiatives for sand dunes.

3.2.4 Information sources used

In recent years virtually all areas of vegetated sand dune in the region have been surveyed using the NVC (Rodwell 1991a, 1991b, 1992, 1995, in prep.). This work was part of the sand dune survey of Great Britain initiated by the NCC in 1987 and continued after 1991 by the JNCC on behalf of country conservation agencies. The survey covered 29 dune sites in the region (Table 3.2.3, Map 3.2.2) and excluded only a number of small sites in Dumfries and Galloway, comprising a few insignificant bay dunes (Mather 1979), and a site on the Isle of Man, which has been surveyed using the Phase 1 habitat survey (DAFF in press). Survey of dunes in Scotland is still in progress and it is not possible to give absolute figures for the extent or nature of the dune resource in Dumfries and Galloway. Scottish Natural Heritage has recently commissioned a project aiming to complete the NVC survey of Scottish dunes by 1998. The lack of full survey data for Scotland prevents calculation of precise figures on the extent of the sand dune resource for either the West Coast or Great Britain. An estimate of dune habitats for Scotland is used here, based on a sample set of sites (Dargie 1993), to allow some form of British context to be made.

NVC surveys use a reliable, consistent methodology yielding very detailed information (Rodwell in prep.). The vegetation is mapped and described, and information on coastal erosion and accretion, atypical vegetation and adjoining land use is also recorded. The data represent a sound baseline for future dune vegetation studies and both strategic and local management of the dune resource. Individual site reports and national reports for England (Radley 1994), Scotland (Dargie 1993) and Wales (Dargie 1995) are available from the JNCC. Most data discussed here are derived from the national reports. In addition, the bryophytes, lichens and fungi of the Sefton Coast are well documented (Atkinson & Houston 1993), as are fungi for Sandscale and Walney Island (Rotheroe 1994).

The early geomorphological survey of Scottish beaches (Mather 1979; Ritchie & Mather 1984) used a consistent methodology and also included information on site use, especially for recreation. It offers a good baseline for the survey date. The ITE survey (Shaw *et al.* 1983) was not as detailed as an NVC survey; no mapping of vegetation was undertaken and the extent of each vegetation type is unknown. However, a useful descriptive site account is included and species records for each site are available. Only Torrs Warren is included in both the ITE and the geomorphological surveys; the management of its geomorphology has been covered by Single & Hansom (1994). The geomorphology of the Ayres has been surveyed by Dackombe & Smith (1988).

3.2.5 Acknowledgements

Special thanks are due to John Lamb, Manx Nature Conservation Trust, for providing information on sand dunes on the Isle of Man. Assistance with sources was kindly provided by the Coast Management Officer, Metropolitan Borough of Sefton, and the Coastal Conservation and Species Conservation Branches of the Joint Nature Conservation Committee. The area of dunes in the Isle of Man was provided by courtesy of the Department of Agriculture, Fisheries and Forestry (DAFF).

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Flora, fauna, habitat information, location of site reports, site management - England	*Coastal Ecologist, English Nature HQ, Peterborough, tel: 01733 340345
Flora, fauna, habitat information, location of site reports, site management - Scotland	*Coastal Ecologist, Research and Advisory Services Directorate, Scottish Natural Heritage HQ, Edinburgh, tel: 0131 554 9797
Flora, fauna, habitat information, location of site reports, site management - Wales	*Coastal Ecologist, Countryside Council for Wales HQ, Bangor, tel: 01248 370444
Flora, fauna, habitats, management - Isle of Man	*Biological Records Officer, Manx National Heritage, Douglas, tel: 01624 675522
Issues, coastal zone management initiatives	Coast Management Officer, Formby Council Offices, Freshfield Road, Formby, Merseyside L37 6PQ, tel: 0151 934 2960
Advice on national and international policy and dune conservation	*Coastal Conservation Branch, JNCC, Peterborough, tel: 01733 62626

* Starred contact addresses are given in full in the Appendix.

3.3 Vegetated shingle structures and shorelines

Dr R.E. Randall

3.3.1 Introduction

Shingle means sediments larger than sand but smaller than boulders: that is, between 2 mm - 200 mm in diameter. Where the coast features shingle, it is often mixed with large amounts of sand, or else sand dunes (see section 3.2) have developed on it. Shingle sites include both simple fringing beaches and also more complex structures where the shingle is vegetated yet not buried by more than 20 cm of sand. Such sites are covered in section 3.2. Shingle plant communities around Britain are distinctive (Sneddon & Randall 1993a), with some communities being widespread and others limited to a particular region or substrate. Much of the coast of this region is bordered by extensive spreads of shingle but large areas are subject to high levels of recreational pressure (Steers 1964) or industrial activity and considerable areas are unvegetated as a result of natural disturbance on a high-energy coastline.

This region contains a considerable amount of the British shingle resource, especially in the fringing shingle beaches of Cumbria and the raised shingle beaches of North Solway, and the region as a whole has a wide representation of shingle vegetation communities. Many of the Cumbrian beaches are disturbed and have little natural vegetation, but the Scottish raised beaches on the east coast of Luce Bay are particularly significant for their large range of plant communities, from pioneer through to prostrate scrub and, at Rascarrel Bay, to woodland. This region contains the most southerly sites for some northern species (e.g. oyster plant *Mertensia maritima*) and also the most northerly sites for some southern species (e.g. yellow horned-poppy *Glaucium flavum*). Pure shingle is uncommon in western Britain; Claymoddie and Milton Point are important in this respect. Foulney, Biggar and Powfoot are significant sites for showing the influence of adjacent saltmarsh on shingle vegetation. Gronant and Grune Point are good examples of the influence of a sand matrix on shingle vegetation. Several sites, particularly those around Luce Bay, are significant in having representative north-western communities containing sea radish *Raphanus maritimus*.

3.3.2 Important locations and species

The major shingle sites in the region are shown on Map 3.3.1 (see also Tables 3.3.1 and 3.3.2). On the Clwyd coast around Llandulas and Abergele a drift terrace built up against pre-glacial limestone cliffs is the source of shingle for multiple-ridge beaches that have formed in the area between Llandulas and Abergele. Further east shingle is found in association with large quantities of aeolian sand at Gronant. At the actively growing eastern end of the spit, the vegetation is strongly shingle-influenced, but westwards the sand cover increases to form a large dune system (see section 3.2.).

The Merseyside and Lancashire coasts are virtually devoid of shingle, except at a small area of fringing beach near Bolton-le-Sands, but some sandy shingle recurs in the north of Morecambe Bay and becomes especially significant

Map 3.3.1 Vegetated shingle structures and fringing shingle beaches. Source: Sneddon & Randall (1993a).

around the spit of Foulney Island and the barrier island of Walney. Here, as well as sand, saltmarsh influences are significant in lower shingle areas. There is an extensive area of sandy shingle fringing beach along much of the Cumbria coast, frequently backed by cliff. However, much of this area is lacking in vegetation as a result of exposure or industrial disturbance. Towards Grune Point there is extensive dune cover and a sandy raised shingle beach.

The north Solway coast has sandy and marshy shingle from Powfoot to Dornoch and a boulder shore backed by a raised shingle beach at Rascarrel Bay. From Burrow Head to Auchenmalg Bay there is a significant, almost continuous raised beach of sandy or occasionally pure shingle, which varies from a narrow strip to more complex spit and multiple ridge systems, such as at Philip and Mary and at Claymoddie. Raised sandy shingle recurs on the Rhinns but only at isolated sites, often exposed to high-energy seas (Steers 1973).

The Ayres in the Isle of Man is a post-glacial raised beach consisting of a series of shingle ridges mostly lying below 10 m Ordnance Datum, with a thin covering of blown sand. The beach stretches for 8 km along the northern tip of the island and is up to 1.3 km broad. The seaward edge has a narrow discontinuous belt of sand dunes (section 3.2) and the inland margin is marked by a former cliffline. The raised beach ridges are still actively accumulating, fed by erosion of glacial drift cliffs to the south, and there is a magnificent modern storm beach curving around the Point of Ayre.

The sandy nature of the substrate at many of the shingle sites in this region is strongly reflected in the vegetation. A common pioneer assemblage in the north of the region on sandy shingle strands and structures is a community

Table 3.3.1 Surveyed shingle sites

Site name	*Grid ref.*	*Site type*	*Area surveyed (ha)*	*Conservation status*	*Human activities*
Clwyd					
Llandulas	SH 930783	Multiple storm ridges	15.9	SSSI	Recreation, sea defence, vegetation clearance, rabbit grazing
Gronant	SJ 100850	Sandy shingle spit	1.9	SSSI	Light recreation
Cumbria					
Foulney	SD 240650	Multiple ridge spit and island	21.6	SSSI/CWT	Erosion control, rabbit grazing
South Walney	SD 234620	Barrier island with sandy spit	11.4	SSSI/CWT	Sheep and cattle grazing, past gravel extraction
North Walney	SD 177724	Sandy shingle foreshore and slack	0.4	SSSI/NNR/CWT	Rabbit grazing
Grune Point	NY 140560	Composite sandy shingle spit	23.1	within Solway SSSI/SPA/ Ramsar site	Livestock grazing, vehicular access
Dumfries & Galloway					
Powfoot	NY 180650	Fringing beach, raised beach & spit	9.0	SSSI	Erosion control livestock and rabbit grazing
Rascarrel Bay	NX 810470	Boulder shore & raised beach	4.8	None	Minor recreational access
Claymoddie	NX 430360	Raised beach system	30.0	SSSI	Farming, past gravel extraction
Philip & Mary	NX 340430	Sandy shingle spit	2.7	None	None
Milton Point	NX 320460	Pure shingle raised beach system	4.1	None	Shingle extraction
Shore Cottage	NX 300470	Sandy and shelly raised beach	3.9	None	Loss to agriculture, rabbit and cattle grazing
Chapel Finian	NX 280490	Raised beach with sand overlay	3.6	None	Car park - light recreation
Auchenmalg Bay	NX 240520	Sandy, cuspate raised beach spit	3.6	None	Light recreation and rabbit grazing
Ardwell - Chapel Rossan	NX 110450	Sandy shingle	0.4	None	Heavy recreation and gravel extraction
Morroch Bay	NX 040500	Sandy shingle raised multiple ridge beach		None	None
Isle of Man					
The Ayres	NX 430035	Extensive multiple ridge raised beach system	Not surveyed	MNH	Sand/gravel extraction, vehicular access, light recreational pressure
Total in Region 13			***136.4***		

Source: Sneddon & Randall (1993b, 1994a, 1994b). Key: CWT - Cumbria Wildlife Trust; SSSI - Site of Special Scientific Interest; SPA - Special Protection Area; NNR - National Nature Reserve; MNH - Manx National Heritage.

dominated by sea radish *Raphanus maritimus*, sea mayweed *Tripleurospermum maritimum* and false oat-grass *Arrhenatherum elatius*. On some fringing beaches the sea radish occurs with orache *Atriplex prostrata* and curled dock *Rumex crispus*. Where saltmarsh influences occur in Cumbria, a more southerly community of sea beet *Beta vulgaris* subsp. *maritima* and curled dock is present. The southern sandier parts of the region have pioneer assemblages of sea sandwort *Honkenya peploides*, sea-holly *Eryngium maritimum* and sand couch *Elymus farctus* subsp. *boreali-atlanticus*. Where maritime influences occur further inland or a silt matrix occurs, a secondary pioneer community of red fescue *Festuca rubra*, thrift *Armeria maritima* and sea plantain *Plantago maritima* is present. Mature, stable areas with a sandy matrix have assemblages of red fescue with ribwort plantain *Plantago lanceolata* and bird's-foot trefoil *Lotus corniculatus* and a large range of other arenacious species. Pure shingle areas are often dominated by false oat-grass and saltmarsh-influenced grasslands by creeping bent *Agrostis stolonifera*, sea couch *Elymus pycnanthus*, sea-milkwort *Glaux maritima* and sea rush *Juncus maritimus*.

A very important aspect of the raised shingle beaches of the north Solway coast is the acid woody vegetation of gorse *Ulex europaeus*, bramble *Rubus fruticosus* and low-growing blackthorn *Prunus spinosa* scrub, with burnet rose *Rosa pimpinellifolia*. Rascarrel Bay (Dumfries & Galloway) is unique among shingle shores in having a wet woodland with grey willow S*alix cinerea* and hazel *Corylus avellana* with a bramble and Yorkshire-fog *Holcus lanatus* understorey.

An extensive area of lichen heath is present on the raised beach at the Ayres on the Isle of Man. The abundance and diversity of earth-growing and rock-growing lichens is striking and includes the most northerly locality for *Usnea articulata,* which is normally corticolous (grows on tree bark)

Table 3.3.2 Fringing shingle beaches (early 1980s survey)

Site name	*Grid ref.*	*Length of shore (km)*	*Site type*
Clwyd			
Colwyn Bay	SH8979	1.0	Sandy
Rhyl	SJ0081	3.5	No vegetation
Cumbria			
Silverdale	SD4575	0.5	Sandy
Bardsea	SD3074	2.0	Sandy
Biggar	SD1966	7.0	Marshy
Duddon - Millom	SD1878	8.0	Sandy
Bootle	SD0787	3.0	Shingle ridge
Esk	SD0696	13.0	Sandy
Drigg	SD0498	2.0	Sandy, little vegetation
Seascale	NY0203	4.0	Sandy
Nethertown	NX9807	2.0	No vegetation
Workington	NX9828	2.0	No vegetation
Siddick	NX9932	1.5	No vegetation, boulders
Maryport	NY0337	6.0	No vegetation
Allonby	NY0743	6.0	Sandy
Lees Scar	NY 0952	2.5	Sandy
Dumfries & Galloway			
Burrow Head	NX4634	2.0	Sandy
Back Bay	NX3639	3.0	Sandy
Mull of Galloway	NX1532	0.5	No vegetation
Mull of Logan	NX0742	2.0	No vegetation
Loch Ryan	NX0668	2.0	No vegetation
Total		***71.5***	

Source: Randall (unpublished).

but here grows on the ground. A series of wet hollows, mimicking the slacks of a true dune system, increases the interest of the site.

The most important rare shingle plant species of the region is the oyster plant, which was lost from Foulney (Cumbria) in the late 1970s - (Randall 1988) and was not found at Abergele (Clwyd) its most southerly known location - in 1989. However, it is still present at Bootle (Cumbria) and along the western shore of Luce Bay (Dumfries & Galloway). The endemic Isle of Man cabbage *Coincya monensis* subsp. *monensis* occurs on some of the fringing beaches of Cumbria (Randall 1989), often where there is little other vegetation, and on the Isle of Man. Ray's knotgrass *Polygonum oxyspermum* subsp. *raii* has decreased markedly this century but is still present near Gronant, Clwyd, and on the north Solway shingle and has considerable populations along the fringing beaches of Cumbria, especially where there is little trampling by livestock.

Important faunal associations are the tern *Sterna* spp. colonies at Gronant (Clwyd) and the Ayres (Isle of Man), on the shingle spits, and gull colonies in the surrounding area at south Walney (Cumbria), and at Grune Point (Cumbria). Foulney Island (Cumbria) also has extensive gull colonies, which influence the vegetation. This complex contains the largest ground nesting colony of herring gulls *Larus argentatus* and lesser black-backed gulls *L. fuscus* in Europe (Randall *et al.* 1990) (see also section 5.10). Offshore shingle scars have noteworthy winter wildfowl populations that also graze on the shingle vegetation. The saltmarshes of the inner Solway coast have significant wildfowl populations, which graze on the adjacent shingle, as at Powfoot (Dumfries & Galloway). Rabbits and domestic livestock influence the vegetation by grazing and trampling at many sites. Walney Island, Cumbria, and the Ayres, Isle of Man, have been noted for their rich invertebrate associations, but other sites have not been fully surveyed for invertebrates (see also section 5.3).

3.3.3 Human activities

Much of the Welsh shingle in this region is subject to high levels of recreational pressure, including trampling, vehicular access and litter. Public access control over much of the Walney Island nature reserve plays a significant part in stabilization of the vegetation, and grazing management agreements are in place. Areas of the Cumbrian coast are subject to industrial pollution, but the presence of the railways from Maryport to Whitehaven and St. Bees to Seascale affords considerable protection from recreational access to the fringing beaches. The north Solway shore is subject to erosion in the Powfoot area and stabilization works have affected the shingle. The Ardwell - Chapel Rossan area is subject to intense recreational pressure, but elsewhere on the Solway recreation on coastal shingle is light. Management agreements are in place for beaches in Sites of Special Scientific Interest (SSSIs).

Grazing by domestic stock is an important practice on many of the shingle structures in the region. Overgrazing creates short swards with few and only common species. Too little or no grazing may allow bracken and scrub to invade from the landward side.

Large-scale sand and gravel extraction has removed some 64 ha of gorse *Ulex gallii* heath at the eastern edge of the Ayres (Isle of Man), whilst also encouraging plants that favour exposed sand and shingle, including common cudweed *Filago vulgaris*, small cudweed *F. minima* and heath cudweed *Gnaphalium sylvaticum*.

3.3.4 Information sources used

Not all shingle sites are vegetated, especially not those on exposed high-energy coasts (e.g. Mull of Galloway, Mull of Logan) or where disturbance is great (e.g. Workington, Nethertown). Unvegetated sites have not been surveyed.

Many of the region's fringing shingle beaches were examined by the author in the early 1980s as part of a survey sponsored by British Petroleum. Beaches visited were only examined qualitatively and target notes were used to describe physical and biological features of interest. This information became the basis of the geographical variation data published in Randall (1989).

All the major vegetated shingle structures of the region (with the exception of those on the Isle of Man) were surveyed during the NCC's 1989 national shingle structure survey, which used the National Vegetation Classification (NVC) framework (Sneddon & Randall 1993a, b, 1994a, b).

3.3.5 Acknowledgements

Special thanks are due to John Lamb, Manx Nature Conservation Trust, for providing information on shingle

structures and shorelines on the Isle of Man. The sand and gravel extraction figure at the Ayres in the Isle of Man was provided by courtesy of the Department of Agriculture, Fisheries and Forestry.

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B. Further reading

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Type of information	*Contact address and telephone no.*
Shingle sites - north Wales	*North Wales Regional Officer, Countryside Council for Wales HQ, Bangor, tel: 01248 370444
Shingle sites - Cumbria	*Conservation Officer, Cumbria Wildlife Trust, Ambleside, Cumbria, tel: 015394 32476
Shingle sites - Cumbria	*Conservation Officer, Cumbria Local Team, English Nature, Blackwell, tel: 015394 45286
South Walney Nature Reserve	Warden, Cumbria Wildlife Trust, South Walney, Barrow-in-Furness, Cumbria LA14 3YQ, tel: 01229 471066
Grune Point	Warden, South Solway NNR, Kirkbride, Carlisle, Cumbria CA5 5JR tel: 016973 51517
Shingle sites, Dumfries and Galloway Coast	*Dumfries & Galloway Area Office, Scottish Natural Heritage, Dumfries, tel: 01387 247010
Shingle sites - Isle of Man coast	*Biological Records Officer, Manx National Heritage, Isle of Man, tel: 01624 675522
Shingle sites - Isle of Man coast	*Conservation Officer, Manx Nature Conservation Trust, Isle of Man, tel: 01624 801985
Phase 1 habitat survey, Isle of Man	*Senior Ecological Surveyor, Department of Agriculture, Fisheries and Forestry, Isle of Man, tel: 01624 685835

* Starred contact addresses are given in full in the Appendix.

3.4 Coastal lagoons

Dr R.S.K. Barnes & Dr R.N. Bamber

3.4.1 Introduction

The term coastal lagoons is used here to include true lagoons, i.e. those wholly or partially separated from the sea by a natural sedimentary barrier, and also artificial brackish ponds and coastal pools, of a similarly restricted tidal range and often containing comparable lagoonal wildlife. Lagoons are commonly shallow, often with a varying salinity ranging from above to below normal sea-water levels (35‰). Freshwater systems are not considered.

This chapter summarizes the coastal lagoons of the region. The single natural lagoon system ('true' lagoon), in an RSPB bird reserve at South Walney, Cumbria, totals 15 ha, which is 2% of Britain's total natural lagoonal resource (6.7% if The Fleet, Dorset - by far Britain's largest lagoon, comprising nearly 70% of the total resource - is excluded). In addition, a 13 ha low-salinity lagoon exists behind the man-made sea wall at Hodbarrow, Cumbria. The cliff morphology of much of the Dumfries & Galloway coast precludes lagoon formation. No lagoons in the region were regarded by Barnes (1989) as being 'especially noteworthy in the national context'.

Lagoons are a nationally rare habitat and a 'priority habitat type' under Annex 1 of the EC Habitats Directive. Therefore, although the region's lagoonal resource is not significant nationally in terms of its extent, the habitat type is of national and international importance wherever it occurs and in whatever quantity. The scale of the contribution of the lagoons of the region to Britain as a whole is shown in Table 3.4.1.

3.4.2 Important locations and species

Map 3.4.1 shows the location of the South Walney system and Hodbarrow Lagoon and other sites discussed; Table 3.4.2 lists the area of the surveyed lagoons in the region and that of the habitat as a whole. In addition to the sites at South Walney and Hodbarrow, a number of other potential sites occur in the region. An unsurveyed excised meander, now used as a boating lake, exists on the Clwyd Estuary at Rhyl, Clwyd. At Connah's Quay, Clwyd, north of the river there are large saline pools on industrial waste-land, supporting roosting terns but suffering high contamination

Map 3.4.1 Coastal lagoons and locations mentioned in the text.

loads. Also, a number of unsurveyed recreational 'lakes' exist around Merseyside and Lancashire: the Marine Lakes at West Kirby and Southport and Fairhaven Lake, Lytham St. Anne's, Lancashire. Within the region there are also a number of docks offering brackish water of restricted tidal range. Of these, only Cavendish Dock at Barrow, Cumbria (SD210680), approaches a lagoonal habitat; Liverpool Docks, Merseyside (SJ344895), support a diverse and evolving estuarine community. Potential (unsurveyed) smaller saline pools occur in the Duddon Estuary, Cumbria, opposite Hodbarrow.

A number of saline lagoon-like pools have been identified in the Isle of Man, though only one has been well surveyed: the Mooragh Park Boating Lake at Ramsey, which at 2.5 ha is the largest on the island. Others include a permanent true lagoon, with considerable freshwater input from a small river, at Port Cornaa (0.15 ha); a transient lagoon at Rue Point, which appears generally to be present for only a few months over the winter (0.5 ha); a flooded coastal quarry with slight saline influence near Scarlett Point (1 ha), and a number of saline high tidal ponds at

Table 3.4.1 Lagoonal areas[a] for region in context

Region	*Lagoonal area (ha)*	*Overall % of GB total*	*% of GB total excl. The Fleet*
Cumbria	28	2	4
Isle of Man	≃5	<1	<1
Other counties	0	0	0
Region 13	***33***	***2.5***	***5***
West Coast	98	8	13
North Sea Coast	1,163	92	87
Great Britain	1,261	-	-

Key: [a]all figures have been rounded to the nearest whole hectare.

Table 3.4.2 Lagoons surveyed

Name	*Grid ref.*	*Area (ha)*	*Type*
Cumbria			
South Walney Lagoon	SD225623	15	Natural
Hodbarrow Lagoon	SD170780	13	Percolation pool
Isle of Man			
Mooragh Park, Ramsey	SC473878	2.5	Artificial
Region 13		***30.5***	

Source: Barnes (1988, 1989); T.J. Holt (pers. comm.).

Langness, Poyllvaaish and Scarlett Point (totalling less than 1 ha). A possible further lagoon-like pool may exist as part of the Lhen Estuary.

No important lagoonal plant species are recorded for the region. True lagoons support only three types of aquatic vegetation, namely stands of green algae (*Chaetomorpha*, *Ulva* and *Enteromorpha* spp.), of sea-grasses and similar plants (predominantly tasselweeds *Ruppia* spp.) and, much more rarely, of stoneworts (especially *Lamprothamnium*). Much of the area of their beds, however, is bare sediment, devoid of vegetation cover. Fringing stands of reeds *Phragmites* spp., saltmarsh plants and/or sedge *Scirpus maritimus* are usual. The lagoons of the region contain no significant submerged vegetation, although Cavendish Dock contains extensive beds of beaked tasselweed *Ruppia maritima*. The dominant marginal plant at Walney is common ragwort *Senecio jacobaea*. An as yet unidentified stonewort has recently been found in the flooded quarry at Scarlett, on the Isle of Man. This lagoon has little saline influence and is mainly dominated by freshwater or coastal species, although the lagoonal specialist isopod *Idotea chelipes* occurs. The stonewort *Chara aspera* occurs in nearby brackish pools at Scarlett Point (Allen 1984).

Lagoons possess a characteristic invertebrate fauna that shows little regional variation, even within Europe. In Britain, several of these species are very rare and are protected under the Wildlife and Countryside Act 1981. None of these protected species, nor any other notable lagoonal invertebrate species, occurs in the region. The lagoons at Cavendish Dock are important for wildfowl (see also section 5.12). The lagoons and associated saltmarsh areas at Langness on the Isle of Man support wintering and migrant wildfowl and waders that are unremarkable in a regional context but are important in a Manx context (see section 5.12).

3.4.3 Human activities

South Walney Lagoon forms part of a nature reserve frequented by considerable numbers of bird-watchers; it is heavily influenced by man and some of the pools are used as an oyster farm. Sea water enters the lagoons through an artificial pipe. Cavendish Dock is within South Walney and Piel Channel SSSI. Hodbarrow Lagoon is used for watersports. Mooragh Park Lake, on the Isle of Man, is a shallow sluiced boating pond which is periodically drained for cleaning. The shingle bank at the lagoon at Port Cornaa was in the past regularly reinforced by bulldozer to create a safer, freshwater, bathing pool (Garrad 1972).

3.4.4 Information sources used

All potential lagoons in the region were surveyed in 1987 as part of the NCC's national lagoon survey (Barnes 1991), though this did not cover the Isle of Man. Mooragh Park boating lake on the Isle of Man was surveyed as part of an environmental assessment of the Ramsey estuary (Nadasen *et al.* 1994).

The detailed reports of the surveys of the region's lagoons carried out by Hill, Cameron & Hawkins in 1987 and by Barnes in 1988 are available, including maps of the habitats and species lists. The data are summarized by Barnes (1989) and Smith & Laffoley (1992), from which the data given here (except those for Manx lagoons) are derived.

3.4.5 Acknowledgements

Special thanks are due to Terry Holt for providing information on lagoons on the Isle of Man. We are also grateful for information supplied by Dr S. Smith.

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B. Further reading

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Brackish lagoons of the region	Dr R.S.K. Barnes, St. Catharine's College, Cambridge CB2 1RL, tel: 01223 336606
Lagoons in England	*Maritime Team, English Nature HQ, Peterborough, tel: 01733 340345
Walney Lagoon	The Warden, Coastguard Cottages, South Walney Nature Reserve, Barrow-in-Furness, Cumbria LA14 3YQ, tel: 01229 471066

* Starred contact addresses are given in full in the Appendix.

3.5 Wet grassland

Dr H.T. Gee

3.5.1 Introduction

This section covers both coastal grazing marsh subject to maritime influence and lowland wet grassland adjacent to tidal reaches of estuaries, both here referred to as wet grassland. No national survey exists of wet grassland as here defined, or indeed of coastal grazing marsh or lowland wet grassland separately, so detailed inter-region comparisons are not possible.

Coastal grazing marsh is a distinctive habitat consisting of low-lying grassland drained by a series of ditches that may be either brackish or freshwater. Much grazing marsh was formed by the enclosure of saltmarsh behind sea walls. Characteristically, much of this region is low-lying, and most freshwater marsh would once have been continuous with saltmarsh. With the land-claim of both habitats for agricultural purposes, large tracts of lowland wet grassland were formed, sometimes extending for many kilometres inland; these are covered along with strictly coastal sites. Smaller areas of freshwater grazing marsh have been created landward of natural barriers such as sand dunes or shingle beaches. Also included are lowland wet grasslands that lie next to tidal stretches of rivers and show brackish influence. Wet grassland sites may remain wet throughout the year and may be managed for stock grazing and/or as hay meadow.

Land-claim of saltmarsh for agricultural and, to a lesser extent, industrial use has taken place on many of the estuaries in the region, notably the Clwyd, Mersey, Ribble and Wyre, and around Morecambe Bay. Dargie (1993) calculated a total area of 34,500 ha of wet grassland in the English counties in this region, approximately one third of which (12,834 ha) is coastal. Wet grassland would appear to be an extensive habitat in this region, especially in north Cumbria and Lancashire, whilst conversely it is a limited resource in the Merseyside and Cheshire area (Dargie 1993).

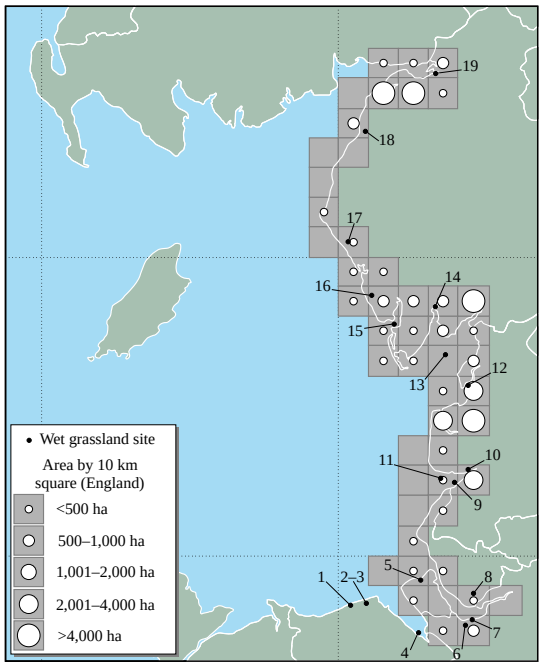
An important feature of the region are the merses of the outer Solway Firth, which are under tidal influence and are for the most part grazed upper saltmarshes. These habitats are discussed in section 3.6. In places there has been some land claim of the merses behind a sea wall, usually for arable farming, good farmland being at a premium in south-west Scotland. There are, therefore, few coastal areas of wet grassland in Dumfries & Galloway. There is no known true grazing marsh in the Isle of Man, and there has been no survey of wet grassland as here defined.

None of the wet grasslands in Region 13 would appear to be a nationally important example of this habitat, although it is included in seven SSSIs in the region, most of them notified for their ornithological interest.

3.5.2 Important locations and species

Table 3.5.1 lists wet grassland sites in Region 13 (shown on Map 3.5.1).

In the south of the region there are significant areas of wet grassland at the confluence of the rivers Clwyd and Elwy, downstream of St. Asaph, Clwyd. Small patches of



Map 3.5.1 Wet grassland sites (numbers refer to Table 3.5.1) and the area of wet grassland in coastal 10 km squares in English counties in the region. Source: Dargie (1994).

wet grassland are found behind the sand dunes of the north Clwyd coast, especially associated with the Prestatyn Gutter, a heavily engineered tidal inlet. Around the river Dee approximately 6,000 ha of land has been claimed from the estuary since 1730 (Pye & French 1993). Whilst much of this land has now been converted to arable use or has been lost to industrial and urban development, significant areas of wet grassland remain, such as Sealand Ranges at the head of the estuary and several small sites along the Welsh shore. Even some of the arable areas around the Dee Estuary retain wetland habitat features of conservation interest.

Saltmarshes of the south bank of the Mersey Estuary were claimed for the construction of the Mersey Ship Canal. The conservation value of the land-claimed area of wet grassland has declined, and intensive agriculture and waste disposal have led to the removal, in 1991, of the Ince and Frodsham Marshes from the Mersey Estuary SSSI. Both these marshes and the Gowy Meadows are however, designated Grade A Sites of Biological Interest (SBIs) by the local authority. Along the north Wirral coast, wet grassland has been formed by the partial draining of fresh marshes behind the coastal strip of sand dunes. Despite loss to urbanisation, significant areas still exist and a good example is preserved at Meols Meadow SSSI.

Approximately 2,320 ha of saltmarsh have been claimed from the Ribble Estuary since 1800 (Pye & French 1993). Much of this has now been turned over to arable use and those areas of wet grassland included within the Ribble Estuary and Newton Marshes SSSIs are chiefly of note for their wintering and migrant bird populations (see also section 5.12). Similarly some 1,300 ha of land have been claimed from Morecambe Bay from the thirteenth to the nineteenth centuries (Gray 1972). Little information exists

Table 3.5.1 Areas of wet grassland identified in Region 13 and shown on Map 3.5.1

No.	*Site*	*Grid ref.*	*Conservation status of the wet grassland*
	Clwyd		
1	Clwyd Estuary	SJ010790	Undesignated
2	Pwll-y-bont	SJ057811	SNCI associated with the Prestatyn Gutter
3	Old Morfas	SJ062827	SNCI associated with the Prestatyn Gutter
	Clwyd/Dee Estuary		
4	Dee Estuary	SJ350683	Several small sites mainly in Wales and including Sealand Ranges SNCI
	Merseyside		
5	Meols Meadow	SJ245903	SSSI (7.1 ha)
	Cheshire		
6	Hale	SJ478823	Adjacent to north bank of Mersey Estuary SSSI
7	Gowy Meadows	SJ435725	SBI (Grade A)
8	Ince, Helsby and Frodsham Marsh	SJ470770 SJ482763 SJ503777	SBI (Grade A)
	Lancashire		
9	Banks Marsh	SD387227	Small area of Banks Marsh included in Ribble Estuary SSSI
10	Newton Marsh	SD450292	SSSI (65.6 ha)
11	Ribble Estuary	SD375240	Small areas around the Ribble Estuary outside the SSSI
12	Lune Estuary	SD395550	Small areas adjacent to SSSI
13	Morecambe Bay	SD360700	Small areas adjacent to SSSI
	Cumbria		
14	Roundsea Wood and Mosses	SD335823 SD348805	Areas both within and adjacent to SSSI
15	Duddon Estuary	SD190775	Area at North End Marsh within and adjacent to SSSI
16	River Annas	SD086874	Annaside SSSI
17	River Ehen Flood Plain	NY011051	SNCI
18	Salta Moss	NY086454	SSSI (45 ha)
19	Upper Solway Flats and Marshes	NY160610	Small areas adjacent to SSSI, SPA and Ramsar Site

Source: Dargie *et al.* (1994). Key: SNCI = Site of Nature Conservation Interest; SSSI = Site of Special Scientific Interest; SBI = Site of Biological Interest (a local authority designation); SPA = Special Protection Area for birds; see Chapter 7 for full details.

about the current condition of much of this claimed land, but its importance for waders and wildfowl in extreme weather and at high tides is of note (see section 5.12).

There has been considerable land claim in the Duddon Estuary, much of it dating back to the sixteenth century (Fahy *et al.* 1993). Apart from a small area of North End Marsh on Walney Island, little of this claimed wet grassland lies within the boundaries of the SSSI. There are small areas of wet grassland associated with the flood plains of the lower reaches of a number of rivers draining the west Cumbria coast, e.g. the River Annas and the River Ehen. Land-claim of wet grassland in the upper Solway Firth has been small-scale and piecemeal, and there are few records for claimed areas (Black *et al*. 1994). Much of this land claim has been around the estuaries of the Rivers Esk, Annan and Eden and the shores of Moricambe Bay (Solway). Adjacent to the upper Solway Firth there are also areas of coastal raised mire, such as Salta Moss SSSI, which have been claimed for agriculture through processes such as ditch drainage, producing a habitat akin to coastal wet grassland. There are no significant areas of coastal grazing marsh claimed from the outer Solway Firth, although some small areas behind the sea wall were claimed for the creation of arable farmland. In places, such farmland has reverted to upper saltmarsh, as the sea wall has fallen into disrepair and been breached. An area of reinstated upper saltmarsh behind the sea wall at Caerlaverock Wildfowl and Wetlands Trust Reserve provides additional grazing for the wintering geese population of the area (see also section 5.12).

Typically, the botanical interest of wet grassland is associated with the ditch systems rather than the fields between. The classic field flora is dominated by NVC grassland community MG5 crested dog's-tail *Cynosurus cristatus* - common knapweed *Centaurea nigra* meadow and pasture (Rodwell 1992), as was observed at Sealand Ranges (CCW 1992). The 75 ha of MG5 grassland on this site probably represents the largest area of this community in Clwyd. Similarly, grazing marsh may show evidence of its saltmarsh origins, as it does at Sealand, where approximately 1 ha of land retained red fescue *Festuca rubra* SM16 and saltmarsh flat-sedge *Blysmus rufus* SM19 saltmarsh communities (Rodwell in prep.). Some sites, such as Meols Meadow and the grazing marsh in the Ribble Estuary SSSI, continue to support a species-rich neutral grassland flora in the fields.

Salta Moss and Roundsea Woods and Mosses SSSIs retain heath and mire vegetation communities (Rodwell 1991), despite having been cut and drained to produce a form of coastal grazing marsh. The retention of this type of flora is dependent upon the maintenance of a high water table.

The wet grassland ditches in this region do not necessarily support nationally scarce species. They do, however, provide a refuge for locally uncommon species. For example, the ditches on the Old Morfas SNCI (Site of Nature Conservation Interest - a local authority designation), Clwyd, support fine-leaved water-dropwort *Oenanthe aquatica*, whilst the Frodsham and Ince Marshes, adjacent to the Mersey, support aquatic species that are rare in Cheshire, including water-violet *Hottonia palustris* and whorl-grass *Catabrosa aquatica*. Ditches in the wet grasslands on the south side of the Ribble Estuary SSSI are

influenced by brackish ingress and support the regionally rare species brackish water-crowfoot *Ranunculus baudotii*. The ditch flora at Newton Marsh includes a number of species that are rare in Lancashire.

Wet grassland is recognised as an important habitat for breeding waders (see also section 5.11), especially in lowland Britain (Davidson 1991), although in this region the amount of agricultural improvement that has taken place means that few of the existing wet grasslands support populations of breeding waders. The chief ornithological interest of the wet grasslands of the region is the use made of them as high-tide and severe-weather roosts by the waders and wildfowl that use the region's estuaries in winter and on passage (see section 5.12). For example, in winter, the wet grasslands on the Ribble Estuary may support large numbers of redshank *Tringa totanus*, grey plover *Pluvialis squatarola* and black-tailed godwit *Limosa limosa*, whilst the nearby Newton Marsh SSSI often supports up to 10,000 waders and wildfowl in the winter - most notably large flocks of golden plover *Pluvialis apricaria*. The wintering pink-footed geese *Anser brachyrhynchus* of south Lancashire often graze on Hesketh Marshes on the south coast of the Ribble Estuary, whilst areas behind the sea wall along the south side of the Solway Firth are often used by barnacle geese *Branta leucopsis* and other wildfowl.

Areas of former grazed wet grassland associated with the head of the Dee Estuary near Shotwick support the only Welsh population of breeding corn buntings *Miliaria calandra* and good densities of breeding yellow wagtail *Motacilla flava* - both species that have declined significantly as breeding birds in Britain in recent years.

Wet grasslands on the banks of the Annas and Ehen Rivers on the west Cumbria coast support populations of the Schedule 5 amphibian the natterjack toad *Bufo calamita*. The importance of the Annaside site for this species has resulted in its designation as a SSSI.

The fresh and brackish-water invertebrate fauna of wet grassland ditches in the region are not noted for rarities - possibly a reflection of the degree to which the habitat has been modified by human use - although scarcer water beetles are well represented (see also section 5.3).

3.5.3 Human activities

Intensification of agriculture has led to a reduction in the conservation value of many wet grasslands. Overgrazing and reseeding reduce the diversity of the grassland plant communities and threaten breeding birds. Improved drainage reduces the water table within the fields, making them less suitable for feeding wading birds. A combination of drainage, nutrient enrichment and reduced ditch management causes ditches to dry out or become clogged with vegetation.

In the southern part of this region, notably on the Dee and Mersey Estuaries, much wet grassland has been lost to industry. Further north, particularly in the extensive areas of land claimed from the Ribble and Wyre Estuaries, much of the land is now under arable production.

Changes to wet grasslands may also result from proposals to reflood them in order to create saltmarsh or as part of managed retreat of the coastline. Reflooding of the Ince and Frodsham Marshes to reconvert them to saltmarsh was suggested as a potential mitigation for the saltmarsh loss that would have resulted from the construction of the Mersey Barrage (Mahon 1993). These marshes are also covered by proposals for the development of a pilot conservation management project produced by the Mersey Basin Business Foundation to enhance the conservation interest of land under industrial ownership in the Mersey Basin.

The idea of using areas of claimed land around the Solway Firth for managed retreat of saltmarsh if erosion becomes dominant along stretches of this coast was proposed by Black *et al.* (1994). This would require the removal of the sea wall and its repositioning further inland, to allow for the reversion of the claimed land to saltmarsh. At present, much of this coastline is accreting, and so managed retreat is not necessary.

3.5.4 Information sources used

No national survey of the wet grassland resource in Britain has been carried out. In England, however, the extent of lowland wet grassland is summarised by Dargie (1993). He collated information on lowland wet grassland sites and produced figures for the total area in each county, thus including areas of coastal wet grassland (used in Map 3.5.1). A fuller breakdown of information and listings of sites by county are presented in Dargie *et al.* (1994). County reports are held by English Nature.

There are comprehensive, site-specific data on wintering birds for the small areas of wet grassland adjacent to the Clwyd Estuary (Gouldstone 1993a) and the Welsh coast of the Dee Estuary (Gouldstone 1993b). Wet grassland at Prestatyn, Clwyd, near Hamilton Oil Point of Ayr Terminal, has had detailed surveys of its breeding, wintering and migrant birds, aquatic flora and fauna and grasslands (Nicholas Pearson Associates 1993 a-d). These will continue to be monitored during the construction and operation of the terminal. Adjacent to the inner Dee, 57.4 hectares of the Sealand Ranges MOD land were subject to a full National Vegetation Classification (NVC) survey (see e.g. Rodwell 1991) in 1992 (Osley 1992). These data are relatively comprehensive for field flora and identify a variety of communities ranging from relict upper saltmarsh to more typical metotrophic grasslands (Rodwell 1992).

The fauna and flora of the Ince and Frodsham Marshes have been surveyed by the National Rivers Authority (NRA) and the Cheshire Wildlife Trust. The NRA undertook a survey of the ditch flora in 1994. They also have a regular biological monitoring station and monitor water chemistry for sites on the Frodsham Marshes. Information on the flora of these marshes was presented in Anon. (1992) and Mahon (1993). These botanical data are comprehensive for the flora of some main river ditches and a few of the smaller ditches. Comparison of recent floral survey data with records for the site from before 1971 (Mahon 1993) shows that the floristic diversity of the ditches has declined severely in recent years, with a number of locally uncommon species disappearing from the site. The invertebrate data collated by the NRA are used to assess water quality, and so identification is not necessarily to species level. It is therefore not possible to make an assessment of the conservation interest of this fauna from the data held.

The floodplain of the River Eden (Cumbria) has been

surveyed and Phase II NVC habitat data are available (SGS Environment 1994). Surveys of the terrestrial and aquatic invertebrates and amphibians of the flood plain were also undertaken. Some ditches on land claimed from the saltmarsh of the outer Solway Firth were looked at by K. Peberdy of the Wildfowl and Wetland Trust (Peberdy 1989), who observed that these ditches held little botanical interest.

3.5.5 Acknowledgements

Thanks are due to the staff of English Nature, Countryside Council for Wales and Scottish Natural Heritage, and also to the Cheshire Wildlife Trust, for providing information.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Wet grassland in Clwyd	*Countryside Council for Wales, Mold, tel: 01352 754000
Wet grassland in Merseyside Dee & Merseyside Estuaries	*English Nature, Wigan, tel: 01942 820342
Wet grassland in Cheshire	*Cheshire Wildlife Trust, Nantwich, tel: 01270 670180
Wet grassland in Lancashire and Cumbria	*English Nature, Blackwell, tel: 015394 45286
Wet grassland in Dumfries & Galloway	*Scottish Natural Heritage, Dumfries, tel: 01387 247010
Lowland wet grassland in England	*Grassland Ecologist, English Nature HQ, Peterborough, tel: 01733 340345

* Starred contact addresses are given in full in the Appendix.

3.6 Saltmarsh

Dr M.I. Hill

3.6.1 Introduction

The total amount of saltmarsh in the region is 13,524 ha, representing 60% of the saltmarsh area on the west coast and 30% of that in Britain (Table 3.6.1). This reflects the presence of large estuaries and wide intertidal areas. Lancashire and Cumbria each contain more than 4,000 ha of saltmarsh. A high percentage of the region's coastline (at Mean High Water) comprises saltmarsh: 46% of the Lancashire coast, 45% in Cheshire and 30% in Cumbria. In contrast, only 6% of the Merseyside coast and less than 1% of the Manx coast is fronted by saltmarsh. An important feature of the region's saltmarshes, compared with those of Britain as a whole, is the high percentage of mid to upper marsh communities, elsewhere often lost through progressive land claim. Common cord-grass *Spartina anglica* is the most extensive pioneer vegetation and has colonised substantial areas of intertidal flats since its introduction to many of the region's estuaries between 1920 and 1940.

Most of the saltmarshes are estuarine or open embayment type, with back barrier marshes at Walney Island. They are generally sandy, with clayey silts only in the higher marshes of inner estuaries. An exception is the Mersey Estuary, where saltmarshes have muddy substrates.

A particular characteristic of saltmarshes in the region is the development of cliffs and terraces formed by movement of river channels. Such terraces are most evident in the Solway, Duddon and Morecambe Bay. Many of the saltmarshes (English shore of the Dee and Ribble, and parts of Morecambe Bay) have increased in area in recent years, with mudflats being colonised by common cord-grass. At sites where erosion is occurring, it is mainly due to channel migrations (Pye & French 1995) rather than currents, waves or tides.

Map 3.6.1 Saltmarsh sites surveyed in National Saltmarsh Survey, and Isle of Man sites (see Table 3.6.2). Source: JNCC Coastal Database.

3.6.2 Important locations and species

The saltmarsh sites surveyed during the national survey (see section 3.6.4) are listed in Table 3.6.2 (Map 3.6.1), along with Isle of Man sites.

The saltmarshes in Region 13 are mostly concentrated in the Dee and Ribble Estuaries, Morecambe Bay and the inner Solway Firth. Large areas of saltmarsh are also found in the Mersey and Duddon Estuaries and Wigtown Bay in the outer Solway.

Saltmarsh in the Isle of Man is limited to around 11 ha in total, of which around 8.6 ha are found at Langness (Port Erin Marine Laboratory unpublished data) and 2.3 ha on Sulby Estuary at Ramsey (Nadasen *et al.* 1994), with tiny areas elsewhere, including the estuaries of the Neb at Peel and the Silver Burn at Castletown (Nadasen *et al.* 1994), and at Poyllvaaish, Knock Rushen, Derbyhaven (Allen 1984) and Port Cornaa.

Most of the saltmarshes in this region are grazed and are therefore characterised by a grassy turf. A notable exception

Table 3.6.1 Areas (ha)[a] of saltmarsh communities for region in context

	Spartina	*Pioneer*	*Low-mid*	*Mid-upper*	*Drift-line*	*Upper swamp*	*Trans-ition*	*Wet depre-ssion*	*Total*	*% of region total in county*	*% of area total in region*
Clwyd	83	104	327	127	234	33	5	0	914	7	-
Cheshire	199	335	534	479	86	43	187	0	1,864	14	-
Merseyside	149	102	122	117	2	1	0	0	493	4	-
Lancashire	547	246	776	2,434	20	15	1	0	4,039	30	-
Cumbria	223	60	685	2,635	23	17	519	0	4161	31	-
Dumfries & Galloway	89	36	139	1406	28	43	200	<1	2,042	15	-
Isle of Man	0	*	*	*	*	*	*	*	11	<1	-
Region 13	***1,289***	***882***	***2,584***	***7,198***	***392***	***153***	***912***	***<1***	***13,524***	**-**	**-**
West Coast	3,487	1,340	4,159	11,270	473	410	1,327	<1	22,593	-	60
GB	6,948	3,470	12,353	16,042	1,824	1,475	1,670	2	44,381	-	30

Source: National Saltmarsh Survey (Burd 1989a-e). Key: *sites not surveyed in detail (113 ha in region, see Table 3.6.2); they are included in the Total figure but are not subdivided by community type; [a]all figures have been rounded to the nearest whole hectare.

is part of the English shore of the Dee Estuary. The typical saltmarsh vegetation zonation in the region is from a pioneer zone of common cord-grass *Spartina anglica* to a low-mid marsh of common saltmarsh-grass *Puccinellia maritima*. In parts of the Solway, common saltmarsh-grass is the first colonist of the mudflats. Red fescue *Festuca rubra* saltmarsh (Juncetum gerardii) is the main mid-to-upper marsh vegetation type. Sea-purslane *Halimione portulacoides* saltmarsh is less widespread than on south and east coasts because of the prevalence of grazing. Driftline vegetation is dominated by either common couch *Elymus repens* or sea couch *Elymus pycnanthus* saltmarsh. Upper marsh zones in the north of the region can be rich in sedges *Carex* spp. and rushes *Juncus* spp. and have transitions to freshwater and brackish marshes.

The saltmarshes on the Solway are of particular interest since they lie at the boundary between western and Scottish marsh types (Adams 1978). They contain a wide range of plant communities, including transitions to grassland and brackish fen, which are more characteristic of Scottish marshes and are unusual in this region.

Several saltmarsh species reach or approach the northern limits of their west coast ranges at the Solway. They include: sea-purslane, sea wormwood *Artemisia maritima*, sea lavender *Limonium vulgare*, lax-flowered sea lavender *Limonium humile*, sea couch and hard-grass *Parapholis strigosa*. On the west coast north of the Solway, common cord-grass occurs at only a few sites and is not an important pioneer species. It is rare in the Isle of Man, possibly because much of the Manx saltmarsh overlies rocky substrata with relatively little mud. It was first recorded on the island in the mid 1970s (Allen 1984), since when it appears to have spread very little. It is not thought to have been introduced onto the island. Lesser centaury *Centaurium pulchellum*, wild celery *Apium graveolens* and strawberry clover *Trifolium fragiferum*, which become restricted to upper marsh habitats at the northern edge of their range, reach their northern limit at the 'Solway Line' (Adam 1990).

Saltmarsh flat-sedge *Blysmus rufus* saltmarsh occurs at several sites, notably the north shore of the Solway and around Morecambe Bay. It is usually found in wet depressions and flushes in the upper marsh. It has also been recorded in the land-claimed, non-tidal Sealand Ranges at the head of the Dee Estuary (Osley 1992; Rhind in prep.), and in the Isle of Man, including the saltmarshes at Langness and elsewhere (Allen 1984; unpublished data, Port Erin Marine Laboratory). Saltmarsh flat-sedge is one of the few 'northern' elements in British saltmarsh flora.

Details of the distribution of eelgrass *Zostera* spp. are not available, but they do not appear to be abundant. Certainly they are not usually associated with the Manx saltmarshes, though a very small area of *Zostera marina* exists near St. Michael's Island, Derbyhaven (unpublished data, Port Erin Marine Laboratory), and this species has in the past been recorded elsewhere on the island (Allen 1984). All three British species of eelgrass are classed as nationally scarce.

Saltmarshes in the region provide breeding sites for a wide range of bird species, including oystercatcher, lapwing, redshank, dunlin, snipe, curlew, shelduck, black-headed gull, lesser black-backed gull and common and arctic tern. They also provide roosting sites for waders and grazing for wildfowl. The saltmarshes are a key habitat for the Svalbard population of barnacle geese which all winter on the Solway. The saltmarsh and associated pools at Langness on the Isle of Man support numbers of wintering and migrant wildfowl and waders that are important in a Manx context.

At sites on the Cumbrian coast and around the Solway, natterjack toads use the upper parts of saltmarshes for foraging.

Table 3.6.2 Saltmarsh sites surveyed

Name	*Grid ref.*	*Saltmarsh area (ha)[a]*
River Clwyd	SJ002797	43
Dee Estuary	SJ220800	2,108
Mersey Estuary (including Alt)	SJ460780 + SD295035	848
River Ribble	SD408254	2,184
Morecambe Bay:		
River Wyre	SD360419	294
Cockerham and Pilling	SD415497	303
River Lune	SD452588	677
Carnforth	SD470725	914
River Kent	SD451792	232
River Leven	SD331781	592
Rampside	SD233658 + SD269690	60
South Walney	SD200650	241
North Walney	SD176722	49
Duddon Sands	SD200800	488
Ravenglass (Esk Estuary)	SD084962	158
Inner Solway Firth:		
Moricambe Bay	NY185554	1,190
Burgh Marsh	NY300607	524
Rockcliffe Marsh	NY322640	565
Gretna to Redkirk**	NY311658*	30
Browhouses	NY281650*	16
Torduff Point	NY260642*	7
Dornock	NY228654*	17
Annan	NY198648*	49
Milnfield Merse	NY184657*	13
Priestside Bank	NY110653*	146
Caerlaverock	NY045647*	563
Nith Estuary	NX987708*	12
Greenmerse & Kelton**	NX982712*	62
Kirkconnell Merse	NX987683*	205
Carse Bay	NX985604*	35
Southwick	NX916557	56
Rough Firth	NX835557	57
Auchencairn/Orchardton	NX810520	78
Mullock Bay	NX711439	1
Kircudbright Bay:		
Manxman's Lake	NX680490	27
River Dee***	NX684513	50
Fleet Bay***	NX578545	28
Wigtown Bay (Cree Estuary)	NX458581	554
Garlieston	NX482471	1
Luce Bay	NX165564	36
Isle of Man:		
Sulby Estuary, Ramsey**	SC454945	2
Langness**	SC282672	9

Source: National Saltmarsh Survey (Burd 1989a-e). Key: *Scottish sites grouped as 'Inner Solway Firth' on Map 3.6.1; **no survey data available; ***sites not completely surveyed; [a]all figures have been rounded to the nearest whole hectare. Note: for large sites the grid reference given is a reasonably central point. Some sites listed are amalgamations of sites in Burd (1989).

The region's saltmarshes support a wide range of invertebrates, particularly rich in upper marsh zones where pools, seepages, driftline debris and tall vegetation occur. Many Red Data Book (threatened: see footnote to Table 5.3.1) and nationally notable species have been recorded (see also section 5.3). For example, at the Gronant/Talacre dunes, the vulnerable (RDB2) sandhill rustic moth occurs on saltmarsh within the dune system.

Many of the region's saltmarshes are within Sites of Special Scientific Interest (SSSIs) (Table 3.6.3), emphasising the importance and widespread distribution of the habitat in the region. Saltmarsh in the Duddon and Esk Estuaries is within the Lake District National Park. There are large areas of saltmarsh within nature reserves owned and managed by the RSPB and County Wildlife Trusts. Caerlaverock on the north coast of the Solway Firth is a National Nature Reserve (NNR) for saltmarsh interests, amongst others.

3.6.3 Human activities

In the past, large areas of saltmarshes in the region were claimed for agriculture. Current uses include turf-cutting, grazing and wildfowling. The merses in Caerlaverock NNR are managed to provide preferential grazing for geese, reducing damage to adjacent farmland.

Common cord-grass, the main colonist of new mudflats, has increased greatly in extent since it was introduced to many estuaries. Measures to control its spread have been attempted at several sites, including the Ribble Estuary (Lytham St. Anne's and Southport) and in the Dee and Mersey Estuaries. At present, the rate of spread seems to have slowed and it is evident that common cord-grass is replaced by other saltmarsh species as the marsh matures (Hill 1987).

Table 3.6.3 SSSIs containing saltmarsh in region

Name	*Other designations*
Gronant Dunes and Talacre Warren	
Dee Estuary	SPA, Ramsar
Mersey Estuary	
North Wirral Foreshore	
Altcar Sand Dunes and Foreshore	part SPA, Ramsar
Ribble Estuary	part NNR, SPA
Barnaby Sands Marsh	
Burrows Marsh	
Lune Estuary	
Morecambe Bay	
Roudsea Woods and Mosses	NNR
South Walney and Piel Channel Flats	
North Walney	NNR
Duddon Estuary	part NNR
Drigg Coast	
Upper Solway Flats and Marshes	SPA, Ramsar, part NNR, part Biosphere Reserve
Auchencairn and Orchardton Bays	
Torrs to Mason's Walk	
Ravenshall Wood	
Cree Estuary	
Back Bay to Carghidown	

Source: JNCC Integrated Coastal Database. Key: SPA = Special Protection Area; Ramsar = internationally important wetland (Ramsar site); NNR = National Nature Reserve.

Generally Scottish saltmarshes have not been enclosed behind sea walls to form wet grassland, but are managed by grazing (see also section 8.2).

3.6.4 Information sources used

Saltmarshes were surveyed in 1982-84 as part of the NCC's national saltmarsh survey; detailed reports are available and results are summarised in Bibby (1985) and Burd (1989a-e). Data presented here are derived from that database. The national saltmarsh survey provided an intermediate level of detail between Phase 1 habitat survey and the National Vegetation Classification (NVC: Rodwell in prep.). It did not include all areas of transition to other habitats such as sand dune, shingle and freshwater marsh, nor did it cover the Isle of Man. Saltmarsh vegetation in non-tidal, land-claimed marshes and areas of eelgrass were not recorded.

There have been only a few surveys using the National Vegetation Classification: the Mersey Estuary (Environmental Advisory Unit 1991), higher saltmarsh sites on the Welsh shore of the Dee Estuary (Redfern Joslin Associates 1993), the merses of Caerlaverock NNR (Peberdy 1989), the Solway (Bioscan 1992) and Sealand Ranges at the head of the Dee Estuary (Osley 1992). The last also covers non-tidal saltmarsh vegetation.

The Ramsey (Isle of Man) survey was carried out using Phase 1 methods followed by more detailed surveys of individual areas and seasonal follow-up surveys (Lamb 1994 in Nadasen *et al.* 1994). Phase I habitat survey of the whole of the Manx coast is currently being carried out by the Manx Nature Conservation Trust on behalf of the Isle of Man Department of Agriculture Fisheries and Forestry.

There have been many other surveys of saltmarshes in this region, often in connection with proposed developments. Examples include Morecambe Bay (Gray 1972; Gray & Bunce 1972; Gray & Scott 1977, 1987); Mersey (Environmental Advisory Unit 1991; Mersey Barrage Company 1991); Wyre (T.H. Technology 1991), Solway (Bioscan 1992), and Ramsey, Isle of Man (Nadasen *et al.* 1994). Other studies have investigated the changes in saltmarsh vegetation, using permanent quadrats and line transects in the Dee and Ribble Estuaries respectively (Hill 1987). Monitoring of permanent quadrats in the Dee Estuary is ongoing. The re-colonisation of saltmarsh vegetation in parts of the Dee Estuary following construction of pylons and pipelines is being monitored by PowerGen and National Power.

Surveys of the extent and vigour of common cord-grass have been carried out at many sites. Examples include several reports for north-west England in Doody (1984), Dee Estuary (White 1982; Hill 1986), Ribble Estuary (Mullins & Marks 1987), and Morecambe Bay (Whiteside 1987).

Levelled line transects across saltmarshes in Morecambe Bay and the Ribble and Dee Estuaries were part of a study of the niche of common cord-grass by Gray *et al.* (1989). Changes in the extent of sea couch in the upper part of the Dee Estuary are described in Gall (1987).

Few detailed invertebrate surveys of saltmarshes have been carried out in the region. Examples include surveys by the National Museum and Galleries on Merseyside (1994a-c) on the Dee Estuary, and the Gronant/Talacre dunes for Hamilton Bros.

Further Geographic Information System (GIS)-based habitat mapping of the Solway Firth saltmarshes is being carried out by Durham University.

3.6.5 Acknowledgements

Staff of Countryside Council for Wales, English Nature, Scottish Natural Heritage, the Wildfowl & Wetlands Trust and many other organisations kindly provided references and survey reports. Terry Holt provided information for the Isle of Man.

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B. Further reading

Further details of coastal habitat sites, including saltmarshes, are available on the *Coastal & marine UKDMAP datasets* module disseminated by JNCC Coastal Conservation Branch, Peterborough.

Barne, J., Davidson, N.C., Hill, T.O., & Jones, M. 1994. *Coastal and marine UKDMAP datasets: a user manual.* Peterborough, Joint Nature Conservation Committee.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Data from National Saltmarsh Survey	*Coastal Conservation Branch, JNCC, Peterborough, tel: 01733 62626
Phase 1 habitat survey (Isle of Man)	*Manx Nature Conservation Trust, Isle of Man, tel: 01624 801985
Saltmarsh mapping around the Solway	Dept. of Geography, University of Durham, South Road, Durham DH1 3LE, tel: 0191 374 2473

* Starred contact addresses are given in full in the Appendix.

The Mersey Estuary has been extensively used over many centuries as a shipping route and fishing ground and for effluent discharge. By 1948 all fish had disappeared from the estuary, but in recent years improvements in water quality have led to the return of 38 fish species. A Site of Special Scientific Interest, the estuary is a vital link in the chain of coastal sites used by wintering waterfowl, including internationally important numbers of pintail, redshank, teal, dunlin and shelduck. Photo: Peter Wakely, English Nature.

Chapter 4 Marine and estuarine environments

4.1 Estuaries

Dr N.C. Davidson

4.1.1 Introduction

Estuaries are "partially enclosed tidal areas at least partly composed of soft tidal shores, open to saline water from the sea, and receiving fresh water from rivers, land run-off or seepage" (Davidson *et al*. 1991; Davidson & Buck in prep.). They comprise both aquatic (marine, brackish and fresh water) and terrestrial habitats, including adjacent sand dunes, coastal grasslands and maritime heaths. All the estuaries discussed here are covered by the NCC Estuaries Review (Davidson *et al.* 1991) and have at least 2 km of tidal channel or 2 km of shoreline over 0.5 km wide at low tide, either now or historically. This section gives an overview of the main features of the estuarine resource in Region 13; for further details of habitats, species and human uses refer to relevant sections in chapters 3, 5 and 9 respectively.

Over 1,000 km of Region 13's mainland coastline is estuarine and the region is particularly notable for its many large estuaries, which together form the largest area of estuarine habitat (almost 142,700 ha) of any Coastal Directories region. The five small estuaries on the Isle of Man are too small to be included in this section. The contribution of Region 13 estuaries to the wider resource is summarised in Table 4.1.1. Overall, the estuaries in Region 13 form almost 25% by area of the total UK estuarine resource, over 53% of the British West Coast resource, and 7.5% of the estuarine habitat of north-west Europe (Davidson *et al.* 1991). Many have large intertidal areas, of which the region has even larger percentages of the national resource: 32% of the UK estuarine intertidal area and 60% of the British West Coast resource. Similarly there are major estuarine saltmarsh areas in the region: 31% and 62% of the West Coast and GB resource respectively. However, many estuaries in the region extend only a little way inland and (particularly in the north of the region) the surrounding

Map 4.1.1 Estuaries. Source: JNCC Coastal Database.

land rises relatively steeply, restricting the upstream extent of tidal influence. So, despite the large total area of estuaries in the region, the total lengths of their shorelines and main tidal channels make only small contributions to the overall resource: each less than 40% of the West Coast totals.

Six of the fourteen estuaries in Region 13 are larger than 5,000 ha - amongst the largest in Britain - and many cross one or more county boundaries. Each county in the region has a significant share of the total resource, but the largest areas are in Cumbria, since parts of both Morecambe Bay (the largest intertidal area in the UK, at over 34,000 ha) and

Table 4.1.1 Contributions of the region's estuaries to the national resource

Resource	*Regional total (ha/km)*	*West Coast total (ha/km)*	*% West Coast*	*GB total (ha/km)*	*% GB*	*UK total (ha/km)*	*% UK*
Intertidal area	106,490	172,250	61.8	321,050	33.2	332,350	32.0
Saltmarsh area	13,510	22,590	59.8	48,380	27.9	*	*
Total estuarine area	142,700	267,490	53.3	525,650	27.1	581,290	24.5
Shoreline length	1,085	3,238	33.5	9,054	12.0	9,727	11.2
Longest channel lengths	350	950	36.8	2,461	14.2	2,640	13.3

Sources: Buck (in prep.); Davidson & Buck (in prep). Key: *areas of saltmarsh were not available for Northern Ireland and so estuarine saltmarsh area comparisons are not made for the UK. Isle of Man saltmarshes are not within estuaries covered in this region. Areas rounded to the nearest 10 ha; lengths rounded to the nearest 1 km.

the Solway Firth (over 27,500 ha of intertidal flats and saltmarshes) occur in the county; about 65% of total and intertidal areas and 54% of saltmarshes are on estuaries falling wholly or partly within Cumbria. Elsewhere, over 40% of area totals occur in Lancashire estuaries and over 30% on Dumfries & Galloway estuaries. The smallest resource in the region is in Clwyd, but even this includes a major part of the internationally important Dee Estuary. Only the Clwyd Estuary is small (total area <500 ha).

Together, Region 13's estuaries are of great geomorphological, wildife and nature conservation importance. The long stretches of natural shoreline, particularly in the north of the region, together with the many nationally important saltmarshes and sand dunes, rare plant and animal species and migratory waterfowl populations, contribute greatly to the diversity of size, form and features that is a key characteristic of UK estuaries.

4.1.2 Important locations and species

Table 4.1.2 lists the estuaries in the region and summarises their main physical characteristics.

Most estuaries are predominantly sediment-filled, with only the Solway Firth and Mersey Estuary having more than one-third of their area as subtidal habitats. Estuaries in the southern half of the region are coastal plain estuaries with large expanses of mud and sand flats. The sediment-filled Morecambe Bay embayment itself has four large coastal plain river estuaries flowing into it. The Esk Estuary is the only bar-built estuary in the region, formed behind the major sand dune systems of Drigg Point and Eskmeals Dunes. The estuaries of the Dumfries & Galloway coast are shallow glacial basins (fjards), with sandy sediments and often rocky and steeply shelving shorelines. Estuaries in the region often have very extensive saltmarshes, with a wide variety of saltmarsh plant communities, supporting major migrant and wintering waterfowl populations, notably on the Dee and Ribble Estuaries, Morecambe Bay and the Solway Firth. Major sand dunes associated with estuaries are a particular feature of this region, notably behind the broad sandy linear shore of Luce Bay, at the mouth of the Duddon Estuary and Morecambe Bay and bordering the Ribble and Alt Estuaries.

4.1.3 Human activities

In the south of the region the shores of Liverpool Bay estuaries are extensively developed, with sea defences, as are significant parts of the Ribble Estuary and Morecambe Bay. Towards the north of the region estuaries become increasingly rural, with natural shorelines, often with transitions to sand dunes and steeply rising and rocky shores; along the south coast of Dumfries & Galloway estuaries are particularly unspoilt.

Estuarine water quality is generally good in the largely rural estuaries in the north of the region and in the Clwyd and Dee Estuaries, but is much poorer in the Alt and Mersey Estuaries and the upper reaches of the Ribble Estuary (see

Table 4.1.2 Physical characteristics of Region 13 estuaries[a]

Estuary	*Centre grid ref.*	*Geomorph-ological type*	*Total area (ha)*	*Inter-tidal (ha)*	*Salt-marsh (ha)*	*Shoreline length (km)*	*Main channel (km)*	*Spring tidal (m)*	*Sub-tidal (%)*
Clwyd									
33. Clwyd Estuary	SJ0080	Coastal plain	422	386	43	19.1	8.1	6.7	8.5
Clwyd, Cheshire, Merseyside									
34. Dee & N. Wirral	SJ2674	Coastal plain	16,101	12,981	2,108	108.5	36.8	7.6	19.4
Cheshire, Merseyside									
35. Mersey Estuary	SJ4180	Coastal plain	8,914	5,606	847	102.9	45.6	8.9	37.1
Merseyside									
36. Alt Estuary	SD2903	Coastal plain	1,413	1,413	1	14.0	5.2	8.0	<0.1
Merseyside, Lancashire									
37. Ribble Estuary	SD3424	Coastal plain	11,924	10,674	2,184	107.5	28.4	7.9	10.5
Lancashire, Cumbria									
38. Morecambe Bay	SD3668	Embayment	45,462	34,339	3,253	266.5	40.3	8.4	24.5
Cumbria									
39. Duddon Estuary	SD1977	Coastal plain	6,092	5,056	537	65.5	22.6	8.1	17.0
40. Esk Estuary	SD0896	Bar-built	1,134	1,049	158	42.2	11.4	7.7	7.5
Cumbria, Dumfries & Galloway									
41. Inner Solway Firth	NY2762	Complex	42,056	27,550	2,925	213.6	46.3	8.4	34.5
Dumfries & Galloway									
42. Rough Firth & Auchencairn Bay	NX8451	Fjard	1,290	1,289	135	44.4	14.4	6.7	0.1
43. Dee Estuary	NX6747	Fjard	1,144	825	77	28.6	11.7	6.7	27.9
44. Water of Fleet	NX5753	Fjard	790	790	28	19.9	7.2	6.7	0.0
45. Cree Estuary	NX4655	Fjard	4,728	3,340	445	24.3	63.2	6.7	29.4
46. Luce Bay	NX1855	Linear shore	1,228	1,196	36	27.5	8.5	5.3	2.6

Sources: Buck (1993); JNCC Integrated Coastal Database. Key: [a]all area figures have been rounded to the nearest whole hectare. Notes: Estuary numbers are those used in Buck (1993). 'Geomorphological type' relates to nine estuary categories, described further in Chapter 5.7 of Davidson *et al.* (1991) and Chapter 4.5 of Davidson & Buck (in press). 'Spring tidal ranges' are for the monitoring station closest to the mouth of the estuary. Subtidal includes tidal channels remaining water-filled at mean low water.

Table 4.1.3 Human influences and water quality on Region 13 estuaries

Estuary	*Grid ref.**	*Human use type*				*Water quality*
		urban	*industrial*	*rural***	*recreational*	
Clwyd				○		
33. Clwyd Estuary	SJ0080	•			•	A
Clwyd, Cheshire, Merseyside					○	
34. Dee & N. Wirral	SJ2674	•	•	○	•	A (B)
Cheshire, Merseyside						
35. Mersey Estuary	SJ4180	•	•	○	○	(D) C
Merseyside						
36. Alt Estuary	SD2903	○		•	○	D
Merseyside, Lancashire						
37. Ribble Estuary	SD3424	•	○	•	•	(C) B
Lancashire, Cumbria						
38. Morecambe Bay	SD3668	•	○	•	•	A (B)
Cumbria						
39. Duddon Estuary	SD1977	○	○	•	•	A
40. Esk Estuary (Cumbria)	SD0896			•		A
Cumbria, Dumfries & Galloway						
41. Inner Solway Firth	NY2762	○	○	•	○	(1) 2
Dumfries & Galloway						
42. Rough Firth & Auchencairn Bay	NX8451			•	○	1
43. Dee Estuary	NX6747	○		•	○	2, 1
44. Water of Fleet	NX5753			•	○	1
45. Cree Estuary	NX4655			•	○	(2) 1
46. Luce Bay	NX1855			•	○	(2) 1

Sources: Davidson & Buck (in prep.), National Rivers Authority (1991), Scottish Development Department (1987). Key: * Central point. **includes natural resource exploitation. • = major human use; ○ = minor human use. Multiple water quality codes are in downstream sequence; brackets indicate a water quality found in only a small part of the estuary.

also section 9.6). Tidal ranges throughout the region are large: all estuaries are macrotidal (i.e. >4 m spring tidal range) and most are between 6.5 - 8.9 m. Smallest tidal ranges are in Dumfries & Galloway, the smallest being 5.3 m at Luce Bay. Largest tidal ranges are in the Mersey Estuary (8.9 m) and Morecambe Bay and the Solway Firth (each 8.4 m).

Land claim has affected only small parts of most Region 13 estuaries. Large parts of the Dee and Ribble Estuaries (chiefly saltmarsh areas) have, however, been lost to land-claim, mostly for agricultural use. Recreational use of most estuaries occurs at low intensity or on only small parts of each estuary area. Most recreation takes place on the Clwyd, Dee and Ribble Estuaries, Morecambe Bay and the Duddon Estuary. Exploitation of natural resources, chiefly saltmarsh and sand dune grazing, fisheries and shellfisheries, bait collection and wildfowling, is extensive on all but the most urban and industrialised estuaries.

4.1.4 Information sources used

This section is summarised chiefly from JNCC's *An inventory of UK estuaries*, being published in six regional volumes along with an introductory and methods volume. All estuaries in Region 13 are included in *Volume 3. North-west Britain* (Buck 1993). Data presented in the inventory are drawn largely from material collected during 1989-90 (updated to 1993 where appropriate) for the NCC's Estuaries Review (Davidson *et al.* 1991). Saltmarsh data come originally from Burd (1989a-c), whose surveys covered mostly saltmarshes of >0.5 ha.

Hydrological data, e.g. catchment areas and river flows, are available for some but not all estuaries as defined here from sources including National Rivers Authority Catchment Management Plans (see also section 10.2.8). Chapter 10 also gives further information on Estuary Management Plans (section 10.2.3). Catchment areas and river flows are summarised in a five-year catalogue of river flow gauging stations (Marsh & Lees 1993), but note that for whole estuary data further interpretation is usually necessary.

4.1.5 Acknowledgements

Thanks are due to Dr Pat Doody, John Barne and Catherine Smith (JNCC) for helpful comments on draft texts.

4.1.6 Further sources of information

A. References cited

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Burd, F. 1989e. *Saltmarsh survey of Great Britain. Regional Supplement No.12. South West Scotland.* Peterborough, Nature Conservancy Council.

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Davidson, N.C., & Buck, A.L. In prep. *An inventory of UK estuaries. 1. Introduction and methods.* Peterborough, Joint Nature Conservation Committee.

Marsh, T.J., & Lees, M.L., *eds.* 1993. *Hydrometric register and statistics 1986-90.* Wallingford, Institute of Hydrology.

National Rivers Authority. 1991. *The quality of rivers, canals and estuaries in England and Wales.* Water Quality series, No. 4. Bristol, National Rivers Authority.

Scottish Development Department. 1987. *Water quality survey of Scotland 1985.* Edinburgh, HMSO.

B. Further reading

Further details of estuaries are in the *Coastal & marine UKDMAP datasets* module (Barne *et al.* 1994), available from JNCC Coastal Conservation Branch, Peterborough. A list of selected further reading for each estuary discussed in section 4.1 is given in Buck (1993) (above).

Barne, J., Davidson, N.C., Hill, T.O., & Jones, M. 1994. *Coastal and marine UKDMAP datasets: a user manual.* Peterborough, Joint Nature Conservation Committee.

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Countryside Council for Wales. 1993. *Welsh estuaries review.* Bangor, Countryside Council for Wales.

Davidson, N.C. 1991. *Estuaries, wildlife and man.* Peterborough, Nature Conservancy Council.

Noble, L., *ed.* 1993. *Estuaries and coastal waters of the British Isles. An annual bibliography of recent scientific papers. Number 17.* Plymouth, Plymouth Marine Laboratory and Marine Biological Association.

Peck, K. 1993. Estuaries Inventory - research towards a better understanding of the interactions between birds and human activities on UK estuaries. *RSPB Conservation Review, 7:* 42-46.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Integrated Coastal Database: national database of estuaries; coastal habitats; statutory & non-statutory protected sites. Summary data available also in Coastal Directories UKDMAP display version.	*Coastal Conservation Branch, Joint Nature Conservation Committee, Peterborough, tel: 01733 62626
Statutory protected sites; detailed wildlife site information; coastal geomorphology. Estuaries Initiative & estuary management plans. Numerical and some digitised data.	*Marine Conservation Officers/Coastal Ecologist Aquatic Environments Branch, Scottish Natural Heritage, Edinburgh, tel: 0131 446 2400
Statutory protected sites; detailed wildlife site information; coastal geomorphology. Estuaries Initiative & estuary management plans. Numerical and some digitised data.	*Estuarine Ecologist/Initiative Officer/Marine Ecologist, English Nature HQ, Peterborough, tel: 01733 340345
Statutory protected sites; detailed wildlife site information; coastal geomorphology. Numerical and some digitised data.	*Coastal & Marine Ecologist/Coastal Scientist/Marine & Coastal Policy Officer, Countryside Council for Wales HQ, Bangor, tel: 01248 370444
RSPB Estuaries Inventory: mapped and numerical information on land use and selected human activities for 57 major UK estuaries. In Region 13 the Inventory covers the following estuaries: Dee (Clwyd), Mersey, Alt, Ribble, Morecambe Bay, Duddon, Solway, Nith and Kirkcudbright Bay	*Estuaries Inventory Project Officer, RSPB, Sandy, tel: 01767 680551
National River Flow Archive: catchments and river flows from upstream gauging stations; interpreted analyses for whole estuaries.	National Water Archive Manager, Institute of Hydrology, Maclean Building, Crowmarsh Gifford, Wallingford, Oxfordshire OX10 8BB, tel: 01491 838800

* Starred contact addresses are given in full in the Appendix.

4.2 The sea bed

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Prof. S.J. Hawkins

4.2.1 Introduction

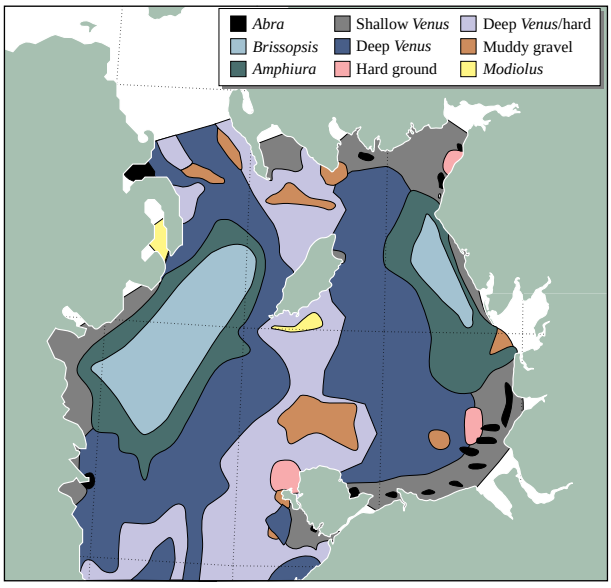
This section covers the occurrence and distribution of groups of species that live on the sea bed (benthic communities, collectively called the benthos), both in the intertidal zone and subtidally; the distribution and occurrence of individually rare and scarce species is covered in section 5.4.

Information on the precise extent of littoral (between tides) and sublittoral (below tides) habitat types in a national context is not yet available. The mainland shores of this region are largely sedimentary, and although there are areas of shingle and boulders, known as 'scars', the extent of littoral rock is very limited. Hilbre Island at the mouth of the Dee Estuary (Clwyd) provides one of the few littoral bedrock sites in Liverpool Bay. The only extensive area of rocky shore on the Cumbrian coast is at St. Bees Head. Some rocky shores are also present along the north Solway coast. By contrast, extensive tracts of intertidal sand and mudflats occur in the estuaries of the Dee, Mersey and Ribble; in Morecambe Bay (where the intertidal area extends to 33,750 ha, the largest single area of intertidal sand and mudflats in Britain (Davidson *et al*. 1991)) and the Solway Firth; and in Wigtown Bay, Luce Bay and the smaller embayments of Dumfries & Galloway. The conservation interest of most of the intertidal areas on the mainland in this region therefore lies less in their biological diversity than in their high productivity (Mills 1995).

Sedimentary substrata also predominate in the sublittoral, being mixtures of coarse, fine and muddy sand with pebbles and occasional cobbles. Lune Deep, to the north-west of Fleetwood, adds to the interest of the area; it has steep sides from which boulders and cobbles outcrop. Rock also occurs between bays in the shallow sublittoral off the north Solway coast. A number of wrecks (of ships, aircraft and other solid material) occur off the coast of this region. These objects offer hard substrata in areas that may be largely sedimentary, thus providing discrete new habitats for opportunistic colonising species that otherwise would not be present (see section 6.1.4).

The waters within the Isle of Man 12 mile territorial limits are shallow, particularly to the east, where they are mostly less than 30 m deep (see also Map 2.3.3). To the south and west they slope gradually down to around 80-90 m at the 12 mile limit. There are extensive shallow sandy banks off the north-east coast. Waters further offshore to the east remain shallow all the way to the UK mainland, but to the west there are depths of around 120-150 m roughly midway between the Isle of Man and Ireland. Although the Isle of Man is relatively small (48 km long; 118 km of coastline), several important marine benthic (sea-bed) habitats and associated plant and animal communities occur. The lower littoral zone of Calf Sound is of great interest because of its tidal rapids.

The majority of the Isle of Man littoral coastline is rocky, from Ramsey to the south of the island (including the Calf), and up the west coast to Peel. The shores of the south and south-west coastline are mostly the steeply sloping bases of



Map 4.2.1 Distribution of sublittoral benthic habitat and community types (see Table 4.2.2). Source: Mackie (1990). Reproduced with the permission of BHP Petroleum Ltd.

high cliffs. The south-east coast is dominated by limestone. Where littoral sediment occurs on the Isle of Man it is either as mobile gravel or shingle on exposed shores, or sand on the more sheltered shores.

The majority of the island's immediate sublittoral areas consist of boulders and bedrock. Sheltered areas of sublittoral sand and mud are found in estuaries and bays. Fine sand is predominant but coarser sediment with small

Map 4.2.2 Key locations of marine biological importance described in the text (see Table 4.2.1; see Map 7.4.1 for locations of Sensitive Marine Areas).

boulders occurs at Port St. Mary. The offshore sediment has been divided into four clear divisions according to the size of the particles: coarse sands, gravel or shell, or stony grounds; fine sand; muddy sand; and mud (Map 4.2.1).

English Nature has identified four Sensitive Marine Areas (SMAs) within this region (English Nature 1994): the Dee Estuary, Morecambe Bay and Lune Deep, the Cumbrian coast, and the Solway (Map 7.4.1). SMA is a non-statutory designation highlighting areas of particular nature conservation interest (see also section 7.4.4).

4.2.2 Important locations and communities

Table 4.2.1 lists locations of marine biological importance mentioned in the text, shown on Map 4.2.2.

Covey (in press b) distinguishes eleven littoral rock, six littoral mixed and eleven littoral sediment marine communities in this region, using the JNCC's Marine Nature Conservation Review (MNCR) biotopes classification, which is based on substrate type and characteristic species. Full descriptions of the communities (outside the scope of this work) are given in Covey (1990), Covey & Davies (1989), Covey & Emblow (1992), Davies (1991, 1992) and Garwood & Foster-Smith (1991).

Table 4.2.1 Locations (1 km squares) of sites of importance mentioned in the text

No. on Map 4.2.2	*Location*	*Grid ref.*
	Clwyd	
1	Dee Estuary	SJ18
	Merseyside	
2	Hilbre Island	SJ1888
3	North Wirral	SJ29
4	South Docks	SJ3489
5	Taylor's Bank	SD2306
	Lancashire	
6	Ribble Estuary	SD4026
7	Preston docks	SD5129
8	Lune Deep	SD2652
9	Heysham	SD4163
	Cumbria	
10	Roa Island	SD2364
11	Head Scar	SD2265
12	Walney Island	SD16
13	Cavendish Dock	SD2067
14	St. Bees Head	NX9413
	Dumfries & Galloway	
15	Auchencairn Bay	NX8351
16	Wigtown Bay	NX45
17	Isle of Whithorn	NX4836
18	Luce Bay	NX15
19	Mull of Galloway	NX1530
20	Loch Ryan	NX06
	Isle of Man	
21	Derbyhaven and Langness	SC2867
22	Scarlett Point	SC2566
23	Bay ny Carrickey	SC2368
24	Port St. Mary Ledges	SC2167
25	Warts Bank	SC1864
26	Calf Sound	SC1666
27	Chicken Rock	SC1364
28	Calf of Man	SC1565
29	Port Erin Bay	SC1969
30	Niarbyl	SC2077
31	White Strand	SC2585

Covey (in press b) distinguishes six sublittoral rock, four sublittoral mixed and four sublittoral sediment marine communities in this region, using the MNCR classification. Table 4.2.2 summarises the types of marine benthic sublittoral community identified in the region by Mackie (1990). Their distribution is shown in Map 4.2.1.

North Wales coast and Liverpool Bay

Between Rhos Point and Point of Ayr (Clwyd), three sediment communities have been recorded from six littoral sites (Garwood & Foster-Smith 1991), though none is of particular conservation importance. The Clwyd Estuary was surveyed by Parsons & Pugh-Thomas (1979), who recorded few species, ragworm *Neanthes diversicolor* (a polychaete) being numerically dominant. The estuary's conservation status is summarised by Buck (1993). One of the few near-shore sublittoral surveys from the stretch of coast between Rhos Point and Point of Ayr was by Rees *et al*. (1977), who sampled from the inshore muddy sand in Colwyn Bay and found it to be dominated by either the bivalve *Abra alba* or the polychaete *Lagis koreni*. Hilbre Island, a low sandstone outcrop, is one of the few natural rocky areas in Liverpool Bay, and was intensively studied at the turn of the century by the Liverpool Marine Biological Committee. An increase in silt deposition and sediment scour around the island since then, however, has considerably reduced the marine biological diversity. The island's algal flora had decreased from 118 species in 1913 to 70 species in 1976 (Betteridge *et al*. 1976). Garwood & Foster-Smith (1991) described the communities present as generally being low diversity examples of common rocky shore communities, typically dominated by fucoid algae, mussels and barnacles. The Dee Estuary SMA has sediment habitats and communities representative of the east basin of the Irish Sea. Most of the interest lies in the wader and wildfowl populations, shellfish and fish stocks, and the small population of grey seals, which haul out on West Hoyle Bank. The infauna of the Dee Estuary has been surveyed by a number of workers. Gillham (1978) identified five main benthic invertebrate associations corresponding to gradients in salinity, height on the shore and particle size; and at the mouth of the estuary, Garwood & Foster-Smith (1991) recognised two community types (corresponding to moderately exposed and relatively sheltered conditions). The fauna of East Hoyle Bank off Hoylake contains an infauna characteristic of open-coast sandy shores (Gillham 1978). Rich infaunal communities were recorded by Garwood & Foster-Smith (1991) from relatively stable fine sands on the North Wirral foreshore, with artificial structures being encrusted with mussels, barnacles and stunted fucoid algae.

The intertidal fauna of the Mersey Estuary was described by Bassingdale (1938), with later studies by Ghose (1979) and Carter (1985). The fauna of the outer estuary was relatively diverse but was low in the areas of the Mersey narrows and the mobile sand flats of the middle estuary. The upper estuary was dominated by oligochaetes. The benthic fauna of the inner estuary is limited, largely because of pollution (Bamber 1988), and an intensive campaign to clean up the estuary was initiated in 1980. The adjacent parts of Liverpool Bay (from Hoylake to Formby) were also studied by Bassingdale (1938), who noted a rich fauna from the muddy sand of Taylor's Bank off Formby. In contrast,

the mobile coarse sand of the Great Burbo Bank off Crosby had a relatively low-diversity fauna. The South Docks complex adjacent to the Mersey Estuary provides unusual man-made habitats for species to colonise. Besides species characteristic of such habitats, Wilkinson *et al.* (1990) also recorded a number considered to be characteristic of saline lagoons (see also section 3.4).

Formby to Barrow-in-Furness

Few areas of hard substrata exist along this stretch of coast. Boulder and cobble scars at Lytham and Fleetwood, boulder training walls in the Ribble Estuary and the boulders and cobbles in consolidated clay at Cleveleys were described by Davies (1991) as being dominated by mussels, barnacles and green algae *Enteromorpha* spp. Little published marine biological information is available for the stretch of coast from Formby to Fleetwood, apart from a survey by Davies (1991). He recognised six communities from areas between Crosby and Fleetwood, the most widespread being the impoverished crustacean/polychaete community from mobile fine sands on the Fylde coast. Areas around Formby and also at the mouth of the Ribble Estuary have a community dominated by the bivalve *Macoma balthica* and the cockle *Cerastoderma edule*. In muddier sediments, found in the Ribble and at the mouth of the Wyre Estuary in Fleetwood, the bivalve *Scrobicularia plana* and the polychaete ragworm *Neanthes diversicolor* dominated. In a later survey by Davies (1992), six sediment communities from the Ribble Estuary were described, featuring varying proportions of polychaete, crustacean and bivalve species. Preston Docks, at the head of the Ribble Estuary, are reported to be highly eutrophic (nutrient-enriched) but to support moderate fish populations (Conlan 1987).

Morecambe Bay and Lune Deep SMA has typical sediment communities of the northern Irish Sea, with low species diversity and high biomass, supporting exceptionally large bird populations. Within Morecambe Bay there are extensive mussel beds, which provide a relatively stable substratum for other organisms to colonise (see Jones 1990). One such mussel bed near Heysham is reputed to have been exploited since the thirteenth century (Gubbay 1988). Connected with heavy deposition of mussel spat in the spring are periodic explosions of the population of common starfish *Asterias rubens*. Similar habitats are provided by pebble and cobble scars, especially if these are bound together by tubes of the polychaete worm *Sabellaria spinulosa*. Anderson (1972) recorded very low invertebrate species richness from the Bay but high abundances of the few dominant species, particularly the bivalve *Macoma balthica*. A large number of sites in Morecambe Bay were sampled by North West Water in 1988. Rostron (1992) described the results of this survey, and of an MNCR (Marine Nature Conservation Review) dredge survey to the west of Walney Island, from which sixteen community types were identified. An *Abra alba/Lagis koreni* (bivalve/polychaete) community predominated, though numbers of *Abra* were relatively low and those of another bivalve *Nucula nitidosa* were very high. Muddy areas sampled at depths greater than 15 m were characterised by the brittlestar *Amphiura filiformis*. Areas of hard ground (not necessarily of bedrock) are found to the north and south of Lune Deep, and to the south and west of Walney Island (Mills 1995). A recent MNCR survey of the Lune Deep, 8 km to the west of Fleetwood, revealed heavily silted boulder and cobble slopes with a dense hydroid and bryozoan turf (Emblow 1992). This unique feature, known as a 'kettlehole', is the result of a huge block of ice becoming buried during the last ice age and melting long after the retreat of the glaciers. It has a maximum charted depth of over 80 m and is subject to strong tidal streams.

A tidal boating lake at Morecambe has abundant algal growths on its walls, together with the immigrant sea squirt *Styela clava* (Mills 1995). Another unusual site is the disused Cavendish Dock near Barrow-in-Furness, which receives warm water effluent from an adjacent power station and displays an unusual community dominated by beaked tasselweed *Ruppia maritima*. The amount present is so great that it can clog the power station intake screens within the dock (K. Hendry pers. comm.). Another seagrass species, eelgrass *Zostera marina*, is found in the Piel Channel. At Head Scar and nearby Roa Island in the Piel Channel, tide-swept pebbles, cobbles and small boulders support a particularly rich fauna characterised by sponges and brittlestars (Emblow 1992; George *et al.* 1992, 1994), which is of considerable regional importance. Small areas of sublittoral rock are present within the Piel Channel and also off Walney Island (C. Lumb pers. comm.).

Table 4.2.2 Main sublittoral communities occurring in the region

*Type**	*Description of habitat/community*
Abra	Occurs as small pockets in shallow (5-30 m) nearshore muddy sands/muds with rich organic content. Typical species include the bivalve *Abra alba* and the polychaete worm *Pectinaria koreni.*
Brissopsis	Occurs in offshore muds at shallow to moderate depth (15-100 m). Typical species include the urchin *Brissopsis lyrifera* and brittlestar *Amphiura chiajei.*
Amphiura	Occurs in offshore sandy muds at shallow to moderate depth (15-100 m). Typical species include the brittlestar *Amphiura filiformis*, urchin *Echinocardium cordatum* and tower shell *Turritella communis.*
Shallow *Venus*	Occurs in shallow (5-40 m) nearshore sands, often in areas with strong currents and sand banks or sand waves. The *Tellina* sub-community occurs in fine stable sands and typical species include the bivalve *Tellina fabula* and the polychaete *Magelona mirabilis.* The *Spisula* sub-community occurs in medium to coarse sands subject to disturbance and typical species include the bivalve *Spisula elliptica* and the polychaete *Nephtys cirrosa.*
Deep *Venus*	Occurs in coarse sand/gravel/shell sediments at moderate depths (40-100 m). Typical species include the urchin *Spatangus purpureus* and bivalves *Glycimeris*, *Astarte* and *Venus* spp.
Hard ground	Muddy and gravelly sand community, with the burrowing anemone *Cerianthus lloydi* being common.
Muddy gravel	Communities of high diversity associated with mixed muddy gravelly sands.
Modiolus	Occurs on coarse sand/gravel/shell/stone sediments at moderate depths. Typical species include the horse mussel *Modiolus modiolus* and the brittlestar *Ophiothrix fragilis.*

Source: Mackie (1990). Key: type codes refer to Map 4.2.1.

Cumbrian coast and Solway Firth

The majority of the littoral habitats along this stretch of coast are mobile fine sand flats of low species richness. This is true for the communities found in the Duddon and Esk Estuaries, where high abundances of a few dominant species are found, particularly the bivalve *Macoma balthica* (Covey & Davies 1989). Species associated with subtidal sand, muddy sand and sandy mud sediments between Ravenglass to St. Bees Head and extending 25 km offshore were recorded by Swift (1993) using a box-corer, during surveys from 1983 to 1989. The Cumbrian Coast SMA includes the sandstone cliffs and rocky shores around St. Bees Head, the most extensive area of rocky shore in the whole of north-west England, with an accompanying wide range of habitats and rich communities, of both rockpools and the lower shore (Covey & Davies 1989). The presence here of extensive reefs of the polychaete *Sabellaria alveolata* is considered to be of national importance (English Nature 1994). Diving in this area has revealed bedrock on the lower shore giving way to boulders at 5 m depth below chart datum, and thence onto a plain of mobile sand (Emblow 1992). The shores between St. Bees Head and Maryport, consisting mostly of cobble, boulders and small outcrops of bedrock, were surveyed by Allen *et al.* (1992). Along parts of the Cumbrian coast around Workington and Whitehaven, 'slagcrete' reefs occur on the shore, the result of the dumping of blast furnace slag. Most are eroding rapidly.

The extensive sandflats of the Solway SMA support a typical estuarine fauna, the diversity increasing in the sublittoral towards the outer Solway, where boulder clay 'scars' appear. The fauna of the sandflats includes a mix of polychaetes and bivalves, together with vast numbers of the burrowing amphipods *Corophium volutator* and *Bathyporeia* spp. (Perkins 1973). The fauna of the mobile mid-channel sandbanks is generally less rich than that of the comparatively stable fringing sandbanks (Rendall & Bell 1993). The boulder scars within the firth can be rapidly smothered by sediment movement (Perkins 1986). These scar grounds possess communities similar to those present in sublittoral rocky areas, with between ten and 100 times the biomass of adjacent sands (Perkins 1981).

The Scottish Solway coast to Loch Ryan

To the west of Auchencairn Bay, shores are generally composed of boulders with occasional bedrock outcrops, with conditions ranging from exposed on the open coast to sheltered in embayments. Open coast littoral communities are typical (Covey & Emblow 1992), though markedly richer than sites in south Cumbria. Eelgrass *Zostera marina* was recorded by Perkins (1988) in the shallows of Auchencairn Bay. Well-developed rockpool communities have been recorded from around the entrance to Wigtown Bay, although the richest sublittoral fringe communities were recorded from the area of the Mull of Galloway (Covey 1990). At a selection of sublittoral sites between Auchencairn Bay and the Mull of Galloway, hard substratum habitats and communities were found by Covey (1992) to be strongly influenced by two factors: the strength of tidal streams and the turbidity of the water column. A distinct discontinuity occurs at the Isle of Whithorn: to the west, communities are richer and dominated by tunicates and sponges; and to the east, erect bryozoans and hydroids dominate. Covey (1992) found sediments off Balcary Point, in Kirkcudbright Bay and in Wigtown Bay to be of muddy sand, often with a high shell-gravel content. Further west, in Luce Bay, sediments are of fine sand with small amounts of mud and shell-gravel. Each substratum type supports a rich infauna. Little information is available for the open coast of the Rhinns peninsula, which comprises mostly rocky shores backed by cliffs. The natural pond at Logan, used for fish, provides an unusual feature. Loch Ryan's subtidal communities show a closer affinity to warmer inlets in southern Britain than to other sealochs (Howson 1989). Loch Ryan has been designated a statutory Marine Consultation Area (MCA) (Nature Conservancy Council 1990) (see also section 7.4.5) on account of its eelgrass *Zostera* spp. beds and the largest natural oyster *Ostrea edulis* beds in Scotland.

Isle of Man

Rocky shores on the Isle of Man are mainly Manx slate with areas of limestone, sandstone and igneous rock. Rocky shores occur frequently on the east coast between Ramsey and Santon Head. The south-east coast is predominantly limestone, which tends to form ledges with shallow rock pools. Here, moderately exposed rocky shores are dominated by barnacles (mainly *Semibalanus balanoides* with occasional *Chthamalus montagui*), limpets (mainly *Patella vulgata* with some *P. ulyssiponensis* (= *P. aspera*) on the lowest part of the shore) and small clumps of bladder wrack *Fucus vesiculosus*, occurring in mosaics, with bladder wrack being much rarer on the more exposed shores (e.g. Scarlett Point). A particularly well-studied example of the mosaic type of shore is the limestone ledges of Port St. Mary (Kallow Point), where crayfish *Palinurus elephas* are occasionally found. Many experimental manipulations of the species assemblage and its environment have been carried out over the years in this area (e.g. Hartnoll & Hawkins 1980, 1985). Other examples of limestone ledges and rock pools occur at Bay ny Carrickey and north of Derby Haven. This type of shore has been extensively studied (e.g. Southward 1953; Hartnoll & Hawkins 1985). Kelps (brown algae) occur to between 10 and 20 m around all rocky Manx shores, the lower limit being determined by the intensity of sea urchin grazing in at least some places (Kain 1962; Jones & Kain 1967). Extensive areas of kelp forest are present in Bay ny Carrickey and in Castletown Bay. Sheltered rocky shores are dominated by stands of knotted wrack *Ascophyllum nodosum* along up to 100-200-metre lengths of the shoreline. The numerous breakwaters and harbours around the island act as artificial reefs, and consequently a large number of crustacean species occur, including the European lobster *Homarus gammarus*.

The area from Scarlett Point round to Langness provides an exceptionally wide variety of habitats and communities because all exposure levels are represented. A site on the east coast of the Langness Peninsula, known as the Boiling Pot, is noted for the effects of currents. Additionally, Niarbyl, Port Erin Bay, and the Calf Sound are all noted for their community diversity (Spence *et al*. 1989; Morrow, Picton & Bishop 1993). There are extensive rock outcrops at Port Erin and Niarbyl.

At high energy sites around the Calf, the Calf Sound and the eastern shores of Langness, gullies occur down to 15 m. The tidal rapids in the Calf Sound promote a very varied sessile (non-mobile) lower-littoral community (Morrow, Picton & Bishop 1993). Exceptionally diverse communities

have been recorded on sublittoral rock in the Calf Sound and at the southern points of the Calf and the eastern shores of Langness. The sublittoral community off Chicken Rock (a rock visible above the sea surface, situated 1 km south-west of the Calf) is particularly diverse, and there are diverse horse mussel *Modiolus modiolus*-dominated communities to the south of the Calf. Of particular interest are the sites called the Bowers and Heifers (between Port Erin and the Calf Sound), and Chicken Rock and Burroo (off the southern tip of the Calf), where the variety of the habitats and the strength of the tidal currents result in a high diversity of species.

The exposed rocky shores of the south-west and west coasts are dominated by the same species as occur on the south-east coast.

The distribution of sediment types and associated communities is well documented around the island (Jones 1951; Bruce *et al.* 1963). Littoral sediments are usually either mobile gravel or shingle on exposed shores, or sand on the more sheltered shores. The general trend of their distribution is described by Mackie (1990) as ranging from coarse ground communities in the west (between Anglesey and the Isle of Man) to finer sand communities in the east (see Map 4.2.1). Shingle or boulder shores are found at Port e Vullen, Port Cornaa, Dhoon Bay, Port Soderick, Santon Gorge, Port Grenaugh, Perwick Bay, Fleshwick, Niarbyl and Aldrick.

Northern littoral sediments, such as around the Point of Ayre, are predominantly mobile gravel or shingle. Finer sand communities tend to occur in the sandy bays found in the south (with the exception of Ramsey): at Peel, Port Erin, Bay ny Carrickey, Sandwick, Derby Haven, Douglas and Laxey. Soft shores of the Isle of Man are generally low in species diversity, since many of them are exposed (e.g. Pirrie *et al.* 1932). The more sheltered shores have a higher species diversity but there is an overall lack of bivalve species. Substantial amounts of maerl are found south-east of Douglas and at Niarbyl (Bruce *et al.* 1963). The sheltered estuaries of the east coast, particularly at Douglas, and the bays at Ramsey, Derby Haven, Port St. Mary, Port Erin and Fleshwick have sheltered areas of sublittoral sand and mud. Fine sand predominates, but coarser sediment with small boulders occurs at Port St. Mary. These sheltered bays act as important habitats for juvenile flatfish; for example, Port Erin Bay is well known as a plaice nursery ground (Nash *et al.* 1992). There is an expanse of mud behind the breakwater at Derby Haven, which is almost the only fully marine (as opposed to estuarine) intertidal mud around the island. The bivalve *Loripes lucinalis* is common at Derby Haven and is interesting because it contains symbiotic sulphur bacteria. The small (*c.* 500 m^2 in total) eelgrass *Zostera marina* bed off St. Michael's Island, Derby Haven, is now the only one on the Isle of Man.

Despite the abundance of apparently suitable habitat (sandy gravel), mussels *Mytilus edulis* are relatively rare on the Isle of Man, except in the Peel Estuary, the north end of Peel Bay, White Strand, Ramsey Estuary and at Ramsey Pier. Periwinkles *Littorina littorea* are much more common on the west coast, and much rarer on the south-east coast. The restricted distribution of mussels and periwinkles is thought to be mainly related to a lack of larval supply, which also affects barnacle densities (Hawkins & Hartnoll 1982).

Offshore (defined as beyond 3 km or 50 m depth)

Far less information is available on benthic habitats and communities from offshore locations, beyond that shown on Admiralty charts and British Geological Survey sediment maps. Mackie (1990) considers that nine general types of benthic community can be distinguished in this eastern part of the Irish Sea (Table 4.2.2 and Map 4.2.1). Rees *et al*. (1992) recorded a community dominated by the polychaete *Lagis koreni* and the bivalve *Abra alba* from the dredge spoil dumping ground in Liverpool Bay; it was rapidly replaced by a sparser fauna typical of sandier sediments when spoil dumping ceased at one of the dumping sites. Studies of the benthic communities off north-east Anglesey are being undertaken by MAFF Directorate of Fisheries Research (Kaiser *et al.* 1994; Kaiser & Spencer in press).

Much of the offshore area around the Isle of Man is dominated by the 'deep *Venus*' community, which also includes several other bivalve species and the urchin *Spatangus purpureus* (Jones 1950). Warts Bank, an area of fine shell-gravel banks 2 km off Spanish Head, is considered a unique habitat and has a diverse range of species, including large aggregations of sand eels *Ammodytes* spp. and cod *Gadus morhua* (see also sections 5.7.2 and 9.1.2). A large horse mussel bed with a very diverse associated community exists off the south-east coast of the island (Jones 1951). There is anecdotal evidence that the horse mussel bed is now much more fragmented than previously. Approximately 5-10 miles west of the island, the gravel and shell grounds (which are common around the south of the island) grade into fine sand and then into a deep area of sticky mud, with commercial stocks of Dublin Bay prawn *Nephrops norvegicus* (see also sections 5.5.2 and 9.1.2).

4.2.3 Human activities

A number of activities that affect marine habitats and communities take place within this region; their impacts are discussed more fully in Chapter 9. Local integrated coastal zone management initiatives in this region are described in Chapter 10. Exploitation by fisheries has been intensive: it has been estimated that most of the smoother ground of the eastern Irish Sea has been regularly trawled over since the turn of the century (Taylor & Parker 1993). A Management Strategy for the Dee Estuary has been prepared (A. Jemmet pers. comm.) (see also Chapter 10). Commercially exploitable quantities of oil and natural gas have recently been discovered in Liverpool Bay. Exploitation of these reserves has required pipelines to come ashore to a terminal at Point of Ayr, Clwyd (section 9.5). Further to the north, development of the North Morecambe Gas Field has led to a new pipeline being brought ashore across Walney Island to a British Gas terminal to the east of Roosecote Sands. An environmental assessment study of the effects of laying this pipeline is being undertaken by the Natural History Museum and the British Trust for Ornithology. At the end of 1992, the Walney Channel was dredged to allow access for Trident submarines to and from the shipyards at Barrow-in-Furness. The effects of this operation on sea-bed life were assessed by the Marine Conservation Society's Lancashire area group. A number of marine biological studies have been undertaken in monitoring the discharges of radioactive materials from the reprocessing plant at Sellafield. Benthic sediments up to 25 km off Sellafield were sampled by Swift (1993) between 1983 and 1989, as part of an investigation into the mobilisation of sediment radionuclides. Eroded colliery spoil and slagcrete (blast furnace waste) dumped on

Cumbrian shores constitutes a significant proportion of sedimentary material (Perkins 1990) around Workington and Whitehaven. Sewage sludge disposal at sea has the potential to harm marine life and humans, though this practice is being phased out and will cease entirely by 1998. Studies on sea-bed communities in relation to sewage sludge disposal and spoil dumping in Liverpool Bay (some 10 km and 30 km west of Formby Point respectively) are undertaken by MAFF (see Norton *et al.* 1984, Rees *et al.* 1992), as well as studies of its effects on inshore fish nursery grounds (section 5.6).

The representativeness and diversity of habitats and communities of the Calf of Man led to its proposal as a marine reserve (DAFFIOM 1993). The Calf Marine Trust was set up to promote this. However, plans for the reserve have now been abandoned. The offshore area west of Jurby was until recently closed to fishing to allow the RAF to carry out target practice using dummy bombs. There is presently an area of approximately 1 km^2 just offshore from Port Erin which has been closed to fishing since 1989 - though this has been violated on occasion - in order to study the effects of cessation of dredging upon the stocks of scallops and upon the benthic ecology.

In various parts of the region, seaweed is collected for a variety of purposes including food, medicines, alginate extraction and soil fertiliser. The latter use mainly involves collection of storm-cast material from the top of the beach.

4.2.4 Information sources used

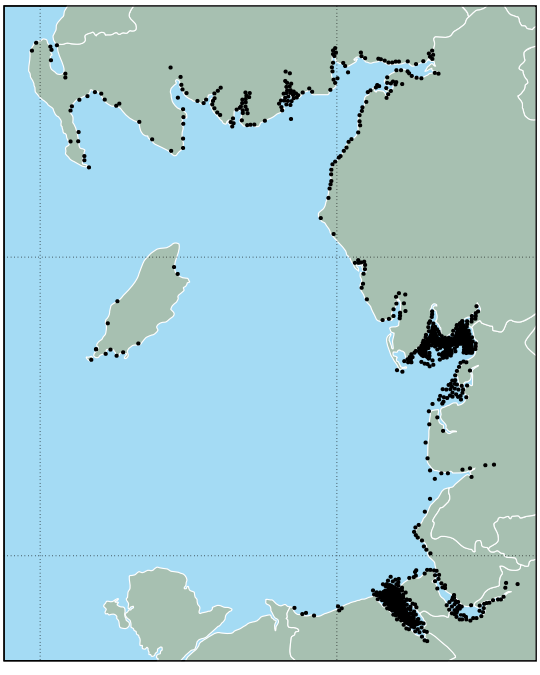
JNCC's MNCR team (and their contractors) have undertaken a number of surveys within this sector, primarily littoral (Covey & Davies 1989; Covey 1990; Davies 1991; Garwood & Foster-Smith 1991; Covey & Emblow 1992; Davies 1992), but also sublittorally, employing diving and dredging techniques (Howson 1989; Covey 1992; Emblow 1992). The MNCR team use a standard recording methodology for both littoral and sublittoral surveys that includes descriptions of both habitats and their associated communities (see Hiscock 1990). The data collected from these surveys, and other survey information from this region, are currently being re-analysed for publication in an MNCR report (Covey in press a). Survey information from other sources may vary considerably in its methodology and coverage. Table 4.2.3 and Maps 4.2.3 and 4.2.4 indicate the scale and distribution of marine benthic site survey in the region.

An appraisal of scientific information for Liverpool Bay was prepared by the Liverpool Bay Study Group (1975); an environmental review of the Irish Sea was carried out by the Irish Sea Study Group (Irish Sea Study Group 1990); and Taylor & Parker (1993) produced an environmental appraisal of the coast of north Wales and north-west England, commissioned by Hamilton Oil. The characteristics of the estuaries within this region are described by Buck (1993). Mills (1995) and Connor & Little (1995) undertook information reviews on behalf of the MNCR. The MAFF Directorate of Fisheries Research laboratory at Lowestoft publishes a series of Aquatic Environment Monitoring Reports (e.g. Rees *et al.* 1992).

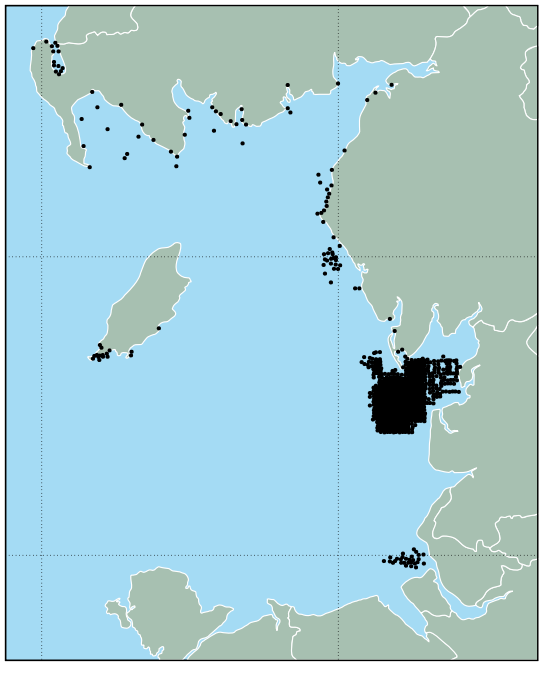
Table 4.2.3 Number of surveyed sites in the region (excluding Isle of Man)

Littoral	*Near-shore sublittoral*	*Offshore*	*Total*
194	86	0	280

Source: MNCR Database 1994. Note: these figures are not comprehensive: additional records may exist in sources that were not consulted.



Map 4.2.3 Littoral (including tidal river) surveys recorded on the MNCR database (see Tables 4.2.3 and 4.2.4). Source: JNCC.



Map 4.2.4 Near-shore sublittoral surveys recorded on the MNCR database (see Tables 4.2.3 and 4.2.4). Source: JNCC.

Some of the earliest descriptions of benthos (sea-bed species) were made for the Isle of Man, e.g. Forbes (1838). Herdman and his co-workers collected extensively in nearshore waters at the turn of the century, and these and other early works were used extensively in the preparation of *The Marine Fauna of the Isle of Man* (Bruce *et al.* 1963), a comprehensive list of intertidal and subtidal fauna recorded from the Isle of Man and surrounding waters that is still of considerable use today. After over 100 years of research, the intertidal in the south of the Isle of Man, from Santon Gorge round to Fleshwick (and to a lesser extent at Niarbyl), is well known. Similarly the offshore areas are better known around the south of the island than elsewhere. The rest of the Isle of Man is relatively poorly known. Geffen *et al.* (1990), Hawkins *et al.* (1990) and Mackie (1990) give useful overviews of the benthic communities of the Isle of Man and surrounding waters.

Only sublittoral sites surrounding the Calf have been surveyed (in 1991 and 1992) using JNCC's MNCR techniques (Morrow, Picton & Bishop 1993). However, several other comprehensive surveys have been carried out: sublittoral survey around the south of the island using grabs and dredges (Jones 1951; summarised in Bruce, Colman & Jones 1963); littoral surveys of Manx beaches (Spence *et al.* 1989); surveys of rocky shores at Santon and at selected sewage outfalls; and of one sandy shore at Ramsey (Holt *et al.* 1993) and Ramsey Bay (Ramsey Marina Project (Nadasen *et al.* 1994)). Additionally, there are some ongoing surveys: the annual scallop survey of Port Erin Marine Laboratory (PEML) records by-catch data and there is also an ongoing Dredge Disturbance Project at PEML assessing the effects of scallop dredging on sublittoral habitats and communities (see also section 9.1). Numerous other projects at PEML have undertaken surveys of benthic habitats on the island for many years. A sublittoral survey of the Isle of Man is currently being organised by volunteer divers (co-ordinated by the Marine Laboratory's sub-aqua club) using phase 1 MNCR techniques. Table 4.2.4 indicates the marine benthic survey coverage around the Isle of Man.

Table 4.2.4 Number of marine benthic sites surveyed - Isle of Man

Littoral	*Near-shore sublittoral*	*Offshore*	*Total*
20	60*	0**	80

Source: MNCR Database 1994. Key: * includes 26 surveys that did not use MNCR techniques; ** large (but unquantifiable) numbers of dredge and grab samples were taken by Jones (e.g. Jones 1951) and other early workers, summarised in Bruce *et al.* (1963). Note: these figures are not comprehensive: additional records may exist in sources that were not consulted.

4.2.5 Acknowledgements

The authors acknowledge the considerable help of JNCC's Marine Nature Conservation Review team (particularly Dr Tim Hill) in compiling and presenting the information given here. The MNCR literature reviews by Dr David Mills (1995; Rhos-on-Sea to the Mull of Galloway) and by David Connor and Mike Little (1995; Mull of Galloway to Loch Ryan) have been widely consulted.

4.2.6 Further sources of information

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Marine nature conservation issues in Wales	*Dr Mandy Richards (Head of Marine Unit), Countryside Council for Wales HQ, Bangor, tel: 01248 370444
Marine nature conservation issues in England	*Marine Ecologist, Marine Task Force, English Nature, Peterborough, tel: 01733 360345
Marine nature conservation issues in Scotland	*Dr John Baxter, Aquatic Environments Branch, Scottish Natural Heritage, Edinburgh, tel: 01315 549797
MNCR database	*MNCR Team, JNCC, Peterborough, tel: 01733 62626
Marine life, fisheries and management of resources in the Irish Sea	Mrs Hilary Davies (Administrator) or Dr Duncan Shaw (Director), Irish Sea Forum, University of Liverpool, Oceanography Laboratories, PO Box 147, Liverpool L69 3BX, tel: 0151 794 4089
Offshore information, N. Wales coast	Ivor Rees, Senior Lecturer, Marine Labs., University College of North Wales, Menai Bridge, Anglesey LL59 5EY, tel: 01248 351151
Studies of marine benthos, Irish Sea	*Dr. Hubert Rees or Andrew Franklin, MAFF Fisheries Laboratory, Burnham-on-Crouch, tel: 01621 782658
Lancashire coastal issues; MCS survey of Roa Island. Littoral & sublittoral habitats and communities, Morecambe Bay	Dr Mark Woombs, Conservation & Projects Officer, Marine Conservation Society, Lancashire Area Group, 4 Springbank Cottages, Wyreside, Knott End-on-Sea, Poulton, Lancashire FY6 0AA, tel: 01253 810 880
Intertidal flora and fauna of Walney Channel & Outer Walney	Dr David George & Ian Tittley, The Natural History Museum, Cromwell Road, London SW7 5BD, tel: 0171 9389431
Ecology of Cavendish Dock	Dr Keith Hendry, APEM Consultants, Enterprise House, Manchester Science Park, Lloyd Street North, Manchester M15 6SE, tel: 0161 2262922
Cumbrian coastal and marine nature conservation issues	*Chris Lumb, English Nature, Blackwell, tel: 01539 445286
Coastal and marine nature conservation issues - Lancashire, Merseyside, Greater Manchester, the Wirral	*Conservation Officer, English Nature North West Local Team, Wigan, tel: 01942 8820342
Local information on Cumbrian marine sites; plus indexed collection of coastal photographs	Betty & Gill Green, Gatesgarth, Santon Bridge, Holmrook, Cumbria CA19 1UX, tel: 019467 26283
Marine nature conservation - Solway Firth	*Roy Cameron, Solway Officer, Scottish Natural Heritage, Dumfries, tel: 01387 247010
General marine ecology: Barrow to Loch Ryan	Dr Eric Perkins, Consultant, Solway Marine Investigations, Grove Cottage, Birkby, Maryport, Cumbria CA15 0RG, tel: 01900 813159
Loch Ryan: habitats and communities	Christine Howson, Consultant, Amisfield, Main Street, Ormiston, East Lothian EH35 5HS, tel: 01875 613256
Isle of Man marine benthic surveys - littoral, sublittoral and offshore	*Prof. T.A. Norton & Dr R.G. Hartnoll, Port Erin Marine Laboratory, Isle of Man, tel: 01624 832027
Isle of Man dredge disturbance project	*Dr Andy Brand, Dr Andy Hill, Port Erin Marine Laboratory, tel: 01624 832027
Sublittoral survey of Isle of Man/diving project	*Lewis Veale, Mike Bates, Port Erin Marine Biologist's Sub-Aqua Club (PEMBSAC), Port Erin Marine Laboratory, Isle of Man, tel: 01624 832027
Isle of Man IRIS (Integrated Recycling of the Island's sewage)	Alan Teare, Department of Highways, Ports and Properties, Sea Terminal Building, Douglas, Isle of Man IM1 2RF, tel: 01624 686902
Calf Marine Trust	*John Lamb, Manx Nature Conservation Trust, Isle of Man, tel: 01624 801985
Isle of Man Marine Committee	*Chairman, Manx Nature Conservation Trust, tel: 01624 801985

*Starred contact addresses are given in full in the Appendix.

4.3 Plankton

M. Edwards & A.W.G. John

4.3.1 Introduction

Plankton include the bacteria (bacterio-), plant (phyto-) and animal (zoo-) plankton. In temperate continental shelf seas, as in this region, the phytoplankton assemblage is dominated by diatoms and dinoflagellates, and the zooplankton, although containing representatives of most animal phyla at some stage, is dominated by crustaceans, principally copepods. The plankton's abundance is strongly influenced by factors such as depth, tidal mixing and temperature stratification, which determine the vertical stability of the water column. The distribution of species, here and elsewhere, is influenced directly by salinity, temperature and water flows into the area (section 2.3) and by the presence of local benthic (bottom-dwelling) communities (section 4.2.2). Many of the species of these communities, including commercially important fish and shellfish (sections 5.5 and 5.7), have temporary planktonic larval forms (meroplankton). Tidal fronts (boundary zones between stratified and well-mixed water masses) in the region (Map 4.3.1) are likely to be of significant biological importance, since they are usually rich in plankton, which attracts other marine life. Phytoplankton blooms are a normal feature in the seasonal development of plankton. Some blooms (transient, unsustainable growths, usually of single species and often associated with a visible discolouration of the water) may reach exceptional proportions (>10^6 cells/l) or contain species (principally dinoflagellates) that can be toxic to humans and possibly have an important economic impact on mariculture, fisheries and tourism. Figure 4.3.1 shows the seasonality of phytoplankton blooms and the numbers of copepods present in the region.

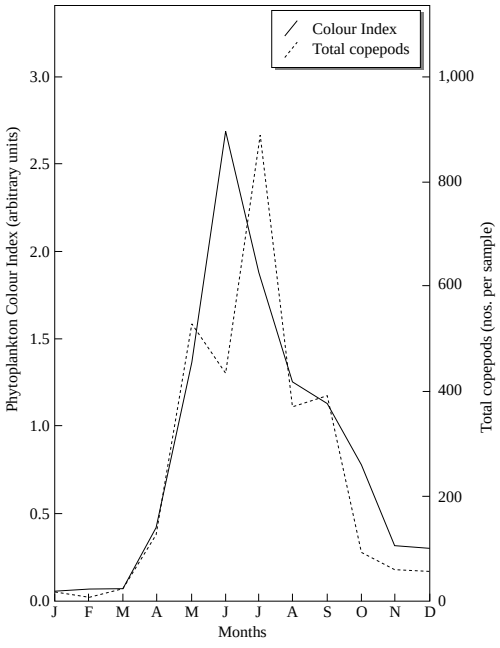
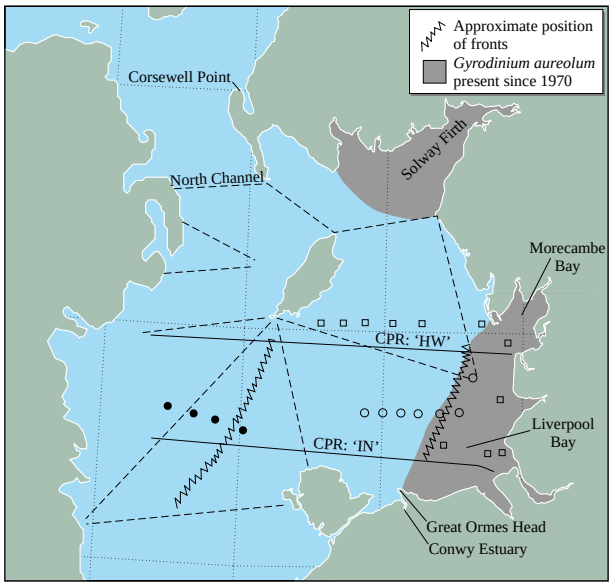


Fig 4.3.1 Average seasonal cycles of an index of phytoplankton colour (a visual estimate of chlorophyll) and the numbers of copepods per sample (approximately 3 m^3 of water filtered), derived from Continuous Plankton Recorder data for 1958-1992. Source: SAHFOS.



Map 4.3.1 Plankton surveys (see Table 4.3.1), the approximate position of 'fronts' and the occurrence of *Gyrodinium aureolum*. Source: SAHFOS.

In Region 13, as elsewhere, the plankton has a fundamental role in the food chain of both benthic (sea-bed) organisms (see sections 4.2 and 5.5) and fish (see sections 5.7 - 5.9). For both ecosystems, the availability of food and nutrients, larval survival, maintaining populations and timing of egg production are highly dependent on the amount of phyto/zooplankton available. Any environmental stress imposed on the plankton will have consequences throughout the food chain and may affect the amount of food available to fish, birds, marine mammals etc. In coastal management, plankton can also give early warning of adverse human impacts (for example the effects of eutrophication) and highlight different water masses.

The annual cycle of phytoplankton production in the Irish Sea (Figure 4.3.1) is similar to that in the North Sea, except that the spring bloom commences one month later (April-May). An important difference between the Irish Sea and other continental shelf seas is that there is considerable variability in the timing and magnitude of the spring bloom from year to year. In the Liverpool Bay area high concentrations of phytoplankton are usual, with chlorophyll levels three times higher than those found in the Irish Sea. Highest production values occur inshore in areas affected by nutrient-rich waters (Foster, Voltalina & Beardall 1982) from nearby rivers and from sewage dumping (Burrows & Sharples 1972).

4.3.2 Important locations and species

The Continuous Plankton Recorder (CPR) surveys show that the planktonic assemblage is mainly made up of neritic (coastal) and intermediate (mixed water) species. The

zooplankton is typically dominated by copepods such as *Calanus helgolandicus* (Liverpool Bay), *C. finmarchicus* (Irish Sea), *Pseudocalanus elongatus* and *Paracalanus parvus*. Studies by Williamson (1956) indicated that the chaetognath *Sagitta setosa* was restricted to the eastern part of Liverpool Bay, owing to the closed water circulation within this area (Khan & Williamson 1970). The closely associated species *S. elegans* is found throughout the Irish Sea and Liverpool Bay. An important aspect of the zooplankton in Liverpool Bay is that it contains the eggs and larvae of many commercially exploited fish species, predominantly whiting and dab. Studies by Nichols *et al.* (1993) found 21 species of fish eggs and 40 species of fish larvae in the plankton of the Irish Sea, with maximum abundances found between the Isle of Man and the Cumbrian coast. Seventeen of the species recorded were of commercial importance, with most spawning occurring between March-May. Maximum densities of zooplankton are found in the western Irish Sea in the surface layers of the stratified waters to the north of the western Irish Sea front (see Map 4.3.1). Although there is no enhanced concentration of zooplankton at the western Irish Sea front, a distinct maximum in copepod abundance is found at the Liverpool Bay front (Floodgate *et al.* 1981). At this front the zooplankton development is also one month in advance of that at the western Irish Sea front. The stocks of zooplankton and phytoplankton in the Irish Sea are much lower than those in the North Sea. While there was a downward trend in the abundance of *Pseudocalanus elongatus* in the North Sea between 1950 and 1981, there was no similar trend in the Irish Sea for this species (CPR data).

4.3.3 Human activities

Most of the attention given to phytoplankton in this region has been focused on the Liverpool Bay area, mainly because of the fairly regular occurrence of blooms of *Phaeocystis pouchetii*. In addition to *Phaeocystis*, two other species form exceptional blooms in this region. The dinoflagellate *Gyrodinium aureolum* produces 'red tides' and occurs in the inshore waters of south-east Liverpool Bay and the Solway Firth (see Map 4.3.1), and the luminescent dinoflagellate *Noctiluca scintillans* may also occasionally form blooms in this area. A red tide is formed when a certain species is present in such large numbers that the water becomes discoloured. The red tides caused by *Gyrodinium aureolum* are of particular importance to the coastal manager because they have been associated with invertebrate mortalities (Helm *et al.* 1974). Although there is some evidence to suggest that nutrient enrichment could cause an increase in *Phaetocystis* blooms, the exact relation between eutrophication and enhanced production is not yet clear (van Beusekom & Diel-Christiansen 1994). These blooms can also be associated with widespread invertebrate mortalities (Rogers & Lockwood 1990).

4.3.4 Information sources used

Table 4.3.1 summarises the extent of plankton survey coverage in the region. For an overall picture of zooplankton in this region, the results of Williamson (1956) give some indication. MAFF's Directorate of Fisheries

Table 4.3.1 Details of surveys

Identification in Map 4.3.1	*Frequency*	*Period*	*Reference*
CPR: 'HW'	Monthly	1994-	
CPR: 'IN'	Monthly	1970 to present	
□ PS	Monthly	1968	Khan & Williamson 1970
○ PS	Monthly	1977-1979	Floodgate *et al.* 1981
• PS	Various	1980-1981	Scrope-Howe & Jones 1986
- - - Pl.su	Occasional	1951-1952	Williamson 1956
Liverpool Bay	Occasional	1907-1914	Johnstone, Scott & Chadwick 1934
Liverpool Bay	Monthly	1970	Burrows & Sharples 1972
Conwy Estuary	Occasional	1969-1987 (ongoing)	Rogers & Lockwood 1990
Irish Sea	Spring	1982-1989	Nichols *et al.* 1993

Key: CPR: Continuous Plankton Recorder; PS: Plankton stations; Pl.su: Plankton survey.

Research at Lowestoft undertook numerous spring plankton surveys of this region during the 1980s, investigating the relationship between hydrography and the distribution of fish eggs and larvae. The Continuous Plankton Recorder (CPR) surveys in this region are of particular importance because they contain long-term plankton data which can be used to assess the effects of environmental variability and climatic change.

4.3.5 Further sources of information

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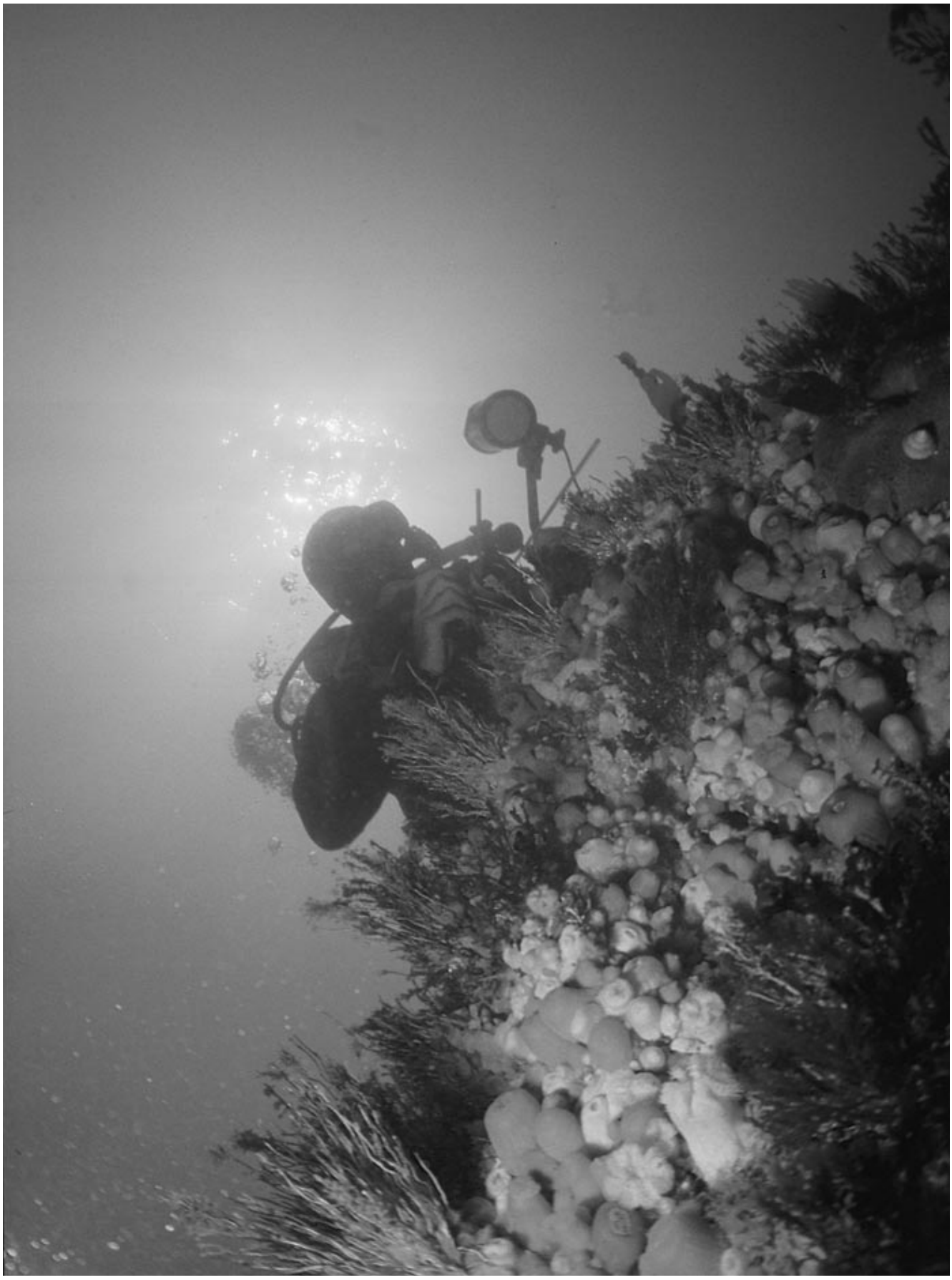
C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Continuous Plankton Recorder (CPR) survey data	Director, Sir Alister Hardy Foundation for Ocean Science, The Laboratory, Citadel Hill, Plymouth PL1 2PB, tel: 01752 222772
Plankton blooms	*Director, Port Erin Marine Laboratory, Isle of Man, tel: 01624 832067
Ichthyoplankton	Director, MAFF Directorate of Fisheries Research, Fisheries Laboratory, Lowestoft, Suffolk NR33 0HT, tel: 01502 562244
General	Chief Fishery Officer, North Western and North Wales Sea Fisheries Committee, University of Lancaster, Bailrigg, Lancaster LA1 4XY, tel: 01524 68745

* Starred contact addresses are given in full in the Appendix.



A number of the marine species found around Region 13 are nationally rare in Britain, and several are more typical of southern, even Mediterranean, waters. Some sites are remarkable for the diversity as well as rarity of the species present, notably off the shores of the Isle and (as here) the Calf of Man, where a dazzling array of marine invertebrates carpet the underwater rocks. Visible in this picture are dense growths of anemones *Metridium senile* and hydroids *Tubularia indivisa*. Photo: Bill Sanderson, JNCC.

Chapter 5 Important species

5.1 Terrestrial lower plants

N.G. Hodgetts

5.1.1 Introduction

This section covers lichens, bryophytes (mosses and liverworts), stoneworts (a group of freshwater and brackish water algae) and fungi occurring in the coastal 10 km squares within the boundaries of the region. This region, which includes the Isle of Man, covers a very wide spectrum of climates and habitats and therefore has a good range of lower plant species and communities. Several of the larger sites in the region are of national, or even international, importance for their lower plants. About 50% of the British bryophyte flora and about 41% of the stonewort flora occur in the region. Similar figures are not available for other groups, but high percentages of both the lichen and fungus floras can be expected, because of the diversity of the region's habitats. Oceanic species are reasonably well represented, although both Region 12 to the south and Region 14 to the north are much richer in oceanic elements.

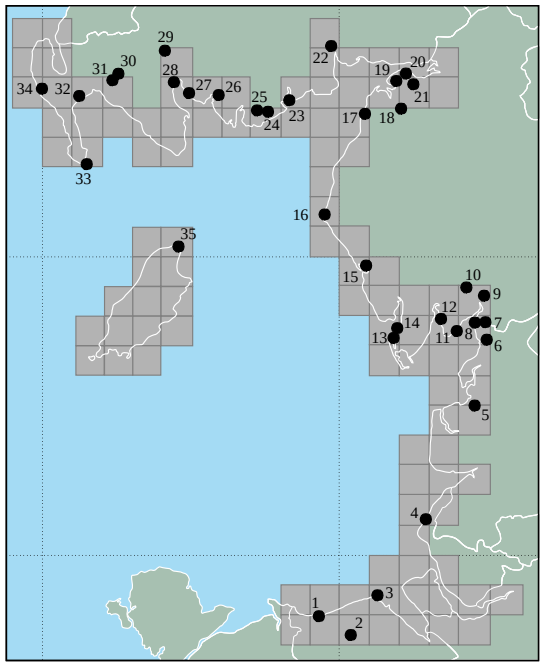
Like higher plants, lower plant species tend to occur in characteristic assemblages that are found in particular habitats. A number of the region's habitats are particularly favoured by lower plants. Ravine woodlands, for example, support many bryophytes, lichens and fungi, particularly myxomycetes (slime moulds); fungi are essential for wood decomposition. Although the wooded ravines of Region 13 are not as rich as those of the two adjacent regions, some of the characteristic oceanic species do occur (e.g. the nationally scarce liverwort *Radula voluta*). An important population of the scarce liverwort *Dumortiera hirsuta* occurs in a coastal ravine near Douglas, Isle of Man.

Historically, the region has contained some of the most important dune systems for lower plants in Britain, but many of these are now badly damaged by commercial and tourist developments, particularly in the Merseyside/ Lancashire area. The region's extensive dune systems, notably dune slacks, are still very important for lower plants, with populations of many lichen species, the liverwort *Petalophyllum ralfsii* and a number of bryophytes and fungi that are restricted to sand-dunes. Many of these fungi are mycorrhizal with higher plants, with willow and marram grass apparently being important associates: fungi are therefore probably instrumental in the process of dune stabilisation.

Some specialist aquatic species of all groups occur where there are streams and rivers, or open water on peatland sites, and some specialist fungi also occur. Temporarily water-filled dune hollows can support interesting stoneworts. In bogs and flushes, bryophytes, particularly *Sphagnum* spp., are often dominant or co-dominant. The remaining more-or-less intact mires of the Solway Firth are nationally important for their extent and for their bryophyte flora. The Solway mires are particularly noteworthy for their populations of the rare moss *Dicranum bergeri*. Formerly, the Lancashire mosses were important for *Sphagnum* species, including *S. obtusum*, now extinct in the UK.

Important areas of coastal (usually cliff-top) grassland and heath usually have thin turf with a complex vegetation mosaic rich in bryophytes, lichens and higher plants. Calcareous grassland is usually richer than neutral or acidic grassland. The often extensive unstable areas are important for maintaining bare ground for colonisation by some of the rare ephemeral lower plants of this habitat. Exposed rocks in this habitat are often good for southern warmth-loving species of bryophyte. The area of exposed rock between high water mark and the cliff-tops is very important for lichens: many distinctive species and communities grow on different rock types. The rocky coasts of south-western Scotland are among the richest in the UK (and Europe) for coastal lichens. Some lichens are distinctive components of the rock-growing vegetation in bird colonies on cliffs, where the rocks are enriched with bird droppings.

Close to the coast in the Silverdale area there is a concentration of limestone pavement sites important for fungi and bryophytes, with distinctive assemblages of lime-loving species, including rarities such as the moss *Tortella densa* and the fungi *Limacella glioderma*, *L. ochraceolutea* and *Volvariella hypopithys*.



Map 5.1.1 Sites in coastal 10 km squares known to be important for lower plants. Site numbers refer to those in Table 5.1.1. Source: JNCC Red Data Book database.

5.1.2 Important locations and species

Map 5.1.1 shows the sites in the region that are known to be important for lower plants and that have had at least some degree of survey work (Table 5.1.1). Many are large, in which case the grid reference given refers to a reasonably central point.

Table 5.1.1 Lower plant sites

Site no.	*Site name*	*Grid ref.*	*Protected status*
	Clwyd		
1	Rhyd-y-foel	SH9177	SSSI
2	Meirchion Valley Woods	SJ0270	SSSI
3	Gronant Dunes & Talacre Warren	SJ1285	SSSI
	Lancashire		
4	Ainsdale-Freshfield Dunes	SD2912	NNR/SSSI
5	Winmarleigh & Cockerham Mosses	SD4448	Part SSSI
6	Warton Crag	SD4972	SSSI
7	Gait Barrows	SD4877	NNR
	Cumbria		
8	Arnside Knott	SD4577	SSSI
9	Levens Park	SD4985	Not protected
10	Whitbarrow	SD4387	SSSI
11	Humphrey Head	SD3973	SSSI
12	Old Park Wood/ Holker Park	SD3377	Part SSSI
13	Walney Island	SD1772	SSSI
14	Sandscale Haws	SD1974	SSSI
15	Ravenglass/Eskmeals	SD0896	SSSI
16	St. Bees Head	NX9413	SSSI
17	Silloth Dunes & Mawbray Bank	NY1052	SSSI
18	Wedholme Flow	NY2153	SSSI
19	Bowness Common	NY2059	SSSI
20	Glasson Moss	NY2360	SSSI
21	Drumburgh Moss	NY2558	SSSI
	Nithsdale		
22	Kirkconnell Flow	NX9769	NNR
	Stewartry		
23	Moyl Peninsula to Rosscarel	NX8352	Part SSSI
24	Heart Moss	NX7647	SSSI
25	Newlaw Moss	NX7347	SSSI
26	Cally Park	NX6054	Not protected
	Wigtown		
27	Dirk Hatteraick's Cave	NX5053	SSSI
28	Carsegowan Moss	NX4358	SSSI
29	Knockman & Garlies Woods & Cumloden Deer Parks	NX4169	Not protected
30	Derskelpin Moss	NX2658	SSSI
31	Flow of Dergoals	NX2457	SSSI
32	Torrs Warren	NX1354	SSSI
33	Mull of Galloway	NX1530	SSSI
34	Dunskey Glen Woods	NX0055	Not protected
	Isle of Man		
35	Point of Ayre	NX4604	Not protected

Sources: references listed in section 5.1.5 and JNCC's protected sites database. Site numbers refer to Map 5.1.1. Key: SSSI = Site of Special Scientific Interest; NNR = National Nature Reserve.

Table 5.1.2 Red Data Book lower plants

Species	*Locations/habitat*
Mosses	
Bryum calophyllum	Calcareous dune slacks, Lancs and Cumbria
Bryum knowltonii	Calcareous dune slacks, Cumbria
Bryum marratii	Calcareous dune slacks, Lancs and Cumbria
Bryum neodamense	Calcareous dune slacks, Lancs
Bryum warneum	Calcareous dune slacks in Lancs and Cumbria
Dicranum bergeri (= undulatum)	Bogs, Solway Firth
*Haematocaulis (Drepanocladus) vernicosus**	Base-rich coastal flushes
Lichens	
Biatoridium monasteriense	Garlies Wood, Newton Stewart, Wigtownshire
Poeltinula cerebrina	nr. Jenny Brown's Point, Lancs.
Sticta canariensis	Dirk Hatteraick's Cave, Wigtownshire
Synalissa symphorea	Arnside Knott, Lancs.
Liverwort	
*Petalophyllum ralfsii**	Open dune slacks

Source: JNCC lower plants database. Key: * = protected under Annex II of the EC Habitats & Species Directive and Appendix I of the Bern Convention.

The region contains a number of threatened species. Red Data Book species (out of a total of 137 bryophytes, twelve stoneworts and 179 lichens on the British Red Lists), excluding extinct species, are listed in Table 5.1.2; some of them are given special protection under national and international legislation. For fungi there is insufficient information for a comprehensive count. The following additional very rare species listed by Ing (1992) occur on coastal dune systems in the area: *Inocybe arenicola* (Sandscale Haws), *Melanoleuca cinereifolia* (North Walney, Sandscale Haws), *Melanoleuca subpulverulenta* (South Walney). The following fungi found on Gait Barrows National Nature Reserve (NNR) are also listed by Ing (1992): *Amanita friabilis*, *Clavicorona taxophila*, *Leptonia rosea*, *Limacella glioderma*, *Microglossum olivaceum*, *Ramaria broomei*. In addition, the region holds 77 of the 313 nationally scarce bryophytes and five of the six nationally scarce stoneworts (figures for nationally scarce species are provisional). There is currently insufficient information to provide regional lists of nationally scarce lichens or fungi.

5.1.3 Human activities

Human activities have substantially influenced important sites in the more urban areas, such as Lancashire and Merseyside, with the result that the lower plant interest is now substantially lower in these areas than it would have been 100 years ago. Current issues that may have a bearing on the lower plant flora of the region include development on sand dune sites, road construction programmes and acid rain. Drainage and lowering of the water table affect wetland sites, particularly bogs and dune slacks. Many of the dune areas have been affected by holiday and leisure developments such as caravan sites and golf courses, and this is likely to remain an issue. Cliff-top grassland and

heathland may be subject to erosion in some places. Pollution is a general problem but may be aggravated in some areas by new power stations, oil spillages, etc. Quarrying is clearly an issue with regard to limestone pavement sites, the best of which are statutorily protected by Limestone Pavement Orders (see section 7.5.4).

Some of the larger and more important sites in the region are NNRs and are therefore managed for nature conservation. Management of dune slacks important for bryophytes should aim to maintain them in a damp and scrub-free condition, with a close herb- and bryophyte-rich sward. Similarly, a close species-rich sward with bare soil should be maintained at important coastal grassland sites: a certain amount of instability and a low level of nutrient input is often desirable to achieve this. Open areas of limestone pavement should be maintained, but, as on sand dunes, care should be exercised in any programme of scrub removal, as scrub (particularly elder) can be important for epiphytes.

5.1.4 Information sources used

Data for bryophytes and the larger lichens are generally good, but are less complete for fungi, algae and the smaller lichens. Most of the sites in Table 5.1.1 were selected for conservation designation partly on the basis of their bryophyte and lichen interest. Some contain rare and scarce species and qualify for SSSI status on the basis of their lower plant flora alone (Hodgetts 1992).

Some of the most important bryophyte sites in the region are well documented. The computerised database at the Biological Records Centre (BRC), Monks Wood, and the Red Data Book database at JNCC include recent records collected over decades by expert bryologists as well as important historical records. Clwyd is particularly well known because of systematic recording for *A bryophyte flora of North Wales* (Hill 1988). Similarly, north Lancashire is well known through work for a Flora (Wigginton 1995). A large number of bryophyte data exist for some of the important dune sites, such as Ainsdale, but there is surprisingly little recent information for many of them. The coastal part of Cumbria and the south-western Scottish coast are rather poorly recorded.

Most important and potentially important coastal lichen sites have been identified in recent surveys (Fletcher 1984; James & Wolseley 1991). However, relatively few of these sites have been comprehensively surveyed, so there are potentially more lichen sites than appear in Table 5.1.1. Many of the listed sites have only rather inadequate information for lichens, particularly microlichens. Even some of the larger sites, such as the dune systems in Cumbria, appear to be rather poorly known.

Data collation for fungi is still at a relatively early stage, and it is not yet possible to incorporate fungi into selection criteria for site designation except in rather an *ad hoc* fashion. All British Mycological Society foray data are currently being put onto a computer database at the International Mycological Institute under a JNCC contract. Some recent work has been done on the coastal dune fungi of Cumbria (Rotheroe 1994). This has resulted in the recording of several rare and scarce species found only on relatively intact dune systems. Gait Barrows NNR has probably been more intensively investigated for fungi than any other site in Britain, because of the efforts of local enthusiasts.

With the exception of stoneworts, algae are poorly known. Sites are not currently selected for conservation designation on the basis of algae except for stoneworts. Computerised stonewort data are held at BRC and JNCC. More information on other freshwater algae may be available from the Freshwater Biological Association.

5.1.5 Further sources of information

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Rotheroe, M. 1994. *Sand-dune fungus survey: Sandscale and Walney Island, Cumbria, 1993/94.* Peterborough, Joint Nature Conservation Committee. (JNCC Report No. 205.)

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B. Further reading

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Hill, M.O., Preston, C.D., & Smith, A.J.E. 1992. *Atlas of the bryophytes of Britain and Ireland. Volume 2. Mosses (except Diplolepideae).* Colchester, Harley Books.

Hill, M.O., Preston, C.D., & Smith, A.J.E. 1994. *Atlas of the bryophytes of Britain and Ireland. Volume 3. Mosses (Diplolepideae).* Colchester, Harley Books.

Livermore, P.D., & Livermore, L.A. 1987. *Fungi of Gait Barrows National Nature Reserve.* Peterborough, Nature Conservancy Council. (Unpublished report.)

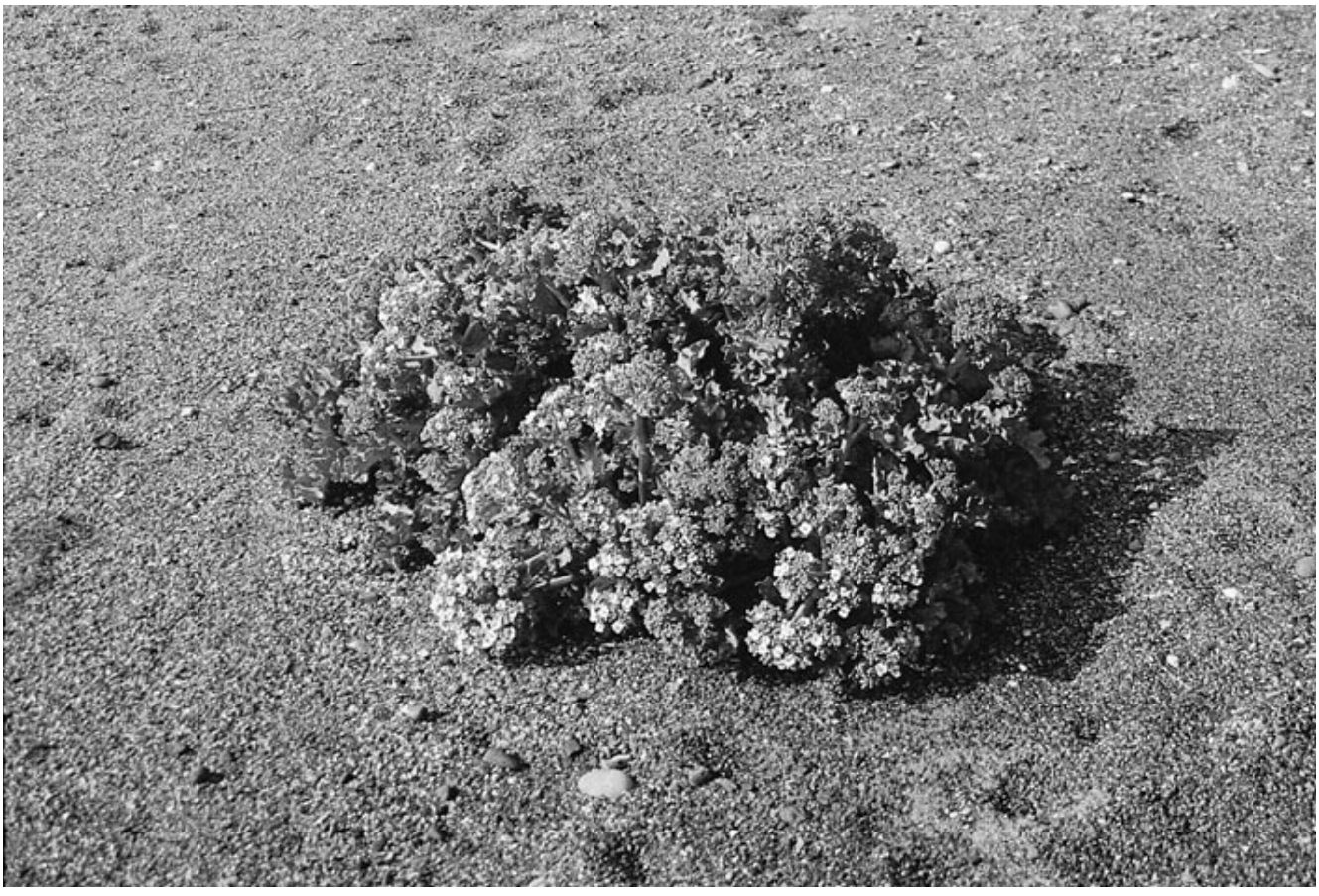
Ratcliffe, D.A., *ed.* 1977. *A nature conservation review.* Cambridge, Cambridge University Press.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Lichens (hard rock coasts)	T. Duke, Sandrock, The Compa, Kinver, Staffs DY7 6HS, tel: 01384 872798
Lichens (general coastal)	P.W. James, c/o Department of Botany, The Natural History Museum, Cromwell Road, London SW7 5BD, tel: 0171 938 9123
Lichens (woodland and general: British Lichen Society database)	Dr A. Fletcher, Leicestershire Ecology Centre, Holly Hayes, 216 Birstall Road, Birstall, Leicester LE4 4DG, tel: 0116 2671950
Fungi (general and sand dune)	M. Rotheroe, Fern Cottage, Falcondale, Lampeter, Dyfed SA48 7RX, tel: 01570 422041
Lichens (general Welsh)	*R. Woods, CCW, Llandrindod Wells, tel: 01597 824661
Fungi (general Scottish)	Dr R. Watling, Royal Botanic Garden, Inverleith Row, Edinburgh EH3 5LR, tel: 0131 552 7171
Fungi (British Mycological Society database)	Dr P. Cannon, International Institute of Mycology, Bakeham Lane, Englefield Green, Egham, Surrey TW20 9TY, tel: 01784 470111

Type of information	*Contact address and telephone no.*
Bryophytes (general Welsh)	*T.H. Blackstock, CCW, Bangor, tel: 01248 370444
Bryophytes (Lancashire)	*M.J. Wigginton, JNCC, Peterborough, tel: 01733 62626
Bryophytes (BRC database)	*C.D. Preston, Biological Records Centre, ITE, Monks Wood, Huntingdon, tel: 01487 773381
Bryophytes (general Scottish)	D.G. Long, Royal Botanic Garden, Inverleith Row, Edinburgh EH3 5LR, tel: 0131 552 7171
Bryophytes (Scottish, lowland)	A.B.G. Averis, 2 Traprain Cottages, Traprain, Haddington, East Lothian EH41 4PY, tel: 01620 860029
Bryophytes (Scottish, upland)	G.P. Rotheroe, Stronlonag, Glenmassan, Dunoon, Argyll PA23 8RA, tel: 01369 6281
Bryophytes (British Bryological Society herbarium)	A.R. Perry, Department of Botany, National Museum of Wales, Cardiff CF1 3NP, tel: 01222 397951
Lower plants (species status; Red Data Book Database; site register etc.)	*N.G. Hodgetts, JNCC, Peterborough, tel: 01733 62626

* Starred contact addresses are given in full in the Appendix.



The beaches of this region support a number of nationally rare and scarce flowering plants, including one (the Isle of Man cabbage) that grows on the west coast of Britain but nowhere else in the world. Sea kale (illustrated) is another scarce beach plant, confined to unstable sand and shingle. Photo: Nick Davidson, JNCC.

5.2 Flowering plants and ferns

V.M. Morgan

5.2.1 Introduction

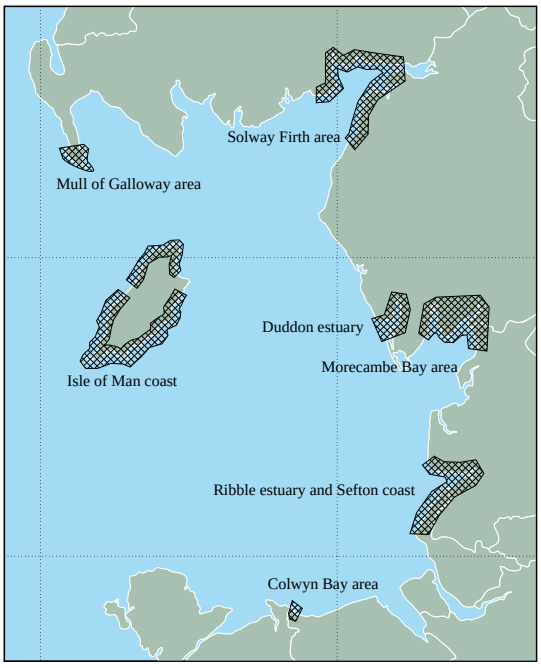
This section describes the importance of the region for vascular plants (i.e. flowering plants and ferns), with particular reference to species that are rare or scarce in Great Britain. Rare and scarce species grow in a wide range of habitats, but of particular importance in the region are sand dunes, wet pasture, limestone cliffs, woodland and grassland. The region is moderately rich in rare species; numbers of rare and scarce species are shown in Table 5.2.1. Parts of the region are of national importance for rare and scarce species: the Morecambe Bay area is a classic British botanical locality. The occurrence of limestone at the coast also means that both plant communities and individual species occur that are more typical of upland than coastal areas in Great Britain. Examples of such species - Teesdale violet *Viola rupestris* and bird's-foot sedge *Carex ornithopoda* - are to be found in ancient woodland, limestone pavement and grassland.

The climate of the region is intermediate between milder Wales and south-west England and colder areas in parts of Scotland outside the region. There are around 260 to 270 growing days for plants per year (Savidge 1963), compared with 320 in parts of Wales outside the region (Ellis 1983). In terms of the European distribution of species, the region contains a mixture of elements, from Mediterranean species such as tree mallow *Lavatera arborea* through more typically continental species (for example grey hair-grass *Corynephorus canescens*); continental southern (hoary rock-rose *Helianthemum canum*) and continental northern (intermediate wintergreen *Pyrola media* and baneberry *Actaea spicata*); alpine (purple oxytropis *Oxytropis halleri*); oceanic southern (dotted sedge *Carex punctata* and sea spurge *Euphorbia paralias*) and oceanic northern (lax-flowered sea-lavender *Limonium humile* and slender naiad *Najas flexilis*); to more northerly elements such as northern montane (holy-grass *Hierochloë odorata* and bird's-eye primrose *Primula farinosa*), arctic-alpine (spring sandwort *Minuartia verna* and yellow saxifrage *Saxifraga aizoides*) and arctic-sub-arctic (oyster plant *Mertensia maritima*).

Table 5.2.1 Numbers* of rare and scarce coastal higher plant species

	Protected species	*Other Red Data Book species*	*Scarce species*
Clwyd	0	1	29
Cheshire	0	0	6
Merseyside	0	1	13
Lancashire	0	2	38
Cumbria	0	6	59
Dumfries & Galloway			
Annandale & Eskdale	0	0	6
Nithsdale	1	1	13
Stewartry	0	1	15
Wigtown	1	1	13
Isle of Man	6	0	9
Region 13	***8***	***12***	***83***

Sources: JNCC rare plants database; Stewart *et al.* (1994; 1993 draft used); BRC database; Isle of Man: Wildlife Act (1990), Allen (1984), Stewart *et al.* (1994). Key: *Excludes known introductions and records from before 1970.



Map 5.2.1 Key localities for rare and scarce higher plants. Sites are listed in Table 5.2.2. Source: JNCC rare plants database.

5.2.2 Important locations and species

The key localities in the region noted for rarities and/or scarce species are shown on Map 5.2.1 and listed in Table 5.2.2; in addition, there are many moderately species-rich sites.

Three of the key localities owe much of their interest to the exposure of carboniferous limestone at the coast: Morecambe Bay and parts of the Solway Firth and Colwyn Bay areas. Areas of limestone cliffs with a rich flora are scattered around the eastern coast of the Irish sea, and where they are relatively sheltered and/or south-facing, the favourable climate supports populations of a number of species that are well to the north of their usual range in Britain. Examples include the rare species Goldilocks aster and spotted cat's-ear, the scarce taxa hoary rock-rose, spiked speedwell *Veronica spicata* subsp. *hybrida* and rare spring-sedge, and a number of more common plants such as squinancywort *Asperula cynanchica*, bee orchid *Ophrys apifera,* thin-spiked wood-sedge *Carex strigosa* and common gromwell *Lithospermum officinale*. The Sefton coast contains the only English locality for Baltic rush *Juncus balticus*, a northern species otherwise confined in Britain to Scotland north of the Firths of Clyde and Forth.

Rare species are listed in Table 5.2.3. There are fourteen nationally rare (Red Data Book) species in the region: 317 rare species were listed for Great Britain in the *British Red Data Book of vascular plants* (Perring & Farrell 1983).

Table 5.2.2 Key localities for rare and scarce plants (records post 1970)

Locality	*Status*	*Species*
Colwyn Bay area[1]	Part SSSI, part undesignated	Red Data Book species: Welsh groundsel *Senecio cambrensis.* Scarce species: hoary rock-rose *Helianthemum canum*; spiked speedwell *Veronica spicata* subsp. *hybrida*, plus five others
Ribble Estuary and Sefton coast	SSSI, part NNR	Red Data Book species: grey hair-grass *Corynephorus canescens* Scarce species: round-leaved wintergreen *Pyrola rotundifolia* subsp. *maritima,* plus seven others
Morecambe Bay area	Part SSSI, part NNR, part undesignated	Red Data Book species: bird's-foot sedge *Carex ornithopoda*, Goldilocks aster *Aster linosyris*, large yellow-sedge *Carex flava*, spotted cat's-ear *Hypochoeris maculata*, the whitebeam *Sorbus lancastriensis* Scarce species: angular Solomon's-seal *Polygonatum odoratum*, baneberry *Actaea spicata*, brown beak-sedge *Rhynchospora fusca*, chives *Allium schoenoprasum,* fingered sedge *Carex digitata*, hoary rock-rose, long-stalked orache *Atriplex longipes,* maidenhair fern *Adiantum capillus-veneris*, rare spring-sedge *Carex ericetorum*, rigid buckler-fern *Dryopteris submontana*, round-leaved wintergreen *Pyrola rotundifolia* subsp. *maritima,* spiked speedwell *Veronica spicata*, touch-me-not balsam *Impatiens noli-tangere*, plus 29 others
Duddon Estuary area	Part SSSI, part NNR, part undesignated	No Red Data Book species Scarce species: rigid buckler-fern, round-leaved wintergreen, touch-me-not-balsam, plus 18 others
Solway Firth area	Part SSSI, part NNR, part undesignated	Red Data Book species: holy-grass, slender naiad, sticky catchfly, yarrow broomrape Scarce species: angular Solomon's-seal, baneberry, brown beak-sedge, chives, fingered sedge, hoary rock-rose, long-stalked orache, maidenhair fern, rare spring-sedge, rigid buckler-fern, round-leaved wintergreen subsp. *maritima*, spiked speedwell, touch-me-not balsam, plus 29 others
Mull of Galloway area	Part SSSI, part undesignated	Red Data Book species: purple oxytropis, small restharrow plus four scarce species
Isle of Man coast	Parts proposed as NNR and Area of Special Scientific Interest	Red Data Book species: dense-flowered orchid *Neotinea maculata* Scarce species: maidenhair fern, plus nine other scarce species

Sources: JNCC rare plants database, Biological Records Centre (BRC) database, English Nature, Scottish Natural Heritage, Countryside Council for Wales, Manx Nature Conservation Trust. Key: [1]The rare and most of the scarce species in the Colwyn Bay area occur away from the shore, although still in coastal 10 km squares. SSSI = Site of Special Scientific Interest; LNR = Local Nature Reserve; NNR = National Nature Reserve. Note: Key localities are those with important populations of rare species and/or many scarce species. Scarce species may occur near to rather than within some localities. Only scarce species known from 16-30 10 km squares in GB are listed by name.

83 species are scarce, i.e. known from fewer than 100 ten km squares in Great Britain, where there are 254 such species (Stewart, Pearman & Preston 1994). One rare species of clean lochs - slender naiad *Najas flexilis* - is considered to be severely threatened in Europe and is listed on Annexes IIb and IVb of the EC Habitats Directive (there are nine such species in Great Britain). Two species - slender naiad and small rest-harrow *Ononis reclinata* - are amongst the 107 listed on Schedule 8 of the Wildlife and Countryside Act (1981). Schedule 7 of the Manx Wildlife Act (1990) lists the Isle of Man cabbage *Coincya monensis* subsp. *monensis*, lesser clubmoss *Selaginella selaginoides*, shepherd's cress *Teesdalia nudicaulis*, pennyroyal *Mentha pulegium*, spring sandwort *Minuartia verna* and all orchid species.

One rare species, large yellow-sedge *Carex flava*, is found nowhere else in Britain (Jermy, Chater & David 1982), although it is widespread in continental Europe and North America. The dense-flowered orchid *Neotinea maculata* is found on the Ayres, Isle of Man, in its only British location outside Ireland (Allen 1984). Welsh groundsel *Senecio cambrensis* is a new species that is thought to have arisen naturally as a hybrid between groundsel *S. vulgaris* and the introduced Oxford ragwort *S. squalidus*. First found in 1948 in the Wrexham area and in Colwyn Bay in 1966, it has now spread to around ten 10 km squares; populations around Edinburgh are of the same species, but are thought to have arisen separately. If it continues to spread as it has so far, the species will become scarce rather than rare.

The region is the world stronghold of the Isle of Man cabbage *Coincya monensis* subsp. *monensis*, a subspecies endemic to the west coast of Britain (i.e. it grows nowhere else), centred on the Irish Sea but with outposts in the Bristol Channel and the Firth of Clyde. Its type locality is at Ramsey on the Isle of Man, where it still flourishes. Discovered in 1660, it is the island's earliest localised plant record and the only plant named after the island (Allen 1984). The subspecies is very abundant locally on sandy shores and open dunes, growing with marram *Ammophila arenaria* and sea radish *Raphanus maritimus* (Rich 1991).

5.2.3 Human activities

Activities that have affected plant communities and populations include industrial, urban, recreational and road development, agriculture, forestry and sea defences. For example, saltmarsh habitats can be affected by intensive grazing, which increases the proportion of grassland to true saltmarsh species. Other coastal marshes can be damaged

Table 5.2.3 Recorded occurrence of nationally rare species

Species	*Recorded occurrence in:* *total no. of squares in GB*	*no. of coastal 10 km squares in region***	*approx. no. of sites in region*	*Key localities*	*Habitat*
Large yellow-sedge *Carex flava*	1	1	1	Morecambe Bay	Damp peat
Bird's-foot sedge *Carex ornithopoda*	11	1	7	Morecambe Bay	Dry limestone
Dense-flowered orchid *Neotinea maculata*	1	1	1	Isle of Man coast	Calcareous dunes
Grey hair-grass *Corynephorus canescens*	12	1	1	Sefton coast	Dunes
Goldilocks aster *Aster linosyris*	7	1	1	Morecambe Bay	Limestone cliffs
Holy-grass *Hierochloë odorata*	13	5	6	Solway Firth; Cree Estuary (NX55)	Wet banks & flushes
Spotted cat's-ear *Hypochoeris maculata*	9	1	1	Morecambe Bay	Grassy cliffs
Sticky catchfly *Lychnis viscaria*	14	2	2	Solway Firth	Cliffs & rocky places
Slender naiad *Najas flexilis**, **	15	1	1	Solway Firth	Clean lochs
Small restharrow *Ononis reclinata**	8	1	1	Mull of Galloway area	Sand or limestone
Yarrow broomrape *Orobanche purpurea*	17	1	1	Solway Firth area	Parasite on yarrow *Achillea millefolia*
Purple oxytropis *Oxytropis halleri*	10	1	1	Mull of Galloway area	Grassy rocky places
Welsh groundsel *Senecio cambrensis*	10	1	2	Colwyn Bay area	Waste ground & roadsides
A whitebeam *Sorbus lancastriensis*	10	4	19	Morecambe Bay	Rocky scrub & woodland on limestone
Teesdale violet *Viola rupestris*	8	1	1	Morecambe Bay	Limestone grassland

Sources: JNCC rare plants database and rare plant survey reports. Key: * = listed on Schedule 8 of the Wildlife & Countryside Act 1981; ** = listed on Annexes IIb and IVb of the EC Habitats Directive and Annex I of the Bern Convention; *** number recorded since 1970, excluding known extinctions. Grid references given only for localities not shown on Map 5.2.1. Note: spiked speedwell *Veronica spicata* is listed on Schedule 8 of the Wildlife & Countryside Act 1981. However it has been excluded from this table as the sub-species found in the region, *V. spicata* subsp. *hybrida,* is scarce rather than nationally rare.

by too little grazing, which leads to the development of rough vegetation at the expense of floral diversity. In addition marshes can be altered or reduced when sea defences are built, as in Morecambe Bay, where the scarce curved sedge *Carex maritima,* in its only site on the English west coast, has not been seen since 1971 (G. Halliday pers. comm.). Where fore-dunes are swept away in stormy weather, coastal erosion can itself lead to the loss of populations, affecting species such as Isle of Man cabbage. Sand dunes can be vulnerable to erosion where there is heavy use by the public; careful design of access routes can often prevent or control such erosion.

5.2.4 Information sources used

All the English and Welsh counties were covered by rare plant surveys between 1987 and 1988, and a series of detailed confidential reports was produced, now held by English Nature, the Countryside Council for Wales and the Joint Nature Conservation Committee (JNCC). Further work has been carried out by English Nature and the Countryside Council for Wales as part of their programmes of monitoring. JNCC maintains a database of nationally rare plant species that includes site records; this provided the data for Scottish sites. Members of the Botanical Society of the British Isles (BSBI) have recently finished collecting up-to-date records of scarce species; these data are held at the Biological Records Centre and have been summarised in *Scarce plants in Britain* (Stewart, Pearman & Preston 1994). Isle of Man data came from the references cited and the Manx Nature Conservation Trust.

5.2.5 Acknowledgements

Special thanks are due to John Lamb, Manx Nature Conservation Trust, for providing information on flowering plants and ferns on the Isle of Man. Thanks are also due to M. Ellis, V. Fleming, G. Halliday, C. Lumb, C. Macduff-Duncan, M.A. Palmer, N. Robinson, C. Spray, C. Sydes, I. Taylor, M.J. Wigginton and staff at the Biological Records Centre.

5.2.6 Further sources of information

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B. Further reading

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Species on SSSIs and NNRs, other protected areas, rare and scarce species, rare plant surveys, licensing and protected species - England	*Coastal Ecologist, Maritime Team, English Nature HQ, Peterborough, tel: 01733 340345
Species on SSSIs and NNRs, other protected areas, rare and scarce species, rare plant surveys, licensing and protected species - Scotland	*Plant Ecologist, International and Biodiversity Branch, Scottish Natural Heritage, Edinburgh, tel: 0131 447 4784
Species on SSSIs and NNRs, other protected areas - Wales	*Group Leader, Statutory Protection & Monitoring Group, CCW HQ, Bangor, tel: 01248 370444
Rare and scarce species, rare plant surveys, licensing and protected species - Wales	*Group Leader, Natural Science Group, CCW HQ, Bangor, tel: 01248 370444
Database of rare and protected species	*Species Conservation Branch, JNCC Peterborough, tel: 01733 62626
Biological Records Centres and active herbaria:	
Clwyd	Department of Botany, National Museum of Wales, Cardiff CF1 3NP, tel: 01222 397951
Lancashire, Merseyside and Cheshire	Assistant Curator, Environmental Records Centre, Botany Department, Liverpool Museum, William Brown Street, Liverpool L3 8EN, tel: 0151 207 0001 ext. 4373
Isle of Man	*Assistant Keeper (Natural History), Manx National Heritage, Douglas, tel: 01624 675522
Cumbria	Curator of the Herbarium, Department of Biological Sciences, The University, Lancaster LA4 1YQ, tel: 01524 65201 ext. 3499
Local BSBI vice-county records:	
Clwyd	Hon. Secretary, Welsh Committee, Botanical Society of the British Isles, c/o National Museum of Wales, Cardiff CF1 3NP, tel: 01222 397951
England (for vice-counties 69 & 70 Westmoreland & Cumberland, contact Uni. of Lancaster as above)	*C.D. Preston, c/o Biological Records Centre, ITE Monk's Wood, tel: 01487 773381
Scotland	c/o Dr P. Macpherson, Hon. Secretary, Scotland Committee, Botanical Society of the British Isles, 15 Lubnaig Road, Glasgow G43 2RY, tel: 0141 632 0723
Isle of Man	*Assistant Keeper (Natural History), Manx National Heritage, Douglas, tel: 01624 675522

* Starred contact addresses are given in full in the Appendix.

5.3 Land and freshwater invertebrates

M.S. Parsons & A.P. Foster

5.3.1 Introduction

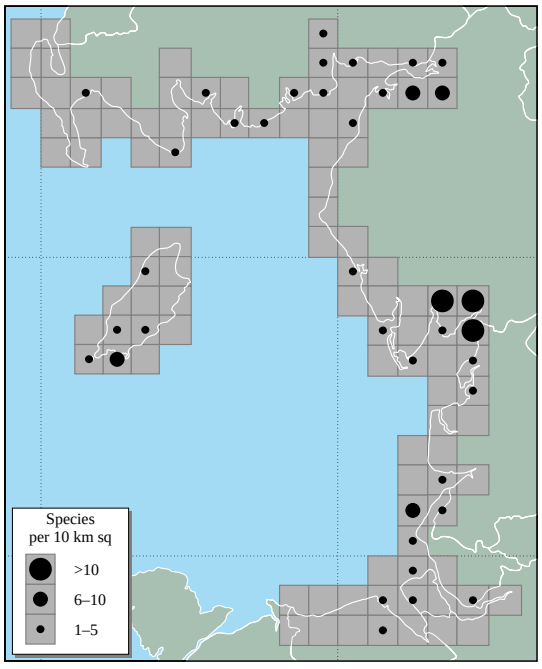
There are over 28,000 species in the better known invertebrate groups in Great Britain (Kirby 1992). This section deals with most insect orders, though not all families, together with a wide range of non-insect invertebrates, known from sites within the coastal 10 km Ordnance Survey grid squares of the region.

The region is nationally important for the conservation of a range of invertebrate species. Of 358 coastal Red Data Book (RDB) and 455 coastal nationally scarce species listed by Kirby (1994a, b), nineteen RDB and 102 nationally scarce have been recorded in the region, according to the JNCC's Invertebrate Site Register (ISR). These totals include recent (since 1969) records for four RDB Hymenoptera (bees, wasps and ants), five RDB Coleoptera (beetles), four Lepidoptera (all moths), five Diptera (flies) and one mollusc (a snail), together with 51 nationally scarce Coleoptera. Coastal RDB species as defined by Kirby (1994a, b) are listed in Table 5.3.1. Other species of equivalent rank, but not covered by Kirby, also occur within the region. Map 5.3.1 shows the numbers of all nationally rare (RDB) invertebrate species (including Kirby's 'coastal' species and all others) recorded in coastal 10 km squares in the region; Map 5.3.2 maps the recorded distribution of all nationally scarce invertebrates in the region. Note that survey effort has not been equal throughout the region, so actual occurrence may differ from recorded distributions.

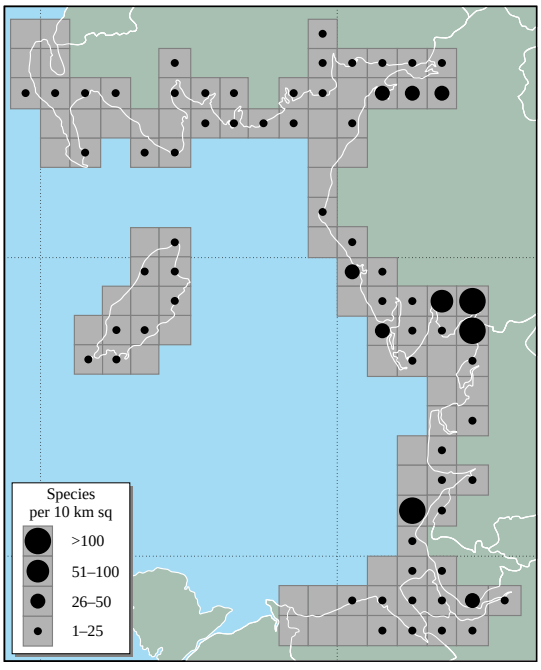
For a few species the only recent British records are from this region, and several other species have a substantial part of their British distribution along this stretch of coast. The region is important not only for individual scarce or threatened species; it includes several nationally and regionally important sites for invertebrates. Several sites around Arnside support significant assemblages of butterflies that include many scarcer species.

5.3.2 Important locations and species

The ISR has records for over 270 coastal sites within this region, some of them subsites of larger areas. Several sites support RDB invertebrates and many are the habitats of a range of nationally scarce species. There are substantial areas of sand dunes along this stretch of coast which support nationally important invertebrate faunas. Perhaps the most outstanding are those in the Ainsdale area and on the Drigg coast. The limestone habitats around the northern end of Morecambe Bay are particularly important for their invertebrate faunas and include Arnside Knott and Gait Barrows, sites known to be of national significance. The complex of mosses and woods around Roudsea Wood is of national importance and supports several RDB species. Several other moss sites are presently considered to be of regional importance. The faunas of the coastal cliff sites are not particularly well documented, but the assemblage of curculionid species (weevils) found at one of these, St. Bees Head, suggests further survey of this habitat in the region may prove rewarding. Areas of saltmarsh and shingle are found as part of a habitat mosaic on some sites, providing



Map 5.3.1 Numbers of nationally rare (i.e. RDB) invertebrate species recorded in coastal 10 km squares (all dates). Distribution may reflect differences in recording effort. Source: JNCC Invertebrate Site Register.



Map 5.3.2 Numbers of nationally scarce invertebrate species recorded in coastal 10 km squares (all dates). Distribution may reflect differences in recording effort. Source: JNCC Invertebrate Site Register.

Table 5.3.1 Coastal Red Data Book (RDB) species in Region 13

Species	*Description and notes on recorded occurrence in the region*
RDB1	
Aegialia rufa	Small (3.5-4.5 mm long) globular red beetle in plant litter just below the surface in sand dunes. Very rare; known from a small number of dunes on the Welsh and Lancashire/Merseyside coasts: Ainsdale Sand Dunes*, Formby Sand Dunes*, North Wirral Foreshore*, Southport Sand Dunes* - Merseyside.
Aphodius brevis	Very rare dung beetle feeding on rabbit and other dry dung in sandy places. Recorded only from coastal dunes in Merseyside. Ainsdale Sand Dunes*, Southport Sand Dunes* - Merseyside.
Mellinus crabroneus	Digger wasp preying on Diptera (flies) and nesting in sandy places. Originally widespread north to Scottish border, but has declined dramatically since 1920s. Possibly now extinct. Silloth Dunes* - Cumbria.
Osmia xanthomelana	A solitary bee quite widespread in England in the last century but since declined; now apparently known from only a single locality. Grange-over-Sands* - Cumbria.
Narrow-mouthed whorl snail *Vertigo angustior*	A small snail found in permanently marshy grassland in dunes and lowland fens. Extremely rare; some colonies under threat from natural habitat changes. Populations in southern Cumbria, south Wales and East Anglia. The Flandrian fossil record shows it to have been once much more widespread. Gait Barrows NNR - Lancashire; White Port - Dumfries & Galloway.
Proposed RDB1	
Paralister obscurus	A largish (6-8 mm) shiny black carrion beetle living in dung and preying on other invertebrates therein. Very rare, with scattered records north to Lancashire. Opportunist species not attached to a particular site or habitat. Ainsdale Sand Dunes* - Merseyside.
Pyrausta sanguinalis	A small moth inhabiting coastal sandhills, the larva feeding in a silken tube amongst the flowers of thyme. Very local; occurred in north Wales, Lancashire and Isle of Man; now possibly extinct on the mainland. North Wirral Foreshore* - Merseyside.
RDB2	
Sandhill rustic moth *Luperina nickerlii gueneei*	Subspecies found locally on coastal sandhills in north Wales (old records exist for Lancashire), the larva feeding in the stem and root crowns of sand couch *Elymus farctus*. Formby Sand Dunes* - Merseyside; Gronant Dunes - Clwyd; Lytham St. Anne's Dunes* - Lancashire.
Nysson interruptus	Solitary wasp that parasitises the nests of other wasps, especially *Argogorytes fargeii*. Most records from the southern counties of England; uncommon. Grange-over-Sands* - Cumbria.
Sphaerophoria loewi	Small yellow and black hoverfly. Occurs in wetlands particularly brackish coastal marshes with stands of sea club-rush *Scirpus maritimus* and reeds *Phragmites* spp. A rarely found species known from Kent to Elgin. Leighton Moss* - Lancashire.
Proposed RDB2	
Cicindela hybrida	A large (12-16 mm) bronze/purple tiger beetle. Adult hunts over open ground, particularly sand and gravel, most often on the coast though not exclusively. Formerly widely distributed north to Cumbria in the west, Norfolk in the east. Nowhere common. Ainsdale Sand Dunes - Merseyside; Drigg Coast*, Ravenglass Dunes - Cumbria.
Nephrotoma quadristriata	Cranefly confined to the major dune systems on the west coast of England and Wales. Usually found at the back of mobile dunes, especially near the edges of slacks. Southport Sand Dunes - Merseyside.
Scrobipalpa clintoni	Small moth; frequents sandy and shingle beaches in western Scotland north to the North Hebrides. Has been found on a shingle beach at or a little above high-water mark in south-facing bays. Larva feeds and pupates in the stems of curled dock *Rumex crispus* in July. Species overwinters as a pupa, the adult flying in May and June. Borgue, Cairnryan - Dumfries & Galloway.
RDB3	
Marsh moth *Athetis pallustris*	Recorded from marginal fenland and marshy places in sand dunes, the larva feeding on meadowsweet *Filipendula ulmaria* and other fen plants. Secretive species found locally in Lincolnshire, Huntingdonshire, Cambridgeshire and Norfolk, a few old records elsewhere. Orton Moss* - Cumbria.
Colletes cunicularius	Mining bee, confined to the sandhills of north-west England and Wales. Restricted to sand dunes, where it colonises old erosion hollows, forming dense colonies on steep inclines. Requires creeping willow *Salix repens* as a pollen source. Can be locally numerous within its range, but has a very restricted distribution and is therefore vulnerable to habitat damage, e.g. by human trampling of dune systems or coastal development. Ainsdale Sand Dunes, Formby Sand Dunes*, Southport Sand Dunes*, North Wirral Foreshore* - Merseyside; Lytham St. Anne's Dunes* (population now extinct) - Lancashire; Sandscale Haws - Cumbria.
Dyschirius angustatus	Small (3-3.5 mm) blackish brown burrowing ground beetle of sandy ground by water, particularly on the coast. Specific predator on small burrowing rove beetles of the genus *Bledius*. Very rare. Recorded from areas of south-east England, the west Cumbrian coast and eastern Scotland. Kirkbride - Cumbria.
Grey moth *Hadena caesia*	Cliffs and rocky places by the sea. Larva feeds on sea campion *Silene uniflora*. Local, western Argyll and several of the Hebridean islands and the Isle of Man. 19th century records from Cumberland. Douglas Head*, Port Soderick*, Derbyhaven*, Perwick Bay* - Isle of Man.
Haematopota bigoti	Coastal blood sucking cleg (horsefly). Larvae found in soil in saltmarshes. Southern coastlands north to Humber/Solway. Very local. Caerlaverock - Dumfries & Galloway; Ribble Estuary* - Lancashire.
Belted beauty moth *Lycia zonaria*	Coastal sandhills; larvae feed on bird's-foot trefoil *Lotus* spp., burnet rose *Rosa pimpinellifolia* and other low-growing plants. Female is wingless; male has brown and white striped wings. Recorded from Caernarvonshire, Flintshire, Cheshire, Lancashire, Argyll and the Hebrides. Altcar Sand Dunes*, Formby Sand Dunes*, Moreton, North Wirral Foreshore - Merseyside; Gronant Dunes* - Clwyd; Sunderland Point - Lancashire.
Nomada hirtipes	Rare southern cuckoo bee associated with the solitary bee *Andrena bucephala*. Grange-over-Sands* - Cumbria.

Table 5.3.1 Coastal Red Data Book (RDB) species in Region 13 (continued)

Species	*Description and notes on recorded occurrence in the region*
RDB3 continued	
Osmia parietina	Mason bee; has occurred in parts of Wales and Scotland; also reported in north-west England. Cocoons have been found in hollows underneath stones. Gait Barrows - Lancashire.
Least minor moth *Photedes captiuncula*	Limestone hills and dales, scrubland and grassy hollows on the top of sea-cliffs. Larva feeds in the stems of glaucous sedge *Carex flacca*. Local, found in Cumbria, Yorkshire, Co. Durham and Northumberland. East Anglian records were probably of migrants. Gait Barrows, Leighton Moss, Thrang End, Warton Crag* - Lancashire; Arnside Knott, Beetham Fell, South Walney, The Howe, Whitbarrow*, Yewbarrow - Cumbria.
Podalonia affinis	Large black and red solitary sand wasp nesting in sandy soil. Prey: caterpillars. Recorded in England north to Yorkshire/Lancashire. Nowhere common. Ainsdale Sand Dunes - Merseyside.
Psen littoralis	Digger wasp, may nest in the stems of marram *Ammophila arenaria*. Prey unknown. Frequents marram dunes, locally common, Devon, parts of Wales, Lancashire and Cumbria. Ainsdale Sand Dunes - Merseyside; Sandscale Haws* - Cumbria.
Proposed RDB3	
Anthicus scoticus	Small (2-2.5 mm long) reddish ant beetle living in strandline refuse, decaying seaweed etc. in saltmarshes. Adults on flowers. Until recently known only from western Scotland, Cumbria and the Isle of Man. Small population recently discovered in Kent. Allonby Bay* - Cumbria.
Dialineura anilis	Stiletto fly associated with sand dunes. Life history unknown though larvae probably develop in damp sand at the base of vegetation. Mainly noted from the Welsh coast and the west coast of Scotland; also known from Somerset and Lancashire. Ainsdale Sand Dunes - Merseyside.
Dolichopus latipennis	Fly usually recorded from saltmarshes or the lower reaches of rivers where there is tidal activity and some salinity. Recorded from Norfolk, Suffolk, Oxfordshire and Dumfriesshire. Biology unknown, though larvae are probably semi-aquatic carnivores at water margins or in damp soil. Adults have been recorded from May to July. Caerlaverock - Dumfries & Galloway.
Hercostomus fulvicaudis	Small metallic fly recorded from a variety of habitats including a reedbed, an estuary, a gravel pit, a Breckland mere and a fen. Grubbins Wood, Rockcliffe Marsh - Cumbria.
Pamponerus germanicus	Robber fly frequenting sand dunes just behind the marram grass belt. Larvae possibly develop in moist sand as predators of other invertebrates. Distributed over the major sand dunes of western Britain from north Devon to the north-east coast of Scotland. Occasionally reported inland. Ballaugh Curraghs* - Isle of Man; Roudsea Woods and Mosses, Rusland Valley Mosses* - Cumbria.
RDB I	
Carpelimus schneideri	Small rove beetle known only from isolated populations in Norfolk, Cumbria and Dumfriesshire. Burrows in mud near salt water; feeds on algae. Wampool Estuary* - Cumbria.
RDB K	
Allomelita pellucida	Amphipod recorded in brackish water in harbours or ditches, sometimes amid aquatic vegetation. In France it has been found 50-100 cm down in the interstices of a gravel beach where freshwater flowed into the sea. Where it occurs, it is often abundant, but there are very few records from Britain. It has been reported from the East Anglian, south and south-west coasts and the Isle of Man. Silverburn Estuary* - Isle of Man.
Proposed RDB K	
Bibloplectus minutissimus	Small beetle found under stones, in grass tussocks and in shingle. Recorded from southern England north to Cumbria. Clarke Gardens - Merseyside.
Bledius terebrans	Rove beetle recorded from river margins and sand hills. Lives in burrows in sandy areas where it probably feeds on algae or detritus. Adults have been recorded in April, June and August. Known only from a few widely scattered vice-counties and recorded from West Sussex north to Easterness in Scotland. Recently recorded from just two vice-counties. *Bledius* colonies tend to shift from site to site and so may be overlooked. Southport Sand Dunes - Merseyside.
Omalium rugulipenne	Rove beetle found under dead seaweed. Local in England; also known from Scotland but probably rarer in the north of its range. Torrs Warren/Luce Sands SSSI - Dumfries & Galloway.

Source: JNCC Invertebrate Site Register. Key: Red Data Book categories: RDB1 = endangered; RDB2 = vulnerable; RDB3 = rare; RDB K = insufficiently known; pRDB = proposed species as categorised in e.g. Hyman & Parsons (1992). *= old records (before approx. 1970). For further description of RDB categories, see Shirt (1987) and Bratton (1991).

opportunities for further invertebrate species, although there are also areas of saltmarsh that are important for their faunas in their own right.

Table 5.3.2 lists sites that are considered to be particularly important for invertebrate conservation, mainly on the basis of data from the ISR. Site selection was based on the range and/or scarcity of species present, the species habitat associations and the amount of the available habitat.

Langness, a narrow peninsula on the Isle of Man, is the only site in the British Isles for the lesser-mottled grasshopper *Stenobothrus stigmaticus*. Also at Langness, Boyce & Fowles (1989) recorded the weevil *Polydrosus pulchellus*, form *insquamosus*; it has been recorded from Devon, Kent and Gloucestershire but was previously last seen in the 1930s. Several scarce or threatened molluscs have been found in the region, including the narrow-mouthed whorl snail *Vertigo angustior*, now known from only about seven sites in the country, including one each in Lancashire and Dumfries & Galloway. The tiger beetle *Cicindela hybrida* is now found only on sites on the coast of Merseyside and Cumbria, and recent records of the dung beetle *Aegialia rufa* have been from Merseyside and Mid Glamorgan only. Scarcer water beetles are well represented in the region: species found include *Acilius canaliculatus* and

Table 5.3.2 Sites important for invertebrate conservation

Site	*Grid ref.*	*Status*
Clwyd		
Rhyd-y-foel	SH9175	SSSI
Gronant Dunes (includes Talacre Warren and Point of Ayr)	SJ1084	SSSI
Merseyside		
Hilbre Island	SJ1987	SSSI, LNR
North Wirral Foreshore	SJ2592	SSSI
Stockton's Wood	SJ4182	NT
Altcar Sand Dunes	SD2804	SSSI, NNR
Formby Sand Dunes	SD2707	SSSI, NT (in part)
Ainsdale Sand Dunes	SD2810	SSSI, NNR, LNR
Southport Sand Dunes	SD3015	SSSI, LNR
Lancashire		
Lytham St. Anne's	SD3130	SSSI, LNR
Winmarleigh Moss	SD4447	SSSI
Warton Crag	SD4973	SSSI, LNR (in part), CWT, NT
Leighton Moss	SD4874	SSSI, RSPB reserve, Ramsar site and SPA
Thrang End	SD4976	SSSI
Hawes Water	SD4776	SSSI
Eaves Wood	SD4676	SSSI, NT
Gait Barrows	SD4877	SSSI, NNR
Lancashire/Cumbria		
Morecambe Bay	SD4666	SSSI, RSPB reserve, NT (in part)
Cumbria		
Middlebarrow Plain	SD4576	
Heathwaite/Arnside Park	SD4476	
Arnside Knott	SD4577	SSSI, NT
Grubbins Wood	SD4477	Wildlife Trust reserve
Beetham Fell	SD4879	
Underlaid Wood	SD4879	
Sizergh Fell	SD4887	NT (in part)
Brigsteer Brow and Park Wood	SD4889	NT
Whitbarrow	SD4487	SSSI, LNR, Wildlife Trust reserve
Meathop Moss	SD4481	SSSI, Wildlife Trust reserve
Meathop Woods and Quarry	SD4379	SSSI
Latterbarrow	SD4382	Wildlife Trust reserve
Nicholls Moss	SD4382	SSSI
Low Wood, Haverthwaite	SD4383	
Yewbarrow	SD4384	
Humphrey Head	SD3973	SSSI
Wart Barrow	SD3976	SSSI
Roudsea Woods and Mosses (includes Ellerside Moss and Deer Dyke Moss)	SD3382	SSSI, NNR
Rusland Valley Mosses	SD3388	SSSI, NNR
South Walney	SD2265	SSSI, Wildlife Trust reserve
North Walney	SD1772	SSSI, Wildlife Trust reserve
Sandscale Haws	SD1974	SSSI, NT
Duddon Mosses (includes Little White Moss)	SD2285	SSSI
Drigg Coast (includes Eskmeals Dunes and Ravenglass Dunes)	SD0696	SSSI, LNR, Wildlife Trust reserve
Hallsenna Moor	NY0006	SSSI
Low Church Moss	NY0105	SSSI
St. Bees Head	NX9413	SSSI, RSPB reserve
Biglands Bog	NY2553	SSSI, Wildlife Trust reserve
Finglandrigg Wood	NY2756	SSSI, NNR
Glasson Moss	NY2360	SSSI, NNR
Scaleby Moss	NY4663	SSSI
Cumbria/Dumfries & Galloway		
Upper Solway Flats & Marshes (includes Rockcliffe Marsh)	NY1565	SSSI, NNR, NT (in part), Wildlife Trust reserve (in part), Ramsar site and SPA
Dumfries & Galloway		
Caerlaverock	NY0464	NNR, WWT, Biosphere reserve
River Nith	NX9777	
White Port	NX8452	
Rascarrel Bay and Balcary Hill	NX8148	
Carrick Ponds	NX5850	SSSI
Torrs Warren - Luce Sands	NX1354	SSSI

Table 5.3.2 Sites important for invertebrate conservation (continued)

Site	*Grid ref.*	*Status*
Isle of Man		
The Ayres (Point of Ayre to Sartfield)	NX4303	MNH (in part), Wildlife Trust reserve (in part)
Langness	SC2866	
Dogmills to the Phurt	NX4600	

Key: LNR - Local Nature Reserve, NNR - National Nature Reserve, NT - National Trust, MNH - Manx National Heritage, RSPB - Royal Society for the Protection of Birds, SPA - Special Protection Area, SSSI - Site of Special Scientific Interest, CWT - County Wildlife Trust, WWT - Wildfowl & Wetlands Trust reserve.

Hydrochus brevis. The belted beauty moth *Lycia zonaria britannica* reaches its southern limit in this part of the country, with recent records from Merseyside and Lancashire. Subspecies *gueneei* of the sandhill rustic moth *Luperina nickerlii*, a subspecies not found outside Great Britain, has recently occurred on only a very few sites along the coast from Anglesey to Clwyd. Sea cliffs in the Isle of Man support the subspecies *mananii* of the grey moth *Hadena caesia,* otherwise known only from just a few coastal sites in Ireland and western Scotland (except for a very few 19th century examples from Cumberland) (Heath & Emmet 1979). The vernal colletes *Colletes cunicularius*, a mining bee that is strictly coastal, has recently been recorded in Merseyside and Cumbria, and the money spider *Centromerus levitarsis* is known only from sites in Devon, Cheshire and Cumbria. On the Isle of Man, the dark bush cricket *Pholidoptera griseoaptera* and dotted bush cricket *Leptophyes punctatissima* are restricted to coastal cliffs.

Table 5.3.3 gives the nine species of invertebrate known from the region that are on international Directives, Conventions, the Wildlife & Countryside Act (1981) or the Manx Wildlife Act (1990).

Invertebrates can be found in the full range of coastal habitats, and many require particular microhabitats. Many species are restricted in their distribution because of their specialised habitat demands. The various stages of the dune succession provide a variety of microhabitats, all of which have distinctive elements to their faunas. A few species, such as the sand dart moth *Agrotis ripae*, can tolerate the harsh conditions found along the unstable fore dunes. On a very few sites, the lacewing *Chrysopa abbreviata* can be found around clumps of marram *Ammophila arenaria,* usually towards the seaward side of the dunes. The tiger beetle *Cicindela hybrida*, which has been recorded at both Ainsdale and along the Drigg coast, is associated with open sandy areas. Old dune blow-outs that are in the early stages of vegetation succession, areas of compacted sand and open clearings in pine plantations are all important nesting sites for aculeate bees and wasps. The vernal colletes *Colletes cunicularis* seems to have a preference for semi-fixed yellow dunes. Dune grassland can be important for a range of species, including many Coleoptera species. Dune slacks support a wide range of species, and those with creeping willow *Salix repens* can include the mirid bug *Monosynamma sabulicola* among their fauna. Several scarce species of Coleoptera associated with carrion and dung, e.g. *Hypocaccus rugiceps,* have also been recorded from these dunes. A rich matrix of rotting organic matter within the upper storm beach is capable of supporting a number of specialised detritivores.

A wide range of Coleoptera have been reported from the region's saltmarshes. Several of these, e.g. the ground beetle *Dyschirius nitidus,* are associated with areas of bare mud. The weevil *Mesites tardii* has been found on at least one saltmarsh in the region. This beetle has been recorded from dead wood on live trees, but it may disperse by utilising driftwood. Many water beetle species are known to be associated with saltmarsh habitats. *Haliplus apicalis*, a species typical of brackish waters, has recently been reported in pools on the grassy edge of one saltmarsh in Cumbria. The moth *Pediasia aridella* has been found on a few sites; this moth is typical of the dry margins of saltings.

The cliff-associated fauna of this region does not appear to be particularly well documented. However, several scarcer species of weevil are known to occur, including *Trichosirocaulus dawsoni,* which occurs in more open conditions. Other species are more typical of short calcareous grassland. Cliff paths can provide suitable situations for invertebrates that rely on areas of bare ground. The soft rock glacial exposures on the north-east coast of the Isle of Man have a considerable invertebrate interest, with the ground beetle fauna being of particular note, as it includes *Bembidion saxatile, B. pallidipenne* and *Aepus marinus;* the notable weevils *Grypus equiseti* and

Table 5.3.3 Protected invertebrate species in the region

Species	*Protected status*	*Locations*
Apus (tadpole shrimp) *Triops cancriformis*	3*	Dumfries & Galloway (last recorded in 1949)
Narrow-mouthed whorl snail *Vertigo angustior*	1	Lancashire, Dumfries & Galloway
High brown fritillary butterfly *Argynnis adippe vulgoadippe*	3**	Lancashire, Cumbria
Marsh fritillary butterfly *Euphydryas aurinia*	1, 2	Cumbria, (?) Dumfries & Galloway
Dotted bush cricket *Leptophyes punctatissima*	4	Isle of Man only
Dark bush cricket *Pholidoptera griseoaptera*	4	Isle of Man only
Lesser mottled grasshopper *Stenobothrus stigmaticus*	4	Isle of Man only
Grey moth *Hadena caesia mananii*	4	Isle of Man only
Pod-lover moth *Hadena perplexa capsophila*	4	Isle of Man only

Key: Protected status codes: 1 = Annex II, EC Habitats Directive; 2 = Bern Convention; 3 = Schedule 5, Wildlife & Countryside Act 1981 (excluding Schedule 5 section 9(5): sale only); 4 = Schedule 5, Manx Wildlife Act 1990; *Variation of Schedules Order 1988; **Variation of Schedules 5 & 8 Order 1992.

Tropiphorus terricola also occur (Boyce & Fowles 1989). The talus zones at the foot of soft cliffs can be rich habitats for invertebrates, including woodlice, centipedes and ground beetles.

The coastal limestone habitats of the southern Lake District support a wide range of butterfly species, including the Duke of Burgundy fritillary *Hemearis lucina*. On a few sites, amongst grassland and scrub, the least minor moth *Photedes captiuncula* can also be found. Several species more typical of scrubby situations occur in this part of the region, for example the brown scallop moth *Philereme vetulata*. The woodlouse *Armadillidium pulchellum* has been found in screes and under mats of moss. Seepages and small streamlets add further diversity and can support several species, such as the cranefly *Orimargo virgo*.

The coastal mire and bog sites contain a range of habitats. The moss woodlands have a range of scarce species, including the saxon moth *Hyppa rectilinea,* which reaches its southern limit in Great Britain to the north of Morecambe Bay. Where there is a plentiful supply of dead and decaying timber a range of saproxylic species may be found, for example the false click beetle *Dirhagus pygmaeus,* which has been recorded at Roudsea Wood. More open areas can support the bordered grey moth *Selidosema brunnearia scandinavaria,* and the large heath butterfly *Coenonympha tullia davus* can occur in good numbers along the coastal plain south of the Lake District, where it frequents more waterlogged situations. A few mosses are known to have a rich water beetle fauna, with many scarce species associated with peaty pools.

Mine trials (unproductive mine shafts) and natural caves can support important invertebrate communities. Such sites on the Isle of Man are currently being investigated (Moseley 1994).

5.3.3 Human activities

Appropriate site management may be vital for maintaining invertebrate interest, since invertebrates occur in the full range of coastal habitats and many require particular microhabitats in a suitable condition, often using subtle features of vegetation structure or areas of bare ground. As invertebrates generally have annual life cycles, the habitat features they utilise must be present in the right condition in each and every year. Site management often overlooks many features that are of importance to invertebrates, many species surviving by default. Several of the important invertebrate sites in the region, for example Altcar Sand Dunes (Merseyside) and Roudsea Woods and Mosses (Cumbria), are protected as National Nature Reserves (NNRs) or by other designations (see Chapter 7) and so are managed at least partly for their nature conservation interest.

As for other nature conservation interests, the main threats to invertebrate communities in the region include inappropriate management of sites and direct habitat loss or degradation, such as by construction of stabilising sea defences, for example on soft rock cliffs, the drainage of coastal marshes, intense visitor pressure on sand dunes, and the clearing away of organic strandline debris. Grazing has the potential to both create and destroy or damage invertebrate habitat. Dung, a component of the rich matrix of rotting organic matter within upper storm beaches favoured by several specialist detritivores, can reduce the value to invertebrates of streams flowing across these beaches, as can slurry or sewage entering the water higher up the streams. Appropriate levels of grazing maintain the varied ground conditions and heights of sward that favour a variety of invertebrates. However, too heavy grazing reduces the value of, for example, maritime grassland for invertebrates, by increasing nutrient levels in the soil and altering soil structure, thus changing the plant species that occur, and by restricting the height of the vegetation. Along flushes, where ground water emerges along slopes, heavy poaching can be particularly damaging, as the trampling crushes the soft plants and cuts through the sward, leading to soil erosion and muddying of the water. Insufficient or no grazing allows vegetation to become rank and dense, reducing the range of species that it can support and favouring commoner species.

Grazing and leisure activities can encourage erosion of dunes and soft cliffs. Whilst a certain amount of site disturbance through erosion can be beneficial to invertebrates that prefer these unstable conditions, excessive erosion will exclude others. The management of coastal habitats for invertebrates is covered by Kirby (1992).

5.3.4 Information sources used

As with most regions in Great Britain, the level of invertebrate recording varies over this section of the coast as well as between the various invertebrate groups. A wide range of invertebrate groups have been studied to varying degrees, although it is probably the butterflies and moths that are the best known over this region's coast. On some sites certain groups have been well documented, and a few sites are particularly well known for a range of scarcer species.

Many of the data referred to here come from the ISR, a computerised GB-wide database that, although not comprehensive, includes information from many sources, specialists and surveys, as well as from the literature (such as entomological journals, the Annual Report and Proceedings of the Lancashire and Cheshire Entomological Society etc.) and local biological records centres. It is the most complete data set available on scarcer species occurring in the region. However, the ISR last trawled records for counties of north-west England over five years ago. Additional information was gleaned from a range of other reports and reviews (see section 5.3.6 A and B). Information for the Isle of Man was obtained from references cited and the Manx Nature Conservation Trust.

The Nature Conservancy Council's England Field Unit undertook a survey of some Cumbrian mosses, including two in this coastal region (Drake, Godfrey & Sanderson 1989). A survey of the butterflies of the Carboniferous limestone hills of the Morecambe Bay area was undertaken between 1983 and 1985 on behalf of the Nature Conservancy Council, and the National Trust's Biological Survey Team has recently recorded invertebrates on many of its properties within parts of this region. The Butterfly Monitoring Scheme also has records from four transects (Pollard, Hall & Bibby 1986). National recording schemes for a range of invertebrate groups contain records from this part of the coast. Most of these schemes are co-ordinated by specialists, with assistance from the Biological Records Centre (Institute of Terrestrial Ecology). In addition to these larger schemes, many groups and individuals hold records of invertebrates for the region (see section 5.3.6 C).

5.3.5 Acknowledgements

Special thanks are due to John Lamb, Manx Nature Conservation Trust, for providing information on invertebrates on the Isle of Man. Thanks are also due to D. Procter (JNCC) and Dr S. Ball (JNCC) for providing the raw data from the ISR and for assistance in producing the maps and Table 5.3.1.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Occurrence of invertebrates in the region (except Isle of Man)	*Biological Records Centre, Institute of Terrestrial Ecology, Monks Wood, tel: 01487 773381
Occurrence of invertebrates in the Isle of Man	*Biological Records Centre (Isle of Man), Manx National Heritage, tel: 01624 675522
Conservation of butterflies and moths - Clwyd, Merseyside, west Cheshire and Lancashire	British Butterfly Conservation Society, Lancashrie Branch, 1 Burrow Heights, Farm Cottages, Scotforth, Lancaster LA2 0PG, tel: 01524 752247
Conservation of butterflies and moths - Dumfries & Galloway (plus central and southern Scotland)	British Butterfly Conservation Society, Glasgow, Art Gallery & Museum, Kelvingrove, Glasgow G3 8AG, tel: 0141 305 2660
Invertebrates in Region 13	Carlisle Museum, Tullie House, Castle Street, Carlisle, Cumbria CA3 8TP, tel: 01228 34781
Invertebrates in Region 13	Clwyd Entomological Society, 15 Beech Avenue, Gresford, Clwyd LL12 8EL
Invertebrates in England	*Dr R. S. Key, Dr C.M. Drake and Dr D.A. Sheppard, Invertebrate Zoologists, Lowlands Team, English Nature HQ, Peterborough, tel: 01733 340345
Invertebrates in Dumfries & Galloway	Scottish Natural Heritage, *Dumfries & Galloway Area Office, Dumfries, tel: 01387 247010

Type of information	*Contact address and telephone no.*
Invertebrates in Clwyd	*A.P. Fowles, Countryside Council for Wales HQ, Bangor, tel: 01248 370444
Invertebrate Site Register (ISR): a computerised national inventory of sites of significance to invertebrate conservation; contains records of local, scarce and threatened species of all groups of invertebrates.	*Invertebrate Site Register, JNCC Peterborough, tel: 01733 62626
Invertebrate interest of National Trust holdings	*The National Trust HQ, Cirencester, tel: 01285 65181
Invertebrates in Clwyd	North Wales Invertebrate Group (North Wales Biological Records Centre), School of Animal Biology, University College of North Wales, Bangor, Gwynedd LL57 2UW, tel: 01248 351151
Entomological data for Region 13	North West Biological Data Bank, Liverpool Museum, William Brown Street, Liverpool, Merseyside L3 8EN, tel: 0151 207 0001
Literature-based entomological records	Scottish Insect Records Index, c/o Dr M.R. Shaw, National Museums of Scotland, Chambers Street, Edinburgh EH1 1JF, tel: 0131 225 7534

*Starred contact addresses are given in full in the Appendix.

Subtidal rock is rare in the north-eastern Irish Sea. It supports dense communities of specialised plants and animals, especially around the Isle of Man, where it is swept by strong currents. There are many different species in the 15 cm by 10 cm area shown here, notably the flower-like anemone *Actinothoe sphyrodeta,* the 'pronged' sponge *Polymastia mamillaris* and, in the bottom left of the picture, the sea squirt *Morchellium argus.* Photo: Bill Sanderson, JNCC.

5.4 Rare sea-bed species

Dr W.G. Sanderson

5.4.1 Introduction

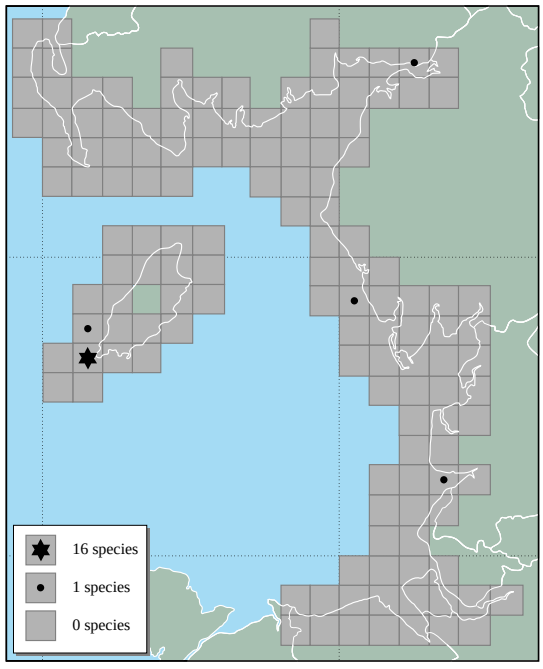
This section considers rare and scarce marine benthic (sea-bed) species, excluding fish. The occurrence and distribution of benthic communities are discussed in section 4.2. 'Nationally rare' marine benthic species in this section are those native organisms known to occur in eight or fewer of the 10 x 10 km squares (of the Ordnance Survey national grid) containing sea within the three-mile territorial limit for Great Britain and the Isle of Man. 'Nationally scarce' are those known to occur in 55 or fewer. This methodology and these criteria are analogous to those used for other groups of organisms in British Red Data Books (e.g. Bratton 1991) and by the International Union for Conservation of Nature and Natural Resources (IUCN) (see IUCN Species Survival Commission 1995). The development of the current criteria and the choice of study area for rarity assessment in the marine benthos of Great Britain are discussed in detail by Sanderson (in prep.). Species considered in this chapter are those conspicuous and readily identifiable in the field by the Marine Nature Conservation Review (MNCR) and similar techniques or for which taxonomic or biogeographic experts consider that sufficient data exist on a national basis to warrant their inclusion. Some species classed here as rare or scarce may also be present in deeper water beyond the study area. In addition, species at the limit of their global distribution (e.g. 'northern' or 'southern' species) may be rare only within Great Britain's territorial seas. A species described here as 'nationally rare' or 'nationally scarce' is therefore not necessarily endangered and, although without doubt of national interest, the conservation importance of these species may need to be carefully considered. The analysis in this section represents the first attempt to quantify the rarity of marine benthic species and to summarise the known occurrence of rare and scarce species. Compared with land-based ecosystems the sea bed is poorly known and therefore as either more data become available or populations change, the status of species listed in this chapter will require re-evaluation.

Six rare and fourteen scarce marine benthic species have been recorded from Region 13. They are reported from the Solway, west Cumbria, the Ribble Estuary and the Isle of Man. The south-west Isle of Man area appears to contain proportionally more of the rare and scarce marine benthic species than the other parts of the region. This observation should be regarded with caution, since survey effort in Region 13 has been uneven, although extensive in the south-west of the Isle of Man.

None of the species presented here is currently protected by statute. The known occurrence of some of the rare and scarce species in Region 13 is summarised in Map 5.4.1.

5.4.2 Important locations and species

Rare and scarce species in the region are shown in Table 5.4.1.



Map 5.4.1 Numbers of rare or scarce marine benthic species recorded in 10 km squares within the 3 mile limit. Distribution may reflect differences in recording effort.

Within this region certain species are nationally rare or scarce because they are Mediterranean - Atlantic species at the margins of their distributions in the British Isles. It has been argued that populations of many sessile (non-mobile) southern species have a poor capacity for recovery and recruit (² reproduce) slowly at the margins of their distribution and are therefore particularly vulnerable to even the most minor, infrequent damage. Communities of southern species have therefore been considered important as reference sites for monitoring the marine environment (Fowler & Laffoley 1993). This argument may also be applicable to northern species at the limit of their distribution in Great Britain. Other genetic, ecological and pragmatic arguments for the conservation of species that are rare because they are at the margins of wider distributions have been summarised elsewhere (see Hunter & Hutchinson 1994). None of the species from this region is known to be a common deep-water species, and so it is unlikely that any appears rare simply because its distribution only just includes the generally shallower near-shore sea area that is the focus of this analysis. Of course, some of the species listed will occur to some extent in the waters of Great Britain beyond the scope of this study.

Most of the nationally rare and scarce species discussed here are found in the Isle of Man. This may be to some extent a result of geographically localised survey effort, since Liverpool University's Port Erin Marine Laboratory is based in the south-west Isle of Man (see Bruce, Coleman & Jones 1963). On the other hand, an assessment of comparable species-rich survey sites has shown the Calf of Man (south-west Isle of Man) to be particularly rich (Morrow, Picton & Bishop 1993). Many small off-shore

Table 5.4.1 Nationally Rare (*) and Scarce marine benthic species found in Region 13

Code	*Species*	*Type of organism*	*Area(s) of occurrence*	*Habitat/ associations*	*Comments*	*Useful reference*
C0150	*Stelletta grubii*	Sponge	SW Isle of Man	On sublittoral rock in localities sheltered from strong waves; often on vertical or overhanging bedrock. Often covered in varied epifauna.	Often obscured by associated epifauna. May well be under-recorded (B.E. Picton pers. comm.).	Ackers, Moss & Picton (1992)
C0156	*Stryphnus ponderosus*(*)	Sponge	S & SW Isle of Man	On sublittoral rock, shells, mud and sand. Often has other sponges attached.	From the Arctic to the Mediterranean. May be rare or under-recorded.	Ackers, Moss & Picton (1992)
C0445	*Tethyspira spinosa*	Sponge	SW Isle of Man (Calf)	On sublittoral rock in wave-exposed localities; often on vertical or overhanging bedrock	Southern species; distribution includes Mediterranean	Ackers, Moss & Picton (1992)
C0767	*Stylostichon dives*	Sponge	SW Isle of Man	On sublittoral rock; often on vertical or overhanging bedrock; can occur with the sponge *Axinella dissimilis*	May be under-recorded. Southern species (?); possibly restricted to south-west British Isles.	Ackers, Moss & Picton (1992)
C0842	*Plocamilla coriacea*	Sponge	SW Isle of Man	Often on vertical or overhanging subtidal bedrock in areas of flowing water. Often has other sponges attached.	Southern species; distribution includes Mediterranean	Ackers, Moss & Picton (1992)
D0729	*Obelia bidentata* (*)	Hydroid	Inner Solway	On a wide variety of substrata	Temperate to warm water global. Hydroids are often overlooked.	Hayward & Ryland (1990)
D1030	*Parerythropodium coralloides*	Soft coral	S & SW Isle of Man (Calf)	On subtidal rock; localities sheltered from strong waves; often on vertical or overhanging surfaces	Southern species. Cryptic, so may be somewhat overlooked as well as scarce.	Manuel (1988)
D1121	*Isozoanthus sulcatus*	Chocolate anemone	SW Isle of Man (Calf)	On sublittoral rock; also on shells	Distribution includes Mediterranean. May be locally common.	Manuel (1988)
D1303	*Halcampoides elongatus*	Burrowing anemone	SW Isle of Man	In subtidal sediments	Nocturnal in hard-to-sample locations	
D1314	*Mesacmaea mitchellii*	Burrowing anemone	SW Isle of Man	Low shore and subtidal sediments; partly protruding	Southern species. Can be locally frequent in south-west England.	Manuel (1988)
D1344	*Edwardsia timida*	Burrowing anemone	SW Isle of Man (Calf)	Low shore and subtidal sediments; partly protruding	Populations are localised	
O0015	*Amalosoma eddystonense*	Echiuran worm	nr Sellafield	Buried quite deep in sediments	Difficult to sample, but still probably scarce	

Table 5.4.1 Nationally Rare (*) and Scarce marine benthic species found in Region 13 (continued)

Code	*Species*	*Type of organism*	*Area(s) of occurrence*	*Habitat/ associations*	*Comments*	*Useful reference*
P1689	*Ophelia bicornis* (*)	Worm	Outer Ribble Estuary	Usually entirely buried in loose, mobile sand in the lower shore	Atlantic European species with very specific habitat requirements. A Northern out-post for this species - may require confirmation.	Hayward & Ryland (1990)
W0567	*Jordaniella truncatula* (*)	Sea snail	SW Isle of Man	Little known; associations unknown	A very rarely recorded and little known species	Graham (1988)
W1314	*Trapania pallida*	Sea slug	SW Isle of Man	Found amongst bryozoans, hydroids and sponges in the rocky subtidal. 10 - 20 m.	Also found in Atlantic France and Spain	Picton & Morrow (1994)
W1557	*Aeolidiella sanguinea* (*)	Sea slug	SW Isle of Man (Calf)	Intertidal on stony ground; feeds on the anthozoan *Sagartia elegans*; often found associated with it.	Southern species; better known from western Ireland and France	Picton & Morrow (1994)
Y0715	*Hincksina flustroides* (*)	Bryozoan (sea mat)	SW Isle of Man (Calf)	Subtidal, often on shell	Southern species. Bryozoans are often over-looked.	Hayward & Ryland (1990)
ZD0258	*Molgula oculata*	Sea squirt	SW Isle of Man (Calf)	Low shore and sublittoral sediments, usually partly protruding	May be found a little more widely than currently known	Hayward & Ryland (1990)
ZM0322	*Callophyllis cristata*	Seaweed	SW Isle of Man (Calf)	Moderately wave-exposed localities; often associated with the haptera ('roots') of kelp	Circumpolar species at southernmost limit in British Isles	Irvine (1983)
ZM0701	*Cruoria cruoriaeformis*	Seaweed	SW of Niabyl (Isle of Man)	Virtually confined to maerl	Southerly species in the British Isles	Maggs & Guiry (1989)

Notes: The species codes, often used in marine conservation and survey work, are after Howson (1987). None of these species has a specific common name: therefore the nearest available group name is given. Calf = Calf of Man: a small offshore islet in the Isle of Man.

islands are often habitat rich when compared to the open coast because, within a small area, they contain both areas exposed to and those sheltered from wave action and currents (Fowler 1990). This may therefore be expected to increase the number of habitat types in the area (and thus the number of species) and correspondingly increase the likelihood that rarities will also be found in such localities. Additionally it is worth noting that laboratories such as Port Erin Marine Laboratory were originally sited near good collecting grounds, in this case, away from the turbid estuarine coast that forms much of the rest of the region. The Isle of Man may, therefore, be the only source of habitat in Region 13 for many species.

5.4.3 Information sources used

The sites of littoral (shore) and sublittoral benthic survey data used for this report have been mapped in section 4.2. A great deal of data are derived from the research activities of Port Erin Marine Laboratory as well as various commercial impact assessment studies. Some of the recent data originate from MNCR survey work and earlier NCC-funded surveys, many of them available as JNCC reports. Additional records have been gathered following personal communications with experts in many taxonomic fields. It has not been possible in this chapter to list all the available literature on which this analysis has been based, but the information reviews and recent papers listed in 5.4.5 and 4.2.5 should allow access to the majority of the available information.

The availability of suitable information in Region 13 is scattered but shows concentrations. Concentrations of data occur in, for example, Liverpool Bay, Morecambe Bay and south of the Isle of Man. Other areas, for example parts of north Wales and the north of the Isle of Man, are lacking comprehensive survey information.

Some areas within Region 13 have a long history of study, e.g. the Isle of Man, where records go back to the last century. Whereas every effort has been made to obtain biogeographic data for rarity assessment in the present study, data have not been used from reports more than thirty years old. There are, however, old records for various rarities around the Isle of Man. These include the sponge

Desmacidon fruticosum, the hydroids *Thecocarpus myriophyllum* and *Laomedea angulata*, several rarely recorded amphipods: *Euonyx chelatus*, *Pectenogammarus planicrurus*, *Stenothoe crassicornis*, *Parvipalpus capillaceus*, *Nannonyx spinimanus*, *Harpinia laevis*, *Eriopisa elongata*, the gastropod *Pherusina gulsonae*, the sea slugs *Hero formosa* and *Janolus hyalinus*, the bryozoans *Alcyonidium mamillatum* and *Schizomavella cristata* and the starfish *Stichastrella rosea* (see Bruce, Coleman & Jones 1963). It would be valuable to re-confirm some of these records.

MNCR survey work uses a consistent methodology to record conspicuous species (Hiscock 1990). Not all the data available from other surveys in this region are as broad in scope and sometimes they have not included less common species or those less familiar to a specialist worker. Inconsistent recording has not, however, seriously reduced the quality of available information for rarity assessment in Region 13. The MNCR of Great Britain is at present incomplete, but in future it will substantially increase the quality and evenness of distribution of the available data from around Great Britain. This, combined with other surveys, will almost certainly expand our knowledge of species that are 'rare' and 'scarce' in the region. Consequently, the nationally rare and scarce status of the organisms presented here may require re-evaluation and in future species may be added to the list for this region. Species with short life histories may require more regular re-evaluation of their occurrence than others.

5.4.4 Acknowledgements

The author is grateful for the assistance of the JNCC Marine Conservation and Coastal Conservation Branches as well as the expert advice of Dr J.M. Baxter, Dr J. Brodie, P.F. Clark, D.W. Connor, Dr M.J. Costello, Dr R.L. Fletcher, Dr J.D. Fish, Dr P. Garwood, Dr J.M. Hall-Spencer, Dr T. Harris, Dr P.J. Hayward, Dr K. Hiscock, J. Light, I. Killeen, Dr G. Könnecker, Dr C.A. Maggs, Dr D. McKenzie, Prof. P.G. Moore, D. Moss, Prof. T.A. Norton, Dr J.D. Nunn, B.E. Picton, D. Seaward, Dr E.C. Southward and Dr R.B. Williams. The general assistance of Dr T.O. Hill has also been of great value, as has the regional expertise of R. Covey, Prof. S.J. Hawkins, Dr T. J. Holt and E.I.S. Rees. Access to the Marine Nature Conservation Review Database, the NIBESRC Database at the Ulster Museum and the ERICA database run by the Cornish Biological Records Unit has been invaluable for the overall national analysis.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Amphipod shrimps	Prof. P.G. Moore, University Marine Biological Station, Millport, Isle of Cumbrae KA28 0EG, tel: 01475 530581
Molluscs	Mrs J. Light, 88 Peperharow Road, Godalming, Surrey GU7 2PN, tel: 01483 417782
Bryozoans (sea mats)	Dr P.J. Hayward, School of Biological Sciences, University College Swansea, Singleton Park, Swansea, West Glamorgan SA2 8PP, tel: 01792 205678
Sea squirts	*D. Connor, Marine Conservation Branch, JNCC, Peterborough, tel: 01733 62626
Sponges, hydroids, sea slugs	B.E. Picton, BioMar, Environmental Science Unit, University of Dublin, Trinity College, Dublin 2, Republic of Ireland, tel: 00353 16772941
Red algae	Dr C. Maggs, School of Biology & Biochemistry, Queen's University of Belfast, Belfast BT7 1NN, tel: 01232 245133
Port Erin Marine Laboratory records	*Prof. T.A. Norton, University of Liverpool, School of Life Sciences, Port Erin Marine Laboratory, Isle of Man, tel: 01624 832027
Irish Sea benthos	E.I.S. Rees, School of Ocean Sciences, University of Wales, Marine Science Laboratory, Menai Bridge, Anglesey, Gwynedd LL59 5EY, tel: 01248 351151

*Starred contact addresses are given in full in the Appendix.

5.5 Exploited sea-bed species

Dr M.G. Pawson & C.F. Robson

5.5.1 Introduction

This section describes the distribution of large populations of species that live on, near, or in the bottom sediments of the sea bed (collectively called 'the benthos') and that are routinely exploited, mainly for human food. The exploitation itself is described in sections 9.1 and 9.2. Many of these species also provide an essential food source for other species, such as fish and birds, for example migrant and wintering waders and wildfowl. Most of the species discussed have planktonic larvae; the dispersal of planktonic larvae and the interrelation between populations of the same species can only be inferred from studies on movements of water masses. Their distributions are determined by factors such as water temperature (see section 2.3) and available habitat/substrate type (see also section 4.3). The species described may also be found elsewhere in the region, but in smaller numbers.

All species apart from *Nephrops* are referred to by their common names in the text. The scientific names of the species are given in Table 5.5.1.

Scallops and queen scallops are widely distributed in offshore gravelly areas between Galloway and north-west Wales, particularly around the Isle of Man, and *Nephrops* occur in the muddy-bottomed deeper zones to the east and west of the Isle of Man. The shallow, sandy estuaries periodically contain large populations of cockles, mussels and brown shrimps, while edible crabs and lobsters are harvested on a small scale from the more exposed parts of the coastline. Lobsters and edible crabs are relatively scarce in this region and are more important in other parts of Britain. Compared with other areas there are only small quantities of native oysters and whelks. There are no large, exploitable populations of spider crabs, deep-water prawns or pink prawns in the region.

Table 5.5.1 Species names

Common name	*Scientific name*
Lobster	*Homarus gammarus*
Edible or brown crab	*Cancer pagurus*
Velvet crab	*Liocarcinus puber*
Dublin Bay prawn, scampi, Norway lobster or langoustine	*Nephrops norvegicus*
Brown shrimp	*Crangon crangon*
Spider crab	*Maja squinado*
Crawfish, spiny lobster	*Palinurus elephas*
Deep-water prawn (or shrimp - referred to as both)	*Pandalus borealis*
Pink prawn (or shrimp - referred to as both)	*Pandalus montagui*
Cockle	*Cerastoderma edule*
Mussel	*Mytilus edulis*
Native oyster	*Ostrea edulis*
Pacific oyster (non-native)	*Crassostrea gigas*
Periwinkle	*Littorina littorea*
Scallop	*Pecten maximus*
Queen scallop	*Aequipecten opercularis*
Whelk	*Buccinum undatum*
Lugworm	*Arenicola marina*
Ragworm	*Neanthes* spp.

5.5.2 Important locations and species

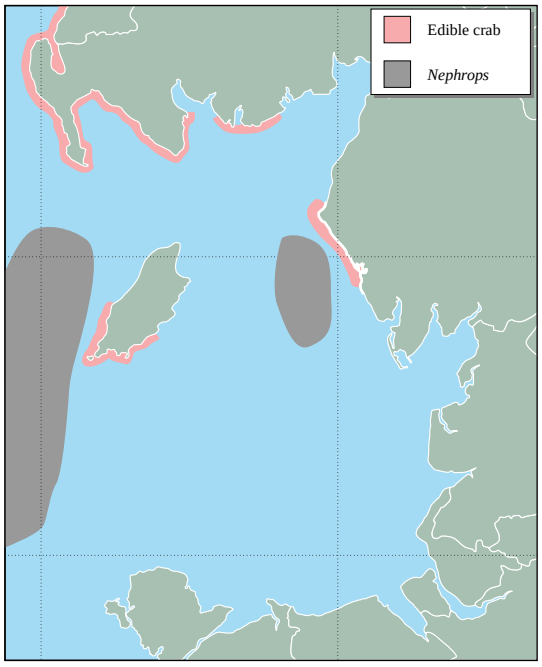
Crustacea

The broadscale distributions of lobster, velvet crab and brown shrimp in the region are shown on Map 5.5.1 and of edible crab and *Nephrops* on Map 5.5.2. Lobster, edible crab and velvet crab are occasionally found inshore along exposed or rocky shorelines throughout the region, particularly along the Cumbrian coast, parts of the Dumfries & Galloway coast and around the southern end of the Isle of Man. Edible crabs are often found on softer sediments - ranging from sand/gravel to rock - than lobsters. Juveniles tend to be found inshore and adults further offshore (Rees & Dare 1993).

The distribution of *Nephrops* is determined by its preference for a sea bed of muddy sand, into which it burrows; in this region there are two relatively discrete populations, one between Cumbria and the Isle of Man and the other between the Isle of Man and the Northern Irish coast. Approximately 5-10 miles west of the Isle of Man, the gravel and shell grounds (which are common around the south of the island) grade into fine sand and then into a deep area of sticky mud with commercial stocks of *Nephrops*.

Brown shrimp are abundant in sandy estuaries, particularly the Ribble Estuary, Morecambe Bay and the Solway Firth, but are also present in the Dee Estuary. Crawfish, which are occasionally found off Port St. Mary ledges, Isle of Man, are more commonly found in south-west England.

Map 5.5.1 Distribution of exploited lobster, velvet crab and brown shrimp. Copyright of MAFF, SOAEFD and Port Erin Marine Laboratory.



Map 5.5.2 Distribution of exploited edible crab and *Nephrops*. Copyright of MAFF, SOAEFD and Port Erin Marine Laboratory.

Molluscs - inshore and estuarine

The main locations where exploitable populations of cockles, mussels and native oyster are found in the region are shown on Map 5.5.3. Cockles are found in the intertidal zone of many sandy estuaries and other sheltered sites in this region. The main locations of significance are the Dee and Ribble Estuaries, Morecambe Bay and large areas of the Solway Firth and Dumfries & Galloway estuaries, all of which probably contain self-sustaining populations.

Map 5.5.3 Main inshore and estuarine locations of exploited native oysters, cockles and mussels. Copyright of MAFF, SOAEFD and Port Erin Marine Laboratory.

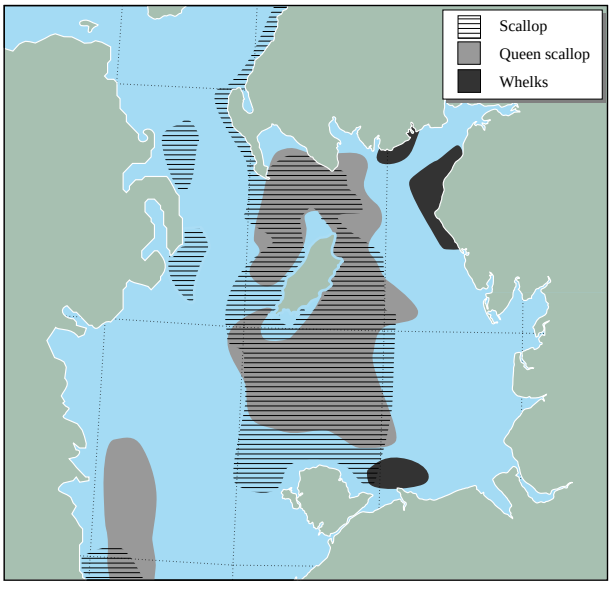
Mussels are found in many coastal sites in the region, from the mid shore to the subtidal zone in water of normal or variable salinity, and in areas exposed to water currents. They attach themselves using 'byssus threads' to sand, gravel or pebble substrata or other mussels and empty shells, and have the effect of binding the substratum. The most important area in the region for mussels is Morecambe Bay. Despite the abundance of apparently suitable habitats, mussels are relatively rare around the Isle of Man, except at Peel Estuary, the north end of Peel Bay, White Strand, Ramsey Estuary and Ramsey Pier. Periwinkles live throughout the region on algae growing on rocky shorelines. On the Isle of Man periwinkles are much more common on the west coast and much rarer on the south-east coast. The restricted distribution of both mussels and periwinkles is thought to be mainly related to a lack of larval supply, which also affects barnacle densities (Hartnoll & Hawkins 1982). Whilst the native or flat oyster can develop on the lower shore of the intertidal zone on a wide range of substrata from mud to bedrock, it is now considered to be quite rare in the region and there is only one exploitable population in the region, at Loch Ryan.

Molluscs - offshore

Scallops and queen scallops live on sandy/gravelly areas of sea bed. Important populations are found along the coast of Scotland to the Mull of Galloway and throughout the central Irish Sea, particularly around the Isle of Man. The principal Irish Sea scallop and queen scallop grounds are around the Isle of Man. Whelks are probably widely dispersed throughout the region and are concentrated to the east of Anglesey and in the Solway Firth. The broadscale distributions of scallops, queen scallops and whelks in the northern Irish Sea are shown on Map 5.5.4.

Polychaetes

The intertidal and subtidal zones in the region's estuaries support populations of polychaetes, such as lugworm and



Map 5.5.4 Main offshore locations of exploited scallops, queen scallops and whelks. Copyright of MAFF, SOAEFD and Port Erin Marine Laboratory.

ragworm. Lugworms are common in less exposed areas where there is a higher organic content in the substratum. They occur elsewhere in a wide range of sediment types from almost pure mud to clean sand (Davidson *et al.* 1991).

5.5.3 Human activities

The exploitation by fisheries of the species covered in this section is described in detail in section 9.1, and by mariculture in section 9.2. In this region the exploitation of mussels is regulated through the Morecambe Bay Regulating Order (see sections 9.1.2 and 9.1.4).

The exploitation of *Nephrops* is regulated in ICES Area VIIa (Irish Sea) by the application of a catch quota management measure, with a precautionary Total Allowable Catch of 20,000 tonnes (in 1995), 6,560 tonnes of which is allocated to the UK (European Council Regulation No. 3362/94). There are also minimum landing size restrictions placed on the exploitation of many crustacean and molluscan species in the region. The minimum landing size of *Nephrops* in ICES area VIIa is 20 mm carapace length and 70 mm overall length.

Coastal areas in the region where the brown shrimp fishery takes place are also important nursery areas for juvenile fish (see section 5.7.3). There is a large by-catch of these juveniles, owing to the small mesh size of the nets used for shrimp, and concern about any possible effect this may have on fish populations is being researched by the University of Humberside (Wray 1995).

Native oyster beds are now quite rare and their decline around Britain has been attributed to various factors, including overfishing, the failure of 'spatfall' (spat are newly settled metamorphosed juveniles), disease (*Bonamia ostreae*) and cold winters (Spencer 1990). The Pacific oyster is a non-native species introduced to encourage the mariculture of oysters (see section 9.2) and does not live naturally in the region. However, small spatfalls of Pacific oyster were recorded in Morecambe Bay, probably owing to the warm summers of 1989 and 1990 (Spencer *et al.* 1994). It is now farmed in preference to the native oyster, owing to its faster growth rate to a marketable size and its resistance to the pest *Bonamia ostreae* (Spencer 1990).

There are no Regulating Orders in Isle of Man waters for the queens fishery, although it is generally accepted that processors do not accept catches with a high proportion of queen scallops of less than 55 mm shell height. Regulating Orders have existed on the scallop fishery in Isle of Man waters almost since its beginning. In 1943 the Isle of Man Government introduced a minimum landing size (110 mm) and a closed season, from 1 June to 1 October inclusive. These were extended to cover the whole of ICES area VIIa (Irish Sea) by UK Government legislation in 1984 and 1986. In addition, a heavily dredged area of 1 km^2 off Port Erin was closed to trawling and dredging by the Isle of Man Government in March 1989, to allow research to be carried out on the potential benefits of rotational closed area management and restocking with cultivated juveniles (Brand *et al.* 1991a). This area remains closed as part of continuing research on the Manx scallop and queens fisheries, commenced by Port Erin Marine Laboratory in 1981. The study was commissioned in response to concern within the industry that stocks were in danger of collapsing and required additional management control. Logbooks are issued to fishermen to monitor catch-effort statistics, and a programme of biological sampling of the major fishing grounds and a large tagging experiment are carried out to obtain age-structures and growth rates (Brand *et al.* 1991a & b). There is also ongoing research to establish the proportion of scallops and queens fished within the 12 mile limit by the Manx fleet (Kate Prudden, pers. comm.).

Growing concerns have been expressed whether the cockle stocks can support recent levels of commercial exploitation without nature conservation interests being affected. The Sea Fisheries (Wildlife) Conservation Act (1992) requires the Sea Fisheries Committees to have due regard for the wider environmental interests when managing fisheries, and the two Committees in the region (the Cumbria and the North West and North Wales Sea Fisheries Committees) undertake annual assessment surveys of the more important stocks. They have the powers to close the fishery on any stock that is depleted, in addition to closing the fisheries during the spawning season. Since 1992 there has been poor recruitment of juvenile cockles throughout the North West and North Wales Sea Fisheries Committee district, and the Committee has not renewed any authorisations for tractor dredging (see section 9.1.3), in an attempt to safeguard the stocks. This situation is unlikely to change until there is a significant increase in the abundance of the stocks. All cockle beds in the Cumbria Sea Fisheries Committee district, including those in the Solway Firth, were closed to fishing in the 1995 season. Other management measures include a minimum landing size.

In Scotland, concern about the low levels of cockle stocks, particularly in the Solway Firth during the 1990s, led to the prohibition of suction dredging. An amendment to the Inshore Fishing (Scotland) Act 1984 allowed prohibition orders to be made that closed the tractor dredging fishery of cockles, by changing the word 'vessels', which excluded tractor-towed dredges, to 'vehicle or any specific description of equipment', which includes them. The order covering the Solway Firth came into effect on 1 November 1994 and lasted initially until the end of July 1995. Many operators switched their efforts to intensive hand-gathering, but this method was deliberately not tackled in the 1994 Act, to avoid making the Act too restrictive. The possible effects of the harvesting of species of shellfish on the benthos, feeding birds and stocks are discussed in some of the references in section 5.5.6B.

Bait collection, especially the digging of polychaetes, can have major localised effects on intertidal habitats and communities and can also cause disturbance to birds when they are concentrated in estuaries and embayments (see sections 5.11.3 and 5.12.3 and references in section 5.5.6B). Bait collection in the region is described in section 9.1.2.

5.5.4 Information sources used

The four maps in this section show schematically the known broad-scale distributions of the main species of interest, based on current knowledge from MAFF Directorate of Fisheries Reasearch, Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD), Port Erin Marine Laboratory (PEML) and Sea Fisheries Committees (SFCs) fishery officers on the locations of the species and their fisheries. There is supporting information

in the form of catch statistics for commercial landings and biological samples of crustacea, collected at the main ports and some secondary ports, plus intertidal surveys for molluscs in selected areas. These data provide some information about the location of spawning and nursery areas, but to establish the links between individual areas for spawning, nursery and adults would require specific research vessel investigations on the planktonic stages, the hydrography and the movement (or otherwise) of juveniles and adults. Barring substantial climate change or over-exploitation, these distributions and relationships are likely to remain stable over several decades. The seaward boundaries on the maps are only indicative, and because only large, exploitable populations are described, the species may also be found elsewhere in the region, but in smaller numbers.

Maps were provided by the Shellfish Resource Group, MAFF Directorate of Fisheries Research, SOAEFD, PEML, and the SFCs. Information was also used from Lee & Ramster (1981). Pawson (1995) presents information including distribution maps of selected species (scallops, cuttlefish, lobster, edible crab and spider crab) around the British Isles and has a species-specific bibliography.

European Council Regulation No. 3362/94 fixes, for 1995, details of the catch quotas for fish species for all European countries, i.e. the Total Allowable Catches (TACs), and certain conditions under which the species may be fished. European Council Regulations are published (where this is obligatory) in Luxembourg in the Official Journal of the European Communities. EC Regulation No. 3362/94 is updated annually (European Council 1994).

5.5.5 Acknowledgements

Thanks go to the following for their advice and for commenting on drafts: R.C.A. Bannister (Shellfish Resource Group, MAFF Directorate of Fisheries Research, Lowestoft), Blaise Bullimore (CCW), Bill Cook (North Western & North Wales Sea Fisheries Committee), D.T. Dobson (Cumbria Sea Fisheries Committee), David McKay and Derek Murison (Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD) Marine Laboratory), Dr Debbie Jones, Dr Terry Holt and Dr Andy Brand (Port Erin Marine Laboratory), Miran Aprahamian (NRA North West Region), Paul Knapman (English Nature) and D. Donnan (SNH).

5.5.6 Further sources of information

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Fish stocks and fisheries advice to assist with management and policy decisions for the coastal zone	*Head of Laboratory, MAFF Directorate of Fisheries Research, Fisheries Laboratory, (Conwy), tel: 01492 593883
Assessment and provision of advice on the conservation of commercial fish and shellfish stocks	*Director, MAFF Directorate of Fisheries Research, Fisheries Laboratory (Lowestoft), tel: 01502 562244
Marine and estuarine research on exploitable species in Scottish waters	SOAEFD Fisheries Research Services, Marine Laboratory, PO Box 101, Victoria Road, Aberdeen, AB9 8DB, tel: 01244 876544
All information on fisheries of the Isle of Man, including statistics	*Fisheries Officer, Department of Agriculture, Fisheries & Forestry, Isle of Man, tel: 01624 685857
Manx scallops and queen scallops	*Dr Andy Brand, Port Erin Marine Laboratory, Isle of Man, tel: 01624 832027
Benthic surveys; Marine Conservation Branch Database	*Marine Conservation Branch, JNCC, Peterborough, tel: 01733 62626
Marine conservation issues and fisheries - Scotland	*Aquatic Environments Branch, SNH HQ, Edinburgh, tel: 0131 446 2400
Marine conservation issues and fisheries - England	*Marine Fisheries Officer, EN HQ, Peterborough, tel: 01733 340345
Marine conservation issues and fisheries - Wales	*Marine and Coastal Section, CCW HQ, Bangor, tel: 01248 370444
Marine conservation issues and fisheries - Isle of Man	*Conservation Officer, Calf Marine Trust, Manx Nature Conservation Trust, Isle of Man, tel: 01624 801985
Marine Fisheries Task Group papers and advice on marine conservation issues	*Marine Advisory Officer, Marine Fisheries Task Group, c/o JNCC, Peterborough, tel: 01733 62626
Marine conservation issues	*Conservation Officer, RSPB, Sandy, tel: 01767 680551
Marine conservation issues	*Fisheries Officer, Marine section, WWF-UK, Godalming, tel: 01483 426444
Marine conservation issues	*Conservation Officer, Marine Conservation Society, Ross-on-Wye, tel: 01989 566017
Irish Sea Study Group publications	*Chairman, Irish Sea Forum, Liverpool, tel: 0151 794 4089
Marine conservation issues	*Administrator, Marine Forum for Environmental Issues, London, tel: 0171 938 9114
Research, specifically into brown shrimp fishery methods	University of Humberside, School of Applied Science and Technology, Humber Lodge, 61 Bargate, Grimsby, South Humberside DN34 5AA, tel: 01482 440440

*Starred contact addresses are given in full in the Appendix.

5.6 Amphibians and reptiles

Dr M.J.S. Swan

5.6.1 Introduction

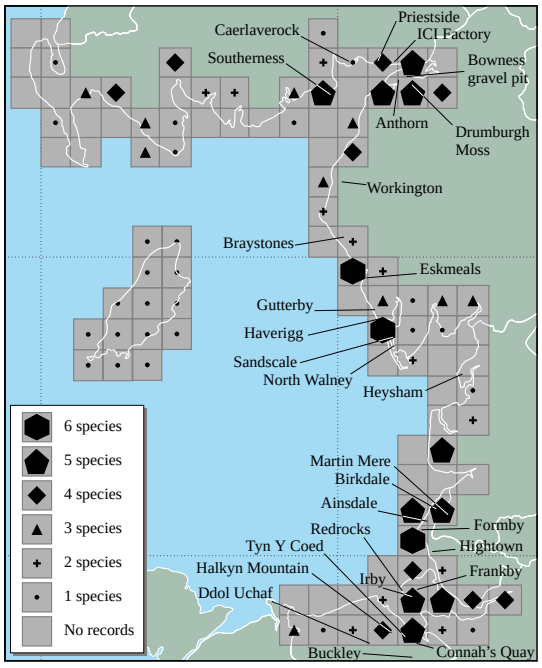
This region is one of the most important areas of Britain for herpetofaunal conservation, both in terms of the diversity and extent of suitable habitat it contains and in terms of its species complement. Not only does it support all nine of the widespread species of amphibian and terrestrial reptile (common frog *Rana temporaria*, common toad *Bufo bufo*, smooth newt *Triturus vulgaris*, palmate newt *T. helveticus*, great crested newt *T. cristatus*, slow-worm *Anguis fragilis*, common lizard *Lacerta vivipara*, grass snake *Natrix natrix* and adder *Vipera berus*), but also the rare and restricted natterjack toad *Bufo calamita* and sand lizard *Lacerta agilis*. One species of marine turtle, the leatherback *Dermochelys coriacea*, has also been recorded in this region.

Reptile and amphibian species are poorly represented on the Isle of Man, owing to the early breach by post-glacial sea-level rise of land bridges between the island and the other British Isles: only the common lizard and the common frog are definitely known to occur, although a review of the status of amphibians and reptiles is currently being undertaken.

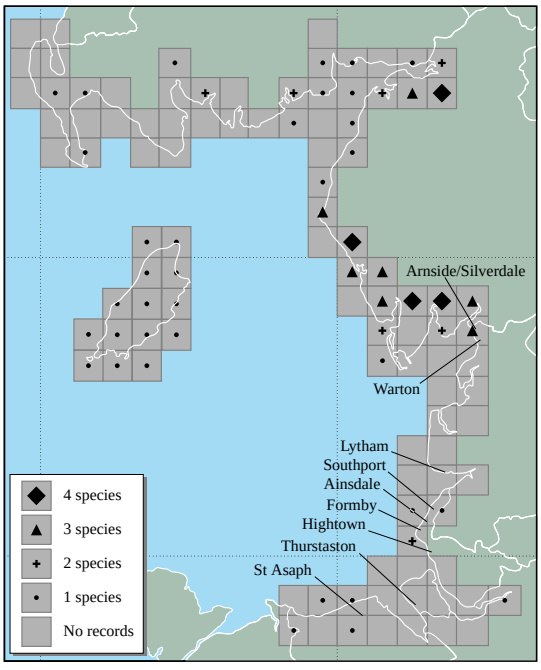
Coastal habitats are essential to the continued existence of natterjack toads and sand lizards in Britain. Of 46 recorded natterjack toad breeding sites in Britain, 41 (89%) are on the coast. Coastal sand dune and marsh systems within this region alone support 74% of natterjack toad breeding sites within the UK. Within recognised 'sites', sand lizards are found in relatively discrete colonies, termed foci. Of 179 separate foci identified throughout the UK (Corbett 1994), 78% occur in coastal 10 km squares, on sand dunes or heathland: the Sefton coast of Merseyside supports 8% of sand lizard foci nationally.

Throughout this region (excluding the Isle of Man), 59% of surveyed 10 km squares support at least three species of amphibian (Map 5.6.1), comparing favourably with the entire British west coast (49%) and Great Britain as a whole (22%). The greatest diversity of amphibian species occurs along the coast of Merseyside, where 80% of squares support at least three species and 60% at least five. The natterjack toad and sand lizard and, to a large extent, the more common reptiles are restricted to coastal habitats, but the great crested newt and the common amphibians also exploit water-bodies in the agricultural hinterland. Groups of natterjack toad breeding sites are located at irregular intervals along the coast, extending from the Wirral in the south to Southerness in Dumfries & Galloway. Sand lizards occur in the region only on the Sefton coast, Merseyside. This isolated population is considered to be geographically and morphologically distinct from those in the south of England, making its conservation particularly important.

Table 5.6.1 shows the numbers of individual amphibian and reptile records in relation to survey effort. Reptile recording is very patchy, and most of the records of reptiles in the region (82%) are for Cumbria and Lancashire (Map 5.6.2). There are few records of amphibians or reptiles on the Clwyd coast, but population densities of the widespread amphibians are high in the Vale of Clwyd and the hinterland of the Dee Estuary. In Merseyside, common frogs, toads and lizards are well distributed, but palmate newts, grass snakes and slow-worms are each known from only a single record. Adders are apparently absent. Coastal



Map 5.6.1 Numbers of amphibian species recorded in coastal 10 km squares and key localities for amphibians. Distribution may reflect differences in recording effort. Source: Biological Records Centre, ITE Monks Wood.



Map 5.6.2 Numbers of reptile species recorded in coastal 10 km squares and key localities for reptiles. Distribution may reflect differences in recording effort. Source: Biological Records Centre, ITE Monks Wood.

Table 5.6.1 Records of amphibians and reptiles related to survey effort

	*Total no. of 10 km squares**	*% 10 km squares surveyed for*			*Total no. of individual records*		*Mean no. of individual records per surveyed 10 km square*	
		Any herp. species	*Amphibians*	*Reptiles*	*Amphibians*	*Reptiles*	*Amphibians*	*Reptiles*
Clwyd	10	80	70	40	369	7	52.7	1.8
Cheshire	5	100	100	20	86	1	17.2	1.0
Merseyside	13	77	79	23	663	10	66.3	6.7
Lancashire	13	38	31	15	41	27	8.2	13.5
Cumbria	29	83	69	76	402	253	20.1	11.5
Dumfries & Galloway	52	77	65	5	173	36	9.7	4.4
Annandale & Eskdale	4	100	75	75	59	11	19.7	3.7
Nithsdale	7	86	71	57	41	8	8.2	2.0
Stewartry	8	63	63	50	35	11	7.0	2.8
Wigtown	20	60	50	25	38	6	3.8	1.2
Isle of Man	13				-	-	-	-
Region 13	***122***	***87***	***76***	***53***	***1,734***	***343***	***25.1***	***6.5***
West Coast	620	63	53	49	3,383	1,536	10.2	5.1
GB coast	1,124	69	59	49	7,524	3,138	11.3	5.7
Great Britain (coast and inland)	2,862	84	79	66	27,182	8,803	12.1	4.7

Sources: Biological Records Centre, Monks Wood; Beebee (1989). *Total includes squares that are partly in the county, but excludes squares that are exclusively marine.

marshes, dune slacks, derelict industrial sites and some of the agricultural hinterland of Lancashire and Cumbria support all of the widespread amphibian species except the palmate newt. Four reptile species are found on the Cumbrian coast, but species diversity apparently decreases north of Whitehaven. On the Scottish Solway coast, amphibians, including natterjack toads, are well distributed, although toads and newts exhibit more localised distributions than frogs. All four common reptile species are also found on this coast, which represents the northern limit of the UK range of the grass snake. Reptile abundance is thought to increase west of Southerness.

5.6.2 Important locations and species

Table 5.6.2 lists coastal 10 km squares (four digits) and coastal 1 km OS grid squares (two digits) in which rare and vulnerable species are found and areas that support regionally or nationally important assemblages (Swan & Oldham 1989) or outstanding populations of widespread species (Maps 5.6.1 and 5.6.2). Some of the sand lizard and many of the natterjack toad sites are either entirely or partly within Sites of Special Scientific Interest (SSSIs) or National Nature Reserves (NNRs).

In Merseyside, natterjack toads are largely confined to the frontal dunes, but in Lancashire, Cumbria and the Scottish Solway coast they also inhabit sandy fields, golf courses, freshwater marshes and saltmarshes, sandy heathland and industrial sites. In many cases, breeding sites are isolated, especially where the protected habitat is within an otherwise disturbed coastline. However, in the few cases where breeding areas are located within extensive, undefended coastlines, natterjacks have colonised water-bodies beyond their core breeding sites. As a 'pioneer' species, natterjacks can readily and rapidly colonise newly formed natural breeding sites that appear on unprotected dynamic coasts, as on the Duddon Estuary and the Scottish shore of the Solway. In this region, as part of English Nature's Species Recovery Programme, natterjacks have been reintroduced to a number of sites from which they were absent.

This region also contains several nationally important strongholds for the great crested newt. High-density clusters of great crested newt breeding ponds occur in Clwyd, between Rhyl and Rhuddlan and between Holywell and Wrexham, on the Wirral, in the coastal hinterland of Southport and Formby and throughout the Fylde area of Lancashire. Large populations of great crested newts are also recorded in dune slacks at Ainsdale NNR and at several natterjack breeding areas on the Cumbrian coast. Great crested newts and the common amphibians tend to occur in the more permanent water-bodies within the dunes.

The sand lizard sites in this region are found exclusively within the Sefton coast dune system. The species requires deep, tangled marram grass, which occurs only where dunes are allowed to be mobile. Unfortunately, the sand dunes on Merseyside have become stabilised and so the habitat is less suitable for sand lizards.

In Lancashire and southern Cumbria, common lizards are associated with sandy substrates, and adders with areas of limestone pavement.

Amphibians on the Scottish coast are associated with small pools (e.g. kettleholes or flight ponds) or permanantly wet pasture, and are not dependent on field or farm ponds, as they are on much of the coast of Great Britain. Reptiles are most common within the unmanaged strip between agricultural land and the sea, which comprises scrub, gorse, rabbit warrens and bare rock.

Since 1970 six live leatherback turtles *Dermochelys coriacea* have been recorded swimming off the Scottish Solway and Cumbrian coasts. Two others have been found dead in the region, one entangled in fishing gear in Scotland (Herpetofauna Consultants International in prep. a) and one stranded at Birkdale (C. McCarthy pers. comm.). Three unidentified turtles were also observed at sea off the Scottish coast during the same period (HCI 1994). There have been no recent records from the Isle of Man.

Table 5.6.2 Important areas for reptiles and amphibians

Site name	*Grid ref.*	*Habitat*	*Species present*	*Site/area type**
Clwyd				
St. Asaph's Cemetery	SJ0474	Graveyard	Slow worm	F, W
Vale of Clwyd	SJ07, SJ08	Agricultural land: high pond density	Great crested newt	V
Ddol Uchaf	SJ1471	Nature reserve	Great crested newt	V
Halkyn Mountain	SJ1773	High-density cluster of ponds	Great crested newt	V
Tyn Y Coed	SJ2569	2 ponds	Great crested newt	V
Cobbler's Wood Farm	SJ2666	Farm pond	Great crested newt	V
Llwyni, Connah's Quay	SJ2868	Pond	Great crested newt	V
Standard Clay Pit, Buckley	SJ2965	Disused clay pit	Great crested newt	V
White Lion, Penmynydd	SJ3062	Pond	Great crested newt	V
Broughton	SJ3464	Pond	Great crested newt	V
Merseyside				
Formby - Hightown	SD20	Sand dunes	Natterjack toad, sand lizard	R
Ainsdale NNR	SD21	Sand dunes	Natterjack toad, sand lizard, great crested newt	R
Ainsdale NNR	SD21	Sand dunes	Common frog, common toad, smooth newt, great crested newt, natterjack toad, sand lizard	R
Thurstaston Country Park	SJ2584	Ponds	Common frog, common toad, smooth newt, great crested newt, common lizard	A
Frankby Mere	SJ2587	Wetland	Common frog, common toad, smooth crested newt	A
Redrocks	SJ28	Sand dunes	Natterjack toad	R
Irby	SJ28	Ponds	Great crested newt	V
Southport and Birkdale	SD31	Sand dunes	Natterjack toad, sand lizard	R
Lancashire				
Martin Mere	SD4215	Wetland, high pond density	Common frog, common toad, smooth newt, great crested newt	A
Lytham Sand Dunes NR	SD3927	Sand dunes	Common lizard	F
Heysham Chemical Works	SD4159	Cooling ponds, fire ponds, rubble	Common toad, smooth newt	A
Warton Crag	SD4773	Limestone cliff, saltmarsh	Slow worm, common lizard	F
Leighton Moss	SD4875	Reedbeds, dykes	Common frog, common toad, slow worm, common lizard	F
Lancashire/Cumbria				
Arnside/Silverdale	SD4477	Limestone pavement, hazel coppice	Slow worm, adder	F
Cumbria				
North Walney - Haverigg	SD17, SD27, SD28, SD18	Sand dunes, sandy fields, marshes, ditches, derelict industrial sites, golf courses	Natterjack toad (ten breeding areas), great crested newt	R
Sandscale Haws	SD17	Sand dunes	Common frog, common toad, smooth newt, palmate newt, great crested newt, natterjack toad	R
Gutterby - Braystones	SD18, SD08, SD09, NY00	Sand dunes, sandy fields, marshes, coastal grazing, golf courses	Natterjack toad (seven breeding areas), great crested newt	R
Ravenglass Dunes and Eskmeals	SD09	Sand dunes	Common frog, common toad, smooth newt, palmate newt, great crested newt, natterjack toad, common lizard, adder	R
Silloth Dunes	NY15	Sand dunes	Common frog, common toad, smooth newt, great crested newt, natterjack toad	R
Drumburgh Moss	NY2558	Peat bog	Common frog, common toad, smooth newt, palmate newt, great crested newt	A
Bowness Gravel Pit	NY2061	Mineral extraction site	Common frog, common toad, smooth newt, palmate newt, great crested newt	A
Workington - Anthorn	NX92, NY04, NY15	Industrial sites, coastal grazing, sand dunes, golf courses, freshwater and brackish marshes	Natterjack toad (6 breeding areas)	R

Table 5.6.2 Important areas for reptiles and amphibians (continued)

Site name	*Grid ref.*	*Habitat*	*Species present*	*Site/area type**
Dumfries & Galloway				
Annandale & Eskdale				
ICI factory	NY16	Sandy heath	Natterjack toad, great crested newt	R
Priestside	NY06, NY16	Freshwater and brackish marshes, saltmarshes	Natterjack toad	R
Nithsdale				
Caerlaverock	NY06	Freshwater marshes, saltmarshes	Natterjack toad	R
Kippford - Sandyhills, including Rough Island	NX85	Coastal heath, cliffs, scrub, rocky outcrops, grassland	Slow worm, common lizard, adder	F
Southerness	NX95	Brackish marsh, sandy area	Natterjack toad, great crested newt	R

Sources: Beebee (1989), Corbett (1989, 1993a, b, 1994), Swan & Oldham (1993a, b), Countryside Council for Wales, Scottish Natural Heritage, Lancashire Wildlife Trust Newt Group, National Trust for Scotland, Dumfries & Galloway Regional Council. Key: * sites/areas listed are: R = important site/area for rare amphibian and/or reptile species; V = important site/area for vulnerable amphibian and/or reptile species; A = location of important assemblages of widespread amphibian species; F = location of frequent sightings of widespread reptile species; W = site identified by North Wales Wildlife Trust as having a good herptile population.

5.6.3 Human activities

Sand dunes on the Clwyd coast are so fragmented and degraded that they support very few amphibians or reptiles. Human pressure west of the Dee Estuary has been largely recreational, while on the Welsh side of the estuary, habitats have been lost to industrial development. On the English side of the estuary and throughout the Wirral and Sefton coasts, the pressures are mainly recreational and residential. These pressures, coupled with coast protection works, dune stabilisation projects, reduced grazing and the subsequent spread of scrub and rank vegetation, have rendered large areas of the English coast of the region no longer suitable for the rare species. Other factors, falling short of complete habitat destruction, reduce the viability of existing populations. For example, the spread of residential developments has lowered water tables and increased direct human disturbance, and is also associated with raised levels of predation by domestic cats on sand lizards. Coast protection measures and spreading scrub and rank vegetation have led to a detrimental increase in competition from common species at some sites. Managed destabilisation of the Sefton dunes is being considered to improve sand lizard habitat. Several areas where there are currently no sand lizards are being considered as re-introduction sites, as part of English Nature's Species Recovery Programme.

Few threats to amphibians and reptiles are apparent on the Scottish Solway coast west of Southerness. Those reported on the eastern sector include caravan site development, abandonment of grazing, coast protection measures and inappropriate management (or no management) of water bodies, but these threats are thought to be fairly localised.

The natterjack toad, great crested newt, sand lizard and the leatherback turtle are afforded total protection under the Wildlife and Countryside Act (1981), making it an offence to kill, injure, sell, take or possess them, or to destroy their habitats. All of the terrestrial reptile species are protected from deliberate killing or injury, and from sale. The other four amphibian species are protected from sale only. On the Isle of Man, the Wildlife Act (1990) affords total protection to the common frog, sand lizard (although thought to be absent), common lizard and marine turtles (Dermochelyidae and Cheloniidae). Licences are required from English Nature, Countryside Council for Wales, Scottish Natural Heritage or the Isle of Man Department of Agriculture, Fisheries and Forestry to capture, handle or keep any of the totally protected species.

5.6.4 Information sources used

Amphibian and reptile surveying in Britain has been extensive, with 84% of 10 km squares nationally receiving some coverage, although only 69% of coastal squares have been surveyed (Table 5.6.1). The recording coverage of this region, in terms of the percentages of 10 km squares sampled, is lower for both amphibians (76% of 10 km squares) and reptiles (53%) than in Britain as a whole (79% and 66% respectively), although Clwyd, Cheshire, Merseyside, Cumbria and Annandale & Eskdale have been particularly thoroughly surveyed for amphibians. Reptiles have been less well recorded, although concentrations of records occur in Merseyside, Lancashire and Cumbria. However, the average number of individual records per 10 km square in the region is much higher than the national average for amphibians (25 per 10 km square, compared with twelve nationally) and slightly higher for reptiles (six per square regionally, compared with four nationally). These figures exclude the Isle of Man.

National distribution data for the widespread terrestrial amphibians and reptiles were provided by the Biological Records Centre (BRC) at Monk's Wood (Arnold 1983, Arnold in prep.). These sources comprise post-1970 species records held by BRC and include all the data collected during the National Amphibian and Reptile Surveys (NARS) undertaken by De Montfort University on behalf of English Nature. The NARS formed the focus of national amphibian and reptile recording during the 1980s and early 1990s (Oldham & Nicholson 1986; Swan & Oldham 1989, 1993a, b). Many of these data were collected through a volunteer, mainly amateur, recorder network. Two further reports to Scottish Natural Heritage describe the distributions in Scotland of the adder (Reading *et al.* 1994) and the crested newt (Herpetofauna Consultants International in prep. b).

Natterjack toad breeding sites are regularly monitored

by NNR site managers, wildlife rangers and volunteers. Their information is incorporated in the natterjack toad site register for the UK (Beebee 1989), which is updated annually. This was the main source of the natterjack data presented in this section; it also contains current listings of site-, area- and region-specific published and unpublished research and monitoring papers. A coastwide conservation strategy for the natterjack is described in Simpson (1992).

Both the natterjack toad and the sand lizard are currently the subjects of English Nature Species Recovery Programmes (Whitten 1990). Sand lizard distribution data, extracted from the pilot study for the sand lizard Species Recovery Programme (Corbett 1994), were provided by English Nature. Sand lizard populations are also regularly monitored, and records are held by by the Herpetological Conservation Trust (HCT) and the British Herpetological Society Conservation Committee (BHSCC). A conservation strategy for the Merseyside sand lizard populations was prepared for English Nature in 1992 by the Environmental Advisory Unit (EAU 1992).

A large-scale project to study and conserve the ponds of Cheshire, Merseyside, Lancashire and Greater Manchester has recently been initiated at Liverpool John Moores University.

Turtle information was obtained from the Natural History Museum and Southampton University and from a report to Scottish Natural Heritage (HCI in prep. a). All sightings at sea and strandings should be reported to the Natural History Museum. Concise information on turtle identification, reporting of sightings, UK legislation and instructions on what to do with turtles caught in fishing gear is contained in the *Turtle code* (Nature Conservancy Council 1990).

5.6.5 Acknowledgements

The author wishes to thank the following people for information and for comments on the draft: Brian Arneill, Henry Arnold, Trevor Beebee, Keith Corbett, Paul Day, Cathy Duncan, Matthew Ellis, Alex Emery, Vincent Fleming, Tony Gent, Robin Grayson, David Harpley, Arthur Howatson, Andrew Hull, Dr Colin McCarthy, Richard Mearns, Peter Norman, Chris Reading, Paul Rooney, Clare Spray and Stuart Spray. Special thanks are due to John Lamb, Manx Nature Conservation Trust, for providing information on amphibians and reptiles on the Isle of Man.

5.6.6 Further sources of information

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Amphibians and reptiles, nationally	The British Herpetological Society, c/o The Zoological Society of London, Regent's Park, London NW1 4RY, tel: 0181 452 9578
Conservation of threatened reptiles and amphibians in Britain; priority species in Europe	Conservation Officer, The Herpetological Conservation Trust, 655A Christchurch Road, Boscombe, Bournemouth, Dorset BH1 4AP, tel: 01202 391319
National secretariat to local amphibian and reptile groups	Common Species Co-ordinator, Herpetofauna Groups of Britain and Ireland, c/o HCIL, Triton House, Bramfield, Halesworth, Suffolk IP19 9AE, tel: 01986 84518
National recording schemes and biological data from throughout UK	*Environmental Information Centre, ITE Monks Wood, Huntingdon, tel: 01487 773381
Species Recovery Programmes	*Dr R. Mitchell, English Nature HQ, Peterborough, tel: 01733 340345
Ecological research, monitoring and conservation of natterjack toads	Dr Trevor Beebee, University of Sussex, Falmer, Brighton, East Sussex BN1 9QS, tel: 01273 606755
Turtles	Dr C. McCarthy, Natural History Museum, Cromwell Road, London SW7 5BD, tel: 0171 938 9123
Turtles	Dept. of Oceanography, Southampton University, Highfield, Southampton SO9 5NH, tel: 01703 595000
Reptiles and amphibians - north Wales	*Herpetologist, CCW North Wales Region, Bangor, tel: 01248 370444
Reptiles and amphibians - north Wales	University of Wales - Llysdinam Field Centre, Newbridge-on-Wye, Llandrindod Wells, Powys LD1 6NB, tel: 01597 89308
Reptiles and amphibians - north Wales	North Wales Wildlife Trust, Loggerheads Country Park, nr. Mold, Clwyd CH7 5LH, tel: 01352 810469
Reptiles and amphibians - Clwyd	Clwyd Reptile and Amphibian Group, c/o North Wales Wildlife Trust, Loggerheads Country Park, Loggerheads, Mold, Clwyd CH7 5LH, tel: 01352 810469
Reptiles and amphibians - Clwyd	*CCW, Mold, tel: 01352 754000
Reptiles and amphibians - Clwyd	Deeside Urban Wildlife Group, 10 Ridgeway Close, Connah's Quay, Deeside, Clwyd, tel: 01244 831725
Merseyside: conservation strategy for sand lizards	Sefton Coast Ranger Service/Management Scheme, Formby Council Offices, Freshfield Road, Formby, Merseyside L37 6PQ, tel: 0151 934 2962/2971
Conservation strategy for the Merseyside sand lizards	*English Nature, North West Local Team, Wigan, tel: 01942 820342

*Starred contact addresses are given in full in the Appendix.

C. Contact names and addresses (continued)

Type of information	*Contact address and telephone no.*
Reptiles and amphibians - Ainsdale Sand Dunes NNR	The Warden, Ainsdale Sand Dunes NNR, 2 West End Lodge, Pinfold Lane, Southport, Merseyside PR8 3QW, tel: 01704 578774
Reptiles and amphibians on National Trust properties in West Midlands	National Trust, Mercia Regional Office, Attingham Park, Shrewsbury SY4 4TP, tel: 01743 709343
Reptiles and amphibians on National Trust properties in Cumbria	National Trust, North West Regional Office, The Hollens, Grasmere, Cumbria LA22 9QZ, tel: 01539 435599
Reptiles and amphibians in Cheshire	Cheshire Amphibian and Reptile Group, c/o Cheshire Wildlife Trust, Marbury Country Park, Northwich, Cheshire CW9 6AT, tel: 01270 610180
Newts in Lancashire	*Lancashire Wildlife Trust Newt Group, c/o Lancashire Wildlife Trust, Preston, tel: 01772 324129
Protected sites in Cumbria; Cumbria Natterjack Group	*English Nature, Cumbria Local Team, Windermere, tel: 019662 5286
Reptiles and amphibians in Cumbria	*Cumbria Reptile and Amphibian Group, c/o Cumbria Wildlife Trust, Ambleside, tel: 015394 32476
Ponds: North West England	Ponds Research Unit, Liverpool John Moores University, Trueman Building, 15-21 Webster Street, Liverpool, Merseyside L3 2ET tel: 0151 231 4044
Reptiles and amphibians in Scotland	Wildfowl Trust, Eastpark Farm, Tadorna, Hollands Farm Road, Caerlaverock, Dumfries & Galloway DG1 4RS, tel: 01387 770275
Wildlife Trust sites in Scotland	*Scottish Wildlife Trust, Sanquhar, tel: 01609 50454
Reptiles and amphibians in Scotland	*SNH, Dumfries & Galloway Area Office, Dumfries, tel: 01387 247010
Reptiles and amphibians in Scotland	Scottish Natural Heritage, South West Region, Caspian House, Clydebank Business Park, Clydebank G81 2NR, tel: 0141 951 4488
Reptiles and amphibians in Scotland	*Scottish Natural Heritage, Galloway Office, Newton Stewart, tel: 01671 403440
Reptiles and amphibians in Scotland	Institute of Terrestrial Ecology, Banchory Research Station, Glassel, Banchory, Grampian Region AB31 4BY, tel: 01330 823434
Reptiles and amphibians in south-west Scotland	Dr J.A. Gibson, Scottish Natural History Library, Foremount House, Kilbarchan, Renfrewshire PA10 2EZ, tel: 015057 2419
Reptiles and amphibians on National Trust for Scotland's properties on the Scottish Solway coast	National Trust Ranger Service, Threave Gardens, Castle Douglas, Dumfries & Galloway DG7 1RX, tel: 01556 502575
Reptiles and amphibians on the Isle of Man	*Manx National Heritage, Douglas, tel: 01624 675522
Reptiles and amphibians on the Isle of Man	*Manx Nature Conservation Trust, St. John's, tel: 01624 801985
Protected species licences - England	*Licensing Section, English Nature HQ, Peterborough, tel: 01733 340345
Protected species licences - Wales	*Licensing Officer, CCW HQ, Bangor, tel: 01248 370444
Protected species licences - Scotland	*Licensing Officer, SNH HQ, Edinburgh, tel: 01314 474784
Protected species licences - Isle of Man	*The Wildlife Committee, Department of Agriculture, Fisheries and Forestry, Douglas, tel: 01624 685954
Review of the status of amphibians and reptiles on the Isle of Man	E. Pooley, Ballasoalt, Earystane, Colby, Isle of Man IM9 4HN, tel: 01624 834739

*Starred contact addresses are given in full in the Appendix.

5.7 Fish: exploited sea fish

Dr M.G. Pawson & C.F. Robson

5.7.1 Introduction

This section describes the distribution of sea fish that are of interest because they are exploited by people, mainly for food. Their exploitation by fisheries is described in section 9.1. Sea fish described as pelagic (Table 5.7.1) are most commonly found in shoals swimming in midwater; they typically make extensive seasonal movements or migrations between sea areas. Demersal fish (Table 5.7.2) are those found living at or near the bottom of the sea. For this report, all sea fish that are not 'pelagic' are termed 'demersal'; thus the latter term includes bass and grey mullet. Demersal species are divided here into four groups: elasmobranchs (sharks, skates and rays), gadoids (the cod family), flatfish, and other demersal fish. Most demersal species gather in late winter or spring on persistent and recognisable spawning grounds, to release millions of minute free-floating eggs. From these hatch larvae, which feed on and move with the plankton, often for a hundred miles or more, before metamorphosing into tiny fish, which recruit to inshore nursery grounds.

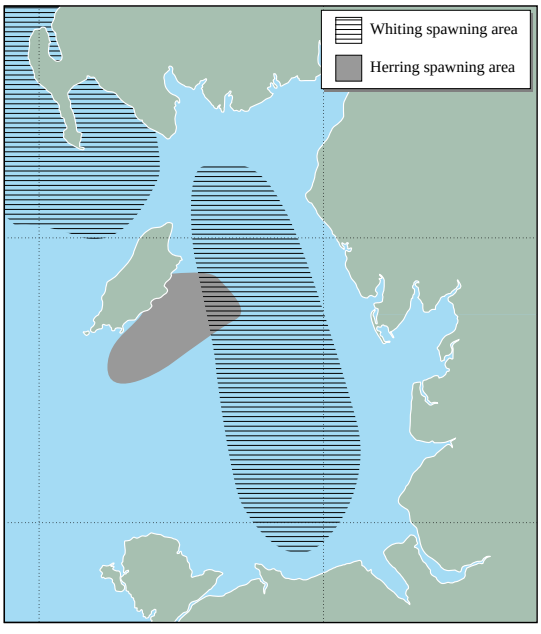
The distribution of exploited sea fish species can be mapped from analysis of catch data. This description of their distribution covers their occurrence at identifiable locations in the region during particular phases of their life history, and Maps 5.7.1 - 4 show the known spawning and nursery areas of key species. Barring substantial climate change, or stock collapse, these distributions and relationships will remain stable over several decades.

Tables 5.7.1 and 5.7.2 list the important pelagic and demersal species occurring in the region and give examples of protection measures in this region.

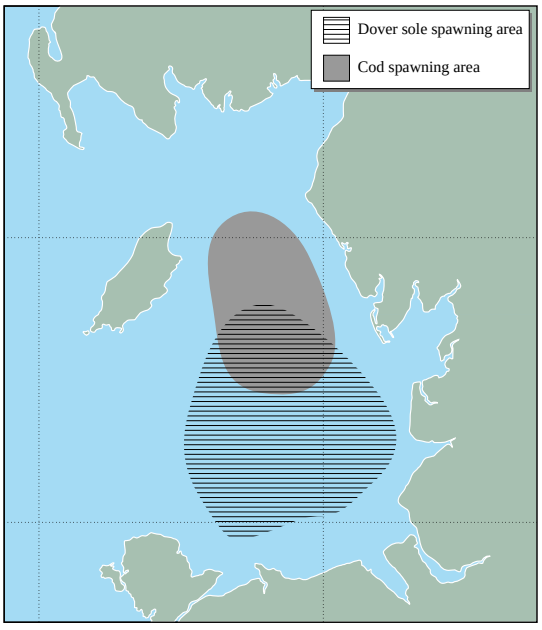
5.7.2 Important locations and species

Of the pelagic species, mackerel is widely distributed around Britain and is present in the seas off the region. Mackerel spawn throughout the shelf waters of the British Isles but most prolifically along the edge of the continental shelf, from February to July. Growing juveniles and adults migrate to coastal waters after spawning, where they remain until autumn. Overwintering concentrations are found west of Scotland, west of Ireland and off Cornwall but not adjacent to this region. Herring are locally much more abundant, especially when spawning south and east of the Isle of Man in the autumn (Map 5.7.1). Juvenile herring are found in nursery areas along the coast north from Liverpool Bay (Map 5.7.4). Sprat are widely dispersed throughout the region and their main egg and larval area of distribution covers the whole region. Juvenile sprat are often found mixed with young herring in inshore areas, when they are known as whitebait.

Elasmobranch species produce relatively small numbers of live young (10 -100 per year, but can be fewer in big sharks) or eggs on the sea bed close to their nursery areas. Several species of shark, including the basking shark, occur sporadically during their summer migrations off the west coast (see sections 5.8 and 9.7 for further information), but only the spurdog is found regularly in sufficient abundance to support a directed fishery. Others are exploited opportunistically. The thornback ray is also important locally, especially *en route* to its spring spawning grounds in shallow bays around the region. A number of other ray species are distributed patchily in the region.



Map 5.7.1 Whiting and herring spawning areas. Source: Lee & Ramster (1981). © Crown copyright.



Map 5.7.2 Dover sole and cod spawning areas. Source: Lee & Ramster (1981). © Crown copyright.

Table 5.7.1 Pelagic species and examples of measures for their protection

Species	*Protection measures*
Mackerel *Scomber scombrus*	QM
Horse mackerel *Trachurus trachurus*	MLS/QM
Herring *Clupea harengus*	MLS/QM
Sprat *Sprattus sprattus*	No limitation

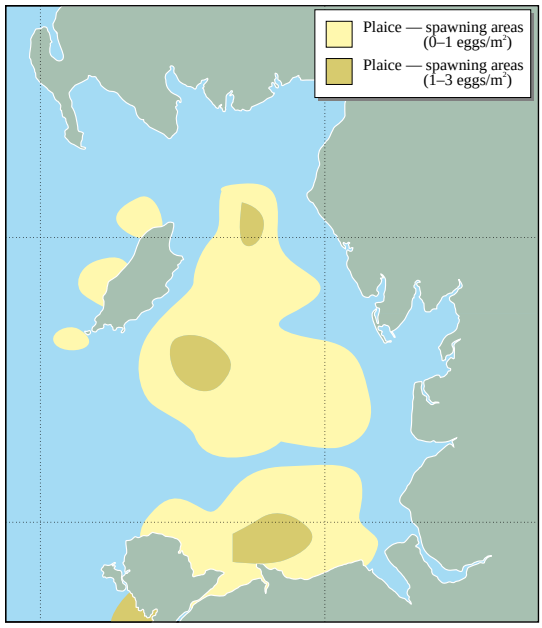
Source: European Council Regulation No. 3362/94; MAFF (pers. comm.). Key: MLS = minimum landing size; QM = catch quota management.

Of the gadoids, cod are widely distributed in the region during the summer. Cod aggregate during February and March in a spawning area in deep water off Cumbria (Map 5.7.2). There are also aggregations occurring at Warts Bank, an area of fine shell-gravel 2 km off Spanish Head, Isle of Man. Whiting are abundant and widely distributed in the region. There are two large recognisable whiting spawning areas in the region (Map 5.7.1). The spawning season is prolonged - from January to July depending on the latitude - and there are likely to be other spawning areas and nursery areas that have not been identified.

Table 5.7.2 Demersal species and examples of measures for their protection

Species	*Protection measures*
Elasmobranchs	
Basking shark *Cetorhinus maximus*	*Isle of Man waters; elsewhere no limitation
Spurdog *Squalus acanthias*	No limitation
Thornback ray *Raja clavata*	No limitation
Gadoids	
Cod *Gadus morhua*	MLS/QM
Whiting *Merlangius merlangus*	MLS/QM
Haddock *Melanogrammus aeglefinus*	MLS/QM
Ling *Molva molva*	No limitation
Pollack *Pollachius pollachius*	MLS/QM
Saithe *Pollachius virens*	MLS/QM
Hake *Merluccius merluccius*	MLS/QM
Flatfish	
Plaice *Pleuronectes platessa*	MLS/QM
Dab *Limanda limanda*	MLS
Dover sole *Solea solea*	MLS/QM
Turbot *Scophthalmus maximus*	MLS
Brill *Scophthalmus rhombus*	MLS
Lemon sole *Microstomus kitt*	MLS
Flounder *Platichthys flesus*	MLS
Other demersal fish	
Bass *Dicentrarchus labrax*	MLS and nursery areas
Grey mullet *Chelon labrosus*	MLS
Angler (monkfish) *Lophius piscatorius*	QM
Conger eel *Conger conger*	MLS
Gurnards *Triglidae* spp.	No limitation
Wrasse *Labridae* spp.	No limitation
Sandeels *Ammodytes* spp.	No limitation

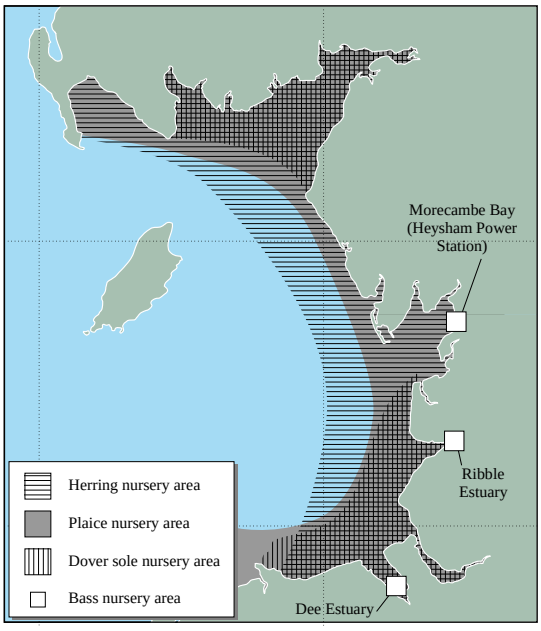
Source: European Council Regulation No. 3362/94; MAFF (pers. comm.). Key: MLS = minimum landing size; QM = catch quota management; *complete protection in Isle of Man territorial waters (12 mile limit).



Map 5.7.3 Plaice spawning areas. Source: Lee & Ramster (1981). © Crown copyright.

Haddock, ling, pollack and saithe are less abundant and more locally distributed, the last three being found particularly around rocky reefs and wrecks. Hake - strictly not a gadoid but included here - are found in the deeper water of the North Channel, though the main part of the population lies outside coastal waters towards the edge of the continental shelf.

Plaice and dab are the most abundant flatfish species: much more is known about the life history of the commercially-exploited plaice. These species occur on sandy areas of sea bed throughout the region, with juveniles living close to the shore in nursery areas, gradually moving to deeper water as they grow. The knowledge of plaice spawning areas is obtained from the distribution of newly spawned eggs in spring, determined by plankton surveys (Lee & Ramster 1981) (Map 5.7.3). There are plaice nursery areas along most of the region's coast, including from the coast of north Wales up the coast of north-west England to the Mull of Galloway (Map 5.7.4) and also in sheltered bays around the Isle of Man, e.g. Port Erin Bay, which is a well known plaice nursery ground (Nash *et al.* 1992). Dover sole, which have a similar lifestyle to plaice and dab, spawn in the early summer (April to June) in a large area within the region (Map 5.7.2). Young Dover sole may spend up to two years in the inshore nursery areas also used by plaice (Map 5.7.4) (Rogers 1993). Turbot and brill are much less abundant but have a similar lifestyle to plaice, dab and Dover sole. None of the flatfish species exhibits extensive migrations, though the larvae can drift for several weeks from offshore spawning grounds to inshore nursery areas. There may be some interchange, either way, between spawning stocks and nursery grounds in this and adjacent regions, for example the Clyde to the north and the Bristol Channel further south. In contrast, a more local distribution is recorded for the lemon sole, with an apparently discrete population occurring in the northern Irish Sea. Flounders migrate from inshore, estuarine and even riverine nursery areas all along the coast of the region to spawn up to 20 or 30 miles offshore in late winter, and there appears to be little coastal movement other than in the egg or larval phase.



Map 5.7.4 Nursery areas of selected pelagic and demersal fish species . Sources: various.

Bass and grey mullet are seasonally abundant inshore and in estuaries in the region, and move south along the coast in the autumn to overwintering areas, before spawning offshore and returning north to feeding grounds in the spring. Bass and grey mullet are close to the northern limits of their ranges around the Cumbrian and Scottish coast and are therefore less abundant there than in the south. They use estuaries and sheltered inshore waters as nursery areas (Map 5.7.4) (Kelley 1988).

Monkfish (angler) spawn in deep water along the continental shelf edge, but juveniles and non-spawning adults can be found throughout the region. Other demersal species of minor commercial importance are conger eel and various gurnard and wrasse species. Sandeels are distributed widely throughout the region and provide an important food source for many commercial species. They burrow in coarse sand at night and during the winter; thus their distribution is influenced by that of coarse sand. Warts Bank often has large aggregations of sandeels, the basis of a minor bait industry.

5.7.3 Human activities

A feature of all fish stocks, and the primary reason for their fluctuation, is the variability of recruitment of juvenile fish to the exploited populations. This variability, the causes of which are not fully understood, is determined by environmental conditions at the time of spawning and in the subsequent larval survival. Exploitation of fish stocks may increase the extent of these fluctuations.

Efforts are made to conserve stocks of pelagic and demersal species by implementing a variety of management measures, including: minimum landing sizes (MLS), minimum mesh size regulations and quantitative controls on catches (through catch quota management by the setting of annual Total Allowable Catches (TACs), further explained in section 9.1). Two such protection measures are presented in Tables 5.7.1 and 5.7.2: catch quota management (QM), which indicates that the UK has been allocated a TAC in ICES Fishing Area VII (which includes Region 13), and MLS. Their implementation means that fish caught below MLS or for which the quota is exhausted must be discarded at sea, and this may affect the exploited species fish stocks, as well as other fish species, birds and species that live on the sea bed. A bylaw has been proposed by Cumbria Sea Fisheries Committee to increase the minimum mesh size of nets used in the plaice nursery areas between Whitehaven and Worthington, to reduce the numbers of immature plaice caught.

In June 1992, MAFF made it compulsory, when fishing for *Nephrops*, to incorporate a section of 80 mm square mesh panelling near to the cod end of nets with a cod end mesh size of 70 mm, in order to reduce the by-catch of juvenile fish.

The catch from shrimp trawlers in the region can also include juvenile fish, particularly flatfish such as plaice and Dover sole. The fish are separated from the crustacea and returned to the sea, but it is unlikely that they all survive (Symonds *et al.* 1985). However, natural mortality in juvenile flatfish is known to be very high, which may mean that the effect of the shrimp fishery may not be as significant as it might appear. MAFF-sponspored research is currently being carried out at the University of Humberside to try to quantify this by-catch.

In order to safeguard the bass fishery in coastal waters, 34 areas in England and Wales have been designated statutory bass nurseries (The Bass (Specified Sea Areas) (Prohibition of Fishing) Order 1990: SI 1990 No. 1156 (Ministry of Agriculture, Fisheries and Food & Welsh Office Agriculture Department 1990)). The nursery areas are where juvenile bass are abundant and are more easily caught, particularly during the summer months. There are two nursery areas in the region - the Dee Estuary and Heysham Power Station. The legislation prohibits fishing for bass from any vessel for the duration of the closed season (1 June - 30 September in both cases), and although fishing from the shore is not covered, anglers are expected to return to the sea any bass caught within nursery areas.

Spawning and nursery areas may be vulnerable to activities such as sewage sludge dumping, dredging and dredged material disposal and the development of infrastructure such as barrages and pipelines. MAFF is a statutory consultee for, or licenses, activities such as these, in which the distributions of exploited fish populations and their identifiable spawning and nursery areas have to be taken into account.

Apart from the basking shark, which is protected within the Isle of Man 12 mile territorial limit, the elasmobranch species do not have any protected status and are vulnerable to exploitation as a result of the relatively long time they take to reach reproductive maturity and the small numbers of young that they produce. The status of some ray species is currently (1995) subject to research through an European Union sponsored project coordinated by MAFF Directorate of Fisheries Research and the North Wales and North Western Sea Fisheries Committee. Current programmes studying the fish fauna of the Isle of Man include monitoring of seasonal migrations of basking shark by Port Erin Marine Laboratory and the Manx Trust for Nature Conservation.

In Scottish inshore waters the principle tool of fisheries management is the Inshore Fishing (Scotland) Act 1984.

This gives the Secretary of State powers to regulate fishing in specified inshore waters and to prohibit the carriage of specified types of net and the use of mobile gear near fixed salmon nets. The single prohibition under the act in the region is the seasonal restriction on the use of mobile gear, which is prohibited from May to September in Luce Bay.

There is currently controversy over the area to the east of the Isle of Man, which is closed to herring fishing from 21 September to 31 December, with some fishermen voicing the opinion that it should be re-opened.

The Isle of Man Angling Federation sets size limits for 28 species of fish plus an 'unclassified' category to cover the remainder. On the whole the clubs follow these size limits.

5.7.4 Information sources used

Whereas the life history of the exploited crustacean and mollusc species can be observed at or near the sites at which they are harvested, the distributions of fish populations can change considerably between juvenile and adult phases and with seasonal migrations. Therefore the information used in this section is based on the distribution and relative abundance of fish species revealed by fisheries catch statistics obtained from recorded commercial landing figures. In addition, information is used from research vessel catch data and data from biological sampling during fishing surveys. Data from these surveys on the occurrence of spawning fish and juveniles can be used to identify spawning and nursery areas. However, this information is sometimes limited, and there may be other areas in addition to those described or shown on the maps where the species might also occur. Research surveys involving plankton sampling, hydrographic studies, fishing and tagging are required to establish the links between spawning groups and specific nursery areas, and between growing juveniles there and the adult populations to which they eventually recruit. Lee & Ramster (1981) has been used extensively as a source for the maps. Pawson (1995) shows distribution maps of selected fish and shellfish species around the northeast Atlantic and the British Isles and has a species-specific bibliography.

European Council Regulation No. 3362/94 fixes, for 1995, details of the catch quotas for fish and shellfish species for all European countries, i.e. the Total Allowable Catches (TACs), and certain conditions under which the species may be fished. European Council Regulations are published (where this is obligatory) in Luxembourg in the Official Journal of the European Communities. EC Regulation No. 3362/94 is updated annually (European Council 1994).

5.7.5 Acknowledgements

Thanks go to the following for their advice and for commenting on drafts: Bill Cook (North Western & North Wales Sea Fisheries Committee), D.T. Dobson (Cumbria Sea Fisheries Committee), Miran Aprahamian (NRA North West Region), Dr R.C.A. Bannister (Shellfish Resource Group, MAFF Directorate of Fisheries Research, Lowestoft), Professor Stephen Lockwood (MAFF Directorate of Fisheries Research, Conwy), M.L. Hearn (MAFF Fisheries Office, Milford Haven), David McKay and Derek Murison (Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD) Marine Laboratory), Dr Debbie Jones, Dr Terry Holt and Dr Andy Brand (Port Erin Marine Laboratory), Paul Knapman (English Nature) and D. Donnan (SNH).

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Advice to assist with management and policy for the coastal zone - England & Wales	*Head of Laboratory, MAFF Directorate of Fisheries Research, Fisheries Laboratory, Conwy, tel: 01492 593883
Assessment and provision of advice on the conservation of exploited fish stocks. MAFF databases e.g. young fish and ground fish surveys - England & Wales	*Director, MAFF Directorate of Fisheries Research, Fisheries Laboratory, Lowestoft, tel: 01502 562244
Assessment and provision of advice on fish stocks in Scotland	SOAEFD Fisheries Research Services, Marine Laboratory, PO Box 101, Victoria Road, Aberdeen AB9 8DB, tel: 01224 876544
All information on fish stocks of the Isle of Man, including statistics	*Fisheries Officer, Department of Agriculture, Fisheries & Forestry, Isle of Man, tel: 01624 685857
Information and data on fish stocks, especially Manx herring	*Dr Richard Nash, Port Erin Marine Laboratory, Isle of Man, tel: 01624 832027
UKDMAP software with maps showing distributions of selected sea fish species and spawning areas	Project Manager, British Oceanographic Data Centre, Proudman Oceanographic Laboratory, Bidston Observatory, Birkenhead, Merseyside L43 7RA, tel: 0151 652 3950
Marine conservation issues and fisheries - Scotland	*Aquatic Environments Branch, SNH HQ, Edinburgh, tel: 0131 446 2400
Marine conservation issues and fisheries - England	*Marine Fisheries Officer, English Nature HQ, Peterborough, tel: 01733 340345
Marine conservation issues and fisheries - Wales	*Marine and Coastal Section, CCW HQ, Bangor, tel: 01248 370444
Marine conservation issues and fisheries - Isle of Man	*Conservation Officer, Calf Marine Trust, Manx Nature Conservation Trust, St. Johns, tel: 01624 801985
Marine Fisheries Task Group papers and advice on marine conservation issues	*Marine Advisory Officer, Marine Fisheries Task Group, c/o JNCC, Peterborough, tel: 01733 62626
Marine conservation issues	*Conservation Officer, RSPB, Sandy, tel: 01767 680551
Marine conservation issues	*Fisheries Officer, Marine Section, WWF-UK, Godalming, tel: 01483 426444
Marine conservation issues	*Conservation Officer, Marine Conservation Society, Ross-on-Wye, tel: 01989 566017
Irish Sea Study Group publications	*Chairman, Irish Sea Forum, University of Liverpool, tel: 0151 794 4089
Marine conservation issues	*Administrator, Marine Forum for Environmental Issues, London, tel: 0171 938 9114
Research, specifically into brown shrimp fishery methods	University of Humberside, School of Applied Science and Technology, Humber Lodge, 61 Bargate, Grimsby, South Humberside DN34 5AA, tel: 01482 440440

*Starred contact addresses are given in full in the Appendix.

Turbot occurs naturally in this region, although not in large numbers; it is targeted by boats using large mesh nets in the Solway Firth, and a minimum landing size applies to protect fish stocks. This picture shows a turbot from the fish farm at Derbyhaven on the Isle of Man, the only place in the region where the species is farmed commercially, largely for export to Spain. Photo: Bill Sanderson, JNCC.

5.8 Fish: salmon, sea trout and eels

Dr M. Aprahamian & C.F. Robson

5.8.1 Introduction

Diadromous fish migrate between fresh water and the sea. The three exploited diadromous fish species covered in this section - the Atlantic salmon, sea trout and eel - are widespread in British waters and have been recorded in rivers in this region. (Twaite shad are also diadromous but are included in section 5.9, as they are not routinely exploited.) The salmonids (salmon and sea trout) spawn in fresh water and then migrate out to sea to mature, while the eel matures in fresh water and reproduces at sea. Sea trout and brown trout are the same species, but the latter is a freshwater form and is therefore not covered in this section. Information on the life-cycles of these fish can be found in Jones (1959), Mills (1971, 1989), Moriarty (1978), Shearer (1992), Sinha & Jones (1975) and Tesch (1977). Table 5.8.1 lists some of the protection measures for salmon, sea trout and eels in the region.

Table 5.8.1 Species and examples of measures for their protection

Species	*Protection measures*
Atlantic salmon *Salmo salar*	EC Habitats and Species Directive Annexes IIa, Va (freshwater only), close season; MLS
Sea trout *Salmo trutta*	MLS, close season
Eel *Anguilla anguilla*	MLS

Sources: European Council Regulation No. 3362/94; MAFF and NRA (pers. comm.). Key: MLS = minimum landing size.

5.8.2 Important locations

Salmon, sea trout and eels have a widespread distribution in rivers and the coastal seas of British waters. The distribution of salmon and sea trout is controlled by natural factors, such as river levels, by man-made barriers that may limit the extent to which they can go upstream, and by pollution levels. They are present in many rivers and the coastal seas of this region in Scotland, England, Wales and the Isle of Man (Map 5.8.1). Also illustrated are the smaller rivers/streams on the Isle of Man, and their tributaries, which probably support the main Manx populations of these species. Eels are probably found in all river systems in the region, as elsewhere in Britain. It is highly likely that there are diadromous fish present in other rivers, small tributaries and streams in the region that are not shown on Map 5.8.1.

5.8.3 Human activities

Under the Water Resources Act (1991), the Welsh and North West Regions of the NRA have a responsibility to regulate, protect and monitor salmon, sea trout and eel fisheries from rivers to coastal waters out to 6 nautical miles from baselines. The two Sea Fisheries Committees in the English and Welsh parts of the region (see section 9.1.3) have powers

Map 5.8.1 Salmon and sea trout rivers. Sources: NRA, SOAEFD, IoM DAFF.

to support the conservation of salmonid fisheries while exercising their responsibilities towards the regulation of sea fisheries (see section 9.1). The NRA uses a variety of techniques, such as netting, electric fishing and monitoring of angling catches, to assess stocks of salmon and sea trout. They are currently (1995) working to produce a 'Fisheries Classification Scheme', under which fisheries will be allocated to a quality class on the basis of fish and river habitat data. The NRA construct fish passes around natural barriers, or make them passable by fish in other ways. The NRA also undertakes physical habitat improvement by, for example, creating pools and adding spawning gravels, riffles and trees for cover.

Under the provisions of the Salmon and Freshwater Fisheries (Protection) (Scotland) Act 1951, the seven Salmon Fishery Statistical Districts in the Scottish part of the region collect data on catches. The 'returns' are made through an annual questionnaire sent to proprietors and occupiers of salmon fishings. A high percentage of the forms sent are returned (>90%). The Montrose Field Station of the Freshwater Fisheries Laboratory collates these data from the statistical districts (see section 9.1.4). Drift netting has been illegal in Scotland since 1962, but is still carried out in the English parts of the region off the south and west Cumbrian coast and in the Ribble and Lune Estuaries.

The effects of exploitation, especially by different catch methods (rod and line or nets), is an issue for salmon and sea trout stocks (MAFF/SO 1991). There are 257 net licences issued by the NRA in the region (1993 figures - see Table 9.1.7), representing just under a third of the total for England and Wales. The catch statistics of salmon and sea trout from the region's rivers compared with the rest of Britain are presented in Table 9.1.2.

Maitland & Campbell (1992) describe the possible effects of a variety of factors on freshwater fish. Issues mentioned that are of relevance in the region include abstraction of water, which may result in the loss of habitat and spawning grounds, and the possible effects on fish stocks of acid deposition (Edwards & Stoner 1990; Diamond *et al.* 1987). Farming and forestry (both afforestation and deforestation) can cause harmful effects in rivers, and waste water treatment - industrial and domestic - in the Liverpool Bay area may have stopped diadromous fish migrating up their natal rivers, perhaps locally causing the elimination of stocks. Where rivers are obstructed for amenity purposes, e.g. at Hodbarrow Lagoon in the Duddon Estuary and as proposed at Creetown, Wigtown Bay, effects on diadromous species are to be expected. The possible effects of proposed tidal barrages on rivers have been investigated for the Mersey, Wyre and Duddon Estuaries and for the Solway Firth (from Southerness to Grune Point).

In Scotland there is considerable evidence of a general decline in the catches of salmon in a number of major rivers. At present, there is no clear explanation for this situation, which may be related to the climate. However, more general concern relating to the state of wild salmon stocks has focused on a wide range of potential natural and anthropogenic effects, including pollution of river and inshore waters caused by, for example, land drainage, water abstraction, afforestation and acid rain; predation by aquatic mammals and birds in the freshwater and marine environment; natural physical cycles in the aquatic environment; and commercial netting operations during migratory phases.

On the Isle of Man, licences to fish commercially for salmon and sea trout have not been granted since 1989, although considerable numbers of salmon and sea trout continue to be caught in streams by poachers.

5.8.4 Information sources used

For the rivers in the Dumfries & Galloway Region of Scotland the distribution of diadromous fish species may be assessed by reference to the Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD) publication *A map of the distribution in Scottish rivers of the Atlantic salmon* Salmo salar *L.* (Gardiner & Egglishaw 1986), on which the information for Scotland on Map 5.8.1 is based. The information for England and Wales has been derived from the National Rivers Authority (NRA) published catch statistics.

The rivers in England and Wales shown in Map 5.8.1 are those that support net fisheries or have mean annual rod catches in excess of 30 salmon or 100 sea trout, plus some small rivers selected by the Welsh and North West Region of the NRA. Tributaries and minor rivers with a shared estuary are included under the main river and any remaining rivers in each NRA region are recorded separately in the 'others' category. The rivers in Scotland shown on Map 5.8.1 are the main ones that are known to contain populations of diadromous species. The information for the Isle of Man was supplied by the Department of Agriculture, Fisheries and Forestry, Fish Hatchery, Isle of Man and Port Erin Marine Laboratory.

European Council Regulation No. 3362/94 fixes, for 1995, details of the catch quotas for fish species for all European countries, i.e. the Total Allowable Catches (TACs), and certain conditions under which the species may be fished. European Council Regulations are published (where this is obligatory) in Luxembourg in the Official Journal of the European Communities. EC Regulation No. 3362/94 is updated annually (European Council 1994).

5.8.5 Acknowledgements

Thanks go to Derek Murison (SOAEFD Marine Laboratory, Aberdeen), David Dunkley (SOAEFD Montrose Field Station), Dr M.G. Pawson (MAFF Directorate of Fisheries Research, Lowestoft), Terry Holt (Port Erin Marine Laboratory) and Les Kneale and Jim Evans (DAFF Fish Hatchery, Cornaa, Isle of Man) for providing information and advice.

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Solomon, D.J. 1992. *Diversion and entrapment of fish at water intakes and outfalls*. London, HMSO and NRA.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Regional scientific information and advice	*Regional Fisheries Manager, Fisheries Department, NRA - Welsh Region, Cardiff, tel: 01222 770088
Regional scientific information and advice	*Regional Fisheries Manager, Fisheries Department, NRA - North West Region, Warrington, tel: 01925 653999
Scientific advice and policy for England and Wales; Fisheries Classification Scheme	*Head of Department, NRA Fisheries Department, Bristol, tel: 01454 624400
General enquiries	*Public Relations Officer, National Rivers Authority - Public Relations Department, Bristol, tel: 01454 624400
Research programme into freshwater habitats and species	Director, Institute of Freshwater Ecology - Head Office, Windermere Laboratory, Far Sawrey, Ambleside, Cumbria LA21 0LP, tel: 015394 42468
Conservation of wild salmon; salmonid research	Director, The Atlantic Salmon Trust, Moulin, Pitlochry PH16 5JQ, tel: 01796 473439
Wild salmon and freshwater fisheries policy	SOAEFD Division K2, Pentland House, 47 Robb's Loan, Edinburgh EH14 1TY, tel: 0131 244 6230
Collation of salmon and sea trout catch statistics in Scotland	SOAEFD, Freshwater Fisheries Laboratory, Montrose Field Station, 16 River Street, Montrose DD10 8DL, tel: 01674 677070
Research into freshwater fish species, habitats, behaviour and exploitation in Scotland	SOAEFD, Freshwater Fisheries Laboratory, Faskally, Pitlochry, Perthshire PH16 5LB, tel: 01796 472060
Additional fisheries data to that published in the Statistical Tables. Marine and estuarine fisheries research	SOAEFD Fisheries Research Services, Marine Laboratory, PO Box 101, Victoria Road, Aberdeen AB9 8DB, tel: 01224 876544
Research in the rivers of SW Scotland	West Galloway Fisheries Trust, 18 Main Street, Kirkcowna, Newton Stewart, Wigtownshire DG8 0HG, tel: 01671 830322
Fisheries of the Isle of Man, including statistics	*Fisheries Officer, Department of Agriculture, Fisheries & Forestry (DAFF), Douglas, tel: 01624 685857
Diadromous fish species in the Isle of Man	*Port Erin Marine Laboratory, tel: 01624 832027
Inter-government convention regulating salmon fishing on the high seas	Secretary, North Atlantic Salmon Conservation Organisation, 11 Rutland Square, Edinburgh EH1 2AS, tel: 0131 228 2551

* Starred contact addresses are given in full in the Appendix.

5.9 Fish: other species

Dr G.W. Potts & S.E. Swaby

5.9.1 Introduction

The region has a great variety of coastal and estuarine habitats, including large tidal bays; it has a particularly rich and well studied fish fauna. There are 130 species of exploited and unexploited fish recorded from off the mainland in this region, comprising two jawless fishes (Agnatha), 22 sharks and rays (elasmobranchs) and 106 bony fishes (teleosts) (based on the largest area surveyed for fishes - the Solway Firth (Potts & Swaby 1993b). The Isle of Man has a long history of fishing and recording fishes, with 146 species consisting of three jawless fishes, 21 sharks and rays and 121 bony fishes (Bruce *et al.* 1963). This region has records of all seven British marine and estuarine species protected under national, European and international legislation (Table 5.9.1). However, these have mostly been individual records of allis and twaite shads *Alosa alosa* and *Alosa fallax*, lampern and sea lamprey *Lampetra fluviatilis* and *Petromyzon marinus* and very occasional sturgeon *Acipenser sturio*. These species are considered threatened in UK and European waters (Potts & Swaby 1993a). In this region their status is not well known, and areas where spawning is thought to occur need to be studied to determine their value in both a national and a European context.

Map 5.9.1 Distribution records on the British Marine Fishes Database of allis shad and lampern. Source: after Potts & Swaby (1993b).

5.9.2 Important locations and species

The Dee Estuary has nineteen species of fish recorded, including the lampern, sea lamprey, sturgeon, allis and twaite shads and the smelt *Osmerus eperlanus* (Potts & Swaby 1993b). While exploited species, such as the flounder *Platichthys flesus*, bass *Dicentrarchus labrax* and grey mullet *Chelon labrosus* and *Liza ramada* are well known (see section 5.7), the unexploited species have yet to be fully catalogued. By 1948 all fish had disappeared from the Mersey Estuary (see section 5.9.3), apart from the occasional pelagic vagrant entering at high water. However, following improvements, fish species numbers increased to 35 (including freshwater species) (Wilson *et al.* 1988). From the Ribble Estuary, which has a history of poor water quality, only fourteen species of fish have been recorded. They are mostly robust, exploited species (flounder, sole *Solea solea*, sand goby, bass and herring *Clupea harengus)*, although smelt have been recorded as being present in small numbers during most of the year.

Morecambe Bay has records of 59 fish species. The littoral fishes are restricted by suitable habitats but are represented by the common goby, shanny *Lipophrys pholis,* butterfish *Pholis gunnellus* and the five-bearded rockling *Ciliata mustela.* Other fish recorded include the tope and surprising records of an albacore *Thunnus alalunga,* stranded alive in 1954, and a white marlin *Tetrapturus albidus* in 1983. The Duddon Estuary does not have a full fish list, as only twelve species have verified records from the Haverigg area. Both species of lampreys have been recorded running up the Rivers Kent and Bela; and the lampern has been recorded in Colton Beck and the sea lamprey in River Leven, in Cumbria (Pickering pers. comm.).

The Solway Firth is a large open estuary with 130 species of fish recorded, including from the beam trawl survey started in 1920 (Cumbria Sea Fisheries Committee). There are regular captures of allis shad in the Solway Firth (Wigtown Bay area), although not in great numbers, which

Table 5.9.1 Scheduled species and protected status

Species	*Wildlife and Countryside Act (Schedule)*	*EC Directive*	*Bern Convention (Appendix)*	*CITES (Appendix)*
Lampern		IIa, Va	III	
Sea lamprey		IIa	III	
Sturgeon	5	IIa, Va	III	I
Allis shad	5	IIa, Va	III	
Twaite shad		IIa, Va	III	
Common goby*			III	
Sand goby*			III	

Source: after Potts & Swaby (1993b). Key: *The sand and common gobies are both very abundant in UK.

suggests a spawning population may exist (Aprahamian & Aprahamian 1990). Map 5.9.1 shows the recorded distribution of lampern and allis shad in the region.

5.9.3 Human activities

Human activities affecting estuaries and adjacent coasts are summarised in Davidson *et al.* (1991); these activities affect the abundance and distribution of fish. Nationally, estuaries are used by up to 180 fish species for migration, spawning, feeding and as nursery grounds (Potts & Swaby 1993b). Urban and industrial development and agricultural pollution have been shown to have a detrimental effect on the estuarine environment, in particular through heavy metals and pesticides in the water (Jones 1979; Gould *et al.* 1987); Liverpool Bay, for example, into which flow the rivers Dee, Mersey and Ribble, is highly industrialised. The Mersey Estuary has been used for waste and pollutants disposal. In addition, dams, weirs, barrages and abstraction intakes, e.g. at Heysham Power Station (Henderson 1989), can impede the passage of migratory fish. While salmon 'passes' allow some selected species to migrate up or down rivers and estuaries, they provide obstacles to the majority of fish, which are unable to reach spawning and feeding grounds further upstream. Urbanisation and the discharge of untreated sewage to the sea and particularly into estuaries results in a reduction in dissolved oxygen to which fish are particularly sensitive (Norton & Murray 1983). The result is that fish leave the area and do not return until treatment plants reduce the amount of sewage and oxygen levels increase (Potts & Swaby 1993b). The possible effects of fisheries on species is discussed in sections 5.7 and 9.1. Sea angling occurs in many places throughout the region (Orton 1994) (see section 9.1.2).

Species such as sea fans and sea urchins are collected in this region as curios. In England this mainly involves the pink sea fan *Eunicella verrucosa,* whereas in Scotland the northern sea fan *Swiftia pallida* is most popular (Eno 1991).

5.9.4 Information sources used

There has been no comprehensive review of fish in this region, although some areas have been well studied. Sites that have been surveyed for fish are mostly confined to the major estuaries and major water bodies. Clwyd is included in the study of the marine and estuarine fish of Wales and the ongoing fish monitoring programme. The Factsheet Book on Welsh fish contains distribution maps on all species recorded in the county, with specific details of scheduled species in the accompanying report (Potts & Swaby 1993c, 1994). The review of the marine and estuarine fish in selected English estuaries, carried out by the Marine Biological Association for English Nature, covers the Dee, Mersey and Ribble, Morecambe Bay, the Duddon and the Solway Firth (Potts & Swaby 1993b). Each area has a verified species list and information on habitats and impacts. Other surveys of different parts of this region have been carried out by the National Rivers Authority, the Cumbria Sea Fisheries Committee, universities (Liverpool, Lancaster) and other research institutes (Institute of Freshwater Ecology). The fish fauna of the Isle of Man is well studied (Bruce *et al.* 1963). Current programmes include monitoring of seasonal migrations of basking shark *Cetorhinus maximus* by Port Erin Marine Laboratory and the Manx Trust for Nature Conservation. MAFF Fisheries Laboratory has records of the fish in this region and the surrounding rivers and estuaries, including unexploited species taken during their sampling programmes. The information obtained from all these sources has been collated on the British Marine Fishes Database.

5.9.5 Acknowledgements

The authors wish to thank Dr Mandy Richards (CCW) for her help in preparing this section.

5.9.6 Further sources of information

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
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Fisheries - Scotland	SOAEFD Fisheries Research Services, Marine Laboratory, PO Box 101, Victoria Road, Aberdeen AB9 8DB, tel: 01224 876544
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Fish conservation - UK	*Marine Advisory Officer, JNCC Peterborough, tel: 01733 62626
Fish conservation - England	*Marine Fisheries Officer, EN HQ, Peterborough, tel: 01733 340345
Fish conservation - Wales	*Marine and Coastal Section, CCW HQ, Bangor, tel: 01248 370444
Fish conservation - Scotland	*Aquatic Environments Branch, SNH HQ, Edinburgh, tel: 0131 446 2400
Fish conservation - Isle of Man	*Conservation Officer, Calf Marine Trust, Manx Nature Conservation Trust, Isle of Man, tel: 01624 801985

* Starred contact addresses are given in full in the Appendix.

5.10 Seabirds

M.L. Tasker

5.10.1 Introduction

This section deals with seabirds both at their colonies on land and while at sea. It covers not only those species usually regarded as seabirds (see Table 5.10.1), but also divers, grebes and seaduck: in other words, those species reliant for an important part of their life on the marine environment. Scientific names of all species are given in the tables.

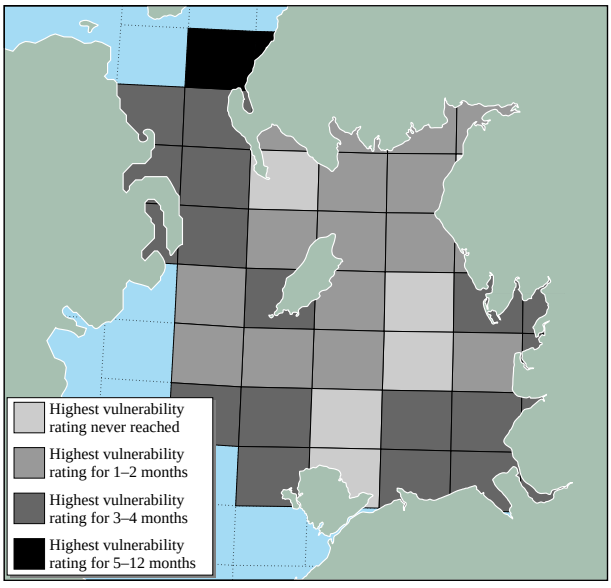
This region is important for seabirds in both national and international contexts. Total numbers of common tern and black-headed, lesser black-backed and herring gull breeding in the region all exceed 1% of their European populations. Numbers of cormorant, shag, great black-backed gull, Sandwich tern, little tern, guillemot, razorbill and black guillemot exceed nationally important levels (Table 5.10.1). The colony of cliff-nesting species at St. Bees Head is notable for being the only such colony in north-west England, and the only English breeding site of black guillemot. Numbers of wintering cormorant in the region exceed 1% of the European populations on the basis of counts at individual sites (Table 5.10.2); there have been insufficient counts of total populations to tell if this is the case for other species.

Areas at sea are of great importance to seabirds. The waters off the Mull of Galloway and to the west of the Isle of Man in particular hold vulnerable concentrations of seabirds during most of the year (Map 5.10.1).

Table 5.10.1 Overall importance of seabirds breeding in the region

Species	*Total*	*%GB*	*% Europe*
Fulmar *Fulmarus glacialis*	2,825	<1.0	<1.0
Manx shearwater *Puffinus puffinus*	75	<1.0	<1.0
Storm petrel *Hydrobates pelagicus*	50	<0.1	<1.0
Gannet *Morus bassanus*	830	<1.0	<1.0
Cormorant *Phalacrocorax carbo*	440	6.4	<1.0
Shag *Phalacrocorax aristotelis*	833	2.2	<1.0
Black-headed gull *Larus ridibundus*	23,400	14.0	1.9
Common gull *Larus canus*	17	<1.0	<1.0
Lesser black-backed gull *Larus fuscus*	19,646	23.8	10.5
Herring gull *Larus argentatus*	21,734	13.7	2.2
Great black-backed gull *Larus marinus*	490	2.6	<1.0
Kittiwake *Rissa tridactyla*	2,941	<1.0	<1.0
Sandwich tern *Sterna sandvicensis*	353	2.5	<1.0
Common tern *Sterna hirundo*	1,000	7.9	1.0
Arctic tern *Sterna paradisaea*	49	<1.0	<1.0
Little tern *Sterna albifrons*	121	4.9	<1.0
Guillemot *Uria aalge*	11,476	1.1	<1.0
Razorbill *Alca torda*	1,540	1.0	<1.0
Black guillemot *Cepphus grylle*	632	1.7	<1.0
Puffin *Fratercula arctica*	162	<1.0	<1.0

Sources: Figures for Britain from Walsh *et al.* (1994), for Europe from Lloyd *et al.* (1991). Note: regional totals are compiled from the most recent available good-quality counts up to 1993. Counts are of pairs, except for guillemots, razorbills, black guillemots and puffins, which are counted individually. Regional totals of terns have been calculated using 1993 colony counts, or the most recent available counts, to minimise possible duplication of numbers.



Map 5.10.1 Relative importance of region and adjacent seas for seabirds. The grid is of 15′N x 30′W rectangles; see text for explanation of vulnerability ratings. Source: JNCC Seabirds at Sea Team.

5.10.2 Important locations and species

The region is characterised by shallow nearshore waters and large estuarine complexes; this geography is reflected in the composition of the seabird community, which comprises mostly birds that prefer these habitats. Most important colonies are located on, or close to, large estuaries, and most of the seabird species for which the region is important feed

Table 5.10.2 Offshore wintering waterfowl populations of at least national importance

	Peak numbers	*1% GB*	*1% NW Europe*
Dee Estuary			
Cormorant *Phalacrocorax carbo*	276	130	1,200
Mersey Estuary			
Great crested grebe *Podiceps cristatus*	120	100	?
Alt			
Cormorant *Phalacrocorax carbo*	278	130	1,200
Ribble			
Cormorant *Phalacorcorax carbo*	195	130	1, 200
Morecambe Bay			
Great crested grebe *Podiceps cristatus*	285	100	?
Cormorant *Phalacrocorax carbo*	1,027	130	1,200
Eider *Somateria mollissima*	7,432	750	20,000
Red-breasted merganser *Mergus serrator*	306	100	1,000
Duddon Estuary			
Red-breasted merganser *Mergus serrator*	307	100	1,000
Solway Firth			
Cormorant *Phalacrocorax carbo*	588	130	1,200
Scaup *Aythya marila*	3,109	110	3,100

Sources: Peak numbers from Waters & Cranswick (1993), Kirby *et al.* (1993), Owen *et al.* (1986) and Birds database; 1% GB from Waters & Cranswick (1993), 1% NW Europe from Rose & Scott (1994). Note: counts are of individuals.

in estuaries, often on exposed intertidal mussel beds (gulls) or creeks and the tide edge (terns). Most breeding seabirds require habitat that is free from predatory mammals, hence nearly all colonies are on offshore islands, cliffs or remote parts of spits, sand dunes and saltmarshes. The large gulls appear to be able to tolerate more disturbance by mammals than the smaller seabird species. Tern colonies do not seem able to tolerate great disturbance, particularly early in the nesting season, and particularly from mammalian predators such as foxes.

Seven colonies hold numbers of seabirds at or above 1% of the total population of the European Union total for that species (Table 5.10.3, Map 5.10.2). A further four colonies are important at the Great Britain level. The greatest concentrations of birds occur at the northern edge of the region, near to the seabird colony at Ailsa Craig (in Region 14). Liverpool Bay and the south-eastern part of the Irish Sea are important during the late winter for seaduck and divers. The North Channel is important during the post-breeding period for auks. Low-lying land in the Ribble Estuary, the entrance to Barrow Harbour, the Duddon Estuary and around the Solway supports internationally important seabird colonies. The Isle of Man has a diverse seabird population, with the little tern colony at Rue Point being the most significant in a biogeographic context. The cliff-nesting seabird colony at St Bees Head is notable for being the only such colony in north-west England. The seabird colonies on the Ribble and at Rockcliffe Marsh in the Solway are within Special Protection Areas (SPAs) established under the EU Birds Directive for their bird populations.

The Ribble Marshes and South Walney hold more than one population of international importance. The feeding areas of birds from these colonies are as important as the breeding areas themselves, as colonies cannot survive without food. Little research has been carried out in the area to determine feeding areas or general ranges; however most of these important colonies comprise birds that feed in nearshore, intertidal or inland habitats.

Map 5.10.2 Colonies holding at least 1% of the GB population of any seabird species. Numbers are those listed in Table 5.10.3. Source: JNCC Seabird Colony Register.

The waters of the area support some nationally important concentrations of seabirds wintering close to the coast or in the large estuaries (Table 5.10.2). Numbers of cormorants in the Dee exceed 2% of the national total. Wintering great crested grebes in the Mersey average more than 1% of the national total. Numbers of cormorants in the Alt and the Ribble Estuaries are nationally important. Morecambe Bay is the most important site in winter in Britain for cormorants, with the average peak number over a period of five winters being more than 1,000 birds. The Bay also holds nationally important flocks of great crested grebe, eider and red-breasted merganser. The Duddon Estuary and the Solway are nationally important for wintering red-breasted mergansers and cormorants respectively. The Solway is internationally important for

Table 5.10.3 Seabird colonies of at least national importance for particular species

*Site no.**	*Colony*	*Grid ref*	*Species*	*Count date*	*Count*	*≥1% EU/GB population*	*Protected status*
1	Gronant	SJ087845	Little tern	1991	54	GB	SSSI
2	Shotton steelworks	SJ297709	Common tern	1992	312	GB	None
3	Ribble marshes	SD390240	Black-headed gull	1989	20,000	EU	SPA
			Common tern	1992	550	EU	None
4	Foulney	SD248640	Sandwich tern	1989	770	EU	SSSI
			Little tern	1992	29	GB	None
5	South Walney	SD220610	Lesser b.-b. gull	1988	31,203	EU	SSSI
			Herring gull	1988	16,525	EU	None
			Sandwich tern	1992	450	GB	None
6	Hodbarrow	SD175783	Sandwich tern	1991	520	EU	SSSI
7	Siddick	NY003322	Little tern	1989	30	GB	None
8	Rockcliffe Marsh	NY315635	Lesser b.-b. gull	1990	1,540	EU	SPA
9	Portling	NX878534	Cormorant	1993	192	EU	None
10	Almorness	NX837517	Lesser b.-b. gull	1987	1,500	EU	None
11	Rue Point	NX413034	Little tern	1989	30	GB	None

Source: JNCC/Seabird Group Seabird Colony Register. Key: * Site numbers are as shown on Map 5.10.2. GB = nationally important; EU = internationally important; SSSI = Site of Special Scientific Interest; SPA = Special Protection Area. Notes: Counts are of pairs, except for little terns at Foulney, which are counted individually. For most species the most recent available good-quality count is presented. For terns (whose numbers may fluctuate markedly from year to year, reflecting inter-colony movements), the highest count from the period 1989-93 is presented.

scaup. The Irish Sea also supports substantial numbers of common scoter; these birds often winter out of (easy) sight of land, and the precise location of the largest flocks appears to vary from year to year. Surveys in the mid-1980s recorded flocks off the Solway, off the Ribble, and in various places off the north coast of Wales (Barton *et al*. 1994). Little and common terns, and black-headed, lesser black-backed and herring gulls occur in moderate to high densities off the large estuaries at several seasons of the year (Stone *et al*. 1995.). There have been no recent comprehensive surveys of the region for nearshore birds.

The most important area overall in the region for the more offshore species is off the Mull of Galloway, in the North Channel. This area, and that to the west of the Isle of Man, holds large numbers of Manx shearwaters in the autumn and moderate densities of several other species (such as guillemots, razorbills and common and arctic terns) at other times of year (Stone *et al*. 1995). The waters between the Lake District and the Isle of Man support moderate densities of guillemots and razorbills in the early autumn. There are, at present, no protected sites at sea in the region. At sea, seabirds' natural foods range from zooplankton to small fish and waste from fishing fleets. Habitats that concentrate any of these foods are preferred. Zooplankton can be concentrated in zones where water masses meet, or where tides converge around islands or over some sea-bed features. Common scoter feed on a range of small or immature shellfish, and are likely to prefer areas with high spatfalls of these species. In general, scoters, divers and grebes tend to feed in areas with less than about 20 m water depth.

5.10.3 Human activities

Seabirds can be particularly affected by marine oil pollution, and spills near the main colonies during the breeding season could be particularly damaging. An oil spill in the Irish Sea in the late 1960s had a damaging effect on seabirds in the area (Hope Jones *et al*. 1970; Holdgate 1971). There have been concerns that offshore oil exploration in the area will add to the risks of oil spill but so far there have been no major spills from this source. Spills (not only of oil) can also occur from non-tanker shipping movements. The major shipping route from the west and south-west into Liverpool passes close to coast in this area. Birds using the sea in this region are not as vulnerable to oil pollution as are those on other parts of the European continental shelf (Map 5.10.1) (Carter *et al*. 1993, Webb *et al*. in prep.), because they are mostly species that feed by diving from the air, not by sitting on the sea surface.

Seabird vulnerability is calculated from the abundance of birds in the rectangles shown on the map and a factor derived from the amount of time spent on the water, the overall population size and the rate at which the species recruits new individuals to the population (for discussion of vulnerability see Carter *et al*. (1993) and Webb *et al*. (in prep.)).

Breeding terns are highly vulnerable to localised disturbance or predation, which may cause colony desertion or failure to rear chicks, and in this region large numbers of terns breed at potentially vulnerable sites, including beaches. Many tern colonies in this region are wardened or otherwise protected, but predation (e.g. by foxes) has nevertheless been a serious problem at some important colonies. Changes of habitats to the landward of gull or tern colonies may increase numbers of foxes in an area, possibly leading to desertion of the colonies.

5.10.4 Information sources used

All seabird colonies in the region were counted between 1984 and 1987. These counts, and all those made since 1969, are held on the JNCC/Seabird Group Seabird Colony Register. Numbers and breeding performance of several species are evaluated annually at several colonies in the region. Surveys of birds at sea have been carried out by JNCC's Seabirds at Sea Team, whose survey effort from ships has been good in the eastern Irish Sea, with the exception of the area off the Solway, where further effort is needed (Stone *et al*. 1995). Waters at 2 km and 5 km from the shore have been surveyed from the air by SAST on a bi-monthly basis over one year (Barton *et al*. 1994). Coverage, from the land, of most nearshore waters in the region has been generally poor.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Seabird colonies	*Coordinator, Seabird Colony Register, JNCC, Aberdeen, tel: 01224 642863
Seabirds at sea	*Seabirds at Sea Team, JNCC, Aberdeen, tel: 01224 642863
Birds database	*Vertebrate Ecology and Conservation Branch, JNCC, Peterborough, tel: 01733 62626
Nearshore waterfowl	*Wildfowl and Wetlands Trust, Slimbridge, tel: 01453 890333

* Starred contact addresses are given in full in the Appendix.

5.11 Other breeding birds

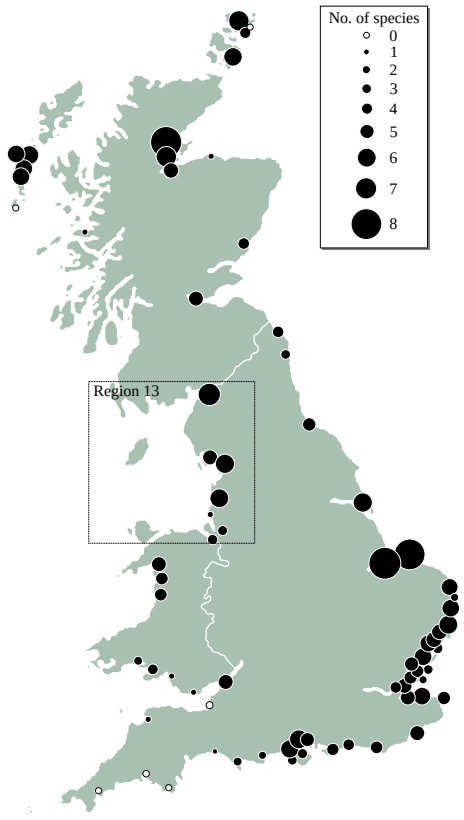
D.M. Craddock & D.A. Stroud

5.11.1 Introduction

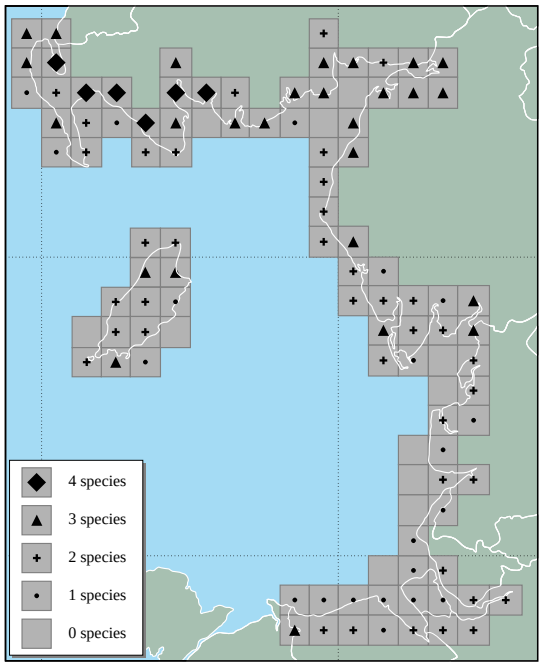
This section outlines the importance of the region for breeding birds other than seabirds. Because of their distinctive ecology and mixed-species breeding colonies, seabirds are described separately in section 5.10.

The physical nature of this coastline is varied and this determines the distribution of the different breeding bird assemblages occurring. As well as stretches of cliff, there are also many major estuarine systems in the region, which hold extensive areas of saltmarsh and associated wet grassland, with wide expanses of intertidal sand and mud flats, backed in places by large vegetated sand dune systems and reed beds.

The variety of habitats present makes the region of considerable importance for breeding birds (in addition to its importance for seabirds). In the context of the west coast of Britain, the Ribble, Morecambe Bay and the Solway have notably species-rich breeding wader assemblages, all with more than six species breeding (Map 5.11.1). Maps 5.11.2, 5.11.3 and 5.11.4 show the incidence of confirmed breeding in coastal 10 km squares of selected species characteristic of three habitat types, respectively wet grassland (teal *Anas crecca*, lapwing *Vanellus vanellus*, redshank *Tringa totanus*, mallard *Anas platyrhynchos*, snipe *Gallinago gallinago* and



Map 5.11.1 Numbers of different breeding waders on estuaries in Britain. Note that numbers relate only to estuarine sites and that the waders also breed elsewhere along the coast. Source: Davidson *et al.* 1991.



Map 5.11.2 Number of confirmed breeding species characteristic of wet grassland (redshank, snipe, lapwing, teal, mallard and pintail) in coastal 10 km squares. Source: based on Gibbons, Reid & Chapman (1993).

pintail *Anas acuta*); shingle, sand dunes and other dry grasslands (ringed plover *Charadrius hiaticula*, oystercatcher *Haematopus ostralegus* and shelduck *Tadorna tadorna*); and cliffs (chough *Pyrrhocorax pyrrhocorax* and peregrine falcon *Falco peregrinus*). The saltmarshes and wet and dry grasslands of the region are of significance in a national context for their populations of breeding waders (Davidson 1991; Davidson *et al.* 1991). There are significant concentrations of saltmarsh-breeding waders, such as redshank, oystercatcher, dunlin *Calidris alpina* and curlew *Numenius arquata,* and substantial proportions of the British west coast populations are present (Allport, O'Brien & Cadbury 1986). The extensive areas of intertidal sands and mud-flats adjacent to saltmarshes provide important feeding areas. Estuarine sand dune systems hold large numbers of breeding shelduck, ringed plover and other waterfowl (Davidson *et al.* 1991; Prater 1989) and, especially in Morecambe Bay and around Walney Island, eider duck *Somateria mollisima,* as well as a number of passerine (e.g. songbird) species. Eider ducks occur more numerously in Scotland; however the eider ducks in Morecambe Bay are the most southerly breeding population in Britain and the only regularly breeding eiders on the west coast of England (Gibbons, Reid & Chapman 1993). The breeding shelduck population on dry grassland in the Ribble Estuary is the most numerous in Britain. The reed beds of Leighton Moss are of national significance and hold the only bitterns and bearded tits breeding north of the Wash and on the west coast of Britain.

The Isle of Man is the most important part of the region for cliff-breeding birds and has an important breeding chough population. In this region peregrine falcons breed

Table 5.11.1 Numbers of pairs of territorial (presumed breeding) ringed plovers in 1984

	Pairs (coastal) counted in survey	*% GB total counted in survey*
Clwyd	8	0.1
Cheshire	2	0.0
Merseyside	10	0.1
Lancashire	19	0.3
Cumbria	164	2.3
Dumfries & Galloway	177	2.5
Isle of Man	70	1.0
Region 13	***450***	***6.2***
Wales	221	3.1
England	1,984	27.5
Scotland	5,002	69.4
GB total	***7,207***	

Source: Prater (1989). Note: survey coverage varied between counties, although it was generally good in the region overall.

mainly in Clwyd, southern Cumbria and Dumfries & Galloway, as well as on the Isle of Man.

Nine coastal wetlands (Luce Bay, Solway Firth, Duddon Estuary, Morecambe Bay, Martin Mere and the estuaries of the Ribble, Alt, Mersey and Dee) are of international importance for their wintering waterfowl populations (Map 5.12.1), and these sites are also of importance, with others, for their breeding birds. The Ribble and Alt Estuaries have been designated as one Special Protection Area (SPA) and Ramsar site to reflect the ecological unity of these areas as demonstrated through waterfowl movements in winter. Leighton Moss is a Ramsar site and SPA for its important breeding populations of reed-bed species, and the Upper Solway Flats and Marshes and the Dee Estuary are also Ramsar sites and SPAs. Numbers of lowland breeding waders, especially those associated with wet grassland areas and saltmarshes, have been declining not only nationally but also internationally (Hötker 1991). The importance for breeding birds of these remaining areas in the region is thus likely to increase.

5.11.2 Important locations and species

Breeding ringed plovers nest in sandier areas along the coast (Davidson *et al.* 1991; Prater 1989) (Table 5.11.1; Map 5.11.5), with largest numbers in Morecambe Bay, the Solway Firth and Luce Bay. At least 50 pairs of breeding ringed plovers nest on each of the Solway Firth and Morecambe Bay - the main concentrations on the west coast of Britain outside the Outer Hebrides.

The Solway Firth, Duddon Estuary, Morecambe Bay, Ribble & Alt, Mersey and Dee Estuaries are of major international importance for their non-breeding waterfowl populations (Pritchard *et al.* 1992); these areas also hold significant populations of breeding waterfowl, particularly waders. Table 5.11.2 summarises breeding shelduck populations holding more than 45 birds: the Ribble, Morecambe Bay, Inner Solway and Duddon Estuary each hold over 100 pairs. This region has three of the five largest populations of shelduck counted in Delany's 1992 survey.

Map 5.11.3 Number of confirmed breeding species characteristic of shingle, sand dunes and other dry grasslands (ringed plover, oystercatcher and shelduck) in coastal 10 km squares. Source: based on Gibbons, Reid & Chapman (1993).

The Inner Solway, Duddon, Morecambe Bay and Ribble all hold both large numbers and high densities of saltmarsh-breeding redshank and oystercatcher, together with occasional dunlin and curlew (Allport, O'Brien & Cadbury 1986). The highest density in the region of saltmarsh-breeding oystercatchers occurs on the Solway (Table 5.11.3), with the Duddon and Morecambe Bay also holding notable densities of this species. Dunlin breed on the saltmarshes of the Solway, Morecambe Bay and the Ribble and are of significance as the most southerly regularly saltmarsh-breeding dunlin in Britain, the main coastal concentrations occurring further north in the Hebrides (Fuller *et al.* 1986). Map 5.11.6 shows the locations of saltmarshes surveyed for their breeding waders in 1985, with densities given in Table 5.11.3.

There are a number of important coastal reed beds and associated wetlands within the region. Leighton Moss, which is the largest reed bed in north-west England, holds nationally important numbers of breeding bittern *Botaurus*

Table 5.11.2 Sites holding at least 45 shelduck on the coast of the region in 1992

Site	*Total*	*Males*	*Pairs*	*Non-breeding birds*	*National rank order**
Dee	875	45	98	641	12
Mersey Estuary	472	0	0	0	22
Ribble Estuary	3,281	131	1,081	988	1
Morecambe Bay	2,144	43	417	621	4
Duddon Estuary	774	32	117	443	14
River Irt & Mite Estuary	68	3	25	15	75
Inner Solway	1,834	36	257	701	5
Wigtown Bay	189	33	44	77	42

Source: Delany (pers. comm.). Key: *determined on total count of birds.

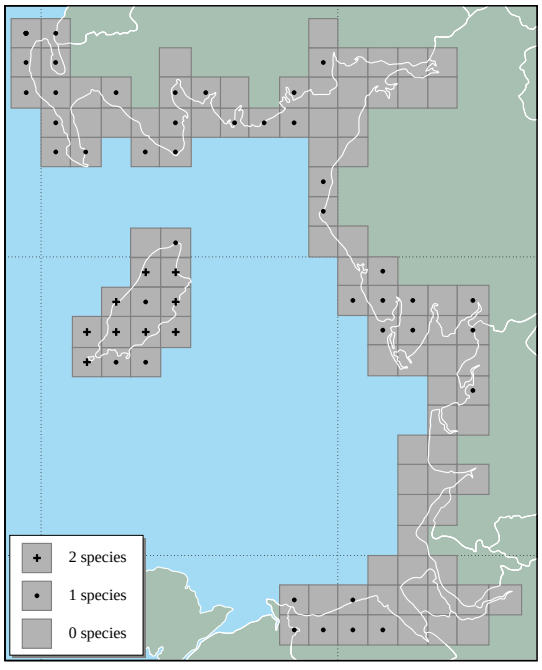
Table 5.11.3 Densities of breeding waders on a sample of saltmarshes surveyed in 1985*

Site no.	Site	Oystercatcher (pairs/km²)	Ringed plover (pairs/km²)	Lapwing (pairs/km²)	Curlew (pairs/km²)	Dunlin (pairs/km²)	Redshank (pairs/km²)	Total waders (pairs/km²)
	Cheshire							
1	Burton	6	-	-	-	-	38	44
	Lancashire							
2	Marsh End	4	-	-	-	-	36	40
3	Banks Marsh	3	-	-	-	2	65	70
4	Hesketh	20	-	-	-	-	74	94
5	Pilling	14	-	11	4	-	74	103
6	Cockerham	9	-	-	-	-	32	41
7	Aldcliffe	12		14	4	4	101	131
8	Carnforth: inner marsh	3	-	24	3	6	83	110
9	Carnforth: outer marsh	21	-	-	-	-	2	23
	Cumbria							
10	Humphrey Head	7	-	30	4	-	23	60
11	North Walney Island	41	-	28	3	-	53	122
12	Rockcliffe: site A	14	-	35	-	-	20	60
13	Rockcliffe: site B	72	8	21	-	2	28	131
	Dumfries & Galloway							
14	Kirkconnell	11	-	7	2	-	21	41
15	Southwick	15	1	-	1	-	1	18

Source: Allport *et al.* (1986). Key: *other saltmarshes in the region were *not* surveyed, so this is not a comprehensive listing. Note: site numbers as shown on Map 5.11.6.

stellaris, marsh harrier *Circus aeruginosus*, shoveler *Anas clypeata*, pochard *Aythya ferina* and bearded tit *Panurus biamicus*, as well as large populations of reed-bed passerines, including reed warbler *Acrocephalus scirpaceus* and sedge warbler *A. schoenobaenus* (Wilson 1990). A number of breeding wildfowl, including little grebe *Tachybaptus ruficollis*, grey heron *Ardea cinerea*, mallard, pochard *Athya ferina*, moorhen *Gallinula chloropus* and coot *Fulica atra*, occur at high densities in some coastal wetlands.

There are a number of coastal SSSIs within the region containing cliff, sand dune and estuarine habitats, and additionally the RSPB reserves at the Dee Estuary,



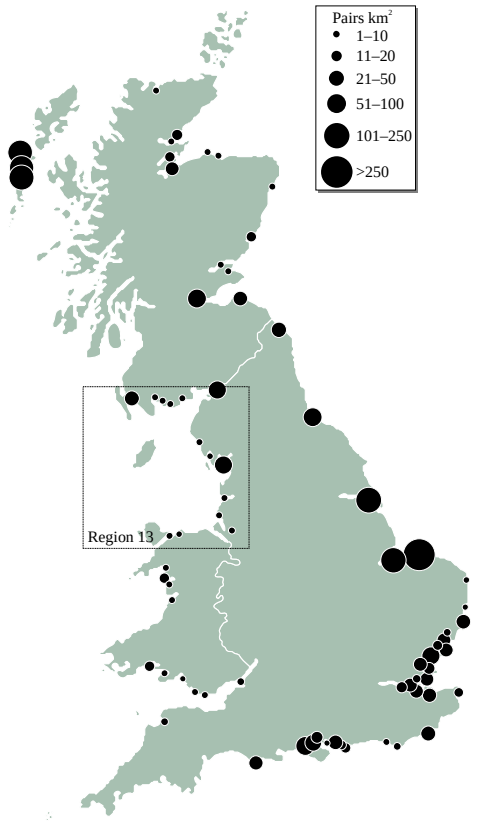
Map 5.11.4 Number of confirmed breeding species characteristic of cliff (chough and peregrine falcon) in coastal 10 km squares. Based on Gibbons, Reid & Chapman (1993).

Morecambe Bay, Leighton Moss, Hodbarrow, Mersehead (Inner Solway) and Campfield Marsh (Solway) have breeding bird interest relevant to this section (see also section 7.5.4).

5.11.3 Human activities

In this region any incremental land claim along the soft coasts of estuarine and sand dune systems has the potential to affect breeding waterfowl populations through loss of nesting and feeding habitat, although at important sites SSSI designation can limit such activity. The appropriate agricultural and other management of wet grassland in the region (see e.g. Coleshaw 1995; Harold 1995; Scholey 1995; Thomas *et al.* 1995) is of crucial importance for their wader populations (see papers in Hötker 1991). Likewise, different grazing regimes on saltmarshes can significantly alter the density and nesting success of breeding waders through effects on vegetation composition and structure (Cadbury, Green & Allport 1987). The correct management of coastal reed beds is of key importance for the continued survival of their characteristic bird assemblage, which in this region includes bittern, shoveler, pochard, marsh harrier, bearded tit, reed warbler and sedge warbler. These needs are outlined in detail by Everett (1989) and Burgess & Evans (1989). Active land management for conservation has, in many coastal areas, increased the populations of breeding waterfowl. Reed-bed management for bitterns on RSPB reserves has served to stabilise numbers in these areas (Everett 1989), although overall the population in the region and nationally is at critically low levels (just fifteen calling males in Britain in 1994). Human disturbance during the nesting season may have significant effects on birds' breeding success (Pienkowski 1992), although for the birds discussed in this section there are few good assessments of the scale of the problem for this region.

Oil pollution is well known as a serious potential threat to waterfowl where high densities of birds occur, and there



Map 5.11.5 Numbers of breeding ringed plover in Britain. Note that numbers shown relate only to estuarine sites and that the species also breeds elsewhere along the coast. Source: Davidson *et al.* (1991) from data in Prater (1989).

Map 5.11.6 Saltmarshes where breeding waders were sample surveyed in 1985. Source: Allport *et al.* (1986).

have been major past oil pollution incidents on the Mersey Estuary. In areas of the highest risk there are, however, well-developed contingency plans for dealing with accidental spillages. There have also been instances of birds being killed by toxic contaminants (Bull *et al.* 1983).

5.11.4 Information sources used

The most recent and comprehensive overview of the status of breeding birds throughout Britain and Ireland is provided by Gibbons, Reid & Chapman (1993). This summarises the results of a national breeding bird census undertaken between 1988 and 1991 and compares distributions at the 10 x 10 km square level with those recorded in the first breeding bird atlas of 1968-1972 (Sharrock 1976). Whilst these data are one of the best sources for comparisons at county, regional or national scales, care should be taken with their use to assess individual sites or 10 km squares. This is because the tetrad coverage of each 10 km square was not always the same, and since the atlas survey period (1988-1991) distributions of some breeding species may have changed. Between- and within-region comparisons of precise distributions and densities based on coastal 10 x 10 km should be undertaken with caution, as there may be greatly varying amounts of land within each square.

For a number of species, additional extensive survey work has been undertaken by volunteers. Usually these surveys have been organised as part of wider British surveys (e.g. for ringed plover (Prater 1989), mute swan *Cygnus olor* (Delany, Greenwood & Kirby 1992) and shelduck (Delany pers. comm.)). Intensive monitoring is undertaken on RSPB reserves (Hirons & Lambton 1991).

5.11.5 Acknowledgements

The authors would like to thank David Cole (JNCC), George Boobyer (JNCC) and Simon Delany (WWT) for their assistance, and Dominic Counsell (SNH), Tim Cleeves (RSPB), Kathy Duncan (SNH), Matthew Ellis (CCW) and Stephanie Tyler (RSPB) for their comments.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Breeding atlas data	*Dr Rowena Langston, Development Unit, British Trust for Ornithology, Thetford, tel: 01842 750050
Coastal breeding wildfowl data	*Wildfowl & Wetlands Trust, Slimbridge, tel: 01453 890333
Site designations (Scotland)	*SNH HQ, Edinburgh, tel: 0131 554 9797
Site designations (England)	*Designations Team, English Nature HQ, Peterborough, tel: 01733 340345
Site designations (Wales)	*CCW HQ, Bangor, tel: 01248 370444
RSPB Reserves, Clwyd	*Regional Officer, RSPB Wales Regional Office, Newtown, tel: 01686 626678
RSPB Reserves, Cheshire, Merseyside, Lancashire	*Regional Officer, RSPB North West Regional Office, Huddersfield, tel: 01484 861148
RSPB Reserves, Cumbria	*Regional Officer, RSPB North England Regional Office, Newcastle upon Tyne, tel: 0191 281 3366
RSPB Reserves, Dumfries & Galloway	*Regional Officer, RSPB South and West Scotland Regional Office, Glasgow, tel: 0141 945 5224

* Starred contact addresses are given in full in the Appendix.

5.12 Migrant and wintering waterfowl

D.A. Stroud & D.M. Craddock

5.12.1 Introduction

This section describes the importance of the region for waterfowl, defined as waders and wildfowl (divers, grebes, ducks, geese and swans together with coot *Fulica atra*). The importance of offshore areas for wintering divers, grebes, seaducks and cormorant *Phalacrocorax carbo* is outlined in section 5.10.

A large extent of this region's coast is estuarine in nature, and as many of the estuaries are large, the region is of great importance for wintering waterfowl in UK and international contexts. It holds about 665,000 waterfowl in mid-winter, a third of the British total. For many species, sites within the region are the most important within the UK, and for several the region holds a significant proportion of the total UK population, either in the migration periods or in winter. The Dee, Mersey, Ribble & Alt Estuaries, Morecambe Bay, the Duddon Estuary and the Solway Firth are individually and collectively of major international importance for their waterfowl populations. Also, since it is on the west of the British mainland, the region can increase in importance in periods of severe cold weather further east in Britain or Europe, when there may be major influxes of waterfowl, such as wigeon and teal, from other coastal regions or inland areas (Ridgill & Fox 1990). Some sites also act as local cold weather refuges, as inner parts of estuarine systems freeze more slowly than other coastal and inland wetlands, so providing open water when other sites are unavailable (Owen, Atkinson-Willes & Salmon 1986).

Although not all sections have been regularly monitored, the rocky shoreline of the region is also of importance for several wader species. Densities of wintering shorebirds on non-estuarine coasts are among the highest on the west coast of Britain and are exceeded only in parts of eastern Scotland and Northern Ireland (Moser & Summers 1987; Table 5.12.1). They are highest on the Cumbrian and Isle of Man coasts.

Table 5.12.2 shows the total January 1993 waterfowl count for this coastal region and for England, Scotland, Wales and Britain (but not the Isle of Man). However, comparisons between these figures give only a rough guide to the relative importance of the region, since the data (from Rose & Taylor 1993 and Waters & Cranswick 1993) are uncorrected for coverage; some areas are better counted than others.

The coastline, especially the large estuaries of the region, is of major importance for migrant waterfowl in spring and autumn. The region lies on the major migratory flyway of the east Atlantic, and many birds moving to and from wintering areas on the African, Mediterranean and south-west European coasts to arctic breeding grounds pass through and stage on the coast here. The extent to which this occurs varies between species, but it emphasises the international responsibility for the conservation of these areas and their migrant waterfowl populations.

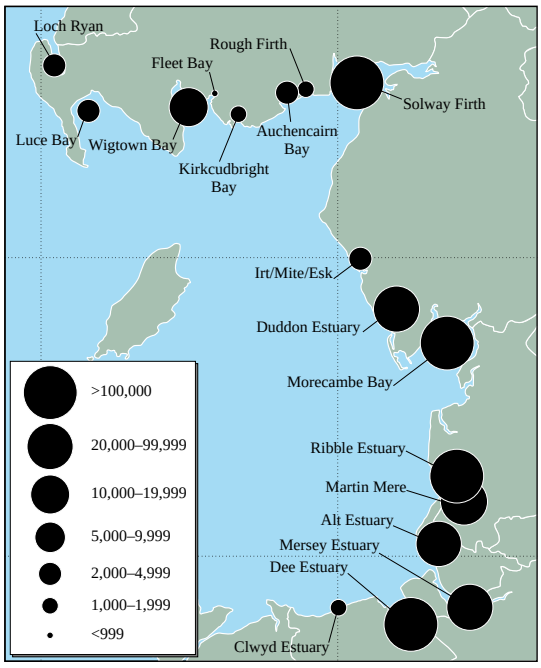
5.12.2 Important locations and species

Ten coastal wetlands (the estuaries of the Dee, Mersey, Alt and Ribble, and Martin Mere, Morecambe Bay, Duddon Estuary, Solway Firth, Wigtown Bay and Luce Bay) are internationally important for their wintering waterfowl populations (Table 5.12.3). The Ribble and Alt Estuaries have been designated as one Special Protection Area (SPA) and Ramsar site to reflect the ecological unity of these areas as demonstrated by waterfowl movements (Kirby *et al.* 1988). As well as their international importance for wintering populations of several species of waterfowl, the Solway, Duddon, Ribble and Alt, Mersey and Dee Estuaries, Morecambe Bay and Martin Mere all qualify as of international importance by holding over 20,000 waterfowl (Table 5.12.3). Indeed the region contains four of the seven sites holding the most non-breeding waterfowl in the UK (Ribble, Morecambe Bay, Dee and Solway), all with over 100,000 birds on average. The Ribble Estuary is of particular note, holding populations of seventeen species at levels of national (two species) or international (fifteen species) importance (Table 5.12.3). Ringing studies have shown that many wintering species (e.g. dunlin *Calidris alpina* and grey plover *Pluvialis squatarola*) demonstrate complex patterns of interchange between sites during the course of a winter, which means that individual sites cannot be considered in isolation (Davidson *et al.* 1991). Sites with extensive areas of saltmarsh or grazing marsh in close proximity to intertidal areas, such as the Ribble, the Solway and the Dee, typically have large populations of wigeon. Such areas are also attractive to lapwing, curlew and golden plover, as they provide a wide range of feeding opportunities. Sheltered muddy substrates, as in the Mersey Estuary, are especially

Table 5.12.1 Overall densities of wintering waders on non-estuarine coasts in Region 13

	Number of wader species recorded	*Total number non-estuarine waders*	*Extent of non-cliff, non-estuarine coast in county (km)*	*Extent of coast surveyed (km)*	*Overall density (birds/km coast)*
Clwyd	10	1,951	32.8	25.0	78.0
Cumbria	12	6,570	60.8	60.8	108.0
Dumfries & Galloway	15	4,481	164.1	153.4	29.2
Isle of Man	12	5,919	81.9	60.5	97.8

Source: Winter Shorebird Count - Moser & Summers (1987).



Map 5.12.1 Distribution of main concentrations of wintering intertidal waterfowl. Size of circle proportional to 5-year mean of waterfowl numbers, from Waters & Cranswick (1993). Offshore sea-duck concentrations are not shown (see Kirby, Evans & Fox (1993) and section 5.10), nor are the distributions of those waterfowl, mainly waders, wintering on the non-estuarine coast (see Moser & Summers (1987)).

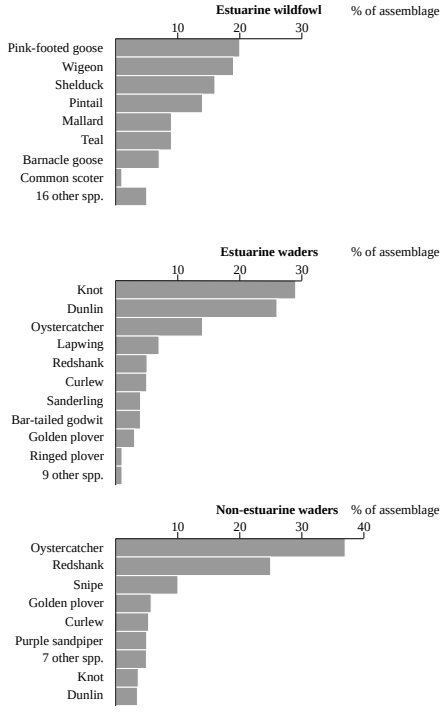


Fig 5.12.1 Relative species composition of non-breeding waterfowl assemblages on coastal areas of the region. Estuarine waterfowl data from Prater (1981), non-estuarine wader data from Moser & Summers (1987).

attractive to dunlin, whilst sandier estuaries and embayments hold larger numbers of knot, oystercatcher and curlew (e.g. Morecambe Bay).

At regularly counted estuaries (Map 5.12.1), a range of different wintering waterfowl assemblages occur, determined by habitat characteristics. There are 22 species of wintering waterfowl that occur at levels of international importance on at least one estuary, and a further seven (Table 5.12.3) that occur at levels of national (i.e. Great Britain) importance. Of particular significance is the entire world population of Svalbard barnacle geese, which winters on the Solway Firth. Very significant proportions of other populations, for example the Canadian/Greenlandic population of knot *Calidris canutus islandica*, occur in winter or on migration (Davidson & Wilson 1992). At many sites, oystercatcher *Haematopus ostralegus* is proportionally the most abundant waterfowl species, being numerous at both large (e.g. English/Welsh Dee, Solway and Duddon) and smaller sites (e.g. Esk, Rough Firth and the Galloway Dee). Overall, however, knot *Calidris canutus* is the most frequently occurring wader (e.g. Alt, Ribble and Morecambe Bay), followed by dunlin (Figure 5.12.1). On the more northerly estuaries within the region, geese occur increasingly frequently, with pink-footed *Anser brachyrhynchus*, greylag *A. anser* and barnacle geese *Branta leucopsis* being important components of the waterfowl assemblage on Scottish estuaries in the region. Large numbers of herbivorous wildfowl, such as wigeon *Anas penelope*, occur especially frequently on the Ribble and Mersey Estuaries, whilst the region is also notable for the concentrations of pintail *Anas acuta* at several estuaries.

Other non-breeding waterfowl occurring regularly on estuaries include cormorant, teal *Anas crecca*, mallard *A. platyrhynchos*, shelduck *T. tadorna*, dunlin (the most numerous waterfowl species on the Mersey), lapwing *V. vanellus*, curlew *Numenius arquata*, golden plover *Pluvialis*

Table 5.12.2 Waterfowl counts for the region, England, Scotland, Wales and Great Britain in January 1993

	Total waterfowl count in January 1993	*Number of sites counted*	*% of count in Region 13*
Coastal sites in Region 13	664,953	21	-
All counted Scottish coastal sites	299,676	78	-
All counted English coastal sites	1,577,388	106	-
All counted Welsh coastal sites	183,897	30	-
All counted British coastal sites*	2,060,961	214	32.3

Source: Waters & Cranswick (1993) and Rose & Taylor (1993). Key: *excludes the Isle of Man. Note: Care should be taken in interpretation as count coverage varies from country to country and has not been corrected. Region 13 straddles the borders of England, Wales and Scotland, so comparisons between regional totals and English, Welsh and Scottish totals could be misleading.

Table 5.12.3 Wintering waterfowl numbers on estuaries in the region

Site	*Site protection status*	*Five year mean numbers wintering waterfowl*	*1992/93 peak waterfowl numbers*	*1992/93 peak wildfowl numbers*[a]	*1992/93 peak wader numbers*[a]	*Species occurring at levels of national or international* importance*
Clwyd Estuary		3,956	4,718	884	3,834	-
Dee Estuary (England/Wales)	SPA & Ramsar	**145,760	186,422	28,124	158,298	Pintail*, redshank*, knot*, oystercatcher*, shelduck*, black-tailed godwit*, teal*, turnstone*, dunlin*, curlew*, bar-tailed godwit*, grey plover*, sanderling, cormorant
Mersey Estuary		**82,942	80,090	30,571	49,519	Pintail*, redshank*, teal*, dunlin*, shelduck*, grey plover, wigeon, great crested grebe, curlew, black-tailed godwit
Alt Estuary	SPA & Ramsar (with Ribble Estuary)	**45,793	13,232	1,678	11,554	Knot, bar-tailed godwit*, grey plover, sanderling, cormorant
Martin Mere	SPA & Ramsar	**26,229***	29,401	27,964	1,437	Bewick's swan*, whooper swan*, wigeon*, pintail*, teal
Ribble Estuary	SPA & Ramsar (with Alt Estuary)	**237,721	230,741	85,838	144,903	Bewick's swan*, whooper swan*, knot*, wigeon*, oystercatcher*, redshank*, black-tailed godwit*, bar-tailed godwit*, dunlin*, pintail*, shelduck*, sanderling*, grey plover*, lapwing*, teal*, golden plover, cormorant
Morecambe Bay		**223,068	219,701	32,317	187,384	Curlew*, turnstone*, bar-tailed godwit*, pintail*, oystercatcher*, knot*, grey plover*, lapwing*, dunlin*, redshank*, black-tailed godwit, wigeon, teal, eider, goldeneye, red-breasted merganser, ringed plover, golden plover, sanderling
Duddon Estuary		**34,929	43,068	8,016	35,052	Pintail*, knot*, redshank, sanderling, oystercatcher, curlew, red-breasted merganser, dunlin, grey plover, shelduck
Irt/Mite/Esk Estuary		4,073	4,311	1,722	2,589	-
Solway Estuary	SPA & Ramsar (Upper Solway Flats and Marshes)	**123,935	123,572	32,799	83,773	Barnacle goose*, pink-footed goose*, knot*, bar-tailed godwit*, curlew*, turnstone*, oystercatcher*, redshank*, pintail*, whooper swan*, scaup*, dunlin, shelduck, wigeon, ringed plover, golden plover, goldeneye, shoveler, cormorant, grey plover, black-tailed godwit
Auchencairn Bay		4,208	2,825	590	2,235	-
Wigtown Bay		16,603	11,870	5,292	6,578	Pink-footed goose*, whooper swan, curlew
Loch Ryan		4,665	4,936	2,245	2,691	Scaup, red-breasted merganser
Luce Bay		2,594	3,329	554	2,775	Greenland white-fronted goose*, greylag goose*
Rough Firth		1,795	2,498	419	2,079	-
Kirkcudbright Bay		1,363	1,434	739	695	-
Fleet Bay		604	602	181	421	-

Source: WeBS data from Waters & Cranswick 1993. Key: *Species occurring at levels of international importance. **Internationally important site by virtue of holding ≥20,000 waterfowl. ***Excludes wader data. [a]Includes divers, grebes and cormorants. Notes: See Waters & Cranswick (1993) for further detail on interpretation of counts and limitations of data. Protection status follows Pritchard *et al.* (1992). SPA = Special Protection Area, Ramsar = site classified as internationally important under the Ramsar Convention. The winter season used by WeBS is November to March for waders and September to March for wildfowl.

apricaria, redshank *Tringa totanus,* bar-tailed godwit *Limosa lapponica* and black-tailed godwit *L. limosa*. Liverpool Bay and the outer parts of its estuaries are important for seaduck: common scoter *Melanitta nigra*, red-breasted merganser *Mergus serrator*, goldeneye *Bucephala clangula*, long-tailed duck *Clangula hyemalis*, eider *Somateria mollissima* and scaup *Aythya marila* occur offshore in important numbers (Kirby, Evans & Fox 1993) (see also section 5.10).

Wader species occurring on non-estuarine coasts vary greatly with exposure and type of substrate (Moser & Summers 1987), and relative species abundance differs between the mainland and the Isle of Man. On mainland coasts, oystercatcher is the most abundant wader species, followed in order of decreasing abundance by redshank, snipe, golden plover, knot, curlew, purple sandpiper *Calidris maritima* and dunlin (Moser & Summers 1987). On the Isle of Man, redshank is markedly the most common wader species, followed by snipe *Gallinago gallinago* and oystercatcher.

The region is of considerable significance during spring migration periods for sanderling *Calidris alba*, ringed plover and dunlin, amongst others, and in autumn for curlew sandpiper *C. ferruginea,* with large numbers using especially the major estuaries as staging sites. The Dee Estuary is also an important late summer moulting area for shelduck (Prater 1981). Other important moulting sites include the Ribble Estuary (from August to October) and the Dee Estuary in Dumfries & Galloway.

5.12.3 Human activities

Wintering waterfowl are potentially affected, either directly or indirectly, by a wide range of human activities. The importance of saltmarsh and grazing marsh for wintering waterfowl can be greatly increased by appropriate management.

Wildfowling occurs, especially in estuaries, although it is generally subject to good regulation (see also section 9.7.2). The impacts and regulation of wildfowling on the Ribble Marshes and Caerlaverock National Nature Reserves (NNRs) have been reviewed by Owen (1992). Permit systems generally operate and there is close liaison in the regulation of wildfowling between local shooting clubs, the British Association for Shooting and Conservation (the BASC) and English Nature, the Countryside Council for Wales and Scottish Natural Heritage local staff. Owen (1992) made a number of recommendations for improving the operation of existing schemes to regulate shooting on NNRs.

There has been a long-term increase in wigeon numbers on the Ribble, associated with the extension of the no-shooting refuge area on the NNR (Fox *et al.* 1994). This has resulted in an increase in the wintering population and an increase in the average shooting bag, but a decline in the proportion of the population of wigeon shot (Bell & Fox 1991). This experience highlights the need to review the adequacy of refuges on other sites also.

Incremental land claim, including for barrage schemes, has the potential to affect waterfowl populations through loss of feeding habitat (Goss-Custard 1977; Goss-Custard & Yates 1992), although at important sites, SSSI designation allows limitation of such activity. Coastal windfarm developments in sensitive areas also have the potential to be highly disruptive to wintering waterfowl (as reviewed by Crockford 1992). In such a highly populated region, disturbance to waterfowl as a result of recreational activities can also have significant effects. Some preliminary work has been undertaken on the Dee by Kirby, Clee & Seager (1993). Oil pollution, such as resulted from the oil spill in Liverpool Bay in 1979 (Head *et al.* 1980), is well known as a serious potential threat to wintering waterfowl in areas where high densities of birds occur.

Bait digging and shellfish collection from intertidal sediments, as well as other recreational activities in the more heavily populated parts of the region, are potentially disruptive and may prevent waterfowl using feeding areas. Research is needed on the extent of disturbance caused by these activities and its significance for waterfowl population, in order to ensure that coastal management planning can best minimise negative impacts. The significance of these activities varies not only from site to site (in relation to the intensity of the activity and the size/topography of the site) but also with the time of year (Davidson & Rothwell (1993) and papers therein). Disturbance may be a particular problem if it occurs in cold periods when wintering waterfowl need to feed almost continuously in order to survive.

Oil pollution is well known as a serious potential threat to waterfowl where high densities of birds occur, and there have been major past oil pollution incidents on the Mersey Estuary. In areas of the highest risk, however, there are well-developed contingency plans for dealing with accidental spillages. There have also been instances of birds being killed by toxic contaminants (Bull *et al.* 1983).

5.12.4 Information sources used

As with other areas of the UK, migrant and wintering waterfowl are well surveyed by the Wetland Bird Survey (WeBS - organised by the British Trust for Ornithology, the Wildfowl & Wetlands Trust, The Royal Society for the Protection of Birds and the JNCC). This volunteer-based survey collates monthly counts from coastal and inland wetlands throughout the UK. Coastal coverage is generally good for estuaries, although the open coast is not thoroughly surveyed on an annual basis. The non-estuarine coast is poorly counted (Waters & Cranswick 1993). The WeBS waterfowl count scheme publishes an extensive annual summary report, the most recent being Waters & Cranswick (1993), covering the winter season 1992/93. This report summarises species trends, based on counts at wetlands throughout the UK. It also tabulates counts of total waterfowl numbers at all counted estuaries. It is the primary source of information on wintering and migrant waterfowl in the UK. Copies are available from either of the WeBS National Organisers listed in section 5.12.6. The annual report can only summarise what are very detailed data, and in summary form such counts may be subject to misinterpretation for a number of reasons. Detailed count data for sites can be provided by WeBS, and inspection of these data is recommended for any planning-related activity. WeBS counts are generally undertaken at high tide, when waterfowl gather in high densities on traditional roosting areas. To complement this information, at selected estuaries WeBS organises low-tide counts to give information on the feeding distributions of waterfowl

during the intertidal period. Sites in the region at which such information is already available include Clwyd Bay, the Mersey Estuary (Clark *et al.* 1990), Dee Estuary, Solway Estuary (Quinn *et al.* 1993), Alt Estuary, Duddon Estuary, Wigtown Bay and Luce Bay.

The whole UK coastline was surveyed for wintering waders during the Winter Shorebird Count of 1984/85 (Moser & Summers 1987). Information on the wintering waterfowl of the non-estuarine shore is important for placing annual estuaries counts in a wider perspective. WeBS are planning a repeat national survey in the near future, subject to funding availability.

Although now becoming slightly dated, Owen, Atkinson-Willes & Salmon (1986) give a thorough and comprehensive account of the wildfowl and wetlands of the region, summarising data available up to the mid-1980s. The volume is an invaluable source of initial information on sites and species, although this should now be supplemented by more recent count information available from WeBS and Davidson *et al.* (1991).

Prater (1981) gives useful descriptive accounts of the birds of British estuaries, as well as placing these in a wider national and international context, using data from the period 1969-1975. As in Owen, Atkinson-Willes & Salmon (1986), much of the numerical information is dated and the site accounts should be supplemented by the more recent reviews of Davidson *et al.* (1991).

For sites of international importance (either proposed or designated), *Important bird areas in the UK,* jointly published by RSPB and the country nature conservation agencies (Pritchard *et al.* 1992), provides further information. Data on the important bird populations of each site are summarised, together with information on location and habitats.

There have been a number of more detailed studies of the wintering waterfowl of the Mersey Estuary (Clark *et al.* 1990; Clark, Mawdesley & Nobbs 1990; Rehfisch *et al.* 1991), Dee Estuary (Mitchell, Moser & Kirby 1988; Kirby, Clee & Seager 1993), Alt Estuary (Fawby 1989; Kirby *et al.* 1988), Morecambe Bay (Prater 1972; Woolfall 1992) and the Solway Firth (Moser 1984; Moser & Carrier 1983; Quinn *et al.* 1993). Additionally, the Svalbard barnacle goose population wintering on the Solway has been the subject of a long-term population study undertaken by the Wildfowl and Wetlands Trust (WWT) (e.g. Owen & Black 1989).

5.12.5 Acknowledgements

We would like to thank Simon Delaney (WWT) for his assistance and also Tim Cleeves (RSPB), Mathew Ellis (CCW), Chris Rollie (RSPB) and Peter Cranswick (WWT) for their comments.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
High tide and low tide counts of wintering and migrant wildfowl (WeBS)	*Peter Cranswick: WeBS National Organiser (Waterfowl), The Wildfowl & Wetlands Trust, Slimbridge, tel: 01453 890333
High tide counts of wintering and migrant wader (WeBS)	*Ray Waters: WeBS National Organiser (Waders), The British Trust for Ornithology, Thetford, tel: 01842 750050
Low tide counts of wintering and migrant wader (WeBS)	*Julianne Evans: WeBS National Organiser (Low Tide Counts), The British Trust for Ornithology, Thetford, tel: 01842 750050
Site designations (Scotland)	*SNH, Edinburgh, tel: 0131 554 9797
Site designations (England)	*Ornithologist, EN HQ, Peterborough, tel: 01733 340345
Site designations (Wales)	*CCW HQ, Bangor, tel: 01248 370444

* Starred contact addresses are given in full in the Appendix.

5.13 Land mammals

SGS Environment

5.13.1 Introduction

This section covers mammals that occur in the coastal 10 km squares in the region, concentrating on those that are truly coastal, such as otters, and those that occur on the coast for reasons of shelter and foraging, such as the greater horseshoe bat *Rhinolophus ferrumequinum*. Other mammals - common and widespread throughout Britain, feral or recently introduced - have not been considered.

The region supports a number of nationally important species, although their distribution is patchy. There are eight species of bat: lesser horseshoe *Rhinolophus hipposideros*, whiskered *Myotis mystacinus*, Natterer's *M. nattererii*, Daubenton's *M. daubentonii*, noctule *Nyctalus noctula*, Leisler's *N. leisleri*, pipistrelle *Pipistrellus pipistrellus* and brown long-eared *Plecotus auritus*. The whiskered, Natterer's, noctule, pipistrelle and brown long-eared populations in the region are classed as vulnerable, and the Daubenton's is classed as not threatened in Europe. The most important species in the region is the lesser horseshoe, which is endangered in Europe and globally (Stebbings & Griffith 1986). There are red squirrel *Sciurus vulgaris* populations in south Cumbria, Merseyside and areas of Dumfries & Galloway. Dormice *Muscardinus avellanarius* are recorded frequently in south Cumbria but are absent elsewhere. The otter *Lutra lutra* is only common in Dumfries & Galloway, as is the pine marten *Martes martes*.

All British bats, the otter and the red squirrel are listed under Schedule 5 of the Wildlife & Countryside Act and Annex II of the Bern Convention (except for the red squirrel, which is on Annex III). (In addition, the stoat and the hedgehog are Schedule 6 species in the Manx Wildlife Act 1990.) Table 5.13.1 summarises the recorded distribution of protected species in the region.

5.13.2 Important locations and species

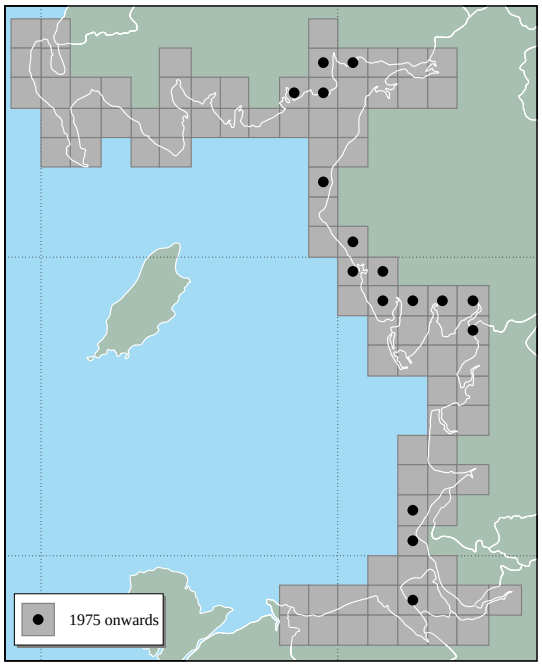
The otter is associated with semi-aquatic areas including rivers, lakes and coasts and is the terrestrial mammal that uses coastal areas most frequently. It is classed as endangered and is absent from many areas of England. The Welsh population is important because of its size and genetic diversity, which would enable the species to recolonise areas if conditions improve. For Clwyd there were no coastal records of otters, although there were several positive sites inland on the river Clwyd system (Andrews, Howell & Johnson 1993). Otter records are absent throughout most of Lancashire and Cumbria, with only one coastal record from south Cumbria (Strachan *et al.* 1990), although Cumbria is said to have an expanding otter population, which probably uses coastal routes (Cumbria Wildlife Trust pers. comm.). The rivers Waver and Wampool are important otter areas in the Solway (C. Lumb pers. comm.). Otters are relatively common along the Dumfries & Galloway coast (Green & Green 1987), although there they are likely to be at lower densities than they are in the Scottish Highlands and Islands (Morris 1993).

The national bat habitat survey (Walsh & Harris in prep.) includes coastal habitats and demonstrates that bats utilise the coast for foraging. Bats are likely to find areas of semi-natural habitat of most value for foraging, although shelter and natural features for flightlines are also important. The lesser horseshoe is recorded from Clwyd and there is one record near Southport (Arnold 1993). The pipistrelle occurs in Dumfries & Galloway and there are a few coastal records from north Cumbria and south Lancashire. English Nature's Bat Sites Register should confirm the important sites in the region. Natterer's, Daubenton's, pipistrelles and brown long-eared bats have been recorded roosting in coastal caves and fissures around the Isle of Man.

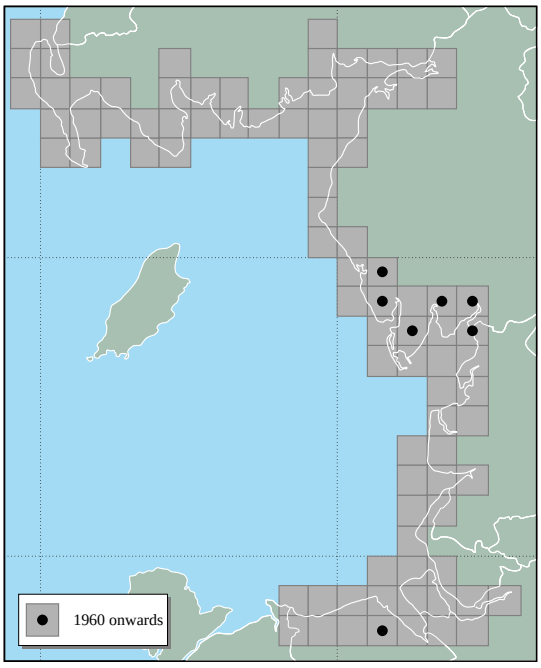
Table 5.13.1 Records of protected species distribution

Protected species	*Estimate of importance in region*
Lesser horseshoe bat*	Rare: Cheshire & Clwyd only, absent elsewhere
Whiskered bat*	Rare
Natterer's bat*	Rare: recorded on the Isle of Man
Daubenton's bat*	Rare: absent Cumbria; recorded on the Isle of Man
Noctule bat*	Rare: absent Cumbria
Leisler's bat*	Rare: Dumfries & Galloway & Isle of Man only
Pipistrelle bat*	Frequent: ubiquitous; recorded on the Isle of Man
Brown long-eared bat*	Rare: recorded on the Isle of Man
Red squirrel*	Common Cumbria, frequent east Dumfries & Galloway, rare elsewhere; absent from Isle of Man
Dormouse*	Frequent south Cumbria, present Clwyd; absent elsewhere
Pine marten*	Rare
Polecat/ferret^{+}	Occurs on the Isle of Man; occasional Clwyd and Cumbria, absent elsewhere
Otter*	Common Dumfries & Galloway, rare elsewhere

Source: Arnold (1993). Key: *Schedule 5 species, $^{+}$Schedule 6 species, Wildlife and Countryside Act, 1981. Note: All bats and the otter are protected under Schedule 5 and listed in Schedule 6 of the Manx Wildlife Act 1990; the hedgehog and stoat are listed under Schedule 6.



Map 5.13.1 Recorded distribution of the red squirrel in coastal 10 km squares. Records from 1960 onwards. Source: Arnold (1993).



Map 5.13.2 Recorded distribution of the dormice in coastal 10 km squares. Records from 1960 onwards. Source: Arnold (1993).

The red squirrel is extinct over much of England and Wales (Morris 1993) and has a patchy distribution. Red squirrels will use broad-leaved, mixed and pure conifer woodlands. However, because grey squirrels have a competitive advantage over reds in broad-leaved woodlands, the best populations of reds are found in large, pure conifer plantations with good seed crops and relatively low tree densities (Holm 1987). Red squirrel records in the region (Map 5.13.1) are predominantly from south Cumbria (Timber Growers UK 1992) (although they are thought to be widespread in the county (Cumbria Wildlife Trust pers. comm.)). There is some evidence that red squirrels are expanding their range in west Lancashire and north Merseyside (Skelcher 1993), and there are also populations in the conifer plantations that form an almost continuous belt along the Sefton coast. The main areas are at Formby Point National Trust site and Ainsdale National Nature Reserve (NNR), and there are suburban populations recorded in Merseyside at Southport, Crosby and Maghull. Red squirrels are recorded from as far inland as Ormskirk north to Hesketh Hall, both in Lancashire. There are frequent records from Dumfries & Galloway.

The present populations of red squirrels in the region may be the result of an introduction of the European sub-species; however, the long-maintained absence of grey squirrels achieved through the zeal of local gamekeepers makes the existence of a relict native population likely (Martin Garbett pers. comm.).

Dormice are classed as vulnerable and locally endangered (Morris 1993); they are on the edge of their European range in Britain. They are specialist feeders that occur primarily in woodlands but also in edge habitats such as hedgerows and scrub. They are often associated with ancient woodlands with a coppiced hazel understorey and a diverse tree and shrub layer. Dormice are found in south Cumbria and Clwyd but are absent from the rest of the region. In Cumbria they appear to be associated with the woodlands around Grange-over-Sands and Broughton-in-Furness (Map 5.13.2).

The pine marten is extinct over most of England and Wales and there is only one record in this region, in south Cumbria (Arnold 1993). They are present in Dumfries & Galloway, although not specifically in coastal areas. They are dependent on large, mixed conifer plantations, although the more mature plantations are less valuable.

Polecats are recorded from a variety of habitats, particularly farmland that is not intensively managed, especially in Wales and the adjacent English counties. They are known to use the coastal dunes and strips of remnant habitat between farmland and the coast. In this region there are occasional records from Clwyd and there is known to be a population in Cumbria (Cumbria Wildlife Trust). The Isle of Man is an area where the polecat/ferret is particularly prevalent (Lever 1977).

On the Isle of Man, where they are a protected species (Table 5.13.1), stoats are of the Irish subspecies *Mustela erminea* ssp. *hibernica* (King 1989). On the mainland, stoats (not of this subspecies) are widespread and common.

5.13.3 Human activities

The north Wales coast and parts of the Lancashire coast are dominated by the tourism industry. This could prevent otters from recolonising the area because of the lack of shelter and the high levels of disturbance. Also, large stretches of the coast are industrial; in addition, therefore, to the lack of semi-natural habitat, there is often a reduction in water quality, which may prevent otter recolonisation by limiting available food and shelter. Major oil spills, such as occurred in Liverpool Bay in 1979 (Head *et al.* 1980), can impact upon mammals as well as birds. Oil-laden sea spray could affect roosting bats in coastal localities.

Agricultural intensification, especially the use of

pesticides, has an adverse effect on all bat species. Removing hedgerows and woodland destroys bat roosting and foraging sites as well as reducing shelter. The destruction, fragmentation and inappropriate management of ancient woodlands within the coastal areas may also result in the decline of local dormice populations. The loss of mature hedgerows, particularly those that connect with other woodlands, will also have a severe effect on the dormouse population. The decline in the rate of softwood planting over large areas may contribute to the decline in numbers of both the red squirrel and pine marten.

Controlling predators, pests and vermin, such as the poisoning and trapping of mink and grey squirrel, can also kill non-target species such as polecat. However, red squirrel populations may be threatened with extinction where greys are not controlled.

The red squirrel and dormouse are currently the subjects of English Nature Species Recovery Programmes (Whitten 1990), which aim to secure the unassisted long-term survival of the species in the wild.

5.13.4 Information sources used

There are no reliable estimates of the numbers of mammals in the region or Britain that could be used to quantify the resource. Using data from Arnold (1993) (although these records are incidental rather than comprehensive), an estimate has been made of the frequency of their occurrence in the region. As a general observation (Morris 1993), mammal surveys are not recorded with the same intensity as botanical ones and the occurrence of mammals within 10 km squares is not enough to establish the status of species. There have been no comprehensive surveys for any of the bats, or for dormice or polecats, although there are recent records for all of them. There are currently insufficient data to establish the importance of bat species in the region. The Biological Records Centre data for bats (Stebbings & Griffith 1986) also demonstrate the bias that can occur for rarer species, as the commoner bats are clearly under-recorded. It is probable that more species than those listed in Table 5.13.1 do occur and that the absence of records is due to under-recording. A red squirrel survey was undertaken in 1991 (Timber Growers UK 1992), based on questionnaires sent to all Timber Growers UK members. Red Alert South-west Scotland is currently carrying out a survey of red squirrels.

5.13.5 Acknowledgements

The authors thank all those people cited in the text for contributing information and time. Special thanks are due to John Lamb, Manx Nature Conservation Trust, for providing information on terrestrial mammals on the Isle of Man.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Local site and species information - England	*English Nature HQ, Peterborough, tel: 01733 340345
Local site and species information - Scotland	*SNH HQ, Edinburgh, tel: 0131 447 4784
Local site and species information - Wales	*CCW HQ, Bangor, tel: 01248 370444
Local site and species information - National Trust sites	Martin Garbett, National Trust, Victoria Road, Freshfield, Formby, Merseyside L37 1LJ, tel: 01704 878 591
Local site and species information - Isle of Man	*Manx National Heritage, Biological Records Officer, Isle of Man , tel: 01624 675522
NPI Red Alert North West Initiative	*NPI Red Alert North West Project Officer (North), Cumbria Wildlife Trust, Ambleside, tel: 015394 32476, or *NPI Red Alert North West Project Officer (South), Lancashire Wildlife Trust, Preston, tel: 01772 324129
Bats - Clwyd	Karen Willson, Clwyd Bat Group, Ash House, Llewellyn Road, Coedpoeth, Wrexham LL11 3PB, tel: 01978 759313
Bats - Cheshire	Mike Freeman, Cheshire Bat Group, 10 Carlton Road, Witton Park, Northwich CW9 5PR, tel: 01606 41581
Bats - Merseyside	Clem Fisher, West Lancashire/Merseyside Bat Group, Liverpool Museum, William Brown Street, Liverpool L3 8EN, tel: 0151 207 0001 ext. 298
Bats - Lancashire	Stephen Bradley, Lancashire Bat Group, 85 Windermere Road, Lancaster LA1 3EZ, tel: 01524 33056
Bats - Dumfries & Galloway	Dr Peter Hopkins, Dumfries and Galloway Bat Group, Barbuchany, Newton Stewart, Wigtownshire DG8 6QE, tel: 01671 3870
Bats - Isle of Man; survey of status of mammals on the Isle of Man	Ed Pooley (Manx Bat Group), Ballasoalt, Earystane, Colby, Isle of Man IM9 4HN, tel: 01624 834739
Otters	Jim and Rosemary Green, The Vincent Wildlife Trust Otter Rehabilitation Centre, Barjarg, Barr Hill, Girvan, Ayrshire KAS26 0RB, tel: 01465 821225
General mammal information	The Mammal Society, Unit 15, Cloisters House, Cloisters Business Centre, 8 Battersea Park Road, London SW8 4BG, tel: 0171 498 4358
General mammal information	*Institute of Terrestrial Ecology, Monks Wood, tel: 01487 773381
General mammal information - Isle of Man	*Manx National Heritage, Isle of Man, tel: 01624 675522

*Starred contact addresses are given in full in the Appendix.

5.14 Seals

C.D. Duck

5.14.1 Introduction

This region holds surprisingly few common or grey seals and makes no significant contribution to the UK population of either species (Table 5.14.1).

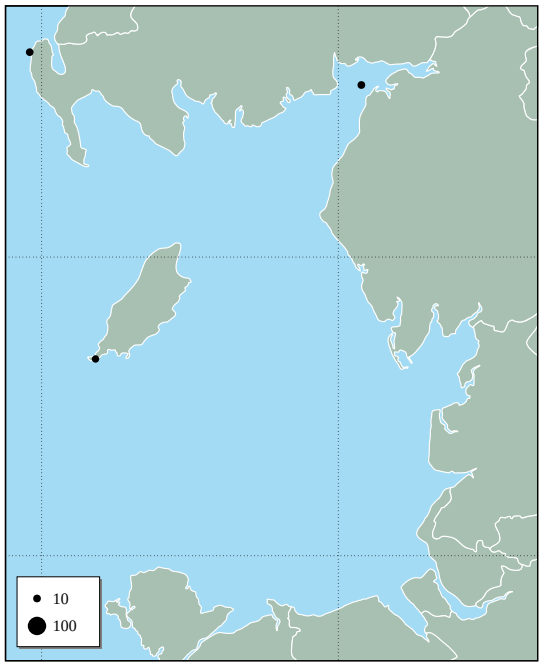
5.14.2 Important locations

There are very few common seals in this region. Small groups can be found on the north end of The Rhinns in Galloway and around Calf Sound, Isle of Man. Occasional animals are recorded on West Hoyle Bank at the mouth of the River Dee and at various sites in Morecambe Bay, along the Cumbrian coast and on sandbanks in the Solway Firth. The closest sizeable common seal colonies are in County Down, Northern Ireland, and off the Mull of Kintyre in Scotland.

Around the Calf of Man, the Cumbrian coast and on The Rhinns in Galloway, common seals use rocky haul-out sites. Along the Lancashire coast, Morecambe Bay and the Solway Firth they haul-out on sandbanks and mudflats. The distribution of common seals in the region in August is shown on Map 5.14.1. Circles represent the numbers of seals at each haul-out site at an approximate 1 km square resolution (see Table 5.14.2).

There are no major grey seal breeding sites in the region (Map 5.14.2). Circles represent the numbers of pups born at each site; important haul-out sites are numbered. The breeding sites of most of the grey seals that haul-out in the region during the summer are unknown, although up to 25 pups are born at a number of sites round the Isle and Calf of Man (Graner 1994; K. Watterson pers. comm.), where grey seals breed on isolated rocky beaches and in caves. There has been one record of an aborted pup on West Hoyle Bank at the mouth of the River Dee (V. Seager pers. comm.). The closest breeding sites of any significance are in south-west Wales and the Inner Hebrides in Scotland.

Grey seal numbers in the region increase during the summer months: haul-out sites on the Isle and Calf of Man (up to 500 seals in summer), and the north Solway coast and



Map 5.14.1 Distribution of common seals in the region in August. Size of circle represent the number of seals at each location (see Table 5.14.2). Sources: SMRU; Calf of Man Bird Observatory; Port Erin Marine Laboratory, Liverpool University.

The Rhinns, east of Kirkudbright Bay (up to 150) are on rocky or shingle beaches and caves, while on West Hoyle Bank (up to 400) and in Morecambe Bay they are on sandbanks and mudflats. Table 5.14.3 lists grey seal breeding and haul-out sites in the region.

5.14.3 Human activities

The seals on West Hoyle Bank are visited regularly during the summer months by tour boats operating out of West Kirby. There are less frequent seal and seabird watching tours in the Solway Firth, operating out of Maryport in

Table 5.14.1 Numbers of common and grey seals in the region in relation to the rest of GB

County	*Common seals*		*Grey seals*		
	Number of seals	*% of GB total*	*Pup production*	*% of GB total*	*Associated population >1 year old*
Clwyd	0	0	0	0	0
Cheshire	0	0	0	0	0
Merseyside	0	0	0	0	0
Lancashire	0	0	0	0	0
Isle of Man	5-10	0.02	20-25	0.07	80
Cumbria	0	0	0	0	0
Dumfries & Galloway	9	0.03	0	0	0
Region 13	***14***	***0.05***	***20-25***	***0.07***	***80***
GB total	***28,350***	***-***	***33,850***	***-***	***115,000***

Sources: Sea Mammal Research Unit (SMRU), Port Erin Marine Laboratory, Calf of Man Bird Observatory.

Table 5.14.2 Common seal numbers in areas regularly surveyed

Area surveyed	*Grid ref.*	*Number of seals*	*% of region total*
Solway Firth (Silloth to Mull of Galloway)	NY083587 (NY094530 to NX157303)	1	~5
The Rhinns, Galloway (Mull of Galloway to east Loch Ryan)	NW967704 (NX157303 to NX056712)	8	~50
Calf of Man	SC168665	5-10	~45

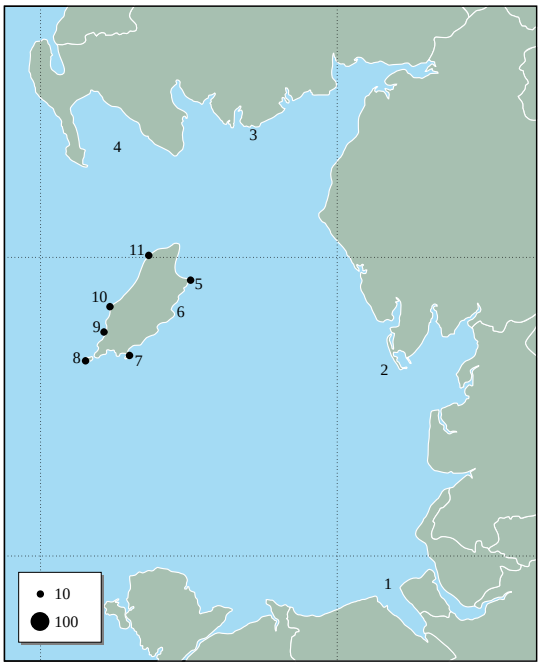
Sources: Sea Mammal Research Unit (SMRU); Calf of Man Bird Observatory; Port Erin Marine Laboratory, Liverpool University. Data collated in 1994.

Cumbria. Two small boats operate seal and seabird tours out of Port Erin and one out of Peel, on the Isle of Man, during the summer months.

There is a small fixed-net salmon fishing industry in the Solway Firth and most rivers flowing into the Firth are important for salmon and sea-trout sport angling (see also section 9.1). Although seals are recorded at certain river estuaries during the summer months, when salmon are running, they do not appear to interfere unduly with these fisheries. There are reports of occasional shooting of seals that persistently remove fish from fixed nets. There are also numerous inshore fishing boats operating throughout the region, and the Irish Sea is an important shipping route. Seal numbers and distribution do not appear to be affected by either of these operations.

Exploratory prospecting for offshore oil has been undertaken in the region, with a view to production commencing in 1996. Richardson *et al.* (1989) have reviewed the literature on the impact of oil-related developments on marine mammals, concluding that the potential impacts on seals are relatively minor. Seismic surveying has taken place in the region but this is unlikely to affect seals unless they happen to be in the vicinity of the seismic arrays. Seals are always susceptible to contamination from spilled oil but such occurrences are rare.

Seals are vulnerable to contamination and pollution of coastal waters by other toxic substances. In this region they have higher concentrations of pollutants, such as organochlorines (Baker 1989), in their bodies than are found



Map 5.14.2 Grey seal pup production. Size of circle represents the number of pups born along the section of coast. Figures refer to important haul-out sites in Table 5.14.3. Sources: Port Erin Marine Laboratory, Liverpool University; Hilbre Islands Nature Reserve.

anywhere else on the UK coast. Lead and mercury are of particular concern (Law *et al.* 1991, 1992).

A number of amenity and power generation barrage proposals are still pending in the region (see also Table 9.7.1 and section 8.3.2). These could have considerable impacts, not only by causing habitat loss and change, but also by increasing levels of water use and disturbance in the area.

Several of the seal breeding and haul-out sites in the region are managed at least partly for their wildlife interest. West Hoyle Bank is within the Dee Estuary Site of Special Scientific Interest (SSSI), with Hilbre Island being a designated Local Nature Reserve: both are owned by the Wirral MBC. Part of the Dee Estuary is owned and managed by the Royal Society for the Protection of Birds (RSPB) and other areas are managed under agreement with the National Rivers Authority (NRA). A nature reserve at Connah's Quay is managed by the Deeside Naturalists Society. South Walney Island is within the South Walney

Table 5.14.3 Grey seal pup production and important haul-out sites

Site		*Grid ref.*	*Main breeding site*	*Important haul-out site*	*Number of pups born*
1	West Hoyle Bank	SJ165880		-	One (aborted)
2	South Walney Is.	SD230610		-	None
3	Mullock Bay	NX710435		-	None
4	Little Scares	NX264345		-	None
5	Maughold Head	SC499913	-		~2
6	The Cletts	SC169661		-	None
7	Langness	SC285653	-	-	~2
8	Calf of Man	SC155655	-	-	5
9	Stroin Vuigh	SC212741	-		~3
10	Contrary Head	SC227827	-	-	~6
11	Cronk ny Arrey Laa	SC350995	-	-	~4

Sources: Port Erin Marine Laboratory, Liverpool University; Hilbre Islands Nature Reserve. Data collated in 1994. Note: numbers refer to locations on Map 5.14.2.

and Piel Channel Flats SSSI and is a Cumbria Wildlife Trust site. Much of the coastal area of the Isle of Man, including the Calf of Man, Stroin Vuigh and Maughold Head, is owned by Manx National Heritage, a government body with jurisdiction out to the limits of the territorial waters. All such land is designated as Nature Reserves under the Manx Musuem and National Trust Act 1886, as amended.

5.14.4 Information sources used

In general, common seals are surveyed in August, during their annual moult, when the greatest and most consistent numbers of seals can be counted. Grey seal population estimates are based on pup production data because the numbers of grey seals at haul-out sites outside the breeding season are unpredictable and can vary greatly from day to day. For comparability with regions elsewhere in GB the information presented here refers mainly to grey seal numbers and distribution during the breeding season.

The Scottish coast and the south Solway coast, as far as Silloth, was surveyed by the Sea Mammal Research Unit (SMRU) in August 1992 as part of a survey of common seals round Scotland. Observations of common and grey seals are made throughout the year on the Calf of Man by the Calf of Man Bird Observatory and on West Hoyle Bank by the Hilbre Nature Reserve Rangers. For seals round the Isle of Man there have been independent studies run from Liverpool University's Port Erin Marine Laboratory (Graner 1994; K. Watterson pers. comm.).

5.14.5 Acknowledgements

Information was kindly supplied by John Baker (Liverpool University Veterinary Field Station), John Bishop and Ken Watterson (Port Erin Marine Laboratory), Roy Cameron (SNH), Bill Makin (South Walney Nature Reserve), Norman McCanch (Calf of Man Bird Observatory), Vicky Seager (Hilbre Islands Reserve Ranger), Norman Hammond, Dai Morgan, Peter Ulrich, John Lamb (Conservation Officer, Manx Nature Conservation Trust) and Larch Garrad (Manx National Heritage). Thanks are also due to John Bishop, Ailsa Hall (Sea Mammal Research Unit), Norman Hammond, Dai Morgan and Ken Watterson for commenting on the manuscript.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Seals on West Hoyle Bank	The Warden (Coastal Ranger - Wirral), Hilbre Islands Nature Reserve, c/o the Post Office, Grange Road, West Kirby, Wirral L48 4HA, tel: 0151 678 5488
Seals on the Isle and Calf of Man	*Manx Nature Conservation Trust, Isle of Man, tel: 01624 801985
Seals on the Calf of Man	*The Warden, Calf of Man Bird Observatory, c/o Manx National Heritage, Isle of Man, tel: 01624 801985
Seals in Region 13 - England	*English Nature, North West Local Team, Blackwell, Cumbria, tel: 01966 25286
Seals on the Solway Firth - Scotland	*Scottish Natural Heritage, Dumfries & Galloway Regional Office, Dumfries, tel: 01387 247010
Seals on the north coast of the Solway Firth	*Scottish Wildlife Trust, Sanquhar, tel: 01659 50454
Seal numbers and distribution around the UK	Sea Mammal Research Unit (SMRU), High Cross, Madingley Road, Cambridge CB3 0ET, tel: 01223 311354

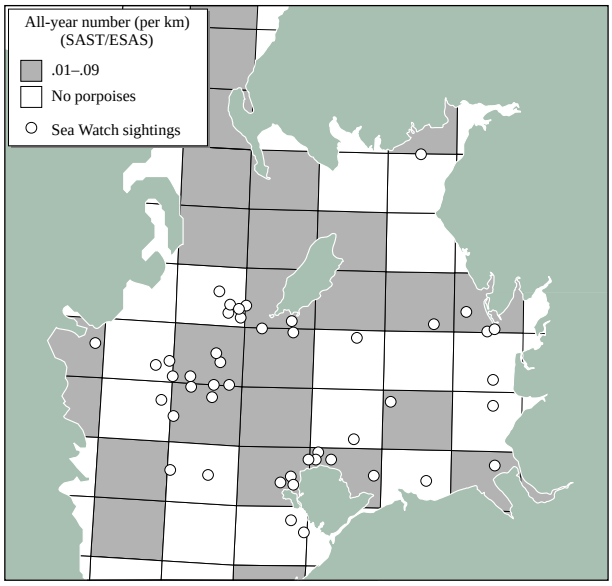
* Starred contact addresses are given in full in the Appendix.

5.15 Whales, dolphins and porpoises

Dr P.G.H. Evans

5.15.1 Introduction

The coastal waters of the region are relatively unimportant for cetaceans. Twelve species have been recorded since 1980 along the coasts or in nearshore waters (within 60 kilometres of the coast) of the region; of these, only three species are either present in the region throughout the year or have been recorded annually since 1980 as seasonal visitors. These three represent around 10% of the UK cetacean fauna (26 species). The species most frequently recorded in nearshore waters are the harbour porpoise *Phocoena phocoena* and bottlenose dolphin *Tursiops truncatus*, although neither is common. Offshore, the most abundant and frequently observed species is the common dolphin *Delphinus delphis*, a species that is widespread in warm temperate to tropical seas throughout the world. In Britain and Ireland, it is commonest offshore in the English Channel approaches and southern and central Irish Sea, and off western Ireland and south-west Scotland. The harbour porpoise and bottlenose dolphin are listed in Annex II of Council Directive 92/43 EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora, as species whose conservation requires the designation of special areas of conservation (SACs - see also section 7.2). For geographical comparisons of sightings rates for various cetacean species in UK waters, see Evans (1990, 1992) and Northridge *et al.* (1995).



Map 5.15.1 Harbour porpoise: all-year numbers sighted per kilometre of Seabirds at Sea survey (source: JNCC SAST/ESAS); and sightings reported to the Sea Watch sighting system (source: Evans (1992)).

5.15.2 Important locations and species

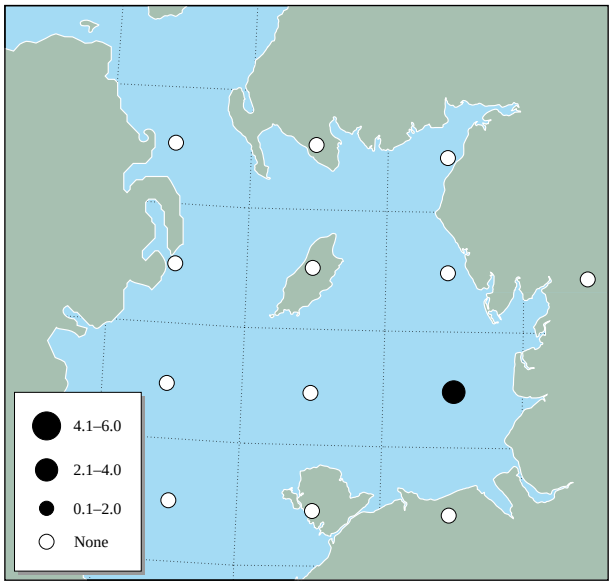
Table 5.15.1 lists species resident or regularly occurring in Region 13. Other cetacean species recorded in the region include minke whale *Balaenoptera acutorostrata*, fin whale *Balaenoptera physalus*, sei whale *Balaenoptera borealis*, sperm whale *Physeter macrocephalus*, northern bottlenose whale *Hyperoodon ampullatus*, white-beaked dolphin *Lagenorhynchus albirostris*, striped dolphin *Stenella coeruleoalba*, Risso's dolphin *Grampus griseus* and long-finned pilot whale *Globicephala melas*.

Waters in the eastern part of the region are shallow (less than 50 m depth) and relatively uniform in depth, with few cetaceans. South-west of the Isle of Man, depths of 160 m are recorded, increasing to 200 m in the North Channel. These areas have higher densities and a greater diversity of cetacean species. Although nowhere in this region are cetaceans common, most nearshore sightings are reported from off prominent headlands, such as at Spanish Head and Point of Ayre (Isle of Man), St. Bees Head, Burrow Head, the Mull of Galloway and Corsewall Point; and the small islands of Hilbre, Calf of Man and Walney. The boundary between the fast-moving mixed water of the tidal stream and stratified slack water forms the Irish Sea front (Pingree & Griffiths 1978) (see also section 4.3.2). Nutrient enrichment associated with this front has resulted in concentrations of harbour porpoises and common dolphins, with occasional minke whales (Hope-Jones *in litt.* 1983; Evans 1992) (Table 5.15.1).

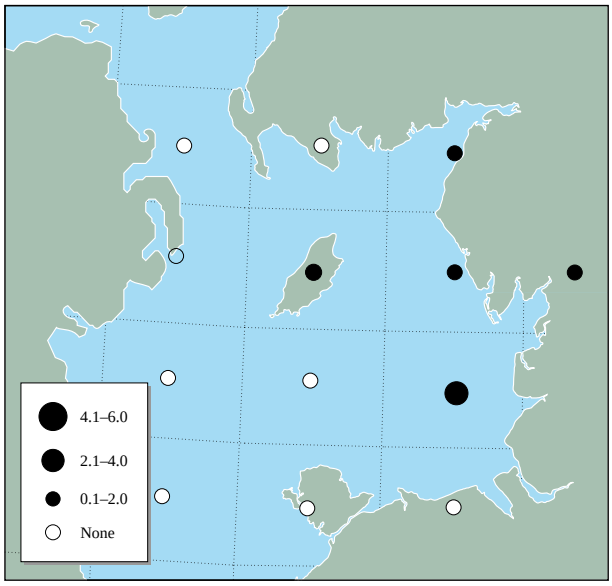
Several localities are known to be relatively important to cetaceans. For instance, harbour porpoises are seen in small numbers, mainly between July and September, in coastal waters around the Calf of Man. In offshore waters south-west of the Isle of Man, common dolphins, sometimes in large numbers, are seen regularly between June and October. Harbour porpoises are recorded here annually, and occasionally minke whales and bottlenose dolphins. In Morecambe Bay (Lancashire), small numbers of bottlenose dolphins are recorded off Heysham, usually between April and September, and small numbers of harbour porpoises are seen off St. Bees Head (Cumbria), mainly between July and

Table 5.15.1 *Cetacean species recorded in the region*

Species	*Status, distribution and seasonal occurrence*
Harbour porpoise *Phocoena phocoena*	Small numbers, mainly around the Isle of Man, in Morecambe Bay and the Solway Firth (Map 5.15.1); most sightings between July - September.
Common dolphin *Delphinus delphis*	Offshore species: central and western parts of the Irish Sea (particularly south-west of the Isle of Man); also in the North Channel west of the Mull of Galloway and occasionally eastwards into the Solway Firth (Map 5.15.2). Most sightings between June and November.
Bottlenose dolphin *Tursiops truncatus*	Small numbers recorded in the Solway Firth south into Morecambe Bay (Map 5.15.3); sightings mainly between July and September.



Map 5.15.2 Common dolphins: summer 1992. Number of sightings per 1,000 km travelled (from 'platforms of opportunity'). Source: Evans (1992).



Map 5.15.3 Bottlenose dolphins: summer 1992. Number of sightings per 1,000 km travelled (from 'platforms of opportunity'). Source: Evans (1992).

September. Also during late summer, occasionally bottlenose dolphins are seen here. In the outer Solway Firth (Cumbria/Dumfries & Galloway), small numbers of common and bottlenose dolphins are recorded occasionally near Maryport, mainly between July and September, and off the Mull of Galloway (Dumfries & Galloway), harbour porpoises are seen in small numbers, mainly between July and September.

5.15.3 Human activities

Cetaceans in the region face three potential pressures from human activities: conflicts with fisheries (either by competition for a common food resource, or accidental capture in fishing gear), habitat degradation (mainly by pollution), and disturbance (from underwater sounds).

The main fishing port in the region is Fleetwood, but others of some importance include Barrow, Workington and Maryport. Most boats are involved in the shellfish industry, although some fish with otter trawls and others with seine nets. In the Dee, Ribble, Lune and Kent Estuaries, salmon are fished for using drift, seine and trammel nets (Northridge 1988), in which small numbers of porpoises and dolphins are occasionally reported accidentally captured. Off the coasts of the Isle of Man, particularly to the south and west, common dolphins have been reported as a by-catch of the bottom-set gill-net fishery during July and August (Sea Watch unpubl. data). Although quantitative information on accidental catches does not exist (Northridge 1988), twelve common dolphins were said to have died accidentally in one week during fishing activities (K. Watterson pers. comm.), and J.R. Baker reports that about 25% of cetacean and pinniped (e.g. seals) deaths in the area are attributable to drowning, generally in fishing gear.

There are few data on contaminant levels in cetaceans from the region. Mean total PCB (25 congeners) levels of 31 harbour porpoises and six common dolphins sampled from the Irish Sea as a whole (from the Bristol Channel to the Solway Firth), in the period 1988-92, amounted to 11 ppm in harbour porpoises and 15 ppm in common dolphins (Kuiken *et al.* 1994). However, two bottlenose dolphins found stranded further south on the Dyfed coast in 1988 and 1992 respectively contained high levels of PCBs (up to 290 ppm), DDT (up to 150 ppm), and mercury (up to 190 ppm), which, as inputs of these contaminants are low in that area, were thought to have come from outside the region (Morris *et al.* 1989; Law *et al.* 1991, 1992). The most obvious source of contaminants would be the northern Irish Sea, since Liverpool Bay is a centre of industrial activity and marine mammals sampled in this region have the highest levels of PCBs, mercury and lead in the British Isles.

Recreational activities (speedboats, jet skis etc.) at resorts such as Colwyn Bay, Rhyl, Blackpool and Morecambe pose threats of direct physical damage from collisions and disturbance from the high frequency (>1 kHz) noise generated by these vessels (Evans *et al.* 1992). Heavy shipping may also disturb cetaceans. Sound frequencies produced by ships' engines overlap those used by cetaceans, particularly baleen whales (not resident in or a regular visitor to this region), but also dolphins and porpoises when cavitation of the propeller occurs. Negative responses (vessel avoidance and increased dive times) by both bottlenose dolphins and harbour porpoises to such sounds have been reported by Evans *et al.* (1992; in press). Other underwater sounds from seismic activities (as part of oil and gas exploration in the Irish Sea) involve lower frequencies, and are therefore most likely to affect baleen whales, which communicate primarily at these frequencies (20-500 Hz), although Baines (1993) reported a possible temporary effect on the presence of porpoises around Strumble Head, Dyfed (Region 12). It is possible that porpoises are affected through changes to the distribution of their fish prey (Evans 1995). A code of conduct for boat users has been produced (Seawatch Foundation & UK Mammal Society 1992).

5.15.4 Information sources used

Information on cetacean status and distribution comes primarily from the national sightings database (1973-present) maintained by the Sea Watch Foundation (SWF) and the strandings scheme organised by the Natural History Museum in London (1913-present). Systematic land-based watches have been carried out by the wardens of the Calf of Man. As part of seabird surveys of the west coast of Britain, offshore effort-related data have been collected by JNCC's Seabirds at Sea Team between 1986 and 1990 (Northridge *et al*. 1995), various merchant vessels operated by the Isle of Man Steam Packet Company, and several sailing boats. Coverage is relatively poor in Liverpool Bay, the North Channel and off the south coast of Dumfries & Galloway, although no area has intensive coverage. Effort has been highest between June and September, when sea conditions are usually best. Strandings and sightings data, while helpful in providing some indications of the current status of populations, their distribution and migration patterns, do not as yet allow any definitive statements to be made about any species.

5.15.5 Acknowledgements

Thanks are due to J. Heimlich-Boran for help in the preparation of the maps, and to all those persons who have contributed valuable sightings data, particularly the systematic observations provided by the wardens of the Calf of Man bird observatory, the crew of the Isle of Man Steam Packet Company, J. Hagan, R.J. Law, J. Ramster, J. Strawbridge, M. Tasker, K. Watterson and A. Webb.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Cetacean strandings	Dr D. George & A. Muir, Natural History Museum, Cromwell Road, London SW7 5BD, tel: 0171 938 8861
Cetacean sightings & surveys	Dr P.G.H. Evans, Sea Watch Foundation, c/o Dept. of Zoology, University of Oxford, South Parks Road, Oxford 0X1 3PS, tel: 01865 727984
Cetacean sightings & surveys	*Seabirds & Cetaceans Branch, JNCC Aberdeen, tel: 01224 642863
Cetacean strandings, Scotland	Scottish Strandings Coordinator SAC Veterinary Services, Drummond Hill, Inverness, tel: 01463 243030
Cetacean organochlorine & heavy metal levels	*Dr R.J. Law, Directorate of Fisheries Research, MAFF Fisheries Laboratory, Burnham-on-Crouch, tel: 01621 782658
Cetacean pathology	Dr J.R. Baker, Veterinary Field Station, 'Leahurst', Neston, Wirral, Cheshire L64 7TE, tel: 0151 794 6120

*Starred contact addresses are given in full in the Appendix.

Chapter 6 History and archaeology

This chapter is divided into two sections: the first, section 6.1, describes the history and archaeology of the mainland of the region and the second, section 6.2, that of the Isle of Man, which until comparatively recent times was a separate kingdom where events followed a chronology different from that on the mainland. Each section tells of past human activity, drawing on archaeological (the physical remains) and historical evidence, which is inevitably incomplete. Distribution of known sites is biased by the uneven spread of survey work: many missing details can be found only by the discovery and investigation of new sites. Archaeological sites are vulnerable and those not yet located can unwittingly be destroyed. Sections 6.1.3 and 6.2.3 give information on the provisions for safeguarding known and unknown sites, and on the organisations that manage archaeology; sections 6.1.4 and 6.2.4 set out the extent of survey work, and describe how to report new discoveries.

The coast of Region 13 is very often muddy and sheltered, and harbours and quaysides have silted up over the years, occasionally entombing (and so protecting) derelict ships at their moorings. That is what happened to this 19th century timber-built hopper barge, locally crafted to transport dredged sand. Its internal partitions now protrude from the mud in Foryd Harbour, Rhyl, Clwyd. Photo: Alison Gale.

6.1 History and archaeology - the mainland

A.B. Gale & V. Fenwick

6.1.1 Introduction

The visible evidence of this region's past is dominated by a few periods. The Roman period is illustrated by the great port of Chester and to the north the coastal forts stretching from Ravenglass to the Solway Firth and Hadrian's Wall. From the Medieval period religious houses and castles remain, such as Basingwerk Abbey, Lancaster Castle, Piel Castle, Dundrennon and Furness Abbeys. The impact of the industrial era is evident in the ports of Liverpool, Whitehaven and Maryport. These edifices are merely the robust survivors from a continuum of human activity since prehistory, exploiting the rich habitats of the lowlands around the extensive estuaries and rivers and developing communication within and beyond the Irish Sea.

Locations of sites mentioned in the text are shown on Map 6.1.1. Archaeological sites on land are very diverse, including both standing remains, from Roman forts to 20th century military defences, through buried remains, to surface scatters of worked flint or other material. In the intertidal zone, discoveries have historically tended to be artefacts, particularly flint tools and waste flakes, eroded from the foreshore or cliff. In recent years archaeological surveys have targeted *in situ* features with a maritime function, such as fish weirs and abandoned boats. Archaeological work now embraces sites that do not have a maritime function but which have been inundated by rising sea-level. Many such sites are found both on land and on the foreshore; they may also survive on the sea bed.

Shipwrecks are expected to be the most numerous subtidal sites. Written accounts tell of hundreds of ship losses in the approaches to the ports and in the Irish Sea. These records, which show the potential for ship sites to be found, are comprehensive for the 19th century, relatively complete for the 18th, and patchy for the 14th to 17th centuries. For earlier periods it is necessary to examine documentary evidence for sea-borne trade and extrapolate the extent of ship losses by considering the hazards to navigation. This process has then to be extended into the prehistoric period by looking at archaeological evidence for trade and seafaring.

Palaeo-environments, the landscapes of history and prehistory, survive as peat beds in terrestrial wetlands, for example in Sefton, the Over Wyre area and on the Solway Plain. The preserved vegetation of the peat, especially pollen, can be analysed to yield dates and to help reconstruct the palaeo-environment. This can reveal the presence of man by, for example, revealing past tree clearance or crop cultivation. The waterlogged conditions also preserve organic artefacts, which rarely survive on dry sites. As well as on land, peat is also exposed on the foreshore in many places around the region. Erosion has revealed remains of both creatures from the period and human artefacts. Foreshore deposits also include fallen trees and stumps known as submerged forests.

Map 6.1.1 Archaeology: locations mentioned in the text (excluding Isle of Man sites - see section 6.2).

6.1.2 History and archaeology of the region

Hunters, gatherers and early farmers (Palaeolithic, Mesolithic and Neolithic)

Rare evidence for the earliest inhabitants of northern Britain has escaped destruction by subsequent glaciation only within shelters, such as at Cefn Cave, Clwyd (*c.* 200,000 BC), and Lindale Low Cave (*c.* 12,000 BC). The discovery at Poulton-le-Fylde of an elk carcass, together with the barbed weapons that killed it (*c.* 10,000 BC), demonstrates the potential for open-site preservation beneath post-glacial sands and peats, and even beneath the Irish Sea (Cowell 1991).

Until the late 8th millennium BC the Merseyside coastline lay more than 15 km further west. The general trend of rising sea level, with intermittent regression, has preserved Mesolithic material, inundating the seasonally occupied camp sites of hunter-fisher-gatherers. Today, their distribution can be gauged from flint artefacts found on the eroding cliffs and beaches, as at Prestatyn, North Wirral, Eskmeals (now inland), Drigg, St. Bees, Luce Bay and the Rhinns, and in estuaries, including the Clwyd, Dee, Mersey and Alt.

Dumfries & Galloway has many long cairns, the burial monuments used by Britain's earliest farmers. Evidence for these Neolithic communities is generally lacking elsewhere in the region. Their farming know-how was probably introduced via trade links, and it is the distribution of these links that accounts for the varying dates from which Neolithic cultural material appears in the region (Cowell 1991). Distribution of the later stone circles has also been linked to postulated transport routes used after *c.* 2,500 BC

for stone axes or unfinished rough-outs. Examples of the latter, as well as evidence for working of good quality flint, have been found on Walney Island (Tyson 1994). Such flint working sites are also found on the beaches of south-west Cumbria. Arable farm sites have been identified at Bidston Moss, Wirral, and Mount Pleasant, Great Crosby.

Metal-working peoples (Bronze Age and Iron Age)

The importance of water transport in prehistory is clear, but remains of early sea-going craft have yet to be found. Estuarine and river craft of Bronze-Age date have been discovered, for example two boats uncovered during the construction of Preston Docks. Coastal erosion has revealed other types of site, for example a Bronze Age settlement and a timber structure near the Irt; and at Formby the sea has revealed numerous human and animal footprints. Burial mounds, and thus by inference settlements, tend to be associated with river valleys.

Possible Iron Age huts were exposed at Meols on the Wirral peninsula in the 19th century. The unique concentration of continental Iron Age coins, from Gaul, Armorica and even Carthage, highlights Meols as a pre-Roman *entrepôt* (trading centre) on the western seaway of Britain.

There is a small promontory fort at Burton Point overlooking the Dee. Similar sites occur elsewhere, for instance at Castle Haven, Barsalloch Point, Mull of Galloway and Kemp's Walk. On Ardwall Point is the best-preserved broch (stone tower) in western Galloway, probably built by local chieftains fearful of Roman military strength.

The Roman province

Wales was a Roman military zone, with its northern legionary base established at Chester (Deva) in the 1st century AD. This river port, on the navigable Dee, was a focal point for land and waterborne transport. A road led up the Wirral Peninsula to the probable civilian port at Meols. From further afield cargoes were received, for example lead from 1st-2nd century smelting furnaces on the Clwyd coast at Pentre. The search for other coastal shipping points must take account of the late Roman/early post-Roman marine transgression, which made now land-locked settlements, such as that at Prestatyn, accessible by ship.

In the Mersey near Runcorn twenty lead ingots from a sandbank beside the channel may have derived from 1st century AD shipwrecks, but unfortunately no contemporary ships have been found in the region.

The Solway Firth was the frontier zone, with the western end of Hadrian's Wall following the southern shore to Bowness. Beyond this, a chain of mile fortlets and turrets extended 23 miles along the coastal dunes - a watch system made necessary by the density of coastal traffic. Supply ports were constructed at Maryport, at Ravenglass and probably on the River Wyre. On the Dumfries & Galloway coast beyond Hadrian's Wall, patterns of Romano-British settlement are little understood, but evidence has come from islands and crannogs (lake dwellings) (Stell 1986).

Roman departure to Norman conquest

Evidence from the Dark Ages is scanty, but Meols clearly continued as a seaport and had contacts with Norse-Irish cultures, while Chester remained an administrative centre. This region possesses, at Whithorn and Kirkmadrine on the Rhinns, remains providing rare early evidence for the survival of Christianity into the post-Roman period. From the 7th century, pilgrims came by land and sea to Hilbre Island (off the Wirral) and the shrine of St. Ninian at Whithorn, Dumfries & Galloway. Promontories and offshore islands, such as at Llandrillo (Rhôs-on-Sea) and St. Bees, were favoured sites for monasteries. Chapels, such as Chapel Finian at Hilbre Island, and cemeteries were sited on raised beaches. Fish was a regular dietary requirement for Christians, and the foundations of medieval fish-weirs have been found at Rhôs-on-Sea and net sinkers at Hope and Rhyl. Sea salt was an important manufacture concentrated around the Arnside peninsula (Morecambe Bay).

Strategic sites, such as the Mote of Mark, defended the area prior to conquest by the Northumbrian Angles in the 7th century. However, place names between the Wirral and Solway show the extent of settlement by Norse colonists arriving from Ireland, probably in the 10th century (Moore 1970).

Medieval period

Many towns located on minor rivers were formerly important ports accessible to shallow-draft seagoing vessels and were protected by castles or town walls. Cardoness Castle (Dumfries & Galloway), for example, could be reached by vessels of eight tons.

The 13th and 14th centuries brought stability and expansion of trade; contacts with Ireland were important to this region. In 1207 King John acquired Liverpool as a new port to support his Irish campaigns, which in turn stimulated trade. Lancaster supplied ships for the king in 1297 and in subsequent centuries is noted as importing wine, corn and foodstuffs and conducting trade with Dublin (Whincop & White 1986). The wealthy abbey of Furness had daughter houses at Calder and Rushen (Isle of Man) and control of Inishlounaght (Ireland). The harbour at Furness was necessary for communication and trade, and Piel Castle was strengthened to protect it against the Scots.

Storm surges overcame a number of medieval settlements, most notably on the Sefton coast. Such problems also caused the Abbey of Stanlow, founded beside the Mersey in 1178, to be abandoned in the 13th century.

Post medieval and modern times

Chester remained the head port for the customs collection district covering the south of the region, but silting of the River Dee necessitated successive moves downstream, to Shotwick in the 16th century and later to Parkgate. Coastal changes determined the fate of other ports: the 17th century fishing village at Formby now lies beneath sand dunes; in 1796 the market town of Ulverston resorted to building a canal to maintain its link with Morecambe Bay, while nearby Greenodd was cut off when the channels silted; and 19th century silting caused Portpatrick to lose its place to deep water Stranraer as the main ferry terminal for northern crossings to Ireland.

The burgeoning port of Liverpool derived its prosperity from foreign trade. It was a focus for coastal shipping,

which brought goods for export and distributed imports such as tobacco around the Irish Sea. By 1699 it was the third largest trading port in England, its prosperity built on sugar and cotton imports from the West Indies. The improved rivers and canal system, especially the Manchester Ship Canal, opened in 1894, provided a large hinterland served by the port. The Atlantic trade remained central and was facilitated in the 19th century by construction of enclosed docks and warehouses. From this base the port was a natural point of departure for Irish emigrant ships and the later luxury liner services.

Up river Carlisle, like Chester, was a head port overshadowed by its member port, Whitehaven. While initially active in the coastal trade, reshipping foreign imports received from Lancaster and Liverpool, Whitehaven's massive growth in the 18th century resulted from the expansion of coal exports from the Lancashire and Cumbrian coalfields. The harbours at Maryport and Workington were also constructed for this trade. Like Liverpool, these Cumbrian ports also took part in slave and tobacco trades. Raw materials stimulated trade at Dalbeattie and Dumfries, which exported the product of local stone quarries. Ships were built in the majority of ports, using imported timber and iron. Local reserves spawned the iron-making and founding industry around Furness.

6.1.3 Human activities

Integrated management

The adoption of coastal zone management in many mainland areas of the region (see Chapter 10) provides opportunities for new approaches to the integrated management of land, shore and sea-bed archaeological sites. Research projects can now be set in a wider context: for instance, research at Formby Point Beach is undertaken within the Sefton Coastal Management Scheme (Cowell *et al.* 1993). Historic Scotland and The Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS) have become involved in the Focus on Firths Project, which includes the Solway Firth, in order to take advantage of such opportunities.

Activities and processes affecting the archaeological resource

There are a number of factors likely to have a physical influence on archaeological sites (Bayliss 1994; Morecambe Bay Strategy steering Group 1994), although as archaeological monitoring has been limited these influences cannot yet be quantified (Ashmore 1994). It is important to remember, however, that the resource does not consist entirely of discrete sites such as intact wrecks. Many sites are scattered and palaeo-environments can be extensive, stretching across terrestrial, inter-tidal and sub-tidal zones.

Erosion has been a long-term problem; its impact is visible on buildings such as Piel Castle. Much of the Wirral is below sea level, but approximately 70% is protected by sand dunes as much as 10 m high. Nevertheless, an estimated mile-wide strip of land has been eroded in 400 years, causing the loss in the last century of the medieval port of Meols, a nationally important site containing evidence of almost continuous occupation from neolithic to modern times. At intertidal sites, sea erosion of the foreshore can both reveal and destroy archaeological features; such threats can be met only by rapid recording projects (see Cowell *et al.* 1993; Middleton 1992).

Demolition and rebuilding can also both reveal and destroy fragile remains of earlier waterfronts sealed beneath extant structures. Liverpool docks demonstrate the considerations that have to be taken into account in preserving the fabric and character of historic maritime buildings and structures during redevelopment as part of economic regeneration. Other ports such as Maryport face similar redevelopment. Medieval and earlier waterfront structures also survive in locations that were not developed by the Victorian dock builders. Other developments, such as flood defences and sewage outfalls, directly impinge on the intertidal area. Oil and gas pipelines are also a consideration. These come ashore at the Point of Ayr,

Table 6.1.1 Numbers of coastal Scheduled Ancient Monuments per county/Scottish region

Area	*No. of Scheduled Ancient Monuments*
Clwyd[a]	**67**
Colwyn	11
Rhuddlan	25
Delyn	31
Alyn & Deeside	0
Cheshire[b]	**16**
Ellesmere Port and Weston	4
Vale Royal	3
Halton	6
Warrington	3
Merseyside[b]	**10**
Wirral	6
Liverpool	4
Sefton	0
Lancashire[b]	**19**
West Lancashire	0
South Ribble	1
Preston	0
Fylde	Not listed
Blackpool	Not listed
Wyre	3
Lancaster	15
Cumbria[b]	**67**
South Lakeland	27
Barrow-in-Furness	4
Copeland	14
Allerdale	21
Carlisle	1
Dumfries & Galloway[c]	**228**
Annandale	4
Nithsdale	18
Stewartry	63
Wigtown	143
Region 13	***407***
Wales (whole country)[c], *	2,700
England (whole country)[c],*	13,000
Scotland (whole country)[c], *	5,300
GB (whole country)[c],*	***21,000***

Sources: [a]Cadw (1993); [b]English Heritage (1994); [c]Breeze (1993).
Note: except where marked*, totals are of all sites occurring in 10 km x 10 km squares of the National Grid that include sea, as shown on Ordnance Survey 1:50,000 series maps.

Clwyd, and at Barrow-in-Furness, and are laid between Galloway and Ireland.

Bait digging has been identified as an activity that may disturb archaeological sites in the Duddon Estuary (Bayliss 1994), and the same may be true for cockle fishing on the Dumfries & Galloway coast (Brann pers. comm.). Few subtidal sites have been surveyed and so it is difficult to gauge the influence that activities may have on the archaeological resource. Clearly some activities may directly damage or destroy sites, for example salvage diving, dredging for navigation or aggregates or the use of fishing gear that is in contact with the sea bed. Chemical or physical changes to the sea bed or water column may also alter the equilibrium of remains that are in a sensitive state of preservation.

Protection of sites, monuments and wrecks

On the mainland of this region, four statutory designations can be applied specifically to protect *in situ* remains of archaeological or historic importance. The Ancient Monuments & Archaeological Areas Act 1979 (AMAA) provides for Scheduled Ancient Monuments. The AMAA definition of monument includes sites both on land and in UK territorial waters, including remains of vehicles, vessels and aircraft. In practice, however, in England and Wales scheduling has been applied only above low water mark (Firth 1993). In contrast, Scotland has precedents for scheduling underwater remains and there is no bar to using this designation for wreck sites in order to cater for visitor access while providing protection (Fojut pers. comm.). There are published lists of criteria for determining the national importance of a monument (Welsh Office 1991; DoE 1990; Scottish Office 1994). The numbers of coastal Scheduled Ancient Monuments in the region and nationally are given in Table 6.1.1. The numbers are increasing in England and Wales through review programmes, and in Scotland the present rate of increase is 300 per year. Sites and Monuments Records - archaeological databases maintained at county (regional in Scotland) level - are a key source of information on sites of local and regional significance.

The Town & Country Planning (Listed Buildings and Conservation Areas) Act 1990 provides for buildings considered of special architectural or historic importance to be designated as Listed Buildings, and Conservation Areas provide for the preservation of historic environments, commonly in urban areas. Listed Buildings in the region include maritime structures such as docks, dock gates, warehouses and lighthouses.

Shipwrecks of archaeological or historic importance can be designated under the Protection of Wrecks Act 1973, although the Act has not been used in this region. Fewer than 45 wrecks have been designated for the whole of Britain, and their distribution cannot be accepted as a reasonable guide to the total sea-bed resource. Table 6.1.2 shows the numbers of wreck sites recorded in the National Monuments Record (Maritime Section) for England and Scotland.

In addition, Hadrian's Wall and the coastal forts in this region have been included in the World Heritage List as a World Heritage (Natural) Site, under the Unesco Convention concerning the protection of the world cultural and natural heritage 1972 (Davidson *et al.* 1991). "The primary criterion is 'outstanding universal value' in one or more of six precisely defined criteria" (Cleere 1993).

Table 6.1.2 Records entered in the National Monuments Record - Maritime Section, England and Scotland

County/Region	*Site type:*		
	*Known wrecks**	*Documented casualties*	*Obstructions*
Merseyside	551	383	371
Lancashire	146	306	86
Cumbria*	-	-	-
Dumfries & Galloway	86**	-	-

Source: England - RCHME (pers. comm. August 1995); Scotland - RCAHMS (pers. comm. June 1995). Key: *no information for Cumbria has yet been entered on the RCHME database; **information from Hydrographics Department; figure includes unidentified obstructions but not documented casualties.

Key organisations and their responsibilities

Welsh Historic Monuments Executive Agency (Cadw), English Heritage and Historic Scotland execute the responsibilities of the Secretaries of State in respect of the Ancient Monuments and Archaeological Areas Act (1969) and (except in England, where the Department of National Heritage retains responsibility) the Protection of Wrecks Act (1973). Cadw, English Heritage and Historic Scotland fund rescue archaeology and survey work, inspect Scheduled Ancient Monuments, assist owners by drawing up management agreements which are supported by grants and directly manage those monuments in care.

The Royal Commissions on the Ancient and Historical Monuments of England, Scotland and Wales (RCHME, RCAHMS and RCHAMW) have responsibility for the survey and inventory of archaeological sites. Each maintains an index of terrestrial sites as part of their respective National Monuments Records (NMRs). In 1992 new Royal Warrants extended their remit to the territorial seas. All three Royal Commissions have established NMR Maritime Sections. They are lead agencies for local databases of archaeological sites known as Sites and Monuments Records (SMRs). The essential role of Sites and Monuments Records in providing a source of information and advice for planning authorities has been confirmed (DoE 1990; Welsh Office 1991; Scottish Office 1994). SMRs are maintained by the county councils in England, by the Regional authority in Scotland, and by the Clwyd Archaeology Service (Clwyd County Council) and the Clwyd-Powys Archaeological Trust jointly, in Clwyd (see section 6.1.6 B).

Development control

To landward of low water mark, archaeology is considered within the unified system of development control provided by the planning system. The Department of the Environment has issued guidance notes (DoE 1990) explaining the requirements for planning authorities and developers to have regard for archaeological remains. In essence there is a presumption in favour of preservation *in situ* of archaeological remains and their settings. DoE (1990) therefore recommends that it is in the interest of the developer, as part of their research into a potential project,

"to make an initial assessment of whether the site is known or likely to contain such remains". The Sites and Monuments Records provide information on the location of recorded archaeological sites and should be consulted at an early stage. Prior consent from Cadw (in Wales), English Heritage or Historic Scotland is necessary for any works that will destroy, damage, repair or remove a Scheduled Monument, and there is a presumption against destruction. In England there is now also a presumption against the destruction of Listed Buildings, and consent is required from English Heritage prior to any demolition, alteration or extension (DoE 1994). For certain types of development (listed in Schedules 1 and 2 to the Town & County Planning (Assessment of Environmental Effects) Regulations 1988), formal Environmental Assessments may be necessary. This should include information on any effects on the cultural heritage. Planning decisions should take into account more detailed policies, which appear in Development Plans. In England and Wales the County Structure Plans and Local Plans of their constituent districts, and for the Merseyside area the Unitary Development Plans, and in Scotland Regional Structure Plans, all contain policies on archaeology. The Lake District National Park Authority (LDNPA), which is a planning authority, also has archaeological policies (LDNPA 1994).

Further policies and information related to archaeology appear in a variety of management plans (see also Chapter 10). A strategy document outlines the archaeological resource of Cheshire and objectives for research, preservation and interpretation (Cheshire County Council 1991). On Merseyside, the authorities for the Wirral and Sefton are active in coastal zone management and recognise archaeology as a consideration. Lancashire County Council is preparing an archaeological strategy. Published documents related to management initiatives for Morecambe Bay and the Duddon Estuary include the cultural heritage as an issue (Bayliss 1994; Morecambe Bay Strategy Steering Group 1994). Other bodies with responsibilities for managing the coast, such as the National Trust, also often include archaeological considerations in their policies.

To seaward of low water mark there is a sectoral approach to development control (DoE 1993). Regulation, including requirement for Environmental Assessment, is divided between a range of government departments and agencies. Until recently, the lack of information on the extent of the resource and the absence of a management structure for archaeology in the subtidal zone had precluded its consideration by many local authorities. However, growing awareness of marine archaeology is leading to voluntary consideration of the archaeological resource. This is assisted by a *Code of practice for seabed developers*, which has been published by the Joint Nautical Archaeology Policy Committee (1995). In this region some developers have already included consideration of the archaeological resource in their planning, by, for example, examining sidescan (graphic images obtained by using sound waves) data for features (Hampshire & Isle of Wight Trust for Maritime Archaeology 1994).

Reporting archaeological information

The three Royal Commissions and the SMRs are the accepted reporting points for new archaeological information. Information and enquiries concerning Designated Historic Wrecks and Scheduled Monuments within the region should be directed to Cadw, Historic Scotland or English Heritage (Department of National Heritage for wrecks in English waters); and concerning Listed Buildings to Cadw, English Heritage, or, in Scotland, the local authority.

In England and Wales the only legal requirement to report archaeological and historical artefacts arises when the objects fall within the laws on either Treasure Trove or Salvage. The law of Treasure Trove is used to secure important treasures for the nation (Longworth I993). Objects of gold or silver found on land must be reported to the National Museum of Wales or the British Museum, the police or the coroner. Should a coroner's inquest then declare the objects Treasure Trove, the National Museum of Wales or the British Museum may retain them and, in return, make an *ex gratia* payment to the finder. The National Museum of Wales may waive its right in favour of another museum.

In Scotland the combination of the laws of Treasure Trove and Bona Vacantia ('lost property') means that, in effect, all antiquities can be claimed by the Crown (Longworth 1993). All finds should be reported to a museum, the police or the Procurator Fiscal, who dispose of them in accordance with procedures similar to those outlined for England and Wales (Historic Scotland 1994).

The Merchant Shipping Act 1894 requires any recovered wreck to be reported to the Receiver of Wreck. For this purpose, wreck is defined as any ship, aircraft, hovercraft or parts of these, their cargo, or equipment, found in or on the shores of the sea, or any tidal water. The Receiver provides advice and supplies forms for reporting recovered wreck. These include a form which finders may use to volunteer to the RCHME, RCAHMW or RCAHMS information on the identity and condition of wreck sites. The Receiver advertises reported wreck, regardless of age, so that owners can claim their property. After one year, unclaimed wreck becomes the property of the Crown and is disposed of in order to pay the expenses of the Receiver and any salvage awards. During the statutory year, such items may be lodged with an appropriate museum or conservation facility with suitable storage conditions. There is a policy of offering unclaimed wreck of historic, archaeological or artistic interest to registered museums. Finders are often allowed to keep unclaimed wreck in lieu of a salvage award. The responsibility of the Receiver to the finder, with regard to salvage awards, remains regardless of the historic character of the wreck.

6.1.4 Information sources

The rapid compilation of records for the National Monuments Records - Maritime Section, RCHME, is due to end in 1995. The records have been compiled from the Hydrographic Department Wreck Index (see Table 6.1.2). This lists mainly 20th century shipwrecks and unidentified sea-bed obstructions. To these will be added records of shipping casualties and details of finds made by fishermen and divers. Similar work is planned by RCAHMS and RCAHMW; RCAHMS have commenced their recording using information from the Hydrographic Department Wreck Index. RCAHMW have initiated their work with coastal surveys in south Wales. Published accounts show that the coasts of Scotland and Wales are as rich in wrecks as

the coast of England: 650 wrecks are recorded on the coast of Galloway alone (Miller 1992). The Sites and Monuments Records of this region have yet to be extended beyond low water mark. Apart from the Hydrographic Department Wreck Index, no other archaeological subtidal surveys are known to have been conducted to date.

English Heritage and the RCHME have commissioned a project, England's Coastal Heritage, which will inform the development of a strategic approach to survey, recording and management. The latter element is examining the relationship between archaeology and current developments in the management of the coast. Under the project, the Aerial Photographic Unit of RCHME is investigating the feasibility of using aerial photographs for intertidal survey, and Reading University is producing a synthesis of information within the National Monuments Record (NMR), Sites and Monuments Records (SMRs) and published sources. At the time of writing, the executive summary was due for publication in December 1995. Historic Scotland is working with the Solway Firth Forum to develop a strategic approach to archaeological survey, recording and management in that area.

The North West Wetlands Survey (NWWS) is an eight-year programme of intensive archaeological and palaeoecological work on the low-lying wetlands of the north-west, including Cheshire, Merseyside, Lancashire and Cumbria. It is funded by English Heritage.

In Clwyd there has been no specific coastal survey, but a number of environmental assessments have been required by the planning process. In Prestatyn several have provided information on the growth of peat following changes to marine conditions (Thomas 1993; Owen 1993; Bell *et al.* 1993). This area had already been studied in relation to prehistoric changes in sea level and, consequently, the coastline (Manley 1981). The Clwyd Archaeology Service has supported surveys of two historic vessels in Foryd Harbour, Rhyl. This project was conducted in advance of redevelopment and improvement of the harbour, which may necessitate their destruction. A timber fish weir and coastal defences have been surveyed in the intertidal zone at Rhôs-on-Sea.

Cheshire County Council has made a small grant to a voluntary group which is undertaking a survey aimed at identifying wrecks on the sea bed of Liverpool Bay.

In 1981 the Merseyside Docklands History Survey was established to survey the South Docks of Liverpool (Ritchie-Noakes 1984; Phillips 1983). The NWWS has undertaken work on the wetlands of the coastal plain, notably on the Wirral and in Sefton. Also in Sefton, there has been a study of the historic landscape (Lewis 1992). The archaeological potential of the Mersey Estuary has been highlighted by a review which concludes that "although a number of individually important sites such as Meols and Hale Cliff Wharf are recorded, a systematic survey is overdue" (Stammers 1994). Such survey should consider, amongst other things, ship, boat and harbour installations. To the north of the Mersey, individual prehistoric sites such as footprints and fish weirs have been surveyed on Merseyside by the National Museums and Galleries, Liverpool Museum.

A number of general surveys have included coastal sites: a review of archaeology was undertaken by the Lake District National Park Authority in advance of submitting policies to Local Plans; coastal sites (terrestrial and intertidal) were included in surveys of Mesolithic material (Cherry & Cherry 1983, 1984 & 1985); and RCAHMS surveys have covered coastal forts (RCAHMS 1985) and sand dune areas of Torrs Warren and Luce Bay (RCAHMS 1987). Some intertidal survey has been undertaken in response to sea defence construction throughout the region.

6.1.5 Acknowledgements

Thanks are due to the staff of all the organisations mentioned in the text who gave their time to provide information. The authors are also indebted to Jane Tyson of Reading University, who made available information from the England's Coastal Heritage project.

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B. Contact names and addresses

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Wales: statutory body responsible for archaeological conservation. Funding of rescue archaeology and survey.	Inspector of Ancient Monuments, Cadw, Brunel House, 2 Fitzalan Road, Cardiff CF2 1UY, tel: 01222 500200
England: Scheduled Ancient Monuments; Listed Buildings; designated wreck sites; rescue archaeology; management of monuments in care	Chief Archaeologist, English Heritage, 23 Savile Row, London W1X 2HE, tel: 0171 9733000
Scotland: Scheduled Ancient Monuments; Listed Buildings; designated wreck sites; rescue archaeology; management of monuments in care	Principal Inspector of Monuments, Historic Scotland, Longmore House, Salisbury Place, Edinburgh EH9 1SH, tel: 0131 668 8650
Maritime archaeological sites in England; code of practice for sea bed developers (published by the Joint Nautical Archaeology Policy)	Head of Recording (Maritime), Royal Commission on the Historical Monuments of England, National Monuments Record Centre, Kemble Drive, Swindon SN2 2GZ, tel: 01793 414600
Archaeological sites in England (general)	National Monuments Record, Royal Commission on the Historical Monuments of England, National Monuments Record Centre, Kemble Drive, Swindon SN2 2GZ, tel: 01793 414600
National Monuments Record of Scotland	Royal Commission on the Ancient & Historical Monuments of Scotland, National Monuments Record of Scotland, John Sinclair House, 16 Bernard Terrace, Edinburgh EH8 9NX, tel: 0131 662 1456
National Monuments Enquiry Service for Wales, designated Historic Wrecks, Scheduled Monuments, Listed Buildings	National Monuments Record Archive & Library, Royal Commission on the Historic & Ancient Monuments of Wales, Crown Building, Plas Crug, Aberystwyth, Dyfed SY23 1NL, tel: 01970 621200
Clwyd Sites and Monuments Record (SMR) (jointly with Clwyd-Powys Archaeological Trust)	Archaeology Manager, Clwyd Archaeology Service, Department of Development & Tourism, Shire Hall, Mold, Clwyd CH7 6NB, tel: 01352 702745
Advice on planning applications; Clwyd Sites and Monuments Record (jointly with Clwyd Archaeology Service)	Principal Curatorial Officer, Clwyd-Powys Archaeological Trust, 7a Church Street, Powys SY21 7DL, tel: 01938 553670
Cheshire SMR	Principal Conservation Officer (Archaeology), Cheshire County Council, Environmental Planning Service, Commerce House, Hunter Street, Chester CH1 2QP, tel: 01244 603160
Merseyside SMR	SMR Officer, Field Archaeological Section, Liverpool Museum, William Brown Street, Liverpool L3 8EN, tel: 0151 478 4258
Lancashire SMR	Chief Archaeologist, Lancashire Sites & Monuments Record, Lancaster University Heritage Consultancy, Furness College, Lancaster LA1 4YW, tel: 01524 65201
Cumbria SMR	*SMR Officer, Economy and Environment Division, County Offices, Kendal, tel: 01539 814379
Dumfries & Galloway SMR	Regional Archaeologist, Department of Physical Planning, Dumfries & Galloway Regional Council, Area Sub Office, 4 Market Street, Castle Douglas DG7 1BE, tel: 01556 502351
Archaeology in Lancashire (excluding planning)	County Archaeologist, Lancashire Records Ofice, Bow Lane, Preston, Lancashire PR1 8ND, tel: 01772 263032
Archaeology in the Lake District National Park (including planning)	*Archaeologist, Lake District National Park Authority, Kendal, tel: 01539 724555
Reporting of recovered wreck in Britain	Receiver of Wreck, Coastguard Agency, Spring Place, 105 Commercial Road, Southampton SO15 1EG, tel: 01703 329474
Historic wreck sites in England	The Secretary, The Advisory Committee on Historic Wreck Sites, Department of National Heritage, Room 306, 2-4 Cockspur Street, London SW1Y 5DH, tel: 0171 211 6369 or 6367
Advice on finds; reporting point for Treasure Trove in Wales	National Museum of Wales, Department of Archaeology and Numismatics, Cathays Park, Cardiff CF1 3NP, tel: 01222 397951
Reporting of Treasure Trove in England	The British Museum, Bloomsbury, London WC1 3DG, tel: 0171 323 8454 (Prehistoric to Romano-British) or 0171 323 8629 (Medieval to Present)

* Starred contact addresses are given in full in the Appendix.

6.2 History and archaeology - Isle of Man

Dr P.J. Davey & J.J. Woodcock

6.2.1 Introduction

The Isle of Man is important for the great range and richness of its archaeological remains and landscapes. Some 4,500 archaeological sites have been identified to date. Because of their island locations, these sites and their associated cultural material offer many opportunities to study the influences of external cultural contacts as against indigenous developments.

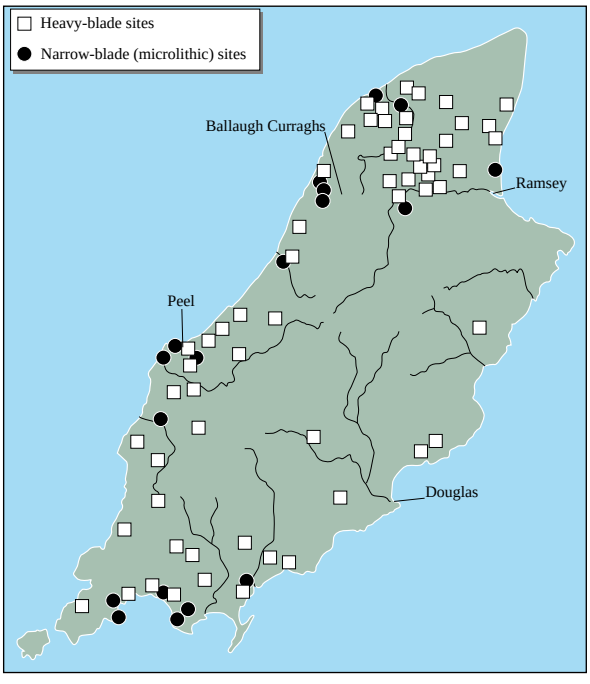
There are a great variety of terrestrial sites of all periods along the coast of the Isle of Man. Not all are strictly coastal by nature, but through erosion or changes in sea level many now find themselves in this category. In particular, most of the prehistoric occupation and burial sites tend to be on the lower-lying coasts of the island. There are also a number of areas of land claim, particularly along the present-day waterfronts at Peel, Douglas and Ramsey, known to contain archaeological evidence of earlier waterfronts, coastal defences and harbour works (Davey 1992). Alterations to the coastline have also resulted in the apparent relocation into the intertidal zone of sites of all periods, including, notably, a number of early prehistoric date. Such sites, often associated with palaeo-environmental deposits, lie mostly around the coasts of the northern plain, where erosion has been most marked. Artefacts which have eroded from the sandy cliffs are found on the beaches, and charred layers in the face of the cliffs indicate the possible remains of settlement areas. Other important archaeological features with a maritime function are found around the coast, including fish weirs, way marks, wrecks and fortifications of many dates.

A range of former terrestrial sites is likely to survive on the sea bed, as indicted by the quantities of rolled flint artefacts that can still be found on the storm beaches in the north of the island. On the north-east side of the island, in particular, where offshore waters are shallowest, it is likely that submerged early prehistoric occupation sites will have survived, with associated palaeo-environmental evidence. Palaeo-environmental evidence survives elsewhere in kettleholes, lake bed deposits, submerged forest beds and buried occupation horizons, now eroding from the cliffs (McCarroll *et al.* 1990). The Ballaugh Curraghs, a wetland of international importance in the north of the island (and a proposed Ramsar site) and the nearby cliff sections contain important late-glacial deposits of pollen, insects and specimens of the Irish elk *Cervus giganteus* (Mitchell 1958).

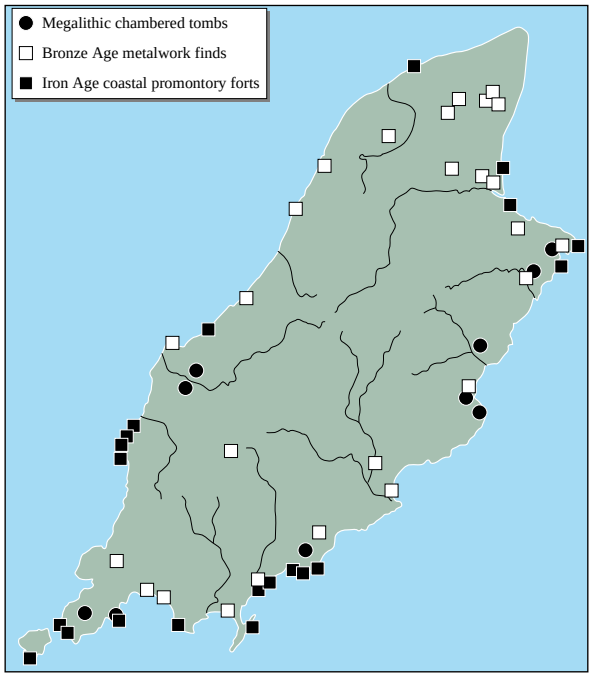
Large numbers of shipwrecks have occurred in Manx waters, and at least one - the Racehorse, which foundered off Langness in 1822 - has been formally protected.

6.2.2 History and archaeology of the region

There is no direct evidence of a Palaeolithic presence on the island, although the abandoned sea-caves, now far above sea level, may yet yield such evidence (Garrad 1978). The Manx Mesolithic period (*c.* 7,500 - 4,000 BC) included both a microlith and a heavy blade industry (Woodman 1978) (Map 6.2.1). Settlement appears to have been predominantly coastal, with a concentration of heavy-blade fabrication sites on the northern plain (McCartan 1990). The Neolithic and Bronze Ages (4,000 - 500 BC), however, are well represented. Megalithic chambered tombs, in particular, seem to have a remarkably coastal distribution, none being situated in the more central, upland areas of the island (Henshall 1978)



Map 6.2.1 Mesolithic sites on the Isle of Man. Source: after McCartan (1990). Locations mentioned in section 6.2.1.



Map 6.2.2 Neolithic and Bronze Age sites and Iron Age coastal promontory forts on the Isle of Man.

(Map 6.2.2). Sites of the later Neolithic Ronaldsway Culture and the early Bronze Age similarly appear to be consistently situated within a few kilometres of the coast (Moffatt 1978), as do finds of Bronze Age metalwork (Davey 1978). The majority of the 22 Iron Age (500 BC - AD 500) promontory forts (Gelling 1952, 1958, 1959, 1968), later to be re-inhabited during the Norse period (AD 1000 - 1250), are located around the south and south-east coasts (Map 6.2.2). Given the coastal distribution of known sites, other sites are likely to have been lost to erosion.

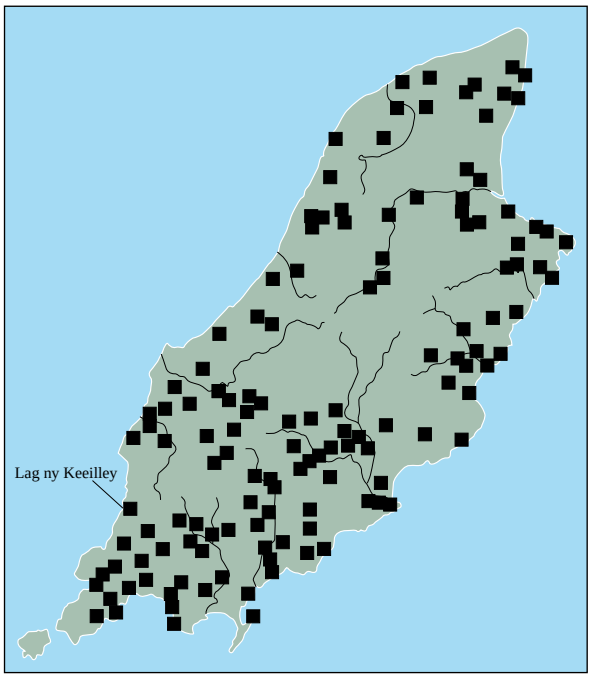
There was no Roman occupation of the Isle of Man. The Isle of Man has over two hundred chapel (keeill) and burial ground sites dating from the early Christian period (AD 500 - 1000) (Map 6.2.3). Some, such as Lag ny Keeilley, are situated in spectacular coastal locations; others have already been lost to erosion and fall within the subtidal category. Numbers of impressive burials mounds, including ship burials, dating from the arrival of the Norse invaders (AD 1000 - 1250), are found on coastal ridges and headlands around the perimeter of the island (Map 6.2.4) (Bersu & Wilson 1966; Kermode 1930; Bruce & Cubbon 1930); again, other sites are likely to have been lost to erosion.

There was no Norman occupation of the island. The two high medieval period (AD 1250-1406) castles, at Peel and Castletown, and their associated settlements and harbours saw considerable development during this period. Three monastic orders were based on the island, all with their houses and much of their property on the coast, at Douglas, Ballasalla and Ballabeg. The pattern of quarterland farms became established; many existing sites are assumed to be medieval in origin. A number have their origins in prehistoric times (e.g. Kerrowdhoo; Davey *et al.* 1995). Map 6.2.4 shows the locations of medieval castles, mottes, tower houses and monastic sites on the island. The late medieval and early modern periods (AD 1406 -1830) saw a rapid increase in fishing and harbour developments, such as at Derbyhaven. Many early mines, mining trials (unproductive mineshafts) and quarries occur in the coastal zone, as do a complex of coastal forts and batteries, constructed as a response to the Spanish Armada, the English Civil War and the Napoleonic threat (Map 6.2.4) (Curphey 1968).

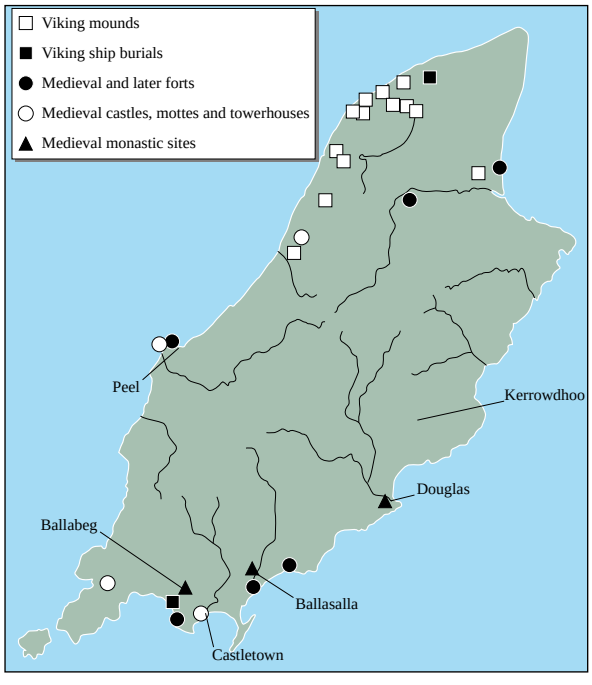
From the late 19th century on, a high proportion of the commercial enterprises of the Isle of Man owed their existence to the tourist industry (Bawden *et al.* 1972). The mid-Victorian sea-side holiday culture is represented at Douglas, Port St. Mary, Port Erin and Port Soderic, which was purely a creation of the tourist industry. There are harbours at Ramsey, Douglas, Castletown and Peel, and there are a number of lighthouses all around the island (Robertson 1971).

The industrial heritage of the island is largely limited to small-scale manufacturing enterprises connected with the fishing industry - boat building, rope and net works and fish preserving (Bawden *et al.* 1972) and the extractive industries, such as quarrying, mining, gravel and salt extraction (Bawden *et al.* 1972), many of which impinge very closely on the coast. The Laxey Wheel is a major reminder of the importance of the lead mining industry on the east coast of the island (Bawden *et al.* 1972). The Manx narrow-gauge railway network was initially developed to serve an industrial requirement. Three stretches, those between Douglas and Port Erin, between Douglas and Ramsey and a considerable stretch of the Manx Northern railway, now abandoned, closely follow the coast.

The first and second world wars are also well represented by sites with a largely coastal distribution. They include the derelict remains of tourist accommodation and leisure facilities, which were requisitioned in order to provide for foreign internees, and evidence of extensive communications and radar systems at a number of coastal locations around the island. In the north of the island, at Andreas and Jurby, the earthworks and buildings associated with airfields are remarkably well preserved.



Map 6.2.3 Early Christian period keeill sites on the Isle of Man. Source: after Kinvig (1975).



Map 6.2.4 Norse and Medieval sites on the Isle of Man.

6.2.3 Human activities

On land and intertidally, along certain parts of the coastline, natural erosion poses a substantial threat (*cf.* Rouse 1990). In addition, a range of economic developments pose possible threats to the coastal zones: sewage outfall construction and maintenance; pipe-line and cable laying; and sea defence construction, as at Bay ny Carrickey or the outworks at Douglas Harbour. Aggregate dredging may occur in the future. Fishing, in particular bottom fishing, the dredging of harbours and salvage operations or wreck investigations are the most likely hazards for subtidal sites.

Protection of sites, monuments and wrecks

There are three principle Acts of Tynwald that apply to archaeological sites and artefacts from the Isle of Man and its territorial waters. The Manx Museum and National Trust Acts 1959 to 1986 define an 'ancient monument' and 'archaeological objects' and the means by which ancient monuments are protected. Under their terms, any ancient monument in danger of destruction may be placed under the protection of the Trust; the discovery of an archaeological object must be reported to a member of the police or to an officer of the Trust within a period of fourteen days; an export licence is required to remove any items of archaeological interest from the Isle of Man and its territorial waters; a licence, issued by the Trust, is required before any archaeological excavation may be undertaken; and written consent is required before a metal detector may be used on an archaeological site. The Manx law of Treasure Trove is, in principle, identical to that which applies in the United Kingdom (see section 6.1.3). The High Bailiff, in his capacity as Coroner of Inquests, will decide whether or not a find is Treasure Trove.

The Wreck and Salvage (Ships and Aircraft) Act 1979 applies to all wrecks and sites of wrecks occurring within Manx territorial waters. Part III defines the means by which a wreck on the sea bed is designated as a restricted area or a prohibited area and by which such sites are protected. Under its terms a licence from the Harbour Board is required to dive or to excavate or remove objects from within a restricted area. Archaeological activity in any other area within territorial waters is governed by the Manx Museum and National Trust Acts 1959 to 1986. A licence from the Trust is required for any archaeological investigation on the sea bed, finds must be reported to the Trust within fourteen days, and an export licence is needed to remove any items of archaeological interest from Manx waters.

Town and Country Planning Acts 1934 - 1991 define 'registered buildings' and 'conservation areas'. European Community regulations on environmental assessment have been voluntarily adopted by the Manx government in planning its own large-scale developments.

Development control

The Isle of Man Development Plan (1981) designated "waterways, docks and harbours of traffic importance" at Port Erin, Port St. Mary, Castletown Bay, Derbyhaven, Douglas Bay, Laxey Bay, Ramsey Bay and Peel Bay. Over 135 km of coastline are considered to be "areas of high landscape or coastal value and scenic significance". The conservation areas at Castletown, Laxey, Maughold, Peel and Ramsey include significant coastal and intertidal elements. Registered buildings on the coast include limekilns, lighthouses, a powder house, warehouses, a foundry, swing bridge and a brewery. The two 19th century Stephenson lighthouses on the Calf of Man are Scheduled Ancient Monuments. These sites and structures are protected against inappropriate development under the provisions described above.

6.2.4 Information sources

A number of archaeological surveys with a coastal element have been undertaken in recent years or are in progress. On land these include the Meayll survey, the Manx wetland survey, the vernacular building survey, and the Peel Town survey. Subtidally, a database has been prepared by A. Corkhill of wrecks in Manx waters since 1800, including records of over 970 wrecks. Information from these surveys is held by the Centre for Manx Studies. In the intertidal zone, Quaternary survey and monitoring by the University of Wolverhampton has focused largely on the cliff exposures and submerged forest in the north of the island (Dackombe & Thomas 1985).

6.2.5 Acknowledgements

Thanks are due to Fenella Bazin, Nick Johnson (Centre for Manx Studies), Andrew Johnson (Manx National Heritage), and Pat Newton (Department of Local Government and the Environment).

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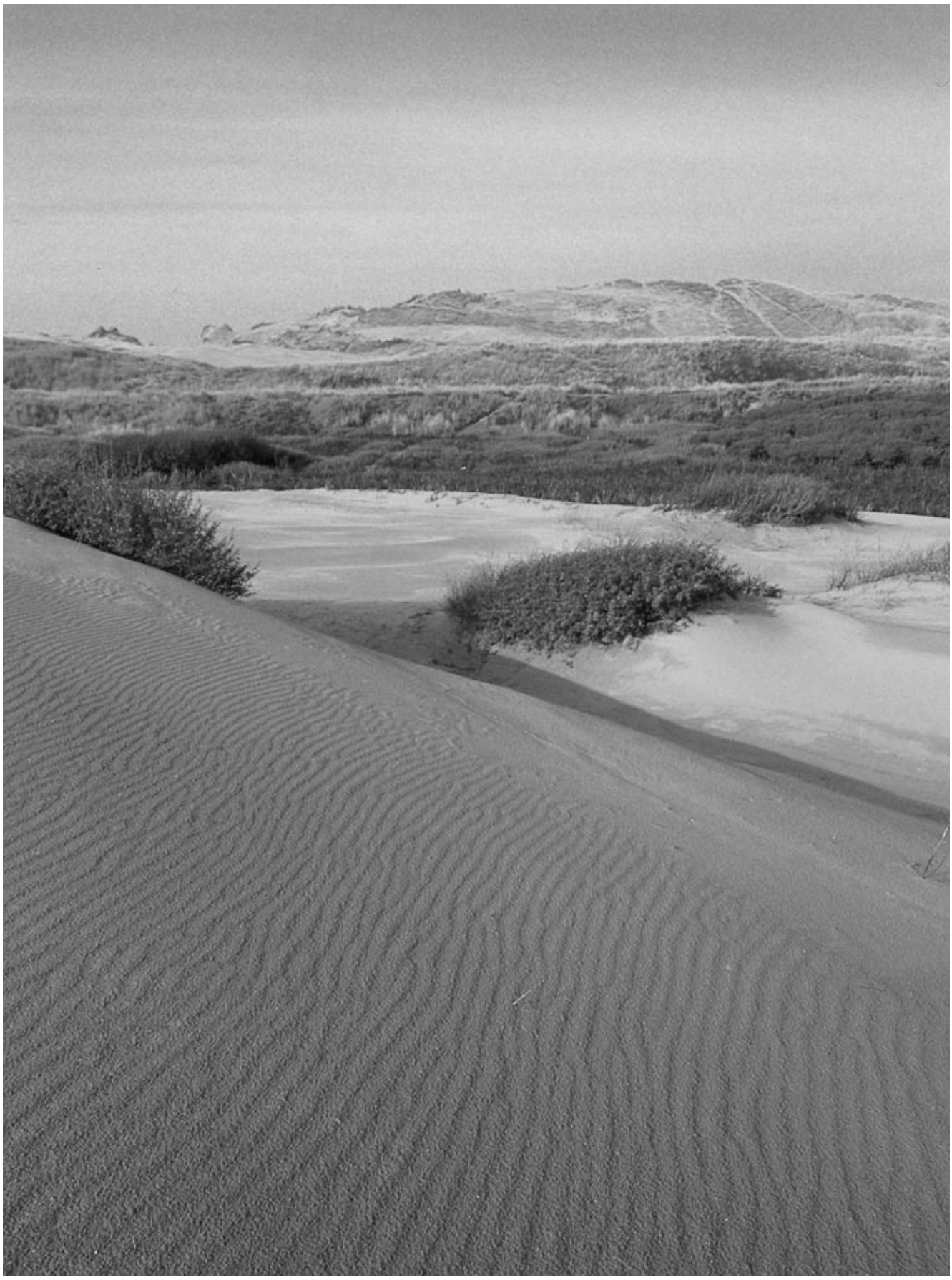
Solly, M. 1994. *Government and law in the Isle of Man.* Castletown, Parallel Books.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Sub-aqua clubs on the Isle of Man	*M. Bates, c/o Port Erin Marine Laboratory, tel: 01624 832027
Archaeological research	The Centre for Manx Studies, 6 Kingswood Grove, Douglas IM1 3LX tel: 01624 673074
Fish stocks; pollution levels; marine research	*Port Erin Marine Laboratory, tel: 01624 832027
History, archaeology and natural history of the Isle of Man	Isle of Man Natural History and Antiquarian Society, Honorary Secretary, 5 Peveril Avenue, Peel IM5 1QB, tel. 01624 842456
Protected sites; conservation policy	*The Manx Nature Conservation Trust, St. Johns, tel: 01624 801985
Listed buildings; conservation areas; planning authority for the Isle of Man	Department of Local Government and the Environment (DLGE), Murray House, Mount Havelock, Douglas IM1 2SF, tel: 01624 685954
Receiver of Wreck; wreck exploration licensing; ports and harbours on the Isle of Man	*The Chief Harbour Master, Douglas, tel: 01624 686600
Deputy Receivers of Wrecks	*Castletown Harbour Master, tel: 01624 823549
	*Laxey Harbour Master, tel: 01624 861663
	*Ramsey Harbour Master, tel: 01624 812245
	*Port St. Mary Harbour Master, tel: 01624 833206
	*Port Erin Harbour Master, tel: 01624 833205
	*Peel Harbour Master, tel: 01624 842338
Reporting of Treasure Trove	Chief Secretary, Government Office, Bucks Road, Douglas IM1 3PG, tel: 01624 685685
Reporting of archaeological finds	The Isle of Man Constabulary, Department of Home Affairs, 88 Woodbourne Road, Douglas IM2 3AP, tel: 01624 623355
Ancient Monuments; monuments in care; site survey; excavation, export and metal detecting licensing; reporting of archaeological finds; Sites and Monuments Register (SMR)	*Inspector of Ancient Monuments, The Director, Manx National Heritage (The Manx Museum and National Trust), Douglas, tel: 01624 675522

* Starred contact addresses are given in full in the Appendix.



More than a third of England's vegetated sand dunes are found in Region 13 and many are outstanding for the numbers of rare and threatened species they support or the size of their wildlife populations. Almost all are protected by one or more conservation designations. Ainsdale Dunes National Nature Reserve is one such site; the picture shows mobile dunes in the foreground, with an area of dune slack - a wet depression scooped out by the wind - behind, backed by stable, marram-covered dunes. Photo: Peter Wakely, English Nature.

Chapter 7 Coastal protected sites

R.G. Keddie

7.1 Introduction

7.1.1 Chapter structure

This chapter incorporates statutory and non-statutory site protection mechanisms operating at international, national and local level, including those administered by voluntary bodies and other organisations who own land. It covers only the various types of site protection mechanisms currently found within this region, giving a brief explanation for each category. For the purposes of this chapter, any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal. Where a site straddles the boundaries of two Coastal Directories Project regions and there is no easy way of calculating the percentage of the site lying in each, the site area has been halved, one half being included in each region. Data included in this section are correct as at September 1995, unless otherwise stated.

Statutory protected sites are those notified, designated or authorised under European Directives and/or implemented through British legislation (most notably the Wildlife and Countryside Act 1981) by a statutory body, thereby having recognised legal protection. 'Non-statutory sites' include a wide variety of sites that are not directly protected by legislation but which are recognised by statutory bodies or owned, managed or both by non-statutory organisations for their nature conservation or aesthetic value. Note that the categories of conservation protection (e.g. National Nature Reserve, RSPB Reserve) are not mutually exclusive. In many localities several different types of protected site overlap, since they have been identified for different wildlife and landscape conservation purposes. Patterns of overlap are often complex, since site boundaries for different categories of site are not always the same.

Further explanation of the various site protection mechanisms can be found in Davidson *et al.* (1991). Planning Policy Guidance Note (PPG) 9 - Nature Conservation (DoE 1994) also gives useful summaries of existing site protection mechanisms. It sets out the Government's objectives for nature conservation and provides a framework for safeguarding the natural heritage under domestic/international law, emphasises the importance of both designated sites and undesignated areas for nature conservation, advises that potential Special Protection Areas (SPAs) and candidate Special Areas of Conservation (SACs) should be treated similarly to classified SPAs and designated SACs, and deals with the treatment of nature conservation issues in development plans. It also includes copies of the Ramsar Convention, the Birds Directive and the EC Habitats Directive (including lists of important species and habitat types). The statutory framework for site protection is set out in the Habitats etc. Regulations 1994.

The following types of protected site have not been included in this chapter:

- archaeological designations and protected sites (covered in Chapter 6);
- 'Sites of Importance for Nature Conservation' (SINCs): a general term for the variously-named non-statutory sites identified by local authorities and wildlife trusts as having special local value for nature conservation but not currently managed for nature conservation; the most common are Sites of Nature Conservation Importance. For more information, see Collis & Tyldesley (1993);
- sites designated for fisheries purposes, e.g. Bass Nursery Areas and areas covered by Several Orders and Regulating Orders, which are summarised in Table 7.1.1 and covered in more detail in sections 5.7, 9.1 and 9.2.

Non-site based measures contained in conventions and directives aimed at broad species and habitat protection, such as the Bonn Convention, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), parts of the EC Birds Directive and parts of the EC Habitats Directive, are also not covered. For further information, see references in section 7.1.3 A.

This chapter is divided into five sections. A regional summary of all categories of site is given in Table 7.1.1. Section 7.2 covers those site-based protection measures falling under international conventions or European directives. Sites identified under national statute are discussed in section 7.3, whereas section 7.4 covers sites without statutory protection but which are identified, owned or managed by statutory bodies; and finally, other types of sites (i.e. those identified, owned or managed by charities, trusts etc.) are described in section 7.5. For each category of protected site, a list of coastal sites is given (clockwise around the coast), showing their type, area/length and location, with an accompanying map. Each section concludes with further information sources and contact points relevant to the region.

7.1.2 Importance of the region

The region contains all the protected coastal limestone pavements of Britain, along with a large proportion by area of Britain's coastal Environmentally Sensitive Areas (31%), Biosphere Reserves (20%), Ramsar sites (20%) and Special Protection Areas (19%). There are also substantial areas of Sites of Special Scientific Interest and National Nature Reserves. Table 7.1.1 summarises site protection in the region, showing the numbers and areas of each type of site and comparing these with West coast and British (whole country coast) totals.

Table 7.1.1 Summary of site protection in Region 13

	Number of protected sites					*Area covered by site protection*				
	Region	*West Coast*	*% of West Coast total in region*	*GB coast*	*% of GB coastal total in region*	*Region (ha)*	*West Coast (ha)*	*% of West Coast total in region*	*GB coast (ha)*	*% of GB coast total in region*
Biosphere Reserves	1	7	14.3	8	12.5	5,469	21,746	25.1	27,243	20.1
Ramsar sites	6	21	28.6	53	11.3	56,410	105,528	53.5	276,263	20.4
Special Protection Areas	7	34	20.6	78	9.0	55,239	113,223	48.8	292,363	19.1
Environmentally Sensitive Areas	2.5+	10	25.0	17	14.7	433,900+	1,118,067	38.8	1,397,545	31.0
Geological Conservation Review	32	490	6.5	980	3.3	n/ap	n/ap	n/ap	n/ap	n/ap
National Nature Reserves	7	38	17.9	79	8.8	13,420	52,152	25.7	86,708	15.5
Sites of Special Scientific Interest	80	634	12.6	1,183	6.8	122,547	370,404	33.1	700,781	17.5
Marine Consultation Areas	0.5+	23	2.2	29	1.7	2,080+	103,287	2.0	111,896	1.9
Areas of Special Protection	3	9	33.3	23	13.0	n/av	n/av	n/av	n/av	n/av
Limestone Pavement Orders	17	17	100.0	17	100.0	1,022	1,022	100.0	1,022	100.0
Bass nursery areas	2	16	12.5	34	5.9	n/av	n/av	n/av	n/av	n/av
Regulating Orders	1	4	25	8	12.5	4,047	10,453	38.7	94,584	4.3
The Ministry of Defence	7	45	15.6	110	6.4	6,166	18,960	32.5	53,409	11.5
National Scenic Areas	3	23	13.0	27	11.1	19,100	693,400	2.8	745,800	2.6
National Parks	1	4	25.0	6	16.7	229,200	571,100	40.1	745,000	30.8
Heritage Coasts	1	27.5	3.6	45	2.2	6#	890#	0.7	1,539#	0.4
Areas of Outstanding Natural Beauty	2	9.5	21.1	24	8.3	19,000	185,100	10.3	899,900	2.1
Local Nature Reserves	8	25	32.0	94	8.5	832	4,569	18.2	13,300	6.3
Country Parks	4	14	28.6	34	11.8	106	1,498	7.1	4,441	2.4
Regional landscape designations	5	29	17.2	63	7.9	65,997	435,283	15.2	508,124	13.0
The National Trust & The National Trust for Scotland	12	255	4.7	444	2.7	767	45,191	1.7	62,648	1.2
Manx National Heritage	14	14	100.0	14	100.0	738	738	100.0	738	100.0
Royal Society for the Protection of Birds	9	28	32.1	81	11.1	8,115	14,125	57.5	38,680	21.0
Wildfowl and Wetlands Trust	1	3	33.3	6	16.7	726	1,113	65.2	1,585	45.8
The Wildlife Trusts	26	94	27.7	216	12.0	1,605	13,006	12.3	23,417	6.9
Sensitive Marine Areas	4	10.5	38.1	27	14.8	n/av	n/av	n/av	n/av	n/av
Woodland Trust	10	29	34.5	64	15.6	94	363	25.9	1,458	6.4
Candidate coastal/marine SACs	6	38	15.8	71	8.5	n/av	n/av	n/av	n/av	n/av
Candidate coastal/terrestrial SACs	4	25	16.0	40	10.0	n/av	n/av	n/av	n/av	n/av

Source: JNCC. Key: n/ap = not applicable; n/av = not available. # = Length (km). +Sites lying partly within Region 14; half the relevant site area has been included in the total. Notes: site types not currently found in the region: World Heritage (Natural) Sites, Biogenetic Reserves, Marine Nature Reserves, John Muir Trust sites, Voluntary Marine Nature Reserves. In this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

7.1.3 Further sources of information

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7.2 Sites designated under international conventions and directives

This section describes those types of site designated under international conventions to which the UK is a contracting party and sites designated under UK statute to implement EC Directives concerning wildlife and landscape conservation. Sites protected by domestic legislation only are covered in section 7.3.

7.2.1 Biosphere Reserves

Biosphere Reserves are non-statutorily protected areas representing significant examples of biomes - terrestrial and coastal environments, throughout the world - protected for conservation purposes. They have particular value as benchmarks or standards for the measurement of long-term changes in the biosphere as a whole. They were devised by UNESCO as Project No. 8 of their Man and the Biosphere (MAB) ecological programme, and were launched in 1970. Criteria and guidelines for selection of sites were produced by a UNESCO task force in 1974. All British sites are also National Nature Reserves (section 7.3.1). There is one coastal Biosphere Reserve (5,469 ha) in Region 13, at Caerlaverock (Table 7.2.1 and Map 7.2.1).

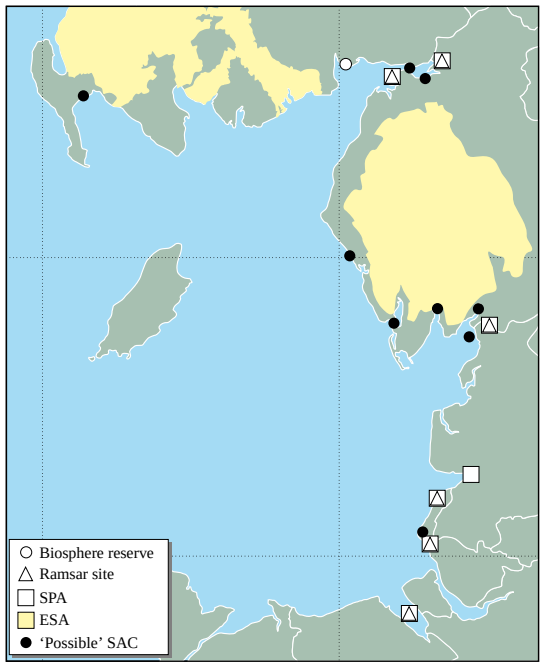
Table 7.2.1 Biosphere Reserves

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date designated*
Dumfries & Galloway	**1**			
Caerlaverock		NY005603	5,469	1976
Region 13	***1***		*5,469*	
West Coast	7		21,746	
GB coast	8		27,243	
GB whole country	13		44,258	

Sources: JNCC, Scottish Natural Heritage. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

7.2.2 Wetlands of international importance (Ramsar sites)

Ramsar sites are statutory areas designated by the UK government on the advice of the conservation agencies under the Ramsar Convention (the Convention on wetlands of international importance especially as waterfowl habitat). Contracting parties (of which the UK is one) are required to designate wetlands of international importance and to promote their conservation and 'wise use'. Ramsar sites are designated for their waterfowl populations, their important plant and animal assemblages, their wetland interest or a combination of these. There are six coastal Ramsar sites (56,140 ha) in Region 13 (Table 7.2.2 and Map 7.2.1). Table 7.2.2 summarises the interest for which the sites have been designated, and sections 5.10, 5.11 and 5.12 describe the importance of these sites for the region's birds.



Map 7.2.1 Coastal Biosphere Reserve, Ramsar sites, Special Protection Areas, Environmentally Sensitive Areas and 'possible' Special Areas of Conservation (November 1995). Source: JNCC.

7.2.3 Special Protection Areas

The 1979 EC Directive on the Conservation of Wild Birds (the Birds Directive) requires member states to take conservation measures particularly for certain rare or vulnerable species and for regularly occurring migratory species of birds. In part this is achieved through the designation of statutory Special Protection Areas (SPAs) by the UK government on the advice of the statutory conservation agencies. This designation is implemented through the Wildlife and Countryside Act 1981; all SPAs have first to be notified as SSSIs. There are seven coastal SPAs (55,239 ha) in Region 13 (Table 7.2.3 and Map 7.2.1). Table 7.2.3 summarises the interest of these sites, and sections 5.10, 5.11 and 5.12 describe the importance of these sites for the region's birds.

7.2.4 Special Areas of Conservation

Special Areas of Conservation (SACs) are one of the tools to be used to implement the EC Habitats Directive. They are areas identified as outstanding examples of selected habitat types or areas important for the continued well-being or survival of selected non-avian species. The protection measures are based around a series of six annexes: Annexes I & II require the designation of SACs for certain habitats and species; Annex IV prohibits the taking of certain species; Annex V requires the taking of certain species to be monitored; and Annex VI prohibits some means of capture

Table 7.2.2 Ramsar sites

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date designated*	*Selection criteria used*
Merseyside, Cheshire & Clwyd					
Dee Estuary		SJ2380	13,055	1985	Representative wetland; regularly supports 20,000 waterfowl and 1% of a waterfowl species population
Merseyside					
Alt Estuary (part of Ribble and Alt)		SD280040	1,160	1985	Regularly supports 20,000 waterfowl and 1% of a waterfowl species population
Merseyside/Lancashire					
Ribble & Alt		SD375240 & SD285030	12,120	1995	Rare species; regularly supports 20,000 waterfowl and 1% of a waterfowl species population
Lancashire					
Leighton Moss		SD483749	125	1985	Representative wetland; regularly supports substantial numbers of individual waterfowl indicative of wetlands
Cumbria					
Rockliffe Marshes (Part of Upper Solway Flats & Marshes)		NY320640	1,897	1986	Representative wetland; rare species; regularly supports 20,000 waterfowl and 1% of a waterfowl species population
Cumbria/Dumfries & Galloway					
Upper Solway Flats & Marshes		NY160610	28,053	1992	Representative wetland; rare species; regularly supports 20,000 waterfowl and 1% of a waterfowl species population
Region 13	***6***		***56,410***		
West Coast	21		105,528		
GB coast	53		276,263		
GB whole country	91		387,577		

Sources: JNCC, CCW, EN, SNH. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

or killing of mammals and fish. In the UK the Directive will be implemented through the Habitats etc. Regulations 1994. A list of 'possible' SACs was announced by the Government on 31 March 1995. There are five possible SACs proposed for their coastal/marine interest in Region 13, from a total of 71 such sites in GB, and four proposed terrestrial coastal SACs, from a total of 40 in GB (see Map 7.2.1 and Table 7.2.4) (see JNCC (1995) for more information).

7.2.5 Environmentally Sensitive Areas

European Community authorisation for Environmentally Sensitive Areas (ESAs) is derived from Article 19 of Council Regulation (EEC) No. 797/85 - National Aid in Environmentally Sensitive Areas. ESAs are statutory areas in which the Government seeks to encourage environmentally sensitive farming practices, prevent damage that might result from certain types of agricultural intensification, and restore traditional landscapes, for which member states are allowed to make payments to farmers.

There are two whole and part of one other ESA (433,900 ha) that include land in Region 13 (Table 7.2.5 and Map 7.2.1). Twenty-two ESAs (3,101,200 ha) have been designated in England, seven in Wales and ten in Scotland (Parliamentary News, 1994).

7.2.6 Acknowledgements

Thanks are due to Alan Law (JNCC), Siaron Hooper (English Nature), WOAD, SOAEFD and the Ministry of Agriculture, Fisheries and Food (MAFF).

7.2.7 Further sources of information

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IUCN. 1982. *The world's greatest natural areas. An indicative inventory of natural sites of World Heritage quality.* IUCN Commission on National Parks and Protective Areas for World Heritage Committee.

L'Hyver-Yésou, M.-A. 1993. Biogenetic Reserves. *Naturopa,* No. 71: 22-23.

Table 7.2.3 Special Protection Areas (SPAs)

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date designated*	*Selection criteria used*
Clwyd, Cheshire & Merseyside					
Dee Estuary		SJ2380	13,055	1985	Internationally important numbers of ten wintering waterfowl species, nationally important numbers of three further wintering waterfowl species and breeding terns, regularly supports over 20,000 waterfowl
Merseyside					
Alt Estuary*		SD280040	1,160	1985	Internationally important numbers of 4 wintering waterfowl species, nationally important numbers of wintering grey plovers, regularly supports over 20,000 waterfowl
Merseyside/Lancashire					
Ribble & Alt*		SD375240 & SD285030	8,768	1995	Internationally important numbers of 15 wintering species, nationally important numbers of 3 wintering wader species, nationally important breeding populations of 2 species of terns and 2 species of migratory gulls, regularly supports over 20,000 waterfowl
Lancashire					
Ribble Estuary*		SD3724	2,182	1982	Internationally important numbers of 10 waterfowl species, nationally important numbers of common tern, black-headed gull and redshank regularly supports over 20,000 waterfowl
Leighton Moss		SD483749	124	1985	Nationally important numbers of breeding bittern, marsh harrier, bearded tit, and wintering teal and shoveler
Cumbria					
Rockliffe Marshes (Part of Upper Solway flats & Marshes)		NY320640	1,897	1986	Internationally important numbers of nine wintering waterfowl species; nationally important numbers of six further wintering waterfowl species
Cumbria/Dumfries & Galloway					
Upper Solway Flats & Marshes		NY160610	28,053	1992	Internationally important numbers of nine wintering waterfowl species; nationally important numbers of six further wintering waterfowl species
Region 13	***7***		***55,239***		
West Coast	34		113,223		
GB coast	78		289,428		
GB whole country	107		354,650		

Sources: JNCC, CCW, EN, SNH, Pritchard *et al.* (1992). Key: *Ribble and Alt are each designated in their own right, as well as now jointly. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

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Table 7.2.4 Possible Special Areas of Conservation (SACs) in Region 13

Site name	*No. of sites*	*Interest*	*Qualifying interest*
Merseyside			
Sefton Coast		Coastal/marine	Dunes with creeping willow *Salix arenaria*; embryonic shifting dunes; fixed dunes with herbaceous vegetation (grey dunes); humid dune slacks.
Lancashire, Cumbria			
Morecambe Bay		Coastal/marine	Atlantic salt meadows (Glauco-Puccinellietalia); large shallow inlets and bays; mudflats and sand flats not covered by seawater at low tide; perennial vegetation of stony banks; glasswort *Salicornia* spp. and other annuals colonising mud and sand.
Morecambe Bay Pavements		Terrestrial/coastal	Narrow-mouthed whorl snail *Vertigo angustior*, hard oligo-mesotrophic waters with benthic vegetation of mosses *Chara* spp. formations. Juniper *Juniperus communis* formations on heaths or calcareous grasslands. Limestone pavements. Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia). Yew *Taxus baccata* woods.
Cumbria			
Roudsea Woods and Mosses		Terrestrial/coastal	Active raised bogs. Yew *Taxus baccata* woods.
Duddon Mosses		Terrestrial/coastal	Active raised bogs.
Drigg Coast		Coastal/marine	Dunes with creeping willow *Salix arenaria*; estuaries; Eu-atlantic decalcified fixed dunes (Calluno-Ulicetea).
Solway Mosses		Terrestrial/coastal	Active raised bogs.
Cumbria, Dumfries & Galloway			
Solway Firth		Coastal/marine	Atlantic salt meadows (Glauco-Puccinellietalia); estuaries; mudflats and sandflats not covered by seawater at low tide; glasswort *Salicornia* spp. and other annuals colonising mud and sand; sandbanks that are slightly covered by sea water all the time.
Dumfries & Galloway			
Torrs Warren - Luce Sands		Coastal/marine	Decalcified fixed dunes with crowberry *Empetrum nigrum;* embryonic shifting dunes; Eu-atlantic decalcified fixed dunes (Calluno-Ulicetea); shifting dunes along the shoreline with marram *Ammophila arenaria* (white dunes).
Region 13	***9***		
West Coast	34		
GB marine/maritime or terrestrial	111		

Sources: JNCC, SNH, English Nature. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

Table 7.2.5 Environmentally Sensitive Areas

Site name	*No. of sites*	*Area (ha)*	*Date designated*	*Selection criteria used*
Cumbria				
Lake District		245,400	1993	Wild open upland and montane communities supporting breeding dotterel *Charadrius morinellus*; moorland with breeding raptors and waders; fellside; sheltered lowland farming with herb-rich and neutral grasslands, farmland flora and fauna, woodlands and wetlands.
Dumfries & Galloway				
Stewartry		60,312	1993	Dykes, woodland and hedgerows, small wetland areas, rough and scrub, grassland flora, grazing wildfowl; archaeological interest with earth works, rock carvings and early medieval mottes.
Dumfries & Galloway/Strathclyde				
Western Southern Uplands[a]		128,188	1993	Heather moorland, heather as habitat for bird species, especially grouse, raptors and waders; native woodland, archaeological interests on rough grazing.
Region 13	**2.5[b]**	**433,900**		
West Coast	10	1,118,067		
GB coast	17	1,397,545		

Sources: English Nature, MAFF, SOAEFD, SNH. Key: [a]the Strathclyde part of Western Southern Uplands is in Region 14; half of the area has been included in the total for Region 13; [b]see text. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Ramsar sites, SPAs (Wales)	*Senior Officer, CCW North Wales Region, Bangor, tel: 01248 372333
Ramsar sites, SPAs, Special Areas of Conservation (Cheshire, Merseyside, Lancashire)	*Conservation Officer, English Nature North West Local Team, Wigan, tel: 01942 820342
Ramsar sites, SPAs, Special Areas of Conservation, ESAs (Cumbria)	*Conservation Officer, English Nature Cumbria Local Team, Blackwell, tel: 015394 45286
Biosphere Reserve, Ramsar sites, SPAs, Special Areas of Conservation, ESAs (Scotland)	*SNH Dumfriesshire and Galloway Office, Dumfries, tel: 01387 247010
Ramsar sites, SPAs (Wales)	*Regional Officer, RSPB Wales Regional Office, Newtown, tel: 01686 626678
Ramsar sites, SPAs (Cheshire, Merseyside, Lancashire)	*Regional Officer, RSPB North West Regional Office, Huddersfield, tel: 01484 861148
Ramsar sites, SPAs (Cumbria)	*Regional Officer, RSPB North England Regional Office, Newcastle upon Tyne, tel: 0191 281 3366
Ramsar sites, SPAs (Scotland)	*Regional Officer, RSPB South and West Scotland Regional Office, Glasgow, tel: 0141 945 5224
ESAs (England)	MAFF/ADAS Land Service, Ministry of Agriculture, Fisheries and Food, Whitehall Place, London SW1A 2HH, tel: 0171 270 3000
ESAs (Scotland)	*Scottish Office Agriculture, Environment and Fisheries Department, Edinburgh, tel: 0131 556 8400
Special Areas of Conservation	*European Wildlife Division, DoE, Bristol, tel: 0117 9878811 ext. 8341

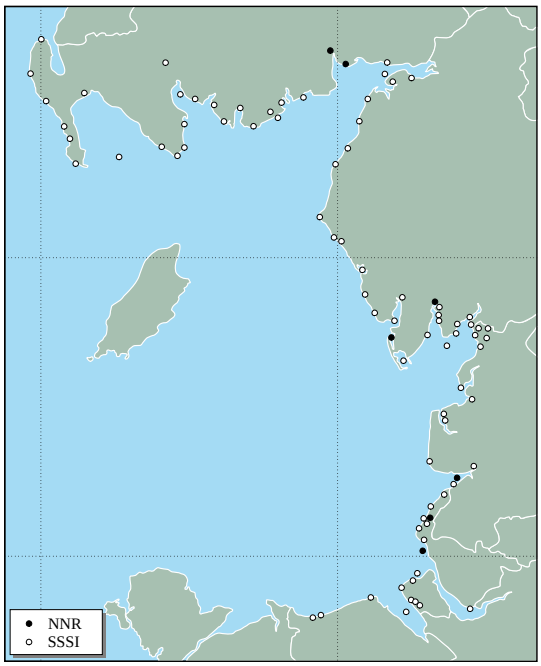
*Starred contact addresses are given in full in the Appendix.

7.3 Sites established under national statute

Included in this section are the eight types of site identification made under national legislation relating to wildlife, landscape and amenity value. Identifications are made by the statutory conservation agencies (in this region the Countryside Council for Wales, English Nature and Scottish Natural Heritage), local authorities or the government acting on advice from these bodies. The Isle of Man Government has not, to date (November 1995), made any statutory nature conservation designations.

7.3.1 National Nature Reserves

National Nature Reserves (NNRs) contain examples of some of the most important natural and semi-natural ecosystems in GB. They are managed to conserve their habitats, providing special opportunities for scientific study of the habitats, communities and species represented within them (Marren 1994). They are declared by the country agencies under section 19 of the National Parks and Access to the Countryside Act 1949, or section 35 of the Wildlife and Countryside Act 1981. All NNRs are also Sites of Special Scientific Interest (SSSIs). There are seven coastal NNRs (13,420 ha) in Region 13 (Table 7.3.1 and Map 7.3.1).



Map 7.3.1 Coastal National Nature Reserves and Sites of Special Scientific Interest. Source: English Nature, SNH, CCW, JNCC. Note: a single symbol may represent more than one site in close proximity.

7.3.2 Sites of Special Scientific Interest

Sites of Special Scientific Interest (SSSIs) are notified under the Wildlife and Countryside Act 1981. They are intended to form a national network of areas, representing in total the parts of Britain in which the natural features, especially those of greatest value to wildlife conservation, are most highly concentrated or of highest quality. Each SSSI represents a significant fragment of the much-depleted resource of wild nature remaining in Britain. Within the area of an SSSI the provisions of the Wildlife & Countryside Act 1981 and its 1985 amendments aim to limit or prevent operations that are potentially damaging to the wildlife interest of the area. There are 80 coastal SSSIs (122,547 ha)

Table 7.3.1 National Nature Reserves

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date last designated*	*Habitats*
Merseyside	**2**				
Cabin Hill		SD280000	28	1991	Sand dunes, dune slacks, abandoned cultivation
Ainsdale Sand Dunes		SD288105	492	1965	Sand dunes, wet dune slacks and planted pinewood
Lancashire	**1**				
Ribble Estuary (formerly Ribble Marshes)		SD393247	4,520	1980 (renamed 1995)	Grazed and ungrazed saltmarsh, tidal mud and sandflats
Cumbria	**2**				
Roudsea Wood & Mosses		SD335822; SD350805	388	1955, 1988	Foreshore, ancient broadleaved woodland, raised bog and valley fen
North Walney		SD177724	144	1991	Sand dunes, dune slacks, shingle, dune heath, saltmarsh and tidal mudflats
Dumfries & Galloway	**2**				
Caerlaverock		NY005603	7,706	1957	Saltmarshes, mudflats, neutral grasslands, reedbeds and freshwater marsh
Kirkconnel Flow		NX970700	142	1959	Raised bog with mixed woodland
Region 13	***7***		***13,420***		
West Coast	38		52,152		
GB coast	79		86,708		
GB whole country	288		195,531		

Sources: EN, SNH, CCW, JNCC; Marren (1994). Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

Table 7.3.2 SSSIs in Region 13

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date last notified*
Clwyd	**4**			
Rhyd-y-Foel Limestone		SH907770	106	1983
Llanddulas Beach		SH932782	14	1983
Gronant Dunes and Talacre Warren		SJ100847	470	1983
Dee Estuary		SJ220800	10,741	1983
Merseyside	**14**			
Heswall Dales		SJ261821	30	1983
The Dungeon		SJ251831	1	1987
Dee Cliffs		SJ238832	18	1983
Red Rocks		SJ207878	11	1983
Meols Meadows		SJ245903	7	1990
North Wirral Foreshore		SJ250920	2,110	1983
Mersey Estuary		SJ440800	6,706	1985
Altcar Sand Dunes & Foreshore		SD285030	1,467	1983
Formby Sands & Foreshore		SD270076	425	1984
Freshfield Dune Heath		SD294093	27	1984
Ainsdale Sand Dunes		SD288106	509	1984
Southport Sand Dunes & Foreshore		SD305150	1,690	1983
Hesketh Golf Links		SD352190	15	1989
Ribble Estuary		SD375240	9,232	1984
Lancashire	**12**			
Newton Marsh		SD450292	66	1986
Lytham St. Anne's Dunes		SD310305	119	1991
Burrows Marsh		SD353446	37	1984
Barnaby Sands Marsh		SD350461	67	1984
Cockerham Marsh		SD446516	10	1986
Lune Estuary		SD395550	6,978	1990
Leighton Moss		SD483749	125	1984
Crag Bank		SD489697	4	1985
Warton Crag		SD494730	73	1986
Jack Scout		SD459737	7	1991
Cringlebarrow and Deepdale		SD498753	50	1983
Eaves Wood		SD466763	52	1984
Lancashire/Cumbria	**1**			
Morecambe Bay		SD360700	30,288	1990
Cumbria	**24**			
Far Arnside		SD451761	2	1986
Arnside Knott		SD447771	166	1984
Meathop Woods & Quarry		SD436795	38	1984
Wart Barrow		SD393768	27	1987
Humphrey Head		SD392739	30	1984
Barker Scar		SD335779	18	1985
Skelwith Hill		SD331810	3	1985
Roudsea Woods & Mosses		SD335823	476	1989
Sea Wood		SD294735	26	1984
South Walney & Piel Channel Flats		SD220650	2,494	1986
Duddon Mosses		SD230870, SD228882, SD241875, SD230810, SD225860, SD220850, SD190849	356	1987
Duddon Estuary		SD190775	6,814	1991
Shaw Meadow & Sea Pasture		SD122812	8	1989
Annaside		SD083874	17	1989
Drigg Coast		SD070955	1,413	1986
Low Church Moss		NY016057	6	1984
Silver Tarn, Holas with Harnsey Mosses		NX998068	5	1986
St. Bees Head		NX945133	83	1984
Siddick Pond		NY002304	21	1984
Maryport Harbour		NY029363	4	1989
Salta Moss		NY086454	45	1982
Silloth Dunes and Mawbray Banks		NY105525	188	1991
Bowness Common		NY205601	759	1983
Glasson Moss		NY238603	225	1986
Cumbria/Dumfries & Galloway	**1**			
Upper Solway Flats & Marshes		NY160610	29,951	1988

Table 7.3.2 SSSIs in Region 13 (continued)

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date last notified*
Annandale & Eskdale	**1**			
Royal Ordnance, Powfoot		NY165657	37	1994
Stewartry	**8**			
Port O'Warren		NX876534	6	1990
Auchencairn & Orchardton Bays		NX809517, NX818532	179	1988
Abbey Burn Foot to Balcary Point		NX790469	186	1988
Heart Moss		NX770480	22	1984
Torrs to Mason's Walk		NX710437	168	1987
Shoulder O'Craig		NX663491	1	1988
Borgue Coast		NX610457	749	1988
Carrick Ponds		NX581506	45	1990
Wigtown	**15**			
Ravenshall Wood		NX510531	44	1988
Lower River Cree		NX413649, NX448619	156	1991
Cree Estuary		NX465545	3,457	1987
Cruggleton Bay		NX477448, NX479448	1	1989
Isle of Whithorn Bay		NX476363	4	1990
West Burrow Head		NX452341	2	1989
Back Bay to Carghidown		NX400367	237	1988
Torrs Warren - Luce Sands		NX140545	2,409	1985
Scare Rocks		NX258333	2	1986
Mull of Galloway		NX115315	104	1987
Port Logan		NX092402	5	1988
Grennan Bay		NX074438	7	1989
Morroch Bay		NX017524	12	1990
Salt Pans Bay		NW966614	29	1988
Corsewall Point to Milleur Point		NX000729	60	1994
Region 13	***80***		***122,547***	
Wales	903		205,640	
England	3,813		875,165	
Scotland	1,379		859,678	
West Coast	634		370,404	
GB coast	1,183		700,781	
GB whole country	6,095		1,940,483	

Sources: CCW, EN, SNH, JNCC. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

in Region 13, as at September 1995 (Table 7.3.2 and Map 7.3.1). 8.07% of the total land mass of Britain is SSSI, as at September 1994.

Of the 80 coastal SSSIs in the region, nearly half (48%) include intertidal land to Mean Low Water Mark, while only around one twentieth (6%) are purely terrestrial. Over 86% were selected at least partly for their biological interest and nearly one fifth at least partly for their earth science (geological or geomorphological) interest. Of the total, over one tenth have both biological and earth science interest.

Table 7.3.3 Local Nature Reserves

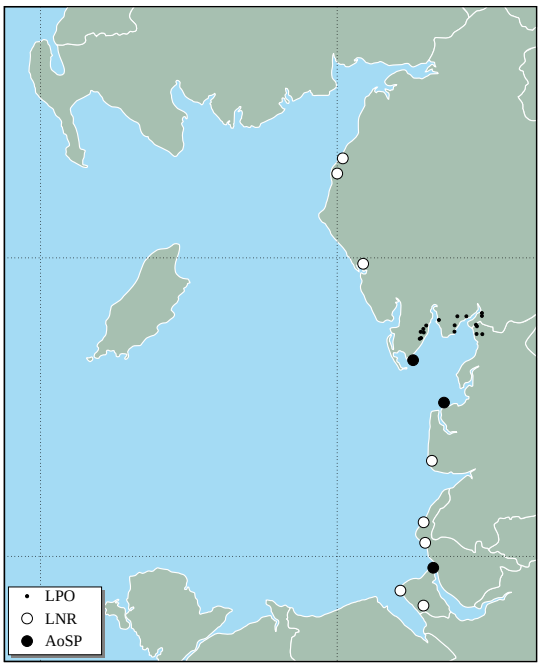
Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date designated/ opened*
Merseyside	**4**			
Heswall Dales		SJ2682	17	1990
Hilbre Island		SJ1987	49	1983
Ravenmeols Hills		SD2705	70	1983
Ainsdale & Birkdale Sand Hills		SD3013	248	1980
Lancashire	**1**			
Lytham St. Anne's		SD310305	39	1968
Cumbria	**3**			
Drigg Dunes & Gullery, Ravenglass		SD070960	383	1954
Harrington Reservoir		NX996260	7	1991
Siddick Pond		NY001305	19	1977
Region 13	***8***		***832***	
West Coast	25		4,569	
GB coast	94		13,300	
GB whole country	396		21,513	

Sources: CCW, EN, SNH. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

Examples of a very wide range of habitats and species occur within the SSSIs in this region, the most frequently occurring habitats being open water, saltmarsh, sand dunes, dry grassland, maritime heath, reed bed and woodland, these habitats occurring in 17% - 40% of sites. SSSIs in the region include many sites of interest for their rare plants, terrestrial invertebrates, breeding seabirds or internationally important migrating/wintering bird populations. Further details of SSSIs may be found in the coastal and marine UKDMAP datasets module disseminated by JNCC Coastal Conservation Branch (BODC 1992; Barne *et al.* 1994).

7.3.3 Local Nature Reserves

Local Nature Reserves (LNRs) are designated by local authorities, under section 21 of the National Parks and Access to the Countryside Act 1949, for the same purposes as NNRs, but because of the local rather than the national interest of the site and its wildlife. Under this Act local authorities have the power to issue bylaws to protect the LNR. There are eight LNRs (832 ha) in Region 13 (Table 7.3.3 and Map 7.3.2).



Map 7.3.2 Coastal Local Nature Reserves, Areas of Special Protection and Limestone Pavement Orders (LPO). Source: English Nature, DoE.

7.3.4 Areas of Special Protection

'Area of Special Protection' (AoSP) is a designation replacing Bird Sanctuary Orders under the 1954 to 1967 Protection of Birds Acts, which were repealed and amended under the Wildlife and Countryside Act 1981. Designation aims to prevent the disturbance and destruction of the birds for which the area is identified, by making it unlawful to damage or destroy either the birds or their nests and in some cases by prohibiting or restricting access to the site. There are three AoSPs in Region 13 (Table 7.3.4 and Map 7.3.2).

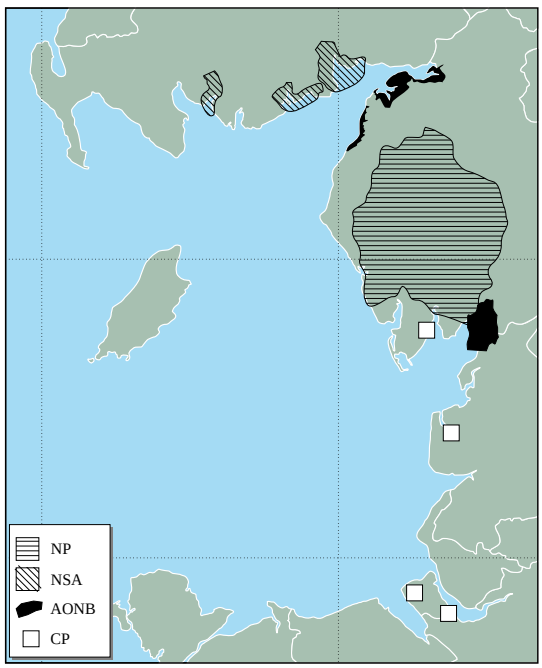
Table 7.3.4 Areas of Special Protection (AoSPs)

Site name	*No. of sites*	*Date designated*
Lancashire	**2**	
Southport (No. 692)		1956
Wyre-Lune (No. 1796 & No. 2000)		1963
Cumbria	**1**	
Foulney Island (No. 1839)		1980
Region 13	***3***	
West Coast	9	
GB coast	23	
GB whole country	38	

Source: DoE European Wildlife Division. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

7.3.5 Areas of Outstanding Natural Beauty

The primary purpose of the Area of Outstanding Natural Beauty (AONB) designation is to conserve natural beauty, but account is taken of the need to safeguard agriculture, forestry, other rural industries, and the economic and social needs of local communities (Countryside Commission 1994). AONBs are statutorily designated (in England by the Countryside Commission and in Wales by the Countryside Council for Wales), under the National Parks and Access to the Countryside Act 1949. AONBs are not designated in Scotland (see section 7.3.7). There are two AONBs (19,000 ha) in Region 13 (Table 7.3.5 and Map 7.3.3). In 1995 the total area covered by AONBs was just over 14% of the countryside of England and Wales.



Map 7.3.3 Coastal Areas of Outstanding Natural Beauty, National Parks, Country Parks and National Scenic Areas. Source: Countryside Commission; Countryside Commission for Scotland (1978).

Table 7.3.5 Areas of Outstanding Natural Beauty (AONBs)

Site name	*No. of sites*	*Area (ha)*	*Date designated*
Lancashire/Cumbria	**1**		
Arnside and Silverdale		7,500	1972
Cumbria	**1**		
Solway Coast		11,500	1964
Region 13	***2***	***19,000***	
West Coast	9.5	185,000	
GB coast	24	899,900	
GB whole country		2,123,700	

Source: Countryside Commission. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

7.3.6 National Parks

The purpose of National Parks is to preserve and enhance the most beautiful, dramatic and spectacular expanses of countryside in England and Wales (Countryside Commission 1993), while promoting public enjoyment of them, and having regard for the social and economic well-being of those living within them. National Parks in England and Wales were statutorily designated by the National Parks Commission and confirmed by the Government between 1951 and 1957, and one area with similar status, The Broads, was established in 1989. The Countryside Commission (England) and the Countryside Council for Wales advise government on National Parks, each of which is administered by a Park Authority. There is one National Park, the Lake District (229,200 ha), in Region 13 (Table 7.3.6 and Map 7.3.3).

Table 7.3.6 National Parks

Site name	*No. of sites*	*Area (ha)*	*Date designated*
Lake District		229,200	1951
Region 13	***1***	***229,000***	
West Coast	4	571,000	
GB coast	6	745,000	

Source: Countryside Commission. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

7.3.7 National Scenic Areas

National Scenic Areas are designated by Scottish Natural Heritage as the best of Scotland's landscapes, deserving special protection in the nation's interest. Special development control measures for the 40 National Scenic Areas in Scotland were introduced by the Scottish Development Department in 1980. This designation replaces two earlier categories of importance for scenic interest, which served to fulfil some of the approaches embodied in the National Park and AONB designations in England and Wales. The seaward boundary of National Scenic Areas is the same as that for planning purposes in Scotland, i.e. mean low water of spring tides. There are three National Scenic Areas (19,100 ha) that include areas within the coastal zone in Region 13 (see Table 7.3.7 and Map 7.3.3).

Table 7.3.7 National Scenic Areas

Site name	*No. of sites*	*Area (ha)*	*Date designated*
Dumfries & Galloway	**3**		
Nith Estuary		9,300	1980
East Stewartry Coast		4,500	1980
Fleet Valley		5,300	1980
Region 13	***3***	***19,100***	
West Coast	23	693,400	
GB coast	27	745,800	

Sources: Countryside Commission for Scotland (1978), SNH. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

7.3.8 Country Parks

Country Parks are primarily intended for recreation and leisure opportunities close to population centres and do not necessarily have any nature conservation interest. Nevertheless, many are in areas of semi-natural habitat and so form a valuable network of locations at which informal recreation and the natural environment co-exist. They are statutorily declared and managed by local authorities under section 7 of the Countryside Act 1968. There are four coastal Country Parks (106 ha) in Region 13 (Table 7.3.8 and Map 7.3.3).

Table 7.3.8 Country Parks

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date designated/ opened*
Cheshire	**2**			
Eastham Woods		SJ363816	28.7	1971
The Wirral		SJ215869-350783	42.9	1969
Lancashire	**1**			
Wyre		SD355431	*12.88	1991
Cumbria	**1**			
Bardsea		SD299740	34.4	1972
Region 13	***4***		***106***	
West Coast	14		1,498	
GB coast	34		4,441	
GB whole country	281		35,150	

Source: Countryside Commission. Key: *shoreline length in km. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

7.3.9 Limestone Pavement Orders

Limestone Pavement Orders afford statutory protection for limestone pavements under the Wildlife and Countryside Act 1981. An Order prohibits the removal or damage of limestone within a designated area and is created by the relevant local authority, after notification of an area for its importance by English Nature and the Countryside Commission (Cumbria County Council 1993). Limestone pavements are increasingly under threat as demand for limestone for rockeries and gardens has increased. They are of interest for, and are subsequently designated for, their unusual plant assemblages, geological and geomorphological features or landscape attributes, most notably their glaciogenic landforms (Webb 1995). They are identified as a priority habitat under the Habitats and Species Directive. There are seventeen coastal Limestone Pavement Orders (1,022 ha) in Region 13 (Table 7.3.9 and Map 7.3.2), representing 100% of the coastal Orders in GB.

Table 7.3.9 Limestone Pavement Orders

Site name	*No. of sites*	*Area* (ha)*	*Date of Order*
Lancashire	**17**		
Warton Crag and Grisedale Wood		274	1992
Heald Brow		85	1991
Eaves Wood		40	1991
Cumbria			
Middlebarrow		16	1991
Underlaid Wood		176	1991
Haverbrack Bank		42	1991
Meathop Fell		26	1993
Grange-over-Sands Woodlands		102	1994
Wartbarrow and Kirkhead		73	1993
Humphrey Head		25	1994
Old Park and Waitham Woods		32	1994
Hermitage Hill		4	1994
Bardsea Park		24	1990
Wellhouse and Hag Woods		7	1991
Birkrigg Common		65	1992
Scales and Baycliff Haggs		27	1992
Scroggs Close		6	1991
Region 13	***17***	***1,022***	
West Coast	17	1,022	
GB coast	17	1,022	

Sources: EN, JNCC. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal. Key: *areas rounded to the nearest hectare.

7.3.10 Acknowledgements

Thanks are due, in particular, to Ray Woolmore (Countryside Commission), and also to Roger Bolt (JNCC), Phillip Biss, Chris Lumb and Simon Webb (English Nature), Site Safeguards Team (Countryside Council for Wales), Kathy Duncan and Natasha O'Connel (Scottish Natural Heritage), Neale Oliver (DoE) and Paul Johnson (Countryside Commission).

7.3.11 Further sources of information

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
SSSIs (Wales)	*Senior Officer, CCW North Wales Region, Bangor, tel: 01248 372333
NNRs, SSSIs, LNRs, AoSP, Limestone Pavement Orders (Merseyside, Lancashire)	*Conservation Officer, English Nature North West Local Team, Wigan, tel: 01942 820342
NNRs, SSSIs, LNRs, AoSP, Limestone Pavement Orders (Cumbria)	*Conservation Officer, English Nature Cumbria Local Team, Windermere, tel: 015394 45286
NNRs, SSSIs, NSAs (Scotland)	*SNH Dumfriesshire and Galloway Office, Dumfries, tel: 01387 247010
Areas of Special Protection	*European Wildlife Division, DoE, Bristol, tel: 0117 987 8811
AONB, Country Park (Cheshire, Lancashire)	*Countryside Commission, North West Region, Manchester, tel: 0161 237 1061
AONB, National Park, Country Park (Cumbria)	Countryside Commission, Northern Region, Warwick House, Grantham Road, Newcastle upon Tyne NE2 1QF, tel: 0191 232 852
National Scenic Areas (Scotland)	*Department of Physical Planning, Dumfries & Galloway Regional Council, Dumfries, tel: 01387 261234
Coastal and marine UKDMAP datasets	*Coastal Conservation Branch, JNCC, Peterborough, tel: 01733 62626

*Starred contact addresses are given in full in the Appendix.

7.4 Sites identified by statutory agencies

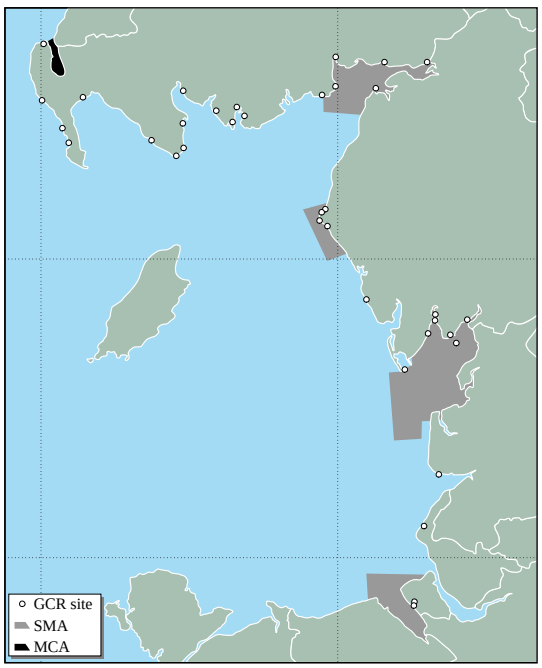
This section covers sites which, although not protected by statute, have been identified by statutory agencies as being of nature conservation or landscape importance.

7.4.1 Nature Conservation Review sites

Nature Conservation Review (NCR) sites are non-statutory sites that are the best representative examples of wildlife habitat; for some coastal sites, for example estuaries, all sites that were above a critical standard of nature conservation importance were selected. Ratcliff (1977) related this particularly to migrant and wintering waterfowl populations and breeding bird assemblages. The NCR helps to identify sites that may qualify for declaration as National Nature Reserves. There are 953 NCR sites (approximately 1,500,000 ha) in Britain. 149 of them (approximately 360,000 ha) are coastal as defined by Ratcliffe (1977), but his definition of 'coastal' differed from that adopted in this chapter.

7.4.2 Geological Conservation Review sites

Geological Conservation Review (GCR) sites are non-statutory sites identified as having national or international importance for earth science. The GCR selection process describes and assesses key sites in the context of their geology, palaeontology, mineralogy or geomorphology; GCR sites are the earth science equivalent of NCRs. There are 32 coastal GCR SILs within Region 13 (Map 7.4.1), listed in Table 7.4.1 with an indication of whether they were selected for their geological or their coastal geomorphological interest. Detailed scientific accounts of 519 (coastal and inland) GCR SILs have been published or are in preparation in nine volumes of a planned 42-volume *Geological Conservation Review* series.



Map 7.4.1 Coastal Geological Conservation Review sites, Sensitive Marine Areas and Marine Consultation Areas. Source: English Nature, SNH, JNCC. Note: a single symbol may represent more than one site in close proximity.

7.4.3 Heritage Coasts

A Heritage Coast is an area selected for having a coastline of exceptionally fine scenic quality exceeding 1 mile in length, substantially undeveloped and containing features of

Table 7.4.1 GCR SILs

Site name	*No. of sites*
Merseyside	**4**
Thurstaston	
The Dungeon - Thurstaston	
Thurstaston	
Ainsdale*	
Cumbria	**8**
Meathop Quarry	
Humphrey Head	
Barker Scar	
Skelwith Hill	
Iron Pit Spring Quarry	
Walney Island*	
St. Bees	
Fleswick - St. Bees	
Cumbria/Dumfries & Galloway	**1**
Upper Solway (Skinburness, Calvo, Newton, Whitrigg, Kirkbride, Longcroft, Anthorn, Campfield, Bowness, Burgh and Rockcliffe Marshes)*	
Dumfries & Galloway	**19**
Redkirk Point	
Newbie	
Solway Firth (North Shore)*	
Kirkbean	
Southwick Needle's Eye	
Balmae Coast	
Shoulder o' Craig	
Meikle Ross	
Borlocco	
Cree*	
Cruggleton Bay (North)	
Isle of Whithorn Bay	
West Burrow Head	
Black Bay, Monreith	
Luce Sands*	
Port Logan	
Grennan Bay	
Morroch Bay	
Corsewall Point	
Region 13	***32***
West Coast	490
GB coast	980
GB whole country	3,002

Sources: EN, JNCC, SNH. Key: *sites selected wholly or partly for their coastal geomorphological interest. Note: Site names that occur more than once refer to SILs at different grid reference points but with the same name. In this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

special significance and interest. This non-statutory designation is agreed between local authorities and (in England) the Countryside Commission and (in Wales) the Countryside Council for Wales, as an aid to local authorities in planning and managing their coastlines. The Heritage Coast designation is not used in Scotland. There is one Heritage Coast (6 km) in Region 13, at St Bees Head (Table 7.4.2 and Map 7.4.2). Of the English coastline encompassed by Heritage Coasts, 39.5% is owned or managed by the National Trust (Heritage Coast Forum 1993).

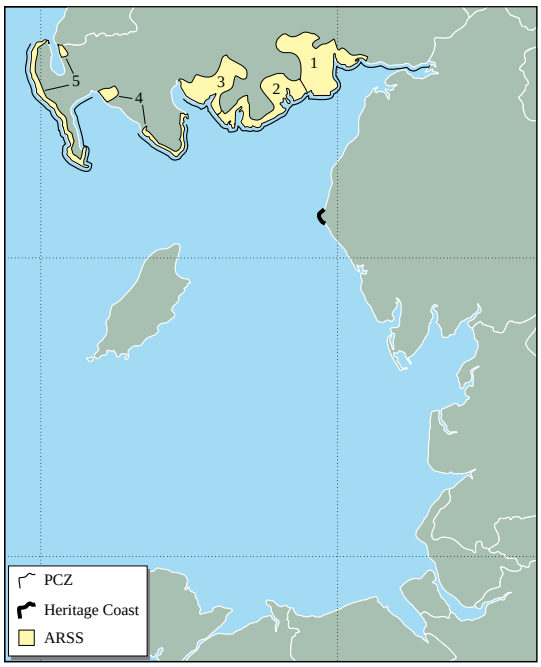
Table 7.4.2 Heritage Coasts

Site name	*No. of sites*	*Grid. ref.*	*Length (km)*	*Date designated*
Cumbria	**1**			
St. Bees Head[a]		NX954155-NX959118	6	1989
Region 13	***1***			
West Coast	27.5*		890	
England & Wales	45		1,539	

Source: Countryside Commission. Key: [a]completely defined, i.e. also has a defined landward boundary; *part of one site is in Region 10 and therefore partly also on the North Sea coast.

7.4.4 Sensitive Marine Areas

Sensitive Marine Areas (SMAs) are non-statutory marine areas that are nationally important and notable for their marine animal and plant communities or which provide ecological support to adjacent statutory sites. They are identified by English Nature, with a further aim of raising awareness and disseminating information to be taken into account in estuarine and coastal management planning. These areas rely on the co-operation of users and local communities for sustainable management, with the help of grant aid. SMA is the term used for areas described in previous technical documents (e.g. English Nature 1994a) as 'Important Areas for Marine Wildlife' under English Nature's initiative *Managing England's marine wildlife* (English Nature 1994b). There are four Sensitive Marine Areas within Region 13 (Table 7.4.3 and Map 7.4.1), compared with a total of 27 around the coast of England, of which ten whole sites and part of one other are on the West Coast.



Map 7.4.2 Heritage Coasts, coastal Areas of Regional Scenic Significance (ARSS) and Preferred Conservation Zones. Numbers refer to Table 7.4.5. Sources: Countryside Commission; Cobham Resource Consultants (1988); Scottish Development Department (1974).

Table 7.4.3 Sensitive Marine Areas

Site name	*No. of sites*	*Date established*
Clwyd/Cheshire	**1**	
Dee Estuary & North Wirral Coast		1994
Lancashire/Cumbria	**1**	
Morecambe Bay & Lune Deep		1994
Cumbria	**1**	
Cumbria Coast		1994
Cumbria/Dumfries & Galloway	**1**	
Solway		1994
Region 13	***4***	
West Coast	10.5	
England coast	27	

Sources: NCC (1990), English Nature (1994a).

7.4.5 Marine Consultation Areas

The non-statutory Marine Consultation Area designation identifies areas considered by Scottish Natural Heritage to deserve particular distinction in respect of the quality and sensitivity of the marine environment within them. Their selection encourages coastal communities and management bodies to be aware of marine conservation issues in the area. There is one Marine Consultation Area (2,080 ha) in Region 13 (see Table 7.4.4 and Map 7.4.1).

Table 7.4.4 Marine Consultation Areas

Site name	*No. of sites*	*Area (ha)*	*Date established*
Dumfries & Galloway/Strathclyde	**1**		
Loch Ryan[a]		2,080	1990
Region 13	***1***		
West Coast	23	103,287	
Scotland	29	111,896	

Source: NCC (1990). Key: [a]the Strathclyde part of Loch Ryan MCA is in Region 14; half the area of the MCA has been included in Region 13.

7.4.6 Regional Landscape Designations

Regional Landscape Designations (RLDs) provide a mechanism whereby Scottish planning authorities can identify sites where there should be a strong presumption against development (Cobham Resource Consultants 1988).

The designation recognises that these scenic areas have considerable unexploited potential for tourism and therefore for benefiting local economies. Local circumstances and the absence of central guidance since 1962 means that regional landscape designations vary in title, scale and objectives from one planning authority to another (Cobham Resource Consultants 1988), such that there are at least five types of RLD.

In Region 13 there are five areas (approximately 65,997 ha) covered by RLDs (in this region they are all Areas of Regional Scenic Significance) that include areas somewhere within the coastal zone (see Table 7.4.5 and Map 7.4.2). There has been no monitoring or further comprehensive study of the number of RLDs since Cobham Resource Consultants (1988).

Table 7.4.5 Regional Landscape Designations (RLDs)*

*Site no.***	*Site name*	*No. of sites*	*Area (ha)*
	Dumfries & Galloway	**5**	
1	Nith Estuary and Criffel Uplands		24,445
2	Kircudbright Bay and Stewartry Coast		17,649
3	Fleet Estuary and Valley		16,836
4	Machars Coast		2,574
5	Rhinns Coast		4,483
	Region 13	***5***	***65,997***
	West Coast	29	435,283
	Scotland coast	63	508,124
	Scotland whole country	178	1,468,000

Sources: Cobham Resource Consultants (1988), Dumfries & Galloway Regional Council. Key: *in this region all RLDs are Areas of Regional Scenic Significance (ARSS); **site number is as shown on Map 7.4.2. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

7.4.7 Preferred Conservation Zones (PCZ)

Preferred Conservation Zones (PCZs) are non-statutory coastal areas in Scotland, of particular national, scenic, environmental or ecological importance, in which major new oil- and gas-related developments would in general be inappropriate or would have a socio-economic impact on a small community, and would only be justified in exceptional circumstances (see also section 9.5). They are areas with a distinctive aesthetic appeal, heritage and character, where tourism and recreation take priority over major industrial processes. PCZs are the opposite of Preferred Development Zones. In Region 13 there are three PCZs (see Table 7.4.6 and Map 7.4.2). This compares with 22 PCZs on the Scottish mainland and numerous potential PCZs around the islands (only the larger islands have defined Preferred Conservation Zones), of which eight whole defined PCZs and the majority of the 1,771 km Dounreay to Machrihanish PCZ are on the West Coast.

Table 7.4.6 Preferred Conservation Zones (PCZs)

Location
Dumfries & Galloway
Port William - Eggerness Point
Carsluith - The River Sark
Craiglaggan - Glenluce

Source: Scottish Development Department (1974)

7.4.6 Acknowledgements

Thanks are due to Ray Woolmore and Paul Johnson (Countryside Commission), Roger Bolt (JNCC), Phillip Biss, Paul Gilliland and Kevin Page (English Nature), Donald Balsillie, Kathy Duncan and Natasha O'Connel (Scottish Natural Heritage), and Site Safeguards Team (Countryside Council for Wales).

7.4.7 Further sources of information

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C. Contact names and addresses

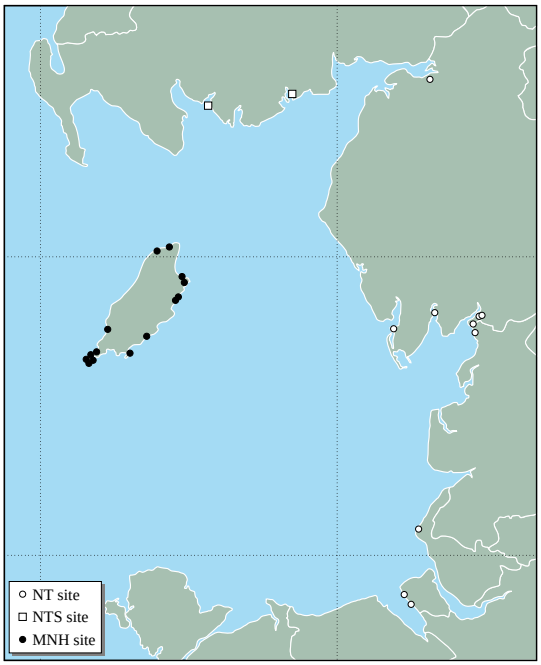
Type of information	*Contact address and telephone no.*
NCR sites, GCR sites, SMAs (Cheshire, Merseyside, Lancashire)	*Conservation Officer, English Nature North West Local Team, tel: 01942 820342
NCR sites, GCR sites, SMAs, (Cumbria)	*Conservation Officer, English Nature Cumbria Local Team, tel: 015394 45286
NCR sites, GCR sites, MCA (Scotland)	*SNH Dumfriesshire and Galloway Office, Dumfries, tel 01387 247010
Heritage Coasts (Cumbria)	Countryside Commission, Northern Region, Warwick House, Grantham Road, Newcastle upon Tyne NE2 1QF, tel: 0191 232 852
ARSSs, PCZs	*Department of Physical Planning, Dumfries & Galloway Regional Council, Dumfries, tel: 01387 261234

*Starred contact addresses are given in full in the Appendix.

7.5 Other types of protected site

7.5.1 The National Trust

The National Trust is an independent charity that is currently the largest private landowner in Britain. The National Trust owns about 230,000 ha of land in England, Wales and Northern Ireland, and over 200 buildings of outstanding importance. It has also accepted or bought covenants that protect against development for a further 31,600 ha of land and buildings. Many of the tenanted properties have individual intrinsic value; together they protect large areas of unique landscape and countryside. The National Trust has statutory powers to protect its properties, under an Act of Parliament (1907) that declares its holdings of land and buildings inalienable; these properties cannot be sold or mortgaged. In addition, National Trust properties can be protected by bylaws. In 1985 the National Trust relaunched its 1965 campaign 'Enterprise Neptune' to raise funds for the purchase of coastal areas. A total of 850 km of coast are now owned or managed by the National Trust (National Trust 1993). There are ten National Trust sites (721 ha) in Region 13 (Table 7.5.1 and Map 7.5.1).



Map 7.5.1 Coastal National Trust, National Trust for Scotland and Manx National Heritage sites. Sources: NT, NTS, MNH. Note: a single symbol may represent more than one site in close proximity.

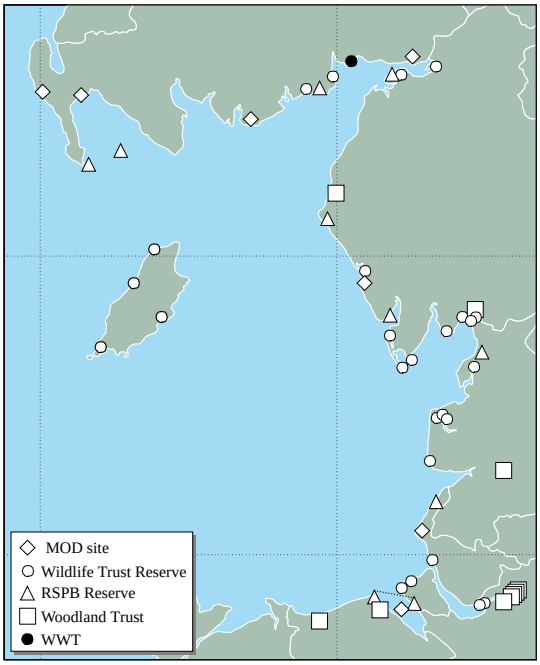
7.5.2 The National Trust for Scotland

The National Trust for Scotland is a charitable organisation, established in 1931 (National Trust for Scotland Order Confirmation Act 1935) for the purposes of promoting the permanent preservation of Scotland's heritage of fine buildings, beautiful landscape and historic places, and to encourage public enjoyment of them. The Trust now has over 100 properties in its care, including over 40,500 ha of countryside, from forest, mountains and moorland to the coast (National Trust for Scotland 1993). Land that is not owned by the Trust can be protected by a Conservation Agreement under power given to the National Trust for Scotland by a 1938 Act of Parliament. Conservation agreements are entered into voluntarily by landowners who wish their land to come under a form of protection short of full Trust ownership. The National Trust for Scotland practises active conservation and management of its land. There are two National Trust for Scotland sites (767 ha) in Region 13 (Table 7.5.2 and Map 7.5.1).

Table 7.5.1 National Trust sites

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date acquired*	*Landform*
Merseyside	**3**				
Heswall		SJ246825	16	1978	Coastal meadow and farmland
Caldy Hill		SJ224855	5	1929-32	Coastal hill
Formby		SD275080	200	1967-83	Sand dunes, foreshore, pine woods and heath
Lancashire	**2**				
Bank House Farm		SD460752	27	1983-85	Limestone coastal fringe and coastal fields
Jack Scout		SD459737	7	1983	Coastal limestone pasture and scrub
Cumbria	**5**				
Heathwaite		SD450768	24	1986	Limestone grassland and woodland
The Knott		SD456774	86	1946-80	Pasture and woodland
Plumpton Marsh		SD324804	3	1990	Saltmarsh
Sandscale Haws		SD185755	284	1984	Sand dunes and marsh
Solway Commons		NY310605	69	1972	Saltmarsh and common land
Region 13	***10***		***721***		
West Coast*	255		45,191		
England & Wales coast	426		37,478		

Sources: National Trust, JNCC. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal. Key: *includes National Trust for Scotland.



Map 7.5.2 Other voluntary and private sites. Source: Ministry of Defence (MOD), Wildlife Trusts, RSPB, Wildfowl & Wetlands Trust (WWT), Woodland Trust. Note: a single symbol may represent more than one site in close proximity.

7.5.3 Manx National Heritage

The Manx National Trust (now Manx National Heritage) was created by Act of Tynwald in 1951 as an expansion of the remit of the Manx Museum and Ancient Monument Trustees. It has a similar role on the Isle of Man to that of the National Trust and National Trust for Scotland. Manx National Heritage protects in perpetuity for their aesthetic and wildlife value the areas which it owns; most of them are coastal. The National Trust for England and Wales, who acquired the Calf of Man in 1937, first let and then gave the site to the Manx National Trust in 1986. The National Trust has a representative amongst Manx National Heritage's Trustees. There are fourteen coastal Manx National Heritage sites (738 ha) (Map 7.5.1).

7.5.4 The Royal Society for the Protection of Birds

The Royal Society for the Protection of Birds (RSPB) has substantial non-statutory reserve holdings and currently manages over 130 reserves (84,000 ha) in Britain (RSPB 1993). Wherever possible, reserves are purchased, so that the level of safeguard for the wildlife and their habitats is high. Where reserves are leased, the RSPB aims to acquire long leases (longer than 21 years) with appropriate management rights. There are nine RSPB sites (8,115 ha) in Region 13 (the two Dee Estuary locations comprise one site) (Table 7.5.4 and Map 7.5.2).

Table 7.5.2 National Trust for Scotland sites

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date acquired*	*Landform*
Stewartry	**2**				
Rockcliffe		NX845541	45	1965-90	Rocky coast and islands
Murray Isles		NX562501	1	1991	Islands
Region 13	***2***		***46***		
West Coast*	255		45,191		
Scotland coast	19		25,170		

Sources: NTS, JNCC. Note: In this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal. Key: *includes National Trust.

Table 7.5.3 Manx National Heritage sites

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date acquired*	*Landform*
Calf of Man		SC159655	249	1986	Islet, cliffs, rough pasture and maritime heath
Kitterland Islet		SC171666	4	1971-1977	Coastal grassland
The Sound		SC174666	1	1974	Rough pasture
Spanish Head, the Chasms and Cregneash		SC187666	152	1939-1988	Cliffs, pasture and farmland
St. Michael's Isle		SC296674	5	1984	Islet, coastal grassland
Marine Drive		SC357731	17	1966	Cliffs
Bulgham Brooghs		SC456857	15	1975	Cliffs and rough pasture
Dhoon		SC460863	13	1973-1975	Cliffs and rough pasture
Maughold Head and Brooghs		SC488924	44	1953-1984	Cliffs and pasture
Gob ny Rona		SC471931	4	1964	Low cliffs and rough ground
The Ayres: Outer Ballakesh		NX433036	20	1973	Maritime heath on blown sand over shingle
The Ayres: Outer Ballakeyl		NX397026	10	1976-1980	Maritime heath on blown sand over shingle
Early Cushlin and Creggan Mooar		SC221756	196	1957-1991	Cliffs and pasture
Meayll Hill		SC190677	8	-	Heath
Total	***14***		***738***		

Source: Manx National Heritage. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

Table 7.5.4 Royal Society for the Protection of Birds sites

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date acquired*	*Interest*
Clwyd/Cheshire	**1**				
Dee Estuary: Point of Ayr[a]		SJ113833	4,713[b]	1979	Intertidal sand and mudflats, shingle spit, sand dunes, saltmarsh, extensive numbers of nesting and wintering waders, wintering and migrating wildfowl, raptors, passerines
Dee Estuary: Gayton Sands[a]		SJ274789			Mudflats, saltmarsh and reedbed, extensive numbers of nesting and wintering waders, wintering and migrating wildfowl, raptors, passerines
Merseyside	**1**				
Marshside		SD352204	110	1994	Unimproved grazing marsh, lowland wet grassland, wintering and breeding waterfowl
Lancashire	**1**				
Morecambe Bay & Leighton Moss		SD486666 & SD477750	2,647	1974	Grazed saltmarsh, intertidal sandflats, reed swamp, meres, willow, alder scrub, woodland on limestone slopes, breeding bitterns, breeding and wintering waders, breeding and roosting passerines, breeding and wintering wildfowl, migrating terns, migrating and breeding raptors
Cumbria	**3**				
Hodbarrow		SD174791	105	1986	Coastal brackish lagoons, limestone scrub and grassland, estuary banks, nesting waders and terns, migrating passerines, wintering waterfowl and waders
Campfield Marsh		NY195616	221	1986	Saltmarsh, gorse scrub, grazed pasture, open water, lowland raised mire, roosting waders, wintering waterfowl, wintering seabirds, raptors
St. Bees Head		NX962118	22	1973	Sandstone cliffs, grass and scrub, large cliff seabird colony and offshore seabirds
Dumfries & Galloway	**3**				
Mersehead Farm		NX925560	279	1993	Grazing marsh, arable land, saltmarsh and intertidal complex, breeding and wintering waterfowl
Scar Rocks		NX263345 & NX258333	2	1987	Inaccessible granite rocks, breeding gannets and grey seals
Mull of Galloway		NX157304	16	1975	Rugged granite cliffs, nesting colonies of seabirds
Region 13	***9***		***8,115***		
West Coast	28		14,125		
GB coast	81		38,680		

Sources: RSPB (1994; *in litt*.). [a] These sites are collectively known as the Dee Estuary, [b]with a combined area of 4,713 ha. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

7.5.5 The Wildfowl & Wetlands Trust

As well as their wildfowl collections, used extensively for education, The Wildfowl & Wetlands Trust (WWT - formerly the Wildfowl Trust) has established non-statutory reserves in a number of key wintering areas for migrant wildfowl. The level of protection afforded to such sites is high, since the land is either owned or held on long-term leases by the Trust. There is one WWT site (726 ha) in Region 13, at Caerlaverock (Table 7.5.5 and Map 7.5.2).

Table 7.5.5 Wildfowl & Wetlands Trust sites

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date acquired*
Dumfries & Galloway	**1**			
Caerlaverock		NY051657	726	1971
Region 13	***1***		***726***	
West Coast	3		1,113	
GB coast	6		1,585	

Source: WWT. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

Table 7.5.6 Wildlife Trusts sites

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date acquired*
Cheshire Wildlife Trust	**4**			
Red Rocks Marsh		SJ206880	4	1973
Crooked Meadow		SJ244903	3	1985
Pickerings Scrape		SJ486829	0.1	1987
Hale Duck Decoy		SJ478827	2	1976
Lancashire Wildlife Trust	**6**			
Seaforth Dock Nature Reserve		SJ315970	40	1985
Lytham St. Anne's		SD310307	16	1968
Fleetwood Marsh		SD328455	1	1987
Burrows Marsh		SD354449	46	1970
Armhill & Barnaby's Sands		SD350461	58	1970
Oxcliffe Marsh		SD455623	3	1985
Cumbria Wildlife Trust	**10**			
Grubbins Wood		SD447780	10	1974
Beach Wood		SD453787	1	1970
Blawith and Brown Robin		SD415787	27	1977
Humphrey Head		SD391738	23	1992
Foulney Island		SD245640	11	1974
South Walney Island		SD215620	93	1963
North Walney Island		SD172728	144	1985
Eskmeals Dunes		SD087944	68	1970
Bowness-on-Solway Gravel		NY207616	7	1966
Rockcliffe Marsh		NY325640	1,012	
Scottish Wildlife Trust	**2**			
Drummains Reedbed		NX984610	6	1974
Southwick Coast		NX910558	17	1984
Manx Nature Conservation Trust	**4**			
Onchan Wetlands		SC402783	0.4	1987
Breagle Glen		SC196688	0.4	1988
Coolidarry		SC314901	7	1976
Cronk y Bing		NX378015	6	1993
Region 13	***26***		***1,605***	
Wales	46		1,191	
England	140		8,406	
Scotland	26		13,805	
Isle of Man	4		14	
West Coast	94		13,006	
GB coast	216		23,417	

Sources: Wildlife Trusts (1990 data), Manx Nature Conservation Trust, Scottish Wildlife Trust, JNCC. Notes: there are no coastal Wildlife Trust sites in Clwyd; in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

7.5.6 The Wildlife Trusts

The Wildlife Trusts were established to promote non-statutory nature conservation at a local level. They own, lease and manage, by agreement with owners, over 1,800 nature reserves (more than 52,000 ha). There is usually one trust covering a whole county or group of counties, although both Scotland and the Isle of Man each have a single Trust. The Trusts with coastal sites in the region are the Manx Nature Conservation Trust, the Cheshire Wildlife Trust, the Lancashire Wildlife Trust, the Cumbria Wildlife Trust and the Scottish Wildlife Trust. There are 26 coastal Wildlife Trust sites (1,605 ha) in Region 13 (Table 7.5.6 and Map 7.5.2). The Wildlife Trusts were revising their databases when this section was being collated; 1990 data on English/Welsh Wildlife Trust Sites have therefore been used, with Scottish data extracted from Scottish Wildlife Trust (1994) and Isle of Man data from MNCT (1994).

7.5.7 The Ministry of Defence

As at August 1994, the Ministry of Defence (MoD) owned sites covering some 320 km of coastline around the UK, not all of it significant for its nature conservation value. The MoD gives high priority to nature conservation on the Defence Estate, subject to the overriding importance of military training. The restrictions to public access on some

Table 7.5.7 MoD sites

Site name	*No. of sites*	*Area (ha)**	*Habitats*	*Protected status*
Clwyd/Cheshire	**1**			
Sealand Ranges		477	Saltmarsh	SSSI, Ramsar
Merseyside	**1**			
Altcar		250	Sand dunes, salt marsh	No designations
Cumbria	**1**			
Eskmeals		692	Sand dunes	SSSI, Bird Sanctuary
Dumfries & Galloway	**4**			
Eastriggs		984	Sand	SSSI, NCR site
Kirkcudbright		1,909	Rock/sand	SSSI
West Freugh		1,849	Sand dunes	SSSI
Wigtown		6	Cliff, sand/shingle	No designations
Region 13	***7***	***6,166***		
West Coast	45	18,960		
GB coast	110	53,409		

Source: Ministry of Defence. Key: *all areas are approximate and include land leased or used under licence; SSSI = Site of Special Scientific Interest; NCR = Nature Conservation Review site. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

sites mean that they can be amongst the most pristine areas of wildlife habitat in the region. There are seven coastal MOD sites (6,166 ha) in Region 13 (Table 7.5.7 and Map 7.5.2).

7.5.8 The Woodland Trust

The Woodland Trust was established in 1972 with the aim of conserving, restoring and re-establishing trees (particularly broad-leaved) and woodland plants and wildlife in the United Kingdom. There are ten Woodland Trust sites (94 ha) in Region 13 (Table 7.5.8 and Map 7.5.2).

Table 7.5.8 The Woodland Trust sites

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*
Clwyd	**2**		
Coed y Gopa & Coed Bryngwenalt		SH935765	47
Coed y Garth		SJ135815	6
Cheshire	**5**		
Haddocks Wood, Runcorn		SJ544836	10
Marshgate Wood		SJ553838	1
Lodge Plantation, Runcorn		SJ557837	7
Pitts Heath Wood, Runcorn		SJ560838	4
Green Wood, Runcorn		SJ562840	9
Lancashire	**1**		
Dog Kennel Wood		SD554274	5
Cumbria	**2**		
Crag Wood		SD457807	4
Land at Harras Moor		NX978186	1
Region 13	***10***		***94***
West coast	29		363
GB coast	64		1,458

Source: Woodland Trust (1993). Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

7.5.9 Acknowledgements

The author wishes to thank Andrea Firth (MoD), Dr L.S. Garrad (MNH), and Jo Burgon and Richard Offen (The National Trust), Dr J. Fenton (National Trust for Scotland), Bob Scott (RSPB), Mark Pollitt (Wildfowl & Wetlands Trust), Sarah Hawkswell (the Wildlife Trusts), Dr A. Somerville (Scottish Wildlife Trust), Manx Trust for Nature Conservation, Andrew Johnson (Manx Natural Heritage) and The Woodland Trust.

7.5.10 Further sources of information

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Harrison, S., *ed*. 1986. *100 years of heritage - the work of the Manx Museum and National Trust*. Douglas, Manx Museum and Manx National Trust

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
National Trust sites (England and Wales)	*Coast and Countryside Adviser, The National Trust, Cirencester, tel: 01285 651818
National Trust sites in region	*Regional Land Agent, The National Trust, North West Regional Office, Ambleside, tel: 015394 35599
National Trust for Scotland sites in region	*The National Trust for Scotland, Edinburgh, tel: 0131 226 5922
Manx National Heritage sites	*The Manx Museum and National Trust, Douglas, Isle of Man, tel: 01624 661899
RSPB sites (Cheshire, Merseyside, Lancashire)	Regional Officer, RSPB North West Regional Office, Westleigh Mews, Wakefield Road, Denby Dale, Huddersfield, West Yorkshire HD8 8QD, tel: 01484 861148
RSPB sites (Cumbria)	Regional Officer, RSPB North England Regional Office, 4 Benton Terrace, Newcastle upon Tyne NE2 1QU, tel: 0191 281 3366
RSPB sites (Scotland)	Regional Officer, RSPB South and West Scotland Regional Office, Unit 3.1, West of Scotland Science Park, Kelvin Campus, Glasgow G20 0SP, tel: 0141 945 5224

Type of information	*Contact address and telephone no.*
Wildfowl & Wetlands Trust at Caerlaverock	John Doherty, The Wildfowl and Wetlands Trust, Eastpark Farm, Caerlaverock, Dumfriesshire DG1 4RS, tel: 01387 770200
Manx Nature Conservation Trust sites	*Conservation Officer, Manx Nature Conservation Trust, Isle of Man, tel: 01624 801985
Cheshire Wildlife Trust sites	*Conservation Officer, Cheshire Wildlife Trust, Nantwich, tel: 01270 610180
Lancashire Wildlife Trust sites	*Conservation Officer, Lancashire Wildlife Trust, Preston, tel: 01772 324129
Cumbria Wildlife Trust sites	*Conservation Officer, Cumbria Wildlife Trust, Ambleside, tel: 015394 32476
Scottish Wildlife Trust sites	*Conservation Officer, Scottish Wildlife Trust HQ, Edinburgh, tel: 0131 312 7765
The Woodland Trust sites	The Woodland Trust, Autumn Park, Dysart Road, Grantham, Lincolnshire NG31 6LL, tel: 01476 74297
MOD sites	Conservation Officer, MOD Conservation Office, B2/3, Government Buildings, Leatherhead Road, Chessington, Surrey KT9 2LU, tel: 0181 391 3028/9

*Starred contact addresses are given in full in the Appendix.

Chapter 8 Land use, infrastructure and coastal defence

S.L. Fowler, M.J. Dunbar, Dr T.J. Holt, C.A. Crumpton & M.J. Goodwin

8.1 Introduction

This chapter is divided into three sections: (rural) land use, covering agriculture (especially as it affects important coastal wildlife habitats) and woodland; infrastructure, covering population distribution, industry, ports, harbours, ferries, pipelines, cables and power generation; and coastal defence, including sea defence and coast protection.

Considerable lengths of the coastline of this region are relatively undeveloped. However, the region is dominated by the heavily populated and industrialised central area. In the south, Clwyd has an important coastal tourism industry, with major coastal road and rail links and some coastal agriculture. Parts of the Dee Estuary are industrialised, with ports and major coastal road and rail links. Merseyside is heavily developed and is one of the largest and most important conurbations in the country. Lancashire has significant coastal industries at Preston and Fleetwood, but also serves an important leisure market, with the largest coastal resort in the UK at Blackpool, and has extensive areas of natural coastal sand dunes on the Sefton coast and saltmarsh in the Ribble, and some coastal agriculture. Cumbria is dominated inland by the Lake District National Park. Its coastal land has lost most of its former industrial use and is now used mainly for livestock grazing, with the exceptions of the main towns of Barrow-in-Furness, Whitehaven and Workington. Sellafield is a major industrial complex on the Cumbria coast. The coast of Dumfries & Galloway is almost entirely rural, with few towns and little development, as is the Isle of Man, apart from around Douglas and Onchan.

Coastal habitats in Region 13 range from the pristine, mostly in the sparsely populated north of the region, to the heavily altered or destroyed, in the more developed, industrialised south. Extensive tracts of sand dunes, in particular, have in places been modified by the construction of golf courses, transformed by afforestation or buried by housing developments, as here at Hightown, on the Sefton Coast, Merseyside. Photo: Coastal Conservation Branch, JNCC.

8.2 Land use

S.L. Fowler, M.J. Dunbar & Dr T.J. Holt

8.2.1 Introduction

Agriculture, especially market gardening and grazing on coastal marshes, is the major (rural) land use in most of the region. Agriculture is generally of similar importance in the region as it is in other regions on the west and south coasts of England, with arable farming concentrated in the main river valleys and stock rearing of greater regional importance than it is on the mostly arable-farmed east coast. Local authorities in the north-west and Wales are encouraging farm businesses to diversify their activities. In the south, the areas fringing the estuaries are most important; those parts of Clwyd, southern Cheshire, Merseyside and Lancashire that are not built-up are popular for market gardening, particularly on the rich alluvial soils of the estuaries of the Dee, Mersey, Ribble and Lune and the peatlands (drained peat bogs) further inland in the Fylde. Local markets are provided by the large urban populations. Several of the region's estuaries, notably the Dee and Ribble, have suffered from extensive land claim for agriculture (Table 8.2.1; see also section 8.4).

Table 8.2.1 Historical land claim of saltmarsh for agriculture

Location	*Area affected (ha)*	*Dates*
Dee Estuary	3,160	by 1857
Mersey Estuary	492	19th century
Ribble Estuary	1,960	19th century
Morecambe Bay	1,300	by 1900

Source: Doody (undated)

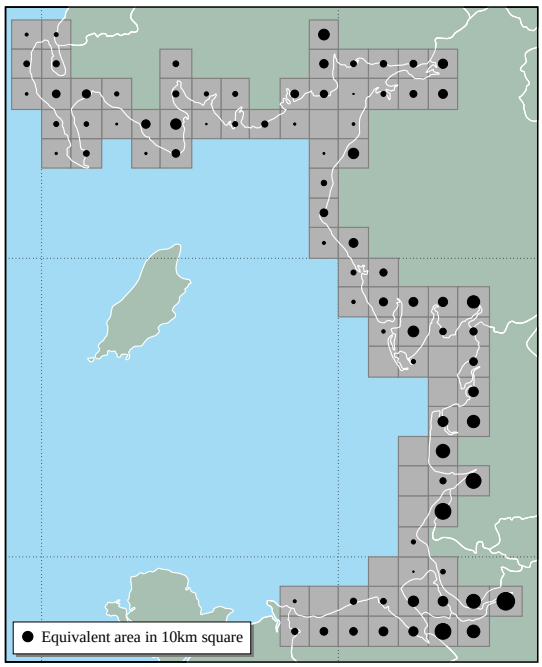
Much coastal land in Cumbria, Dumfries & Galloway and the Isle of Man is used for livestock grazing. The sand dunes of Wales, England and Scotland have been affected by agriculture for most of their existence (Dargie 1993). The characteristic semi-natural vegetation of most stable dunes is grasslands or heathlands, which have developed as a result of grazing of the indigenous vegetation by sheep, cattle and rabbits.

Grazing is the oldest form of saltmarsh management. There are approximately 44,000 ha of saltmarsh in Great Britain, of which about 31,600 ha are grazed, with major concentrations in the south-east and north-west of England. In the region there are 13,184 ha of saltmarsh on which some grazing takes place. This accounts for nearly 98% of the region's total saltmarsh (Burd 1989), and represents approximately 42% of grazed saltmarsh in Great Britain. Stocking densities vary in the UK. Doody's 1988 study of saltmarsh management identified levels across the UK ranging from one to six animals per hectare, with grazing usually only taking place from May to September.

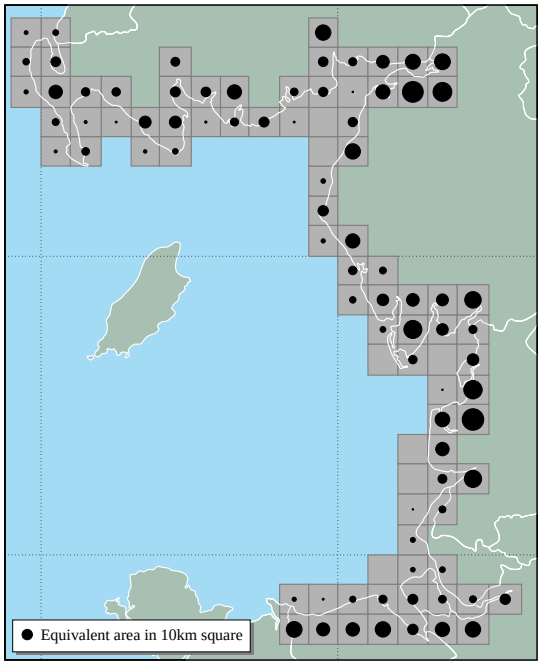
North Wales and the northern parts of this region contain some heavily wooded areas, but not many of these are close to the coast. The few significant stands are generally located on sheltered inlets. Two notable areas of coastal woodland are the large Arnside and Silverdale woods (Lancashire and Cumbria), and there is dune afforestation at Formby (Merseyside) and Torrs Warren (Dumfries & Galloway).

8.2.2 Locations and land uses

Maps 8.2.1, 8.2.2 and 8.2.3 show the distribution in the region of, respectively, tilled land, heavily managed mown/grazed turf and lightly managed meadow/semi-natural grassland. Agricultural land on the undeveloped areas of the Clwyd coast is Grade 2 or 3. The small part of the Merseyside coast in agricultural use is of poorer quality, Grade 3c or lower. The area to the south of the Ribble (north-east of Southport) is notable for its intensive market gardening. In Lancashire, agricultural land abutting the coast is all Grade 3, although there are some significant areas of Grade 1 (the highest quality) and Grade 2 land set back from the coast behind the urban coastal fringe, for example between Southport and the Ribble. Inland from Blackpool agricultural land is Grade 2 and 3, with Grade 3 and some areas of Grade 4 further north and around Heysham. Most coastal agricultural land further north in the region is Grade 3. In the Isle of Man the higher cliffs on the east and west coasts support mainly unenclosed rough grazing, as do several kilometres of unusual lichen heath west of the Point of Ayre. There are improved fields on the lower areas, including from Niarbyl to Jurby on the west coast and numerous areas from Ramsey to Port St. Mary on the east coast (Allen 1984). These areas are used predominantly for cattle grazing and/or silage or hay production.



Map 8.2.1 Tilled land (GB only). Note: area of circle indicates the area of this land cover type in the 10 km square. Source: Countryside Survey (1990), ITE Monks Wood.



Map 8.2.2 Pastures and amenity swards, mown or grazed to maintain a short turf throughout the year (GB only). Note: area of circle indicates the area of this land cover type in the 10 km square. Source: Countryside Survey (1990), ITE Monks Wood.

No grazed dunes exist in the Welsh part of this region. However a high percentage of the sand dunes of Lancashire and Cumbria are grazed by stock (see Map 8.2.4), in line with the predominance of livestock farming in the north and west of England. Only one sand dune site on the Dumfries & Galloway coast has so far been subject to detailed survey (Dargie 1993): Torrs Warren, where heavy grazing was recorded.

Grazing takes place on many of the saltmarshes of the region, for example on the Mersey Estuary (sheep and cattle), Ribble Estuary (cattle), in the Morecambe Bay and Duddon Sands area, and on the Solway Firth (cattle in summer, sheep in winter) (Map 8.2.4). Grazing takes place to a lesser extent in the Wyre Estuary. Areas of grazed and ungrazed saltmarsh exist on the Dee Estuary, Morecambe Bay, Ravenglass, Auchencairn Bay and Wigtown Bay (see Map 9.3.2). At Morecambe Bay and around the Solway Firth there are good examples of transition from saltmarsh to grassland, which are also grazed. Saltmarsh is important in Cumbria for the wintering of sheep, for example on the Solway, where marsh is grazed by cattle in summer and sheep in winter. No appreciable grazing takes place on the limited Manx saltmarshes.

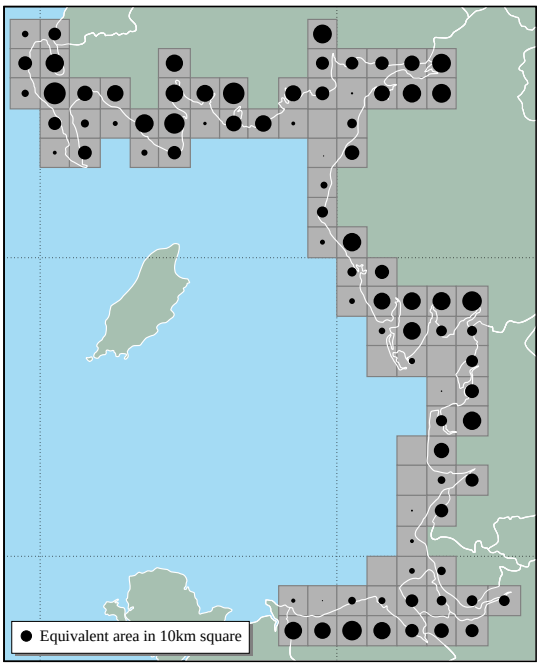
Turf cutting is carried out commercially around Morecambe Bay and on the Solway but is done on a small scale elsewhere. The area of turf cut varies, but at the Duddon Sands Site of Special Scientific Interest (SSSI) in Cumbria, a study recommended that to keep the cutting sustainable, no more than 1% of the saltmarsh should be removed each year (Scott & Hodson 1988).

Table 8.2.2 shows the locations and size of areas of woodland in the region. There is little coastal woodland in the south of the region. There are small areas of ancient semi-natural woodland behind the urban areas of Colwyn Bay and Prestatyn, and isolated areas at Llanddulas (although all of this and some of the woods at Prestatyn have been replanted). There are also narrow strips of ancient semi-natural woodland on old sea cliffs near Gronant in Clwyd and Connah's Quay (Cheshire). Only tiny fragments of ancient woodland remain in Merseyside, but there are plantations on the dunes at Formby and Ainsdale Hills (Doody undated). In Lancashire and Cumbria, there is significant ancient woodland (>500 ha) in the Arnside and Silverdale area, at Grange-over-Sands, on the Esk Estuary and in a few other areas (see Map 8.2.5). Between Carnforth and Silverdale the ancient woodland has natural transitions to saltmarsh, a very rare circumstance in the UK. Extensive areas of the ancient woodland on the south Cumbria coast have been replanted. Dumfries & Galloway has more extensive coastal woodland: there are narrow strips in some areas, and some large stands at Dalbeattie, and Kirkcudbright and Wigtown Bays. There are many thousands of hectares of afforestation in the

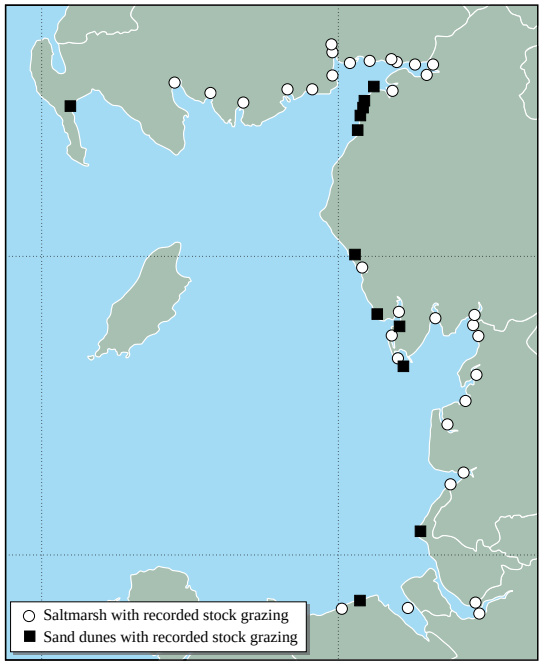
Table 8.2.2 Areas of significant coastal forestry and woodland

*Site no.**	*Location*	*Grid ref.*	*Details*
	Clwyd		
1	Llanddulas	SH9277	100 ha mixed
2	East of Gronant	SJ1580	75 ha mixed (on old sea cliffs)
	Merseyside		
3	Formby and Ainsdale Hills	SD2810	300 ha coniferous. Popular for leisure.
	Lancashire/Cumbria		
4	Arnside and Silverdale	SD4676	500 ha broad-leaved
	Cumbria		
5	Foulshaw Moss	SD4682	300 ha coniferous
6	Grange over Sands	SD4178	200 ha mixed
7	Greenodd	SD3382	150 ha mixed - Roudsea wood
8	River Leven	SD3584	Many hundreds of ha on banks of river just upstream of tidal limit
9	Ravenglass	SD1096	100 ha mixed
	Dumfries & Galloway		
10	Priestside	NY1266	100 ha mixed
11	Clarencefield	NY0768	200 ha coniferous
12	Caerlaverock NNR	NY0265	50 ha mixed
13	Dalbeattie	NX8353	200 ha coniferous
14	Kirkcudbright Bay	NX6748	200 ha mixed
15	Water of Fleet	NX5753	150 ha mixed
16	Wigtown Bay	NX4853	300 ha coniferous and mixed stands
17	Craignarget Hill	NX2652	300 ha coniferous, close to coast
18	Torrs Warren	NX1656	200 ha coniferous, on dunes
	Isle of Man		
19	Ballure	SC4592	<10 ha plantation
20	Traie-ny-Halsall	SC4788	<5 ha possible relict oak woodland
21	Kerroodhoo	SC2276	Conifer plantation
22	Glen Maye	SC2279	Manx National Glen with coastal frontage

Source: Ordnance Survey 1:25,000 maps. Key: *site numbers are those on Map 8.2.5.



Map 8.2.3 Meadows, verges and low intensity amenity grasslands and semi-natural cropped swards, not maintained as short turf (GB only). Note: area of circle indicates the area of this land cover type in the 10 km square. Source: Countryside Survey (1990), ITE Monks Wood.



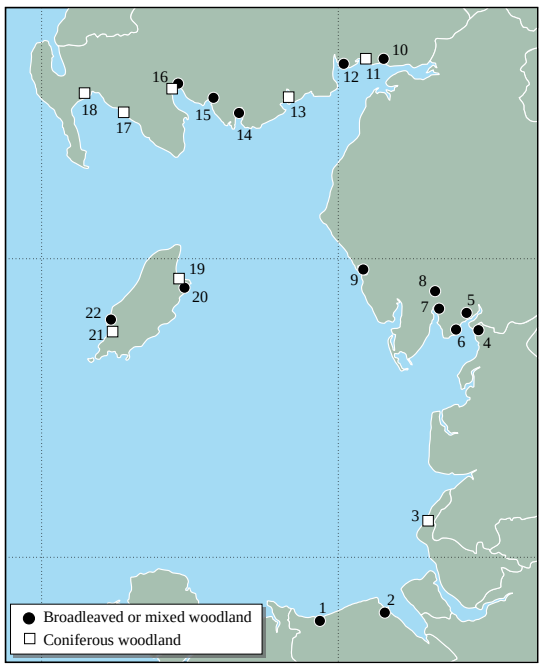
Map 8.2.4 Saltmarshes and sand dunes with recorded grazing (GB only). See Maps 3.6.1 and 3.2.2 for distribution of saltmarsh and sand dune sites. Source: JNCC Coastal Database.

Dumfries area, but these are several kilometres from the coast. Afforestation has been carried out on sand dunes at Torrs Warren.

Except for recent conifer plantations, the Isle of Man has been relatively unwooded for a long time. However, very small areas of possibly relict oak woodland likely to be descended from native Manx stock (Garrad 1972) survive at seven places on the coast, the largest (>5 ha) being at Traie-ny-Halsall, Maughold. Small (usually <10 ha) mixed or predominantly broadleaved woodlands exist in many of the Manx National Glens, several of which are coastal or within a kilometre of the coast. Because these are all narrow glens any coastal frontage is always very small and the woods may extend 1 km or more inland. At Glen Maye the area designated as Manx National Glen is not coastal but the woods extend almost to the coast. There are a number of other small wooded coastal areas, which include significant numbers of broadleaved trees, again usually in relatively sheltered glens, the larger of which are shown on Map 8.2.5. Large conifer-dominated forestry plantations are mainly found inland, but a small (<10 ha) plantation at Ballure near Ramsey has a coastal (cliff-top) frontage, while others near Knockaloe (Peel), Ramsey (two plantations), Fleshwick and Kerroodhoo (Dalby) are within 1 km of the coast. Only those at Kerroodhoo and Ballure (Ramsey) are larger than about 15 ha (Table 8.2.2).

8.2.3 Information sources used

The main source of information for this section was the Countryside Survey 1990 (ITE 1993), which is based primarily on high resolution satellite images. These images show the dominant land cover for each 25 m x 25 m area (pixel) of Great Britain. These are classified into seventeen key types (including tilled land and managed grassland), and field surveys of randomly selected areas were used to check the results. Maps 8.2.1, 8.2.2 and 8.2.3 are derived from this data held in the DoE Countryside Information System. The main limitations of these data are derived from errors in classifying areas covered by a mixture of land types and from the form of presentation used in the maps. The Countryside Information System can provide data on a 1 km square framework, but this level of detail was not



Map 8.2.5 Coastal woodland. Numbers refer to Table 8.2.2. Source: Ordnance Survey Landranger maps. © Crown copyright.

considered appropriate here. More detailed information on agricultural land use and grades is available from ADAS (for example, information on set-aside targets), National Park documents and local plans, and in the case of the Isle of Man from terrestrial phase 1 survey information (in preparation by the Manx Nature Conservation Trust on behalf of the Isle of Man Department of Agriculture, Fisheries and Forestry). Sand dune and saltmarsh grazing information for Map 8.2.4 comes from the JNCC's Integrated Coastal Database, and from cited references.

Some woodland information (Map 8.2.5) was obtained from the 1:50,000 scale Ordnance Survey Landranger maps, which differentiate between coniferous, mixed and broad-leaved woodland. The former Nature Conservancy Council's Inventory of Ancient Woodlands (Spencer & Kirby 1992) provides comparative data for the region and Great Britain; provisional county inventories, from which the data used here were extracted, are available from English Nature local teams and Scottish Natural Heritage and Countryside Council for Wales offices. Areas of Isle of Man woodlands were estimated from 1:25,000 Ordnance Survey maps.

8.2.4 Further sources of information

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Radley, G.P. 1994 *Sand dune vegetation survey of Great Britain. Part 1: England.* Peterborough, Joint Nature Conservation Committee.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Agricultural land grades, set-aside - Clwyd	ADAS Land Service, Trem Clwyd, 41 Canol-y-Dre, Ruthin, Clwyd LL15 1QA, tel: 01824 704060
Agricultural land use - Clwyd	Welsh Office Agriculture Department (WOAD), Government Buildings, Penrallt, Caernarfon LL55 1EP, tel: 01286 674144
Agricultural land grades, set-aside - Cheshire	ADAS Land Service, Lyme Building, Westmere Drive, Crewe, Cheshire CW1 1ZD, tel: 01270 250910
Agricultural land use - Cheshire	MAFF, Berkeley Towers, Merrievale Road, Crewe, Cheshire CW2 6PT, tel: 01270 69211
Agricultural land grades, set-aside - Cumbria	ADAS Land Service, Agricola House, Gilwilly Trading Estate, Penrith CA11 9BU, tel: 01798 865651
Agricultural land use - Cumbria	MAFF, Eden Bridge House, Lowther Street, Carlisle CA3 8DX, tel: 01228 234000
Land use and agricultural land grades, set aside - Scotland	*SOAFD, Edinburgh, tel: 0131 244 6203 or 0131 244 6001
Land use information in Scotland	Macaulay Land Use Research Institute, Craigbuckler, Aberdeen AB9 2QJ, tel: 01224 318611
ITE Countryside Survey 1990	*Department of Rural Affairs, DoE, Bristol, tel: 0117 921 8811
Land use and agriculture in the Isle of Man	*DAFF, Douglas, tel: 01624 685835
Soil surveys in England and Wales	John Hazelden, Soil Survey and Land Research Centre, Cranfield University, Silsoe, Bedford MK45 4DT, tel: 01525 863000
Distribution, ownership and management of woodlands - Clwyd	Chief Conservator, Forestry Authority, North Wales Conservancy, Clawdd Newydd, Ruthin, Clwyd LL15 2NL, tel: 01824 750492/493
Distribution, ownership and management of woodlands - Cumbria	Cumbria and Lancashire Conservancy, Peil Wyke, Bassenthwaite Lake, Cockermouth, Cumbria CA13 9YG, tel: 017687 76616
Distribution, ownership and management of woodlands - Dumfries & Galloway	Dumfries and Galloway Conservancy, 134 High Street, Lockerbie, Dumfriesshire DG11 2BX, tel: 01576 202858
Distribution, ownership and management of woodlands Isle of Man	Chief Forestry Officer, Department of Agriculture, Fisheries and Forestry, Division of Forestry, Amenity and Lands, Forestry House, Laurel Bank, St. Johns, Isle of Man IM4 3NN, tel: 01624 801263

* Starred contact addresses are given in full in the Appendix.

8.3 Infrastructure

S.L. Fowler, M.J. Dunbar, Dr T.J. Holt, C.A. Crumpton & M.J. Goodwin

8.3.1 Introduction

This section summarises the infrastructure of the region, including population distribution, industry (including oil refining), ports, harbours, ferries, pipelines, cables and power generation, and land claim for these developments. Oil and gas exploration and development are covered in section 9.5.

The south-eastern part of the region, around Merseyside and Lancashire, is one of the most densely populated in the country, comparable to Greater London, Glasgow, Edinburgh and the area from Tyne & Wear to Cleveland, and is dominated by the industrial centres on Merseyside and coastal Cheshire. The total population of Merseyside, for example, is well over one million. Over the last few years there has been significant population movement away from Merseyside and into rural Cheshire and Clwyd (Clwyd County Council 1979). Planning Policy Guidance Note 11 (DoE 1988) required Unitary Development Plans to provide for a basic requirement of nearly 50,000 new dwellings on Merseyside between April 1986 and March 2001. Map 8.3.1 shows the cover of continuous urban development in the region (ITE 1993).

Changes in the size of the Isle of Man population are affected by changes in the Manx and UK economies and can therefore be somewhat episodic. Present regulations limit immigration to some extent, and legislation exists to allow more direct control of population size, should it become necessary in the future. Development of coastal areas outside the main towns and villages is strongly limited by the 1982 Development Plan, which was reviewed in 1995.

In total, about 42 square kilometres of land in the region is (or was formerly) occupied by heavy industrial activity, with over 70% of this industry located in Merseyside and coastal Cheshire. Other large industrial areas in the region are located at Deeside (Clwyd), Fleetwood, Barrow, Heysham, Sellafield and Workington. With the run down and closure of the heavy industries, collieries and shipyards along the region's coastline, many areas of industrial development, such as those along the Cumbrian coast, have been abandoned. Efforts are being made to find new uses for these areas and alternative sources of employment for local populations, but the scale of industrial use in the area is never likely to return to its former levels.

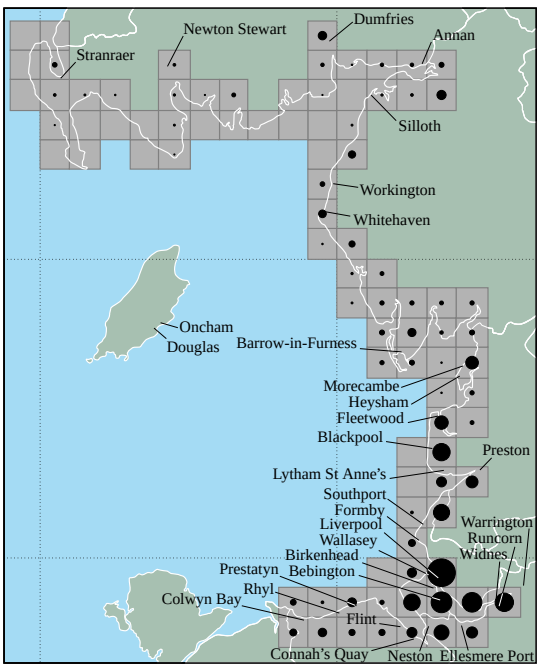
The international ports on Merseyside are among the largest in Britain and are of considerable importance in both a regional and a national context. There has been a general decline with the change of much international passenger traffic from sea to air, although the Port of Liverpool has shown a recent upward trend. Some of the major shipbuilding and repair yards in the region have closed down or may shortly close.

The region's 14 million tonnes/year oil refining capacity at the end of 1992 represented approximately 15% of the UK total.

Although the number of power producers has increased since privatisation, conventional power production is still largely controlled by two companies, PowerGen and National Power. UK power stations owned by National Power and PowerGen have a combined capacity of 36,500 MW - approximately 90% of conventional power production in the UK (PowerGen pers. comm.). The remainder is produced by numerous smaller companies. The operational conventional power station in the region produces 1.5% of the UK's conventionally-produced power and 6.8% if the two Combined Cycle Gas Turbine stations currently under construction are included. Approximately one-fifth of UK electricity is currently produced by nuclear power. This is produced by thirteen power stations (eleven owned by Nuclear Electric plc and two by British Nuclear Fuels Ltd.). Heysham's two reactors represent the largest concentration of nuclear power (a maximum of 2,380 MW) in the country. There has been a proposal recently for a Pressurised Water Reactor (PWR) at Chapelcross, Solway.

The scope for power generation using wind farms on the coast in this region is better than on the east coast because the prevailing wind direction in Britain is south-westerly. Britain's total wind energy power production in 1994 was 160.5 MW (British Wind Energy Association *in litt.*). Haverigg Wind Farm's power production capacity represents 0.7% of the UK's total wind-generated capacity. In the past few years there have been several investigations into the feasibility of tidal power barrages in the region, notably on the Mersey, Wyre and Duddon Estuaries, although no such schemes are currently being pursued.

The road and rail system is well developed in the south of the region. It has evolved over the last 150 years to serve the tourist, residential and industrial centres of the Welsh north coast, Merseyside, coastal Cheshire and Lancashire.



Map 8.3.1 Distribution of areas of industrial and residential development (GB only). Note: area of circle indicates the area of this land cover type in the 10 km square. Major towns and cities are also shown. Source: Countryside Survey (1990); ITE Monks Wood.

The northern part of the region is less accessible, although roads to Barrow and along the Cumbrian coast are being improved.

Industrial developments in the region have been associated with two major effects on the natural environment: land claim for the construction of industrial infrastructure such as factories and transport links (see also section 4.1), and the disposal of waste. In the Ellesmere Port area, for example, there is considerable pressure on land for industrial development, including green-field sites and intertidal areas. Major infrastructure may cause disruption to natural coastal processes where it impinges directly on the coast, for example through the construction of sea defences or coast protection works, or land claim (see section 8.4), and from dredging operations at sea (see section 9.4). Chronic contamination is likely to result from the normal operation of some of this infrastructure, as well as possible acute pollution events as a result of accidents. The Mersey and Wyre Estuaries have been particularly severely affected by industrial pollution.

8.3.2 Important locations

Residential development

Residential development in the region divides roughly into four areas. Clwyd on the north Wales coast has many small coastal towns with a high summer tourist population. Merseyside and Lancashire are dominated by the industrial city of Liverpool, nearby dormitory settlements on the Wirral and Southport coasts and the large coastal tourist centres of Blackpool and Morecambe. Although the coast becomes more rural in character to the north, the coastal strip of Cumbria contains some of the county's most urbanised environments, from Barrow to Maryport. Dumfries & Galloway is largely rural, with scattered small towns and villages.

The north Clwyd coast is moderately built-up and has a large seasonal tourist population. It is also a popular location for retirement. Major towns include Colwyn Bay, Abergele, Rhyl, Prestatyn, Flint and Connah's Quay. Chester lies further inland on the River Dee. The northern parts of Cheshire are industrialised, as is southern Merseyside, which is dominated by the industrial and residential areas of Wirral and Liverpool/Bootle. Liverpool is one of the major cities in the UK, although it has suffered over the last two decades from decline in both its population and its industrial base (see Chapter 10 for information on some of the efforts put into reversing this decline). On the Wirral are the towns of Wallasey, Birkenhead, Bebington, Ellesmere Port and Neston. Widnes and Runcorn are about 20 km from the sea on the Mersey Estuary, and Warrington is even further inland, though still on a tidal stretch of the estuary.

Further north the major use of the coast is recreation, from Formby and Southport through Lytham St. Anne's and the major resort of Blackpool to Morecambe and Heysham. As in north Wales, these towns also have a large retired population. Just north of Blackpool is Fleetwood, once noted for its fish processing industries, but now in decline. The River Ribble at Preston, although 12 km inland, is still tidal.

The northern half of the region is much less densely populated than the south. Major towns and cities include Barrow-in-Furness, famous for its shipbuilding industry, Grange-over-Sands, Millom, Whitehaven, Workington, Maryport, Silloth, Annan, Dumfries, Kirkcudbright, Newton Stewart and Stranraer.

Almost three quarters of the Isle of Man population of 69,788 live in the coastal towns of Douglas, Onchan, Ramsey, Peel, Port Erin, Castletown, Port St. Mary, Kirk Michael and Laxey. The adjoining towns of Douglas and Onchan together account for 44% of the population.

Populations of all the major towns and villages in the region are shown in Table 8.3.1 (Map 8.3.1).

Industry

Coastal industry in Clwyd is mainly based on the Dee Estuary and includes a colliery at the Point of Ayr, Hamilton Oil and Gas terminal and Mostyn Dock, with Connah's Quay and Shotton (which has areas of new industry) of particular importance.

Table 8.3.1 Centres of population in Region 13

Town	*Population*
***Clwyd**	413,500
Colwyn Bay	26,300
Rhyl	22,700
Prestatyn	16,400
Flint	16,400
Connah's Quay	14,800
***Cheshire**	966,100
Wirral	336,000
Wallasey	90,000
Birkenhead	124,000
Bebington	64,2000
Ellesmere Port & Neston	81,500
***Merseyside**	2,415,800
Liverpool/Bootle	474,500
Widnes	54,400
Runcorn	63,800
Warrington	135,000
***Lancashire**	1,409,900
Formby	25,800
Southport	89,700
Preston	130,000
Lytham St. Anne's	39,700
Blackpool	150,000
Fleetwood	28,500
Morecambe & Heysham	41,200
***Cumbria**	489,200
Barrow-in-Furness	73,000
Whitehaven	26,700
Workington	27,600
Silloth	2,900
****Dumfries & Galloway**	147,900
Annan	8,900
Dumfries	32,100
Newton Stewart	3,700
Stranraer	11,300
*****Isle of Man**	69,788
*****Douglas & Onchan**	≅51,600

Sources: Cook (1993), except *mid-1993 population estimates (OPCS 1994); **mid-1994 population estimates (Registrar General Scotland 1995); ***1991 census.

Merseyside and coastal parts of Cheshire are heavily developed. There are several industrial areas on the Wirral, including Birkenhead (a seaport mainly for industrial goods), Bebington (soap, chemicals, engineering works), and Ellesmere Port (metals, paper, engineering, oil refining, car manufacture). Widnes and Runcorn have significant industry, particularly chemicals. There are two oil refineries in the region, both on the Mersey Estuary, at Eastham (1 million tonnes per year capacity at the end of 1992) and Stanlow (13 million tonnes per year). At least half the tonnage of cargo entering the Mersey Estuary is in the form of hydrocarbons (whether oil, gas, orimulsion or coal) which total some 11 million tonnes per year. Liverpool/ Birkenhead is one of the largest ports in the United Kingdom. It has some ship repairing, electrical manufacture and engineering, flour milling, sugar refining, seed and rubber processing and car manufacturing industries. The docks area is also experiencing an expansion in warehousing facilities, as new ones are built and existing ones refurbished. Developments supported by the Merseyside Development Corporation include the sites (primarily disused dockland) of Atlantic Avenue (between Pier Head and Bootle), the Pier Head itself and regeneration at New Brighton. However, Merseyside and Lancashire also have the highest proportion of derelict industrial land in England (North West Regional Association 1994). Fleetwood has fish processing facilities and a large chemical plant nearby. There is also a small amount of salt extraction (brine pumping) from coastal land on the east bank of the River Wyre near Knott End-on-Sea. The major British Aerospace works at Warton is close to the river Ribble; aircraft are tested over the estuary and open sea.

In the north of the region, the most significant areas of industrial activity are at Barrow-in-Furness, Whitehaven and Workington. Barrow is the major regional industrial centre outside Merseyside. It grew rapidly in the 19th century, with iron and steel works, but is now dominated by the ship and submarine building activities of VSEL (Vickers Ship Building and Engineering) and has numerous other coastal developments, for example the second largest gas terminal in Europe. Sellafield is a major reprocessing plant for nuclear material; radioactive waste is stored on site. It has many of the characteristics of a large chemical works. Of the two main towns of the west Cumbrian coast, Whitehaven has significant industry based around raw materials (coal, methane gas, cement, chemicals) and the Marchon detergent and chemical works. Workington (the major industrial centre in the north of the region), like Barrow, formerly had significant iron and steel industries, but employment now comes mainly from many small industrial estates and a bus manufacturing works.

There is very little industrial activity in Dumfries & Galloway. Aside from shipping, Stranraer's major industry centres around food and drink processing, including creameries and brewing. The Loch Ryan area is the only coastal area likely to experience industrial development in the near future; it has been designated as a preferred zone for coastal development (Bown 1990; SDD Circular No. 19/77) and is an ideal deep water port.

The Isle of Man has no heavy industry but there are a number of small industrial areas with miscellaneous light industries within 1 km of the coast. The main ones are Peel Road and South Quay on the Douglas Estuary, Ramsey Shipyard (light industry and boat building/repairs), Riverside in Ramsey, Ronaldsway Aircraft Corporation and other sites at the airport, and small-scale fish processing (mainly scallops and herring) at Peel and Port St. Mary.

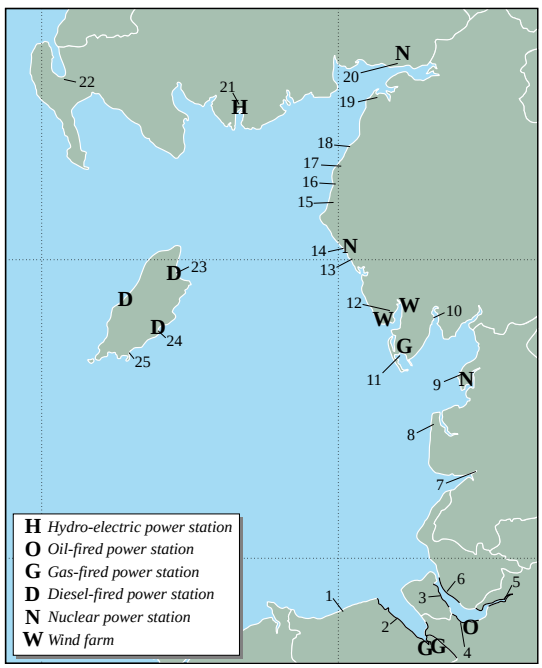
Enterprise Zones were formerly designated in two areas in the region: Delyn, designated on 21 July 1983, and Workington - Maryport, designated on 4 October 1983; both designations have now lapsed after the statutory 10 years.

Locations of major coastal industrial infrastructure are listed in Table 8.3.2; the major areas of coastal industrial development in which they occur are shown on Map 8.3.2.

Ports and harbours

The major estuaries and natural harbours were the original locations for most port and harbour developments in the region. Some started out primarily as fishing ports and remain as such. Others, particularly in the industrial parts of the region, have become much more important for trade, shipbuilding, and land-based industry. Many traditional ports in the area have fallen into decline or disuse over the past few decades, owing to industrial decline, the diversion of passenger traffic to air transport and freight to road or rail routes, and redirection of commercial shipping to newer harbours closer to main shipping routes or at deeper sites at the mouths of estuaries. Some disused docks and associated warehousing close to city centres are now the focus of ambitious redevelopment schemes incorporating office use, some light industry, housing and recreation (the latter occasionally including marinas). Present-day commercial ports are shown on Map 8.3.3 and their facilities listed in Table 8.3.3. Many are constructed alongside areas of land claim in estuaries, and almost all require capital and maintenance dredging (see section 9.4).

The most important ports in the region are on the Mersey (Liverpool and Birkenhead) and at Fleetwood,



Map 8.3.2 Industrial infrastructure and coastal power stations and wind farms. Source: Ordnance Survey Landranger maps. © Crown copyright. See Table 8.3.2 for location details.

Table 8.3.2 Major areas of coastal industrial development

*Area no.**	*Site/area*	*Grid ref.*	*Details*
	Clwyd		
1	Rhyl	SJ0080	5 ha industrial estate on Clwyd Estuary
2	Point of Ayr	SJ1283	15 ha coal mine and miscellaneous 'works'; gas terminal
2	Mostyn Quay	SJ1780	5 ha works, 30 ha docks area and quay
2	Greenfield	SJ2078	5 ha works, 75 ha business park
2	Flint	SJ2573	10 ha works, 15 ha industrial land along railway
2	Connah's Quay/Shotton	SJ3070	120 ha paper mill; power station under construction
2		SJ3071	250 ha steel and paper mill; power station
2	Hawarden Airport	SJ3565	50+ ha large aircraft factory
2	Deeside Industrial Park	SJ3371	120 ha industrial estate, 2 km north of Dee, to be expanded to 200 ha
	Cheshire		
4	Ellesmere Port	SJ3879	200 ha motor works
4		SJ4376	>700 ha oil refinery and storage
4		SJ4576	Ince oil-fired power station
4		SJ4776	>50 ha misc. works
4		SJ3979	10 ha paper works
5	Runcorn	SJ5081	>50 ha chemical works and other industry
5		SJ5083	30 ha docks
5	Warrington	SJ5787	50 ha works
5	Widnes	SJ4984	15 ha chemical works
5		SJ5386	10 ha chemical works (1 km from tidal Mersey)
5		SJ5285	20 ha other misc. industry; 50 ha man-made ponds
	Merseyside		
3	Birkenhead	SJ3290	200 ha docks
3		SJ3387	100 ha oil terminal
3	Bebington	SJ3683	120 ha chemical works
3		SJ3484	50 ha soap works (1 km from coast) Port Sunlight - Lever
6	Halewood	SJ4484	120 ha motor works 2 m from coast
6	Garston	SJ4084	>50 ha docks and other associated development
6	Liverpool	SJ3490	600 ha of docks (16 km coastal length), some converted for leisure use, others infilled
	Lancashire		
7	Preston	SD5129	40 ha docks
7		SD4127	50 ha Warton aerodrome
7	Springfields	SD4730	BNFL uranium processing works
8	Fleetwood	SD3447	50 ha docks
8		SD3444	100 ha chemical works; >100 brine wells on east bank of river Wyre
9	Heysham	SD4159	25 ha industrial estate 500 m from coast
9		SD4059	70 ha nuclear power station; 40 ha docks
	Cumbria		
10	Ulverston	SD3077	30 ha chemical industry
11	Barrow in Furness	SD2367	20 ha gas terminal for British Gas Irish Sea fields, large tanks for condensate
11		SD2068	200 ha docks and shipbuilding (VSEL)
11		SD2267	20 ha power station, 90 ha reservoir
11		SD1972	10 ha works to north of Barrow
11		SD1973	10 ha works to north of Barrow
12	Millom	SD1880	10 ha ship breaking and aggregate export
13	Drigg	SD0699	Low level radioactive waste dump
14	Sellafield	NY0203	200 ha nuclear power station and reprocessing; gas-fired power station
15	Whitehaven	NX9615	40 ha Marchon chemical works
16	Lowca	NX9822	5 ha small works
	Cumbrian coast		Several former coal mines & iron works. Remains of salt pans for salt making
17	Workington	NX9928	100 ha railway yards and misc. industrial
17		NY0031	10 ha mill 200 m from coast
18	Maryport	NY0336	50 ha harbour and docks
19	Silloth	NY1254	10 ha works (flour mill), 25 ha docks
	Dumfries & Galloway		
20	Annan	NY1865	8 ha metal and chemical industries; Chapelcross power station (5 km inland)
21	Kirkudbright	NX6953	Tongland hydro-electric power station
22	Stranraer	NX0660	10 ha industrial estate
	Isle of Man		
23	Ramsey	SC4594	Light industry
24	Douglas	SC3775	Light industry
25	Ronaldsway	SC2868	Ronaldsway Aircraft Corporation works

Source: Ordnance Survey 1:50,000 maps. Key: *area number is as shown on Map 8.3.2.

Heysham and Stranraer. Liverpool, which used to be one of the main trans-Atlantic ports, is now run by the Mersey Docks and Harbour Company, which is redeveloping sites at Birkenhead Dock, including the former Hornby Dock (now filled in). The Mersey port area remains one of the largest commercial ports in the UK, handling 29 million tonnes of cargo in 1994, and has facilities for the largest ships. Part of Liverpool Port was designated a container freeport in 1984 as part of the regeneration strategy and is now operating at a profit. The major trades include containers, timber, forest products, grain and animal feedstuffs. Liverpool is the major ferry port in the region, serving passenger ferry routes to Douglas, Dublin and Belfast and two cross-Mersey routes to Birkenhead.

The Manchester Ship Canal still handles 8 million tons of shipping per year. Fleetwood (with container and ro-ro facilities) handled 1.7 million tonnes in 1992; there are twice daily ro-ro ferries to Larne, a summer car ferry to the Isle of Man, and a ferry across the Wyre Estuary to Knott End-on-Sea. Heysham handled 1.9 million tonnes (1992), mainly ro-ro and container cargo and facilities for oil and gas service craft, and serves a ferry route to Douglas (Isle of Man). Barrow-in-Furness is important for ship building and has the second largest gas terminal in Europe. Stranraer and Cairnryan both have scheduled car ferry services to Larne; significant freight traffic is also carried on this route. Stranraer also has a catamaran route to Belfast.

The main ports on the Isle of Man are Douglas, Ramsey, Peel and Port St. Mary. Douglas handles all Isle of Man ferries, including ro-ro and catamaran passenger ferries to Heysham, and to a lesser degree Liverpool, and additional summer services to Fleetwood, Dublin, Belfast and Ardrossan. It also handles ro-ro cargo, small coasters, tankers and some fishing boats. The gross registered tonnage for Douglas in 1994 was approximately 4.5 million tonnes (Isle of Man Department of Transport, Harbours Division pers. comm.). Ramsey handles mainly small cargo vessels and some fishing boats. Peel and Port St. Mary are fishing ports, though Peel handles occasional small tankers, cargo boats and pleasure steamers. In 1993 total passenger arrivals to the Isle of Man by ferry were 227,000 (Kelly 1994). Non-fishing arrivals are summarised in Table 8.3.4.

Table 8.3.3 Ports and harbours

Port	*Facilities, cargo and turnover (tonnes)*
Clwyd	
Llanddulas	Aggregates from nearby quarries
Rhyl	Small quay, fishing port
Mostyn	Wood pulp, paper, bulk dry chemicals, steel products, 270,000 t (1991)
Cheshire	
Connah's Quay	Fishing port
Shotton	Steel products
Merseyside	
Hoylake	Fishing port
Birkenhead	Major port facilities
Manchester Ship Canal (Eastham & Ellesmere)	Handles 8 million tonnes of traffic per year
Garston	620,000 t (1992) rail facilities, general cargo, container facilities, coal, steel
Liverpool	Part designated as free port in 1984. Mersey Docks and Harbour Company has statutory responsibility for maintaining the approaches and channels to the River Mersey and operates Liverpool Freeport (free trade zone).
Lancashire	
Fleetwood	Container and ro-ro facilities, 1.7 million t (1992). Main Irish Sea fishing port, fleet of approx. 50 vessels >10 m
Lancaster/Glasson Dock	180,000 t (1992)
Heysham	1.9 million t (1992), ro-ro & container facilities, oil & gas service craft
Cumbria	
Barrow	230,000 t (1992) quarried limestone, nuclear fuel, gas, oil; shipbuilding
Millom	Small port, ship breaking, aggregate export
Whitehaven	Quarry gravel; small fishing port
Workington	480,000 t (1992); small fishing port
Maryport	Small fishing port
Silloth	Small dock, 70,000 t (1992); grain, animal feedstuffs, dried milk and cement clinker
Dumfries & Galloway	
Annan	Small fishing port
Kirkcudbright	Small fishing port
Stranraer	Ferry and fishing port, freight services to N. Ireland
Cairnryan	Ferry port, freight services to N. Ireland
Isle of Man	
Ramsey	Freight and fishing port
Douglas	Ferry port, some freight, small tankers c. 4.5 million t (1994) and fishing port
Port St. Mary	Fishing port
Peel	Occasional freight, small tankers, fishing port

Sources: various. Note: see also Map 9.1.1 for fishing ports.

Map 8.3.3 Ports and harbours. Sources: various.

Table 8.3.4 Numbers of commercial boat/ship arrivals (excluding fishing boats) in Manx harbours, 1994

Harbour	*Number*
Douglas	1,460
Ramsey	343
Peel	54

Source: Isle of Man Department of Transport, Harbours Division.

Cables and pipelines

There are cables from Walney Island to the Morecambe Bay gas field, and telephone cables across Morecambe Bay from Blackpool and Haverigg point to the Isle of Man.

Gas pipelines run from the offshore fields in Liverpool Bay to the Point of Ayr (Clwyd) and from the Morecambe Bay gas fields to Walney (see Map 9.5.1). Bord Gais Eireann (BGE) has completed work on a Gas Interconnector Project from Moffat (Dumfries & Galloway) to Loughshinny, County Dublin, Eire. The sub-sea pipeline leaves the British coast at Brighouse Bay on the Solway and connects the British Gas pipeline system in the UK with the gas transmission pipeline network in Ireland. A second Gas Interconnector Project, from Twynholm (Dumfries & Galloway) to Ballylumford Power Station, County Antrim, Northern Ireland, has been proposed by Premier Transco Ltd, a subsidiary of British Gas, for construction in 1995 and 1996.

Power generation

There are three operational conventional power stations on the region's mainland coast, two more under construction and a further three on the Isle of Man. The Ince (Cheshire) orimulsion/oil fired power station has a capacity of 530 MW, Lakeland Power's gas fired Roosecote Power Station at Cavendish Dock, Barrow, has an output capacity of 220 MW and the new gas fired power station at BNFL Sellafield provides an on-site source of power for the Sellafield complex. The Deeside combined cycle gas turbine (CCGT) power station (under construction) will have a capacity of 500 MW and at the time of writing was due to open in 1995 (National Power pers. comm.). PowerGen's Connah's Quay CCGT station will have a capacity of 1,400 MW and is due to commence production in the summer of 1996.

In the Isle of Man, electricity is almost all supplied by the Manx Electricity Authority's diesel powered plants at Peel (capacity 40 MW on the upper estuary), Douglas (capacity 50 MW, a few hundred metres upstream of the highest saline influence on the Douglas river) and at Ramsey (close to the harbour, now used only infrequently). The Authority also has two small inland hydroelectric plants, total 1.2 MW, and private plans have recently been put forward for a small inland wind farm.

There are three nuclear power stations in the region (as well as one just outside the region, at Wylfa, Anglesey (Region 12)). The station at Heysham has two reactors, Heysham 1 and Heysham 2, which came on line in 1983 and 1988 respectively. These reactors are the advanced gas cooled reactor (AGR) type. The reactors have a combined operating capacity of 2,380 MW (Nuclear Electric pers. comm.). Sellafield is the largest of BNFL's UK sites and operates a Magnox power station (Calder Hall), a Magnox fuel reprocessing plant, a thermal oxide reprocessing plant (THORP) and waste treatment plants and storage facilities. The Calder Hall Power Station consists of four Magnox reactors, each with an output capacity 60 MW. The nuclear power station at Chapelcross is not strictly coastal, being sited some 5 km inland, to the north of Annan. Decommissioning of the existing reactor at Chapelcross is being considered, and preliminary studies have been undertaken into the possible construction of new nuclear power stations at Sellafield and/or Chapelcross.

Tongland hydro-electric power station, sited at the tidal limit of the (Galloway) River Dee, is the lowest of a chain of such stations harnessing the fall of the river above Kirkcudbright.

There are two wind farms operating on the coast in this region, at Kirkby Moor and Haverigg. With five 225 KW turbines, the Haverigg site has a production capacity of 1.125 MW. Kirkby Moor has twelve 400 KW turbines with a total output capacity of 4.8 MW. At the time of writing, no other wind farms were under construction (BWEA pers. comm.). However, proposals exist for wind farms at Lowca, Haverigg (extension), Drigg, Oldside, Siddick and Silloth (English Nature pers. comm.). There are no other commercial renewable energy production operations on the coast in this region (DTI 1994), although there have been several proposals for tidal power barrages. (Leisure barrages (marine lakes) are discussed in section 9.7.) The Mersey tidal power barrage plans are the most developed in the region, although for economic reasons the project is not being proceeded with for the time being. The feasibility of constructing barrages on the Wyre and Duddon Estuaries was also the subject of preliminary investigations. None of these barrages is currently under active consideration, as tidal barrages no longer qualify for the government's non-fossil fuel option (NFFO) subsidy.

8.3.3 Information sources used

Sources of information for this section included Cook (1993), Buck (1993), the 1991 census and Ordnance Survey Landranger 1:50,000 maps. The Office of Population Censuses and Surveys publishes 1991 census data on a district basis and population estimates for subsequent years based on those data (e.g. OPCS 1994). Cook (1993) presents town and city data from population censuses from a number of dates, including the 1981 census, and is therefore somewhat out of date.

Map 8.3.1 is adapted from the ITE (1993) Countryside Survey database, which is derived from 1990 satellite imagery. Areas represent land cover types 'urban' and 'suburban/rural development' (see notes in section 8.2.3).

For ports and harbours, Taylor & Parker (1992) provide figures for 1991, and 1992 data are taken from North West Regional Association (1994). Brady (1995) lists details of all fishing vessels, their base ports and main fishing methods (see also section 9.1). Other information was derived from the two national handbooks for the British Ports Federation (undated) and Sutton (1989), which may be incomplete or out of date, and the Department of Transport, Harbours Division, Isle of Man. In 1991 the BPF was replaced by the British Ports Association and the UK Major Ports Group. Lord Donaldson (1994) records that there is virtually no clear information available on where ships go within UK waters, and that no records are kept of how many ships use UK port facilities. Under MARPOL (the United Nations' International Convention on the Prevention of Pollution from Ships), the UK must provide port facilities that are "adequate to meet the needs of ships using them and do not cause undue delay to ships". These facilities should prevent ships from discharging oil and other wastes into the sea. However, Lord Donaldson (1994) describes UK facilities as "inadequate". The UK government has commissioned a survey of all UK port reception facilities for the disposal of ships' wastes (Waste Regulation Council 1995).

Most information on ferries was derived from 1:50,000 Land Ranger Ordnance Survey maps. Cables and pipelines are shown on UKDMAP (BODC 1992) and Admiralty Charts. Dumfries & Galloway Regional Council has further details on gas and electricity services connecting Scotland with N. Ireland.

It is not always clear from these sources whether infrastructures are still in use. Some information on industrial activity and infrastructure may be out of date, as the result of recent local and national declines in industrial activity.

8.3.4 Acknowledgements

Many thanks go to the Planning Division of Cumbria County Council and Dumfries & Galloway Regional Council for their helpful comments.

8.3.5 Further sources of information

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Planning developments (English and Welsh councils, Scottish Regional Councils)	
Clwyd	*Clwyd County Council, Mold, tel: 01352 752121
Colwyn	*Colwyn Borough Council, Colwyn Bay, tel: 01492 515271
Rhuddlan	*Rhuddlan Borough Council, Rhyl, tel: 01745 345000
Delyn	*Delyn Borough Council, Flint, tel: 01352 762345
Alyn & Deeside	*Alyn & Deeside District Council, Ewloe, tel: 01244 525000
Cheshire	*Cheshire County Council, Chester, tel: 01244 602424
Vale Royal	*Vale Royal Borough Council, Winsford, tel: 01606 862862
Ellesmere Port & Neston	*Ellesmere Port & Neston Borough Council, Ellesmere Port, tel: 0151 355 3665
Wirral	*Wirral Borough Council, Wallasey, tel: 0151 638 7070
Liverpool	*Liverpool City Council, Liverpool, tel: 0151 227 3911
Halton	*Halton Borough Council, Widnes, tel: 0151 424 2061
Sefton	*Sefton Borough Council, Southport, tel: 01704 533133
Lancashire	*Lancashire County Council, Preston, tel: 01772 254868
West Lancashire	*West Lancashire District Council, Ormskirk, tel: 01695 577177
Fylde	*Fylde Borough Council, Lytham St. Anne's, tel: 01253 721222
Blackpool	*Blackpool Borough Council, Blackpool, tel: 01253 25212
Wyre	*Wyre Borough Council, Poulton-le-Fylde, tel: 01253 891000
Lancaster	*Lancaster City Council, Lancaster, tel: 01524 582000
Cumbria	Cumbria County Council, Carlisle, tel: 01228 23456
South Lakeland	*South Lakeland District Council, Kendal, tel: 01539 733333

Type of information	*Contact address and telephone no.*
Planning developments (English and Welsh councils, Scottish Regional Councils) (continued)	
Barrow-in-Furness	*Barrow-in-Furness Borough Council, Barrow-in-Furness, tel: 01229 825500
Copeland	*Copeland Borough Council, Whitehaven, tel: 01946 693111
Allerdale	*Allerdale Borough Council, Workington, tel: 01900 604351
Carlisle	*Carlisle City Council, Carlisle, tel: 01228 23411
Dumfries & Galloway	*Dumfries & Galloway Regional Council, Dumfries, tel: 01387 261234
Annandale & Eskdale	*Annandale & Eskdale District Council, Annan, tel: 01461 203311
Nithsdale	*Nithsdale District Council, Dumfries, tel: 01387 253166
Stewartry	*Stewartry District Council, Kirkcudbright, tel: 01557 330291
Wigtown	*Wigtown District Council, Stranraer, tel: 01776 702151
Isle of Man	*Isle of Man Department of Local Government and the Environment, Douglas, tel: 01624 685950
Enterprise Zones	Department of Environment, 2 Marsham Street, London SW1P 3EB tel: 0171 276 6166
Industrial development in Merseyside	Merseyside Development Corporation, 4th Floor, Royal Liver Building, Pierhead, Liverpool L3 1JH tel: 0151 236 6090
Industrial development on the Isle of Man	Department of Industry, 2 Circular Road, Douglas, Isle of Man IM1 1PJ, tel: 01624 685675
Planning/management, Isle of Man	*Planning Officer, Department of Local Government and the Environment, Head Office, Douglas, Isle of Man, tel: 01624 685954
Planning/management (ports and harbours), Isle of Man	Chief Harbourmaster, Department of Highways, Ports and Properties, Sea Terminal Building, Douglas, Isle of Man IM1 2RF, tel: 01624 686600

* Starred contact addresses are given in full in the Appendix.

C. Contact names and addresses (continued)

Type of information	*Contact address and telephone no.*
British Ports Association	Africa House, 64-78 Kingsway, London WC2B 6AH, tel: 0171 242 1200
The UK Major Ports Group Ltd	150 Holborn, London EC1N 2LR, tel: 0171 404 2008
Port reception facilities	Marine Safety Agency, Spring Place, 105 Commercial Road, Southampton SO15 1EG, tel: 01703 329100
Ports	
Port of Liverpool	Mersey Docks & Harbour Company, Maritime Centre, Port of Liverpool L21 1LA, tel: 0151 949 6000
Garston Docks	Associated British Ports, Port Office, Dock Road, Garston, Liverpool L19 2JW, tel: 0151 427 5971
Manchester Port	The Manchester Ship Canal Company, Collier Street, Runcorn, Cheshire WA7 1HA, tel: 01928 567465
Fleetwood Port	Associated British Ports, Dock Office, Fleetwood, Lancashire FY7 6PP, tel: 01253 872323
Heysham Port	Sealink Harbours Ltd., Sea Terminal, Heysham, Lancs. LA3 2XF, tel: 01524 52373
Lancaster Port Commission	11 First Terrace, Sunderland Point, Overton, Morecambe LA3 3HF, tel: 01524 71421
Barrow-in-Furness	Associated British Ports, Port Office, Ramsden Dock Road, Barrow-in-Furness, Cumbria LA14 2TW, tel: 01229 22911
Whitehaven Harbour Commissioners	Harbour Office, Pears House, 1 Duke Street, Whitehaven, Cumbria CA28 7HW, tel: 01946 692435
Port of Workington Dock Office	Cumbria County Council, Prince of Wales Dock, Workington CA14 2JH, tel: 01900 602301
Silloth	Associated British Ports, Dock Office, New Dock, Silloth, Cumbria CA5 4JQ, tel: 016973 31358
Stranraer	Stena Sealink Harbours Ltd., Sea Terminal, Stranraer Harbour, Stranraer, Dumfries & Galloway DG9 8EL, tel: 01776 702262
Department of Transport, Harbours Division (Isle of Man)	Sea Terminal Building, Douglas, Isle of Man IM1 2RF, tel: 01624 686600

Type of information	*Contact address and telephone no.*
Power generation	
Gas Interconnector Project, Brighouse Bay to Loughshinny	Bord Gais Eireann, PO Box 51, Inchera, Little Island, County Cork, Ireland, tel: 00353 2150 9199
Gas Interconnector Project, Twynholm to Ballylumford	Premier Transco Ltd, Ballylumford Power Station, Island Magee, Larne, Co. Antrim, Northern Ireland
Conventional power production, further details of power stations	Corporate Communications Officer, PowerGen plc, Westwood Way, Westwood Business Park, Coventry CV4 8LG, tel: 01203 424000
Conventional power production, further details of power stations	Public Information Officer, National Power plc., Senator House, 85 Queen Victoria Street, London EC4V 4DP, tel: 0171 454 9494
Conventional power production, further details of power stations - Isle of Man	Manx Electricity Authority, PO Box 177, Braddan, Isle of Man IM99 1PS, tel: 01624 687687
Nuclear electricity production (Heysham)	Information Officer, Heysham 1 and 2 Visitor Centre, PO Box 17, Heysham, Morecambe, Lancs. LA3 2YB, tel: 01524 855624
Nuclear power production	Public Information Officer, Nuclear Electric plc., Barnett Way, Barnwood, Gloucester GL4 7RS, tel: 01452 652776
Nuclear reprocessing; Sellafield information	Corporate Publicity Officer, British Nuclear Fuels plc. (Corporate Publicity), Risley, Warrington WA3 6AS, tel: 01925 832000
Renewable energy	Secretary, Energy Technology Support Unit (ETSU), Renewable Energy Enquiries Bureau, Harwell, Oxfordshire OX11 0RA, tel: 01235 432450
Energy production general	Department of Energy, 1 Palace Street, London SW1E 5HE, tel: 0171 238 3000
Energy production general	Secretary, Institute of Energy, 18 Devonshire Street, London W1N 2AU, tel: 0171 580 7124
Wave and hydro power	Project Director, Energy Systems Group, Coventry Polytechnic, Dept of Electrical, Electronic and Systems Engineering, Priory Street, Coventry CV1 5FB, tel: 01203 838861
Radioactive discharges	Information Officer, National Radiological Protection Board (NRPB), Chilton, Didcot, Oxfordshire OX11 0RQ, tel: 01235 831600
Nuclear issues - general	Secretary-General, British Nuclear Forum, 22 Buckingham Gate, London SW1E 6LB, tel: 0171 828 0166

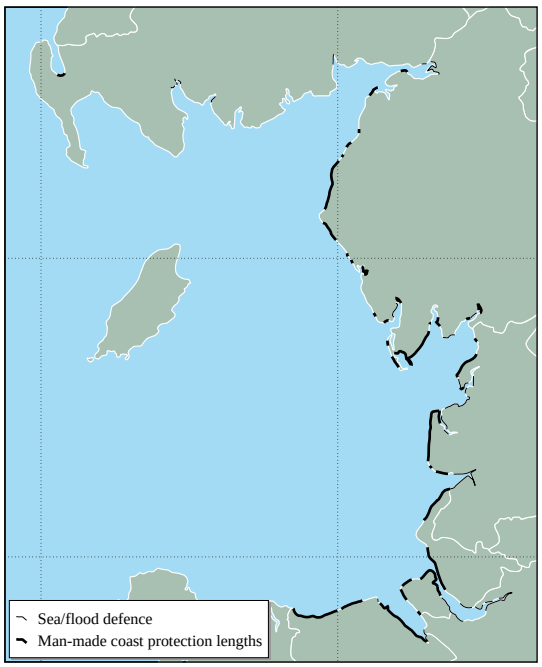
8.4 Coastal defence

S.L. Fowler & Dr T.J. Holt

8.4.1 Introduction

Coastal defence covers two types of works: coast protection and sea defence. Coast protection works prevent or slow the erosion of land and encroachment by the sea. Sea (or flood) defences protect against the flooding of low-lying land; their most important role is to protect human life and property in coastal settlements and industrial areas; many were also built in the past to protect agricultural land and to enable agricultural improvement and drainage. Some forms of coastal defence may protect against both erosion and flooding; others can provide vital 'toe' support to the base of coastal cliffs. It is not always possible to state which function particular lengths of coastal works perform.
In several places along low-lying sections of the coast, naturally-occurring sand dunes are managed as sea defences, for example by stabilisation with marram or conifer planting, or beaches are maintained as a form of coast protection, by the construction of groynes or beach replenishment, for example. Also, because the information used here comes from several sources, inter- and intra-regional comparisons are not practicable (see also section 8.4.4). There are only a few, short lengths of coastal works in Dumfries & Galloway (HR Wallingford 1995) and the Isle of Man (Joliffe 1981).

The Ministry of Agriculture, Fisheries and Food (MAFF) have recently published a detailed assessment of the extent and state of repair of coast protection works on the English coast (MAFF 1994). According to this report, more coastal works are found on the coasts of south and east England, in Regions 7 to 9 (which are gradually sinking following the end of the ice age), than occur anywhere else in England.



Map 8.4.1 Locations of coastal defence works. Man-made structures such as docks are included as coast protection. Source: MAFF (1994); OS Landranger maps.

Long stretches of these coasts are also heavily developed and/or eroding. Region 6 (which includes some rapidly eroding and low-lying coastal areas) and the Welsh and English coasts of Region 13 are also heavily protected (Map 8.4.1), particularly in comparison with the rocky and rugged rural coasts of the south-west and Scotland, where there is a much lower incidence of coast protection works.

The full results of the 1995 coastal defence survey by the Welsh Office were not available at the time of writing, but will provide an up-to-date overview of the scale and condition of works in Wales when published. According to that survey, 79% of the coast of Clwyd has coastal works of some kind in place; 60% of the coast is protected against erosion (see section 8.4.2). Table 8.4.1 shows that 35% of the region's English coast is protected against erosion. MAFF (1994) records that in north-west England the length of coast with sea defences is above average, reflecting the relatively low-lying character of the coast along which the majority of the man-made structures are found.

Table 8.4.1 England: lengths* of coast with and without coast protection, in Region 13 and nationally

English coastline covered	*Coast protection length (km)*	*Unprotected length (km)*	*Total length* (km)*	*Proportion protected*
Region 13 from Wirral to Carlisle	131	245	375	35
England coastline	***860***	***2,065***	***2,925***	***29***

Source: MAFF 1994 database. Key: *surveyed length, i.e. excluding estuary and harbour shorelines, to nearest km.

According to the MAFF coast protection survey of England (MAFF 1994), there is significant erosion over about 40 km or 9% of the region's English coast, rather more than on the coast of England as a whole (4%), and 30% of its coastal defences require moderate or significant work (Table 8.4.2), rather less than on the coast of England as a whole (35%).

Rising sea levels and increasing frequency of storm conditions and wave heights in the Atlantic as a result of climate change are increasing the future potential for coastal flooding and erosion and decreasing the expected useful life of sea defences and coast protection works in the most vulnerable parts of the region (Irish Sea Forum 1992). Some coastal defences in the region have a residual life of less than five years (MAFF 1994). Much of the coastline in Region 13 is considered at risk from sea-level rise, notably the north Wales coast from Colwyn Bay to the Point of Ayr, virtually all the Lancashire coast, and the inner parts of the Solway Firth. Storm surges, particularly when combined with high spring tides and/or heavy rain causing peak river flows, are the major flooding threat to these areas. In 1990 there was severe coastal flooding of low-lying residential areas in Towyn, near Abergele, Clwyd, caused by a combination of high tides and a storm surge.

Table 8.4.2 England: length and condition of coast protection works and state of coastal erosion on the English coast

MAFF survey area	*Length of coast defended km*	*Length of coast suffering significant erosion km*	*Total coast length* km*	*Proportion of coast defended %*	*Proportion of defences requiring work*		*Proportion of coast suffering significant erosion %*
					Significant work (%)	*Moderate work (%)*	
NW England (York NW Area)**	131	40	472	28	6	24	9
England	***860***	***134***	***3,763***	***23***	***6***	***29***	***4***

Source: MAFF (1994). Key: *estimated whole coast length to nearest km, including estuaries and harbours; see also section 8.4.4; **all within Region 13.

8.4.2 Important locations

Table 8.4.3 shows the extent and ownership of coastal works on the Welsh coast of the region. There are extensive areas of private coastal defences along the Colwyn coast and the Dee Estuary (Delyn). Coastal works include extensive lengths of urban sea front (e.g. at Rhyl and Prestatyn) owned by the district councils and lengths of coast adjacent to the railway, owned by Railtrack.

Table 8.4.3 Wales: ownership of coastal works (sea defence and coast protection) in Colwyn, Rhuddlan and Delyn (Clwyd)

	Owner			
	Local authority km	*NRA km*	*Railtrack km*	*Private/other km*
Colwyn	13	0	4	2
Rhuddlan	9	0	0	1
Delyn	2	1	8	9
Clwyd	***24***	***1***	***13***	***12***

Source: Welsh Office 1995 survey. Note: lengths given to nearest km.

60% of the region's Welsh coastline is protected against erosion and 18% defended against flooding (compared with about 30% and 5% respectively for the whole of the north Wales coast) (Table 8.4.4).

Table 8.4.5 summarises the lengths of sea defences and their ownership in the English part of the region, from the National Rivers Authority (NRA) sea defence survey.

Table 8.4.6 details the length of coast protection works on the north-west coast of England that were covered by the MAFF coast protection survey (MAFF 1994).

In some of the region's estuaries the shoreline is completely artificial for several kilometres, and virtually all estuaries have been to some extent altered as a result of flood defence works, land claim, dredging or canalisation (Table 8.4.7). Major flood defence works are generally confined to the larger estuaries.

Erosion rates of 0.5 to 1.5 m per year have been recorded on the south-west coast of the Wirral (MAFF 1994). The Wirral peninsula is protected by extensive coastal works over 65% of the coast, mainly concrete sea walls, with parts also protected by rocky revetments. On the north side there are three offshore breakwaters (length unknown) and, off New Brighton, about 1.5 km of groynes.

The very heavily developed Merseyside coast is protected by extensive coastal defences. To the north of the Mersey, Crosby is protected by approximately 4 km of sea wall. Large areas of sand dune at Sefton are eroding at a rate of more than 2 m a year. The whole Sefton coast has about 58% of artificial coast protection, but otherwise is largely defended through low-key management (including fencing) of the dune habitat, which is an important natural dynamic coastal defence. The urban area of Southport has about 10 km of clay and concrete embankments, some running along the sands and some along the promenade.

The high value infrastructure at Blackpool and on the Wyre is completely protected against erosion by extensive coastal defences. There are about 4 km of sea walls at Lytham and a total of about 19 km of continuous sea wall stretching along the coast to Fleetwood. Morecambe has suffered from severe flooding and coastal erosion over the years, the last event being in 1990, and has a programme of major investment in flood defence. Investment so far is £6.5 million and the total is expected to be £20 million by the end of the decade. Phase IV, started in 1993, will result in extensive alterations to the stone jetty (which acts as a wave barrier).

There are significant coast protection works around the Barrow area, including about 7 km of sea wall and additional areas protected by embankments and rocky revetments. Extensive protection on the Cumbrian coast fringes the coastal railway and also dates from the period when there was more coastal industrial activity here. Maryport and Silloth each have about 2.5 km of sea walls;

Table 8.4.4 Wales: lengths* of coast with and without coastal works in Colwyn, Rhuddlan and Delyn (Clwyd)

Local authority	*Sea defence (km)*	*Coast protection (km)*	*Undefended soft coastline (km)*	*Undefended hard coastline (km)*	*Total length coastal works (km)*	*Total length undefended coast (km)*	*Total coast length (km)*	*Proportion protected (%)*
Colwyn	3	16	3	<1	20	4	23	87
Rhuddlan	<1	9	4	0	9	4	13	69
Delyn	8	12	6	0	20	6	27	74
Clwyd	***12***	***38***	***13***	***<1***	***50***	***13***	***63***	***79***

Source: Welsh Office 1995 survey. Key: *to nearest km.

Table 8.4.5 England: ownership of sea defences in Region 13

	Owner					
	Local authority (km)	*NRA (km)*	*Private/ other (km)*	*Total protected coast (km)*	*Total coast length (km)*	*Proportion protected (%)*
English parts of region	51	69	28	148	375	40
England total	***242***	***805***	***212***	***1,259***	***2,925***	***43***

Sources: NRA Sea Defence Survey (1991). Note: lengths given to nearest km.

Silloth also has groynes along the length of the wall. 'Coastal squeeze' (where semi-natural coastal habitat is increasingly squeezed between an eroding coast or rising sea levels on the one hand and fixed or encroaching coastal defence works or other infrastructure on the other) is evident in dune systems south of Silloth.

The terraced nature of the low-lying coasts around the Solway Firth, in part the result of long-term uplift, make these coasts less prone to major flooding than the coasts along the southern shores of the region. Coastal erosion, although not a problem in most areas, does occur and defences have been created around Gretna. Further west, much of the coast is generally rocky and undeveloped but there are local areas of coastal defence around Luce Bay and the developed parts of Loch Ryan.

In the Isle of Man, severe erosion takes place over much of the northern plain, from Kirk Michael round to Ballure, south of Ramsey, although there is also some accretion at several points around this coast; erosion is most severe to the western side. Rates of erosion on the northern plain areas over the last century or so are presented in Joliffe (1981), who calculated values of up to 1.2 m per year (mean 0.48 m per year) for various strips of this coastline. Sand and gravel extraction from beaches around the Point of Ayre and elsewhere is thought to have contributed to the problem in the past (Joliffe 1981), but no longer continues. However, there is little sea defence on this section of coast except in Ramsey, where there is a sea wall along the promenade. The Isle of Man Department of Transport (IoM DoT) policy is only to protect public works, principally roads, and not private property. Private property has been lost or is threatened on several parts of this coast, particularly in the Kirk Michael and Jurby areas.

Sea walls and groynes are not much in evidence in the Isle of Man outside of towns and harbours. Sea walls are found in all the harbours and in the bays at Douglas, Ramsey, Castletown, Peel, Port St. Mary and Laxey. Groynes are present in Douglas, Castletown and Peel Bays. Several hundred metres of road on the north side of the isthmus at Langness were recently protected by rock-filled gabions. Sea walls at Gansey, and to a lesser extent at North Douglas Promenade and Castletown Promenade, have required repair or enhancement in recent years. Repairs at Gansey have been extensive, with the addition of several hundred metres of toe protection using massive boulders. Peel sea wall also has boulder toe protection. Douglas Harbour has been given additional protection since the early 1980s by a concrete breakwater of around 370 m length. Beach nourishment has not been used for sea defence on the Isle of Man, though movement of about 1,000 tonnes of sand from Peel to Port Soderick was carried out in 1984 in order to create a recreational beach (which rapidly disappeared). Accumulation of sand against the sea wall at Port Erin is periodically moved down the beach, while accumulated shingle on the north part of Laxey sea wall, adjacent to the harbour, is periodically taken approximately 500 m south along the beach.

8.4.3 Management

Departmental responsibility for sea defence and coast protection lies with the Ministry of Agriculture, Fisheries and Food (MAFF) in England and Wales, the Scottish Office Agriculture, Environment and Fisheries Department in Scotland, and the Department of Transport (formerly the Department of Highways, Ports and Properties) in the Isle of Man. In England and Wales operational responsibility for

Table 8.4.6 England: length of coast protection (against erosion) on the north-west coast*, by local authority

Local authority	*Protected coast length km*	*Unprotected coast length km*	*Total coast length km*	*Amount of total coast protected %*
Wirral	16	9	24	65
Sefton	14	10	24	58
Fylde	5	9	15	37
Blackpool	11	0	11	100
Wyre	9	0	9	100
Lancaster	12	19	30	27
S. Lakeland	14	30	43	32
Barrow-in-Furness	16	56	72	22
Copeland	16	69	85	19
Allerdale	18	43	61	30
Region 13 (English parts)	***131***	***245***	***374***	***35***
England total	860	2,065	2,925	29
% of English coast	15	12	13	-

Source: MAFF (1994). Key: *as surveyed by MAFF (i.e. excludes estuary and harbour shoreline lengths).

Table 8.4.7 Flood defence and land claim in estuaries*

Location	*Type of defence*
Clwyd Estuary	Canalised upstream of Rhyl, with extensive embankments protecting claimed land
Ribble Estuary	3 km of defences on the north bank and 7 km on the south bank. Extensive land claim (2,230 ha since 1800).
Lune Estuary	About 5 km on each of north and south banks.
Duddon Estuary	8 km of defences in several stretches on the south bank. Railway embankments also serve as flood defences, including one continuous stretch of about 16 km, and several other stretches of >2 km.
Solway Firth	Parts are protected by embankments, particularly in the south, but also on the north shore of the upper estuary.

Sources: Ordnance Survey Landranger 1:50,000 series maps; Davidson *et al.* (1991). Key: *see also Table 8.2.1 and section 8.3.1.

coast protection works (to combat erosion) lies generally with District Councils under the Coast Protection Act (1949). Railtrack (formerly British Rail) maintains some stretches of coastal works alongside railway lines, to prevent erosion or flooding. Flood or sea defences are the responsibility of the National Rivers Authority (NRA) in England and Wales (under the Water Resources Act 1991 and the Land Drainage Act 1994), although the Internal Drainage Boards and local authorities are also empowered to undertake flood defence works. In Scotland, the Regional Councils have powers as coast protection authorities (to protect land from erosion, encroachment and to prevent flooding of non-agricultural land).

8.4.4 Information sources used

MAFF has recently published the Coast Protection Survey of England (MAFF 1994), which assesses the extent, adequacy and state of repair of coast protection works and notes defence requirements over the next three to five years. (Defence includes the full range of works from very large concrete berms and sea walls to small-scale wooden groynes which control long-shore sediment movement.) The survey also identified lengths of unprotected coast which were significantly eroding and where works might be necessary during the next ten years. These detailed data are held by the contractors (Sir William Halcrow & Partners) and MAFF on a GIS database. The above information for coastal directory regions was provided by the contractors with the agreement of MAFF. In Tables 8.4.1 and 8.4.6, from MAFF (1994), shoreline lengths differ from those shown in Table 8.4.2, from the MAFF database, owing to to the exclusion of inner estuary and harbour coastlines from the survey.

The NRA holds details of sea defence works in England and Wales obtained during a sea defence survey in 1991 on a proprietary database cross-referenced to maps, which may be viewed at regional NRA offices by prior arrangement. No information from the database was available for this review, so the tables provided above from published summaries are incomplete. However, the database is an accurate and detailed source of information, although now due for updating.

Summaries of the extent of coast protection and sea defence works in estuaries are also available for those sites covered by English Nature's Estuaries Initiative coastal processes reports (Coastal Research Group 1994a-f). For example, the Mersey Estuary Management Plan project has produced a supplementary topic paper covering land drainage and coastal defence for the estuary (University of Liverpool Study Team 1995) (see also Chapter 10). This holds detailed information on coastal defences in the estuary.

Coastal defence works in Scotland are summarised briefly in the *Coastal cells in Scotland* draft report (HR Wallingford 1995) and are also dealt with in the *Review of Scottish coastal issues* (Burbridge & Burbridge 1994).

There is no authoritative review of present sea defences and coast protection on the Isle of Man, although there are a number of unpublished reports on selected cases.

8.4.5 Acknowledgements

Many thanks go to the Planning Division of Cumbria County Council and other consultees for their helpful comments.

8.4.6 Further sources of information

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National Rivers Authority. 1993. *NRA Flood defence strategy.* London, NRA.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Coast protection survey database for Wales (1994/95)	*Huw Payne, Welsh Office Environment Division, Cardiff, tel: 01222 823176
Departmental responsibility for flood defence and coast protection policy, provision of grants towards capital expenditure by the responsible bodies. Coast Protection Survey of England.	*Ministry of Agriculture, Fisheries and Food (MAFF), Flood and Coastal Defence Division, London, tel: 0171 238 6660
Flood defence and coast protection policy, grants towards capital expenditure.	Scottish Office Environment Department, New St. Andrew's House, Edinburgh EH1 3TG, tel: 0131 244 4042
Coast protection and prevention of the flooding of non-agricultural land - England and Wales	*District Councils
Coast protection - Scotland	*Dumfries & Galloway Regional Council, Dumfries, tel: 01387 260034
Storm Tide Warning Service	Meteorological Office, Johnstone House, London Road, Bracknell, Berkshire RG12 2SZ, tel: 01344 420242
Flood defence - general	*NRA HQ, Bristol, tel: 01454 624400
Flood defence - Wales, sea defence survey 1991 regional database	*NRA Welsh Region, Rivers House, Cardiff, tel: 01222 770088
Flood defence - England; sea defence survey 1991 regional database	*NRA North West Region, Warrington, tel: 01925 653999
Flood defence - Dumfries & Galloway	*Dumfries & Galloway Regional Council, Dumfries, tel: 01387 261234 (260034)
Co-operation between parties responsible for coastal defences, identification of research needs and promotion of strategic planning of coastal defences - England	*English Coastal Groups Forum, MAFF Flood and Coastal Defence Division
Co-operation between parties responsible for coastal defences, identification of research needs and promotion of strategic planning of coastal defences - Wales	*Huw Payne, Welsh Coastal Groups Forum, Welsh Office Environment Division, Cardiff, tel: 01222 823176
Co-ordination and liaison between agencies undertaking coastal works	*A.M. Rhodes, Borough Engineer, Chairman, Liverpool Bay Coastal Group, Metropolitan Borough of Wirral, Bebington, tel: 0151 643 9000
Co-ordination and liaison between agencies undertaking coastal works	Dr B. Hodgson, Tidal Dee Users Group, NRA, Shire Hall, Mold, Clwyd CH7 6FA, tel: 01352 700176
Co-ordination and liaison between agencies undertaking coastal works	R. Reed, North Western Coastal Group, Engineering Service Unit, Wyre Borough Council, Civic Centre, Breck Road, Poulton-le-Fylde FY6 7PU, tel: 01253 887215
Coastal Engineering Advisory Panel	Anne-Marie Ferguson, Institute of Civil Engineers, Great George Street, London SW1P 3AA, tel: 0171 222 7722
Departmental responsibility for flood defence and coast protection policy - Isle of Man. Works to protect highways and harbours from erosion and encroachment by the sea, subject to planning approval.	B. Cowley, Design Division, Department of Transport, Sea Terminal Building, Douglas, Isle of Man IM1 2RF, tel 01624 686667

* Starred contact addresses are given in full in the Appendix.

For many years herring was the main species landed to ports in this region. Recently, though, pelagic fish have been supplanted by shellfish (particularly scallops and queen scallops) as the species group landed in the largest quantities. Of the total combined British and Isle of Man landings of shellfish, 15% are made to ports in this region. Ships such as the Research Vessel *Roagan* work with the fisheries authorities on the Isle of Man to assess the dredging methods used for scallops and the composition of the catches. Photo: Bill Sanderson, JNCC.

Chapter 9 Human activities

9.1 Fisheries

C.F. Robson

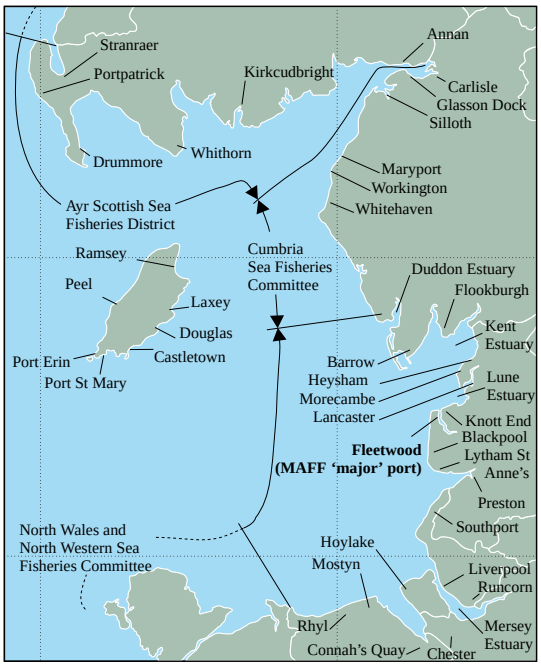
9.1.1 Introduction

This section gives an overview of the main fishing activities in the coastal waters and rivers of the region. There are fisheries for pelagic, demersal and several marine shellfish species (demersal fish live on or near the sea bed; pelagic fish do not) and diadromous species - salmon, sea trout and eels - which spend part of their lives in fresh water and part at sea. The section also covers sea angling and bait collection. For more information about the species concerned, including their scientific names, see sections 5.5, 5.7 and 5.8.

Fleetwood is the single 'major' fishing port (as defined by MAFF) in the region. Dumfries & Galloway and its landing ports are part of the Ayr Scottish Sea Fisheries District and the Isle of Man has four main fishing ports (Douglas, Port St. Mary, Peel and Ramsey) and three other smaller ones (Map 9.1.1).

In 1992, 3.6% of all recorded landings of fish and shellfish species in Britain were made in this region. The total tonnages of pelagic, demersal and shellfish species landed in the region represent 1.0%, 1.8% and a significant 14.8% respectively of the British totals. The region is important for a wide range of shellfish species, which are landed for UK or Isle of Man markets or for live export abroad. The landings of scallops and queen scallops contribute substantially to the total catch for Britain and the Isle of Man: 10.8% and 74.8% respectively. Other significant shellfish landings in the region, compared with Britain, are for cockles (12.3%), mussels (19.5%) and brown shrimp (17.1%). A summary of the totals for pelagic, demersal and shellfish species is given in Table 9.1.1.

The inshore fleet of north Wales, Cheshire and Lancashire is made up of trawlers and seiners and smaller boats and vehicles that fish close inshore, particularly in intertidal areas. Vehicles such as specially constructed vans are used along the Lancashire coast to tow small mesh trawls for shrimp, and, off the Cumbrian coast, several boats use beam trawls to catch shrimp. The otter trawling and seining fleet fish throughout the eastern Irish Sea and Solway Firth, although the majority stay within 20 miles of the coast, targeting cod, whiting, plaice, Dover sole, rays and *Nephrops* and occasionally dredging for scallops. The



Map 9.1.1 Fishing ports, Sea Fisheries Committees and Scottish Sea Fisheries District (see section 9.1.1 for explanation). © Crown copyright.

Table 9.1.1 Species group landings in 1992 (tonnes)

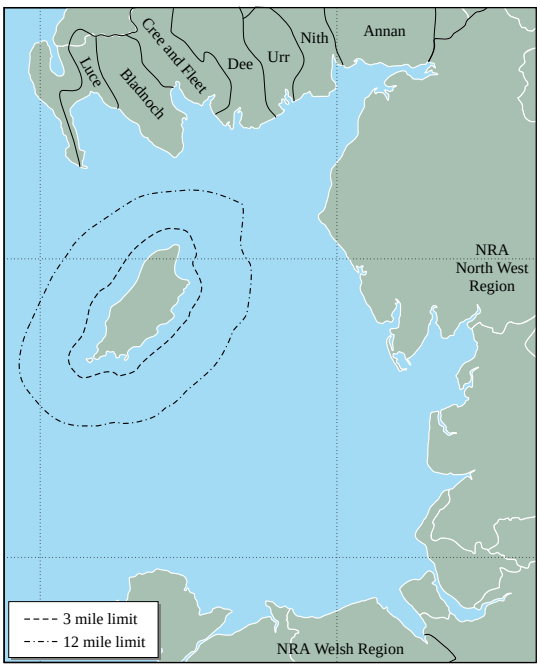
Species	*Region 13 (incl. Isle of Man)*	*Isle of Man*	*'West Coast'*	*England & Wales*	*Scotland*	*Britain and Isle of Man*	*% of West Coast total landed in region*	*% of combined British and Isle of Man total landed in region*
Pelagic	2,507	857	68,026	23,809	227,669	252,335	3.7	1.0
Demersal	4,954	309	47,404	81,237	193,914	275,460	10.5	1.8
Shellfish	15,479	3,445	42,984	55,360	46,112	104,917	36.0	14.8
All species	***22,940***	***4,611***	***158,414***	***160,406***	***467,695***	***632,712***	***14.5***	***3.6***

Source: Ministry of Agriculture, Fisheries and Food (1994a); Scottish Office Agriculture and Fisheries Department (1993); Isle of Man Department of Agriculture, Fisheries & Forestry (pers. comm.). Note: amounts landed are rounded up to the next whole tonne. Calculating the figures in this table was a complex process: refer to section 9.1.4.

Nephrops fishery takes place mainly off the Cumbrian coast and to the west of the Isle of Man. Also along the Cumbrian coast pots are set for lobsters, and nets and lines take demersal fish. Molluscs such as cockles and mussels are gathered in intertidal areas in the region.

Despite the recent decline in the importance of herring, fishing is still one of the most important industries on the Isle of Man, where the principal fisheries are for scallops and queen scallops and, to a much lesser degree, whitefish and herring. Potting for lobsters also takes place off the south of the island. Herring is one of the main pelagic species in the Irish Sea and most of the region's landings are to Isle of Man fishing ports. The Isle of Man was the centre for the Irish Sea herring fishery for over a century, despite great fluctuations in catches. The amount of herring landed by the Manx fleet is now much reduced, with most Manx landings now being by boats from Northern Ireland. Nowadays the majority of Irish Sea herring fished are landed in ports outside the region (Brand 1987; Smith 1951). Since 1939 most of the fishing effort in the Isle of Man has been concentrated on the scallop and the queen scallop. In 1992, the Manx landings comprised 7.6% of the total scallop and 24.5% of the total queen scallop landings for Britain and the Isle of Man. However, at one time, the Manx landings accounted for approximately 60% of the total scallop catch for the UK.

In the English and Welsh parts of the region three diadromous species - salmon, sea trout and eel - support both net and rod and line fisheries, the most important of which are for salmon (and grilse, which are salmon that have spent not more than one winter at sea before maturing) and sea trout. In the Scottish Salmon Fishery Statistical Districts in the region (see Map 9.1.2), salmon (including grilse) and sea trout support rod and line fisheries from rivers and netting stations along the coast. Eel are exploited from the time they enter fresh water as elvers, during their stay in fresh and estuarine water and as they migrate to sea



Map 9.1.2 Scottish salmon fishery statistical districts, NRA regions and Isle of Man territorial limits. Source: Scottish Office (1994); IoM DAFF (pers. comm.). © Crown copyright.

Table 9.1.2 Average catch (numbers of fish) of salmon and grilse and sea trout 1989 - 1993

Totals	*Salmon and grilse*	*Sea trout*
Region 13*	***24,091***	***14,303***
West Coast*	58,582	37,024
England & Wales	67,347	76,337
Scotland	187,481	65,468
GB	254,829	141,813
% of West Coast total in region	41.4	39.5
% of GB total in region	9.7	10.4

Source: Scottish Office Department of Agriculture and Fisheries (1990); National Rivers Authority (1991, 1992, 1993, 1994a, b) and Scottish Office (1991, 1992, 1993, 1994). Key: *in this table the totals for Region 13 and the 'West Coast' do not include figures for the Isle of Man. Note: Calculating the figures in this table was a complex process: refer to section 9.1.4.

as silver eels. The main angling interest for this species is within fresh water, though there is a certain amount of angling for eel along the coast.

Table 9.1.2 shows that the average total recorded catch of salmon and grilse made by all methods between 1989 and 1993 in the region represents 9.7% of the British total and 41.4% of the total for the 'West Coast'. The average total recorded catch of sea trout made by all methods in between 1989 and 1993 in the region represents 10.4% of the British total and 39.5% of the total for the 'West Coast'.

9.1.2 The fisheries

Pelagic species

Table 9.1.3 gives the quantities of various pelagic species landed in 1992 in the region, compared with landings nationally. The Isle of Man was the centre of the Irish Sea herring fishery before the major decline in catches that began in the 1980s. The average annual landing of herring during the 1920s and 1930s was 10,000 tonnes, declining to 2,000 tonnes during 1945-65 and then increasing again to 40,000 tonnes in 1974. As a result of heavy fishing pressure on the Manx stock during the 1970s, restrictions were placed on the fishery: the spawning ground to the east of the island was closed to fishing from 21 September to 31 December by the EC, and remains so. The relatively low quantity of herring landed (856 tonnes in 1992) has been attributed to restrictive quotas by the EC and a lack of demand for fish, which result in a low fishing effort (Anon. 1991). Juvenile herring and sprat were once commonly caught in seine and filter nets: this fishery has recently declined, owing to a fall in demand. Mackerel are caught within 12 miles of the coast, although seldom by local fleets; most of the fish landed at Cumbrian ports are caught by visiting pelagic boats.

Demersal species

Table 9.1.4 gives the quantities of various demersal species landed in 1992 in the region, compared with landings nationally. Inshore otter trawlers target demersal fish for

Table 9.1.3 Pelagic species landings in 1992 (tonnes)

Species	*Region 13 (incl. Isle of Man)*	*Isle of Man*	*West Coast*	*England & Wales*	*Scotland*	*Britain and Isle of Man*	*% of West Coast total landed in region*	*% of combined British and Isle of Man total landed in region*
Argentines	P	0	43	0	180	180	-	-
Herring	857	856	10,944	915	83,879	85,650	7.8	1.0
Horse mackerel	P	0	125	1,026	473	1,499	-	-
Mackerel	1,650	1	55,360	9,142	141,583	150,726	3.0	1.1
Pilchard	0	0	P	4,244	0	4,244	0	0
Sprat	0	0	1,554	8,478	1,554	10,032	0	0
Whitebait	0	0	0	1	0	1	0	0
Others	0	0	0	3	0	3	0	0
Total	***2,507***	***857***	***68,026***	***23,809***	***227,669***	***252,335***	***3.7***	***1.0***

Source: Ministry of Agriculture, Fisheries and Food (1994a); Scottish Office Agriculture and Fisheries Department (1993); Isle of Man Department of Agriculture, Fisheries and Forestry pers. comm. Key: P = species landed in the region in small quantities (here <0.5 tonnes); - = % not calculated. Note: Amounts landed are rounded up to the next whole tonne. Calculating the figures in this table was a complex process: refer to section 9.1.4.

Table 9.1.4 Demersal species landing in 1992 (tonnes)

Species	*Region 13 (incl. Isle of Man)*	*Isle of Man*	*West Coast*	*England & Wales*	*Scotland*	*Britain and Isle of Man*	*% of West Coast total landed in region*	*% of combined British and Isle of Man total landed in region*
Elasmobranchs								
Dogfish	286	66	5,899	3,625	9,657	13,348	4.8	2.1
Skates and rays	513	15	4,011	4,142	3,670	7,827	12.8	6.6
Gadoids								
Cod	977	96	6,084	23,530	35,898	59,524	16.1	1.6
Haddock	45	13	4,365	3,706	49,867	53,586	1.0	0.1
Hake	81	6	3,031	1,621	1,993	3,620	2.7	2.2
Ling	23	1	1,433	1,708	4,318	6,027	1.6	0.4
Pollack (lythe)	37	4	1,102	1,734	1,285	3,023	3.4	1.2
Saithe	80	8	1,570	2,284	10,311	12,602	5.1	0.6
Whiting	990	44	4,322	5,088	35,923	41,055	22.9	2.4
Whiting, Blue	0	0	0	P	6,531	6,531	0.0	0.0
Flatfish								
Brill	51	1	126	392	50	443	40.5	11.5
Dab	48	0	198	456	759	1,215	24.2	4.0
Dover sole	313	7	855	2,812	57	2,876	36.6	10.9
Flounders	100	0	106	269	4	273	94.3	36.5
Halibut	P	0	28	80	114	194	-	-
Halibut, Greenland	0	0	18	117	20	137	0.0	0.0
Lemon sole	21	7	569	3,000	2,566	5,573	3.7	0.4
Megrim	4	0	2,658	1,471	2,566	4,037	0.2	0.1
Plaice	1,083	15	3,138	15,970	7,902	23,887	34.5	4.5
Turbot	16	1	181	545	196	742	8.8	2.2
Other species								
Catfish	0	0	39	557	1,378	1,935	0.0	0.0
Conger eel	33	0	411	403	107	510	8.0	6.5
Gurnard	108	6	259	589	32	627	41.7	17.2
Monkfish/ angler	93	19	4,865	3,102	11,557	14,678	1.9	0.6
Redfish	0	0	56	581	193	774	0.0	0.0
Sand eel	0	0	0	P	4,152	4,152	0.0	0.0
Torsk (tusk)	1	0	42	13	194	207	2.4	0.5
Witch	2	0	576	192	1,789	1,981	0.4	0.1
Others	45	0	1,414	3,151	682	3,833	3.2	1.2
Fish roes	4	0	48	99	144	243	8.3	1.6
Total	***4,954***	***309***	***47,404***	***81,237***	***193,914***	***275,460***	***10.5***	***1.8***

Source: Ministry of Agriculture, Fisheries and Food (1994a); Scottish Office Agriculture and Fisheries Department (1993); Isle of Man Department of Agriculture, Fisheries and Forestry pers. comm. Key: P = species landed in the region in small quantities (here <0.5 tonnes); - = % not calculated. Notes: amounts landed are rounded up to the next whole tonne. Calculating the figures in this table was a complex process: refer to section 9.1.4.

most of the year, making mixed landings of cod, whiting, plaice, Dover sole, turbot, rays and dogfish. Many otter trawlers operating out of Fleetwood alternate between demersal fish and *Nephrops*. On the whole, beam trawlers over 10 m concentrate on flatfish and occasionally switch to scallop dredging, and those under 10 m primarily use twin beam trawls for shrimp and occasionally flatfish. Dover sole are targeted by both local and visiting beam trawlers. During the summer, flatfish and rays (mainly thornback ray) become more available and a lot of effort centres around Solway Firth, where plaice, Dover sole, turbot, brill and rays are caught. Longlines are set in a few areas for dogfish (especially spurdog), cod and rays. Gill, tangle and trammel nets are generally used by smaller boats to catch demersal fish. Trammel nets are usually used to catch small flatfish such as Dover sole, plaice and flounder. Larger mesh nets are set for rays, turbot and brill. Gill nets are set for cod, pollack and dogfish. Cod are landed mostly during the colder months and the cod spawning ground off the Cumbrian coast (see section 5.9) attracts both trawlers and seine netters during February to April.

The Cumbrian and Scottish coast is near the northerly range of the distribution of both bass and mullet, and fishing here for these species is more seasonal than in the southern part of the region. Fixed and drifted gill nets are used for bass around estuaries, often taking a by-catch of grey mullet. However, the use of nets around rivers supporting populations of salmonids has been prohibited in order to protect salmon and sea trout migrating back to natal rivers to spawn. Consequently, handlining for bass has become more popular in such areas. Bass are caught in the warmer months and grey mullet are sometimes taken as a by-catch in gill nets. There are two MAFF designated Bass Nursery Areas in the region (see section 5.8.5) and bass fishing from boats is prohibited in these areas during specified times of year.

Shellfish

Table 9.1.5 gives the quantities of various shellfish species landed in 1992 in the region, compared with landings nationally.

Scallops and queen scallops (queens) are landed by trawlers and dredgers throughout the region. Important fisheries for scallops and queens exist around the Dumfries & Galloway coast and the Isle of Man. Scallops are fished by dredging, and either dredging or beam trawling is used for queens (see Mason (1987) for further information on gear). Fishing by the Manx fleet is concentrated on the inshore grounds, those 30 km from the island being fished more by boats from ports in Scotland, England, Wales, N. Ireland and the Republic of Ireland. Together these boats generally land fewer scallops but more queens than the Manx fleet, and their activities are more seasonal. Amounts of scallops and queens landed around the region in 1992 are shown in Table 9.1.6.

Cockles are harvested along many of the sandy stretches of the coastline in the region from the Dee Estuary up to the Duddon Estuary and in the Solway Firth, and in 1992 this fishery made an important contribution to the national landings total. However, due to low stocks this fishery has been increasingly restricted (see section 5.5.3). Cockles are gathered by hand, by tractor dredge and by hydraulic suction dredgers operated on boats. The bulk of the effort of the cockle fishery in the Solway Firth occurs on the Scottish side, where nine tractors and most of the fourteen boats that work hydraulic suction dredges are based. Together they landed 2,363 tonnes of cockles in 1992, out of the regional total of 3,947 tonnes (SOAEFD pers. comm.). These landing figures could be underestimates - the actual values are probably much higher due to landings made at smaller locations where no checks or obligations to register landings exist (C. Rollie pers. comm.).

The mussel fishery in the region has expanded since the late 1980s, owing to increased demand, but production varies from year to year depending on the quality of spatfall. The Morecambe Bay Mussel Fishery Order (see section 9.1.3) provides for exclusive rights to beds in the specified area; from these beds the majority of mussels exploited in the region are dredged. Public mussel beds are harvested by hand along the shore from the end of the summer, and boats are sometimes used to take fishermen to mussel beds further out in the Bay. Mussel seed is collected from areas where there is little chance that it will become established within the Fishery Order area, or where water quality is poor, and is re-layed in sheltered areas (see also section 9.2.2). Mussels are also harvested in other areas, including the Esk Estuary (Ravenglass), principally by hand, although boats are sometimes used to ferry fishermen out to intertidal beds.

Whelks are caught in pots, mainly off Great Orme and around the Solway Firth. They were fished in small quantities during the early 1990s around the Isle of Man, but this ceased in late 1994.

The otter trawl fleet catch *Nephrops* from as close as 3 miles offshore, although the main fishing grounds are found west of Whitehaven (see Map 5.5.2 and section 5.5). The minimum mesh size of nets is 70 mm, plus an obligatory 80 mm square mesh section incorporated into the cod-end in order to allow small whiting to escape. The fishery attracts a lot of effort from visiting boats from Scotland and Northern Ireland. *Nephrops* are targeted from late summer through to spring. Fishermen therefore alternate between trawling for demersal fish and for *Nephrops*, depending on the season, state of the tide and the weather, market demand and fishing restrictions (e.g. catch quotas). Considering that the fishery for *Nephrops* is the most important in the Irish Sea, a comparatively small tonnage is landed in Manx ports, most going to other ports around the Irish Sea.

The brown shrimp fishery is one of the traditional coastal inshore fisheries, occurring along the large expanses of fine sediment shore in the region, mainly in the Dee and Ribble Estuaries, in Morecambe Bay and in the Solway Firth. Small mesh trawls attached to beams are towed, either by vehicles in very shallow areas inaccessible by boat, or by boats along narrow channels, typically at low tide when the brown shrimp are found in greatest densities. Fishing effort is greatest in autumn and spring and less during the winter, when the cold weather forces the shrimp into deeper waters, and in summer, when shrimp moult. The catch is sorted and any juvenile flatfish caught are returned to the sea (see section 5.5.3). Shrimp push nets, which are worked by hand, are still used in the south of the region, sometimes in preference to mechanical methods. The brown shrimp fishery in the Solway Firth has attracted foreign interest since the late 1980s, with the arrival of a Danish shrimp fishing company that has obtained UK fishing licences.

Table 9.1.5 Shellfish landings* in 1992 (tonnes)

Species	*Region 13 (incl. Isle of Man)*	*Isle of Man*	*West Coast*	*England & Wales*	*Scotland*	*Britain and Isle of Man*	*% of West Coast total landed in region*	*% of combined British and Isle of Man total landed in region*
Cockles	3,947	0	5,848	29,501	2,546	32,047	67.5	12.3
Crabs	22	16	7,853	9,453	7,501	16,971	0.3	0.1
Lobsters	6	1	447	504	564	1,073	1.3	0.6
Mussels	1,277	0	1,690	3,488	3,067	6,555	75.6	19.5
Nephrops	464	14	11,271	1,918	17,707	19,627	4.1	2.4
Periwinkles	30	0	1,592	70	1,837	1,908	1.9	1.6
Queens	8,431	2,766	9,066	2,989	5,518	11,272	93.0	74.8
Scallops	892	633	3,771	2,589	5,068	8,291	23.7	10.8
Shrimps	127	0	128	563	180	743	99.2	17.1
Squids	76	15	623	919	1,071	2,007	12.2	3.8
Whelks	207	0	488	1,535	858	2,393	42.4	8.7
Others	P	P	207	1,831	195	2,026	-	-
Total	***15,479***	***3,445***	***42,984***	***55,360***	***46,112***	***104,917***	***36.0***	***14.8***

Source: Ministry of Agriculture, Fisheries and Food (1994a); Scottish Office Agriculture and Fisheries Department (1993); Isle of Man Department of Agriculture, Fisheries and Forestry pers. comm. Key: *excluding landings of farmed shellfish - see section 9.2. P = species landed in the region in small quantities (here <0.5 tonnes); - = % not calculated. Note: Amounts landed are rounded up to the next whole tonne. Interpretation of the figures in this table is complex: refer to section 9.1.4.

Shrimp trawlers from other parts of the UK also periodically base themselves in the Solway.

Lobster and, to a lesser extent, edible and velvet crab are exploited on a relatively small scale, especially in the north of the region - around the more exposed and rocky parts of the Cumbrian and Dumfries & Galloway coast. They are targeted using creels from spring through till autumn and (rarely) in winter. Lobsters and edible crab are also targeted by potting at inshore sites off the south and south-east of the Isle of Man, off Peel, Douglas and Langness and around the Calf. Shore crabs are also collected in many areas in the region for bait.

Squid and periwinkle represents a minor part of the shellfish industry in the region, including the Isle of Man.

Diadromous species

The distribution of diadromous fish species in rivers in the region is discussed in section 5.9. Many rivers, estuaries and stretches of coast in north Wales and north-west England support salmonid net fisheries, the most important of which are in the Eden and (border) Esk rivers, where 165 haaf net licences were issued in 1993 (National Rivers Authority 1994b). Various types of net, including cribb, baulk, seine, coracle, drift and lave, are used to catch salmon and sea trout from spring through to the end of the summer. Fyke nets are used in some rivers and estuaries in North Wales and north-west England in order to catch eels, and dip nets are used to catch elvers, in particular on the rivers Wyre and Keer. For adult eels (brown/yellow and silver stages) the main areas of exploitation are in Morecambe Bay. In 1992 in the North West Region of the NRA approximately 0.4 tonnes of adult eels, from both fresh and sea water, and 0.3 tonnes of elvers were caught (nominal catch). Table 9.1.7 shows the average numbers of salmon and grilse and sea trout caught in the region's rivers and fisheries in the five years between 1989 and 1993, the methods used to catch them, and the numbers of net licences issued for catching salmon and grilse in 1993.

Table 9.1.6 Total landings of scallops and queen scallops in the region in 1992 (tonnes)

	Scallops	*Queens*
English and Welsh parts of Region 13	24	686
Dumfries & Galloway	235	4,969
Isle of Man	633	2,766
Region 13	***892***	***8,431***

Source: MAFF (1994a); Scottish Office Agriculture and Fisheries Department (1993); Isle of Man Department of Agriculture, Fisheries and Forestry, pers. comm. Notes: amounts landed are rounded up to the next whole tonne. Calculating the figures in this table was a complex process: refer to section 9.1.4.

Sea angling

Sea angling is distinguished from two other types of sport fishing: game fishing for salmon, sea trout, brown and rainbow trout (the first two are covered here) and coarse fishing, which is for freshwater fish species and so is not covered here. Sea angling has three main forms: angling from the shore, inshore fishing within about 5 km of the shore and deep sea fishing. It is a popular sport practised by over two million people in Great Britain (Fowler 1992). Its governing body in England is the National Federation of Sea Anglers, which has approximately 570 affiliated clubs with approximately 33,000 individual members. The equivalent body in Wales, the Welsh Federation of Sea Anglers, has approximately 62 affiliated clubs with around 4,000 individual members. In Scotland the governing body is the Scottish Federation of Sea Anglers, which has approximately 64 affiliated clubs and approximately 200 additional personal members, who are not always a member

Table 9.1.7 Salmon and grilse and sea trout five-year (1989-1993) average catch (as numbers of fish reported to NRA and Scottish Office), catch methods used and number of net licences for salmon and grilse issued in 1993

	Salmon and grilse	*Sea trout*	*Method used/ net licences issued*
English & Welsh river/fishery			
Clwyd	208	640	Rod, sling nets (3)
Dee (Clwyd)	1,320	164	Rod, nets: seine (21), trammel (4)
Ribble	649	509	Rod, drift nets (6)
Calder	6	2	Rod
Wyre	9	29	Rod
Lune	3,660	2,439	Rod, nets: haaf (26), drift (10), seine (1)
Kent	533	363	Rod, lave nets (8)
Leven	150	101	Rod, lave nets (6)
Duddon	47	100	Rod, seine nets (1)
Esk	61	70	Rod
Irt	83	45	Rod
Ehen	149	89	Rod
Derwent	818	154	Rod
Ellen	22	19	Rod
S & W Cumbria	446	20	Drift nets (4)
Eden	1,433	551	Rod
Esk (Border)	332	386	Rod
Eden & Esk (Border)*	1,692	2,232	Nets: haaf (165), crib (2)
Scottish Salmon Fishery Statistical District			
Annan	2,674	3,034	**
Nith	4,605	2,282	**
Urr	367	77	**
Dee (Kirkudbright)	147	18	**
Cree & Fleet	2,085	748	**
Bladenoch	1,798	84	**
Luce	798	144	**
Region 13	***24,091***	***14,303***	***257***

Source: National Rivers Authority (1991, 1992, 1993, 1994a & 1994b); Scottish Office Department of Agriculture and Fisheries (1990) and Scottish Office (1991, 1992, 1993, 1994). Key: * net licences granted (by the NRA) for the Eden and the Esk cover both rivers; **statistics for the Scottish Districts do not specify methods. Notes: 'sea trout' here includes all migratory trout. 'Nets' are defined as instruments other than rod and line. No licences to catch salmon and grilse or sea trout have been issued by the Isle of Man Government since 1989.

of an affiliated club. There are six sea angling clubs on the Isle of Man: Peel, Ramsey, Douglas, Ellan Vannin, Southern and Mannin. Douglas is the largest club, with around 200 members. The clubs are affiliated to the Isle of Man Angling Federation. Taking into account occasional anglers who are not members of clubs, it is estimated there may be over 600 sea anglers on the island (see also section 9.7.2). Orton (1994) lists contact addresses for fishing clubs in the region and national angling organisations.

In Region 13, sea angling occurs in many places. Mackerel are caught on handlines and provide an important resource for the chartered angling sector in the southern part of the region. Both Colwyn Bay and Rhyl are popular shore and boat angling areas, with whiting, plaice, dab, tope, rays and gurnards being caught there (Orton 1994). Another popular place for sea angling is from Southport pier, where exploited species (dab, flounder, dogfish, mullets and rays) are caught (Orton 1994). Beach and pier angling also occurs off Blackpool beach and at Fleetwood. Throughout the year good quantities of a variety of species are caught at Morecambe (Orton 1994). Bass (and bass fishermen) are known to congregate in the warmer water areas at the Heysham power station outfall (Kelley 1988). MAFF have designated a small area around the outfall as a statutory bass nursery area. Barrow-in-Furness has good angling for bass, cod and rays, amongst others. The main sea fishing stations in Dumfries & Galloway are along the west coast of Wigtownshire, in Luce Bay and at Loch Ryan. Orton (1994) also gives information on further sea fishing stations in the region, the facilities available and likely catch species.

Bait collection

Bait collection for sea angling occurs in many areas in the region, although some areas are more prolific than others and may attract commercial collectors. Anglers often collect their own bait locally, while commercial collectors travel in teams to suitable shores. Many species are collected, including ragworm, lugworm, peeler crabs (moulting shore crabs), mussels, cockles, limpets, razor shells, squid, mackerel and sandeels. Different bait species are targeted according to the species of fish being caught as well as the location and time of year. The main collecting techniques on the shore are digging and boulder turning. Bait digging, especially for lugworms, is carried out over the lower part of muddy and sandy shores around the time of low water. Fowler (1992) identified that the exploitation of bait species was taking place at many locations in the region. Areas such as the Dee Estuary, Hilbre Island, River Lune, Duddon Estuary, Luce Sands and Stanraer experience larger numbers of diggers and some problems have been encountered (see Section 5.5).

9.1.3 Management and issues

Responsibility for the management of fisheries in coastal waters rests with the Commission for the European Union (EU), who delegate it to member states under the Common Fisheries Policy (CFP). EU regulations are implemented through UK law, usually by means of statutory instruments, which define limits and restrictions and set down powers of enforcement and penalties. All national regulation measures, including local sea fisheries bylaws, must conform with the requirements of the CFP. Areas landward of low water mark (baseline) and areas within Bay Closing Lines are excluded from these regulations.

The CFP seeks to manage stocks of fish in EU waters on a biological basis (MAFF 1994a) by implementing catch quota management measures, by setting agreed annual Total Allowable Catches (TACs) for particular stocks. The policy came into effect in 1983 and was subject to a mid-term review in 1993, with a full review planned for 2002. The CFP is described in Coffey (1995), which sets out the basic elements of the policy and contributes to the debate on fisheries and the environment. A central principle of the policy is the rule of 'equal access' - that all member states of the EU have equal access to all community waters and all fishing resources. However, since 1973 a number of exceptions have been adopted, based on various precedents and historic fishing patterns. Between 6 and 12 nautical miles from baseline (low water mark), access is permitted to vessels from other member states, based on historic fishing rights; specifically within Region 13, these rights are therefore limited to Belgium, France and the Republic of Ireland (see British Admiralty Chart Q6385 for details). Beyond 12 nautical miles in Region 13, access is also open to Denmark, Germany and the Netherlands, but not Spain, Portugal or other EU member states, none of which has a historic record of fishing within ICES Division VIIa.

For the purpose of stock assessment, the UK coastal waters have been designated by the International Council for the Exploration of the Sea (ICES) into statistical areas. The coastal seas around this region are part of one 'division': Division VIIa (Irish Sea). ICES provides scientific advice on the management of all the important commercial species of fin fish and some shellfish stocks in all areas of the north-east Atlantic. This work is summarised in the annual report of the Advisory Committee for Fisheries Management, which is responsible for providing scientific advice on TACs and other conservation measures to the international fisheries commissions, including the EU. The TAC is intended to reflect the maximum level of exploitation which a given stock can sustain. Precautionary TACs are applied to important stocks where there is not enough scientific data to make an analytical assessment. Once the TACs are set for each stock, they are divided between members states in the form of catch quotas. European Council Regulation No. 3362/94 fixes, for 1995, details of the catch quotas for fish and shellfish species for all European countries and certain conditions under which the species may be fished. The TACs, UK quotas and 'uptake' for 1991 and 1992 for each species are given in MAFF (1994a). European Council Regulation No. 3760/92 summarises the CFP, including the proportions by which TACs are allocated as national quotas. Minimum landing sizes and whether an annual quota applies in the region for the important pelagic and demersal species are listed in Tables 5.7.1 and 5.7.2.

In the English and Welsh parts of this region, the NRA (Dee Estuary), the North Western and North Wales Sea Fisheries Committee (NW & NWSFC) and the Cumbria Sea Fisheries Committee (CSFC) manage the sea fisheries from the high water mark out to 6 nautical miles offshore from UK baselines (as defined by the Territorial Water Order in Council 1964). The boundary between these two Sea Fisheries Committees is at Haverigg Point (Map 9.1.1). An NW & NWSFC bylaw prohibits nets with meshes of under 90 mm being used within 3 miles of the coast, unless towed. Other bylaws state that no portion of a fixed or drift net can be within 200 m of another and that stake nets cannot exceed 275 m in length. Cumbria Sea Fisheries Committee bylaws restrict individual vessels' maximum aggregate shrimp trawl beam length to 6 m. Local MAFF Sea Fisheries Inspectorate officers deal with quota management, enforcement of UK and EU fisheries legislation and licensing of fishing vessels. Also in the English and Welsh parts of the region, the Welsh and North West Regions of the National Rivers Authority (NRA) have a responsibility to regulate, protect and monitor salmon, sea trout and eel fisheries from rivers to coastal waters out to the 6 mile limit. Orton (1994) describes the structure of the NRA and the licensing procedures, seasons, catch and size limits for each NRA region. The Sea Fisheries Committees also have powers to support this conservation of salmonid fisheries whilst exercising their responsibilities towards the regulation of sea fisheries. Bylaws have been introduced by the NW & NWSFC to restrict netting around estuaries, to prevent the illegal use of nets to catch salmon. All the salmon fisheries are subject to a closed season, which lasts from around the start of September to the end of February.

In England and Wales MAFF's Directorate of Fisheries Research (DFR) Laboratory at Lowestoft is responsible for collecting and collating information on fish stocks exploited by UK vessels. The MAFF DFR Fisheries Laboratory at Conwy is the Directorate's centre for assessing the implications of non-fisheries activities and coastal zone usage on fish stocks and fisheries. MAFF DFR databases are described in Flatman (1993).

Regulating Orders are granted in England by MAFF to a responsible body to enable it to regulate the fishery for particular wild stock molluscan shellfish species. The specified shellfish stock may only be fished in accordance

Table 9.1.8 Regulating Orders in the region

Title	*Species*	*Location*	*Grid ref.*	*Grantee*	*Approx area (ha)*	*Expiry date*
Morecambe Bay Mussel Fishery Order 1978	Mussels	Morecambe Bay, near Lancaster, Lancashire	SD245610	NW & NWSFC	4,047	2008

Source: MAFF (1994b) and Grantee

with the terms of the order and any regulations made under it. There is one Regulating Order in this region (Table 9.1.8), of eight in Britain covering a total of approximately 99,889 ha (as at July 1994).

In Scotland the administration and management of sea fisheries is carried out by the Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD) in accordance with the CFP of the European Union. Research relating to the CFP and other fisheries management requirements is carried out by the SOAEFD Marine Laboratory, Aberdeen. In Dumfries & Galloway the Ayr Sea Fisheries District stretches north from the Scottish border, beyond the limit of Region 13 (see Map 9.1.1); the district office collects data on landings at all ports in the district. Administration and enforcement of sea fisheries legislation within Sea Fisheries Districts is the responsibility of the Sea Fisheries Inspectorate branch of the Scottish Fisheries Protection Agency, which operates the Fisheries Protection Fleet and aircraft. In Scottish inshore waters (to 3 miles), the principle instrument of fisheries management is the Inshore Fishing (Scotland) Act 1984. This gives the Secretary of State powers to regulate fishing in specified inshore waters and to prohibit the carriage of specified types of net and the use of mobile gear near fixed salmon nets. The single prohibition under the act in the region is the seasonal restriction on the use of mobile gear, which is closed from May to September in Luce Bay.

In Scotland the salmon and sea trout catches are recorded by Salmon Fishery Statistical Districts. There are seven in the region, shown on Map 9.1.2 and listed in Table 9.1.7. In Scotland there is no public right to fish for salmon, and exclusive rights for each stretch of river are privately owned. Coastal and estuarine fisheries are similarly governed by heritable titles.

The Isle of Man is independent of the UK Government and enacts its own fisheries legislation. A 3 mile territorial limit has existed around the island since the Fisheries Act 1927, under which the Isle of Man Department of Agriculture, Fisheries and Forestry (IoM DAFF) has unilateral jurisdiction to grant permits to fish, to restrict the length of vessels (currently to under 15 m) and deals with quotas and the collection and collation of fish stock information. The Port Erin Marine Laboratory undertakes collection of fisheries data, stock assessments and ongoing research on behalf of IoM DAFF. The UK's Territorial Sea Act 1987 was amended in July 1991 to include the Isle of Man, giving it a 12 mile territorial limit, although legislative changes cannot be made in the 3 to 12 mile zone by the Isle of Man Government without the concurrence of the UK Government. The 3 and 12 mile Isle of Man territorial limits are shown on Map 9.1.2. Within the 12 mile limit fisheries regulations are enforced jointly by the Royal Navy and the island's own inshore protection vessel. The Manx vessel has responsibility solely within the 3 mile limit. On the Isle of Man licences for the right to fish commercially for salmon and sea trout have not been granted since 1989. However, Port Erin Marine Laboratory possesses a licence to take either species for scientific research.

Regulating Orders have existed on the scallop fishery in Isle of Man waters almost since its beginning. In 1943 the Isle of Man Government introduced a minimum landing size (110 mm) and a closed season, from 1st June to 1st October inclusive. These were extended to cover the whole of ICES Division VIIa (Irish Sea) by UK Government legislation in 1984 and 1986. There are no such regulating orders on the queens fishery, although it is generally accepted that processors do not accept catches with a high proportion of queen scallops of less than 55 mm shell height.

Issues relating to the fisheries for pelagic, demersal and shellfish species and sea angling and bait collection are closely linked to wildlife conservation in several ways. Issues include the effects on target species as major components in marine ecosystems, the changed availability of food for predators (especially cockles for foraging oystercatchers - see section 5.5.3 for an account of the cockle fishery), the effects on non-target species (especially the shrimp fishery - see section 5.7.3), and effects on species and habitats of nature conservation interest. These issues are under consideration by the 'Marine Fisheries Task Force', an inter-agency team of the statutory nature conservation organisations (the Countryside Council for Wales, English Nature, Scottish Natural Heritage and the Department of the Environment for Northern Ireland, together with the JNCC). A consultation draft paper prepared by the group, entitled *Developing an action programme for sea fisheries and wildlife* (Marine Fisheries Task Force 1994), identifies the main areas where marine fisheries (broadly defined to encompass the exploitation of all living marine resources) affect wildlife and identifies any action needed.

Further information on issues concerning the species targeted is given in sections 5.5.3, 5.7.3, and 5.8.3.

9.1.4 Information sources used

Inshore fisheries review of England, Scotland and Wales, 1992/1993 (Gray 1994) has been used in compiling this section. Gray (1994) describes the different types of fishing gear used inshore and any restrictions. It also gives details of the numbers of boats operating from ports in the region, the amount of fishing effort involved by various methods and which species or species groups are targeted during the different seasons. Gray (1995), a review of the coastal fisheries of England and Wales between 1992 and 1994, has also been used in compiling this section. Brady (1995) lists details of all fishing vessels, their base ports and main fishing methods. The key GB statutes relating to fisheries are described in Eno & Hiscock (1995) and, for Scotland, Cleator & Irvine (1994). Figures given in Tables 9.1.1 - 9.1.7 come from various sources : MAFF, NRA, SOAEFD and IoM DAFF; their interpretation is described below.

Pelagic, demersal and shellfish species

Statistics given in this section are for landings recorded in the region in 1992, not estimated catches made in the region. Some fish caught in the region may not be landed in the region's ports or even in the UK; other fish are landed in the region but are caught outside it; and until 1993, boats under 10 m were not obliged to register their landings. The data presented give an indication of the economic importance of the species that were landed in the region in 1992 (used as a reference year), compared with the rest of Britain and the Isle of Man. Data for 1993 for England and Wales have also been published in MAFF (1995). Data for Scotland for 1993 and 1994 have been published in SOAFD (1994, 1995).

The tonnages of various pelagic, demersal and shellfish

species (fresh and frozen) landed by UK vessels at the major ports in England and Wales come from *UK sea fisheries statistics for 1991 and 1992* (MAFF 1994a); this applies to Fleetwood, the single 'major port' in England and Wales in the region. A total for the 'other' ports (see Map 9.1.1) was provided by the MAFF Fisheries Statistics Unit. Statistics for the Scottish Sea Fisheries Districts are based on *Scottish Sea Fisheries Statistical Tables*, published annually by the Scottish Office Agriculture, Environment and Fisheries Department (formerly the Scottish Office Agriculture and Fisheries Department) (SOAFD 1993). The contributions to fish and shellfish landings by Scottish vessels landed in the part of the Ayr Sea Fisheries District within this 'region' were provided by SOAEFD. The total landed in the four major ports (Ramsey, Peel, Douglas and Port St. Mary) and other smaller ports on the Isle of Man was obtained from the Isle of Man Department of Fisheries & Forestry (IoM DAFF).

The total landings for the Ayr Sea Fisheries District, 'major' and 'other' ports in the English and Welsh parts of the region and for the Isle of Man have been combined to give the figures in the 'Region 13' column for Tables 9.1.1 and 9.1.3 - 9.1.5.

The figures in the 'West coast' column in Tables 9.1.1 and 9.1.3 - 9.1.5 were calculated by adding together all the landings data for the six regions on the west coast of Great Britain, including the Isle of Man, as covered by Doody (1993).

The figures in the 'England & Wales' column were obtained by adding together all of the MAFF data for England and Wales, those in the 'Scotland' column by adding together all of the SOAEFD data for Scotland, and those in the 'Britain and Isle of Man' column by combining MAFF, SOAEFD and IoM DAFF data. Because these organisations do not use the same categories, landings in some of their categories have been added to the 'others' rows in the tables in this section. Also, SOAEFD publish the weight of fish as 'standard landed weight' (gutted fish with head on), whereas MAFF and IoM DAFF publish them as 'nominal live weight' (whole fish). These two are the same for pelagic and shellfish species, but converted data from SOAEFD were used for all demersal species, apart from sandeels (which are not gutted), so that all the data presented are in 'nominal live weight'.

A specialist subset of the electronic mapping system UKDMAP (see 'Core reading list' - section A3 in the Appendix), called SHELLMAP, is being prepared by the MAFF Fish Diseases Laboratory in Weymouth, to meet the requirements of the EC shellfish harvesting and hygiene directives. The software includes charts of all coastal areas (principally estuaries) that support known molluscan shellfisheries, showing all details of the production areas and their classification; however the database is confidential for commercial reasons and access is restricted.

Diadromous species

NRA reported catches for salmon, grilse and sea trout vary in accuracy from year to year, as they represent only declared catches by individuals with a net or rod and line licence; in addition, catches themselves fluctuate, and so the relationship between catch and stock is not straightforward. Further, in 1992, the introduction of changes to the catch recording system may have resulted in a temporarily reduced level of recording. The annual NRA *Salmonid and freshwater statistics for England and Wales* (National Rivers Authority 1991, 1992, 1993, 1994a & b) contains more detailed information.

The data for the Scottish salmon fishery statistical districts are based on returns made in response to an annual questionnaire sent to proprietors and occupiers of salmon fishings under the provisions of section 15 of the Salmon and Freshwater Fisheries (Protection) (Scotland) Act 1951. Over 95% of the forms sent in the region in 1992 were returned. The figures presented are the reported catch and no allowance is made for non-returns or gaps in the roll of proprietors and occupiers. Therefore the figures given in Table 9.1.7 should be used only as an indication of the pattern of the catch in the region. In order to protect commercial confidentiality, the reported catches for each Scottish district are not published split by method, as they are in England & Wales. However, in this region, the majority of their reported catch is made by rod and line and fixed engines. A *Statistical Bulletin* of Scottish salmon and sea trout catches for each individual Fishery Statistical District (see Map 9.1.2) is published annually (SODAF 1990; SO 1991-1994).

Sea angling

In the 84th edition of *Where to fish*, Orton (1994) lists much useful information relating to angling, including the locations from which various species of fish can be caught.

Bait collection

Bait collection is discussed by Fowler (1992), who presents results from a survey around the coast of Britain in 1985.

9.1.5 Acknowledgements

The author thanks the following members of the 'Fisheries Working Group' for their contributions and comments, which enabled the production of this section: Miran Aprahamian (NRA North-West Region), Russell Bradley (Association of SFCs), Blaise Bullimore (Countryside Council for Wales), Phil Coates (SWSFC), Bill Cook (NW & NWSFC), Clare Eno (JNCC), Nancy Harrison (RSPB), Paul Knapman (English Nature), Stephen Lockwood (MAFF DFR), Indrani Lutchman (WWF UK), Mike Pawson (MAFF DFR) and Mark Tasker (JNCC).

Thanks are also due to Dr Andy Brand (Port Erin Marine Laboratory), R.C.A. Bannister (MAFF DFR, Lowestoft), D.T. Dobson (Cumbria Sea Fisheries Committee), David Donnan (Scottish Natural Heritage), David Dunkley (SOAEFD Montrose Field Station), Dr Terry Holt and Dr Debbie Jones (Port Erin Marine Laboratory), David McKay and Derek Murison (SOAEFD Marine Laboratory), C. Rollie (RSPB, Dumfries & Galloway) and staff at IoM DAFF for providing information specifically about this region and for reviewing drafts.

9.1.6 Further sources of information

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Scientific aspects of managing important fish and shellfish stocks	General Secretary, International Council for the Exploration of the Sea, Palaegade 2 -4, DK-1261 Copenhagen K, Denmark, tel: 00 45 331 57092
Central contact for the local Sea Fisheries Committees - England & Wales; general policy issues	Chief Executive, Association of Sea Fisheries Committees, Buckrose House, Commercial Street, Norton, Malton, North Yorkshire YO17 9HX, tel: 01653 698219
Local inshore fisheries, local bylaws, national and EU legislation	Clerk and Chief Fisheries Officer, North Wales and North Western Sea Fisheries Committee, Bailrigg, University of Lancaster, Lancaster, Lancashire LA1 4XY, tel: 01524 68745
Local inshore fisheries, local bylaws, national and EU legislation and the Morecambe Bay Regulating Order	Chief Fisheries Officer, Cumbria Sea Fisheries Committee, Sea Fisheries Office, 6 Duncan Square, Whitehaven, Cumbria CA28 7LN, tel: 01946 693047
Assessment of implications of non-fisheries activities and coast usage on fish stocks and fisheries; advice to assist with management and policy decisions for the coastal zone: England and Wales; interaction between fisheries and non-fisheries conservation issues in England & Wales; seals and fisheries	*Head of Laboratory, MAFF Directorate of Fisheries Research, Fisheries Laboratory (Conwy), tel: 01492 593883
Assessment and advice on the conservation of fish stocks exploited by UK vessels	*Director, MAFF Directorate of Fisheries Research, Fisheries Laboratory (Lowestoft), tel: 01502 562244
Additional statistics other than in publications (available from HMSO)	MAFF Fisheries Statistics Unit, Nobel House, 17 Smith Square, London SW1P 3JR, tel: 0171 238 6000
Local fisheries (Clwyd), quota management, licensing of fishing vessels and enforcement, UK and EU legislation	District Inspector, MAFF Sea Fisheries Inspectorate, Fisheries Office, 5 Hamilton Terrace, Milford Haven, Dyfed SA73 2AL, tel: 01646 693412
Local fisheries (north-west England) quota management, licensing of fishing vessels and enforcement, UK and EU legislation	District Inspector, MAFF Sea Fisheries Inspectorate, Fisheries Office, 26 London Street, Fleetwood, Lancashire FY7 6J6, tel: 013917 35115/6
National NRA fisheries policy and projects; salmonid and freshwater statistics for England and Wales	*Head of Department, Fisheries Department, NRA Head Office, Bristol, tel: 01454 624400
Diadromous fisheries; salmonid and freshwater statistics for Welsh part of the region	Regional Fisheries Manager, NRA Welsh Region - Fisheries Department, Rivers House, St. Mellons Business Park, St. Mellons, Cardiff CF3 0LT, tel: 01222 770088
Diadromous fisheries; salmonid and freshwater statistics for north-west England	Regional Fisheries Manager, NRA - North West Region - Fisheries Department, PO Box 12, Richard Fairclough House, Knutsford Road, Warrington WA4 1HG, tel: 01925 653999
Inter-government convention regulating salmon fishing on the high seas	Secretary, North Atlantic Salmon Conservation Organisation, 11 Rutland Square, Edinburgh EH1 2AS, tel: 0131 228 2551
Administration of fisheries and mariculture in Wales	*Welsh Office Agriculture Department, Fisheries Department, Division 2B, New Crown Buildings, Cathays Park, Cardiff CF1 3NQ, tel: 01222 823567
Statistics on sea fish landings in Scotland. Analysis and dissemination of data and statistics on vessels in the Scottish fishing fleet.	SOAEFD Division J4, Chesser House West, Edinburgh EH11 3AF, tel: 0131 244 6438
International fisheries policy for Scotland. Fisheries conservation including quota policy.	SOAEFD Division J1, Chesser House West, Edinburgh EH11 3AF, tel: 0131 244 6442
Domestic fisheries policy for Scotland. Inshore and shellfisheries management - including Regulating Orders, enforcement and ` environmental aspects	SOAEFD Division J2, Chesser House West, Edinburgh EH11 3AF, tel: 0131 244 6442
Marine and estuarine fisheries research in Scottish waters; interaction between fisheries and non-fisheries conservation issues in Scotland; seals and fisheries	SOAEFD Fisheries Research Services, Marine Laboratory, PO Box 101, Victoria Road, Aberdeen AB9 8DB, tel: 01224 876544
Diadromous fish and fisheries information for Scotland	SOAEFD Freshwater Fisheries Laboratory, Montrose Field Station, 16 River Street, Montrose, Angus DD10 8DL, tel: 01674 677070
Wild salmon and freshwater fisheries policy for Scotland	SOAEFD Division K2, Pentland House, 47 Robb's Loan, Edinburgh EH14 1TY, tel: 0131 244 6230

C. Contact names and addresses (continued)

Type of information	*Contact address and telephone no.*
Scottish Office publications sales	HMSO, 731 Lothian Road, Edinburgh EH3 AA2, tel: 0131 228 4181
Research in the rivers of SW Scotland	West Galloway Fisheries Trust, 18 Main Street, Kirkcowna, Newton Stewart, Wigtownshire DG8 0HG, tel: 01671 830322
Fisheries on the Isle of Man	*Fisheries Officer, Department of Agriculture, Fisheries & Forestry, Isle of Man, tel: 01624 685857
Fisheries on the Isle of Man, especially Manx herring fishery; interaction between fisheries and non-fisheries conservation issues in Isle of Man; seals and fisheries	*Dr Richard Nash, Port Erin Marine Laboratory, tel: 01624 832027
Manx scallop and queen fishery	*Dr Andy Brand, Port Erin Marine Laboratory, tel: 01624 832027
Fishing gear technology	Technical Director, Sea Fish Industry Authority, Seafish Technology Division, Sea Fish House, St. Andrews Dock, Hull, North Humberside HU3 4QE, tel: 01482 27837
Shellfish production (commercial)	Director, Shellfish Association of the UK, Clerk, Fishmongers Hall, London Bridge, London EC4R 9EL, tel: 0171 6263531
Affiliated sea angling clubs in Wales	Secretary, Welsh Federation of Sea Anglers, 46 Lydstep Crescent, Gabalf, Cardiff CF4 2RA, tel: 01222 621795
Affiliated sea angling clubs in England	Secretary, National Federation of Sea Anglers, 51a Queens Street, Newton Abbot, Devon TQ12 2QJ, tel: 01626 331330
Affiliated sea angling clubs in Scotland	Secretary, Scottish Federation of Sea Anglers, Caledonia House, South Gyle, Edinburgh EH12 9DQ, tel: 0131 7177192
Affiliated sea angling clubs in the Isle of Man	Isle of Man Angling Federation, c/o Mrs. I. Glover (Marine Secretary), 11 Berkely Street, Douglas IM2 3QB
Game fishing	Director, Salmon and Trout Association, Fishmongers Hall, London Bridge, London EC4R 9EL, tel: 0171 2835838
Marine Fisheries Task Group paper; interaction between fisheries and non-fisheries conservation issues	*Marine Advisory Officer, JNCC Peterborough, tel: 01733 62626
Interaction between fisheries and non-fisheries conservation issues in England	*Marine Fisheries Officer, EN HQ, Peterborough, tel: 01733 340345
Interaction between fisheries and non-fisheries conservation issues in Wales	*Marine and Coastal Section, CCW HQ, Bangor, tel: 01248 370444
Interaction between fisheries and non-fisheries conservation issues in Scotland	*Aquatic Environments Branch, SNH HQ, Edinburgh, tel: 0131 446 2400
Interaction between fisheries and non-fisheries conservation issues in Isle of Man	*Conservation Officer, Calf Marine Trust, Manx Nature Conservation Trust, Isle of Man, tel: 01624 801985
Interaction between fisheries and non-fisheries conservation issues	*Marine Policy Officer, RSPB HQ, Sandy, tel: 01767 680551
Interaction between fisheries and non-fisheries conservation issues	*Fisheries Officer, WWF-UK, Godalming, tel: 01483 426444
Interaction between fisheries and non-fisheries conservation issues	*Conservation Officer, Marine Conservation Society, Ross-on-Wye, tel: 01989 566017
Interaction between fisheries and non-fisheries conservation issues	*Chairman, Irish Sea Forum, Liverpool, tel: 0151 794 4089
Interaction between fisheries and non-fisheries conservation issues	Honorary Secretary, The Marine Forum for Environmental Issues, c/o University College Scarborough, Filey Road, Scarborough YO11 3AZ, tel: 01723 362392
Seals and fisheries	Co-ordinator, Wildlife & Countryside Link Seals Group, 15 Park Road, East Grinstead, West Sussex RH19 1DW, tel: 01342 315400
Seals and fisheries	Sea Mammal Research Unit (SMRU), High Cross, Madingley Road, Cambridge CB3 0ET, tel: 01223 311354

* Starred contact addresses are given in full in the Appendix.

9.2 Mariculture

C.F. Robson

9.2.1 Introduction

Mariculture is the cultivation of marine species in coastal waters. In this region mariculture occurs in Luce Bay, the Isle of Man and Morecambe Bay.

9.2.2 Locations and species

Map 9.2.1 shows the location of commercial mariculture areas and the species that are cultivated in the region. Table 9.2.1 lists the main species that are under commercial cultivation in the region and in Great Britain and the Isle of Man. There is currently no cultivation of algae or polychaetes in the region. However, techniques have been developed for the cultivation of large brown algae (kelps) on ropes in Derbyhaven, Isle of Man. Spores were seeded onto ropes in tanks and once young plants were established the ropes were transferred to the sea to mature. The peak harvests of a few dry tonnes a year were in 1989 to 1990 and cultivation ceased in 1992.

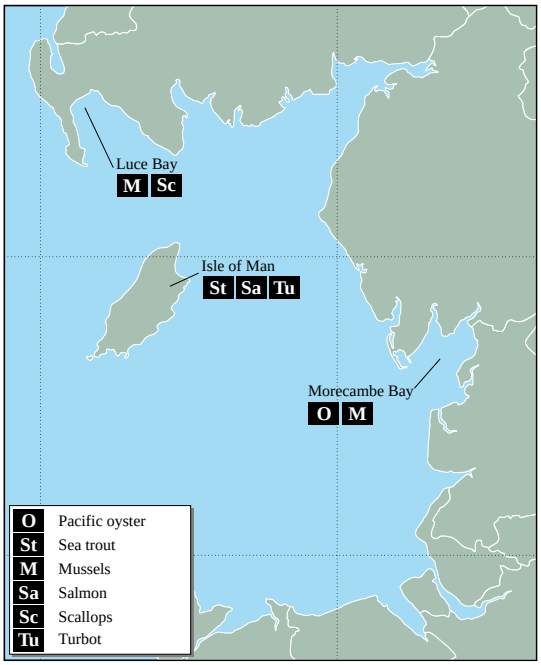
Salmonids

Sea trout are cultured at Cornaa and salmon at Laxey on the Isle of Man by the Department of Agriculture, Fisheries and Forestry (DAFF). They are released as juveniles in late winter or spring, usually in estuaries. There is no caged cultivation of salmonids for commercial purposes in the region.

Table 9.2.1 Main species that are cultivated in the region and in Great Britain

Species	*Native or non-native species*	*Cultivated in region?*
Salmonids		
Atlantic salmon *Salmo salar*	Native	✓
Sea trout *Salmo trutta*	Native	✓
Non-salmonids		
Turbot *Scophthalmus maximus*	Native	✓
Halibut *Hippoglossus hippoglossus*	Native	
Shellfish: bivalve molluscs		
Common mussel *Mytilus edulis*	Native	✓
Pacific oyster *Crassostrea gigas*	Non-native	✓
Hard shelled clams *Mercenaria mercenaria*	Non-native	
Manila clams *Tapes philippinarum*	Un-established introduction	
Palourde *Tapes decussatus*	Native	
Scallop *Pecten maximus*	Native	✓
Queen scallop *Aequipecten opercularis*	Native	✓
Polychaetes		
King ragworm *Neanthes virens*	Native	

Sources: MAFF, Crown Estates Commissioners, NWNWSFC, SOAEFD, IOMDAFF (pers. comms.). Note: For the JNCC's Marine Nature Conservation Review (MNCR), non-native species are those introduced species that are established in the wild; other introduced species are described as un-established introductions.



Map 9.2.1 General location of mariculture areas and species in culture. Sources: MAFF, Crown Estates Commissioners, NWNWSFC, SOAEFD, IOMDAFF (pers. comms.).

Non-salmonids

There is small land-based hatchery at Derbyhaven on the Isle of Man, which produces approximately 250,000 juvenile turbot a year for export to Spain and elsewhere.

Shellfish

Shellfish farming in the region is concentrated in Morecambe Bay and Luce Bay. Morecambe Bay is an important production area for mussels, most of which are exploited by dredging although a small proportion are hand-gathered. They are exploited from an area covered by the Morecambe Bay Fishery Order (see section 9.1.3). They are also a valuable source of mussel seed, which is harvested for transplanting within Morecambe Bay (but outside the Fishery Order area) and also elsewhere, e.g. Menai Strait. Mussels are being cultivated semi-experimentally in three areas on sub-tidal ground lays ('relaying'), in order to complement the natural fishery for this species, and a Several Order has been applied for. The raft culture of mussels on long lines is currently being undertaken in Luce Bay on a site leased from the Crown Estate.

The Pacific oyster is reared in trays and bags on trestles at low water of spring tides in Morecambe Bay. There is also a commercial bivalve nursery situated in a disused gravel pit on Walney Island. This stocks a range of hatchery-reared bivalve species such as hard-shelled clams and Manila clams for sale to the shellfish cultivation industry.

Scallops and queen scallops are cultivated by a single operator in Luce Bay in Scotland; details of methods and tonnage produced are not available. The cultivation of scallops at Port Erin on the Isle of Man is small-scale and experimental. It has been largely limited to tank culture of the early stages and field trials on the potential for reseeding of the sea bed; large scale reseeding trials have so far not been carried out. There have been a few small partially successful trials of hanging cultivation systems at sea, but in practice Manx waters have proved too exposed for this type of cultivation. Unenclosed bottom culture (reseeding) shows some potential (Wilson 1994), but present Manx legislation effectively prevents commercialisation of this method, as there is no equivalent of the Several Order, needed to allow ownership of species placed on the sea bed. There has, however, been much research carried out on settlement patterns of spat (Brand *et al.* 1991). Some scallop spat from MAFF DFR hatchery at Conwy is being grown on at the commercial site at Walney Island.

9.2.3 Management and issues

The Food Safety (Live Bivalve Molluscs) Regulations (which implement European Council Directives) require that all waters from which bivalve molluscs are taken for human consumption are classified by the Ministry of Agriculture, Fisheries and Food (in England & Wales), the Scottish Office Agriculture and Fisheries Department (in Scotland) or DAFF (in the Isle of Man), following sampling carried out by the Port Health Authority or Local Authority. Samples of live shellfish are submitted to the Public Health Laboratory Service (in England & Wales) or SOAEFD Marine Laboratory (in Scotland) or DAFF on the Isle of Man for bacteriological examination and, depending on the resulting category (A - D), restrictions and further treatment may apply before human consumption is permitted. Samples are taken regularly and the classification can change.

A specialist subset of the electronic mapping system UKDMAP (see 'Core reading list' - section A3 in the Appendix), called SHELLMAP, is being prepared by the MAFF Fish Diseases Laboratory in Weymouth, to meet the requirements of the EC shellfish harvesting and hygiene directives. The database includes charts of all coastal areas (principally estuaries) that support known molluscan shellfisheries, showing all details of the production areas and their classification; however the software is confidential for commercial reasons, and access is restricted.

The consent of the owners or managers of the sea bed is required and a lease may be needed before structures for mariculture can be erected on the sea bed. In many areas on the mainland consent must be sought from the Crown Estate, since it owns or manages 55% of the foreshore and the same proportion of the beds of tidal rivers between mean high and low water in GB, together with virtually the entire territorial sea bed. Of the remainder of the mainland foreshore the majority is owned by the Duchies of Cornwall and Lancaster. In Scotland, most licensing of sea-bed (subtidal) sites for the purpose of mariculture is controlled by the Crown Estate Commissioners' (CEC) Edinburgh office, following a formal consultation procedure involving a range of interested bodies including local authorities, River Purification Boards, SOAEFD and Scottish Natural Heritage (Crown Estate 1987, 1989a, 1989b). As far as ownership of the foreshore in the Isle of Man is concerned, there is no equivalent of the Crown Estate. Sea-bed licences are usually granted by the Harbours Division of the Department of Highways, Ports and Properties. Throughout the region, if the intended structures are potentially hazardous to navigation the Department of Transport or equivalent must also authorise their construction, and if they are to be above mean low water mark, planning permission must be sought from the local authority, who will take nature conservation and landscape considerations into account.

Several Orders are granted under section 1 of the Sea Fisheries (Shellfish Act) 1967 and are administered in England by MAFF. They are granted to an individual, a co-operative or a responsible body, e.g. a Sea Fisheries Committee, to enable the cultivation of the sea bed within a designated area of water and to conserve and develop named molluscan species of shellfish; none has been granted in this region. Sea Fisheries Committees may sub-let the rights of a several fishery, subject to the consent of MAFF.

The introduction of non-native shellfish species for cultivation has caused concern over their potential to establish self-sustaining populations, which may affect marine ecosystems. Since January 1993 there have been new, less stringent, requirements for the control of shellfish disease in Great Britain and for the 'deposit' and importation of molluscan shellfish and lobsters, under the EC Fish Health Directive (Directive 91/67). Under this legislation, only the deposit of shellfish originating from areas in which *Bonamia ostreae* occurs is now controlled. (*Bonamia* is a parasite that infects the blood cells of native oysters, causing high mortalities amongst the oysters.) These changes in the legislation have caused concern that the transfer of molluscan shellfish may be accompanyied by accidental releases of associated non-native predators, pests, parasites and diseases. Shellfish and fish farms in England and Wales have to be registered with MAFF or Welsh Office Agriculture Department as appropriate under the Fish Farming and Shellfish Farming Business Order 1985. Registration is designed to assist MAFF in dealing with any outbreaks of pests and diseases. Registration of fish farming and shellfish farming businesses in Scotland with SOAEFD is required by an Order under the Disease of Fish Act 1937 and 1983. Diagnosis, collation of information and research on fish- and shellfish-related diseases in Scotland is carried out by SOAEFD Marine Laboratory, and in England and Wales by the MAFF Fish Diseases Laboratory at Weymouth.

Issues relating to the cultivation of marine species are closely linked to marine nature conservation interests, particularly the possible effects on species and habitats of nature conservation interest. For instance, the intensified activity of mussel farming in Luce Bay has created the potential for eider ducks, which feed on mussels, increasingly to predate the farmed shellfish, causing a conflict between interests in the area. This can be minimised if shellfish farmers take the precations outlined in Galbraith (1992). Issues for mariculture in general and marine nature conservation interests are under consideration by the 'Marine Fisheries Task Force', an inter-agency team of the statutory nature conservation organisations (the Countryside Council for Wales, English Nature, Scottish Natural Heritage and the Department of the Environment for Northern Ireland, together with the JNCC). A

consultation draft paper prepared by the group, entitled *Developing an action programme for sea fisheries and wildlife* (Marine Fisheries Task Force 1994), identifies the main areas where marine fisheries (broadly defined to encompass the exploitation of all living marine resources and therefore including mariculture) affect wildlife and identifies any action needed.

9.2.4 Acknowledgements

Thanks to the following members of the Fisheries Working Group for their contributions and comments: Bill Cook (NW & NWSFC), Phil Coates (SWSFC), Brian Spencer (MAFF DFR Conwy), Paul Knapman (English Nature), Blaise Bullimore (Countryside Council for Wales), Indrani Lutchman (WWF UK), Clare Eno (JNCC), Mark Tasker (JNCC) and Nancy Harrison (RSPB). Additional thanks go to D.T. Dobson (Cumbria Sea Fisheries Committee), Derek Murison (SOAEFD Marine Laboratory), Dr P.D. McGovern (Crown Estate, Scotland), M.G. Pawson (MAFF Directorate of Fisheries Research, Lowsetoft), Dr Debbie Jones, Dr Terry Holt and Dr Andy Brand (Port Erin Marine Laboratory), David Donnan and Roy Cameron (Scottish Natural Heritage), G. Rutherford (Seabait Ltd.), A. Herbert & A. Panayi (Crown Estate) and C. Rollie (RSPB, Dumfries & Galloway) for providing information specifically about this region and for reviewing drafts.

9.2.5 Further sources of information

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B. Further reading

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Wildlife & Countryside Link Seals Group. 1995. *Seals and fisheries: the facts.* East Grinstead, Wildlife & Countryside Link Seals Group.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Central contact for the local Sea Fisheries Committees; general Sea Fisheries Committees policies (England and Wales only)	Chief Executive, Association of Sea Fisheries Committees, Buckrose House, Commercial Street, Norton, Malton, North Yorkshire YO17 9HX, tel: 01653 698219
Mariculture activities and local bylaws - England	Clerk and Chief Fisheries Officer, North Wales and North Western Sea Fisheries Committee (NW & NWSFC), University of Lancaster, Bailrigg, Lancaster, Lancashire LA1 4XY, tel: 01524 68745
Local bylaws - England	Chief Fisheries Officer, Cumbria Sea Fisheries Committee, Sea Fisheries Office, 6 Duncan Square, Whitehaven, Cumbria CA28 7LN, tel: 01946 693047
Fisheries and mariculture in Wales, including Several Orders	Welsh Office Agriculture Department, Fisheries Department, Division 2B, New Crown Buildings, Cathays Park, Cardiff CF1 3NQ, tel: 01222 823567
Fisheries and mariculture in England, including Several Orders	MAFF (Aquaculture Division), Nobel House, 17 Smith Square, London SW1P 3JR, tel: 0171 238 5940
Leases in England and Wales	The Crown Estate Commisioners, Marine Estates, 16 Carlton House Terrace, London SW1Y 5AH, tel: 0171 210 4377
Scientific advice: marine fish and shellfish cultivation; advice on management and policy issues for the coastal zone; interaction between mariculture activities and marine nature conservation issues - England & Wales	*Head of Laboratory, MAFF Directorate of Fisheries Research, Fisheries Laboratory (Conwy), tel: 01492 593883
Bivalve mollusc production areas; classification of shellfish waters and shellfish diseases - England & Wales	Head of Laboratory, Directorate of Fisheries Research, MAFF Fish Diseases Laboratory, Barrack Road, The Nothe, Weymouth, Dorset DT4 8UB, tel: 01305 206600
Technical advice on shellfish depuration	Sea Fish Industry Authority, Sea Fish House, St. Andrews Dock, Hull, North Humberside HU3 4QE, tel: 01482 27837
Leases in Scotland	The Crown Estate Commisioners, Crown Estate Office, 10 Charlotte Square, Edinburgh EH2 4DR, tel: 0131 226 7241
Fish and shellfish farming policy, disease control, Several Orders in Scotland	SOAEFD, Division K4, Pentland House, 47 Robb's Loan, Edinburgh EH14 1TY, tel: 0131 244 6224
Research into fish and shellfish cultivation in Scotland, interaction between mariculture activities and marine nature conservation issues in Scotland	SOAEFD Fisheries Research Services, Marine Laboratory, PO Box 101, Victoria Road, Aberdeen AB9 8DB, tel: 01224 876544

Type of information	*Contact address and telephone no.*
Fisheries and mariculture in Isle of Man	*Isle of Man Department of Agriculture, Fisheries and Forestry, Douglas, tel: 01624 685857
Scientific advice on fisheries and mariculture in the Isle of Man	*Port Erin Marine Laboratory, tel: 01624 832027
Salmon farming	Director, Scottish Salmon Growers Association, Drummond House, Scott Street, Perth PH1 5EJ, tel: 01738 635420
Commercial advice on shellfish	Director, Shellfish Association of the UK, Fishmongers Hall, London Bridge, London EC4R 9EL, tel: 0171 6263531
Interaction between mariculture activities and marine nature conservation issues in Scotland	*Aquatic Environments Branch, SNH HQ, Edinburgh, tel: 0131 446 2400
Interaction between mariculture activities and marine nature conservation issues in England	*Marine Fisheries Officer, EN HQ, Peterborough, tel: 01733 340345
Interaction between mariculture activities and marine nature conservation issues in Wales	*Marine and Coastal Section, CCW HQ, Bangor, tel: 01248 370444
Interaction between mariculture activities and marine nature conservation issues on the Isle of Man	*Conservation Officer, Calf Marine Trust, Manx Nature Conservation Trust, St. Johns, tel: 01624 801985
Marine Fisheries Task Group paper; interaction between mariculture activities and marine nature conservation issues	*Marine Advisory Officer, JNCC Peterborough, tel: 01733 62626
Mariculture and marine nature conservation issues	*Coastal Policy Officer, RSPB HQ, Sandy, Beds., tel: 01767 680551
Mariculture and marine nature conservation issues	*Fisheries Officer, WWF-UK, Godalming, tel: 01483 426444
Mariculture and marine nature conservation issues	*Conservation Officer, Marine Conservation Society, Ross-on-Wye, tel: 01989 566017
Irish Sea Study Group publications	*Chairman, Irish Sea Forum, Liverpool, tel: 0151 794 4089
Interaction between mariculture activities and marine nature conservation issues	*Honorary Secretary, The Marine Forum for Environmental Issues, Scarborough, tel: 01723 362392
Seals and mariculture	Co-ordinator, Wildlife & Countryside Link Seals Group, 15 Park Road, East Grinstead, West Sussex RH19 1DW, tel: 01342 315400
Seals and mariculture	Sea Mammal Research Unit (SMRU), High Cross, Madingley Road, Cambridge CB3 0ET, tel: 01223 311354

*Starred contact addresses are given in full in the Appendix.

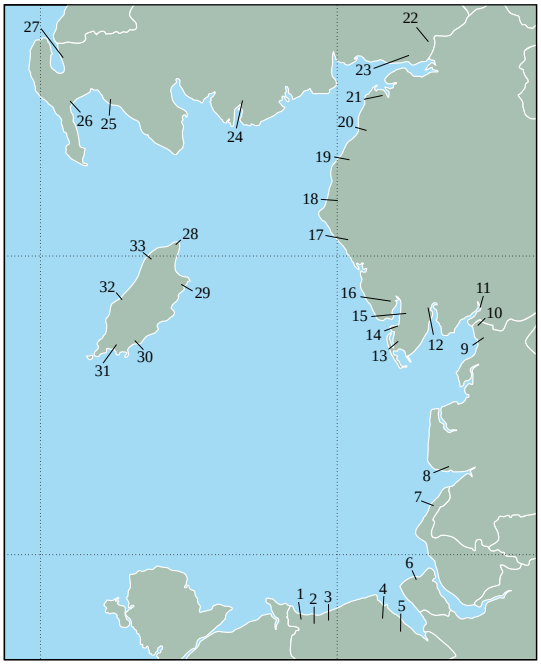
9.3 Quarrying and landfilling

C.A. Crumpton & M.J. Goodwin

9.3.1 Introduction

In this section, quarries are included as coastal if they are less than 2 km inland, and landfill sites if they are in a coastal 10 km square. The minerals quarried in the region on a commercial basis are silica sand, salt, sand and gravel, sandstone, igneous rock, clay and shale, limestone, marble, slate, coal, fireclay, chert, tufa, gypsum, anhydrite, barytes and iron ore (hematite). This wide variety of minerals is important for uses including concrete mix, building stone, railway ballast, agriculture, iron and steel making, glass making, and roofing materials and other constructional uses.

Table 9.3.1 presents production levels by whole county, compared with British levels, for the main minerals quarried in the region. Figures for slate, chert and coal production are not available on a regional basis. However, there are 42 slate quarries in Britain with a total production in 1991 of 360,000 tonnes. In 1991, total British production of chert was 5,000 tonnes. Of the 266 coal mines in Britain, four are located along the region's coast. Total British production of coal in 1991 was 92,713,000 tonnes.



Map 9.3.1 Coastal quarries. Numbers refer to Table 9.3.2. Source: BGS (1994, 1995). © Crown copyright.

9.3.2 Important locations

There are 40 coastal quarries in this region, including seven in the Isle of Man (Table 9.3.2; Map 9.3.1). They extract limestone (ten), chert (one), coal (four), sand and/or gravel (fourteen), clay and shale (two), silica sand (one), slate (two), igneous rock (one), marble (one) and sandstone (four). The chert quarry in Clwyd is currently the only one in Britain. Three of the four coal mines in the region are on the north Cumbrian coast, the other being in Clwyd. Most limestone is quarried in the western part of Clwyd and around the Cumbrian side of Morecambe Bay, with one quarry on the Isle of Man. Sand and gravel extraction occurs throughout the region. Igneous rock is extracted in the region only at Millom in Cumbria. Salt is extracted from brine wells on the River Wyre at Fleetwood. On the Isle of Man, the Manx slate quarry at Maughold and the marble quarry at Castletown both probably produce less than 1,000 tonnes per year (Isle of Man Department of Industry pers. comm.).

Map 9.3.2 shows the location of the region's currently used coastal landfill sites, according to Aspinwall's Sitefile Digest (Aspinwall 1994); the status codes are defined in

Table 9.3.1 Minerals production# in Region 13 (1993)

	Limestone		*Sand & gravel*		*Clay & shale*		*Igneous rock*		*Sandstone*	
	Tonnes	*% of GB total*	*Tonnes*	*% of GB total*	*Tonnes*	*% of GB total*	*Tonnes*	*% of GB total*	*Tonnes*	*% of GB total*
Clwyd	7,867,000	7.4	1,178,000	1.3	213,000	2.0	0	0	31,000	0.3
Cheshire	0	0	2,200,000[c]	2.5	34,000	0.3	0	0	1,575,000[a]	13.0
Merseyside	0	0	500,000	0.6	51,000	0.5	0	0	0	0
Lancashire	5,301,000	5.0	800,000[f]	0.9	565,000	5.1	n/a	n/a	1,565,000	12.9
Cumbria	5,184,000	4.9	914,000[e]	1.0	n/a	n/a	891,000[c]	1.8	47,000	0.4
Dumfries & Galloway	1,216,000[b]	1.1	1,041,000[d]	1.2	19,000	0.2	324,000	0.7	n/a	n/a
Isle of Man*	50,000	<0.1	12,226,000	12.5	n/a	n/a	n/a	n/a	n/a	n/a
Region 13	***19,618,000***	***18.5***	***18,859,000***	***21.1***	***n/a***	***n/a***	***n/a***	***n/a***	***n/a***	***n/a***
England	84,123,000	79.4	74,833,000	83.6	9,883,000	90.7	24,783,000	50.4	9,003,000	74.4
Scotland	1,432,000	1.4	11,359,000	12.7	622,000	5.7	20,806,000	42.3	1,716,000	14.2
Wales	20,330,000	19.2	3,278,000	3.7	386,000	3.5	3,621,000	7.4	1,381,000	11.4
Great Britain*	***105,885,000***		***89,470,000***		***10,891,000***		***49,209,000***		***12,100,000***	

Main source: BGS (1995). Key: #amounts rounded up to next whole thousand tonnes; [a]includes Greater Manchester; [b]includes Lothian, Strathclyde and Tayside; [c] includes Durham. Other sources: [d]Scottish Office (1995); [e]Northern Region Working Party on Aggregates (1994); [f]North West Regional Aggregates Working Party (1994); *Isle of Man figures are 1991 estimates from the Manx Department of Industry; **excluding Isle of Man; n/a = not available.

Table 9.3.2 Coastal quarries in Region 13

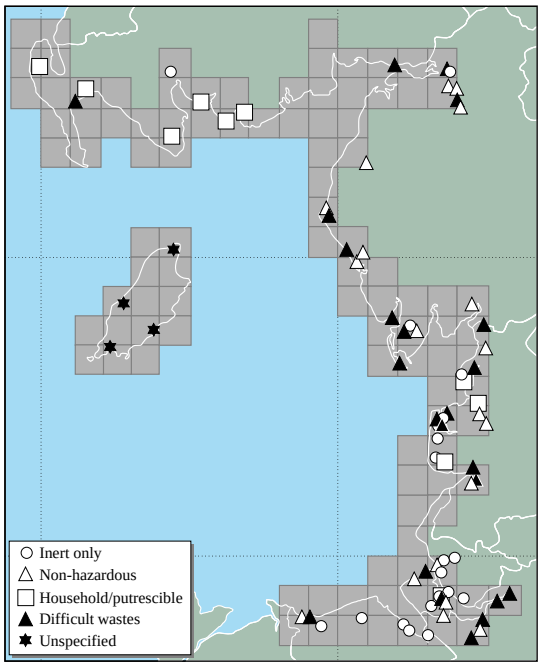
*Site no.**	*Location*	*Operator*	*Mineral*
	Clwyd		
1	Old Colwyn	Plas Gwilym Quarry Co.	Limestone
2	Llysfaen	RMC North West Aggregates	Limestone
3	Abergele	ARC Northern	Limestone
3	Abergele	Tilcon Western	Limestone
4	Holywell	RMC North West Aggregates	Limestone
4	Holywell	Alfred McAlpine Quarry Products	Chert
4	Point of Ayr	British Coal - Northern Group	Coal (deep mined)
5	Bagillt	Clay Colliery - J.A. Morgan and Sons	Sand and gravel
	Merseyside		
6	Moreton	Barker and Briscoe Ltd.	Clay and shale
7	Ribble Estuary	Southport Sand Co. Ltd.	Silica sand
	Lancashire		
8	St. Anne's	Southport Sand Co. Ltd.	Sand and gravel
9	Warton	Tilcon Eastern	Sand and gravel
	Cumbria		
10	Silverdale	ARC Northern	Limestone
11	Milnthorpe	Tarmac North West	Limestone
12	Ulverston	Burlington Slate Ltd.	Limestone
13	Barrow-in-Furness	Tilcon Eastern	Limestone
13	Barrow-in-Furness	Roose and Walney Sand and Gravel Co.	Sand and gravel
14	Askam-in-Furness	Furness Brick and Tile Co. Ltd.	Clay and shale
15	Kirkby-in-Furness	Burlington Slate Ltd.	Slate
16	Millom	Evered Bardon - Bardon Roadstone	Igneous
17	Holmrook	Peel Place Sand and Gravel	Sand and gravel
18	Whitehaven	Cumbria Stone Quarries Ltd. (2 quarries)	Sandstone
18	Whitehaven	Mainband Colliery Co. Ltd.	Coal (deep mined) (closed)
19	Workington	Wimpey Construction/BC Opencast	Coal (closed)
20	Maryport	R & A Young Mining Ltd/BC Opencast	Coal (closed)
21	Silloth	Greggains	Sand and gravel
	Dumfries & Galloway		
22	Gretna	Wimpey Asphalt	Sand and gravel
23	Annan	Dunhouse Quarry Co. Ltd.	Sandstone
24	Kirkcudbright	W.J. Barr and Sons	Sandstone
25	Glenluce	W.J. Barr and Sons	Sand and gravel
26	Sandhead	W.J. Barr and Sons	Sand and gravel
26	Sandhead	R. Potter and Co.	Sand and gravel
27	Cairnryan	W.J. Barr and Sons	Sandstone
	Isle of Man		
28	Point of Ayre	Island Aggregates Ltd.	Sand and gravel
29	Maughold	Dreemskerry Quarry	Manx Slate
30	Ballasalla	C. Kniveton Ltd.	Limestone
31	Castletown	Manx Marble & Granite Company Ltd.	Mainly marble
32	Ballahara, Peel	Corletts	Sand and gravel
32	Lhergydhoo, Peel	Sugarray Ltd.	Sand and gravel
33	Jurby	Small-scale extraction	Dune sand

Source: BGS (1994), except for Isle of Man information, which is from the Isle of Man Department of Industry. Key: * shown on Map 9.3.1.

Table 9.3.3. Most coastal landfill sites are clustered around the major centres of population and industry, such as on the Mersey Estuary, the Lancashire coast and south Cumbria. There are very few sites north of Barrow-in-Furness; on the Dumfries & Galloway coast, most are for household wastes. The Isle of Man has one major landfill site, at Ballacallow, about 1 km from the coast at Point of Ayre in the north of the island. It takes mainly putrescible/household waste from virtually the whole island, while inert wastes are landfilled at Kewaigue, near Douglas, and Lhergydhoo, near Peel. Small amounts of putrescible/household wastes are landfilled near Port St. Mary, though this is likely to stop by the end of the decade. The Ballacallow and Lhergydhoo landfills are both associated with worked-out sand and gravel extraction.

9.3.3 Management

Whilst production of sand and gravel in the region decreased between 1990 and 1993, production of crushed rock rose sharply. The British Geological Survey estimates that in the period 1992-2006, demand for land-won aggregates in England will be about 3.1 billion tonnes, of which 1.2 billion tonnes would comprise sand and gravel and 1.9 billion tonnes crushed rock (BGS 1995). A further 1.1 billion tonnes is expected to be derived from marine sources, from imports from Scotland and Wales and also from secondary and recycled materials. These figures, if realised, would represent a significant shift in production since the late 1980s from onshore quarrying towards the use of imported and secondary materials. In order to help meet the extra demand, the development of a number of large



Map 9.3.2 Coastal landfill sites. Source: Site File Digest (Aspinwall 1994). Note: a single symbol may represent more than one site in close proximity.

coastal quarries is envisaged, although none is planned for this region.

Landfill site licensing in Great Britain is the responsibility of the 152 Waste Regulation Authorities (WRAs). In England these are the county councils and in Wales and Scotland the district councils, usually through their Environmental Health or Technical Services Departments. Waste management licences were introduced by the 1990 Environmental Protection Act to replace the disposal site licences previously required by the 1974 Control of Pollution Act. Each WRA is required to maintain a public register of waste management licences for private sites in its area and a register of resolutions referring to its own sites.

In the Isle of Man responsibility for landfill site planning is held by the Department of Local Government and the Environment. The Isle of Man potentially has a great problem with waste disposal. Landfilling at Ballacallow must cease after 1997 and no acceptable replacement site has yet been found. The Isle of Man Government's preferred option for future waste disposal is now incineration and it is expected that detailed plans will be announced in the near future. Presently 14% of the island's 'green list' recyclable municipal waste (paper, glass and aluminium), together with all scrap metal, is exported for recycling. However, because the Isle of Man is not a full member of the EC, it cannot export other wastes (such as old engine oil) to EC member states without a bilateral agreement. There is no such agreement at present, so a number of such wastes are presently being stockpiled. The Isle of Man Government is actively pursuing a bilateral agreement with the UK government.

In April 1996, the new Environment Agency (for England and Wales) and the Scottish Environmental Protection Agency will come into force, instigated by the Environment Bill. The new agencies will integrate the functions of Her Majesty's Inspectorate of Pollution (HMIP), the local waste regulatory authorities and the National Rivers Authority (NRA) (for England and Wales; the River Purification Boards (RPBs) in Scotland). The activities of the new agencies will be grouped under two broad headings: pollution prevention and control, including waste regulation, the work of HMIP and the NRA's/RPB's work on water quality; and water management, covering the NRA's/RPB's other functions. However, there will be a strong link between pollution prevention and control, and water management, to ensure continuing integrity of estuarine and coastal management. Also within the Environment Bill is the requirement for mine operators to give the agencies at least six months' notice of their intention to abandon a mine, in order that steps can be taken to avoid future pollution from minewater. Also relevant to quarrying and landfilling are the provisions relating to producer responsibility for waste. These will provide a mechanism to ensure that business initiatives on re-using, recovering and recycling waste are not undermined by those seeking to avoid their obligations.

In general terms the agencies' boundaries will follow political boundaries, to facilitate local accountability. At the time of writing, the boundary of the Welsh region had not been finalised. Whilst most of the agencies' interactions with local authorities on waste planning and management will be with county/regional councils, many of the boundaries will follow district council/unitary authority boundaries, depending on which provides the 'best fit'.

Table 9.3.3 The status of the region's coastal landfill sites

Status code	*Definition*	*Number in region*
1 Inert only	Uncontaminated excavated natural earth materials, and uncontaminated brick rubble and concrete with similar properties to natural earth materials.	24
2 Non-hazardous	Mainly uncontaminated and industrial wastes such as packaging materials, wood and plastic. Some of these wastes are biodegradable but not rapidly so.	21
3 Household/ putrescible	Typical contents of a household dustbin and similar wastes of industrial origin e.g. food processing wastes.	10
4 Difficult wastes	Any wastes which require particular handling techniques at the disposal site, e.g. vehicle tyres, dry feathers, animal carcasses. They are not the same as Special Wastes, which are toxic and require pre-notification of disposal to the Waste Regulation Authority.	24
Unspecified - Isle of Man only		4
Total		***79***

Source: Aspinwall & Co. (1994). Note: status codes are as shown on Map 9.3.2 (except for Isle of Man sites).

9.3.4 Information sources used

Mainland data on quarrying were obtained from the British Geological Survey's Directory of Mines and Quarries and are the most up to date and comprehensive available. In a very small number of cases, exact addresses of quarries were not listed and therefore it was not known if they were coastal. Data for quarrying in the BGS Directory of Mines and Quarries may be up to three years old and may therefore include information on some operations that have now ceased. Owing to the method of compiling the statistics, some county/region figures for minerals production include amounts produced in counties or regions outside Region 13, as noted in Table 9.3.1.

The data for landfilling were provided by Aspinwall & Co. from their Sitefile Digest on waste treatment and disposal. This contains regularly updated information from the 152 Waste Regulation Authorities (WRAs) and represents the most up to date collection of public information on British waste management available. Data for the Isle of Man were obtained from the Isle of Man Department of Local Government and the Environment.

9.3.5 Acknowledgements

Thanks go to Dr Ron Moore and Susan Morley (Aspinwall and Co.) for providing information from the Sitefile Digest.

9.3.6 Further sources of information

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BGS (British Geological Survey). 1995. *United Kingdom Minerals Yearbook 1994.* Keyworth, Nottingham, British Geological survey.

B. Further reading

Eno, N.C., *ed*. 1991. *Marine conservation handbook.* 2nd ed. Peterborough, English Nature.

Perkins, E.J. 1990. Coal-mining wastes as a factor in the marine environment. *Porcupine Newsletter, 4*: 203-210.

Scottish Office. 1994. *The Scottish environment - statistics, No. 4 1993.* Edinburgh, Government Statistical service.

C. Contact names and addresses

Type of information	Contact address & telephone no.
Landfill database and Sitefile Digest	Aspinwall & Co., Walford Manor, Baschurch, Shrewsbury SY4 2HH, tel: 01939 261144
Waste regulation; minerals planning: Colwyn	*Director of Housing and Technical Services/Minerals Planning Officer, Colwyn District Council, tel: 01492 515271
Waste regulation; minerals planning: Rhuddlan	*Borough Health Officer & Housing Manager/Minerals Planning Officer, Rhuddlan District Council, tel: 01745 345000
Waste regulation; minerals planning: Delyn	*Commercial Services Manager/Minerals Planning Officer, Delyn District Council, Canton Depot, Bagillt, Clwyd CH6 6JB, tel:01352 715005
Waste regulation; minerals planning: Alyn and Deeside	*Director of Housing and Works/Minerals Planning Officer, Alyn & Deeside District Council, tel: 01244 525000
Waste regulation; minerals planning: Cheshire	Chief Waste Regulation Officer/Minerals Planning Officer, Cheshire County Council, Commerce House, Hunter Street, Chester CH1 2QW, tel: 01244 603597
Waste regulation: Merseyside	Assistant Director - Regulation, Merseyside Waste Disposal Authority, Level 4, Steers House, Canning Place, Liverpool L1 8JW, tel: 0151 709 3607
Waste regulation; minerals planning: Lancashire	Assistant County Surveyor - Waste Regulation/Minerals Planning Officer, Lancashire County Council, County Surveyors Dept., PO Box 9, Guild House, Cross Street, Preston PR1 8RD, tel: 01722 264666
Waste regulation; minerals planning: Cumbria	Waste Regulation Manager/ Minerals Planning Officer, Cumbria County Council, Dept. of Highways & Transportation, Citadel Chambers, Carlisle CA3 8SG, tel: 01228 812369
Minerals planning: Dumfries & Galloway	*Department of Physical Planning, Dumfries & Galloway Regional Council, Dumfries, tel: 01387 261234 (260034)
Waste regulation; minerals planning: Annandale and Eskdale	*Director of Environmental & Leisure Services/Minerals Planning Officer, Annandale and Eskdale District Council, tel: 01461 203311
Waste regulation; minerals planning: Nithsdale	*Director of Environmental Services/Minerals Planning Officer, Nithsdale District Council, tel: 01387 253166
Waste regulation; minerals planning: Stewartry	*Director of Environmental Health and Leisure Services/Minerals Planning Officer, Stewartry District Council, tel: 01557 30291
Waste regulation; minerals planning: Wigtown	*Director of Technical Services/Minerals Planning Officer, Wigtown District Council, tel: 01776 702151
Mines and quarries (British Directory of Mines and Quarries) - England, Wales and Scotland	Director, British Geological Survey, Keyworth, Nottingham NG12 5GG, tel: 0115 936 3100
Details of disused collieries	Coal Authority, Bretby Business Park, Ashby Road, Burton-on-Trent, Staffs. DE15 0QD, tel: 01283 553291
Mines and quarries - Isle of Man	L. Crellin, Isle of Man Government - Department of Industry, Illiam Dhone House, 2 Circular Road, Douglas IM1 1PJ, tel: 01624 685675
Landfill and waste disposal - Isle of Man	*Chief Environmental Health Officer, Isle of Man Government - Department of Local Government and the Environment, Mount Havelock, Douglas, tel: 01624 685894

* Starred contact addresses are given in full in the Appendix.

9.4 Marine aggregate extraction, dredging and solid waste disposal at sea

C.A. Crumpton & M.J. Goodwin

9.4.1 Introduction

Sand and gravel on the sea bed are important sources of industrial aggregate for concrete production, beach replenishment and beach protection. Marine aggregates satisfy an increasing part of the total demand for sand and gravel in Britain, each year accounting for 15% of the national total requirement (Crown Estate 1994). The main market is in the south-east of England. Marine sand and gravel are extracted by commercial mineral companies under licence from the Crown Estate. There is no equivalent body to the Crown Estate in the Isle of Man, and no licences for marine aggregate extraction presently exist for Manx waters. Recent applications have been rejected on environmental grounds.

The national demand for aggregate increased steadily during the 1980s. In response, the aggregate industry invested in new ships, which allowed more efficient exploitation of licence areas and new, deeper waters to be dredged (Kenny & Rees 1994). Marine extraction in England and Wales reached a peak of 28 million tonnes in 1989, but has since fallen steadily. In 1994, a total of 20,792,887 tonnes of aggregate from the bed of the territorial sea and continental shelf were landed under licence from the Crown Estate. This figure includes approximately 6 million tonnes of aggregate that were dredged in Great Britain but exported to landing ports abroad. The 290,846 tonnes of marine aggregate dredged in the region represents about 1% of this total (Crown Estate 1995) (Table 9.4.1). In this region, no sand or gravel has been extracted recently for contract fill or beach nourishment (using material as extracted, not processed).

Navigational dredging is the responsibility of individual harbour authorities, although a licence from MAFF is required for disposal of the dredged material offshore. Capital dredging refers to the one-off removal of sediment, chiefly when deepening shipping channels and during the construction of new dock facilities. Thereafter, maintenance dredging is the regular dredging of existing ports and their approaches to maintain safe navigation. The majority of dredged material, which can range in composition from silts to boulder clay and rock, is deposited at sea, although dredged material is used for land claim and increasingly for beach recharge. During the NCC's Estuaries Review surveys, carried out in 1989, out of a total of 155 review sites (estuaries), capital dredging was taking place in fifteen and maintenance dredging in 72 estuaries around Great Britain - 9.7% and 46.5% respectively of the estuaries surveyed. Dredged material was being disposed of in ten (6.5%) of the estuaries surveyed (Davidson *et al*. 1991).

Since 1988 there has been a downward trend in the wet tonnage of dredged material deposited in the seas of the UK, from 44,303,995 tonnes in 1989 to 29,866,256 tonnes in 1993 (Table 9.4.2) (MAFF 1995). In 1993 dredged material deposited in the region (3,972,790 tonnes) constituted 13% of the total dredged material deposited around the UK as a whole.

The disposal of solid wastes, including sewage sludge, at sea requires a licence from MAFF (SOAEFD in Scottish waters) (Food and Environment Protection Act 1985). Some sewage sludges are principally of domestic origin and contain low levels of metals and other persistent components. Others include industrial inputs, resulting in higher concentrations of contaminants. In terms of sewage disposal, the UK produces some 1.1 million tonnes of dry solids (tds) annually and disposes of approximately 300,000 tds (equivalent to about 10,000,000 wet tonnes) to the sea. About 60,000 tds are deposited annually in

Table 9.4.1 Marine dredged aggregates and contract fill/beach nourishment material licensed, extracted and landed in the region and Great Britain in 1994 (tonnes)

	Aggregates:#		*Contract fill/beach nourishment:*	*Total aggregates and contract fill/ nourishment:*
	licensed	*extracted*	*extracted*	*landed*
Region 13*	**804,999**	**290,846**	**0**	**223,579****
England and Wales***	37,726,599	20,792,887	1,286,372	15,441,500

Source: Crown Estate (1995). Key: #excludes contract fill/beach nourishment material; *North West dredging area; **all landed at Liverpool; ***no marine aggregates are dredged off Scotland.

Table 9.4.2 Dredged material licensed and disposed of at sea in 1993

	Licences issued	*Sites under licence*	*Sites used*	*Tonnes licensed*	*Wet tonnage deposited*
Region 13	12	23	15	9,459,590	3,972,790
England and Wales	110	89	67	66,074,966	26,086,503
Scotland	26	46	22	3,174,050	2,025,525
UK	***143***	***146***	***110***	***70,245,516***	***29,866,256***

Source: MAFF (1995). Note: licences may commence at any time and generally last for one year.

Region 13 (Table 9.4.3). UK sewage sludge production is set to increase dramatically over the next decade, to a predicted 3.3 million tds by 2006. Under the Urban Waste Water Treatment Directive (91/271/EEC), all sewage sludge disposal by marine vessels is set to be phased out by 1998. It will have to be replaced by disposal on land, by tipping or incineration. In the Isle of Man small amounts of sludge are sometimes discharged down short sea outfalls along with normal sewage.

Solid industrial waste was waste rock from mining operations, which was disposed of at sea, chiefly in north-east England. There was one licensed site in this region, at Point of Ayr Colliery (now closed), Clwyd, where mine waste was used for foreshore land claim (Table 9.4.3). Licences for these activities terminated at the end of 1995.

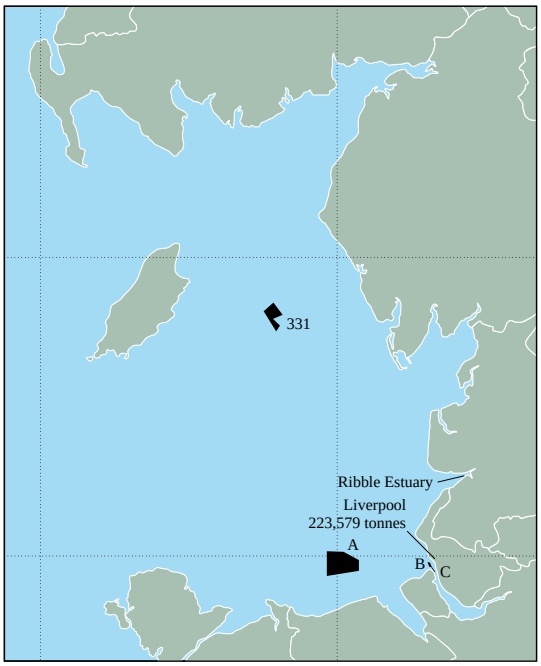
9.4.2 Important locations

Marine aggregates dredging

Map 9.4.1 shows the areas in the region licensed by the Crown Estate in 1994 for marine aggregate dredging (Crown Estate 1995). Aggregates normally come from the extraction areas closest to the landing port concerned, but it is not always possible to specify where the aggregate landed at specific ports was dredged, owing to the movement of aggregate to different markets. Occasionally a cargo may have come from a completely different licence, as the dredger may have moved from one licensed area to another, but the amounts involved will be small in overall terms.

In Liverpool Bay, approximately 14 km north of Rhyl, aggregate is extracted by United Marine Dredging Ltd and Norwest Sand and Ballast Company (site A on Map 9.4.1). Building sand is dredged from two very small licence areas at the mouth of the Mersey Estuary (sites B and C on Map 9.4.1). A limited amount of material was taken from the licence area off the north Wales coast into Belfast, Briton Ferry and Swansea. Up to 200,000 tonnes of sand is extracted each year from around the Ribble Estuary, taken mainly from sand banks off Southport and Lytham St. Anne's. An area located approximately 33 km due west of the Cumbrian coast is dredged by United Marine Dredging Ltd. (Map 9.4.1).

Liverpool is the only port in the region where aggregates were landed. In 1994, 223,579 tonnes of marine dredged aggregates were landed there, all of it dredged locally (Crown Estate pers. comm.) and serving local markets. None of the material dredged was landed in mainland Europe (Crown Estate pers. comm.).



Map 9.4.1 Licensed marine aggregate dredging areas, tonnage landed at Liverpool, and site of sand extraction (Ribble Estuary). 331, A, B & C are licence codes. Source: Crown Estate (1994).

Navigational dredging

Significant regular maintenance dredging takes place in few locations in the region: on the mainland these are the Mersey Estuary, the entrance to the port at Barrow-in-Furness in Morecambe Bay and the inner Solway Firth at the entrance to Annan Harbour. Dredging of the approach channels to the Mersey Docks started in 1890, with the material being disposed of near the mouth of the Mersey. Approximately 3 million tonnes of material were dredged from the channels and docks of the Mersey in 1990 (Irish Sea Study Group 1990b). In the Isle of Man, only Douglas Harbour is frequently dredged. Ramsey, Laxey, Castletown, Peel and Port St. Mary harbours are probably dredged less than once per year on average.

Dredged material disposal

Significant quantities of dredged material are deposited in Liverpool Bay (Map 9.4.2 and Table 9.4.5). Material from the Mersey Docks has been deposited in the Mersey Estuary since 1825 and in Liverpool Bay since 1874. In recent years, substantial quantities of material have been deposited in Morecambe Bay. Some of this material originated from extensive capital dredging in the Walney Channel, associated with the Trident submarine project at Barrow-in-

Table 9.4.3 Disposal of other solid materials at sea in 1993 (in tonnes of dry solids - tds)

Type of material	*Site code (Map 9.4.2)*	*Deposition site*	*Tonnage licensed*	*Tonnage deposited in the region*	*Tonnage deposited in the region*	*National % deposited in the region*
Solid industrial waste - minestone	IS095	Point of Ayr, Clwyd	100,000	57,043	2,205,670	2.6
Sewage sludge (2 licences)	IS070	Liverpool Bay	1,970,000	1,983,241	9,923,196	20.0

Source: MAFF (1995).

Map 9.4.2 Sites of licensed disposal of materials (dredged, except where stated) at sea used in 1992 and 1993 (see Tables 9.4.3 and 9.4.5). Source: MAFF (1995). © Crown copyright.

Furness (Irish Sea Study Group 1990a), but large volumes dredged from Fleetwood and Heysham approaches are also deposited in the Bay. There are other disposal sites in the Irish Sea, one located in the Solway Firth (IS310) and another off the Isle of Man (IS300). Dredged material from the six ports on the Isle of Man at which dredging occurs is is deposited only at licensed positions (Map 9.4.2), which in theory can vary from year to year but which in practice remain reasonably constant. A single licence for depositing dredged material is issued annually to the Department of Transport's own dredger; in 1994-1995 the licence was for up to 24,200 tonnes, to cover all six of the main harbours/ports. In most years it is unlikely that the licence figure is reached (IoM DoT pers. comm.). In 1994/5 an external contractor was granted a licence to dispose of 95,000 tonnes of material from the redevelopment of Douglas outer harbour at the designated deposition site for Douglas.

9.4.3 Management and issues

Marine aggregates dredging

Marine sand and gravel are extracted by commercial mineral companies under licence from the Crown Estate. Government policy for the provision of aggregates, formulated in 1982 and 1989, has encouraged marine extraction of sand and gravel: Minerals Planning Guidance Note 6 (which refers to England only) states that "it has a very important role to play in maintaining supplies of aggregate and, as far as possible, its use is to be encouraged" (Crown Estate 1992). The government has announced its intention (as at November 1995) to change the system whereby approval is given for the issuing of licences for aggregate extraction. The current system involves obtaining a favourable 'Government View', through a non-statutory analysis and consultation process co-ordinated by the Department of the Environment. The government intends that, in future, applications for marine aggregate extraction licences should be subject to the same type of process as terrestrial planning applications under the Town and Country Planning Acts, regardless of the ownership of the sea bed. The interim position is described in Department of the Environment (1995), which recommends that "the dredging industry will find it helpful to produce a formal Environmental Statement to support most applications for a production licence".

Aggregates from terrestrial sources are insufficient to meet demand (Doody *et al.* 1993), and dredging for marine aggregates tends to arouse less controversy than terrestrial extraction (although it is not therefore without implications - see below). The government promotes environmentally sustainable coastal defences, and, as a result, the use of sand and gravel for beach recharge is predicted to grow substantially (NERC undated; see also section 8.4). High quality marine aggregate exists in coastal areas adjacent to the main markets in south-east England (Kenny & Rees 1994).

Aggregate extraction from the sea bed commonly involves using either suction pipes or bucket dredges. The former method creates long shallow tracks or large round holes several metres deep, depending on whether the pipe is trailed or fixed. The latter method results in localised depressions, the size of which depends on the capacity of the bucket dredge. The biological implications of extraction depend upon the characteristics of the individual area concerned and are potentially far reaching. If an area is used by fish for spawning, for which a stable bed is

Table 9.4.4 Locations in the region where significant navigational dredging occurs

Location	*Type of dredging*	*Comments*
Mersey Estuary and docks: Liverpool, Birkenhead, Garston and the Manchester Ship Canal	Capital & maintenance	Regular dredging of entrance channel - up to 1 million m^3 per annum
Morecambe Bay: significant dredging at the ports of Barrow, Fleetwood and Heysham	Capital & maintenace	115,000 m^3 of silt removed annually from port entrance at Barrow-in-Furness
Inner Solway Firth	Maintenance	5,000 m^3 removed annually from Annan harbour entrance
Douglas	Maintenance	

Source: Davidson *et al.* (1991)

Table 9.4.5 Dredged material disposed of at licensed sites in the region in 1992 and 1993

Site name	*MAFF code (on Map 9.4.2)*	*Dredging waste type*	*Depth*	*Distance from coast*	*Deposited tonnage*	
			(m)	*(km)*	*1992*	*1993*
Mersey (Garston site)	IS110	Maintenance	0-10	n/a	233,103	161,522
Mersey (mid river site)	IS120	Maintenance	5	n/a	8,000	68,950
Mersey off Bromborough	IS127	Maintenance	5	1	0	0
Liverpool Bay	IS140	Maintenance	8	n/a	1,575,240	2,069,272
Liverpool Bay	IS150	Maintenance	19	n/a	14,900	4,170
Morecambe Bay: Lune Deep	IS170	Maintenance	32	n/a	547,714	502,507
Barrow A	IS180	Capital	5	7	0	0
		Maintenance			0	0
Lune River B	IS192	Maintenance	n/a	0	4,860	24,890
Morecambe Bay B	IS200	Maintenance	5	n/a	383,639	247,642
Barrow D	IS205	Capital	11	8	90,094	
		Maintenance	11	8	90,094	n/a
					744,742	492,780
Barrow B	IS210	Capital	14	n/a	15,960	157.570
		Maintenance			59,700	0
Whitehaven	IS230	Maintenance	15	n/a	31,140	n/a
Solway Firth	IS240	Maintenance	12	n/a	112,962	153,686
Silloth	IS240	Maintenance	7	1	0	n/a
Portpatrick	IS290	Maintenance	58	3	0	0
Burrow Head B	IS300	Capital	50	16	11,206	45,093
Burrow Head A	IS310	Capital	43	3.5	114,825	12,762
North Channel, Scotland	MA010	Maintenance	150	6	22,378	1,020
Stranraer	MA015	Capital	225	8	30,000	0
Isle of Man	IS410	n/a	n/a	2.9	0	0
Isle of Man	IS450	n/a	n/a	3.2	0	0
Isle of Man	IS400	n/a	n/a	2.5	11,628	7,046
Isle of Man	IS440	n/a	n/a	5.7	0	0
Isle of Man	IS430	n/a	n/a	0.9	0	0
Isle of Man	IS420	n/a	n/a	0	7,962	6,880
Isle of Man	IS460	n/a	n/a	20.1	17,000	17,000
Total					***4,037,053***	***3,972,790***

Source: MAFF. Key: n/a = not available;

required, egg laying can be disrupted. Short- or long-term changes in sediment deposition can result, as well as inevitable changes in the topography of the bed. Disturbance of muddy material in order to access underlying aggregate can destroy feeding grounds for flatfish through the displacement of muddy sand fauna. Where aggregate is overlain by clean sand, it is thought unlikely that long-term damage to benthic fauna will occur (Irish Sea Study Group 1990b).

Navigational dredging

All dredging activities have short-term, localised effects, such as the removal of material and organisms, but long-term effects on, say, fish stocks or morphology are much more difficult to assess, owing to the difficulty of determining which effects are the result of dredging and which the result of the many other factors operating (Doody *et al*. 1993).

Dredged material disposal at sea

The primary legislation in force to control the disposal of dredged material at sea in the UK is the Food and Environmental Protection Act (1985) (deposition at sea and in intertidal areas). Also, the Oslo Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft, and the London Convention on the Dumping of Wastes at Sea include within their scope disposal of dredged material at sea. In this region, licences to deposit dredged material are issued by MAFF (in Wales by MAFF on behalf of the Secretary of State for Wales), the Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD) and the Isle of Man Department of Transport. Each licence is subject to certain conditions, which have become more stringent in the last few years. Illegal dumping of material may occur: for instance, in 1986 and 1987 six and three cases respectively of alleged illegal dumping were investigated in England and Wales (MAFF 1989).

Blanketing of the sea bed is the main potential impact of the disposal of dredged material. If the input rate is significantly greater than the natural sedimentation rate, benthic flora and fauna may be killed through the prevention of respiration and feeding. Other effects include the localised elevation of heavy metals concentrations originating from industrial waste and effluent discharged into the rivers from which the material was dredged. Localised increases in water column turbidity, which are often caused by dredged material disposal, may interfere with fish migration for as long as the increase lasts. Changes in sediment particle size can result in changes in benthic flora and fauna which, whilst not damaging *per se*, may affect the distribution of higher animals by altering the

food chain. Shallows over banks of sediment may also be created, which could be a navigation hazard (Irish Sea Study Group 1990b).

MAFF's (1995) report on the aquatic environment gives details of the effects of the disposal of dredged material and other kinds of waste off the region's shores. A particular point source of persistent organic chemicals in the region is the sewage sludge disposal site in Liverpool Bay (Map 9.4.2). Illegal dumping of material occurs infrequently.

9.4.4 Information sources used

The statistics on marine aggregate extraction relate to royalty returns to the Crown Estate (as owners of the foreshore and sea bed) for 1994. There is no equivalent of the Crown Estate Commissioners in this respect in the Isle of Man.

The information on the disposal of dredged material, sewage sludge and solid industrial waste is derived from licences granted by MAFF, which licenses these activities in England and Wales.

9.4.5 Acknowledgements

Thanks are due to the Crown Estate Commissioners for information on marine aggregate extraction in the region, and to Dr C. Vivian of MAFF Fisheries Laboratory, Burnham-on-Crouch, for providing information on solid waste disposal at sea.

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Welsh Office. 1993. *Environment digest for Wales; No. 7*, 1992. Cardiff.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Marine aggregate extraction licensing	Business Manager, Marine Estates (Offshore), Crown Estate, 16 Carlton House Terrace, London SW1Y 5AH, tel: 0171 210 4377
Marine resource management (managing agents offshore for the Crown Estate)	Posford Duvivier, Eastchester House, Harlands Road, Haywards Heath, West Sussex RH16 1PG, tel: 01444 458551
Offshore geoscience data including 1:250,000 maps of geology of coastline	Director, British Geological Survey, Keyworth, Nottingham NG12 5GG, tel: 01602 363100
Licensing of disposal at sea in England and Wales	MAFF, Marine Environment Protection Division, Nobel House, 17, Smith Square, London SW1P 3JR, tel: 0171 238 5830
Licensing of disposal at sea - Scotland	*SOAEFD, Edinburgh, tel: 0131 244 6203 or 0131 244 6001
Marine sand and gravel extraction	British Marine Aggregate Producers Association (BMAPA) and British Aggregate Construction Materials Industries (BACMI), 156 Buckingham Palace Road, London SW1 9TR, tel: 0171 730 8194
Sand and gravel extraction	Sand and Gravel Association (SAGA), 1 Bramber Court, 2 Bramber Road, London W14 9PB, tel: 0171 381 8778
Disposal of dredged material at sea - international	The Oslo and Paris Commissions, New Court, 48 Carey Street, London WC2A 2JE, tel: 0171 242 9927
Disposal of dredged material at sea - international	London Convention Secretariat, International Maritime Organisation (IMO), 4 Albert Embankment, London SE1 7SR, tel: 071 735 7611
Scientific assessments of dredging and waste disposal, and database of licensed disposal operations at sea	*Head of Laboratory, MAFF Directorate of Fisheries Research, Fisheries Laboratory, Burnham-on-Crouch, tel: 01621 782658
Isle of Man dredged material licensing	Marine Administration, Isle of Man Department of Transport, Sea Terminal Building, Douglas, Isle of Man IM1 2RF, tel: 01624 686643

* Starred contact addresses are given in full in the Appendix.

9.5 Oil and gas developments

C.A. Crumpton, M.J. Goodwin & J.H. Barne

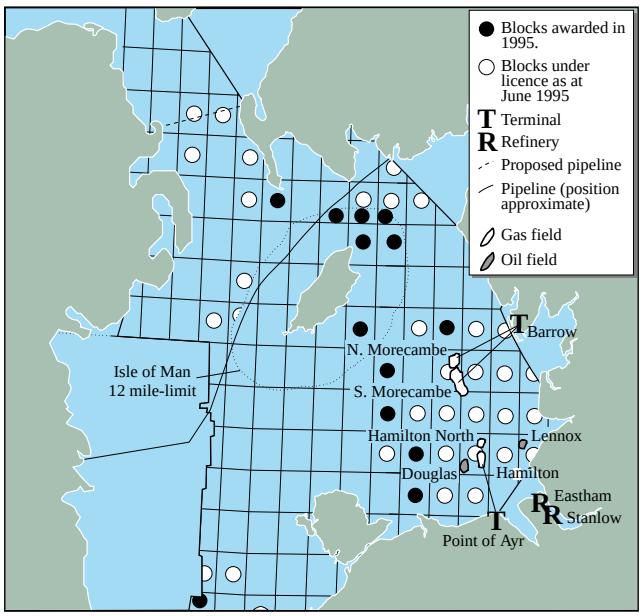
9.5.1 Introduction

This section describes oil and gas exploration and related development in the region; oil and gas infrastructure is described in section 8.3.

Exploration for oil and gas in the area has been carried out since 1969, and the region is of increasing importance to the oil and gas industry. This was reflected by the number of licences awarded during the 14th offshore oil and gas licensing round in 1993, when eighteen out of the 110 blocks awarded lay in this region. This trend has continued in the 16th round (the 15th round did not apply to the Irish Sea), the results of which were announced in June 1995. No licences for exploration in this region were included in those announced in November 1995 under the 17th round. Map 9.5.1 shows blocks under licence in the region as at July 1995, highlighting those that have been awarded most recently (estuaries such as the Ribble, Dee, Mersey and the Solway Firth are included in landward licensing rounds; elsewhere the offshore blocks are delineated right up to the coast). Fields, pipelines and onshore installations are also shown on the map. Map 9.5.2 shows sedimentary basins and structural 'highs', which determine the distribution of oil and gas deposits. One significant discovery of gas in the region was announced in 1993. Compared with the south of the region, there has been less exploration of the northern Irish Sea to date.

The Isle of Man government extended its jurisdiction from 3 miles to 12 miles offshore in 1991 by purchasing the ownership rights from the UK Crown Estate Commissioners. The Isle of Man goverment awarded six blocks in its territorial waters in its 1st Round of Licensing in July 1995.

Five exploration and four appraisal wells were commenced in 1993, representing 8% of total UK exploration and appraisal drilling. Total UK Continental Shelf (UKCS) oil production in 1993 was a record 100.1 million tonnes from 85 fields, including fifteen new ones. Gas production was a record 65.5 billion cubic metres from 50 fields, including thirteen new ones. Total UK oil consumption in 1993, including imports, was 84.6 million tonnes. The Gross National Product arising within the UK oil and gas production sector was £7,700 million in 1993 (1.4% total UK GNP). Estimated 'undiscovered recoverable reserves' in the Irish Sea (Regions 12 and 13), the Southern Basin of the North Sea (Regions 5, 6 and 7) and the Celtic Sea (Regions 11 and 12) combined are 0-70 million tonnes for oil and 245-890 billion cubic metres for gas (DTi 1994).



Map 9.5.1 Oil and gas licensing, fields and infrastructure. Source: DTI (1994). © Crown copyright.

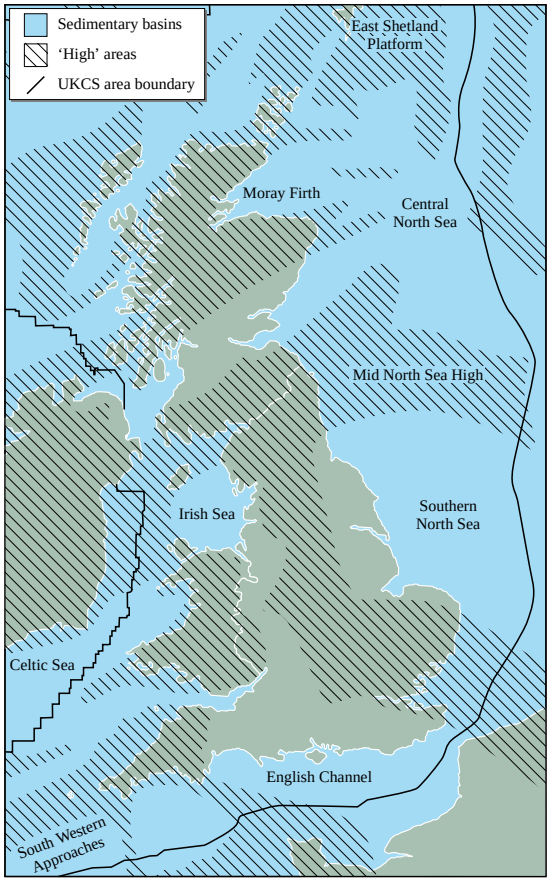
9.5.2 Important locations

Table 9.5.1 lists oil and gas fields within approximately 30 km of the region's shore that were in production or development as at 15 March 1994. Significant discoveries have been made at the Morecambe and North Morecambe gas fields. The Morecambe Bay gas field is linked to the Barrow terminal and Condensate Storage Facility by a 34 km long, 1.5 m diameter pipeline. In a new development in 1993, the first two oil fields in the Irish Sea (the Douglas and Lennox fields) were approved for development as part of a four-field cluster of platforms. Oil from these fields will be transferred to tankers at an offshore buoy. Gas from the Hamilton and Hamilton North fields in Liverpool Bay is to be piped to the Point of Ayr (Clwyd) landing point, to be transported to Connah's Quay to provide fuel for a power station.

Table 9.5.1 Fields within approximately 30 km of shore in production or development at 15 March 1994

Field name	*Oil or Gas*	*Production or Development*	*Estimated original recoverable reserves*	*Peak production*	*Production start*
Morecambe South	Gas	Production	150.0 bcm	8.6 bcm/yr	1985
Morecambe North	Gas	Development	29.0 bcm	3.1 bcm/yr	1994
Hamilton	Gas	Development	14.6 bcm	-	1996
Hamilton North	Gas	Development	6.7 bcm	-	1996
Douglas	Oil	Development	11.6 mt	1.9 mt/yr	1995
Lennox	Oil	Development	7.6 mt	1.4 mt/yr	1995

Source: DTI (1995). Key: bcm = billion cubic metres; mt = million tonnes.



Map 9.5.2 UK Continental Shelf (UKCS) sedimentary basins and structural 'highs'. Source: DTI (1994). © Crown copyright.

9.5.3 Management and issues

In July 1995 the 7th onshore oil and gas exploration licensing round was announced, under which applications were invited for licences covering both land and certain inshore 'watery areas'. Licences are awarded by the Department of Trade and Industry, in consultation with a wide range of organisations, including government departments, environmental agencies, local groups, local authorities, fishermen's federations and other non-governmental organisations. A range of conditions may be applied, linked to the environmental sensitivity of the block (see Davies & Wilson (1995) for conditions applied to the 16th round. For more recent sets of conditions consult the DTI.) The 7th landward licensing round is currently under consideration. Interest has been shown in exploration in three estuaries in the region - the Dee Estuary, Morecambe Bay and the Solway Firth - and licences may result. The range of potential issues for nature conservation is wide. For example, the potential for oil spills to harm birds and marine and coastal wildlife is well known, especially in sheltered embayments and estuaries, such as Liverpool Bay and Morecambe Bay.

9.5.4 Information sources used

Many of the data used here come from the DTI's 'Brown Book' (DTI 1995), which should be referred to for further explanation.

9.5.5 Acknowledgements

Thanks are due to Colin Macduff-Duncan, Esso, for assistance with this section.

9.5.6 Further sources of information

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Oil and gas developments in the UK	Public Relations Officer, Department of Trade and Industry, 1 Palace Street, London SW1E 5HE, tel: 0171 215 5000
Oil and gas industry issues	Public Relations Officer, UK Offshore Operators Association, 3 Hans Crescent, London SW1X 0LN, tel: 0171 589 5255
Oil transportation and terminals	Technical Adviser, Oil Companies International Marine Forum (OCIMF), 15th Floor, 96 Victoria Street, London SW1E 5JW, tel: 0171 828 7966
General information on the oil industry	Librarian, Institute of Petroleum Library and Information Service, 61 New Cavendish Street, London W1M 8AR, tel: 0171 467 7100
Oil spillages in the UK	Executive Secretary, British Oil Spill Control Association (BOSCA), 4th Floor, 30 Great Guildford Street, London SE1 0HS, tel: 0171 928 9199
Oil spillages	Marine Pollution Control Unit, Spring Place, 105 Commercial Road, Southampton, SO15 1EG, tel: 01703 329484
Gas industry in Britain	Director and Secretary, Society of British Gas Industries, 36 Holly Walk, Leamington Spa, Warwickshire CV32 4LY, tel: 01926 334357
Oil and gas exploration and development in Isle of Man waters	Isle of Man Department of Industry, 2 Circular Road, Douglas, Isle of Man IM1 1PJ, tel: 01624 685675
Oil and gas transportation in the Isle of Man	Isle of Man Department of Transport, Sea Terminal Building, Douglas, Isle of Man, IM1 2RF, tel: 01624 686600
Licensing the use of dispersants for oil spills – England & Wales	MAFF Marine Environment Protection Division, Nobel House, 17 Smith Square, London SW1P 3JR, tel: 0171 238 6000
Licensing the use of dispersants for oil spills – Scotland	Marine Environment and Wildlife Branch, SOAEFD, Pentland House, 46 Robb's Loan, Edinburgh EH14 1TW, tel: 0131 244 6232
Scientific assessments of oil dispersants and effects of gas and oil exploitation on the marine environment	*Head of Laboratory, MAFF DFR, Fisheries Laboratory, Burnham-on-Crouch, tel: 01621 782658

9.6 Water quality and effluent discharges

C.A. Crumpton, M.J. Goodwin & T.J. Holt

9.6.1 Introduction

This section summarises information about water quality and effluent discharge from a number of sources. Sewage sludge disposal is covered in section 9.4. Full interpretation of the information base on pollutants and water quality is complex and beyond the scope of this book.

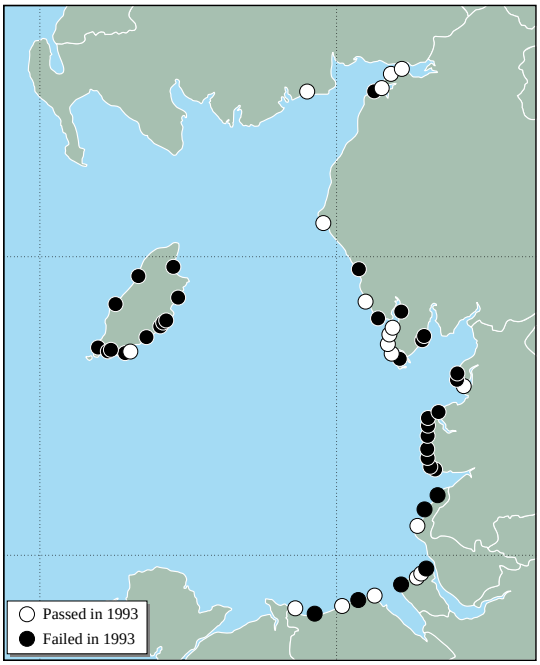
Waste products and effluents containing contaminants reach the marine environment in this region in a number of ways: sewage, agricultural run-off and trade effluents are discharged from outfalls into rivers or directly into the sea, and contaminants can reach the sea by airborne means, for example aerosols and rain. Industrial contaminants can enter the marine environment through intentional licensed release or accidentally. Discharges occurring outside the region may also have an effect.

It should be noted that Region 13 receives inputs of contaminants from other regions and indeed other countries that may equal or exceed those actually generated within the region. For example, by far the largest input of nutrients to the region's waters is through the St. George's Channel. The residual flow northward through the Irish Sea brings with it large quantities of nutrients including nitrogen and phosphorous. Set against the inflow of organic materials from the Atlantic, the total nutrient load from domestic and industrial wastes in the region is not as great as is commonly thought (Irish Sea Study Group 1990). However, nutrient levels around point sources can be substantially elevated, particularly adjacent to widely used or heavily populated areas.

Other sources of potential contamination are those direct outfalls of untreated sewage at which small amounts of pesticides have been detected. Elevated organochlorine, pesticide and PCB concentrations have been found in the livers of fish caught in Morecambe Bay. Also, synthetic organic chemicals have been identified as measurable quantities of organochlorine residues in the region's waters and sediments and in certain marine animals. Further north in the region, in the St. Bees Head/north-eastern Isle of Man area, organochlorine residues are lower, indicating that the contamination evident in the Liverpool Bay and Morecambe Bay areas does not extend northwards to any significant extent (Irish Sea Study Group 1990).

In the region there are many large trade effluent outfalls, concentrated mainly around the industrialised areas of Deeside, Merseyside, the nuclear power station at Heysham and scattered along the coast of Cumbria. Table 9.6.1 shows the numbers of trade and sewage outfalls in the region, by county/Scottish region. There are no significant trade effluent outfalls along the coast of Dumfries & Galloway. No data were available for the Isle of Man.

There are 52 bathing waters in this region, as identified under the EC Bathing Water Directive (76/160/EEC). Of these, only eighteen (about 35%) complied with the mandatory standards in 1993 (see Map 9.6.1 and Table 9.6.2). The 1993 data for the UK as a whole, assessed by DoE in accordance with the EC Bathing Water Directive, show a very slight increase in compliance with the mandatory standards (79.4%) compared with 1992 (78.8%). The NRA



Map 9.6.1 Bathing water quality. Locations of EC-identified bathing waters sampled in 1993 survey (see Table 9.6.2). Source: NRA (1994). Adapted with permission.

expects a more dramatic increase in compliance after the majority of capital schemes being undertaken by the Water Service companies (Regional Councils in Scotland) are completed in 1995. Trend data show that although the national percentage of bathing waters consistently complying with the mandatory standards has remained at around 64%, the number consistently failing has come down. Analysis of median faecal coliform values suggests that the improved water quality has been maintained over the last four years.

Overall, beach quality in the region is poor. Only 1% of the beaches in the region were rated as 'excellent' in the Coastwatch 1993 survey (Table 9.6.3). None of the twenty beaches awarded Blue Flags in 1993 in the UK was in this region, although eighteen were in England or Wales. Again, out of the 165 Tidy Britain Group Seaside Award beaches in 1994, none was in this region. The main items of litter found along its coastline are plastics (including sheeting, fishing gear, bottles and containers), textiles, paper and debris from

Table 9.6.1 Summary of trade and sewage outfalls with maximum consented daily flows >6,000 m³

	Sewage	*Trade*	*Total*
Clwyd	4	1	5
Cheshire	9	9	18
Merseyside	2	2	4
Lancashire	11	10	21
Cumbria	6	7	13
Dumfries & Galloway	2	0	2
Region 13*	***34***	***29***	***63***

Sources: NRA and Solway RPB databases. Key: *excluding the Isle of Man.

ship wreckage. Sewage and sanitary materials are also present (Coastwatch UK 1993). Medical waste, including syringes and needles, is an increasing problem, the source of which is not known (McGilvray 1994). Many Manx beaches collect particularly large amounts of litter, including much sewage-derived material (Beachwatch 1993, 1994). The Isle of Man tested water from thirteen sites covering eleven beaches in 1994 (Map 9.6.1), of which only that at Derbyhaven, where discharge is infrequent, complied with the mandatory standards in 1992, 1993 and 1994. In the Isle of Man (population just under 70,000) approximately 70% of the sewage is discharged to sea untreated, via short sea outfalls. These are often close to the main bathing beaches, and many are exposed at low tide.

9.6.2 Important locations

In the Coastwatch UK survey in 1993, beaches in Clwyd generally attained better results than the national average, with the exception of some items, notably sewage and sanitary materials. There was, however, a general deterioration over the year 1992/3. Elsewhere in the region, however, a very different picture emerged. In Merseyside, beach quality was generally worse than in 1991/2, and was below the national average quality on all items including sewage and sanitary materials. Lancashire, too, experienced higher than average litter levels in nearly all categories. Sewage pollution was a particular problem, being up to five times worse in this county than the national average. In Cumbria, beaches were below the national average on overall quality and achieved worse results than in 1991/2. The quantity of sewage and sanitary items found was many times higher than the national average. Even in Dumfries & Galloway, with the exception of tar, sanitary materials and medical waste, results were consistently worse than the national average. Some litter items, e.g. plastic packaging, were found at twice the national average levels. Most of this litter is thought to have originated outside the region.

In 1993, in its annual survey of EC-designated bathing waters, the NRA found that bathing waters in the central part of the region and around the Isle of Man were of particularly poor quality. None of those sampled along the Fylde coast of Lancashire passed the mandatory coliform standard, and only one on the Isle of Man passed. Bathing waters elsewhere in the region were of variable quality (Table 9.6.2 and Map 9.6.1) (NRA 1994). According to the Solway River Purification Board's analysis of coastal water quality in the Solway from 1989 to 1994, which used Scottish Office standard procedures, there has been very little change in water quality over the period. 90% of the Solway's coastal waters over a total length of 279 km were consistently rated excellent, around 7% good, around 4.5% unsatisfactory and less than 1% seriously polluted (although this category was very gradually increasing in size) (Scottish Office 1992). In Dumfries & Galloway, Sandyhills Beach (which passed the EC mandatory standard) was the only one designated under the EC Bathing Waters Directive in 1993. The poor record is the result of the large number of short outfalls in the area that discharge effluent given only primary treatment (Table 9.6.4). Dumfries & Galloway Regional Council estimate that 65% of sewage treatment schemes requiring upgrading will be completed by 1996 (Ash Consulting Group 1994).

Map 9.6.2 shows the locations of all the sewage outfalls in Region 13 (excluding the Isle of Man, for which data were not available) with consented (see section 9.6.3) 'dry weather flows' (i.e. flows undiluted by rain) in excess of 10 m^3 per day. Table 9.6.4 lists the 33 sewage outfalls in the region whose consented 'dry weather flows' are in excess of 6,000 m^3 per day, showing their locations and the type of discharge. The fourteen such outfalls discharging primary treated sewage jointly discharge more than 1.5 million m^3, compared with less than 200,000 m^3 daily from the seven such outfalls discharging sewage that has had secondary treatment, and less than 250,000 m^3 from the nine such discharging untreated sewage. It is notable that the two biggest outfalls in the region, at Sandon in Merseyside (950,000 m^3) and Clifton Marsh in Lancashire (191,000 m^3), discharge sewage that has had only primary treatment. However, Cheshire and Merseyside discharge no sewage that has not had at least primary tratment. North of the Ribble, only Workington in Cumbria has a large sewage outfall. In total the waters of the region receive more than 2 million m^3 of sewage daily, including sewage that has had some other form of treatment, from large outfalls within the region alone.

Table 9.6.5 lists major sources of trade effluent in the region, with their maximum consented output, where specified; those locations with grid references are shown on Map 9.6.3. Data were not available for the Isle of Man. In Region 13, by far the largest volume of trade effluent from these large outfalls is of cooling water from the power

Table 9.6.2 Bathing waters survey 1993

	Pass	*Fail*	*Total*
NRA Welsh Region (sites surveyed in this region)	3	2	6
NRA North West Region	13	21	33
Dumfries & Galloway (Solway River Purification Board)	1	0	1
Isle of Man	1	12	13
Region 13	***18***	***35***	***53***
England and Wales	332	86	418
Scotland	18	5	23
Great Britain total	350	91	441

Source: DoE (1993); DoLGE (1995) (Isle of Man). Note: pass denotes compliance with Bathing Water Directive (76/160/EEC): Coliform standards.

Table 9.6.3 Beach quality in the region compared with national standards in 1993

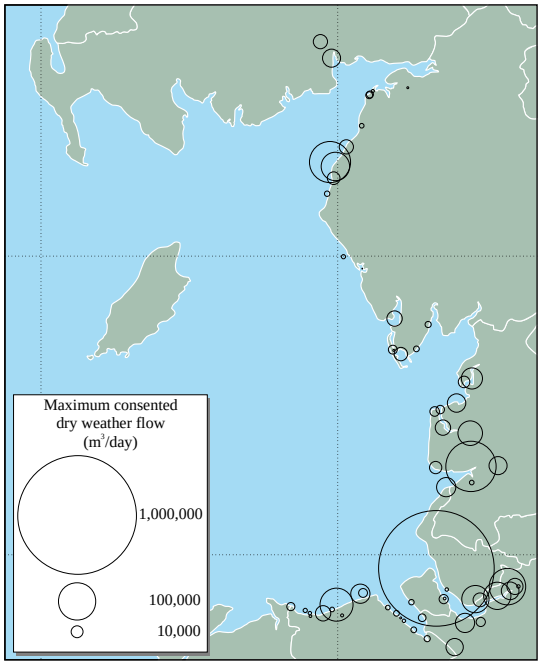
	% of beaches rated as:		
*Area**	*excellent*	*moderate*	*polluted*
Clwyd	5	42	53
Merseyside	0	26	74
Lancashire	0	27	73
Cumbria	1	36	63
Dumfries & Galloway	0	32	68
Region 13*	***1***	***33***	***66***
England*	10	44	46
Wales	7	39	54
Scotland	7	37	56
Great Britain*	8	42	50

Source: Coastwatch UK (1993). Key: *The Isle of Man and Cheshire were not included in the survey.

Table 9.6.4 Sewage outfalls to tidal waters in the region* with consented 'dry weather flows' >6,000 m^3 per day

			Maximum consented daily dry weather sewage flow (m^3)					
Name of outfall	*Location*	*Grid ref.*	*Primary treated*	*Secondary treated*	*Untreated*	*Other*	*Total*	*Notes*
Clwyd			**0**	**0**	**80,000**	**49,925**	**129,925**	
Pensarn Sea Outfall	Abergele	SH952793				18,145		Macerated/ comminuted sewage
Rhyl Sea Outfall	Rhyl	SH994821			80,000			
Golf Course Outfall	Prestatyn	SJ076857				25,300		Macerated/ comminuted sewage
Prestatyn Sewage Disposal Scheme Sewage Effluent	Prestatyn	SJ086860				6,480		Fine screened sewage
Cheshire			**176,750**	**131,544**	**0**	**0**	**308,294**	
Chester Sewage Treatment Works	Chester	SJ395665		22,044				
Morganite Ceramic Fibres Ltd	Bromborough	SJ362827	8,200					
Warrington South Sewage Treatment Works	Warrington	SJ587855		26,000				
Warrington North Sewage Treatment Works	Warrington	SJ581868	90,900					
Thames Case Limited Arpley	Warrington	SJ602869	20,000					
Ellesmere Port Sewage Treatment Works	Ellesmere Port	SJ432747		29,500				
Helsby Sewage Treatment Works	Helsby	SJ487750	6,650					
Runcorn Sewage Treatment Works	Runcorn	SJ541838		54,000				
Widnes Sewage Treatment Works	Widnes	SJ468828	51,000					
Merseyside			**966,800**	**0**	**0**	**0**	**966,800**	
Halewood Sewage Treatment Works	Halewood	SJ484826	16,800					
Sandon Sewage Treatment Works	Liverpool Sandon	SJ337930	950,000					
Lancashire			**235,400**	**54,600**	**78,200**	**45,000**	**413,200**	
Southport Sewage Treatment Works	Southport	SD369207			31,200			
Walton Le Dale Sewage Treatment Works	Walton Le Dale	SD546282		27,600				
Clifton Marsh Sewage Treatment Works	Preston	SD454278	191,000					
Fairhaven Tanks	Lytham St. Anne's	SD335273			13,000			
Manchester Square Outfall	Blackpool	SD305358				45,000		Screened sewage (maximum 6 mm)
Poulton Le Flyde Sewage Treatment Works	Poulton Le Fylde	SD358407		17,000				
Chatsworth Avenue Gravity Outfall	Fleetwood	SD330460			8,000			
Pilling Sewage Treatment Works	Pilling	SD406488			26,000			
Middleton Overton Sewage Treatment Works	Middelton Overton	SD430579		10,000				
Stodday Sewage Treatment Works	Lancaster	SD456588	34,400					
Cumbria			**158,990**	**0**	**102,639**	**0**	**261,629**	
Barrow Waste Water Treatment Works	Barrow-in -Furness	SD214672			14,350			
Millom Sewage Treatment Works	Millom	SD192793	16,000					
Shore Road Salterbeck Outfall	Workington	NX985265			13,159			
Northside and Low Seaton Outfall	Workington	NX988303			60,921			
Workington Waste Water Treatment Works	Workington	NX972318	120,270					
North Pier Outfall	Maryport	NY029370			14,209			
Dumfries & Galloway			**36,340**	**0**	**0**	**0**	**36,340**	
Airds Point sewage outfall	Airds Point	NX992661	22,720					
Troqueer sewage outfall	Dumfries	NX972744	13,620					
Region 13*			***1,541,560***	***186,144***	***247,839***	***69,878***	***2,079,821***	

Source: MAFF and Solway RPB sewage outfalls databases. Key: *data were not available for the Isle of Man.



Map 9.6.2 England and Wales: consented sewage outfalls. Area of circle is proportional to consented 'dry weather flow'. Map shows all outfalls with consented flow greater than 10 m^3/day. Sources: MAFF; Scotland: sewage outfalls with consented 'dry weather flows' >6,000 m^3/day: Solway RPB. See also Table 9.6.4.

Map 9.6.3 Authorised and consented trade effluent discharges listed in Table 9.6.5. Source: NRA, Solway RPB.

stations at Heysham, on the south side of Morecambe Bay (3,400,000 m^3), and Roosecote (346,000 m^3), on the north side. The effluent at Heysham comes from six separate outfalls less than four kilometres from a holiday camp (at Middleton) and around 10 km from the holiday resort of Morecambe. That at Roosecote discharges into the narrow channel between Walney Island and Barrow-in-Furness. Untreated trade effluent in the region comes mainly from chemical plant, manufacturing processes and nuclear industries in Cheshire, Lancashire and Cumbria. Neither Clwyd nor Merseyside has any large outfalls for untreated trade effluent. Clwyd, however, contributes more than half the region's treated trade effluent discharged from large outfalls. In total, from outfalls in the region with a consented daily flow in excess of 6,000 m^3, the coastal waters of the region receive more than 5.5 million m^3 of trade effluent daily, of which nearly 4.5 million m^3 is cooling water. The various inputs of metals to the Mersey Estuary and Liverpool Bay have resulted in elevated concentrations within sediments in both areas compared with other parts of the Irish Sea. Owing to the natural affinity of many metals to sediment particles, the prevailing direction of currents and the process of settlement, metals associated with solids are retained within the Liverpool Bay area.

9.6.3 Management and issues

A range of legislation is in force to control discharges to the aquatic environment. In England the primary statute is the Water Resources Act 1991, in Scotland, the Control of Pollution Act 1974, and in the Isle of Man, the Water Pollution Act 1993. In England the NRA has overall responsibility for the control of discharges and the maintenance of water quality. The NRA authorises sewage discharges to the sea by issuing 'consents', with MAFF as a statutory consultee to safeguard fishery interests. Trade effluent involving 'scheduled' (hazardous) substances must be authorised by Her Majesty's Inspector of Pollution under the Environmental Protection Act 1990, with the NRA as a statutory consultee. The substances are listed in the Trade Effluents (Prescribed Substances and Processes) Regulations 1989, 1990 & 1992. Environmental Quality Standards (EQSs) are set for many of the substances in the Surface Water (Dangerous Substances) (Classification) Regulations 1989 and 1992. The NRA's booklet on *Discharge consents and compliance* (NRA 1994) contains details on national and European discharge regulations (see section 9.6.6). Sewage disposal on land in England and Wales is controlled by the local Waste Regulation Authorities (see section 9.3). Discharges from nuclear installations are licensed under the Radioactive Substances Act 1993 by Her Majesty's Inspectorate of Pollution (HMIP) (the Environment Agency from April 1996 - see below). Their effect on the aquatic environment is monitored by MAFF Directorate of Fisheries Research (MAFF 1994).

In 1988 all disposal of liquid industrial waste at sea in this region ceased, in accordance with the Ministerial Declarations of the 2nd and 3rd North Sea Conferences. Under the Urban Waste Water Treatment Directive (91/271/EEC), except in 'high natural dispersion areas', all significant sewage discharges (thus including all those in Table 9.6.4) to coastal waters, where the outfalls serve populations >10,000 (roughly equivalent to 1,800 m^3 per day, and to estuaries, where they serve populations >2,000 (roughly 360 m^3 per day), will require at least secondary treatment, to be phased in by 2005. However, some outfalls will be permitted to discharge sewage with a minimum of primary treatment, provided that comprehensive studies, currently being carried out by the relevant water companies, show that there will be no adverse effects on the environment. In this region these outfalls, all discharging into 'high natural dispersion areas', are at West Colwyn Bay,

Table 9.6.5 Trade effluent outfalls with a consented daily flow >6,000 m3

			Maximum consented daily effluent flow (m3)				
Owner	*Location*	*Grid ref.*	*Treated*	*Untreated*	*Cooling water*	*Site drainage*	*Total*
Clwyd			**90,000**	**0**	**0**	**0**	**90,000**
Kimberley Clarke Ltd	Flint	SJ246741	20,000				
British Steel Corporation	Deeside	SJ295711	20,000				
Shotton Paper Company Plc	Shotton	SJ295711	50,000				
Cheshire			**15,000**	**53,800**	**658,500**	**0**	**727,300**
Shell UK Ltd	Ellesmere Port	SJ430766		12,000			
Associated Octel	Ellesmere Port	SJ417769	15,000				
Bridgewater Paper Company	Ellesmere Port	SJ393787			103,500		
ICI	Runcorn	SJ500800		41,800			
Castner	Runcorn	SJ498805			400,000		
Salt Union Limited	Runcorn	SJ494819			155,000		
Merseyside			**11,500**	**0**	**60,000**	**0**	**71,500**
Unichem International	Wirral	SJ345845			9,600		
Shell UK	Tranmere	SJ332873	11,500				
Cargill Plc	Bootle	SJ324961			50,400		
Lancashire			**0**	**99,008**	**3,400,000**	**0**	**3,499,008**
BNFL Plc	Preston	SD471311		36,000			
ICI Chemicals & Polymers	Hillhouse	SD346438		9,600			
ICI Chemicals & Polymers	Hillhouse	SD343443		10,000			
ICI Chemicals & Polymers	Hillhouse	SD337454		10,000			
Nuclear Electric Plc	Heysham (main outfall)	SD396597			2,880,000		
Nuclear Electric Plc	Heysham (3 outfalls)	SD396597			520,000		
Nuclear Electric Plc	Heysham (2 outfalls)	SD395597		33,408			
Cumbria			**44,400**	**45,360**	**346,000**	**12,000**	**447,760**
Lakeland Power Ltd	Roosecote Marsh	SD220684			346,000		
Bowater Scott Corporation Ltd	Barrow	SD192726		11,360			
Glaxochem Ltd	North Lonsdale	SD314773	14,400				
Albright & Wilson Ltd	Whitehaven	NX963161		28,000			
BNFL Plc	Sellafield	NY000020		6,000			
BNFL Plc	Sellafield	NY000020				12,000	
Iggesund Paperboard Plc	Workington	NY002312	30,000				
Region 13*			***160,900***	***198,168***	***4,464,500***	***12,000***	***5,535,568***

Source: NRA and Solway RPB databases. Key: *there are no trade effluent outfalls with consented flows >6,000m3 in Dumfries & Galloway; no data were available for the Isle of Man.

Towyn, Prestatyn, North Wirral, Braystones, Workington South and Workington North. Information for Scotland was not available at the time of writing (November 1995).

In April 1996, the new Environment Agency (for England and Wales) and the Scottish Environmental Protection Agency will become operational. The new agencies will integrate the functions of HMIP, the local waste regulatory authorities and either the NRA in England and Wales or the regional RPBs in Scotland. The activities of the new agencies will be grouped under two broad headings: pollution prevention and control, including waste regulation, the work of HMIP and the NRA's/RPB's work on water quality; and water management, covering the NRA's/RPB's other functions. However, there will be a strong link between pollution prevention and control and water management, to ensure continuing integrity of estuarine and coastal management.

There are currently several schemes (statutory and non-statutory) for assessing the quality of beaches and their waters in relation to waste disposal. First, there is the EC Bathing Water Directive (76/160/EEC), with its associated monitoring of identified bathing waters for levels of coliforms (bacteria that indicate sewage presence). In England and Wales, monitoring is carried out by the NRA. In Scotland this is done by the regional River Purification Boards. Any measures required to improve the quality of the waters are a matter for the dischargers of industrial effluent or the sewerage authorities. Under the terms of the Environmental Protection Act 1990, the quality of bathing beaches is the responsibility of district councils. The Isle of Man Government has resolved to ensure that all Manx bathing beaches comply with EC guideline standards. In order to achieve this, the Isle of Man Department of Transport has developed proposals to replace the Isle of Man's aging sewage disposal system with high quality secondary treatment at either a single, or possibly two, centralised treatment plants, followed by effluent disposal to sea (the Integration and Recycling of the Island's Sewage (IRIS) project). Secondly, there is the European Blue Flag Award Scheme for beaches that meet the EC guideline standards of beach and water quality, as well as certain land-based criteria. Thirdly, there is the Tidy Britain Group Seaside Award Scheme, designed to complement the Blue Flag scheme, for beaches that meet the minimum standards of beach and water cleanliness and selected land-based criteria but not the Blue Flag standard. Finally there are the annual litter surveys of Coastwatch UK and Beachwatch, both of which employ volunteers to survey lengths of coastline for litter and other signs of pollution. Beachwatch UK is organised by Readers Digest and the Marine

Conservation Society.

In common with other parts of the UK coast, coastal waters in the region receive sewage and trade effluent directly from both large and small outfalls. In addition other outfalls, both large and small, discharge into rivers a short distance from the coast The smaller discharges, not discussed here, also contribute to effects on the maritime environment, both in this region and beyond. For instance, radioactive discharges from Sellafield, which enter the sea from outlets not listed in Table 9.6.4, are traceable, as Caesium-137, for many years and over long distances. This radionuclide is carried northwards around the Scottish coast to the North Sea, arriving at the Norwegian coast about five years after discharge.

9.6.4 Information sources used

Part two of the Irish Sea Study Group's report *An environmental review* (Irish Sea Study Group 1990) provides a wide range of detailed information on water quality, bringing together information from surveys from statutory bodies and research organisations.

The Department of the Environment (DoE) Environmental Protection Statistics Division publishes an annual *Digest of environmental protection and water statistics* (DoE 1995), which provides detailed national statistics on aspects of environmental protection, including coastal and marine waters, radioactivity, waste and recycling, and wildlife. MAFF (Directorate of Fisheries Research, Lowestoft) publishes two annual Aquatic Environment Monitoring Reports (AEMR). One reports on radioactivity in the marine environment, the other deals with non-radioactive pollution and waste disposal operations at sea.

Schemes such as the Tidy Britain Group Seaside Award and the European Blue Flag are monitored during the year previous to the publication of their results. Monitoring of the EC Bathing Waters and other beaches under schemes such as Coastwatch UK and Beachwatch take place over one or two days. The results may therefore be skewed by heavy rain or localised effects at the time of survey. Coastwatch UK and Beachwatch do not sample the whole coastline in their region, owing to a shortage of volunteers. The results may therefore sometimes be unrepresentative because of the small sample size.

Other information sources available include the NRA's Water Quality Series reports (e.g. NRA 1995), its quarterly ship- and air-borne National Coastal Baseline Survey, which monitors a large number of water quality parameters in coastal waters, including metals, nutrients and turbidity (Boxall *et al.* 1993). For information on Scottish pollution control in the region, the Solway River Purification Board's reports should be consulted (see section 9.6.6 C). MAFF holds a database of consented sewage outfalls in England and Wales. Further information on discharges can be obtained from the local offices of the NRA or HMIP, who issue discharge consents and authorisations.

9.6.5 Acknowledgements

Thanks are due to Mrs F.L. Franklin of MAFF Fisheries Laboratory, Burnham-on-Crouch, for sewage outfalls data, and to Terry Gulliford of the NRA Welsh Region, Ian Whitfield and Cath Denyer of the NRA North Western Region and Alastair McNeill of the Solway RPB for providing information on trade and domestic outfalls in their regions.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Discharge consents in Wales	*National Rivers Authority - Welsh Region, Cardiff, tel:01222 770088
Discharge consents, North-west England	*National Rivers Authority - North West Region, Warrington, tel: 01925 653999
Discharge consents, Cumbria	*National Rivers Authority - Northern Area Office, North West Region, Carlisle, tel: 01228 25151
Bathing waters, discharge consents and water quality in Dumfries & Galloway	*Chief Scientist, Solway River Purification Board, Dumfries, tel: 01387 720502
Water quality in north-west England	North West Water Ltd, Dawson House, Great Sankey, Warrington WA5 3LW, tel: 01925 234000
Water quality in Wales	Dwr Cymru Welsh Water, Plas y Ffynnon, Cambrian Way, Brecon, Powys LD3 7HP, tel: 01874 623181
Sewage infrastructure and the IRIS Project (Isle of Man)	Department of Transport, Sea Terminal Building, Douglas, Isle of Man IM1 2RF, tel: 01624 686600
Pollution from large industrial sites (Wales)	HM Inspectorate of Pollution (HMIP) (Wales), Brunel House, 11th Floor, 2 Fitzalan Road, Cardiff CF2 1TT, tel: 01222 495558
Pollution from large industrial sites (Cheshire, Merseyside)	HMIP (Runcorn), Kings Court, Unit 2, Manor Park, Runcorn WA7 1HR, tel: 01925 655211
Pollution from large industrial sites (Lancashire, Cumbria)	HMIP (Lancaster), Mitre House, Church Street, Lancaster LA1 1BG, tel: 01524 382102
Beachwatch	*Marine Conservation Society, Ross-on-Wye, tel: 01989 66017
Coastwatch	Project Officer, Coastwatch UK, Farnborough College of Technology, Boundary Road, Farnborough, Hampshire GU14 6SB, tel: 01252 377503
Tidy Britain Group Seaside Awards	Lion House, 26 Muspole Street, Norwich NR3 1DJ, tel: 01603 762888
Aquatic environmental research and monitoring related to radioactivity in the aquatic environment	*Director, MAFF Directorate of Fisheries Research, Lowestoft, tel: 01502 562244
Aquatic environmental research and monitoring related to non-radioactive waste disposal at sea; consented outfalls database	*Head of Laboratory, MAFF Directorate of Fisheries Research, Fisheries Laboratory, Burnham-on-Crouch, tel: 01621 782658

Type of information	*Contact address and telephone no.*
Sewage pipeline outfalls and waste regulation, Colwyn	*Director of Housing and Technical Services, Colwyn District Council, tel: 01492 515271
Sewage pipeline outfalls and waste regulation, Rhuddlan	*Borough Health Officer & Housing Manager, Rhuddlan District Council, tel: 01745 345000
Sewage pipeline outfalls and waste regulation, Delyn	Commercial Services Manager, Delyn District Council, Canton Depot, Bagillt, Clwyd CH6 6JB, tel: 01352 715005
Sewage pipeline outfalls and waste regulation, Alyn and Deeside	*Director of Housing and Works, Alyn & Deeside District Council, tel: 01244 525000
Sewage pipeline outfalls and waste regulation, Cheshire	Chief Waste Regulation Officer, Cheshire County Council, Commerce House, Hunter Street, Chester CH1 2QW, tel: 01244 603597
Sewage pipeline outfalls and waste regulation, Merseyside	Assistant Director - Regulation, Merseyside Waste Disposal Authority, Level 4, Steers House, Canning Place, Liverpool L1 8JW, tel: 0151 709 3607
Sewage pipeline outfalls and waste regulation, Lancashire	Assistant County Surveyor - Waste Regulation Lancashire County Council, County Surveyor's Dept., PO Box 9, Guild House, Cross Street, Preston PR1 8RD, tel: 01772 263799
Sewage pipeline outfalls and waste regulation, Cumbria	Waste Regulation Manager, Cumbria County Council, Dept. of Highways & Transportation, Citadel Chambers, Carlisle CA3 8SG, tel: 01228 812369
Sewage pipeline outfalls - Dumfries & Galloway	*Water and Sewerage Department, Dumfries & Galloway Regional Council, Dumfries, tel: 01387 261234 (260034)
Waste regulation, Annandale and Eskdale	*Director of Environmental & Leisure Services, Annandale and Eskdale District Council, tel: 01461 203311
Waste regulation, Nithsdale	*Director of Environmental Services, Nithsdale District Council, tel: 01387 253166
Waste regulation, Stewartry	*Director of Environmental Health and Leisure Services, Stewartry District Council, tel: 01557 30291
Waste regulation, Wigtown	*Director of Technical Services Wigtown District Council, tel: 01776 702151

* Starred contact addresses are given in full in the Appendix.

9.7 Leisure and tourism

M.J. Dunbar, S.L. Fowler, Dr N.C. Davidson, D.A. Stroud, Dr D.R. Jones, Dr T.J. Holt & Prof. S.J Hawkins

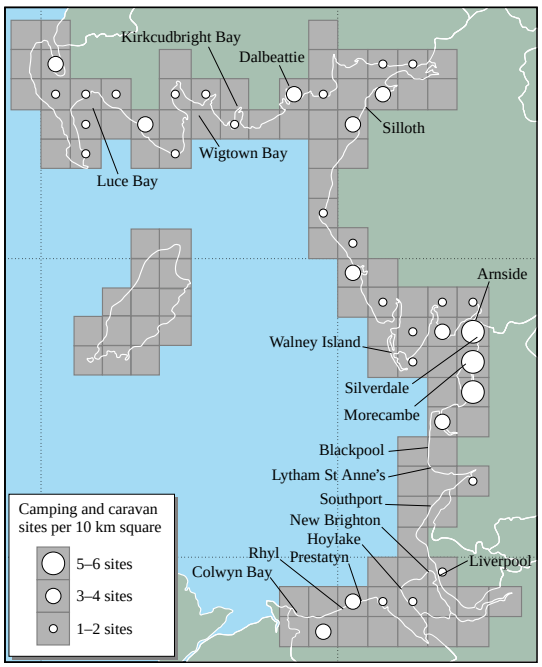
9.7.1 Introduction

This region is important nationally for leisure activities and tourism. The north Wales and Lancashire coasts are dominated by traditional seaside resorts, while Cumbria and Dumfries & Galloway are important for more active leisure pursuits. Tourism provides significant income for the region and is a major employer (see section 9.7.3). Blackpool is the premier regional tourist centre and is the largest coastal resort in the UK, with over 17 million visitors each year.

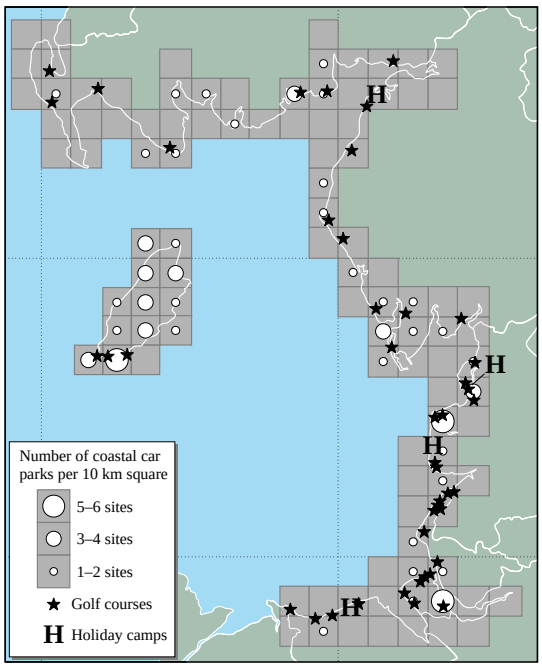
A wide range of land-based leisure activities take place along the coast, including walking, camping, golf, beach recreation, bird watching, wildfowling, horse riding, angling and, increasingly, the use of motorised vehicles on beaches and dunes (Buck 1993; Taylor & Parker 1993). The most important examples of land-based leisure infrastructure on the coast are golf courses, caravan parks and campsites, rural car parks (which provide the access points necessary for most land and water-based leisure activities) and leisure centres or amusement parks. These tend to be concentrated near centres of population or in other traditional coastal holiday resorts. 85 caravan parks and/or campsites are shown adjacent to the coast on Ordnance Survey Landranger maps. There are 38 coastal golf courses in the region and a total of 57 rural coastal car parks. Locations of land-based leisure and tourism activities are marked on Maps 9.7.1 and 9.7.2.

Interest in watersports in Britain is stronger than ever. Despite strong tides and some pollution problems in Liverpool Bay, this region is moderately important on a national scale for water-based leisure (Map 9.7.3 and Table 9.7.1). This reflects the high seasonal population on the north Wales and Lancashire coast, coupled with Merseyside's large resident population. There is plenty of potential for further conversion of derelict or disused industrial or commercial centres for water-based leisure use.

The main infrastructure developments for water-based leisure activities in the region include marinas, yacht moorings, dinghy parks and launching slips for sailing and power-boating activities. More than 50 affiliated sailing or yacht clubs are listed for the region by the Royal Yachting Association (1992), most of them in the English counties in the region. Virtually all the coastal towns have slipways used by leisure craft, and there are many areas with small concentrations of leisure moorings. Both long-established and modern centres for yachting, power boating and other water sports are widely distributed along the coast. Many are concentrated in the sheltered waters of bays and inlets and near centres of population. The newest facilities are sometimes associated with the regeneration of waterfronts or areas where employment and/or tourism had been in decline (for example at Liverpool Docks, Glasson Dock, Whitehaven and Maryport). There are seven marinas in this region, with others under construction or planned. Several of these marinas have been adapted from former commercial shipping facilities, such as at Albert Dock, Liverpool, and Fiddlers Ferry on the old St. Helens Canal. Provision of marina berths on the Merseyside and Lancashire coasts is on a nationally significant scale.



Map 9.7.1 Important tourist centres in the region and numbers of caravan sites in coastal 10 km squares. Source: Ordnance Survey Landranger maps. © Crown copyright.



Map 9.7.2 Number of car parks in coastal 10 km squares in the region; locations of coastal golf courses and holiday camps. Source: Ordnance Survey Landranger maps. © Crown copyright.

Table 9.7.1 Existing and proposed water-based leisure and tourism facilities

Site	*Grid ref.*	*Facilities*
Clwyd		
Rhyl	SJ0081	Marine lake; marina proposal
Cheshire		
Dee	SJ2287	Moorings/anchorages; marine lake at West Kirby
Merseyside		
Mersey	SJ3590	Leisure harbours at Liverpool: Albert Dock and Coburg; Brunswick Docks marina; marine lake at Bebington
Lancashire		
Fiddlers Ferry (old St. Helens Canal)	SJ5687	Marina
Crosby	SJ3297	Marine lake
Southport	SD3417	Marine lake
Ribble	SD5230	Preston: two marinas: Albert Edward Dock and Hesketh Bank. More marinas proposed. Marine lake at Lytham.
Wyre	SD3448	Fleetwood: Wyre Dock marina (extension proposed); moorings/anchorages on river
River Lune	SD4556	Marina at Glasson, convenient access from M6; moorings/anchorages
Morecambe	SD4464	Several boating lakes
Cumbria		
Barrow	SD6288	Harbour; moorings/anchorages
Hodbarrow Lagoon	SD1778	13 ha lagoon used for leisure
Ravenglass	SD0796	Moorings/anchorages
Whitehaven	NX9718	Harbour redevelopment, marina under construction
Workington	NX9929	Harbour; moorings/anchorages
Maryport	NY0337	Marina
Silloth	NY1153	Harbour
Dumfries & Galloway		
Kippford	NX8455	Marinas under construction; moorings/anchorages
Kirkcudbright	NX6851	Marinas under construction; moorings/anchorages
Wigtown Bay	NX5752	Several moorings/anchorages, e.g. in Fleet Bay; leisure barrage proposal for Creetown
Isle of Man		
Ramsey	SC4594	Yacht club; proposed marina; diving club
Douglas	SC3875	Yacht club; proposed marina; two diving clubs
Castletown	SC2667	Diving club
Port St. Mary	SC2167	Yacht club; proposed marina; diving club; watersports centre (Gansey)
Port Erin	SC1969	Diving club
Peel	SC2484	Yacht club

Source: Buck (1993), D'Olivera & Featherstone (1993), IOMDTT (1988) and miscellaneous publications, e.g. tourist brochures. Note: There are many other areas with small concentrations of leisure moorings, and virtually all the coastal towns have slipways for leisure craft.

Limited facilities (primarily recreational craft moorings) are also found in most of the small fishing ports and harbours around the coastline, often where traditional fishing activities have declined. Other important water sports practised in the region using the same basic recreational infrastructure (or not requiring infrastructure other than land access to the coast) include wind surfing, scuba diving, sea angling, jet-skiing, water skiing, canoeing, surfing and bathing. Casual surfing, canoeing, jet-skiing and wind-surfing take place from many of the region's beaches. Angling takes place from the shore and at sea.

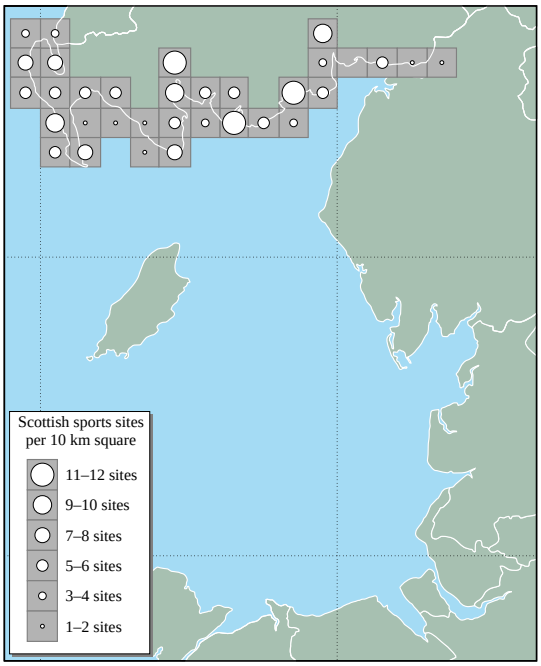
The Isle of Man has 118 km of coastline, much of it unspoilt, predominantly cliff-backed rocky shore, with sheltered sandy bays in the south and long exposed sand or shingle beaches in the north. There are few designated amenity areas outside of the towns. There is public access to all Manx National Heritage land, much of which is coastal. There is a coastal footpath which extends right around the island. Most of the island is within easy reach of the coast for leisure; consequently, despite a recent marked decline in tourist numbers, the island remains very popular for water-based leisure activities, for both local people and visitors.

9.7.2 Important locations

Table 9.7.1 lists the locations of existing and proposed water-based leisure and tourism facilities in the region (Map 9.7.3).

Tourism on the north Wales coast is highly developed; in the 19th and early 20th century this was the traditional destination for residents of the developing industrial towns of Lancashire. Resorts such as Colwyn Bay, Rhyl and Prestatyn have benefited particularly from good road and rail links (Evans & Thomason 1990). As in many other regions, in north Wales the tourism industry has suffered a decline in both visitor numbers and spending in recent years, although it is making increased effort to attact visitors back; for example Rhyl's facilities now include the 'Tropical Sun Centre' (a large leisure centre on the seafront), Ocean Beach funfair and attractions, a Sea Life Centre, marine lake and a watersports centre. The Sports Council for Wales (1992), in conjunction with the Countryside Council for Wales, has created a GIS database of sites used for recreation on land and water throughout the country (the Natural Facilities in Wales database). 41 of the 500 coastal sites are in Clwyd. There are at least twelve caravan parks and/or

Map 9.7.3 Important locations for water-based leisure. Sources: Tourist Offices.



Map 9.7.4 Numbers of recreation sites by coastal 10 km square held on the Countryside Sports database. Source: The Scottish Sports Council.

campsites in Clwyd, many of them in between towns, and also at least one large holiday camp. There are three coastal golf courses in Clwyd and six RYA-affiliated sailing or yacht clubs. Table 9.7.2 shows the breakdown of land- and water-based sites within Clwyd, by local authority district.

Table 9.7.3 shows the distribution of known accommodation in coastal districts in Clwyd in 1991; the original document (Wales Tourist Board 1991) should be referred to for an explanation of the assumptions and constraints in using the data. It is not known how much of this accommodation is on or near the coast, but in most areas it is probably a large proportion.

In the south of the region, tourist boards and local councils have to balance the daily leisure needs of a densely populated area (over one million people in Merseyside alone), with visitors coming for longer holidays from further afield. The area presents various problems for potential water sports participants, owing to the strong tides, a large tidal range and a reputation for polluted waters around centres of population. Perhaps because of these features, marine lakes, generally constructed in the late 19th century, are popular. That at Rhyl is given over to general holiday recreation; at West Kirby, the marine lake is used for dinghy sailing, windsurfing and other watersports. Part of Birkenhead Docks has been turned into a tourist attraction. The Wirral has many recreation facilities, at Hoylake and New Brighton, for example, including coastal country parks and golf courses. There are sixteen coastal golf courses in the heavily urbanised stretch from the Dee Estuary to Fleetwood. The city of Liverpool is a major tourist attraction. Restored by the Liverpool Development Corporation, the Albert Dock has over five million visitors a year, and is second only to Blackpool as a regional attraction. There are few caravan parks and/or campsites in Cheshire and Merseyside, with only ten between the Wirral and the Wyre.

The Blackpool coast, Morecambe and Southport are the other main holiday resorts in the region. Southport relies on its elegant 19th century charm to attract visitors, and is famous for its golf courses, many of which border the sea. The beach at Lytham St. Anne's is a nationally important centre for sand yachting.

Blackpool is still one of the UK's most popular seaside resorts and the focal point of tourism on the Fylde coast. Despite a decline in its traditional family holiday trade over the past few decades, it still has over 17 million individual

Table 9.7.2 Land- and water-based recreation sites in Clwyd within 10 km of the coast

District	*Land-based sites*	*Water-based sites*
Colwyn	11	19
Rhuddlan	15	21
Delyn	10	5
Alyn & Deeside	3	5
Clwyd	**39**	**50**
Wales	**549**	**619**

Source: Natural Facilities Database (Sports Council for Wales/CCW). Sites may be important for land- and/or water-based leisure; the figures are not exclusive. 'Land-based sites' include those listed in the database as 'air-based'.

Table 9.7.3 Known bedspaces in tourist accommodation in Clwyd

District	*Serviced*	*Self-catering*	*Caravan/camping*
Colwyn	2,069	1,407	5,248
Rhuddlan	2,544	6,507	3,432
Delyn	745	77	3,509
Alyn & Deeside	108	0	465
Total	***5,466***	***7,991***	***12,654***

Source: Wales Tourist Board (1991).

Table 9.7.4 Number of sites in Dumfries & Galloway at which one or more recreational activity is taking place

Annandale and Eskdale	10
Nithsdale	21
Stewartry	63
Wigtown	130
Dumfries & Galloway	**224**

Source: The Scottish Sports Council Countryside Sports Database.

visits each year and an income from tourism of over £400 million (Rusbridge 1992). The resort is particularly well known for its Pleasure Beach, Tower and Sandcastle (a modern leisure complex). It had over 43,000 bed spaces in the early 1990s (Taylor & Parker 1993), including nearly 8,000 in hotels and 33,000 in guesthouses. The resort is now successfully serving the conference and business meetings market.

Morecambe is being extensively redeveloped. Over the past 30 years numbers of visitors have declined markedly, owing to a lack of investment, competition from cheap foreign holidays and concern over pollution in the Irish Sea (Bottle 1994; Lancaster City Council 1994). Several large sea front leisure complexes are planned or in the process of being built. The Morecambe Bay area, including the south of Walney Island, has 24 camping/caravan sites, with a concentration in the area around Arnside and Silverdale, which has become another popular tourist destination. It has suffered less from the decline affecting the seaside resorts, partly owing to a higher proportion of overseas visitors and partly to an increasing demand for outdoor activity and general walking holidays. There are twelve coastal golf courses from Morecambe Bay to the Solway. The Lake District National Park in the north of the region is an important tourist destination, but most of the Cumbrian coast is not heavily used for recreation. There are fourteen camping/caravan sites, concentrated around Silloth. The whole of the Solway Firth is used for recreation and leisure activities, but at a very low level. Tides and currents in the Solway Firth are strong, limiting the further development of water-based recreation, although there are some moorings and marinas in the estuaries.

Dumfries & Galloway has many miles of unspoilt coastline and is a popular destination for low-intensity fishing, walking, golf and watersports. The area is now experiencing increased recreational pressure, as tourists who traditionally went to the Lake District attempt to avoid the high-season crowds there. There are 28 camping/caravan sites, generally small and widely scattered, and seven coastal golf courses. There are six RYA-affiliated sailing and yacht clubs in Dumfries & Galloway. The Countryside Sports Database, held by the Scottish Sports Council (SSC), lists 224 records of sport and recreation sites in the coastal 10 km squares of Dumfries & Galloway. The activities recorded are sub aqua (at 64 sites), walking (33), sea angling (24), game angling (18), wildfowling (18), coarse angling (14), sailing (12), orienteering (9), horse riding (7), board sailing (5), canoeing (5), cycling (5), motor sports (3), pony trekking (2), waterskiing (2), rock climbing (1), rowing (1) and shooting (1) (Scottish Sports Council Countryside Sports Database). Note that coverage in the database is not systematic; also, more than one activity may occur at a site. Table 9.7.4 gives a breakdown of recorded activity by district; the distribution of sites is shown on Map 9.7.4.

In 1993 the Isle of Man was visited by approximately 127,000 staying visitors plus 10,000 day trippers. This was an increase of about 25% on 1992 figures, in contrast to a strong downward trend in staying visitors from 1985 to 1992. Douglas (including Onchan) is the most important resort (65% of staying visitors in 1993). Most visitors arrive by ferry to Douglas. The TT motorcycle racing fortnight in late May/early June is the busiest part of the year for tourism. There are no coastal touring or static caravan parks on the island, though small temporary ones may exist during TT week. There is a coastal (links) golf course on Langness peninsula, another at Port St. Mary that runs partly along the cliff top, and a third within 1 km of the coast at Port Erin. There are around 30 rural coastal car parks plus four coastal picnic sites on the island.

Sea angling is a very popular pastime on the Isle of Man (see sections 9.1.2 and 5.7.3), particularly from piers and beaches. Sailing, including yachting and powerboating, is a popular pastime on the island. Tourist boat trips operate from Port Erin and Port St. Mary to the Calf of Man during the summer. The popularity of water-skiing and jet-skiing on the Isle of Man has increased over the last few years, especially in Bay ny Carrickey, off Port Erin and around the Calf. Other watersports practised around the Isle of Man include canoeing (common in Port Erin Bay), surfing (mostly at Bay ny Carrickey), windsurfing (Bay ny Carrickey, Castletown and Derbyhaven) and snorkelling. There are popular bathing beaches at Laxey and White Strand as well as at the larger recreational centres of Ramsey, Douglas, Castletown, Port St. Mary, Port Erin and Peel. Parascending takes place occasionally in Port Erin and elsewhere, although there is no organised club. A watersports centre based at Port Soderick, south of Douglas, was developed to encourage water skiing, jet skiing and diving but operated for only one season and closed in late 1993.

The Isle of Man has some of the best dive sites in the UK, a fact reflected in the number of diving clubs on the island (Table 9.7.1). Diving is concentrated mainly around the south of the island and the Calf. There are recompression facilities at Douglas.

Wildfowling - a traditional coastal activity in the region - is now recreational, although formerly it was commercially practised for food. Coastal quarry species include most ducks, some geese and three waders (only one of which - golden plover *Pluvialis apricaria* - is regularly coastal). In this region the main species are mostly ducks, notably wigeon *Anas penelope,* mallard *A. platyrhynchos* and teal *A. crecca* and geese, especially pink-footed geese *Anser brachyrhynchus.*

Wildfowling is widespread in the region, and is practised especially over much of the larger estuaries. Substantial areas are licensed to clubs and other groups; other areas, especially in Dumfries & Galloway, are shot over by individuals. Shooting on some coastal sites such as parts of the Solway involves both local wildfowlers and those from further afield. The Dee estuary marshes are shot over by a club, as are parts of the southern shore of the Mersey estuary. Three wildfowling clubs shoot over the Ribble estuary marshes. Within the Ribble Marshes National Nature Reserve (NNR) a substantial saltmarsh are has been established as a no-shooting refuge, and this has been associated with a long-term increase in wigeon (the main quarry species) numbers. Three wildfowling clubs

operate on parts of Morecambe Bay, and there is some shooting on the saltmarshes of the Esk estuary. Substantial parts of the saltmarshes and merse of the Solway Firth are shot over by several clubs, and under individual permits on the Caerlaverock NNR, where the main species shot are pink-footed goose, teal, mallard, pintail and wigeon (Owen 1992). There is generally less wildfowling on the estuaries of the Dumfries & Galloway coast than further south in the region: there is wildfowling on the Cree estuary and parts of Rough Firth & Auchencairn Bay and Luce Bay, and at times on the Water of Fleet.

9.7.3 Management and issues

The expansion of tourism and leisure facilities along the coast (particularly those areas closest to the heavily urbanised south of the region and the mill towns of Lancashire and West Yorkshire) dates from the 19th and early 20th century. At this time the region's wide sandy beaches became the main focus for holidays and leisure activities, with rapid growth of the major holiday centres along the north Wales, Fylde and Morecambe coast, and the development of large numbers of coastal camp sites and caravan parks. Many of the latter were established at a time when planning controls were less strict than they have since become, and would probably not obtain planning permission today.

Despite a decline in the numbers of holidaymakers to the coast as a result of the growth of foreign holidays, the leisure industry is vital to the economy of the coastal areas. The tourist business in north-west England alone supports over 250,000 jobs, and the more than 8 million visitors spend over £1,000 million a year in Lancashire, Merseyside and Cumbria alone (North West Tourist Board 1991).

Each local planning authority in the region has produced policies to promote recreation and tourism, which are set out in their structure plans and local plans (see also Chapter 10). These promote the sustainable and balanced development and redevelopment of tourism and leisure facilities within existing resorts and urban areas, or redundant industrial areas and docklands. The policies actively discourage new developments on the open coast and on undeveloped estuarine areas, or any other sites where they would radically alter the function or appearance of the coast. Central government's Policy and Planning Guidelines (PPGs) and the strategies of the Tourist Boards also contribute to the planning and control of tourist developments.

There are several important issues relating to tourism and leisure activity in the region. These include the problems of water quality with regard to the health of swimmers and others undertaking contact water sports (see also section 9.6), the noise and disturbance caused by motorised sports (beach buggies, four-wheel drive vehicles and jet-skis) and the many problems associated with the sheer volume of people using the coast. The latter has resulted in erosion and habitat disturbance from high levels of trampling on coastal paths and beach access points, damage from car parking and walking on dunes (e.g. at Southport and Lytham St. Anne's), and other conflicts both between different coastal user groups and between human activities and the coastal environment. New management strategies are being developed by local authorities to cope with these problems.

A number of marina and amenity barrage proposals are still pending in the region. These could have considerable impacts, not only by causing habitat loss and change, but also by increasing levels of water use and disturbance in the area.

Other activities can harm wildlife in remaining semi-natural habitats. For example, disturbance by dog walkers and other coastal users is probably important in reducing breeding success in a nationally important colony of little terns on the Isle of Man; activities of this kind have also led to the introduction of a voluntary wardening scheme to reduce disturbance to roosting waterfowl on the Dee Estuary.

The Isle of Man does not encourage the use of either touring or static caravans - special permission is required from the Department of Local Government and the Environment to bring a touring caravan onto the island. The quality of bathing waters continues to be a contentious issue in the Isle of Man (see section 9.6). The Isle of Man Department of Tourism and Transport Review in 1988 (IoMDTT 1988) outlined plans to provide more waterfront facilities. Some restrictions on diving around the island exist: the wreck 'The Racehorse', situated off Langness Point, can be dived only with permission from the Isle of Man Sub-Aqua Club, Douglas. Port Erin Breakwater is a voluntary conservation area where divers are asked to refrain from collecting. Basking sharks regularly migrate to Isle of Man waters between June and September (see also section 5.9). These are protected animals in Manx twelve mile territorial waters (Isle of Man Wildlife and Countryside Act 1991). A code of conduct has been suggested to prevent harrassment of the sharks, since boat trips for both divers and tourists to observe them are becoming increasingly popular. Prior permission is needed from Manx National Heritage for sea angling off the Calf of Man.

Wildfowling target species and shooting seasons are regulated through the Wildlife and Countryside Act 1981. The open season for coastal wildfowling in England and Wales is 1 September to 20 February; in Scotland, open season for coastal wildfowling varies from species to species, but for most is the same as in England and Wales. As elsewhere in Britain, much of the wildfowling in Region 13 is operated and managed through wildfowling clubs and syndicates. Much takes place on areas covered by national and international site protection: around 90% of the land shot over in England and Wales is designated as Sites of Special Scientific Interest, and wildfowling takes place on several National Nature Reserves (NNRs) in the region, notably Ribble Marshes and Caerlaverock where it is mostly managed through permit systems. Wildfowling on these and other NNRs is reviewed by Owen (1992). A no-shooting refuge is maintained on the saltmarshes of the Ribble and this has led to an increased wintering population of wigeon and an increased average shooting bag but a smaller proportion of the wintering population shot (Bell & Fox 1991). At Caerlaverock there is a sanctuary area and permit regulation elsewhere in the NNR, under bylaws controlling the public access rights to foreshore shooting in Scotland. As well as statutory constraints on species shot, several sites are subject to further regulation self-imposed by wildfowlers. On the Isle of Man, legislation allows the shooting of mallard, common snipe, teal and wigeon between 1 September and 31 January, and woodcock

between 1 October and 31 January. Shooting is prohibited in the most important area for wildfowl and waders, at Langness, where birds are protected by the Department of Agriculture, Fisheries and Forestry. There is no equivalent of the Crown Estate on the Isle of Man in respect of ownership of the foreshore, and there is no common land on the island, so all shooting is on privately-owned land with the owner's permission.

The representative body for sport shooting in the UK, the British Association for Shooting and Conservation (the BASC), has 19,000 wildfowling members, mostly in 200 affiliated wildfowling clubs. The region's 47 wildfowling clubs with 2,279 members represent 23.5% of total BASC membership, although not all of these may shoot over coastal systems. There is no organised wildfowl shooting club on the Isle of Man.

During periods of severe winter weather, disturbance to waterfowl (including non-quarry species) from shooting threatens the birds' survival; at these times statutory wildfowling bans can be imposed, in England, Scotland and Wales individually or collectively, after fourteen days of freezing conditions (voluntary restraint is called for after seven days). Bans are important in this region since it is used as a refuge when weather further east in Britain and continental Europe is severe (Ridgill & Fox 1990). Further information on the history and operation of cold-weather shooting bans is given by Stroud (1992).

9.7.4 Information sources used

Most of the above information is derived from materials received from Tourist Information Centres (up to date, but of varying detail within the region), from Ordnance Survey 1:50,000 Land Ranger maps and Admiralty Charts and from a nautical almanac (D'Olivera & Featherstone 1993). It is not possible to gauge the scale of some facilities, other than in Wales (where the Sports Council for Wales Natural Facilities database is the source). The maps and tables are therefore only indicative of the distribution of leisure and tourism in the region. Equivalent detailed information as shown in Tables 9.7.2 - 9.7.4 is not readily available for England. The Isle of Man Government's Economic Affairs Division produces annual Passenger Survey Reports, so detailed information on tourists and other visitors is available. Data used are taken mainly from the 1993 report (Kelly 1994). There have been no reports or surveys to date on the number of people involved in water-based leisure activities on the Isle of Man; information given here is therefore anecdotal. In addition to the references cited, some of the information about the distribution and management of wildfowling comes from the NCC's 1989 Estuaries Review data collection (Davidson *et al.* 1991), now held as part of JNCC's integrated coastal database.

9.7.5 Acknowledgements

The authors wish to thank the BASC for help in compiling information on wildfowling, R. Irving for providing other material for this section and Peter Clement (English Nature) for information on licensing. John Crawford and Paula Lloyd Jones kindly provided data from, respectively, the Scottish Sports Council and the Sports Council for Wales/CCW databases.

9.7.6 Further sources of information

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Tourism information service - Britain	Commercial Information Library, British Tourist Authority/English Tourist Board, Thames Tower, Black's Road, Hammersmith, London W6 9EL, tel: 0181 846 9000 x 3011/3015
Tourist facilities - Wales	Wales Tourist Board, Brunel House, 2 Fitzalan Road, Cardiff CG2 1UY, tel: 01222 499909, or 34 Piccadilly, London W1, tel: 0171 409 0969
Tourist Information Centres:	
Colwyn Bay	40 Station Road, Colwyn Bay, Clwyd LL29 8BU, tel: 01492 530478
Rhyl	Town Hall, Wellington Road, Rhyl LL18 1BB, tel: 01745 355068
Birkenhead	Woodside Visitors Centre, Woodside Ferry Terminal, Birkenhead L41 6DU, tel: 0151 647 6780
Runcorn	57-61 Church Street, Runcorn WA7 1LG, tel: 01928 576776
Warrington	21 Rylands Street, Warrington WA1 1EJ, tel: 01925 36501
Liverpool	Merseyside Welcome Centre, Clayton Square Shopping Centre, Liverpool L1 1QR, tel: 0151 709 3631
Southport	112 Lord Street, Southport PR8 1NY, tel: 01704 533333
Preston	The Guildhall, Lancaster Road, Preston PR1 1HT, tel: 01772 253731
Lytham St. Anne's	290 Clifton Drive South, Lytham St. Anne's FY8 1LH, tel: 01253 725610
Blackpool	1 Clifton Street, Blackpool FY1 1LY, tel: 01253 21623
Fleetwood	Ferry Office, Ferry Dock, The Esplanade, Fleetwood FY7 1DL, tel: 01253 773953
Morecambe	Station Buildings, Central Promenade, Morecambe LA4 4DB, tel: 01524 414110
Barrow-in-Furness	Forum 28, Duke Street, Barrow-in-Furness LA14 1HU, tel: 01229 870156
Whitehaven	Market Hall, Market Place, Whitehaven CA28 7JG, tel: 01946 695678
Workington	Central Car Park, Washington Street, Workington CA14 3AW, tel: 0900 602923
Gretna	The Old Blacksmith's Shop, Gretna DG16 5HF, tel: 01461 337834
Dumfries	Whitesands, Dumfries DG1 4FB, tel: 01387 253862

Type of information	*Contact address and telephone no.*
Funding for tourism-related developments - Wales	Welsh Development Agency, Pearl House, Greyfriars Road, Cardiff CF1 3XX, tel: 01222 222666
Funding for tourism-related developments - mid Wales	The Development Board for Rural Wales, Lady Well House, Newtown, Powys SY16 1JB, tel: 01686 626965
Sports - Wales	Senior Planning Officer, The Sports Council for Wales, Sophia Gardens, Cardiff, South Glamorgan CF1 9SW, tel: 01222 397571
Sports - England	Sports Council Headquarters, 16 Upper Woburn Place, London WC1H 0QP, tel: 071 388 1277
Sports - Cumbria	Sports Council Northern Region, Aykley Heads, Durham DH1 5UU, tel: 0191 384 0338
Sports - Cheshire, Merseyside & Lancashire	Sports Council North West Region, Astley House, Quay Street, Manchester M3 4AE, tel: 0161 834 0338
Sports - Scotland (and Countryside Sports database)	Scottish Sports Council, Caledonia House, South Gyle, Edinburgh EH12 9DQ, tel: 0131 317 7200
Water quality of bathing beaches - UK	Marine Conservation Society, 9 Gloucester Road, Ross-on-Wye, Herefordshire HR9 5BU, tel: 01989 566017
Water quality of bathing beaches - Isle of Man	Dr John Robertson, Department of Local Government and the Environment - Government Laboratory, Kingswood Grove, Douglas IM1 3LY, tel: 01624 675151
Tourism - Isle of Man	Isle of Man Government, Department of Tourism and Leisure, Sea Terminal Buildings, Douglas, Isle of Man IM1 2RG, tel: 01624 686801
Sailing - Isle of Man	Isle of Man Yacht Club, New Clubhouse, Lime Street, Port St. Mary, Isle of Man IM9 5ED, tel: 01624 832088
Diving around the Isle of Man	The Secretary, Port Erin Marine Biologist's Sub-Aqua Club, Port Erin Marine Laboratory, Port Erin, Isle of Man IM9 6JA, tel: 01624 832027
Watersports - Isle of Man	Shore Buoys Watersports & Motor Sports Club, By Shore Hotel, Gansey Road, Port St. Mary, Isle of Man IM9 5LZ, tel: 01624 836189
Angling - Isle of Man	Ray Hughes (Chairman), Isle of Man Angling Association, c/o Mrs I. Glover (Marine Secretary), 11 Berkely Street, Douglas IM2 3QB

C. Contact names and addresses (continued)

Type of information	*Contact address and telephone no.*
Marine industries	British Marine Industries Federation, Meadlake Place, Thorpe Lea Road, Egham, Surrey TW20 8HE, tel: 01784 473377
Natural facilities GIS database (Sports)	Rural Surveys Research Unit, Institute of Earth Studies, University of Wales, Aberystwyth, Dyfed SY23 3DB, tel: 01970 622585
Wildfowl and wetlands	*Publicity Officer, Wildfowl & Wetlands Trust, Slimbridge, tel: 01453 890333
Wildfowling (general, including details of affiliated clubs)	Information Officer, The British Association for Shooting and Conservation, Marford Mill, Rossett, Wrexham, Clwyd LL12 0HL, tel: 01224 570881
Wildfowling (general information on wildfowl, habitats and conservation)	*Enquiry Officer, RSPB HQ, Sandy, tel: 01767 680551
Wildfowling (the sport)	Press and Information Officer, British Field Sports Society, 59 Kennington Road, London SE1 7PZ, tel: 0171 928 4742
Severe weather wildfowling bans - England	*Licensing Officer, English Nature HQ, Peterborough, tel: 01733 340345
Severe weather wildfowling bans - Scotland	*Licensing Officer, SNH HQ, Edinburgh, tel: 0131 447 4784
Severe weather wildfowling bans - Wales	*Licensing Officer, CCW HQ, Bangor, tel: 01248 370444
Windsurfing	British Windsurfing Association, 86, Sinah Lane, Hayling Island, Hants. PO11 9JX, tel: 01705 468182
Yachting	Royal Yachting Association, RYA House, Romsey Road, Eastleigh, Hants. SO4 4YA, tel: 01703 629962
Board sailing	UK Board Sailing Association, Mason's Road, Stratford-Upon-Avon, Warwickshire CV37 9NZ, tel: 01789 299574
Jet skiing	UK Jet Ski Association, Goodwood Road, Boyatt Road Industrial Estate, Eastleigh, Hants. SO5 4NT, tel: 01703 601684
Yacht harbours	The Yacht Harbour Association, Hardy House, Somerset Road, Ashford, Kent TN24 8EW, tel: 01303 814434

* Starred contact addresses are given in full in the Appendix.

For relatively unintensively used sites, such as Cabin Hill National Nature Reserve on Merseyside, low-key site management through grazing is enough to maintain the nature conservation interest of the dunes whilst allowing public access and enhancing the reserve's visual appeal. Integrating such local management measures into broader-scale sustainable management of the range of coastal habitats and wildlife in a developed, heavily-used landscape is much more complex. There are many initiatives in Region 13 that aim to achieve this wider objective. Photo: Peter Wakely, English Nature.

Chapter 10 Coastal management

S.L. Fowler

10.1 Introduction

This chapter describes national (section 10.2) and local and regional (section 10.3) coastal management initiatives taking place wholly or partly within Region 13. GB and UK national initiatives without a specific regional focus, notably those led by non-governmental agencies and user groups, are outside the scope of this chapter. However, as the whole chapter concludes with a list of contacts with a wider involvement or interest in coastal management (section 10.3.6), contact points for some of these organisations are included there. In addition, names and addresses of many contacts are given within the relevant section.

10.1.1 Coastal management in the UK

This section outlines the direction of national policy-making, within which many of the regional initiatives operate. Many, frequently competing, issues and activities affect the coastal environment and inshore waters, making the task of coastal planning and management a very complex one, particularly as numerous different authorities are responsible for particular statutory duties. Coastal management promotes an inter-disciplinary approach to multiple use and conflict resolution between interest groups, "to ensure the long-term future of the resources of the coastal zone through environmentally sensitive programmes, based on the principle of balanced, sustainable use" (Gubbay 1990). Coastal management ensures that all land and sea use issues are co-ordinated, including development, conservation, waste disposal, fisheries, transport, and coast protection and flood defence. The advantages of this have been recognised by coastal planners in many areas, and several local authorities and other bodies now promote coastal management. However, approaches differ from area to area, with overlap in some places and patchy coverage elsewhere (Earll 1994; King & Bridge 1994).

The House of Commons Environment Committee Second Report (House of Commons 1992), although limited in scope to England and the estuaries it shares with Wales and Scotland, made recommendations for the planning and implementation of coastal management that have had policy and practical implications throughout the UK. Amongst the Environment Committee's recommendations were:

- the endorsement of an integrated approach to coastal management, incorporating maritime land, sea and intertidal areas;
- a review of existing legislation;
- the need for international (EU-wide) policy initiatives;
- clearer responsibilities for planning and action in the coastal zone, based on a national strategic framework;
- appropriate funding for accountable bodies with responsibilities;
- research into the physical functioning of the coastal zone and associated protection and conservation measures;
- a review of planning mechanisms to allow effective safeguard of the coastal resource;
- monitoring and environmental assessment of coastal activities to assess their impacts;
- the involvement of local communities in coastal management planning;
- the integration of responsibility for coast protection and sea defence under one body;
- better statutory protection for sites of nature conservation importance;
- better provisions for control of marine pollution;
- the need for fisheries activities to take account of marine conservation issues.

Later in 1992, the Department of the Environment and the Welsh Office issued *Planning Policy Guidance: Coastal Planning (PPG 20)*, which made clearer the requirement for planning decisions to take account of environmental and conservation issues.

The Environment Select Committee's recommendations were followed up, in 1993, by the publication of *Development below low water mark: a review of regulation in England and Wales* (Department of the Environment/Welsh Office 1993a), in parallel with the discussion paper *Managing the coast: a review of coastal management plans in England and Wales and the powers supporting them* (Department of the Environment/ Welsh Office 1993b). That same year, The Ministry of Agriculture, Fisheries and Food (MAFF) and the Welsh Office brought out their *Strategy for flood and coastal defence in England and Wales* (MAFF/WO 1993). In this their policy is spelled out: ". . . reducing the risks to people and the developed and natural environment from flooding and coastal erosion by encouraging the provision of technically, environmentally and economically sound and sustainable defence measures."

In December 1994 the Department of the Environment launched a standing forum on coastal management for England (the Coastal Forum); it meets twice a year (see section 10.2.2). In 1995 the Department of the Environment published national policy guidelines for the coast (DoE 1995). These guidelines do not replace existing documents but provide a concise digest, pointing out common themes and principles. Public and private bodies are asked to have close regard to them in taking forward their coastal management functions. In 1994 the Department also undertook to highlight good practice in coastal management plans, clarify the interaction of the different elements of coastal management and review relevant bylaw powers. This *Best practice guide* is being prepared by Nicholas Pearson Associates and should be published in 1996. It will set out the basic principles and objectives relating to coastal management plans, helping to define the respective roles of key players, taking account of the diverse uses of the coastal zone and giving examples of best practice in helping to resolve competing pressures on the coast, and help make clearer how the different elements of coastal management interact, including relationships with other strategies. The *Review of bylaw-making powers for the coast* is examining the

bylaw powers available to bodies with responsibilities for the coast and aims to assess whether they meet modern needs. It is also considering the broader relationship between the voluntary principle and other regulatory mechanisms. A final statement on the outcome of the review is expected in 1996.

The UK government published a Rural White Paper in October 1995, which was to have included a statement on coastal policy, although in the event only sea fishing was addressed. For Wales, a comprehensive PPG draft is at consultation stage. Coastal management in the Isle of Man follows a different pattern from that on the mainland, since the Isle of Man is an internally self-governing dependency of the British Crown. It is not part of the United Kingdom, nor a member of the European Union. Its parliament, Tynwald, enacts its own laws and is not subject to UK or European Union legislation but is signatory to various relevant international conventions.

The European Commission was asked by the Council of the EU to propose a strategy for the whole of the Community coast before the end of 1994. The initial response was to adopt the *Communication on integrated management of coastal zones* (COM/511/95), which sets out proposals for EU funding for demonstration programmes of coastal management. The strategy is to be based on the principles of sustainability and sound ecological and environmental practice, but will have no legal standing.

In 1994, the UK Government published its Regulations to implement the EC Habitats Directive (Department of the Environment/Welsh Office 1994). In Scotland, the EC Habitats Directive will be implemented in accordance with Scottish Offive Environment Division Circular 6/90/95 (Scottish Office 1995). As they relate to the coast, these regulations provide for single management groups to be set up for whole sites, making the production of unified management plans a practical proposition. Where these sites are of European importance for their nature conservation interest, the conservation of that interest must be the primary consideration of the management plan. For this, the regulations require all relevant authorities to exercise a general duty of care for their long-term conservation. At the time of writing, discussions are continuing on how these requirements will work in practice (see also section 10.2.10).

Strategic planning guidelines for the Scottish coast were first set out in Scottish Development Department (1974), based on a series of maps published in Skinner (1974). These guidelines were updated by Scottish Development Department (1981) to cover most of the major developments for port, industrial and power generation purposes. More recently, the Scottish Office has commissioned a review of Scottish coastal issues (Burbridge & Burbridge 1994). This review urges the development of new coastal planning policies and guidelines to deal with the integration of coastal resource-based activities at the local and regional level. The report suggests that these should both support planning authorities in dealing with planning applications and advise on the production of local and regional coastal management plans and strategies. It also suggests the promotion of a national strategy for the sustainable development and management of coastal land and water resources.

10.2 National coastal initiatives with regional elements

10.2.1 Introduction

Partly as a result of developments at a UK and international level, many national bodies are now becoming involved in the promotion of coastal management initiatives, including several with no direct management role through a statutory remit or ownership of coastal land. These include the National Coasts and Estuaries Advisory Group (NCEAG), which advises local authorities and speaks on their behalf, and non-governmental organisations with a particular interest in the conservation of the coastal zone: the Marine Conservation Society, World Wide Fund for Nature (UK) and the Royal Society for the Protection of Birds (RSPB) (see section 10.2.7). Only national initiatives that have distinct local elements in the region are described here. Many other diverse interest groups and organisations now have national policies with regard to coastal management and estuaries management, for example the British Association for Shooting and Conservation and the Royal Yachting Association, and their representatives are involved in most local or regional groups or fora, listed in Table 10.3.1. For further information on regionally-led coastal management initiatives, see section 10.3.

Map 10.2.1 River catchment areas for catchment management plans. Reproduced by kind permission of the NRA.

10.2.2 National coastal fora

The Coastal Forum (for England)

The Coastal Forum was launched in December 1994; it is chaired and serviced by the Department of the Environment and meets twice yearly. It brings together key bodies with interests in the coast, from commerce and industry to leisure and environmental bodies, and includes representatives of central and local government. It provides for an exchange of views on issues related to the coastal zone in England by a wide range of interested bodies. In particular, it seeks to promote understanding of coastal zone initiatives; build on existing liaison arrangements and regional and local level; assist evaluation of action to implement coastal zone initiatives and monitor preparation of a guide to good practice; complement the work of other bodies with interests in coastal issues; and liaise with other relevant initiatives elsewhere in the United Kingdom. Forum proceedings are reported to government ministers. The Forum intends to produce a *Good practice guide* in 1996.

Welsh Coastal Groups Forum

Like the English Coastal Groups Forum, this was established in 1991, to co-ordinate the work of the Welsh Coastal Groups (see section 10.3.2). Members include one representative from each coastal group in Wales (Cardigan Bay, Carmarthen Bay, Swansea Bay, Liverpool Bay and Ynys Enlli to Llandudno), Tidal Dee Users Group, Severn Estuary Coastal Group, the National Rivers Authority, Assembly of Welsh Counties, Council of Welsh Districts, Countryside Council for Wales, British Rail/Railtrack, Welsh Office Planning Division and the Welsh Office Environment Division. The Forum meets twice a year.

English Coastal Groups Forum

Established in 1991, the English Coastal Groups Forum has a remit to promote the formation of coastal groups including bodies with responsibilities for coastal defence and management and the strategic and local planning functions that would influence coastal defence; to further co-operation between those bodies; to act as a link between centrally-based organisations and coastal groups; to facilitate the development of a coastal zone appraisal and management approach, ensuring that the most environmentally consistent practice is adopted in relation to physical development in the coastal zone; to promote common standards of approach; and to identify policy, administrative and research requirements. Forum members include one representative from each coastal group, the National Rivers Authority, Local Authority Associations, English Nature, Railtrack and Department of the Environment. The English Coastal Groups Forum has met three times this year (as at November 1995).

Scotland

There are no formal coastal groups in the Scottish part of the region, and no Scottish Coastal Forum. Hydraulics Research have carried out a study on coastal process cells in Scotland (HR Wallingford 1995: draft report), co-sponsored by Scottish Natural Heritage, the Scottish Office Environment Department and Historic Scotland. This study aims to set out for the first time a framework for management of coastal areas in Scotland and could be used to set up new coastal management initiatives, such as the coastal (engineering) groups established in England and Wales (see section 10.3.2). The final report is due in April 1996. HR Wallingford are also producing a series of eleven regional reports, summarising coastal processes for each of the coastal cells in Scotland.

Isle of Man

There is no coastal group for integrated coastal zone management on the Isle of Man.

10.2.3 Countryside Council for Wales

The Countryside Council's marine and coastal zone policy was launched at the Prince of Wales Lecture in December 1995 (CCW 1995). It commits the Council to striving for the integrated, holistic management of the marine and coastal environment, and includes specific policies to achieve this. A review of coastal management of three test areas in Wales (Swansea Bay, Ceredigion coast and the Menai Strait) has been carried out by the University of Wales Department of Maritime Studies.

10.2.4 English Nature

English Nature organises or participates in a number of national coastal zone management initiatives; some major examples are described below (see also section 10.2.10).

Estuaries Initiative

The Estuaries Initiative for achieving the sustainable management of estuaries is described in *Caring for England's estuaries: an agenda for action* (English Nature 1992); estuary projects are listed in Grabrovaz (1995). Out of a total of 35 projects underway or proposed in the country, six are underway (none proposed) in this region: the Dee Estuary Strategy, the Mersey Estuary Management Plan, the Ribble Estuary Strategy, The Morecambe Bay Strategy, the Duddon Estuary Partnership and the Solway Firth Partnership (a partnership with Scottish Natural Heritage) (see also Table 10.3.1). English Nature's involvement in these projects can vary from full involvement in the management committee through participation in a Topic Group to responding to consultation drafts.

Sensitive Marine Areas

English Nature's Sensitive Marine Areas (SMA) initiative is set out in *Managing England's marine wildlife* (English Nature 1994) (see also section 7.4.4). Under the initiative, which is modelled on the Estuaries Initiative, English Nature and the managers and users of the marine environment are, with joint funding, developing ways of managing areas of marine wildlife importance, based on voluntary measures used in conjunction with existing regulatory controls. Sensitive

Marine Areas within the region include the Dee Estuary and Ribble Coast, Morecambe Bay and Lune Deep, the Cumbrian Coast, and Solway Firth.

Maritime Natural Areas

English Nature has, through consultation, identified 23 proposed Maritime Natural Areas around the coast of England (described in *Conserving England's maritime heritage - a strategy* (EN 1993)). These non-statutory areas represent coherent maritime wildlife systems based on major sediment cells and other coastal features. The seaward boundary of each is the 12 mile limit, and the landward boundary the limit of coastal habitats. The Natural Areas approach is being tried out at one Maritime Natural Area (Lyme Bay, Dorset, in Region 9), and will be applied in future to the Maritime Natural Areas within this region, which include sections of the coast from the Welsh Border to Fleetwood, Fleetwood to Walney, Walney to Maryport, and Maryport to Gretna.

10.2.5 Scottish Natural Heritage

Focus on Firths

The major national coastal management initiative currently under way in Scotland is 'Focus on Firths', instigated by Scottish Natural Heritage (SNH). It aims to promote the protection and better management of the natural resources of the major Scottish estuaries and firths by stimulating understanding and voluntary co-operation among the various users and statutory authorities. A local management forum will be set up for each site, made up of statutory, industrial, voluntary agencies and community representatives as appropriate, to develop proposals for its sustainable management. Three projects are already running: one of them, the Solway Firth Project (in partnership with English Nature) is in this region (see Table 10.3.1).

Marine Consultation Area

This non-statutory designation, similar to English Nature's 'Sensitive Marine Area' identification, is used by Scottish Natural Heritage to indicate important sites and stimulate consultation over developments there (NCC 1990). There is one Marine Consultation Area in the region: Loch Ryan.

10.2.6 Arfordir Group

The Arfordir group is the local authority coastal officers' forum in Wales. It aims to promote integrated coastal management and best management practice for the whole of the Welsh coast, and to achieve Wales-wide representation after local government re-organisation. Membership is free and open to all maritime local authorities; current members include Ceredigion District Council, Pembrokeshire Coast National Park Authority, Snowdonia National Park Authority, Dwyfor District Council, Ynys Môn District Council, Arfon District Council, Aberconwy District Council and Swansea City Council. Arfordir members in Region 13 include Clwyd County Council and the Dee Estuary Study Group.

10.2.7 Royal Society for the Protection of Birds

In 1990, the Royal Society for the Protection of Birds (RSPB) launched a national campaign to promote the importance of estuaries in the UK and the need for coordinated management (Rothwell & Housden 1990). The campaign ran for three years. The RSPB Estuaries Inventory project compiled mapped and numerical information on land use and selected human activities for 57 major UK estuaries. In 1994, the RSPB launched its 'Marine Life' campaign, which aims to increase awareness of the problems facing the marine environment and its wildlife, including pollution, fisheries and shipping safety. It has recently published a *Review of coastal zone management powers* (RSPB 1995). RSPB (1993) reviews strategic planning and management initiatives in part of the region.

10.2.8 Shoreline management plans

MAFF has initiated the preparation of Shoreline Management Plans for coastal defence by coastal local authorities, based on coastal sedimentary sub-cells (see Map 2.4.1). The plans follow government guidelines on assessing the environmental impacts of proposals, including soft defence and 'do nothing' options (MAFF/Welsh Office/Association of District Councils/English Nature/NRA 1994). In the Liverpool Bay area, Wirral Borough Council are leading on a plan to cover the area between the Great Orme and Formby Point, while Blackpool Borough Council are leading on a plan (the Ribble Estuary Strategy - see Table 10.3.1) for the coastline between Formby Point and Rossall Point, Fleetwood. Shoreline management plans are also being prepared for three coastal sub-cells within the North West Coastal Group area (see also Table 10.3.1): Ribble - South Walney (lead authority: Lancaster City Council), South Walney - St. Bees (lead authority: Copeland Borough Council), and St. Bees - Scottish border (lead authority: Allerdale Borough Council).

10.2.9 National Rivers Authority (NRA) catchment management plans

River catchments, including estuaries and coastal waters, are the NRA's basic management unit. A catchment management plan is an agreed strategy to realise the environmental potential of the catchment, within prevailing economic and political constraints. River catchments are shown on Map 10.2.1. Table 10.2.1 gives the National Rivers Authority's Welsh and North West Regions' five year programmes for the completion of consultation reports for river catchment management plans in the region (NRA 1994).

Table 10.2.1 Catchment Management Plans timetable

Catchments	*Timescale*	*Contact*
Conwy	Consultation report available	*NRA Welsh Region, Cardiff, tel: 01222 770088
Menai Strait	Consultation report available	as above
Clwyd	Due for completion in 1994/5	as above
Dee	Due for completion in 1994/5	as above
Weaver	Due for completion in 1997/8 or later	*NRA North West Region, Warrington, tel: 01925 53999
Mersey Estuary	Due for completion in 1996/7	as above
Douglas (Lancs.)	Consultation report available	as above
Crossens	Due for completion in 1994/5	as above
Ribble	Due for completion in 1994/5	as above
Alt	Due for completion in 1994/5	as above
Wyre	Due for completion in 1995/6	as above
Lune	Due for completion in 1997/8 or later	as above
Morecambe Bay	Due for completion in 1996/7	as above
Leven	Due for completion in 1996/7	as above
Cumbrian Coast	Due for completion in 1994/5	as above
Derwent	Due for completion in 1994/5	as above
Eden and its estuary	Due for completion in 1995/6	as above

* Starred contact addresses are given in full in the Appendix.

10.2.10 Designated sites

Site designations are discussed in detail in Chapter 7. However, several statutory and non-statutory designations are also relevant here because they provide a degree of coastal management through their area or site management plans. These often tend to focus strongly on the conservation of landscapes, buildings and/or habitats and species, rather than on wider and more integrated coastal issues, although in management planning for some sites a focus on visitor use and community involvement is important. Designated sites include nature reserves, managed by English Nature, wildlife trusts, local authorities, the RSPB or other bodies for nature conservation objectives, Heritage Coasts (see below) and eventual marine Special Areas for Conservation (see also section 7.1). The National Trust, which has extensive coastal land holdings in the region, has recently been carrying out a complete review of its Coastal Strategy Plans and has an ongoing review of coastal site management plans. It has produced a *Coastal strategy for Wales* (National Trust 1995), which provides guidance for the acquisition of coastal sites under Enterprise Neptune and for responses to coastal issues.

Heritage Coasts

The defined areas of Heritage Coasts include only the finest sections of undeveloped coast (section 7.4.3), although much larger coastal areas are frequently covered by local authority Coastal or Countryside Management Services plans. Most Heritage Coast Services (management teams working from within local authorities) are producing or implementing management plans through their respective local authorities and associated Steering Groups. There is only one Heritage Coast in the region, at St. Bees Head, which is managed by Copeland Borough Council and will in due course have a specific Heritage Coast Management Service; the management plan for an RSPB Nature Reserve within the area is currently in use. The Coastal Heritage Network (CoastNET) (formerly the Heritage Coast Forum) is funded by the Countryside Commission, English Nature and Scottish Natural Heritage, and provides contact between those working on all coastal management projects, including individuals and groups concerned with the management of Heritage Coasts in England (the Arfordir Group - see Section 10.2.6 fulfils a similar role in Wales). It is proposed that the wider remit of the Network will eventually cover the whole of the UK.

Marine Special Areas of Conservation (SACs)

Under the EC Habitats Directive 1992, a list of marine Special Areas of Conservation (SACs) to be designated in the UK must be agreed by the UK Government and the European Commission by 1998 (see section 7.1). A list of possible sites on which consultations will be carried out was published in March 1995. Marine SACs may include intertidal areas and/or subtidal areas; terrestrial SACs may include important coastal maritime habitats such as lagoons, saltmarshes or sand dunes. Under the Habitats etc. Regulations 1994, marine and terrestrial SACs will have to be managed in a way that secures their 'favourable conservation status'. A range of bodies and individuals will be involved, including all 'relevant and competent authorities', e.g. local authorities, the National Rivers Authority (NRA), ports and harbour authorities, Sea Fisheries Committees, Countryside Council for Wales, Scottish Natural Heritage, Department of the Environment (Northern Ireland) and English Nature, as well as owners and occupiers of foreshore land and representatives of those who rely on marine areas for their livelihood or for recreation. Management will be coordinated through an agreed management scheme, backed by existing statutory measures. The Department of the Environment has prepared draft guidelines for the preparation of management schemes for marine SACs, for consideration by the English Coastal Groups Forum (see section 10.2.2) at their November 1995 meeting, with publication due in 1996. At the time of writing, the four country nature conservation agencies are, at the instigation of the Scottish Office, preparing a generic management model for marine SACs, giving an overview of how schemes of management should develop (Laffoley in prep.).

10.3 Regional coastal management groups and initiatives

10.3.1 Introduction

There are currently numerous regional coastal management initiatives arising around the coastline under the leadership of local planning, harbour and port authorities. Other locally-based coastal management initiatives, although not strictly integrated as defined in section 10.1.1, are also under way. These include coastal (engineering) groups (see section 10.3.2), which are primarily concerned with promoting coordination and liaison between organisations undertaking coastal works (section 8.4), and other coastal fora (section 10.3.3). Table 10.3.1 lists regional coastal management initiatives, in many of which local authorities are involved or take a leading role.

10.3.2 Coastal (engineering) groups

Three non-statutory coastal groups (sometimes known as coastal engineering groups) have been established within the region to improve co-ordination and liaison between agencies undertaking coastal works (see section 8.4). The geographical coverage of these groups is based on natural coastal sediment cells (see section 2.4). Their main aim is to seek a co-ordinated approach to all coastal engineering works by member authorities; reduce the risk of works adversely affecting the neighbouring coastline; and improve their understanding of coastal processes. Table 10.3.1 includes coastal groups active in the region. The Llandudno to Mersey (or Liverpool Bay) Coastal Group extends from the Great Orme eastwards to the River Ribble and lies mainly within Region 13, but includes part of Region 12. The North West Coastal Group (incorporating the former River Ribble to Morecambe Bay and the West Cumbria Coastal Groups) covers the remaining area of the English coast. There are no Scottish coastal engineering groups in the region.

10.3.3 Other coastal fora

In some places wider coastal fora have developed from a range of coastal designations and various management initiatives. There are several of these operating in the region, including the North Wales Coastal Forum, the Irish Sea Forum, Dee Estuary Forum, Morecambe Bay Conservation Group and the Solway Firth Partnership, with others likely to be established. The great value of these fora is that they bring all interest and user groups together and enable issues of concern to be examined from all points of view. Table 10.3.1 summarises these initiatives.

10.3.4 Local planning authority and ports/harbours initiatives

The maritime local planning authorities are involved in most, if not all, of the major coastal management initiatives described in this chapter (Table 10.3.1). Their own planning documents (County Structure Plans and Local Plans) also usually pay particular attention to coastal matters, particularly when produced following PPG20 (DoE/WO 1992). In Wales the Welsh Office invited the Assembly of Welsh Counties, in liaison with the District Councils, to draw up proposals for Strategic Planning Guidance, the equivalent of Regional Guidance in England (Bown 1992). As part of this process a number of topic groups were formed, including a Coastal Strategy Working Party (chaired by David Bown, County Planning Officer of Dyfed). The report prepared by this group is, at the time of writing, with the Welsh Office awaiting their response.

On the Isle of Man, planning matters involving substantial works, particularly concerning harbours or sea defences, and the granting of sea-bed licences have usually in the past been handled through the Harbours Division of the Department of Highways, Ports and Properties. In intertidal planning procedures the Department of Local Government and the Environment has sometimes been involved. In practice, procedures for non-fisheries matters below the high tide level are unclear, since they arise relatively infrequently. There is a proposed planning Act, expected to be implemented during 1995, which may enable the extension of planning controls administered through the Department of Local Government and the Environment to the 12 mile limit, and which should, therefore, clarify procedures.

Table 10.3.2 lists examples of local authority planning documents. Note that Dumfries & Galloway Regional Council and the four District Councils are to be amalgamated into one authority, the Dumfries & Galloway Council, in April 1996.

10.3.5 Acknowledgements

Thanks are due to Graham King (NCEAG), Ceri Jones (Sefton Coast), John Houston (Sefton Metropolitan Borough Council), Martin Dodds (Cumbria County Council), Donald Farrell (Cheshire County Council) and Jim Lester (Metropolitan Borough of Wirral) for their helpful comments on the text.

Table 10.3.1 Regional coastal management initiatives

Initiative name	*Activities*	*Organisations involved*	*Contact address & telephone no.*
North Wales Coastal Forum	Established 1992. Covers area extending southwards from lat. 53°40'N, including coast & hinterland. Helps members exchange information and views on coastal issues, develop relationships with international & national government, agencies & bodies and agree action on matters of mutual interest.	Clwyd County Council, Gwynedd County Council, District, Borough and Town Councils, CCW, NRA, North Wales & North Western Sea Fisheries Committee, non-governmental organisations including National Trust, RSPB, Wildlife Trust, Royal Yachting Association, Friends of the Earth, commercial interests, recreational groups and scientific bodies.	John Nicholson, Administrator, North Wales Coastal Forum, Tanrallt, Rhostryfan, Caernarfon, Gwynedd LL54 7NT, tel: 01286 830312
Tidal Dee Users Group	Aims to improve co-ordination and liaison between agencies undertaking coastal works.	Various	Dr B. Hodgson, NRA, Shire Hall, Mold, Clwyd CH7 6FA, tel: 01352 700176
Dee Estuary Strategy	Collaborative approach to managing the Dee Estuary between Rhyl, New Brighton and Chester. Issues covered include leisure and tourism, industry, shipping, pollution and development pressures, conservation. Produced draft Dee Estuary Strategy in 1995 (Metropolitan Borough of Wirral 1995).	Funded by ten organisations: Cheshire and Clwyd County Councils, Wirral Metropolitan, Ellesmere Port, Neston and Delyn Borough Councils, Chester City Council, Alyn & Deeside District Council, English Nature (Estuaries Initiative), CCW, MoD. Managed by Dee Estuary Forum (61 organisations) with Steering Committee & Project Officer.	Dee Estuary Project Officer, Leisure Services and Tourism, Metropolitan Borough of Wirral, Hamilton Street, Birkenhead L41 5FN, tel: 0151 647 2366 ext. 2798
Wirral Coastal Management Plan 1989	The Wirral Metropolitan Borough coast including areas bordering the Irish Sea, Dee and Mersey. Issues: Recreation, conservation, water quality, coastal defence, erosion, siltation, cockling. Producing Area Action Plans.	Metropolitan Borough of Wirral, Department of Leisure Services and Tourism.	Coastal Management Officer, Department of Leisure Services and Tourism, Metropolitan Borough of Wirral, Westminster House, Hamilton Street, Birkenhead L41 5FN, tel: 01516 447 2366 x 2765
Irish Sea Forum	Organises seminars and conferences; publishes proceedings.	Very wide scope	Dr D.F. Shaw/Mrs Hilary Davies, Irish Sea Study Group, Oceanography Laboratories, The University, Liverpool L69 3BX, tel: 0151 794 4089
North West Coastal Network	A network for practitioners between the Dee Estuary and the Solway Firth. Provides network for information exchange.	A Coastal Research and Management Group (see section 10.3.6 C) initiative, supported by the Coastal Heritage Forum and land management agencies, including local authorities, RSPB, English Nature and County Wildlife Trusts.	Coastal Heritage Forum, Centre for Environmental Interpretation, The Manchester Metropolitan University, St. Augustine's, Lower Chatham Street, Manchester M15 6BY, tel: 0161 247 1067
Liverpool Bay (Llandudno to Merseyside) Coastal Group	Aims to improve co-ordination and liaison between agencies undertaking coastal works. Databases of coastal structures and references, and flood risk areas map. Preparation of a shoreline management plan is under consideration.	Aberconwy Borough Council, other local authorities in Region 13, NRA (Welsh and NW regions), Railtrack, MAFF (observer), Welsh Office (observer). Other observers include CCW.	Chairman: A.M. Rhodes, Borough Engineer, Metropolitan Borough of Wirral, Town Hall, Bebington, Wirral L63 7PT, tel: 0151 645 2080
Mersey Basin Campaign	Twenty-five year programme. Aims to clean all 1,700 km of rivers and streams to at least Grade 2 standard, encourage attractive waterside developments and improve public awareness. Has five subdivisions, including the Estuary Project Group.	Campaign is supported by public and private agencies, including EC, local government, voluntary bodies (300 in MB Trust), commercial and industrial interests (MB Business Foundation).	Mersey Basin Campaign Unit, Department of the Environment North West Office, Sunley Tower, Piccadilly Plaza, Manchester M1 4BE, tel: 0161 952 4000

Table 10.3.1 Regional coastal management initiatives (continued)

Initiative name	*Activities*	*Organisations involved*	*Contact address & telephone no.*
Mersey Estuary Management Plan	Includes a wide range of concerns, each with an interest in the future of the Mersey, including environmental and commercial development interests. Technical Steering Group directed work on the Management Plan (University of Liverpool Study Team 1995), which covered the estuary within tidal limits with landward influence to 5 m contour: approx. 200 km^2 area and 50 km length. Issues: navigation and tidal regime, coast and flood defence, wildlife and landscape conservation, fisheries, water quality, recreation, voluntary group participation, land ownership, industrial and urban development. Aims to promote sustainability, improve water quality, biological diversity, commercial prosperity, tourist potential, public access and associated targets. Newsletter; annual conference.	Mersey Basin Campaign Unit (DoE), Cheshire County Council, Sefton and Wirral Metropolitan Borough Council, Liverpool City Council, Halton, Warrington, and Ellesmere Port & Neston Borough Councils, NRA, English Nature (Estuaries Initiative). Management Plan financed by local authorities, DoE (Mersey Basin Campaign), English Nature and NRA, who commissioned Liverpool University to produce Plan. Has links to the Ribble and Dee Estuaries Plans and the Sefton Coast Management Scheme.	Secretary, Mersey Basin Campaign Estuary Project Group, Planning Division, Sefton MBC, 375 Stanley Road, Bootle L20 3RY, tel: 0151 934 3564 Management Plan: Professor P. Batey, Dept. of Civic Design, University of Liverpool, PO Box 147, Liverpool L69 3BX, tel: 0151 794 3107
Sefton Coast Management Scheme	Sefton Coast from Seaforth Docks to Crossens, Southport. Issues: planning, shoreline management, tourism, recreation, water and beach quality, offshore issues (oil and gas), conservation, dockland/resort development and regeneration, environmental education. Co-ordinates production of the Sefton Coast Management Plan	Sefton MBC, NRA, English Nature, Countryside Commission, National Trust, Territorial Army, RSPB, North West Federation for Sport, Recreation and Conservation. Steering Group of elected members and representatives of above; Officers Working Party.	Coast Management Officer, Sefton MBC, Formby Council Offices, Freshfield Road, Formby, Merseyside L37 6PQ, tel: 0151 934 2960
North Western Coastal Group (incorporating the former River Ribble to Morecambe Bay Coastal Group and the West Cumbria Coastal Group)	Aims to improve co-ordination and liaison between agencies undertaking coastal works. Coordinating preparation of shoreline management plans (see section 10.2.8).	Cumbria County Council, Barrow-in-Furness, Blackpool, Fylde, Wyre, Barrow, Copeland and Allerdale District Councils, Lancaster City Council, South Lakeland DC, NRA North West, Associated British Ports.	R. Reed, Engineering Service Unit, Wyre Borough Council, Civic Centre, Breck Road, Poulton-le-Fylde FY6 7PU, tel: 01253 887215
Ribble Estuary Strategy	From Formby Point to Rossall Point and upstream to Preston. Issues: pollution, waste water and radionuclides, availability of information, changes in paths of channels and extent of saltmarsh, adequate provision for recreation. Aims to provide framework for sustainable use through management plan.	Blackpool Borough Council (lead Agency), Lancashire County Council, Fylde, Preston and West Lancashire Boro' Councils, Sefton MBC, English Nature (Estuaries Initiative), NRA, RSPB, BASC, North Wales & North Western Sea Fisheries Committee. Steering Group of officers from above. Officers Working Group. Advisory Group includes local authorities & MPs.	*Planning Department, Blackpool Borough Council, Blackpool, tel: 01253 25212, or *Ribble Estuary Project Officer, English Nature, Blackwell, tel: 01539 445286
Fylde Forum	Set up by NW Water plc to discuss its waste water treatment works programme	Forum involves almost every local authority (officers and members) and organisation in the Blackpool area, as well as many individuals (e.g. fishermen).	Planning Liaison Team, North West Water plc, Pennine House, Stanley Street, Preston PR1 4EA, tel: 01772 822200

Table 10.3.1 Regional coastal management initiatives (continued)

Initiative name	*Activities*	*Organisations involved*	*Contact address & telephone no.*
Morecambe Bay Conservation Group	Public discussion forum founded by the Marine Conservation Society (MCS) Local Group	Steering group includes Marine Conservation Society, RSPB, ICI and other local industry, NW Water, English Nature, Lancaster City Council and other local authorities, wildlife organisations, and individuals. Has at least 50 active members, and some meetings (open to the public) include up to 100 attendees.	Mark Woombs (Marine Conservation Society), Knott End Sea Centre, Spring Bank, Knott End on Sea, Poulton le Fylde, Lancs. F16 0AA, tel: 01253 810880, or Tim Melling, RSPB, Westleigh Mews, Wakefield Road, Derby Dale, Huddersfield HD8 8QD, tel: 01484 861148
Morecambe Bay Forum	Set up by NW Water plc to discuss its waste water treatment works programme	Forum involves almost every local authority (officers and members) and organisation in the Lancaster area, as well as many individuals (e.g. fishermen).	Planning Liaison Team, North West Water plc, Pennine House, Stanley Street, Preston PR1 4EA, tel: 01772 822200
The Morecambe Bay Strategy	Covers Morecambe Bay from Walney Island to Fleetwood including estuaries of the Leven, Kent, Keer, Lune and Wyre. Issues: conflict between users of the estuary including industry, recreation, conservation, pollution and coastal defence.	English Nature (Estuaries Initiative), Cumbria and Lancashire County Councils, Barrow and Wyre Borough Councils, South Lakeland District Council, Lake District Special Planning Board, Lancaster City Council.	*Morecambe Bay Estuary Project Officer, English Nature, Blackwell, tel: 01539 445286
Duddon Estuary Partnership	Duddon Estuary and adjacent coast from North Walney to Haverigg. Issues: water quality, pollution, sea defence, need for economic development, tidal barrage proposal. Draft framework programme 1994. Issue: Solving Groups and annual Open Forum.	Consultative Committee includes local planning authorities, English Nature (Estuaries Initiative), MAFF (as observers), NRA, Cumbria Sea Fisheries Committee, parish councils, local interest groups, voluntary organisations, NFU, and landowners.	*County Planning Department, Cumbria County Council, Kendal, tel: 01539 814457
Solway Firth Partnership	Mull of Galloway to St. Bees Head. Issues: harvesting biological resources, conservation management, coastal defence, maintaining water quality, increasing industrial activity (energy generation, oil and gas), wide consultation, education and awareness, integrated management, data review. Issues newsletter.	Scottish Natural Heritage (Focus on Firths) and English Nature (Estuaries Initiative) funding Project Officer; other statutory and voluntary agencies. Steering Group, Secretariat and Working Group, Topic Groups, Seminars and Forum.	*Solway Project Officer, Scottish Natural Heritage, Dumfries & Galloway Area Office, Dumfries, tel: 01387 247010
Solway Rural Initiative	South Solway Firth from Maryport to Carlisle. Not primarily coastal, but includes preparation of Solway Coast AONB Management Plan, one of a number of plans relating to the Solway Firth Partnership. Issues: recreational pressures, off-road vehicles, wildfowling, cockle fishing, sewage, pollution.	Cumbria County Council, Carlisle City Council, Allerdale Borough Council, Countryside Commission, English Nature, Rural Development Commission.	Coastal Management Officer, Solway Resource Centre, King St., Aspatria, Cumbria CA5 3ET, tel: 016973 22620

* Starred contact addresses are given in full in the Appendix.

Table 10.3.2 Local authority plans (excluding most local and unitary plans)

Planning authority	*Title*	*Date adopted/ current status*
Clwyd County Council	*Clwyd County Structure Plan, First Alteration.* Provides strategic guidance for the county to 1996, and sets the context for the preparation of local plans.	1991
Clwyd County Council	*Clwyd County Structure Plan, Second Alteration.* To cover the period from 1996 - 2011.	Deposite due end 1995
Clwyd County Council	*Clwyd County Special Landscape Area Local Plan.* Covers some coastal areas.	Adopted 1985
Clwyd County Council	*Clwyd Minerals Local Plan.* Operative to 2006.	Deposited summer 1995
Borough of Colwyn	*Coastal Colwyn Local Plan.* Provides detailed policies and proposals for the coastal area of Colwyn Borough to 1996.	Adopted February 1990
Borough of Colwyn	*Colwyn Borough Local Plan.* Will replace the *Coastal Colwyn Local Plan* and provide detailed planning and proposals for the whole borough to the year 2006.	Deposited spring 1995, Public Inquiry autumn 1995
Ruddlan Borough Council	*Ruddlan Borough Local Plan.* Provides detailed policies and proposals for the whole borough to 1996.	Adopted September 1993
Ruddlan Borough Council	*Ruddlan Borough Local Plan Review.* Will provide revised policies and proposals for the whole borough up to 2006.	Deposit October 1995
Delyn Borough Council	*Delyn Local Plan.* Provides detailed policies and proposals for the whole of Delyn to 1996. Now under review.	Adopted October 1993
Delyn Borough Council	*Delyn Local Plan Review.* New local plan for 1996-2006.	Deposit due January 1996
Alyn & Deeside District Council	*Alyn & Deeside Local Plan.* Detailed policies and proposals for the whole district to 2003.	Deposited summer 1994 Public Inquiry spring 1995
Cheshire County Council	*Cheshire 2011: Structure Plan* Consultation Draft revises the structure plan published in 1992.	1995
Cheshire County Council	*Cheshire Minerals Local Plan.* Under review.	1987. Public consultation due on revised version 1996.
Cheshire County Council	*Cheshire Waste Disposal Local Plan.* Under review.	1987. Public consultation due on revised version 1996
Ellesmere Port and Neston Borough Council	*Local Plan to 2001.* New plan to 2011: draft due January 1996.	1993
Halton Borough Council	*Local Plan to 2001*	Post-Public Inquiry draft due autumn 1995
Vale Royal Borough Council	*Local Plan to 2001*	1992
Metropolitan Borough of Wirral	*The Wirral coastal management policy*	Unpublished draft
Metropolitan Borough of Wirral	*Unitary development plan*	At deposit stage in late 1995; to go to Public Inquiry in 1996
City of Liverpool	*Draft unitary development plan*	At deposit stage in late 1995
Sefton Metropolitan Borough Council	*Unitary development plan*	1995
Sefton Metropolitan Borough Council	*Planning and management of the coastal heritage*	1990
Lancashire County Council	*Central and North Lancashire Structure Plan*	1983
Lancashire County Council	*Lancashire Structure Plan 1986* (includes Written Statement, Explanatory Memorandum and modifications)	Approved 1989
Lancashire County Council	*Structure Plan Monitoring Report*	1990
Lancashire County Council	*Local Plan scheme for Lancashire* (including First Amendment September 1989)	1989/91
Lancashire County Council	*Lancashire's woodland heritage*	1986
Lancashire County Council	*Wildlife habitats in Lancashire*	1993
Lancashire County Council	*North West Aggregates Working Party Annual Report*	1993
Cumbria County Council/Lake District Special Planning Board	*Cumbria and Lake District Joint Structure Plan*	1995
Cumbria County Council	*Cumbria Minerals and Waste Local Plan*	Draft 1995. Deposit due December 1995.
Allerdale District Council	*Allerdale District Local Plan*	Deposit due October 1995
Borough of Barrow in Furness	*Barrow in Furness Local Plan*	Draft due autumn 1995
Carlisle City Council	*Carlisle District Local Plan*	Deposited June 1995. Public Inquiry due February 1996.
Copeland Borough Council	*Copeland Local Plan*	Adoption expected early 1996
South Lakeland District Council	*South Lakeland District Local Plan*	Adoption due June 1996

Table 10.3.2 Local authority plans (excluding most local and unitary plans) (continued)

Planning authority	*Title*	*Date adopted/ current status*
Lake District Special Planning Board	*Lake District Local Plan*	Adoption due 1996
Whitehaven Development Company	*A vision for Whitehaven: the Whitehaven Development Company Town and Harbour Initiative*	Consultation document
Dumfries & Galloway Regional Council	*Structure plan written statement.* Under review.	1994
Dumfries & Galloway Regional Council	*Objective 5b Single Programme Document*	1994
Dumfries District	*Dumfries District local plan written statement*	1993
Isle of Man	*Isle of Man Development Plan.* Under review.	1982
Isle of Man	*Isle of Man Strategic Plan*	Due late 1995

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Newsletters

Many national statutory, non-governmental and scientific bodies are now producing publications or newsletters on the subject of coastal management. These provide either information on particular local or national initiatives (such as the statutory or non-governmental organisations' estuaries and firths initiatives) or general information on a range of coastal news (for example the newsletters of Eurocoast UK and the European Union for Coastal Conservation). Some of these publications are listed below. Addresses of those publishing the newsletters are given in section 10.3.6C.

Coastal News. Newsletter of the Coastal Research and Management Group. Publication intended to stimulate co-operation and communication between the many disciplines working in the coastal zone. Contains information on coastal management, reviews of publications and notices of meetings. Published by JNCC.

Coastline UK. Newsletter of the National Coasts and Estuaries Advisory group (NCEAG). Aimed at local authority planners. Published by NCEAG.

Coastline. Quarterly magazine of the European Union for Coastal Conservation (EUCC). Intended to establish a pan-European forum on coastal issues, including coastal management. Published by EUCC.

Coastline. The Bulletin of the Parliamentary All Party Coastal Group. Provides information summaries for MPs. Published by the All Party Coastal Group.

CZM News. Occasional Newsletter of Eurocoast UK, reporting on projects and developments in the field of coastal zone management. Published by Eurocoast UK.

Inshore. Occasional newsletter of the North Wales and North Western Sea Fisheries Committee, by whom it is published.

Marine Scene. Occasional marine newsletter of the statutory conservation agencies in UK. Aimed at marine scientists, and users and regulators of the sea. Published by JNCC.

Wavelength. The Coastal Forum newsletter. Reports the work of the Forum to a wider audience. Published by the Department of the Environment.

National planning/management publications

DoE/Welsh Office. 1992. *Planning policy guidance - coastal planning.* PPG 20. London, HMSO. (Recognises the need to define a coastal zone incorporating areas affected by natural near-shore processes. Advises local authorities to consider the impacts of off-shore and on-shore developments within the full coastal zone. Endorses the precautionary approach.)

DoE/Welsh Office. 1993. *Development below Low Water Mark - a review of regulation in England and Wales*. London, HMSO. (Rejects the 1992 Environment Committee's recommendations for the extension of development controls off-shore. Seeks to strengthen existing arrangements to overcome limitations and drawbacks in the present land-use planning system.)

DoE/Welsh Office. 1993. *Managing the coast: a review of coastal management plans in England and Wales and the powers supporting them*. London, HMSO. (Includes proposals for coastal management plans to be based on a voluntary, multi-agency approach, generally led by local authorities.)

Department of the Environment. 1995. *Policy guidelines for the coast.* London, HMSO.

House of Commons Environment Committee. 1992. *Second report - coastal zone protection and planning*. London, HMSO. (Recommended that coastal zone management be adopted as the framework for all coastal zone planning and management practice in the United Kingdom. Called for a national coastal strategy, a review of the many organisations responsible for the coast, the extension of planning controls offshore, and the establishment of a Coastal Zone Unit in Department of the Environment.)

MAFF. 1994. *Shoreline management plans.* (A procedural guide for operating authorities. 4th draft, July 1994.)

Scottish Office. 1995. *Nature conservation: implementation in Scotland of the EC Directives on the conservation of natural habitats and of wild flora and fauna, and the conservation of wild birds: the conservation (natural habitats, etc.) regulations 1994.* Edinburgh, Scottish Office Environment Division, Rural Affairs Department. (Circular 6/90/95.)

C. Contact names and addresses

(See also Tables 10.2.1 and 10.3.1.)

Organisation/group	*Activities*	*Contact address and telephone no.*
Arfordir Group	Local authorities coastal officers' forum in Wales	*Sarah Soffe, Assistant Maritime Policy Officer, CCW HQ, Plas Penrhos, Fford Penrhos, Bangor, Gwynedd LL57 2LQ, tel: 01248 370444
Coastal Forum	Launched in 1994 by the DoE, the Coastal Forum provides for an exchange of views on issues related to the coastal zone in England by a wide range of interested bodies, including central and local government, and conservation, commercial and recreation organisations. Forum proceedings are reported to government ministers.	Secretariat: Department of the Environment, Room 912, Tollgate House, Houlton Street, Bristol BS2 9DJ, tel: 0117 9878003
Coastal Heritage Network CoastNET	CoastNET was established in 1995 by the Countryside Commission, English Nature and Scottish Natural Heritage, and is serviced by the. Centre for Environmental Interpretation (CEI) at Manchester Metropolitan University. While the network builds on the previous work of the Heritage Coast Forum, and still links the 45 Heritage Coasts, it has a much wider UK and coastal management remit.	CoastNET The Manchester Metropolitan University, St. Augustines, Lower Chatham Street, Manchester M15 6BY, tel: 0161 247 1067
Coastal Research and Management Group (CR&MG)	Liaison between research workers and managers in the field of coastal ecology. Concentrates on research and management issues relevant to landscape and wildlife conservation along the coast zone (marine and terrestrial).	*Coastal Research and Management Group (CR&MG), Coastal Conservation Branch, JNCC, Peterborough , tel: 01733 62626
Coastal Technical Officers Group	The coastal group of the statutory conservation agencies (English Nature, Scottish Natural Heritage, Countryside Council for Wales, Department of the Environment for Northern Ireland, Joint Nature Conservation Committee and the Countryside Commission)	*Coastal Technical Officers Group: Coastal Conservation Branch, JNCC, Peterborough, tel: 01733 62626 (secretariat)
Countryside Council for Wales	Coastal management of designated sites	*Mike Gash, Maritime Policy Officer, CCW HQ, Bangor, tel: 01248 370444
Countryside Commission	Promotion of policies for Heritage Coasts and coastal management.	Natioanl Parks & Planning Branch, Countryside Commission John Dower House, Crescent Place, Cheltenham, GL50 3RA tel: 01242 521381
English Coastal Groups Forum	Established by MAFF in 1991. Co-ordinates the work of the English Coastal Groups (see 10.1.3); promotes the formation of coastal groups; acts as a link between centrally-based organisations and coastal groups; promotes sustainable coastal management and common standards. Forum members include one representative from each coastal group, the National Rivers Authority, Local Authority Associations, English Nature, British Rail/Railtrack and Department of the Environment.	R. Hathaway, Head of Flood and Coastal Defence Division, MAFF, Eastbury House, 30/34 Albert Embankment, London SE1 7TL, tel: 0171 238 6660
English Nature	Management of designated coastal sites; nature conservation and development planning, Estuaries Initiative, Sensitive Marine Areas, Maritime Natural Areas	*English Nature HQ, Peterborough, tel: 01733 340345
Eurocoast UK	The Eurocoast Association aims to improve the basis for protection, development and management of the coastal zone. Primarily a communication network.	Eurocoast UK, Burderop Park, Swindon, Wiltshire SN4 0DQ, tel: 01793 812479
European Union for Coastal Conservation (EUCC)	International grouping of organisations and individuals with an interest in coastal nature conservation matters, including coastal management. The CR&MG (see above) is the core of the UK branch of EUCC.	European Union for Coastal Conservation (EUCC) Secretariat, P.O. Box 11059, NL-2301 EB Leiden, tel: +31 71 122900/123952
Isle of Man Department of Local Government and the Environment		*Department of Local Government and the Environment (DLGE), Douglas, tel: 01624 685954
Joint Nature Conservation Committee – Coastal Conservation Branch	Information and advice on coastal management initiatives. Publishes *Coastal News*, aimed at stimulating co-operation and communication between those involved with the coast.	*JNCC, Peterborough, tel: 01733 866825
Joint Nature Conservation Committee – Marine Conservation Branch	Information and advice on marine issues. Publishes *Marine Scene*, which summarises marine conservation news from the JNCC, Scottish Natural Heritage, English Nature and the Countryside Council for Wales.	*JNCC, Peterborough, tel: 01733 866833

C. Contact names and addresses (continued)

(See also Tables 10.2.1 and 10.3.1.)

Organisation/group	*Activities*	*Contact address and telephone no.*
Les Esturiales Environmental Study Group	International programme for co-operation, the exchange of experience on estuarine management and personal contacts between local authority practitioners in Europe.	Esturiales Environmental Study Group, Professor Graham King, C2M Associates, 2 Newton Villas, Newton, Swansea SA3 4SS, tel: 01792 367552
Marine Conservation Society	Provides advice and supports local coastal management initiatives: runs grant-aided coastal management workshops and courses for coastal managers; promotes the establishment of voluntary coastal groups.	*Marine Conservation Society, Ross-on-Wye, tel: 01989 566017
Marine Forum	National network provides forum for discussion of marine issues relating to the seas around UK. Members include governmental and non-governmental organisations and individuals. Occasional seminars are held, covering a range of topics including coastal management.	Honorary Secretary, The Marine Forum for Environmental Issues, c/o University College Scarborough, Filey Road, Scarborough YO11 3AZ, tel: 01723 362392
Ministry of Agriculture, Fisheries and Food (MAFF) Flood & Coastal Defence Division	Shoreline Management Plans	*MAFF, Flood and Coastal Defence Division, Eastbury House, London, tel: 0171 238 3000
MAFF, Marine Environment Protection Division	Policy advice on marine environmental management	MAFF, Marine Environment Protection Division, Nobel House, 17 Smith Square, London SW1P 3HX, tel: 0171 238 6433
MAFF, Directorate of Fisheries Research	Scientific advice on marine environment and living resources management	*Head of Laboratory, MAFF Directorate of Fisheries Research, Fisheries Laboratory, Conwy, tel: 01492 593883
National Coasts and Estuaries Advisory Group (NCEAG)	On behalf of local authorities, provides advice on sustainable management of coastal and estuarine environments; published guide to good practice (NCEAG 1993)	Secretary, National Coasts and Estuaries Advisory Group (NCEAG), Environment Programme, Kent County Council, Springfield, Maidstone ME14 2LX, tel: 01622 696180
National Rivers Authority	Catchment management planning, 5-year programme, sea defences	*Flood Defence Section, NRA HQ, Bristol, tel. 01454 624400, or NRA Welsh Region, Plas-yr-Afon, St. Mellons Business Park, St Mellons, Cardiff CF3 0LT, tel: 01222 770088, or NRA North West Region, Richard Fairclough House, Knutsford Road, Warrington WA4 1HG, tel: 01925 53999
National Trust	Has extensive coastal land holdings in the region (see section 7.5.1). Recently carried out a complete review of its Coastal Strategy Plans; has an ongoing review of coastal site management plans.	The National Trust Mercia Region, Attingham Park, Shrewsbury, Shropshire SY4 4TP, tel: 01743 709343 The National Trust Northwest Region, The Hollens, Grasmere, nr. Ambleside, Cumbria LA22 9QZ, tel: 01539 435599
Royal Society for the Protection of Birds	Launched national campaign in 1990 to promote the importance of estuaries in the UK. Monitors the development of coastal zone initiatives around the UK. In 1994, launched Marine Life campaign, to increase awareness and to promote integrated coastal and marine management. Manages some coastal nature reserves. Produced a regional strategy.	*D. Huggett, Coastal Policy Officer, RSPB HQ, Sandy, tel: 01767 68055

C. Contact names and addresses (continued)

(See also Tables 10.2.1 and 10.3.1.)

Organisation/group	*Activities*	*Contact address and telephone no.*
Scottish Office Development Department	Coastal policy and planning. Preparation of Rural White Paper.	Dr Cath Murphy, Room 6/61, Scottish Office Development Department, New St. Andrew's House, Edinburgh EH1 3TG, tel: 0131 244 4807
Scottish Office Environment Department	Departmental responsibility for flood defence and coast protection	Alistair Moir, Environment Department, Scottish Office, 27 Perth Street, Edinburgh EH3 5RB, tel: 0131 244 4042
Scottish Natural Heritage	Focus on Firths, Marine Consultation Areas, coastal cells in Scotland	Focus on Firths Project Manager, Scottish Natural Heritage, 2/5 Anderson Place, Edinburgh EH6 5NP, tel: 0131554 9797
Welsh Coastal Groups Forum	Coordinates the work of the Welsh coastal groups	Hugh Payne, Welsh Coastal Groups Forum, Environment Division, Welsh Office, Parc Cathays, Cardiff CF1 3NQ, tel: 01222 823176
World Wide Fund for Nature - UK	Provides funding for research, local voluntary policy development and local initiatives, and publications on integrated coastal management. Draws on considerable international experience with coastal management initiatives.	*World Wide Fund for Nature - UK, Godalming, tel: 01483 426444

Addresses and telephone numbers of local planning authorities are given in full in the Appendix, as are * starred contact addresses.

Scientific research, public enjoyment and nature conservation combine in the management of this natural brackish pool on Sandscale Haws in the Duddon Estuary Site of Special Scientific Interest. The pool is a breeding site for the rare natterjack toad, for which the region is of overwhelming national importance, as it holds three-quarters of the toad's breeding sites in the UK. Photo: Peter Wakely, English Nature.

Appendix

A.1 Frequently cited contact names and addresses

Name	*Contact address and telephone no.*
Statutory bodies	
Countryside Commission, HQ	John Dower House, Crescent Place, Cheltenham, Gloucestershire GL50 3RA, tel: 01242 521381
Countryside Commission (North Western Region)	7th Floor, Bridgewater House, Whitworth Street, Manchester M1 6LT, tel: 0161 237 1061
Countryside Council for Wales (CCW) HQ	Plas Penrhos, Fford Penrhos, Bangor, Gwynedd LL57 2LQ, tel: 01248 370444
CCW North-East Area Office	Victoria House, Grosvenor Street, Mold, Clwyd CH7 1EJ, tel: 01352 754000
CCW East Area Office	3rd Floor, The Gwalia, Ithon Road, Llandrindod Wells, Powys LD1 6AA, tel: 01597 824661
Department of Agriculture, Fisheries & Forestry (DAFF), Isle of Man	Murray House, Mount Havelock, Douglas, Isle of Man IM1 2SF, tel: 01624 685857
Department of the Environment (DoE), European Wildlife Division	DoE, Room 9/03B, Tollgate House, Houlton Street, Bristol BS2 9DJ, tel: 0117 987 8811
DoE, Department of Rural Affairs	Department of the Environment, Room 919, Tollgate House, Houlton Street, Bristol BS2 9DJ, tel: 0117 921 8811
DoE, Water Resources and Marine	Romney House, 43 Marsham Street, London SW1P 3PY, tel: 0171 276 0900
English Nature (EN) HQ	Northminster House, Peterborough PE1 1UA, el: 01733 340345
EN North West Local Area Team (Lancashire, Merseyside, coastal districts of Cheshire)	Pier House, Wallgate, Wigan WN3 4AL, tel: 01942 820342
EN Cumbria Local Area Team	Blackwell, Bowness-on-Windermere, Windermere, Cumbria LA23 3JR, tel: 015394 45286
Government Office for Merseyside (covers DTI, DoE, DoT)	Government Office for Merseyside, Graham House, Derby Square, Liverpool L2 7UP, tel: 0151 224 6300
Isle of Man Department of Local Government and the Environment (DoLGE)	Murray House, Mount Havelock, Douglas IM1 2SF, tel: 01624 685954
Institute of Terrestrial Ecology (ITE), Monks Wood	Abbots Ripton, Huntingdon, Cambridgeshire PE17 2LS, tel: 01487 773381

Name	*Contact address and telephone no.*
Statutory bodies (continued)	
ITE, Merlewood	Institute of Terrestrial Ecology, Windermere Road, Grange-over-Sands, Cumbria LA11 6JU, tel: 01539 532264
Joint Nature Conservation Committee (JNCC) HQ	Monkstone House, City Road, Peterborough, Cambs. PE1 1JY, tel: 01733 62626
JNCC (Seabirds at Sea Team)	Seabirds and Cetaceans Branch, Joint Nature Conservation Committee, 17 Rubislaw Terrace, Aberdeen AB1 1XE, tel: 01224 642863
Manx National Heritage	Douglas, Isle of Man IM1 3LY, tel: 01624 675522
Ministry of Agriculture, Fisheries and Food (MAFF) Directorate of Fisheries Research, Fisheries Laboratory, Conwy	Benarth Road, Conwy, Gwynedd LL32 8UB, tel: 01492 593883
MAFF Directorate of Fisheries Research, Fisheries Laboratory, Lowestoft	Pakefield Road, Lowestoft, Suffolk NR33 OHT, tel: 01502 562244
MAFF Directorate of Fisheries Research, Fisheries Laboratory, Burnham-on-Crouch	Remembrance Avenue, Burnham-on-Crouch, Essex CM0 8HA, tel: 01621 782658
MAFF Flood and Coastal Defence Division	Eastbury House, 30/34 Albert Embankment, London SE1 7TL, tel: 0171 238 3000
National Rivers Authority (NRA), HQ	Rivers House, Waterside Drive, Aztec West, Almondsbury, Bristol BS12 4UD, tel: 01454 624400
NRA - Welsh Region	Rivers House, St. Mellons Business Park, St. Mellons, Cardiff CF3 0LT, tel: 01222 770088
NRA - North West Region	PO Box 12, Richard Fairclough House, Knutsford Road, Warrington WA4 1HG, tel: 01925 653999
NRA - Northern Area Office, NW Region	Chertsey Hill, London Road, Carlisle, Cumbria CA1 2QX, tel: 01228 25151
Scottish Natural Heritage (SNH) HQ	12 Hope Terrace, Edinburgh EH9 2AS, tel: 0131 447 4784
SNH Research & Advisory Division	Bonington Bond, 2 Anderson Place, Edinburgh EH6 5NP, tel: 01315 549797
SNH Dumfries & Galloway Area Office	Carmont House, Crichton Royal Estate, Bank End Road, Dumfries DT1 4UQ, tel: 01387 247010

Name	*Contact address and telephone no.*
Statutory bodies (continued)	
SNH Dumfries & Galloway Sub-Office	23 Albert Street, Newton Stewart, Wigtownshire DG8 6EF, tel 01671 403440
Scottish Office Agriculture, Environment and Fisheries Department (SOEAFD)	Pentland House, 47 Robb's Loan, Edinburgh EH14 11Y, tel: 0131 244 6203 or 0131 244 6001
Solway River Purification Board	Rivers House, Irongray Road, Dumfries DG2 0JE, tel: 01387 720502
Welsh Office Environment Division	Parc Cathays, Cardiff CF1 3NQ, tel: 01222 823176
Coastal fora	
North Wales Coastal Forum	Chairman, Stephen Pritchard, Ysgoldy, Bryncroes, Pwllheli, Gwynedd LL53 8EB, tel: 01758 83423
Irish Sea Forum	Irish Sea Forum Administrator, Centre for Marine and Coastal Studies, Faculty of Science, University of Liverpool, PO Box 147, Liverpool L69 3BX, tel: 0151 794 4089
Wildlife Trusts	
North Wales Wildlife Trust	376 High Street, Bangor, Gwynedd LL57 1YE, tel: 01248 351541
Cheshire Wildlife Trust (includes the Wirral)	Grebe House, Reaseheath, Nantwich, Cheshire CW5 6DA, tel: 01270 610180
Lancashire Wildlife Trust	Cuerden Park Wildlife Centre, Shady Lane, Bamber Bridge, Preston PR5 6AU, tel: 01772 324129
Cumbria Wildlife Trust	The Badgers Paw, Church Street, Ambleside, Cumbria, LA22 0BU, tel: 015394-32476
Scottish Wildlife Trust HQ	Crammond House, Kirk Crammond, Crammond Glebe Road, Edinburgh EH4 6NS, tel: 0131 312 7765
Scottish Wildlife Trust (Dumfries & Galloway Office)	Unit 4, Enterprise Trust Workshop, Queensberry Square, Sanquhar, Dumfries & Galloway DG4 6BY, tel: 01659 50454
Manx Nature Conservation	The Courtyard, Tynwald Mills, St. Johns, Isle of Man IM4 3AE, tel: 01624 801985

Name	*Contact address and telephone no.*
Wildlife Trusts (continued)	
The National Trust	33 Sheep Street, Cirencester, Gloucestershire GL7 1QW, tel: 01285 651818
The National Trust North Wales Office	Trinity Square, Llandudno, Gwynedd LL30 2DE, tel: 01492 860123
The National Trust, North West Regional Office	The Hollens, Grasmere, Ambleside, Cumbria LA22 9QZ, tel: 015394 35599
The National Trust for Scotland	5 Charlotte Square, Edinburgh EH2 4DU tel: 0131 226 5922
Royal Society for the Protection of Birds (RSPB) HQ	The Lodge, Sandy, Bedfordshire SG19 2DL, tel: 01767 680551
RSPB Wales Office	Bryn Adern, The Bank, Newtown, Powys SY16 2AB, tel: 01686 626678
RSPB North West Regional Office	Westleigh Mews, Wakefield Road, Denby Dale, Huddersfield, West Yorkshire HD8 8QD, tel: 01484 861148
RSPB North England Regional Office	4 Benton Terrace, Newcastle upon Tyne NE2 1QU, tel: 0191 281 3366
RSPB South and West Scotland Regional Office	Unit 3.1, West of Scotland Science Park, Kelvin Campus, Glasgow G20 0SP, tel: 0141 945 5224
The Wildfowl & Wetlands Trust (WWT) HQ	Slimbridge, Gloucestershire GL2 7BX, tel: 01453 890333
Worldwide Fund For Nature - UK (WWF-UK)	Panda House, Weyside Park, Cattershall Lane, Godalming, Surrey GU7 1XR, tel: 01483 426444
Marine Conservation Society	9 Gloucester Road, Ross-on-Wye, Herefordshire HR9 5BU, tel: 01989 566017
The British Trust for Ornithology	The Nunnery, Nunnery Place, Thetford, Norfolk IP24 2PU, tel: 01842 750050
Others	
Marine Forum for Environmental Issues	Honorary Secretary, c/o University College Scarborough, Filey Road, Scarborough YO11 3AZ, tel: 01723 362392
Port Erin Marine Laboratory	University of Liverpool, Port Erin, Isle of Man IM9 6JA, tel: 01624 832027

A.2 Local planning authorities, ports and harbour authorities addresses

Name	*Address and telephone no.*
Allerdale Borough Council	Allerdale House, New Bridge Road, Workington, Cumbria CA14 3YJ, tel: 01900 604351
Alyn & Deeside District Council	Civic Offices, St. David's Park, Ewloe, Deeside, Clwyd CH5 3PW, tel: 01244 525000
Annandale & Eskdale District Council	Council Chambers, Annan, Dumfriesshire DG12 6AQ, tel: 01461 203311
Barrow-in-Furness Borough Council	Town Hall, Barrow-in-Furness, Cumbria LA14 2LD, tel: 01229 825500
Barrow-in-Furness: Associated British Ports	Port Office, Ramsden Dock Road, Barrow-in-Furness, Cumbria LA14 2TW, tel: 01229 22911
Blackpool Borough Council	Town Hall, Blackpool, Lancs. FY1 1AD, tel: 01253 25212
Carlisle City Council	Civic Centre, Carlisle, Cumbria CA3 8QG, tel: 01228 23411
Castletown Harbour Office	The Quay, Castletown, Isle of Man IM9 1LD, tel: 01624 823549
Cheshire County Council	County Hall, Chester, Cheshire CH1 1SF, tel: 01244 602424
Clwyd County Council	Shire Hall, Mold, Clwyd CH7 6NB, tel: 01352 752121
Colwyn Borough Council	Civic Centre, Colwyn Bay, Clwyd LL29 8AR, tel: 01492 515271
Copeland Borough Council	PO Box 19, Council Offices, Catherine Street, Whitehaven, Cumbria CA28 7NY, tel: 01946 693111
Cumbria County Council	The Courts, Carlisle, Cumbria CA3 8NA, tel: 01228 23456/401265, or County Offices, Kendal, Cumbria LA9 4RQ, tel: 01539 814379
Delyn Borough Council	Delyn House, Chapel Street, Flint, Clwyd CH6 5BD, tel: 01352 762345
Dumfries & Galloway Regional Council	Council Offices, English Street, Dumfries DG1 2DD, tel: 01387 261234
Ellesmere Port & Neston Borough Council	Council Offices, 4 Civic Way, Ellesmere Port, South Wirral L65 0BE, tel: 0151 355 3665
Fleetwood: Associated British Ports	Dock Office, Fleetwood, Lancs. FY7 6PP, tel: 013917 2323
Fylde Borough Council	Town Hall, Lytham St. Anne's, Lancs. FY8 1LW, tel: 01253 721222
Halton Borough Council	Municipal Building, Kingsway, Widnes, Cheshire WA8 7QF, tel: 0151 424 2061
Heysham: Sealink Harbours Ltd	Sea Terminal, Heysham, Lancs. LA3 2XF, tel: 01524 52373

Name	*Address and telephone no.*
Chief Harbour Master, Isle of Man	Department of Transport, Sea Terminal Building, Douglas, Isle of Man IM1 2RF, tel: 01624 686600
Isle of Man	Department of Local Government and the Environment (DLGE), Murray House, Mount Havelock, Douglas IM1 2SF, tel: 01624 685954
Lake District National Park Authority	Murley Moss, Oxenholme Road, Kendal, Cumbria LA9 7RL, tel: 01539 724555
Lancashire County Council	County Hall, Preston, Lancs. PR1 8XJ, tel: 01772 254868
Lancaster City Council	Town Hall, Lancaster, Lancs. LA1 1PJ, tel: 01524 582000
Lancaster Port Commission	11 First Terrace, Sunderland Point, Overton, Morecambe, Lancs. LA3 3HF, tel: 01524 71421
Laxey Harbour Keeper	Laxey Harbour, Kent Road, Laxey, Isle of Man IM4 7DB, tel: 01624 861663
Liverpool (Port of)	Mersey Docks & Harbour Company, Pier Head, Liverpool, Merseyside L3 1BZ, tel: 0151 200 2020
Liverpool City Council	Planning and Transport Departments, Steers House, Canning Place, Liverpool, Merseyside L1 8JA, tel: 0151 225 5672/3
Liverpool: Associated British Ports	Port Office, Dock Road, Garston, Liverpool, Merseyside L19 2JW, tel: 0151 427 5971
Manchester Port	The Manchester Ship Canal Company, Collier Street, Runcorn, Cheshire WA7 1HA, tel: 019285 67465
Maryport harbour	Maryport Harbour Commissioners, 4 Lawson Street, Maryport, Cumbria CA15 6ND, tel: 01900 818447
Nithsdale District Council	Municipal Chambers, Dumfries DG1 2AD, tel: 01387 253166
Peel Harbour Master	Harbour Office, East Quay, Peel, Isle of Man IM5 1AR, tel: 01624 842338
Port St. Mary Harbour Master	Harbour Office, The Quay, Port St. Mary, Isle of Man IM9 5EA, tel: 01624 833206
Port Erin Harbour Master	Harbour Master's Office, Breakwater Road, Port Erin, Isle of Man IM9 6JA, tel: 01624 833205
Preston District Council	PO Box 10, Town Hall, Preston PR1 2RL, tel: 01772 254881

Name	*Address and telephone no.*
Ramsey Harbour Master	Ramsey Harbour Office, East Quay, Ramsey, Isle of Man IM8 1BG, tel: 01624 812245
Rhuddlan Borough Council	Russell House, Churton Road, Rhyl, Clwyd LL18 3DP, tel: 01745 345000
Sefton Borough Council	Town Hall, Southport, Merseyside PR8 1DA, tel: 01704 533133
Silloth: Associated British Ports	Dock Office, New Dock, Silloth, CA5 4JQ, tel: 016973 31358
South Lakeland District Council	South Lakeland House, Lowther Street, Kendal, Cumbria LA9 4UQ, tel: 01539 733333
South Ribble District Council	Civic Centre, West Paddock, Leyland, Preston, Lancs. PR5 1DH, tel: 01772 421491
Stewartry District Council	Council Offices, Cannonwalls, High Street, Kirkcudbright, Dumfries & Galloway DG6 4JG, tel: 01557 330291
Stranraer: Sealink Harbours Ltd	4/6 South Strand Street, Stranraer, Dumfries & Galloway DG9 7JW, tel: 01776 703515
Vale Royal Borough Council	Wyvern House, The Drumber, Winsford, Cheshire GW7 1HA, tel: 01606 862862
Warrington District Council	Town Hall, Warrington, Cheshire WA1 1UH, tel: 01925 444400
West Lancashire District Council	Council Offices, 52 Derby Street, Ormskirk, Lancs. L39 2DF, tel: 01695 577177
Whitehaven Harbour Commissioners	Harbour Office, Pears House, 1 Duke Street, Whitehaven, Cumbria CA28 7HW, tel: 01946 692435
Wigtown District Council	District Offices (Environmental Health), Sun Street, Stranraer, Wigtownshire DG9 7JJ, tel: 01776 702151, or District Offices (Leisure Services, Technical Services), Dunbae House, Church Street, Stranraer, Wigtownshire DG9 7JQ, tel: 01776 702151
Wirral Borough Council	Town Hall, Brighton Street, Wallasey, Merseyside L44 8ED, tel: 0151 638 7070
Workington (Port of)	Dock Office (Cumbria County Council), Prince of Wales Dock, Workington, Cumbria CA14 2JH, tel: 01900 2301
Wyre Borough Council	Civic Centre, Breck Road, Poulton-le-Fylde, Lancs. FY6 7PU, tel: 01253 89100

A.3 Core reading list

There are a number of important publications that either provide information on a variety of topics covered in these regional reports (and so are frequently referred to) or give a good overview of regional and national information on coasts and seas. They are listed below.

Barne, J., Davidson, N.C., Hill, T.O., & Jones, M. 1994. *Coastal and marine UKDMAP datasets: a user manual.* Peterborough, Joint Nature Conservation Committee.

British Oceanographic Data Centre. 1992. *UKDMAP (United Kingdom digital marine atlas).* Birkenhead, BODC (Computer software.).

Brown, A., *ed.* 1992. *The UK Environment.* London, HMSO.

Buck, A.L. 1993. *An inventory of UK estuaries. 3. North West Britain.* Peterborough, Joint Nature Conservation Committee.

Burbridge, P.R., & Burbridge, V. 1994. *Review of Scottish coastal issues.* Edinburgh, Scottish Office.

Davidson, N.C., Laffoley, D.d'A., Doody, J.P., Way, L.S., Gordon, J., Key, R., Drake, M.C., Pienkowski, M.W., Mitchell, R., & Duff, K.L. 1991. *Nature conservation and estuaries in Great Britain.* Peterborough, Nature Conservancy Council.

Donn, S., & Wade, M. 1994. *UK directory of ecological information.* Chichester, Packard.

Eno, N.C., *ed.* 1991. *Marine conservation handbook.* 2nd ed. Peterborough, English Nature.

Gray, M.J. 1995. *The coastal fisheries of England and Wales, Part III: a review of their status 1992-1994.* Lowestoft, MAFF Directorate of Fisheries Research. (Fisheries Research Technical Report, No. 100.)

Gubbay, S. 1988. *A coastal directory for marine conservation.* Ross-on-Wye,Marine Conservation Society.

Irish Sea Study Group. 1990. *The Irish Sea; an environmental review. Part 1; Nature conservation. Part 2; Waste inputs and pollution. Part 3; Exploitable living resources. Part 4; Planning development and management.* Liverpool, Liverpool University Press.

Lee, A.J., & Ramster, J.W. 1981. *Atlas of the seas around the British Isles.* Lowestoft, MAFF.

Rice, K.A., & Putwain, P.D. 1987. *The Dee and Mersey estuaries: environmental background.* Wallasey, Shell UK.

Robinson, A., & Millward, R. 1983. *The Shell book of the British coast.* Newton Abbot, David and Charles.

Steers, J.A. 1964. *The coastline of England and Wales.* Cambridge, Cambridge University Press.

Taylor, P.M., & Parker, J.G., *eds.* 1993. *The coast of north Wales and north-west England: an environmental appraisal.* London, Hamilton Oil Company Ltd.

Welsh Office. 1994. *Environmental digest for Wales. No. 8. 1993.* Cardiff.

A.4 Contributing authors

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