JOINT NATURE CONSERVATION COMMITTEE

Coasts and seas of the United Kingdom

Region 9 Southern England: Hayling Island to Lyme Regis

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

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Contents

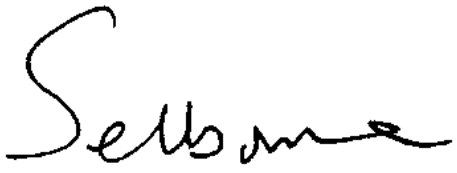
Foreword

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, The Department of the Environment (Northern Ireland), the National Rivers Authority, the Countryside Commission, 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 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 Earl of Selborne
Chairman, Joint Nature Conservation Committee

How to use this book

These notes provide some general guidance about finding and interpreting the information in 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 a 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 9') 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
Derry City Council
Devon County Council
Dorset County Council
Down District Council
Dumfries and Galloway Regional Council
Dyfed County Council
Eastbourne Borough Council
English Nature
Essex County Council
Fife Regional Council
Forest of Dean District Council
Gwynedd County Council
Hampshire County Council
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Norfolk County Council
North Cornwall District Council
North East Fife Regional Council
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Somerset County Council
South Pembrokeshire District Council
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Stroud District Council
Tayside Regional Council
Torridge District Council
UK Offshore Operators Association [2]
Vale of Glamorgan Borough Council
Water Executive (Northern Ireland)
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.

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

As this photo shows, the coastal zone is a complex, intensively-used environment in which people's homes and work places jostle for space with wildlife habitats, leisure and defence needs. Region 9 is nationally important for watersports of all kinds, having reputedly the largest leisure sailing fleet in the world. Portland Harbour, its once thriving naval base dominating the shore, is one of the most popular venues for wind surfing in the country. Photo: Nick Davidson, JNCC.

Chapter 1 Overview

1.1 The Coastal Directories Project

Dr J.P. Doody

1.1.1 Introduction

Developing sound 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 of the North Sea, the Second International Conference on the 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.

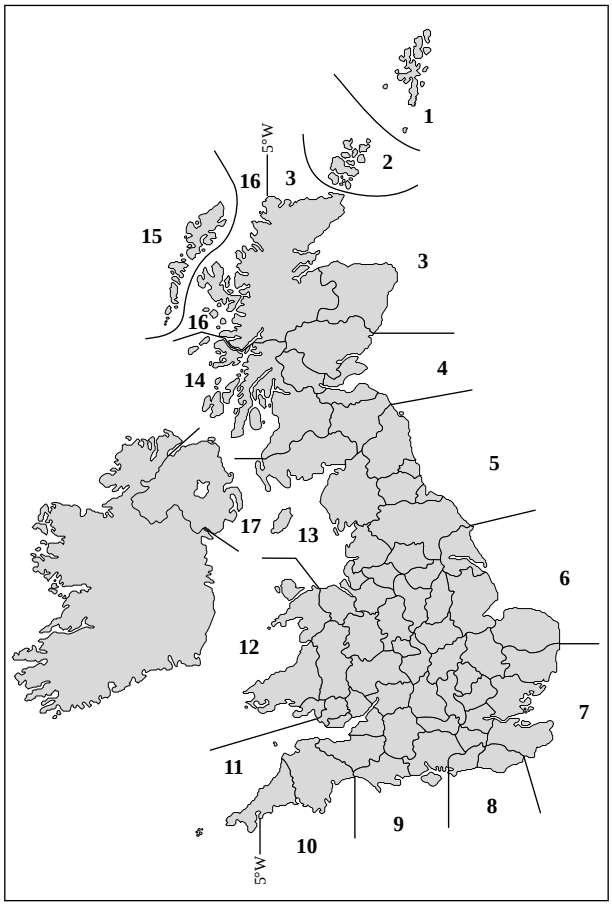
At the second meeting of the NSTF, in 1989, the UK suggested that the North Sea QSR should include consideration of terrestrial habitats and species. This was to involve the collection of information dealing with the coastal margin of the North Sea (defined as being east of longitude 5° West - i.e. from 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 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 and published their report on *Coastal zone protection and planning* in March 1992 (House of Commons Environment Committee 1992). This report, together with initiatives at UK and European levels, encouraged 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.



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

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 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 comprise 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); in addition the core steering group also meets at least annually.

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, Department of the Environment (Northern Ireland)
Core steering group	Steer work, provide information and support	See page 2
Main steering group (includes, amongst others, all funding consortium members)	Review progress, consider new developments, provide expert advice and act as consultees	All members, through an annual steering group seminar and individually

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	1996
Region 10. South-west England: Seaton to Zone Point	Due 1996
Region 11. The Western Approaches: 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.* Western Isles	Due 1996
Region 16.* West Highland: 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: *Regions 15 and 16 will be published 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 was 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

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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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.

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 9 covers the coasts of Hampshire, the Isle of Wight and Dorset. The coastline of the region is 637 km long, which is 11.6% of the total coastline of England and 3.4% of that of Great Britain. Whilst the north Solent coast is generally low-lying and includes a number of important estuaries, much of the coast of the Isle of Wight and Dorset is composed of cliffs, of both soft and relatively harder rock. This gives an extremely varied landscape that includes all the major coastal geomorphological structure and habitat types. The coast is relatively sheltered from winter storms and the prevailing winds are from the south-west. The Solent has major ports at Southampton and Portsmouth, with major industrial and commercial development and naval facilities, and has the most intensive leisure boating activity in Great Britain. The Solent hinterland is mostly under intensive agriculture, both arable and pastoral, although around Poole Harbour (as elsewhere in Dorset) agriculture is less intensive, with considerable surviving areas of semi-natural habitats such as heaths and woodland. Bournemouth is a major coastal tourist resort. Large parts of the undeveloped coastline, including much of the Dorset coast and the Isle of Wight, are also popular tourist destinations. However there are many quiet areas, such as in the New Forest and on the southern shores of Poole Harbour and the west Dorset coast, where heavy visitor pressure is confined to a few 'honey pots'.

The region is relatively unaffected by changes in local government structure. The Isle of Wight already is a unitary authority, and Portsmouth, Southampton, Bournemouth and Poole are due to become unitary authorities in April 1997. Elsewhere in Hampshire and Dorset the two-tier structure will remain.

1.2.2 Structure and landscape

In terms of its geology, this region is composed largely of sedimentary rocks formed in Mesozoic (245 - 65 million years ago) and Tertiary (5 million years ago) times. The chalk and older rocks have been flexed into a series of east-west trending folds, with younger rocks (predominantly clays and sandstones) preserved in the Hampshire Basin and older rocks exposed in the eroded up-folds. The Solent and the English Channel itself are relatively young features, having been created by inundation (thus cutting off the Isle of Wight, England's largest island) since the last ice age. Both erosion and deposition are significant processes along parts of the coast.

This part of Great Britain was free from the ice sheets that covered much of the land during the ice-ages of the Pleistocene; the solid geology therefore remains exposed on land and determines the nature of much of the coastline. The coast can be divided into two zones, defined by the underlying geology. These comprise, first, the Solent estuaries and Poole Harbour, which are generally sediment sinks with accreting intertidal estuarine habitats, beaches and shingle structures; and second, the stretches of eroding cliffs, along the south Wight and Dorset coasts.

The estuaries of the Solent developed as a result of the rise in sea level following the last glacial period. The cliffs are composed of a variety of 'soft' rocks with varying degrees of resistance to erosion. In general the hardest rocks are chalk and Jurassic limestones. Water seepage through the geological strata locally causes instability, slumping and consequent erosion. Steep and unstable cliffs are particularly prevalent on the Isle of Wight, as at Ventnor, where major problems occur for house owners.

Offshore the geology is largely obscured by sediments. The region has a variety of sea-bed substrates, including sheltered and exposed chalk, limestone ridges, tide-swept pebbles and cobbles, and mudflats. The seas are relatively shallow - under 20 m - off the coast, with the 40 m depth contour only approaching the coastline near Portland Bill and off the south coast of the Isle of Wight. Depths of over 60 m are reached towards the centre of the English Channel.

The region is experiencing an absolute rise in sea level coupled with a relative fall in the level of the land, as the northern part of Britain recovers from the removal of the weight of the ice cover after the end of the last ice age. Region 9 lies in a part of Great Britain that is estimated to be subsiding at approximately 0.5 mm per year; however, relative sea level is thought to be rising at a rate of up to 2 mm per year, and extensive low-lying areas are threatened by flooding. The tidal range is one of the lowest in Britain; at under 2 m in Poole Bay and Christchurch Bay, it rises to 2.5 m at Portland and a maximum of only 4.5 m at the eastern edge of the region. Tidal currents are strong in places, and there is significant longshore drift in several of the sedimentary cells in the region (see section 2.4). These forces contributed to the development of Chesil Beach, a shingle barrier enclosing The Fleet lagoon.

1.2.3 The natural environment

The main nature conservation interest of this region lies onshore, in its terrestrial habitats and associated wildlife and the geological structure from which the habitats derive. The varied and geomophologically dynamic coastline features a number of important habitats, including shingle structures, lagoons, estuaries and cliffs.

Shingle structures include Chesil Beach and Browndown Beach, two of the most significant vegetated shingle sites in Britain. Chesil Beach is one of Britain's most important shingle structures, and the enclosed lagoon (The Fleet) is by far the largest natural lagoon in Great Britain. The region holds 70% of the British lagoon resource - 88% of those that are nationally noteworthy (all lagoonal habitat is of recognised European importance). The estuaries around the shores of the Solent are all of national significance, in terms

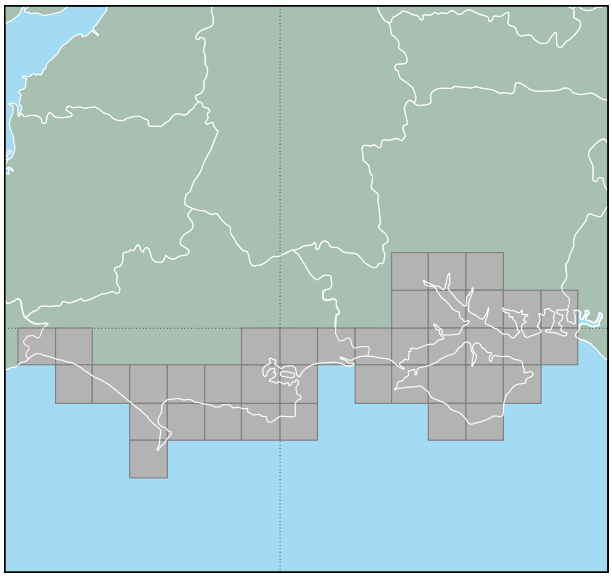
Map 1.2.1 Rivers, major towns and other coastal locations in the region

of both their geomorphological type and the habitats and species that they support. In addition, several of the cliffs are nationally important for their geological interest, those formed of chalk having high biological interest as well.

Inland, although still within the defined limits of the region, several nationally rare non-maritime semi-natural habitats are present, notably including ancient woodland and lowland heaths. As a habitat the latter is of recognised European importance, and regional examples (for instance the Dorset heaths) hold nationally important populations of a number of rare species, especially of birds, reptiles and amphibians. The bogs and wet heaths of Dorset are particularly important for their *Sphagnum* moss communities, which have distinctive southern elements uncommon elsewhere in the country. The region is the most important area in the UK - coastal or inland - for reptiles and amphibians. Its heaths, both dune heath and non-maritime lowland heath, support not only all nine of the widespread species of amphibian and terrestrial reptile, but also the rare and restricted sand lizard *Lacerta agilis* and smooth snake *Coronella austriaca* and the recently reintroduced natterjack toad *Bufo calamita*. Three European herptile species are also established here. The area of Studland Heath and Poole Harbour is the most important for herptiles, with its dry sandy dunes and contiguous heathland. As far as ancient woodland is concerned, the New Forest, the most important lowland lichen site in Britain, is probably also the best surviving example of pasture woodland in western Europe and is unique in its diversity of lichens and fungi.

The region is of international significance for the range of rare and scarce flowering plants and ferns it supports, influenced by the diverse range of habitats (some of them nationally scarce), the warm climate and the relatively sheltered nature of the coast. Many of these plants are more typical of Mediterranean countries. One plant is endemic to the Isle of Portland, four more are restricted in the UK to this region, and seven others have their British strongholds here.

Amongst animal species, the region is nationally important for the conservation of many coastal invertebrates, at least twelve of which are either restricted to or have a large part of their range within this area, and many of them are here at the northern edge of their international distributions. Many of the rare and scarce invertebrates rely on specific associations with plants that are restricted to particular habitats and may require sheltered and warm micro-habitats. The region's lagoons, cliffs, chalk grasslands, heaths and woods are particularly notable for their rare invertebrates. The New Forest is amongst the most important sites in the UK for dead-wood invertebrates, which, like the diverse lower plant flora, are a feature of centuries-old sustainably managed woodland. Old trees, especially in pasture woodland (where invertebrate prey are abundant), and coastal caves are also important for bats, for which the region is particularly important in a national context: eleven of the fourteen species of British bat have been recorded here. The dormouse, once common throughout lowland Britain but now nationally rare, depends largely on continuous expanses of structurally diverse woodland; management that produces these conditions, such as coppicing, is now all but defunct outside nature reserves. In parts of Region 9 the species is still relatively common. There are also some



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

notable populations of red squirrels here - the only ones in the south of England - on the Isle of Wight and the islands of Brownsea and Furzey in Poole Harbour (where there are no grey squirrels). In most of the UK the red squirrel is extinct. Otters, absent from much of England and Wales, are present in reasonable numbers around the Solent.

Because of the warmth and shelter provided within its estuaries, the region is of national and international significance for migrant and wintering birds, especially at times of harsh weather conditions elsewhere in Britain and Europe. Seven species occur at levels of international importance on at least one estuary, and a further fifteen species occur at levels of national (i.e. Great Britain) importance. Chichester Harbour, Langstone Harbour, Portsmouth Harbour and the Solent, Southampton Water, Poole Harbour and the Fleet are individually and collectively of international importance for their waterfowl populations. For some non-breeding waterfowl species, for example dark-bellied brent geese *Branta bernicla bernicla*, sites within the region are amongst the most important in the UK, and for several other species the region holds a significant proportion of the total UK population, either in the migration periods or in winter.

The most important seabird breeding colonies are of species nesting on saltmarsh or shingle, notably gulls and terns. There are internationally important colonies of two species: black-headed gull *Larus ridibundus* in the Beaulieu Estuary and little tern *Sterna albifrons* in Langstone Harbour; and there are several other colonies of national importance in the region. The lack of hard rock cliffs with suitable nesting sites and the comparative scarcity of prey in marine waters off this region are reflected in the absence in the region of cliff-nesting seabird colonies of any significance. However there are small populations of a wide variety of species at several cliff locations. These include a small population of puffins *Fratercula arctica* and guillemots *Uria aalge* on the Purbeck cliffs.

The region's marine, estuarine and non-estuarine environments are described in further detail below.

The sea and sea bed

The region reflects the transition between the warm,

'Lusitanian' waters in the west of the English Channel and the colder 'Boreal' waters in the east. The area also has a varied series of sea-bed substrates, including sheltered and exposed chalk, limestone ridges, tide-swept pebbles and cobbles, mudflats and enclosed lagoons. The combination of varied substrates and degrees of exposure with a wide range of sea temperatures supports a rich and diverse marine fauna and flora. There are also a wide variety of introduced species, brought in by shipping. The main areas of interest are described briefly below.

The Solent provides particularly unusual conditions in that it is sheltered yet has a strong tidal flow. To the west the contrast between hard and soft shores in both sheltered and exposed situations provides a series of significant areas. These include, at Studland, a sheltered chalk coastline supporting important algal communities and beds of eelgrass *Zostera* spp. The area also includes the exposed and geologically varied Kimmeridge Voluntary Marine Wildlife Reserve. The Portland and the Fleet Sensitive Marine Area includes the shallow lagoon of the Fleet. Lyme Bay, extending all the way to Exmouth, is another important marine area. A number of rare marine species are found in this area, especially those associated with its reefs.

This region is the most important in Britain for its lagoons. The Fleet, the single most important natural lagoon in Great Britain, is by far the biggest (480 ha) and most diverse, with over 200 animal species, including thirteen lagoonal specialists - the vast majority of the especially notable specialist lagoonal species in Great Britain. There are a number of other smaller lagoons, especially along the Hampshire coast, and a number of artificial lagoons, which have developed within former sea-salt production pools, and moats and pools retained behind sea walls. At Gilkicker, near Portsmouth Harbour, the artificial saline lagoon has a particularly rich assemblage of species, including at least three that are nationally rare. Poole and Christchurch Harbours are quasi-lagoonal in character, with relatively poor flushing by tidal waters. They are warm in summer and support a number of species characteristic of saline lagoons. Portland Harbour is also very important, particularly for a number of southern species at the edge of their ranges, including the lagoon sand worm *Armandia cirrhosa*.

All seven of the fish species considered threatened in UK and European waters are recorded in this region. In addition there are records of Couch's goby *Gobius couchi*, a species that has been recorded from only a few sites in the south-west of England and Ireland. Several locations are significant nursery areas for sea bass *Dicentrarchus labrax,* and the region is important for a number of other species of exploited sea fish, such as Dover sole, plaice, cod and mackerel. Basking sharks *Cetorhinus maximus* are occasionally seen throughout the region, particularly off the south coast of the Isle of Wight in warmer weather. The three diadromous fish species widespread in British waters - the Atlantic salmon *Salmo salar*, sea trout *Salmo trutta* and eel *Anguilla anguilla* - are all present in this region.

The region's population of the native oyster *Ostrea edulis* is nationally significant, as it is the largest stock in Britain and probably also in northern Europe. There are also important populations of scallops *Pecten maximus*, queen scallops *Aequipecten opercularis*, mussels *Mytilus edulis*, whelks *Buccinum undatum*, lobster *Homarus gammarus*, edible crab *Cancer pagurus* and spider crab *Maja squinado*.

Sightings of cetaceans are few, when compared with areas further north. However, bottlenose dolphins *Tursiops truncatus* are regularly recorded in the nearshore waters around the Isle of Purbeck. Common dolphins *Delphinus delphis* are seen less frequently; harbour porpoises *Phocoena phocoena* occur in Lyme Bay and long-finned pilot whales *Globicephala melas* are recorded throughout the region in deeper waters. There are no seal colonies within the region.

Estuarine shores

The fourteen estuaries that occur in this region are all relatively small in UK terms: taken together they represent 3% of the UK estuary resource (Davidson *et al*. 1991). However, proportionally they have large areas of tidal mudflats - a reflection of their very sheltered nature and the abundant sediment - and nearly 6% of British saltmarsh. The estuaries of the Solent and on the north coast of the Isle of Wight collectively form an important area of tidal and subtidal habitats. These are of great conservation significance, notably for their history of saltmarsh development, and their marine communities, associated wet grassland and lagoonal systems.

As elsewhere, estuaries in the region, with their complexes of habitats, are important for a wide variety of breeding, wintering and migrating birds: 21 species of wintering waterfowl occur in internationally or nationally important numbers on at least one estuary. Prominent amongst these are the dark-bellied brent goose and dunlin *Calidris alpina*, which occur in numbers of international importance in Chichester Harbour, Langstone Harbour, Portsmouth Harbour and the Solent/Southampton Water. Poole Harbour, together with Portland and the harbours of the Solent, is important for three species of marine wintering waterfowl: great-crested grebe *Podiceps cristatus*, cormorant *Phalacrocorax carbo* and red-breasted merganser *Mergus serrator*, the last species probably occurring in internationally important numbers.

The extensive saltmarshes of the region represent approximately 6% of the total resource in Great Britain. Most of the marshes present today are relatively young and are dominated by cord-grass *Spartina* spp. The region is of particular historical importance as the place of origin, in Southampton Water, of the invasive new species common cord-grass *Spartina anglica*. This formed from hybridisation between smooth cord-grass *S. alterniflora*, introduced in the 19th century in ship's ballast from America, and the native small cord-grass *S. maritima*. Rapid expansion of the species' distribution during the next 100 years or so, by deliberate introduction and natural spread, led to it becoming dominant throughout the area. This rapid expansion has been followed by an almost equally rapid decline (die-back). Although cord-grass still dominates some 65% of the saltmarsh in the region, important transitional marshes also occur. These include areas dominated by swamp at the margins of several sites, including Poole Harbour. There are also transitions to other habitats, including heathland, grassland, scrub and oak woodland, that are absent from most other regions, either because of heavy grazing, as in the north, or because of enclosure, as in many areas of England and Wales. These transitional habitats are particularly valuable for invertebrates. Major colonies of black-headed gulls and several species of tern breed on the saltmarshes and associated beaches and shingle spits.

Some enclosure of saltmarsh for grazing has occurred around most of the estuaries of this region. Although as elsewhere many of the resulting wet grasslands have been converted to intensive agriculture, significant areas still remain. These occur particularly within the North Solent National Nature Reserve and around Poole Harbour and some of the other smaller estuaries. The region's wet grasslands are important on a national scale and include floristically rich sites. Farlington and Warblington are particularly noteworthy because of the gradation of types of calcareous grassland and the presence of the uncommon corky-fruited water-dropwort *Oenanthe pimpinelloides*. Brackish water influences are common, as are typical communities dominated by sea club-rush *Scirpus maritimus* and grey club-rush *Schoenoplectus tabernaemontani*.

Wet grasslands in the region are important both for wintering and breeding birds. The former include 5-10% of the world population of the dark-bellied brent goose. Breeding birds include large numbers of redshank *Tringa totanus*, lapwing *Vanellus vanellus* and oystercatcher *Haematopus ostralegus* as well as an impressive assemblage of ducks of a variety of species. These grasslands are also important for some of Britain's scarcest invertebrates, including nationally important species such as the short and long-winged coneheads (grasshoppers) *Conocephalus dorsalis* and *C. discola*. Reedbeds in the region support breeding populations of bearded tit *Panurus biamicus* and a number of rare warblers.

Non-estuarine shores

Sea cliffs are very common in the area and are of major nature conservation significance for their flora, invertebrate fauna, fossils and geological interest. They occur both as soft erodible rocks - the clays and sandstones that dominate large stretches of the southern coast of the Isle of Wight and west Dorset - and as the more resistant chalk and limestone cliffs, such as the Needles or the rocks of Old Harry in Poole Bay. The softer cliffs that are unprotected by artificial structures may lose their biological interest in the short term because of the rapidity of sediment movement down the cliff face. At many sites, especially in west Dorset, considerable biological conservation interest survives, including a variety of open, unstable grassland and scrub communities. In places there are good populations of a number of orchids and other scarce plant species. Other cliffs have been artificially protected by a variety of physical structures, which in their turn obscure important geological features. Mobility of the cliff face is an important component in maintaining the geological exposures and open habitats.

The calcareous cliff flora of Purbeck on the south Dorset coast is amongst the richest in Great Britain and is considered to be of European importance. These hard-rock cliffs are less exposed to the forces of the Atlantic weather systems than cliffs further west, and plant communities that are influenced by maritime factors are restricted to the base of the cliffs. On this limestone and on the chalk of the Isle of Wight, calcareous grasslands occur on the steep slopes and provide examples of inland vegetation types long since destroyed elsewhere by agricultural, urban and industrial development. The Needles to St. Catherine's Point (Isle of Wight) and Durlston Head to Ringstead Bay (Dorset) are among the most important locations. The cliffs of the Dorset coast support the majority of the British population of the Lulworth skipper *Thymelicus acteon*, a species at the northern end of its range in Europe. The soft and crumbling cliffs also have a significant range of rare invertebrates, including the mining bee *Lasioglossum puncticolle*, which requires dry, open substrates, and the solitary wasp *Psen atratinus*, which demands wetter conditions.

The region includes a small proportion of the total area of sand dune in Great Britain (<1%) and only 3% of the resource in England. Only one site, Studland Bay dunes, is significant on a national scale. This site comprises a sequence of spits developed over a period of several centuries. Studland contains one of the few examples of dune heath in Great Britain and the only one in the region. The vegetation includes important heath communities (dominated by heather *Calluna vulgaris*), and the dry, open and warm aspect of the dunes supports one of the most important colonies of sand lizards *Lacerta agilis* anywhere in the UK. It is a possible Special Area of Conservation (SAC) under the EC Habitats and Species Directive.

This region contains some of the most important shingle structures in Great Britain, both for their flora and for their geomorphology. Chesil Beach is a 28 km-long bar enclosing a coastal lagoon; together with the other important site, Browndown, it supports some of Britain's most important and extensive plant communities on shingle. These include, on the least modified pioneer areas of pure shingle at Chesil, probably the biggest stands of sea kale *Crambe maritima* and sea pea *Lathryus japonicus* anywhere in Great Britain. Both of these species are considered to be scarce and declining. By contrast, the more stable shingle structure at Browndown has some good examples of acid grass heath with heather.

1.2.4 Landscape and nature conservation

The great value of the area for landscape and nature conservation is reflected in the number and extent of the official designations, which include 75 coastal Sites of Special Scientific Interest and five coastal National Nature Reserves. Much of the county of Dorset is an Area of Outstanding Natural Beauty (AONB), and the region holds nearly 20% of the total extent of AONBs on the North Sea coast and more than 15% of that on the coast of Great Britain. Despite there being none in Hampshire, Heritage Coasts in the region comprise 21% of the total length of Heritage Coasts on the North Sea coast and around 9% of such coasts in England and Wales. There are four designated Special Protection Areas and Ramsar sites, one of which is shared with Region 8 (Sussex). There are also four Voluntary Marine Nature Reserves, at Durlston, Kimmeridge, the Fleet/Portland and Charmouth. The total number of sites and areas of the main designations are given in Table 1.2.1 on page 18 (see also Chapter 7).

1.2.5 Human activities, past and present

There has been continuous occupation here since the end of the last glaciation (*c.* 10,000 BP), and surviving remains make the region of outstanding national importance for its archaeological and historic heritage. Evidence of early hunter/gatherers exists both offshore and on the coast of the region. Copper alloy was manufactured here 4,000 years

Table 1.2.1 Main landscape and nature conservation designations in Region 9

Designation	*No. of sites in region*	*Total area in this region (ha)*	*% of GB coast total in region*
Sites of Special Scientific Interest (SSSIs)	75	51,907	7.4
National Nature Reserves (NNRs)	5	1,820	2.1
Ramsar sites	3.5*	32,895	11.9
Special Protection Areas (SPAs)	3.5*	32,895	11.3
Local Nature Reserves (LNRs)	15	1,077	8.1
National Trust sites	50	5,294	8.5
Wildlife Trusts sites	17	739	3.2
RSPB reserves	4	1,355	3.5
Areas of Outstanding Natural Beauty (AONB)	3.5*	140,900	15.7
Heritage Coasts	4	136 km	8.8**

Key: *one site lies half in this region and half in Region 8 (see section 7.1); **England & Wales only.

ago, and the region benefited from wealth produced by trade with the continent. Ever since the Roman occupation, threats of sea-borne invasion have left a legacy of defensive structures. Among the most recent of these is the Portsmouth naval base, which first became important in the 18th century.

The natural harbours of the area, the adjacent fertile land, the rich tidal waters and the close proximity of the continent combine to make this one of the most notable areas for maritime activity in Britain. The archaeological record offshore is of considerable importance, with an extensive legacy of shipwrecks, many of which remain to be investigated. Amongst the important finds made recently was the *Mary Rose*, Henry VIII 's flagship, now on display in Portsmouth.

The sheltered waters of the Solent and Southampton Water have provided the focus for much industrial and commercial development. Leisure boating and sailing are high among the major industries in the region, catered for by a large number of harbours, marinas and moorings, slipways, boatyards and other facilities. The development of the port of Southampton has greatly reduced the extent of intertidal habitat in Southampton Water. Military use (the naval dockyards at Portsmouth), the major docks in Southampton Water, the oil refinery complex at Fawley and the extensive leisure boatyards contribute to making this area, particularly around Southampton Water, one of the most built-up in Great Britain. Other conurbations, notably the resort of Bournemouth, have altered the landscape of Poole Bay. The region includes Wytch Farm (Poole Harbour), the largest onshore oil field in western Europe. Much of the rest of the area is in agricultural use of varying intensity.

The flat alluvial landscapes of the sediment-filled valleys in which the estuaries and harbours lie are the setting for major infrastructure development, predominantly in Hampshire. Major conurbations have developed near the ports and resorts. Many areas are prone to flooding, and substantial lengths of the estuaries and tidal rivers are bounded by sea banks and sea walls. The many properties that have been built on unstable coastal cliffs have also proved to be a special problem. There have been classic cases of erosion of clay cliffs at Lyme Regis, Barton-on-Sea and Ventnor, and these have thrown into sharp focus many of the issues of existing coast protection and sea defence policy. The natural processes of coastal erosion and accretion have been extensively modified; structures designed to prevent cliff erosion, for example, notably around the town of Bournemouth, clearly illustrate the problem of protecting one part of a coast at the expense of the adjacent area. In many areas groynes and breakwaters designed to prevent beach erosion have been constructed. The maintenance of these sea defence and coast protection works is a major preoccupation for coastal management.

Fishing activity is intense in the inshore areas of the region, and the whole stretch of coastal water is regularly fished, especially for shellfish species, such as edible crab and lobster. The region is important for its long established oyster fishery in the Solent and surrounding area. Exploited sea fish, other than shellfish, are not landed in nationally significant quantities in the region. The cultivation of shellfish species, such as mussels, oysters and clams, takes place mainly in Poole Harbour, but production also occurs in the Solent, Portland and Weymouth Harbours and the Fleet.

The region is of very high value for coastal recreation. Tourism is the largest employer and source of revenue in Dorset and is of great importance also in Hampshire and the Isle of Wight. Common land-based activities include beach recreation, natural history (especially birdwatching), sea angling (from beaches, jetties etc.), wildfowling, fossil collecting, beachcombing and metal detecting, golf, horse and bicycle riding, rock climbing, walking and mountain biking. Water-based recreation is a very important activity in this region. The region is the single most heavily used water area for inshore recreation in Britain and possibly in the north-east Atlantic, with reportedly the largest recreational fleet in the world. The sheltered harbours, especially in the Solent, are ideal sites for watersports, which bring a significant income to the region. Activities include yachting and motor-boating, dinghy sailing, windsurfing, diving, sea angling, sea canoeing, jet skiing, water-skiing and rowing.

There are many groups in the region that aim to improve the sustainable management of the coast, and many initiatives, both locally and nationally instigated, are working to this end. Amongst these are the London and South East Regional Planning Conference (SERPLAN), the Standing Conference on Problems Associated with the Coastline (SCOPAC), the Solent Forum, the Dorset Coast Forum and many others.

1.2.6 Further sources of information

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Chapter 2 Geology and physical environment

2.1 Coastal geology

British Geological Survey

2.1.1 Introduction

The solid geology of the coast of this region is formed of Mesozoic and Tertiary sedimentary rocks. There are many classic sections illustrating features of stratigraphic and structural importance (Map 2.1.1 and Table 2.1.1). The great range of stratigraphy to be seen in these coastal outcrops is a product of the movement of older rocks at depth during the Alpine orogeny. This movement is expressed in the surface rocks as east-west-trending folds, in particular a major northward-facing monocline (step-shaped fold) that extends from near Lulworth Cove, through the Isle of Wight and eastwards into the English Channel. The region is also important for its geomorphological interest and in particular its rotational landslips and undercliff formations.

2.1.2 Stratigraphy

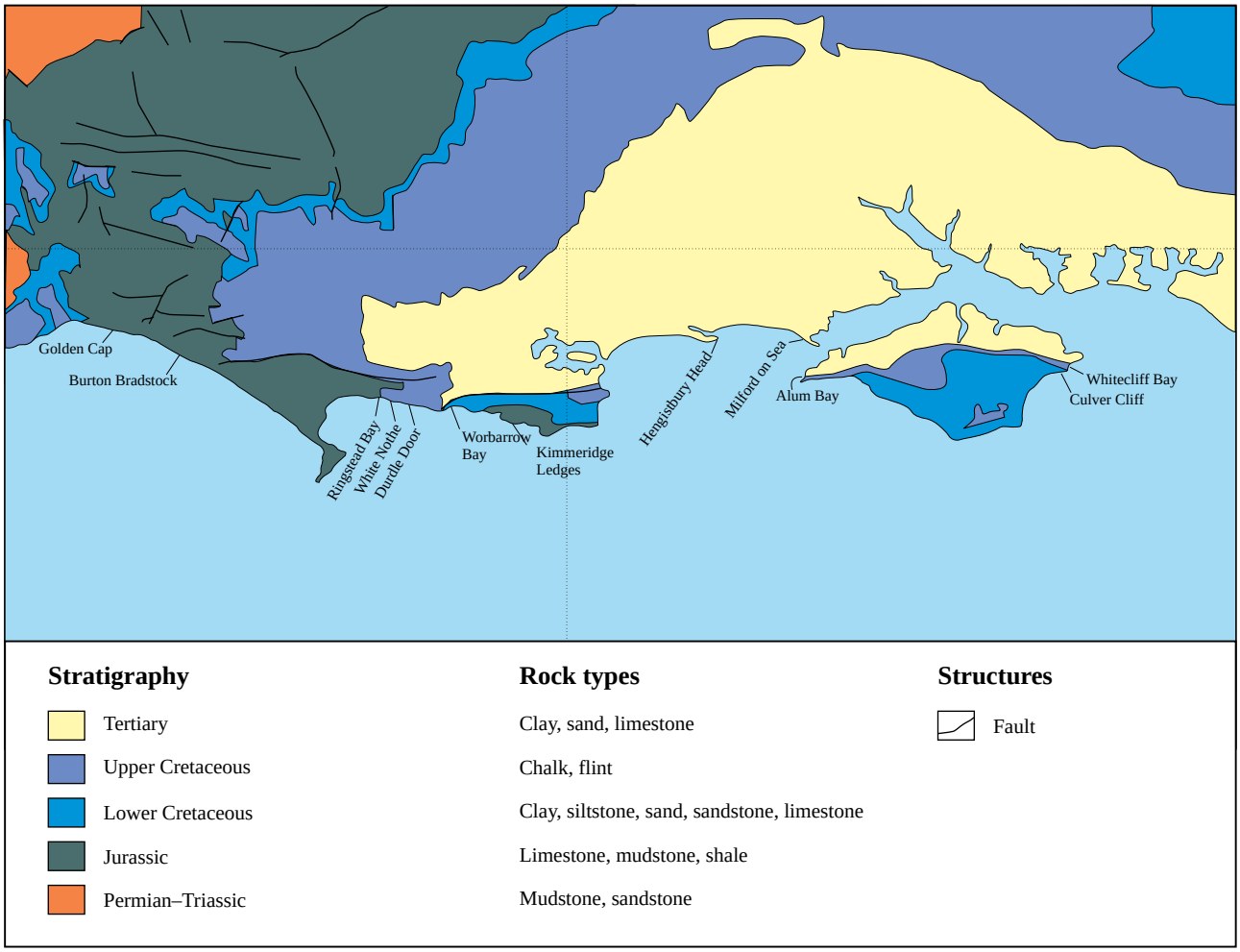
Hampshire

In the east of the region, around the Solent and as far west as Poole Bay, the solid geology comprises Palaeogene (early Tertiary) strata, forming part of the Hampshire Basin, which extends northwards from the Purbeck - Isle of Wight monocline. Between Christchurch and Milford-on-Sea the cliff section comprises gently dipping Palaeogene sands resting on Barton Clay, though exposure is poor, owing to landslipping. There are Palaeogene sections in the cliffs at Hengistbury Head and Bournemouth, although some of these have recently been obscured by coast protection works.

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	1.6		Maximum advance of last glaciation
					Earlier glaciations
	Tertiary (Neogene)	Pliocene	5.1		Alpine orogeny
		Miocene	25		Alpine orogeny
	Tertiary (Palaeogene)	Oligocene	38		Alpine orogeny
		Eocene	55		
		Palaeocene	65		
Mesozoic	Cretaceous			Chalk	
				Upper Greensand	
				Gault Clay	
			144	Wealden Bed	
	Jurassic			Purbeck Beds	
				Portland Beds	
				Kimmeridge Clay	
				Corallian	
				Oxford Clay	
				Fuller's Earth	
				Inferior Oolite	
			213	Bridport Sands	
				Lias	
	Triassic		248		
Palaeozoic (Upper)	Permian		286		
	Carboniferous		360		
	Devonian		408		
Palaeozoic (Lower)	Silurian		438		
	Ordovician		505		
	Cambrian		590		
	Precambrian				

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



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

The Isle of Wight

The most spectacular sections in the Palaeogene are those on the Isle of Wight. At Whitecliff Bay and at Alum Bay (at the extreme ends of the island), sections show the vertical strata involved in the monocline which forms the famous striped cliffs. In the northern part of the island the younger Osborne Beds, Bembridge Marls and Hamstead Beds form low cliffs prone to landslipping. The spine of the island is formed of steeply-inclined to vertical chalk, which, on the east coast, forms Culver Cliff and, on the west, the sharp headland of The Needles, with its chain of sea stacks. Immediately to the south of the monocline the Wealden beds have a broad anticlinal outcrop. The fossiliferous strata on the south-west coast of the island between Hanover Point and St. Catherine's Point form the richest Lower Cretaceous dinosaur site in Britain. These Sstrata are succeeded in the southern part of the island by the Cretaceous sequence of Gault Clay, Upper Greensand and Chalk, with a gentle southerly dip. The cliffs of these Cretaceous formations around the southern part of the island are extensively landslipped through failure of the Gault Clay: particularly good examples are to be found between St. Catherine's Point and Ventnor.

Poole to Weymouth

The coastline of the Isle of Purbeck offers a superb demonstration of the differing resistance to erosion offered by the various formations that make up the Upper Jurassic and Cretaceous succession. A series of embayments - Studland, Swanage and Durlston - are cut respectively in relatively soft Palaeogene, Wealden and Purbeck strata and constrained by headlands of Chalk, Upper Purbeck Limestone and Portland Stone. Further west, the ragged shoreline of the Kimmeridge Ledges is formed by layers of cementstone within Kimmeridge Clay, the cliffs of which are partly slipped.

From Worbarrow Bay to White Nothe the Chalk is steeply inclined and locally inverted as it forms part of the spectacular, northward-facing Purbeck monocline. The Mupe Bay - Worbarrow Bay embayment has been eroded through the soft Wealden beds, with the steeply dipping Chalk forming the back wall. To the east of Lulworth Cove the Purbeck Fossil Forest is exposed. Portland and Purbeck limestones form the portals to Lulworth Cove, where marine erosion has hollowed out the Lower Cretaceous Wealden clays and sands which were preserved under the Upper Cretaceous unconformity. The same limestones are seen at the famous sea-arch of Durdle Door and at Bat's

Head. The cliffs to the west of White Nothe provide excellent exposure of the Upper Cretaceous unconformity, here formed on a surface of Kimmeridge Clay and Portland strata. A sequence of strata older than the Kimmeridge Clay is exposed in the cliffs as far as Weymouth. This comprises the Kimmeridge Clay, which forms an extensively slipped undercliff east of Ringstead, underlain in turn westwards by the Corallian beds and the Oxford Clay.

Weymouth to Lyme Regis

A southward-dipping succession of younger Jurassic strata at the southern end of Chesil Beach forms the Isle of Portland. Kimmeridge Clay crops out around the northern part of the Isle, where it is extensively landslipped. This is overlain by the Portland and Purbeck beds, including the much-quarried Portland Stone (limestone) which forms sheer cliffs on the western side. At the western end of Chesil Beach at Burton Bradstock, degraded and partly landslipped cliffs, formed mostly of Fuller's Earth clays, are protected by the shingle bank. Heading west to Bridport the cliffs comprise Upper Liassic Bridport Sands, capped by a condensed sequence of the Inferior Oolite. Between Bridport and Lyme Regis, cliffs of richly fossiliferous Liassic clays and sands, capped locally and unconformably by Upper Cretaceous Gault Clay and Upper Greensand, rise at Golden Cap to 190 m in height.

2.1.3 Further sources of information

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Melville, R.V., & Freshney, E.C. 1982. *British regional geology: the Hampshire Basin and adjoining areas*. London, HMSO for Institute of Geological Sciences.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Geological information for region and the whole of Britain, including geological maps at 1:50,000 scale	Coastal Geology Group, British Geological Survey, Keyworth, Nottingham NG12 5GG, tel: 0115 936 3100
Geological Conservation Review sites: Hampshire & Isle of Wight	*English Nature Hampshire & Isle of Wight Team, Lyndhurst, tel: 01703 283944
Geological Conservation Review sites: Dorset	*English Nature Dorset Team, Arne, tel: 01929 556688

*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

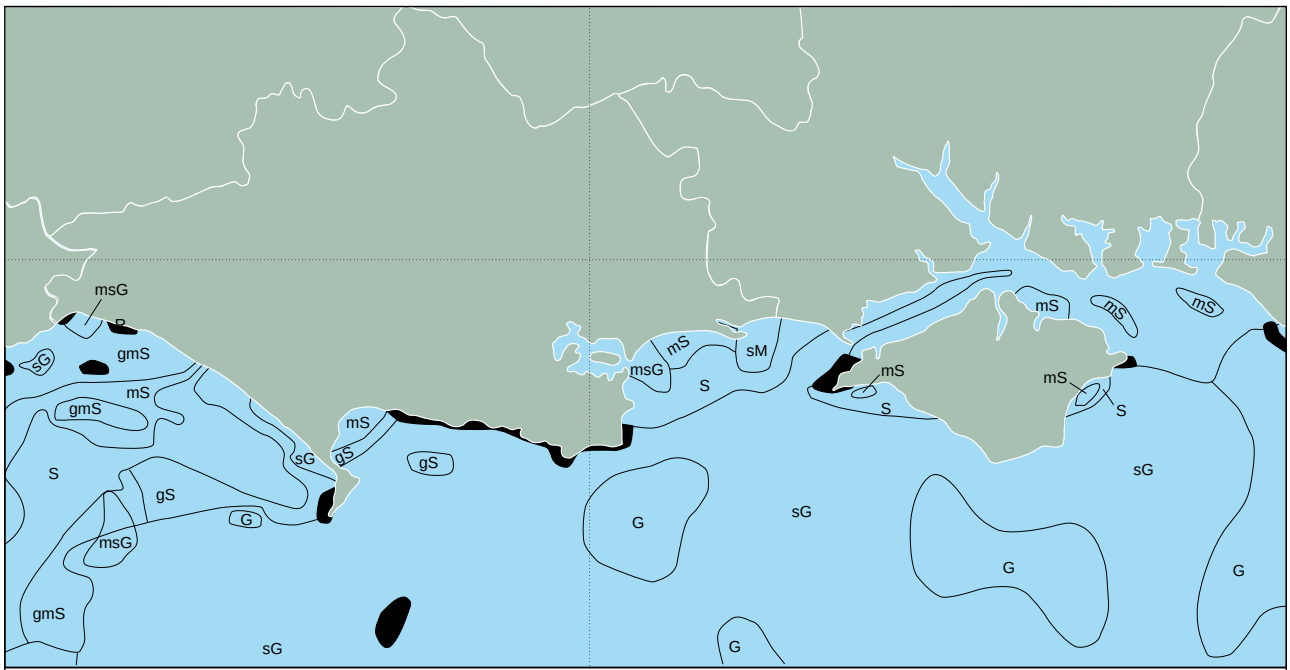
Sea-bed sediments are defined here as the unconsolidated sediments at sea bed laid down since the sea transgressed across the area during the Holocene. The lithology (rock types) and thickness of the sediments have been determined by sampling, high resolution seismic profiling and sidescan sonar.

Significant areas of sediment-free sea bed occur in the region: off the Isle of Wight coast, between St. Alban's Head and Weymouth Bay and off the coast of central Lyme Bay (Map 2.2.1). Over much of the region the sea-bed sediments consist of a discontinuous cover of coarse 'lag' (i.e. winnowed) deposits less than 0.5 m thick. These deposits are mostly gravels and sandy gravels formed of pebbles of flint, chalk, sandstone, limestone and ironstone, derived from the underlying bedrock. Pebbles and cobbles are heavily encrusted with serpulids, bryozoa and barnacles, indicating that they are not being moved about under the present current regime, and that they were probably eroded from the bedrock when sea levels were lower. In some areas longitudinal gravel furrows have formed parallel to the direction of tidal currents.

The lag deposits are locally overlain by mobile bodies of sand, in the form of ribbons, sand waves and rippled sand patches. Nearshore, thicker sands occur, notably Dolphin Sand in Poole Bay (over 10 m thick), south-west of the Isle of Wight, in the eastern Solent and the inner part of Weymouth Bay. These nearshore sediment accumulations are largely composed of medium to fine sand with low carbonate content, and some gravel with shell fragments. Muddier sediments are found in the inshore areas most sheltered from tidal currents.

2.2.2 Pleistocene geology

The Pleistocene ice sheets did not cross the region and Pleistocene deposits in the English Channel are limited to infills of former valleys beneath the Holocene sea-bed



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

sediments (Map 2.2.2). These 'palaeovalleys' form a complex river system incised during periods of lower sea level, modified by later marine processes. The eastern Solent is one such infilled palaeovalley, incised to at least 46 m below Ordnance Datum and containing over 30 m of sediment. The sand and gravel forming the infill of this valley are a mixture of fluvial, estuarine and marine deposits. The western Solent would have been a tributary of the Solent river. No buried channels have been detected near to the coast to the west of the Isle of Wight.

2.2.3 Solid (pre-Quaternary) geology

Rocks deposited before the start of the Quaternary Period (1.6 million years BP) are included by geologists in the category of 'solid geology' (Map 2.2.3). Offshore, most pre-Quaternary rocks are concealed by later sediments, but isolated outcrops do occur, particularly in areas of strong tidal currents (Map 2.2.1).

Permo-Triassic rocks, consisting of reddish brown mudstones, non-marine sandstones and breccias, occur in the westernmost part of the region. They meet the coast on the northern shore of Lyme Bay where they underlie Cretaceous sandstones and chalk. This junction is a major unconformity, which can be traced widely both onshore and further south into the English Channel. These rocks form the lowest rocks in the Portland-Wight Basin. Further east they are succeeded by Jurassic rocks, formed of a varied sequence of dark grey fossiliferous mudstones and shales interbedded with sandstone and limestone. Many of the numerous small faults, synclines and anticlines located onshore can be traced offshore: for example the Isle of Portland is at the axis of a shallow syncline which continues westwards into Lyme Bay. To the north-east, Corallian limestone is exposed in the core of the Lulworth Banks Anticline. The sea bed near the coast displays numerous small linear escarpments, ledges and reefs where differential erosion has caused the harder limestones to stand proud of the softer mudstones.

Near Durlston Head, at the northern edge of the Portland-Wight Basin, Cretaceous rocks crop out on the sea bed and consist of shelly limestones, clay and sandstone. To the north, Chalk caught up in the Isle of Wight Monocline crosses the mouth of Bournemouth Bay, linking the Needles to the mainland. This monoclinal structure is locally faulted.

North of the monocline, the beds dip gently northwards and the Chalk is overlain by Tertiary mudstones, sandstones and limestones.

2.2.4 Further sources of information

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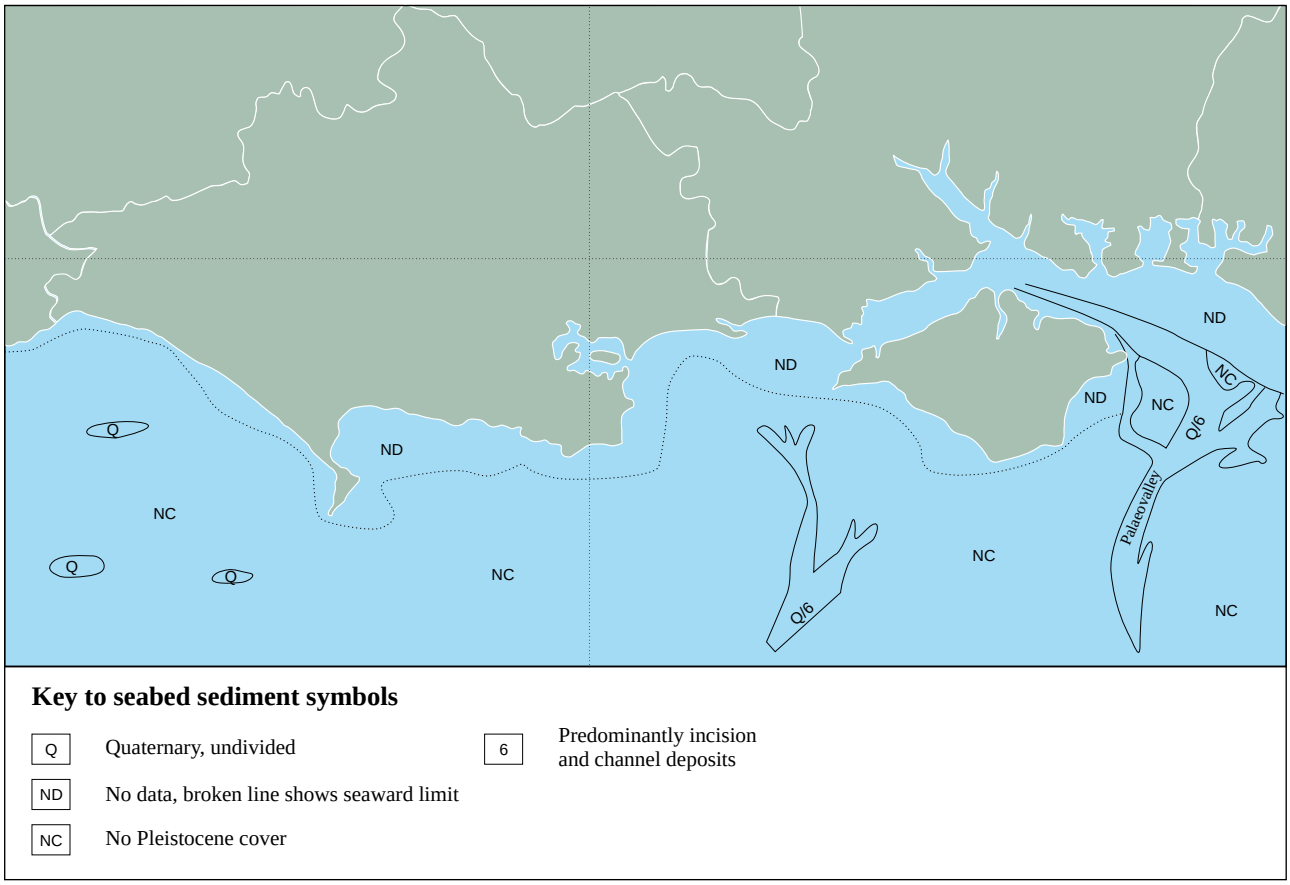
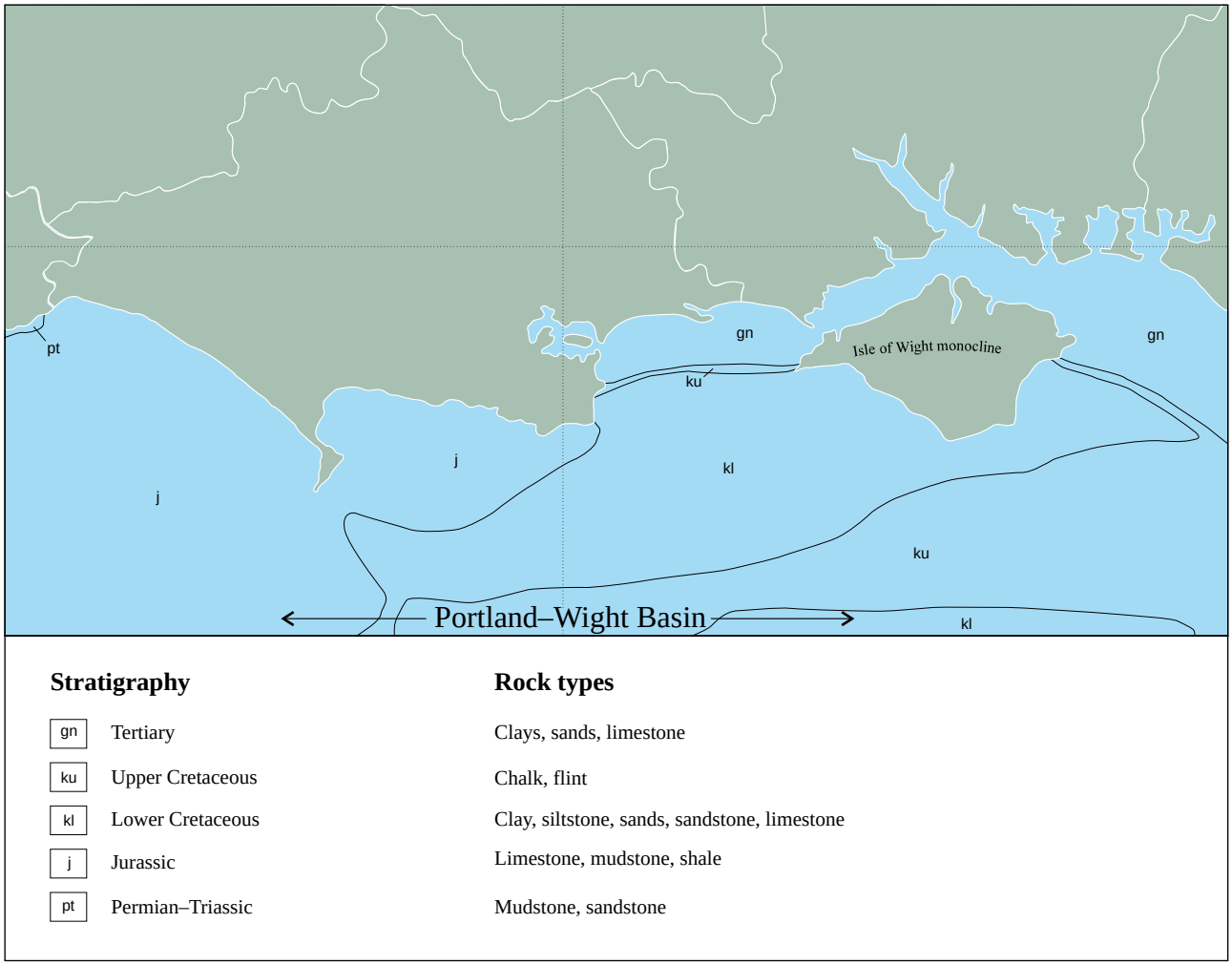


Map 2.2.2 Offshore Pleistocene deposits. Source: British Geological Survey (1994).



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

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D. 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 prevailing winds throughout the year are from the south-west (Figure 2.3.1), with the strongest winds occurring in winter. Winds from the south-east are less frequent and usually less persistent. Spring is the most common season for north-east winds. In winter strong winds may persist for several days. Maps 2.3.1 and 2.3.2 show, respectively, contours of the windspeeds exceeded for 75% and 0.1% of the time.

The coastal waters, estuaries and harbours are subject to local variations in wind conditions, compared with the open sea. Southampton, Portsmouth, and Christchurch and Poole Bays are relatively sheltered from the prevailing winds, but are locally exposed to gales from the south.

During spells of offshore wind, some places are liable to be affected by sudden gusts as a result of the coastal topography. In the vicinity of St. Alban's Head, winds from between east and south-east are common, owing to wind deflection along the Purbeck Hills and the Isle of Wight; similarly Durlston Head experiences winds from the east, caused by the east-west orientation of high ground.

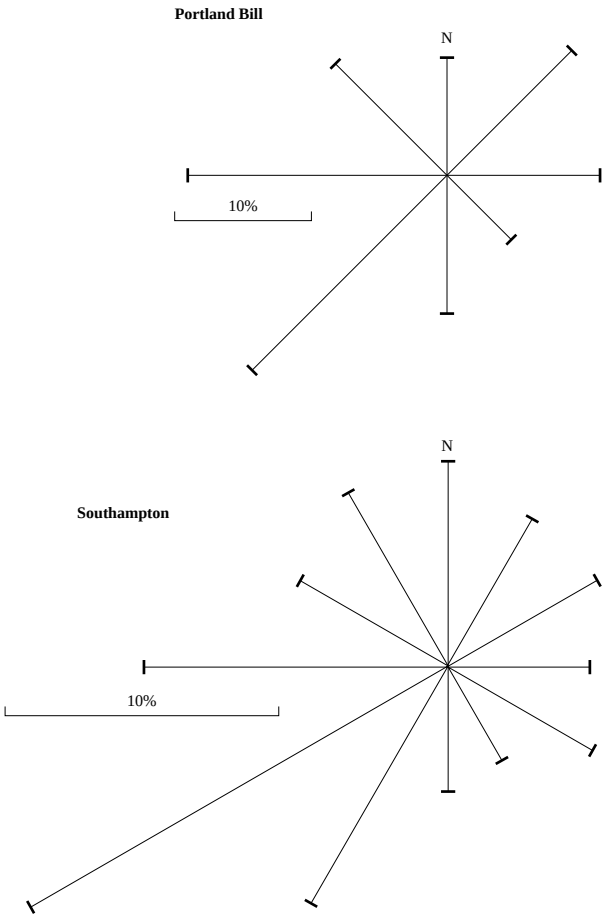
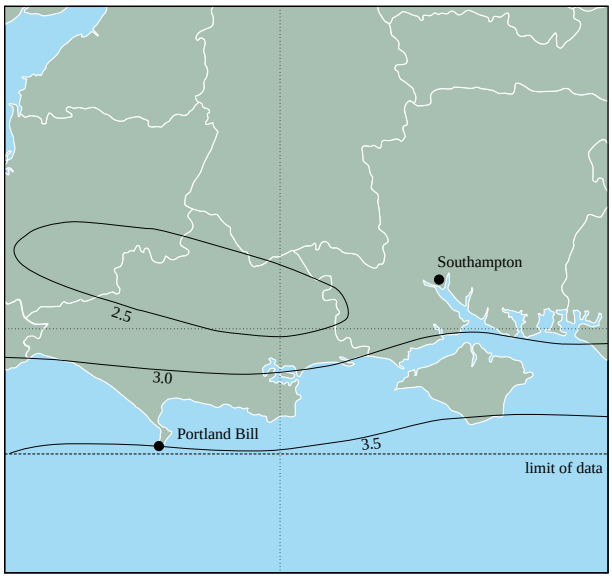


Figure 2.3.1 Wind directions at Portland Bill and Southampton shown as % of observations during the years 1916 - 1950. Source: Hydrographic Office (1960).

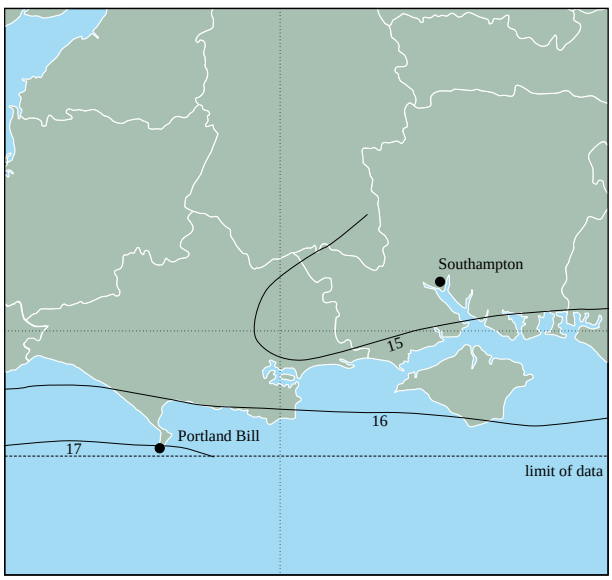


Map 2.3.1 Hourly mean windspeed (in m/s) exceeded for 75% of the time. Source: Caton (1976).

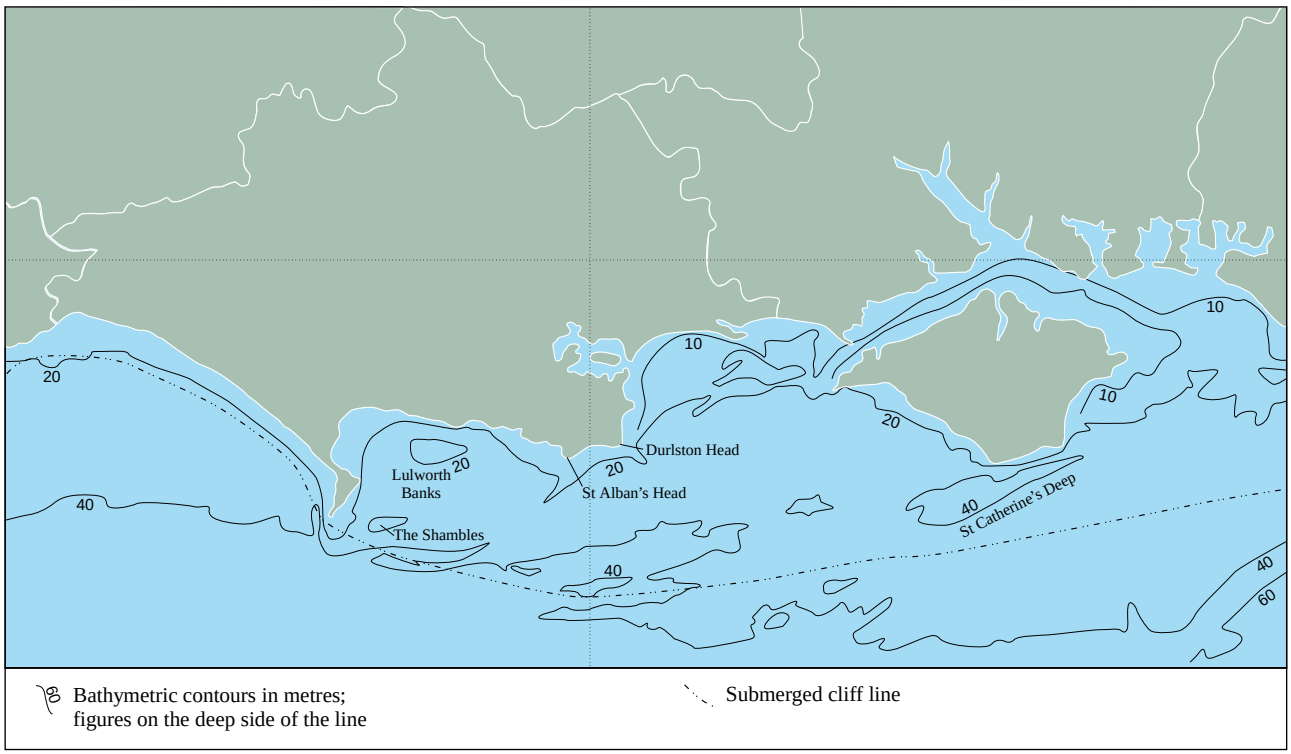
2.3.2 Water depth

The morphology of the sea bed is influenced by the nature of its bedrock, the exposure of the area to wave attack, and the supply of mobile sediment.

Much of the Solent is less than 5 m deep, though depths of between 10 m and 20 m occur in the centre of the channel, especially at the extreme eastern and western ends (Map 2.3.3). The channel is probably being maintained by strong tidal currents. South of the Isle of Wight there is an elongated enclosed deep, St. Catherine's Deep, which was probably formed by tidal scour when sea levels were lower than at present.



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. 10 m contour not shown where it lies close to the shore. Source: British Geological Survey (1987).

South of the Needles water depths exceed 20 m and the sea bed forms a regular submarine erosion surface. Further south this surface is locally cut by a submerged cliff line which approximately follows the 40 m isobath. Poole Bay and Christchurch Bay have extensive shallows less than 10 m deep.

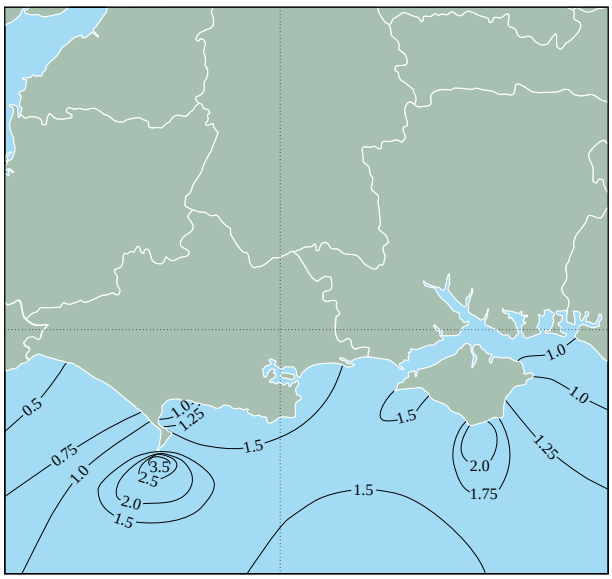
West of St. Alban's Head there are fewer extensive shallow areas near to the coast, the sea bed shelves more steeply and the 20 m isobath is not far offshore. St. Alban's Ledge, Lulworth Banks and the Shambles are shallower areas formed of upstanding rock outcrops or sand banks.

2.3.3 Tidal currents

The behaviour of the tides from Selsey Bill to Portland is very complex. Despite the small tidal range (see section 2.3.4), tidal currents are strong in many areas, for example off Portland Bill (Map 2.3.4). This area of strong currents and turbulence is the result of eddies in the lee of the Bill, the position of the 'race' depending on the state of the tide. Currents of up to 5 m/s have been reported in this vicinity.

Elsewhere along the coast, strong currents or tidal overfalls are common off pronounced headlands, such as St. Alban's Head, St. Catherine's Point and Selsey Bill. In the main bays - Lyme Bay, Weymouth Bay, Poole Bay and Christchurch Bay - currents are weak, especially in shallow water.

In the entrances and channels of the major tidal inlets of Southampton Water, the Solent and Portsmouth, Langstone and Chichester Harbours, tidal currents can be very strong.

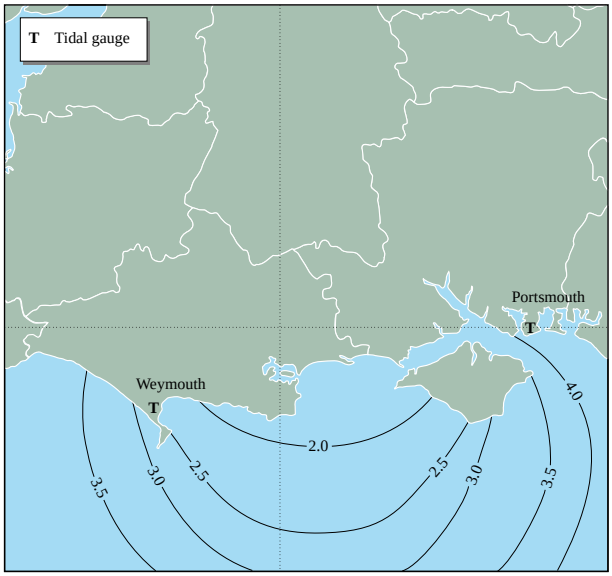


Map 2.3.4 Maximum tidal current speed (in m/s) at mean spring tides. Source: Sager & Sammler (1968).

2.3.4 Tidal range

Tidal range is greatest (>4.0 m) in the east of the region (Map 2.3.5). The smallest tidal ranges in the whole UK, less than 2.0 m at spring tides, are found in the Poole/Christchurch Bay areas. West of Swanage the range increases but even at Portland it is only 2.5 m.

Another feature of the tides in this region is the distortion of the tidal curves due to the effect of shallow water. As a consequence, tides have a marked 'double low water' between Portland Harbour and Lulworth Cove.



Map 2.3.5 Tidal range (m) at mean spring tides. Within the Solent, tidal range falls from >4 m at Portsmouth Harbour to <2 m at the Needles. Source: Lee & Ramster (1981). © Crown copyright.

From Swanage to Southampton 'double high waters' occur. In Poole and Christchurch Bays this distortion results in a long 'stand' of the tide at or very close to the high water level.

Tidal surges caused by fluctuations in atmospheric pressure may produce extreme conditions in the North Sea, but in the English Channel the results are less severe. The maximum surge level expected to occur once in 50 years at Portland Bill is 1.1 m in height, with maximum surge-induced currents of 0.6 m/s. In Poole and Christchurch Bays, however, where tidal ranges are normally small, even a 0.5 m surge may be significant, especially as the long tidal 'stand' at or near high water increases the probability of a surge occurring at this tide level. The storm surges along this coast appear to be strongly correlated with wave action from either the south-west or the south-east. The resulting combination of surge, wave action and tide level can cause problems along stretches of coast susceptible to flooding or erosion.

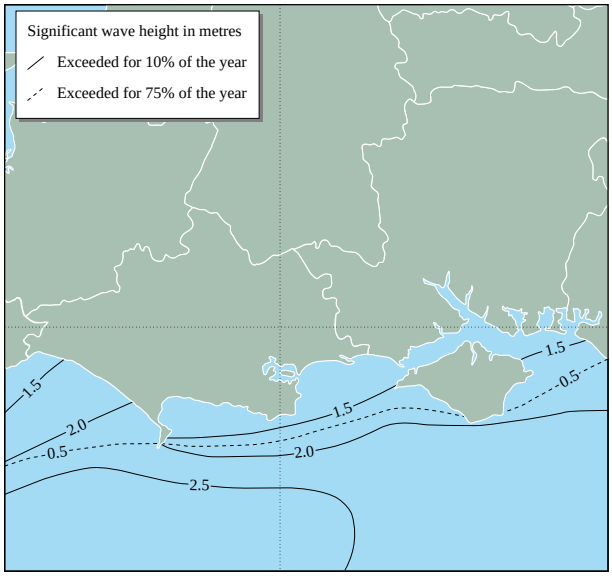
Tidal range increases progressively offshore into the English Channel and is particularly high near the Channel Islands.

2.3.5 Wave exposure and sea state

Waves are generated by the prevailing south-westerly winds, which have a long 'fetch' from the Western Approaches of the English Channel. However the western parts of Lyme Bay, Weymouth Bay and Bournemouth Bay are sheltered from these waves by substantial headlands (Map 2.3.6).

Wave period, the time between successive waves, is significant when considering sea state and exposure. Close to the coast, and especially within the surf zone, the apparent period may be less than offshore, as refraction increases the apparent frequency of waves.

Map 2.3.6 shows the significant wave heights that can be expected to be exceeded for 10% and 75% for the entire year.



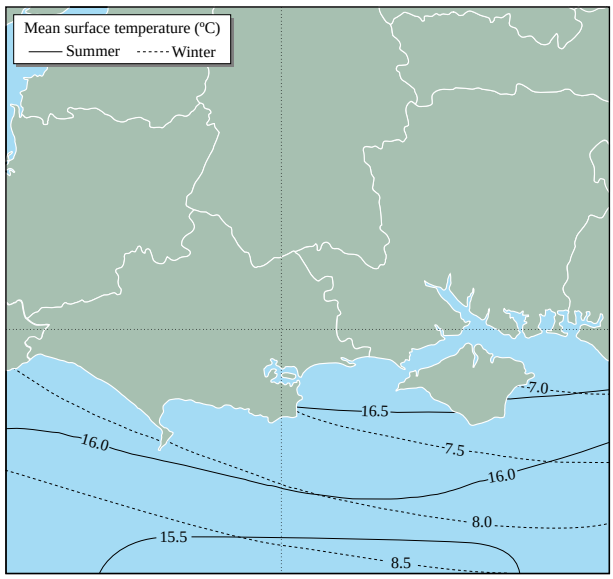
Map 2.3.6 Significant wave height (m) exceeded for 10% and 75% of the year. Source: Draper (1991).

For example at Portland Bill the significant wave height is greater than about 2 m for 10% of the year and 0.5 m for 75% of the year. In the sheltered bays and harbours of much of the region the significant wave height is less than 1.5 m for 90% of the year.

2.3.6 Water characteristics

Water temperature

The mean sea surface temperatures for summer and winter are shown on Map 2.3.7. The data are for August and February, which are the months of, respectively, highest and lowest average sea surface temperature. In winter, average sea surface temperatures increase progressively to the west, from less than 7°C to over 8°C, reflecting the inflow of



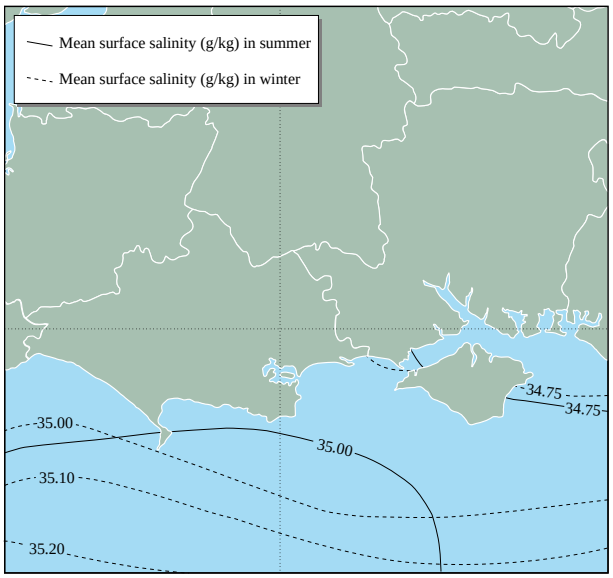
Map 2.3.7 Mean surface water temperature in summer and winter (°C). Source: Lee & Ramster (1981). © Crown copyright.

relatively warm Atlantic waters up the English Channel. In summer temperatures increase northwards from the middle of the English Channel towards the coast.

Salinity

Although lower than in winter, salinity values remain relatively high in summer along the centre of the English Channel due to the movement of Atlantic water towards the North Sea. Salinity values decrease toward the coast in both summer and winter but normally remain above 34.5 g/kg, except locally at river mouths, where there is dilution from freshwater discharge.

The mean surface salinity values for summer and winter are shown on Map 2.3.8, based on data for August and February respectively. Data are averaged for each month, which has the effect of smoothing out salinity gradients in some areas.



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.

2.3.7 Further sources of 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). In this region there are parts of two coastal cells: that from Selsey Bill to Portland Bill (divided into six sub-cells) and that from Portland Bill to Land's End (one sub-cell lies in the region). 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.

Chichester Harbour to Portsmouth Harbour: sub-cell 5a

There is a moderate westward drift in this sub-cell, owing to southerly and easterly waves, a result of the predominant south-westerly waves being diffracted towards the north by the shallow waters off the east coast of the Isle of Wight. In recent years the rate of drift along the coast has been reduced by coast protection schemes, which have reduced the supply of beach material from erosion. The drift is intercepted by harbour mouths, from where beach material is transported offshore by strong ebb tides to form tidal deltas.

There is accretion at the west end of Hayling Island and at the east end of Portsea Island. The lack of mobile beach material has resulted in erosion between Selsey and Hayling.

Portsmouth Harbour to Southampton: sub-cell 5b

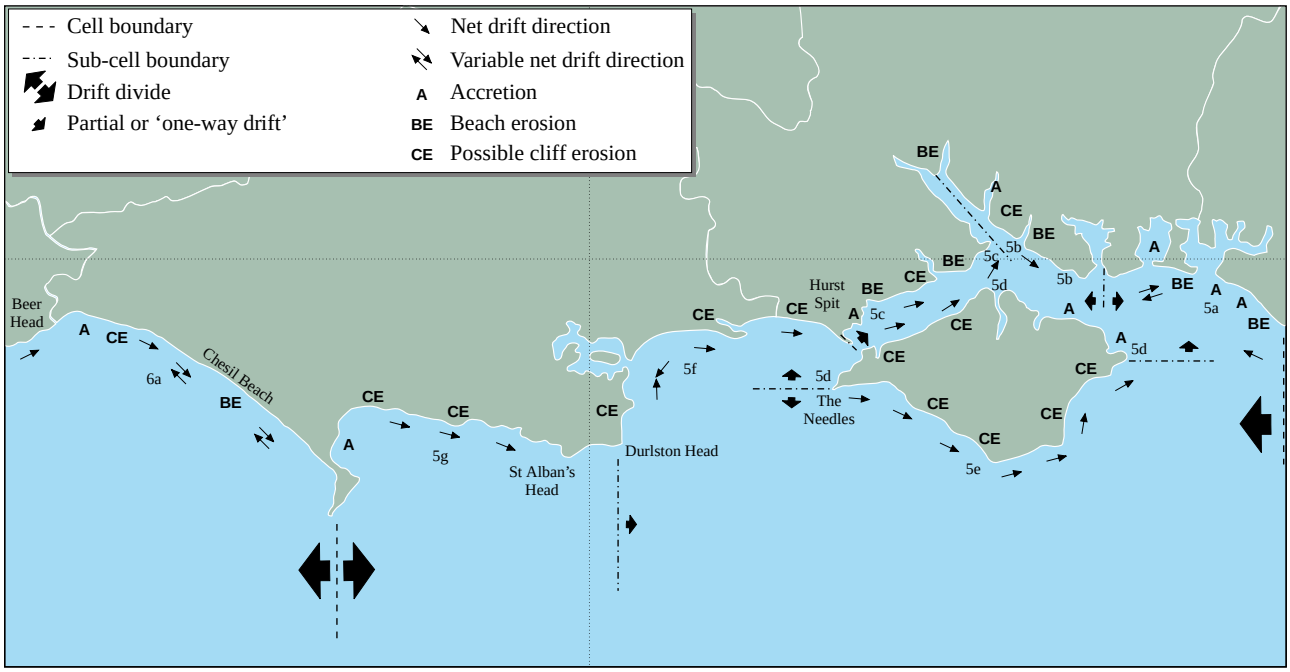
This sub-cell includes the north-east shore of the Solent from Gosport to Southampton. The littoral drift is low and there is a drift divide sited approximately between the mouths of the rivers Meon and Hamble. Tidal currents generally run parallel to the shore and prevent any significant onshore deposition of beach material. Littoral processes are very weak north-west of the Hamble.

There is accretion near the mouth of the river Hamble, and shingle ridges form south-east of Lee-on-Solent. Locally generated wave action in the Solent is sufficiently strong to cause cliff erosion between the rivers Meon and Hamble. There is beach erosion at Lee-on-Solent.

Southampton to Hurst Spit: sub-cell 5c

Littoral drift is low and towards the east on the north shore of the West Solent. There is no discernible drift on the west shore of Southampton Water. Tidal processes dominate in areas protected by mudflats. Locally-generated waves produce a weak littoral drift from east of Beaulieu river towards Calshot Spit.

In the lee of Hurst Spit there is local accretion of shingle. The coastline is prone to erosion, particularly from Keyhaven, where there are extensive areas of intertidal erosion and saltmarsh dieback, to Calshot Spit.



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

The Needles to Foreland (Isle of Wight north coast): sub-cell 5d

There is low northward and eastward drift from Totland to Cowes, decreasing eastwards from Cowes to Ryde. From Foreland to Ryde there is moderate northward drift. The dominant processes are wave action on the west and east coasts, and combined wave and tidal currents on the north coast.

At Ryde and Bembridge there is sand and shingle accretion, the sand being derived from the south-east coast or from the Solent. Erosion and cliff slippage affects most of the coast, but the worst affected cliffs are from Totland to Cowes and from Seaview to Foreland.

Foreland to the Needles (Isle of Wight south coast): sub-cell 5e

There is moderate to high eastward drift from the Needles to St. Catherine's Point, reducing slightly to the east. In Sandown Bay the drift is moderate and northerly.

On the south-west coast there is sand and pebble accretion, owing to cliff erosion. Between St. Catherine's Point and Ventnor and in Sandown Bay there is accretion of pebble and sand beaches. Erosion and cliff slippage is prevalent along the coast, both between the Needles and Hanover Point where the chalk cliffs are being eroded, and further east where the cliffs are formed of clay and soft sandstone.

Hurst Spit to Durlston Head: sub-cell 5f

There is moderate to high easterly drift of sand and shingle in Christchurch and Poole Bays, and little net drift in Swanage Bay. There is local drift reversal at the entrance to Poole Harbour. Tidal currents carry sand eastwards around Hengistbury Head, some of this being transported offshore and some reaching the coast in Christchurch Bay. Rapid tidal currents transport shingle from the end of Hurst Spit onto offshore banks.

Hurst Spit is receding and is being breached in places. In the eastern part of Christchurch Bay and at Christchurch Harbour entrance there is accretion of shingle. There is slippage and erosion of unstable cliffs of clays, sands and gravels in the central part of Christchurch Bay and at the east end of Poole Bay. Sand is accreting in Poole Harbour entrance and in Studland Bay. There is also cliff erosion in Swanage and Durlston Bays.

Durlston Head to Portland Bill: sub-cell 5g

There is low and intermittent eastward drift within this sub-cell. Tidal currents have little impact on the coastline, being relatively weak close to the shoreline. There is an anticlockwise current-induced circulation of sand in Weymouth Bay, resulting in sand accretion. Pebble beaches occur within deeply incised embayments.

Erosion is widespread. Wave action on unstable cliffs, which consist of a variety of rock types such as mudstones, shales, limestone and chalk, has formed deeply incised bays and stacks. The rate of erosion is fairly rapid, due to a combination of weathering, slippage and wave undercutting.

Portland Bill to Lyme Regis: sub-cell 6a

Littoral drift is variable in direction but generally eastward. Chesil Beach is receding slowly and is now prone to overtopping. It appears to have no contemporary supply of material, and wave action dominates the evolution of the beach.

To the west of Chesil the coastline consists of soft, easily eroded mudstone cliffs. Waves erode these cliffs and transport fine particles seaward in suspension. This process is particularly marked east of Lyme Regis, where the soft, sandy/shale cliffs are prone to slippage on a large scale. Sand and shingle has built up at Lyme Regis due to the trapping effect of the harbour and consequent downdrift erosion to the east.

2.4.2 Further sources of information

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B. Further reading

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Turner, N. 1990. Sand transport on the seabed in Poole and Christchurch Bays. *In: Poole Bay, a natural resource.* Dorchester, The Marine Committee of the Dorset Trust for Nature Conservation.

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

*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

Apparent sea-level rise is the combined effect of local crustal movements (owing to the removal of the weight of ice since the last glacial period, Scotland is rising whereas southern England is sinking) and global rises in sea level, estimated as rising between 1.5 and 2 mm/year. Reviews which attempt to estimate future changes in apparent sea level (e.g. Woodworth 1987) cite the regional and temporal variability shown by tide gauge data as major causes of uncertainty.

Shennan (1989) shows no primary data for the region but extrapolation of the rates of crustal movement estimated elsewhere in the country suggests a crustal subsidence rate of about 0.5 mm/year. This subsidence reinforces the current global rise in sea level to produce a rise in sea level along the coast that is probably in excess of 2 mm/year. Emery & Aubrey (1985), however, indicate a sea level rise of 4-8 mm/year across most of the region (Map 2.5.1).

2.5.2 Flooding in the region

The potential for flooding (see Map 2.5.1) is high in the low-lying ground fronting Chichester, Langstone and Portsmouth Harbours. Extensive areas of high flooding potential exist along Southampton Water and westwards to Lymington, and along valleys incised into the north coast of the Isle of Wight. Parts of Christchurch and Poole Harbour are also low-lying. West of Studland the coast is mostly cliffed, but parts of Weymouth, the area behind Chesil Beach, and some areas near Lyme Regis also have high potential for flooding. Isostatic sinking of the land and the increasing frequency of storm conditions and wave heights in the Atlantic are increasing the future potential for flooding and erosion on the coast and decreasing the original expected useful life of coastal works.

2.5.3 Further sources of information

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Shennan, I. 1989. Holocene crustal movements and sea-level changes in Great Britain. *Journal of Quaternary Science, 4*(1): 77-89.

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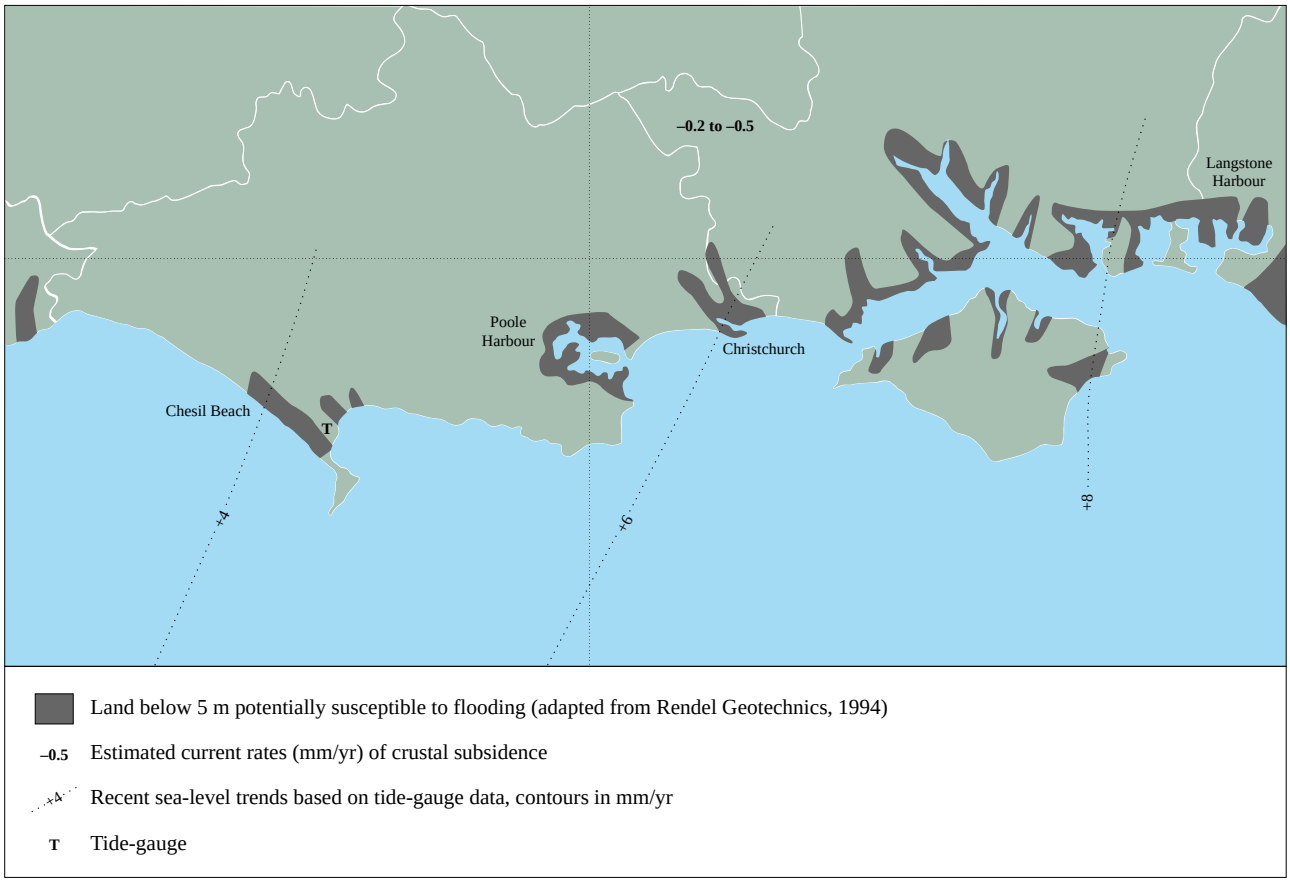

Map 2.5.1 Areas below 5 m above OD and thus susceptible to flooding, and estimated rates of crustal movement (after Shennan 1989) and sea-level rise (after Emery & Aubrey 1985).

B. Further reading

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Woodworth, P. 1990. Measuring and predicting long term sea level changes. *NERC News, 15:* 22-25. Swindon, NERC.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Flood defence - east of Christchurch	*National Rivers Authority - Southern Region, Worthing, tel: 01903 820692
Flood defence - west of Christchurch	*National Rivers Authority - South Western Region, Exeter, tel: 01392 444000
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

The region is here divided into three sections on the basis of its geomorphology: first, the soft shores of the Solent, stretching west as far as Poole Harbour and Studland Bay, second the predominantly cliffed coast of the south of the Isle of Wight and Dorset between Studland and Weymouth, and third, a western section comprising Portland Bill and the coast of Lyme Bay. Major coastal landforms are shown on Map 2.6.1. This region contains, particularly in parts of the Isle of Wight and the Dorset coast, some of the best-known and most spectacular coastal scenery in southern Britain: despite there being none in Hampshire, Heritage Coasts in the region comprise 21% of the total length of Heritage Coasts on the North Sea coast and around 9% of such coasts in England and Wales (see also Chapter 7).

Hayling Island to Studland Bay, including the north shore of the Isle of Wight

The landforms of the eastern section of the region are controlled by the underlying geology of Tertiary rocks, which are largely soft clays and sandstones, resulting in a mainly low-lying coastline. The series of large embayments that indent the coast - Chichester, Langstone and Portsmouth Harbours, the Solent, Southampton Water and Poole Harbour - have been formed by the drowning of low-lying coastal land as the sea rose after the last glaciation. They are characterised by muddy sediments and saltmarsh, particularly in Langstone Harbour, Portsmouth Harbour, on both sides of Southampton Water, the north shore of the western Solent (between Calshot and Hurst Castle) and Poole Harbour.

In places the mud is mixed with sand or shingle, and there are notable deposits of shingle on the open coast between the embayments, for example on Hayling and Portsea Islands and at Browndown, Needs Ore Point (at the mouth of the Beaulieu River) and Hurst Spit. The Hampshire coast has many saline lagoons, some associated with shingle structures, for example at Gilkicker, and others behind the low-lying coast between Calshot and Keyhaven.

On the north coast of the Isle of Wight there is a series of smaller inlets that are also sedimentary in nature: Bembridge Harbour (which is almost closed off by the Duver, a spit of shingle and sand), the muddy inlets of Wootton Creek, King's Quay, Newtown River and the River Yar, and the classic drowned river valley of the River Medina at Cowes. There are lengthy stretches of cliff on the Isle of Wight north coast, although these are generally low and relatively soft. Elsewhere on the non-estuarine coast of the island, the large expanse of sand flats at Ryde gives way to mud around Wootton Creek. Mud and sand extends from Gurnard Ledge (west of Cowes) to Newtown River, backed by low cliffs. Low cliffs west of Yarmouth increase in height to Alum Bay, next to The Needles, where they form a spectacular multi-coloured vertical section of Tertiary strata.

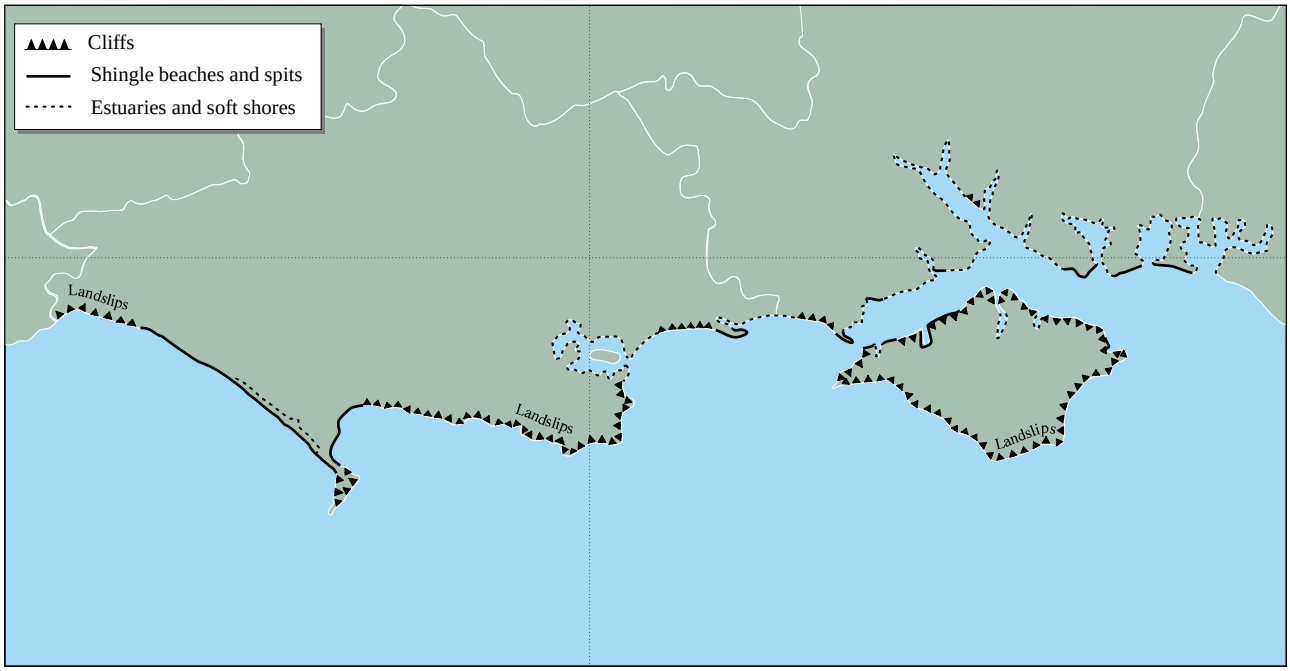
On the mainland, west of Hurst Spit, shingle and sand backed by low cliffs predominate as far as Christchurch, beyond which beaches are mainly sandy as far as Studland: sand spits have formed at Hengistbury Head and Sandbanks, as well as at Studland, where an important dune site is backed by heathland. Although there are smaller areas elsewhere, the only substantial areas of sand dune in the region are found at Sinah Common (Hayling Island), the Duver and Studland. At Handfast Point (Old Harry), near Swanage, chalk forms a prominent white headland and stacks.

Isle of Wight south coast and Purbeck coast to Weymouth

These sections of coast generally have prominent cliffs, and a wide variety of rocks are exposed by the complex structure. Folds and faults run east-west, parallel to the Dorset coast part of this section. On the south coast of the Isle of Wight the rocks are Cretaceous and Jurassic in age, composed of chalk, limestone, clay, sandstone and other sediments. These rocks also occur on the mainland, south and west from Handfast Point.

Chalk cliffs form prominent landmarks at Culver Down in the east of the Isle of Wight and even more spectacularly at Tennyson Down and The Needles in the west. In between, sandy beaches are present along the frontage of Sandown and Shanklin, where the hinterland is low-lying, before the land climbs again, rising quite steeply from the sea between Shanklin and Blackgang. Along the stretch between Bonchurch (near Ventnor) and Niton (near St. Catherine's Point) the cliffs are unstable, owing to the presence of the underlying Gault Clay, and slumping is widespread, leading to irregular undercliffs. Steep valleys, known as 'chines', occur where streams reach the sea by cutting down through the high ground, as at Luccombe. To the west of Blackgang the coast is formed of lower cliffs, 20 - 40 m high, which run for some 15 km, broken occasionally by chines. High ground formed of chalk is reached after Compton Chine, but the downs are cut at Freshwater Bay where the north-flowing River Yar rises in marshes only a few hundred metres from the south coast.

In Dorset, shingle beaches backed by cliffs predominate to the west of Studland. West of Old Harry, cliffs formed of Bridport Sands, Portland Beds, Upper Greensand and Chalk tend form sheer faces, while those with Jurassic clay formations, the Wealden Beds and the Gault Clay are generally degraded and prone to landslip. Extensive irregular undercliffs are seen, for example at Kimmeridge Bay and at the eastern end of Ringstead Bay. Chalk forms downland behind the coast between Worbarrow Bay and White Nothe; at the coast itself are older rocks, which give the coastal landscape much of its special quality. Differential erosion, where the sea has broken through a hard vertical stratum (the Portland Limestone) and hollowed out softer rock behind (the Purbeck Beds), has created well-known features such as Lulworth Cove and Durdle Door. West of Redcliff Point the land falls to Lodmoor, a low-lying area of wet grassland on the outskirts of Weymouth.



Map 2.6.1 Major coastal landforms

Weymouth to Lyme Regis

The dominant landforms of this section of coast are the Isle of Portland (actually a peninsula), Chesil Beach and the cliffs of west Dorset. The Isle of Portland juts far out into the English Channel and nearly all its shore is cliffed: the northern part is higher (130 m), with irregular slumped undercliffs, but the land surface slopes more gently down to sea level at Portland Bill.

Joining the Isle of Portland to the mainland and stretching north-westwards for 28 km, as far as Burton Bradstock, lies Chesil Beach, a long shingle bar that encloses the Fleet, a brackish lagoon (see also sections 3.3 and 3.4). The lagoon stretches from Weymouth to Abbotsbury, more than half the length of the shingle bar, and behind it lie undulating hills, which west of Abbotsbury slope directly down onto the shingle beach.

West of Burton Bradstock lie more cliffs, often slumped as a result of clay underlying harder rocks. Among these cliffs are some of the most prominent features of the Lyme Bay coast, including Thorncombe Beacon and Golden Cap (191 m).

2.6.2 Further sources of information

A. Further reading

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Steers, J.A. 1964. *The coastline of England and Wales.* 2nd ed. Cambridge, Cambridge University Press.

Steers, J.A. 1981. *Coastal features of England and Wales.* Cambridge, Cambridge University Press.

B. Contact names and addresses

Type of information	*Contact address and telephone no.*
Coast protection	*Ministry of Agriculture, Fisheries and Food, Flood and Coastal Defence Division, London, tel: 0171 238 3000
Geomorphological information for region	Coastal Geology Group, British Geological Survey, Keyworth, Nottingham NG12 5GG, tel: 0115 936 3100

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

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 UK coast there are other semi-natural habitats of importance that are not directly influenced by the sea, including for example lowland heathland, woodlands, dry grasslands (other than that on typically coastal substrates - sand, shingle or cliff) and peatlands.

In this region, there are a number of important areas of non-maritime habitat close to the coast, principally ancient woodland, lowland heaths and calcareous grassland. Lowland heath is a habitat of European importance, protected under the EC Habitats and Species Directive, and regional examples (for instance the Dorset heaths) hold nationally important populations of a number of rare species, especially of birds (see section 5.11), reptiles and amphibians (see section 5.6). As far as ancient woodland is concerned, the New Forest is probably the best surviving example of pasture woodland in western Europe and is unique in its diversity of lichens and fungi (see section 5.1). The New Forest is among the most important sites in the UK for dead-wood invertebrates (see section 5.3) and is a Special Protection Area for birds. Chines (narrow gorges) in the cliffs of the Isle of Wight also retain good examples of ancient woodland, important for dormice; these woods, and others in the region, make it one of the most important regions in the country for bats (see also section 5.13). The combination of chalk exposures with the mild climate results, in the Isle of Wight, in some of the best examples of maritime chalk grassland in the country; St. Alban's Head and the Isle of Portland are classic botanical localities for higher plants of calcareous soils (see also section 5.2).

Lowland heath is one of the rarest and most threatened terrestrial habitats in Europe. The few scattered remnants now surviving in England comprise a large part of the European resource and are often highly significant for their rare species. Studland Heath National Nature Reserve is home to two of the rarest, the sand lizard and the smooth snake, and has been designated a Biogenetic Reserve - one of only eighteen in Europe. Photo: Peter Wakely, English Nature.

3.1 Cliffs and cliff-top vegetation

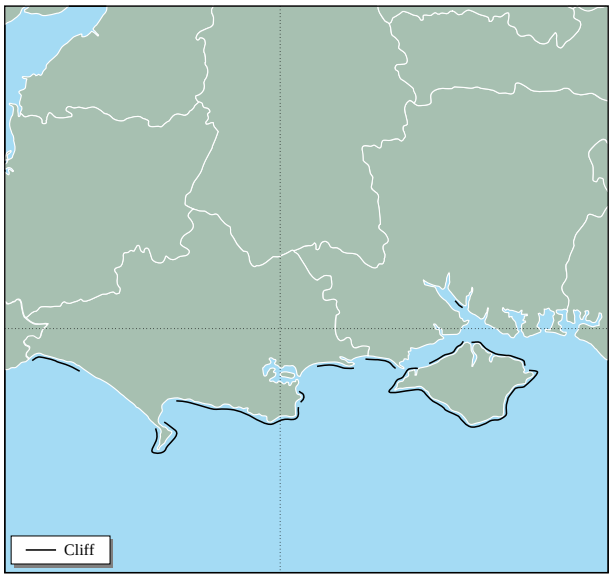
Dr T.C.D. Dargie

3.1.1 Introduction

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 strata, Tertiary and Quaternary deposits.

The coast of Hampshire, Isle of Wight and Dorset contains a good length of cliff and a moderate extent of cliff and cliff-top habitats. The region has a total cliff length of 131 km (Table 3.1.1 and Map 3.1.1), representing 3% of the British resource, and is therefore of modest importance in the national context. However, the total extent of soft unprotected cliff is large (80 km) and represents a significant proportion (31%) of this cliff type in England.

Cliffs in the region exhibit good diversity in form (Table 3.1.2) (Doody *et al*. 1993). West Dorset has soft Jurassic cliffs between Lyme Regis and Burton Cliff, rising to 191 m OD at Golden Cap. The Purbeck Coast between Osmington and Studland has a very varied array of soft and hard cliffs set in Jurassic clays and limestone, with more restricted Cretaceous chalk, together with other outstanding cliffed landforms (small bays, headlands, stacks and natural arches). Soft cliffs associated with Tertiary materials are common on the Isle of Wight around Hamstead, but are more extensive on the southern coasts, where they are cut in Jurassic rocks, with major Cretaceous chalk cliffs in the west (Tennyson Down) and in the east (Culver Cliffs).



Map 3.1.1 Cliffs and cliff-top habitat. Marked sectors have >90% cliffed coast. Source: JNCC Cliffs Database.

Table 3.1.1 Cliff and maritime cliff grassland resource in context

	Soft cliffs		*All cliffs*		*Maritime cliff grassland*	
	Total length (km)	*% of total in Region 9*	*Total length (km)*	*% of total in Region 9*	*Total area (ha)*	*% of total in Region 9*
Hampshire	7.2	-	6.5	-	0	-
Isle of Wight	41.5	-	52.5	-	52	-
Dorset	31.5	-	72.5	-	57	-
Region 9	***80.2***	***-***	***131.5***	***-***	***109***	***-***
England	256.0	31	1,164.5	11	1,895	6
East Coast	?	?	1,799.5	7	?	?
Great Britain	?	?	4,059.0	3	?	?

Source: Pye & French (1993). Key: ? = area, length or percentage not known.

Table 3.1.2 Lengths (km) of cliff types

	Vertical >20 m high		*Vertical <20 m high*		*Non-vertical >20 m high*		*Non-vertical <20 m high*	
Area	*Length (km)*	*% of total length in Region 9*	*Length (km)*	*% of total length in Region 9*	*Length (km)*	*% of total length in Region 9*	*Length (km)*	*% of total length in Region 9*
Hampshire	0	-	0	-	5.5	-	1.0	-
Isle of Wight	18.0	-	0	-	25.5	-	9.0	-
Dorset	28.0	-	2.0	-	40.0	-	2.5	-
Region 9	***46.0***	-	***2.0***	-	***71.0***	-	***12.5***	-
England	320.0	14.4	49.0	4.1	628.5	11.3	167.0	7.5
East Coast	600.5	7.7	379.5	0.5	558.5	12.7	261.0	4.8
Great Britain	1,325.0	3.5	818.0	0.2	1,371.0	5.2	545.0	2.3

Source: JNCC Coastal Resources Database (cliff height and angle categories).

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 can develop undercliff vegetation of woodland, scrub, tall herb and rank grassland, often very close to the sea. This has developed in several areas in this region (notably on the north and south coasts of the Isle of Wight), but its full extent is uncertain. Slumped material is extensive on some cliffed coasts and in a few places maintains a mosaic of cliff habitats of different ages. The full regional extent of cliff-top habitat has not been surveyed, but the moderate exposure of the coast to very strong winds and heavy spray deposition probably allows mainly maritime grassland to develop, with most of this restricted to hard cliffs.

The scenic contribution of cliffs within the region is outstanding, with tall and lengthy soft cliffs in Jurassic and Tertiary strata for substantial lengths of the west Dorset and Isle of Wight coasts, and imposing hard vertical cliffs cut in Jurassic limestone and chalk in east Dorset and of chalk in the western Isle of Wight, where the cliffs terminate in the imposing stacks of the Needles. This scenic value is recognised in the 44 km (Isle of Wight) and 92 km (Purbeck and west Dorset) of Heritage Coast, each with important cliffed sections (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. Cliff habitats between Dancing Ledge and Chapman's Pool (Purbeck) have been mapped by Cooper (1988), recording 16 ha of very varied grassland on Jurassic limestones and shales. No other detailed map information is available, but a zonation is recognised on the hard limestone cliffs of the south coast (Mitchley & Malloch 1991), ranging from high spray and exposure conditions (NVC cliff vegetation communities MC1 rock samphire *Crithmum maritimum* - rock sea-spurrey *Spergularia rupicola* rock-crevice, MC4 wild cabbage *Brassica oleracea* cliff ledge, MC8 red fescue *Festuca rubra* - thrift *Armeria maritima* maritime grassland) to more sheltered cliff-top conditions (MC11 red fescue *Festuca rubra* - wild carrot *Daucus carota* maritime grassland and CG2 sheep's fescue *Festuca ovina* - meadow oat-grass *Avenula pratensis* calcicolous grassland, which is probably common on Cretaceous chalk cliff tops). The total extent of maritime cliff grassland in the region is estimated at 109 ha (Table 3.1.1), with very little in Hampshire (possibly confined to Beckton Bunny), the cliffs there being mostly soft and relatively sheltered.

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; one of these, the nationally scarce early spider orchid *Ophrys sphegodes*, occurs in the region. Other nationally rare and scarce species more typical of other habitats also occur on cliffs and several nationally scarce species are present in the region: wild cabbage, dwarf mouse-ear *Cerastium pumilum*, sea kale *Crambe maritima*, Portland spurge *Euphorbia portlandica*, early gentian *Gentianella anglica*, golden samphire *Inula crithmoides*, tree mallow *Lavatera arborea*, rock sea-lavender *Limonium binervosum*, hairy bird's-foot-trefoil *Lotus subbiflorus*, white horehound *Marrubium vulgare*, hoary stock *Matthiola incana*, oxtongue broomrape *Orobanche loricata*, yarrow broomrape *O. purpurea*, sea radish *Raphanus maritimus*, bulbous meadow-grass *Poa bulbosa*, Nottingham catchfly *Silene nutans* and suffocated clover *Trifolium suffocatum*. The south Dorset coast and the Needles to St. Catherine's Point cliff sectors are considered of national importance for their botanical interest (Doody *et al*. 1993) (see also section 5.2). Maritime heath is an important national feature of cliff-top habitat but is probably absent in the region, and no lichen heath of national or regional importance is recorded for regional cliffs (Fletcher *et al*. 1984).

A population of the rare sand lizard *Lacerta agilis* is present on Bournemouth Cliffs. There are no major cliff sites with important seabird colonies (Stroud *et al*. 1990) in the region, though smaller seabird populations are present, notably on the south-west Isle of Wight cliffs. Some cliffed locations, notably Portland Bill, are important for recording bird passage migrants. 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). Several cliffs in the region have excellent or good invertebrate lists, with some notable and rare (Red Data Book) species; South Dorset Coast SSSI, Isle of Portland, West Dorset Coast, Durlston Head, Hanover Point to St. Catherine's Point, Nilton to Ventnor Undercliff, Bembridge Down SSSI, Lulworth Cove, Studland Cliffs SSSI, Golden Cap Estate and Compton Down SSSI are regionally important cliff locations on the JNCC's Invertebrate Site Register (see also section 5.3).

This coastline is characterised by a wide variety of erosional problems, from rapidly eroding cliffs to actively unstable landslide complexes. The high chalk cliffs of Freshwater Bay and Culver Cliff on the Isle of Wight, and Studland Bay and White Nothe, Dorset, are subject to relatively low rates of retreat, usually less than 0.3 m/year, involving rockfalls and topples. Large ancient pre-existing landslide complexes occur on the Isle of Wight Undercliff, and on the north-east coast of the Isle of Portland. In these areas, slow, intermittent ground movement can cause significant damage to property situated on the unstable slopes. Elsewhere, cliffs tend to be developed in interbedded sequences of soft sedimentary rocks. This can give rise to relatively rapid erosion on exposed coasts, such as the south-west coast of the Isle of Wight, and highly dynamic landslide complexes, as in Christchurch Bay (e.g. Naish Farm and Chewton Bunny) and West Dorset (e.g. Black Ven, Stonebarrow and Golden Cap) (Jones & Lee 1994).

3.1.3 Human activities

Cliffs are among the least modified of terrestrial habitats, although 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), though these are probably uncommon in the region, where arable agricultural land often reaches close to the cliff edge. Targets for re-creating maritime cliff grassland from arable or improved pasture are discussed by Pye & French (1993). In general visitor erosion and residential development have caused low to moderate habitat loss and vegetation disturbance in this region. However, footpaths have heavy usage in some parts of the region and local erosion is present (e.g. South West Coast Path, southern Isle of Wight cliffs). Outside the towns, much of the cliffed coast is largely undeveloped, although there is some caravan park development close to cliffs, with at least one large site in a major location (Durdle Door), and car parks are common. Access to the South Dorset Coast is restricted by military activity and this has probably prevented recreational development.

The scale of residential development on soft cliff sectors has led to protection of parts of the cliff foot by coastal defences (as at Weymouth, Bridport Bay, Durleston Cliffs, Swanage and Ventnor).

3.1.4 Information sources

Detailed NVC survey is confined to one study in Dorset (Cooper 1988), which was part of a pilot study involving thirteen surveys to assess the feasibility of mapping all cliff habitat in Britain. 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 cliff vegetation studies and both strategic and local management of the cliff resource.

No other detailed surveys exist for the region, and existing information is insufficient to detail the regional extent of individual cliff and cliff-top habitats, apart from maritime cliff grassland.

3.1.5 Acknowledgements

Assistance with sources was kindly provided by JNCC's Species Conservation Branch. Thanks also go to Rendel Geotechnics for information on landsliding and cliff erosion.

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.

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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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	*Coastal Ecologist, English Nature, Peterborough, tel: 01733 340345
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 region has only a small extent of vegetated sand dune habitat, represented by three sites: Hayling Island, The Duver at St. Helen's, Isle of Wight, and Studland Bay (Map 3.2.1). Their total area is 234 ha, representing only 3% of the dune resource of England and less than 1% of the area for Great Britain (Table 3.2.1). On area alone the regional dunes are of only minor importance in the national context. However, they are important in a regional context, owing to their rarity. Small additional areas are present elsewhere but have not been included in national dune surveys, i.e. Sinah Common (Hampshire) and Bembridge Harbour (Isle of Wight).

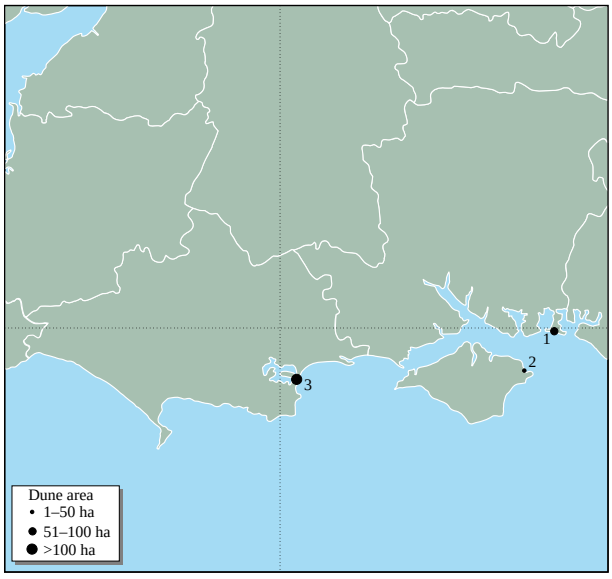
Table 3.2.1 Region 9 vegetated dune resource in context

	Total area (ha)	*% of total in Region 9*
Hampshire	53	-
Isle of Wight	11	-
Dorset	170	-
Region 9	***234***	**-**
England	9,282	3
North Sea Coast	25,356	1
GB	50,200	<1

Sources: Dargie (1993), Dargie (1995), Radley (1994), JNCC Coastal Resources Database. Note: the totals for the North Sea Coast and Great Britain are provisional estimates, as Scotland has not been systematically surveyed.

Despite their small extent, the dunes in the region are quite varied. There are transitions to saltmarsh and shingle, and a good range of foredune, mobile dune and fixed dune types, all acidic except at The Duver, St. Helen's, which has only stable dune grassland and scrub. The extent of National Vegetation Classification (NVC) dune vegetation types (Radley 1994) occurring in the region, including other land cover (e.g. bare ground, car park, caravan park), is given in Table 3.2.2.

All sand dune sites in the region are covered by some form of national or international designation. The Duver, St. Helen's, is a Site of Special Scientific Interest (SSSI) owned by the National Trust and is within an Area of Outstanding Natural Beauty. Studland Bay, owned by the National Trust, is part of the Poole Basin Special Protection Area (SPA) and Ramsar site; part is managed as a National Nature Reserve (NNR), and the site falls within a stretch of Heritage Coast. Accreting dunes at Bembridge Harbour lie partly within an SSSI.



Map 3.2.1 Sand dune sites. Numbers refer to Table 3.2.3. Source: JNCC Sand Dune Database.

3.2.2 Important locations and species

Sand dune sites in the region are summarised in Table 3.2.3. All the sites are spit dunes developed at the mouths of estuaries and strongly dependent on river sediment or strong inshore coastal currents for their sand supply. The Studland Bay site is a particularly fine example (Diver 1933). At 204 ha, it is the only site in the region large or diverse enough to support any dune wetland, here comprising open water, mire, swamp, wet heath and extensive birch and willow woodland.

90 NVC communities (Radley 1994) have been recorded for all the sand dunes of England, Scotland and Wales, with a total of 156 types for communities and sub-communities

Table 3.2.2 Areas (ha) of dune vegetation types

	Strand and embryo dune	*Mobile and semi-fixed dune*	*Acidic fixed dune grassland*	*Neutral and cal careous fixed dune grassland*	*Dune heath and bracken*	*Dune slack*	*Other dune wetland*	*Dune wood-land and scrub*	*Trans-isitions salt marsh*	*Trans-itions to mari-time cliff*	*Other land cover*
Hampshire	2	11	3	0	9	0	0	13	3	0	12
Isle of Wight	1	0	8	0	0	0	0	3	1	0	1
Dorset	1	15	1	0	65	0	12	39	0	0	37
Region 9	***3***	***26***	***12***	***0***	***74***	***0***	***12***	***55***	***3***	***0***	***49***
England	179	2,484	671	2,170	197	487	150	1,189	141	30	1,044
GB*	340	8,504	4,953	15,228	2,615	2,175	4,114	8,965	836	64	2,406

Sources: Dargie (1993), Dargie (1995), Radley (1994), JNCC Coastal Resources Database. Note: in the absence of full data for Scotland, figures for the North Sea Coast have not been calculated; *totals for Great Britain are provisional estimates.

Table 3.2.3 Sand dune sites in Region 9

Code	*Name*	*Grid ref.*	*Area (ha)*	*Dune type*	*Conservation status*
1	Hayling Island	SZ695992	93	spit	None
2	The Duver, St. Helen's*	SZ636891	13	spit	AONB, NT, SSSI
3	Studland Bay	SZ034846	204	spit	HC, NNR, NT, RS, SPA, SSSI

Source: Radley (1994). Code refers to mapped site location (see map 3.2.1). Abbreviations: AONB - Area of Outstanding Natural Beauty; HC - Heritage Coast; NT - National Trust; SPA - Special Protection Area; SSSI - (Biological) Site of Special Scientific Interest. Key: *also included in section 3.3.

combined, not all of them exclusive to dunes. A notable feature of the dunes of this region is the presence of lyme-grass *Leymus arenarius* (normally a northern species in British dunes) in NVC mobile dune types (SD5 *Leymus arenarius* community, SD6b and SD6c marram *Ammophila arenaria* community, *Leymus arenarius* - sand couch *Elymus farctus* and *Leymus arenarius* sub-communities). Dune heath (H11 sand sedge *Carex arenaria* - heather *Calluna vulgaris* community) is extensive at Studland Bay and the region is the largest locus for this habitat in England. Though dune slack habitat is not present, the wetland of Studland Bay (wet heath, mire, swamp, open water and much W4 downy birch *Betula pubescens* - purple moor-grass *Molinia caerulea* woodland) is diverse and is the largest extent of non-slack wetland upon English North Sea coast dunes.

None of the five nationally rare higher plants found in Great Britain mainly or exclusively on dunes occurs in the region. Of the twelve such nationally scarce higher plants, sea stork's bill *Erodium maritimum*, Portland spurge *Euphorbia portlandica*, sea spurge *E. paralias*, seaside centaury *Centaurium littorale*, rush-leaved fescue *Festuca juncifolia* and dune fescue *Vulpia membranacea* are present. Other nationally scarce species, more typical of other habitats, also occur on dunes in the region, including Nottingham catchfly *Silene nutans*, upright chickweed *Moenchia erecta*, bird's-foot clover *Trifolium ornithopodioides*, suffocated clover *T. suffocatum*, clustered clover *T. glomeratum*, corky-fruited water-dropwort *Oenanthe pimpinelloides*, bastard-toadflax *Thesium humifusum*, ivy broomrape *Orobanche hederae*, dotted sedge *Carex punctata* and squirreltail fescue *Vulpia ambigua.* For such a small set of sites these species represent a significant assemblage in national terms. No site is of national importance for lichens (Fletcher *et al*. 1984; Alvin 1960).

The inclusion of Hayling Island and Studland Bay in designated Ramsar sites and Special Protection Areas indicates that they are parts of habitat complexes that support bird populations of international importance (Stroud, Mudge & Pienkowski 1990) (see also sections 5.10, 5.11 and 5.12). Ringed plover *Charadrius hiaticula* is the only breeding wader species of which large numbers use regional estuaries with dunes.

This region is one of the most important in the country for reptiles and amphibians, for which dunes and heaths are particularly important habitats (see also section 5.6). The area of Studland Heath and Poole Harbour is the most important reptile site in Britain, supporting all six native species. Of 179 separate sand lizard colonies in the UK (Corbett 1994), 78% occur in coastal 10 km squares and 70% of the total are located in this region.

The JNCC Invertebrate Site Register summarises the invertebrate interest of sites. All dune sites in the region have good records for nationally rare (Red Data Book) and other rare/notable species. Studland Dunes SSSI is also part of the most outstanding coastal site in the region (South Haven Peninsula) for invertebrates and one of the most notable coastal sites in Britain (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 other common vegetation types (Doody 1989). The most notable cases in the region are the losses of dune habitat to residential and recreational development, assisted by extensive groyne systems to alter sand sediment distribution along much of Christchurch Bay/Poole Bay (see also section 8.4). None of the dune sites in the region is grazed (Radley 1994).

All sites have long been used for recreation and probably experience some of the highest dune visitor numbers in Britain, and all sites suffer from local severe erosion due to trampling. Recreational use is controlled by car parking restrictions and the provision of hardened paths and boardwalks to reduce erosion. There are very high visitor numbers at Studland Bay and erosion is pronounced in the foredunes, where fenced marram grass planting has been necessary to rehabilitate much of this zone. Fortunately, inner sectors of the site are rarely used by visitors and remain in near-natural condition. A golf course is part of the Hayling Island site, and mineral extraction is also occurring at this site; vehicles have caused severe local damage to dune grassland.

Conservation management is now a major activity at the sand dune sites of the region (Radley 1994), all of which are designated (Table 3.2.3) or have other forms of planning control. Dune use is one component of a Coastal Recreation Strategy prepared by the Southern Council for Sport and Recreation, covering Hampshire, Isle of Wight, the Solent and Chichester Harbour. A Coastal Recreation Officer has recently been appointed, initially to develop an information and monitoring system for coastal recreation.

3.2.4 Information sources used

Survey of dunes in Scotland is still in progress and it is not possible to give accurate figures on the extent of the dune resource for either the North Sea coast or Great Britain. An estimate of dune habitats for Scotland has been used here, based on a sample set of sites (Dargie 1993), to allow some form of British context to be made for the region.

All areas of vegetated sand dune in the region have been surveyed in recent years using the National Vegetation

Classification (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. 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.

3.2.5 Acknowledgements

Assistance with sources was kindly provided by JNCC's Coastal Conservation and Species Conservation Branches.

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B. Further reading

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

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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	*Coastal Ecologist, English Nature, Peterborough, tel: 01733 340345
Invertebrate data	*Invertebrate Site Register, Joint Nature Conservation Committee, Peterborough, tel: 01733 62626
Coastal recreation – Hampshire	*Coastal Recreation Officer, Hampshire County Council, Winchester, tel: 01962 846027
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.

Chesil Beach is the most striking shingle feature in the region. Here at its eastern end it is a fine example of a tombolo, linking the Isle of Portland to the mainland. Westward, the shingle bar encloses the Fleet Lagoon and eventually merges with the Bridport fringing shingle beach. As a geomorphic structure it is unique in Britain, and some of its shingle plant communities occur nowhere else in Britain. Photo: Nick Davidson, JNCC.

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 2-200 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. Such sites are covered in section 3.2. 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 (e.g. at Hayling Island). Shingle plant communities around Britain are distinctive (Sneddon & Randall 1993), with some communities being widespread and others limited to a particular region or substrate.

Much of the coast of this region is bordered by shingle, and the irregular physiography of the coastline has resulted in the formation of major shingle structures (Steers 1964). Frequently the shingle is admixed with considerable amounts of silt or clay and is adjacent to saltmarsh or lagoonal features. This region contains, in Browndown and Chesil, two of the major shingle features of Britain, both significant for their size and lack of fine matrix over considerable parts of their extent. According to Sneddon (1992), on a floristic and size ranking of the most important shingle structures in Britain, Chesil is 4th, Browndown 9th and the Duver 13th. Several sites, particularly Browndown, Newtown and the other silty matrix sites, are significant in having representative southern plant communities. The Hayling and Eastney fringing beaches and the Duver are good examples of sand matrix on shingle. Thus the region's >34.5 km of fringing shingle beach has a wide representation of shingle vegetation communities. The scale of the region's shingle resource in a national context is shown in Table 3.3.1.

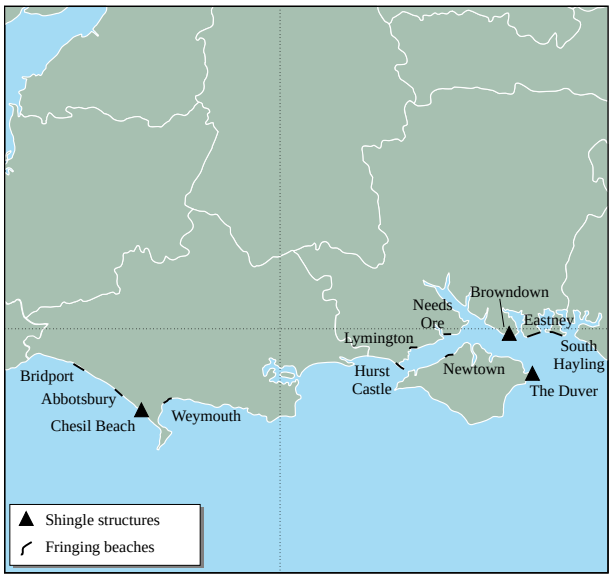
3.3.2 Important locations and species

The major sites are shown on Map 3.3.1 (see also Tables 3.3.2 and 3.3.3). Chichester and Langstone Harbours are protected from the open sea by multiple ridge sand/shingle spit systems, and shingle islets. At Chichester much of the shingle is relatively unstable and little vegetation has established. At St. Helen's, Isle of Wight, the common land

Table 3.3.1 Area of vegetated shingle structures in Region 9

	Area (ha)
Hampshire	64.3
Isle of Wight	19.1
Dorset	250.1
Region 9	***333.5***
North Sea Coast	4,472.3
England	4,353.1
Great Britain	5,129.1
% North Sea Coast total in region	7.5
% England total in region	7.7
% GB total in region	6.5

Source: Sneddon & Randall (1994)



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

of the Duver comprises a sandy shingle spit system developed on the northern bank of an estuary, grading towards and including a silty shingle marsh complex. Browndown, in the Solent, is an extensive shingle structure making up a cuspate foreland with some sand matrix but in large part comprising pure shingle ridges. The Beaulieu estuary has simple clay matrix spits at Calshot and Needs Ore Point, with a mobile fringing shingle beach between. On the Isle of Wight, at Newtown Harbour, Norton Point and King's Quay, there are small shingle spits with clay matrices showing good representations of southern shingle-to-marsh transitions. Silty fringing shingle occurs at Lymington and develops into a long spit at Hurst Castle, with terminal recurved shingle ridges containing a silt and clay matrix. Much of the spit has been disturbed during sea defence works in recent years. Other than a similar but smaller silty shingle spit at Hengistbury Head, most of the Dorset shingle is in the west of the county where there is continuous pure shingle from Weymouth to Bridport. The Chesil beach forms the most significant feature along this stretch of coast. In the east it is a fine example of a tombolo, linking Portland Island to the mainland. In the centre it is a shingle bar enclosing the Fleet Lagoon, and in the west it merges with the Bridport fringing beach. As a geomorphic feature it is unique in Britain (Ambios Environmental Consultants 1995).

The silty nature of the matrix in many of the shingle beaches of this region is strongly reflected in the vegetation, as is the absence of matrix at some sites. A common pioneer assemblage in the region on sandy shingle is a cosmopolitan community dominated by sea sandwort *Honkenya peploides* and marram *Ammophila arenaria*, with sea campion *Silene maritima*. Where there is little matrix, there are a series of species-poor sea campion communities, some of which are unique to Chesil Beach. Large areas there are dominated by bladder campion *Silene vulgaris* associated with either curled dock *Rumex crispus* or Danish scurvygrass *Cochlearia danica*.

Table 3.3.2 Surveyed shingle sites

Site name	*Location*	*Area surveyed (ha)*	*Site type*	*Conservation status*	*Activities/ management/disturbances*
St. Helen's Common, The Duver, IOW*	SZ640890	19.1	Sandy/shingle spit	Common land/ NT/SSSI	Heavy recreational pressure
Browndown	SZ580990	64.3	Multiple ridge system	SSSI	Military use
Chesil Beach	SY500880-SY683735	250.1	Bar/tombolo	SSSI/LNR/NT	Local gravel extraction, local recreation

Source: after Sneddon & Randall (1994). Key: SSSI = Site of Special Scientific Interest; NT = National Trust; LNR = Local Nature Reserve; *also included in section 3.2.

More widespread on undisturbed pure shingle is a pioneer community of campion with sea kale *Crambe maritima* and yellow horned-poppy *Glaucium flavum*. Another important southern community on pure shingle is dominated by the nationally rare sea pea *Lathyrus japonicus*, sometimes with curled dock, yellow horned poppy, Portland spurge *Euphorbia portlandica*, creeping thistle *Cirsium arvense*, prickly sow-thistle *Sonchus asper* or campion. Silty matrix areas are usually dominated by sea beet *Beta vulgaris* subsp. *maritima*, often with the prostrate form of bittersweet *Solanum dulcamara* or thrift *Armeria maritima*. Where there is transition to saltmarsh, the southern golden-samphire *Inula crithmoides* and, at Chesil, shrubby sea-blite *Suaeda vera* are important.

The most stable areas of Chesil have a mature red fescue *Festuca rubra* grassland with Danish scurvygrass and lichen. Elsewhere the presence of a finer matrix results in a more species-rich grassland, with mosses, bird's-foot-trefoil *Lotus corniculatus*, ribwort plantain *Plantago lanceolata* and stonecrops *Sedum acre/S. anglicum*. At Browndown these communities are replaced further inland by acid grass heath vegetation with ling *Calluna vulgaris*, gorse *Ulex europaeus*, bramble *Rubus fruticosus* or blackthorn *Prunus spinosa* scrub. The most nutrient-poor areas of stable shingle support a bryophyte and lichen flora containing *Dicranum scoparium*, *Ceratodon purpureus*, *Racomitrium canescens* complex and *Cladonia* spp. including *C. cervicornis verticillata*, *C. coccifera*, *C. foliacea*, *C. furicata*, and *C. rangiformis*. On Hurst Castle spit the scrub also contains hawthorn *Crataegus monogyna* and pedunculate oak *Quercus robur*.

Table 3.3.3 Fringing shingle beaches

Site name	*Location*	*Length of structure (km)*	*Site type*
South Hayling	SZ7598	3.5	Sandy shingle
Eastney	SZ6898	0.5	Sandy shingle
Calshot spit	SU4902	1.5	Silty shingle
Needs Ore Point	SZ4392	2.5	Silty shingle
Newtown	SZ4292	2.0	Silty shingle
Lymington	SZ3495	2.0	Silty shingle
Hurst Castle spit	SZ3290	2.5	Silty shingle/ part bare
Weymouth	SY6879	18.0	No matrix, sparse vegetation
Bridport	SY4790	2.0	No matrix, sparse vegetation

Source: Randall (unpublished survey, early 1980s)

The most important plant species of shingle in the region is the large population of sea pea at Chesil. This species has declined markedly or become extinct at its other south coast sites (Randall 1977). Sea kale is also declining in Britain (Scott & Randall 1976). Little-robin *Geranium purpureum* is limited to south and west coast sites and has some of its best development on open shingle at Browndown and Hurst Castle. The sites for shrubby sea-blite on the Fleet shore at Chesil are the most westerly populations of this species in Britain, as is the population of sea heath *Frankenia laevis* at Newtown (other than a disjunct site on shingle in Anglesey). The sandy shingle at Hayling Island has extensive spreads of the declining Ray's knotgrass *Polygonum oxyspermum*.

Important faunal associations are the colonies of tern *Sterna* spp., ringed plover *Charadrius hiaticula* and black-headed gulls *Larus ridibundus* that breed on the shingle of Chichester Harbour, the tern colonies of Hurst Castle and Chesil and the swannery of the Fleet. Browndown, Hurst Castle and Chesil are all known to support national rarities among their invertebrate populations (Morris & Parsons 1991) (see also section 5.3). The other sites have not been fully surveyed for invertebrates.

3.3.3 Human activities

Although rabbits graze extensively on Browndown and Chesil, there is no stock grazing on shingle in this 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. Many of this region's shingle sites have some conservation status but are subject to high levels of recreational pressure, including trampling and vehicular access. The site at Browndown continues to be used for military training, though shooting on site ceased in 1977. Past clearance of vegetation, excavation and structural change and vehicular access have all affected the area. However, restricted access has limited recreational pressures in the past, and even since 1977 their effects have been only local. Management is currently carried out by the MoD Browndown Conservation Group in conjunction with English Nature. Erosion control at Browndown, Hurst Castle and Chesil has affected the vegetation, as has gravel extraction and fishing access at the western end of Chesil. Wardening and fencing of the Fleet shore during the bird breeding season has helped stabilize the vegetation, as has the positioning of a boardwalk at Abbotsbury.

3.3.4 Information sources used

Not all shingle sites are vegetated, especially not those on exposed high-energy coasts or where disturbance is great. Unvegetated sites have not been surveyed. The major vegetated shingle structures of the region were surveyed during the NCC's 1989 national shingle structure survey, which used the National Vegetation Classification (NVC) framework (Sneddon & Randall 1993, 1994; Ferry *et al.* 1990).

Not all shingle sites fall into the category of shingle structures. 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).

Browndown has been studied over many years by the local Conservation Group of the Ministry of Defence (MoD), and Chesil Beach has been examined by the Fleet Study Group (Ladle 1981).

3.3.5 Acknowledgements

J.R. Aitchison kindly provided information on Browndown.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Chesil Beach	*Assistant Conservation Officer, EN Dorset Local Team, Wareham, tel: 01929 556688
Browndown, Newtown, Hurst Castle spit, Beaulieu Estuary	*Assistant Conservation Officer, EN Hants & IOW Local Team, Lyndhurst, tel: 01703 283944
Rare species, Hants. Coast	*Conservation Officer, Hampshire & Isle of Wight Wildlife Trust, Eastleigh, tel: 01794 613836/613737
Browndown	Conservation Officer, MoD, Browndown Training Camp, Gosport, Portsmouth, PO13 9UG, tel: 01705 580233
Rare species, Dorset coast	*Conservation Officer, Dorset Wildlife Trust, Dorchester, tel:. 01305 264620

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

In Hampshire there are a number of lagoon-like relict sea-salt production pools, which, like natural lagoons (a nationally rare habitat and a 'priority habitat type' under the EC Habitats Directive), can harbour some very specialised species. Eight Acre Pond, Lymington, is one of the very few locations in Britain for the nationally rare lagoon sandworm. Half of Great Britain's lagoonal habitat is found in this region. Photo: Peter Wakely, English Nature.

3.4 Coastal lagoons

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

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 g/kg). Freshwater systems are not considered.

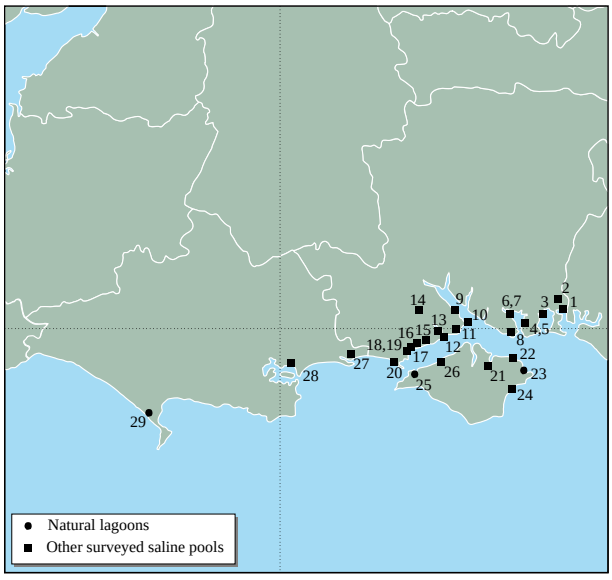
This chapter summarizes the coastal lagoons of the region. The three natural lagoon systems, Bembridge Lagoons and Yar Bridge, Isle of Wight, and The Fleet inside Chesil Bank, Dorset, total over 490 ha, amounting to almost 70% of Britain's total natural lagoonal resource and 88% of the lagoonal resource that was regarded by Barnes (1989) as being 'especially noteworthy in the national context'.

The region contains a large number of relict 'salterns' (historic sea-salt production pools), small moats associated with fortifications and pools retained behind sea-walls; while many of these are now either freshwater, reduced in size to insignificance or fully marine/estuarine owing to progressive destruction of their sea-walls, a significant resource of coastal saline ponds remains, comprising some 56 ha in Hampshire alone.

Lagoons are a nationally rare habitat and a 'priority habitat type' under Annex 1 of the EC Habitats Directive. The total lagoonal habitat resource of the region (natural and artificial) comprises nearly 50% of that of the whole of Great Britain. The region's lagoons harbour the majority of rare species associated with this habitat, some of them unique to the region, and include a type locality. The region is therefore clearly the most important for lagoons in Britain and of great international importance, most notably through the presence of Britain's largest, richest and overwhelmingly most significant lagoon: The Fleet, Dorset. The scale of the contribution of the lagoonal areas of the region to Britain as a whole is shown in Table 3.4.1 and of true lagoons in Table 3.4.2.

3.4.2 Important locations and species

Map 3.4.1 shows the location of the lagoons and other notable saline pools discussed; Table 3.4.3 lists the area of the surveyed lagoons and that of the habitat as a whole.



Map 3.4.1 Coastal lagoons and notable areas of lagoonal habitat. Numbered sites are listed in Table 3.4.3.

True lagoons support only three types of aquatic vegetation, namely stands of green algae (*Chaetomorpha*, *Ulva* and *Enteromorpha*), of sea-grasses and similar plants (predominantly *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 sea club-rush *Scirpus maritimus* are usual. All these communities occur in the region.

The foxtail stonewort *Lamprothamnium papulosum*, which occurs in The Fleet and locally elsewhere, is protected under the Wildlife and Countryside Act 1981. The region includes the only lagoonal sites for this species in Great Britain.

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 & Countryside Act 1981. All but two of these especially notable British lagoonal species occur in the region (see also section 5.4). The type locality of the starlet sea anemone *Nematostella vectensis* is Bembridge Harbour Lagoon, and twelve of the 18 GB lagoonal sites for

Table 3.4.1 Lagoonal areas for the region in context

Region	*Lagoonal area (ha)**	*Overall % of GB total*	*% of GB total excl. The Fleet*
Hampshire	56	4	7
Isle of Wight	30	2	4
Dorset	500	40	3
Region 9	***586***	***46***	***14***
North Sea Coast	1,163	92	87
Great Britain	1,261	-	-

Sources: Seaward (1985), Sheader & Sheader (1985, 1987a, 1987b, 1989a). Key: *areas rounded to the nearest whole hectare.

Table 3.4.2 Nationally noteworthy* lagoonal areas for region and country

	*Lagoonal area (ha)***	*Overall % of GB total*	*% of GB total excl. The Fleet*
Hampshire	10.5	2	16
Isle of Wight	0	0	0
Dorset	480.0	88	0
Region 9	***490.5***	***90***	***16***
North Sea Coast	521.0	96	63
Great Britain	545.0	-	-

Key: **sensu* Barnes (1989); **areas rounded to the nearest 0.5 ha.

Table 3.4.3 Lagoons surveyed

Site no. (on Map 3.4.1)	*Name*	*Grid ref.*	*Area (ha)*	*Type*
	Hampshire			
1	Slipper Pond, Emsworth	SU754056	1.0	Sluiced pond
2	Peter Pond, Emsworth	SU753057	1.0	Sluiced pond
3	Shut Lake, Langstone Harbour	SU681039	2.3*	Sea inlet
4	Seaward Tower Moat, Gosport	SZ622995	1.0	Sluiced moat
5	Cockle Pond, Gosport	SZ617998	2.0	Sluiced pond
6	Workhouse Lake, Gosport	SZ609993	1.0	Sea inlet
7	Little Anglesey Lake, Gosport	SZ605988	2.3*	Sluiced sea inlet
8	Fort Gilkicker Moat, Gosport	SZ608978	4.3*	Sluiced ponds
9	Ashlett Pond, Fawley	SU465045	4.3*	Sluiced millpond
10	Calshot Pond, Fawley	SU486018	<1.0	Sluiced pond
11	Stansore Point, Fawley	SZ464987	<1.0	Sluiced pond
12	Warren Park Shore, Beaulieu	SZ416973	2.4*	Sluiced ponds
13	Gins & Blackwater, Beaulieu	SZ411966	7.0	Percolation pools
14	Monk's Pond, Beaulieu	SU385024	5.0	Sluiced millpond
15	Sowley Lagoon, Beaulieu	SZ379960	7.5	Sea inlet
16	Normandy Farm Lagoon	SZ332947	5.0	Sluiced ponds
17	Eight-Acre Pond, Lymington	SZ327938	3.0	Sluiced pond
18	Pennington-Oxey Sea Front	SZ326926	2.3*	Sluiced ponds
19	Keyhaven-Pennington Front	SZ324923	1.0	Sluiced ponds
20	Sturt Pond, Milford-on-Sea	SZ296912	3.0	Sea inlet
	Isle of Wight			
21	Old Mill Pond, Wootton	SZ547919	15.0	Sluiced millpond
22	Seaview Lagoon	SZ625917	2.0	Sluiced pond
23	Bembridge Lagoons	SZ636882	10.0	Percolation pools (natural lagoons)
24	Sandown Boating Lake	SZ606848	1.5	Sluiced pond
25	Yar Bridge, Yarmouth	SZ349897	0.5	Percolation pool (natural lagoon)
26	Newtown Quay Lagoon	SZ418911	1.0	Sea inlet
	Dorset			
27	Hengistbury Head, Christchurch	SZ178907	2.0	Sea inlet pools
28	Blue Lagoon, Poole	SZ035900	18.0	Typical lagoon
29	The Fleet, Weymouth	SY635795	480.0	Typical natural lagoon

Source: Barnes (1988, 1989). Note: areas correct to the nearest 0.5 ha, except where marked*.

this species occur in the region, as do twelve of the fifteen sites for the lagoon sand shrimp *Gammarus insensibilis* (Sheader & Sheader 1987c), one of the twelve sites for the lagoonal worm *Alkmaria romijni* (Thomas & Herbert 1990) and all three sites for the lagoon sandworm *Armandia cirrhosa*. Also significant is the diversity of lagoonal species within some of the region's lagoons. Over 200 species are recorded for The Fleet, thirteen of these being lagoonal specialists. A number of the smaller lagoons have six or more lagoonal specialist species in their communities, and Eight Acre Pond, Hampshire, has ten lagoonal specialist species, four of them protected.

The region's lagoons, as elsewhere, also support numerous wading birds and wildfowl. The Fleet supports a swannery (see also sections 5.11 and 5.12).

3.4.3 Human activities

Little active management is applied to the coastal lagoons themselves, although the surrounding land is often intensively managed for nature conservation or recreation, especially where the site has been designated. The Fleet has been put forward as a possible Special Area of Conservation under the EC Habitats Directive, and is an SSSI (Site of Special Scientific Interest), a Ramsar Site (internationally important wetland) and a Special Protection Area (SPA) (for birds) and is within an Area of Outstanding Natural Beauty (AONB) (see also Chapter 7). The whole area is managed by the Ilchester Estates. Oysters are farmed commercially in The Fleet on a small scale, and the upper Fleet incorporates the Abbotsbury Swannery, formerly a source of food for the monks of Abbotsbury and now a commercial tourist attraction. Slipper Pond, Hampshire, is owned and protected to a degree by the Slipper Mill Pond Preservation Association. Shut Lake, Hampshire, is within the Farlington Marshes Local Nature Reserve (LNR), an SSSI and a Ramsar/SPA site. Water levels are controlled on the Lymington/Keyhaven Marshes.

Some of the larger coastal ponds are used for recreation. There is a sailing club based on Eight Acre Pond and a marina in Blue Lagoon, Dorset; Cockle Pond, Gosport, is a concrete model-boating pond in which algicides have in the past been used to keep down the algae *Chaetomorpha* spp.

There is some active creation of new lagoons, for example at Normandy Farm, Hampshire (McDonagh & Sheader 1991). The biodiversity of some sites appears to be suffering because of the redevelopment of sea-walls or the disrepair of old sluice gates, and because of water level management for wading birds. At Bembridge/Brading Lagoon, reed-bed management has been implemented following an influx of animal slurry, which resulted in increased reed growth.

3.4.4 Information sources used

All likely lagoons in the region were surveyed as part of the NCC's national lagoon survey in 1980-1988 (Seaward 1985; Sheader & Sheader 1985, 1987a, 1987b, 1989a). Much intensive surveying of the region's lagoons has been undertaken through specific projects by the University of Southampton Department of Oceanography, Portsmouth Polytechnic, the Isle of Wight Natural History & Archaeological Society and Fawley Aquatic Research Laboratories.

The intensive interest in the region's lagoonal resource has resulted in a wealth of significant data on both the biota and the habitat characteristics, with much repeated surveying giving seasonal and longer-term information rarely available from lagoonal habitats elsewhere in Great Britain. Information on The Fleet is summarised in Ladle (1981). The Fleet has been the subject of diverse and intensive study over the last 20 years by the Fleet Study Group, whose work continues and includes the organization of local symposia: the report on the latest such is in press. Detailed reports are available, including maps of the habitats and species lists. The data are summarised by Barnes (1989), Sheader & Sheader (1989b) and Smith & Laffoley (1992), from which the data in this section were derived.

3.4.5 Acknowledgements

We are grateful for information supplied by D. Seaward, R. Herbert and Dr M. Sheader and for comments from Dr P. Dyrynda.

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B. Further reading

Further details of coastal habitat sites are available on the *Coastal & marine UKDMAP datasets* module disseminated by the JNCC. Further details of lagoons and quasi-lagoonal features are available on the *UKDMAP datasets* module disseminated by the British Oceanographic Data Centre (BODC 1991).

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Various. 1980. [Articles on the Fleet.] *Proceedings of the Dorset Natural History and Antiquarian Society, 100.*

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Brackish lagoons	Dr R.S.K. Barnes, St. Catherine's College, University of Cambridge, Cambridge CB2 1RL, tel: 01223 333296
Brackish lagoons of the region	Dr M. Sheader, Department of Oceanography, University of Southampton, Southampton SO9 5NH, tel: 01703 595000
Lagoons in England	*Maritime Team, English Nature HQ, Peterborough, tel: 01733 340345
Lagoons on the Isle of Wight	R. Herbert, Medina Valley Centre, Dodnor Lane, Newport, Isle of Wight PO30 5TE, tel: 01983 522195
Fleet Nature Reserve	D. Moxom, Chesil Beach Centre, Portland Beach Road, Portland, Dorset DT4 9XE, tel: 01305 760579
Fleet Study Group	Mrs J. Fitzpatrick, 24 Oakbury Drive, Preston, Weymouth, Dorset DT3 6JD, tel: 01305 832721

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

3.5 Wet grassland

Dr H.T. Gee

3.5.1 Introduction

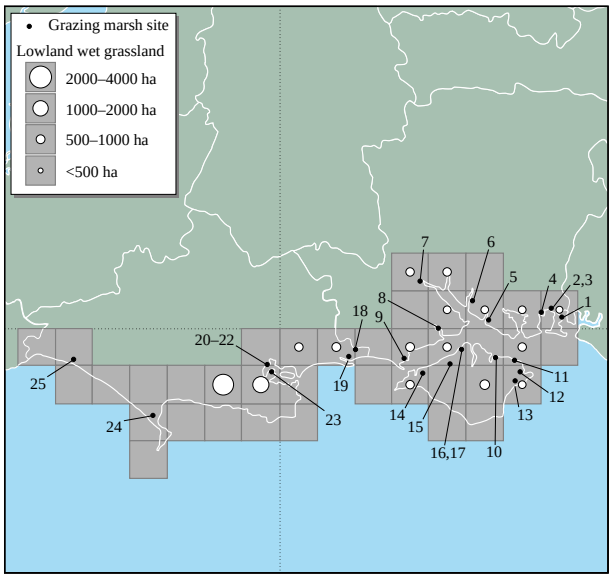
This section covers both coastal grazing marsh subject to maritime influence and lowland wet grassland adjacent to tidal reaches of estuaries, both here referred to as wet grassland. No national survey exists of wet grassland as here defined, or indeed of coastal grazing marsh or lowland wet grassland 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. 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 transitional areas of wet grassland between upper saltmarsh and dry land. Wet grassland sites may remain wet throughout the year and may be managed for stock grazing and/or as hay meadow. Wet grassland receiving brackish influence is particularly widespread in Region 9 and include sites in south Hampshire, Isle of Wight and around Poole Harbour and Lodmoor, Dorset. The historical use of some of these sites as saltings has probably contributed to the prevalence of brackish influence.

The national importance of the wet grassland of this region, particularly in Hampshire, is recognised by its inclusion in twenty Sites of Special Scientific Interest (SSSIs) (Table 3.5.1). The region's wet grassland is also of international importance for birds, with some key sites such as Chichester and Langstone Harbours designated as Special Protection Areas (SPA)/Ramsar sites. They provide grazing land for the internationally important wintering populations of dark-bellied brent geese *Branta bernicla bernicla* and many other wildfowl and wader species, together with important breeding populations of several nationally rare bird species. They also support many locally and some nationally scarce plants and invertebrates (see also sections 5.5.2, 5.3, 5.10, 5.11 and 5.12). Wet grassland forms an important part of the North Solent and Lymington and Keyhaven National Nature Reserves (NNRs), the Farlington Marshes and Hook and Warash Local Nature Reserves (LNRs) and the RSPB reserve at Lodmoor. The reedswamp at Titchfield Haven SSSI is also designated as an LNR.

3.5.2 Important locations and species

Map 3.5.1 shows the locations of sites listed in Table 3.5.1 as coastal grazing marsh and the area of lowland wet grassland in coastal 10 km squares in the region. Coastal grazing marsh is chiefly located around Southampton Water and the Solent coast of Hampshire. Further west, East Home Meadows, Wareham Meadows and the Moors SSSI are wet grassland sites associated with the estuaries of the rivers Frome and Piddle, which drain into Poole Harbour, Dorset. Other areas of wet grassland include, on the Isle of Wight, Brading Marshes (associated with the eastern Yar) and transitional grasslands around the Newtown Estuary, and small patches on the Dorset coast, around Christchurch Harbour, Weymouth and Bridport.



Map 3.5.1 Locations of (numbered) sites listed in Table 3.5.1 as coastal wet grassland and the areas of lowland wet grassland in coastal 10 km squares in the region. Sources: various, and after Dargie *et al.* (1994).

A number of the grazing marshes in this region support floristically rich grasslands. Farlington and Warblington Meadows are particularly noteworthy for their diverse flora, reflecting varied calcareous influences across the site. Warblington Marsh shows a transition from base-rich fresh marsh to land-claimed saltmarsh, and supports the uncommon corky-fruited water-dropwort *Oenanthe pimpinelloides*. The flora of East Holme Meadows is also rich, and the distribution of plant species across the site follows the changing underlying soils, from dry acid sward on the edge of the flood plain, dominated by red fescue *Festuca rubra*, Yorkshire fog *Holcus lanatus* and sweet vernal grass *Anthoxanthum odoratum*, to damper grassland dominated by creeping bent *Agrostis stolonifera* and tufted hair-grass *Deschampsia cespitosa*. Seasonally wet areas support typical fen or marsh species, including tubular water-dropwort *Oenanthe fistulosa*, common spike-rush *Eleocharis palustris* and marsh cinquefoil *Potentilla palustris*. The ditches in East Holme Meadows and other sites, such as Christchurch Harbour and Purewell Meadows, also support locally important relict populations of marsh plants. At Purewell Meadows and East Holme Meadows a number of ditch species occur that are of restricted distribution in Dorset, including bog bean *Menyanthes trifoliata*, red pondweed *Potamogeton alpinus*, lesser water-plantain *Baldellia ranunculoides* and flowering rush *Butomus umbellatus*.

Some sites support relatively impoverished grassland communities, reflecting extensive brackish influence, rather

Table 3.5.1 Wet grassland sites in Region 9

No.	*Site*	*Grid ref.*	*Conservation status of the wet grassland*
	Hampshire		
1	Hayling Island	SU735035 SU733033	Several sites on the east side of the island in Chichester Harbour SSSI
2	Warblington Meadow	SU730052	SSSI, Ramsar, SPA (4.26 ha), AONB. Adjacent to Chichester Harbour SSSI.
3	Southmoor	SU713048	Remnant grazing marsh within Langstone Harbour SSSI
4	Farlington Marshes	SU685040	LNR, part of Langstone Harbour SSSI, SPA, Ramsar
5	Titchfield Haven	SU539035	SSSI
6	Warash Marsh	SU492068	Part of Lee-on-Solent to Itchen Estuary SSSI
7	Lower Test Valley	SU360153	SSSI
8	Beaulieu River	SZ415975	Part of North Solent SSSI and NNR
9	Lymington Marsh Pennington Marsh Keyhaven Marsh	SZ333942 SZ325929 SZ314917	Part of Hurst Castle and Lymington River Estuary SSSI
	Isle of Wight		
10	Quarr Abbey	SZ567928	Undesignated
11	Seaview	SZ622915	Undesignated
12	Brading Marshes	SZ625880	SSSI
13	Sandown Levels	SZ605850	Undesignated
14	Afton Marshes	SZ344866	SSSI
15	Newton Estuary	SZ415908	SSSI
16	Thorness Bay	SZ458936	SSSI
17	Gurnard	SZ474953	Undesignated
	Dorset		
18	Purewell Meadows	SZ168934	SSSI (12.6 ha); freshwater marsh
19	Christchurch Harbour	SZ175915	SSSI (adjacent to River Stour)
20	Keysworth and Lytchett Bat	SZ000890	Part of Poole Harbour SSSI
21	Wareham Meadows	SY932886 - SY932872	Two-part SSSI (204.3 ha)
22	East Holme Meadows	SY911861 to SY890865	SSSI
23	The Moors	SY950870	SSSI (156.8 ha)
24	Lodmoor	SY688813	SSSI and RSPB Reserve (71.5 ha)
25	River Brit	SY465910	Small area within West Dorset Coast SSSI

Source: Dargie *et al.* (1994). Key: SSSI = Site of Special Scientific Interest; LNR = Local Nature Reserve; numbers refer to Map 3.5.1.

than agricultural improvement. Such sites, characterised by the common bent *Agrostis capillaris*, creeping bent *A. stolonifera*, Yorkshire-fog *Holcus lanatus* grasslands and similar communities, occur for example at Lymington and Keyhaven, Christchurch Harbour, Keysworth and Lodmoor. On many of these sites the ditches are dominated by sea club-rush *Scirpus maritimus* and grey club-rush *Schoenoplectus tabernaemontani*. The only British site for viper's-grass *Scorzonera humilis* is on wet grassland in the vicinity of Poole Harbour. The Moors SSSI (Dorset) is an atypical site within the context of this region, being land claimed in part from coastal mire and wet heath. In areas of the site, the ditch communities retain considerable conservation value, as they support species, including bog pondweed *Potamogeton polygonifolius* and floating club-rush *Eleogiton fluitans,* that are typical of acid waters but atypical for wet grasslands.

Wet grassland is recognised as an important habitat for breeding waders (see also section 5.11), especially in lowland Britain (Davidson 1991). At both the Beaulieu River and Lymington and Keyhaven Marshes, important numbers of redshank *Tringa totanus*, lapwing *Vanellus vanellus*, oystercatcher *Haematopus ostralegus* and ringed plover *Charadrius hiaticula* occur. The North Solent NNR supports an impressive breeding assemblage of ducks, including important numbers of shelduck *Tadorna tadorna*, plus tufted duck *Aythya fuligula* and shoveler *Anas clypeata* and less common species such as garganey *Anas querquedula* and gadwall *A. strepera*. A borrow pit on Lymington and Keyhaven Marsh has been developed into a lagoon with islands, which support a colony of breeding little tern *Sterna albifrons*. Lodmoor SSSI has considerable ornithological importance and is an RSPB reserve. As with the other sites it is locally important for its breeding lapwing and snipe *Gallinago gallinago* populations. The reedbeds also support bearded tit *Panurus biamicus* and Cetti's warbler *Cettia cetti*, plus possibly Savi's warbler *Locustella luscinioides* and marsh warbler *Acrocephalus palustris*. The site is also of importance for migrating waders, and it regularly supports a range of less common species such as jack snipe *Lymnocryptes minimus*, spotted redshank *Tringa erythropus* and whimbrel *Numenius phaeopus*. On the Isle of Wight, Brading Marshes support good breeding assemblages of waders and wildfowl, plus Cetti's warbler, barn owl *Tyto alba* and one of the largest heronries on the island.

The wet grassland of the Hampshire coast westwards from Chichester Harbour forms an intrinsic part of the matrix of habitats used by the internationally important wintering waterfowl populations of this region. Of special note are dark-bellied brent geese *Branta bernicla bernicla*, for which this region is particularly important: Langstone Harbour, which includes Farlington Marshes, supports 5-10% of their world population. Wet grassland may be important for high tide and hard weather waterfowl roosts: for example the site at Keysworth is used by the bird populations of Poole Harbour.

Reedbeds on the Lymington River support one of only two colonies of the much depleted Hampshire population of otters *Lutra lutra*. The reedbeds of Titchfield Haven, the Lymington River and Keyhaven River support important breeding populations of Cetti's warbler and bearded tit, plus large populations of other warblers.

The grasshopper population of the wet grassland in this region typically includes nationally scarce species, such as the short and long-winged coneheads *Conocephalus dorsalis* and *C. discolor* at Keyhaven Marsh and Purewell Meadows, whilst *C. dorsalis* and *Chorthippus albomarginatus* have been recorded from Lodmoor SSSI. The wet grasslands also support a good range of odonate (dragonfly/damselfly) species, including the nationally notable *Libellula fulva* on East Holme Meadows SSSI (see also section 5.3).

At Lymington and Keyhaven Marshes, North Solent NNR, Farlington Marshes and Brading Marshes there are brackish borrow dykes and/or lagoons associated with the grazing marshes. These lagoons and lagoon-like features are a nationally rare habitat, often supporting a specialist biota including Red Data Book plants and invertebrates protected under Schedule 5 of the Wildlife & Countryside Act 1981 (see sections 3.4 and 5.4).

3.5.3 Human activities

In addition to the nationwide threats to grazing marsh of agricultural improvement, conversion to arable use, and loss beneath landfill, urban and industrial development, grazing marsh in southern Hampshire faces a major threat from rising sea levels and the effects of dredging. Along much of the coast of Chichester and Langstone Harbours, and around the Solent, the sea walls are in poor repair (see also section 8.4). Many sites are experiencing increased brackish influence and at some sites on Hayling Island the coastal wall has been breached giving rise to unmanaged coastal retreat. In view of this, the future of grazing marsh in south Hampshire is not guaranteed, despite extensive designation of sites.

The tidal regimes of the estuaries of the Meon, Lymington and Keyhaven Rivers are substantially modified, with tidal flow excluded from the River Meon and Lymington River by one-way valves. As a result, low-lying land alongside these rivers has filled with common reed *Phragmites australis*, and at Titchfield Haven on the River Meon the reedbeds grade into unimproved freshwater marsh, habitats whose wildlife communities differ from those in the previously existing brackish-influenced wet grassland.

There are management agreements on most of the important grazing marsh sites in all three counties. Most aim to manage the land in a positive way through regulated grazing, ditch management and, as at Farlington, hay cropping. At sites such as Brading Marshes the management plans control the use of herbicides and fertilisers and make provision for scrub clearance to maintain the rush pastures. On the North Solent NNR water level management is undertaken to maximise the site's attractiveness to breeding birds. The pastures are kept wet in spring, and the reed-filled ditches are periodically cut and dead vegetation removed. Similar water-level management is undertaken at Farlington Marshes, controlled by sluices and bunds. Farlington Marshes is also an important public amenity, receiving in excess of 50,000 visitors annually.

3.5.4 Information sources used

There has been no national survey specifically of grazing marsh in Britain. In England, however, the extent of lowland wet grasslands, including coastal grazing marsh, was surveyed by Dargie (1993). Information available varies widely between the counties of England. Within this region Dargie (1993) found information to be particularly incomplete for both Hampshire and the Isle of Wight. A fuller breakdown of information and listings of sites by county is given in Dargie *et al.* (1994). These county reports are held by English Nature.

Management plans exist for many of these sites and so botanical survey data are usually available (e.g. Cox 1994). There are National Vegetation Classification (NVC) survey maps, available from English Nature Hampshire and Isle of Wight Local Team, for Brading Marshes, North Solent NNR, Farlington Marshes, Lymington and Keyhaven NNR and Keysworth Marsh. In addition, there are plant species lists for many of the sites, including Warblington Meadow. In contrast to the grasslands, the aquatic flora and fauna of the ditches have been poorly surveyed. Breeding and wintering bird populations are counted throughout the region, with particularly comprehensive data for prestige sites such as the North Solent NNR (e.g. Hughes 1994). There are also records of Odonata (dragonflies and damselflies) for the North Solent NNR.

3.5.5 Acknowledgements

Thanks are due to the staff of English Nature, including Bob Lord, Site Manager of North Solent NNR, and John Maskrey, Hampshire County Council, for providing information on wet grassland in their areas.

3.5.6 Further sources of information

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Rodwell J.S., *ed.* 1995. *British plant communities. Volume 4: aquatic communities, swamps & tall-herb fens.* Cambridge, Cambridge University Press.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Wet grassland in Hampshire and Isle of Wight	*English Nature, Hampshire & Isle of Wight Local Team, Lyndhurst, tel: 01703 283944
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Wet grassland in Dorset	*English Nature, Dorset Local Team, Arne, tel: 01929 556688
Wildlife Trust sites in Hampshire & Isle of Wight	*Hampshire & Isle of Wight Wildlife Trust, Eastleigh, tel: 01703 613636
Wildlife Trust sites in Dorset	*Dorset Wildlife Trust, Forston, tel: 01305 264620
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* Starred contact addresses are given in full in the Appendix.

3.6 Saltmarsh

Dr M.I. Hill

3.6.1 Introduction

Saltmarshes in the region are generally of recent origin (less than 120 years) and are found mainly in the harbours or embayments and small estuaries. The total amount of saltmarsh in the region is 2,737 ha, 12.6% of the saltmarsh area on the North Sea coast of Britain, 8.7% of that in England and 6.2% of the British resource (Table 3.6.1). The majority of the region's saltmarsh (71.8%) is in Hampshire. 22% of the coastline length (at Mean High Water) of both Dorset and Hampshire supports saltmarsh, compared with 10% of the Isle of Wight coastline. Saltmarsh sediments mostly range from sandy to clayey silts. The marshes have been badly affected by erosion, especially since the 1950s (Pye & French 1993).

The saltmarshes are dominated by common cord-grass *Spartina anglica*, which occupies 65% of the total area, a much greater proportion than in Britain as a whole (where the average is 16%). This means that there is a low percentage of mid and upper marsh vegetation types compared with other regions. Natural transitions from saltmarsh to other habitats are often of particular interest, with a high diversity of plants and invertebrates, but in this region their extent appears to have been underestimated by the national survey (Table 3.6.1).

Some saltmarshes in this region are grazed, but in general grazing is less prevalent here than in most of the rest of Britain.

Map 3.6.1 Saltmarsh sites. Source: JNCC Saltmarsh 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 and shown on Map 3.6.1. The largest areas of saltmarsh are in Chichester and Poole Harbours, the west side of Southampton Water (Hythe - Calshot), the Beaulieu River and the Solent from Lymington River to Keyhaven. Saltmarsh is also found behind the shingle barrier of Chesil Bank, along the Fleet. Key saltmarsh sites in the region include Southampton Water, where the hybrid common cord-grass *Spartina anglica* evolved (see below), and the Medina Estuary, which has one of the best examples of mature mixed saltmarsh in southern Britain.

Most of the saltmarsh in the region is within Sites of Special Scientific Interest (SSSIs) (Table 3.6.3). Saltmarsh in the Fleet, Chichester, Langstone and Portsmouth Harbours is within designated Special Protection Areas and Ramsar sites.

Saltmarsh vegetation is present in several sites that are no longer tidal, but where saline influence persists, such as Titchfield Haven (the former estuary of the River Meon), Radipole Lake (former estuary of the River Wey), Brading Marshes (former estuary of the River Yar near Bembridge), Warblington Meadow and Lodmoor. Some land has been returned to saltmarsh by the breaching of seawalls, as at Newtown, in the lower Beaulieu River and on Hayling Island, for example.

A typical zonation in the region is from a pioneer and low marsh zone of common cord-grass, to sea purslane *Halimione portulacoides* or common saltmarsh-grass *Puccinellia maritima*. The main upper marsh vegetation type is sea rush *Juncus maritimus* or red fescue *Festuca rubra* saltmarsh. Upper marsh swamps can be extensive, with large stands of sea club-rush *Scirpus maritimus* and common reed *Phragmites australis* at sites such as Poole Harbour,

Table 3.6.1 Areas (ha)* of saltmarsh communities in region in context

	Spartina	*Pioneer*	*Low-mid*	*Mid-upper*	*Drift-line*	*Upper swamp*	*Trans-ition*	*Wet depres-sion*	*Total*	*% of region total in county*	*% of area total in region*
Hampshire	1,177	69	259	67	26	19	7	0	1,694	62	-
Isle of Wight	31	9	68	66	20	20	0	0	214	8	-
Dorset	559	11	6	74	19	128	1	0	830	30	-
Region 9	***1,767***	***90***	***333***	***207***	***64***	***167***	***9***	***0***	***2,737***	**-**	**-**
North Sea coast	3,461	2,130	8,194	4,772	1,350	1,066	342	2	21,788	-	13
England	5,166	2,641	10,299	9,948	1,493	686	833	0	31,533	-	9
GB	6,948	3,470	12,353	16,042	1,824	1,475	1,670	2	44,370	-	6

Source: National Saltmarsh Survey (Burd 1989a-c). Key: *areas have been rounded to the nearest whole hectare.

Table 3.6.2 Saltmarsh sites surveyed

Name	*Grid ref.*	*Area (ha)***
Hampshire		
Chichester Harbour*	SU760000	367
Langstone Harbour	SU700030	100
Portsmouth Harbour	SU620035	181
River Hamble	SU495101	89
Eling and Bury	SU373122	41
Hythe to Calshot	SU440064 - SU479029	225
River Beaulieu	SZ416998	185
Keyhaven to Lymington	SZ335938	506
Isle of Wight		
King's Quay	SZ537938	14
River Medina	SZ508923	13
Newtown Harbour	SZ420910	120
Yar Estuary	SZ352885	66
Dorset		
Christchurch Harbour	SZ175910	50
Poole Harbour	SZ000880	697
Lodmoor	SY687813	32
Chesil and the Fleet	SY620800	51

Source: National Saltmarsh Survey (Burd 1989a-c). Note: for large sites the grid reference given is a reasonably central point. Key: *excludes the West Sussex part of the harbour; **areas have been rounded to the nearest whole hectare.

Christchurch Harbour and Lincegrove and Hackett's Marshes on the Hamble.

Several good examples of transitional habitats are found, such as transitions to heathland along the western side of Poole Harbour at Arne, Studland and Godlingston Heaths; transitions to grassland, scrub and oak woodland in the Solent east of the Lymington River; transitions to shingle at Hurst Castle Spit; and transitions to wet grassland in the Newtown and Medina Estuaries.

Common cord-grass, a hybrid between native small cord-grass *Spartina maritima* and the north-American smooth cord-grass *Spartina alterniflora,* originated in Southampton Water (Gray *et al.* 1990). It then spread along the south coast and reached its maximum extent between the 1930s and 1950s. In the last 40 years, common cord-grass saltmarsh in the region has undergone considerable erosion and dieback. Smooth cord-grass, although an introduced species, is listed in the Red Data Book (RDB) (i.e. is considered threatened; see section 5.2.1) and is now found at only one site in Britain, at Marchwood in the Eling and Bury Marshes of Southampton Water. Small cord-grass has declined rapidly this century and is now nationally scarce; it is found in small patches in the Solent and Isle of Wight. Townsend's cord-grass *Spartina townsendii* (the sterile *S. alterniflora x maritima*) is also present at several sites, for example at Hythe and in Poole Harbour.

A number of other nationally rare and scarce saltmarsh plants occur in the region (Stewart *et al.* 1994). The nationally rare species dwarf spike-rush *Eleocharis parvula* is present on mudflats at the saltmarsh edge in the Beaulieu River and in Christchurch Harbour. The nationally scarce eelgrasses *Zostera noltii*, *Z. marina* and *Z. angustifolia* are found in intertidal and subtidal zones at many sites, particularly in Hampshire and the Isle of Wight, and totalled more than 400 ha in the Solent (Tubbs & Tubbs 1983). *Zostera* spp. beds declined dramatically in the 1930s, but have shown recovery since 1960. Other nationally scarce species found in these saltmarshes include golden samphire *Inula crithmoides* (for example at the Keyhaven, Newtown and Medina estuaries), marsh sow-thistle *Sonchus palustris* (Beaulieu River), lax-flowered sea lavender *Limonium humile* (King's Quay shore, Newtown, Medina, Beaulieu River), marsh mallow *Althaea officinalis* (the Fleet, the Solent, most estuaries on the Isle of Wight), shrubby sea-blite *Suaeda vera* (Poole/Christchurch Harbours), divided sedge *Carex divisa* (Newtown, Medina) and bulbous foxtail *Alopecurus bulbosus*. These species are found mostly on the upper levels of the marsh, near the limit of tidal influence.

Large colonies of black-headed gulls *Larus ridibundus*, common terns *Sterna hirundo*, Sandwich terns *Sterna sandvicensis* and little terns *S. albifrons* breed on the saltmarshes and associated beaches and shingle spits. Saltmarshes of the Beaulieu River, the islands in Langstone Harbour, and between Lymington and Hurst Castle, are particularly important (see section 5.10). Saltmarshes also provide breeding sites for waders such as oystercatcher *Haematopus ostralegus* and redshank *Tringa totanus* (see section 5.11).

As elsewhere, saltmarshes in this region provide roosting sites for waders and grazing for wildfowl. Saltmarsh vegetation and *Zostera* spp. beds are an important food source for dark-bellied brent geese *Branta bernicla bernicla* (see also section 5.12).

Saltmarshes can support a diverse terrestrial invertebrate fauna with many RDB and nationally notable species (see also section 5.3). The invertebrate fauna is

Table 3.6.3 SSSIs containing saltmarsh in region

Hampshire
Chichester Harbour (SPA, Ramsar)
Warblington Meadow
Langstone Harbour (SPA, Ramsar)
Portsmouth Harbour
Lee on the Solent to Itchen Estuary
Titchfield Haven
Lincegrove and Hackett's Marshes
Upper Hamble Estuary & Woods
Lower Test Valley
Eling and Bury Marshes
Hythe to Calshot Marshes
North Solent
Hurst Castle and Lymington River Estuary

Isle of Wight
Brading Marshes to St. Helen's Ledges
Ryde Sands & Wootton Creek
King's Quay Shore
Medina Estuary
Thorness Bay
Newtown Estuary
Yar Estuary

Dorset
Christchurch Harbour
Poole Harbour
Arne
Studland and Godlinston Heaths
Lodmoor
Radipole Lake
Portland Harbour shore
Chesil and the Fleet (SPA, Ramsar)

Source: JNCC Integrated Coastal Database

particularly rich in upper marsh and transition zones where pools, seepages, driftline debris and tall vegetation occur. Examples of important species include the short-winged conehead *Conocephalus discolor* and long-winged conehead *C. dorsalis* (bush crickets). These are found at the fringes of several saltmarshes in the region, especially the sea couch *Elymus pycnanthus* driftline.

3.6.3 Human activities

Grazing is probably the oldest form of saltmarsh management; in this region it takes place predominantly at Chichester Harbour and to a lesser extent at Southampton Water and North Solent. Areas of largely ungrazed saltmarsh exist at Chichester Harbour, Langstone Harbour, Portsmouth Harbour, Southampton Water and Poole Harbour. Figures for stocking densities vary in the UK, from one to six animals per hectare, with grazing usually taking place only from May to September (Doody 1988). Other operations include hay making, samphire *Salicornia* spp. gathering, wildfowling and reed cutting. Several areas are managed as nature reserves. In this region, large areas of saltmarsh have been claimed for industrial development. For example at Southampton Water over 1,000 ha of saltmarsh have been claimed for industrial and port developments.

The main issues affecting saltmarsh in the region are erosion and the die-back of common cord-grass. Their causes are complex, but appear to be a combination of sea-level rise, increased storminess and wave attack and local sediment starvation. Other factors such as dredging and navigation may contribute to the problem locally (Pye & French 1993).

Where it is not possible to justify maintaining sea walls protecting low-lying pastures, new areas of saltmarsh may be formed by managed or unmanaged retreat (see also section 3.5.3).

3.6.4 Information sources used

Saltmarshes were surveyed in 1984/5 as part of the NCC's national saltmarsh survey; detailed reports are available and results are summarised in Burd (1989a-c). 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. Saltmarsh vegetation in non-tidal, reclaimed marshes and areas of eelgrass were not recorded.

Most surveys of saltmarsh in the region have been concerned with the extent and vigour of *Spartina* spp. marshes, for example in Langstone Harbour (Haynes 1984) and Poole Harbour (Hubbard 1965; Gray & Pearson 1984). Dicks (1976) monitored the recovery of existing and re-planted *Spartina* marsh following damage from oil pollution in Southampton Water. Other surveys of saltmarsh vegetation include the distribution of *Zostera* spp. in the Solent (Tubbs & Tubbs 1983).

3.6.5 Acknowledgements

Staff of English Nature kindly provided information and reference material.

3.6.6 Further sources of information

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Doody, J.P. 1988. The management of saltmarshes. *Coastal habitat network, No. 2* (April).

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Stewart, A., Pearman, D.A., & Preston, C.D., *eds.* 1994. *Scarce plants in Britain.* Peterborough, JNCC.

Tubbs, C.R., & Tubbs, J.M. 1983. The distribution of *Zostera* and its exploitation by wildfowl in the Solent, southern England. *Aquatic Biology, 15:* 223-239.

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.

Adam, P. 1990. *Saltmarsh ecology.* Cambridge, Cambridge University Press.

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British Oceanographic Data Centre. 1992. *United Kingdom digital marine atlas. User guide. Version 2.0.* Birkenhead, Natural Environment Research Council, British Oceanographic Data Centre.

Halcrow & Partners. 1994. *A guide to the understanding and management of saltmarshes.* Bristol, National Rivers Authority. (R & D Note No. 324.)

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
Saltmarsh sites in England	*Coastal Ecologist, English Nature HQ, Peterborough, tel: 01733 340345
Saltmarsh in Hampshire and Isle of Wight	*English Nature, Hampshire & Isle of Wight Local Team, Lyndhurst, tel: 01703 283944
Saltmarsh in Dorset	*English Nature, Dorset Local Team, Arne, tel: 01929 556688
Wildlife Trust sites in Hampshire & Isle of Wight	*Hampshire & Isle of Wight Wildlife Trust, Eastleigh, tel: 01703 613636
Wildlife Trust sites in Dorset	*Dorset Wildlife Trust, Forston, tel: 01305 264620

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

Estuaries in Region 9 are small in comparison with those further north. Although very heavily used for recreation, they support large numbers of migrant and wintering waterfowl and illustrate particularly well all the stages of saltmarsh development. At the Lymington River estuary, extensive swathes of the vigorous hybrid common cord-grass *Spartina anglica*, which first arose in the late 19th century in Southampton Water, now dominate the seaward edge of the saltmarsh. Elsewhere in the region the species is dying back as fast as it first spread. 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 are composed of both aquatic (marine and freshwater) and terrestrial habitats including adjacent sand dunes, coastal grasslands and maritime heaths. Estuaries in this Directory are all those covered by the NCC Estuaries Review, with the minimum size for selection being 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 9; for further details of habitats, species and human uses refer to relevant sections in Chapters 3, 5 and 9 respectively.

There are more than 19,300 ha of estuarine intertidal and subtidal habitat in Region 9, which represents 1% of the estuarine habitat of north-west Europe (Davidson *et al.* 1991). Like other estuaries on the south coast of England, those of Region 9 are small in comparison with the major estuaries and embayments further north. They do, however, form an important suite of estuaries of considerable conservation significance, notably for their history of saltmarsh development, their marine communities, their associated wet grassland and lagoon systems, and the large numbers of migrant and wintering waterfowl these habitat mosaics support. This importance is retained even though many of these estuaries are amongst the most extensively used for recreation in the UK. The contribution of Region 9 estuaries to the wider resource is summarised in Table 4.1.1. Overall the fourteen estuaries in Region 9 (Map 4.1.1) form over 3% by area of the total UK estuarine resource and 7.5% of the British North Sea coast resource. Many have substantial intertidal flats and marshes and form a larger percentage of the country's intertidal resource: almost 8% of the British North Sea coast resource. Saltmarsh is a major feature of Region 9 estuaries, where it forms almost 6% of the total British estuarine saltmarsh area.

Map 4.1.1 Estuaries. Source: JNCC Coastal Database.

4.1.2 Important locations and species

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

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

Resource	*Regional total (ha/km)*	*North Sea coast total (ha/km)*	*% North Sea coast*	*GB total (ha/km)*	*% GB*	*UK total (ha/km)*	*% UK*
Intertidal area	10,741	136,580	7.9	321,050	3.3	332,350	3.2
Saltmarsh area	3,415	20,651	16.5	48,380	8.3	*	*
Total estuarine area	19,307	258,102	7.5	525,650	3.6	581,290	3.3
Shoreline length	593.5	5,645	10.5	9,054	6.6	9,727	6.1
Longest channel lengths	119.0	1,484	8.0	2,461	4.8	2,640	4.5

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; **totals include the part of Chichester Harbour in West Sussex (Region 8). Notes: areas rounded to the nearest 10 ha; lengths rounded to the nearest 1 km; since each estuary is treated as a single site, percentages are given for all estuaries falling wholly or partly in each geographical unit.

region are coastal plain or bar-built geomorphological types and are mostly shallow and predominantly sediment filled; 56% (almost 11,000 ha) of estuary area in the region is intertidal. Saltmarshes form a major component of the intertidal zone in many of the estuaries, and substantial parts of these saltmarshes are common cord-grass *Spartina anglica* swards. The largest areas of *Spartina* spp. marsh in Britain are in Poole Harbour and the estuaries bordering the Solent. Southampton Water is notable as the location where common cord-grass originated, as a fertile hybrid between a native and an introduced species (see section 3.6). Particular features of Region 9 estuaries are their strong marine influence (since freshwater inflows are generally small), the importance of sand and shingle spits in their formation, and their intensive recreational use. As in many parts of coastal southern Britain, most Region 9 estuaries have large human populations nearby, and substantial parts of their shorelines are urban and artificially defended. Only the Beaulieu River and the Newtown Estuary are in predominantly rural surroundings and have largely natural shoreline transitions, although important areas of natural transition do occur elsewhere, such as on Southampton Water.

Within Region 9 much of the resource is in Hampshire - 64% of the total estuary area in the region lies here, as does 67% of the intertidal area and over 70% of estuarine saltmarshes. Dorset estuaries form almost 30% of the total resource, whilst the five small estuaries of the Isle of Wight together form less than 7% of the total area in the region. The fourteen estuaries on the coast of Hampshire, the Isle of Wight and Dorset are all relatively small, compared with many estuaries elsewhere in the UK. The largest estuaries in the region, Southampton Water in Hampshire and Poole Harbour in Dorset, each have a total area of less than 4,000 ha.

Eleven of the fourteen estuaries in the region lie in the Solent basin. These include the intertidal basins of Chichester, Langstone and Portsmouth Harbours - systems with little freshwater inflow, extensive muddy tidal flats, saltmarshes and eelgrass *Zostera* spp. beds and partially closed by sand and shingle spits at their mouths - and the predominantly subtidal inlet of Southampton Water, which comprises the confluent estuary of the Test, Itchen and Hamble rivers, with fringing saltmarshes and extensive tidal reedbeds in the upper reaches. Further west on the Hampshire shore of the Solent is the narrow meandering estuary of the Beaulieu River, with an important vegetated shingle spit across its mouth, and the broad expanse of saltmarshes around the Lymington River, bounded at its western end by the botanically important Hurst Castle shingle spit. Saline, brackish and freshwater lagoons and ponds are particularly important features of the Lymington Estuary and Beaulieu River.

Also bordering the Solent are the five small estuaries on the north coast of the Isle of Wight, each less than 500 ha in total area. These Isle of Wight estuaries vary considerably in form, from the artificially truncated Bembridge Harbour in the east, through the narrow estuary of Wootton Creek with its extensive associated exposed sandflats on Ryde Sands, the narrow muddy Medina Estuary, with one of the best examples of mature mixed saltmarsh on the southern British coast, and the branching mud, sand and shingle-filled basin of the Newtown Estuary, to the small, narrow muddy Yar Estuary near the western tip of the island.

As in Hampshire and the Isle of Wight, sand and shingle spits are an important feature of the three Dorset estuaries, almost closing the shallow tidal basins of Christchurch Harbour and Poole Harbour. The Fleet and Portland Harbour, which at 14 km long is the largest tidal lagoon in

Table 4.1.2 Physical characteristics of Region 9 estuaries

Estuary	*Centre grid ref.*	*Geomorpho-logical type*	*Total area (ha)*	*Inter-tidal area (ha)*	*Salt-marsh (ha)*	*Shoreline length (km)*	*Main channel length (km)*	*Spring tidal range (m)*	*Sub-tidal (%)*
W. Sussex/Hampshire									
128. Chichester Harbour	SU7600	Bar-built	2,946	2,342	1,077	80.6	8.1	4.2	20.5
Hampshire			**12,352**	**7,201**	**2,404**	**338.0**	**61.4**		**41.7**
129. Langstone Harbour	SU7002	Bar-built	1,925	1513	100	43	7.7	4.2	21.4
130. Portsmouth Harbour	SU6203	Bar-built	1,593	964	181	55.2	10.8	4.1	39.5
131. Southampton Water	SU4506	Coastal plain	3,975	1,376	355	109.8	20.2	4.0	65.4
132. Beaulieu River	SU4100	Bar-built	546	417	185	31.3	10.4	3.2	23.6
133. Lymington Estuary	SZ3395	Coastal plain	1,367	589	506	18.1	4.2	2.5	56.9
Isle of Wight			**1,294**	**1,090**	**213**	**83.7**	**18.0**		**15.8**
134. Bembridge Harbour	SZ6388	Coastal plain	158	130	0	7.7	2.3	3.1	17.7
135. Wootton Creek & Ryde Sands	SZ5592	Coastal plain	475	466	14	18.5	1.8	3.8	1.9
136. Medina Estuary	SZ5093	Coastal plain	219	101	13	19.6	7.4	4.2	53.9
137. Newtown Estuary	SZ4191	Bar-built	332	296	120	30.0	3.3	2.9	10.8
138. Yar Estuary	SZ3589	Coastal plain	110	97	66	7.9	3.2	2.5	11.8
Dorset			**5,561**	**2,450**	**798**	**171.8**	**39.6**		**55.9**
139. Christchurch Harbour	SZ1791	Bar-built	239	122	50	21.4	6.6	1.2	49.0
140. Poole Harbour	SZ0189	Bar-built	3,805	2,050	697	102.9	16.3	1.4	46.1
141. The Fleet & Portland Harbour	SY6181	Bar-built	1,617	278	51	47.5	16.7	1.9	2.8

Sources: Buck (in prep.); JNCC Integrated Coastal database. Estuary numbers are those used in Buck (1993). Notes: approx. three-quarters of Chichester Harbour lies in West Sussex (Region 8); '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.

Britain but which also qualifies as an estuary according to the Estuaries Review definition given in section 4.1.1 (Davidson *et al.* 1991), has formed behind the 28 km long narrow shingle ridge of Chesil Beach.

Tidal patterns in the estuaries of the Solent are more complex than the fairly steady curves of most UK estuaries. The interaction of the main tidal wave with its higher harmonics, which is relatively more important in the Solent than elsewhere on the UK coast, results in there being a pause in the rising tide at about mid-tide level followed by a rapid rise to a prolonged high water stand (see also section 2.3.4). Tidal ranges in the region are generally small. They are macrotidal (i.e. their spring tidal range exceeds 4 m) on the four major Hampshire estuaries in the east of the region and in the Medina Estuary. Around the Solent estuaries are mesotidal (i.e. 2-4 m tidal range), and tidal ranges are smallest in the west of the region where the enclosed inlets of Christchurch Harbour, Poole Harbour and the Fleet and Portland Harbour are amongst only nine microtidal estuaries in the UK, the smallest range here being the 1.2 m of Christchurch Harbour.

4.1.3 Human activities

Industrial influence on estuaries in the region is limited, restricted chiefly to the naval docks and installations of Portsmouth Harbour, the extensive port and dock complexes of the upper parts of Southampton Water - an estuary that also has major oil industry and power station developments - and the port and industrial developments on the northern shore of Poole Harbour. Poole Harbour is also the site of the major onshore oil extraction facilities centred on Furzey Island and Wytch Farm, on the southern shore of the basin.

Estuarine water quality is good in most of the region's estuaries, but only fair water quality occurs in several places: in an upper reach of Portsmouth Harbour, and along much of the southern shore of Southampton Water, Lymington River, the upper parts of the Medina Estuary and the inner, Holes Bay, part of Poole Harbour.

Most of the region's estuaries have been affected to some extent by land-claim and other habitat modification, particularly in their upper reaches. Some areas of marsh claimed from estuaries such as Langstone Harbour, Beaulieu River and Lymington River have subsequently developed interest as some of the largest remaining areas of wet grassland on the south coast (see also section 3.5). Land-claim, much of it for port, industial and waste disposal purposes, has particularly extensively affected Langstone Harbour, Portsmouth Harbour, Southampton Water and Bembridge Harbour (Davidson *et al.* 1991).

Almost all estuaries in the region, with the exception of the Newtown Estuary and the Fleet and Portland Harbour, are used extensively for a wide variety of leisure and recreational activities, particularly for water-based recreation (see also section 9.7). The Solent is a major centre for sailing, wind-surfing, power-boating and water-skiing. Much of this activity takes place outside the estuaries, but there are large numbers of moorings, marinas and repair-yards within estuaries in the region, especially in Chichester and Langstone Harbours, Southampton Water, Lymington Estuary, most of the Isle of Wight estuaries (notably the Medina Estuary) and the northern part of Poole Harbour. Wildfowling is widespread, especially on Hampshire estuaries.

Some use of the natural resources occurs on most estuaries in the region, including shellfisheries (particularly in the Hampshire estuaries and the Fleet), some bait-digging on most of the region's estuaries, a limited amount of stock grazing on saltmarshes, and reed-cutting for thatching from reedbeds adjacent to several estuaries. Table 4.1.3 summarises human uses and water quality on estuaries in the region.

Table 4.1.3 Human uses and water quality on estuaries in Region 9

Estuary	*Grid ref.**	*Human use type*				*Water quality*
		urban	*industrial*	*rural***	*recreational*	
Hampshire						
128. Chichester Harbour	SU7600	○		●	●	A
129. Langstone Harbour	SU7002	●		●	●	A
130. Portsmouth Harbour	SU6203	●	○	○	●	(B),A
131. Southampton Water	SU4506	●	●	○	●	A,B
132. Beaulieu River	SU4100			●	●	A
133. Lymington Estuary	SZ3395	○		●	●	B
Isle of Wight						
134. Bembridge Harbour	SZ6388	●		○	●	A
135. Wootton Creek & Ryde Sands	SZ5592	●		○	●	A
136. Medina Estuary	SZ5093	●	○	●	●	B,A
137. Newtown Estuary	SZ4191			●	○	A
138. Yar Estuary	SZ3589			●	●	A
Dorset						
139. Christchurch Harbour	SZ1791	●		○	●	A
140. Poole Harbour	SZ0189	●	●	●	●	(B),A
141. The Fleet & Portland Harbour	SY6181	○	○	●	○	n/a

Sources: Buck (in prep.); National Rivers Authority (1991). Key: *central point; **includes natural resource exploitation; n/a = water quality assessment not available; ● = major human use; ○ = minor human use. Notes: multiple water quality codes are in downstream sequence; brackets indicate a water quality found in only a small part of the estuary.

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 9 are included in *Volume 6. Southern England* (Buck in prep.). Data presented in the inventory are drawn largely from material collected during 1989-90 (updated to 1995 where appropriate) for the NCC's Estuaries Review (Davidson *et al.* 1991). Estuaries covered by the inventory include both river discharge estuaries with varying degrees of freshwater dilution through to fully saline inlets and embayments with substantial areas of intertidal soft sediments. Small river or stream discharge estuaries are not covered where the tidal channel is less than 2 km long. Saltmarsh data come originally from Burd (1989a-c), whose surveys covered mostly saltmarshes of >0.5 ha. Protected site and human activity information is usually included where part or all of the site falls within 1 km of the defined shoreline.

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 10.2.6). Further information on Estuary Management Plans is given in section 10.2.3. Catchment areas and river flows are summarised in a five-year catalogue of river flow gauging stations data (Marsh & Lees 1993), but note that for whole estuary data further interpretation is usually necessary.

4.1.5 Acknowledgements

Thanks go to John Barne, JNCC, for help in preparing data used in this chapter, and to Dr P. Dyrynda, University of Wales, and Dr Pat Doody, John Barne and Catherine Smith (JNCC) for helpful comments on draft texts.

4.1.6 Further sources of information

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Davidson, N.C., Laffoley, D.d'A., Doody, J.P., Way, L.S., Gordon, J., Key, R., Drake, C.M., Pienkowski, M.W., Mitchell, R.M., & Duff, K.L. 1991. *Nature conservation and estuaries in Great Britain.* Peterborough, Nature Conservancy Council.

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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.* Bristol, National Rivers Authority. (Water Quality Series, No. 4.)

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 (in prep.) (section 4.1.6.A 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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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, JNCC, Peterborough, tel: 01733 62626
Statutory protected sites; detailed wildlife site information; coastal geomorphology. Estuaries Initiative & estuary management plans. Numerical and some digitised data.	*Estuarine Ecologist/Estuaries Initiative Officer/Marine Ecologist, English Nature HQ, Peterborough, tel: 01733 340345
RSPB Estuaries Inventory: mapped and numerical information on land use and selected human activities for 57 major UK estuaries in Region 9, covering all estuaries except Christchurch Harbour and The Fleet and Portland Harbour.	*Estuaries Inventory Project, 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

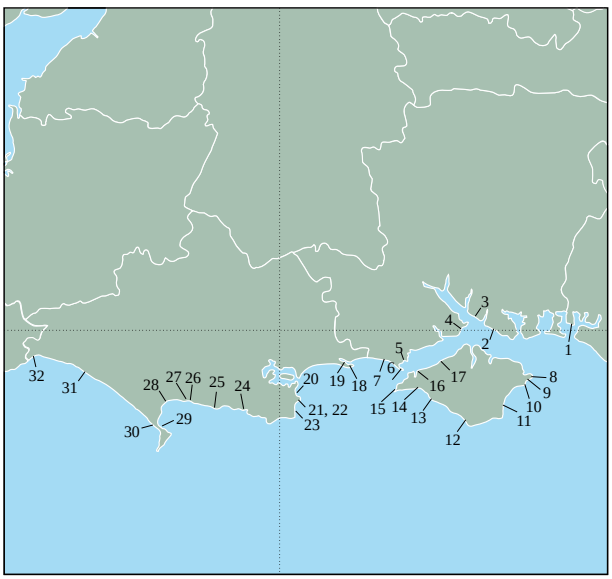
R.A. Irving

4.2.1 Introduction

This section covers the occurrence and distribution of sea bed habitats and 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.

This central region of the English Channel, especially the Solent area, acts as a transition between Lusitanian (warm temperate) and Boreal (cold temperate) marine biogeographical provinces, with representatives of the flora and fauna of both being present. The Solent itself contains many flourishing introduced species, brought to the area by shipping activities. Information on the precise extent of littoral (shore) and sublittoral (below low water mark) habitat types in a national context is not yet available.

In this region, littoral rock is limited to limestone outcrops at the eastern end of the Isle of Wight, the Purbeck coast and Portland Bill; the boulder shore along the Undercliff between Ventnor and St. Catherine's Point; the ironstone reefs at Hanover Point; and softer chalk outcrops at both the east (very restricted) and west ends of the Isle of Wight, at Handfast/Ballard Points and along the southern Purbeck coast. Sublittoral rock occurs as limestone outcrops at Bembridge; chalk outcrops at Culver Cliff, the Needles, Ballard Ledges and White Nothe; and the ironstone boulders of the Christchurch Ledges off Hengistbury Head. Discrete reefs also occur in Lyme Bay. Man-made structures, such as the dock walls at Southampton and the pilings of Swanage Pier, also provide hard substrata for colonisation. The range of chalk intertidal, cliff and cave habitats on the Isle of Wight is of international nature conservation importance.



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

Littoral sediment is widespread, occurring as mixed sediments on Solent shores, as mud and sandy mud in the large shallow harbours, including Poole Harbour, Weymouth Bay and Portland Harbour, and forming a number of sandy beaches. The extensive shingle bank forming Chesil Beach has little marine life associated with it on account of its mobile nature. Sublittoral sediment is widespread, especially as mixed sediments (of cobbles, pebbles, gravel and sands) in the Solent, with larger areas of sand being present further offshore (see Map 2.2.1). Burrowing bivalves dominate the infauna of these areas, particularly clams in Southampton Water, and other species in Poole Bay. The introduced slipper limpet *Crepidula fornicata* dominates the benthos of some mixed sediment areas of the Solent and in Poole Bay.

A number of wrecks (ships, aircraft and other solid material) occur off the coast of this region, as elsewhere. These objects offer hard substrata in areas that may be largely sedimentary, thus providing discrete new habitats for opportunistic colonising species, which otherwise would not be present (see also section 6.4).

4.2.2 Important locations and species

Table 4.2.1 lists locations of marine biological importance mentioned in the text (Map 4.2.1). Known benthic communities of particular nature conservation importance occur on the Bembridge Ledges (Collins *et al.* 1990), in Poole Harbour, at Swanage, Kimmeridge, in Portland Harbour, in the Fleet and on reefs in Lyme Bay. It is likely there are other areas of equal importance but for which there is currently insufficient information.

English Nature has identified four Sensitive Marine Areas (SMAs), covering most of the region's coast (English Nature 1994). The SMA designation is non-statutory, serving to highlight areas of particular marine nature conservation interest (see also section 7.4.4). The Solent and Isle of Wight SMA runs from Pagham Harbour to Hurst Spit and includes the whole of the Isle of Wight. This area has an unusual tidal regime and encompasses a diverse range of habitats and communities, some of them particularly rich. Several biotopes that occur within this SMA are considered to be of national importance (Fowler 1995). These include communities with piddocks in soft chalk, clay or peat; *Zostera* spp. beds on muddy sands; and communities including the bivalve *Mya arenaria* and polychaetes in muds and muddy gravels under conditions of reduced salinity. It is also significant for the internationally important numbers of wildfowl and waders found primarily in the shallow harbours, and for a number of brackish-water lagoons (see also section 3.4). The Poole Bay and Isle of Purbeck SMA extends from Christchurch Harbour to Lulworth Cove. A wide range of rock types (including chalk) occurs within this area, as well as areas of sediment. The sheltered, shallow harbours at Christchurch and Poole support a number of unusual marine species, as well as high numbers of over-wintering wildfowl and waders. Included in this area is the Kimmeridge Voluntary Marine Wildlife Reserve,

centred on Kimmeridge Bay. The Portland and the Fleet SMA runs from Ringstead Ledges to Burton Bradstock and includes the Isle of Portland and the shallow lagoon of the Fleet, bounded by the long stretch of Chesil Beach. Rich sediment communities are found in Portland Harbour, as well as a number of species rarely recorded elsewhere in Britain. The Fleet is an internationally important saline lagoon. Lyme Bay SMA adjoins the Portland and the Fleet SMA and extends to Straight Point, east of Exmouth. Lyme Bay features some rare marine species associated with its reefs.

The Solent system (north shore: Chichester Harbour to Hurst Spit)

The three natural harbours of Chichester, Langstone and Portsmouth all display similar benthic habitats. Mud and muddy-sand predominate, with cobbles, pebbles and shells apparent in drainage channels. At the narrow entrance to Chichester Harbour is a 20 m-deep trench with steep sides where the sediment is bound together by tubes of the polychaete worm *Sabellaria spinulosa* (English Nature 1994). Small areas of silty pebbles and shells among the moorings at the entrance to the Emsworth Channel have rich communities of sponges, hydroids and sea squirts associated with them. These areas escape the attentions of oyster dredges during the winter months (Irving 1994).

Table 4.2.1 Locations of marine interest mentioned in the text

No. on Map 4.2.1	*Location*	*Grid ref.*
	Sussex/Hampshire	
1	Chichester Harbour	SZ7598
	Hampshire	
2	Browndown	SZ5799
3	Solent Breezes	SU5103
4	Stanswood Bay	SU4700
5	Keyhaven - Lymington	SZ3190-SZ3394
6	Hurst Spit	SZ3189
7	Milford-on-Sea	SZ2791
	Isle of Wight	
8	Bembridge Ledges	SZ6587
9	Whitecliff Bay	SZ6486
10	Culver Cliff	SZ6385
11	Horse Ledge	SZ5880
12	Blackgang	SZ4876
13	Hanover Point	SZ3783
14	Freshwater Bay	SZ3485
15	The Needles	SZ2984
16	Yar Estuary	SZ3589
17	Newtown Harbour	SZ4191
	Dorset	
18	Christchurch Ledges	SZ1890
19	Christchurch Harbour	SZ1791
20	Studland Bay	SZ0484
21	Old Harry/Handfast Point	SZ0582
22	Ballard Ledges	SZ0581
23	Swanage Pier	SZ0378
24	Kimmeridge Bay	SY9079
25	Worbarrow Bay	SY8779
26	White Nothe	SY7780
27	Ringstead Bay	SY7581
28	Weymouth Bay	SY7080
29	Portland Harbour	SY6975
30	Fleet lagoon rapids	SY6577
31	West Bay	SY4690
32	Broad Ledges	SY3492

Important eelgrass *Zostera* spp. beds occur within the harbours (and in some of the estuaries draining into the western Solent), with extensive cover also of green algae *Enteromorpha* spp. This plant cover, coupled with the very high biomass of invertebrates present in the mud of these harbours, provides food for large numbers of waders and wildfowl during the winter months.

The shores of the Solent and Southampton Water are predominantly sedimentary, although seven rocky littoral sites are known to have been surveyed in the Solent (Crisp & Southward 1958). The sedimentary communities can be split into five main types: crustacean-polychaete; sandmason worm *Lanice conchilega*; lugworm *Arenicola marina*; carpet shell *Venerupis pullastra*; and furrow shell *Scrobicularia plana* (Holme & Bishop 1980). The shores at both Browndown and Solent Breezes are proposed by Holme & Bishop (1980) as being sites of marine biological importance on account of their varied sheltered habitats. Further west, the mud/gravel shore at Keyhaven - Lymington has a limited range of invertebrates, but because it is typical of a sheltered, stable west Solent shore, Holme & Bishop (1980) listed it as a proposed site of marine biological importance.

Subtidally, the Solent is a high energy/high turbidity regime, with limited hard substrata. Habitats range from sheltered silty mud to tideswept cobbles, pebbles, shells and coarse sand. The main channel of the eastern Solent is characterised by mud and sandy mud, with patches of sand at some estuary mouths. In the western Solent, where tidal currents are stronger, mounds of gravel and flint stones occur, with occasional exposures of soft clay. The maximum depth in the Solent is 60 m at the Hurst Spit narrows, though elsewhere it rarely exceeds 25 m depth. Four littoral and nine sublittoral habitat types have been identified in the Solent, with a low diversity of algal and epifaunal communities (Dixon & Moore 1987). Infaunal communities are dominated by polychaetes and are also of low density and diversity. Species abundance and diversity does, however, increase with increasing substratum size and stability, stable pebbles and cobbles being coated by growths of sea squirts, hydroids and bryozoans. Gravel mixed with varying quantities of sand is the most common sea-bed type. The introduced slipper limpet is widespread, its empty shells augmenting pebbles as a substratum for encrusting and sessile (non-mobile) forms to colonise, particularly in the eastern Solent. Several other non-native species, such as the Pacific sea squirt *Styela clava* and the Japanese seaweed *Sargassum muticum*, form large populations within the Solent area, having probably arrived on ships' hulls, with imported shellfish or in ballast water. The American hard-shelled clam *Mercenaria mercenaria* was at one time very numerous in Southampton Water, but only small numbers now remain (see section 5.5). Stanswood Bay and the north side of the west Solent have been noted for their higher richness of benthic communities compared with other areas in the Solent, and because of their native oyster *Ostrea edulis* populations (Dixon & Moore 1987). Stanswood Bay also boasts the largest eelgrass *Zostera marina* bed in the south-east (Gubbay 1988). The diversity of algal species increases outside the enclosed area of the Solent, owing to greater water clarity and the increasing abundance of hard substrata.

The Isle of Wight

The island's shores are mostly composed of a mix of sand and shingle, though there are a few areas of hard substrata, particularly at the east and west ends. The limestone platforms of Bembridge Ledges and Whitecliff Bay are the most easterly examples of extensive hard shores (other than chalk) in the English Channel. They have eroded to form a complex of crevices characteristic of limestone pavements, with a wealth of algae and littoral invertebrates (Titley 1988; George *et al*. 1989). Some of the species here are also at the easterly edge of their range (for instance, this is the most easterly site at which all three limpet *Patella* species are found). In the sublittoral too, the variety of habitats supports a rich diversity of marine life. The limestone bedrock is extensively bored by the bivalves *Barnea* and *Hiatella*, giving rise to rough surfaces colonised by a range of encrusting sponges, hydroids and bryozoans. Kelp extends to about 7 m below chart datum (Collins & Mallinson 1988, 1989a). Indeed, the area around Bembridge is considered to be of national importance for its range of habitats, species and diverse communities (Fowler 1995). The small coastal exposure of chalk at Culver Cliff displays rare chalk cliff algal communities, ranked by Fowler & Tittley (1993) as being the fifth most important in the country and as being of national conservation importance. The chalk extends about 1 km offshore, forming low-lying ridges running parallel to the shore, with occasional chalk boulders (Wood 1992). Sedimentary mixtures tend to dominate the sea bed in this area, in places revealing underlying hard, flat mudstone. Occasionally in Sandown Bay, discrete soft mud mounds are present, some 8-15 cm deep and 2-3 m across, bound by tubes of the amphipod *Ampelisca diadema*. Horse Ledge, south of Shanklin, has some interesting rockpool formations and a high diversity of marine life, including a number of unusual algae, e.g. *Padina pavonica* (English Nature 1994). The boulder shores along the undercliff east of Blackgang have high densities of the dogwhelk *Nucella lapillus* that appear to have been minimally affected by TBT antifouling paint (see also section 9.6), and which are probably an important source for re-populating the Solent coast (Herbert 1988).

Important rocky shore communities are found on the ironstone reefs off Hanover Point (R. Herbert pers. comm.). At Freshwater Bay, a little further west, the chalk shore has a high diversity of intertidal algae (English Nature 1994). The algal communities on the chalk cliffs from here round to Alum Bay were ranked fourth most important in the country and are of national importance (Fowler & Tittley 1993). The chalk exposures around the Needles extend into the sublittoral, forming 3-5 m high cliffs, small caves, gullies and boulder slopes. The island's most varied chalk topography is found on the north side of the Needles and in Alum Bay; this area also appears to support the greatest range of animal life (Wood 1992). The subtidal chalk caves here are the only examples known in Britain and are of national importance (Fowler 1995). The whole of this area is affected by strong tidal currents. The Yar Estuary contains a sheltered estuarine boulder shore and a sea bed which supports a rich and diverse fauna of sponges, hydroids and anemones. Holme & Bishop (1980) proposed Newtown Harbour as a site of marine biological importance, largely because of its undeveloped and unpolluted nature.

Hurst Spit to Durlston Head

A shingle shoreline extends from Hurst Spit to Milford-on-Sea and becomes progressively more sandy from there westwards into Christchurch Bay. Christchurch Harbour shows several lagoonal characteristics, on account of its shallowness, limited flushing and brackish water (Sheader & Sheader 1985) (see also section 3.4). One of the most interesting features in the sublittoral of this area is the Christchurch Ledges, extending about 5 km off Hengistbury Head in a south-easterly direction. The ledges feature ironstone boulders supporting a dense covering of kelp *Laminaria hyperborea* in shallow water, and small algae, bryozoans, hydroids, sponges and anemones in deeper water. Stands of the eelgrass *Zostera marina* also occur in the sediments. Extensive mussel *Mytilus edulis* beds in the area are reported to have been devastated since 1978 by the starfish *Asterias rubens* (Collins & Mallinson 1986).

Poole Harbour's littoral and sublittoral diversity is low, yet the high productivity of the extensive mudflats makes the area important for waders and wildfowl (Howard & Moore 1988). Dense stands of the tubicolous peacock worm *Sabella pavonina* are an unusual feature of the sublittoral, the mud tubes often providing attachment sites for other fauna. There are also at least four rare marine invertebrate species present in the Harbour (see also section 5.4).

In Studland Bay there is a large stand of eelgrass *Zostera marina* close to the shore (Jensen *et al*. 1990). Further south, a chalk platform is present at 5-8 m depth between Handfast and Ballard Points (the Ballard Ledges), though mobile sand and gravel keep parts of this area devoid of attached life. Rich communities have been recorded from the pier pilings at Swanage (Robins & Thurston 1969), where the easy access and shallow water make it a popular spot for shore diving. Rock extends up to 2 km offshore between Peveril Point and Durlston Head (English Nature 1994).

Poole Bay is described as the only site in the English Channel to contain all five sediment types (mud, muddy sand, sand, muddy gravel, and gravel) (Holme 1966). An experimental artificial reef, made from power station fuel ash and gypsum, was installed in the bay in 1989. Initial colonisation was rapid: 80 marine species were identified on it within two months (Collins *et al*. 1994; Jensen *et al.* 1994). A bed of maerl (an unusual calcareous alga) is present at Handfast Point. The two species present, *Phymatolithon calcareum* and *Lithothamnion coralloides*, are uncommon in the Channel, and this site is believed to provide the most easterly records for these species in the Channel (English Nature 1994). The maerl bed has a rich and diverse benthic community, dominated by polychaetes and amphipods (Rowe *et al*. 1990).

Durlston Head to Portland Bill

The intertidal ledges to the east of Kimmeridge Bay display a wide variety of organisms. With such a wide range of wave exposure and a mixture of soft and hard substrata, habitats and communities representative of many conditions can be found here (Gubbay 1988). Shallow water extends from the shore to a submerged collapsed former cliff line 1-2 km offshore. The sea bed off Kimmeridge features a mixture of horizontal ledges, vertical faces and boulder slopes, swept clear of sediment by strong tidal streams (Davies 1995). Though chalk strata are apparent in the cliff

at Worbarrow Bay, chalk does not feature here in the sublittoral (Wood 1992). Similarly, little sublittoral chalk is found further west between Durdle Door and White Nothe, though a harder Portland limestone reef runs parallel to the shore, forming exposures known as the Bull, the Blind Cow, the Cow and the Calf (Wood 1992). At White Nothe itself, a series of shallow chalk ledges is present close to the cliffs, running at right angles to the coast and dominated by algae. A little further offshore, these ledges give rise to chalk boulders, cobbles and sand. Though the attached life on chalk and limestone is similar, a greater variety of sponges is found on limestone (Wood 1992) .

Weymouth Bay is a sheltered sandy bay where the sand inshore gives way to mud and gravel further offshore. The sediments support a high diversity of bivalve molluscs. There is an extensive eelgrass *Zostera marina* bed extending from Ringstead Bay into Weymouth Bay. Portland Harbour, on the east side of the Portland peninsula, is a large sheltered water mass enclosed by man-made breakwaters. A restricted water exchange with the open sea leads to slightly elevated water temperatures, and this in turn has led to the harbour being colonised by many southern species (Davies 1995). It is the only location along the south coast of England that provides a fine mud habitat, and has a unique flora and fauna, including notable stands of the sea pen *Virgularia mirabilis*, high numbers of the sea squirt *Phallusia mammillata*, and the only known population in Britain of the rare black-faced blenny *Tripterygion delaisi*. While most of the sea bed within the harbour is soft mud, the concrete blocks of the breakwaters and a couple of well-known wrecks, popular with divers, provide contrasting hard substrata. The sediment shores have eelgrass *Zostera* spp. beds and important bivalve communities. Portland Bill itself is a limestone outcrop that forms the eastern limit of the outer basin of the English Channel. The steeply sloping shore on the west side of the Bill is exposed to the prevailing wind-driven waves and swell. It provides the best example of an exposed rocky shore within Lyme Bay and is therefore of regional importance (Ambios Environmental Consultants 1995). Strong tidal streams are present off the Bill, restricting survey access to the sublittoral, which, as a consequence, is poorly recorded.

Portland Bill to Lyme Regis

Below low water, the nearshore zone off Chesil Cove has large boulders present, which support a low algal diversity but a rich community of hydroids, sea squirts and sponges (Dixon 1979). Chesil Bank then stretches 28 kilometres to near West Bexington. The Bank is noted for its paucity of marine flora and fauna, due to the mobile nature of the pebbles. In the sublittoral, the steep bank of pebbles grades rapidly into a gentle slope of pebbles and sand, with little algal cover but a reasonable diversity of mobile faunal species, especially crabs (Dixon 1979). The Fleet, enclosed by Chesil Bank, is the largest tidal lagoon in Britain and is of international importance for its plant and animal communities (see also section 3.4). The outer (easternmost) section of the Fleet lagoon is characterised by tidal rapids supporting highly unusual benthic communities. These contain a substantial number of rare and/or warm-water algae, invertebrates and fish (Dyrynda & Farnham 1985; Dyrynda & Cleator 1995). The fine sand near the entrance to the lagoon at Ferry Bridge has been found to contain high densities of the polychaetes *Pygospio elegans* and *Capitella capitata*. The presence of the polychaetes *Clymenura clupeata* and *Spio theeli* confirms the national importance of this site (Ambios Environmental Consutlants 1995).

The shore from Abbotsbury to Lyme Regis is predominantly of shingle backed by cliffs. Broken bedrock and boulders have a rich attached fauna, with shallower zones being characterised by algae ('*Halidrys siliquosa*' community). Approximately 1 km off West Bay is a series of ledges, which feature several species of nature conservation interest, including the seafan *Eunicella verrucosa* and the bryozoan *Pentapora foliacea* (V. Copley pers. comm.). The flat bedrock platforms forming Broad Ledge at Lyme Regis are exposed to wave action from the south and are regarded as being of regional conservation importance (Ambios Environmental Consultants 1995). Large numbers of gastropod snails, such as *Monodonta lineata* and *Littorina littorea*, are found here in the mid-shore zone.

Offshore

For many offshore (defined as beyond 3 km or 50 m depth) areas, there is little information available in the public domain on the detailed nature of the sea bed. However, the results of some recent environmental assessment studies relating to near-shore oil and gas exploration are available (e.g. Ambios Environmental Consultants 1995). General information on bathymetry and sea-bed geology is shown on Admiralty charts and British Geological Survey sediment charts.

Seven epibenthic community types have been identified from hard sublittoral substrata within Lyme Bay (Ambios Environmental Consultants 1995). The communities of most interest (and regarded as being of regional/national conservation importance) occur on circalittoral limestone and shale ledges and boulder habitats, believed to be widespread within eastern Lyme Bay, including Swire Ledges (3 km south-west of West Bexington), Saw-tooth Ledges (approximately 3-4 km south of West Bay) and West Tennants Reef (10 km south of Lyme Regis). Of particular note were impressive stands of the seafan *Eunicella verrucosa*, the bryozoan *Pentapora foliacea* and a population of the rare solitary coral *Leptopsammia pruvoti* (Devon Wildlife Trust 1993). The large size of some of these slow-growing animals suggests a relatively stable habitat not subject to disturbance. Apparent absentees from the Lyme Bay sublittoral fauna include the common sea urchin *Echinus esculentes*, the sea cucumber *Holothuria atra* and the spiny star fish *Marthasterias glacialis*. Sublittoral sediments within Lyme Bay support an extremely diverse fauna, with over 400 taxa being recorded from recent grab samples (Ambios Environmental Consultants 1995). Sea bed types range from clean sand, through muddy sand and sandy gravel to gravel. The most common community is associated with muddy sand, dominated by the bivalve *Corbula gibba*, the polychaetes *Chaetozone setosa* and *Megalona filiformis* and the amphipod *Bathyporeia tenuipes*. Sandy gravel areas closer inshore typically feature the polychaetes *Lumbrineris gracilis*, *Mediomastus fragilis* and *Pisione remota*. Further offshore, Holme (1966) identifies five species/habitat associations, defined by Jones (1950), that are based on sediment type rather than biota; commonest are the boreal offshore sand, muddy sand and gravel associations, for which he lists typical species.

4.2.3 Human activities

A number of activities that affect marine habitats and communities take place within this region. Extraction of marine aggregate from a number of near-shore gravel beds is of prime concern (see also section 9.4). A number of exploratory drilling platforms are now active within the region, with actual oil production from BP's Wytch Farm field in Poole Harbour and at Wareham (see also section 9.5). Oyster dredging is extensive throughout the Solent, as well as trawling, set netting, potting, cockle raking, clam dredging and winkle picking (see section 9.1). Bait digging is also widespread. The Solent area is home to one of the largest pleasure sailing fleets in the world, and many other water-based recreational activities occur within the region (see section 9.7).

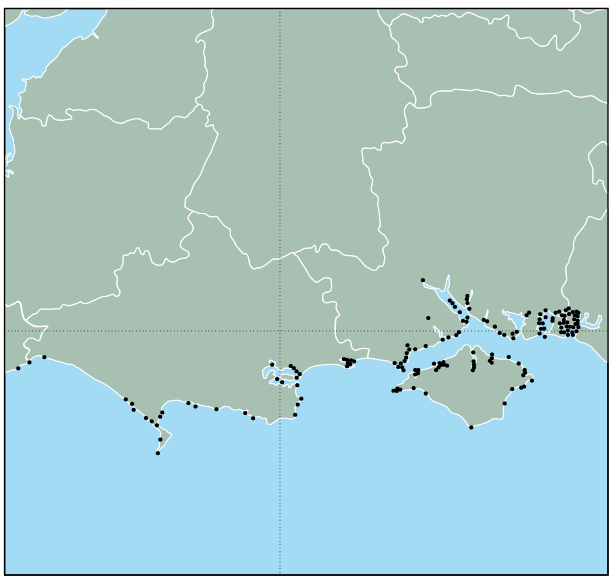
Several sewage treatment works discharge into the area and some dredging of harbour channels takes place. Langstone Harbour is one of only two coastal sites in the UK (the other being the Ythan estuary on the north-east coast of Scotland (Region 3)) identified in 1992 by the Department of the Environment as exhibiting problems associated with eutrophication (nutrient enrichment) (OSPARCOM 1992). However, the UK has subsequently reclassified the two areas as 'possible problem areas', since their nutrient status is still under investigation.

In 1989 an artificial reef was constructed north of The Foreland, Studland Bay (Dorset), at a depth of about 10 m below chart datum and about 3 km from natural rocky outcrops in Poole Bay. The reef consists of 50 tonnes of blocks of pulverised fuel ash (PFA) and flue gas desulphurisation gypsum (FGD). The project was initiated to test the use of PFA and gypsum produced by local coal powered power stations in providing artificial reefs for fishery enhancement. At the moment about 50% of UK PFA production is sold to the construction industry and the remainder dumped in land fill sites. The latter is becoming an expensive option and the construction of artificial reefs may become more attractive (Collins *et al.* 1994; Jensen *et al.* 1994).

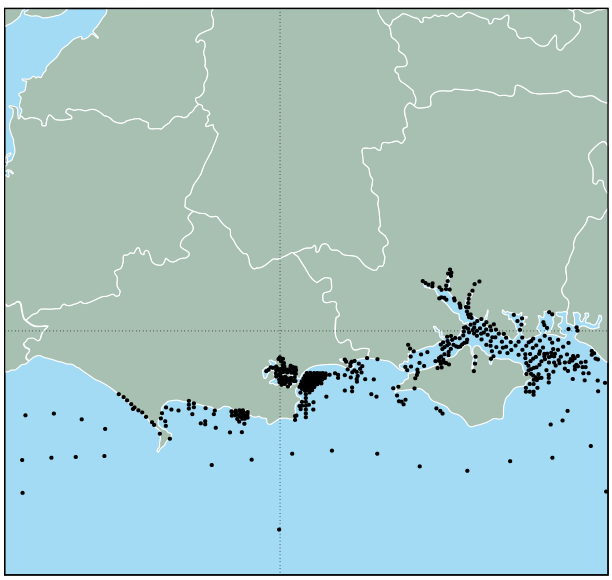
The intertidal ledges at Kimmeridge Bay are easily accessible and display a wide range of organisms, making them an ideal site for educational groups to explore. Besides the nature conservation and geological interest of the area, visitor pressure was one of the main reasons for establishing the Kimmeridge Marine Wildlife Reserve in 1978. This voluntary reserve includes 8 km of coast either side of Kimmeridge Bay; the seaward boundary being along a line from Clavell's Hard to Bacon Hole. An underwater nature trail, one of the first in Britain, has been set up at Worbarrow Bay (Collins & Mallinson 1989b).

4.2.4 Information sources used

JNCC's Marine Nature Conservation Review (MNCR) team (and their contractors) use a standard recording methodology for both littoral and sublittoral surveys, which includes descriptions of both habitats and their associated communities (see Hiscock 1990). Survey information from other sources may vary considerably in its methodology and coverage. The MNCR *Review of current knowledge* series, in which this region is covered in Covey (in prep.) and Davies (in prep.), summarises the results of many previous surveys. A summary of marine survey work carried out in the Solent and adjoining waters for Southern Water Services was provided by Southern Science (1991). A review of nature conservation features and information within the Solent and Isle of Wight Sensitive Marine Area has recently been published (Fowler 1995). The NCC/MNCR has surveyed several inlets along this coast as part of its harbours, rias and estuaries programme: the Solent (Dixon & Moore 1987); Christchurch Harbour (Dixon 1988); Poole Harbour (Howard & Moore 1988); Newtown & Bembridge Harbours (Howard *et al.* 1988b); the Yar (Johnston 1989); and Portland & Weymouth Harbours (Howard *et al.* 1988a). The macrobenthos of chalk shores in the region has been investigated by MNCR contractors (George *et al.* 1989), and the outcrops of chalk in the sublittoral by Wood (1992). Table 4.2.2 and Maps 4.2.2 and 4.2.3 indicate the scale and distribution of marine benthic site survey in the region.



Map 4.2.2 Littoral surveys recorded on the MNCR database. Source: JNCC.



Map 4.2.3 Near-shore sublittoral surveys recorded on the MNCR database. Source: JNCC.

Table 4.2.2 Number of surveyed sites in the region with marine benthic habitat and species information held on the MNCR database

Littoral	*Near-shore sublittoral*	*Offshore*	*Total*
109	112	0	221

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

Sea bed mapping studies are being carried out off the coast by, or on behalf of, a number of oil companies, as part of their environmental assessment programmes to comply with oil and gas exploration licence conditions. Off the Dorset coast, Amoco, British Gas and Kerr-McGee have undertaken survey work, although some information from surveys commissioned by prospecting oil companies in this region remains confidential. A series of sites further out in the English Channel were surveyed by Holme (1961, 1966, 1967), using grabs and anchor-dredges, to describe sediment types and their associated communities.

Environmental impact assessment studies, associated with exploratory oil drilling, have been undertaken of the sea bed at Freshwater Bay by the Department of Oceanography, University of Southampton (Jensen *et al*. 1991, 1992a). The presence of Wytch Farm oilfield in the area has prompted much work on behalf of British Petroleum Exploration (e.g. Institute of Offshore Engineering 1986; Collins *et al*. 1991; Jensen *et al*. 1992b). Current sublittoral studies include pre- and post- drilling surveys in East Poole Bay, for Elf Enterprise Caledonia, and a survey of the sandeel population of Hook Sand (at the entrance to Poole Harbour), for British Petroleum Exploration (A. Jensen pers. comm). A detailed programme of study of the biological colonisation and physical and chemical integrity of the artificial reef in Poole Bay has been carried out by a team from the Department of Oceanography, Southampton University. Detailed records have been made of the epifauna, infauna and fish that have colonised these reefs with time (Collins *et al*. 1994). The potential use of such reefs for lobster stock enhancement programmes has also been studied (Jensen *et al*. 1994).

Barnes (1971) lists the fauna recorded from the shores of Southampton Water. Marine life colonising the dock walls at Southampton was studied by Collins & Mallinson (1987), who revealed the importance of introduced species in the communities on artificial substrata. Little is known of the near-shore sublittoral zone off the south-west coast of the Isle of Wight, but a remote sensing survey of this area was completed by the BioMar team on behalf of English Nature during the summer of 1994 (R. Foster-Smith pers. comm.). Light (1994) has compiled an atlas of the distribution of marine molluscs in sea area Wight.

The littoral interest from Hurst Spit to Durlston Head has been relatively poorly researched because of the impoverished nature of the open coast. Poole Harbour's littoral and sublittoral habitats and communities have been well studied, the available literature prior to 1988 being reviewed by Howard & Moore (1988). A more recent study of the harbour's sedimentary shores (Dyrynda & Lewis 1994) assessed the potential impact of recreational activities such as bait digging on shore ecology. Littoral studies in Poole Bay have been limited, with information available from a few sites surveyed by Holme & Bishop (1980). A detailed study of the algae of Studland Bay and Old Harry Rocks was carried out by by Tittley (1988). The Dorset Trust for Nature Conservation (1974) highlighted the shores at Studland Bay and Peveril Point in their conservation assessment of the county's coast. The sediment types and the main infaunal and epifaunal communities found in Poole Bay have been described by Jensen *et al*. (1989). The former Nature Conservancy Council funded extensive subtidal surveys of Poole Harbour during the 1980s (see e.g. Dyrynda 1987). More recently, Fawley Aquatic Research Laboratories (funded by Dorset County Council) undertook a marine ecological assessment of Holes Bay within Poole Harbour, covering the intertidal and subtidal benthos and fish populations (Dyrynda 1989). On the whole, access to the shore is difficult along the section of coast from Durlston Bay to Weymouth Bay and consequently the littoral zone has been poorly studied. Nearshore sublittoral habitats and communities of the Purbeck coast are described by Dixon *et al*. (1978). Nearshore sublittoral communities of the shore from Abbotsbury to Lyme Regis were studied during the third Dorset Trust for Nature Conservation underwater survey (Dixon 1979). The Devon Wildlife Trust has undertaken some surveys of reefs in Lyme Bay (funded by WWF UK), concentrating particularly on the effects scallop dredging may be having on the benthos (Devon Wildlife Trust 1992). A thorough environmental assessment study of Lyme Bay has recently been undertaken on behalf of Kerr-McGee (Ambios Environmental Consultants 1995).

4.2.5 Acknowledgements

The author acknowledges the 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 in preperation by Roger Covey (Eastern Channel to Durlston Head) and Dr Jon Davies (Durlston Head westwards) have been widely consulted. Thanks are due to English Nature's Maritime and local teams for their helpful comments.

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B. Further reading

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C. Contact names and addresses

Type of information	Contact address and telephone no.
Marine nature conservation issues in England	*Marine Ecologist, Marine Task Force, EN HQ, Peterborough, tel: 01733 340345
Benthic habitats & communities of West Bracklesham Bay; Bembridge Ledges; Christchurch Ledges; & Worbarrow Bay underwater nature trail	Dr Ken Collins & Jenny Mallinson, Department of Oceanography, Southampton University, Highfield Road, Southampton, Hants. SO9 5NH, tel: 01703 595000
Benthic habitats & communities within Chichester Harbour and Bracklesham Bay	Robert Irving, MCS Sussex Seasearch Co-ordinator, 14 Brookland Way, Coldwaltham, Pulborough, West Sussex RH20 1LT, tel: 01798 873581
Benthic habitat information relating to coastal water quality	Dr Nigel Thomas, Southern Science Ltd., Hampshire Office, Sparrowgrove, Otterbourne, Winchester, Hants. SO21 2SW, tel: 01962 714585
Benthic infaunal communities	Dr Roger Bamber, Director, Fawley Aquatic Research Labs. Ltd., Marine & Freshwater Biology Unit, Fawley, Southampton, Hants. SO4 1TW, tel: 01703 893513
Littoral and sublittoral marine biology of the Isle of Wight; marine recorded for IoW Natural History and Archaeological Society	Roger Herbert, Medina Valley Field Centre, Dodnor Lane, Newport, Isle of Wight PO30 5TE, tel: 01983 522195
Habitats and communities of sublittoral chalk outcrops on the Isle of Wight & in Dorset	Chris Wood, Hollybush, Chequers Lane, Eversley, Basingstoke, Hants. RG27 0NY, tel: 01734 734127
Poole Bay artificial reefs project	Dr Ken Collins, Department of Oceanography, Southampton University, Highfield Road, Southampton, Hants. SO9 5NH, tel: 01703 595000
Poole Bay artificial reefs project; benthic studies within Poole Harbour, Poole Bay & Portland Harbour	Dr Anthony Jensen, Department of Oceanography, Southampton University, Highfield Road, Southampton, Hants. SO9 5NH, tel: 01703 593428
Marine ecology of Poole Harbour and the Fleet	Dr Peter Dyrynda, School of Biological Sciences, University College of Wales, Singleton Park, Swansea SA2 8PP, tel: 01792 295678
Poole Harbour: benthic studies	Dr Paul Kingston, Institute of Offshore Engineering, Heriot-Watt University, Research Park, Riccarton, Edinburgh EH14 4AS, tel: 0131 4495111
Littoral & sublittoral ecology of the Dorset coast, especially Isle of Purbeck	Sarah Welton (Marine Conservation Society Education Officer), 38 West Street, Bere Regis, Wareham, Dorset BH20 7HW, tel: 01929 471562
Purbeck Marine Wildlife Reserve	Peter Tinsley, Reserve Warden, Dorset Wildlife Trust, 15 North Square, Dorchester, Dorset DT1 1HY, tel: 01305 264620
Dorset Marine Forum	Doug Young, Chairman, 15 Wyatts Lane, Wareham, Dorset BH20 4NH, tel: 01929 552816
Distribution of marine algae; algae of the Fleet	Dr Bill Farnham, Marine Laboratory, University of Portsmouth, Ferry Road, Hayling Island, Hants. PO1 0PG, tel: 01705 463231
Benthic communities present on nearshore reefs, Lyme Bay	Mike Camplin, Marine Survey Officer, Devon Wildlife Trust, 188 Sidwell Street, Exeter, Devon EX4 6RD, tel: 01392 79244

* 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 marine 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 5.6), 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 (transient, unsustainable growths, usually of single species and often associated with a visible discolouration of the water) are a normal feature in the seasonal development of plankton. Some blooms 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.

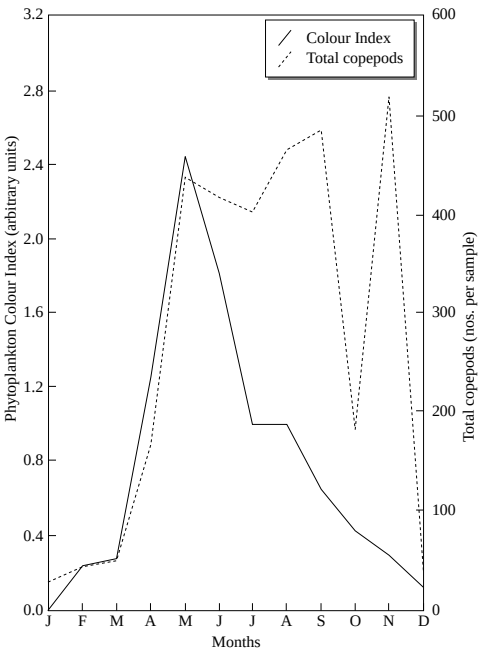
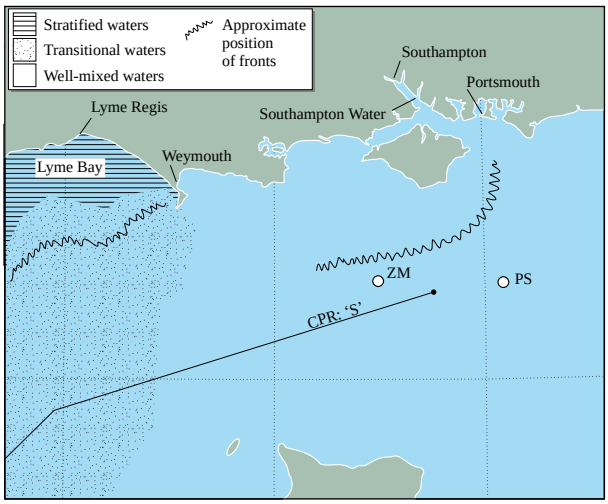


Fig 4.3.1 Average seasonal cycles of an index of phytoplankton colour (a visual estimate of chlorophyll) and numbers of copepods per sample (approximately 3 m^3 of water filtered). Source: Continuous Plankton Recorder data for 1958-1992.



Map 4.3.1 Plankton surveys, 'fronts' and areas of well mixed and transitional water. See Table 4.3.1 for details of surveys.

In Region 9, 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 English Channel (Figure 4.3.1) is similar to that in the Irish Sea, except that the spring bloom commences one month earlier (March-April). Throughout this region the waters are relatively shallow, usually not exceeding 40 m. Mean surface temperature and salinity vary (depending on season), between 7-16°C and 34.75-35 g/kg, respectively. Inshore waters are well mixed, except to the west of Weymouth, where there is a boundary between stratified water in Lyme Bay and well-mixed water offshore (see Map 4.3.1).

4.3.2 Important locations and species

The Continuous Plankton Recorder (CPR) surveys (see e.g. Warner & Hays (1994)) show that the planktonic assemblage is made up mainly of neritic (coastal water) species, although southern intermediate (mixed water) species can also be present at certain times of the year. Other than these surveys, which examined plankton distribution, few measurements of phytoplankton have been made in this region. In the Test estuary of the Solent, very high chlorophyll levels (*c.* 240 g l^{-1}) occur on a regular basis, owing to blooms of *Mesodinium rubrum*. Annual chlorophyll

Table 4.3.1 Details of surveys

Identification in Map 4.3.1	*Frequency*	*Period*	*Reference*
CPR: 'S'	Monthly	1957 to present	
Southampton Water	Monthly	1987-1988	Leakey, Burkill & Sleigh 1992
Southampton Water	Occasional	1988	Hays, Purdie & Williams 1989
PS	Occasional	1976	Holligan *et al.* 1978
ZM	Occasional	1984	Agoumi 1985
Whole region	Occasional	1970-1984	Riley, Symonds & Woolner 1986
Channel	Occasional	1978-1979	Boucher 1980

Key: CPR: Continuous Plankton Recorder; PS: Plankton stations; ZM: Zooplankton measurement.

concentration is typically of the order of 10-20 g l^{-1} in the Solent, decreasing towards the sea. In deeper waters of the central English Channel, where strong mixing and turbidity occur, the spring phytoplankton bloom is delayed, with chlorophyll levels of only 0.5 g chl *a* l^{-1} and primary production of 4 mg C m^{-3} h^{-1} (Holligan *et al.* 1978). In comparison with other areas around the British Isles, in this region the overall abundance of the phytoplankton is very low and its seasonal duration short. Copepods, mainly *Temora longicornis, Acartia clausi, Pseudocalanus elongatus* and *Centropages hamatus,* typically dominate the zooplankton populations, forming more than 75%. During summer, zooplankton biomass levels are quite high (600-2,200 mg m^{-2}), although still substantially lower than those in French coastal waters. During winter, the biomass and production in the central Channel substantially decreases to <10 mg m^{-3} dry weight until April, when higher values start to reappear. Copepods are also the group with the highest diversity in the zooplankton, with overall zooplankton biodiversity increasing towards the open sea. The predatory zooplankton, including chaetognaths, decapods and medusae, peak between May and September, with fish eggs and larvae being of particular importance in the plankton between April and June.

4.3.3 Human activities

Plankton are of particular importance to coastal managers in this region since 'red tides' occur almost annually in Southampton Water, caused by the ciliate *M. rubrum*. The discolouration of the water usually appears between late May and mid-June and can last several weeks, with *M. rubrum* cell numbers exceeding 1,000 ml^{-1}. These blooms have a dramatic effect on the estuary by substantially depleting the oxygen concentration (Lockwood 1986). Although *M. rubrum* is generally accepted to be non-toxic, the degree to which other organisms in the estuary can tolerate oxygen levels of only 20-30% saturation in bottom waters has not yet been determined. There have also been isolated reports from around the world of fish and invertebrate mortalities associated with red tides caused by *M. rubrum* (Crawford, Purdie & Lockwood 1992).

4.3.4 Information sources used

With the exception of the data from the CPR survey, there are few long time series of plankton measurements in the central English Channel. Information on the distribution of plankton is almost entirely limited to sporadic surveys (e.g. Holligan *et al.* 1978; Boucher 1980; Agoumi 1985), and as a result little is known of the plankton in this region. MAFF's Directorate of Fisheries Research at Lowestoft undertook occasional surveys of this area during the 1970s and early 1980s, investigating the distribution of fish eggs and larvae (ichthyoplankton) in the plankton. The CPR survey is of particular importance because it provides long-term plankton data, which can be used to assess the effects of environmental variability and climatic changes on the marine biota. Table 4.3.1 summarises plankton surveys in Region 9, shown on Map 4.3.1.

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 633100
Plankton research	Head of Department, Department of Oceanography, Southampton University, University Road, Southampton SO9 5NH, tel: 01703 595000 ext. 3642
Ichthyoplankton	*Director, MAFF Directorate of Fisheries Research, Fisheries Laboratory, Lowestoft, tel: 01502 562244
Dorset plankton	Warden, Purbeck Marine Reserve, Dorset Wildlife Trust, 15 North Square, Dorchester, Dorset DT1 1HY, tel: 01305 264620

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

Chapter 5 Important species

5.1 Terrestrial lower plants

N.G. Hodgetts

5.1.1 Introduction

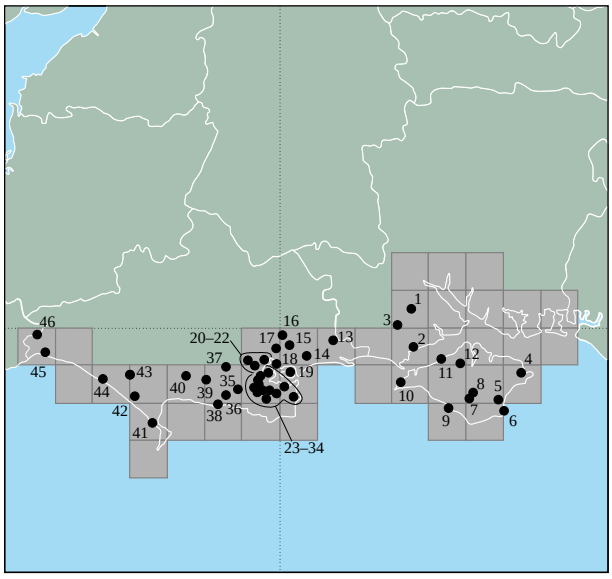
This section covers lichens, bryophytes (mosses and liverworts), stoneworts (a group of freshwater and brackish water algae - the latter are covered in section 5.4) and fungi occurring in the coastal 10 km squares within the boundaries of the region. This region is of great importance for lower plants, a reflection of its varied geology, the relatively warm climate and the great variety of habitats present. About 42% of the British bryophyte flora and about 34% 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. Many lower plants with predominantly Mediterranean distributions (e.g. the liverwort *Southbya nigrella*) reach the northern limits of their European distributions here. Particularly important lower plant habitats occurring include calcareous and non-calcareous coastal grassland, wet heath and bog, pasture woodland, crumbling cliffs, brackish lagoons and the largely anthropogenic 'wastes' of the Isle of Portland.

There are many sites of national importance for lower plants and at least one, the New Forest, of very great international importance. The most important lowland lichen site in Britain, the New Forest is probably also the best surviving example of pasture woodland in western Europe and is unique in its diversity of lichens and fungi. The bogs and wet heaths of Dorset are particularly important for their *Sphagnum* moss communities, which have distinctive southern elements. There are also many small, 'miscellaneous' sites, such as patches of coastal grassland, landslips, parklands, churchyards, pathsides etc., which individually do not appear very significant but which collectively comprise a substantial resource in this region.

5.1.2 Important locations and species

Table 5.1.1 shows all 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. Many are large, in which case the grid reference given refers to a reasonably central point. Sites are arranged in a clockwise order around the coast (Map 5.1.1).

Like higher plants (see section 5.2), lower plant species tend to occur in characteristic assemblages that are found in particular habitats. In this region, pasture woodland is important for all non-aquatic lower plant groups, but particularly for lichens and fungi. Some oceanic lichen and fungi species normally found further west occur in this region only in this habitat. Bryophytes, particularly *Sphagnum* spp. and including the scarce *S. pulchrum*, which



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

is particularly abundant in this area, are often dominant or co-dominant in the bogs and wet heaths. Some specialist fungi also occur.

The dynamic nature of the region's crumbling cliffs and landslips ensures that there is a constant supply of fresh ground available for colonisation by lower plants, including many rare and scarce southern species (e.g. *Southbya nigrella*, *Philonotis marchica*). Important areas of coastal (usually cliff-top) grassland and heath usually have thin turf with complex mosaics rich in bryophytes, lichens and higher plants. The often extensive unstable areas here maintain bare ground for colonisation by some of the rare ephemeral lower plants of this habitat. Calcareous grassland is usually richer in species than neutral or acidic grassland, and the occurrence of the lichen *Fulgensia fulgens* in some abundance on chalk downland on the Isle of Wight is particularly notable. Exposed rocks in this habitat are often good for southern warmth-loving species of bryophyte. The Isle of Portland is pock-marked with disused limestone quarries, where the thin soil overlying the limestone supports a characteristic community of rare and scarce bryophytes, including *Southbya nigrella*, *Eurhynchium meridionale* and *Gymnostomum viridulum*. Some specialist aquatic species of all groups occur where there are streams and rivers. Some lichen species are specialists of coastal shingle: for example, the most nutrient-poor areas of stable shingle at Chesil Beach and Browndown support a bryophyte and lichen flora containing *Dicranum scoparium*, *Ceratodon purpureus*,

Racomitrium canescens complex and *Cladonia* spp. including *C. cervicornis verticillata, C. coccifera, C. foliacea, C. furicata,* and *C. rangiformis*.

The area contains a number of threatened species, some of which are given special protection under national and international legislation. These and other Red Data Book (i.e. nationally rare) species, excluding those with a status of Indeterminate, Insufficiently Known or Extinct (out of a total of 223 bryophytes, twelve stoneworts and 368 lichens on the British Red Lists), are listed in Table 5.1.2. In addition, the region holds 68 of the 313 nationally scarce bryophytes and three of the six nationally scarce stoneworts (provisional figures). There is currently insufficient information to provide regional lists of nationally scarce fungi and lichens.

5.1.3 Human activities

Current factors that may have a bearing on the lower plant flora of the region include housing and industrial developments and road construction programmes. Lowering of the water table may have an effect on wetland sites, particularly bogs and wet heath. Some areas are affected by holiday and leisure developments such as caravan sites and golf courses. Cliff-top grassland and heathland are subject to erosion in some places. Pollution is a general problem but may be aggravated in some areas by agricultural run-off, oil spillages etc. Specific issues relevant to the New Forest are important in this region, for example grazing of ponies, ownership matters, commoners' rights etc. Commercial collection of edible fungi has recently become an important issue in the New Forest.

Many of the larger and more important sites in the region are NNRs or SSSIs and therefore nature conservation is taken into account in their management. Management considerations on these and other sites that are important for lower plants include the following. Overgrazing in the important pasture woodland areas has an effect on the lower plant communities in the long term, as the woods tend to become more senescent (dominated by older trees). On the other hand, undergrazing leads to the development of a thick understorey of shrubs such as holly, and should also be avoided: a balance needs to be struck. Burning of bog and heathland sites is usually damaging to the lower plant communities. Equally damaging, particularly in wet heathland sites, is scrub invasion. However, coastal scrub is often important for lower plants, and any clearance operations should be handled with care. A close species-rich sward with some bare soil should be maintained at important coastal grassland sites: the correct grazing regime, a certain amount of instability and a low level of nutrient input is often desirable to achieve this. Open areas on the Isle of Portland should be maintained and kept free from brambles and other scrub.

Table 5.1.1 Lower plant sites in coastal 10 km squares

Site no.	*Site name*	*Grid ref.*	*Protected status*
	Hampshire		
1	New Forest	SU3404	part SSSI
2	Hurst Castle & Lymington River Estuary	SZ3494	SSSI
3	Roydon Woods	SU3000	SSSI
	Isle of Wight		
4	Brading Marshes	SZ6287	SSSI
5	Greatwood & Cliff Copses	SZ5780	SSSI
6	Bonchurch Landslips	SZ5878	SSSI
7	The Wilderness	SZ5082	SSSI
8	Cridmore Bog	SZ4981	SSSI
9	Hanover to St. Catherine's Point	SZ4479	SSSI
10	Headon Warren & West High Down	SZ3185	SSSI
11	Newtown Harbour	SZ4291	SSSI
12	Parkhurst Forest	SZ4790	part SSSI
	Dorset		
13	Town Common	SZ1396	SSSI
14	Bourne Valley	SZ0692	SSSI
15	Canford Heath	SZ0295	SSSI
16	Corfe & Barrow Hills	SZ0097	SSSI
17	Upton Heath	SY9894	SSSI
18	Ham Common	SY9890	SSSI
19	Poole Harbour (Brownsea Island)	SZ0288	SSSI
20	Holton Heath	SY9591	SSSI
21	Morden Bog	SY9191	SSSI
22	Sandford Heath	SY9390	SSSI
23	Stoborough & Creech Heaths	SY9384	SSSI
24	The Moors	SY9587	SSSI
25	Arne	SY9688	SSSI
26	Hartland Moor	SY9485	SSSI
27	Blue Pool & Norden Heath	SY9383	SSSI
28	Norden	SY9483	SSSI
29	Hartland Moor	SY9485	SSSI
30	Thrasher's Heath	SY9783	SSSI
31	Brenscombe Heath	SY9882	SSSI
32	Studland & Godlinston Heaths	SZ0184	SSSI, part NNR
33	Ballard Down	SZ0381	not protected
34	Corfe Common	SY9681	SSSI
35	Povington & Grange Heaths	SY8984	SSSI
36	Lulworth Park & Lake	SY8582	SSSI
37	Hyde Heath	SY8589	SSSI
38	South Dorset Coast	SY8380	SSSI
39	Winfrith Heath	SY8086	SSSI
40	Warmwell Heath	SY7587	SSSI
41	Isle of Portland	SY6872	part SSSI
42	Chesil & The Fleet	SY6081	SSSI
43	Valley of Stones	SY6087	SSSI
44	Abbotsbury Castle	SY5686	SSSI
45	Newlands Batch	SY3893	SSSI
46	Lambert's Castle	SY3698	SSSI

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

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 mentioned in this section were selected for protection partly or wholly on the basis of their bryophyte and lichen interest. Many of the sites contain rare and scarce species and qualify for SSSI status on the basis of their lower plant flora alone (Hodgetts 1992). Most important bryophyte sites in the region are well documented. The computerised database at the Biological Records Centre (BRC), Monks Wood, and the Lower Plants Database at JNCC include recent records collected over decades by expert bryologists as well as important historical records. Dorset and large parts of Hampshire are

Table 5.1.2 Red Data Book lower plants

Species	*Locations/habitat*
Liverworts	
Cephaloziella baumgartneri	Calcareous rock, St. Catherine's Point, Isle of Wight, & Portland
Cephaloziella turneri	Calcareous ground, Parkhurst Forest, Isle of Wight
Pallavicinia lyellii	The Wilderness, Isle of Wight, & South Hampshire (unlocalised record)
*Southbya nigrella***	On wet compacted limey soil on Portland and on boulders at St. Catherine's Point, I. of Wight
Mosses	
*Acaulon triquetrum***	On skeletal soil in cliff-top grassland on the south coast of the Isle of Wight
*Drepanocladus vernicosus**	Small-sedge fen in the New Forest
Ephemerum stellatum	Hayling Island, Hampshire (unlocalised record)
Eurhynchium meridionale	Thin turf over limestone at several places on Portland
Funaria pulchella	Thin soil over limestone on Portland
Habrodon perpusillus	Near Chapman's Pool, Purbeck, Dorset
Leptodontium gemmascens	Near Brighstone, Isle of Wight
Philonotis marchica	Soil slumps and wet sandstone in Blackgang Chine, Isle of Wight
Tortula cuneifolia	Lee-on-the-Solent, Hampshire
Tortula rhizophylla	Near Brook Green, Isle of Wight (stubble field)
Weissia squarrosa	Near Combley Great Wood, Isle of Wight (stubble field)
Weissia tortilis	Open chalk turf at scattered sites in Dorset & the Isle of Wight
Stoneworts	None (but see section 5.4)
Lichens	
Arthonia astroidestra	Smooth bark in New Forest (unlocalised record)
Bacidia herbarum	On mosses on chalk turf, Bindon Hill and Durdle Door, Dorset
Bacidia incompta	Basic bark at a number of localities throughout region
Buellia saxorum	On sarsen stones in the Valley of Stones, Dorset
Calicium adspersum	New Forest area, probably on old oak bark (unlocalised records)
Caloplaca flavorubescens	Trees near Anderson (ash) and Kingston, Dorset
Caloplaca luteoalba	Elm bark (unlocalised records throughout region)
Catillaria laureri	Beech trunks in Busketts Wood, New Forest
Cladonia peziziformis	On acid soil near Lambert's Castle, Dorset
Cliostomum corrugatum	On birch, Brownsea Island, Dorset
Collema fragile	Shaded limestone boulder, Isle of Portland, Dorset
Collema fragrans	Nutrient-enriched bark, several localities in Dorset and Hampshire
Cryptolechia carneolutea	Elm bark, several localities in Dorset and Isle of Wight
Cyphelium tigillare	Gatepost near Brockenhurst, Hampshire
Dictyonema interruptum	On tree trunk, Wareham, Dorset (but probably now extinct)
Diploschistes gypsaceus	Calcareous rock, Dorset (unlocalised records)
Enterographa sorediata	Dry side of oak trunks, New Forest
Fulgensia fulgens	Thin soil in chalk downland, Tennyson Down, Isle of Wight
Lecanactis amylacea	Ancient oak bark, New Forest
Lecania chlorotiza	On tree, Isle of Wight (unlocalised record)
Opegrapha fumosa	Mature oak trunks, New Forest
Parmelia minarum	On beech, New Forest
Parmelia quercina	Well-lit trees at scattered sites throughout region
Pertusaria velata	Bark of mature trees, New Forest and other unlocalised records
Physcia tribacioides	Well-lit trees near Brading, Isle of Wight, and Lymington, Hampshire
Poeltinula cerebrina	On limestone, Isle of Portland, Dorset
*Teloschistes flavicans***	On trees at Hyde Wood and Lulworth Park, Dorset
Wadeana minuta	Bark of mature trees, New Forest
Zamenhofia rosei	Old oaks in the New Forest

Sources: References listed in section 5.1.5c and JNCC's lower plant database. For fungi there is insufficient information for a reliable assessment to be made of the rarity of individual species. Key: *protected under Annex II of the EC Habitats & Species Directive and Appendix I of the Bern Convention; **protected under Schedule 8 of the Wildlife & Countryside Act 1981.

reasonably well known through systematic recording for County Floras.

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 Tables 5.1.1 and 5.1.2. Some of the sites listed have only rather inadequate information for lichens, particularly microlichens. However, most of the larger and more well known sites have had at least some degree of lichen survey in recent years. The New Forest is a mecca for lichenologists, and is becoming progressively more well known.

Data collation for fungi is still at a relatively early stage, and it is not yet possible to incorporate fungi into criteria for selecting sites for protection, 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.

With the exception of stoneworts, algae are poorly known. No sites are currently selected for protection on the basis of their algae other than 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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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 9389123
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 267 1950
Bryophytes & lichens (general and epiphytic)	R. Stern, County Recorder Southern Hampshire, Botany Bay, Main Street, Fishbourne, Chichester PO18 8AY, tel: 01243 5734318
Fungi (general and sand dune)	M. Rotheroe, Fern Cottage, Falcondale, Lampeter, Dyfed SA48 7RX, tel: 01570 422041
Fungi (British Mycological Society database)	Dr P. Cannon, International Institute of Mycology, Bakeham Lane, Englefield Green, Egham, Surrey TW20 9TY, tel: 01784 470111
Bryophytes (Dorset)	Dr M.O. Hill, Institute of Terrestrial Ecology, Monks Wood, Abbots Ripton, Huntingdon PE17 2LS, tel: 014873 381
Bryophytes (BRC database)	*C.D. Preston, Biological Records Centre, ITE Monks Wood, tel: 01487 773381
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.

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), particularly species that are rare or scarce in Great Britain, occurring in the region's coastal 10 km national grid squares, whether or not they are regarded as 'coastal' species. The region is of international importance for rare and scarce species (Table 5.2.1). Classic British botanical localities include the Isle of Wight coast, St. Alban's Head and the Isle of Portland, as well as the New Forest and the Dorset heaths, which although overlapping with the coastal region and affected by the coastal climate, are not strictly maritime in nature.

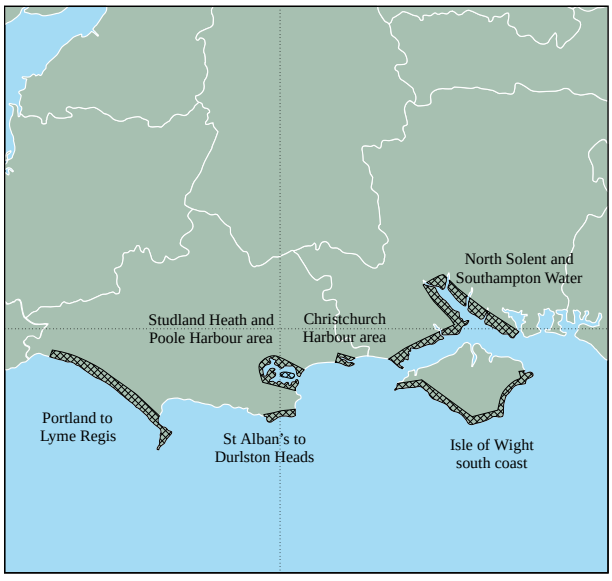
The special conditions that support centres of exceptional plant biodiversity, such as those in Map 5.2.1, are a combination of geology, climate and history. The geology of the region is particularly diverse and includes sequences of chalk, clay, sand and limestone, all of which can support diverse assemblages of plants. The climate is generally mild: the coastal strip itself is virtually frost-free (Roberts 1984), and south-facing slopes can become very hot and dry. The combination of chalk exposures with the coastal climate results, in the Isle of Wight, in some of the best examples of maritime chalk grassland in the country. Because of these factors, a number of different elements, defined by Matthews (1955), are found in the flora. Typically southern continental species can be divided into those with a continental distribution, such as early spider-orchid *Ophyrs sphegodes* and yellow-vetch *Vicia lutea*; and oceanic types, including Bithynian vetch *Vicia bithynica*, narrow-leaved water-dropwort *Oenanthe silaifolia* and yellow bartsia *Parentucellia viscosa*. 'Mediterranean' species represented include nit-grass *Gastridium ventricosum*, sea-heath *Frankenia laevis* and shrubby sea-blite *Suaeda vera.*

A number of Britain's most threatened species are present in this region, including seventeen that are amongst the 107 listed on Schedule 8 of the Wildlife & Countryside Act (1981). Seventeen of the 317 nationally rare (RDB) species listed for Great Britain in the *British Red Data Book of vascular plants* (Perring & Farrell 1983) occur in the region. Of the 254 scarce (i.e. known from up to 100 ten km squares in Great Britain) species in Great Britain, 108 occur in this region (Stewart *et al.* 1994).

Table 5.2.1 Numbers of rare and scarce coastal species*

	*Protected species***	*Other rare (RDB) species*	*Scarce species*
Hampshire	5	8	77
Isle of Wight	6	2	64
Dorset	11	15	86
Region 9	***17***	***18***	***108***

Sources: JNCC Rare Plants database; Stewart *et al.* (1994; 1993 draft used); BRC database. Key: RDB = Red Data Book; *excludes known introductions and records from before 1970; **listed for special protection in the Wildlife & Countryside Act (1981) or on appropriate annexes of the EC Habitats Directive or the Bern Convention.



Map 5.2.1 Key localities for rare and scarce higher plants (listed in Table 5.2.3). Source: adapted from BRC data.

Of the nine vascular plant species protected under European law that occur in Britain, one, the endemic (i.e. occurring nowhere else) early gentian *Gentianella anglica*, is found in this region, where it has its stronghold. Although not nationally rare, since 1930 it has declined from over 60 ten km squares to 36; it is now considered to be vulnerable (Perring & Walters 1990; Morgan & Palmer 1991). There are still some large early gentian populations in the region: at least two million plants can be counted in the Isle of Wight in good years and there were over 200,000 in Dorset in 1994 (D. Pearman pers. comm.).

The New Forest and the Dorset heaths include heathland habitats that are listed in Annex I of the EU Habitats Directive.

5.2.2 Important locations and species

Overall, the region is exceptionally rich in rare species (Table 5.2.2). Two subspecies of rock sea-lavender grow on the Isle of Portland: one, *Limonium recurvum* subsp. *recurvum*, is endemic to Portland. The other subspecies, *L. recurvum* subsp. *portlandicum*, is otherwise known only from County Kerry in Ireland. Three other rare species are known in Britain only from this region: slender centaury *Centaurium tenuiflorum*, wood calamint *Calamintha sylvatica* and viper's-grass *Scorzonera humilis*; and seven have their British stronghold in the region: Dorset heath *Erica ciliaris*, with around two-thirds of its localities in Dorset (Perring & Farrell 1983), where its range may be expanding (Chapman & Rose 1994), Hampshire purslane *Ludwigia palustris*, Martin's ramping-fumitory *Fumaria martinii*, wild gladiolus *Gladiolus illyricus*, field cow-wheat *Melampyrum arvense*, pennyroyal *Mentha pulegium* and small fleabane *Pulicaria vulgaris*.

Table 5.2.2 Recorded occurrence of nationally rare (RDB) and/or protected species

Species	*Recorded occurrence in*			*Key localities*	*Habitat*
	10 km squares in GB	*10 km squares in region*	*No. of sites in region (approx.)*		
Bermuda-grass *Cynodon dactylon*[5]	16	4	7	North Solent & Southampton Water; Bournemouth (SZ09); Studland Heath & Poole Harbour area	Open sandy vegetation
Compact brome *Bromus madritensis*	17	2	2	Portland to Lyme Regis	Roadsides
Dorset heath *Erica ciliaris*[4]	11	5	25	Studland Heath & Poole Harbour area; Dorset heaths & grassland (SU30, SY89, SY99, SZ08)	Lowland heath
Dwarf spike-rush *Eleocharis parvula*	5	2	2	North Solent & Southampton Water; Christchurch Harbour area	Intertidal mud
Early gentian *Gentianella anglica*[1, 2, 3]	36	17	>50	Widespread	Chalk & dunes
Early sand-grass *Mibora minima*	6	1	1	Studland Heath & Poole Harbour area	Open sandy ground
Early spider-orchid *Ophrys sphegodes*[1]	14	2	4	St Alban's to Durlston Heads	Dry calcareous grassland
Field cow-wheat *Melampyrum arvense*[1]	7	1	1	Isle of Wight south coast	Disturbed chalk
Four-leaved allseed *Polycarpon tetraphyllum*	12	2	2	Studland Heath & Poole Harbour area; Portland to Lyme Regis	Open sandy ground
Grass-poly *Lythrum hyssopifolia*[1, 4]	6	1	1	Dorset heaths & grassland (SY99)	Wet hollows in arable fields
Hairy-fruited cornsalad *Valerianella eriocarpa*	6	3	4	St. Alban's to Durlston Heads; Portland to Lyme Regis	Rocky places
Hampshire-purslane *Ludwigia palustris*[4]	6	3	12	New Forest (SU30, SU40, SZ39)	Shallow pools
Heath lobelia *Lobelia urens*	6	3	2	Christchurch (SZ19, SZ29); Dorset heaths (SY78)	Damp heaths
Hoary stock *Matthiola incana*[5]	11	3	10	Isle of Wight south coast; Portland to Lyme Regis (may not be native at latter site)	Cliffs
Jersey cudweed *Gnaphalium luteoalbum*[1, 4]	2	1	1	Dorset heaths & grassland (SY99)	Sandy places
Little-robin *Geranium purpureum*	21	11	16	Langstone Harbour (SU70); North Solent & Southampton Water; Portland to Lyme Regis	Rocky & stony places
Lizard orchid *Himantoglossum hircinum*[1, 4]	18	1	1	Dorset heaths & grassland (SY99)	Calcareous grassland
Martin's ramping-fumitory *Fumaria martinii*[1]	3	1	1	Isle of Wight south coast	Allotments
Nit-grass *Gastridium ventricosum*	23	3	8	North Solent & Southampton Water; St Alban's to Durlston Heads; near Weymouth (SY78); Portland to Lyme Regis	Open grassland & arable fields
Oxtongue broomrape *Orobanche loricata*[1]	3	1	1	Isle of Wight south coast	Parasite on hawkweed oxtongue *Picris hieracioides*
Pennyroyal *Mentha pulegium*[1]	12	3	18	New Forest (SZ29, SZ39); Portland to Lyme Regis	Inundation grassland
Pheasant's-eye *Adonis annua*		1	1	St. Alban's to Durlston Heads	Cultivated & waste ground
Rock sea-lavender *Limonium recurvum*	*c.* 4	2	2	Portland to Lyme Regis	Limestone rocks & cliffs
Sea knotgrass *Polygonum maritimum*[1]	4	1	1	Christchurch Harbour area	Sandy beaches
Sharp-leaved pondweed *Potamogeton acutifolius*[6]	11	1	1	Studland Heath & Poole Harbour area	Ditches in grazing marshes
Slender bird's-foot-trefoil *Lotus angustissimus*		1	1	North Solent & Southampton Water	Dry grassland & shingle
Slender centaury *Centaurium tenuiflorum*[1]	2	2	4	Isle of Wight south coast; Portland to Lyme Regis	Open grassland & unstable cliffs

Table 5.2.2 Recorded occurrence of nationally rare (RDB) and/or protected species (continued)

Species	*Recorded occurrence in*			*Key localities*	*Habitat*
	10 km squares in GB	*10 km squares in region*	*No. of sites in region (approx.)*		
Slender cottongrass *Eriophorum gracile*[1, 4]	6	2	1	New Forest (SZ29, SU30)	Valley mires
Slender marsh-bedstraw *Galium debile*	7	4	17	New Forest (SU30, SU40, SZ29, SZ39)	Inundation grassland
Small fleabane *Pulicaria vulgaris*[1]	9	2	3	New Forest (SU31); Avon Valley (SZ19)	Inundation grassland
Stinking goosefoot *Chenopodium vulvaria*[1]	12	2	2	Dorset heaths & grassland (SY99); Portland to Lyme Regis	Open waste ground
Viper's-grass *Scorzonera humilis*[1, 4]	1	1	1	Studland Heath & Poole Harbour area	Wet grassland
Wild gladiolus *Gladiolus illyricus*[1, 4]	6	2	9	New Forest (SZ29, SZ30)	Acid grassland
Wood calamint *Calamintha sylvatica*[1]	1	1	1	Isle of Wight (SZ48)	Scrubby woodland
Yarrow broomrape *Orobanche purpurea*	17	4	8	Isle of Wight south coast; Arreton (SZ58); Portland to Lyme Regis	Parasite on yarrow *Achillea millefolium*

Sources: JNCC rare plants database and rare plant survey reports. Key: [1]Schedule 8, Wildlife & Countryside Act 1981; [2]Annexes IIb & IVb Ec Habitats Directive; [3]Annex I, Bern Convention; [4]confined in the region to the New Forest area or the Dorset Heaths and grassland; [5]may be introduced; [6]candidate Red Data Book species, known to have declined in Europe: figures given are provisional; [7]candidate Red Data Book species, not yet fully listed in the rare plant database: figures are provisional. Notes: figures are for numbers of 10 km squares in GB in which species recorded since 1970, excluding known extinctions. Grid references are given for localities not shown on Map 5.2.1.

The region is also the stronghold of a number of other scarce species of which it contains some of the largest and/or most secure populations. Examples include bog hairgrass *Deschampsia setacea*, brown beak-sedge *Rhynchospora fusca*, coral-necklace *Illecebrum verticillatum*, divided sedge *Carex divisa*, dotted sedge *Carex punctata*, marsh clubmoss *Lycopodiella inundata*, mossy stonecrop *Crassula tillaea*, narrow-leaved lungwort *Pulmonaria longifolia* and yellow centaury *Cicendia filiformis*. Conversely, some scarce species, such as marsh sow-thistle *Sonchus palustris* and shrubby sea-blite *Suaeda vera*, occur as outliers of distributions centred elsewhere.

Rare and scarce species grow in a wide range of habitats, but of particular importance are calcareous grassland and cliffs, mires, woodland, cultivated ground, inundation grassland and grazing marshes. Transitions between different habitat types are an important feature of some of the key localities, in terms of their quality and species diversity, for example from mudflats through saltmarsh to heathland and pasture, as in Poole Harbour, or the complex mosaics of chalk, sand and gravel substrates with associated chalk heath in the Isle of Wight. Key localities for the region's rare and scarce species are shown on Map 5.2.1 and listed in Table 5.2.3. In addition to the key localities that are noted for rarities, there are many moderately species-rich sites throughout the region.

5.2.3 Human activities

In the past, some species have been threatened by collecting, particularly in the era of botanical exchange clubs around the end of the last century, when herbarium specimens were swapped amongst botanists. Apart from certain 'choice' species, such as wild gladiolus, problems of collecting have passed.

Many of the rare species depend on the maintenance of open vegetation and cannot compete if vigorous or weedy species dominate. Where swards are undergrazed or dunes over-stabilised, populations of species such as pennyroyal, viper's-grass and early spider-orchid can diminish; species such as four-leaved allseed *Polycarpon tetraphyllum* and sea knotgrass *Polygonum maritimum* depend on trampling. Under-management of ditches is thought to have resulted in the loss from the region of one rare species, cut-grass *Leersia oryzoides* (FitzGerald 1990). Changes in land use, such as afforestation and agricultural intensification, can also affect rare species. Examples include the reduction in range of field cow-wheat with the introduction of more intensive arable farming, and species of the heaths of Dorset, where a recent survey suggests that over 80% of heathland sites existing in the 1930s have since been damaged by afforestation or lack of grazing (Byfield & Pearman 1994).

Construction projects for industry, sea defences, roads, recreation and residential developments can affect species indirectly or by land claim: as most of the important sites for rare species have been designated as Sites of Special Scientific Interest (SSSI), these factors now affect scarce species more intensely than rare ones. Examples include early gentian (Morgan & Palmer 1991) and Babington's leek *Allium ampeloprasum* var. *babingtonii* (FitzGerald 1990).

Mineral extraction has removed sites of some rare species such as slender bird's-foot-trefoil (Everett 1988), and aquatic plants such as sharp-leaved pondweed *Potamogeton acutifolius* and pillwort *Pilularia globulifera* are vulnerable to changes in water quality.

5.2.4 Information sources used

All the counties in the region were covered by rare plant surveys between 1985 and 1989, and a series of detailed confidential reports were produced, now held by English Nature and the Joint Nature Conservation Committee

Table 5.2.3 Key localities for nationally rare (RDB) and scarce species

Locality	*Species*	*Status*
North Solent & Southampton Water	RDB: Bermuda grass *Cynodon dactylon*, dwarf spike-rush *Eleocharis parvula*, little-robin *Geranium purpureum,* nit-grass *Gastridium ventricosum*, slender bird's-foot-trefoil *Lotus angustissimus* Scarce species: annual beard-grass *Polypogon monspeliensis*, brown beak-sedge *Rhynchospora fusca*, coral-necklace *Illecebrum verticillatum*, marsh sow-thistle *Sonchus palustris*, narrow-leaved lungwort *Pulmonaria longifolia*, small cord-grass *Spartina maritima*, yellow centaury *Cicendia filiformis*, plus 37 other scarce species	part SSSI part NNR part LNR part undersignated
Isle of Wight south coast (St. Helen's Ledges to Freshwater Cliffs)	RDB: early gentian *Gentianella anglica*, field cow-wheat *Melampyrum arvense*, hoary stock *Matthiola incana*, Martin's ramping-fumitory *Fumaria martinii*, oxtongue broomrape *Orobanche loricata*, slender centaury *Centaurium tenuiflorum*, yarrow broomrape *Orobanche purpurea* Scarce species: autumn squill *Scilla autumnalis,* galingale *Cyperus longus*, narrow-leaved lungwort, sea heath *Frankenia laevis*, white horehound *Marrubium vulgare*, plus 29 other scarce species	part SSSI part LNR part undesignated
Christchurch Harbour area	RDB: dwarf spike-rush *Eleocharis parvula*, sea knotgrass *Polygonum maritimum* Scarce species: brown beak-sedge, plus 21 other scarce species	SSSI
Studland Heath & Poole area	RDB: Bermuda grass, Dorset heath *Erica ciliaris;* early gentian, early sand-grass *Mibora minima*, four-leaved allseed *Polycarpon tetraphyllum*, sharp-leaved pondweed *Potamogeton acutifolius*, viper's-grass *Scorzonera humilis* Scarce species: annual beard-grass, brown beak-sedge, galingale, narrow-leaved lungwort, yellow centaury plus 42 other scarce species	part SSSI part NNR part LNR part undesignated
St. Alban's to Durlston Heads	RDB: early gentian, early spider-orchid *Ophrys sphegodes*, hairy-fruited cornsalad *Valerianella eriocarpa*, nit-grass, pheasant's-eye *Adonis annua* Scarce species: galingale, slender bedstraw plus 29 other scarce species.	part SSSI part NNR part LNR part undesignated
Portland to Lyme Regis	RDB: compact brome *Bromus madritensis*, early gentian, four-leaved allseed, hairy-fruited cornsalad, heath lobelia, hoary stock *Matthiola incana*, little-robin, nit-grass, pennyroyal, rock sea-lavender *Limonium recurvum*, slender centaury, stinking goosefoot, yarrow broomrape Scarce species: Babington's leek *Allium ampeloprasum* var. *babingtonii*, long-stalked orache, spiral tasselweed plus 39 other scarce species.	part SSSI part undesignated

Source: JNCC Rare Plants database and rare plant survey reports. Key: SSSI = Site of Special Scientific Interest; NNR = National Nature Reserve; LNR = Local Nature Reserve. Note: 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.

(JNCC). Further work has been carried out by English Nature as part of their programme of monitoring. *Endangered wildife in Dorset: the county Red Data Book* (Mahon & Pearman 1993) is a useful source. JNCC maintains a database of nationally rare plant species, which includes site records. 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 *et al.* 1994).

5.2.5 Acknowledgements

Thanks are due to J.H. Barne, M.A. Palmer, D. Pearman, 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 - Hampshire and Isle of Wight	*English Nature, Hants. & IoW Local Team, Lyndhurst, tel: 01703 283944
Species on SSSIs and NNRs, other protected areas, rare and scarce species, rare plant surveys, licensing and protected species - Dorset	*English Nature, Dorset Local Team, Arne, tel: 01929 556688
Database of rare and protected species	*Species Conservation Branch, JNCC, Peterborough, tel: 01733 62626
Biological Records Centre: Hampshire	*Ms N. Court, Ecology Section, Planning Dept., Hampshire County Council, Winchester, tel: 01962 846741
Biological Records Centre: Dorset	*Keeper of Records, Dorset Environmental Records Centre, Dorchester, tel: 01305 224281
Local BSBI vice-county records	*C.D. Preston, ITE Monk's Wood, Huntingdon, tel: 01487 773381
Higher plants in Hampshire	*Hampshire Flora Group, Hampshire & Isle of Wight Wildlife Trust, Eastleigh, tel: 01703 613636
Higher plants in Isle of Wight	*Colin Pope, County Ecologist, Isle of Wight Council, Newport, tel: 01983 821000

* 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 insects 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. Lagoonal species are covered in section 5.4.

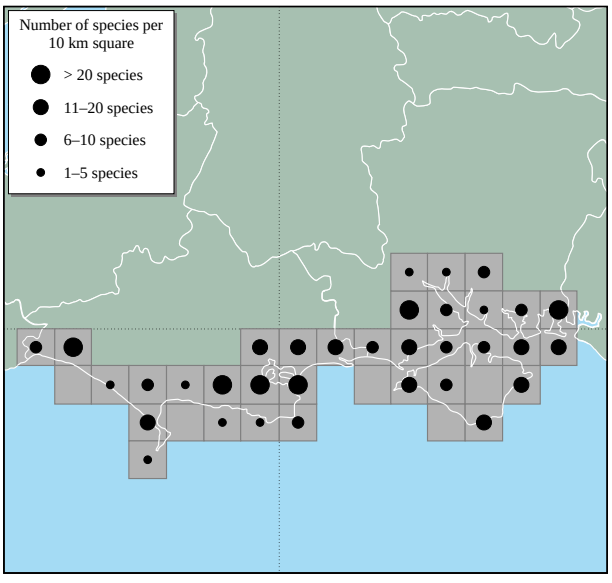
An impressive number of Red Data Book (RDB - nationally rare) and Nationally Scarce species are represented along the region's coast, exhibiting a particularly rich species diversity. Of the 358 coastal RDB and 455 coastal Nationally Scarce invertebrate species that are listed by Kirby (1994a, b) as known to be associated with coastal habitats, 93 and 194 respectively have been recently recorded from the region (data from JNCC's Invertebrate Site Register (ISR)). These totals include recent (post 1969) records for twenty RDB Hymenoptera (bees, wasps and ants), thirteen RDB Coleoptera (beetles) and seven RDB Lepidoptera (moths and butterflies). 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 of the region; Map 5.3.2 is the equivalent map for Nationally Scarce invertebrates. Note that survey effort has not been equal throughout the region, so actual occurrence may differ from recorded distributions.

The region is nationally important for the conservation of many coastal invertebrates that are either restricted to or have a large part of their range within this area, many of which for climatic reasons are at the edge of their range in

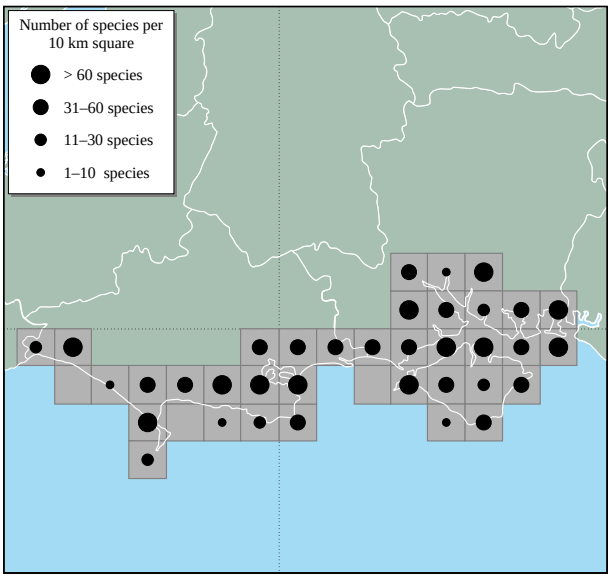
Table 5.3.1 Protected invertebrate species

Species	*Protected status*	*Comments*
Hampshire and Dorset		
Southern damselfly *Coenagrion mercuriale*	1, 3	
Medicinal leech *Hirudo medicinalis*	2, 4, 5*, 6	
Hampshire, the Isle of Wight and Dorset		
Desmoulins' whorl snail *Vertigo moulinsiana*	1	
Mole cricket *Gryllotalpa gryllotalpa*	5	Status uncertain
The Isle of Wight		
Reddish buff moth *Acosmetia caliginosa*	5	
A water beetle *Paracymus aeneus*	5**	
The Isle of Wight and Dorset		
Wart-biter *Decticus verrucivorus*	5	Old record and an unconfirmed recent sighting

Source: JNCC's Invertebrate Site Register. Key: protected status codes: 1 = Annex II, EC Habitats Directive; 2 = Annex V, EC Habitats Directive; 3 = Appendix II, Bern Convention; 4 = Appendix III, Bern Convention; 5 = Schedule 5, Wildlife & Countryside Act 1981 (excluding Schedule 5 section 9(5): sale only); 6 = Appendix II, CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora); *variation of Schedule Order 1988; **variation of Schedules 5 and 8 Order 1992.



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



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

Britain. In addition, this region hosts substantial proportions of both the British Orthoptera (crickets and grasshoppers) and Odonata (dragonflies and damselflies) fauna, some areas being nationally important for species assemblages.

Seven species of terrestrial and freshwater pool invertebrates recorded from the region are afforded legal protection under various international directives and conventions or are listed on Schedule 5 of the Wildlife & Countryside Act 1981 (Table 5.3.1).

5.3.2 Important locations and species

Table 5.3.2 lists coastal RDB species recently recorded from the region. Among the species wholly or mainly restricted to this region are the shore bug *Saldula setulosa* (known only from Dorset), the scaly cricket *Pseudomogoplistes squamiger* (restricted to Dorset), the ground beetle *Cicindela germanica* (known from the Isle of Wight and Dorset), the Glanville fritillary butterfly *Melitaea cinxia* (known primarily from the Isle of Wight), the mason bee *Osmia xanthomelana* (the Isle of Wight), the British whorl snail *Truncatellina callicratis* (colonies along the coast from the Isle of Wight to south Devon), and the moths *Eudarcia richardsoni* (Dorset only and a GB endemic), *Ischnoscia borreonella* (Dorset and south Devon) and Morris's wainscot moth *Photedes morrisii morrisii* (known from a small area on the south Devon and Dorset coast). Subspecies *lunigera* of the crescent dart moth *Agrotis trux*, which is known from several sites along this part of the coast, is recorded from only a very small number of sites outside the British Isles. Subspecies *cretaceus* of the silver-studded blue butterfly *Plebejus argus* is now known only on Portland, Dorset (Heath & Emmet 1990). The small weevil *Pachytychius haematocephalus* has only ever been recorded on herb-rich grassland on steep south-facing slopes in Dorset and south Hampshire, and is currently known from only one site: Gilkicker Fort.

The ISR has records for just over 350 coastal sites within this region, some of them subsites of larger areas. Several support a number of RDB species, while many are the habitats of a range of Nationally Scarce species. Table 5.3.3 lists sites of major importance for the conservation of invertebrates. Site selection was based on the range and/or scarcity of species present, the species habitat associations and the amount of the available habitat. Four of the twenty sites listed as nationally outstanding for Orthoptera (grasshoppers and crickets) and allied families (Marshall & Haes 1988) are found in this region: the Isle of Portland (fourteen species); the Dorset Heathlands (from Winfrith Heath to Newton Heath and Littlesea by Studland Bay; 24 species); the Purbeck Hills (from Worbarrow Bay to The Foreland at Studland; 21 species); and the New Forest (including Needs Ore; 24 species). A mapping scheme for the Odonata (dragonflies and damselflies) of Dorset (Prendergast 1991) has indicated that many areas support impressive assemblages. Since 1970, between 25 and 27 species (excluding vagrants) have been recorded in each of the four 10 km squares around Poole Harbour (centred on OS grid reference SZ0090).

Table 5.3.2 Coastal Red Data Book (RDB) species with post 1969 records

Species	*Notes*
RDB 1	
Anthophora retusa	A solitary bee, formerly widespread in England but now restricted to a few southern localities.
Atylotus rusticus	A horsefly recorded recently from the Lewes/Pevensey Levels and Farlington Marshes. Old records from the Cambridgeshire fens, where it is now presumed extinct. Larvae probably live in pools or damp mud.
Cafius cicatricosus	A rove beetle recorded only in and under drifted seaweed or the sand under it. Predatory, mainly on fly (Diptera) larvae. Known only from south coast of England.
Drypta dentata	A 7-9 mm long metallic blue ground beetle with red appendages. Found in moist places on or near the coast. Very rare, previously known from various places on the south coast, but now only from a single site on the Isle of Wight and from a site in Dorset.
Melecta luctuosa	A bee recorded mainly from southern heathland but with some coastal sites. A nest parasite of the endangered bee *Anthophora retusa*. It is rare and has declined dramatically since the beginning of the century. Very few post 1969 records.
Nomada errans	A nomad bee recorded from a short stretch of the Dorset coast near Swanage. A nest parasite of the rare bee *Andrena nitidiuscula*.
Omophlus rufitarsis	A beetle found between a coastal shingle bank and saltmarsh. Adults are found on flowers and at the roots of thrift *Armeria maritima*. Also found under wet seaweed at the edge of tidal pools in saltmarsh.
Osmia xanthomelana	A solitary bee which was quite widespread in England in the last century but now apparently known from only a single locality.
Paracymus aeneus	A small brown water beetle with reddish legs. Rediscovered in 1991 at a site in the Essex saltmarshes, where it has not been seen since 1931. Otherwise known only from a brackish pool between the old railway line and Bembridge Harbour, Isle of Wight.
Pseudomogoplistes squamiger	A small wingless cricket living amongst rocks and shingle sheltered from vigorous wave action. Confined to a single site on the south-east coast of Britain.
Fire bug *Pyrrhocoris apterus*	Confined as a breeding species, so far as is known, to a single small islet off the coast of Devon, where it feeds on tree mallow *Lavatera arborea*.
Sitona gemellatus	A small (4-5 mm) brown weevil on various legume species, particularly restharrow *Ononis* spp. and medick *Mediago* spp. Larvae develop in the roots, adults found on the foliage. Frequents coastal cliffs; very rare, known only from two small areas of coast in south-west England.

Table 5.3.2 Coastal Red Data Book (RDB) species with post 1969 records (continued)

Species	*Notes*
pRDB 1	
Anthicus tristis	A small beetle of coastal shingle and sand at the edges of saltmarsh. It probably feeds on decaying vegetation. Adults have been recorded in April.
Brachmia lutatella	A small moth of coastal slopes and found at the base of coastal cliffs. Also recorded in a garden. The larva feeds from April to early July in the rolled leaves of cock's foot *Dactylis glomerata*, especially on stunted plants growing in crevices on the cliff face. Adult flies from July until early September.
Metzneria littorella	A small coastal moth, frequenting sparsely vegetated areas on landslips and cliff edges. The larva feeds on the seeds of buck's horn plantain *Plantago coronopus* from September to March. It pupates in the stem just under the seed head, the pupal stage lasting from March or April to May. The adult flies from April to June. In Britain it is known only from the Isle of Wight.
Scrobipalpula tussilaginis	A coastal moth of sparsely vegetated sand or clay soil from recent cliff slippages. The larvae feed in a mine in a leaf of coltsfoot *Tussilago farfara*. First recorded in 1983 from Axmouth to Lyme Regis NNR, Dorset/South Devon. It is now known from five sites along the south coast of England. It is difficult to distinguish from *S. psilella*.
RDB 2	
Cathormiocerus socius	A weevil of maritime grasslands and sparsely vegetated cliffs. The larvae feed on roots, possibly of plantains *Plantago* spp. In Britain, known only from the south coast of the Isle of Wight.
Cryptocheilus notatus	A spider-hunting wasp, known from only about a dozen counties in southern England. Rare. It nests in the burrows of small mammals, especially moles. Its prey includes spiders of the genera *Agelena*, *Trochusa*, *Tegenaria* and *Drassodes*.
Euodynerus quadrifasciatus	A mason wasp. Rare; Surrey, Dorset and South Devon. At Sidmouth the species breeds in holes in pebbles on the beach.
Hahnia candida	A tiny spider less than 2 mm long, so far known only from Dorset. It is mostly found under stones on coastal cliffs or shingle.
Lasioglossum laticeps	A mining bee confined to the coast of Dorset and Devon. It frequents coastal undercliffs and landslips, nesting, usually gregariously, in clay-like soils. Adults have been noted on common fleabane *Pulicaria dysenterica*, wild carrot *Daucus carota* and ragwort *Senecio* spp.
Limonia bezzii	A cranefly associated with coastal lagoons and intertidal gravel with *Enteromorpha* spp., where the larvae probably develop.
Nomada conjungens	A bee closely resembling a wasp. Most records are from south-west England (including Dorset and the Isle of Wight) but it is also known from East Kent and Suffolk. It is a parasite of the mining bee *Andrena proxima*; the larvae utilising the nests and larval food provisions of the host. Found on sunny bare sandy banks in which the host nests. Most records are from coastal cliffs.
Nysson interruptus	A solitary wasp that parasitises the nests of other wasps, especially *Argogorytes fargeii*. Most records are from the southern counties of England; uncommon.
Otiorhynchus ligustici	A ground-dwelling weevil. Larvae feed on the roots of various plants, but prefer kidney vetch *Anthyllis vulneraria*. Recorded from a wide area of Britain, but few records are recent.
Philanthus triangulum	A yellow and black digger wasp found on lowland heath, coastal sand dunes and cliffs where it excavates nest burrows in sandy soil. The nest is stocked with paralysed bees, mostly honeybees *Apis mellifera*, but also wild species. The British stronghold is on the Isle of Wight, but there are recent records from other sites in southern England.
Psen atratinus	A digger wasp currently known in Britain only from the south coast of the Isle of Wight, where it occurs around wet flushes at the base of clay cliffs or on landslips. Females may nest in dead reeds *Phragmites* spp. stems, but nests have never been found in this country. On the wing from June to August.
Morris's Wainscot moth *Photedes morrisii morrisii*	Found on grassy slopes and undercliffs; larvae feeding in the stems of tall fescue *Festuca arundinacea*. Very local along the coast from Devon to Dorset.
Saldula setulosa	A rare shore bug confined to a single site on the Dorset coast; on sandy silt at or around high tide mark.
Sphecodes spinulosus	A cuckoo bee, brood parasite of halictine bees. Its host is unknown. Very rare, known only from about eight counties in southern England.
Valvata macrostoma	An aquatic snail occurring mainly in well-oxygenated, richly-vegetated marsh drains. It is extremely local and vulnerable to agricultural changes. It is frequently recorded in error due to the juveniles of *V. piscinalis* being of a similar shape. There is a recent record from the region that requires confirmation.
RDB 3	
Andrena alfkenella	A widespread but very local solitary bee, frequenting sandy places on heathland and the coast, or chalk grassland or chalk heath. It probably nests in burrows in dry, bare soil or short turf, and feeds on pollen from various umbellifers, crucifers and other flowers. Rare and local, seldom numerous at a site. Records are confined to southern England, north to Lincolnshire.
Andrena nitidiusculus	A mining bee of southern England, usually found in coastal clay exposures, but also on sandy heath in Surrey and inland downs in Hampshire. It gets pollen from umbellifers, and nectar from a wider range of plants.
Andrena proxima	A mining bee, frequenting coastal landslips and soft-rock cliffs, inland on heathland, banks of country lanes and other disturbed situations. It has also been reported from chalk downland in Kent and Berkshire. It is closely associated with flowers of umbellifers, in Britain including cow parsley *Anthriscus sylvestris* and rough chervil *Chaerophyllum tementulum*. The nest burrows are probably in warm, sunny areas with short turf or sparse vegetation. Extremely scarce: about 20 post-1969 sites, mostly in south Devon, the Isle of Wight and Kent. Single records for Berkshire and East Sussex.

Table 5.3.2 Coastal Red Data Book (RDB) species with post 1969 records (continued)

Species	*Notes*
RDB 3 (continued)	
Aphrosylus mitis	This tiny fly has been recorded from a number of localities in southern England. Most records are from estuarine localities and on intertidal rocks. The biology is not known; there appears to be an association between some members of the genus and acorn barnacles, but the relationship is not understood.
Atylotus latistriatus	A horsefly. A saltmarsh species, confined to southern England. Males are attracted to the flowers of sea-lavender *Limonium* spp.
Cathormiocerus maritimus	A weevil. The larvae probably feed on the roots of plants, the adults occurring at the base of plants, particularly buck's-horn plantain *Plantago coronopus*. Plant-eating, possibly various types. It frequents cliffs and rough open ground near the coast.
Cathormiocerus myrmecophilus	A weevil. The larvae probably feed on the roots of plants, the adults occurring at the base of plants. Born from unfertilised eggs. It frequents cliffs.
Cicindela germanica	The smallest (8-11 mm) British tiger beetle, a fast-running bronze green species, hunting on coastal grasslands, undercliffs etc. Dorset, Devon and Isle of Wight only. Very uncommon.
Coelioxys quadridentata	A rare bee, parasitic on the leaf cutter bee *Megachile willoughbiella,* which nests in sandy places. Predominantly a southern species.
Corophium lacustre	A tube-dwelling amphipod found in slightly brackish stretches of rivers. Often found with *C. multisetosum*.
Diodontus insidiosus	A solitary wasp which nests in burrows in open, sandy situations, especially heathland and sandpits on Tertiary deposits. Burrows are probably stocked with aphids, as in other members of the genus. Widespread but very local in heathland areas of southern England, with post-1969 records for Dorset, the New Forest, north Hampshire and West and East Sussex.
Dolichocephala ocellata	A very small empidid fly of low herbage in damp situations. It is apparently very local and rare, but is possibly confused with the much commoner *D. guttata*.
Eubria palustris	A small black beetle found in dead grass and other plant remains, in either water or very wet conditions. Very rare and mainly southern in distribution.
Graptodytes bilineatus	A water beetle of stagnant water close to the sea, recorded from the Essex marshes, Dungeness, Chesil Beach and the Outer Humber. There are old records for Somerset, but it was not found in recent searches of the area.
White spot moth *Hadena albimacula*	Found on shingle beaches and chalk or limestone cliffs. The larva feeds on Nottingham catchfly *Silene nutans*. It is very local on the southern coast; Kent, Hampshire and south Devon.
Haematopota bigoti	A coastal blood-sucking cleg. Larvae have been recorded from soil in saltmarshes. Found on southern coastlands north to the Humber and south-west Scotland. Very local.
Haematopota grandis	A horsefly associated with saltmarshes. The larvae are undescribed.
Haplodrassus minor	A rare spider found under tide litter or sparse vegetation and on shingle banks near the seashore. It has been recorded from southern England, East Anglia and Gwynedd.
Hylaeus euryscapus	A yellow-faced bee of soft-rock cliffs, landslips, open expanses of sand or shingle and coastal dunes; possibly nesting in burrows in loose sand. Its pollen sources are unknown. Rare, found in southern coastal counties, about 12 post-1969 localities.
Portland ribbon wave moth *Idaea degeneraria*	A very local species, centred on the Isle of Portland, Dorset, found on rough grassy and bushy undercliff. It has occurred at Torquay, Devon.
Lasioglossum angusticeps	A mining bee known in Britain only from the south coast of England. It nests in coastal soft-rock cliffs; one nest has been found in exposed clay, possibly an atypical location.
Beautiful gothic moth *Leucochlaena oditis*	A species of grassy slopes and cliffs by the sea. The larvae feed on grasses. It is very local in south-west England, Isle of Wight, Dorset and south Devon.
Leptothorax interruptus	A small ant of warm, sandy or stony areas such as dry heathland or coast. It nests in peat and moss. Confined to the extreme south of England: reasonably frequent in the New Forest, local on the Dorset heaths, Rye Harbour (East Sussex) and Dungeness (Kent).
Limonia goritiensis	A cranefly of seepages on coastal cliffs and rock faces. Biology unknown, although larvae probably develop in damp soil or moss beside seepages. It has a widely scattered but very local distribution. Found mainly in the north and west, but the localities are very dispersed.
Glanville fritillary butterfly *Melitaea cinxia*	A species of rough ground, especially near the coast; formerly found in Kent and Sussex, but now confined to the Isle of Wight with occasional sightings in Hampshire, which are probably strays. The larvae are gregarious, feeding on ribwort plantain *Plantago lanceolata* and buck's-horn plantain *P. coronopus*.
Myopites eximia	A picture-winged fly of saltmarshes and saline shingle banks. The larval foodplant is golden samphire *Inula crithmoides*. Scattered records along the southern coast of England from Dorset to Essex.
Nysius graminicola	A small ground bug, recently discovered as an established species at Studland Bay, Dorset. Its exact status in Britain is uncertain: it may be a recent colonist.
Podalonia affinis	A large black and red solitary sand wasp that nests in sandy soil. Its prey is caterpillars. Found in England north to Yorkshire/Lancshire, but nowhere common.
Strongylognathus testaceus	An ant associated with nests of the ant *Tetramorium caespitum,* which it enslaves. Known only from Hampshire, Dorset and Devon.
Truncatellina callicratis	A tiny spire-shaped snail confined to the south coast of England in arid situations such as unvegetated screes. It can be locally abundant.
Urophora spoliata	A small clear-winged fly in a family with mostly picture-wings. It is associated with saw-wort *Serratula tinctoria* but its detailed biology is unknown. Known only from south Hampshire and the Isle of Wight.

Table 5.3.2 Coastal Red Data Book (RDB) species with post 1969 records (continued)

Species	*Notes*
pRDB 3	
Agriotes sordidus	A click beetle, found on the banks of tidal rivers, coastal and estuarine habitats, including under stones on a beach. Biology unknown; larvae probably develop in soil at the roots of plants. Very local, possibly declining. Records are centred around the Isle of Wight, the Thames Estuary and the Essex coast, with scattered records to south Wales.
Cynaeda dentalis	An extremely local coastal micro-moth. Larvae feed in the stem and on the leaf bases of viper's bugloss *Echium vulgare*. Southern and south-eastern England, from Suffolk to Devon.
Dromius vectensis	A 3.4-3.8 mm long reddish brown ground beetle with conspicuous markings. Found among vegetation on sandy ground, most often on the coast. Widespread but rare along southern coastal counties.
Eudarcia richardsoni	An apparently endemic small moth known only from rocky habitats at Portland and Puntfield Cove, Dorset. The larva constructs a portable case and feeds from this on lichens or algae growing on rocks.
Orthotylus rubidus	An infrequently-recorded plant bug of the upper saltmarsh on the south and east coasts of England; it feeds on glassworts *Salicornia* spp. in infrequently flooded areas.
Platytes alpinella	A moth of sandy coasts; larvae feed on *Tortula* spp. and other mosses. Very local and rather uncommon, found along the south coast from Devon to Kent, also in East Anglia, Lincolnshire and Yorkshire.
Pogonus luridipennis	A 6-8.5 mm long metallic green and yellow ground beetle found in saltmarshes under seaweed and driftwood. Found in south and east England north to the Humber. Very local.
RDB I	
Bledius crassicollis	A small rove beetle which burrows into sandy river banks. Mainly found in southern and eastern England. Very local.
Halobrecta princeps	A rove beetle recorded from coastal cliffs and the shoreline. Found in seaweed on the shore, under large stones lying on shingle and in crevices at base of coastal cliffs. Difficult to identify.
Medon pocoferus	A rove beetle of coastal shingle around the high-water mark. Found among shingle on the shore, in fine shingle and rock crevices and under seaweed. Adults are found from March to May and in August.
Scopaeus laevigatus	A predatory rove-beetle, found beside springs and pools in cliff crevices and broken sandy cliff faces. Known from only two sites in Devon and one in Dorset.
RDB K	
Anergates atratulus	A permanent social parasitic ant in the nests of the ant *Tetramorium caespitum*. Very local; Hampshire, Dorset and south Devon.
Heriades truncorum	A solitary bee largely confined to southern heathlands. It nests in dead wood and pithy stems in sunny situations; also found on chalk grassland. It may need conifer resin; pines feature at most sites. There are scattered records in south-east England with post-1969 records for two sites in Surrey. Possibly introduced to Britain in wood; may be a recent colonist.
Sphaerius acaroides	A very small (<1 mm), black, globular beetle. Found in old fens in southern England and from seepages on soft-rock cliffs in Dorset. Probably overlooked.
pRDB K	
Aloconota planifrons	A rove beetle of coastal undercliffs and sand-pits. Found on fine shingle under large stones. Difficult to identify.
Astenus procerus	A rove beetle of chalky or sandy places near coast. Occasionally found inland. Found in moss, at the roots of grass and in vegetation.
Brachypterolus villiger	A small beetle, related to the pollen beetles. It is found associated with toadflax *Linaria* spp. on the continent and probably in Britain also, but here most often with thrift *Armeria maritima*. Recorded from Devon to Essex.
Peritrechus gracilicornis	A very rare ground bug. Found on the south coast of England, with only a single recently-known colony.
Thinobius brevipennis	A very small rove beetle, found in muddy places in fens, wet places on or under cliffs, moist sandy places, at the edges of pools and probably also dune slacks.

Source: ISR. Key: Red Data Book categories: RDB 1 = endangered; RDB 2 = vulnerable; RDB 3 = rare; RDB I = indeterminate; RDB K = insufficiently known; pRDB = proposed species as categorised in e.g. Hyman & Parsons (1992). For further description of RDB categories, see Shirt (1987) and Bratton (1991).

Invertebrates are found in the full range of coastal habitats, although most of the scarce or threatened species occurring in this region have exacting habitat requirements and so have a restricted distribution.

Many coastal cliff sites in the region are known to have a nationally significant invertebrate fauna. The different cliff types support differing assemblages, with some species restricted to limestone, chalk or crumbling cliffs. Calcareous cliffs of the region provide a range of microhabitats; for example, short dry grassland in exposed places amongst rocks and screes, as at Church Ope Cove, can support the British whorl snail *Truncatellina callicratis*. The Lulworth skipper *Thymelicus acteon*, a butterfly almost entirely confined to the Dorset coast in Great Britain, is at the northern edge of its range and can live only in the warmest and most sheltered areas. Most of its sites are steep, south-facing grassy slopes where its foodplant (tor-grass *Brachypodium pinnatum*) grows tall. At the cliff edge, moths such as the square-spot dart *Euxoa obelisca* occur. Cliff paths can provide suitable situations for invertebrates that rely on areas of bare ground, e.g. many bee and wasp species. A significant range of invertebrates can be found on low undercliffs, soft-rock and crumbling cliffs, e.g. the rare Glanville fritillary *Melitaea cinxia* (a butterfly), which requires frequent cliff falls, as its foodplant becomes choked by other vegetation after just a few years. Several bees and wasps are associated with south-facing crumbling cliffs and landslips, which usually provide warm and sunny conditions, ideal nest spots and often with abundant nectar sources. Some Hymenoptera prefer dry substrates and sparsely vegetated conditions, e.g. the mining bee *Lasioglossum puncticolle*, yet others can be found by wet

flushes at the base of clay cliffs, e.g. the solitary wasp *Psen atratinus,* as in its chine (cliff cleft) sites on the Isle of Wight. Seepages and trickles can provide suitable habitat for a number of invertebrates, such as the cranefly *Limonia goritensis*.

The region's sand dune systems are reasonably well known and are either regionally or nationally important for invertebrates, particularly as part of a larger habitat mosaic, such as in the Studland area. A range of microhabitats can be found in each stage of the dune succession, all of which have their own distinctive invertebrate faunas. Only a comparatively few species can tolerate the harsh conditions found along the unstable fore dunes. The sand dart moth *Agrotis ripae* is typical of this part of the succession. Where marram *Ammophila arenaria* starts to stabilise the dunes, the shore wainscot moth *Mythimna littoralis* is one of a number of species that often occur. The compacted sand of the mature dunes is ideal for bees and wasps, providing nesting sites and an abundance of nectar sources. Dune grassland can be important and damper areas in slacks can also support characteristic species. At Studland and Arne, the dunes grade into sandy heath. The heaths of this part of the country are known to support nationally significant assemblages of a number of insect orders. The ruby-tailed wasp *Hedychrum niemelai*, a parasitoid of other wasps, has been found on open sandy heathland in this area. The flooded bomb craters on the Arne Peninsula are valuable for their Odonata fauna and have proved important for studying the ecology and behaviour of many species.

Estuaries have a range of habitats that can be exploited by invertebrates, and this region possesses enough mud-flat habitat to support an impressive range of species; the crescent striped moth *Apamea oblonga* is typical of brackish estuaries. Enough saltmarsh habitat remains to support an impressive range of invertebrates. More stable parts of the upper saltmarsh provide habitat for a range of characteristic species, e.g. the froghopper *Oliarus leporinus,* which frequents grassy areas. Many saltmarsh invertebrates are more dependent on substrate conditions than on vegetation structure. *Saldula setulosa* is an intertidal insect that has been found at Poole Harbour at the extreme upper edge of the tidal zone, along a thin strip of sandy silt with little vegetation. Some species are found amongst moist rotting vegetation at the high-water mark. The looping snail *Truncatella subcylindrica* can be found in this microhabitat beside sheltered lagoons and estuaries. Banks of creeks also provide opportunities for many species, e.g. the ground beetle *Dicheirotrichus obsoletus*, and saltpans and brackish ditches can contain a small but distinctive water beetle fauna.

Two areas of coastal shingle, Chesil Beach and Browndown, are considered to be of national importance for the conservation of invertebrates. Remaining areas of shingle appear comparatively poorly known but at least one site (Hurst Castle Spit) is thought to be important in the regional context and with further recording may be proven to be even more significant. Coastal shingle is an exacting habitat in which to survive. A surprising range of invertebrates can be found, with some species occurring only in these shingly habitats. The scaly cricket *Pseudomogoplistes squamiger* hides beneath rocks and rubble on the foreshore of its site adjacent to a sheltered salt-water lagoon. More vegetated areas support many species of moth, such as the white spot *Hadena albimacula,* which has been found at Browndown. *Megalonotus dilatatus*, a ground bug, is frequently found where bare earth is exposed, but is often associated with a light covering of leaf litter in which it shelters. On Chesil Beach, the darkling beetle *Omophlus rufitarsus* occurs in sparsely vegetated areas at the interface between shingle and saltmarsh. Also at Chesil, the cranefly *Geranomyia bezzi* can be found at the intertidal zone of coastal lagoons where the algae *Enteromorpha* spp. occur.

There are seemingly few coastal wet grasslands with a well-recorded invertebrate interest. Webb's wainscot moth *Archanara sparganii* is one of many species often found in such places and good assemblages of moths have in the past been recorded from Freshwater, probably from Freshwater Marsh. Estuaries have a range of habitats that can be exploited by invertebrates, and enough saltmarsh and mud-flat habitat remains to support an impressive range.

5.3.3 Human activities

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 or the clearing away of organic strandline debris. For example, vehicles associated with the construction of sea defences at one site in the region have been responsible for the loss of a bee colony through compaction of their nesting site (G.R. Else pers. comm.). Appropriate site management is 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. Grazing has the potential to both create and destroy or damage invertebrate habitat. 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 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. On some sites insufficient or no grazing allows vegetation to become rank and dense, reducing the range of species that it can support and favouring commoner species. Parsons & Sterling (1995) cover the microhabitat requirements of the endemic moth *Eudarcia richardsoni* at its two known sites and discuss potential threats to this species. The management of coastal habitats for invertebrates is covered by Kirby (1992), and the Butterflies Under Threat Team (BUTT 1986) discusses the management of chalk grassland for butterflies.

Table 5.3.3 Sites of importance for the conservation of invertebrates

Site	*Grid ref.*	*Status*
West Sussex/Hampshire		
Chichester Harbour (includes Thorney Island in part)	SZ7698	SSSI, NT (in part), Ramsar site and SPA
Hampshire		
Sinah Common	SZ7099	County Trust reserve (in part)
Farlington Marshes	SU6804	SSSI, LNR, part County Trust reserve, Ramsar site, SPA
Hilsea Moats	SU6604	
Portsdown	SU6306	SSSI (in part)
Cams Hall Pond	SU5805	
Gilkicker Point Golf Course (includes Gilkicker Lagoon and Gilkicker Fort)	SZ6097	SSSI (in part)
Browndown	SZ5899	SSSI (in part)
Titchfield Haven	SU5302	SSSI, LNR
Hook & Warsash	SU4904	SSSI (in part), LNR
*Blackwell Common	SU4301	SSSI
*Keeping & Spearbed Copse	SU4001	NNR (in part)
North Solent (includes Beaulieu Estuary, Needs Ore & Gin Marshes, and Warren Park Shore Lagoons)	SZ4197	SSSI, NNR
*East End Pond	SZ3697	SSSI
*Crockford Stream complex	SZ3599	SSSI
Isle of Wight		
Firestone & Briddlesford Copse	SZ5590	SSSI
The Duver, St. Helen's	SZ6389	SSSI, NT
Brading Marshes	SZ6287	SSSI
Bembridge Harbour	SZ6488	SSSI
Whitecliff Bay and Bembridge Ledges	SZ6587	SSSI
Bembridge Down	SZ6385	SSSI (in part), NT (in part)
Brading Down	SZ5986	
Luccombe Bay	SZ5879	NT (in part)
Bonchurch Landslips	SZ5878	SSSI
Ventnor Downs	SZ5678	SSSI, NT (in part)
Rew Down	SZ5477	SSSI
Niton - Ventnor Undercliff	SZ5376	County Trust reserve (in part), NT (in part)
Hanover Point to St. Catherine's Point	SZ4480	SSSI, NT (in part)
Brighstone Down	SZ4284	
Mottistone Down	SZ4184	NT
Compton Down	SZ3685	SSSI, NT
Freshwater Marshes	SZ3486	SSSI, LNR
Headon Warren & West High Down (includes Tennyson Down)	SZ3185	SSSI, NT
Yar Estuary	SZ3588	SSSI
Bouldnor Wood	SZ3890	
Nunneys Wood	SZ4089	SSSI
Newtown Harbour (includes Newtown Marshes)	SZ4291	SSSI, LNR, NT (in part)
Parkhurst Forest	SZ4791	SSSI (in part), Forestry Commission
Dorset		
Hengistbury Head	SZ1790	SSSI, LNR
Town Common	SZ1496	SSSI
Luscombe Valley	SZ0490	LNR
Canford Heath	SZ0395	SSSI
Poole Harbour (includes Blue Lagoon)	SZ0090	
Stoborough and Creech Heaths (includes Middlebere Heath, Slepe Heath and Stoborough Marsh)	SY9284	NNR (in part), SSSI
Creech Woods and Clay Pit	SY9183	
Blue Pool & Norden Heaths	SY9383	SSSI
Hartland Moor and Arne Heaths (includes The Moors on Arne and Arne RSPB reserve)	SY9585	NNR (in part), SSSI, RSPB reserve
Corfe Common	SY9681	SSSI
Rempstone Heaths (includes Newton Heath)	SY9984	SSSI (in part)
Nine Barrow Down	SY9981	
Brownsea Island	SZ0288	County Trust reserve/NT
South Haven Peninsula (includes Little Sea, Studland Heath and Studland Dunes)	SZ0284	NNR (in part), SSSI (in part), NT (in part)
Godlingston Heath	SZ0182	SSSI
Purbeck Ridge (east) (includes Godlingston Hill, Ballard Down, Ballard Cliff and the Foreland at Studland)	SZ0181	SSSI, NT (in part)
Townsend	SZ0278	SSSI, County Trust reserve
Stonehill Down	SY9181	SSSI

Table 5.3.3 Sites of importance for the conservation of invertebrates (continued)

Site	*Grid ref.*	*Status*
Povington & Grange Heaths	SY8883	SSSI (in part)
South Dorset Coast (includes Chapman's Pool, Durlston Head, Dancing Ledge, Worth Matravers, Kimmeridge Bay, Tyneham Gwyle, Worbarrow Bay, Lulworth Cove, Durdle Door, Ringstead Bay and Osmington Mills)	SY8085	SSSI, NT (in part), County Trust reserve (in part)
White Horse Hill	SY7184	
Chalbury Hill & Quarry	SY6983	SSSI
Lodmoor	SY6881	SSSI, RSPB reserve
Isle of Portland (includes Church Ope Cove, Suckthumb Quarry and West Weare)	SY6972	SSSI (in part), LNR (in part)
Chesil & the Fleet (includes Cogden Beach, East Fleet and West Fleet)	SY6081	SSSI, County Trust reserve (in part), Ramsar site and SPA
Eaglehead & Bloodstone Copses	SZ5887	SSSI
West Dorset Coast (includes Eype Down & Eype's Mouth, Golden Cap Estate, Black Ven & the Spittles and Charmouth undercliff)	SY4092	SSSI, NT (in part)
Dorset/Devon		
Axmouth to Lyme Regis	SY3090	NNR, NT (in part)

Source: ISR. Key: LNR - Local Nature Reserve; NNR - National Nature Reserve; NT - National Trust; RSPB - Royal Society for the Protection of Birds; SSSI - Site of Special Scientific Interest; SPA - Special Protection Area for birds; *part of the New Forest SSSI.

5.3.4 Information sources used

The data used here come from the ISR, a computerised GB-wide database based on literature searches of entomological journals and those of local naturalist societies, collation of data from local biological record centres and the Biological Records Centre, Monks Wood, and consultation with invertebrate specialists and non-governmental organisations.

This region has been comparatively well recorded, most groups of invertebrates having been studied, although the levels of recording vary along the coast and between invertebrate groups. The popular groups, such as the Lepidoptera, Orthoptera etc., are probably the best known here, but even within these groups new discoveries, including additions to the British fauna (such as in Langmaid 1994), are regularly made. As with other regions, more work is needed, particularly along comparatively under-worked (and often more inaccessible) parts of the coast.

Historically, the counties of the region have been well-served by invertebrate zoologists, with many being resident in this part of the country and many others visiting. Currently, the region has several active entomologists and, because of the quality of the habitats and the range of species to be found, it still attracts many visiting invertebrate specialists. A few sites that are known to support a range of restricted species act as 'honeypots' and are regularly worked. This may mean that the faunas of some other sites are not as well known as they could be and further, potentially important, sites may be overlooked altogether.

There have been a number of surveys relating to aspects of the region's fauna in recent years and there are also a number of groups actively recording invertebrates. The Hampshire and the Isle of Wight Branch of the British Butterfly Conservation Society has produced an annual report since 1985, and the Proceedings of the Dorset Natural History & Archaeological Society have annual reports on a variety of invertebrate groups that include many records from coastal habitats. The Isle of Wight Natural History and Archaeological Society produces Proceedings and a Bulletin, both of which contain invertebrate data. The Butterfly Monitoring Scheme also has transects on three sites (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 coordinated by specialists with assistance from the Biological Records Centre. National distribution maps are available for a wide range of invertebrate groups, including many for which this region is important. For example, Heath & Emmet (1979, 1983, 1990) map many Lepidoptera (butterfly and moth) species. There are also a number of county-based publications (e.g. Goater (1974) and Goater (1992), covering moths and butterflies) and mapping schemes which are being undertaken within the region for various orders and families, e.g. butterflies, larger moths and pyralid moths, Odonata, and Diptera: Syrphidae (hoverflies).

5.3.5 Acknowledgements

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Occurrence of invertebrates in the region	*Biological Records Centre, Institute of Terrestrial Ecology, Monks Wood, tel: 01487 773381
Invertebrate site and species information	*Dr R.S. Key, Dr C.M. Drake and Dr D.A. Sheppard, Invertebrate Zoologists, Lowlands Team, English Nature HQ, Peterborough, tel: 01733 340345
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
Conservation of butterflies in Hampshire & the Isle of Wight	British Butterfly Conservation Society, Hampshire & Isle of Wight Branch, c/o A. Hold, 22 Brook Road, Fair Oak, Eastleigh, Hampshire SO5 7BA, tel: 01703 694309
Conservation of butterflies in Dorset	British Butterfly Conservation Society, Dorset Branch, c/o B. Dicker, Sunnydene, Higher Holton, Wincanton, Somerset BA9 8AP, tel: 01963 32453
Dorset Biological Records Centre	Dorset Environmental Records Centre, c/o Dr P.H. Sterling, Colliton Annex, County Hall, Dorchester, Dorset DT1 1XJ, tel: 01305 251000
Odonata in Hampshire & the Isle of Wight	A. Hold, 22 Brook Road, Fair Oak, Eastleigh, Hampshire SO5 7BA, tel: 01703 694309
Species distribution databank - Isle of Wight	D.G.J. Telfer, Isle of Wight Environmental Records Centre, 131 Medina Park, Folly Road, East Cowes PO32 6NF
Invertebrate interest of National Trust holdings	*Biological Survey Team, National Trust, Cirencester, tel: 01285 651818
Aculeate Hymenoptera in Britain and the region	G.R. Else, Northcroft, St. Peters Road, Hayling Island, Portsmouth, Hampshire PO11 0RX, tel: 0171 938 9123 (day)
Lepidoptera in Britain and the region	Dr J.R. Langmaid, Wilverley, 1 Dorrita Close, Southsea, Hampshire PO4 0NY, tel: 01705 732406

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

5.4 Rare sea-bed species

Dr W.G. Sanderson

5.4.1 Introduction

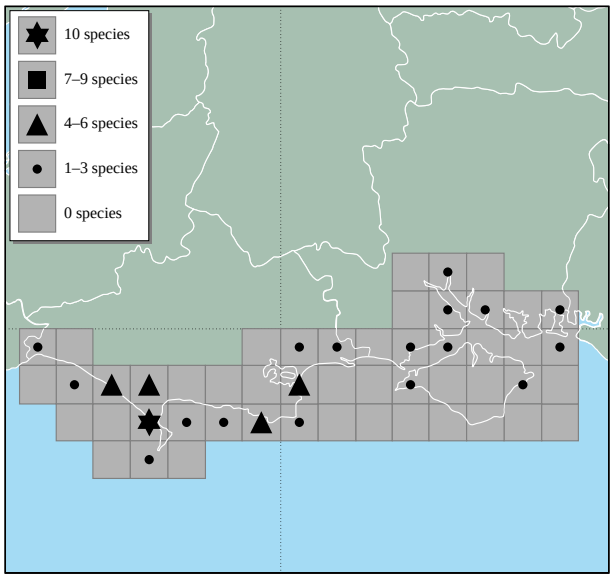
This section considers rare and scarce marine benthic (sea-bed) species, excluding fish. The occurrence and distribution of benthic communities is discussed in section 4.2. 'Nationally rare' marine benthic species in this section are those native organisms that occur in eight or fewer of the 10 km squares (of the Ordnance Survey national grid) containing sea within the three-mile territorial limit for Great Britain. 'Nationally scarce' are those that occur in nine to 55 such squares. 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. Species at the limit of their global distribution (e.g. 'northern' or 'southern' species) may be rare only within Great Britain's territorial seas. Indeed, there are a number of Lusitanian species described here that are at the margins of their range in Region 9. 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 species listed here needs 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 in Great Britain. As either more data become available or populations change, the status of species listed in this chapter will require re-evaluation.

Like other regions in south-west Britain, Region 9 appears to be comparatively rich in nationally rare and scarce species: there are 23 rare and 21 scarce marine benthic species recorded from this region. Maps 5.4.1 and 5.4.2 summarise their current known occurrence. Areas around the east and west Isle of Wight, the Purbeck coast, Poole Harbour and near-shore reefs in Lyme Bay, in addition to areas of lagoonal habitats (Gosport, Isle of Wight, Calshot to Keyhaven and the Fleet), apparently contain more rare and scarce marine benthic species than other areas. This assertion may be somewhat artificial, however, since survey effort in this region is not uniform. A total of nine of the rare and scarce species in Region 9 are currently protected under the Wildlife and Countryside Act 1981.

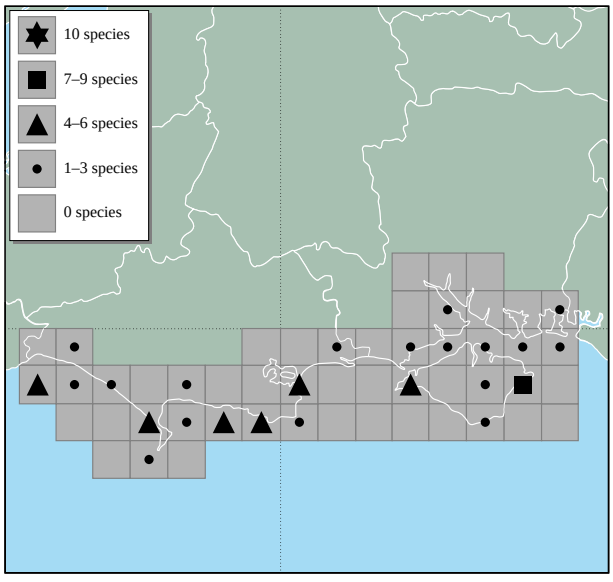
5.4.2 Important locations and species

Table 5.4.1 lists the rare and scarce marine benthic species that have been recorded in Region 9, together with their known areas of occurrence. Species names are after Howson (1987).

Some nationally rare and scarce species described here are restricted to very specific habitat types in Great Britain that are themselves rare or scarce and in some cases threatened. Such species may therefore be of high nature conservation importance. Fifteen of the species listed here are found in lagoon-like habitats and there is a concentration of this habitat type in Region 9 (see also section 3.4). Lagoons are susceptible to both natural and



Map 5.4.1 Numbers of rare marine benthic species recorded in 10 km squares containing sea within the 3 mile limit. Apparent distribution may be influenced by differences in recording effort.



Map 5.4.2 Numbers of scarce marine benthic species recorded in 10 km squares containing sea within the 3 mile limit. Apparent distribution may be influenced by differences in recording effort.

Table 5.4.1 'Nationally rare' and 'nationally scarce' marine benthic species found in the region

Species	*Common name*	*Area(s) of occurrence*	*Habitat/ associations*	*Comments*	*Useful reference*
Stelletta grubii	Sponge	Needles & Ventnor (IoW); between Freshwater & Scatchels Bay, Purbeck coast	On rock, often dark or overhung, from the intertidal to a little over 100 m. Associated with epifaunal organisms.	Often obscured by associated epifauna. May therefore be somewhat under-recorded (B.E. Picton pers. comm.).	Ackers *et al.* (1992)
*Thymosia guernei**	Sponge	Inshore reefs in Lyme Bay	Often with *Polydora* or brittle stars. Overhangs and recesses on rock. Sites exposed to flowing water or wave action.	May be a southern species. May have very specific habitat requirements.	Ackers *et al.* (1992)
*Suberites massa**	Sponge	Southampton Docks, Yar estuary (IoW), Poole Harbour, Fleet	Silty brackish waters. Hard substrata. Subtidal, but intertidal in shaded locations.	Also from Brittany & the Mediterranean	Ackers *et al.* (1992)
*Dysidea pallescens**	Sponge	Inshore reef in Lyme Bay	Known from subtidal rock	Also Mediterranean. Known from southern British sites. As with all sponges, its rarity should be regarded with caution.	Ackers *et al.* (1992)
Hartlaubella gelatinosa	Hydroid	Poole Harbour	Intertidal to 15 m. Often in gentle current. Tolerant of silt & brackish water.	Known from Oslo to the Mediterranean & Black Sea. Recent name change - some confused records.	Hayward & Ryland (1990)
Laomedea angulata	Hydroid	Langstone Harbour, Calshot, Studland Bay	Often on eelgrass. Extreme low water to 8 m.	Southern. Found in S. England and further south.	Hayward & Ryland (1990)
*Obelia bidentata**	Hydroid	Poole Harbour	On wood, shells, wrecks, sand. 0-200 m+. Occasionally intertidal.	Known also from warmer European coasts. Temperate to warm water globally.	Hayward & Ryland (1990)
Eunicella verrucosa#	Pink sea fan	Near-shore reefs in Lyme Bay	On rocky surfaces, especially between 20-200 m.	Cautiously regarded as scarce. Southern. SW Europe, Mediterranean & N. Africa. Not uncommon locally. Historically heavily collected at some British locations. Colonies long lived & slow growing.	Manuel (1988), Fowler & Laffoley (1993)
Isozoanthus sulcatus	Ginger tiny anemone	Alum Bay (IoW), Purbeck coast, Weymouth & inshore reefs in Lyme Bay	Silty rock. 0-25 m. Occasionally in pools on the shore.	N. & W. France, Norway & Denmark. Locally not uncommon.	Manuel (1988)
Aiptasia mutabilis	Trumpet anemone	Bembridge (IoW), Purbeck coast and inshore reefs in Lyme Bay	Lower shore pools to 30 m. More often amongst kelp holdfasts.	Southern. Also known south to Mediterranean	Hayward & Ryland (1990)
Nematostella vectensis#	Starlet anemone (Isle of Wight thread star)	Various lagoons: on IoW; near Emsworth (?); between Calshot and Keyhaven; at Hengistbury Head and a lagoon in Poole Harbour (?)	Lagoon-like habitats. In fine soft mud with tentacles exposed. Sometimes attached to vegetation such as sea grasses or filamentous algae.	Also at limited known sites in Canada & USA (Pacific & Atlantic coasts). Type locality is Harbour Farm Lagoon (IoW). Vulnerable habitat.	Bratton (1991); Smith & Laffoley (1992)
*Scolanthus callimorphus**	Worm anemone	Fleet & Portland Harbour	Low shore to 10 m. Burrows in sand or gravel. Often near eelgrass.	Southern. Often on N. French coast & also Mediterranean. Only known from this area in UK.	Manuel (1988)

Table 5.4.1 'Nationally rare' and 'nationally scarce' marine benthic species found in the region (continued)

Species	*Common name*	*Area(s) of occurrence*	*Habitat/ associations*	*Comments*	*Useful reference*
*Caryophyllia inornata**	A cup coral	Purbeck coast	Typically in sheltered & shaded location. On rock (0-30 m).	Resembles more common relative. Edge of range in GB. Common in the Mediterranean.	Manuel (1988)
*Hoplangia durotrix**	Weymouth carpet coral	Purbeck coast	On rocks in shaded locations. Shallow subtidal (0-5 m).	South-western species. South to Mediterranean	Manuel (1988)
*Leptopsammia pruvoti**	Sunset coral	Off Isle of Portland & near-shore reefs off Lyme Regis (several records in small area)	On rock. Often sheltered from strong current. 10-40 m	Southern. Also SW Europe & Mediterranean. Slow growing in GB.	Manuel (1988); Fowler & Laffoley (1993)
*Sternaspis scutata**	A bristle worm	Portland Harbour	In sediment	Mediterranean species currently known from only two areas in GB	
Armandia cirrhosa#*	Lagoon sand worm	Eight Acre Pond (?) (in the area between Calshot & Keyhaven), Fleet & Portland Harbour	In Britain found in brackish to full-strength sea water. In shingle & sandy sediments.	Elsewhere from the Adriatic, Mediterranean & E. Atlantic. Recently re-discovered in GB	Bratton (1991)
Alkmaria romijni#	Tentacled lagoon worm	Christchurch Harbour, Wooton Mill Pond (IoW)	In sediment. Low shore to a depth of a few metres. Brackish water.	Also Netherlands, Baltic, Morocco. May yet be found in other brackish ditches and pools in GB.	Bratton (1991); Holthe (1986)
Meiosquilla desmaresti	A mantis shrimp	Southampton Water, Stanswood Bay (Solent), Osborne Bay (IoW)	May be associated with eel grass in GB. Subtidal to 40 m.	English Channel, W. Mediterranean & N. Africa. Habitat may be understudied and therefore more common than records suggest.	Mauchline (1984)
Apherusa ovalipes	Amphipod	Bembridge (IoW)	In association with subtidal algae	Occasionally elsewhere in Atlantic Europe	Hayward & Ryland (1990)
*Menigrates obtusifrons**	Amphipod	Pennington Spit (W. Solent)	From 10-200 m. May occur in low salinity.	Northern, Arctic species. Also from Iceland, NW Norway to Channel Islands.	Lincoln (1979)
Gammarus insensibilis#	Lagoon sand shrimp	Newton Quay Lagoon (IoW), various lagoons at Gosport & between Calshot & Keyhaven, Hengistbury Head & Fleet	Brackish water. In Britain from lagoon-like habitats. Part of weed-associated fauna.	Atlantic Europe to Mediterranean & Black Sea. In GB it is probably restricted to lagoons.	Bratton (1991)
Synisoma lancifer	A sea slater	Hanover Point, Shanklin (IoW), Purbeck coast	Amongst algae & boulders in the subtidal fringe	Distinctive southern species. South of GB to Mediterranean.	Naylor (1972)
Caecum armoricum#*	DeFolin's lagoon snail	Fleet	In pebble beach at places where sea water percolates through	Shells from Black Sea, Mediterranean & Atlantic coast of N. France but only other live records are from Morocco. Probably rare throughout range.	Bratton (1991).
*Truncatella subcylindrica**	Looping snail	Hamble (Southampton Water), King's Quay, Freshwater (IoW), Portsmouth, Fleet	Under high shore rocks & detritus in estuaries & lagoons on sheltered shores	Southern. Atlantic France, Spain, Portugal & Mediterranean. In GB may have suffered habitat loss.	Graham (1988)
Paludinella littorina#*	Lagoon snail	Whitecliff Bay (IoW), Fleet	Upper shore living in shingle & in caves & crevices	Southern. Mediterranean, & from Britain to Madeira.	Killeen & Light (1994); Bratton (1991)

Table 5.4.1 'Nationally rare' and 'nationally scarce' marine benthic species found in the region (continued)

Species	*Common name*	*Area(s) of occurrence*	*Habitat/ associations*	*Comments*	*Useful reference*
*Trapania maculata**	Sea slug	Off Portland Bill	Subtidal. On sponges, bryozoans & hydroids.	Southern. Also from Brittany & W. Mediterranean.	Picton & Morrow (1994)
Trapania pallida	Sea slug	Brandy Bay (Purbeck coast)	Usually found amongst bryozoans, hydroids & sponges. Rocky subtidal (10-20 m).	Also W. Scotland to Atlantic France & Spain	Picton & Morrow (1994)
Tenellia adspersa#*	Lagoon sea slug	Fleet	Intertidal & shallow subtidal. Normally brackish, feeding on a range of hydroids.	May prove to occur more widely in GB. Elsewhere globally distributed. Populations fluctuate widely in Fleet.	Picton & Morrow (1994)
Pholadidea loscombiana	Burrowing bivalve	Purbeck coast, Abbotsbury, off Burton Bradstock, West Bay ledges & Chideock	Burrows in compacted materials such as clay, hard muds or soft stones from the low shore down	Mainly southern, occurring south of GB to Spain. Habitat infrequently sampled but still probably scarce.	Hayward & Ryland (1990)
*Amathia pruvoti**	A bryozoan	Newton Harbour (IoW), Studland Bay	Mixed with other attached organisms	Also from W. Mediterranean & Aegean	Hayward (1985)
*Epistomia bursaria**	A bryozoan	Bembridge (IoW), Solent Breezes, Christchurch Ledge, Swanage	Epiphytic. 20-40 m	Known from N. & W. Mediterranean as well. May be locally common at few sites of occurrence.	Ryland & Hayward (1977)
Phallusia mammillata	Sea squirt	Purbeck coast, Weymouth, Portland Harbour, Fleet, wreck of *Baygitano* & near shore reefs (off Lyme Regis)	On hard substrata. Lower intertidal to 180 m.	Present in SW of England. Also Spain & the Mediterranean.	Hayward & Ryland (1990)
Molgula oculata	Sea squirt	Bembridge (IoW)	Unattached in sand & gravel with siphons protruding. Low tide to 80 m.	Shetland to the Bay of Biscay. May be somewhat overlooked.	Hayward & Ryland (1990)
Gracilaria bursa-pastoris	Red alga	Langstone, Bembridge & Ventnor (IoW), Solent, Studland, Portland, Fleet	On stone in sheltered places. Upper subtidal, often with sand deposition.	Probably widely distributed in warmer waters.	Dixon & Irvine (1977)
Gracilaria multipartita	Red alga	Fleet	On stone from upper subtidal to 15 m. Tolerant of sand & silt deposition.	Probably widely distributed in warmer waters	Dixon & Irvine (1977)
*Bornetia secundiflora**	Red alga	Purbeck coast	Boulders & bedrock. Subtidal fringe to 3 m depth. Moderate to exposed sites.	Southern; also S. to Morocco & Mediterranean	Maggs & Hommersand (1993)
*Dasya punicea**	Red alga	Studland	On friable rock or sand. 10-13 m depth. Sheltered coasts. Record may require confirmation.	Otherwise from France, Mediterranean & Caribbean. Records may require expert confirmation. Displacement of native algal species by non-native 'Japweed' *Sargassum muticum* has been observed at Studland site (I. Tittley pers. comm. 1995).	Maggs & Hommersand (1993)
*Lophosiphonia reptabunda**	Red alga	Purbeck coast	On eroding sandstone	Recorded at this site from 1890s. Only known site in GB. Subtropical species also known from African coast.	

Table 5.4.1 'Nationally rare' and 'nationally scarce' marine benthic species found in the region (continued)

Species	*Common name*	*Area(s) of occurrence*	*Habitat/ associations*	*Comments*	*Useful reference*
Zanardinia prototypus	Brown alga	Purbeck coast	On hard substrata. Subtidal to 20 m. Especially on silty rock.	Ephemeral species - probably substantial fluctuations in population size between years	Fletcher (1987)
Carpomitra costata	Brown alga	Osmington Mills	On bedrock & boulders. Subtidal to 37 m. Tolerant of sand cover.	Probably a summer annual	Fletcher (1987)
Asperococcus compressus	Brown alga	Handfast Point	Intertidally on rock & other algae in pools & to 10 m	Distributed around the British Isles but rare	Fletcher (1987)
*Cladophora battersii**	Green alga	Fleet	Lagoon-like habitats. Tangled around base of eelgrass & on stones. Lower intertidal & shallow subtidal.	Also old records from Ireland & the former Yugoslavia	Burrows (1991)
Lampro-thamnium papulosum#*	Foxtail stonewort	Lagoons: Fort Gilkicker Moat (Gosport), Bembridge Harbour (IoW), Eight Acre Pond (Calshot to Keyhaven area), Fleet	Lagoon-like habitats. On sand, gravel or pebbles. <2 m of water. Tolerant of water flow & exposure.	Also recently discovered in Outer Hebrides. Very restricted habitat in Britain. Also Norway to Mediterranean (E. to Tunisia).	Stewart & Church (1992)

Key: * = nationally rare; # = protected under the Wildlife & Countryside Act 1981; (?) = there is reason to believe that the species may no longer exist at this site. Notes: many of the scarce species are only a little more common than the rare species listed; species names after Howson (1987); in the absence of a specific common name the nearest available group name has been used.

anthropogenic changes. Changes in the lagoonal systems at, for example, Normandy Farm (SZ332947) and Eight Acre Pond near Lymington (SZ327938) appear to have had substantial effects on the rare and scarce fauna at these sites (see Smith & Laffoley 1992) (see also section 3.4). Any action that may change, for example, the salinity of the coastal lagoons is relevant to the lagoonal fauna and flora of the region. It is also interesting to note that scattered live specimens of maerl, a twig-like coraline plant (although as yet unidentified to species level (I.M.T. Dixon pers. comm. 1995)), have been found amongst sub-fossil dead material between Weymouth and Kimmeridge; certain species of maerl are nationally rare or scarce. Indeed, 'biological reefs' of maerl (rather than scattered, fragmented specimens) have been considered of nature conservation importance. Similarly, intertidal chalk, found on the Isle of Wight and on the Purbeck coast, is a rare habitat type, comprising about 0.6% of the British coast (I. Tittley pers. comm. 1995), and may well contain rare species.

Within this region of Great Britain certain species are also 'nationally rare' or 'scarce' because they are Mediterranean-Atlantic species at the margins of their distribution in Great Britain. It has been argued that populations of many sessile (non-mobile) southern species have a poor capacity for recovery and replace their numbers 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). Conversely, the amphipod *Menigrates obtusifrons* is close to the southern-most extent of its distribution (from the Arctic) in the English Channel (Lincoln 1979) and may similarly of be of interest. There are other genetic, ecological and pragmatic arguments for the conservation of species that are rare because they are at the margins of wider distributions (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 appear rare simply because their distribution only just includes the generally shallower near-shore sea area that is the focus of this study. Some species, however, will occur to some extent in the waters of Great Britain outside the scope of this report.

5.4.3 Information sources used

The sites of intertidal and subtidal benthic data utilised in this analysis are mapped in section 4.2. In Region 9 some of the available data come from MNCR survey work and earlier NCC-funded surveys. Many of the studies in the region have resulted from the activities of the universities of Southampton and Portsmouth, the Southern Water Authority, the Central Electricity Research Laboratory and various other commercial concerns that have necessitated environmental impact assessments. The Devon Wildlife Trust has recently gathered much useful data and additional records have also been considered in the present study 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 sections 4.2.6 and 5.4.5 should allow access to most of the available information.

Suitable information in the sublittoral zone of this region is uneven; for example, some of the more offshore areas are lacking in suitable information. Littoral surveys are also patchily distributed, although lagoons in the region have

received some specific attention (Smith & Laffoley 1992). Barnes (1988), however, warns that species from lagoonal habitats may also occur in brackish drainage ditches, which have not yet been adequately surveyed.

Some data in Region 9 go back several decades, but data from records prior to 1965 have not been used to assess rarity, as they may be out of date. There are old records from this region for the bivalve *Donax variegatus*, for example, but the species may no longer exist in the study area (D.S. Seaward pers. comm. 1995). It would be valuable to re-survey the sites of old records.

MNCR survey work uses a consistent methodology to record conspicuous species (Hiscock 1990). Not all the data available from surveys in this region are as broad in scope as MNCR surveys and they may not include less common species or those less familiar to a specialist worker. Inconsistent recording has undoubtedly reduced the quantity of available information for rarity assessment in the region. The MNCR of Great Britain is at present incomplete but in future will substantially increase the quality and evenness of distribution of the available data. Combined with other surveys, this will almost certainly expand our knowledge of the 'nationally rare' and 'scarce' species in Region 9. Consequently the nationally rare and scarce status of the organisms presented here may require re-evaluation, and in future further species may be added to the list for the region. Populations of species with short life histories, such as ephemeral algae and seaslugs, may be prone to fluctuation from year to year and may require more regular re-evaluation of their occurrence than others.

5.4.4 Acknowledgements

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C. Contact names and addresses

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The Fleet Study Group	D.R. Seaward, Barn Court, Chetnole, Sherborne, Dorset DT9 6NY, tel: 01935 873066
Lyme Bay records	M. Camplin, Devon Wildlife Trust, Shirehampton House, 35-37 St. Davids Hill, Exeter EX4 4DA, tel: 01392 79244
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Bryozoans (sea mats)	Dr P.J. Hayward, School of Biological Sciences, University College Swansea, Singleton Park, Swansea, West Glamorgan SA2 8PP, tel: 01792 205678
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Amphipods	Prof. P.G. Moore, University Marine Biological Station Millport, Isle of Cumbrae KA28 0EG, tel: 01475 530581
Red algae	Dr C.A. Maggs, School of Biology & Biochemistry, Queen's University of Belfast, Belfast BT7 1NN, tel: 01232 245133
Sponges, sea slugs, hydroids	B.E. Picton, BioMar, Environmental Science Unit, University of Dublin, Trinity College, Dublin 2, Republic of Ireland, tel: 00353 16772941
Sea squirts	*D.W. Connor, Marine Conservation Branch, JNCC, Peterborough, tel: 01733 62626

* 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 to be found in Table 5.5.1.

The native oyster is nationally significant in the region as the stock is the largest in Britain and probably in northern Europe. There are also important populations of scallops, queen scallops, mussels, whelks, lobsters, edible crabs and spider crabs in the region. There are no exploitable quantities of *Nephrops*, deep water prawns, crawfish or brown shrimps in the region.

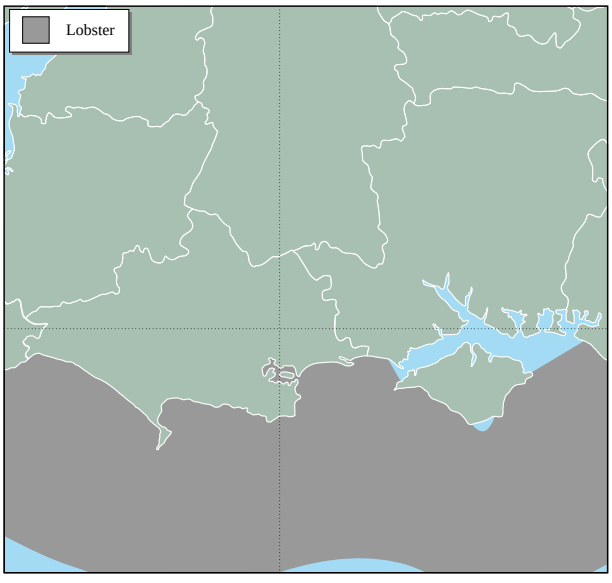
Table 5.5.1 Species names

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*
Hard-shelled clams (non-native)	*Mercenaria mercenaria*
Native oyster	*Ostrea edulis*
Pacific oyster (non-native)	*Crassostrea gigas*
Periwinkle	*Littorina littorea*
Scallop	*Pecten maximu*
Queen scallop	*Aequinpecten opercularis*
Whelk	*Buccinum undatum*
Cephalopods (octopus, squid and cuttlefish)	*Eledone cirrhosa, Loligo* spp. & *Sepia officinalis*
Lugworm	*Arenicola marina*
Ragworm	*Neanthes virens* & *Hediste diversicolor*

5.5.2 Important locations and species

Crustacea

The broadscale distribution of lobster in the region is shown in Map 5.5.1 and of edible crab and spider crab on Map 5.5.2. Lobster, edible crab and velvet crabs are distributed throughout the region wherever there is suitable habitat, from close inshore and offshore out into the Channel. Edible crabs are often found on softer sediments - ranging from sand/gravel to rock - than lobsters. Juvenile edible



Map 5.5.1 Distribution of exploited crustacea: lobster. © Shellfish Resource Group, MAFF Directorate of Fisheries Research (Lowestoft).

Map 5.5.2 Distribution of exploited crustacea: edible crab and spider crab. © Shellfish Resource Group, MAFF Directorate of Fisheries Research (Lowestoft).

crabs tend to be found inshore and adults further offshore (Rees & Dare 1993). The edible crab is very mobile and spawning for the stocks takes place to the west of the region. Lobster abundance is relatively low but edible crab stocks are extensive. Pink prawns are present in small quantities in the region, notably in Poole Bay and off Portland. Crawfish are a Lusitanian species (i.e. have a more westerly distribution) and are unlikely to be found in this region. Other species of crustacea, such as *Nephrops*, deep-water prawns and brown shrimps are not found in exploitable quantities in the region.

Molluscs - inshore and estuarine

The main locations where exploitable populations of native oysters, hard-shelled clams, cockles and mussels are found in this region are shown on Map 5.5.3. Cockles are found in the intertidal zones of many sandy estuaries and other sheltered sites in this region. The main location of significance is the intertidal zone of the sheltered Poole Harbour. 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 only significant wild mussel stock is in deep water off Portland Bill. Periwinkles live throughout the region on algae growing on rocky shorelines.

The Solent area is one of the few areas left in the UK that supports a natural stock of native oysters. It is the largest stock in Britain and probably in northern Europe. The native oysters in Poole Harbour were almost wiped out by the protozoan parasite *Bonamia ostreae* (see section 5.5.3), but a small population still exists in Poole Bay. Hard-shelled clams, a non-native species, were introduced into Southampton Water in the 1920s and have since colonised Southampton Water and the North Solent, Portsmouth, Langstone and Chichester Harbours and Newtown Harbour on the Isle of Wight. It is not known whether all these stocks are reproducing and the stocks in the Solent have declined substantially recently because good 'spatfall' (spat are newly settled metamorphosed juveniles) is infrequent.

Octopus, squid and cuttlefish are common inshore in spring and summer. Cuttlefish are concentrated in the western Channel during the winter and spawn in April and May. Lyme Bay is one of the major spawning areas in the western Channel.

Molluscs - offshore

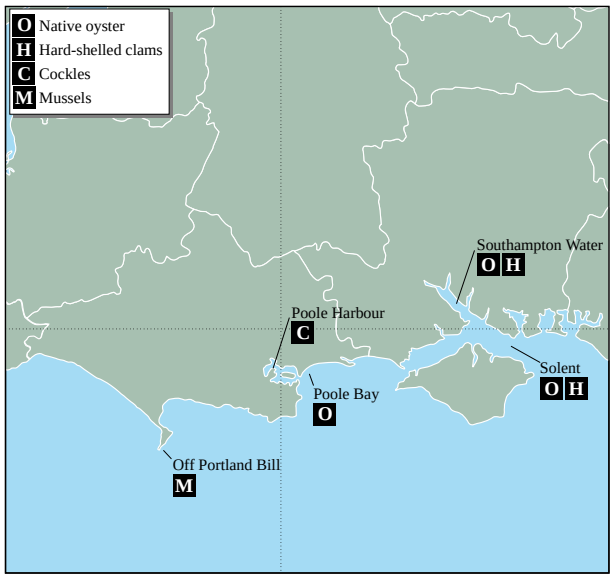
Scallops and queen scallops live on sandy/gravely areas of sea bed and are both present in the region. Research suggests that some areas of scallop beds are self-recruiting, whereas others depend on immigration from other areas (Pawson 1995); thus the two areas of scallops present in the region may be distinct stocks. Queen scallops are found in a smaller area in Lyme Bay. Whelks are widely distributed throughout the region, with important areas off Chesil Beach, Poole Bay and to the east of the Isle of Wight. The broad-scale distributions of scallops, queen scallops and whelks in the region are shown in Map 5.5.4.

Polychaetes

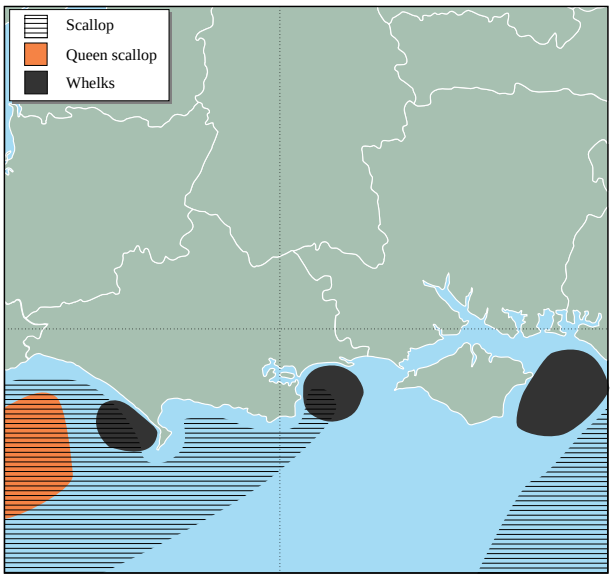
The intertidal and subtidal zones in the region's estuaries support populations of polychaetes, such as lugworm and ragworm. Lugworms are common in less exposed areas where there is a higher organic content in the substratum. They occur elsewhere in a wide range of sediment types from almost pure mud to clean sand (Davidson *et al.* 1991). Both ragworm and lugworm are dug for angling bait in several parts of the region (see section 9.1.2).

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



Map 5.5.3 Main locations of exploited mollusc species: inshore and estuarine. © Shellfish Resource Group, MAFF Directorate of Fisheries Research (Lowestoft).



Map 5.5.4 Main locations of exploited mollusc species: offshore. © Shellfish Resource Group, MAFF Directorate of Fisheries Research (Lowestoft).

mariculture in section 9.2. The major issues relating to the shellfish industry in the region are the generally unregulated levels of exploitation, apart from restrictions on the exploitation of molluscan shellfish such as through Several Orders (see section 9.1.3) and minimum landing sizes, and the possible effects of harvesting on the benthos, feeding birds and stocks of shellfish. A Southern Sea Fisheries Committee bylaw empowers the Committee to close a shellfish bed if the stock is considered to be depleted. The effects of scallop dredging in Lyme Bay have recently been investigated (Devon Wildlife Trust 1992).

Native oyster beds are now quite rare, and their decline around Britain has been attributed to various factors, including overfishing, the failure of spatfall, cold winters (Waugh 1964) and *Bonamia*. The native oysters in Poole Harbour were almost wiped out by the protozoan parasite *Bonamia ostreae*, and there is concern that it could spread to other areas. The Solent is one of the very few places where *Bonamia* has not killed all the native oysters, a fact attributed to the depth of the water and the strength of the tidal currents. However, the disease is present in the Solent at low levels in localized areas. The Pacific oyster is a non-native species which is now cultivated (see section 9.2) in preference to the native oyster, owing to its faster growth rate to a marketable size and its resistance to *Bonamia* (Spencer 1990). The Pacific oyster does not survive naturally in the region, but some small spatfalls of Pacific oyster have been recorded elsewhere around the UK, probably owing to the warm summers of 1989 and 1990 (Spencer *et al.* 1994). Another issue of concern in the region is the introduction of other non-native species such as the hard-shelled clam (Mitchell 1974; Walker 1985) and the effect that their subsequent exploitation has had on the habitat and native species (Sheader 1986; Cox 1991).

Bait collection, especially digging for 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 5.5.6.B). 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 Research fishery officers and the Southern Sea Fisheries Committee 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 (see sections 9.1 and 9.2), 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, and the Southern Sea Fisheries Committee. 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. Richardson & Walker (1991) contains a map showing the locations of the main hard-shelled clam stocks.

5.5.5 Acknowledgements

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Shellfish 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, Lowestoft, tel: 01502 562244
Marine science research	*Southampton University, tel: 01703 595000
Marine science research	*Portsmouth University, tel: 01705 876543
Benthic surveys: Marine Nature Conservation Review Database	*Marine Conservation Branch, JNCC, Peterborough, tel: 01733 62626
Marine conservation issues and fisheries	*Fisheries Liaison Officer, English Nature HQ, Peterborough, tel: 01733 340345
Marine Fisheries Task Group papers; marine conservation	*Marine Advisory Officer, Marine Conservation Branch, JNCC, Peterborough, tel: 01733 62626
Marine conservation and issues	*Conservation Officer, RSPB, Sandy, tel: 01767 680551
Marine conservation and issues	*Fisheries Officer, Marine Section, WWF-UK, Godalming, tel: 01483 426444
Marine conservation and issues	*Conservation Officer, Marine Conservation Society, Ross-on-Wye, tel: 01989 566017
Marine conservation and issues	*Honorary Secretary, The Marine Forum for Environmental Issues, Scarborough, tel: 01723 362392
Marine conservation issues	*Dorset Wildlife Trust, Dorchester, tel: 01305 264620
Marine conservation issues	*Hampshire & Isle of Wight Wildlife Trust, Eastleigh, tel: 01703 613636

* 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. It supports not only 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 sand lizard *Lacerta agilis* and smooth snake *Coronella austriaca* and the recently reintroduced natterjack toad *Bufo calamita*. This is the most important part of the country for Britain's rare reptiles.

Three continental European herptile species are also established here: the wall lizard *Podarcis muralis* (Walters pers. comm.) and the African clawed toad *Xenopus laevis* (Simmonds 1987) are found on the Isle of Wight; the former is also reported in Poole. A colony of European tree frogs *Hyla arborea* has been recorded at a pond in the New Forest, although this population may now be extinct (Snell 1991). Two species of marine turtle, the leatherback *Dermochelys coriacea* and loggerhead *Caretta caretta*, have been found on the shore of this region.

The natterjack toad, great crested newt, sand lizard, smooth snake and both the turtle species are totally protected under the Wildlife & Countryside Act 1981, although all the species listed are afforded some degree of protection under national and international legislation (Table 5.6.1).

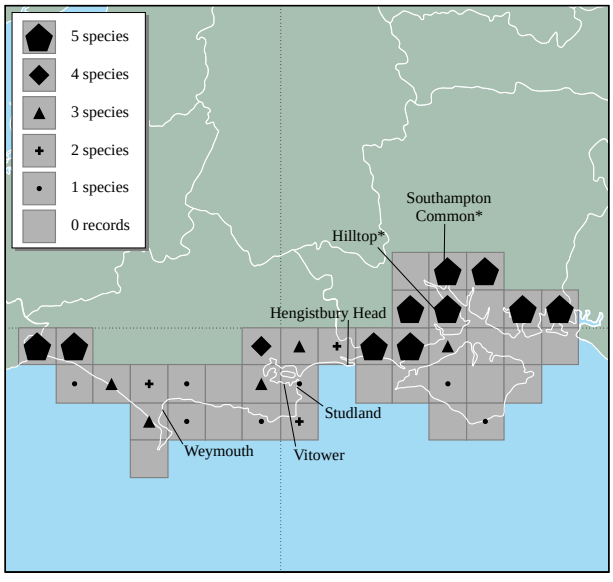
Table 5.6.2 shows the numbers of amphibian and reptile records in relation to survey effort. Hampshire and Dorset have been particularly thoroughly surveyed for both amphibians and reptiles, in terms of the average number of records available per 10 km square.

Throughout this region, 68% of surveyed 10 km squares support at least three species of amphibian (Map 5.6.1),

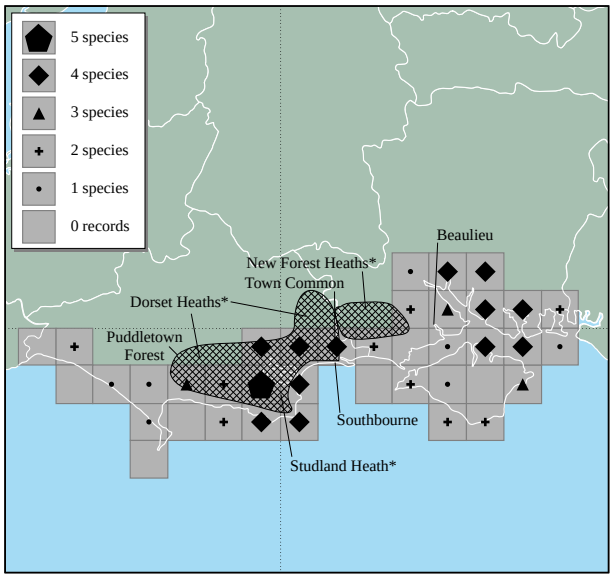
Table 5.6.1 Protected status of amphibians and reptiles occurring in region

Species	*Protection (see footnote)*
Amphibians	
Common frog *Rana temporaria*	1, 2, 3
Common toad *Bufo bufo*	1, 2
Smooth newt *Triturus vulgaris*	1, 2
Palmate newt *Triturus helvetica*	1, 2
Great crested newt *Triturus cristatus*	1, 2, 3,
Natterjack toad *Bufo calamita*	1, 2, 3
European tree frog *Hyla arborea*	1
African clawed toad *Xenopus laevis*	1
Reptiles	
Slow worm *Anguis fragilis*	1, 2
Common lizard *Lacerta vivipara*	1, 2
Sand lizard *Lacerta angilis*	1, 2, 3
Grass snake *Natrix natrix*	1, 2
Adder *Vipera berus*	1, 2
Smooth snake *Coronella austriaca*	1, 2, 3
Wall lizard *Podarcis muralis*	1
Loggerhead turtle *Caretta caretta*	1, 2, 3, 4
Leatherback turtle *Dermochelys coriacea*	1, 2, 3, 4

Key: 1 = Wildlife & Countryside Act (1981); 2 = Bern Convention (1979) ; 3 = EC Habitats & Species Directive (1992); 4 = CITES Convention.



Map 5.6.1 Numbers of amphibian species recorded in coastal 10 km squares and *key localities for amphibians (listed in Table 5.6.3). Distribution may reflect differences in recording effort. Source: Biological Records Centre, ITE Monks Wood. Note: not all rare species data are held by BRC and therefore some records may not be shown.



Map 5.6.2 Numbers of reptile species recorded in coastal 10 km squares and *key localities for reptiles (listed in Table 5.6.3). Large localities shown cross-hatched. Distribution may reflect differences in recording effort. Source: Biological Records Centre, ITE Monks Wood. Note: not all rare species data are held by BRC and therefore some records may not be shown.

Table 5.6.2 Records of amphibians and reptiles related to survey effort

		% 10 km squares surveyed for:			*Total no. of individual records:*		*Mean no. of individual records per surveyed 10 km square*	
	*Total no. of 10 km squares**	*Any herp. species*	*Amphibians*	*Reptiles*	*Amphibians*	*Reptiles*	*Amphibians*	*Reptiles*
Hampshire	16	100	63	94	234	147	23.4	9.8
Dorset	20	95	85	80	253	289	14.9	18.1
Isle of Wight	11	82	36	73	30	43	7.5	5.4
Region 9	***44***	***100***	***70***	***89***	***517***	***480***	***16.7***	***12.3***
East coast of GB	504	76	66	49	4,141	1,602	12.5	6.5
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); Braithwaite *et al.* (1989) and Corbett (1994). Key: *total includes squares that are partly in the county, but excludes squares that are exclusively marine.

comparing favourably with Great Britain as a whole (22%), and with the entire British coast (49%), but less well with the whole east coast (76%). A greater proportion of 10 km squares in this region (51%) also support at least three species of reptile (Map 5.6.2) than in Great Britain as a whole (45%) or the whole coast (43%).

Coastal habitats are essential to the continued existence of Britain's rare amphibians and reptiles. In particular, the mature heathland and sand dune systems of this region are of prime importance to the success of the reptile species nationally. Outside the sand dune and heathland areas, south-facing cliffs and cliff-tops comprise important reptile habitats. On the seaward side of the grazed downland, the narrow strips of scrub, long grass, scree, coastal paths and bare rock provide cover and an abundant food supply. These linear habitats are an essential refuge between heavily grazed grassland, built-up areas and the sea, for both rare and common species.

For the rare reptiles, the mature heathland, only fragments of which remain, and the undisturbed sand dunes constitute the most important habitats. 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: 70% of UK sand lizard foci are located in this region. Dorset and Hampshire are similarly important for Britain's rarest reptile, the smooth snake. Its national distribution is restricted to Dorset, Hampshire and a few heathland sites in Surrey, and 36 out of 40 (90%) recorded breeding sites in the UK are situated on heathland in this region (Braithwaite *et al.* 1989).

5.6.2 Important locations and species

Table 5.6.3 lists coastal 10 km squares (two digits) and coastal 1 km OS grid squares (four digits) in which rare and vulnerable species are found and areas that support regionally or nationally important species assemblages (Swan & Oldham 1989) or outstanding populations of widespread species (Maps 5.6.1 and 5.6.2).

Throughout, this region provides important habitats for both rare and widespread species. In the Portsmouth and Hayling Island areas, common lizards, slow worms and adders are common on heathland, dune, grazing marsh and sea-wall bank habitats behind the shingle line. They are also found along the cliffs between Studland and Swanage and west of Swanage. Slightly inland, all six native reptile species are present in the New Forest and Beaulieu areas, although the presence of sand lizards is the result of reintroductions, and the species is still rare here. Puddletown Forest and Dorchester delimit the approximate western edge of the sand lizard and smooth snake ranges, respectively (although there are unconfirmed reports of smooth snakes in Devon). Adders and grass snakes are common in the Chesil and Fleet Lagoon area. The four common reptile species, the European wall lizard and the African clawed toad are also found on the Isle of Wight. Frogs and toads are well distributed along most of the coast, but unfortunately there is a gap in the survey coverage between Studland and Weymouth. All three newt species are present along the mainland coast and on the Isle of Wight (Frazer 1976). There are two natterjack toad breeding sites in this region - Hengistbury (dune and heathland) and Vitower (heathland, grassland and upper saltmarsh), in Dorset. Natterjack toads have recently been successfully reintroduced to these sites and sustained by a programme of habitat management, as part of the English Nature Species Recovery Programme.

The single most important reptile area in Britain is Studland Heath NNR and Poole Harbour, Dorset, which supports all six species. The particular significance of the reserve lies in the extent and diversity of the habitats it contains: a relatively undisturbed sand dune system contiguous with heathland hinterland. A valuable rare reptile reserve is also maintained by the Herpetogical Conservation Trust at Town Common, north-east of Bournemouth.

Since 1990, one loggerhead turtle *Caretta caretta*, and three unidentified turtles, probably the leatherback *Dermochelys coriacea*, have been recorded in this region. One of the unidentified turtles was found alive at Southbourne, Dorset, while the loggerhead and the two other unidentified animals were recorded in Hampshire and the Isle of Wight.

Table 5.6.3 Important areas for rare and vulnerable amphibian and reptile species.

Site name	*Grid ref.*	*Habitat*	*Species present*
Hampshire			
Southampton Common Lake	SU4114	Urban park	Great crested newt, nationally important amphibian species assemblage
Hilltop, New Forest	SU4003	Forest, heathland	Great crested newt
New Forest Heaths	SU20, SU10	Heathland	Sand lizard (six sites)
Dorset			
Dorset Heaths west of the River Avon, enclosed within the area defined by Verwood, Christchurch, Poole and Wimborne	SU10	Heathland	Sand lizard (eleven sites)
	SZ19	Heathland	Sand lizard (ten sites), smooth snake (esp. around Hurn and Avon Valley), natterjack toad (Hengistbury)
	SZ09	Heathland	Sand lizard (fifteen sites), smooth snake
	SZ08	Heathland	Sand lizard (four sites), smooth snake
	SY99	Heathland	Sand lizard (eight sites), smooth snake
Dorset Heaths west of Sherford River and north of R. Frome	SY99	Heathland	Sand lizard (twelve sites), smooth snake
	SY98	Heathland	Sand lizard (six sites), smooth snake (particularly around Wareham)
	SY89	Heathland	Sand lizard (eleven sites), natterjack toad (Vitower)
	SY88	Heathland	Sand lizard (fifteen sites), smooth snake
	SY79	Heathland	Sand lizard (one site)
	SY78	Heathland	Sand lizard (one site), smooth snake
Studland Heath	SZ08	Heathland	Sand lizard (six sites), smooth snake
Dorset/Purbeck Heaths south of the R. Frome, i.e. from Studland to Lulworth	SY98	Heathland	Sand lizard (28 sites), smooth snake
	SY88	Heathland	Sand lizard (four sites), smooth snake

Sources: Beebee (1989), Braithwaite *et al.* (1989), Corbett (1994), Swan & Oldham (1993a, b). Owing to the sensitivity of the information, broad areas rather than precise grid references are indicated.

5.6.3 Human activities

Much of the heathland in this region has been destroyed and degraded by a combination of neglect, inappropriate management, afforestation and the encroachment of building development, the latter particularly around Bournemouth and Christchurch. Residential developments on heathland sites increase direct human disturbance and are associated with increased fire risk and raised levels of predation of lizard populations by domestic cats. Oil-related developments have also impinged on important rare reptile sites.

Natterjack toads are included in the English Nature Species Recovery Programme, the background and principles of which are outlined in Whitten (1990). Following an initial pilot study, which identified sites within this region as potential (re-) introduction sites, the natterjack toad Species Recovery Programme is currently being implemented (Denton & Beebee 1992, 1993, 1994). A three-year Species Recovery Programme for the sand lizard, begun in 1994, is being implemented by the Herpetological Conservation Trust in partnership with English Nature and the Worldwide Fund for Nature, and a Species Recovery Programme for the smooth snake is also under consideration by English Nature.

5.6.4 Information sources used

Amphibian and reptile surveying in Britain has been widespread, with 84% of 10 km squares receiving some coverage nationally, although coastal coverage (69% of squares) has been less extensive. In terms of the proportion of 10 km squares where some surveying has been carried out, the coastline of this region has been surveyed more extensively than most of the coast of Britain, for both amphibians (70% in the region compared with 59% on the British coast) and reptiles (89% in the region compared with 49% on the British coast) (Table 5.6.2).

National distribution data for the widespread amphibians and terrestrial reptiles were provided by the Biological Record 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 (EN). 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). Most of these data were collected through a volunteer, mainly amateur, recorder network.

Natterjack toad breeding sites are regularly monitored by NNR site managers, wildlife rangers and volunteers. Their information is incorporated into 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. The site register also contains current listings of site-, area- and region-specific published and unpublished research and monitoring papers.

Information on the distribution of sand lizards, extracted from the pilot study for the sand lizard Species Recovery Programme (Corbett 1994), was provided by English

Nature. Much of the smooth snake information is derived from the results of an extensive survey of the species by the British Herpetological Society carried out between 1984 and 1987 (Braithwaite *et al.* 1989). Sand lizard and smooth snake populations are regularly monitored by the Herpetological Conservation Trust (HCT) and the British Herpetological Society Conservation Committee (BHSCC).

Marine turtle distribution data were supplied by the Natural History Museum and Southampton University; all sightings at sea and strandings should be reported to the Natural History Museum in London. 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: Henry Arnold, Tony Braithwaite, Trevor Beebee, Keith Corbett, Colin Fitzsimmons and Tony Gent.

5.6.6 Further sources of information

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Conservation and captive breeding of amphibians and reptiles, nationally	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: 0198 684 518
National recording schemes and biological data from throughout UK	*Environmental Information Centre, ITE Monks Wood, Huntingdon, tel: 01487 773381
Turtles	Dr Colin 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
The turtle code; amphibians and reptiles in England; Species Recovery Programme	*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
Designated sites, Hampshire & Isle of Wight	*English Nature, Hants. & IOW Local Team, Lyndhurst, tel: 01703 283944
Hampshire & Isle of Wight	Hampshire Amphibian and Reptile Group, c/o *Hampshire & Isle of Wight Wildlife Trust, Romsey, tel: 01794 513786
Designated sites, Dorset	*English Nature, Dorset Local Team, Arne, tel: 01929 556688
Amphibian and reptile research	Institute of Terrestrial Ecology, Furzebrook Research Station, Wareham, Dorset BH20 5AS, tel: 019295 51518
Amphibians and reptiles in Dorset	Dorset Amphibian and Reptile Group, c/o *Dorset Wildlife Trust, Dorchester, tel: 01305 264620

* 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 - 5.7.4 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.

Table 5.7.1 and 5.7.2 list respectively 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 are widely distributed around Britain and are present in the region during their migration between spawning and overwintering areas. Two stocks of mackerel are found in north-west European waters: the North Sea stock and the continental Western stock. The Western stock spawn along the shelf edge west of Britain between February and June. Some of the stock then migrates eastwards through the English Channel into the central North Sea, while some remains in the west. The spawning is quite wide ranging and includes, in low intensity, areas offshore of this region (Map 5.7.1). Overwintering concentrations are found west of Scotland, west of Ireland and off Cornwall (Lee & Ramster 1981).

Herring are locally abundant in the summer and autumn in feeding areas throughout the region. There are no distinct autumn/winter spawning areas in the region but there are two south of the region, off the coast of France (Lee & Ramster 1981).

Sprats are widely dispersed throughout the shallower areas of the region, and especially in Lyme Bay. The whole region is a spawning area, delimited by the main egg and larval distribution. Spawning mainly peaks from February to April and is temperature-dependent. Sprats migrate inshore to overwinter and are common at that time of year in an area between Portland Bill and the Isle of Wight. No clearly-defined nursery areas have been identified. Juvenile sprat are often found mixed with young herring in inshore areas, such as Langstone Harbour, 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 occur sporadically, such as the spurdog, blue shark and lesser spotted dogfish. Rays such as the thornback ray and the cuckoo ray are also present.

Of the gadoids, cod are seasonally abundant and widely distributed in the region, and although there are no pronounced aggregations of cod for spawning in the region,

Table 5.7.1 Pelagic species and examples of measures for their protection

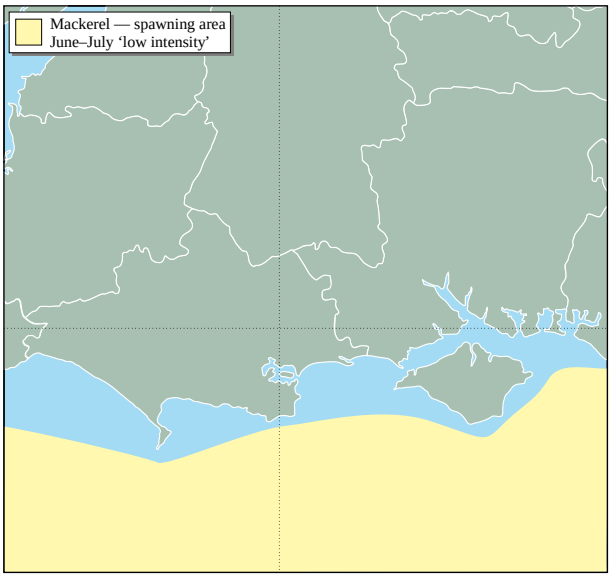
Species	*Protection measures*
Mackerel *Scomber scombrus*	QM
Herring *Clupea harengus*	QM/MLS
Sprat *Sprattus sprattus*	QM

Sources: European Commission (1996); MAFF (pers. comm.). Key: MLS = minimum landing size; QM = catch quota management.

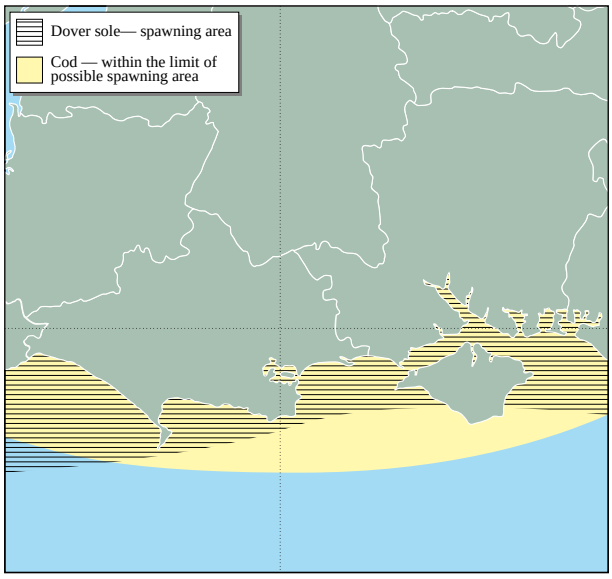
Table 5.7.2 Demersal species and examples of measures for their protection

Species	*Protection measures*
Elasmobranchs	
Spurdog *Squalus acanthias*	No limitation
Thornback ray *Raja clavata*	No limitation
Lesser spotted dogfish *Scyliorhinus canicula*	No limitation
Cuckoo ray *Raja naevus*	No limitation
Blue shark *Prionace glauca*	No limitation
Gadoids	
Cod *Gadus morhua*	MLS/QM
Whiting *Merlangius merlangus*	MLS/QM
Ling *Molva molva*	No limitation
Pollack *Pollachius pollachius*	MLS/QM
Flatfish	
Plaice *Pleuronectes platessa*	MLS/QM
Dab *Limanda limanda*	MLS
Dover sole *Solea solea*	MLS/QM
Lemon sole *Microstomus kitt*	MLS
Turbot *Psetta maxima*	MLS
Brill *Scophthalmus rhombus*	MLS
Flounder *Platichthys flesus*	MLS
Other demersal fish	
Bass *Dicentrarchus labrax*	MLS
Grey mullets *Chelon labrosus*, *Liza ramada* and *L. aurata*	MLS
Monkfish (angler) *Lophius piscatorius*	QM
Sandeels *Ammodytes* spp.	No limitation
Conger eel *Conger conger*	MLS

Sources: European Commission (1996); MAFF (pers. comm.). Key: MLS = minimum landing size; QM = catch quota management.



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



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

an area offshore of the coast is within the limit of possible spawning (Map 5.7.2). Whiting are widely distributed around Britain and are common in the region, especially in inshore waters. There are no identified whiting spawning areas in the region. The spawning season is prolonged - from January to July depending on the latitude - and there are likely to be spawning areas and nursery areas all around the coast that have not been identified. Ling and pollack are less abundant than other gadoids and more locally distributed and are found in particular around areas of stony ground, reefs and wrecks.

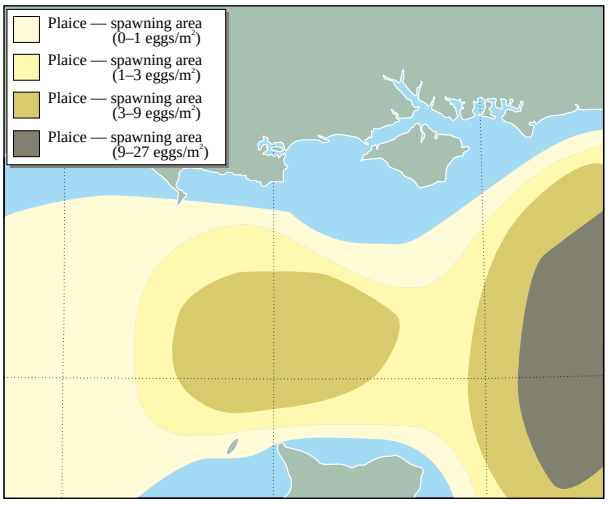
Plaice and dab are the most abundant flatfish species: much more is known about the life history of the commercially-exploited plaice. Plaice spawn from December to March with the peak spawning being in January and February. Knowledge of plaice spawning areas is obtained from the distribution of newly spawned eggs in spring, determined by plankton surveys (Lee & Ramster 1981) (Map 5.7.3). Plaice are found on sandy areas of sea bed throughout the region, with juveniles living close to the shore in the same nursery areas as Dover sole (see below), gradually moving to deeper water as they grow. Dab spawn from January to June and juveniles also move to coastal nurseries in the autumn and migrate to deeper water as they grow. Dover sole, which have a similar lifestyle to plaice and dab, spawn in the early summer (April to June) all along, and offshore of, the coast of the region (Map 5.7.2). Young Dover sole may spend up to two years in inshore nursery areas (Map 5.7.4). 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. In contrast, a more local distribution is recorded for the lemon sole, which occurs in small numbers throughout the region. It is assumed that adults spawn where they are found and probably do not make extensive migrations. Flounders migrate between 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 long-shore coastal movement other than in the egg or larval phase.

Bass and mullet species are seasonally abundant inshore and in estuaries in the region and arrive at the region's coast in the early spring from warmer areas further west. Bass spawn in the region from March to May (Map 5.7.4) and there has been a strong recruitment of stocks that is thought to be linked to warm sea temperatures in spring (Pawson 1992). From June onwards juvenile bass are found extensively in the creeks, estuaries, backwaters and shallow bays that border the region. There are eight known bass nursery areas in the region: Chichester Harbour, Langstone Harbour, Portsmouth Harbour, Southampton Water, Fawley Power Station Outfall - Stanswood Bay, Poole Harbour, Weymouth/Portland Harbour and the Fleet (Kelley 1988), and these areas (apart from Weymouth/Portland Harbour) are designated by MAFF as bass nursery areas with angling restrictions imposed (see Map 5.7.4 and section 5.7.3).

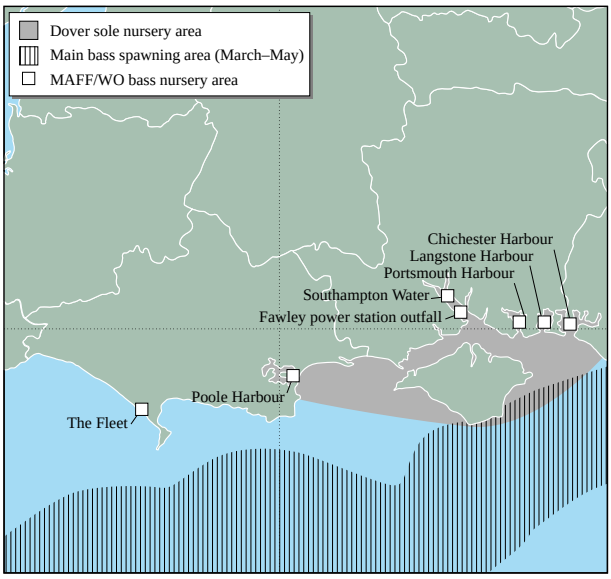
Monkfish (angler) spawn in deep water along the continental shelf edge mainly between March and June, but juveniles and non-spawning adults can be found throughout the region. Other demersal species of commercial importance are conger eel and various wrasse species. Sandeels are distributed widely throughout the region and are common in the shallow harbours and bays. Sandeels provide an important food source for many other exploited fish species. They burrow in coarse sand at night and during the winter; their distribution is thus influenced by that of coarse sand.

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 scale of these fluctuations.



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



Map 5.7.4 Bass nursery and spawning areas and Dover sole nursery area. Sources: MAFF & WO (1990); Pawson (1992, 1995). © Crown copyright.

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), explained further in section 9.1). Two such protection measures are listed in Tables 5.7.1 and 5.7.2: MLS, and catch quota management (QM), which indicates that the UK has been allocated a TAC in ICES Divisions VIId (English Channel, East) and/or Division VIIe (English Channel, West), which cover Region 9. 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.

In order to safeguard the bass fishery in coastal waters, 34 bass nursery areas 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 most easily caught, particularly during the summer months. There are seven designated bass nursery areas in the region (Table 5.7.3 and Map 5.7.4). The legislation prohibits fishing for bass from any vessel for the duration of the closed season, and although fishing from the shore is not covered, anglers are expected to return to the sea any bass caught within nursery areas.

Table 5.7.3 MAFF/WO designated bass nursery areas in the region

Name of area	*Duration of closed season*
Chichester Harbour	1 May - 31 October
Langstone Harbour	1 May - 31 October
Portsmouth Harbour	1 May - 31 October
Southampton Water	1 May - 31 October
Fawley Power Station Outfall - Stanswood Bay	1 May - 31 October
Poole Harbour	1 May - 31 October
The Fleet	All year

Source: Ministry of Agriculture, Fisheries and Food & Welsh Office Agriculture Department (1990)

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.

Spawning and nursery areas may be vulnerable to other activities, such as aggregate extraction, sewage sludge dumping, dredging and dredge 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. Other activities, such as sea angling (see section 9.1.2) and seismic activity for oil and gas exploration (Turnpenny & Nedwell 1994), may also have an effect on populations.

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 as a source for the maps, as well as Pawson (1995), which shows distribution maps of selected fish and shellfish species around the north-east Atlantic and the British Isles and has a species-specific bibliography.

European Council Regulations detailing 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 can be fished, are published in Luxembourg in the Official Journal of the European Communities. These regulations are updated annually and the regulations for 1996 are in preparation at the time of writing (see e.g. European Commission 1996).

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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. Marine conservation issues	*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.	*Director, MAFF Directorate of Fisheries Research, Fisheries Laboratory, Lowestoft, tel: 01502 562244
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 science research	*Southampton University, tel: 01703 595000
Marine science research	*Portsmouth University, tel: 01705 876543
Marine conservation issues and fisheries	*Fisheries Liasion Officer, English Nature HQ, Peterborough, tel: 01733 340345
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, 9 Gloucester Road, Ross-on-Wye, Herefordshire HR9 5BU, tel: 01989 566017
Marine conservation issues	*Honorary Secretary, The Marine Forum for Environmental Issues, Scarborough, tel: 01723 362392
Marine conservation issues	*Dorset Wildlife Trust, Dorchester, tel: 01305 264620
Marine conservation issues	*Hampshire & Isle of Wight Wildlife Trust, Eastleigh, tel: 01703 613636

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

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.

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 (Map 5.8.1). 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 the region in other rivers, small tributaries and streams, shown on the map of river quality in NRA (1994) but not shown on Map 5.8.1.

Map 5.8.1 Salmon and sea trout rivers. Source: NRA.

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); MLS; close season
Sea trout *Salmo trutta*	MLS; close season
Eel *Anguilla anguilla*	MLS

Sources: European Commission (1996); MAFF and NRA (pers. comm.). Key: MLS = minimum landing size.

5.8.3 Human activities

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). Under the Water Resources Act (1991), the Southern and South Western 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 NRA issues licences to individuals to fish for salmon, sea trout and eels. In 1993 nine net licences to take salmon and sea trout were issued in the region. The catch statistics of salmon and sea trout from the region's rivers are presented in section 9.1.4. The NRA uses a variety of techniques, such as electric fishing and monitoring of angling and net catches, to assess fish stocks of salmon and sea trout. A 'Fisheries Classification Scheme' is being produced so that comparisons of the status of fish stocks may be made between different sites or river reaches. Fisheries will be allocated a quality class on the basis of fish data and basic river habitat data. The NRA may make impassable barriers, such as mills, and flow control structures, such as dams, passable by a variety of means, including the construction of fish passes. The NRA also undertakes physical habitat improvement, such as creating pools and cleaning spawning gravels.

Maitland & Campbell (1992) summarise the possible effects of various issues of relevance to freshwater fish. Issues mentioned of relevance in the region include industrial and domestic pollution, which may block the movement of migratory species and cause the elimination of stocks.

5.8.4 Information sources used

The seven rivers and coastal areas 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 Southern and South Western Regions of the NRA, for example the Piddle and Frome. The information has been derived from the National Rivers Authority published catch statistics (see section 9.1.2). 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. There are therefore diadromous fish present in other rivers and streams that are not shown on Map 5.8.1. For example the River Meon and nearly all the rivers and streams within the New Forest hold populations of sea trout, though this is not the case for Isle of Wight streams (NRA Southern Region pers. comm.).

The Institute of Freshwater Ecology (part of the Natural Environment Research Council) conducts a programme of research into freshwater habitats and species. Their 'fish counters' yield information on various species of fish, and other studies involve sampling salmon, sea trout and eel from rivers in the UK. In addition NRA Southern Region operates fish counters on the Test and Itchen.

European Council Regulations detailing 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 can be fished, are published in Luxembourg in the Official Journal of the European Communities. These regulations are updated annually and the regulations for 1996 were in preparation at the time of writing (see e.g. European Commission 1996).

5.8.5 Acknowledgements

Thanks go to Stuart Bray (NRA South West Region) and Robin Cranshaw (NRA Southern Region) for their comments on this section and to Catherine Smith (JNCC) for producing Map 5.8.1.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Regional scientific information and advice	*Regional Fisheries Manager, Fisheries Department, NRA Southern Region, Worthing, tel: 01903 820692
Regional scientific information and advice	*Regional Fisheries Manager, Fisheries Department, NRA South West Region, Exeter, tel: 01392 444000
Scientific advice and policy for England; 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
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

There are 92 species of expoited and unexploited fish (out of a national total of 336) recorded from off the mainland in this region, comprising two jawless fish (Agnatha), eight sharks and rays (elasmobranchs) and 82 bony fish (teleosts) (Holmes 1975; Potts & Swaby 1993b). The species regional total is not definitive: some groups, such as skate, have not been identified to species level and the list must be considered incomplete. This region has published 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 *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* and very occasional sturgeon *Acipenser sturio*. These species are considered threatened in UK and European waters (Potts & Swaby 1993a).

5.9.2 Important locations and species

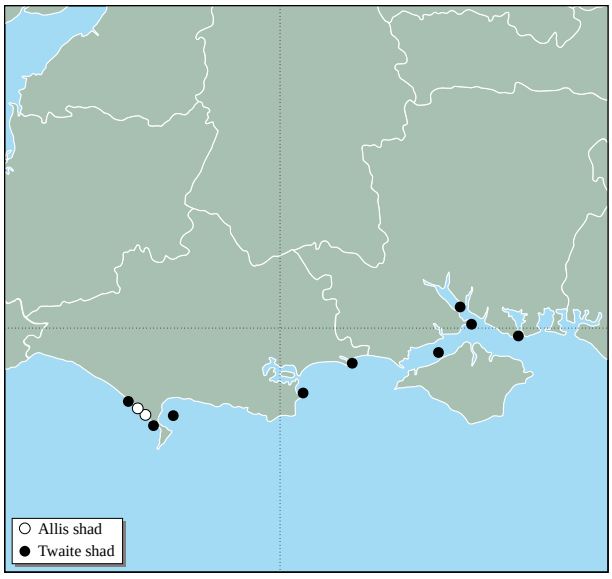
Map 5.9.1 shows the distribution of records of twaite shad and allis shad. In addition the lampern, sea lamprey and allis shad have all been recorded from the Solent and all but the allis shad have confirmed records from Poole Harbour (Ladle pers. comm. 1993). The allis shad was also recorded by Draper (1964) as being caught during late summer and autumn from the coastal waters of the Isle of Wight. The twaite shad was described as having similar habits but arriving around October, and was reported by Draper to be more common than the allis shad.

The associations of fish with habitats are given in Potts & Swaby (1993c). Major marine habitat types have been identified and divided into a series of 'ecotypes', including estuarine, littoral, sublittoral, offshore habitats and specialist habitats (symbiotic and other relationships). These are further refined with reference to substrate types (mud, sand, gravel and particulate substrate, bedrock or boulders (reef) and water column, where appropriate). This classification provides a structure for identifying and classifying fish/habitat associations. However, many fish have complex life-styles and habitat requirements and may occupy several habitats during different phases of their life-cycles.

Langstone Harbour is a nursery area for many species of fish, including flatfish, bream (Bramidae), sprat *Sprattus sprattus*, herring *Clupea harengus*, pilchard *Sardina pilchardus* and mullets. (Portsmouth Polytechnic 1976).

A total of 80 species have been recorded from the intake screens of Fawley power station in Southampton Water (Henderson 1989). Species found in the Solent include the smelt *Osmerus eperlanus*. In the western arm of the Solent, stingray *Dasyatis pastinaca* and smoothhound *Mustelus mustelus* are found, and stingrays congregate on the sand banks in the mouth of the River Beaulieu (Henderson pers. comm.) and at Lymington (Orton 1994).

Sharks recorded from Isle of Wight waters by Draper (1964) include basking sharks *Cetorhinus maximus*, which are best viewed from the cliffs at Freshwater. The porbeagle *Lamna nasus* is reported as a summer visitor following in pursuit of schools of mackerel, and the thresher shark *Alopias vulpinus* is commonly spotted off the Needles. Some unusual fish have been recorded from the waters around the Isle of Wight. Recent records include a tadpolefish *Raniceps raninus* from the Needles in 1986 and a triggerfish *Balistes carolinensis* in 1987 from Compton Bay. Another four triggerfish were caught from Ventnor Undercliff in 1989 (see Herbert 1988, 1989a, b). Shore fish off Bembridge and St. Helen's include butterfish *Pholis gunnellus*, the five-bearded rockling *Ciliata mustela*, the sand goby *Pomatoschistus minutus* and the shanny *Lipophrys pholis*, which is frequent in pools and under rocks. The fifteen-spined stickleback *Spinachia spinachia* is common amongst *Sargassum* weed. Sublittoral surveys have recorded dragonet *Callionymus lyra* and the scorpionfish *Taurulus bubalis*. Other notable observations were the red gurnard *Aspitrigla cuculus* and a corkwing wrasse *Crenilabrus melops* building a nest. Fish



Map 5.9.1 Distribution records on the British Marine Fishes Database of sea lamprey and sturgeon. Source: after Potts & Swaby (1993a).

Table 5.9.1 Scheduled species and protected status

Species	*Wildlife and Countryside Act (Schedule)*	*EC Habitats & Species Directive (Annex)*	*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.

recorded off Hengistbury and Christchurch Ledge include four different species of goby - the sand, painted, rock, and black gobies *Pomatoschistus minutus, P. pictus, Gobius paganellus* and *Gobius niger* (Collins & Mallinson 1986).

Fifty-three fish species have been recorded from Poole Harbour (Potts & Swaby 1993b); notable species include smelt, garfish *Belone belone,* red sea bream *Pagellus bogaraveo* and red mullet *Mullus surmuletus* (Ladle pers. comm. 1993). Twelve fish species have been recorded from the Fleet Lagoon, including the unusual redband fish *Cepola rubescens* and the rare Couch's goby *Gobius couchi* (Dyrynda 1984), which has been recorded from only a few sites in the south-west of England and Ireland.

5.9.3 Human activities

Human activities affecting estuaries and adjacent coasts are summarised in Davidson *et al.* (1991) and have an effect on 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. Oil exploration and seismic surveying activity can have an adverse impact on fish (Turnpenny & Nedwell 1994). Dams, weirs and power stations water intakes (Henderson *et al*. 1984) can injure or impede migratory fish, which are then unable to reach spawning and feeding grounds. Salmon 'passes' are built around dams and weirs to allow some selected species to migrate up or down the affected rivers and estuaries. Urbanisation and the disposal of untreated sewage in estuaries result in a reduction in dissolved oxygen to which fish are particularly sensitive. 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). Larger sharks such as basking sharks *Cetorhinus maximus* have been observed avoiding coming close to the shore if speed boats are close by (Draper 1964). The possible effects of fisheries on fish species is discussed in section 5.7 and 9.1. Sea angling occurs in many places throughout the region (Orton 1994) (see section 9.1.2).

5.9.4 Information sources used

The fish of the Hampshire and Dorset coast have been well studied, especially in the larger coastal harbours, Southampton Water and around the Isle of Wight. Surveys in this region have mostly been carried out by the universities (Portsmouth and Southampton), the National Rivers Authority (NRA), and other institutes (Fawley Aquatic Research Laboratories). There is a long-term data-set on fish caught on the intake screens of Fawley power station in Southampton Water, which has enabled populations of individual species, for example the sand smelt *Atherina presbyter,* to be studied over time (Henderson *et al*. 1984).

The fish of Langstone Harbour have been recorded by a variety of methods, including seine netting, angling and shore searches. The review of estuarine fish in selected English estuaries (Potts & Swaby 1993b), carried out by the Marine Biological Association for English Nature, is included in the British Marine Fishes Database and covers UK fish and individual records for this area, particularly Chichester, Langstone and Poole Harbours. Information is being gathered from a variety of sources, including the NRA, the Southern Sea Fisheries Committee, anglers and fishermen. The data include published literature, unpublished reports and personal communications from fish biologists.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
British Marine Fishes Database	Dr G.W. Potts and S.E. Swaby, Marine Biological Association UK, Citadel Hill, Plymouth PL1 2PB, tel: 01752 222772
Fisheries	*Director, MAFF Directorate of Fisheries Research, Lowestoft, tel: 01502 562244
Marine conservation issues and fisheries - UK	*Marine Advisory Officer, JNCC Peterborough, tel: 01733 62626
Marine conservation issues and fisheries - England	*Fisheries Liaison Officer, EN HQ, Peterborough, tel: 01733 340345

* 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 (listed in Table 5.10.1), but also seaducks, cormorant, divers and grebes that are reliant for an important part of their life on the marine environment. (Section 5.12.2 includes includes information on these waterfowl species, where they occur close inshore, especially within estuaries.) Scientific names of all species are given in the tables.

This region is important for seabirds in both national and international contexts. Fifteen species of seabird breed in the region, two (black-headed gull and little tern) in numbers of international importance (more than 1% of their European populations). Numbers of three further species (cormorant, Sandwich and common terns) are nationally important, while more than 1% of the small British populations of Mediterranean gull and roseate tern also breed here. Table 5.10.1 summarises the importance of the region for breeding seabirds.

Nationally important populations of offshore waterfowl (exceeding 1% of British totals) winter at five sites in the region. Wintering numbers of great crested grebes, cormorants and red-breasted mergansers are nationally important, and the numbers of mergansers probably exceed internationally important levels. In addition, a high proportion of the small British wintering population of black-necked grebes occurs in this region, at Langstone Harbour, in the largest British flock. Concentrations of birds at sea in this region are generally low, but are largest near the colonies during the breeding season.

Map 5.10.1 Colonies holding more than 1% of the GB population of any seabird species. Numbers are those listed in Table 5.10.2. Source: JNCC Seabird Colony Register.

5.10.2 Important locations and species

Most breeding seabirds require habitat that is free from predatory mammals, so nearly all colonies are on offshore islands, cliffs or remote parts of saltmarshes. The large gulls appear to be able to tolerate more disturbance by mammals than the smaller seabird species. Some of the tern colonies in this region are on beaches and are particularly vulnerable. Three colonies hold numbers of seabirds at or above 1% of the total population of the European Union total for that species (Table 5.10.2; Map 5.10.1). A further five colonies are important at the Great Britain level. Colonies on the

Table 5.10.1 Overall importance of seabirds breeding in the region

Species	*Total*	*% GB*	*% Europe*
Fulmar *Fulmarus glacialis*	114	<1.0	<1.0
Cormorant *Phalacrocorax carbo*	340	5.0	0.4
Shag *Phalacrocorax aristotelis*	95	<1.0	<1.0
Mediterranean gull *Larus melanocephalus*	4-6	>1.0	<1.0
Black-headed gull *Larus ridibundus*	23,814	14.2	2.0
Lesser black-backed gull *Larus fuscus*	2	<1.0	<1.0
Herring gull *Larus argentatus*	309	<1.0	<1.0
Great black-backed gull *Larus marinus*	21	<1.0	<1.0
Kittiwake *Rissa tridactyla*	188	<1.0	<1.0
Sandwich tern *Sterna sandvicensis*	308	2.2	0.6
Roseate tern *Sterna dougallii*	3	>1.0	<1.0
Common tern *Sterna hirundo*	499	3.9	0.5
Little tern *Sterna albifrons*	217	9.0	1.2
Guillemot *Uria aalge*	819	<1.0	<1.0
Razorbill *Alca torda*	25	<1.0	<1.0
Puffin *Fratercula arctica*	43	<1.0	<1.0

Sources: figures for Great Britain from Walsh *et al.* (1994) and for Europe from Lloyd *et al.* (1991). Notes: counts are of pairs, except for guillemots, razorbills and puffins, which are counted individually. Regional totals are compiled from the most recent available good-quality counts up to 1993.

Table 5.10.2 Recent counts of seabird colonies in the region holding more than 1% of the EU or 1% of the Great Britain total for particular species

Site no.	*Colony*	*Grid ref.*	*Species*	*Year*	*Count*	*>1% EU/GB*	*Protected status*
1	Langstone Harbour	SU699030	Little tern	1989	171	EU	SPA
2	Beaulieu Estuary/	SZ429979	Black-headed gull	1991	8,726	EU	SSSI
	Needs Ore Point		Sandwich tern	1989	198	GB	None
			Common tern	1989	350	GB	None
			Little tern	1989	42	GB	None
3	Solent, west of Needs Ore	SZ330930	Black-headed gull	1991	5,930	GB	SSSI
			Common tern	1993	212	GB	None
			Little tern	1990	53	GB	None
4	Needles to Freshwater	SZ311849	Cormorant	1991	154	EU	None
5	Brownsea	SZ020880	Common tern	1992	135	GB	SSSI
6	Round Island	SY965902	Black-headed gull	1991	5,350	GB	SSSI
7	Ballard Down	SZ051820	Cormorant	1993	118	GB	None
8	Chesil Beach	SY550850	Little tern	1992	55	GB	SPA

Source: JNCC/Seabird Group Seabird Colony Register. Key: Site number refers to Map 5.10.1. GB = nationally important; EU = internationally important; SPA = Special Protection Area; SSSI = Site of Special Scientific Interest. Notes: all counts are of pairs of birds; count >=1% of the GB total = nationally important population; count >=1% of the EU total = internationally important. For most species the most recent available good-quality count is presented, except 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.

marshes of the Solent and associated estuaries and in Poole Harbour hold most of the breeding seabirds in the region. The feeding areas of birds from these colonies are as importance as the breeding areas themselves, as colonies cannot survive without food. Most of the birds from these important colonies feed on the Solent, in Poole Harbour or inland. The little terns of Chesil Beach feed in the Fleet or close by in Lyme Bay.

At sea, seabird food sources range from zooplankton to small fish and offal 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 seabed features. Most of the seabird species for which the region is important feed in estuaries, often on exposed intertidal areas, or in other shallow, inshore waters. Five sites in the region - Langstone Harbour, Chichester Harbour, Southampton Water, Poole Harbour and the Fleet/Portland Harbour - support nationally important populations (exceeding 1% of British totals) of marine-wintering waterfowl (Table 5.10.3). Both Poole Harbour and Langstone Harbour support more than one species at this level.

5.10.3 Human activities

Seabirds can be particularly affected by marine oil pollution, although in summer the main species in this region (terns and gulls) would be more vulnerable to indirect effects on food supply. Large winter roosts of gulls, which occur on the sea in some parts of the region, would be at direct risk, however, as would localised concentrations of wintering waterfowl, such as grebes and seaduck. Spills can also occur from non-tanker shipping movements. The English Channel as a whole is an important route for tankers and other vessels, and within this region there is a major oil refinery at Fawley, near Southampton.

Table 5.10.3 Important locations in the region for marine-wintering waterfowl (seaducks, divers, grebes and cormorant)

*Species**	*Peak numbers*	*1% GB*	*1% NW Europe*
Langstone Harbour			
Black-necked grebe *Podiceps nigricollis*	28	1	1,000
Cormorant *Phalacrocorax carbo*	140	130	1,200
Red-breasted merganser *Mergus serrator*	174	100	1,000
Chichester Harbour			
Red-breasted merganser *Mergus serrator*	142	100	1,000
Southampton Water			
Cormorant *Phalacrocorax carbo*	148	130	1,200
Poole Harbour			
Slavonian grebe *Podiceps auritus*	10	4	50
Cormorant *Phalacrocorax carbo*	237	130	1,200
Red-breasted merganser *Mergus serrator*	332	100	1,000
The Fleet/Portland Harbour			
Red-breasted merganser *Mergus serrator*	260	100	1,000

Sources: Peak numbers from Waters & Cranswick (1993), Kirby *et al.* (1993), Owen *et al.* (1986) and JNCC Birds database; 1% GB from Waters & Cranswick (1993), 1% NW Europe from Rose & Scott (1994). Key: *in addition, the total population of great crested grebes in the region (mainly at Southampton Water and Langstone Harbour) exceeds the 1% GB level (>100 birds).

Important numbers of terns (particularly little terns) breed in this region, and colonies of these species are particularly vulnerable to disturbance and predation (which may cause desertion of colonies or large-scale breeding failure). Most of the tern colonies in the region are wardened or otherwise protected, but predation (e.g. by foxes) has nevertheless been a serious problem in some years.

The eggs of black-headed gulls are collected on a commercial basis in parts of the Solent, for instance at Beaulieu, Lymington and Poole.

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 cliff colonies, and at most of the tern colonies, in the region. Surveys of birds at sea in the English Channel have been carried out by JNCC's Seabirds at Sea Team, and, in this region have been supplemented by detailed surveys of the Solent and of the waters off east and mid Dorset. The latter surveys have also included land-based counts of inshore species. In addition, 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. Information on locations of marine-wintering waterfowl has been compiled from these and other published sources and includes sites covered by the Wetland Bird Survey (WeBS) (see section 5.12.4).

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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

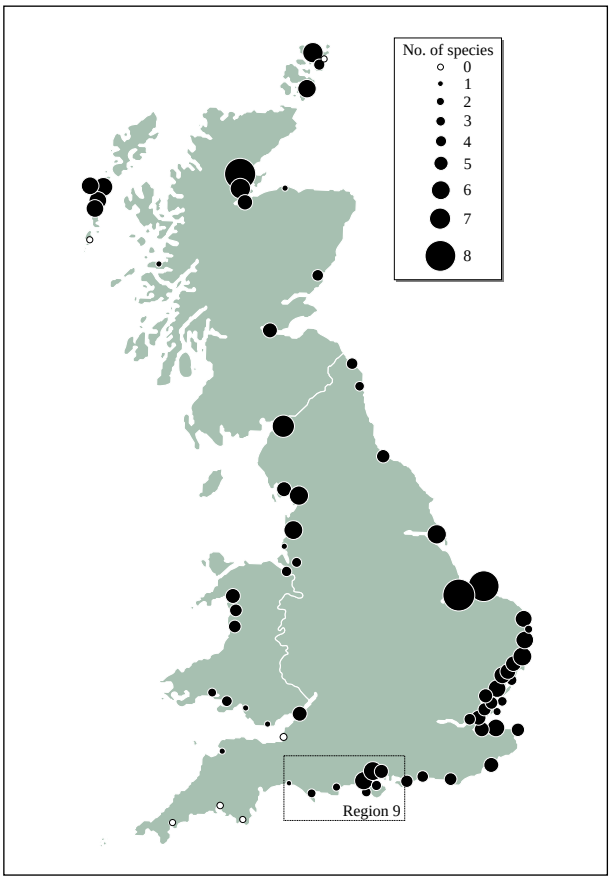
D.M. Craddock & D.A. Stroud

5.11.1 Introduction

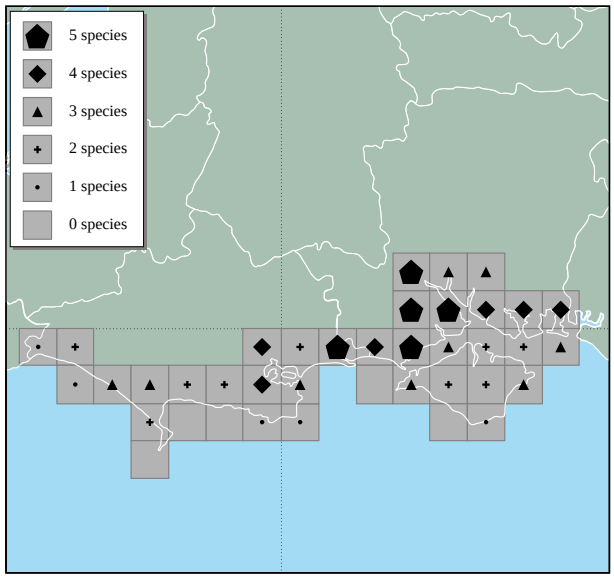
This section outlines the importance of the region to breeding birds other than seabirds. Because of their distinctive ecology and mixed-species breeding colonies, seabirds are described separately in section 5.10.

The region contains a wide range of habitats, which support important assemblages of breeding birds and determine their distribution (Aspinall & Tasker 1990). Examples of these include extensive wet grasslands, such as at Brading Harbour and along several river valleys, areas of reedbed (e.g. in Poole and Christchurch Harbours), freshwater marshes, fen meadows, wet ditches and transitions to peatland mires. The abundance of intertidal habitats provides important feeding areas for waterfowl nesting in the surrounding areas.

The saltmarshes and wet coastal grasslands of the region are of significance in both an English and a national context for their populations of breeding waders (Davidson 1991; Davidson *et al.* 1991). Indeed, several wader species have their southern English strongholds in this area (Maps 5.11.1 and 5.11.2), such as redshank *Tringa totanus*, oystercatcher *Haematopus ostralegus* and lapwing *Vanellus vanellus*. Several of the saltmarsh and wet grassland areas around the Solent have diverse breeding wader assemblages. Numbers of



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



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

lowland breeding waders, especially those associated with these habitats, have been declining, not only nationally but also internationally (Hötker 1991). The importance of this region for these breeding birds is thus likely to increase proportionally.

5.11.2 Important locations and species

The saltmarshes of Poole Harbour, Southampton Water, Beaulieu Estuary, Langstone Harbour, Newtown Estuary and Solent Marshes all hold notable densities of saltmarsh-breeding redshank, lapwing, snipe *Gallinago gallinago* and oystercatcher (Table 5.11.1), with lower densities on associated wet grasslands (Davidson 1991). In particular, the saltmarshes of the Newtown and Beaulieu Estuary (Needs Ore) hold some of the highest densities of breeding waders, with the density of redshank on the Beaulieu being the greatest in Britain (Allport, O'Brien & Cadbury 1986). Chichester, Langstone and Poole Harbours, Chesil Beach and the Fleet, Portsmouth Harbour and Southampton Water and Solent Marshes also hold significant breeding bird populations (Pritchard *et al.* 1992).

Mute swans *Cygnus olor* breed colonially at Abbotsbury on the Fleet - one of the most important sites in Britain where this occurs. A national survey in 1990 found 102 nesting pairs and 300 non-breeders here (Delany Greenwood & Kirby 1992). The colony has been the subject of a long-term population study (Perrins & Ogilvie 1981).

A number of breeding wildfowl, including little grebe *Tachybaptus ruficollis*, grey heron *Ardea cinerea*, mallard *A. platyrhynchos*, pochard *Aythya ferina*, moorhen *Gallinula chloropus* and coot *Fulica atra*, occur at high densities in some coastal wetlands. Map 5.11.3 show the incidence of confirmed breeding in coastal 10 km squares of selected

Table 5.11.1 Densities of breeding waders on a sample of saltmarshes surveyed in 1985*

Site	*Oystercatcher pairs/ km²*	*Lapwing pairs/ km²*	*Redshank peak nests/ km²*	*Total wader pairs/ km²*
Hampshire				
Eling	3		69	72
Langdown	2		19	21
Needs Ore	24	27	109	160
Hurst Castle	3		79	82
Isle of Wight				
Newtown Estuary	11	5	50	66
Newtown Res	6		23	29
Yarmouth	2	2	47	51
Dorset				
Keysworth Point			95	95

Source: Allport, O'Brien & Cadbury (1986). Key: *other saltmarshes in the region were *not* surveyed, so this is not a comprehensive listing.

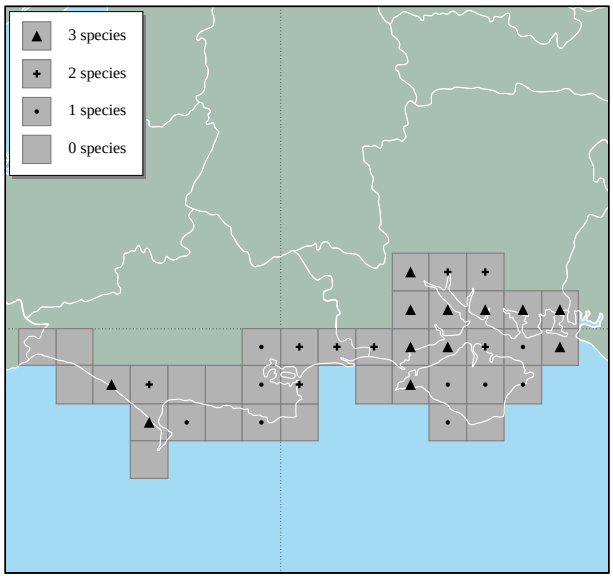
Table 5.11.2 Numbers of pairs of territorial (presumed breeding) ringed plovers in 1984

	Pairs (coastal) counted in survey	*% GB total counted in survey*
Hampshire	150	2.1
Isle of Wight	4	0.1
Dorset	30	0.4
Region 9	***184***	***2.6***
England	1,984	27.5
GB total	**7,207**	**-**

Source: Prater (1989). Note: survey coverage varied between counties.

waterfowl species characteristic of shingle, sand dunes and other dry grassland (ringed plover *Charadrius hiaticula*, oystercatcher, shelduck). Breeding ringed plovers nest in parts of the Solent and elsewhere along the coast, such as Chesil Beach (Davidson *et al.* 1991; Prater 1989; Table 5.11.2 and Map 5.11.4). The Solent/Isle of Wight area is a major stronghold for this species in the south of England.

There are a number of important coastal reedbeds and associated wetlands within the region, such as at Radipole Lake, and these contain important populations of reedbed passerines, including bearded tit *Panurus biamicus*, reed warbler *Acrocephalus scirpaceus*, sedge warbler *A. schoenobaenus*, Savi's warbler *Locustella luscinioides* and Cetti's warbler *Cettia cetti*.

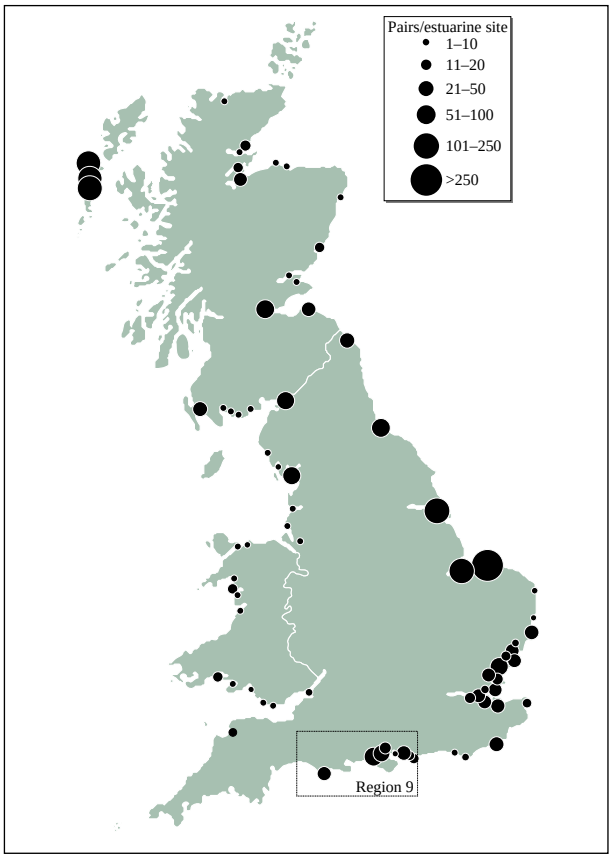


Map 5.11.3 Number of confirmed breeding species characteristic of shingle, sand dunes and other dry grasslands (ringed plover, oystercatcher and shelduck) in coastal 10 km squares. Source: based on Gibbons, Reid & Chapman (1993)

5.11.3 Human activities

In this region 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.

Active land management for conservation has, in many coastal areas, increased the populations of breeding waterfowl. Within the region there are a number of coastal SSSIs that contain cliff, sand dune and estuarine habitats. Additionally there are RSPB reserves at Langstone Harbour, Radipole and Lodmoor, and Arne (in Poole Harbour). Reed-bed management on RSPB reserves has served to enhance bird populations and extend the habitat in these areas (Everett 1989). The appropriate agricultural and other



Map 5.11.4 Numbers of breeding ringed plover in Britain. Source: Davidson *et al.* (1991) from data in Prater (1989). Note: numbers shown relate only to estuarine sites; species also breeds elsewhere along the coast

management (e.g. by winter flooding) of wet grassland in the region, aided in places by agricultural support programmes, is of crucial importance for their wader populations (see also papers in Hötker 1991; Green, Cadbury & Williams 1987; Green 1991). On the North Solent NNR water level management is undertaken to maximise the site's attractiveness to breeding birds. The pastures are kept wet in spring, and the reed-filled ditches are periodically cut and dead vegetation removed. Similar water-level management, controlled by sluices and bunds, is undertaken at Farlington Marshes. 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).

Human disturbance during the breeding 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 in coastal areas where high densities of birds occur. In areas of the highest risk, however, there are well-developed contingency plans for dealing with accidental spillages.

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 the data are one of the best sources for comparisons at county, regional or national scales, care should be taken with their use in assessing 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.

Extensive survey work has also been undertaken for a number of species by volunteers. Usually these surveys have been organised as part of wider British surveys (e.g. for ringed plover (Prater 1989), mute swan (Delany, Greenwood & Kirby 1992) and shelduck (S. Delany pers. comm.)).

5.11.5 Acknowledgements

We thank David Cole (JNCC), George Boobyer (JNCC), Simon Delany and WWT for unpublished shelduck data and Victoria Copley (English Nature) for comments.

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Hughes, K. 1994. *Breeding bird census of the North Solent NNR.* Lyndhurst, English Nature. (Unpublished report.)

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Breeding atlas data and breeding wader data	*Development Unit, The British Trust for Ornithology, Thetford, tel: 01842 750050
Breeding bird surveys; coastal habitat management	*RSPB HQ, Sandy, tel: 01767680551
Coastal breeding wildfowl data	*Wildfowl & Wetlands Trust, Slimbridge, tel: 01453 890333
Site designations	*EN HQ, Peterborough, tel: 01733 340345
Local ornithological club	Peter Morrisson, Dorset Bird Club, 7 Thornton Avenue, Warsash, Southampton SO3 9FL, tel: 01489 570149
Local ornithological club	Hampshire Ornithological Society, Mrs Ilene Bowman, 53 Lonnen Road, Colhill, Wimborne, Dorset BH21 7AT, tel: 01202 884788

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

The Fleet lagoon holds the largest wintering concentration of mute swans in Britain, with an average of 1,055 birds in the season. Formerly reared by monks for food, the swans breed colonially on the Fleet at Abbotsbury - one of the most important sites in Britain where this occurs. In 1990, 102 nesting pairs and 300 non-breeders were found here. Photo: Pat Doody, JNCC.

5.12 Migrant and wintering waterfowl

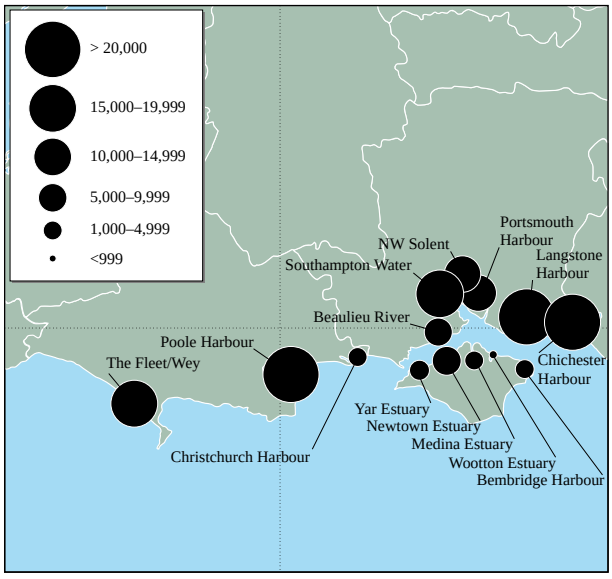
D.A. Stroud & D.M. Craddock

5.12.1 Introduction

This section describes the importance of the region to waterfowl, defined as waders and wildfowl (divers, grebes, ducks, geese and swans together with coot *Fulica atra*). The section notes the occurrence of marine-wintering waterfowl (divers, grebes, seaducks and cormorant *Phalacrocorax carbo*) where these occur close inshore, especially within estuaries; their overall regional distribution, including the importance of offshore areas, is covered in section 5.10.

A large extent of this region's coast is either estuarine or soft coast. The estuaries of the region are of importance for migrant waterfowl in spring and autumn. The region lies on the principal 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 is undertaken varies between species, but it emphasises the international responsibility for the conservation of these areas and their migrant waterfowl populations.

The sheltered nature of many of the estuaries means that the region is of importance for wintering waterfowl in both UK and international contexts (Map 5.12.1). There are seven species that occur at levels of international importance on at least one estuary, and a further fifteen species that occur at levels of national (i.e. Great Britain) importance. Of particular note are significant proportions of some British and international populations that occur in winter or on migration, e.g. black-tailed godwit *Limosa limosa*, bar-tailed godwit *L. lapponica* and dark-bellied brent goose *Branta bernicla bernicla* (Salmon & Fox 1991). Overall this region holds, in mid-winter, over 98,000 waterfowl (Table 5.12.1). Chichester Harbour, Langstone Harbour, Poole Harbour, Chesil Beach and the Fleet, Portsmouth Harbour and The Solent, and Southampton Water are individually and collectively of international importance for their waterfowl populations. For some non-breeding waterfowl species, for example dark-bellied brent geese, sites within the region are amongst the most important in the UK, and for several other species the region holds a significant proportion of the total UK population, either in the migration periods or in winter. The region can increase in importance in periods of severe cold weather further north in Britain or elsewhere in continental Europe. Under these conditions, there may be major influxes of waterfowl, such as wigeon *Anas penelope* and teal *Anas crecca*, from other coastal regions or inland areas (Ridgill & Fox 1990). Locally some sites can also act as cold weather refuges when parts of the estuarine systems freeze more slowly than other coastal and inland wetlands, and thus provide open-water feeding when other sites are unavailable (Owen, Atkinson-Willes & Salmon 1986). Table 5.12.1 gives the total January 1993 waterfowl count for this coastal region as a proportion of the coastal totals for England and Great Britain. However, such comparisons can give only a rough approximation of relative regional importance, since the data are uncorrected for coverage - some areas are better counted than others.



Map 5.12.1 Distribution of main concentrations of wintering intertidal waterfowl. Size of circle proportional to five-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)).

Table 5.12.1 Waterfowl counts in Region 9, England and Great Britain in January 1993

	Total waterfowl count	*Number of sites counted*	*% of count in Region 9*
Coastal sites in Region 9	98,306	12	-
All counted English coastal sites	1,577,388	106	6.2
All counted British coastal sites	2,060,961	214	4.8

Sources: Waters & Cranswick (1993); Rose & Taylor (1993).
Note: care should be taken in interpretation as the count coverage varies from country to country and this has not been corrected.

Densities of wintering shorebirds on non-estuarine coasts are very low (Moser & Summers 1987; Aspinall & Tasker 1990) (Table 5.12.2), owing to the limited feeding available on the predominantly exposed sandy beaches. The (small) range of wader species occurring here varies greatly with the degree of exposure of the coast and the type of substrate (Moser & Summers 1987).

5.12.2 Important locations and species

The varying species composition of the region's wintering waterfowl assemblages (Figure 5.12.1) is determined both within and between sites by habitat characteristics. Sites such as the Solent, Chichester and Langstone Harbours, which have large populations of brent geese, once had large

Table 5.12.2 Overall densities of wintering waders on non-estuarine coasts

	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 wader density (approx. nos. bird/km coast)*
Dorset	7	244	125.7	113.0	2
Hampshire	10	644	34.0	34.0	19
Isle of Wight	12	1,238	79.3	77.0	16
Region 9	***n/a***	***2,126***	***239.0***	***224.0***	***9***

Source: from the Winter Shorebird Count - Moser & Summers (1987). Key: n/a = not available.

extents of saltmarsh or other grassland in close proximity to intertidal areas. Where they still exist, such areas are also attractive to godwits, lapwing *Vanellus vanellus*, curlew *Numenius arquata*, grey plover *Pluvialis squatarola*, and golden plover *Pluvialis apricaria*, as they provide a wide range of feeding opportunities as well as being secure roosting areas. Today high tide roost sites and brent goose feeding areas are becoming increasingly scarce around areas such as the Solent (Sinton pers. comm.). On estuaries, sheltered muddy substrates (such as occur in Chichester and Langstone Harbours) are especially attractive to dunlin *Calidris alpina*, whilst sandier estuaries and embayments hold larger numbers of oystercatcher *Haematopus ostralegus* and curlew. The brackish water lagoon of the Fleet is especially attractive for diving ducks such as pochard *Aythya ferina* and coot.

The five coastal wetlands of Chesil Beach and the Fleet, Chichester and Langstone Harbours, Poole Harbour, Portsmouth Harbour and The Solent, and Southampton Water are of international importance for their wintering waterfowl populations. Chichester and Langstone Harbours have been jointly designated as one Special Protection Area (SPA) and Ramsar site to reflect the ecological unity of these areas as demonstrated by waterfowl movements. Likewise the waterfowl counting areas of Southampton Water, Portsmouth Harbour and The Solent are being considered for site protection as a single unit. As well as their international importance for wintering populations of several species of waterfowl, Chichester, Langstone and Poole Harbours all qualify as sites of international importance by virtue of their holding of over 20,000 waterfowl (Table 5.12.3). Chichester and Langstone Harbours are of particular note, holding populations of sixteen species at levels of national (eleven) or international (five) importance.

At regularly counted estuaries, nationally as well as internationally important numbers of dark-bellied brent geese are found (Salmon & Fox 1991). This species is an important component of the waterfowl assemblage occurring within the region and the most abundant species of wildfowl (Figure 5.12.1). Together, brent geese, shelduck *Tadorna tadorna*, wigeon and teal comprise over 80% of the estuarine wildfowl assemblage (Figure 5.12.1). The region is also notable nationally for the concentrations of both bar-tailed and black-tailed godwit on many of the estuaries, whilst grey plover is also characteristic of the region, and numbers have increased markedly in recent years (Tubbs 1991).

Other regularly occurring non-breeding waterfowl include cormorant, teal, mallard *Anas platyrhynchos*, shelduck, dunlin (the most numerous wader in the region - Figure 5.12.1), curlew, golden plover, redshank *Tringa totanus* and red-breasted merganser *Mergus serrator*. Important numbers of other marine-wintering waterfowl occur in the region, mostly inshore and within estuaries (see section 5.10 and Kirby, Evans & Fox (1993)). Nationally important numbers of pochard, coot, little grebe *Tachybaptus ruficollis*, shoveler *Anas clypeata* and wigeon occur on the Fleet lagoon, and this site also holds the largest wintering concentration of mute swan *Cygnus olor* in Britain (averaging 1,055 birds in 1988/89 - 1992/93).

On non-estuarine shores, oystercatcher is the most abundant wader species, followed in order of decreasing abundance by golden plover, purple sandpiper *Calidris maritima*, grey plover, knot *Calidris canutus*, curlew and bar-tailed godwit (Moser & Summers 1987) (Figure 5.12.1), although total numbers are small, especially in Dorset.

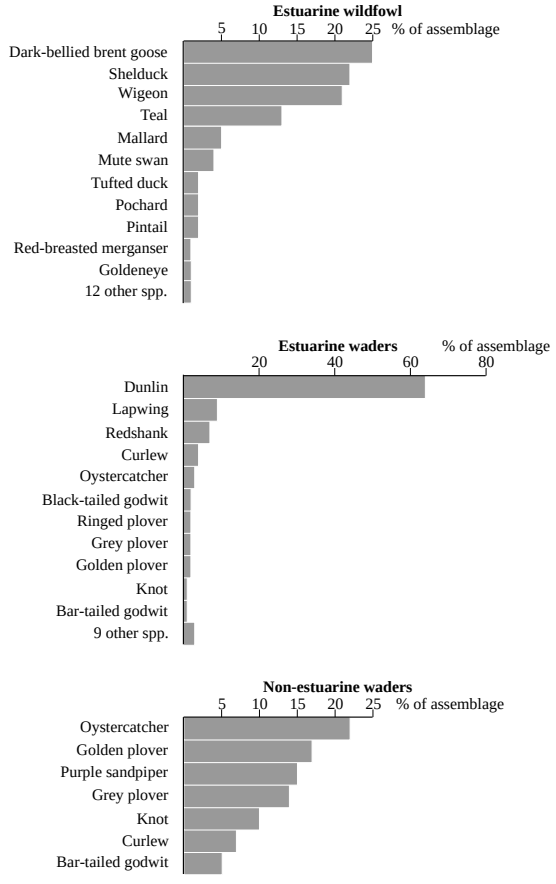


Fig. 5.12.1 Relative species composition of non-breeding waterfowl assemblages on coastal areas of the region. Estuarine waterfowl data from Prater (1981), non-estuarine wader data from Moser & Summers (1987)

Table 5.12.3 Wintering*** waterfowl numbers on southern England estuaries

Site	*International protected status*	*Five year mean nos. wintering*** waterfowl*	*1992/93 peak waterfowl numbers*	*1992/93 peak wildfowl numbers*	*1992/93 peak wader numbers*	*Species occurring at levels of national or international* importance*
Chichester Harbour	SPA & Ramsar (Chichester and Langstone Harbours)	**52,453	54,619	16,732	37,887	Dark-bellied brent goose*, dunlin*, ringed plover*, grey plover*, bar-tailed godwit*, little grebe, shelduck, red-breasted merganser, sanderling, black-tailed godwit, curlew, redshank
Langstone Harbour	SPA & Ramsar (Chichester and Langstone Harbours)	**52,236	47,418	10,215	37,203	Dark-bellied brent goose*, dunlin*, cormorant, shelduck, shoveler, red-breasted merganser, ringed plover, grey plover
Portsmouth Harbour	SPA & Ramsar	13,611	10,600	4,104	6,496	Dark-bellied brent goose*, black-tailed godwit, dunlin, red-breasted merganser
Southampton Water		19,751	19,966	8,100	11,866	Cormorant, little grebe, dark-bellied brent goose, teal, grey plover, dunlin, black-tailed godwit, bewick's swan, ringed plover
NW Solent		13,140	13,997	5,297	8,700	Dark-bellied brent goose*, black-tailed godwit
Beaulieu Estuary		7,821	9,208	3,575	5,633	Dark-bellied brent goose, black-tailed godwit, grey plover
Newtown Estuary		7,594	7,390	4,263	3,127	Dark-bellied brent goose, black-tailed godwit
Brading Harbour (Bembridge)		2,815	4,117	1,202	2,915	-
Yar Estuary		2,012	1,850	1,481	369	-
Medina Estuary		1,353	2,049	419	1,630	-
Wootton Estuary		639	735	298	437	-
Christchurch Harbour		4,282	6,006	771	5,235	Mute swan
Poole Harbour		**22,821	28,437	8,843	19,594	Black-tailed godwit*, shelduck*, dark-bellied brent goose, dunlin, cormorant, pochard, red-breasted merganser, avocet, curlew, redshank
Fleet/Wey	SPA & Ramsar (Chesil Beach and The Fleet)	17,928	18,761	16,756	2,005	Mute swan, dark-bellied brent goose, wigeon, shoveler, pochard, red-breasted merganser, coot, little grebe

Source: WeBS data from Waters & Cranswick (1993). International protected status follows Pritchard *et al.* (1992). Key: SPA = Special Protection Area; Ramsar = site classified as internationally important under the Ramsar Convention; *species occurring at levels of international importance; **sites holding >20,000 waterfowl are of international importance by virtue of absolute numbers; ***winter season used by WeBS is November to March for waders and September to March for wildfowl; - = none. Notes: see Waters & Cranswick (1993) for further detail on interpretation of counts and limitations of data. WeBS data above include divers, grebes and cormorants.

5.12.3 Human activities

Wintering waterfowl are potentially affected, either directly or indirectly, by a wide range of human activities. Wildfowling occurs especially in estuaries, although it is generally subject to good regulation. The impacts and regulation of wildfowling have been reviewed on National Nature Reserves (NNRs) by Owen (1992). Permit systems generally operate and there is close liaison in the regulation of wildfowling between local shooting clubs, British Association for Shooting and Conservation (BASC) and English Nature local staff. Owen (1992) made a number of recommendations for improving the operation of existing schemes to regulate shooting on NNRs.

Tubbs (1991, 1992) has reviewed the probable impact of wildfowling since the early years of the century, based on bag-records, and concluded that recent population increases for many species may represent recovery from the effects of former high hunting pressure both locally in the 'greater Solent' and elsewhere in the range of the species.

Incremental land claim, including barrage schemes, shoreline housing development, port development and increased dredging for larger ships and marinas, has the potential to further affect waterfowl populations through loss of feeding habitat, although at important sites, SSSI designation can sometimes allow limitation of such activity.

Coastal windfarm developments in sensitive areas have the potential to be highly disruptive to wintering waterfowl (as reviewed by Crockford 1992), although there are no such developments in the region at present.

Recreational impacts on wintering waterfowl can be significant. More than 1.1 million people live within 15 km of the Solent and it holds 25,800 yacht berths and moorings - the largest recreational fleet in the world (Hampshire County Council 1993). There is continuing pressure for marina expansion, e.g. for harbours, jetties and slipways, and recreational activities occur such as wind surfing and water-skiing. The digging of fishing bait and shellfish collection from inter-tidal sediments, and other recreational disturbance, are potentially disruptive activities that may deny waterfowl access to feeding areas. The significance of these activities varies, not only from site to site (in relation to intensity and size/topography of 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. Further information is needed for this region on the extent of such disturbance, as well as research into the significance of its impact on waterfowl populations, in order to ensure that coastal management planning can best minimise negative impacts.

Oil pollution is well known as a serious potential threat to wintering waterfowl in areas where high densities of birds occur. There are well developed contingency plans to cope with oil spillages and other precautions are taken in areas of high risk, such as the Solent. However, the large size of the estuaries causes tremendous logistical problems in the implementation of these contingency plans. There are occasional oil spills connected with the oil refinery at Fawley, but these are usually well contained.

5.12.4 Information sources used

As with other areas of the UK, migrant and wintering waterfowl in the region 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 (Waters & Cranswick 1993). The WeBS waterfowl count scheme publishes an extensive annual summary report, the most recent being Cranswick *et al.* (1995) 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, as well as inland sites. 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. The WeBS waterfowl 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 for which such information is already available include Chichester Harbour, Langstone Harbour (Tubbs & Tubbs 1980), Poole Harbour, Southampton Water, Portsmouth Harbour and the north-west Solent.

The whole UK coastline was surveyed for wintering waders during the Wintering Shorebird Count of 1984/85 (Moser & Summers 1987), and there are current WeBS plans for a repeat national survey, possibly in 1996/97. Such information on the wintering waterfowl of the non-estuarine shore is important to place annual estuaries counts into a wider perspective, although for this region large non-estuarine populations are unlikely to be found owing to the characteristics of the non-estuarine shoreline.

Although the data are 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 those data presented should now be supplemented by more recent count information, available as indicated elsewhere in this section.

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 Langstone Harbour (Tubbs 1977; Tubbs & Tubbs 1980), Poole Harbour (Collins 1986; Ward 1989; Aspinall & Tasker 1990), Southampton Water (Rose 1988) and the Solent (Kirby & Tubbs 1989). Additionally, there have been a number of detailed studies of dark-bellied brent geese and their interaction with agriculture in the Chichester/Langstone Harbour area (Tubbs & Tubbs 1982).

5.12.5 Acknowledgements

We would like to thank Simon Delany at WWT for providing unpublished shelduck data, and Peter Cranswick (WWT), Mark Robins (RSPB), Colin MacDuff-Duncan (ESSO), Victoria Copley (EN) and Rebecca Sinton (RSPB) for comments.

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Waters, R.J., & Cranswick, P.A. 1993. *The Wetland Bird Survey 1992-1993: wildfowl and wader counts.* Slimbridge, British Trust for Ornithology/ Wildfowl and Wetlands Trust/Royal Society for the Protection of Birds/Joint Nature Conservation Committee.

B. Further reading

Aspinall, S., & Tasker, M.L. 1991. *Birds of the Solent and Southampton Water.* Peterborough, Joint Nature Conservation Committee.

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 waders (WeBS)	*Ray Waters, WeBS National Organiser (Waders), The British Trust for Ornithology, Thetford, tel: 01842 750050
Low tide counts of wintering and migrant waders (WeBS)	*Julianne Evans, WeBS National Organiser (Low Tide Counts), The British Trust for Ornithology, Thetford, tel: 01842 750050
Birds in Region 9	RSPB, SW Region, 10 Richmond Road, Exeter, Devon EX4 4JA, tel: 01392 432691
Birds in England	*Ornithologist, EN HQ, Peterborough, tel: 01733 340345
Sites designated for their ornithological interest	*Designations Team, English Nature HQ, Peterborough, tel: 01733 340345

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

5.13 Land mammals

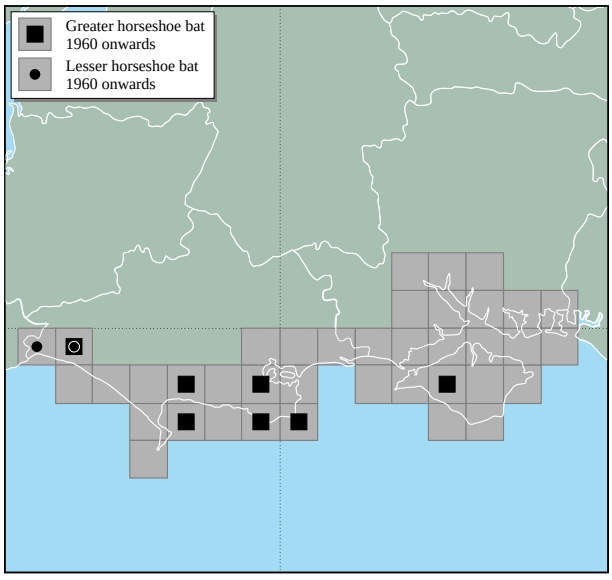
SGS Environment

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.

This region is particularly important for bats, with eleven of the fourteen species of British bat recorded from the coast. These are the greater horseshoe, lesser horseshoe *R. hipposideros* (Map 5.13.1), whiskered *Myotis mystacinus*, Natterer's *M. nattereri*, Bechstein's *M. bechsteinii* (Map 5.13.2), Daubenton's *M. daubentonii*, serotine *Eptesicus serotinus*, noctule *Nyctalus noctula*, pipistrelle *Pipistrellus pipistrellus*, brown long-eared *Plecotus auritus* and grey long-eared *P. austriacus* (Map 5.13.3). Both species of horseshoe bat are classed as endangered in Europe and the world (Stebbings & Griffith 1986): the populations in this region are on the easterly edge of their range. The Bechstein's and grey long-eared populations are very important in the British context. Several other mammal species are nationally important in this region: the dormouse *Muscardinus avellanarius* is common in the Isle of Wight. The red squirrel *Sciurus vulgaris* is relatively widespread on the Isle of Wight but is absent (except on islands in Poole Harbour) from the mainland. The otter *Lutra lutra* is rare in the region, with populations in Hampshire and Dorset (Arnold 1993). The otter is classed as endangered and is absent from many areas of England and Wales (Morris 1993).

All British bats are listed under Appendix II of the Bern Convention and the dormouse, red squirrel, stoat and brown hare are listed in Appendix III. All British bats, the otter, the dormouse and the red squirrel are also afforded protection under Schedule 5 of the Wildlife and Countryside Act (1981). Badgers are fully protected, under a series of Acts consolidated by the Protection of Badgers Act 1992. Table 5.13.1 summarises the recorded distribution of protected species in the region.



Map 5.13.1 Recorded coastal distribution of the greater and lesser horseshoe bat. Source: Arnold (1993).

5.13.2 Important locations and species

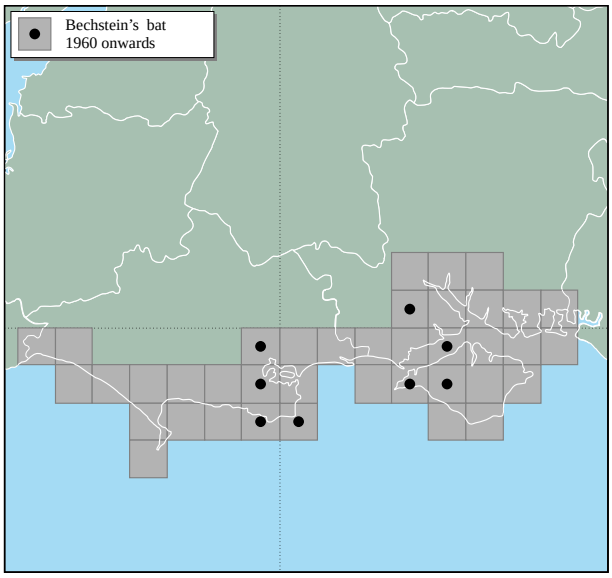
The otter is associated with semi-aquatic areas, including rivers, lakes and coasts, and is the terrestrial mammal that uses coastal areas most frequently. No otters were recorded for this region during the 1984-1986 survey of England, although otters are known from the lower reaches of the Piddle and in the Studland Bay area (Strachan *et al.* 1990). Arnold (1993) cites several records from around the Lymington and Beaulieu systems, and it is thought that there may be a population of otters still in this area (Strachan *et al.* 1990).

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

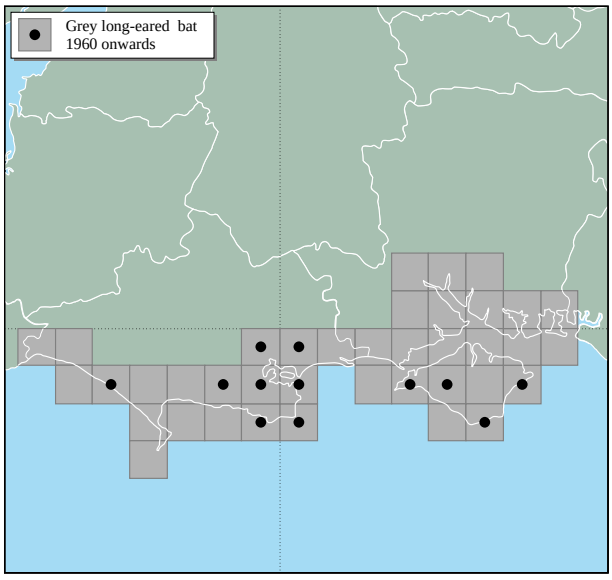
Table 5.13.1 Records of protected species distribution

Species	*Estimate of importance in region*
Greater horseshoe bat	Occasional, most easterly coastal record in Britain
Lesser horseshoe bat	Rare, Dorset only
Whiskered bat	Occasional
Natterer's bat	Frequent
Bechstein's bat	Rare Hampshire and Isle of Wight, occasional east Dorset, absent west Dorset
Daubenton's bat	Absent Hampshire, Isle of Wight, occasional Dorset
Serotine bat	Rare Hampshire, frequent Isle of Wight, occasional Dorset
Noctule bat	Occasional
Pipistrelle bat	Common
Brown long-eared bat	Rare Hampshire, common Isle of Wight, common east Dorset, absent west
Grey long-eared bat	Frequent, stronghold of British population
Red squirrel	Absent Hampshire, common Isle of Wight, rare Dorset (absent mainland)
Dormouse	Common Isle of Wight, rare east Dorset
Otter	Rare

Source: Arnold (1993)



Map 5.13.2 Recorded coastal distribution of the Bechstein's bat. Source: Arnold (1993).



Map 5.13.3 Recorded coastal distribution of the grey long-eared bat. Source: Arnold (1993).

horseshoe bats forage around woodlands, scrub, grassland and open water, whilst the Bechstein's and grey long-eared are more closely associated with woodland. There are several records of the greater horseshoe in the area. These include a hibernaculum in a road and rail tunnel at Ventnor (SZ57) (English Nature's Bat Sites Register) and Elephant's Hole (SZ52), a cave system in the undercliff on the south side of the island (R. Sparshott pers. comm.). There is also a summer roost at Carisbrook Castle (Arnold 1993) on the Isle of Wight and two hibernacula in disused mines in the sea cliffs on the Isle of Purbeck (V. Copley pers. comm.). The grey long-eared and Bechstein's records are centred on the Isle of Wight and around the Isle of Purbeck, where there are also populations of the greater and lesser horseshoe.

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). Although the red squirrel is rare in the region, there are some notable populations here - the only ones in the south of England - on the Isle of Wight and on Brownsea and Furzey Islands in Poole Harbour (Timber Growers UK 1992). On the islands in Poole Harbour the red squirrels are dependent on the annual crop of Scots pine cones and the absence of predators (R.E. Kenwood pers. comm). On the Isle of Wight red squirrels are found in broad-leaved woodland, the last location in the country for this species in its natural habitat. In Hampshire and Dorset (and elsewhere in mainland Britain) red squirrels are less successful in the modern conifer plantations of Corsican pine *Pinus nigra* var. *maritima*, because these yield a poorer cone crop than Scots pine, and because of competition with grey squirrels and predation by foxes (Kenwood *et al*. in press).

The dormouse is classified as vulnerable and locally endangered (Morris 1993); they are on the edge of their European range in Britain. They are specialist feeders and are associated with ancient semi-natural woodlands and edge habitats such as hedgerows and scrub. Woodlands of less than 20 ha are unlikely to retain a viable population if they are isolated from other suitable habitat (Bright, Mitchell & Morris 1994). Dormice are common on the Isle of Wight, in the wooded chines (cliff clefts); they were recorded from the New Forest by Arnold (1993), although they are now believed to be absent from the southern part that falls within Region 9, but still present in small numbers on the northern edge of the forest (T. Mitchell-Jones pers. comm.). There are few records for Dorset (Arnold 1993); these are concentrated in the western end around Bridport, although there is also a record from the area of the Arne National Nature Reserve. Dormice are present within the West Dorset Coast Site of Special Scientific Interest, in the ancient hedgerows, scrub and woodland.

5.13.3 Human activities

The high levels of tourism in this area may result in disturbance, which could prevent otters from recolonising. Currently the water quality of the rivers and estuaries around the industrial areas is mainly very good, although there is the potential for deterioration from industrial pollutants, which also could prevent recolonisation by otters. 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: indeed, the loss of any semi-natural habitats will reduce the quality of the environment for most species of bat. The loss of mature hedgerows, particularly those that connect with other woodlands, will also have a severe effect on the dormouse population, as will destruction, fragmentation and inappropriate management of ancient woodlands, including hazel coppice. The survival of the red squirrel in this region will be partly dependent on the control of the greys, which appear to be absent from some areas at the present time, and partly on the retention of 'islands' of favourable habitat, such as Scots pine woodlands. Controlling predators, pests

and vermin, such as the poisoning and trapping of mink and grey squirrel, can also kill non-target species such as red squirrels.

5.13.4 Information sources used

There are no reliable estimates of the numbers of mammals in the region or in Britain that could be used to quantify the resource. Using the data from Arnold (1993) (although these records are incidental rather than comprehensive), an estimate has been made for 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. However the data for all the mammals discussed confirm the presence in this region of several nationally important species.

There have not been any specifically coastal surveys within this region and even the national surveys such as the otter surveys have their limitations when used to assess the importance of the coastal areas. There have been no comprehensive surveys for any of the bats although there are recent records of all of the species (BRC data). The known roosts of the greater and lesser horseshoes have been monitored regularly and there are recent records for many sites. The BRC data for bats demonstrates the bias that can occur for rarer species, as the commoner bats are clearly under-recorded. The information from the English Nature Bat Sites Register may confirm further records. The absence of dormice records for parts of Dorset may be a result of under-recording, and the results from the Great Nut Hunt (Morris, Bright & Mitchell-Jones in press) have confirmed one further site on the Dorset coast. The data from the red squirrel survey 1991 (Timber Growers UK 1992) agree with the distribution shown by Arnold (1993).

5.13.5 Acknowledgements

The author thanks R.E. Kenwood (ITE), Clive Chatters (Hampshire Wildlife Trust) and T. Mitchell-Jones, V. Copley and R. Sparshott (English Nature) for contributing information and time.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
National site and species information	*Mammal Ecologist, English Nature HQ, Peterborough, tel: 01733 340345
Biological Records Centre: records of mammal distributions	*ITE Monks Wood, Huntingdon, tel: 01487 773381
Local site and species information in Hampshire and the Isle of Wight	*English Nature, Lyndhurst, tel: 01703 283944
Local site and species information in Dorset	*English Nature, Wareham, tel: 01929 556688
Mammal sites in Dorset	*Dorset Wildlife Trust, Dorchester, tel: 01305 264620
Mammal records in Dorset	*Dorset Environmental Records Centre, Dorset County Council, Dorchester, tel: 01305 224281
Mammal sites in Hampshire & the Isle of Wight	*Hampshire & Isle of Wight Wildlife Trust, Eastleigh, tel: 01703 613636
Ecology on the Isle of Wight	*Dr C. Pope, County Ecologist, Isle of Wight Council, Newport, tel: 01983 521817
Bats in Dorset	Dave Mockford, Dorset Bat Group, 28 Filleul Road, Sandford, Wareham, Dorset DT10 1BP, tel: 01929 553407
Mammals in Region 9	Institute of Terrestrial Ecology, Furzebank Research Station, Furzebank, Wareham, Dorset BH20 5AS, tel: 01929 551518
Bats in Hampshire	Mick Finniemore, Hampshire Bat Group, Drocheneford, Mill Lane, Droxford SO3 1QS, tel: 01489 877547
Otters	*National Rivers Authority Southern, Worthing, tel: 01903 820692
Otters	*National Rivers Authority South Western, Exeter, tel: 01392 444000
General mammal information	The Mammal Society, Unit 15, Cloisters House, Cloisters Business Centre, 8 Battersea Park Road, London SW8 4BG, tel: 0171 498 4358

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

5.14 Seals

C.D. Duck

5.14.1 Introduction

There are no significant haul-out or breeding sites for either common or grey seals in this region. Seals are occasionally recorded throughout the region, grey seals more frequently than common seals. Individual animals have remained for prolonged spells in certain areas, for instance Poole Harbour.

5.14.2 Human activities

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 is unlikely to affect seals unless they happen to be very close to the seismic arrays. Seals are always susceptible to contamination from spilled oil but such occurrences are rare.

5.14.3 Information sources used

Information regarding the occurrence of seals in the region was obtained from contacts named in sections 5.14.4 and 5.14.5 C.

5.14.4 Acknowledgements

Thanks are due to Victoria Copley of English Nature, Richard Surrey of the Dorset Environmental Record Centre, Mick Rogers of the Portland Bird Observatory, Durlston Country Park, the Hampshire and Isle of Wight Naturalist Trust, and the Dorset Wildlife Trust.

5.14.5 Further sources of information

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Turnpenny, A.W.H., & Nedwell, J.R. 1994. *The effects on marine fish, diving mammals and birds of underwater sound generated by seismic surveys.* Southampton, Fawley Aquatic Research Laboratories Ltd.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Seal numbers and distribution around UK	NERC Sea Mammal Research Unit (SMRU), University of St. Andrew's, School of Biochemical and Medical Sciences, St. Andrew's, Fife KY16 8LB, tel: 01334 463472
Seal sightings from Portland Bird Observatory	The Warden, Portland Bird Observatory and Seal Centre, The Old Lower Light, Portland Bill, Dorset DT5 2JT, tel: 01305 820553
Records of seal sightings in Dorset	*Keeper of Records, Dorset Environmental Records Centre, Dorset County Council, Dorchester, tel: 01305 224281
Seal sightings in Dorset	*Marine Officer, English Nature, Wareham, tel: 01929 556688
Seals in Hampshire and Isle of Wight	*Hampshire and Isle of Wight Wildlife Trust, Eastleigh, tel: 01703 613636/613737

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

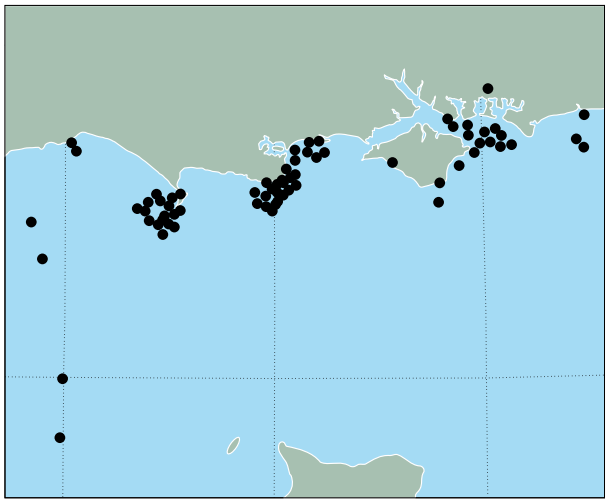
5.15 Whales, dolphins and porpoises

Dr P.G.H. Evans

5.15.1 Introduction

The region is relatively unimportant for cetaceans (whales, dolphins and porpoises), with only four out of 26 species of the UK cetacean fauna (about 15%) recorded regularly in the region since 1980. The waters of the English Channel adjacent to the coasts of Hampshire and Dorset are uniformly shallow (less than 50 m deep) and are therefore favoured primarily by cetacean species that are frequently associated with relatively shallow continental seas, such as the harbour porpoise *Phocoena phocoena* and bottlenose dolphin *Tursiops truncatus*. Indeed, the great majority of cetacean sightings in nearshore waters, i.e. within 60 km of the coast, involve the bottlenose dolphin, the remainder comprising almost entirely (in descending order of relative abundance) long-finned pilot whale *Globicephala melas*, harbour porpoise and common dolphin *Delphinus delphis*. Both bottlenose dolphin and harbour porpoise occur in continental seas of the North Atlantic, although the harbour porpoise is also widely distributed on the continental shelf from the Barents Sea south to the coast of France, concentrated mainly in the north and west. The harbour porpoise and bottlenose dolphin are both listed in Annex II of the Habitats & Species Directive as species whose conservation requires the designation of Special Areas of Conservation. The cetacean species recorded further offshore most frequently and in greatest abundance are the long-finned pilot whale and common dolphin. The long-finned pilot whale has a worldwide distribution, being common throughout the deep waters of the North Atlantic from the Iberian Peninsula north to the Faroe Islands and Iceland. In Britain and Ireland it occurs mainly along the Atlantic seaboard and in the northern North Sea, while the common dolphin is often sighted offshore in the English Channel approaches, the southern Irish Sea, off western Ireland, and off south-west Scotland.

Other cetacean species recorded in the region include humpback whale *Megaptera novaeangliae*, white-beaked dolphin *Lagenorhynchus albirostris*, Atlantic white-sided dolphin *Lagenorhynchus acutus*, Risso's dolphin *Grampus griseus*, and killer whale *Orcinus orca*. For geographical comparisons of sightings rates for various cetacean species in UK waters, see Evans (1990, 1992a) and Northridge *et al.* (1995). Table 5.15.1 summarises recorded sightings of cetacean species in the region.



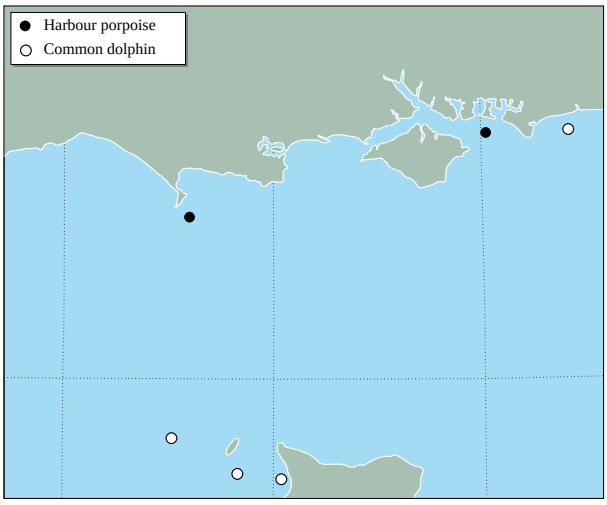
Map 5.15.1 Bottlenose dolphin sightings reported to the Sea Watch sighting system. Source: Evans (1992)

5.15.2 Important locations and species

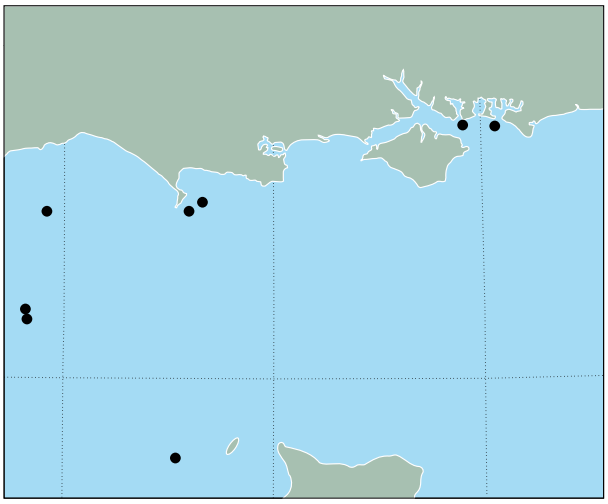
Prominent headlands and enclosed bays are favoured by bottlenose dolphins (Map 5.15.1) and other cetaceans. Bottlenose dolphins are recorded in small numbers annually in summer (July - September) in the Solent (Hampshire). In the coastal waters around Hengistbury Head and St. Catherine's Point, Isle of Wight (Hampshire) bottlenose dolphins are recorded in small numbers annually in late summer (August - September). Every year bottlenose dolphins are observed in the coastal waters around Durlston Head (Dorset), with peak numbers generally in spring (March - April) and autumn (September - December). Around Portland Bill (Dorset) bottlenose dolphins are observed every year, with peak numbers in spring (March - April) and autumn (October).

Table 5.15.1 Cetacean species recorded in the region

Species	*Status, distribution and seasonal occurrence*
Harbour porpoise *Phocoena phocoena*	Occurs in small numbers in nearshore waters, mainly during April and between August and October.
Bottlenose dolphin *Tursiops truncatus*	Although observed throughout the Channel, numbers are apparently small and sightings may reflect the movements of only a few groups. Sightings occur in the region in all months of the year but with distinct peaks between September and April, particularly around December - January and March - April around Durlston Head.
Common dolphin *Delphinus delphis*	Relatively deep-water species recorded mainly offshore, but with small numbers observed in the vicinity of Durlston Head and Poole Bay between October and January.
Long-finned pilot whale *Globicephala melas*	Deep water species recorded mainly more than 10 km from the coast. Sightings in the Western Channel occur throughout the year, but with largest numbers between May and October. An easterly movement into the region appears to occur around October, the species remaining in those waters until December or January, but with a secondary peak in numbers during April.



Map 5.15.2 Common dolphin and harbour porpoise sightings reported to the Sea Watch sighting system. Source: Evans (1992).



Map 5.15.3 Long-finned pilot whale sightings reported to the Sea Watch sighting system. Source: Evans (1992).

Harbour porpoises (Map 5.15.2) are recorded in small numbers, primarily between March and April, and in August. A few common dolphins are seen annually, almost exclusively between October and January, and between 1992 and 1994 a young common dolphin took up residence in the vicinity of Calshot in the Solent. Long-finned pilot whales are also seen annually in almost every month of the year, but with peak numbers between October and December (Map 5.15.3). South of the region in mid-Channel lies the Hurd Deep, a narrow trough with a maximum depth of 172 m, where common dolphins and long-finned pilot whales have been reported during recent surveys.

5.15.3 Human activities

ASCOBANS (Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas) is an international agreement under the Bonn Convention between countries bordering the North and Baltic Seas, with the aim of promoting the conservation of small cetaceans. It was ratified by the UK in 1993. Participating states agree to cooperate on issues including national legislation and research into, for example, cetacean population sizes and the effects of fishing.

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, e.g. ship propellers, seismic survey).

Most fishing activities in the region use methods that do not present a threat to cetaceans. However, it is recognised that small cetaceans are at risk of capture by set nets (gill, tangle and trammel nets), large trawls and purse seines (Northridge 1988). Both trawling and set netting are widespread throughout this region, but there is no quantitative information on cetacean catch levels in the region, if any.

Contaminant levels in cetaceans from the Channel are high compared with those elsewhere in UK. Mean total PCB (25 congeners) levels of 25 common dolphins and ten harbour porpoises sampled from the Channel coast of England (Kent to north Devon) between 1988 and 92 amounted to 31 ppm in the former case and 40 ppm in the latter (Kuiken *et al.* 1994), although it should be noted that some of the porpoises and almost all the common dolphins were collected further west, from Devon and Cornwall.

Recreational activities (speedboats, jet skis etc.) in the vicinity of resorts such as Southampton, Poole, Swanage and Weymouth pose threats of disturbance from the high frequency (>1 kHz) noise generated by these and other vessels (Evans *et al.* 1992b, 1994). Heavy shipping may also disturb cetaceans, besides posing a threat from collisions. 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.* (1992b, 1994). Other underwater sounds from seismic activities (as part of oil and gas exploration off the coast of Dorset) will be at lower frequencies, and are therefore most likely to affect baleen whales, which communicate primarily at these frequencies (20-500 Hz). It is possible that porpoises are also affected (Baines 1993), perhaps 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 London Natural History Museum (1913-present). Systematic land-based watches have been carried out by the staff of Portland Bill Bird Observatory since 1965, and at Durlston Country Park since 1988. Offshore effort-related data have been collected by various merchant vessels and some sailing boats. However, coverage is generally better in nearshore waters than offshore, with some exceptions. Effort has been highest between the months of July and September when sea conditions are also usually best. JNCC's Seabirds and

Cetaceans at Sea Team (SAST) has only limited survey information on cetaceans in the English Channel. Strandings and sightings data, while helpful in providing some indications of current status of populations, their distribution and migration patterns, do not as yet allow any definite statements to be made about any species.

A major international collaborative programme, the Small Cetaceans Abundance in the North Sea (SCANS) Project (which includes this region), aims to provide an authoritative baseline assessment of abundance based on intensive survey work in summer 1994.

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 D. Budworth, N. Riddiford, I. Robertson, M. Rogers and M. Turnbull.

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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 OX1 3PS, tel: 01865 727984
Cetacean sightings and surveys	*Seabirds & Cetaceans Branch, JNCC Aberdeen, tel: 01224 642863
Cetacean monitoring (visual and acoustic) around Durlston Head	R. Williams and E. Harland, Coastwatch, Durlston Country Park, Durlston, Swanage, Dorset, tel: 01929 424443
SCANS Project	*European Wildlife Division, Department of the Environment, Bristol, tel: 0117 987 8000
Cetacean organochlorine & heavy metal levels	*Dr R.J. Law, MAFF Directorate of Fisheries Research, 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.

With its long tradition of sea-borne trade and its strategic importance, the coast of Region 9 has accumulated an impressive legacy of historic wrecks. Even when they have lain on the sea bed for centuries, wrecks can be recovered in an astonishingly complete state. This was demonstrated by the raising of the well-preserved *Mary Rose*, Henry VIII's flagship, which sank off Spithead in 1545. It is now on display in Portsmouth. Photo: Bill Sanderson, JNCC.

Chapter 6 History and archaeology

6.1 Introduction

A. Gale & V. Fenwick

The physical remains of the human past - archaeological evidence - are an integral and irreplaceable part of the coastal resource. Archaeological sites, whether discrete or part of wider landscapes, are fragile, and those not yet located can be unwittingly destroyed. The distribution of known sites is biased by the uneven spread of survey work, and the discovery and scientific investigation of new sites is vital to developing a full picture of the past. This chapter provides an introduction to the archaeology of the region; gives information on the provisions for safeguarding known and unknown sites; and describes the extent of survey work and how to report new discoveries. Map 6.1.1 shows archaeological locations mentioned in the text.

For the earliest inhabitants of this region, the 'Solent river system' provided a rich source of food. Subsequently, rising sea level created the Isle of Wight and natural harbours such as Langstone, Portsmouth, Christchurch and Poole and estuaries such as Southampton Water, the Medina, Bembridge Harbour and the Yar. These unrivalled harbours, within easy reach of the continent, with a fertile hinterland and good access to Winchester (once a capital city) and London, have since supported a very high level of maritime activity. In more recent centuries they have sustained trade and defence of national importance.

The region is rich in upstanding monuments, ranging from prehistoric burial mounds to Medieval merchant houses in Southampton; from the Cobb at Lyme Regis to the piers at Bournemouth; and from the Roman fortress at Portchester to the Royal Naval Dockyard at Portsmouth. Aerial reconnaissance, collection of individual finds and excavation have extended knowledge beyond the immediately visible remains. There has been important excavation work of old waterfronts in urban and rural locations, and the region has pioneered the extension of archaeological investigation and management into the intertidal and subtidal zones.

Whereas early investigation of the foreshore was mainly confined to collecting scatters of artefacts, modern surveys in, for example, Langstone Harbour and Wootton Creek, focus on examining inundated landscapes. These palaeo-environments are composed largely of submerged peat deposits, relict forests and the silted courses of earlier waterways. These waterlogged conditions preserve environmental evidence, such as trees dating to the 4th millenium BC, man-made structures and artefacts of wood and other organic materials, which rarely survive on dry land sites. From surveyed intertidal areas it can be seen that the submerged landscapes extend beyond low water mark to the sea bed proper.

Shipwrecks are, however, predicted to be the most numerous site type. Written accounts show that the hazards of this region caused hundreds of shipwrecks, especially on the south-west coast of the Isle of Wight and Chesil Beach. The rediscovery of the well-preserved *Mary Rose*, Henry VIII's flagship, which sank off Spithead, Portsmouth, in 1545, demonstrates that large parts of vessels can survive in the sea bed for centuries. Records of losses, 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.

Map 6.1.1 Archaeology: locations mentioned in the text

6.2 History and archaeology of the region

6.2.1 Hunters, gatherers and early farmers (Palaeolithic, Mesolithic and Neolithic)

Flint tools found in gravel beds in the valleys of this region, which is particularly rich in such finds, show that they were used by Palaeolithic hunting groups. Such implements trawled from the sea bed may have been redeposited from eroded sites or may have come from now submerged landscapes. Hengistbury Head is the only non-cave occupation site known in the region that dates from the earliest (Palaeolithic) period (Cunliffe 1978).

After the last Ice-Age, as the climate warmed, early Mesolithic peoples used the same river valleys and also occupied Hengistbury Head. A nationally important flint-working site has been excavated in Southampton. Mesolithic flint tools are also associated with peat deposits, which extend offshore, suggesting the existence of now submerged occupation sites. These sites will have been used prior to the rise in sea-level that flooded the coastal plains, separated Britain from Europe and, with the broaching of the Purbeck - Needles ridge, created the Isle of Wight. Significant Palaeolithic and Mesolithic material has been recovered off the Isle of Wight from cliff gravels that originated as river terraces of the western Yar.

Burial mounds, known as long barrows, are the main visible evidence from the Neolithic period. Their location on high ground, such as at Tennyson Down, Isle of Wight, indicates early cultivation of the valleys below. Rempstone, near Corfe Castle, Dorset, has one of the region's few examples of the other commonly-known Neolithic monument, a stone circle, which like the barrows contains little if any organic material. Palaeo-environments in the marine zone are, however, producing the missing organic evidence of domestic architecture and life-style; for example underwater off Yarmouth there are alignments of wooden posts which dendrochronology (tree-ring dating) places in this period.

6.2.2 Metal-working peoples (Bronze Age and Iron Age)

By the 2nd millenium BC it is evident that the indigenous people were able to manufacture copper-alloy objects, and a new burial custom using round barrows became prevalent. The region immediately benefited from wealth produced by trade with the continent. Five excavated barrows in the region contained pots from Brittany (Tomalin 1988). Evidence of proficiency in sea transport is provided by the use of stone from the Isle of Wight to cap a barrow at Puncknowle, south-east of Bridport, Dorset. Nothing of the ships that carried these cargoes has been found in this region, though a group of 20 stone anchors found in Poole Bay remains undated. The apparent comparative lack of settlement remains is now being redressed as foreshore deposits are recognised.

Iron supplanted bronze for utilitarian purposes soon after 600 BC. From this time trading connections, sea communication and immigration become increasingly apparent. Possibly in response to unsettled conditions, hill forts were constructed on a number of sites overlooking rivers and estuaries, such as at Tournerbury, Exbury and Hengistbury Head. The rich range of artefacts reveals that the latter promontory, which dominates Christchurch Harbour, was an entrepôt (trading centre) for goods such as wine and glass from the Continent, while copper came along the coast from Cornwall. In addition the valuable surface deposits of iron ore were exploited and worked on the site.

Julius Caesar's 1st century BC campaigns in Gaul disrupted trade with Hengistbury. Caesar described wooden boats fastened with iron nails and propelled by leather sails crossing between Gaul and the region. An iron anchor and chain, such as he described, was found at Bulbury Camp, north of Wareham, but remains of an actual vessel of this kind have yet to be discovered. A huge (*c.* 70 m) logboat recovered from near Poole (*c.* 300 BC) would have provided transport for goods within this large harbour. The surrounding area was intensively used for the production of salt, and objects of Kimmeridge shale were lathe-turned and traded widely. An increase of imported wares after the decline of Hengistbury suggests that Furzey Island, Green Island and the Ower Peninsula in Poole Harbour may have taken over as distribution centres.

6.2.3 The Roman province

The 1st century AD Roman army of occupation rapidly subdued the tribes of the region and created towns. The highly productive farms were reorganised to contribute manpower and agricultural produce to the Roman economy. Pottery production utilised clays from around the New Forest and Poole Harbour area. Salt and shale continued to be important commodities, and an oyster industry developed. The Solent was known as Magnus Portus, with a port established near modern Southampton. In Poole Harbour, Hamworthy was a supply port for the military invasion campaign, and Wareham, on the Frome, also developed.

In the 3rd century the threat from Saxon raiding parties prompted construction and strengthening of a string of 'Saxon shore forts', which stretched from Norfolk to Hampshire. The exceptionally well-preserved 3rd century Porchester Castle has survived from this system.

6.2.4 Roman departure to Norman conquest

Following the Roman withdrawal, Germanic immigrants settled the region. Few physical remains of the early communities have survived except for their cemetries; some of the grave goods provide evidence of contact between people in the region and in northern France.

More written records survive from after the introduction of Christianity. These contain incidental references to maritime activity, especially the early Viking raids. Thus St. Adhelm is known to have taken ship at Wareham for a

pilgrimage; Southampton and Portland were attacked in 840; and Poole Harbour provided shelter for a massive Viking fleet, which wintered at Wareham and, on departing in 876, lost 120 ships in a storm off Swanage. From scanty archaeological evidence it has been suggested that the Solent enjoyed increasing trade from the 6th century and that by the 8th century Saxon religious houses on inland river valleys had small ports at the river mouths.

From the 8th century Hamwic, at the mouth of the River Itchen, became the focus of Hampshire as an administrative centre and port. Excavations have demonstrated its international trading connections. Other settlements of significant size are commonly associated with navigable waterways, for example at Farnham, Ebbsfleet, the Hamble, Whippingham, Shalfleet and Freshwater (Tomalin 1990). Many of these did not develop further in later centuries and there is a high likelihood that archaeological evidence survives.

6.2.5 Medieval period

In the 10th century Southampton replaced Hamwic on a new site slightly further west. It rapidly established itself in the wool and wine trade and was later specially appointed to be the exclusive market for metal export. The 15th century import of Mediterranean luxury goods saw the high point of prosperity, but changing patterns of trade brought decline, and revival did not come until the 19th century.

During the rise of Southampton, religious houses around the region, for example at Quarr (near Ryde, on the Isle of Wight), Titchfield, Beaulieu and Christchurch, had major interests in trade, which fostered maritime activity in a variety of havens. Their influence is demonstrated by Wareham, which was the chief port in Poole Harbour and of such significance as to have its own moneyer (mint). Wareham declined, as a result of silting, while Poole expanded, exporting wool and cloth and importing wine, iron and bay salt (Burwash 1969). Up-river Bridport was a prosperous port which dominated the supply of hemp and ropes to the navy from 1200 to 1500. However, as early as 1274, construction of West Bay Harbour at the river mouth sought to provide a port on the open coast. From the 14th century the Cobb at Lyme Regis similarly sheltered ships.

The region has two surviving medieval lighthouses: the chapel on St. Alban's Head and the St. Catherine's Oratory, Isle of Wight, on the downs behind the present lighthouse. These buildings are indicative of the volume of medieval shipping and the possibility of shipwrecks whose remains may survive on the sea bed.

The region was also strategically important. The Hamble and Portsmouth were used to build and repair royal ships. Having deeper water, Portsmouth gained favour. Defensive works were in place by 1420, and in 1495 the country's first dry dock was built there (Coad 1981). The Solent was a key area in the coastal fortifications that Henry VIII built south from the Thames; surviving examples include Southsea, Calshot and West Cowes castles.

6.2.6 Post medieval and modern times

Defence remained a key issue into the present century and the region has an extraordinary wealth of defensive structures, particularly of Napoleonic (1790-1815), Palmerstonian (mid-19th century) and 1939-1945 War date. The four iron and concrete forts constructed betweeen Portsmouth and the Isle of Wight are particularly notable. Portsmouth Naval Base rose to pre-eminence in the 18th century. The resulting availability of naval contracts fostered the shipbuilding industry in Hampshire and the Isle of Wight. With the exception of Bucklers Hard, however, little evidence of the slipways has been located.

Following the decline of Southampton in the 16th century, London and Bristol dominated foreign trade at a national level. Therefore shipping from small ports from Fareham to Lyme was mainly occupied in coastal trade and trade with the nearby continent. Local trade was stimulated by the concentration of military and naval activity. For example, many tide mills were constructed, as on Fishbourne Creek, the Medina, the Yar and the Itchen and at Eling (Southampton Water), to provide flour for the 18th century fleet.

Poole continued to prosper, with Portland stone becoming her main export (Willan 1967). Baltic timber was a major import and the Newfoundland fishery a main activity. The recent (late 20th century) failure of the latter has contributed to the decline of the port. Cowes received foreign shipping, often calling to register cargoes at the Customs House before carrying them on to European ports. In later years the shipyards of this small, naturally sheltered port met the repair needs of ships bound in or out of the English Channel. The shipwrecks recorded in this region are predominantly of passing ships rather than those destined for its ports.

In the 19th century, as now, Portsmouth, Southampton, Poole and Weymouth served as packet (ferry) ports. As a first-rank liner and cargo port, Southampton invested in innovative dock structures. Since the demise of this trade, the deep lower estuary has served the oil terminal of Fawley Refinery. For other ports the leisure trade, building and accommodating sailing and cruising craft, has provided alternative employment.

6.3 Human activities

6.3.1 Integrated management

Today's intensive use of this region has led to the growth of many organisations with an interest in management, the preparation of a variety of management plans and the application of many conservation designations. The work of Hampshire and Isle of Wight County Archaeological Officers (CAOs), followed by the creation of the Hampshire & Wight Trust for Maritime Archaeology (HWTMA), has raised the profile of archaeology amongst coastal managers. This is reflected in the consideration given to land, intertidal and sea-bed archaeology by the many initiatives for integrated coastal management (see section 6.3.5).

6.3.2 Activities and processes affecting the archaeological resource

The region's archaeological resource does not consist entirely of discrete sites such as intact wrecks. Many sites are scattered. Some sites, including palaeo-environments, are extensive and straddle the terrestrial, intertidal and sub-tidal zones. The potential effects of development in the terrestrial zone are recognised (see Section 6.3.5).

The region is a major tourist destination, with many scheduled and listed sites featuring as attractions. This has contributed to redevelopment of waterfront areas, such as the Historic Naval Dockyard, Portsmouth, Port Solent Marina, and Ocean Village, Southampton. Smaller havens, such as Yarmouth, Lymington and Christchurch, also cater for visitors and yachtsmen. In such developments the preservation of historic buildings and structures requires careful planning.

Modern development has permitted excavation near the historic waterfronts in Southampton and Poole, showing the type of material that survives from early trading centres. Evidence may be anticipated from other ports and harbours that are no longer in use, for example the completely reclaimed havens of Brading and Titchfield. The archaeology of rural areas therefore demands consideration. Archaeological work was required in, for example, the area around and islands within Poole Harbour, in advance of oil exploration and extraction.

Sites in the intertidal and sub-tidal zones are also exposed to potentially damaging human activities. Extraction of beach material as aggregate, construction of outfalls, groynes and sea defences, ship wash, and individual activities such as bait digging and metal detecting have all given cause for concern. On the sea bed, incidental recovery of artefacts is often the only indication of an impact on an archaeological site, as for instance during the navigational dredging of the approaches to Poole Harbour and oyster fishing in the Solent and Southampton Water. Extractive industries potentially affect sea bed sites. This region is targeted for both aggregate and oil exploration and exploitation. Concern over the former has long been expressed by the Isle of Wight County Archaeologist. Unfortunately, too little survey work on intertidal and subtidal sites has been completed to allow the influence of these diverse activities to be quantified.

Natural erosion is seen both on the exposed coast and within sheltered areas of the Solent. For example, modern erosion of Hengistbury Head is an archaeological concern, and Flowers Barrow (Dorset) graphically demonstrates the loss of cliff-top sites (Dorset County Council 1994); rapid erosion at Wootton Creek prompted a pioneering survey project (Tomalin 1995); and the partial collapse of a Mulberry Harbour Unit construction site on the Hampshire coast (Mulberry Harbours were prefabricated floating units built for the World War II allied invasion of Normandy) resulted in a major stabilisation programme.

6.3.3 Protection of sites, monuments and wrecks

In this region, three statutory designations are intended to protect *in situ* remains of archaeological or historic importance. The Ancient Monuments & Archaeological Areas Act 1979 provides for Scheduled Ancient Monuments (SAMs). 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, scheduling has only been applied above low water mark (Firth 1993a). There is a presumption against the destruction of SAMs and prior consent is necessary for any works that will destroy, damage, repair or remove such a monument. There is a published list of criteria for determining the national importance of a monument (DoE 1990). The number of scheduled sites is being increased as a result of a review - the Monuments Protection Programme. Table 6.3.1 shows the numbers of coastal SAMs in this region.

The Town & Country Planning (Listed Buildings and Conservation Areas) Act 1990 provides for Listed Buildings - buildings considered of special architectural or historic

Table 6.3.1 Numbers of Scheduled Ancient Monuments (SAMs) in coastal 10 km squares in the region

Location	*No. of SAMs*
Hampshire	**235**
Havant	6
Portsmouth	47
Gosport	18
Eastleigh	7
Fareham	5
Southampton	40
New Forest	112
Isle of Wight	**69**
Medina	15
South Wight	54
Dorset	**358**
Christchurch	12
Bournemouth	3
Poole	13
Purbeck	155
West Dorset	151
Weymouth & Portland	24
Region 9	***662***

Source: English Heritage (1994)

Table 6.3.2 Historic wrecks designated in the region

Name	*Location*	*Grid ref.*	*Description*	*Designation order*
Mary Rose	Spithead	SZ632964	Henry VIII's flagship. Built 1509, sank 1545.	1974 No. (1974/55)
Grace Dieu	Hamble River	SU501068	Built 1415 Southampton, sank 1436.	1974 No. 2 (1974/56)
Yarmouth Roads Wreck	Yarmouth	SZ357900	Late 16th century vessel.	1984 No. 3 (1984/1963)
Assurance/Pomone	Needles	SZ289848	Assurance 44 gun 5th rate warship, lost 1738. Pomone 38 gun 5th rate. Built 1805 Medway, sank 1811.	1974 No. 5 (1974/457)
Invincible	Horse Tail, East Solent	SZ679937	74 gun 3rd rate warship. Built 1745 Rochefort, sank 1758.	1980 No. 2 (1980/1307)
Studland Bay Wreck	Studland Bay	SZ061846	16th century vessel.	1984 No. 2 (1984/1658)

Source: Department of Natural Heritage; grid references: RCHME.

importance. There is now a presumption in favour of the preservation of Listed Buildings and their settings, and consent is required prior to any demolition, alteration or extension (DoE 1994).

The Protection of Wrecks Act 1973 provides for the designation of shipwrecks of national importance for their artistic, archaeological or historical value. Archaeological investigation is only permitted under licence from the Department of National Heritage. Within the designated area it is illegal to tamper with or remove material, to use diving or salvage equipment or to deposit anything that may damage or obliterate the wreck. Table 6.3.2 shows the six wrecks that have been designated within the region (Archaeological Diving Unit 1994). However, as fewer than 45 wrecks have been designated for the whole of Britain, their distribution cannot be accepted as a reasonable guide to the total seabed resource (see section 6.4).

6.3.4 Key organisations and their responsibilities

English Heritage and the Department of National Heritage are responsible for sites protected under, respectively, the Ancient Monuments & Archaeological Areas Act (1979) and the Protection of Wrecks Act (1973). English Heritage inspects monuments, assists owners by drawing up management agreements supported by grants, and directly manages those monuments in Guardianship. It also funds rescue archaeology and related research projects.

The Royal Commission on the Historical Monuments of England (RCHME) has a statutory responsibility for the survey and inventory of archaeological sites in England. It maintains a computerised database of archaeological sites: the National Monuments Record (NMR). In 1992 new Royal Warrants extended the remit of RCHME to the territorial seas, and a Maritime Section has since been added to the NMR. RCHME is the lead agency overseeing data standards in local archaeological databases - Sites and Monuments Records (SMRs) - which are usually maintained at local authority level.

Hampshire and Dorset County Councils, the Isle of Wight Council and Southampton City Council have archaeological officers and maintain SMRs. Portsmouth is also expected to develop its own records within the museums service. The role of SMRs as a source of information and advice for planning authorities was recently confirmed (DoE 1990). The Isle of Wight pioneered the extension of the SMR to the twelve mile territorial limit and, since RCHME developed their maritime project, Hampshire SMR has also been extended. Local authorities can therefore access data on sea-bed sites which can inform their response to offshore developments.

The Hampshire & Wight Trust for Maritime Archaeology (HWTMA) has been formed to "promote the maritime archaeological study of the sea areas Solent and Wight and immediate hinterlands" (HWTMA 1994). This umbrella organisation brings together local authorities, educational, research and environmental groups, and other interested parties. It raises funds for and conducts survey work within the region.

6.3.5 Development control

To landward of low water mark archaeology is considered within the unified system of development control provided by the planning system. Planning Policy Guidance Note 16 (Department of the Environment 1990) explains the regard that should be accorded to archaeological remains. In essence there is a presumption in favour of preservation *in situ* because "the desirability of preserving an ancient monument and its setting is a material consideration in determining planning applications whether that monument is scheduled or unscheduled". Stress is laid on early consultation between planning authorities and developers, with information and advice from the SMR, in order to reconcile the needs of archaeology and development. Where preservation *in situ* is not justified, planning authorities may require the developer to make "appropriate and satisfactory provision for excavation and recording of remains". The SMRs contain details of known archaeological sites and areas of archaeological potential.

Planning decisions should take into account more detailed policies, which appear in Development Plans. The Structure Plans of Hampshire, the Isle of Wight and Dorset, and the Local Plans of their constituent districts, include general policies related to archaeology. Policies on maritime archaeology were included in Hampshire's strategy for the coast (Hampshire County Council 1991a). It is now hoped that Hampshire's County Structure Plan will include underwater archeology (Hampshire County Council 1994).

Further policies and information relating to archaeology appear in a variety of local and/or site management plans. In Hampshire the River Hamble Local Plan contains archaeological policies which include the riverbed (Hampshire County Council 1991b). On the Isle of Wight, the South Wight Borough coastal strategy examines management of a zone to the twelve mile limit. This includes many archaeological considerations (South Wight Borough Council 1994). The Heritage Coast Plan for the island also includes archaeological policies. Dorset County Council have prepared a strategy document, which includes archaeology (Dorset County Council 1994). Other bodies with responsibilities for managing the coast, such as the National Trust, also often include archaeological considerations in their policies.

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.

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. For instance, the early extension of the Isle of Wight Sites and Monuments Record (IWSMR) enabled South Wight District Council to pursue archaeological evaluation ahead of licensing aggregate dredging. The IWSMR also made it possible to include desk-top assessment of the sea-bed resource within the environmental assessment (Geodata Institute 1989). Such practice is encouraged by a new *Code of practice for seabed developers* (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 1994b, c).

6.3.6 Reporting archaeological information

The Royal Commission on the Historical Monuments of England (RCHME) and the Sites and Monuments Records (SMRs) are the accepted reporting points for new archaeological information, although there is a legal requirement to report archaeological and historical artefacts only 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 1993). Objects of gold or silver found on land must be reported to the British Museum, the police or the coroner. Should a coroner's inquest then declare the objects Treasure Trove, the British Museum may retain them and, in return, make an *ex gratia* payment to the finder.

The Merchant Shipping Act 1894 requires any recovered wreck to be reported to the Receiver of Wreck. Wreck is now 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 information on the identity and condition of wreck sites. The Receiver advertises reported wreck, regardless of age, in order that owners may 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. Forms for reporting recovered wreck are available from the Receiver. These include a section on which finders may report the location and condition of wreck sites to RCHME.

6.4 Information sources

6.4.1 Information gathering and collation

The rapid compilation of records for the National Monuments Records - Maritime Section, RCHME, was completed in 1995. The records have been compiled from the Hydrographic Department Wreck Index (see Table 6.4.1). 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.

Table 6.4.1 Records entered in the National Monuments Record - Maritime Section

County	*Known wrecks*[1]	*Documented casualties*[2]	*Unidentified obstructions*[3]
Hampshire/Isle of Wight	327	890	197
Dorset	91	650	45
Total	***418***	***1,540***	***242***

Source: RCHME (October 1994). Key: [1]primarily sites recorded on the Hydrographic Wreck Index; [2]historic records of ship losses; [3]net fasteners etc.

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 feasibilty 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.

This region has developed innovative projects to investigate the archaeological resource of specific localities, using integrated surveys of the terrestrial, intertidal and sub-tidal zones. The County Councils have taken the lead role as recipients of English Heritage funding for the landward portion of the work. The HWTMA has fostered cooperation between diverse organisations to promote the integration of subtidal elements. The Langstone Harbour Project aims to identify all archaeological sites within the harbour and, using a Geographic Information System, to create predictive models for the recovery of further archaeological data. The Quarr/Wootton Project is investigating use of Wootton Creek. Survey of the intertidal area has been extended beyond low water mark using remote sensing equipment and divers, and onto Ryde Middle Bank using divers (Tomalin 1995; HWTMA 1995). Parallel work has been undertaken at Newtown and Yarmouth. This followed 'underwater fieldwalking' between 1984 and 1989, which sought the source of Roman ceramics recovered from fishing dredges in Yarmouth Roads. Peat exposures in an offshore 'cliff' were also examined. The Beaulieu River Project has completed a topographical survey from low water mark to the top of the village street at Buckler's Hard; excavation of the slipways used both terrestrial and underwater techniques. Investigation has now been extended to both banks of the river and over a greater length of the estuary (HWTMA 1995).

The development of the Wytch Farm Oil Field has necessitated extensive survey around Poole Harbour, including Green and Furzey Islands and the Ower Peninsula. This work included a desk-top study of changes in the coastline of Poole Bay (Cox 1991). Further work has been commissioned by BP on the Isle of Purbeck. Other development proposals have produced a number of desk-top assessments of the sub-tidal zone. These include the sea bed between the Needles and Atherfield Point (Geodata Institute 1989), the Shingles (HWTMA 1993), and Hook Sands outside Poole Harbour (Gale 1990).

Within the region, except for the integrated surveys described above, foreshore survey has focused on specific sites. In some cases this has been reactive. At Bouldnor frequent fieldwalking recovered midden (rubbish tip) material being eroded from the foreshore; and in Lymington River timbers visible at very low tide were surveyed and tentatively identified (Adams & Rackley 1994). A number of desk-top and preliminary surveys have been undertaken, such as between Hurst Spit and Calshot (HWTMA 1993; Adams & Rackley 1994); on the effects of groyne construction on Hengistbury Head (HWMTA 1994a); and in West Bay, Bridport, in advance of sea defence construction (HWTMA 1994b).

The HWTMA are conducting a number of projects. The work of a Trust member on a possible Roman quarry, now submerged and known as the Mixon Reef, is being extended. Survey of a composite wreck in Alum Bay (Firth 1993b) is being followed by investigation of chemical and biological processes at the sediment/water interface. The Mary Rose Trust is undertaking research into the influence of sewage dicharge on wreck site environments (Allen 1994). The Dorset County Archaeology Officer is coordinating a Research Strategy for Poole Harbour as a drowned landscape.

6.4.2 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

Type of information	*Contact address and telephone no.*
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
Maritime archaeological sites; code of practice for sea bed developers (published by the Joint Nautical Archaeology Policy)	Head of Recording (Maritime), National Monuments Record, Royal Commission on the Historical Monuments of England, National Monuments Record Centre, Kemble Drive, Swindon SN2 2GZ, tel: 01793 414600
Archaeological sites (general)	National Monuments Record, Royal Commission on the Historical Monuments of England, National Monuments Record Centre, Kemble Drive, Swindon SN2 2GZ, tel: 01793 414600
Hampshire SMR	SMR Officer, Planning Department, Hampshire County Council, The Castle, Winchester, Hampshire SO23 8UE, tel: 01962 846737
Hampshire SMR (Southampton)	SMR Officer, Heritage Arts & Entertainment Management Unit, Directorate of Leisure & City Services, Southampton City Council, Civic Centre, Southampton SO14 7LP, tel: 01703 832242
Isle of Wight SMR	SMR Officer, County Archaeological Unit, 61 Clatterford Road, Carisbrooke, Isle of Wight PO30 1NZ, tel: 01983 529963
Dorset SMR	SMR Officer, Planning Department, Dorset County Council, Colliton Park, Colliton Annexe, Dorchester, Dorset DT1 1XJ, tel: 01305 224921
Maritime archaeology, Hampshire and Isle of Wight	The Director, Hampshire & Wight Trust for Maritime Archaeology, Administration Buildings, University of Southampton, University Road, Southampton, Hampshire SO17 1BJM, tel: 01703 593290
Historic wreck sites	The Secretary, The Advisory Committee on Historic Wreck, Department of National Heritage, Room 306, 2-4 Cockspur Street, London SW1Y 5DH, tel: 0171 211 6369/6367
Reporting of recovered wreck	Receiver of Wreck, Coastguard Agency, Spring Place, 105 Commercial Road, Southampton S015 1EG, tel: 01703 329474
Reporting of Treasure Trove	The British Musem, Bloomsbury, London W1 3DG, tel: 0171 323 8629 (Medieval to Present), or 0171 323 8454 (Prehistoric to Romano-British)

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

The New Forest, probably the best surviving example of pasture woodland in western Europe, is unique in its diversity of lichens and fungi. This is a particularly fine specimen of the Dryad's saddle fungus, dependent, like many other fungi, on ancient semi-natural woodland. The New Forest is also among the most important sites in the UK for dead-wood invertebrates and, as a Ramsar site and Special Protection Area, is internationally important for certain birds, notably the woodlark, nightjar and Dartford warbler. Photo: Nick Davidson, JNCC.

Chapter 7 Coastal protected sites

7.1 Introduction

R.G. Keddie

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 but 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.

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 a large proportion by area of Britain's coastal Biogenetic Reserves (40%), Several Orders (22%) and Areas of Outstanding Natural Beauty (16%) and a large proportion by number of Britain's coastal Biogenetic Reserves (60%), Voluntary Marine Nature Reserves (31%), Ministry of Defence sites (26%) and Country Parks(18%). Substantial areas also fall within Sites of Special Scientific Interest, National Nature Reserves, Local Nature Reserves

Table 7.1.1 Summary of site protection in Region 9

	Number of protected sites					*Area covered by site protection*				
	Region	*North Sea Coast*	*% of North Sea Coast total in region*	*GB coast*	*% of GB coastal total in region*	*Region (ha)*	*North Sea Coast (ha)*	*% of North Sea Coast total in region*	*GB coast (ha)*	*% of GB coast total in region*
Ramsar sites	3.5+	32	10.9	53	6.6	32,895+	170,735	19.3	276,263	11.9
Special Protection Areas	3.5+	44	8.0	78	4.5	32,895+	179,141	18.4	292,363	11.3
Biogenetic Reserves	3	4	75.0	5	60.0	1,504	2,477	60.7	3,777	39.8
Candidate coastal/marine SACs*	6.5+	35	18.6	71	9.2	n/av	n/av	n/av	n/av	n/av
Candidate coastal/terrestrial SACs*	3	15	20.0	40	7.5	n/av	n/av	n/av	n/av	n/av
Environmentally Sensitive Areas*	1	7	14.3	17	5.9	5,200	279,478	1.9	1,397,545	0.4
National Nature Reserves	5	41	12.2	79	6.3	1,820	34,556	5.3	86,708	2.1
Sites of Special Scientific Interest	75	549	13.7	1,183	6.3	51,907	330,377	15.7	700,780	7.4
Areas of Special Protection	2	14	14.3	23	8.7	n/av	n/av	n/av	n/av	n/av
Bass nursery areas	7	18	38.9	34	20.6	n/av	n/av	n/av	n/av	n/av
Regulating Orders	2	4	50.0	8	25.0	20,415	89,436	22.8	99,889	20.4
Several Orders	5	17	29.4	22	22.7	690	2,062	33.5	3,157	21.9
Local Nature Reserves	15	69	21.7	94	16.0	1,077	8,731	12.3	13,300	8.1
Areas of Outstanding Natural Beauty	3.5	14.5+	24.1	24	14.6	140,900	714,800+	19.7	899,900	15.7
Country Parks	6	20	30.0	34	17.6	371	2,943	12.6	4,441	8.4
Geological Conservation Review sites+	124	490	25.3	978	12.7	n/ap	n/ap	n/ap	n/ap	n/ap
Heritage Coasts	4	17.5+	22.9	45	8.9	136#	649#	21.0	1,539#	8.8
Sensitive Marine Areas	4	16.5+	21.2	27	13.0	n/av	n/av	n/av	n/av	n/av
Voluntary Marine Nature Reserves	3.5+	8.5+	47.1	13	30.8	n/av	n/av	n/av	n/av	n/av
National Trust sites	50	190[a]	26.3[a]	444[a]	11.3[a]	5,294	17,457[a]	30.3[a]	62,648[a]	8.5[a]
Royal Society for the Protection of Birds reserves	4	53	7.5	81	4.9	1,355	24,555	5.5	38,680	3.5
The Wildlife Trusts reserves	17	123	13.8	216	7.9	739	10,413	7.1	23,397	3.2
The Woodland Trust reserves	2	35	5.7	64	3.1	10	1,095	0.9	1,458	0.7
The Ministry of Defence sites	28	65	43.1	110	25.5	3,972	34,449	11.5	53,409	7.4

Source: JNCC. Key: n/ap = not applicable; n/av = not available; # = length (km); +sites lying partly within Region 8; half the relevant site area has been included in the total; *sites lying partly within Region 10; half the relevant site area has been included in the total; [a]includes National Trust for Scotland sites. Notes: site types not currently found in the region: World Heritage (Natural) Sites, Biosphere Reserves, Marine Nature Reserves, National Parks, Wildfowl and Wetland Trust sites. 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.

and National Trust sites. Table 7.1.1 summarises site protection in the region, showing the numbers and areas of each type of site and comparing these with North Sea coast and British (whole country coast) totals.

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7.2 Sites designated under international conventions and directives

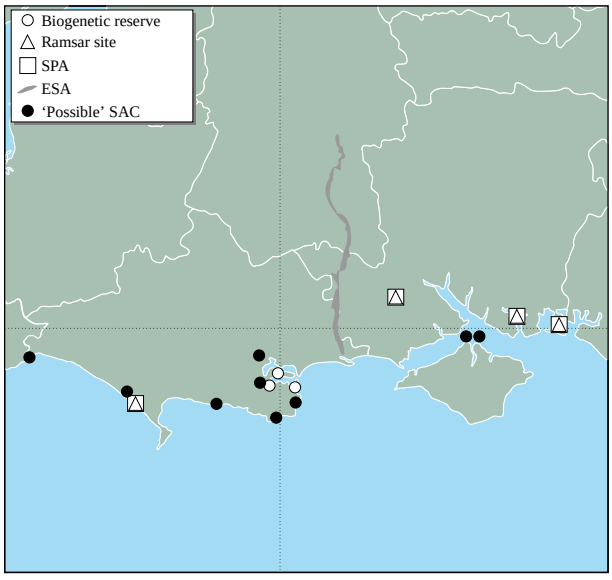
This section describes those types of site designated under international conventions to which the UK is a contracting party and sites designated under UK statute to implement EC Directives concerning wildlife and landscape conservation. Sites protected by domestic legislation only are covered in section 7.3.

7.2.1 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; all Ramsar sites have first to be designated as Sites of Special Scientific Interest (SSSIs) (see section 7.3.2). There are three whole and part of one other coastal Ramsar sites (32,895 ha) in Region 9 (Table 7.2.1 and Map 7.2.1). All are also Special Protection Areas (SPAs - see section 7.2.2). 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.

7.2.2 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 Sites of Special Scientific Interest (SSSIs) (see section 7.3.2). There are three whole and part of one other coastal SPA (32,895 ha) in Region 9 (Table 7.2.3 and Map 7.2.1). All are also Ramsar sites (see section 7.2.1). Table 7.2.3 summarises the interest of these sites, and



Map 7.2.1 Coastal Biogenetic Reserves, Ramsar sites, Special Protection Areas, possible Special Areas of Conservation and Environmentally Sensitive Area. Source: JNCC

Table 7.2.1 Ramsar sites

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date designated*	*Selection criteria used*
Hampshire/West Sussex	**1***				
Chichester & Langstone Harbours*		SU740010	5,764*	1987	Representative wetland; regularly supports 20,000 waterfowl and 1% of a waterfowl species population
Hampshire	**2**				
Portsmouth Harbour		SU620035	1,248	1995	Genetic and ecological diversity; 1% of a waterfowl species population
New Forest		SU298081	28,001	1993	Representative wetland; rare species; genetic and ecological diversity
Dorset	**1**				
Chesil Beach and The Fleet		SY6081	763	1985	Representative wetland; rare species; and 1% of a waterfowl species population
Region 9	***3.5****		***32,895****		
North Sea coast	32		170,735		
GB coast	53		276,263		
GB whole country	91		387,577		

Sources: JNCC, EN. Key: *site lying partly within Region 8; half the relevant site area has been included in the regional total. 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 7.2.2 Special Protection Areas (SPAs)

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date designated*	*Qualifying interest*
Hampshire/W. Sussex	**1***				
Chichester & Langstone Harbours*		SU740010	5,764*	1987	Internationally important numbers of seven species of wintering waterfowl; nationally important numbers of eight wintering species and two species of breeding tern; regularly supports over 20,000 waterfowl
Hampshire	**2**				
Portsmouth Harbour		SU620035	1,248	1995	Internationally important numbers of wintering dark bellied brent goose; nationally important numbers of grey plover, dunlin and black-tailed godwit
New Forest		SU298081	28,001	1993	Nationally important numbers of breeding hobby, nightjar, woodlark, Dartford warbler and wood warbler; wintering and breeding raptors and passerines
Dorset	**1**				
Chesil Beach & The Fleet		SY6081	763	1985	Nationally important numbers of breeding mute swan and little tern, and four species of wintering wildfowl
Region 9	***3.5****		***32,895****		
North Sea coast	44		179,141		
GB coast	78		292,363		
GB whole country	107		354,650		

Sources: JNCC, EN. Key: *sites lying partly within Region 8; half the relevant site area has been included in the total. 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.

sections 5.10, 5.11 and 5.12 describe the importance of these sites for the region's birds.

7.2.3 Biogenetic Reserves

In 1973 the European Ministerial Conference on the Environment recommended that a European network of reserves to conserve representative examples of European flora, fauna and natural areas be established. All sites in the UK are existing Sites of Special Scientific Interest (SSSIs), and most are also National Nature Reserves (DoE Press Release 1992). There are three coastal Biogenetic Reserves (1,504 ha) in Region 9 (see Table 7.2.3 and Map 7.2.1), of five in the UK, all of which are heathland sites. In 1992 there were eighteen sites declared in Europe (DoE 1992): eleven heathland and seven dry grassland reserves (data provided by International Branch, JNCC).

Table 7.2.3 Biogenetic reserves

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date designated*
Dorset	**3**			
Arne		SY9788	430	1992
Hartland Moor NNR		SY953850	443	1992
Studland Heath NNR		SZ028838	631	1992
Region 9	***3***		***1,504***	
North Sea coast	4		2,477	
GB coast	5		3,777	

Source: JNCC, English Nature, DOE. 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.

7.2.4 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 and 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 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 whole and part of one other possible SAC proposed for their maritime interest in Region 9, from a total of 71 such sites in GB, and three 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). Two of the coastal/marine possible SACs in the region (Solent and Isle of Wight Lagoons, and Chesil and the Fleet) contain lagoons, a priority habitat under the EC Habitats and Species Directive.

Table 7.2.4 Possible Special Areas of Conservation (SACs) in Region 9

Site name	*No. of sites*	*Qualifying interest*
Hampshire/Isle of Wight/West Sussex	**1**	
Solent and Isle of Wight Maritime		Atlantic salt meadows (Glauco-Puccinellietalia); estuaries; reefs; *Spartina* swards (Spartinion); vegetated sea cliffs of the Atlantic and Baltic coasts
Hampshire/Isle of Wight	**1**	
Solent and Isle of Wight Lagoons		Lagoons
Dorset/Hampshire	**1**	
Dorset Heaths		Southern damselfly *Coenagrion mercuriale*; dry heaths (all subtypes); northern Atlantic wet heaths with cross-leaved heath *Erica tetralix*
Dorset	**5**	
Dorset Heaths (Purbeck and Wareham)		Southern damselfly *Coenagrion mercuriale*; dry heaths (all subtypes); northern Atlantic wet heaths with cross-leaved heath *Erica tetralix*, southern Atlantic wet heaths with Dorset heath *Erica ciliaris* and cross-leaved heath *Erica tetralix*
Studland Dunes		Embryonic shifting dunes; eu-atlantic decalcified fixed dunes (Calluno-Ulicetea); shifting dunes along the shoreline with marram *Ammophila arenaria* (white dunes)
St. Albans Head to Durlston Head		Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia); important orchid sites; vegetated sea cliffs of the Atlantic and Baltic coasts
Isle of Portland to Studland Cliffs		Early gentian *Gentianella anglica*; vegetated sea cliffs of the Atlantic and Baltic coasts
Chesil and the Fleet		Annual vegetation of drift lines; lagoons; perennial vegetation of stony banks
Devon, Dorset	**1***	
Sidmouth to West Bay*		Vegetated sea cliffs of the Atlantic and Baltic coasts
Region 9	***8.5****	
GB	111	

Source: JNCC. Key: *site lying partly within Region 10. 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.

7.2.5 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 is one ESA (5,200 ha) that includes land in Region 9 (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), Siâron Hooper (English Nature), WOAD, SOAEFD and the Ministry of Agriculture, Fisheries and Food (MAFF).

Table 7.2.5 Environmentally Sensitive Areas

Site name	*No. of sites*	*Area (ha)*	*Date designated*	*Interest*
Dorset and Hampshire	**1**			
Avon Valley		5,200	1993	Traditional pastoral landscape; grasslands, streams, small woods, scrub, willow carr, remains of water meadow systems; breeding waders and overwintering wildfowl
Region 9	***1***	***5,200***		
North Sea coast	7	279,478		
GB coast	17	1,397,545		

Sources: English Nature, MAFF. 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.

7.2.7 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.*
Ramsar sites, SPAs, Special Areas of Conservation (Hampshire, Isle of Wight)	*Conservation Officer, EN Hants. & IOW Local Team, Lyndhurst, tel: 01703 283944
Ramsar sites, SPAs, Special Areas of Conservation, ESAs (Dorset)	*Conservation Officer, EN Dorset Local Team, Wareham, tel: 01929 556688
Ramsar sites, SPAs (Hampshire, Isle of Wight)	*RSPB South-east Regional Office, Shoreham-by-Sea, tel: 01273 463642
Ramsar sites, SPAs (Dorset)	*RSPB South-west Regional Office, Exeter, tel: 01392 432691
ESAs	MAFF/ADAS Land Service, Ministry of Agriculture, Fisheries and Food, Whitehall Place, London SW1A 2HH, tel: 0171 270 3000
Special Areas of Conservation	*European Wildlife Division, DoE, Bristol, tel: 0117 9878000 ext. 8341

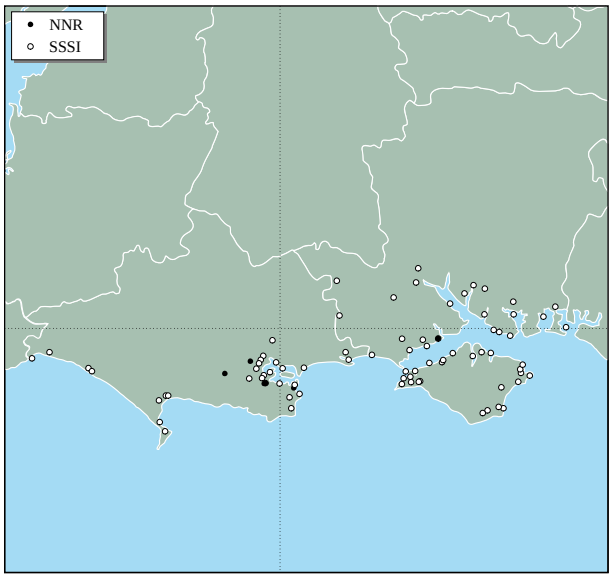
*Starred contact addresses are given in full in the Appendix.

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 nature conservation agencies (in this region English Nature), local authorities or the government acting on advice from these bodies.

7.3.1 National Nature Reserves

National Nature Reserves (NNRs) contain examples of some of the most important natural and semi-natural ecosystems in Great Britain. 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 (SSSI). There are five coastal NNRs (1,820 ha) in Region 9 (Table 7.3.1 and Map 7.3.1).



Map 7.3.1 Coastal National Nature Reserves and Sites of Special Scientific Interest. Sources: English Nature, 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 74 whole and part of two other coastal SSSIs (51,907 ha) in Region 9, 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 75 coastal SSSIs in the region, just over one third (36%) are purely terrestrial, while the rest (64%) include some intertidal land. Over 92% were selected at least partly for their biological interest and nearly two-fifths at least partly for their earth science (geological or geomorphological) interest. Of the total, over one third have both biological and earth science interest. Examples of a very wide range of habitats and species occur within the SSSIs in this region, the most frequently occurring habitats being tidal flats, saltmarsh, wet grassland, dry grassland,

Table 7.3.1 National Nature Reserves

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date last declared*	*Habitats*
Hampshire	**1**				
North Solent		SZ415974	820	1980-1994	Saltmarsh and grazing marsh, sand dunes, shingle islands and ridges, reedbeds, riverine meadows, estuarine mudflats and alder-willow woodland
Dorset	**4**				
Holton Heath		SY915910	117	1986-89	Wet and dry heathland, bogs, mature oak woodland and overgrown wood-pasture
Arne		SY850875	9	1986	Reedbed
Hartland Moor		SY953850	243	1986	Dry and wet heath, valley mire
Studland and Godlingston Heaths		SZ028838	631	1986	Sand dunes, wet and dry heath, damp woodland, freshwater and foreshore
Region 9	***5***		***1,820***		
North Sea coast	41		34,556		
GB coast	79		86,708		
GB whole country	288		195,531		

Sources: EN, 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 9

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date last notified*
W. Sussex/Hampshire[a]	**1**			
Chichester Harbour[a]		SU760000	3,680[a]	1985
Hampshire	**19**			
Warblington Meadow		SU730052	4	1987
Langstone Harbour		SU700030	2,069	1985
Portsmouth Harbour		SU620035	1,127	1985
Portsdown		SU618068; SU666064	81	1984
Gilkicker Lagoon		SZ609978	4	1984
Lee-on-Solent to Itchen Estuary		SZ569994	632	1992
Browndown		SZ580990	64	1985
Titchfield Haven		SU539035	131	1983
Lincegrove & Hackett's Marshes		SU486088	38	1984
Botley Wood & Everett's and Mushes Copses		SU540104	350	1986
Upper Hamble Estuary & Woods		SU510110	149	1987
Lower Test Valley		SU360153	139	1986
Eling & Bury Marshes		SU355120	110	1986
Hythe - Calshot Marshes		SU445063	437	1984
North Solent		SZ387957	1,189	1990
Sowley Pond		SZ374967	48	1984
Lymington River Reedbeds		SZ323969	41	1984
Hurst Castle & Lymington River Estuary		SZ340940	1,044	1986
New Forest		SU298081	27,734	1987
Isle of Wight	**25**			
Medina Estuary		SZ508924	48	1985
King's Quay Shore		SZ536935	97	1987
Ryde Sands		SZ557932; SZ634908	403	1993
St. Helen's Ledges		SZ639898	29	1988
The Duver, St. Helen's		SZ636892	16	1984
Brading Marshes		SZ637880	256	1984
Whitecliff Bay & Bembridge Ledges		SZ657872	132	1986
Bembridge Down		SZ628856	56	1984
Lake Allotments		SZ586838	0	1988
Bonchurch Landslips		SZ582785	28	1986
Ventnor Downs		SZ575786	163	1987
Rew Down		SZ550775	24	1985
St. Lawrence Bank		SZ536768	1	1986
Hanover Point to St. Catherine's Point		SZ365854	263	1986
Compton Down		SZ365856	196	1984
Freshwater Marshes		SZ344866	23	1986
Watcombe Bay		SZ343855	3	1971*
Lacey's Farm Quarry		SZ323862	0	1993
Headon Warren & West High Down		SZ316852	276	1984
Colwell Bay		SZ330884	5	1959
Yar Estuary		SZ353886	99	1985
Harts Farm Meadows		SZ424904	31	1986
Bouldnor & Hamstead Cliffs		SZ390910	96	1987
Newtown Harbour		SZ425915	654	1984
Gurnard Ledge to Saltmead Ledge		SZ450934	71	1987
Dorset	**30**			
Highcliffe - Milford Cliffs		SZ240928	111	1991
Purewell Meadows		SZ168934	13	1985
Christchurch Harbour		SZ175915	353	1986
Avon Valley (Bickton - Christchurch)		SU150030	605	1989
Poole Bay Cliffs		SZ058891	12	1989
Corfe Mullen Pastures		SY975964	12	1994
Ham Common		SY981907	32	1987
Holton Heath		SY949922	164	1986
Black Hill (Holton)		SY946909	3	1994
Sandford Heath		SY938902	50	1987
Wareham Meadows		SY932886	204	1987
Arne		SY966880	563	1986
Poole Harbour		SZ000890	4,049	1990
The Moors		SY950870	5	1984
East Holme Meadows		SY911861; SY890865	17	1989
Hartland Moor		SY948855	300	1986
Rempstone Heaths		SY990849	175	1987

Table 7.3.2 SSSIs in Region 9 (continued)

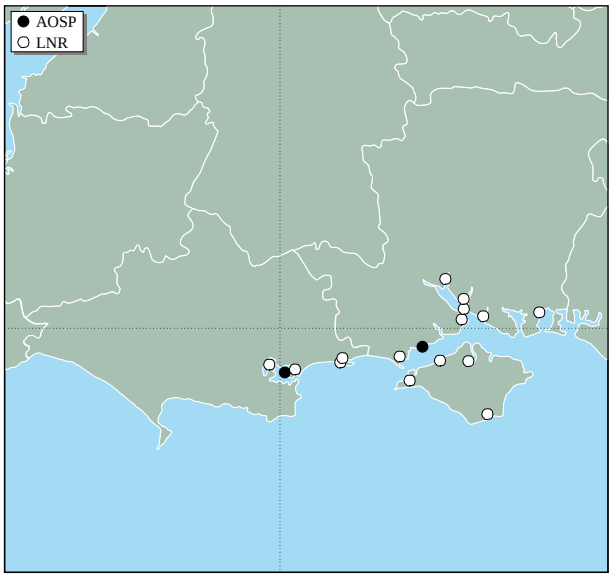
Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date last notified*
Dorset (continued)				
Studland & Godlingston Heaths		SZ030845	759	1987
Studland Cliffs		SZ038828; SZ048813	18	1986
Purbeck Ridge (East)		SZ020812	142	1986
Townsend		SZ023782	14	1986
South Dorset Coast		SY697816	1,761	1986
Lodmoor		SY688813	72	1985
Radipole Lake		SY672805	96	1985
Isle of Portland		SY690722	369	1987
Portland Harbour Shore		SY675747	30	1987
Chesil and the Fleet		SY496885	990	1986
Burton Bradstock		SY487892	0	1986
Newlands Batch		SY382936	24	1988
West Dorset Coast		SY335914	596	1991
Dorset/Devon	**1[b]**			
Axmouth to Lyme Regis Undercliffs[b]		SY256896	335[b]	1986
Region 9	***76[a, b]***		***51,907[a, b]***	
England	3,813		875,165	
North Sea coast	549		330,377	
GB coast	1,183		700,781	
GB whole country	6,095		1,940,483	

Sources: EN, JNCC. Key: [a]the W. Sussex part of Chichester Harbour is in Region 8; half of the area has been included in the total for Region 9; [b]the Devon part of Axmouth to Lyme Regis Undercliffs is in Region 10; half of the area has been included in the total for Region 9; *sites notified before the 1981 Wildlife and Countryside Act and not yet renotified are not afforded protecion under this Act: these sites may later be renotified. 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.

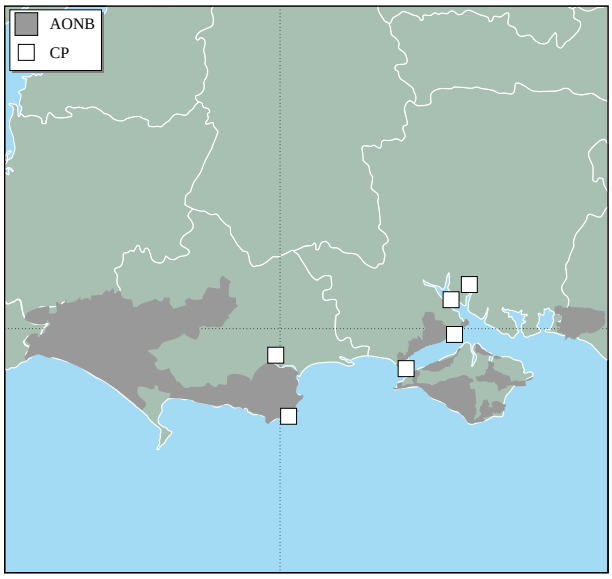
maritime heath, reed bed, scrub and woodland, these habitats occurring in 17-47% of sites. SSSIs in the region include many sites of interest for their rare plants, lower plants, marine species, terrestrial invertebrates, breeding seabirds and other breeding birds or internationally important migrating/wintering 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 fifteen LNRs (1,077 ha) in Region 9 (Table 7.3.3 and Map 7.3.2).



Map 7.3.2 Coastal Local Nature Reserves and Areas of Special Protection. Source: English Nature.



Map 7.3.3 Coastal Areas of Outstanding Natural Beauty and Country Parks. Source: Countryside Commission.

Table 7.3.3 Local Nature Reserves

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date last notified*
Hampshire	**7**			
Farlington Marshes		SU685043	119	1974
Titchfield Haven		SU537030	85	1973
Hook with Warsash		SU488052	220	1988
Mercury Marshes		SU486075	7	1988
Chessel Bay		SU440127	14	1989
Calshott Marshes		SU484024	49	1979
Lymington-Keyhaven marshes		SZ320925	194	1990
Isle of Wight	**4**			
Werrar Marshes		SZ500915	9	1983
Rew Down		SZ551774	5	1984
Newtown Marshes		SZ425915	120	1966
Freshwater Marshes		SZ345864	16	1983
Dorset	**4**			
Stanpit Marsh, Christchurch		SZ169920	51	1964
Hengistbury Head		SZ165910	154	1991
Luscombe Valley		SZ045891	5	1993
Ham Common		SY980907	29	1992
Region 9	***15***		***1,077***	
North Sea coast	69		8,731	
GB coast	94		13,300	
GB whole country	396		21,513	

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.

7.3.4 Areas of Special Protection

Area of Special Protection (AoSP) is a designation replacing Bird Sanctuary Orders made 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 two AoSPs in Region 9 (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*
Hampshire	**1**	
Gull Island and Warren Shore (No. 578) and Needs Ore Point		1984
Dorset	**1**	
Poole Harbour (No. 1258)		1978
Region 9	***2***	
North Sea coast	14	
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 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. There are three whole and part of one other AONB (140,900 ha) in Region 9 (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.

Table 7.3.5 Areas of Outstanding Natural Beauty (AONBs)

Site name	*No. of sites*	*Area (ha)*	*Date designated*
Hampshire	**2**		
Chichester Harbour[a]		1,400[a]	1964
South Hampshire Coast		7,700	1967
Isle of Wight	**1**		
Isle of Wight		18,900	1963
Dorset	**1**		
Dorset		11,290	1959
Region 9	***3.5***[a]	***140,900***	
North Sea coast	9.5	714,800	
GB coast	24	899,900	
GB whole country		2,123,700	

Source: Countryside Commission. Key: [a]excludes 6,000 ha of Chichester Harbour AONB located in W. Sussex. 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 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

Table 7.3.6 Country Parks

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date designated/opened*
Hampshire	**3**			
Upper Hamble		SU501114	161	1981
Lepe and Calshot Foreshores		SZ461986 & SU477008	50	1969
Royal Victoria		SU457080	60	1980
Isle of Wight	**1**			
Fort Victoria		SZ335895	20	1971
Dorset	**2**			
Durlston		SZ028773	58	1973
Upton Park		SY995930	22	1979
Region 9	***6***		***371***	
North Sea coast	20		2,943	
GB coast	34		4,441	
GB whole country	281		35,150	

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.

so form a valuable network of locations at which informal recreation and the natural environment co-exist. They are declared and managed by local authorities under section 7 of the Countryside Act 1968. There are six coastal Country Parks (371 ha) in Region 9 (Table 7.3.6 and Map 7.3.3).

7.3.7 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), Neale Oliver (DoE) and Paul Johnson (Countryside Commission).

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
NNRs, SSSIs, LNRs, AoSP (Hampshire and Isle of Wight)	*Conservation Officer, English Nature Hampshire & IoW Local Team, Lyndhurst, tel: 01703 283944
NNRs, SSSIs, LNRs, AoSP (Dorset)	*Conservation Officer, English Nature Dorset Local Team, Wareham, tel: 01929 556688
NNRs, SSSIs, LNRs, AoSP (Region 9)	*Designations Team, EN HQ, Peterborough, tel: 01733 340345
LNRs, Country Parks (Hampshire)	*Hampshire County Council, Winchester, tel: 01962 841841
LNRs, Country Parks (Dorset)	*Dorset County Council, Dorchester, tel: 01305 251000
LNRs, Country Parks (Isle of Wight)	*Isle of Wight Council, Newport, tel: 01983 821000

Type of information	*Contact address and telephone no.*
Areas of Special Protection	*European Wildlife Division, DoE, Bristol, tel: 0117 987 8000
AONB, National Park	*Countryside Commission (CC), Cheltenham, tel: 01242 521381
Country Parks, Hampshire and IoW	*CC South-east Region, London, tel: 0171 831 3510
Country Parks, Dorset	*CC South-west Region, Bristol, tel: 01179 739966
Coastal and marine UKDMAP datasets	*Coastal Conservation Branch, JNCC, Peterborough, tel: 01733 62626

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

Dorset is recognised as one of the loveliest counties in England; the greater part has been selected as an Area of Outstanding Natural Beauty. The Dorset coast - almost continuously designated as Heritage Coast - is one of the country's most acclaimed landscape assets. Monmouth Beach at Lyme Regis, famous for its fossils, is a Geological Conservation Review site and part of the West Dorset Site of Special Scientific Interest. Lyme Bay itself is a Sensitive Marine Area, especially important for the creatures that live on its limestone reefs. Photo: Nick Davidson, JNCC.

7.4 Sites identified by statutory agencies

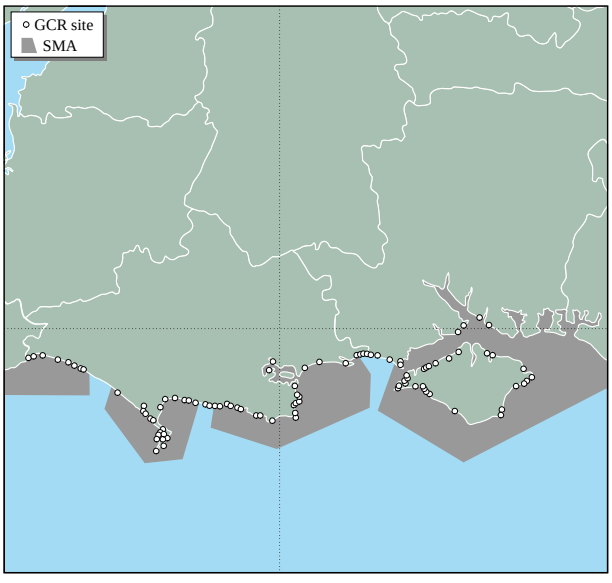
This section covers sites which, although not protected by statute, have been identified by statutory agencies as being of nature conservation or landscape importance.

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 124 coastal GCR Single Interest Localities (SILs) within Region 9 (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. The large number of SILs in this region in proportion to the length of its coast reflects its major importance, particularly in the Isle of Wight and Dorset, for coastal earth science conservation. 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 and Sensitive Marine Areas. Sources: English Nature, 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 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. There are four Heritage Coasts (136 km) in Region 9 (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*
Isle of Wight	**2**			
Tennyson		SZ551768-SZ318866	34	1974
Hamstead		SZ463947-SZ374092	11	1974
Dorset	**2**			
Purbeck		SZ037868-SZ034774 SY702853-SY710816	50	1981
West Dorset		SY331913-SY683732	41	1984
Region 9	***4***		***136***	
North Sea coast	17.5		647	
England & Wales	45		1,539	

Source: Countryside Commission. Note: all these sites are 'completely defined', i.e. they also have a defined landward boundary.

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 9 (Table 7.4.3 and Map 7.4.1), compared with a total of 27 around the coast of England, of which sixteen whole sites and part of one other are on the North Sea coast.

Table 7.4.1 GCR SILs

Site name	*No. of sites*
Hampshire	**14**
Lee on Solent (2 sites)	
Hillhead Cliffs	
Calshot Cliffs	
Stone Point	
Keyhaven Marsh*, Hurst Castle	
Hurst Castle Spit*	
Paddy's Gap	
Hordle - Beacon Cliffs	
Hordle Cliff	
Hordle (2 sites)	
Barton Cliff	
Barton	
Isle of Wight	**38**
King's Quay	
Chapel Corner	
St. Helen's	
Bembridge	
Whitecliff Bay (2 sites)	
Whitecliff Bay - Bembridge	
Whitecliff	
Redcliff	
Sandown Bay	
Sandown Bay to Whitecliff Bay	
Yaverland	
Luccombe Chine	
Shanklin Chine - Monks Bay	
Atherfield to Rocken End	
Hanover Point	
Compton Brook - Atherfield	
Compton Bay - Brightstone Bay	
Compton Chine	
Totland Bay - Alum Bay	
Compton Bay	
Colwell Bay (2 sites)	
Southwest Isle of Wight*	
Headon Hill (3 sites)	
Lacey's Farm Quarry	
Totland	
Bouldnor Cliff (5 sites)	
Thorness Bay (2 sites)	
Hampstead Ledge	
Gurnard	
Hampshire/Dorset	**3**
Barton (2 sites)	
Solent Cliffs West	
Dorset	**68**
Highcliffe	
Friars Cliff	
Hengistbury	
East Bournemouth Cliffs	
Western Bournemouth Cliffs	
Lake	
Arne	
South Haven Peninsula*	
Ballard Down*	
Handfast Point - Ballard Down	
Studland Bay	

Site name	*No. of sites*
Dorset (continued)	
Ballard Point to Studland Bay	
Punfield Cove	
Swanage	
Durlston Bay (4 sites)	
Winspit-Seacombe	
Houns-tout	
Swyre Head - Chapman's Pool	
Gaulter Gap - Broad Bench	
Tyneham Cap - Hounstout	
Gad Cliff	
Worbarrow Bay	
Mupe Bay and Worbarrow Bay	
Walton Cliff	
Lulworth Cove	
Dungy Head - Mupe	
Durdle Door	
White Nothe to Bacon hole	
White Nothe (2 sites)	
Cliff House	
Ringstead	
Black Head	
Furzy Cliff, Overcombe	
Furzy Cliff - Peveril Point	
Osmington	
Sandsfoot	
Nicodemus Knob	
Yeolands - Grove Cliff	
Perryfield Quarry	
Freshwater Bay	
Portland Bill	
Blacknor	
Tar Rocks	
West Cliff	
West Cliff - Kingbarrow - Yeolands and Grove Cliff, Portland	
Maggot - Kingbarrow - Waycroft	
King Barrow	
Smallcombe Sands	
East Fleet - Small Mouth	
Lynch Cove	
Tidmoor Point to East Fleet Coast	
Crookhill Brickpit	
Shipmoor Point - Butterstreet Cove	
Cliff Hill Road Section	
Burton Cliff and Cliff Hill Road Section	
East Cliff	
Chesil Beach*	
Walton Cliff (2 sites)	
Seatown - Walton Cliff	
Goldencap - Lyme Regis*	
Charmouth	
Black Ven	
Lyme Regis	
Dorset/Devon	**2**
Lyme Regis	
Pinhay Bay - Fault Corner	
Region 9	***125***
North Sea coast	508
GB coast	1,059
GB whole country	3,002

Sources: EN, JNCC. 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.

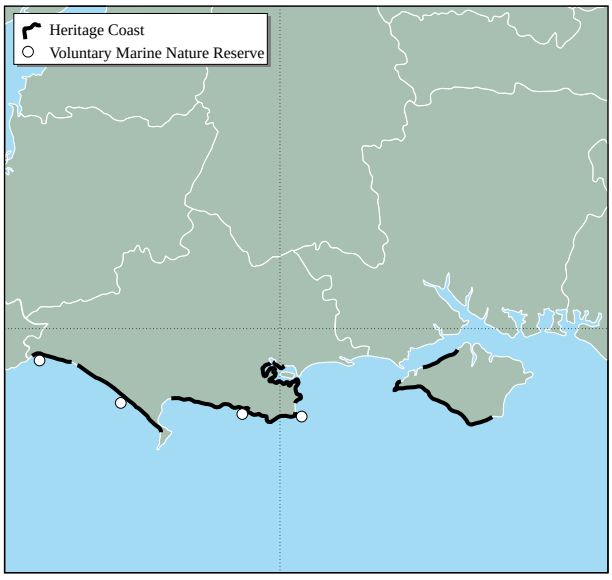
Table 7.4.3 Sensitive Marine Areas

Site name	*No. of sites*	*Date established*
Hampshire/W. Sussex	**1**	
Solent and Isle of Wight		1994
Dorset	**2**	
Poole Bay & Isle of Purbeck		1994
Portland & The Fleet		1994
Devon/Dorset	**1**	
Lyme Bay		1994
Region 9	***4***	
North Sea coast	16.5	
England coast	27	

Sources: NCC (1990), English Nature (1994a).

7.4.5 Voluntary Marine Nature Reserves

Voluntary Marine Nature Reserves (VMNRs) (also called voluntary marine conservation areas or voluntary marine wildlife areas) may be set up by representatives of the users of a subtidal area or an area of shore in order to initiate management of that area. Management may have a variety of purposes, from conservation of a marine biologically important area, to use for educational purposes. These reserves or conservation areas usually have a management committee or steering group composed of users of the area, interested members of the public, fishermen, harbour authorities and local Wildlife Trusts. There are four VMNRs within Region 9, all in Dorset (Table 7.4.4 and Map 7.4.2).



Map 7.4.2 Heritage Coasts and Voluntary Marine Nature Reserves. Source: Countryside Commission.

Table 7.4.4 Voluntary Marine Nature Reserves

Site name	*No of sites*
Dorset	**4**
Durlston Marine Research Area	
Kimmeridge	
Fleet/Portland	
Charmouth	
Region 9	***4***
North Sea coast	9.5
GB coast	14

Sources: EN, Marine Conservation Society, WWF (UK)

7.4.6 Acknowledgements

Thanks are due to Ray Woolmore and Paul Johnson (Countryside Commission), Roger Bolt (JNCC) and Phillip Biss, Paul Gilliland and Kevin Page (English Nature).

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 (Hampshire and IoW)	*Conservation Officer, EN Hants. and IoW Local Team, Lyndhurst, tel: 01703 283944
NCR sites, GCR sites, SMAs, VMNRs (Dorset)	*Conservation Officer, EN Dorset Local Team, Wareham, tel: 01929 556688
Heritage Coasts (Hampshire and IoW)	*Countryside Commission, South-east Region, London, tel: 0171 831 3510
Heritage Coasts (Dorset)	*Countryside Commission, South-west Region, Bristol, tel: 01179 739966

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

The reedbeds at Radipole Lake, Dorset, are managed by the Royal Society for the Protection of Birds to enhance the habitat for its rare breeding songbirds. These include bearded tits, reed warblers, sedge warblers, Savi's warbler and Cetti's warbler. This region is one of the very few in Britain in which Cetti's warbler breeds, and Dorset and Hampshire hold the largest populations in the country. Photo: Nick Davidson, JNCC.

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 in England, Wales and Northern Ireland are now owned or managed by the National Trust (National Trust 1993). There are fifty coastal National Trust sites (5,294 ha) in Region 9 (Table 7.5.1 and Map 7.5.1).

7.5.2 The Royal Society for the Protection of Birds

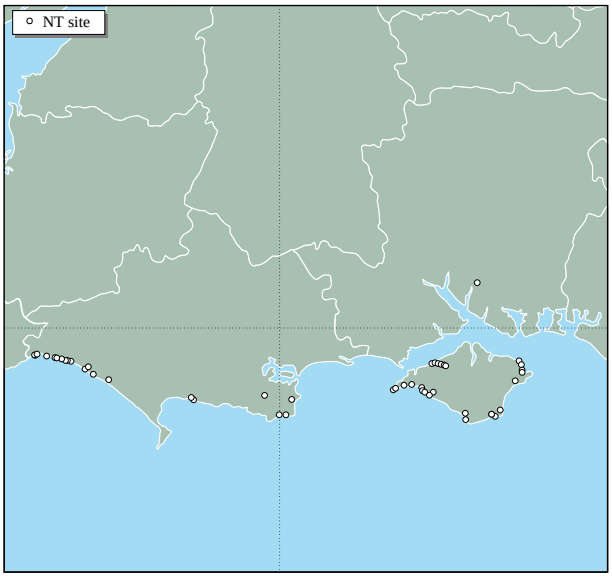
The Royal Society for the Protection of Birds (RSPB) has substantial non-statutory reserve holdings and currently manages over 130 reserves (84,000 ha) in Britain (RSPB 1993). Wherever possible, reserves are purchased, so that the level of safeguard for the wildlife and their habitats is high. Where reserves are leased, the RSPB aims to acquire long leases (longer than 21 years) with appropriate management rights. There are four RSPB sites (1,335 ha) in Region 9 (Table 7.5.2 and Map 7.5.2).

7.5.3 The Wildlife Trusts

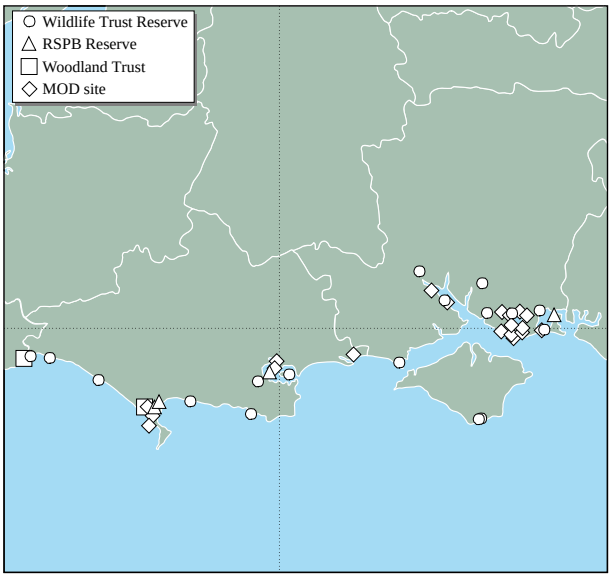
The Wildlife Trusts were established to promote non-statutory nature conservation at a local level. They own, lease and manage, by agreement with owners, over 1,800 nature reserves (more than 52,000 ha). There is usually one trust covering a whole county or group of counties, although both Scotland and the Isle of Man each have a single Trust. The Trusts with coastal sites in the region are the Hampshire and Isle of Wight Wildlife Trust and the Dorset Wildlife Trust. There are seventeen coastal Wildlife Trust sites (739 ha) in Region 9 (Table 7.5.3 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 to calculate the GB coast total, with Scottish data extracted from Scottish Wildlife Trust (1994) and Isle of Man data from MNCT (1994).

7.5.4 The Ministry of Defence

As at August 1994, the Ministry of Defence (MoD) owned, leased or used under licence landholdings 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 sites mean that they can be amongst the most pristine areas of wildlife habitat in the region. There are 28 coastal MoD sites (3,972 ha) in Region 9 (Table 7.5.4 and Map 7.5.2).



Map 7.5.1 Coastal National Trust sites. Source: National Trust. Note: a single symbol may represent more than one site in close proximity.



Map 7.5.2 Other voluntary and private sites. Sources: Wildlife Trusts, RSPB, Woodland Trust, Wildfowl & Wetlands Trust, Ministry of Defence. Note: a single symbol may represent more than one site in close proximity.

Table 7.5.1 National Trust sites

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date acquired*	*Landform*
Hampshire	**1**				
Hamble River		SU523118	30	1927-1929	Wood and farmland
Isle of Wight	**27**				
Priory Bay, Horestone Point		SZ634907	1	1982	Coastal woodland
Priory Woods		SZ637899	22	1986	Coastal woodland
St. Helen's Common		SZ633892	4	1925-1935	Common land
St. Helen's Duver		SZ637891	12	1961	Spit of sand and shingle
Bembridge & Culver Downs		SZ624860	42	1967	Cliffs and downland
Luccombe Farm		SZ577794	99	1977-1981	Beach, cliffs and downland
St. Boniface Down		SZ570782	90	1922	Coastal downland
Littleton & Luccombe Downs		SZ563784	37	1966	Coastal downland
Knowles Farm & St. Catherine's Point		SZ495755	69	1967	Foreshore, cliff and farmland
St. Catherine's Hill		SZ494772	10	1967	Coastal hill
Mottistone Estate		SZ405837	263	1965-1987	Cliff, coastal farmland, woodland and village
Sudmoor Point		SZ395828	18	1977	Cliff and farmland
Brook Chine		SZ385835	30	1959-1971	Shore and coastal grazing land
Hanover Point & Shippards Chine		SZ378841	11	1961	Cliffs and coast
Compton Farm		SZ376850	97	1957	Coastal down, pasture and farmland
Afton Down		SZ350858	93	1958-1967	Coast and downland
Tennyson Down		SZ330855	64	1927-1986	Cliffland
Headon Warren & West High Down		SZ310851	186	1977-1980	Shore, chalk cliffs, downland , heath and farmland
The Needles Headland		SZ300848	16	1975-1976	Chalk cliffs and downland
Hamstead		SZ410910*	32	1963	Coast
Newtown River		SZ415905	Entire estuary	1965-1991	Estuary, foreshore, saltmarsh and coast land
The Quay Fields		SZ420908	5	1964	Pastureland
Newtown-Old Town Hall		SZ424905	10	1933-1970	Coast
Old Vicarage Copse		SZ428902	3	1967	Copse and nature reserve
Harts Farm		SZ429904	14	1982	Pasture
Walter's Copse		SZ432905	14	1970	Woodland and nature reserve
Town Copse		SZ429907	5	1960	Woodland
Dorset	**22**				
Brownsea Island		SZ020880	202	1962	Beach, heath, woodland and nature reserve
Whitecliff Farm & Ballard Down		SZ030810	90	1976	Undercliff, farmland and downland
Belle Vue Farm		SZ015770	21	1976	Rough cliff grazing
Spyway Farm		SZ000770	47	1994	Cliffs and coastland
Corfe Castle Estate		SY959824	2,954	1982	Beach, cliffs, bays, woodland, farmland and nature reserves
Ringstead Bay		SY770810	111	1949	Coastal farmland
Burning Cliff & Whitenothe Cliff		SY765815	43	1968	Cliffs, undercliffs
Labour-in-Vain Farm		SY545865	91	1979	Chesil Bank, farmland, and freshwater marsh
Cogden Beach		SY503880	15	1994	Beach and coastland
Burton Bradstock: Bindbarrow		SY493898	7	1990	Coastal grassland
Burton Bradstock: Burton Cliff		SY483893	34	1967-1973	Cliff and coastal land
Downhouse Farm		SY440915	71	1966	Undercliff and farmland
Eype		SY436918	7	1994	Coastal pasture
Chideock		SY434919	31	1994	Coastland
Doghouse Hill		SY432914	29	1967-1990	Cliffs and hills
Ridge Cliff & West Cliff		SY422920	79	1966-1989	Cliff, undercliff and farmland
Golden Cap		SY407923	11	1978	Cliffs
St. Gabriel's		SY401924	78	1967	Undercliff and cliff top
Cain's Folly		SY375928	13	1976	Undercliff and rough pasture
Black Ven		SY356933	20	1966-1987	Cliff and undercliff
The Spittles		SY350930	51	1974	Cliff and nature reserve
Ware Cliffs		SY333917	12	1987	Cliffs and grassland
Region 9	***50***		***>5,294***		
North Sea coast*	190		>17,457		
GB coast*	444		>62,648		

Source: National Trust. Key: *includes National Trust for Scotland. 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 7.5.2 Royal Society for the Protection of Birds reserves

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date acquired*	*Interest*
Hampshire	**1**				
Langstone Harbour		SU718029	554	1980	Mudflats and creeks, saltmarsh and shingle islands; little tern colony, breeding waders, wintering wildfowl
Dorset	**3**				
Arne & Stodborough Heath		SY973882	651	1979	Heathland, valley bogs, woodland, reedbeds and saltmarsh; reptiles, breeding passerines and raptors, migrating waders, wintering waterfowl
Lodmoor		SY686807	61	1982	Grazing marsh, reedbeds, pools and scrub; passerines (summer and migrating), waders and waterfowl (summer and wintering)
Radipole Lake		SY675799	89	1975	Reedbeds, shallow pools, rough pasture and scrub; breeding reedbirds and waterfowl, overwintering waterfowl
Region 9	***4***		***1,355***		
North Sea coast	53		24,555		
GB coast	81		38,680		

Sources: RSPB (1994; *in litt*.). 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 7.5.3 Wildlife Trusts sites

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*	*Date acquired*
Hampshire	**8**			
Hayling Island		SZ692997	1	1962
Farlington Marshes		SU679045	117	1972
Pewit Island		SU609039	1	1974
Upper Titchfield Haven		SU542039	17	1967
Curbridge		SU528118	10	1968
Lower Test		SU365150	110	1978
Hythe Saltmarsh		SU433074	9	1964
Keyhaven Marshes		SZ310910	243	1965
Isle of Wight	**2**			
Niton Undercliff		SZ529765	3	1984
St. Lawrence Bank		SZ536768	1	1979
Dorset	**7**			
Brownsea Island		SZ025882	101	1962
Ridge		SY943865	2	1961
Purbeck Marine Reserve		SY920778	<1	1978
Whitenothe		SY765812	47	1969
West Bexington		SY527866	13	1964
St. Gabriel's Bank		SY402925	<1	1970
Spittles & Black Ven		SY350930	65	1969
Region 9	***17***		***739***	
England	140		8,406	
North Sea coast	123		10,413	
GB coast	216		23,397	

Sources: Wildlife Trusts (1990 data), 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.

7.5.5 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 two Woodland Trust sites (10 ha) in Region 9 (Table 7.5.5 and Map 7.5.2), both in Dorset.

7.5.6 Acknowledgements

The author wishes to thank Andrea Firth (MoD), Jo Burgon and Richard Offen (The National Trust), Bob Scott (RSPB), Sarah Hawkswell (the Wildlife Trusts), Siân Pullen (WWF-UK), Sarah Welton (Marine Conservation Society) and The Woodland Trust for help in compiling this section.

Table 7.5.4 MoD sites

Site name	*No. of sites*	*Area (ha)**	*Habitats*	*Protected status*
Hampshire	**21**			
Tipner		16	Shoreline, mudflats	Abutting SSSI & Ramsar site
HMS Nelson (Gunwharf)		12	Built up, quay	
HM Naval Base		123	Built up, quay	
Whale Island		32	Shoreline, mudflats	Abutting SSSI & Ramsar site
Horsea Island		36	Mudflats	Part SSSI & Ramsar site
RNAY Fleetlands		70	Mudflats	Part SSSI, Ramsar site
Pewit Island		8	Mudflats	Within SSSI & Ramsar site
RNAD Gosport		254	Mudflats	Abutting SSSI & Ramsar site
Royal Clarence Yard		15	Quays	Abutting SSSI & Ramsar site
Oil Fuel Depot		11	Mudflats	Abutting SSSI & Ramsar site
Burrow Island		0.4	Mudflats	
HMS Dolphin		19	Quays, sea wall	Abutting SSSI & Ramsar site
DRA Fraser Eastney		6	Shingle shoreline	
Eastney Pennisula		1	Shingle	
Haslar Hospital		22	Sea wall	
Fort Monckton		16	Foreshore sand & shingle beach	
Haslar Cemetery		6	Mudflats	Abutting SSSI & Ramsar site
DRA Haslar		14	Part built up, part mudflats	Abutting SSSI & Ramsar site
Browndown		110	Sand & shingle beach	SSSI
Marchwood Barracks		116	Part built up, part mudflats	
RAF Hythe		10	Mudflats	
Dorset	**7**			
Christchurch		14	Mudflats adjoining R. Stour	
Poole RM		60	Heathland, foreshore	Part SSSI
Hamworthy		2	Foreshore, mudflats	
Lulworth		2,552	Cliff (limestone, chalk, clay), beach	SSSI, Heritage Coast, VMNR
Portland		287	Limestone boulders, clay	SSSI
Weymouth (Chickerell)		109	Tidal lagoon, shingle beach	SSSI, Ramsar site, Heritage Coast
Weymouth (Wyke Regis)		49	Tidal lagoon, shingle beach	SSSI, Ramsar site, Heritage Coast
Region 9	***28***	***3,970***		
North Sea coast	65	34,449		
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; VMNR = Voluntary Marine Nature Reserve. 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 7.5.5 The Woodland Trust sites

Site name	*No. of sites*	*Grid ref.*	*Area (ha)*
Dorset	**2**		
Chickerell Downs		SY648798	5
Slopes Farm		SY337926	5
Region 9	***2***		***10***
North Sea coast	35		1,095
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.

7.5.7 Further sources of information

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
National Trust sites	*Coast and Countryside Adviser, The National Trust, Cirencester, tel: 01285 651818
National Trust sites, Hampshire and Isle of Wight	*Regional Land Agent, The National Trust Southern Office, Dorking, tel: 01372 453401
National Trust sites, Dorset	*Regional Land Agent, The National Trust Wessex Office, Warminster, tel: 01985 847777
RSPB reserves, Hampshire and Isle of Wight	*Regional Officer, RSPB South-east Regional Office, Shoreham-by-Sea, tel: 01273 463642
RSPB reserves, Dorset	*Regional Officer, RSPB South-west Regional Office, Exeter, tel: 01392 432691
Hampshire & Isle of Wight Wildlife Trust reserves	*Conservation Officer, Hampshire & Isle of Wight Wildlife Trust, Eastleigh, tel: 01703 613636
Dorset Wildlife Trust reserves	*Conservation Officer, Dorset Wildlife Trust, Dorchester, tel: 01305 264620
The Woodland Trust properties	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.

The New Forest is not, as might be thought, a continuous expanse of trees. Instead it contains a mixture of habitats, including fragments of lowland heath. Here at Fawley, where the New Forest stretches to the southern shore of Southampton Water, the forest edge is occupied by the largest oil refinery in Europe, covering over 500 hectares of Beaulieu Heath. Photo: Peter Wakely, English Nature.

Chapter 8 Land use, infrastructure and coastal defence

M.J. Dunbar, S.J. Everett, S.L. Fowler, J.A. Norton, 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, shipping lanes, pipelines, cables and power generation; and coastal defence, including sea defence and coast protection.

The Solent is one of the busiest waterways in the UK, and the adjacent English Channel one of the busiest shipping channels in the world. This region is the premier area in the UK for leisure boating, and boating facilities have had a significant impact on the coastline, most notably at the numerous marina developments and on the whole of the river Hamble (see also section 9.7). The coastlines of Hampshire and north Wight are dominated by the Solent and the harbours and river estuaries around Portsmouth and Southampton, which serve the leisure boating industry, commercial shipping and HM forces based at Gosport and Portsmouth (see also Chapter 9). There are major industries situated along the western shore of Southampton Water. These areas, with the Dorset coast from Christchurch to Poole and Weymouth, are the principal urbanised stretches of coast in the region. The majority of the very long Dorset coastline is, however, undeveloped land on top of extensive cliffs. Populations of coastal towns throughout the region increase significantly during holiday periods. Parts of the coast are also managed for nature conservation and informal recreation, especially in the New Forest. The National Trust is an important landowner on the south, south-west and north-west coasts of the Isle of Wight and in Dorset. The Ministry of Defence owns or leases considerable portions of the Dorset coast.

Lyme Regis, like many of the coastal towns in the region, experiences a major influx of tourists in the summer, attracted to its picturesque waterfront and medieval sea wall, the Cobb. As elsewhere in the region, infrastructure to cater for the needs of these visitors, such as accommodation, roads, car parks, camp sites and so on, are heavily used and have to be located with sensitivity. In 1995, after this photo was taken, a large sewage outfall was constructed at the further end of the car park, also serving as a form of coast protection. Photo: Nick Davidson, JNCC.

8.2 Land use

S.L. Fowler & M.J. Dunbar

8.2.1 Introduction

Agriculture is the dominant (rural) land use in the region, outside the developed areas. Overall, the region is fairly representative of the south coast, rural land use being a mixture of arable and grazing intermediate between conditions in the important live-stock rearing areas of the west coast and those on the arable east coast of Britain.

Extensive areas of coastal semi-natural habitat are managed by grazing. This is probably the oldest form of saltmarsh management. There are approximately 44,000 ha of saltmarsh in Great Britain, about 31,600 ha of which are grazed, with major concentrations in south-east and north-west England. Approximately 21% of the total area of saltmarsh in this region is grazed, representing less than 1.5% of the total British area of grazed saltmarsh (Burd 1989) (see also section 3.6.3). Figures for stocking densities vary in the UK. However, 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.

The dunes of England have probably been affected by agriculture for most of their existence (Radley 1994). However, during a recent survey of dune vegetation in England, grazing by domestic stock was recorded at only 34 out of 121 dune sites (Radley 1994). None of the dune sites in the region is grazed, probably at least partly because they are heavily used for recreation.

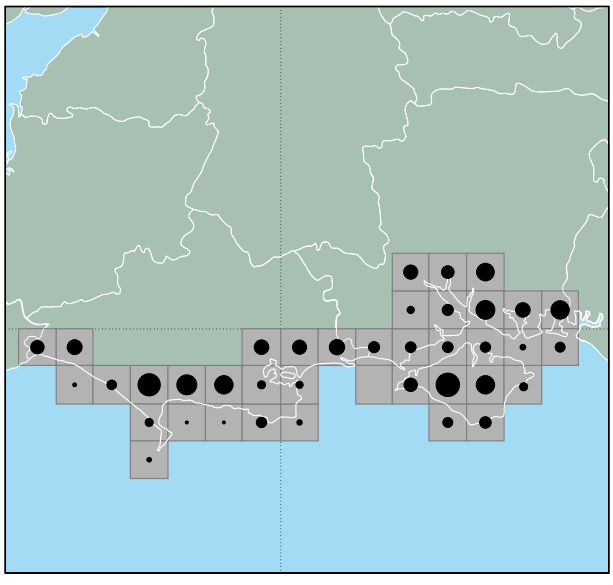
Parts of the Solent shore, notably the Beaulieu river, areas of North Wight, and Poole Harbour, Dorset, have the main coastal woodland areas in the region; further inland, but still within the coastal 10 km squares that define the region, the New Forest is one of the most important, and largest, stetches of ancient semi-natural woodland still remaining in the UK. The region's coastal woodlands are notable in south-east England for the significant extent of estuarine edge woodland, grading to saltmarsh, that they represent.

8.2.2 Locations and land uses

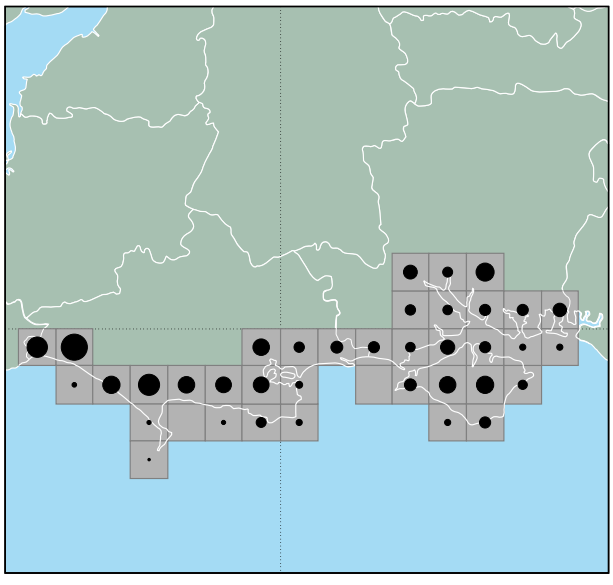
Maps 8.2.1 and 8.2.2 show the distribution in the region of, respectively, tilled land and heavily managed mown/grazed turf. The size of the circles in relation to the squares is proportional to the amount of that land cover type in the 10 km square.

Most of the productive land in Hampshire and the Isle of Wight is situated away from the shore. The north of Hayling Island is largely agricultural land or used for horse grazing, and the eastern shore of Southampton Water between Hill Head and Hook is mainly arable farmland. The western Solent, between Calshot and Lymington, is mostly undeveloped land used for arable farming or grazing. The Dorset coastline is regionally important for agricultural production, with large areas of cliff-top grassland and arable land on more level areas. Much of the coastal land on the southern Isle of Wight consists of arable land, though some cliffs are topped by semi-natural coastal grasslands.

There are only small coastal woodlands in Hampshire, at the Victoria Country Park (Netley), Fawley, and between Calshot, Beaulieu and Lymington. Large areas of the original coastal woodlands of eastern Hampshire were used as a source of ship-building timber between the 15th and 19th century. The Beaulieu area has an unusual quantity of coastal woodland cover, owing to long-established land ownership patterns and the area's traditional importance as a managed source of ship-building timbers. The extensive ancient semi-natural woodlands of the New Forest mainly



Map 8.2.1 Tilled land. Note: area of circle indicates the area of this land cover type in the 10 km square. Sources: Countryside Survey (1990); ITE Monks Wood.



Map 8.2.2 Mown/grazed turf. Note: area of circle indicates the area of this land cover type in the 10 km square. Sources: Countryside Survey (1990); ITE Monks Wood.

Table 8.2.1 Coastal woodlands >15 ha in Region 9

*Site no.**	*Location*	*Grid ref.*	*Details*
	Hampshire		
1	Netley	SU4607	15 ha broad-leaved (Country Park)
2	Netley	SU4409	20 ha broad-leaved
3	Fawley	SU4405	60 ha broad-leaved
4	Calshot	SU4700	100 ha broad-leaved
5	Beaulieu River	SZ4199	400 ha mixed and broad-leaved on both banks
6	Solent, Beaulieu to Lymington	SZ3896	50 ha mixed in numerous small stands
	Isle of Wight		
7	Norris Castle	SZ5196	15 ha broad-leaved
8	Osborne Bay	SZ5295	200 ha broad-leaved and mixed stands
9	Wootton Mill Pond	SZ5490	Broad-leaved (area unknown)
10	Niton	SZ5276	20 ha broad-leaved
11	Tennyson Down	SZ3385	30 ha broad-leaved/calcareous scrub
12	Bouldnor Cliff	SZ3890	150 ha mixed
13	Newtown Harbour	SZ4390	Broad-leaved (area unknown)
14	Burnt Wood	SZ4492	50 ha mixed
	Dorset		
15	Highcliffe Castle	SZ2092	15 ha mixed
16	Brownsea Island	SZ0288	150 ha broad-leaved and mixed
17	Holton Heath	SY9591	200 ha coniferous and mixed
18	Arne	SY9687	250 ha coniferous and mixed
19	Newton Heath, south of Poole Harbour	SY9984	500 ha conifer plantation

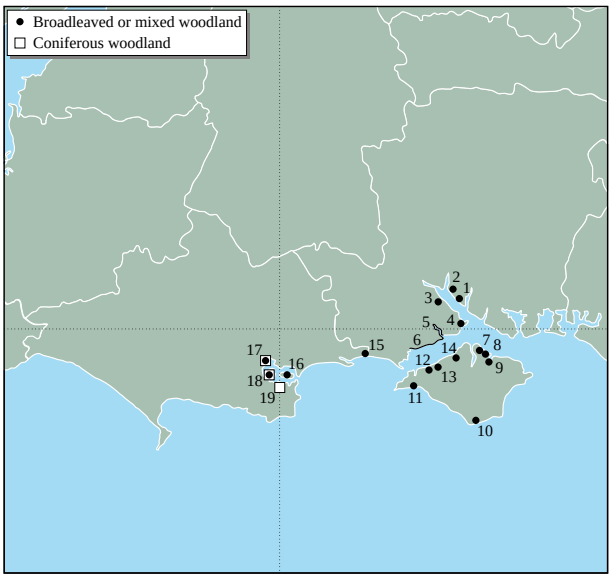
Source: Ordnance Survey 1:25,000 maps. Key: *site numbers are those on Map 8.2.3.

lie a few kilometres to the north of the western Solent, although some extend to the sea. On the Isle of Wight there are woodlands along Osborne Bay, east of Cowes and between Yarmouth and Newtown. The extensive, mainly coniferous, plantations on the heaths around Poole Harbour, between Poole and Wareham, on the Arne peninsula, and on Purbeck between Arne and Studland, are mainly planted on former heathland and are nationally significant in terms of their extent. At a number of locations woodland grades into saltmarsh, a transition uncommon elsewhere in England. Table 8.2.1 lists coastal woodlands in the region (Map 8.2.3).

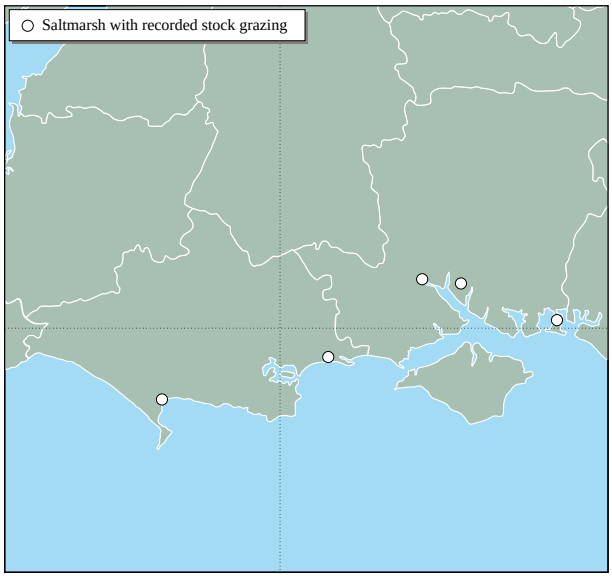
Saltmarshes are grazed mostly in Chichester Harbour and to a lesser extent at Southampton Water and on the north Solent (Map 8.2.4).

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. Land cover is classified into seventeen key types (including tilled land and managed



Map 8.2.3 Areas of coastal woodland >15 ha. Numbers refer to Table 8.2.1. Source: Ordnance Survey Landranger maps. © Crown copyright.



Map 8.2.4 Saltmarshes with recorded grazing. No sand dune sites in the region are recorded as being grazed by stock. See Maps 3.6.1 and 3.2.1 for distribution of saltmarsh and sand dune sites. Source: JNCC Coastal Database.

grassland) and field surveys of randomly selected areas were used to check the results. Maps 8.2.1 and 8.2.2 are derived from printouts of these data from the DoE Countryside Information System. The main limitations of the data derive 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 considered appropriate here. More detailed information on agricultural land use should be available from ADAS (for example, information on set-aside targets), Heritage Coast plans and local plans. Woodland information (Map 8.2.3) was obtained from the 1:50,000 scale Ordnance Survey Landranger maps. The former Nature Conservancy Council's inventory of ancient woodlands (Spencer & Kirby 1992) is a further source of comparative data for the region, and the Forestry Commission has afforestation maps that cover the region. Sand dune and saltmarsh grazing information for Map 8.2.4 comes from the JNCC's Integrated Coastal Database, and from cited references.

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Shell/Southampton University. 1987. *The Solent estuary - environmental background*. Southampton, Shell/Southampton University.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Land use, agricultural land grades, set-aside (MAFF /ADAS Land Service), saltmarsh grazing (general information)	MAFF, Whitehall Place, London SW1A 2HH, tel: 0171 270 3000
Land use, agricultural land grades, set-aside (MAFF /ADAS Land Service)	ADAS, Oxford Spire Business Park, The Boulevard, Kidlington, Oxford OX5 1NZ, tel: 01865 842742
ITE Countryside Survey 1990	*Department of Rural Affairs, DoE, Bristol, tel: 0117 9218811
ITE Countryside Survey 1990	*Land Use Group, ITE Merlewood, tel: 01539 532264
ITE Countryside Survey 1990	*Environmental Information Centre, ITE Monks Wood, tel: 01487 773381
Soil surveys	John Hazelden, Soil Survey and Land Research Centre, Cranfield University, Silsoe, Bedford MK45 4DT, tel: 01525 863000
Inventory of ancient semi-natural woodland in Hampshire & Isle of Wight	*EN Hants. & IoW Local Team, Lyndhurst, tel: 01703 283944
Inventory of ancient semi-natural woodland in Dorset	*EN Dorset Local Team, Arne, tel: 556688
Distribution, ownership and management of woodlands - Hampshire & Isle of Wight	Forestry Authority, Conservator, Hampshire and West Downs Conservancy, Alice Holt, Wrecclesham, Farnham, Surrey GU10 4LF, tel: 01420 23337
Distribution, ownership and management of woodlands - Dorset	Forestry Authority, West Country Conservancy, The Castle, Mamhead, Exeter, Devon EX6 8HD, tel: 01626 890666

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

8.3 Infrastructure

S.L. Fowler, J.A. Norton, M.J. Dunbar, C.A. Crumpton & M.J. Goodwin

8.3.1 Introduction

The region has some of the most as well as some of the least developed stretches of coast in the UK. The most intensively developed stretches of coast include areas that are very vulnerable to coastal erosion. The coast of eastern Hampshire between Southampton and Portsmouth is one of the most heavily developed sections of the UK coastline; extensive areas are urbanised and 1.1 million people live within 15 km of the Solent shore (Tubbs 1990). The only comparable areas of coastal development in Britain are the major industrial conurbations of the north-east (Region 5), the Thames estuary (which is much more heavily urbanised) (Region 7) and the Wirral to Blackpool coast, in the north-west (Region 13). The Isle of Wight coastline is still predominantly rural, although the south-east, between Ventnor, Shanklin and Sandown, has considerable development associated with the tourist industry. From Christchurch Bay to Poole, Dorset, virtually the entire coastline is heavily built up, the main coastal population centre being the Christchurch/Bournemouth/Poole conurbation. However, the large majority of Dorset's coastline is rural and undeveloped.

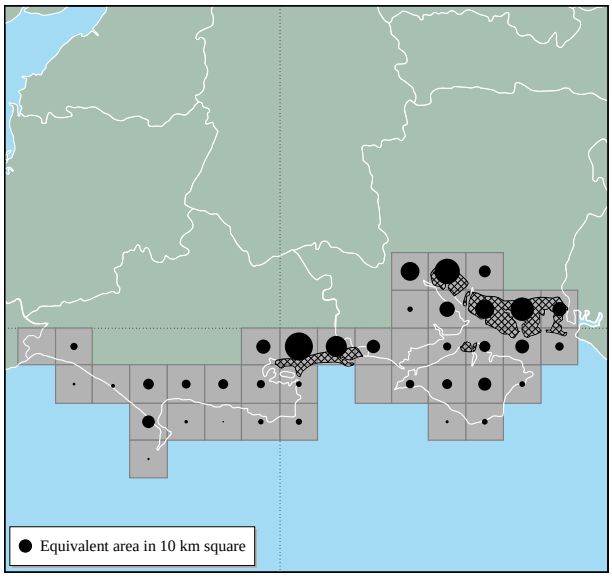
The Solent is one of the busiest waterways in the UK, and the adjacent English Channel one of the busiest in the world. There are traffic separation schemes in the English Channel, and a voluntary tanker exclusion zone in the Needles Channel (International Maritime Organisation). There are many regular national and international ferry services running from the region's ports. The very large number of ferries across the Solent, including hydrofoil and hovercraft services, is unparalleled in the UK. Isle of Wight and cross-channel ferries account for 75% of all commercial shipping movements in the Solent. The region's international ferry facilities are of national importance, and several industrial activities occurring in the region are important on a regional and national scale. These include the shipyards of Southampton Water, the numerous boatyards, and the chemical and petrochemical complexes on Southampton Water. Southampton has been one of Britain's major ports for 150 years or more. It is the leading deep-sea cargo port on the English Channel and one of the largest international ports in Britain (currently ranking fourth in terms of the tonnage handled). Several other ports are important for their commercial and ferry services. With the increase in size and draft of modern vessels, there has been a tendency for new docks and jetties to be built where deeper water is available close to shore; however the naturally sheltered deep water and the double tide in the Solent and Southampton Water have enabled ports there to be maintained with less large-scale capital and maintenance dredging than has been required in other locations.

There is a continuing high demand for land for urban and industrial uses in the east of this region, which may affect the coast in the future. Land claim has taken place in Poole Harbour and on the shores of Portland Harbour, near the entrance to the Fleet. New industrial developments on the coast are still occasionally associated with land claim for the construction of factories and transport facilities and the disposal of wastes and effluent. However, in many coastal industrial areas the initial period of growth in the previous two centuries or so has been followed by dereliction, as heavy industries (such as steel and ship building) declined. Several traditional ports in the region have declined or fallen into disuse, due to failing industries, the contraction of the armed forces and the diversion of passenger traffic to air transport and of freight to road or rail routes. However, industry in this region has not suffered as much as in the north-east or north-west of England (Regions 5 and 13), for example. Some disused docks and associated warehousing in the region are the focus of ambitious redevelopment schemes incorporating office use, some light industry, housing and recreation, generally including marinas and marina villages.

8.3.2 Important locations

Residential development

Map 8.3.1 shows the distribution of areas of urban and suburban development in the region. Centres of population are listed in Table 8.3.1. The main centres of population in Hampshire are Portsmouth and Southsea (virtually the whole of Portsea Island is built-up), Gosport, Southampton and Lymington. South Hayling, Southsea, Lee-on-Solent and Milford-on-Sea are the main seaside tourist resorts in the county. North of Portsmouth/Hayling lie the conurbations of Cosham and Havant, linked, on the north side of Portsmouth Harbour, to Paulsgrove and Portchester, and including a large marina complex and commercial development. Fareham occupies the lower eastern shore of



Map 8.3.1 Distribution of areas of industrial and residential development. Note: area of circle indicates the area of this land cover type in the 10 km square. Major built-up areas are cross hatched. Sources: ITE (1993); ITE Monks Wood pers. comm.

Southampton Water between Hill Head and Warsash and abuts the top end of Portsmouth Harbour. Beyond here are the built up areas of Hamble, Netley and Woolston, suburbs of Southampton. The town of Hythe and an associated marina development are situated on the western shore of Southampton Water, north of Fawley power station.

On the Isle of Wight, Newport on the River Medina is the commercial centre, south of Cowes. The main coastal resorts are at Ryde, Sandown, Shanklin, Ventnor, Freshwater, Totland and Yarmouth. The populations of these towns rise markedly in the summer months.

Dorset's main coastal population centres are Bournemouth, Christchurch, Poole, Weymouth and the Isle of Portland. The smaller resort town of Swanage is situated on the Isle of Purbeck. To the west of Portland the coastline is largely undeveloped, with some smaller towns, including Bridport and Lyme Regis, although this area does have a locally significant tourist population in the summer months.

There is considerable pressure for new residential development along the coast, owing in part to the substantial inflow of retired people to the region and also the continued demand for waterfront properties, particularly where associated with offices and leisure facilities. New applications for holiday developments (hotels and holiday chalets) continue to be submitted. There is some conflict between residential development of coastal areas and other activities, such as boatyards, which have no alternative venues but do not have the same high economic value. Recent urban developments in the region have included quite large numbers of substantial marinas with associated housing (see Section 9.7), and applications are extant for housing on former boatyards and MOD properties.

Industrial development, ports and harbours

Map 8.3.2 shows the main locations of coastal industrial infrastructure in the region, including the power station; Map 8.3.3 shows the locations of ports and harbours; Table 8.3.2 lists all these locations. As industry in the region is so closely allied to its port and harbour activities, the two are discussed together. Main fishing ports in the region are

Table 8.3.1 Major population centres

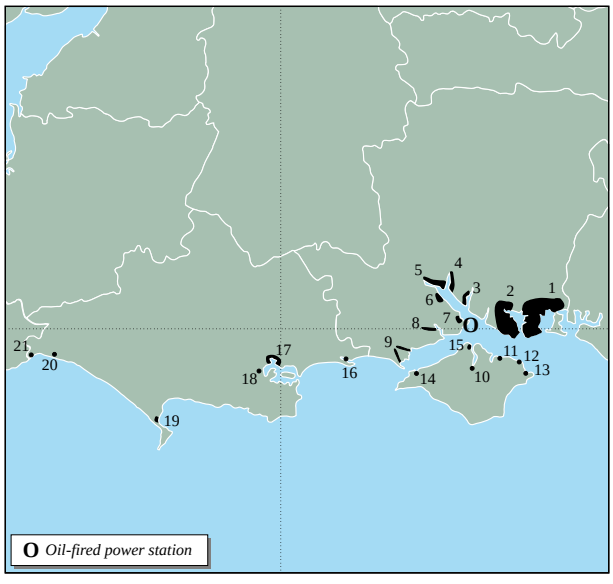
	Population
Hampshire	
Cosham/Havant	120,500
Portsmouth/Southsea	185,200
Fareham (borough)	100,500
Gosport	77,300
Southampton	204,500
Lymington	38,700
Isle of Wight	
Newport	23,600
Cowes	20,000
Ryde	24,300
Dorset	
Christchurch	41,300
Bournemouth	159,000
Poole	135,400
Swanage	8,600
Weymouth/Isle of Portland	62,800
Bridport	6,900
Lyme Regis	3,500

Sources: Borough figures (mid-1993 population estimates based on 1991 census): Office of Population Censuses and Surveys (1994); town/city figures (1981 data): Cook (1993). Locations are shown on Map 1.2.1.

Langstone and Chichester Harbours, Portsmouth, River Hamble, Southampton Water, Bembridge, Yarmouth, Christchurch Harbour, Poole Harbour, Weymouth and Portland, with several other small fishing centres along the open coast. There are small harbour facilities at Lymington, Keyhaven and Lyme Regis.

The ten harbours in Chichester Harbour, most of which lies in adjacent Region 8, are largely used for recreation and fishing craft, and there are around 250 slipways and jetties, some of which are pontoon structures. The two landing quays in Langstone Harbour are managed by Langstone Harbour Board. 80 ha (4-6%) of Langstone Harbour has been land-claimed, mostly for refuse tipping (Tubbs 1990).

Portsmouth and Gosport are the main bases for the Royal Navy in the UK; the bases, naval docks and related



Map 8.3.2 Industrial infrastructure and coastal power stations. Numbers refer to Table 8.3.2.

Map 8.3.3 Ports and harbours

Table 8.3.2 Industrial, port and harbour developments

Site no.	*Site name*	*Grid ref.*	*Details*
	Hampshire		
1	Chichester Harbour	SZ7405	Fishing fleet; marina
1	Langstone Harbour	SU7002	Fishing fleet (Langstone Harbour Fishermen's Association), sand and gravel wharves
1	Portsmouth	SU6402 - SU6300	Port with container, ro-ro, lo-lo, bulk/general cargo; numerous naval bases and dockyards, cross-Channel and Solent ferries, Solent hovercraft service, passenger ferries from Portsea Island to Gosport and Hayling Island
1	Havant	SU7005	20 ha large sewage works
		SU7105	Light industry along north side of Langstone Harbour expanding onto marshland
1	Portsea Island	SU6703	50 ha industrial estate
		SU6602	50 ha works
2	Priddy's Hard, Gosport	SU6100	Disused Royal Ordnance depot now proposed housing development
2	Gosport	SU6100	HMS Dolphin submarine base, Haslar naval hospital; HM detention centre. 20 ha light industry/manufacturing; Browndown army firing ranges.
2	Fareham	SU5805	20 ha works and quay
2	Lee-on-Solent	SU5602	HMS Daedalus naval base and airfield for disposal by MOD
3	River Hamble	SU4807	*c.* 20 ha; twelve boatyards, major leisure boat-building industry
3	Hamble	SU4707	25 ha oil storage terminal; airfield
4, 5	Southampton	SU4012 - SU4310	Major UK port; ferries to Isle of Wight and cross-Channel. Atlantic cruise liners. Hydrofoil to Isle of Wight. 200 ha industry associated with docks, e.g. Redbridge Engineering Works - to be redeveloped. 100 ha shipbuilding and repair yards on river Itchen, e.g. Vosper Thornycroft.
6	Marchwood	SU3911	100 ha disused power station and large area of unused land claim
6	Hythe	SU4208	Small harbour
7	Fawley	SU4504	700 ha oil refinery; Rechem chemical incinerator, International Synthetic Rubber, Monsanto Chemicals Ltd, Union Carbide Ltd
7	Fawley	SU4702	75 ha oil-fired power station (National Power)
7	Fawley	SU4704	Esso Oil terminal
8	Beaulieu	SU4000	Boat building/repair yard
9	Lymington	SZ3395	Port with ro-ro, small fishing fleet, passenger ferries to Yarmouth
		SZ3396	Small boat yards
9	Keyhaven	SZ3191	Small fishing fleet
	Isle of Wight		
10	Newport	SZ5091	Port, general cargo; 5 ha small works
11	Wootton Bridge	SZ5492	Small boat building/repair yard
11	Wootton Creek	SZ5593	Small harbour, ro-ro ferry terminal, Solent ferry
12	Ryde	SZ5993	Small harbour; Solent ferry and hovercraft terminals
13	Bembridge	SZ6489	Boat building/repair yard, harbour, hovercraft builders, lay up berths for commercial vessels, bunkering. Small fishing fleet.
14	Yarmouth	SZ3690	Port, general cargo, small fishing fleet, ro-ro ferries to Lymington
15	Cowes	SZ5096	Port, general cargo & bulk commodities, passenger & vehicle hydrofoil to Southampton; 10 ha boat yards, aerospace yards, chain ferry across Medina River
	Dorset		
16	Christchurch Harbour	SZ1791	Passenger ferry across harbour
17	Poole Quay	SZ0090	20 ha power station; 20 ha light industry associated with docks
17	Poole Harbour	SY9785	Port with ro-ro and general cargoes. Wytch Farm oil field.
17	Poole Harbour	SZ0090	Vehicle ferry from Studland to Sandbanks; passenger ferry from Poole to Brownsea Island and Studland; cross-Channel ferry
18	Wareham Quay	SY9287	Small port facilities
19	Weymouth	SY6879	10 ha light industry near docks
19	Weymouth	SY6779	Port with ro-ro, general cargo; Cherbourg and Channel Islands ferry/catamaran services
19	Portland Harbour	SY6974	Naval docks
20	Bridport	SY4690	Small port
21	Lyme Regis	SY3391	Small harbour (the Cobb)

Note: site numbers refer to Map 8.3.2.

industries, on either side of the harbour mouth, dominate Portsmouth Harbour. Some light industry is situated on the west side of the harbour at Fleetlands, Gosport. Dwindling ship repair and overhaul activity in the dockyard and the release of other MOD land will allow a number of historic naval buildings to be used for other purposes. Although the activities of the naval dockyard have declined markedly in the last 20 years, the number of warships based in Portsmouth may increase. Consequently, all the available quays within the dockyard are likely to continue to be

required for naval use. Portsmouth Harbour has had a long history of piecemeal land claim occurring over several centuries. The single largest land-take, in the 1960s, was of 240 ha of estuarine habitat (25% of the surviving total) claimed for refuse disposal and for construction of the M27 motorway and Port Solent.

The commercial port at Portsmouth is governed by the Portsmouth Commercial Docks Board. It has expanded rapidly in recent years, mainly as a result of the growth of cross-channel ferry traffic, and phase VII of the expansion is currently in progress. The port has container, ro-ro (roll on, roll off), lo-lo (crane load and unload), bulk/general cargo and passenger ferry facilities. Small passenger ferries operate services between Hayling Island and Portsea Island, and Portsea Island and Gosport. A passenger ferry crosses the mouth of the river Hamble. There are restrictions on small craft movements at the entrance to Portsmouth Harbour, and at Calshot, where the Solent and Southampton Water meet.

Southampton Water is one of the most developed estuaries on the south coast of England, with a high proportion of the shore dominated by urban areas, industry and port facilities. Southampton Water and the Solent have lost a substantial area of natural estuarine habitat to industrial development. This includes at least 1,090 ha in the docks area, and 80 ha on the Fawley shore (Doody undated; Tubbs 1990) - more than half of the former intertidal area. The largest industrial users of coastal land in the region are concentrated around Southampton Water, where there is deep water access for large vessels. There are eight major dock complexes within the estuary and three major shipbuilding sites. Southampton is one of the largest international ports in Britain; it handled 31.4 million tonnes, including oil, in 1994 (R. Facey pers. comm.). Other freight handled includes general cargoes and bulk trades, especially wine, grain, submarine cables, vehicles and construction materials. A passenger ferry operates across Southampton Water between Southampton Docks and Hythe, and another to the Isle of Wight. Cross-channel ferry services were resumed in 1991, and the two passenger terminals at Southampton (P&O Cruises and Cunard) still operate liner services to New York.

During the 1960s and 1970s Southampton experienced a period of decline in both passenger and freight traffic, and the great liners, which had been such a feature of the waterfront, all but disappeared. The Dock Labour Scheme, now abolished, may have contributed to this decline (Department of Transport pers. comm.). New methods of freight handling, including the use of containers, were introduced during this period. Situated at the western end of the docks, the container terminal (with two rail-freight terminals), administered and operated by Southampton Container Terminals Ltd., became the main focus of activity. This shift in emphasis, together with the rising demand for waterside leisure development, prompted the use of part of the Eastern Docks for two developments, at Ocean Village and Town Quay; Ocean Dock and Empress Dock remain in commercial use. The operators of the Eastern and Western Docks are confident that the port's trade, which began to recover during the 1980s, will continue to expand in the next decade. It seems unlikely, therefore, that any further docks will be disposed of for other forms of development.

Important industries around Southampton include the oil refinery at Fawley (where there has been a refinery operation of some sort since 1921), associated petrochemical industries, several chemical works and the nearby power station (see below). Fawley handles approximately 17% of UK oil refinery capacity - an annual capability of 15.6 million tonnes (300,000 barrels per day) - making it the largest refinery in the UK. The site itself covers approximately 506 ha. The marine terminal, where some 2,300 ship movements take place annually, consists of five deep sea and four coaster berths. About 5% of Fawley's production is distributed by rail or road, 10% by sea and 85% by pipelines. Pressure on coastal land for further industrial development is continuing, with land at Dibden Bay (between Marchwood and Hythe) being subject to port development proposals.

Boatyards are a familiar sight in the Solent area, servicing the thriving leisure boating industry as well as commercial and military customers. Ship and boat yards are predominant on the Itchen and Hamble rivers; the former has significant commercial/military trade, while the latter is predominantly leisure. The bulk of work at most yards on the Solent is now boat maintenance, repair and winter storage. Although many yards still build boats on a small scale, the majority of new boats are constructed at factories inland. The organisation of the industry has undergone great change: many yards are now within marina complexes and old family firms have been taken over by larger public companies. Some firms have proposed the introduction of other uses into their yards, in the light of the success in urban areas of mixed use developments, such as Ocean Village (Portsmouth) and Port Solent (Southampton).

On the Isle of Wight there are harbour and port facilities and ferry terminals at Yarmouth (general cargo, ferry and recreational facilities), Cowes (general and bulk cargo, passenger and vehicular ferries and recreational facilities), Fishbourne/Wootton Creek (the vehicle ferry terminal west of Ryde), and a hovercraft terminal at Ryde. Passenger and vehicle ferries to the Isle of Wight operate between Portsmouth/Ryde, Southampton/Cowes and Lymington/Yarmouth. There is also a passenger hovercraft service between Portsmouth and Ryde, and a hydrofoil service between Southampton and Cowes. A passenger and vehicle ferry crosses the Medina at Cowes. There is a ship-building yard and numerous boat-building yards on the Medina between Cowes and Newport. Other harbours are at Newport (recreational and general cargo) and Bembridge. At Bembridge, the harbour caters for commercial fishing and sailing boats, and there are three boat-building/repair yards with lay-up berths for commercial vessels and bunkering facilities. There is a small boatyard at Wootton Bridge.

Important ports in Dorset include Poole, Weymouth and Portland. Poole has followed the same development path as towns around Southampton Water, although on a smaller scale, and looks likely to expand in the future. Industries in Poole include an engineering works and a chemical works. The port handles ro-ro and bulk/general cargoes, and has passenger ferry facilities. Quite large quantities of commercial, military and recreational traffic use Poole Harbour and the buoyed shipping channel across Studland Bay. Passenger ferries run in Christchurch and Poole Harbours, including between Poole and Brownsea Island, Sandbanks and Studland. A vehicle ferry links the mouth of Poole Harbour, between Sandbanks and Studland. These locations are also visited by passenger ferries from

Bournemouth, the Isle of Wight and Swanage. Vehicle ferries run from Poole to the Channel Islands and Cherbourg. There is a large oilfield at Wytch Farm on the south side of Poole Harbour (see section 9.5).

There are small boat trips along the Purbeck coast from Swanage and Lulworth. Weymouth Harbour has ro-ro and general cargo handling facilities and is used by recreational craft. From Weymouth there is a vehicle ferry to Cherbourg and a passenger hydrofoil service to the Channel Islands. The large naval base at nearby Portland Harbour is being vacated by the Royal Navy, leaving substantial opportunities for new port-related developments at one of the south coast's largest and most strategically-placed harbours. The formerly important medieval harbours of Wareham, Bridport and Lyme Regis are now used mainly by recreational and inshore fishing traffic.

Power generation

The only commercial power station in this region, at Fawley, on the south side of Southampton Water, is oil-fired. It is ideally located to take advantage of the concentration of oil refining activity around Southampton Water (see also section 9.5) (although permission for a second power station at Fawley was recently refused). Its capacity - 483 MW (National Power pers. comm. 1994) - represents approximately 1.2% of the total UK conventional power production (36,500 MW). There are no commercial renewable energy producing operations in this region (DTI 1994), although the scope for wind farming on some parts of the coast is considerable (but less than on the west coast), owing to the south-westerly direction of the prevailing winds. There are no nuclear power stations in this region.

8.3.3 Information sources used

Sources of information for this section included Cook (1993), Buck (in prep.), Hampshire County Council (1987, 1991) and Ordnance Survey Landranger 1:50,000 maps. Some of the information on industrial activity and infrastructure may be out of date, as a result of recent local and national declines in industrial activity. The Office of Population Censuses and Surveys has published 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. Much of the information on ports and harbours was derived from the two national handbooks for the British Ports Federation (BPF) (undated) and Sutton (1989), which may be out of date. In 1991 the BPF was replaced by the British Ports Association and the UK Major Ports Group. Associated British Ports (1994-1995) provides detailed information on Southampton. Most information on ferries was derived from 1:50,000 Land Ranger Ordnance Survey maps and Admiralty Charts. The British Marine Industries Federation, which is the representative body for all types of company involved in the small vessel sector of the marine industry, is an important source of information on local marine industries and activities in the region.

Map 8.3.1 is from the ITE (1993) Countryside Survey 1990 database and combines suburban/rural developments (comprised of mixtures of buildings with vegetation cover) and continuous urban development. The Countryside Survey 1990 data is based primarily on high resolution satellite images, which show the dominant land cover for each 25 m x 25 m area (pixel) of Great Britain. Map 8.3.2 includes areas of city development as well as traditional industries. It does not show modern industries where infrastructure is associated with extensive areas of managed grassland and trees.

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 port facilities as "inadequate". The UK government has commissioned a survey of all UK port reception facilities for the disposal of ship's wastes. The results, which should look at what facilities are available and their quality, were due in September 1994.

8.3.4 Acknowledgements

Thanks to go R. Facey, Associated British Ports, for information on Southampton port activity.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Planning developments	Local authorities: see Appendix A.2
Trading statistics for member ports	British Ports Association, Africa House, 64-78 Kingsway, London WC2B 6AH, tel: 0171 242 1200
Trading statistics for member ports	The UK Major Ports Group Ltd, 150 Holborn, London EC1N 2LR, tel: 0171 404 2008
Marine small craft industry	British Marine Industries Federation, Meadlake Place, Thorpe Lea Road, Egham, Surrey TW20 8HE, tel: 01784 473377
Marine small craft industry	Poole Project Officer, Cobbs Quay Marina, Hamworthy, Poole BH15 4EL, tel: 01202 679678
Control of certain maritime activities	International Maritime Organisation, 4 Albert Embankment, London SE1 7SR, tel: 0171 735 7611
Ports	See Appendix A.2
Cowes (Trust port)	*Cowes Harbour Commissioners, tel: 01983 293952
Bembridge (company port)	*Bembridge Harbour Improvements Co. Ltd., tel: 01983 872828
Hamble (municipal port)	*River Hamble Management Committee, Warsash, tel: 014895 6387
Langstone (trust port)	*Langstone Harbour Board, Hayling Island, tel: 01705 463419
Newport (municipal port)	*Isle of Wight County Council, Newport, tel: 01983 521817
Poole (trust port)	*Poole Harbour Commissioners, tel: 01202 685261
Portland port	*Portland Port Ltd., tel: 01305 824044
Portsmouth (municipal port)	*Port Manager's Department, Portsmouth City Council, tel: 01705 822251
Solent Harbour	*Solent Harbour Masters Association, Southampton, tel: 01703 330022
Southampton port	*Associated British Ports, tel: 01703 330022
Weymouth (municipal port)	*Weymouth and Portland Borough Council, Weymouth, tel: 01305 760620
Yarmouth (trust port)	*Yarmouth (Isle of Wight) Harbour Commissioners, tel: 01983 760321
MOD sites in the region	Public Relations, MOD, Gosport, Hampshire, tel: 01705 722351
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	Public Information Officer, National Power plc, Senator House, 85 Queen Victoria Street, London EC4V 4DP, ` tel: 0171 454 9494
Renewable energy	Renewable Energy Enquiries Bureau, Energy Technology Support Unit (ETSU), Harwell, Oxfordshire OX11 0RA, tel: 01235 432450
Wind energy	The Administrator, British Wind Energy Association, 42 Kingsway, London WC2B 6EX, tel: 0171 404 3433
Nuclear electricity production in general	Public Information Officer, Nuclear Electric plc, Barnett Way, Barnwood, Gloucester GL4 7RS, tel: 01452 652776
UK electricity production general information (UK Electricity Annual)	Information Officer, Electricity Association plc, 30 Millbank, London SW1P 4RD, tel: 0171 344 5700
Energy production (general)	Department of Energy, 1 Palace Street, London SW1E 5HE, tel: 0171 238 3000

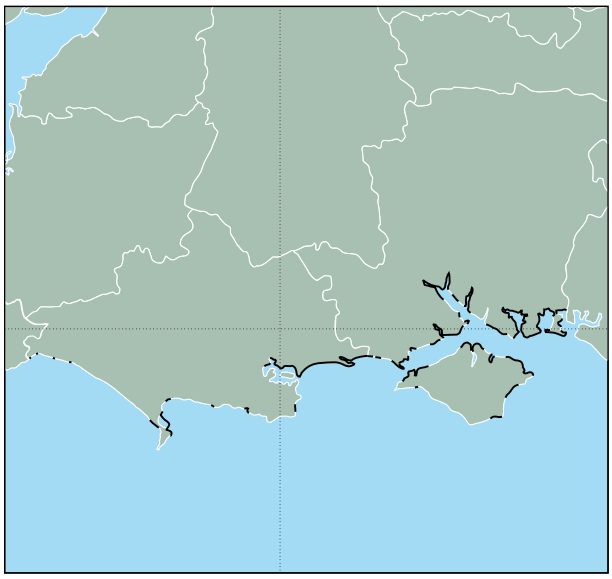
* Starred contact addresses are given in full in the Appendix.

8.4 Coastal defence

M.J. Dunbar, S.J. Everett, S.L. Fowler & J.A. Norton

8.4.1 Introduction

Coastal defence covers two types of works: coast protection and sea (or flood) defence. Coast protection works prevent or slow the erosion of land and encroachment by the sea. Sea defences protect low-lying land from flooding by the sea or rivers, especially to preserve human life and property in coastal settlements and industrial areas; many lengths were built in the past to protect low-lying agricultural land from flooding by the sea and to allow agricultural improvement and drainage. It is sometimes difficult to differentiate between the two different categories of coastal works, particularly where they protect against both erosion and flooding, or are owned and maintained privately or by bodies that are not usually responsible for coastal defences, for example the Ministry of Defence (MoD). Because of the complexity of distinguishing between coast protection and sea defence works in Region 9, this section describes coastal defence works in general around the coast, irrespective of the purpose for which they were constructed. The works range from simple wooden groynes installed on beaches to control coastal sediment movement, to major concrete engineering works (berms and seawalls). Some of these forms of coastal defence can provide vital 'toe' support to the base of coastal cliffs.



Map 8.4.1 Locations of the majority of coastal defence works. Sources: MAFF (1994), NRA (1992) and Ordnance Survey maps. © Crown copyright.

Table 8.4.1 Coast protection in Region 9 and in England

Coastline	*Total length (km)*	*Undeveloped length (km)*	*Coast protection length (km)*	*% protected*
Region 9	625.4	363.3	262.1	42
England	***2,924.8***	***2,065.1***	***860.0***	***29.4***

Source: MAFF 1994 database

Coastal defence works in Britain are most widely distributed along urban and industrial coastlines, especially the heavily developed coasts of south-east England (Regions 6 to 9) and north-west England (Region 13), and along subsiding or eroding coasts. Tubbs (1995) reports that the most rapid relative sea-level rise in Britain (currently about 5-8 mm/yr) is taking place on the English Channel coast from the Solent eastwards (see also section 2.5). These factors make coastal defence an important activity in this region.

There are two major sources of current information about coastal defence in England: the Coast Protection Survey of England (MAFF 1994) and the Sea Defence Survey of 1991 (NRA 1992). In this region the two surveys have been partially brought together but the process is still incomplete. Map 8.4.1, showing coast protection and sea defence around the region's coast, is a partial amalgamation of data from the two surveys: for detailed information about individual areas MAFF or the relevant NRA Regional Office should be consulted (see section 8.4.6 C). Tables 8.4.1 and 8.4.2 show summary results from the Coast Protection Survey. Region 9 has some of the most heavily protected coastline in England (after Regions 7 (Lowestoft to Dungeness) and 8 (Rye Bay to Chichester Harbour)): 42% of the coast is protected against erosion. Table 8.4.2 indicates

Table 8.4.2 Condition of coast protection works and state of coastal erosion on the English coast

Survey area	*Total length of coast*** (km)	*Length of coast defended* (km)	*Length of coast suffering significant erosion* (km)	*Proportion of coast defended* (%)	*Proportion of defences requiring work*		*Proportion of coast suffering significant erosion* (%)
					Significant work (%)	*Moderate work (%)*	
Tunbridge Wells (Thames to Hants./Dorset border)*	830	389	23	47.0	6	44	2.8
Taunton Area (Dorset to Wales)*	1,479	146	3	9.9	2	15	2.3
England	***3,763***	***860***	***134***	***23***	***6***	***29***	***4***

Source: MAFF (1994). Key: *these areas include parts of Region 9; figures for Region 9 alone were not available; **estimated whole coast length to nearest km, including estuaries and harbours; see also section 8.4.4.

Table 8.4.3 Distribution of sea (flood) defences (km**) in England and Wales

NRA Region	*NRA*	*Local authority*	*Privately owned*	*Total*
Southern*	144	41	11	195
Wessex*	43	30	24	97
England & Wales*	***805***	***242***	***212***	***1,259***

Source: NRA (1992). Key: *Region 9 includes part of NRA Southern Region and part of what was Wessex Region at the time of the survey; Wessex and South Western Regions have since been amalgamated; figures for Region 9 alone were not available; **lengths have been rounded to the nearest whole km. ***Thames Region was omitted from the survey as, being inland, it has no sea defences.

the condition of these coast protection works and the degree of erosion that they are experiencing.

Table 8.4.3 summarises data from the NRA Sea Defence Survey (NRA 1992). Owing to the distribution of responsibility between the various bodies concerned in this region, major estuaries such as Portsmouth and Poole Harbours and Southampton Water are covered in the Coast Protection Survey rather than the Sea Defence Survey. This helps to explain why there appear to be relatively few extensive stretches of sea defence in the region compared with other parts of south-east England.

8.4.2 Important locations

Table 8.4.4 shows a breakdown of protected lengths of coast in the region by district, from the MAFF Coast Protection Survey. Many areas in the region, including land claimed from the sea, are vulnerable to flooding. More information on these is given in section 2.5.

There are significant protection works in the Solent: coastal defence works are particularly extensive on the Hampshire coast, which, being largely low-lying, has attracted industrial, residential and defence-related development. Stretches protected include Chichester, Portsmouth and Langstone Harbours, Hayling Island, Southampton Water and from Calshot to Beaulieu River.

Along much of the coast of Chichester and Langstone Harbours, and around the Solent, the sea walls are in poor repair. At some places on Hayling Island the coastal wall has been breached, giving rise to unmanaged coastal retreat (see section 3.5). The threat of similar occurrences elsewhere has been prevented by local landowners taking independent action. Future flood defence works by the NRA are dependent upon economic justification and so replacement of deteriorating sea walls may not be assured. The cliffs at Barton-on-Sea are suffering erosion (Hampshire County Council 1987) and erosion is also occurring at Hurst Castle Spit.

Large sections of the east Wight coast, including the dunes at The Duver (St. Helen's), are protected against coastal erosion. Erosion of residential land along the south coast, between Ventnor and Blackgang Chine, has led to parts of the cliff foot being protected. Smaller lengths of coast near the western point of the island are also protected.

The whole of Christchurch Bay as far as Poole Harbour has been defended: the construction of groynes, which are present for lengthy stretches, has probably altered patterns of sediment transport over the past century. Areas around Portland (including the harbour) are protected, and a major new protection scheme at Lyme Regis is combining coast protection with amenity value, incorporating a new sewage pumping station and storm drain storage. The scale of residential development on soft, eroding cliff sectors has led to parts of the cliff foot being protected, for example at Swanage, Durlston Cliffs, Weymouth and Bridport Bay.

Table 8.4.4 Lengths* of coast protection works

Council frontage	*Total length (km)*	*Undeveloped** length (km)*	*Coast protection length (km)*	*% protected*
Hampshire				
Havant	32	4	27	86.7
Portsmouth	44	1	43	97.7
Gosport	24	2	22	90.8
Fareham	17	3	14	84.9
Eastleigh	6	0	6	100
Southampton	22	0	22	100
Isle of Wight				
Medina	34	10	24	70.6
South Wight	90	70	19	21.5
New Forest	55	24	31	56.3
Christchurch	11	6	4	39.8
Dorset				
Bournemouth	16	5	11	69.4
Poole	27	4	24	85.8
Purbeck	173	171	2	1.3
Weymouth & Portland	34	22	11	33.8
West Dorset	43	41	2	4.7
Region 9	***625***	***363***	***262***	***41.9***
England whole coast	2,925	2,065	860	29.4
% of English coast totals in region	21.4	17.6	30.5	-

Source: MAFF 1994 database. Key: *rounded to the nearest whole kilometre; **i.e. lacking man-made coast protection.

8.4.3 Management

Departmental responsibility for coast protection and sea defence in England lies with MAFF. In England and Wales operational responsibility for coast protection works are generally the responsibility of District Councils under the Coast Protection Act (1949), although other bodies may maintain some stretches of coast protection, for example alongside railway lines. Sea defences are generally the responsibility of the National Rivers Authority (NRA) under the Water Resources Act 1991 and the Land Drainage Act 1994, although Internal Drainage Boards and local authorities are also empowered to undertake flood defence works. MAFF set up a Coastal Groups Forum in 1991 to promote the formation of coastal groups, to further co-operation between parties responsible for coastal defences, to identify research needs and to promote strategic planning of coastal defences. The forum meets twice a year and includes representatives of the NRA and the regional coastal groups, which co-ordinate the work of adjacent coastal defence agencies (see Chapter 10).

One non-statutory regional coastal group has also been established to promote co-ordination between coastal defence agencies in the region: the Standing Conference on Problems Associated with the Coastline (SCOPAC). Problems of lack of beach material caused by 'updrift' defences are now being addressed by liaison between authorities through SCOPAC, although as the SCOPAC area stretches from West Sussex to Dorset, its western boundary falls in the centre of the Lyme Bay coastal sediment cell. Moves are now being made to work closely with the Devon local authorities along the Lyme Bay coastline (Dorset County Council 1994). More detailed information is given in section 10.2.5.

8.4.4 Information sources used

MAFF (1994) have recently published a detailed assessment of the extent and state of repair of coast protection works on the English coast and defence requirements to the end of the century. The survey also identified lengths of unprotected coast that were significantly eroding and where works might be necessary during the ten years following the survey. These detailed data are held by the contractors (Sir William Halcrow & Partners) and MAFF on a Geographic Information System (GIS), from which the information in Tables 8.4.1, 8.4.2 and 8.4.4 and on Map 8.4.1 was extracted. In these tables it is important to distinguish between whole-coast lengths and figures that refer only to coastal lengths included in the survey.

The National Rivers Authority carried out its Sea Defence Survey in 1991 (NRA 1992). The results are held mainly in a proprietary database cross-referenced to maps, and may be viewed at regional NRA offices by prior arrangement. No detailed information from the database was available at the time of writing, so Table 8.4.3, drawn from the published summary, is general in scope. However this is a very accurate and detailed source of information, although now due for updating (by the time of publication, most of the defences classified as in need of significant or moderate works may have been improved or be included in a medium term capital programme). Region 9 includes parts of NRA Southern Region and NRA South-Western Region. The survey did not identify many lengths of defences in the region; coastal works in inlets have been recorded mainly under the MAFF Coast Protection Survey.

The estuaries inventory sheets compiled by the Joint Nature Conservation Committee (Buck in prep.) indicate that there have been many flood protection works, including land claim in Langstone, Portsmouth and Bembridge Harbours. SCOPAC have carried out unpublished coastal studies for, for example, Hampshire County Council.

8.4.5 Acknowledgements

Thanks are due to officers of the County Councils, MAFF, the NRA, DoE, Clive Chatters (Hampshire Wildlife Trust) and English Nature staff.

8.4.6 Further sources of information

A. References cited

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B. Further reading

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This region is currently the most important in the English Channel for oil and gas developments. The Wytch Farm oil field, the largest onshore field in western Europe, in fact lies largely under Poole Harbour and the adjacent sea bed. The oil is extracted by 'nodding donkeys' on the harbour's Purbeck shore. Photo: Nick Davidson, JNCC.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
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 3000
Coast protection and prevention of the flooding of non-agricultural land - England and Wales	*District Councils or unitary authorities
Co-operation between parties responsible for coastal defences, identification of research needs and promotion of strategic planning of coastal defences	*English Coastal Groups Forum, MAFF Flood and Coastal Defence Division
Co-ordination and liaison between agencies undertaking coastal works	The Secretary, Standing Conference on Problems Associated with the Coastline (SCOPAC), c/o County Hall, Newport, Isle of Wight PO30 1UD, tel: 01983 821000
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 - Hampshire, Isle of Wight	*NRA Southern Region, Worthing, tel: 01903 820692
Flood defence - Dorset	*NRA South Western Region, Exeter, tel: 01392 444000
Coastal Engineering Research Advisory Committee	International Council for the Exploration of the Sea, Palægade 2-4, DK-1261, Copenhagen K, Denmark

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

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 and demersal fish and several marine shellfish species (demersal fish live on or near the sea bed; pelagic fish tend to live mid-water) and diadromous fish (which spend part of their lives in fresh water and part at sea - in this section salmon, sea trout and eels). 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.

A large proportion of the coastal waters in the region, such as the Solent and in Chichester, Langstone, Portsmouth and Poole Harbours, are very sheltered, and fishing activity is intense in these areas. The whole stretch of coastal water is also regularly fished, especially for shellfish species such as edible crab and lobster. The region is important for its long established oyster fishery in the Solent and surrounding area, which has one of the few remaining natural stocks of native oysters in the UK that supports a commercial fishery. It is the largest stock in Britain and probably also in northern Europe.

The main fishing ports are Weymouth, Poole, Portsmouth and Bembridge; fish landings are also recorded by the Ministry of Agriculture, Fisheries and Food (MAFF) at a scatter of smaller harbours throughout the region (see Map 9.1.1). Many fishing vessels work a wide variety of fishing gear, and they switch methods several times a year according to seasonal movements of species or changes in market demand. Small boats fish throughout the year for high value species such as oysters, edible crab, lobsters, scallops, Dover sole and bass. There are no major fish markets in the region and the majority of the catch landed is sold through local wholesalers, to meet the thriving demand from local hotels and caterers. The three cross-Channel ferry ports at Portsmouth, Southampton and Poole give good access to the continental markets, and a large percentage of the shellfish is exported, mainly to France and Spain.

Map 9.1.1 MAFF-defined fisheries landing ports

In 1992, 0.7% of all recorded landings of fish and shellfish species in Britain were made in this region, which is significantly below the average in all regions of 5.8%. However, the landings of non-quota (see section 9.1.3) species such as lobster and edible crab, which are very important in the region, are probably under reported (see section 9.1.4). The total tonnages of pelagic, demersal and shellfish species landed in the region represent 0.1%, 0.3% and a more significant 3.3% respectively of the British totals. The region is most important for the wide range of shellfish species that are landed, for UK markets or for live export abroad. Proportions of combined British and Isle of Man total shellfish landings made in the region are: crabs (12.7%), lobsters (6.4%) and mussels (9.2%). A summary of the total

Table 9.1.1 Species group landings in 1992 (tonnes)

Species group	*Region 9*	*North Sea coast*	*England & Wales*	*Britain and Isle of Man*	*% of North Sea coast total landed in region*	*% of combined British and Isle of Man total landed in region*
Pelagic	154	184,309	23,809	252,335	0.1	0.1
Demersal	712	228,056	81,237	275,460	0.3	0.3
Shellfish	3,476	61,933	55,360	104,917	5.6	3.3
All species	***4,342***	***474,298***	***160,406***	***632,712***	***0.9***	***0.7***

Source: Ministry of Agriculture, Fisheries and Food (1994); 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.

landings in 1992 for pelagic, demersal and shellfish species is given in Table 9.1.1.

Three diadromous species - salmon, sea trout and eel - support both net and rod-and-line fisheries in the region, the most important of which are for salmon (and grilse, which are young salmon that have spent not more than one winter at sea before maturing) and sea trout. The main rivers fished are the Test, Itchen and Avon. Other than rod and line, seine netting is the only method used (see section 9.1.2). As shown in Table 9.1.2, a very small percentage of the salmon and grilse recorded as caught in Great Britain is from this region, although the percentage is higher for sea trout.

Table 9.1.2 Average catch (numbers of fish) of salmon and grilse and sea trout 1989 - 1993

	Salmon and grilse	*Sea trout*
Region 9	938	899
North Sea coast	196,247	104,789
England & Wales	67,347	76,337
GB	***254,829***	***141,813***
% of North Sea coast total in region	0.4	0.8
% of GB total in region	0.3	0.6

Source: Scottish Office Department of Agriculture and Fisheries (1990); National Rivers Authority (1991, 1992, 1993, 1994a, 1994b); Scottish Office (1991, 1992, 1993, 1994). Note: calculating the figures in this table was a complex process: refer to section 9.1.4.

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. Herring and sprat fisheries are not very intensive as there is little local demand. Gill nets are sometimes used to catch herring and mackerel, whereas sprat are occasionally targeted by trawlers during the colder months, especially when cod are scarce inshore and oyster dredging is uneconomic because of low catch weight. Horse mackerel was the only pelagic species landed in this region in any significant quantities, making up 5.4% of the British and Isle of Man total in 1992.

Demersal

Table 9.1.4 gives the quantities of various demersal species landed in 1992 in the region, compared with landings nationally. Demersal species, such as Dover sole, plaice, rays and turbot, are targeted from spring to autumn. The plaice fishery peaks in autumn, when they begin their spawning migration. Cod and whiting are targeted during colder months and long lines are used to catch cod, pollack, rays, dogfish and tope, often in areas with strong water currents. Many methods are used to catch bass, which also attracts a lot of effort from part-time fishermen and anglers. Since the late 1980s an increasing number of trawlers have paired-up to tow mid-water trawls for bass, and French pair trawlers target bass offshore. Sandeels are exploited in many enclosed areas, providing bait for the bass fishery.

Shellfish

Table 9.1.5 gives the quantities of various shellfish species landed in 1992 in the region, compared with landings nationally.

There are extensive shellfisheries in the region, mainly for lobster, edible crab, spider crab, native oyster and mussels. Lobster, edible crab and spider crab support the most valuable fishery in the region. Potting grounds for these species exist throughout the region - from close inshore out to the median line between England and France - and are worked all year. The number of pots worked varies and may reach a thousand or more per boat. Velvet crabs and green (shore) crabs are also taken.

The native oyster fishery in the Solent and surrounding area is long established (Key & Davidson 1981). There is a Regulating Order for native oysters that covers most of the Solent, and one in Poole Harbour (see section 9.1.3). The native oysters are dredged and the beds are managed by the laying down of 'cultch' (oyster shells), which encourages spatfall. The yield from the Solent oyster fishery ranges from 300 to 500 tonnes a year. The natural population of native oysters in Poole Harbour was almost wiped out by

Table 9.1.3 Pelagic species landings in 1992 (tonnes)

Species	*Region 9*	*North Sea coast*	*England & Wales*	*Britain and Isle of Man*	*% of North Sea coast total landed in region*	*% of combined British and Isle of Man total landed in region*
Argentines	0	137	0	180	0	0
Herring	1	74,706	915	85,650	<0.1	<0.1
Horse mackerel	81	1,374	1,026	1,499	5.9	5.4
Mackerel	3	95,366	9,142	150,726	<0.1	<0.1
Pilchard	0	4,244	4,244	4,244	0	0
Sprat	69	8,478	8,478	10,032	0.8	0.7
Whitebait	0	1	1	1	0	0
Others	P	3	3	3	-	-
Total	***154***	***184,309***	***23,809***	***252,335***	***0.1***	***0.1***

Source: Ministry of Agriculture, Fisheries and Food (1994); Scottish Office Agriculture and Fisheries Department (1993); Isle of Man Department of Agriculture, Fisheries & 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.

Table 9.1.4 Demersal species landings in 1992 (tonnes)

Species	*Region 9*	*North Sea coast*	*England & Wales*	*Britain and Isle of Man*	*% of North Sea coast total landed in region*	*% of combined British and Isle of Man total landed in region*
Elasmobranchs						
Dogfish	22	7,449	3,625	13,348	0.3	0.2
Skates and rays	105	3816	4,142	7,827	2.8	1.3
Gadoids						
Cod	28	53,440	23,530	59,524	0.1	<0.1
Haddock	P	49,221	3,706	53,586	-	-
Hake	P	589	1,621	3,620	-	-
Ling	1	4,594	1,708	6,027	<0.1	<0.1
Pollack (lythe)	18	1,921	1,734	3,023	0.9	0.6
Saithe	P	11,032	2,284	12,602	-	-
Whiting	34	36,733	5,088	41,055	0.1	0.1
Whiting, blue	0	6,531	P	6,531	0	0
Flatfish						
Brill	11	317	392	443	3.5	2.5
Dab	3	1,017	456	1,215	0.3	0.2
Dover sole	99	2,021	2,812	2,876	4.9	3.4
Flounder	P	167	269	273	-	-
Halibut	0	166	80	194	0	0
Halibut, Greenland	0	119	117	137	0	0
Lemon sole	19	5,004	3,000	5,573	0.4	0.3
Megrim	P	1,379	1,471	4,037	-	-
Plaice	196	20,749	15,970	23,887	0.9	0.8
Turbot	5	561	545	742	0.9	0.7
Other species						
Catfish	0	1,896	557	1,935	0	0
Conger eel	9	99	403	510	9.1	1.8
Gurnard	5	368	589	627	1.4	0.8
Monkfish/angler	3	9,813	3,102	14,678	<0.1	<0.1
Redfish	P	718	581	774	-	-
Sandeel	P	4,152	P	4,152	-	-
Torsk (tusk)	0	165	13	207	0	0
Witch	0	1,405	192	1,981	0	0
Others	154	2,419	3,151	3,833	6.4	4.0
Fish roes	0	195	99	243	0	0
Total	***712***	***228,056***	***81,237***	***275,460***	***0.3***	***0.3***

Source: Ministry of Agriculture, Fisheries and Food (1994); Scottish Office Agriculture and Fisheries Department (1993); Isle of Man Department of Agriculture, Fisheries & 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.

the parasite *Bonamia*, and currently some native oysters dredged from Poole Bay are placed in Poole Harbour for fattening, to be used when the market demands. The demise of native oysters elsewhere has encouraged more visiting and local boats to dredge the Solent oyster beds. These stocks are at a moderate level, and although the private 'lays' (see section 9.2.2) help to maintain the stock, they too rely on the successful spawning of the wild native oysters.

Mussels are dredged from beds in deep water off Portland Bill. Some of the mussels are re-layed in Poole Harbour for fattening (see section 9.2.2) and also stored in Portland Harbour so that demand can be met in the winter. Hard-shelled clams are dredged from Southampton Water and the North Solent. At its peak this fishery yielded 15,000 tonnes per year, but this has reduced significantly with a decline in the stock, thought to be due to over exploitation combined with infrequent spatfall. Scallops are mainly dredged, with a limited amount collected by SCUBA diving, for example from Lulworth Bank.

Whelks are taken by potting throughout the region, and small local fisheries exist for cockles, mainly in Poole Harbour. Cuttlefish and squid are fished inshore by otter trawlers in spring and summer. Pots are used to catch pink prawns in some harbours and bays, for example off the Portland Harbour breakwater and in Poole Bay, where there is a closed season from 1 January to 31 July. Under a bylaw covering the Southern Sea Fisheries Committee District, hand-gathering of periwinkles is permitted only between 16 September and 14 May, when they are situated in dense aggregations on accessible shores.

Diadromous species

The distribution of diadromous fish species in rivers in the region is discussed in section 5.9. Salmon and sea trout in the region support a seine net fishery, with nine net licences issued in 1993. Seine netting takes place in the Itchen, Avon and Stour Estuaries and in Poole Harbour. Eel are exploited from the time they enter fresh water as elvers, during their

Table 9.1.5 Shellfish landings* in 1992 (tonnes)

Species	*Region 9*	*North Sea coast*	*England & Wales*	*Britain and Isle of Man*	*% of North Sea coast total landed in region*	*% of combined British and Isle of Man total landed in region*
Cockles	3	26,199	29,501	32,047	<0.1	<0.1
Crabs	2,155	9,117	9,453	16,970	23.6	12.7
Lobsters	68	622	504	1,069	10.9	6.4
Mussels	600	4,865	3,488	6,555	12.3	9.2
Nephrops	0	8,368	1,918	19,639	0	0
Periwinkles	50	315	70	1,907	15.9	2.6
Queens	P	2,207	2,989	11,273	-	-
Scallops	111	4,519	2,589	8,290	2.5	1.3
Shrimps	P	615	563	743	-	-
Squids	32	1,382	919	2,005	2.3	1.6
Whelks	10	1,905	1,535	2,393	0.5	0.4
Others	447	1,819	1,831	2,026	24.6	22.1
Total	***3,476***	***61,933***	***55,360***	***104,917***	***5.6***	***3.3***

Source: Ministry of Agriculture, Fisheries and Food (1994); 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. Calculating the figures in this table was a complex process: refer to section 9.1.4.

stay in fresh and estuarine waters and as they migrate to sea as silver eels. Fyke nets are used in many of the estuaries and harbours of the region, for example Emsworth, Chichester, Portsmouth and Poole Harbours. Fyke nets catch silver eels in the rivers in autumn and winter, and dip nets are used to catch elvers migrating inshore and up the rivers in late winter and spring. NRA Southern Region has introduced a charging scheme for all eel fishing from 1 April 1995.

Table 9.1.6 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 Salmon and grilse and sea trout five-year (1989-1993) average catch (as numbers of fish reported to NRA), catch methods used and number of net licences for salmon and grilse issued in 1993

	Salmon & grilse	*Sea trout*	*Method used/ net licences issued*
River			
Test	199	134	Rod
Itchen	164	209	Rod, seine net** (1)
Beaulieu	2*	8	Rod, seine net** (1)
Hants. area (Southampton Water/Solent)	7	14	Seine net (2)
Avon	193	153	Rod
Stour	1	6	Rod
Avon & Stour	192	320	Seine net (6)
Poole Harbour	40	23	Seine net (1)
Piddle	8	8	Rod
Frome	131	23	Rod
Region 9	***938***	***899***	***11***

Source: National Rivers Authority (1991, 1992, 1993, 1994a, 1994b). Key: *as salmon do not occur in the Beaulieu River the reported salmon catch shown is erroneous; the species reported caught should have been sea trout; **private right only. Notes: 'sea trout' here includes all migratory trout. 'Nets' are defined as instruments other than rod and line. It is known that the 1992 and 1993 catches for the Test, Itchen, Avon and Frome Rivers were under-reported by anglers.

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. Orton (1994) lists contact addresses for fishing clubs in the region and national organisations.

Sea angling occurs in many places in the region such as Chichester Harbour, Southampton Water, Swanage and in the estuaries of the Lymington and Beaulieu Rivers. Hayling Island and Bay also have good shore angling, with tope, rays, bass and mackerel being regularly caught. Southsea's four miles of beach provide good angling all year, although the best angling is from boats, with tope, rays and bass being especially good. Fawley Power station is a popular angling location, with a wide range of species being caught, including allis and twaite shad. Christchurch and Poole Bay has all-year-round sea angling, but the best months are from June to September. Boat, beach and quay angling are popular in Poole Harbour. Chesil Beach is famous for year-round angling off the steeply-sloping shelf, and the surrounding areas also provide good angling. Portland has good bass angling; beach angling from Bridport yields bass, pouting, thornback rays, conger and various flatfish; Lyme Regis is also known for bass, mackerel and pollack. Many part-time fishermen in places such as Swanage, Weymouth and Lyme Regis rely on summer visitors who pay to fish for mackerel using hand-lines. Orton (1994) also lists further details on the sea

fishing stations, including 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 (Fowler 1992). Anglers often collect their own bait locally, while commercial collectors travel in teams to suitable shores. Areas such as Langstone Harbour, upper Medina Estuary, Portchester, Titchfield Haven, the Solent, Poole Harbour, Portland Harbour and around Weymouth experience larger numbers of diggers, and some problems have been encountered (see section 5.5.6 B). Much of the Solent coastline is inaccessible to bait collectors as it is either privately owned or covered by conservation designations. Many species are collected in the region, including ragworm, lugworm, peeler crabs (moulting shore crabs), mussels, cockles, limpets and razor shells. 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 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.

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 (see Gray (1995) for a brief description), 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 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 1994) by implementing catch quota management measures, through 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 baselines (low water mark) and beyond 12 nautical miles, access for vessels from other member states is limited, based on historic fishing rights (see British Admiralty Chart Q6385).

For the purpose of stock assessment, waters around the UK are divided into statistical areas by the International Council for the Exploration of the Sea (ICES). The coastal seas around this region are part of two 'divisions': Division VIId (English Channel, East of 2°W) and division VIIe (English Channel, West of 2°W). 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 that 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 member states in the form of catch quotas. European Council Regulations detailing the catch quotas for fish and shellfish species for all European countries, i.e. the TACs, and certain conditions under which the species can be fished, are published in Luxembourg in the Official Journal of the European Communities. These regulations are published annually and the regulations for 1996 were in preparation at the time of writing (see e.g. European Commission 1996). The TACs, UK quotas and 'uptake' for 1991 and 1992 for each species in the two ICES statistical divisions in the region are given in MAFF (1994). European Council Regulation No. 3760/92 (European Council 1992) 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 this region the Southern Sea Fisheries Committee (SSFC) manages the sea fisheries from the high water mark out to 6 nautical miles from UK baselines (as defined by the Territorial Water Order in Council 1964). The SSFC has bylaws that restrict vessels fishing within the Sea Fisheries District to a maximum size of 12 m overall length and which require such vessels to register with that office if they wish to fish commercially. At present there are 741 boats with permits to fish, of which 504 are full time and 237 fish on a seasonal or casual basis. In addition there are another twelve larger vessels based within the district that fish outside it. Local MAFF Sea Fisheries Inspectorate officers deal with quota management, enforcement of UK and EU fisheries legislation and licensing of fishing vessels.

The NRA's South Western and Southern Regions have responsibility to regulate, protect and monitor salmon, sea trout and eel fisheries from rivers to coastal waters out to the 6 nautical mile limit. Orton (1994) describes the structure of the NRA and the licensing procedures, seasons, catch and size limits for NRA regions.

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 stocks of molluscan shellfish species. The specified shellfish stock may be fished only in accordance with the terms of the order and any regulations made under it. There are two Regulating Orders in this region

Table 9.1.7 Regulating Orders in the region

Title	*Species*	*Location*	*Grid ref.*	*Grantee*	*Approx. area (ha)*	*Expiry date*
Poole Fishery Order 1985*	Oysters, mussels, cockles and clams	Poole Harbour, Dorset	SZ042861 - SZ042874	Southern Sea Fisheries Committee	3,220	2015
Solent Oyster Fishery Order 1980	Oysters	The Solent, Hampshire & Isle of Wight	SZ525995	Southern Sea Fisheries Fisheries Committee	17,195	2010

Source: MAFF (1995b) and Grantee. Key: *Poole Fishery Order is a combined Regulating and Several Order and is also mentioned in section 9.2.2.

(Table 9.1.7), out of nine in Britain covering a total of approximately 215,889 ha (as at July 1995). The Poole Fishery Order is a combined Regulating and Several Order as it also allows the Southern Sea Fisheries Committee to lease grounds in Poole Harbour that are used for the cultivation of species (see section 9.2.2).

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; for instance, factors such as over-fishing, pollution and development are thought to have been responsible for seriously reducing the eel fishery in the region. Issues include the effects on target species as major components in marine ecosystems, the changed availability of food for predators, the effects on non-target species, and effects on species and habitats of nature conservation interest. These issues are under consideration by the 'Marine Fisheries Task Group', 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 Group 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

The coastal fisheries of England and Wales (Gray 1995) has been used in compiling this section. It describes the different types of fishing gear used inshore to catch specific species. Its 'Regional' section 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. 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). Figures given in Tables 9.1.1 - 9.1.7 come from various sources: MAFF, NRA, the Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD) and the Isle of Man DAFF; their interpretation is described below.

Pelagic, demersal and shellfish species

Statistics given here are for landings recorded in the region, 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. Vessels are not required to report landings of non-quota species, and as these make up the great majority of landings made in the region the figures for these species are certainly underestimates. The Southern Sea Fisheries Committee should be consulted for clarification. The data presented do, however, give an indication of the economic importance of the species that were recorded as 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 (1995a).

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 1994). A total for the 'other', smaller, ports (see Map 9.1.1) was provided by the MAFF Fisheries Statistics Unit. These data have been combined to give the figures in the 'Region 9' column for Tables 9.1.1 and 9.1.3 - 9.1.5.

The figures in the 'North Sea 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 ten regions on the North Sea coast of Great Britain, as covered by Doody *et al.* (1993).

The figures in the 'England & Wales' column were obtained by adding together all of the MAFF data for England and Wales, and those in the 'Britain and the 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 provide 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'.

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 licence; in addition, catches themselves fluctuate, and so the relationship between catch and stock is not straightforward. For instance, the NRA Southern Region indicate that sea trout catches are generally under reported by rod anglers and that there is a significantly higher number caught in

Hampshire than is reported. Further, in 1992, the introduction of changes to the catch recording system may have resulted in a temporarily reduced level of recording. Therefore the figures given in Tables 9.1.2 and 9.1.6 provide only an indication of the patterns of the catch in the UK and the region respectively. The annual NRA *Salmonid and freshwater statistics for England and Wales* (National Rivers Authority 1991, 1992, 1993, 1994a & b) contains more detailed information.

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: Stephen Lockwood (MAFF DFR), Mike Pawson (MAFF DFR), Miran Aprahamian (NRA North-West Region), Bill Cook (NW & NWSFC), Phil Coates (SWSFC), Russell Bradley (Association of SFCs), Neil Downes (Devon Sea Fisheries Committee), Paul Knapman (English Nature), Blaise Bullimore (Countryside Council for Wales), Indrani Lutchman (WWF UK), Clare Eno (JNCC) and Mark Tasker (JNCC).

Thanks go to M.A. Whitley (Southern Sea Fisheries Committee) for providing a great deal of information specific to this region and for checking drafts and maps. Thanks are also due to Stuart Bray (NRA South West Region), Robin Crawshaw (NRA Southern Region) and Colin Bannister (MAFF DFR) for their comments on drafts.

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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 33157092
Central contact for the local Sea Fisheries Committees; 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 information and advice on bylaws, National and EC legislation	Clerk and Chief Fishery Officer, Southern Sea Fisheries Committee, 64 Ashley Road, Poole, Dorset BH14 9BN, tel: 01202 721373
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; interaction between fisheries and non-fisheries conservation issues	*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; seals and fisheries	*Director, MAFF Directorate of Fisheries Research, Fisheries Laboratory (Lowestoft), tel: 01502 562244
Shellfish hygiene and fish diseases	Head of Laboratory, MAFF Fish Diseases Laboratory, Barrack Road, The Nothe, Weymouth, Dorset DT4 8UB, tel: 01305 206600
Additional statistics other than those in publications (available from HMSO)	MAFF Fisheries Statistics Unit, Nobel House, 17 Smith Square, London SW1P 3JR, tel: 0171 238 6000
Local fisheries, quota management, licensing of fishing vessels and enforcement, UK and EC legislation, from Thames to Lyme Regis	Inspector, MAFF Sea Fisheries Inspectorate, District Fisheries Office, Fish Market, Rock-a-Nore Road, Hastings, East Sussex TN34 3DW, tel: 01424 424109
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
Regional information and advice on diadromous fisheries; salmonid and freshwater statistics	*Regional Fisheries Manager, National Rivers Authority - Southern Region - Fisheries Department, Worthing, tel: 01903 820692
Regional information and advice on diadromous fisheries; salmonid and freshwater statistics	*Regional Fisheries Manager, National Rivers Authority - South Western Region - Fisheries Department, Exeter, tel: 01392 444000
Fishing gear technology	Technical Director, Sea Fish Industry Authority, Seafish Technology Division, Sea Fish House, St. Andrew's Dock, Hull, North Humberside HU3 4QE, tel: 01482 327837
UKDMAP software; mapped fishing areas of selected species, ICES Statistical Division boundaries etc.	Project Manager, British Oceanographic Data Centre, Proudman Oceanographic Laboratory, Bidston Observatory, Birkenhead, Merseyside L43 7RA, tel: 0151 652 3950
Shellfish production (commercial)	Director, Shellfish Association of the UK, Clerk, Fishmongers' Hall, London Bridge, London EC4R 9EL, tel: 0171 626 3531
Affiliated angling clubs	Secretary, National Federation of Sea Anglers, 51a Queens Street, Newton Abbot, Devon TQ12 2QJ, tel: 01626 331330
Game fishing	Director, Salmon and Trout Association, Fishmongers' Hall, London Bridge, London EC4R 9EL, tel: 0171 2835838
Interaction between fisheries and non-fisheries conservation issues	*Fisheries Liaison Officer, English Nature HQ, Peterborough, tel: 01733 340345
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	*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 marine issues	*Honorary Secretary, The Marine Forum for Environmental Issues, Scarborough, tel: 01723 362392
Information and advice on marine conservation issues - Dorset	*Dorset Wildlife Trust, Dorchester, tel: 01305 264620
Information and advice on marine conservation issues - Hants. and Isle of Wight	*Hampshire & Isle of Wight Wildlife Trust, Eastleigh, tel: 01703 613636
Seals and fisheries	NERC Sea Mammal Research Unit (SMRU), University of St. Andrew's, School of Biochemical and Medical Sciences, St. Andrew's, Fife KY16 8LB, tel: 01334 463472
Seals and fisheries	Susan Joy, Co-ordinator, Wildlife & Countryside Link Seals Group, 15 Park Road, East Grinstead, West Sussex RH19 1DW, tel: 01342 315400

* 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 the cultivation of shellfish is mainly concentrated in Poole Harbour, but production also occurs in the North Solent, Weymouth and Portland Harbours and the Fleet at Abbotsbury.

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 salmonids, non-salmonid fish, algae or polychaetes in this region.

Some mussels that are dredged from off Portland Bill (see section 9.1.3) are stored in Portland Harbour. The majority, however, are re-layed on sub-tidal ground lays in Poole Harbour for fattening, and this accounts for 90% of the mussel production from Poole Harbour.

The Pacific oyster is cultivated in trays on trestles in two sheltered areas of this region. The main production occurs in the Fleet at Abbotsbury, and there are also smaller quantities cultivated in Poole Harbour. Native oysters are also cultivated in the Fleet but the majority are cultivated at Calshot and Stanswood Bay in the North Solent, where Several Orders (Table 9.2.2) ensure the conservation and development of the stocks. Both areas are naturally replenished in that they rely on the successful spawning of the wild native oysters in the Solent. 'Cultch' (oyster shells) is put down to encourage this 'spatfall'.

Map 9.2.1 General location of mariculture areas and the species in culture. Sources: MAFF; Crown Estates Commissioners; SSFC; La Tene Maps (1995). © Crown copyright.

Clams (the hard-shelled clam and the Manila clam) are cultivated in small quantities in Poole Harbour.

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 MAFF, following sampling

Table 9.2.1 Main species cultivated in the region and in Great Britain

Species	*Species status*	*Cultivated in region?*
Salmonids		
Atlantic salmon *Salmo salar*	Native	
Sea trout *Salmo trutta*	Native	
Non-salmonids		
Turbot *Psetta maxima*	Native	
Halibut *Hippoglossus hippoglossus*	Native	
Shellfish: bivalve molluscs		
Common mussel *Mytilus edulis*	Native	✔
Native oyster *Ostrea edulis*	Native	✔
Pacific oyster *Crassostrea gigas*	Un-established introduction	✔
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, SSFC, La Tene Maps (1995). 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.

carried out by the Port Health Authority or Local Authority. Samples of live shellfish are submitted to the Public Health Laboratory Service 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 database of the current hygiene status of shellfish harvesting areas is maintained by MAFF (Fisheries Division, Nobel House, and DFR Fish Diseases Laboratory, Weymouth).

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. In January 1993 the European Union introduced 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 accompanied by accidental releases of associated non-native predators, pests, parasites and diseases. Shellfish and fish farms have to be registered with MAFF 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.

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 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 Great Britain, together with virtually the entire territorial sea bed. Of the remainder of the foreshore the majority is owned by the Duchies of Cornwall and Lancaster (the River Erme is privately owned). If the structures are potentially hazardous to navigation the Department of Transport 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. In this region much of the coast is protected by national and international designations, including Site of Special Scientific Interest (SSSI), Heritage Coast and AONB (Area of Outstanding Natural Beauty), as well as by local and voluntary conservation measures, so nature conservation and landscape considerations also apply.

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 to enable the cultivation of the sea bed within a designated area of water and to conserve and develop named molluscan species of shellfish. Sea Fisheries Committees may sub-let the rights of a several fishery, subject to the consent of MAFF. There are five Several Orders in this region (Table 9.2.2), out of 22 in Britain covering a total of approximately 3,151 ha (as at July 1995). In addition the Poole Harbour Fishery Order (which is a combined Regulating and Several Order - Table 9.1.7) allows the Southern Sea Fisheries Committee to lease grounds in Poole Harbour, used to fatten mussels and native oysters and also for the small-scale cultivation of Pacific oysters, hard-shelled clams and Manila clams. The existence of a Several Order does not necessarily mean that mariculture is actively occurring at the location covered.

Mariculture and its effects are limited in this region compared with some other parts of Britain. However, 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. These issues for mariculture in general are under consideration by the 'Marine Fisheries Task Group', 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 Group 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 are due to the following members of the Fisheries Working Group for their contributions and comments: Bill

Table 9.2.2 Several Orders in the region

Title	*Species covered*	*Grid ref.*	*Location*	*Grantee*	*Approx. area (ha)*	*Year of expiry*
Portland Harbour Fishery Order 1989	Oysters, scallops mussels	SY675755	Portland Harbour, Dorset	Portland Oystermen Ltd	150	2000
Calshot Oyster Fishery Order 1982	Oysters	SU495013	The Solent, Hampshire	Calshot Oyster Fishermen Ltd	223	2005
Emsworth Channel Fishery Order 1975	Oysters, mussels, clams	SZ744020	Between Hayling and Thorney Islands, Hampshire	Emsworth Harbour Fishermen's Federation Ltd.	49	2005
Stanswood Bay Oyster Fishery Order 1973	Oysters	SU478000	The Solent, Hampshire	Stanswood Bay Oystermen Ltd	262	2005
Marchwood Clam Fishery Order 1972	Clams	SU39651145	Southampton Water, Hampshire	Newtown Oyster Fishery Co. Ltd.	6	2002

Source: MAFF (1995). Note: Regulating Orders are summarised in Table 9.1.7.

Cook (NW & NWSFC), Phil Coates (SWSFC), Brian Spencer (MAFF DFR Conwy), Dr P.D. McGovern (Crown Estate, Scotland), Neil Downes (Devon Sea Fisheries Committee), Paul Knapman (English Nature), Blaise Bullimore (Countryside Council for Wales), Indrani Lutchman (WWF UK), Clare Eno (JNCC) and Mark Tasker (JNCC).

Additional thanks go to M.A. Whitley (Southern Sea Fisheries Committee) and Alan Herbert and Andy Panayi (Crown Estate Commissioners) for providing information specific to this region.

9.2.5 Further sources of information

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Scottish Salmon Growers Association. 1990. *Salmon farming and predatory wildlife.* Perth, Scottish Salmon Growers Association.

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	Chief Executive, Association of Sea Fisheries Committees, Buckrose House, Commercial Street, Norton, Malton, North Yorkshire YO17 9HX, tel: 01653 698219
Several Orders; mariculture activities and local bylaws	Clerk and Chief Fishery Officer, Southern Sea Fisheries Committee, 64 Ashley Road, Poole, Dorset BH14 9BN, tel: 01202 72137
Fisheries and mariculture in England, including Several Orders; seals and mariculture	MAFF (Aquaculture Division), Nobel House, 17 Smith Square, London SW1P 3JR, tel: 0171 238 5940
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	*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	Head of Laboratory, MAFF Directorate of Fisheries Research, Fish Diseases Laboratory, Barrack Road, The Nothe, Weymouth, Dorset DT4 8UB, tel: 01305 206600
Technical advice on shellfish purification (depuration)	Sea Fish Industry Authority, Sea Fish House, St. Andrew's Dock, Hull, North Humberside HU3 4QE, tel: 01482 327837
Leases	The Crown Estate, Marine Estates, 16 Carlton House Terrace, London SW1Y 5AH, tel: 0171 210 4377
Salmon farming	Director, Scottish Salmon Growers Association, Drummond House, Scott Street, Perth PH1 5EJ, Scotland, 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	*Fisheries Liaison Officer, EN HQ, Northminster House, Peterborough PE1 1UA, tel: 01733 340345
Marine Fisheries Task Group paper; interaction between mariculture activities and marine nature conservation issues	*Marine Advisory Officer, JNCC Peterborough, tel: 01733 62626
Interaction between mariculture activities and marine nature conservation issues	*Coastal Policy Officer, RSPB HQ, Sandy, Beds., tel: 01767 680551
Interaction between mariculture activities and marine nature conservation issues	*Fisheries Officer, WWF-UK, Godalming, tel: 01483 426444
Interaction between mariculture activities and marine nature conservation issues	*Conservation Officer, Marine Conservation Society, Ross-on-Wye, tel: 01989 566017
Interaction between mariculture activities and marine issues	*Honorary Secretary, The Marine Forum for Environmental Issues, Scarborough, tel: 01723 362392
Interaction between mariculture activities and marine nature conservation issues	*Dorset Wildlife Trust, Dorchester, tel: 01305 264620
Interaction between mariculture activities and marine nature conservation	*Hampshire & Isle of Wight Wildlife Trust, Eastleigh, tel: 01703 613636
Seals and mariculture	NERC Sea Mammal Research Unit (SMRU), University of St. Andrew's, School of Biochemical and Medical Sciences, St. Andrew's, Fife KY16 8LB, tel: 01334 463472
Seals and mariculture	Co-ordinator, Wildlife & Countryside Link Seals Group, 15 Park Road, East Grinstead, West Sussex RH19 1DW, tel: 01342 315400

* 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

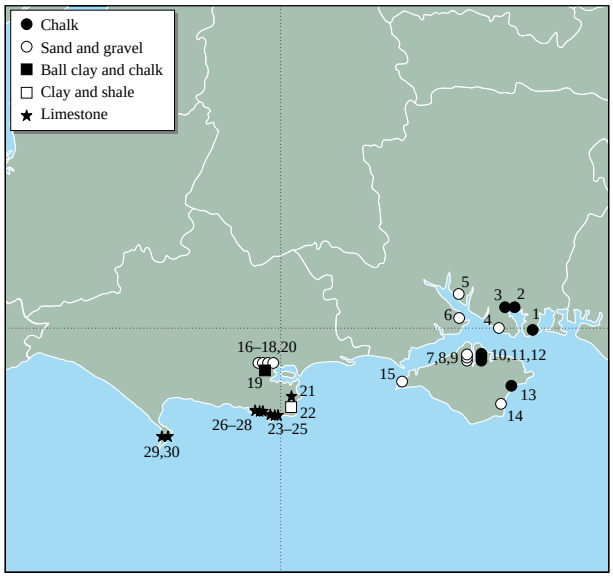
In this section, quarries are included as coastal if they are less than 2 km inland and landfill sites if they are in a coastal 10 km square. The minerals quarried in the region on a commercial basis are limestone, sand and gravel, chalk, ball clay, and clay and shale. These minerals are put to a variety of uses including as roadstone, concrete mix, cement, and building stone.

Table 9.3.1 presents production levels by whole county, compared with British levels, for the main minerals quarried in the region.

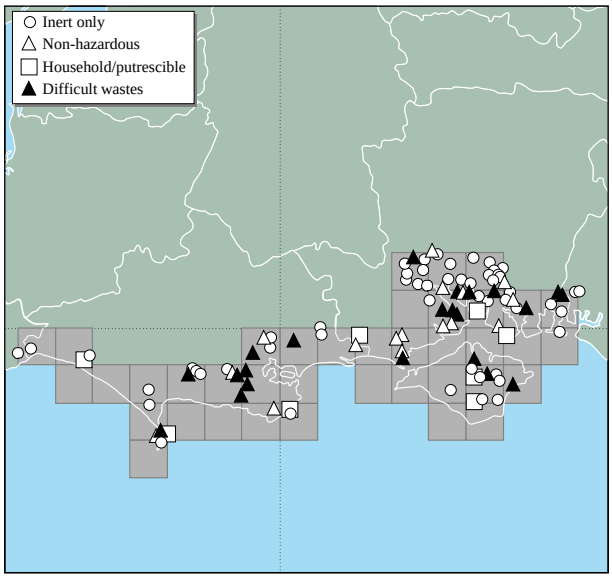
9.3.2 Important locations

In this region there are 33 coastal quarries extracting one or more minerals (Map 9.3.1). Of these quarries, twelve extract limestone, twelve extract sand and gravel, one extracts ball clay and chalk, eight extract chalk, and one extracts clay and shale (Table 9.3.2). In Hampshire and the Isle of Wight only chalk, sand and gravel are extracted. In Dorset, which has a more varied geology, a greater variety of minerals is exploited: sand, gravel, clay, shale, ball clay, chalk and limestone. Two products of the county's extractive industry have national significance: Portland stone and Purbeck marble, both forms of limestone. Of the 80,000 tonnes of limestone produced in Dorset in 1993, 50,000 was Portland Limestone and the remainder Purbeck Limestone. Portland stone rubble is used for the construction of coast protection works; block Portland stone has been used for centuries for fine buildings, monuments and tombstones. Crushed Portland stone is used for cement and road construction. Purbeck marble was particularly fashionable in Victorian times as a decorative stone in buildings. Ball clay is used in the manufacture of tiles and ceramics; other clay is used for brick, tile and pipe-making. Of the total amount of ball clay produced in Great Britain in 1990, 18% came from Dorset.

Map 9.3.2 shows the location of the region's currently used coastal landfill sites, according to Aspinwall's Sitefile Digest (Aspinwall & Co. 1994); the status codes are defined



Map 9.3.1 Coastal quarries. Numbers refer to Table 9.3.2. Source: BGS (1994). © Crown copyright



Map 9.3.2 Coastal landfill sites. Note: a single symbol may represent more than one site in close proximity. Source: Aspinwall & Co. (1994)

Table 9.3.1 Minerals production* in Region 9 (1993)

	Chalk		*Sand & gravel*		*Clay & shale*		*Ball clay*		*Limestone*	
	Tonnes	*% of GB total*	*Tonnes*	*% of GB total*	*Tonnes*	*% of GB total*	*Tonnes*	*% of GB total*	*Tonnes*	*% of GB total*
Hampshire	>52,000[a]	n/a	2,760,000[a]	3.1	20,000	0.2	0	0	0	0
Isle of Wight	20,000	0.2	239,000	0.3	0	0	0	0	0	0
Dorset	16,000[b]	n/a	1,502,000[b]	1.7	n/a	n/a	n/a	n/a	80,000	n/a
Region 9	***>88,000***	***>0.2***	***4,501,000***	***5.1***	***>20,000***	***>0.2***	***n/a***	***n/a***	***n/a***	***n/a***
England	9,076,000	100	74,833,000	83.6	9,883,000	90.7	357,000	74.5	84,123,000	80.0
Great Britain	9,076,000	100	89,470,000	100	10,891,000	100	479,000	100	105,885,000	100

Sources: BGS (1995); [a]Hampshire County Council; [b]Dorset County Council. Key: n/a = not available; *amounts rounded up to the next whole thousand tonnes.

Table 9.3.2 Coastal quarries in the region

Site no.	*Location*	*Operator*	*Mineral*
	Hampshire		
1	Havant	Wessex Construction and Plant Hire	Chalk
2	Fareham	Leigh Environmental Ltd. (Downend)	Chalk
3	Fareham	Leigh Environmental Ltd. (Warren Farm)	Chalk
4	Lee-on-Solent	RMC-Hall Aggregates	Sand and gravel
5	Netley	RMC-Hall Aggregates	Sand and gravel
6	Fawley	RMC-Hall Aggregates	Sand and gravel
	Isle of Wight		
7	Newport	B.R. and G.A. Draper	Sand and gravel
8	Newport	Evered Bardon - Vectis Ltd	Sand and gravel
9	Newport	Westridge Construction Ltd	Sand and gravel
10	Newport	Arreton Chalk and Plant Hire Ltd	Chalk
11	Newport	Cheverton Chalk and Gravel	Chalk
12	Newport	R.J. Cook	Chalk
13	Sandown	D.L. Mosdell Ltd	Chalk
14	Shanklin	A.J. Mew	Sand and gravel
15	Totland	Knighton Sandpit Ltd	Sand and gravel
	Dorset		
16	Wareham	Drinkwater Sabey Ltd.	Sand and gravel
17	Wareham	Drinkwater Sabey Ltd. - Wareham Ball Clay	Sand and gravel
18	Wareham	ARC-Southwestern	Sand and gravel
19	Wareham	ECC Ball Clays	Ball clay and chalk
20	Wareham	ECC Quarries	Sand and gravel
21	Swanage	Redland Bricks	Clay and shale
22	Swanage	J. Suttle Esq.	Limestone
23	Acton	Wellman and Harris	Limestone
24	Acton	D. & P. Lovell	Limestone
25	Acton	Landers Quarries	Limestone
26	Worth Matravers	Tarmac-Southern	Limestone
27	Worth Matravers	Several operators	Limestone
28	Worth Matravers	W.J. Haysom & Son	Limestone
29	Portland	AS Quarries (2 quarries)	Limestone
30	Portland	ARC Southwestern (3 quarries)	Limestone

Source: BGS (1994). Note: site numbers refer to Map 9.3.1.

Table 9.3.3 The status of the region's coastal landfill sites

Status code	*Definition*	*No. in region*
1 Inert only	Uncontaminated excavated natural earth materials, and uncontaminated brick rubble and concrete with similar properties to natural earth materials.	59
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.	19
3 Household/ putrescible	Typical contents of a household dustbin and similar wastes of industrial origin e.g. food processing wastes.	8
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.	23
Total		***109***

Source: Aspinwall & Co. (1994). See Map 9.3.2.

in Table 9.3.3. Landfill sites in the region are concentrated around the industrial and urban areas of Hampshire.

9.3.3 Management

Landfill site licensing in Great Britain is the responsibility of the 152 Waste Regulation Authorities (WRAs). In England these are included in the County Councils, usually in the 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 April 1996, the new Environment Agency (for England and Wales) will come into force, under the 1995 Environment Act. The new agency will integrate the functions of Her Majesty's Inspectorate of Pollution (HMIP),

the local WRAs and the National Rivers Authority (NRA). In general terms the agency's regional boundaries will follow council, district or national administrative boundaries, to facilitate local accountability. The activities of the new agency will be grouped under two broad headings: pollution prevention and control, including waste regulation, the work of HMIP and the NRA's work on water quality; and water management, covering the NRA's other functions. However, there will be a strong link between these two sets of functions, to ensure the continuing integrity of estuarine and coastal management. Also within the Environment Act 1995 is the requirement for mine operators to give the agency at least six months' notice of their intention to abandon a mine, in order that steps can be taken to avoid pollution from minewater. Provisions relating to producer responsibility for waste 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.

Minerals Planning Guidance Note 6 (DoE 1994) identifies a general need for the south-east to supply a total of some 29-30 million tonnes of sand and gravel to the south-west over the period up to the year 2006. (Dorset falls inside the south-west region in terms of national mineral planning.) Dorset County Council has voiced concerns that the Guidance Note does not adequately reflect the needs of the south-west of England for a continuing supply of sand and gravel from the south-east (SWRAWP 1994).

The Dorset Minerals and Waste Local Plan (1992-2001) identifies ten preferred areas for sand and gravel extraction, with a combined yield of approximately 12 million tonnes per year. This was intended to provide a ten-year supply. No new provision was considered necessary to maintain crushed rock supplies.

9.3.4 Information sources used

Data on quarrying were obtained from the British Geological Survey's *Directory of mines and quarries* (BGS 1994) and are the most up to date and comprehensive available. Nevertheless these data may be up to three years old and may therefore include information on some operations that have now ceased. In a very small number of cases, exact addresses of quarries were not listed and therefore it was not known if they were coastal.

The data for landfilling were provided by Aspinwall & Co. from their Sitefile Digest on waste treatment and disposal (Aspinwall & Co. 1994). This contains regularly updated information from the 152 WRAs and represents the most up to date collection of public information on British waste management available.

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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Central Statistical Office. 1993. *Business monitor PA1007: minerals.* London, HMSO.

South East Regional Aggregates Working Party. 1995. *Regional Aggregates Working Party Annual Report (RAWP 220).* London, SERAWP.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Landfill database and Sitefile Digest	Ron Moore/ Susan Morley, Aspinwall & Co., Walford Manor, Baschurch, Shrewsbury SY4 2HH, tel: 01939 261144
Aggregates extraction (land-based) in the region	South East Regional Aggregates Working Party, 14, Buckingham Gate, London SW1E 6LB, tel: 0171 931 8777
Waste regulation - Hampshire	*Chief Waste Regulation Officer, Hampshire County Council, Winchester, tel: 01962 847019
Local minerals plans - Hampshire	*Minerals Planning Officer, Hampshire County Council, Winchester, tel: 01962 846746
Waste regulation, local minerals plans - Dorset	*Chief Waste Regulation Officer/Minerals Planning Officer, Dorset County Council, Dorchester, tel: 01305 251000
Waste regulation, local minerals plans - Isle of Wight	*Chief Waste Regulation Officer/Minerals Planning Officer, Isle of Wight County Council, Newport, tel: 01983 821234
Mines and quarries (British Directory of Mines and Quarries)	Director, British Geological Survey, Keyworth, Nottingham NG12 5GG, tel: 0115 936 3393

* 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 end uses such as concrete production, beach replenishment and beach protection. High quality marine aggregate exists in this region and in other coastal areas adjacent to the main markets in south-east England (Kenny & Rees 1994). The national demand for aggregate from all sources increased steadily during the 1980s. Aggregates from terrestrial sources are insufficient to meet the rising total demand for sand and gravel in Britain (Doody *et al.* 1993), and marine aggregates satisfy an increasing proportion of the requirement - 15% in 1992 (Crown Estate 1995).

Marine sand and gravel are extracted by commercial mineral companies under licence from the Crown Estate. Marine aggregates extracted in England and Wales reached a peak of 28 million tonnes in 1989, but amounts have since fallen steadily. In 1994, a total of 20,792,887 tonnes of aggregate (excluding contract fill and beach nourishment) were dredged from the bed of the territorial sea and continental shelf of England and Wales. This figure includes approximately 6 million tonnes of aggregate that were dredged in Great Britain but exported to landing ports abroad. The 1,962,626 tonnes of marine aggregate landed in the region represent 9.4% of the total dredged in Great Britain in 1994 (Table 9.4.1) (Crown Estate 1995).

Navigational dredging is of two types: capital dredging and maintenance dredging. 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 estuaries around Great Britain, capital dredging was taking place in fifteen and maintenance dredging in 72 - 9.7% and 46.5% respectively of the estuaries surveyed.

The amount of dredged material deposited in the region in 1993 (1,461,570 tonnes) (Table 9.4.2) constituted 4.9% of the total deposited around the UK as a whole in 1993. This compares with 6.3% for 1992, when 1,827,623 tonnes were deposited in the region and 29,161,946 tonnes were deposited around the UK as a whole. Between 1988 and 1992 inclusive, a yearly average of 34,700,000 tonnes (wet weight) of dredged material was deposited at sea in England and Wales. Amounts varied between 40,810,718 tonnes (wet weight) in 1989 and 24,243,998 tonnes in 1992 (MAFF 1994).

Other solid materials deposited under licence from MAFF include sewage sludge and solid industrial waste. 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 11,000,000 wet tonnes) to the sea. A total of 268,016 wet tonnes were deposited in 1993 at the Nab Tower site, the only licensed sludge disposal site in this region. Southern Water Plc have ceased disposing of sewage sludge from their Southampton Sewage Treatment Works. 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.

Solid industrial waste is waste rock from mining operations, and disposal at sea occurs chiefly in north-east England. There are no licensed disposal sites in this region.

9.4.2 Important locations

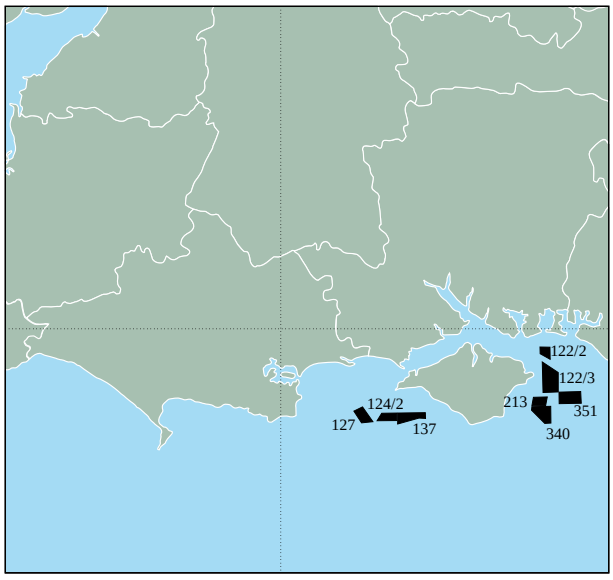
Marine aggregates dredging

Extensive gravel sheets and banks are located in the region (see section 2.2). Examples include gravel sheets south of the Isle of Wight and gravel banks in the area of the west Solent and the Needles. Only thin ribbons of sand are found in much of the area further west of the Isle of Wight,

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 extracted*	*Total aggregates and contract fill/beach nourishment landed*
	licensed	*extracted*		
South Coast**	9,738,400	4,932,372	55,115	4,987,487
England and Wales***	***37,726,599***	***20,792,887***	***1,286,372***	***15,441,500***

Source: data from Crown Estate (1995). Key: *excludes contract fill/beach nourishment material; **figures include all of the Crown Estate's 'South Coast' region, which extends eastwards off the Sussex coast and thus includes the whole of Region 9 as well as Region 8 and part of Region 7; ***no marine aggregates are dredged off Scotland.



Map 9.4.1 Licensed dredging areas for marine aggregates. Source: Crown Estate (1995).

Map 9.4.2 Solid waste disposal sites at sea - dredged material (see Table 9.4.5) and sewage sludge (site WI060). Source: MAFF (1994). © Crown copyright.

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 9	32	45	4	1,635,560	1,461,570
England and Wales	110	89	67	66,074,966	26,086,503
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.

but to the east of the Isle of Wight there are several areas of continuous sand, burying underlying gravels. Map 9.4.1 shows the areas, all in the east of the region, licensed by the Crown Estate for marine aggregate dredging (Crown Estate 1995). Table 9.4.3 lists ports in the region landing marine aggregates and their annual tonnages landed. 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 this region however, the aggregate landed in Hampshire, the Isle of Wight and Poole is dredged from the licences around the Isle of Wight and off Littlehampton (Crown Estate pers. comm.).

Table 9.4.3 Total tonnages of marine dredged aggregates landed in the region (1994)

Landing port	*Tonnes*
Hampshire	**1,744,343**
Bedhampton	325,025
Langstone	117,496
Portsmouth	103,065
Fareham	73,499
Gosport	12,454
Woolston	46,632
Kendall's Wharf	126,398
Crown (Southampton)	10,659
Southampton	929,115
Isle of Wight	**149,710**
Newport	27,579
Cowes	98,117
Other ports	24,014
Dorset	**68,573**
Poole	68,573
Region 9	***1,962,626***

Source: Crown Estate (1995)

Navigational dredging

Table 9.4.4 lists locations in the region at which navigational dredging occurs, showing approximate amounts dredged annually. Poole Harbour is the largest harbour in the region and indeed is one of the biggest natural harbours in the world. Under Section 22 of the Poole Harbour Act 1914, the Poole Harbour Commissioners (PHC) have the sanction to dredge in order to maintain safe navigation, remove obstructions and clean the harbour. Deep water channels within the Harbour, specifically the North Channel and the Middle Ship Channel, are regularly dredged to maintain their depths at 3.6 and 6.0 m below Chart Datum respectively. In an average year, 70,000 m^3 of material are dredged from commercial shipping channels by the PHC (Posford Duvivier Environment 1992). Additionally, maintenance dredging needs to be carried out near existing boatyards and similar facilities, but the quantities of material involved are small.

Dredged material disposal

Table 9.4.5 lists the main sites used for the disposal of dredged material in 1992 and the quantities of material disposed of at each site (Map 9.4.2). Maps for 1993 were not available at the time of writing.

The majority of material dredged from Poole Harbour is disposed of at a licensed offshore disposal site off 'Old

Table 9.4.4 Locations in the region where dredging occurs

Location	*Type of dredging*	*Amounts dredged per year (tonnes)*	*Comments*
Hampshire			
Chichester Harbour	Capital & maintenance	1,000 - 50,000	Dredging occurs every few years. A number of dredgings occur to maintain access to marinas and yacht yards
Langstone Harbour	Maintenance	Up to 20,000	
Portsmouth Harbour	Maintenance	Up to 250,000	Dredging to allow access for naval and other vessels
Southampton Water	Maintenance	500,000 - 750,000	
Beaulieu River	Maintenance	Unknown	Some removal at the estuary mouth combined with 'raking' of the sand bar
Lymington Estuary	Maintenance	Approx. 50,000	
Isle of Wight			
Bembridge Harbour	Maintenance	Up to 10,000	Dredging occurs every few years
Wootton Creek & Ryde Sands	Maintenance	Unknown	Dredging to maintain ferry access
Medina Estuary	Maintenance	Approx. 40,000	
Yar Estuary	Maintenance	Approx. 10,000	
Dorset			
Poole Harbour	Maintenance	1,100,000	

Sources: Davidson *et al.* (1991); MAFF

Table 9.4.5 Amounts of dredged material disposed of at each licensed site in the region in 1992 and 1993

	MAFF code (see map 9.4.2)	*Tonnage disposed of*								*Depth (m)*
		Capital		*Maintenance*		*Sewage sludge*		*Total*		
		1992	*1993*	*1992*	*1993*	*1992*	*1993*	*1992*	*1993*	
Nab Tower	WI060	49,517	591,337	550,371	570,687	9,190	29,025	609,078	1,191,049	40
Hurst Fort	WI080	0	0	114,866	109,600	300	0	115,166	109,600	25-50
Needles	WI090	0	0	0	9,568	0	0	0	9,568	25
Swanage Bay	WI110	997,893	0	105,486	151,353	0	0	1,103,379	151,353	20
Region 9		***1,047,410***	***591,337***	***770,723***	***841,208***	***9,490***	***29,025***	***1,827,623***	***1,461,570***	

Source: MAFF

Harry', south of the harbour (site WI110). Approximately 35,000 m^3 of the 700,000 m^3 of material from a capital dredging project carried out in 1992 to widen the Middle Ship Channel and to enlarge the Hamworthy Shipping basin were used for beach nourishment at Sandbanks. From a total of 1,182,000 m^3 of material arising from the Swash Channel dredging scheme, 1,024,000 m^3 were pumped ashore and used for a major beach nourishment scheme at Bournemouth beach to help to reduce erosion (Posford Duvivier Environment 1992). The remaining coarse material was deposited at sea.

An artificial reef has been constructed north of The Foreland, Studland Bay (Dorset), at a depth of about 10 m below chart datum and about 3 km from natural rocky outcrops in Poole Bay. The project was initiated in 1989 to test the use of waste pulverised fuel ash (PFA) and flue gas desulphurisation (FGD) gypsum, produced by local coal-fired power stations, in providing artificial reefs for fishery enhancement. At the moment about 50% of UK PFA production is sold to the construction industry and the remainder deposited in land fill sites. The latter is becoming an expensive option and the construction of artificial reefs may become more attractive. The Oceanography Department, Southampton University, has studied the biological colonisation and physical and chemical integrity of the reef (Collins *et al.* 1994).

9.4.3 Management and issues

In response to the increase in demand for aggregate in the 1980s, 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). These factors expand the area of sea bed affected by aggregate dredging and potentially intensify the effects. 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).

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 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".

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).

Aggregate extraction from the sea bed commonly involves using either suction pipes or hoppers. 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 hopper. 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 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 1990).

Navigational dredging

Navigational dredging is the responsibility of individual harbour authorities, although a licence from MAFF is required for disposal of the dredged material offshore.

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. Each licence is subject to 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 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 impacts include the localised elevation of levels of metals originating in 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.

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. The regional landing port totals do not equate to the amount dredged from each region, owing to the presence of the export market, and movement of aggregate to meet differing home market demands. Figures were not available for all the individual ports on the Isle of Wight.

The information on the disposal of dredged material, sewage sludge and solid industrial waste is derived from licences granted by MAFF. One of the region's three marine disposal sites for dredged material (WI060) is bisected by the region's eastern boundary. However, the total quantity of dredged material disposed of at this site was included in the figure for the region as a whole.

9.4.5 Acknowledgements

Thanks are due to the Crown Estate Commissioners for information on marine aggregate extraction in the region, Dr C. Vivian of MAFF Fisheries Laboratory, Burnham-on-Crouch, for providing information on solid waste disposal at sea, and to Ian Cromie of the British Marine Aggregate Producers Association for his useful comments.

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Pullen, S. Undated. *Dumping of dredged spoils from ports: contamination, pollution control.* Godalming, World Wide Fund for Nature.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Marine sand and gravel extraction in the UK (BMAPA & BACMI)	British Marine Aggregate Producers Association/British Aggregate Construction Materials Industries, 156 Buckingham Palace Road, London SW1 9TR, tel: 0171 730 8194
Marine resource management (managing agents offshore for the Crown Estate)	Technical Manager, Posford Duvivier, Eastchester House, Harlands Road, Haywards Heath, West Sussex RH16 1PG, tel: 01444 458551
Marine aggregate extraction licensing	Business Manager, Marine Estates (Offshore), Crown Estate, 16 Carlton House Terrace, London SW1Y 5AH, tel: 0171 210 4377
Sand and gravel extraction	Sand and Gravel Association (SAGA), 1 Bramber Court, 2 Bramber Road, London W14 9PB, tel: 0171 381 8778
Offshore geoscience data including 1:250,000 maps of geology of coastline	Director, British Geological Survey, Keyworth, Nottingham NG12 5GG, tel: 01602 363100
Disposal of dredge spoil at sea	The Oslo and Paris Commissions, New Court, 48 Carey Street, London WC2A 2JE, tel: 0171 242 9927
Database of licensed disposal operations at sea	*Dr C. Vivian, Marine Environmental Protection Division, Ministry of Agriculture, Fisheries and Food, Fisheries Laboratory, Burnham-on-Crouch, tel: 01621 782658
Disposal of dredged material at sea - international	London Convention Secretariat, International Maritime Organisation (IMO), 4 Albert Embankment, London SE1 7SR, tel: 0171 735 7611
Disposal of pulverised fuel ash as artifical reefs	Oceanography Centre, Southampton University, University Road, Southampton SO9 5NH, tel: 01703 595666

*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.

This region is currently the most important in the English Channel for oil and gas developments. In the results of the 14th Offshore Licensing Round, announced in June 1993, five of the 110 blocks awarded were located in the English Channel. In the 16th offshore oil and gas licensing round announced in July 1995 a further two blocks were awarded. The 7th onshore licensing round is now underway. Estuaries such as the Solent are included in landward licensing rounds; elsewhere the offshore blocks are delineated right up to the coast. In 1993 one exploration well was drilled in the English Channel out of the 110 exploration and appraisal wells drilled within the UK Continental Shelf (UKCS). Map 9.5.1 shows blocks under licence in the region as at 1 January 1994, together with those awarded in the 16th Round. Map 9.5.2 shows sedimentary basins and structural 'highs', which determine the distribution of oil and gas deposits. In terms of national significance the known oil and gas reserves in the region are small.

Total 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 (DTI 1994). The Gross National Product arising within the UK oil and gas production sector was £7.7 billion in 1993 (1.4% total UK GNP).

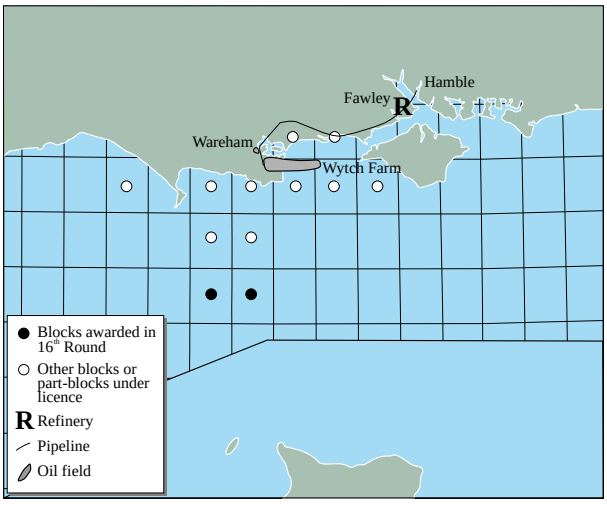
9.5.2 Important locations

Wytch Farm, the largest onshore oil field in western Europe and the only significant oil field in the region, is located at Poole Harbour, largely under the harbour and adjacent sea. The field is connected by pipeline to Hamble. In 1993 the Wytch Farm oil field had estimated recoverable reserves of 41.1 million tonnes, including an offshore extension. Development of this extension commenced in 1993 via extended-reach drilling from the Goathorn Peninsula. Extraction had previously occurred on a small scale at Kimmeridge, but this site is no longer in production.

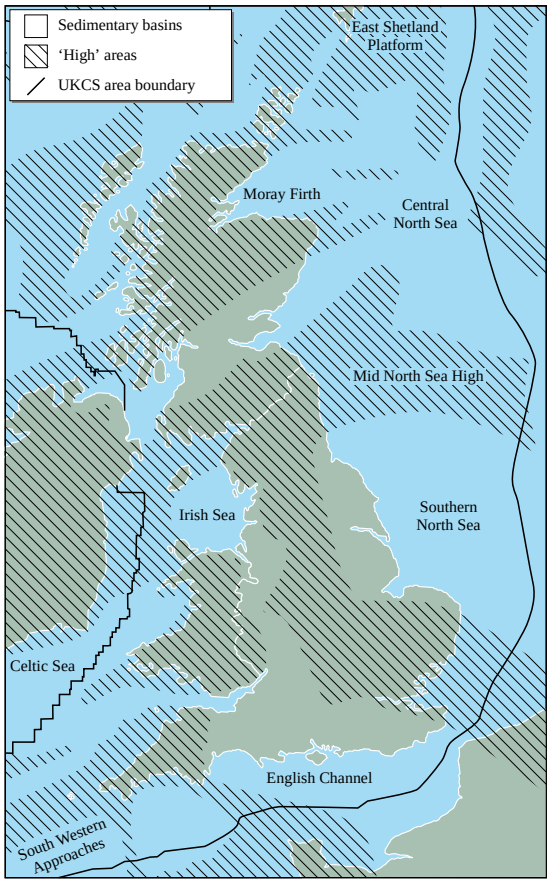
The location of Fawley refinery is shown on Map 9.5.1.

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'. This round is still under consideration. 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, according to the environmental sensitivity of the block (Davies & Wilson 1995). The potential for oil spills to harm birds and marine and coastal wildlife is well known,



Map 9.5.1 Oil and gas licensing, fields and infrastructure. Source: DTI. © Crown copyright.



Map 9.5.2 UK Continental Shelf (UKCS) sedimentary basins and structural 'highs'. Source: DTI. © Crown copyright.

Table 9.5.1 Fields in production or development at 15th March 1994 within approximately 30 km of shore

Field name	*Oil or Gas*	*Production or Development*	*Estimated original recoverable reserves*	*Peak production*	*Production start*
Wytch Farm	Oil	Production	41.1 mt	3.4 mt/yr	1979
Wareham	Oil	Production	0.45 mt	0.1 mt/yr	1991

Source: DTI (1994). Key: mt = million tonnes.

especially in sheltered embayments and estuaries, such as Poole Harbour. Concern has been expressed particularly about the potential risk to seals and dolphins of oil-related developments in the region. There is a very small risk of injury to seals in the immediate vicinity of a vessel conducting seismic surveys. The air-gun arrays used in seismic surveys generate high levels of low frequency sound, most of which is outside the known hearing range of seals and is unlikely to disturb them. In the case of cetaceans, results obtained during seismic surveys by Marathon Oil UK Ltd and BHP Petroleum Ltd in the Irish Sea were inconclusive, and experimental evidence for disturbance arising from seismic activities remains lacking (Evans *et al*. 1993).

9.5.4 Information sources used

Many of the data used here come from the DTI's 'Brown Book' (DTI 1994), which should be referred to for further explanation. It is updated annually. Figures for blocks awarded in the 14th Offshore Licensing Round and wells drilled in 1993 were only available for the English Channel as a whole and not for individual regions.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Oil and gas developments	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
Gas industry	Director and Secretary, Society of British Gas Industries, 36 Holly Walk, Leamington Spa, Warwickshire CV32 4LY, tel: 01926 334357
Oil spillages: government body carrying out pollution control at sea	Marine Pollution Control Unit, Spring Place, 105 Commercial Road, Southampton SO15 1EG, tel: 01703 329484
Response (privately-funded) to oil spills: worldwide	Oil Spill Response, Oil Spill Service Centre, Lower William St., Northam, Southampton SO14 5QE, tel: 01703 331551
Research into oil pollution	Oil Pollution Research Unit, Fort Popton, Angle, Pembroke, Dyfed SA71 5AD, tel: 01646 641404

Type of information	*Contact address and telephone no.*
Advice on oil pollution strategies worldwide	International Tanker Owner's Pollution Federation Ltd, Staple Hall, Stonehouse Court, 87-90 Houndsditch, London EC3A 7AX, tel: 0171 621 1255
Advice on oil spill control equipment	British Oil Spill Control Association (BOSCA), 4th Floor, 30 Great Guildford Street, London SE1 0HS, tel: 0171 928 9199
Licensing of drilling muds and oil spill dispersants	MAFF Marine Environment Protection Division, Nobel House, 17 Smith Square, London SW1P 3JR, tel: 0171 238 6000
Toxicological assessment of drilling muds and oil spill dispersants	*Head of Laboratory, MAFF DFR, Burnham-on-Crouch, tel: 01621 782658
Local information on the environmental effects of exploration and production - Hampshire and Isle of Wight	*Hampshire and Isle of Wight Wildlife Trust, Eastleigh, tel: 01703 613636
Local information on the environmental effects of exploration and production - Dorset	*Dorset Wildlife Trust, Dorchester, tel: 01305 264620
Information on the environmental effects of exploration and production	*WWF - UK, Godalming, tel: 01483 426444

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

9.6 Water quality and effluent discharges

C.A. Crumpton & M.J. Goodwin

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 pollutants can enter the marine environment through intentional licensed release or accidentally. Discharges occurring outside the region may also have an effect.

In Region 9, coastal industrial development and its associated effluent discharges and potential for contamination are concentrated around the Solent, in particular around Southampton Water and Portsmouth Harbour. This area supports a wide variety of industry, including power production and oil refining. Its densely populated coastline can also experience contamination through sewage discharge, from direct outfalls (Table 9.6.1) and from sewage received from river discharges.

Table 9.6.1 Numbers of trade and sewage outfalls with maximum consented daily flows >6,000 m^3

	Sewage	*Trade*	*Total*
Hampshire	8	4	12
Isle of Wight	1	0	1
Dorset	4	0	4
Region 9	***13***	***4***	***17***

Sources: NRA database

There are 57 bathing waters in this region, as identified under the EC Bathing Water Directive (76/160/EEC). Of these, 54 (approximately 95%) complied with mandatory standards in 1995, showing a steady improvement year-on-year (Table 9.6.2). The 1995 data for the UK as a whole, assessed by DoE in accordance with the EC Bathing Water Directive, show a slight increase in compliance (89%) with the mandatory standards, compared with 1994 (82%). The NRA expects a further increase in compliance after the majority of capital schemes being undertaken by the Water Service companies are completed in 1995. Trend data show that though the percentage of bathing waters consistently complying with the mandatory standards has remained at around 64%, the number consistently failing has reduced. Analysis of media faecal coliform values suggests that the improvement in water quality has been maintained over the last four years.

There are four Blue Flag beaches in the region, representing 23.6% of the UK total of 17 for 1994. The 20 Tidy Britain Group Seaside Award beaches in the region in 1994 represent 12% of the UK total of 162. Overall, beach quality in the region is slightly better than average for Great Britain. Surprisingly, a smaller proportion of beaches are rated 'excellent' and more are rated 'polluted' in Dorset than in Hampshire or the Isle of Wight (Coastwatch UK 1993) (Table 9.6.3). The main items of litter found along the coastline in this region are plastics (including sheeting, fishing gear, bottles and containers), textiles, paper and debris from ship wreckage. Sewage and sanitary materials are also present (Coastwatch UK 1993). Medical waste, including syringes and needles, is an increasing problem, of which the source is not known (McGilvray 1994).

Table 9.6.3 Beach quality in the region compared with national standards in 1993

	% of beaches rated as		
Area	*excellent*	*moderate*	*polluted*
Hampshire	11	67	22
Isle of Wight	13	45	42
Dorset	5	48	47
Region 9	***10***	***53***	***37***
England	10	44	46
Wales	7	39	54
Scotland	7	37	56
Great Britain*	8	42	50

Source: Coastwatch UK (1993). Key: *excluding the Isle of Man.

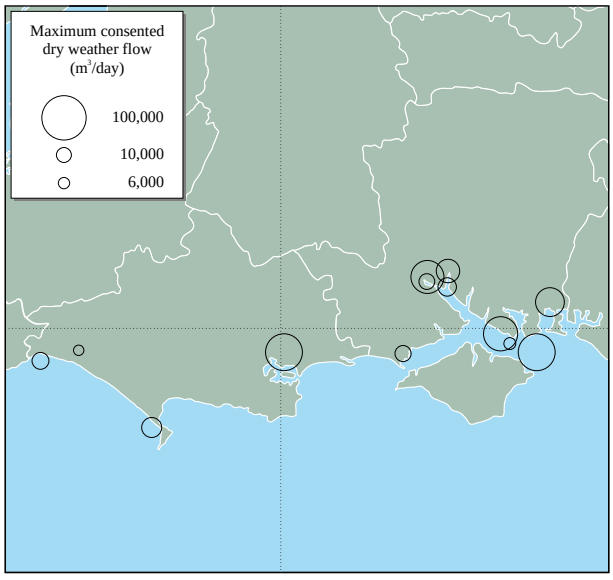
9.6.2 Important locations

All sewage outfalls with consented daily flows greater than 6,000 m^3 are shown on Map 9.6.1 and listed in Table 9.6.4. There are relatively few of these larger outfalls in the region. By far the majority of both large and small outfalls discharge into the Solent and Southampton Water. Almost all sewage entering the Solent from the larger outfalls has had

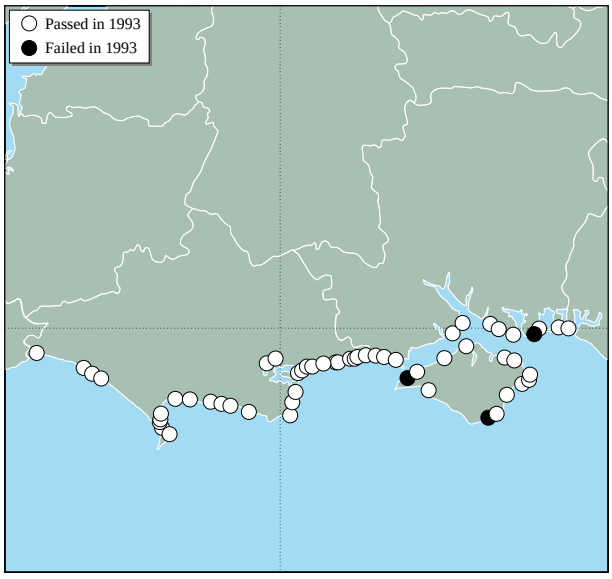
Table 9.6.2 Bathing waters survey, 1993, 1994 & 1995

	Pass			*Fail*			*Total*		
	1993	*1994*	*1995*	*1993*	*1994*	*1995*	*1993*	*1994*	*1995*
Region 9	***51***	***53***	***54***	***6***	***3***	***3***	***57***	***56***	***57***
England & Wales	332	347	380	86	72	45	418	419	425
Scotland	18	16	19	5	7	4	23	23	23
N. Ireland	15	15	15	1	1	1	16	16	16
UK	365	376	413	92	81	51	457	457	464

Source: DoE (1993, and pers. comm.). Note: pass denotes compliance with Bathing Water Directive (76/160/EEC): Coliform standards.



Map 9.6.1 Consented sewage outfalls. Area of circle is proportional to consented 'dry weather flow'. Map shows all outfalls with consented flows greater than 6,000 m^3/day. Trade effluent outfalls not shown (see Map 9.6.2). Source: MAFF.



Map 9.6.2 Authorised and consented trade effluent discharges; numbers refer to Table 9.6.5. Source: NRA.

secondary treatment. All sewage from the larger sewage outfalls in the region, except some from Slowhill Outfall, has had at least some treatment. Slowhill is also the only larger outfall in the region discharging any untreated sewage, although all of the sewage from Eastney and Pennington Outfalls and most or all of that from the larger outfalls on the Isle of Wight and in Dorset has had only treatment that is less intensive than primary treatment. In total the coastal waters of the region receive less than 300,000 m^3 of sewage daily from large outfalls within the region.

Table 9.6.5 lists the larger trade effluent outfalls in the region, i.e. those with a consented daily effluent flow in excess of 6,000 m^3 per day. These are shown on Map 9.6.2. In Region 9, more than 90% of trade effluent from these large outfalls is of cooling water from the oil-fired power station at Fawley on the west side of Southampton Water. The remainder comes from petrochemical industries.

Summary information about water quality in the region's coastal waters is limited (North Sea Task Force 1993). For example, only in Southampton Water has the biological oxygen demand (BOD) been studied. The input of effluent especially from the Fawley Oil Refinery allows phytoplankton to grow and deplete available oxygen in the estuary all year round (Knap *et al.* 1979). Levels of trace metals in waters in the English Channel are close to those found in surface waters of oceans, and very low concentrations of organochlorines occur - according to one study, the lowest concentrations ever measured in seawater (Shultz-Bull *et al.* 1991). In the mid-1980s, high levels of tributyl tin (TBT - an anti-fouling paint used on boats) were recorded in yacht marinas and harbours in the region, especially the Hamble. By 1989, three years after the introduction of legislation to control its use, TBT concentrations in these waters had reduced to one third of earlier levels (Waite *et al.* 1991). However, concentrations in sediments, especially in Poole Harbour and the Itchen Estuary, have not declined from the high levels previously found (Langston *et al.* 1990). TBT is known to affect the growth of benthic organisms.

Although generally good, only fair water quality occurs in several places in the region's estuaries: in an upper reach of Portsmouth Harbour, and along much of the southern shore of Southampton Water, Lymington River, the upper parts of the Medina Estuary and the inner, Holes Bay, part of Poole Harbour (NRA 1991; see also section 4.1.3). Sewage discharge is thought to be a problem in a few estuaries, such as Langstone Harbour, where nutrient enrichment has caused enhanced algal growth (North Sea Task Force 1993). However, the NRA classify the water quality of the Solent as 'good', according to the National Water Council Classification Scheme (NRA 1991). This level of quality has been maintained since the previous survey was carried out in 1985. The amounts of sewage and agricultural effluents have been reduced over the last ten years and this has contributed to a net improvement in water quality.

Map 9.6.3 shows the locations of bathing waters in the region identified under the EC Bathing Water Directive (76/160/EEC), and their compliance with mandatory standards in 1995. Of the twelve such bathing waters on the Isle of Wight, two (at Totland Bay and Ventnor) failed to comply in 1995; in Hampshire, only one (at Southsea) of the 22 bathing waters failed, and none of the 23 in Dorset.

In Hampshire, results of the Coastwatch UK (1993) survey showed that beaches in the county were as good as or better than the national average. Levels of all litter items found were at or below 1992 levels. Only household refuse and ship debris showed increases over 1992. On the Isle of Wight, the number of beaches rated as 'excellent' increased, as did that of beaches rated as 'polluted'. However, the figures remain generally better than the national average. In Dorset, results were generally slightly worse than the national average. Litter levels were higher than in 1992 for the majority of categories, with fewer beaches falling into the 'excellent' category (Coastwatch UK 1993).

The four Blue Flag beaches in the region are located at Hayling Island West, Bournemouth Fisherman's Walk, Bournemouth Durley and Poole Sandbanks. These, with beaches at Hill Head (Lee-on-Solent, Hants.) and Lepe Country Park (near Southampton, Hants.), are also the Tidy Britain Group Premier Seaside Award beaches.

Map 9.6.3 Bathing water quality. Results of 1995 sampling of EC-identified bathing waters. Source: NRA (pers. comm.). Adapted with permission.

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. 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 and 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 is controlled by the local Waste Regulation Authorities (see section 9.3).

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. 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. Cumulatively, these discharges are capable of affecting the maritime environment, both in this region and beyond. Under the Urban Waste Water Treatment Directive (91/271/EEC), except in 'high natural dispersion areas', all significant sewage discharges (thus including all

Table 9.6.4 Sewage outfalls to tidal waters in the region with consented 'dry weather flows' >6,000 m^3 per day

Name of outfall	*Location*	*Grid ref.*	*Maximum consented daily dry weather sewage flow (m^3)* *Untreated*	*Primary treated*	*Secondary treated*	*Other*	*Total from these outfalls*	*Notes*
Hampshire							**183,000**	
Budds Farm	Langstone Harbour	SU707057			41,000		41,000	
Eastney	Longsea outfall off Portsea Island	SZ667932				69,000	69,000	Fine screened only
	Peel Common	SZ577978			55,300		55,300	
Portswood	Southampton (River Itchen)	SU436146			27,700		27,700	
Woolston	Southampton (River Itchen)	SU435104			15,000		15,000	
Millbrook	Southampton (River Test)	SU388125			58,000		58,000	
Slowhill		SU383115	some	some	some		16,000	
Pennington		SZ316932				11,000	11,000	Fine screened (6 mm) only
Isle of Wight							**8,000**	
Ryde		SZ599953			some	some	8,000	Some macerated/ comminuted only
Dorset							**105,124**	
Poole		SZ006938			some	some	67,824	Some fine screened (6 mm) only
Weymouth		SY658745				16,800	16,800	Macerated/ comminuted only
Bridport		SY466944				6,200	6,200	Fine screened (6 mm) only
Charmouth		SY367917				15,300	15,300	Screened only

Sources: NRA Southern and South Western Regions

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 Ventnor, Sandown, Swanage, Weymouth, Bridport and Lyme Regis/Charmouth.

In April 1996, the new Environment Agency will become operational. It will integrate the functions of Her Majesty's Inspectorate of Pollution, the local waste regulatory authorities and the NRA. Its activities will be grouped under two broad headings: pollution prevention and control, including waste regulation, the work of HMIP and the NRA's work on water quality; and water management, covering the NRA'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). Monitoring is carried out by the NRA. 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. 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 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. Coastwatch UK is organised by Farmborough College of Technology and Beachwatch by Reader's Digest and the Marine Conservation Society.

9.6.4 Information sources used

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.

Schemes such as the Tidy Britain Group Seaside Award and the European Blue Flag monitor beaches 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), and 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). MAFF (Burnham-on-Crouch) maintains a national 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 Chris Moore of the NRA South Western Region and R.A. Fisher of the NRA Southern Region for providing information on trade and domestic outfalls in their regions.

Table 9.6.5 Trade effluent outfalls with a consented daily flow >6,000 m^3

*No.**	*Owner*	*Location*	*Grid ref.*	*Maximum consented daily effluent flow (m^3)*
	Hampshire			**6,205,000**
1	Enichem Ltd	Buttash	SU441064	65,000
2	Esso	Cadland Creek	SU451051	204,000
3	Esso	Cadland Creek	SU455049	336,000
4	Fawley Power Station (National Power)	Calshot (long sea outfall)	SU484007	5,600,000**
	Isle of Wight	-	-	**0**
	Dorset	-	-	**0**

Source: MAFF database. Key: *as shown on Map 9.6.2; **cooling water.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Discharge consents - Hampshire & Isle of Wight	*NRA Southern Region, Worthing, tel: 01903 820692
Discharge consents - Dorset	*NRA South Western Region, Exeter, tel: 01392 444000
Water quality - Hampshire & Isle of Wight	Southern Water Services Ltd., Southern House, Yeoman Road, Worthing, West Sussex BN13 3NX, tel: 01903 264444
Water quality - Dorset	Wessex Water Services Ltd., Wessex House, Passage Street, Bristol BS2 0JQ, tel: 01179 290611
Waste regulation, effluent outfalls - Hampshire & Isle of Wight	*Chief Waste Regulation Officer/Minerals Planning Officer, Hampshire County Council, Winchester, tel: 01962 847019
Waste regulation, effluent outfalls - Dorset	*Chief Waste Regulation Officer/Minerals Planning Officer, Dorset County Council, Dorchester, tel: 01305 224003
Pollution from large industrial sites in the region	HMIP, Southern Office, Millenium House, Fleetwood Park, Barley Way, Fleet, Hants. GU13 8UT, tel: 01252 776600
Beachwatch	*Marine Conservation Society, Ross-on-Wye, tel: 01989 66017
Coastwatch UK	Project Officer, Coastwatch UK, Farnborough College of Technology, Boundary Road, Farnborough, Hampshire GU14 6SB, tel: 01252 377503
Tidy Britain Group Seaside Award and European Blue Flag beaches	Lion House, 26 Muspole Street, Norwich NR3 1DJ, tel: 01603 762888
Aquatic environmental research and monitoring related to water quality and waste disposal at sea; consented outfalls database	*Head of Laboratory, MAFF Directorate of Fisheries Research, Fisheries Laboratory, Burnham-on-Crouch, tel: 01621 782658

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

9.7 Leisure and tourism

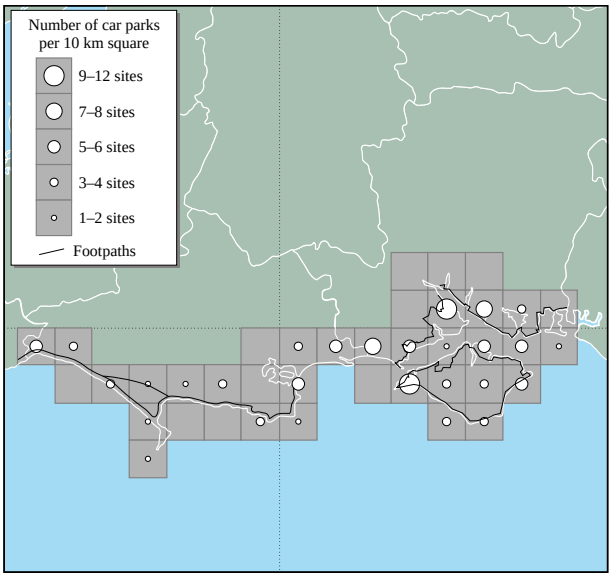
M.J. Dunbar, S.L. Fowler, Dr N.C. Davidson & D.A. Stroud

9.7.1 Introduction

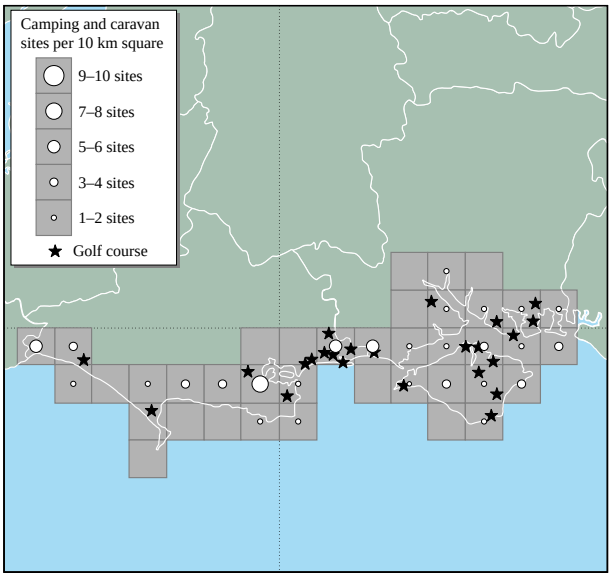
The Solent area (Hampshire and Wight coasts) is of very high value for coastal recreation. The New Forest (Hampshire), the southern part of which lies within the region, is a major tourist attraction, and tourism employs 6% of the local workforce. Visitors to the New Forest as a whole spend 7.15 million days in total in the area, of which 2.75 million are overnight stays. In all, visitors to the New Forest and its local recreational users inject £66 million annually into the local economy, most of it (71%) accounted for by people staying overnight in the New Forest (New Forest Tourist Information Centre pers. comm.). Parts of the southern half of the Isle of Wight have popular beaches. The Dorset coast is less intensively used, but there is considerable visitor pressure on some areas, such as the Poole Harbour and Bournemouth beaches, and Studland, Swanage and Lulworth Cove. Tourism, much of it centred on the coast, is the largest employer and source of revenue in Dorset (Dorset County Council 1994). Short break and activity holidays and educational visits are tending to spread the recreational use of the coast more widely through the year. Common land-based activities include beach recreation, natural history (especially birdwatching), sea angling (from beaches, jetties etc.), wildfowling, fossil collecting, beachcombing and metal detecting, golf, horse and bicycle riding, rock climbing, walking and mountain biking. The infrastructure associated with these activities includes car parks, caravan and camp sites, beach huts, piers, golf courses and paths and trails. Ordnance Survey Landranger maps show 117 car parks (Map 9.7.1), 70 caravan and camp sites and 24 golf courses (Map 9.7.2) in the coastal 10 km squares in the region. The large number of car parks suggests that recreational users are very mobile.

There are also many outdoor activity centres and visitor centres, although facilities for coastal riding are limited. Wildfowling - a traditional coastal activity in the region - is now recreational, although formerly it was commercially practised for food. Targeted coastal species include most ducks, some geese and three waders (only one of which - golden plover *Pluvialis apricaria* - is regularly coastal). Shooting on some coastal sites involves both local wildfowlers and those from further afield. In this region the nineteen wildfowling clubs, with 870 members, represent 9.5% of the total BASC membership of 19,000, most of whom are in the 200 affiliated wildfowling clubs.

Water-based recreation is a very important activity in this region. The region is the single most heavily used water area for inshore recreation in Britain and possibly in the north-east Atlantic, with reportedly the largest recreational fleet in the world (Tubbs 1990). The sheltered areas of Chichester and Langstone Harbours, the Solent, Southampton Water, Poole Harbour and Bay and Portland and Weymouth Harbours are ideal sites for watersports, which bring a significant income to the region (Hampshire County Council 1991). Peak periods of use are during weekends from April to September and in major regatta weeks. Activities include yachting and motor-boating, dinghy sailing, windsurfing, diving, sea angling, sea canoeing, jet skiing, water-skiing and rowing. Leisure boating and sailing are high among the major industries in the region, catered for by a large number of harbours, marinas and moorings, slipways, boatyards and other facilities. There are nineteen purpose-built marinas in the Solent, which account for more than a quarter of total moorings, and five other sites with marina-style facilities (Hampshire County Council 1993). Dinghy sailing takes place in many of the more sheltered creeks of the region as



Map 9.7.1 Number of car parks in coastal 10 km squares in the region and long-distance coastal footpaths. Source: Ordnance Survey Landranger maps. © Crown copyright.



Map 9.7.2 Number of camping/caravan sites in coastal 10 km squares in the region; locations of coastal golf courses. Source: Ordnance Survey Landranger maps. © Crown copyright.

well as on more open water, with the circumnavigation of the Isle of Wight being popular. The double high tide in the region means that it is relatively easy for dinghy cruisers and shallow draft yachts to explore isolated creeks, although landing is forbidden in several areas. Many of the region's dinghy racing clubs host national dinghy championships each year, with 200 or more boats entered in each. Windsurfing takes place from many beaches in the region, with beginners preferring the sheltered inlets and experienced sailors ranging further offshore. Much of the area is of national importance for this sport, although it is declining in the UK. Water-skiing and personal watercraft (jet skis) have undergone considerable growth in the past, and this looks set to continue. Jet-skiing also occurs at some of the sites used for general beach recreation. Coastal rowing is well established, with at least twelve clubs in the region. Canoeing is also widespread, with over 20 clubs in Hampshire alone. Less common activities such as parascending and inflatable towing (e.g. banana rides) are also becoming more widespread on resort beaches. Parascending takes place in some of the sheltered bays, water-traffic permitting.

9.7.2 Important locations

Table 9.7.1 lists larger locations in the region for land-based leisure and tourism. There are many other visitor attractions and facilities in the region that individually do not cover large areas but which cumulatively contribute significantly to the importance of the region for leisure and tourism.

Table 9.7.2 lists existing and proposed water-based leisure and tourism facilities in the region; important locations are shown on Map 9.7.3.

Aside from Southsea and Hayling Island, coastal Hampshire has generally escaped mass tourism developments. Southsea has a long promenade, a pier and a fairground. There is a seaside development on the south-eastern corner of Hayling Island, which also has three holiday camps. Portsmouth has many historic naval attractions, including museums and ships, such as *HMS Victory* and the *Mary Rose*. The 60 mile Solent Way long distance coastal path runs from Portsmouth to Milford on Sea.

Southampton Water and the Solent together represent Britain's premier yachting centre. It has been described as "possibly the most densely populated sailing ground in the world" (Coles & Sylvester-Bradley 1987). There are 140 sailing clubs and numerous activity centres of various descriptions within the Solent area, including 73 sea angling clubs. The growth in watersports facilities in the Solent has been prodigious; for example, moorings have increased from an estimated 7,000 in the mid 1960s to around 25,800 moorings and berths in 1993, excluding dinghies on the shore (Hampshire County Council 1993). The Solent is particularly well known for hosting many prestigious yachting competitions, such as Cowes Week, the start and finish of the Whitbread Round the World Race, and the Round the Island Race. The latter is the largest single sailing competition in the world, with over 1,000 yachts competing each year. All of these events attract large numbers of spectators. According to the latest estimates, there are 8,283 marina berths and 12,333 wet moorings in Hampshire on the Solent (Hampshire County Council 1993). Hampshire County Council/Sports Council (1994) lists 79 public launch points on the Hampshire coast (including nine beach launching sites). Especially popular for dinghy sailing are Chichester, Langstone and Portsmouth Harbours, Southampton Water, Lymington Harbour and Stokes Bay; the latter is also an important site for dinghy racing, as is Hayling Bay, where the major Eurolymp regatta is held every year. There are especially popular sailing schools at Calshot, Hamble and the western harbours. Calshot, Hayling Island and Lee-on-Solent are also important for windsurfing, and the latter and some other parts of Southampton Water are main sites for water skiing and jet-ski launching, which do not occur in the same areas. There is a well regulated water skiing area in Langstone Harbour. Power boat racing takes place in and around the Solent, which is the start and finish point for a number of offshore races, for example the Spithead Trophy. The River Itchen is popular for coastal rowing. Scuba diving in the Solent area is hampered by turbid water, commercial shipping and tidal currents, but the region's maritime heritage (see also Chapter 6) means that diving is popular on the many wrecks.

Much of the Hampshire coast is used for informal recreation, although access to several areas, for example the western Solent and the west of Southampton Water, is restricted by land ownership. To ease the pressure on sensitive areas Hampshire County Council has declared three Country Parks, at Netley, Lepe and Upper Hamble (see section 7.3.6), with bridleways at Chilling and on Hayling Island. The beaches at Ryde and Sandown Bay are also popular for riding, although bylaws restrict usage in the summer. Shore-based angling is popular from the exposed shingle beaches in the region, and bait digging is widespread (see also section 9.1). Many of the more undeveloped sheltered coastal areas of Hampshire are visited for birdwatching, including Chichester and Langstone Harbours, and the Keyhaven - Pennington marshes. The cliffs near Barton-on-Sea are popular for fossil collecting.

Map 9.7.3 Important locations for water-based leisure. Sources: Tourist Offices.

Table 9.7.1 Land-based leisure and tourist facilities

Site	*Grid ref.*	*Notes*
Hampshire		
Hayling Island	SU7200	Hotels, 2 holiday camps, 3 camping and caravan sites
	SZ6999	Golf club
Portsea Island	SZ6498	
	SZ6799	Southsea Pier/promenade and fairground Camp site, golf course, *Mary Rose* and *Victory*
Gilkicker	SZ6097	Golf course
Cams Hall, Fareham	SU5805	Golf course
Solent Breezes	SU5004	Holiday chalets, caravan site
The New Forest	SU30	26,000 bedspaces (not all coastal), mostly in camping and caravan sites. Tourist attractions with >100,000 visitors annually include Beaulieu Motor Museum, Paulton's Park, Buckler's Hard, Exbury Gardens, the New Forest Show, and Lepe Country Park.
Beaulieu River	SU4000	Beaulieu Abbey
Sturt Pond, Milford-on-Sea	SZ2991	Caravan site
Milford-on-Sea and Hordle Cliff	SZ2791	550 beach huts
Barton-on-Sea	SZ2392	145 beach huts
	SZ2492	Golf course
	SZ1791	Naish Farm Holiday Park
Isle of Wight		
East Cowes	SZ5195	Norris Castle, golf course (Osborne House)
Wootton	SZ5493	Holiday village
Ryde	SZ5892	Pier, golf course, caravan/campsite
Sandown	SZ5984	Pier, zoo
Shanklin	SZ5881	Pier
Ventnor	SZ5777	Pier
St. Lawrence	SZ5376	Botanic gardens, bird park
Shepherd's Chine	SZ4480	Holiday camp
Grange Chine	SZ4182	Holiday camps
Freshwater Bay	SZ3485	Golf course
Cowes	SZ4895	Golf course
Dorset		
Christchurch - Poole	SZ2492- SZ0487	More than 20 km of almost continuously developed seafront between Barton on Sea and Sandbanks, continuing around Poole Harbour
Christchurch	SZ1691	Castle, 2 golf courses, beach huts
Bournemouth	SZ0489	Many hotels, piers, golf courses
Poole and Poole Harbour	SY9790	Hotels, caravan sites, zoo
Studland	SZ0382	Golf course, beach huts, hotels
Swanage	SZ0379	2 caravan sites, beach huts, tourist railway
West Lulworth	SY8180	Caravan/campsite
Osmington	SY7382	Caravan site
Preston	SY7082	Caravan site
Weymouth	SY6578	Sea Life Centre, caravan/campsites, golf course
Langton Herring	SY6281	Caravan/campsite
Abbotsbury	SY5784	Gardens, swannery
Burton Bradstock	SY4989	Caravan site
West Bay	SY4591	Caravan sites
Chideock	SY4291	Caravan sites
Charmouth	SY3693	Caravan sites
Lyme Regis	SY3593	3 caravan/campsites, golf course, hotels

Sources: miscellaneous publications, e.g. tourist brochures, Ordnance Survey Landranger maps 1:50,000 series.

Parts of the coast of the Isle of Wight, for example Ryde, Sandown Bay and Compton Bay, are heavily used for beach recreation and general leisure, and have significant tourism-associated infrastructure developments such as guest houses and amusements. There is a Country Park at Fort Victoria (see also section 7.3.6). The 60-mile Isle of Wight Coastal Path runs right round the island (excluding the Osborne estate coast). Birdwatching is popular at Newtown Harbour. According to the latest estimates there are 990 marina berths and moorings and 3,064 other wet moorings on the Isle of Wight (Hampshire County Council 1993). The Sports Council have mapped 34 launching sites on the north coast of the Isle of Wight from Bembridge to Freshwater Bay. Cowes, Gurnard and Bembridge are especially popular for dinghy sailing, and the main site for water skiing and jet-ski launching is Colwell Bay. Hang gliding takes place from several cliff-top sites on the island. Fossil collecting is pursued and a distinctive collection of dinosaur footprints exists.

In Dorset, the beaches adjoining Christchurch, Poole, Swanage and Studland Bays are heavily used, as is the Lulworth Cove area and the coast further west at Lyme

Table 9.7.2 Existing and proposed water-based leisure and tourism facilities

Site	*Grid ref.*	*Description*
Hampshire		
Chichester Harbour	SU7400	Whole harbour important for recreation. About 5,200 yacht berths and moorings (only 800 on Hants. shore) and 3,000 tenders (300 on waiting list) plus 136 visitor moorings/ berths. Five marinas (including Emsworth Yacht Harbour, Northney Marina, Birdham Pool), fourteen sailing and yachting clubs (including Emsworth SC and Hayling Island SC on Hants side), and at least six sailing schools/activity centres. Six public hards/slipways (including two at Langstone and one at Prinstead).
Langstone Harbour	SU7002	About 1,200 moorings, including Langstone marina (300 berths). At least nine sailing clubs and three angling clubs. Sub-Aqua Club. Four main public hards/slipways at Eastney, Hayling Ferry, Broadmarsh and North Hayling Halt. Windsurfing at North Hayling Halt.
Southsea	SZ6498	At least two sailing clubs, two rowing clubs, angling club.
Portsmouth Harbour	SU6203	Fifteen sailing clubs, Sub-Aqua Club; >4,300 berths and moorings (particularly at Portchester, Hardway and Fareham Creek); three angling clubs, numerous public slipways, including Fareham Creek, Hardway, Portsmouth, Camber, Old Portsmouth, and Portchester. Hampshire outdoor centre, Portsmouth.
	SU6305	Very large Port Solent marina village development (650 berths)
	SU6299	Camper and Nicholson marina (350), Haslar marina (under construction 1993: 600 moorings)
Stokes Bay	SZ5998	Three public hards/slipway at No. 2 Battery, sailing club, angling club
Lee-on-the-Solent	SU5601	Public hards/slipways at HMS Daedalus, Marine Parade East, angling and sailing clubs
Hill Head area	SU5402	Two sailing clubs, about 75 moorings
Titchfield Haven	SU5302	Small harbour and sailing club
Southampton Water	SU4309	2,557 moorings, 1,218+ resident marina berths, 1,927 boats ashore (mainly dinghies) 4,861 recreational boat capacity in the ABP harbour area (151 on moorings waiting list). Ten marinas in Southampton Water as a whole (listed below).
River Hamble	SU4805	Four marinas, Port Hamble (340 berths), Hamble Point (230), Mercury Yacht Harbour (346), Swanwick (380+). Eight public slipways at Bursledon (3), Lower Swanwick, Hamble (3) and Warsash. Hamble Quay: 1,867 moorings, 1,273 marina berths, 470 boats ashore, and 30 visitor berths/moorings = total capacity of >3,500, with >1,100 on waiting list. At least four sailing clubs and three canoe clubs.
Woolston to Hamble Point	SU4508	Public slipways at Weston Point, Weston Shore, Netley, and near Royal Victoria Country Park. At least three sailing clubs and an angling club.
River Itchen, Southampton Water	SU4310	Marinas include Ocean Village (500 berths), Shamrock Quay (260), Kemps Quay (180), Itchen (50), Town Quay (136). Several of these include housing developments. Public hards/slipways at Priory Hard, Woodmill Hard, Millbank Hard, Crosshouse Hard, Belvidere Hard, Itchen Ferry and Woolston (two at floating bridge). Two sailing clubs, six rowing clubs, angling club. Hampshire outdoor centres at Woodmill and Southampton (Itchen Bridge)
Totton to Calshot Spit, west shore of Southampton Water	SU3613 to SU4802	Hythe marina village (extension proposed). Hythe pier. Nine sailing clubs and over 1,100 boats. Solent Canoe Club. Public hards/slipways at Eling Creek, Cracknore Hard, Marchwood, Hythe Marina, Ashlett Creek and Calshot Spit. Beach huts.
Calshot Spit	SU4802	Activities Centre in old flying boat hangers, boat park.
Beaulieu	SZ4398	About 500 wet moorings, 355 resident boats ashore, berths for 200 visitors (200 on moorings waiting list). Marina (130 berths) and public hards/slipways at Bucklers Hard. Sailing clubs. Small quay at Exbury Creek.
Lymington	SZ3395	Yachting centre. Two marinas (Lymington Marina and Lymington Yacht Haven). 600 moorings, 1,040 berths, 240+ boats ashore = 1,840+ resident boats and 470 on waiting list. Two public hards/slips. Two sailing clubs, rowing club and canoe club.
Keyhaven and Hurst Spit	SZ3091	583 moorings and 550 boats ashore, 200 on moorings waiting list. Three sailing clubs: Keyhaven, Hurst Castle & Salterns (latter on Eight Acre Pond). Public hard at Keyhaven, sailing club.
Isle of Wight		
Wootton Creek	SZ5593	Yacht Club (60+ dinghies), 168 moorings, one public slipway.
Ryde	SZ5992	Two sailing clubs, four public hards/slipways, about 145 moorings. Vectis Boating and Fishing Club.
Seaview	SZ6291	Yacht club, small boat park and moorings.
Bembridge and St. Helen's	SZ6388	Bembridge Marina, about 600 berths and moorings, 150 for visitors. Three sailing clubs, angling club. Proposal for new 150 marina berths (50 resident, 100 visitor).
Sandown Bay	SZ6083	Sandown and Shanklin Piers, various slipways. Rowing and sailing club. Boat parks. Wight Water Adventure Sports (Welcome Beach), IoW Windsurfing School.
Chale Bay	SZ4876	Blackgang Amusement Park
Freshwater Bay	SZ3485	Seasonal moorings and boat park
Compton Bay	SZ3684	IOW Surf Club hut
Alum Bay	SZ3085	Needles Pleasure Park
Colwell Bay	SZ3388	Windsurfing club

Table 9.7.2 Existing and proposed water-based leisure and tourism facilities (continued)

Site	*Grid ref.*	*Description*
Yarmouth	SZ3589	Two sailing clubs, West Wight canoe club, 522 resident moorings, 240 for visiting boats, 235 boats ashore. 30 new pontoon berths planned. Public hards/slipways at Yarmouth Harbour (two) and River Yar.
Newtown Harbour	SZ4192	About 30 moorings, anchorage for up to 300 visiting boats.
Gurnard Bay, Cowes	SZ4795	Sailing club and angling club.
Cowes Harbour	SZ5096	635 resident moorings, 213 resident berths, 369 boats ashore, and capacity for 1,206 visiting boats. Two marinas: Cowes Yacht Haven, East Cowes Marina and possible marina extensions/developments at Britannia Wharf East Cowes (104 extra berths) and Port Medina (330 berths). Nine clubs/associations. Numerous public slips include Watch House slip, Old Town Quay, Town Quay, East Cowes Esplanade (two), Red Funnel, about five public landings and two other little-used slipways (2,240 total wet moorings with Newport (HCC & SC 1994)).
Newport Harbour	SZ5089	Island Harbour Marina. 209 residential moorings and 25 berths. 300 visitor berths at Town Quay and Island Harbour Marina. Two sailing clubs, three public slipways: Folly Inn and Newport (two).
Dorset		
Christchurch	SZ1892	Harbour, 1,000+ moorings, three sailing clubs, several launching sites, canoe club, Hengisbury Head outdoor centre
Poole Harbour	SZ0288	Nine marinas and boat havens, planning permission for another sheltered yacht haven. 3,600 swinging moorings and 1,944 pontoon and deep water berths, plus 434 pontoon berths and moorings in the River Frome (Poole Harbour Steering Group 1994; Sidaway 1991). Fifteen other boatyards and mooring contractors. Twelve sailing clubs including Royal Motor YC (Sandbanks), Poole YC (Hamworthy), and Parkstone YC. Important facilties include Cobbs Quay Marina (600+ berths), Sunseekers International Marina (50 berths), Gunward and Davis's Boatyard (Holes Bay), Mitchell's Boatyard (Parkstone Bay), Moriconium Quay Marina (Lake), Saltern's Marina (340 berths, Lilliput), Latham's Boatyard, Bray's Boatyard, Lake Pier, Baiter (public slipway), Rockley Point Sailing School, Lilliput Yacht Station, Wareham Quay, Poole Quay (100 berths).
Studland	SZ0484	Launching for small boats
Swanage	SZ0479	Jetty and pontoons for visiting yachts, sailing club, several launching sites
Lulworth Cove	SY8380	Popular anchorage for small craft
Weymouth	SY6878	Harbour and sailing club, national sailing centre, several launching sites
West Bay Harbour/Bridport	SY4792	Harbour
Lyme Regis	SY3592	Harbour, sailing club, powerboat club

Sources: D'Olivera & Featherstone (1993) and miscellaneous publications, e.g. tourist brochures

Regis. Bournemouth, a traditional-style holiday destination and conference location, is one of the largest resorts on the south coast. The Christchurch Bay area is particularly well served for holiday facilities, which include golf courses, beach huts and camping and caravan sites. There are several ferries offering day trips in the Poole Harbour area. Poole Harbour is a popular place for birdwatching, and there is a bird observatory on Portland Bill. Leisure facilities are present at Studland Bay. The Dorset Coast Path (part of the South West Coast Path) runs westwards from Poole and will probably be linked to the Solent Way in the future. Purbeck and the Isle of Portland are internationally-important rock climbing sites; access to certain areas is strictly controlled and management agreements have been drawn up. Dorset County Council (1994) estimates that the cliffs may be used by hundreds of thousands of climbers each year. Fossil collecting is a popular activity at the cliffs near Lyme Regis. There are two Country Parks in Dorset, at Durlston and Upton Park (see also section 7.3.6).

Poole Harbour is the second major boating centre in the region, after Southampton Water, with sailing and power boat club membership of about 8,000 persons (non-member use is likely to be similar or greater), 7,600 boats permanently accommodated in the harbour and up to 4,000 vessels on the water at peak times. There are about 6,000 visiting boat-nights per year. The harbour also supports national and international sailing events. Annual income from recreational activities in the harbour is estimated at about £6 million (Poole Harbour Steering Group 1994). There are nine marinas and boat havens in Poole Harbour (Poole Harbour Steering Group 1994), with extant planning permission for a tenth, pontoon facilities on the River Frome, 3,600 swinging moorings, mainly in the east of the harbour, and eleven sailing clubs. There are proposals to replace swinging moorings in Poole Harbour with sheltered berths in yacht havens without increasing overall numbers. The harbour's total of 7,600 berths and moorings is thought to represent 77% of the total in Dorset, and 8% of those in marinas on the whole of the south coast. There are eighteen slipway sites along the Dorset coast (excluding Poole Harbour, which has only one public slipway), with beach access possible from another thirteen locations, including Christchurch Rowing Club, Swanage Yacht Club and Ocean Bay Watersports (Farnell 1994). Especially popular for dinghy sailing are Swanage Bay, Portland Harbour and Poole Harbour, where there is a popular sailing school. Weymouth Bay is important for dinghy racing and hosts Olympic class regattas. Windsurfing occurs notably at Poole Harbour, Christchurch Bay and Portland Harbour, and many international speed events have been held in the latter, which is also important for water skiing and jet-ski launching. Poole and Weymouth are popular locations for inshore power boat racing; the Royal Motor Yacht Club at Poole is the premier power boat racing club in the UK. The

clearer waters of Swanage and west Dorset are particularly heavily used by divers from the south and east of England, and there are training centres in Poole Harbour and at Swanage.

Wildfowling takes place on at least nine of the region's estuaries, although in many areas shooting is not intensive and is now much less intensive than it was recorded to have been in the earlier part of this century (Tubbs 1991, 1992). In many of these estuaries it is undertaken through wildfowling clubs and syndicates, but elsewhere there are privately-owned shooting rights, and some places are shot over by individuals. Wildfowling on some coastal sites involves both local wildfowlers and those from further afield. Two wildfowling clubs, as well as other areas of private shooting, operate in Chichester Harbour, and a club shoots over parts of Langstone Harbour. There is occasional wildfowling on parts of Southampton Water, and around the Beaulieu River most duck shooting is on land around the estuary rather than intertidally. Around half the intertidal area of the Lymington Estaury is shot over, by two clubs. On the Isle of Wight some low intensity wildfowling occurs on the Newtown Estuary and the upper parts of Wootton Creek. In Dorset, much of Poole Harbour is shot over, some of it by a club and other parts as private shooting, with agreed no-shooting areas around the Arne Peninsula and Brownsea Island. There is some occasional wildfowling in the Fleet and Portland Harbour.

9.7.3 Management and issues

The major issues facing the coast in this region include crowding and conflicts between recreational, commercial and other water users at peak times, increasing demand for sport and leisure facilities, problems of navigational safety and a likely continued pressure for more marina developments. The national and international importance of the region for watersports, combined with its importance for conservation, means that these issues are of great national significance. Tourism in the region and nationally grew through the mid to late 1980s, but declined in the early 1990s recession, although growth is likely to resume in the future (Dorset County Council 1994). Coastal land in this region is likely to come under increasing pressure from people seeking leisure opportunities, on a scale seen in few other areas of the United Kingdom, for a number of reasons: there are good communication links and relative ease of access for the sizeable population in the south of England; existing facilities are good, and the coastline is attractive and varied; and the region has emerged as a popular place to live, with a high quality of life and an increasing number of retired residents. Future planning will be vital to avoid conflicts between the various interest groups (see also Chapter 10).

Recognition of the importance of coastal recreation management is increasing. The desirability of zoning watersports and other activities in some locations is recognised and becoming more important, but zoning may be difficult to implement in many areas. Poole Harbour Aquatic Management Plan identifies major issues and highlights key areas where action is needed to balance conflicts of interest (Poole Harbour Steering Group 1995). Recreation is a topic within estuary management plans being prepared throughout the region (see Chapter 10). Hampshire County Council and the Sports Council have appointed a Coastal Recreation Officer with responsibility for developing strategic projects for recreation in the county.

Measures have already had to be taken to avoid damaging impacts from leisure activities in places; for example, the Solent Way has been routed inland in places on the western Solent to avoid disturbance to wildlife and because of constraints of private land ownership. Similarly, the Dorset Coast Path, which is intended eventually to link with the Solent Way, runs close to coastal cliffs in several areas, and erosion and wildlife disturbance from the large numbers of walkers are a problem (Dorset County Council 1994). Uncontrolled parking, litter and erosion of areas such as Chesil Beach have been reported (DoE/Welsh Office 1993), although these problems are in the process of being resolved. There is also significant demand for improved facilities for coastal riding in the region, and mountain biking is also a growing sport, with similar demands for facilities. New routes must be carefully chosen to avoid erosion and disturbance problems. Local councils are endeavouring to provide suitable facilities for such sports away from the coast (Southern Council for Sport and Recreation 1991).

The high demand for water space has caused conflicts between different recreational groups and other users, such as commercial and defence shipping and fisheries. Improvements in equipment mean that windsurfing is now an all-year-round sport, so care must be taken near the region's many important coastal over-wintering and breeding bird sites (see sections 5.10, 5.11 and 5.12). Beach zonation for windsurfers has been introduced in some areas, including Hayling, Stokes Bay and Lee-on-Solent. Noise and wakes created by recreational power boat use, water-skiing and jet-skiing can cause inconvenience and disturbance to other recreational water users; indeed, all recreational pursuits have the potential to conflict in this way. The Sports Council considers there will be major growth in powered water craft activities over the next few years. Speed limits and non-statutory zoning have been introduced in some places to minimise conflicts. The British Water Ski Federation has drawn up a code of practice, with guidelines for minimising environmental impact. There is sometimes pressure from sponsors to have the power boat racing in the Solent come closer to the shore, whereas the competitors, local residents and conservation bodies would prefer all the racing to be further offshore. Canoe landing is forbidden in several areas, including the entrance to the Beaulieu River.

In general, marina planning applications submitted in recent years have tended to be for much larger sites than in the 1970s and early 1980s, with property development being an integral part of schemes. In 1990 there was one new proposal pending for a marina and associated property development, and four planning applications had been made, for new sites in the Isle of Wight. Of four proposals in Hampshire, three had associated property developments, but there have been no new applications in the past five years. Dorset had three proposals pending with property developments and one without, and a planning application in for one new site and three existing sites (mostly in Poole Harbour) in 1990. Hampshire County Council is questioning whether the limit for the numbers of moorings in the area is now being reached. The British Marine Industries Federation (BMIF) group association for marinas,

the Yacht Harbour Association, has produced a code of conduct for the operation of marinas.

The representative body for sport shooting in the UK is the British Association for Shooting and Conservation (the BASC). Targeted wildfowling species and shooting seasons (the open season for coastal wildfowling in England and Wales is 1 September to 20 February) are regulated through the Wildlife and Countryside Act 1981. As elsewhere in Britain, much of the wildfowling in Region 9 is operated and managed through wildfowling clubs and syndicates. Much takes place on areas covered by national and international site protection, including on several National Nature Reserves (NNRs), where it is mostly managed through permit systems; around 90% of land used for wildfowl shooting in England is designated SSSI. Wildfowling on NNRs is reviewed by Owen (1992). On several estuaries, including Langstone Harbour, there is close co-operation between wildfowling groups and conservation bodies in managing locations and levels of shooting. In Portsmouth Harbour wildfowling is restricted by HM Harbour Master bylaw. Tubbs (1991, 1992) reports that in the first half of this century wildfowling was much more extensive than now in the Solent area, particularly with the widespread use of punt-guns, and suggests that this high hunting pressure may have depressed the size of waterfowl populations, both in Region 9 and more widely.

During periods of severe winter weather, disturbance to waterfowl (including non-targeted species) from shooting threatens the birds' survival; at these times national statutory wildfowling bans can be imposed after fourteen days of freezing conditions (voluntary restraint is called for after seven days). Bans are important in this region since it is used by some species as a refuge when weather further east in continental Europe is severe (Ridgill & Fox 1990). Further information on the history and operation of cold-weather shooting bans is given by Stroud (1992).

The New Forest is owned by the Crown and managed on its behalf by the Forestry Commission. The whole forest is a National Nature Reserve, and its management is complex. Bodies involved include English Nature, Hampshire County Council, the New Forest District Council and the Countryside Commission, as well as commoners (through the Court of Verderers), all of whom are represented on the New Forest Committee, which is advised by the New Forest Consultative Panel, a public forum set up by the Forestry Commission. Issues arising from the intensive use of the New Forest by visitors includes air pollution, littering, traffic congestion, danger to wildlife from traffic, visual intrusion from camp sites, footpath erosion and fire risk. The New Forest District Council has prepared a draft Coastal Management Plan to deal with these and other potentially damaging impacts on the coast. It has also prepared a consultation draft tourism strategy for the New Forest as a whole. Options being considered include the zoning of visitor activities and limited access to certain roads and parts of the forest.

9.7.4 Information sources used

Published sources of data used are listed in section 9.7.6 A; many of them contain far more information than has been mentioned here. Other sources used included tourist brochures and Ordnance Survey Landranger maps. Some sources were not up to date and some new facilities such as golf courses may have been omitted. Other sources include the BMIF Annual Marine Industry Statistics (1989-1994). BMIF have also carried out a national survey of boating and water sports participation (Market Research Solutions Ltd 1994). Useful detail is contained in Chichester Harbour Conservancy (1993). The investment and development monitor being set up by the Dorset Tourism Data Project should provide some useful information on tourism trends. A detailed recreational survey of Poole Harbour was carried out in 1994, and a pilot marine recreation survey of Dorset, carried out in 1993, reached many interesting conclusions (Dorset County Council 1994). The New Forest District Council's New Forest 2000 initiative has produced a *Coastal issues report*, which summarises, in the form of a public consultation document, policy issues for the district's coast (NFDC 1994).

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C. Contact names and addresses

Type of information	Contact address and telephone no.
Tourism information service	British Tourist Authority/English Tourist Board, Commercial Information Library, Thames Tower, Black's Road, Hammersmith, London W6 9EL, tel: 0181 846 9000 x 3011/3015
Tourist Information Centres	
Hayling Island	Beachlands Seafront, Hayling Island PO11 0AG, tel: 01705 467111
Portsmouth	The Hard, Portsmouth PO1 3QJ, tel: 01705 826722
Portsmouth	102 Commercial Road, Portsmouth PO1 1EJ, tel: 01705 822693
Gosport	Gosport Museum, Walpole Road, Gosport PO12 1NS, tel: 01705 522944
Fareham	Westbury Manor, West Street, Fareham PO16 OJJ, tel: 01329 221342; 01983 867979/868600 (Accommodation)
Lyndhurst	New Forest Museum and Visitor Centre, High Street, Lyndhurst, Hants. SO43 7NY, tel: 01703 282269
New Forest	A. Climpson, Tourism Officer, Leisure Services Dept., Hampshire County Council, Appletree Court, Lyndhurst S043 7PA, tel: 01703 285464
Sandown	The Esplanade, Sandown, Isle of Wight PO36 8JY, tel: 01983 403886
Shanklin	67 High Street, Shanklin, Isle of Wight PO37 6JJ, tel: 01983 862942
Ventnor	34 High Street, Ventnor, Isle of Wight PO38 1RZ, tel: 01983 853625
Yarmouth	The Quay, Yarmouth, Isle of Wight PO41 4PQ, tel: 01983 760015
Cowes	The Arcade, Fountain Quay, Cowes, Isle of Wight PO31 7AR, tel: 01983 291914
Ryde	Western Esplanade, Ryde, Isle of Wight PO33 2HE, tel: 01983 562905
Newport	The Car Park, South Street, Newport, Isle of Wight PO30 1JS, tel: 01983 525450
Southampton	Above Bar, Southampton SO9 4XF, tel: 01703 221106
Lymington	The Car Park Rear of Waitrose, St. Thomas Street, Lymington SO41 9BH, tel: 01590 672422
Christchurch	23 High Street, Christchurch BH23 1AB, tel: 01202 471780
Bournemouth	Westover Road, Bournemouth BH1 2BU, tel: 01202 789789
Poole	Dolphin Shopping Centre, Poole BH15 1HE, tel: 01202 673322
Wareham	Town Hall, East Street, Wareham BH20 4NG, tel: 01929 552740
Swanage	The White House, Shore Road, Swanage BH19 1LB, tel: 01929 422885
Weymouth	The King's Statue, The Esplanade, Weymouth DT4 7AN, tel: 01305 765221; 765223/785747 (Accommodation)
Bridport	32 South Street, Bridport DT6 3NQ, tel: 01308 24901
Lyme Regis	Guildhall Cottage, Church Street, Lyme Regis DT7 3BS, tel: 01297 442138
Sport and recreation	Sports Council, Headquarters, 16 Upper Woburn Place, London WC1H 0QP, tel: 0171 388 1277
Sport and recreation - Hampshire and Isle of Wight	Sports Council, Southern Region, 51a Church Street, Caversham, Reading RG4 8AX, tel: 01734 483311
Sport and recreation - Dorset	Sports Council, South West Region, Ashlands House, Ashlands, Crewkerne, Somerset TA18 7LQ, tel: 01460 73491
Coastal recreation in Hampshire	*Coastal Recreation Officer, Hampshire County Council, Winchester, tel: 01962 846027
Coastal recreation in Dorset	*Planning Department, Dorset County Council, Dorchester, tel: 01305 251000
Wildfowl and wetlands	*Publicity Officer, Wildfowl and 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, 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	*Licensing Officer, English Nature HQ, Peterborough, tel: 01733 340345
Sailing activities	Solent Cruising & Racing Association, 18-19 Bath Road, Cowes, IoW PO31 7QN, tel: 01983 293303
Small boat movements - Solent	HM Coastguard - Solent, 44a Marine Parade West, Lee-on-Solent PO13 9NR, tel: 01705 552100

C. Contact names and addresses (continued)

Type of information	*Contact address and telephone no.*
Small boat movements - Portland	HM Coastguard - Portland, MRSC, Portland, 8 Custom House Quay, Weymouth, Dorset DT4 8BE, tel: 01305 760439
Sailing, windsurfing and powerboating	Royal Yachting Association, RYA House, Romsey Road, Eastleigh SO5 4YA, tel: 01703 629962
Marine leisure industries; small craft marine industries	British Marine Industries Federation, Meadlake Place, Thorpe Lea Road, Egham, Surrey TW20 8HE, tel: 01784 473377
Poole Harbour management and zoning	Harbour Project Officer, Poole Harbour Commissioners & Dorset County Council, Engineers Office, 20 New Quay Road, Hamworthy, Poole, Dorset BH15 4AF, tel: 01202 685311
Harbours and moorings	Solent Harbour Masters Association, c/o Hon. Sec., Captain Steven Young, Ocean Gate, Atlantic Way, Southampton SO14 3QN, tel: 01703 330022

Type of information	*Contact address and telephone no.*
Harbour Masters	See Appendix A.2
Chichester	*Chichester, tel: 01243 512301
Langstone	*Hayling Island, tel: 01705 463419
Portsmouth	*Portsmouth, tel: 01705 297395
River Hamble	*Warsash, tel: 01489 576387
Southampton	*Southampton, tel: 01703 330022
Beaulieu	*Beaulieu, tel: 01590 616200
Lymington	*Lymington, tel: 01590 672014
Keyhaven	*Keyhaven, tel: 01590 645695
Cowes	*Cowes, tel: 01983 293952
Newport	*Newport, tel: 01983 520000
Bembridge	*Ryde, tel: 01983 872828
Yarmouth	*Yarmouth, tel: 01983 760321
Christchurch	*Christchurch, tel: 01202 486321
Bournemouth	*Bournemouth, tel: 01202 552066
Poole	*Poole, tel: 01202 440200
Swanage	*Weymouth, tel: 01305 206275
Weymouth	*Weymouth, tel: 01305 206421
Portland	*Portland, tel: 01305 824044
Bridport (West Bay); Lyme Regis	*Dorchester, tel: 01297 442137

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

Leisure, tourism, conservation, industry, housing and defence combine to place heavy demands on the region's coast. At West Bay, Dorset, for example, the many visitors have eroded the fragile cliff-top grasslands down to the bedrock. Reconciling the potentially conflicting needs of all who use the coast is a major preoccupation of statutory and voluntary bodies in the region. Photo: Nick Davidson, JNCC.

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 9. GB and UK national initiatives without a specific regional focus, notably those led by non-governmental agencies and user groups, are outside its scope. However, as the whole chapter concludes with a list of contacts with a wider involvement or interest in coastal management (section 10.4), 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 coastal 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).

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 these 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." Section 10.4 B gives additional notes on the content of these publications.

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.

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 & Species Directive (Department of the Environment/Welsh Office 1994). 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 10.2.7).

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 10.2.3). 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. The British Marine Industries Federation is actively promoting responsible environmental management to its members. For further information on regionally-led coastal management initiatives, see section 10.3.

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 relating 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 at 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.

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 met three times in 1995.

The Coastal Heritage Network (CoastNET)

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 individuals and groups concerned with the management of Heritage Coasts in England (the Arfordir Group fulfills a similar role in Wales); proposals have been put forward to broaden this forum to the whole of the UK.

10.2.3 English Nature

English Nature organises or participates in a number of national coastal zone management initiatives, as detailed below (see also section 10.2.7).

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 under way or proposed in the country, five are under way (none proposed) in this region (Table 10.2.1). English Nature's involvement in these projects may vary from full involvement in the management committee through sitting on a Topic Group to responding to consultation drafts; inclusion of a project in Table 10.2.1 does not imply that it is led by English Nature.

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. Two trial areas will be selected initially from the important areas for marine wildlife identified around the English coast (see Chapter 7), and the Estuaries Initiative model will be used to develop coastal zone management within these sites. The SMAs within the region are the Solent and the Isle of Wight, Poole Bay and the Isle of Purbeck, Portland and the Fleet, and Lyme Bay, which falls partly within the region. The programme will probably include a 6-12 month period of

information gathering, followed by the preparation of a recommended management structure/management plan. It is hoped to achieve this through joint funding with key partners.

Maritime Natural Areas

English Nature has, through consultation, identified 23 Maritime Natural Areas around the coast of England (described in *Conserving England's maritime heritage - a strategy* (English Nature 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, from Portland Bill to Start Point) lying partly within the region. An exercise will be undertaken to review its coastline, adjacent areas, the mechanisms by which the area is regulated and how these may be applied in future, and a framework developed to decide what the management objectives for the area are and how they may be achieved. A strategy will be derived from this review, including the management objectives for the Maritime Natural Area and an action plan for their implementation. Future projects should extend this approach to the other Maritime Natural Areas within this region: Selsey Bill to Studland Cliffs (including the Isle of Wight), and Studland Cliffs to Portland Bill.

10.2.4 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.

10.2.5 Shoreline management plans

Shoreline management plans set out a strategy for coastal defence for a specified length of coast, taking account of natural processes and human and other environmental influences and needs (MAFF *et al.* 1994). They are based on coastal sub-cells and are compiled in accordance with government guidelines on assessing the environmental impacts of proposals, including soft defence and 'do nothing' options, to be produced in association with and grant aided by MAFF. SCOPAC (the non-statutory Standing Conference on Problems Associated with the Coastline, created October 1986) is currently preparing a Shoreline Management Plan for the SCOPAC region, co-ordinating the work of coastal defence agencies in the region - 20 agencies from West Sussex to Dorset - and the Lyme Bay and South Devon Coastline Group (Table 10.3.1). The main objectives are 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 understanding of coastal processes (see also section 8.4). Six separate groups are preparing sub-cell Shoreline Management Plans for coastal defence in the region (Table 10.2.2). All should be completed by the end of 1996. Each is managed by a Shoreline Management Group, which comprises the lead authority, other local authority partners within the coastal sub-cell, the National Rivers Authority, English Nature, MAFF and any other important local organisations (for example, the Poole Harbour Commissioners in Poole and Christchurch Bays). Such groups are also known as Coastal Engineering Groups.

10.2.6 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 10.2.3 gives the National Rivers Authority's five year programme for the completion of consultation reports for the ten river catchment management plans bordering the coast in the region (NRA 1994).

10.2.7 Designated sites

Discussed in detail in Chapter 7, several statutory and non-statutory designations are also relevant here because they provide a degree of coastal management through their area

Map 10.2.1 River catchment areas for catchment management plans. Source: NRA; reproduced by kind permission.

Table 10.2.1 Coastal management initiatives allied to English Nature's Estuaries Initiative

Initiative name	*Activities*	*Organisations involved*	*Contact address and telephone no.*
Chichester Harbour Management Plan	Develops and promotes sustainable use of resources through consultation, consensus and improved understanding; maintenance of a balance of use between interests. 10 year management plan with initial 5 year implementation programme (draft 1993); regular reviews.	Chichester Harbour Conservancy, Countryside Commission, English Nature, West Sussex & Hants. County Councils, various commercial and voluntary organisations.	Environmental Manager, Chichester Harbour Conservancy, Itchenor, Chichester, West Sussex PO20 7AW, tel: 01243 512301
Langstone Harbour Management Plan	Aims to promote sustainable use of Langstone Harbour by managing human activity there; conserve and enhance nature conservation; accommodate appropriate recreation; accommodate appropriate commercial use; involve Harbour users and interested parties in the work of the Harbour Advisory Committee; improve water quality in the Harbour; safeguard landscape and the built and/or historic or archaeological heritage; encourage sustainable land management esp. for nature conservation. Produced a management plan (1994).	Langstone Harbour Board (lead agency), English Nature, Havant Borough Council, Portsmouth City Council, Hampshire County Council	R.B. Tweed LLB, Clerk, Langstone Harbour Board, Ferry Road, Hayling Island, Hants. PO11 0DG, tel: 01705 463419
Portsmouth Harbour Plan	Plan endeavours to achieve broad conservation objectives of sustainable development; any development adversely affecting the nature conservation value of the harbour is not normally permitted. Implemented by LPAs, Queen's Harbour Master, MoD (through Property Services Agency (PSA)) and English Nature. Under review in 1995.	Portsmouth City Council, Gosport and Fareham Borough Councils, Hants. County Council, managed by above plus Harbour Master, PSA and English Nature.	R. Brown, City Treasurer's Department, Portsmouth City Council, Civic Offices, Guildhall Square, Portsmouth PO1 2AR, tel: 01705 822251
Medina Estuary Management Plan	In preparation, 1995.	Cowes Harbour Commissioners (lead agency), English Nature	Captain H.N.J. Wrigley, Harbour Master/Chief Executive, Cowes Harbour Commissioners, Harbour Office, Town Quay, Cowes, Isle of Wight PO31 7AS, tel: 01983 293952
Poole Harbour Aquatic Management Plan (Poole Harbour Steering Group 1995)	Aims to promote sustainable use of harbour, balance demands on natural resources and resolve conflicts of interest. Also published draft aquatic management plant (Poole Harbour Steering Group 1994a), which included a report by RSPB on breeding birds, plus a survey of waterborne craft (Environmental Research Group 1994), a harbour survey (Poole Harbour Steering Group 1994b), and a study of impacts of human shoreline activities (Dyrynda & Lewis 1994). Final Plan published as Poole Harbour Aquatic Management Plan (Poole Harbour Steering Group 1995). Plan implemented through a zoning plan for water users (Pool Harbour Steering Group 1991), speed limits, limits on recreational capacity, PHC bylaws, zone marking, Users Forum for informal information exchange, and publicity effort.	Poole Harbour Steering Group: Poole Harbour Commissioners (lead agency), Dorset County Council, Poole Borough Council, Purbeck District Council, English Nature, National Rivers Authority, Southern Sea Fisheries Committee; assisted by RSPB and British Marine Industries Federation; South Western Council for Sport and Recreation (observers); Atlantic Arc 'Atlantis' Programme (additional funding partner). Input from consultants Portsmouth Univ. Centre for Coastal Zone Management.	*Poole Harbour Commissioners, Harbour Office, Poole, tel: 01202 440200

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

Table 10.2.2 Shoreline Management Plans

Sub-cell	*Lead organisation in management group*
Eastern Solent (Hamble River to Selsey Bill)	Chichester District Council, East Pallant House, East Pallant, Chichester PO19 1TY, tel: 01243 785166
Western Solent (Hurst Castle to Hamble River)	*New Forest District Council, tel: 01703 285000
Isle of Wight	Robin McInnes, Amenities and Coastal Manager, Environment and Engineering Services Department, Isle of Wight Council, Newport, tel: 01983 823770
Poole and Christchurch Bays (Durlston Head to Hurst Castle)	*Directorate of Development Services, Bournemouth Borough Council, tel: 01202 552066
Portland Bill to Durlston Head	*Weymouth and Portland Borough Council, tel: 01305 761222
Lyme Bay (west of Portland Bill)	*West Dorset District Council, tel: 01305 251010

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

Table 10.2.3 Coastal Catchment Management Plans timetable

Catchments	*Timescale*	*Contact*
Itchen	Final plan available	*NRA Southern Region, Worthing, tel: 01903 820692
Test	Final plan available	as above
Hampshire Avon	Consultation reports available	as above
West Hampshire	Due for completion 1996/97	as above
Meon and East Hampshire	Due for completion in 1994/5	as above
Isle of Wight	Due for completion in 1994/5	as above
Frome and Piddle	Due for completion in 1994/5	*NRA South Western Region, Exeter, tel: 01392 444000
Poole Harbour	Due for completion 1995/96	as above
Dorset Stour	Due for completion 1996/97	as above
West Dorset Streams	Due for completion 1996/97	as above

Table 10.2.4 Heritage Coast management plans

Heritage Coast	*Aims*	*Organisations involved*	*Contact address*
Hamstead and Tennyson Heritage Coasts	Managed as Isle of Wight Heritage Coast, part of the AONB, by the Isle of Wight Countryside Management Service, which covers the whole island.	Steering Group: Isle of Wight CC, South Wight Borough Council, Countryside Commission, National Farmers Union, Country Landowners Association, English Nature.	Island Planning Unit, 41 Sea Street, Newport, Isle of Wight PO35 5DN, tel: 01983 822119
West Dorset and Purbeck Heritage Coast Plans	Integrated management of the two Heritage Coasts. West Dorset Heritage Coast Management Plan (1982) and Purbeck Heritage Coast Management Plan (1982) are currently in use.	Managed by Dorset CC as part of Countryside Recreation Group. Funded by Countryside Commission, Dorset CC and West Dorset DC/Purbeck DC.	*Countryside Recreation Group, Dorset CC, Planning Department, County Hall, Dorchester, tel: 01305 251000

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

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 range from nature reserves, managed by English Nature, wildlife trusts, local authorities, the RSPB or other approved bodies for nature conservation objectives, through Heritage Coasts (see below) to the proposed marine Special Areas for Conservation (see below and section 7.1). The National Trust, which has extensive land holdings along the region's coast, has recently been carrying out a complete review of its Coastal Strategy Plans and has an ongoing review of coastal site management plans.

Heritage Coasts

The defined areas of Heritage Coasts include only the finest sections of undeveloped coast (see section 7.4.3). 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. The four Heritage Coast Projects in the region (Hamstead, Tennyson, Purbeck and West Dorset) are all producing or implementing

management plans through their respective local authorities and associated Steering Groups (Table 10.2.4). These plans cover coastal Areas of Outstanding Natural Beauty, but larger coastal areas are also included in the remit of the Countryside Management Services that cover the Heritage Coasts. The Coastal Heritage Network (CoastNET - see section 10.2.2) brings together those managing Heritage Coasts.

Marine Special Areas of Conservation (SACs)

Under the EC Habitats & Species 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), port 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 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 instigation of the Scottish Office, the four country nature conservation agencies are 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 10.2.5), which are primarily concerned with promoting coordination and liaison between organisations undertaking coastal works (section 8.4). In some places wider coastal fora have developed from a range of coastal designations and various management initiatives. Two important examples of several operating in the region are the Solent Forum and the Dorset Coast Forum (see Table 10.3.1 for others). The great value of such 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 lists regional coastal management initiatives, in many of which local authorities are involved or take a leading role.

10.3.2 Local planning authority and ports/harbours initiatives

The maritime local planning authorities are involved in most, if not all, of the major coastal zone management initiatives described in Tables 10.2.1, 10.2.2, 10.2.4 and 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. An important local authority initiative, at county level, is SERPLAN (Coastal Planning Guidelines for the South East), which extends to Hampshire and the Isle of Wight but does not include Dorset (see Table 10.3.1). Hampshire County Council have wide-ranging coastal management initiatives underway. The Isle of Wight Council is a recently formed Unitary Authority, which is in the process of preparing a new Unitary Development Plan, including coastal issues. Dorset County Council are preparing a coastal strategy for the sustainable management of the county's coastline. Recommendations for the management of Poole Harbour are the result of co-operation between the County Council,

Table 10.3.1 Regional coastal management initiatives

Initiative name	*Scope/aims*	*Organisations involved*	*Contact address*
The London and South East Regional Planning Conference (SERPLAN)	Preparing coastal planning guidelines to be incorporated into the Regional Planning Guidance to be issued by the Secretary of State. Strategy proposes protection and enhancement of the region's coastal landscapes, wildlife habitats and recreational opportunities, and balanced sustainable development. Draft coastal planning guidelines (SERPLAN 1992) deal with development control for the developed and undeveloped coast, energy generation, policies for the marine environment, coastal defences and water quality. Working Party from coastal counties will monitor implementation of guidelines (1993), including maintenance of special coastal features, development guidelines, promotion of healthy marine environment, consideration of managed retreat, need for Environmental Assessment, joint working and a tiered approach to management plans.	East Sussex, Hampshire, West Sussex, Kent, Essex, Isle of Wight Joint Planning Unit and SERPLAN.	Secretary, SERPLAN, 14 Buckingham Gate, London SW1E 6LB, tel: 0171 931 8777
Standing Conference on Problems Associated with the Coastline (SCOPAC)	Covers Worthing to Weymouth. Activities include co-ordinating activities of member authorities relating to the coast; promoting and undertaking research into natural processes; preparing Shoreline Management Plan for whole coast and integrating it into a coastal zone management plan. Six research projects completed/in progress. Holds three meetings per year.	East & West Sussex, Hampshire & Dorset CCs, seventeen DCs, three Harbour Auths., NRA, Southern Sea Fisheries Committee, English Nature, Sports Council and one major landowner. Elected members of Conference are assisted by an Officers Working Group.	*The Secretary, SCOPAC, c/o Isle of Wight County Council, Newport, tel: 01983 521817

Table 10.3.1 Regional coastal management initiatives (continued)

Initiative name	*Scope/aims*	*Organisations involved*	*Contact address*
The Solent Forum	Provides a broadly based consultative forum; raises awareness and understanding; contributes to policy development, plan making and strategy formulation. Implements strategy through members of forum.	13 Local Authorities, 10 Harbour Authorities, and 20 other organisations (inc. both commercial & environmental interests).	*County Planning Department, Hampshire County Council, Winchester, tel: 01962 846759
Solent Strategic Guidance Project	Needed in order to establish a general direction for the whole of the Solent in terms of strategic planning and management; to raise awareness and understanding of the main issues; and to set out the ground rules for liaison and consultation. A project officer is to be appointed.	Being developed under the auspices of the Solent Forum	*County Planning Department, Hampshire County Council, Winchester, tel: 01962 846759
Hampshire Coast Strategy	Promotes the special character and role of the Solent; promotes more integrated coastal planning and management. Strategy (Hampshire County Council 1991) implemented through liaison and working with wide range of statutory authorities and agencies.	Hampshire County Council, managed through the Solent Forum (see above).	*County Planning Department, Hampshire County Council, Winchester, tel: 01962 846759
Coastal Recreation Strategy for Sport - Hampshire.	Promotes strategic approach, detailed recommendations for all sports, cautious approach to provision. Coastal Recreation Officer implements Strategy (Southern Council for Sport and Recreation 1991).	Sports Council, Hampshire County Council, managed by Project Officer and Steering Group.	*Countryside & Community Department, Hampshire County Council, Winchester, tel: 01903 741234
Stokes Bay and Browndown Landscape Study	Assesses landscape quality, problems and proposals.	Gosport Borough Council	*Assistant Planning Officer, Gosport Borough Council, Gosport, tel: 01705 545458
Stokes Bay Policy Plan	Management Plan adopted 1982. Multi-issue objectives mainly concerned with land use.	Gosport Borough Council	*Assistant Planning Officer, Gosport Borough Council, Gosport, tel: 01705 545458
New Forest Coastal Management Plan (Draft 1994)	Recommends promotion of a high quality coastal environment; objectives are to protect and enhance important landscape, ecological & historical features; promote research into coastal processes; develop long term coastal protection and maintenance plan; increase public knowledge and enjoyment; promote water quality and beach cleanliness; maintain coastal employment and commercial activity.	New Forest and Christchurch District Councils, Hants. and IOW CCs, EN, SCOPAC, Trust for Maritime Archaeology, and Hants. Wildlife Trust. Managed through Steering Group. Officers Working Group.	Principal Engineer, New Forest DC, Town Hall, Lymington SO41 9ZG, tel: 01703 285908
South Wight Coastal Zone Management Plan	Co-operation through SCOPAC, landslide monitoring and research, general improvement of the coastal environment. Management Plan (McInnes 1994), implemented through the former South Wight Borough Engineers Department and Planning Unit.	Isle of Wight (formerly south Wight) Borough Council with MAFF. Managed through Environment and Engineering Services Department, Countryside Management Service and AONB Officer, Planning Staff.	*Robin McInnes, Isle of Wight Council, Newport, tel: 01983 823770
Isle of Wight Coastal Zone Management Plan	Will update South Wight CZMP by adding remainder of coast, publication due in 1996.		*Robin McInnes, Isle of Wight Council, Newport, tel: 01983 823770

Table 10.3.1 Regional coastal management initiatives (continued)

Initiative name	*Scope/aims*	*Organisations involved*	*Contact address*
Hengistbury Head Management Plan	A comprehensive guide to the understanding of the area forming Hengistbury Head and the southern edge of Christchurch Harbour, with recommendations for its care and maintenance. The Plan aims at keeping or improving the fine natural features of the area and at the same time plans for the optimum public enjoyment of these features.	Bournemouth and Christchurch Borough Councils, English Heritage, English Nature, Dorset County Council, Christchurch Harbour Ornithological Group, Dorset Trust for Nature Conservation, Hampshire County Museums Service, Oxford, Bournemouth and Southampton Universities.	*Hengistbury Head Ranger, Leisure and Tourism Directorate, Bournemouth Borough Council, tel: 01202 702192/420909
South West Regional Planning Conference	Publication of regional planning guidance awaited July 1994. Joint action required by all LPAs and agencies to adopt an agreed vision and set priorities; maintain and enhance coastal features; no development on undeveloped parts of coast.	South West County Councils (Dorset, Devon, Cornwall, Wilts., Somerset, Avon & Glos.) and District Councils.	*Devon County Council, Exeter, tel: 01392 382000
Coastal Strategy for Dorset	Strategy (Dorset County Council 1994) identifies need for co-ordinated review and guidance for development plans, management plans and policies of all coastal agencies. Implementation through inter-agency co-ordination, preparation of widely based coastal management plans.	Dorset County Council with Maritime Districts; co-operative study involving statutory and voluntary agencies.	*Coastal Policy Officer, Planning Department, Dorset County Council, Dorchester, tel: 01305 224132
Dorset Coast Forum	To promote sustainable approach to the management of the coastal zone through encouraging dialogue and co-operation, encouraging the gathering and dissemination of knowledge and working towards producing integrated policies.	Members include all organisations with a regulatory or user interest in the Dorset coast.	*Coastal Policy Officer, Planning Department, Dorset County Council, Dorchester, tel: 01305 224132
Poole Harbour Management Policies	A framework for the (landward) management of the Harbour. Recommends comprehensive management policies related to land-use, habitats and access on shoreline. Implementation through Local Plans, development control policies, PHC bylaws and publicity effort.	Dorset CC, Poole Borough Council, Purbeck DC, Poole Harbour Commissioners, English Nature (Estuaries Initiative), NRA, RSPB, Southern Sea Fisheries Committee.	*Ian Bishop, Assistant Harbour Master, Poole Harbour Commissioners, tel: 01202 440200
Dorset Coastlink	Communication network for marine educators.		Dr Carolyn Heeps, School of Conservation Sciences, Bournemouth University, Talbot Campus, Fern Barrow, Poole, Dorset BH12 5BB, tel: 01202 595178
Lyme Bay Coastal Forum	Covers area from Portland to Start Point and addresses major issues affecting Lyme Bay (oil transport and discharge, inshore water quality, coast protection, marine environmental quality, fishing, tourism, policy and management). Provides a forum for discussion and newsletter.	Joint initiative between Devon and Dorset County Councils, to bring together organisations, agencies, user groups, voluntary bodies and local authorities with an interest in Lyme Bay.	*Coastal Policy Officer, Planning Department, Dorset County Council, Dorchester, tel: 01305 224132 or Environment Department, Devon County Council, County Hall, Exeter EX2 4QH, tel: 01392 382000
Lyme Bay and South Devon Coastline Group	Aims to improve co-ordination and liaison between agencies undertaking coastal works.		M.F. Johnson, Director of Technical Services, South Hams District Council, Follaton House, Plymouth Road, Totnes, Devon TQ9 5NE, tel: 01803 861234

* 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*
Statutory plans		
Hampshire		
Hampshire County Council	*Hampshire County Structure Plan*	Approved 1994
Hampshire County Council	*River Hamble Local Plan: First Alteration*	Adopted 1992
Chichester District Council	*Chichester District Local Plan*	In prep.
Chichester District Council	*Management Plan* (will co-ordinate District Council services)	In prep.
Eastleigh District Council	*Hound, Hamble and Bursledon Local Plan*	Adopted 1985
Eastleigh District Council	*Eastleigh District Local Plan*	Deposited 1994
New Forest District Council	*Forest and Downland Villages Local Plan*	Adopted 1986
New Forest District Council	*New Forest District Local Plan* (consultation draft)	Consultation draft 1994
New Forest District Council	*New Forest District East Local Plan* (unadopted)	Deposited 1991, modified 1994, unadopted
Fareham Borough Council	*Fareham Borough Local Plan*	Adopted 1992
Gosport Borough Council	*Gosport Borough Local Plan*	Adopted 1995
Havant Borough Council	*Havant Borough Local Plan*	Adopted 1994
Portsmouth City Council	*Portsmouth City Local Plan*	Adopted 1995
Southampton City Council	*City of Southampton Local Plan*	Deposited 1993. Report on Public Inquiry in 1995
Isle of Wight		
Isle of Wight Council	*Isle of Wight Structure Plan*	Draft deposited September 1994
Isle of Wight Council	*Unitary Development Plan*	Consultation draft due January 1996
Dorset		
Dorset County Council	*South East Dorset Structure Plan, Second Alteration*	Approved September 1992
Dorset County Council	*Dorset (excluding south east) Structure Plan, Second Alteration*	Approved May 1993
Dorset County Council	*Dorset County Structure Plan*	Consultation draft November 1994
Dorset County Council	*Minerals and Waste Local Plan*	Deposited July 1994.
Purbeck District Council	*Isle of Purbeck Local Plan*	1991
Purbeck District Council	*North East Purbeck Local Plan*	1994
West Dorset District Council	*West Dorset District Local Plan*	Deposited June 1994
West Dorset District Council	*Bridport Local Plan*	1992
Bournemouth Borough Council	*Bournemouth Borough Local Plan*	Consultation draft due spring 1996
Bournemouth Borough Council	*Boscombe Local Plan*	1995
Bournemouth Borough Council	*Bournemouth Town Centre Local Plan*	1988
Christchurch Borough Council	*Christchurch Borough Local Plan*	Consultation draft May 1995
Christchurch Borough Council	*Highcliffe and District Local Plan*	1993
Christchurch Borough Council	*South Christchurch Local Plan*	1993
Poole Borough Council	*Poole Borough Local Plan*	Deposited October 1994
Poole Borough Council	*Poole Coastal Local Plan*	1992
Poole Borough Council	*Poole Town Centre Local Plan*	1987
Purbeck Borough Council	*Purbeck Borough Local Plan*	Deposit due 1996
Weymouth and Portland Borough Council	*Weymouth and Portland Borough Local Plan*	Deposited September 1993
Weymouth and Portland Borough Council	*Isle of Purbeck Local Plan*	1992
Non-statutory plans and Management Guidelines		
Hampshire		
Hampshire County Council	*A Strategy for Hampshire's Coast*	1991
	Beachlands Local Plan	1990
	Calshot Marshes LNR Management Guidelines	1986
	Chichester Harbour Amenity Area Management Plan	1983
Chichester Harbour Conservancy	*Chichester Harbour Management Plan*	1994
	Chilling Coastal Area Draft Management Plan	1989
	Eastney Master Plan	1983
	Fareham to Portchester Foreshore Landscape Strategy	1988
	Hamble Common Management Plan	1985
	Hook Nature Reserve Draft Management Plan	1981
RSPB	*Langstone Harbour Management Plan*	1991
Langstone Harbour Board	*Langstone Harbour Management Plan* (draft)	1995
Portsmouth City Council/ Havant Borough Council	*Langstone Harbour Planning Guidelines*	1983
	Lymington Coastal Area Management Guidelines	1986
	Lymington-Keyhaven Coast Management Proposals	1982
Hampshire County Council/ New Forest District Council	*Lymington-Keyhaven Coast: Policies for future management*	1992
	Mercury Marshes Management Guidelines	1986
	Portsmouth Harbour Plan	1989

Table 10.3.2 Local authority plans (excluding most local and unitary plans) (continued)

Planning Authority	*Title*	*Date adopted/ current status*
Hampshire (continued)		
Hampshire County Council/ New Forest District Council (continued)	*River Itchen Waterside Policy*	1981
	Royal Victoria Country Park Management Plan	1985
	Stokes Bay Policy Plan	1981
	Thorney Island Planning Brief	
	Titchfield Haven LNR Management Plan	1986
	Upper Hamble Country Park Management Guidelines	1986
	Warblington Countryside and Foreshore Area Plan	1982
	West Wood Draft Recreation Plan	1985
Dorset		
Dorset County Council	*The Dorset Coast Today*	1994
Dorset County Council	*The future of Dorset's coast*	1994
Poole Harbour Steering Group (Dorset CC)	*Poole Harbour Aquatic Management Plan Consultation Draft*	1994
Poole Harbour Steering Group (Dorset CC)	*Poole Harbour Management Policies*	1991
Weymouth and Portland Borough Council	*Portland Harbour Management Plan Issues Report*	1995

the Poole Harbour Commissioners and other statutory and non-governmental organisations. Port and Harbour Authorities also have a statutory remit to control activities within their areas of authority, which may include coastal waters, and will receive wider powers to manage Special Areas of Conservation under the EC Habitats Directive. They are listed with local planning authorities in Appendix A2.

Table 10.3.2 lists examples of local authority planning documents.

10.3.3 Acknowledgements

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10.4 Further sources of information

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Department of the Environment/Welsh Office. 1993b. *Managing the coast: a review of coastal management plans in England and Wales and the powers supporting them.* London, HMSO.

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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 10.4C.

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.
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 draw-backs 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. (Highlights government coastal policy and summarises essential guidance.)
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.)

C. Contact names and addresses

(See also Tables 10.2.1, 10.2.2, 10.2.3, 10.2.4 and 10.3.1.)

Organisation/group	*Activities*	*Contact address and telephone no.*
British Marine Industry Federation	The BMIF Environment Initiative is developing a code of practice for the marine industry and a user outreach programme to educate boat users about their environmental responsibilities. It has also produced a Guidance Note on Planning Policies for the Marine Environment.	BMIF, Meadlake Place, Thorpe Lea Road, Egham, Surrey TW20 8HE, tel: 01784 473377
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. It links individuals and organisations working for the sustainable management of the coastal and marine environment. 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 Coastal Heritage Network, Centre for Environmental Interpretation, The Manchester Metropolitan University, St. Augustine's, 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 Commission	Promotion of policies for Heritage Coasts, and coastal management generally	National Parks and Planning Branch, Countryside Commission, John Dower House, Crescent Place, Cheltenham, Glos. GL50 3RA, tel: 01242 521381
English Coastal Groups Forum	Established by MAFF in 1991. Co-ordinates the work of the English Coastal Groups (see section 10.2.2); 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, 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 0QD, 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, PO Box 11059, NL-2301 EB Leiden, tel: +31 71 122900/123952
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

Addresses and telephone numbers of local planning authorities are given in full in the Appendix, as are *starred contact addresses.

C. Contact names and addresses (continued)

Organisation/group	*Activities*	*Contact address and telephone no.*
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
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, Prof. Graham King, CZM 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.	Marine Forum, Natural History Museum, Cromwell Road, London SW7 5BD, tel: 0171 938 9114
Ministry of Agriculture, Fisheries and Food	Shoreline Management Plans (mainly aimed at formulating a coast protection strategy)	MAFF, Eastbury House, 30/34 Albert Embankment, London SE1 7TL, tel: 0171 238 3000
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)	Environment Programme Manager, 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, shoreline management plans.	*Flood Defence Section, NRA HQ, Bristol, tel. 01454 624400, or NRA Southern Region, Southern Water (Winchester Area), Guildbourne House, Chatsworth Road, Worthing, W. Sussex BN11 1LD, tel: 01903 820692, or NRA South West Region, South Western Water (Blandford Area) Manley House, Kestrel Way, Exeter EX2 7LQ, tel: 01392 444000
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.	Southern Office (Hampshire & Isle of Wight), Polesden Lacey, Dorking, Surrey RH5 6BD, tel: 01372 453401, or Wessex Office (Dorset), Eastleigh Court, Bishopstrow, Warminster, Wilts. BA12 9HW, tel: 01985 847777
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
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.

Appendix

A.1 Frequently cited contact names and addresses

Name	*Contact address and telephone no.*
Statutory bodies	
Countryside Commission (CC), HQ	John Dower House, Crescent Place, Cheltenham, Gloucestershire GL50 3RA, tel: 01242 521381
CC, South-west Region	Bridge House, Sion Place, Clifton Down, Bristol BS8 4AS, tel: 01179 739966
CC, South-east Region	4th Floor, 71 Kingsway, London WC2B 6ST, tel: 0171 831 3510
Department of the Environment (DoE), European Wildlife Division/ Dept. of Rural Affairs	DoE, Room 9/03B, Tollgate House, Houlton Street, Bristol BS2 9DJ, tel: 0117 9878000
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, tel: 01733 340345
English Nature, Hants. & IOW Local Team	1 Southampton Road, Lyndhurst, Hampshire SO43 7BU, tel: 01703 283944
English Nature, Dorset Local Team	Slepe Farm, Arne, Wareham, Dorset BH20 5BN, tel: 01929 556688
Institute of Terrestrial Ecology (ITE)	Abbots Ripton, Huntingdon, Cambridgeshire PE17 2LS, tel: 01487 773381
ITE, Merlewood	Windermere Road, Grange-over-Sands, Cumbria LA11 6JU, tel: 01539 532264
Joint Nature Conservation Committee (JNCC), Head Office	Monkstone House, City Road, Peterborough PE1 1JY, tel: 01733 62626
JNCC, Seabirds at Sea Team	7 Thistle Place, Aberdeen AB1 1UZ, tel: 0374 161020 (temporary number)
Ministry of Agriculture, Fisheries and Food (MAFF) Directorate of Fisheries Research (DFR), Fisheries Laboratory, Conwy	Benarth Road, Conwy, Gwynedd LL32 8UB, tel: 01492 593883
MAFF DFR, Fisheries Laboratory, Lowestoft	Pakefield Road, Lowestoft, Suffolk NR33 OHT, tel: 01502 562244
MAFF DFR, 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

Name	*Contact address and telephone no.*
Statutory bodies (continued)	
National Rivers Authority (NRA), HQ	Rivers House, Waterside Drive, Aztec West, Almondsbury, Bristol BS12 4UD, tel: 01454 624400
NRA, Southern Region	Guildbourne House, Chatsworth Road, Worthing, West Sussex BN11 1LD, tel: 01903 820692
NRA, South Western Region	Manley House, Kestrel Way, Exeter EX2 7LQ, tel: 01392 444000
Coastal fora	
Marine Forum for Environmental Issues	Honorary Secretary, The Marine Forum for Environmental Issues, c/o University College Scarborough, Filey Road, Scarborough YO11 3AZ, tel: 01723 362392
Standing Conference on Problems Associated with the Coastline	The Secretary, SCOPAC, c/o County Hall, Newport, Isle of Wight PO30 1UD, tel: 01983 821000
Dorset Coast Forum	Coastal Policy Officer, Planning Department, Dorset County Council, County Hall, Colliton Park, Dorchester, Dorset DT1 1XJ, tel: 01305 224132
Lyme Bay Coastal Forum	Coastal Policy Officer, Planning Department, County Hall, Colliton Park, Dorset County Council, Dorchester, Dorset DT1 1XJ, tel: 01305 224132
Lyme Bay and South Devon Coastline Group	West Dorset District Council, 58-60 High West Street, Dorchester, Dorset DT1 1UZ, tel: 01305 251010
The Solent Forum	County Planning Department, Hampshire County Council, The Castle, Winchester SO23 8UJ, tel: 01962 846759
Wildlife Trusts	
Dorset Wildlife Trust	Brooklands Farm, Forston, Dorchester DT2 7AA, tel: 01305 264620
Hampshire & Isle of Wight Wildlife Trust	8 Romsey Road, Eastleigh, Hampshire SO50 9AL, tel: 01703 613636
National voluntary bodies	
British Trust for Ornithology	The Nunnery, Nunnery Place, Thetford, Norfolk IP24 2PU, tel: 01842 750050
Marine Conservation Society	9 Gloucester Road, Ross-on-Wye, Herefordshire HR9 5BU, tel: 01989 566017

Name	*Contact address and telephone no.*
National voluntary bodies (continued)	
National Trust (NT), Coast and Countryside Adviser	33 Sheep Street, Cirencester, Gloucestershire GL7 1QW, tel: 01285 651818
NT Southern Office (Hampshire and Isle of Wight)	Polesden Lacey, Dorking, Surrey RH5 6BD, tel: 01372 453401
NT Wessex Office (Dorset)	Eastleigh Court, Bishopstrow, Warminster, Wilts. BA12 9HW, tel: 01985 847777
Royal Society for the Protection of Birds (RSPB), HQ	The Lodge, Sandy, Bedfordshire SG19 2DL, tel: 01767 680551
RSPB South-east Office (Hampshire/Isle of Wight)	8 Church St., Shoreham-by-Sea, West Sussex BN48 5DQ, tel: 01273 463642

Name	*Contact address and telephone no.*
National voluntary bodies (continued)	
RSPB South-west Office (Dorset)	10 Richmond Road, Exeter, Devon EX4 4JA, tel: 01392 432691
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
Universities	
Southampton University (Department of Oceanography)	Southampton SO14 3ZH, tel: 01703 595000
Portsmouth University (Centre for Economic Management of Aquatic Resources)	Lockway Road, Portsmouth PO4 8JF, tel: 01705 876543

A.2 Local planning authorities; port and harbour authorities

Authority	*Address*
Bournemouth Borough Council	Town Hall, Bourne Avenue, Bournemouth BH2 6DY, tel: 01202 552066
Christchurch Borough Council	Civic Offices, Bridge Street, Christchurch BH23 1AZ, tel: 01202 486321
Devon County Council	County Hall, Exeter, Devon EX2 4QH, tel: 01382 382000
Dorset County Council	County Hall, Colliton Park, Dorchester DT1 1XJ, tel: 01305 251000
Eastleigh Borough Council	Civic Offices, Leigh Road, Eastleigh SO5 4YN, tel: 01703 614646
Fareham Borough Council	Civic Offices, Civic Way, Fareham PO16 7PP, tel: 01329 236100
Gosport Borough Council	Town Hall, High Street, Gosport PO12 1EB, tel: 01705 584242
Hampshire County Council	The Castle, Winchester SO23 8UJ, tel: 01962 841841
Hampshire County Council (Countryside & Community Department)	Mottisfont Court, High Street, Winchester, Hampshire SO23 7BE, tel: 01962 846027
Havant Borough Council	Civic Offices, Civic Centre Road, Havant PO9 2AX, tel: 01705 474174
Isle of Wight Council	County Hall, Newport, Isle of Wight PO30 1UD, tel: 01983 821000
New Forest District Council	Appletree Court, Lyndhurst, Hampshire SO43 7PA, tel: 01703 285000
Poole Borough Council	Civic Centre, Poole, Dorset BH15 2RU, tel: 01202 675151
Portsmouth City Council	Civic Offices, Portsmouth PO1 2AL, tel: 01705 822251
Purbeck District Council	Westport House, Wareham, Dorset BH20 4PP, tel: 01929 556561
Southampton City Council	Civic Centre, Southampton SO9 4XR, tel: 01703 223855
West Dorset District Council	58-60 High West Street, Dorchester, Dorset DT1 1UZ, tel: 01305 251010
Weymouth and Portland Borough Council	North Quay, Weymouth, Dorset DT4 8TA, tel: 01305 761222

Port/harbour	*Address*
Beaulieu Harbour	Harbour Masters Office, Bucklers Hard Yacht Harbour, Beaulieu, Brockenhurst, Hampshire SO42 7XB, tel: 01590 616200
Bembridge Harbour	Bembridge Harbour Improvements Co. Ltd, Harbour Office, Bembridge, Ryde, Isle of Wight PO35 5NL, tel: 01983 872828
Bridport (West Bay) and Lyme Regis Harbour	Harbour Master, c/o West Dorset District Council, Leisure & Tourism Division, 51 High West Street, Dorchester DT1 1UZ, tel: 01297 442137
Bournemouth Harbour Master	Town Hall, Bourne Avenue, Bournemouth BH2 6DY, tel: 01202 552066
Chichester Harbour Master	Harbour Office, Itchenor, Chichester, West Sussex PO20 7AW, tel: 01243 512301
Christchurch Harbour	Leisure Management Section, Christchurch Borough Council, Christchurch, tel: 01202 486321 (see column opposite); also Christchurch Harbour Association, c/o Christchurch Borough Council, Christchurch, tel: 01202 486321 (see column opposite)
Cowes Harbour Commissioners	Harbour Office, Town Quay, Isle of Wight PO31 7AS, tel: 01983 293952
Keyhaven Harbour	New Forest District Council, Keyhaven River Warden's Office, The Quay, Keyhaven, Lymington SO41 0TR, tel: 01590 645695
Langstone Harbour Board	Ferry Road, Hayling Island, Hampshire PO11 0DG, tel: 01705 463419
Lymington Harbour	The Harbour Office, Bath Road, Lymington SO41 3SE, tel: 01590 67201
Newport (port of)	17 Quay Street, Newport, Isle of Wight PO30 5BE, tel: 01983 520000
Poole Harbour Commissioners	Harbour Project Officer, Poole Harbour Commissioners, 20 New Quay Road, Hamworthy, Poole, Dorset BH15 4AF, tel: 01202 440200
Portland Harbour	Queen's Harbour Master, Naval Base, Portland, Dorset DT5 1BQ, tel: 01305 824044

Port/harbour	Address
Portsmouth (port of)	Port Manager's Department, Portsmouth City Council, Harbour Offices, Continental Ferry Port, George Byng Way, Portsmouth PO2 8SP, tel: 01705 822251
River Hamble Management Committee	Hampshire County Council, Harbour Master's Office, Shore Road, Warsash, Hants. SO3 6FR, tel: 014895 6387
Southampton Harbour Master	Solent Harbour Masters Association, c/o Hon. Sec., Captain Steven Young, Ocean Gate, Atlantic Way, Southampton SO14 3QN, tel: 01703 330022
Southampton port	Associated British Ports, Dock House, Canute Road, Southampton SO9 1PZ, tel: 01703 330022
Swanage	Harbour Master, Borough Engineer's Department, Municipal Offices, North Quay, Weymouth, Dorset DT4 8TA, tel: 01305 206275
Weymouth port	Weymouth and Portland Borough Council, Harbour Master's Office, 20 Custom House Quay, Weymouth, Dorset DT4 8BQ, tel: 01305 760620
Yarmouth port	Yarmouth (Isle of Wight) Harbour Commissioners, The Quay, Yarmouth, Isle of Wight PO41 0NT, tel: 01983 760321

A.3 Core reading list

There are a number of imporant 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.

Ambios Environmental Consultants. 1995. *Lyme Bay Environmental Study*. A report produced by Ambios Environmental Consultants Ltd on behalf of Kerr-McGee Oil (UK) Plc and Partners. 18 volumes covering the physical environment; subtidal and intertidal benthic ecology; marine vertebrates; terrestrial ecology and environmental quality.

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. *United Kingdom digital marine atlas (UKDMAP). User guide. Version 2.0*. Birkenhead, Natural Environment Research Council, British Oceanographic Data Centre.

Buck, A.L. In prep. *An inventory of UK estuaries. 6. Southern England*. Peterborough, Joint Nature Conservation Committee.

Davidson, N.C., Laffoley, D.d'A., Doody, J.P., Way, L.S., Gordon, J., Key, R., Drake, C.M., Pienkowski, M.W., Mitchell, R., & Duff, K.L. 1991. *Nature conservation and estuaries in Great Britain*. Peterborough, Nature Conservancy Council.

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

Doody, J.P., Johnston, C., & Smith, B. 1993. *The directory of the North Sea coastal margin*. Peterborough, JNCC.

Edgar, R.D.M. 1995. *South East England habitat resources survey*. Peterborough, English Nature.

Eno, N.C., *ed*. 1991. *Marine conservation handbook*. 2nd ed. Peterborough, English Nature.

Gubbay, S. 1988. *A coastal directory for marine conservation*. Ross-on-Wye, Marine Conservation Society.

Lee, A. J., & Ramster, J. W. 1981. *Atlas of the seas around the British Isles*. Lowestoft, MAFF.

North Sea Task Force. 1993. *North Sea Quality Status Report 1993*. London; Oslo and Paris Commissions.

Reid, P.C., Auger, C., Chaussepied, M., & Burn, M. 1993. *Quality Status Report of the North Sea 1993. Sub-region 9 Assessment Report*. London, UK Department of the Environment, Republique Francaise Ministere de l'Environnement, Institut Français de Recherche pour l'Exploitation de la Mer.

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*. 2nd ed., 112 - 183 (Geology and geomorphology). Cambridge, Cambridge University Press.

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