



An inventory of UK estuaries

Volume 3 North-west Britain

Compiled by A.L. Buck

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City Road
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ISBN 1 873701 38 1 vol. 3. North-west Britain
ISBN 1 873701 35 7 Set of seven vols.

This report should be quoted as:

Buck, A.L. 1993. *An inventory of UK estuaries. Volume 3. North-west Britain.*
Peterborough, Joint Nature Conservation Committee.

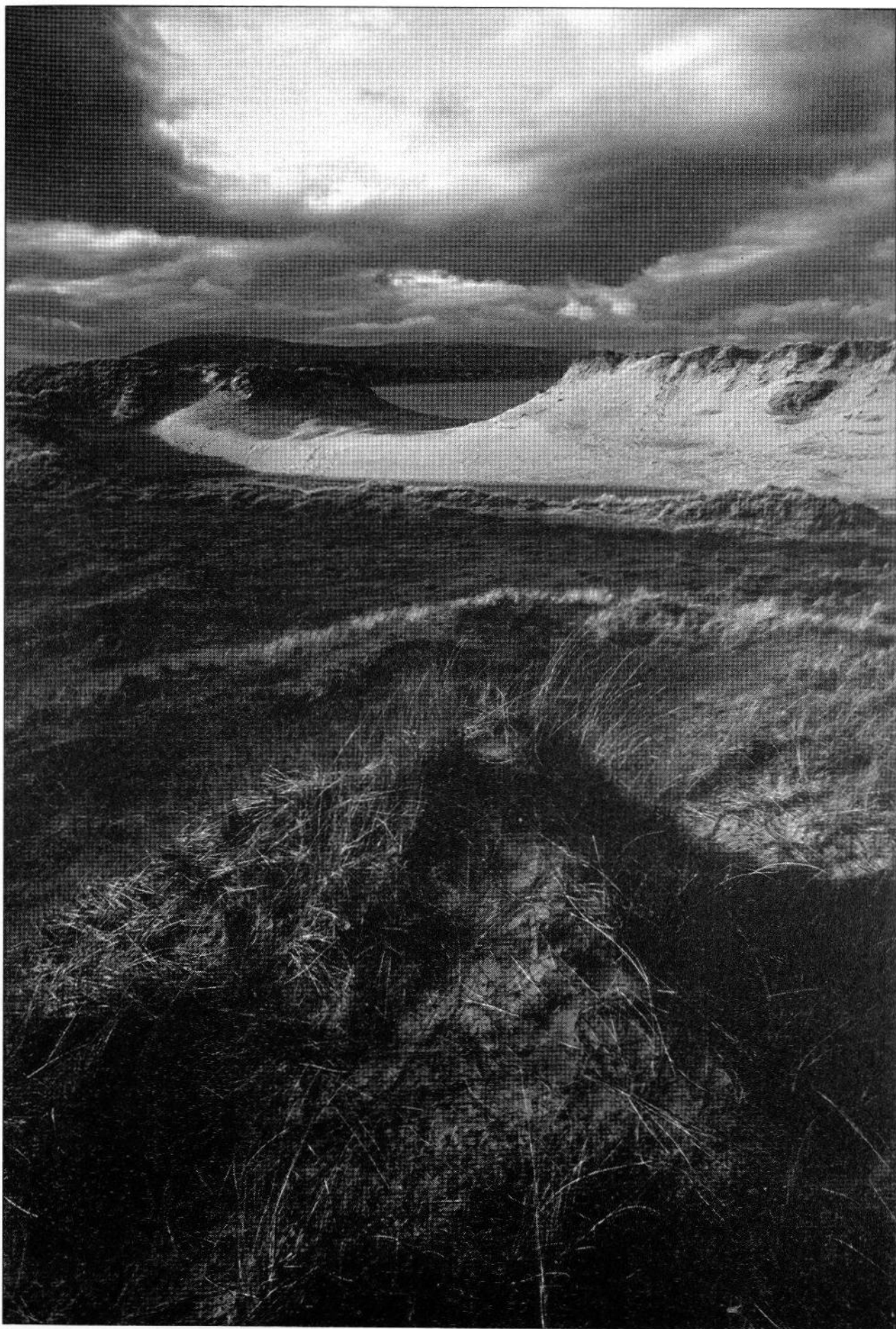
All sections of this report are authored by A.L. Buck unless otherwise indicated.

An inventory of UK estuaries is being produced in seven volumes. The inventory is compiled by the Coastal Review Unit of JNCC's Coastal Conservation Branch. Further reports are in preparation.

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ISBN 1 873701 35 7 Set of seven vols.
ISBN 1 873701 36 5 vol. 1. Introduction
ISBN 1 873701 37 3 vol. 2. South-west Britain
ISBN 1 873701 38 1 vol. 3. North-west Britain
ISBN 1 873701 39 X vol. 4. North and east Scotland
ISBN 1 873701 40 3 vol. 5. Eastern England
ISBN 1 873701 41 1 vol. 6. Southern England
ISBN 1 873701 42 X vol. 7. Northern Ireland

Design by Professional Communications Ltd.
Cover design by Nature Conservation Bureau.
Printed by W. Lake.



Sandscale Haws on the Duddon Estuary, which supports a breeding population of the natterjack toad *Bufo calamita*.
(Peter Wakely, English Nature)



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1 Foreword

Professor Peter Evans

Chairman, Department of Biological Sciences, University of Durham

Viewed worldwide, estuaries are a scarce natural resource, even though some in the deltas of great rivers are of immense size. The British Isles are fortunate in holding a large number and variety of types of estuary, particularly when compared with the rest of temperate and Mediterranean Europe. Yet we have not used most of our estuaries either wisely or sustainably, probably for two reasons: first a lack of knowledge of the natural resources they contain and second a lack of understanding of the effects of the human uses to which they have been, or are being, put.

Pollution problems up-river have readily been apparent to anglers and recreational users alike and there have been long-standing campaigns to improve water quality in many of our rivers. These have begun to bear fruit. Many of the larger estuaries have not attracted such concern from the general public in relation to their water quality. People have increasingly turned their backs on the river corridors as they near the sea and looked further afield for clean recreational areas. As a result discharges of industrial and domestic wastes into estuaries have continued on a large scale, though restrictions are gradually being introduced (or even self-imposed by environmentally aware industrial concerns).

Even less obvious to the general public has been the steady loss of intertidal land within estuaries, to land-claim for industrial development and to dredging for the creation of wider and deeper shipping channels and berths needed to accept the larger vessels in which we import more raw material as our own accessible resources of many minerals and chemicals decline. Intertidal and even permanent shallow-water areas of estuaries have been buried under domestic rubbish and other solid wastes, or sometimes permanently flooded for water storage schemes. To these established, though often not sustainable, uses are being added new demands: barrage schemes for power generation, harbour developments for pleasure craft and many others.

Knowledge of the natural resources of the British estuaries has been slow to accumulate. Even one of the most obvious of the biological resources, the bird populations, had not been counted in more than a few of the smaller estuaries before the 'Birds of Estuaries Enquiry', now organised by the BTO, WWT, RSPB, and JNCC, was launched in 1969. The very idea of attempting a count of all the birds using the shores of the Wash in Lincolnshire and Norfolk was considered impractical before a Cambridge Bird Club team, of which I was a member, attempted the task in the mid-1950s. Quantification of other resources has proven even more difficult: fishery catch statistics do not necessarily permit identification of spawning and nursery areas, yet for several species these lie in estuaries and are vital for the continued health of our fish stocks. The role of algae and other plants in stabilising estuarine shores against erosion is only now becoming

understood in a more quantitative way though it had been appreciated for more than half a century that planting of the cord-grass *Spartina* provided an extra line of defence against erosion of soft shores.

Now we are faced with the reality of sea level rise and the need for rethinking coastal defences. People have come to appreciate the value of the wildlife resources of estuaries, and industries located on estuaries increasingly appreciate the advantages of developing a 'green image' backed by actions such as the reduction of waste discharges to confirm it. This, therefore, is a particularly appropriate time to launch this *Inventory of UK estuaries*, building on the excellent publication *Nature conservation and estuaries in Great Britain* which appeared in 1991. That book, edited by Dr Davidson, who is a co-author of several of the chapters in these present inventory volumes, was the last major review published by the former Nature Conservancy Council. I am proud to have persuaded my fellow Council members in the mid-1980s to commission that work which has, I believe, influenced attitudes to estuary use in a most positive way.

I well recall, during the Examination in Public of the Teesside Structure Plan in 1975, appealing for a national planning policy to be developed for estuarine use. It was considered impossible at that time. But today there is great enthusiasm including guidance from government for coastal conservation and management, in part as a result of our growing international responsibilities for example in relation to the management of the North Sea, the implementation of the Ramsar Convention on Wetlands of International Importance and the acceptance of the EC Directives on the Conservation of Wild Birds (1979) and Habitats and Species (1992). The need for detailed information to enable sensible estuarine management plans to be formulated not only in a local but also a national and international context has never been greater. I commend these volumes to all interested in the planning, sustainable development, management and conservation of UK estuaries. It is an authoritative base-line from which to prepare for the 21st century.

Peter Evans

Durham, January 1993

2 Introduction

N.C. Davidson & A.L. Buck

Coastlines change continually under the forces of wave, tide, current and wind. In some places along the coast the hard rocks laid down millions of years ago or the softer, more recent, glacial deposits are being eroded. These eroded sediments are transported by currents, often for considerable distances, out into deeper water or along the shore. Much of this sediment is deposited along the coastline: coarse sediments forming shingle and sand beaches, and fine particles forming mudflats in sheltered bays, inlets and river estuaries. All these types of estuary act as 'sediment sinks' that trap much of the sediment moving along the coast. Where the estuary is formed by a river discharging into the sea, particles carried downstream by the rivers are deposited in the reduced currents and shelter of the river mouth, adding to the sediments of marine origin.

In time these sediments build up in estuaries, become stable and parts may become vegetated to provide a complex of habitats. Saltmarsh vegetation colonises intertidal flats that have accumulated to levels above mid-tide height. Where sand is blown onshore there is development of sand dunes, or where larger deposits move onshore shingle ridges develop. In the event of restricted drainage within sand dunes or shingle ridges, or even within saltmarshes, saline lagoons can form. This variety of coastal habitats is often in a state of change, adjusting to the short-term effects of winds, tides, waves and currents, and are shaped by the more gradual changes over periods of thousands of years as sea levels rise and fall.

The inflow of water from rivers and the sea brings a continual influx of nutrients. In river estuaries the freshwater brought down the river meets the saline water from the sea. In some estuaries these water bodies mix well, with tidal movements and variations in river flow creating large variations in water salinity over short periods of time.

The complex of estuarine habitats that develops under these conditions supports a variety of plants and animals which have adapted to exploit the nutrient-rich but continually changing tidal conditions. Relatively few species have evolved to cope with the extremes of constantly changing salinity and tidal levels of river estuaries but those that have often occur in great densities. As a result the estuarine mudflats and saltmarshes in temperate regions such as the United Kingdom are amongst the most productive ecosystems in the world. This rich plant and invertebrate life provides an abundant food supply for predators such as fish, which often use the shelter of estuaries for spawning and as nursery areas. Some species of birds and mammals feed on these fish, whilst many others feed directly on the saltmarsh vegetation and on the abundant molluscs, crustaceans and worms living in soft sediments. The relatively mild winter weather conditions of estuaries in the United Kingdom make them additionally attractive wintering grounds for migratory waterfowl from a large area of the northern hemisphere.

The coastline of the United Kingdom is particularly well endowed with estuaries, and these vary greatly in their geomorphological origins, size, shape, extent of freshwater influence, and the complex of marine and coastal habitats that occur there. These estuaries are widely recognised as one of the greatest natural assets in the UK.

UK estuaries vary greatly also in the extent to which they have been used, changed or destroyed by people exploiting their natural resources. People have used estuaries for many centuries and for many purposes. Some uses, such as ports, exploit the shelter offered by the physical structure of the estuary. Others, for example barrages, control or exploit tidal movements. Many traditional practices depend on sustainable use of the rich natural resources such as fish and shellfish found in estuaries. A recent trend has seen estuaries as the focus for leisure activities, in water, land and air. These range from organised activities such as sailing regattas to informal uses such as walking and the quiet enjoyment of these often spectacular wild landscapes and their wildlife.

Effective conservation of estuaries for their wildlife requires the maintenance of the diversity of the estuarine network throughout Britain and internationally, and the sustainable management of individual estuaries in this network. Yet many parts of estuaries have already been destroyed through human activities leading to land-claim and degradation. Such pressures continue and damage can arise through the subtle interaction of the human urge to control estuaries (e.g. by constructing sea defences against flooding) and the estuaries' natural movement in response to rising sea levels.

There is increasing recognition that managing and maintaining our coasts and estuaries for the future depends on co-operation between the groups of users, coastal managers and decision makers. This co-operation is increasingly being sought through processes of integrated coastal zone planning and management (CZM). Many CZM initiatives are focused on estuaries since it is often here that there is most overlap and potential conflict between people and the natural estuarine resource.

In developing estuary management plans there is a need for sound baseline information on the natural resource and how it is being used. Such information is needed both in detail for the estuary under consideration and more broadly so as to set a particular feature or site in its wider national and international context. To provide this British national context as a baseline for the development of sustainable use objectives, the Nature Conservancy Council (NCC) undertook an Estuaries Review which published *Nature conservation and estuaries in Great Britain* as a national overview of estuaries, their wildlife, their conservation and their human uses (Davidson *et al.* 1991).

An inventory of UK estuaries follows on from this national overview, and provides a summary of resource, wildlife, conservation status and human use features on each of the 163 estuaries identified by the Estuaries Review around the coasts of the United Kingdom. Much of the information presented in the inventory was collated between 1988 and 1991 during the work of the Estuaries Review. Where possible, however, we have included more up-to-date information. Where this more recent information is given the relevant dates are indicated in each display. The inventory thus provides a 'snap-shot' in time for the state of the UK estuarine resource at the end of the 1980s.

An inventory of UK estuaries takes the form of a series of standardised dossiers, taking each estuary (as defined by the Estuaries Review) in turn. Each of these reports gives a summary of the key features of interest or significance for estuary management from a nature conservation perspective. An inventory entry is designed to give initial summary information about a feature and to help direct users to more detailed sources of information should this be required. The inventory is not, however, intended to provide comprehensive listings of plant and animal species recorded on the estuary. Nor can it provide more than the initial basis for the development of practical coastal zone management initiatives such as integrated estuary management plans.

The inventory provides part of a sound information base for estuary management. Taken together with the national overview provided by *Nature conservation and estuaries in Great Britain*, the information in the inventory permits estuary managers to set the resource on a particular estuary in its national and international context - an important stage in the identification of management issues. The inventory should also help understanding of the great importance of the UK estuarine resource by the many user-groups and those involved in decision-making. Its availability for use in matters of development planning and control ensures that there is a readily available single source of summarised information, eliminating the need to search through a great variety of sources in many different styles of presentation. In addition the snap-shot information in the summary provides an easy-to-use basis for broad-scale monitoring of change in the estuarine resource and its human uses.

An inventory of UK estuaries is being published in six regional volumes, most including 20-30 estuary reports. The regions are shown in Figure 1. Boundaries have been chosen largely on topographical grounds to provide meaningful geographical zones. For England and Wales these boundaries coincide broadly with the known divisions of major coastal sediment cells.

There is also an introductory volume (volume 1). This provides more detail of the rationale of the inventory, explanations of the approach to site definition and selection, details of the information sources used for the inventory, and summary tables listing estuary locations and characteristics updated and corrected from those in Davidson *et al.* (1991). Users of the inventory are strongly urged to consult this volume for definitions before undertaking detailed interpretation of site reports. Since many people who have helped with the Estuaries Review and inventory work have contributed to more than one volume we have included a full Acknowledgements

section in this introductory publication rather than in each regional volume.

We give below a brief overview of the overall estuarine resource in this North-west Britain coastal area covered by Volume 3, then a short key to using and interpreting the information entries in each site report, followed by the site reports.

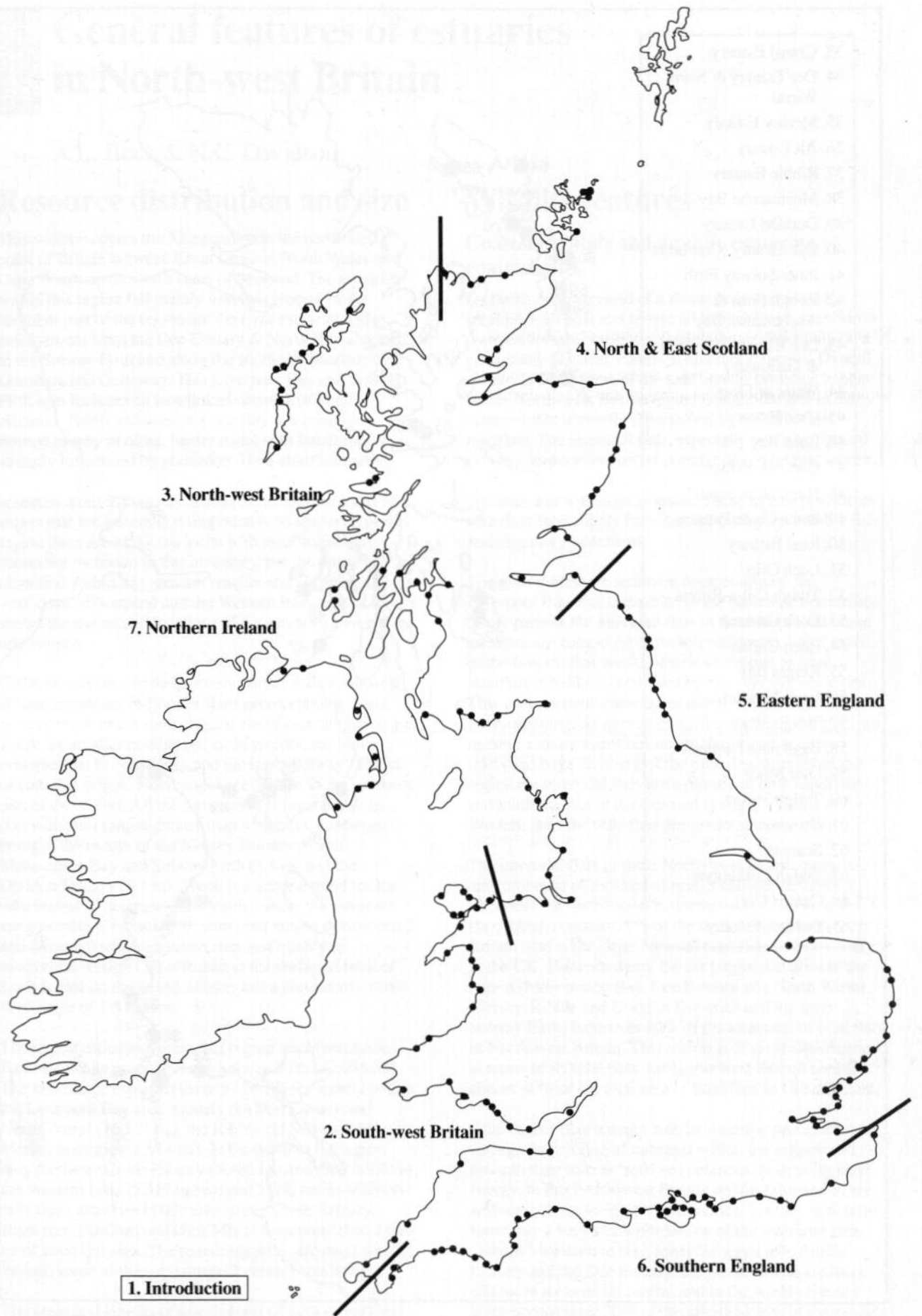


Figure 1 The regional volumes comprising *An inventory of UK estuaries*. Each estuary is marked by its centre grid reference.

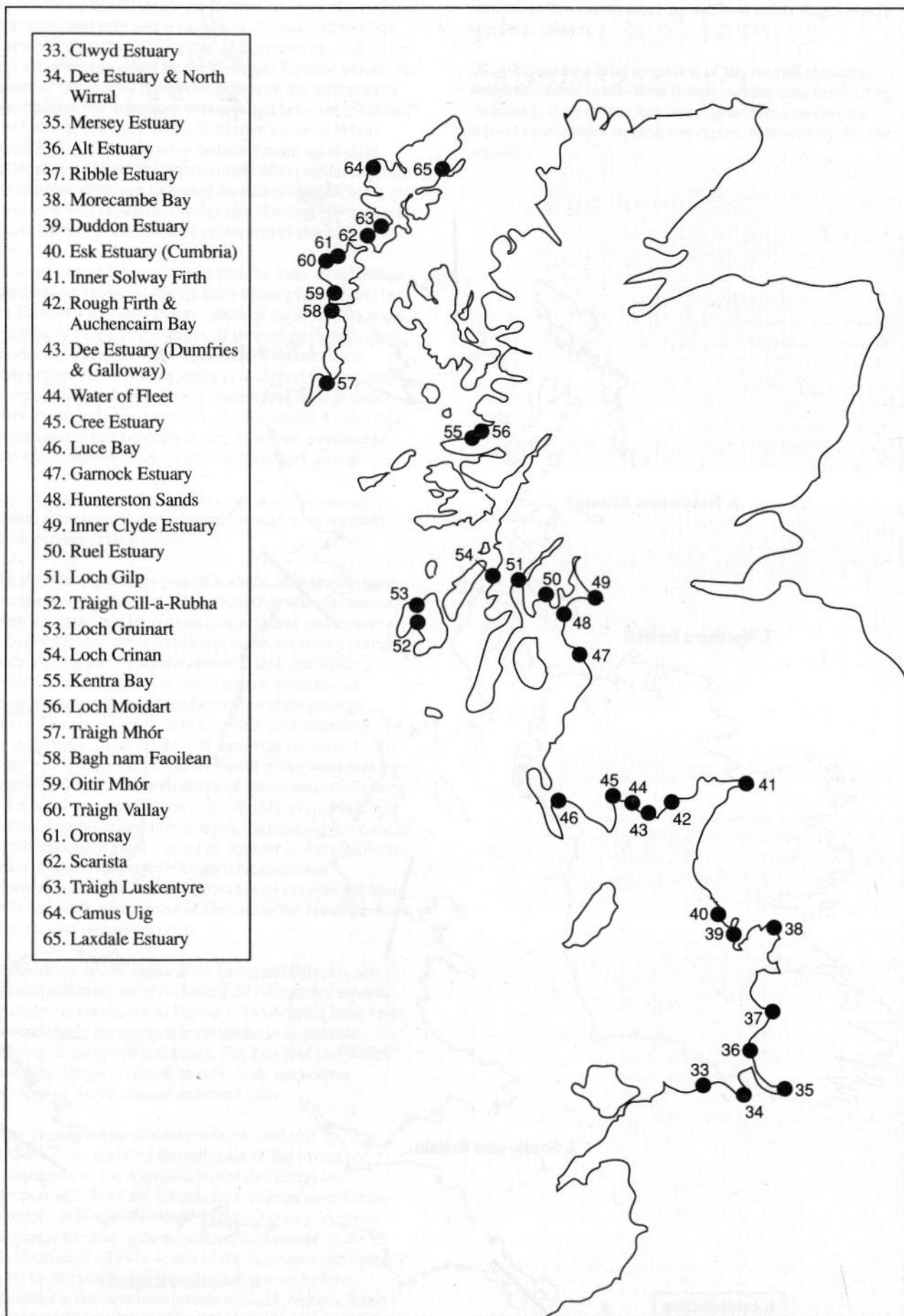


Figure 2 The locations and names of the 33 estuaries covered by Volume 3 of *An inventory of UK estuaries*. See the site map in each regional report for the precise boundaries of the site identified as the core estuary.

3 General features of estuaries in North-west Britain

A.L. Buck & N.C. Davidson

Resource distribution and size

This volume covers the 33 estuaries on the north-west coast of Britain between Great Orme in North Wales and Cape Wrath on the north coast of Scotland. The estuaries within this region fall mainly into two groups. In the southern part of the region are the river estuaries and embayments from the Dee Estuary & North Wirral north to the Solway Firth and along the southern shoreline of Dumfries and Galloway. This Liverpool Bay and Solway Firth area includes an interlinked network of large estuaries. North and west of Luce Bay is a coastline formed mostly of older, harder rocks with landforms strongly influenced by glaciation. Here coastlines are strongly indented and large areas of soft sediments are scattered amid the sounds, embayments and sea lochs of shores that are generally rising relative to sea level. In this region there are many sea lochs with insufficient soft shores for inclusion in this inventory, but the estuaries identified within this area are smaller and occur on the west coast of Scotland and the Western Isles. Figure 2 shows the names and locations of the estuaries covered by this volume.

Eighteen estuaries in the northern part of this North-west Britain region are of fjord or fjard geomorphology, and most of those in the southern part are of coastal plain type. There are smaller numbers of embayments, bar built estuaries and linear shores, and the Inner Solway Firth is of complex origin. Tidal ranges are highest in the southern part of the region. All the estuaries here are macrotidal (i.e. with tidal ranges greater than 4 metres), the largest being at the mouth of the Mersey Estuary (8.9 m), Morecambe Bay and Solway Firth (8.4 m) and the Duddon Estuary (8.1 m). There is a general trend for the tidal ranges to decrease northwards, where the estuaries are generally mesotidal (i.e. with tidal ranges of between 2 and 4 metres) although seven sites just qualify as macrotidal. Tràigh Cill-a-Rubha at the sheltered head of Loch Indaal on the island of Islay has a particularly small tidal range of 1.5 metres.

The largest estuaries within this region are Morecambe Bay (45,462 ha) and the Inner Solway Firth (42,056 ha). The other large estuaries (over 5,000 ha) are mostly within the Liverpool Bay area, namely the Dee Estuary and North Wirral (16,101 ha), the Ribble (11,924 ha) and Mersey Estuaries (8,914 ha). In the north of the region only the Inner Clyde Estuary (5,485 ha) and Oitir Mhór in the Western Isles (5,519 ha) exceed 5,000 ha. In addition only three estuaries in this area (Inner Clyde Estuary, Bagh nam Faoilean and Oitir Mhór) have more than 1,000 ha of intertidal area. The remaining sites, although small, include some of the most unspoilt estuaries in Britain.

The areas and lengths of key features of each estuary are listed in Table 1, and Table 2 provides a summary of the size of the estuarine resource in the North-west Britain region.

Wildlife features

Coastal habitats and aquatic estuarine communities

Estuaries are composed of a mosaic of inter-related subtidal, intertidal and terrestrial habitats, with the relative composition and variety of these habitats depending on a great many physical, chemical and biotic factors. Overall, almost three-quarters of the total area of estuarine habitat in this North-west Britain region is intertidal and in many estuaries this is chiefly represented by sandflats and mudflats. The intertidal flats, especially soft mudflats, of estuaries support important populations of marine worms, molluscs and other invertebrates, often living in high densities and with high biomass. These in turn provide an abundant food supply for estuarine predators, notably fish and migratory waterfowl.

The glacial offshore sediment sources around the Liverpool Bay area contribute to the sediment availability. Many parts of the intertidal flats in these high tidal range estuaries are composed of mobile sediments, since much of the fine silt that would otherwise deposit to form mudflats is held in suspension by high current velocities. This characteristic contributes substantially to the geomorphological interest of such estuaries. Soft mudflats in these estuaries are confined to their more sheltered inlets and bays. In many of the estuaries throughout this region the intertidal flats are a mosaic of both sandflats and mudflats, but in the exposed fjords and fjards of the Western Isles the tidal flats are predominantly sandy.

The intertidal flats of most North-west British estuaries are composed of mosaics of mud and sand. In terms of size, tidal flat distribution is dominated by Morecambe Bay, which contains 29% of the tidal flats in North-west Britain, and is the largest area of tidal flats of any estuary in the UK. Between them, the six largest estuaries in the region (Morecambe Bay, Dee Estuary and North Wirral, Mersey, Ribble and Duddon Estuaries and the Inner Solway Firth) have over 80% of the total area of tidal flats in North-west Britain. This region is of great significance in terms of its tidal flats, for North-west Britain contains almost 40% of the total area of tidal flats in Great Britain.

Saltmarshes play a major role in estuarine processes, both through the cycling of nutrients within the estuary and through their role as 'soft' sea defences dissipating wave energy. In this North-west Britain region saltmarshes are widespread, occurring on 31 estuaries, but they generally form only a very small proportion of the intertidal area. Only in Morecambe Bay, Inner Solway Firth, Ribble Estuary and the Dee Estuary and North Wirral are there extensive areas of saltmarsh, and in the Ribble Estuary these occupy over 20% of the intertidal area of the estuary. In total, eight estuaries in the region (Dee Estuary and North Wirral, Mersey and Ribble Estuaries, Morecambe Bay, Duddon Estuary, Inner Solway Firth, Cree and Ruel

Table 1 Areas, shoreline and channel lengths and mean spring tidal range measurements for estuaries in North-west Britain.

Estuary	Area (ha)	Intertidal area (ha)	Saltmarsh (ha)	Shoreline (km)	Channel length (km)	Tidal range (m)
33. Clwyd Estuary	422	386	43	19.1	8.1	6.7
34. Dee Estuary & North Wirral	16,101	12,981	2,108	108.5	36.8	7.6
35. Mersey Estuary	8,914	5,606	847	102.9	15.6	8.9
36. Alt Estuary	1,413	1,413	1	14.0	5.2	8.0
37. Ribble Estuary	11,924	10,674	2,184	107.5	28.4	7.9
38. Morecambe Bay	45,462	34,339	3,253	266.5	40.3	8.4
39. Duddon Estuary	6,092	5,056	537	65.5	22.6	8.1
40. Esk Estuary (Cumbria)	1,134	1,049	158	42.2	11.4	7.7
41. Inner Solway Firth	42,056	27,550	2,925	213.6	46.3	8.4
42. Rough Firth & Auchencairn Bay	1,290	1,289	135	44.4	14.4	6.7
43. Dee Estuary (D & G)	1,144	825	77	28.6	11.7	6.7
44. Water of Fleet	790	790	28	19.9	7.2	6.7
45. Cree Estuary	4,728	3,340	445	24.3	63.2	6.7
46. Luce Bay	1,228	1,196	36	27.5	8.5	5.3
47. Garnock Estuary	204	161	30	14.7	5.6	3.2
48. Hunterston Sands	291	291	0	16.4	0	2.9
49. Inner Clyde Estuary	5,485	1,841	67	129.7	41.9	3.0
50. Ruel Estuary	426	184	7	15.4	6.7	3.0
51. Loch Gilp	245	143	0	6.8	3.4	3.1
52. Tràigh Cill-a-Rubha	639	288	40	8.6	3.0	1.5
53. Loch Gruinart	973	876	51	18.7	8.1	3.1
54. Loch Crinan	280	168	47	15.3	6.2	3.7
55. Kentra Bay	338	313	41	13.4	4.9	4.3
56. Loch Moidart	881	469	24	34.9	10.1	4.3
57. Tràigh Mhór	242	210	0	6.5	0	3.7
58. Bagh nam Faoilean	2,144	1,264	35	37.5	10.9	4.1
59. Oitir Mhór	5,519	4,028	114	292.4	13.3	4.1
60. Tràigh Vallay	1,113	823	15	22.9	6.9	4.1
61. Oronsay	1,278	825	6	29.9	6.3	4.1
62. Scarista	290	290	40	7.5	0	3.8
63. Tràigh Luskentyre	344	344	32	11.5	4.1	3.8
64. Camus Uig	438	214	10	18.0	5.5	3.6
65. Laxdale Estuary	559	390	96	12.8	4.7	4.1

Table 2 Total areas and lengths of the regional estuarine resource in North-west Britain.

Total area (ha)	Subtidal area (ha)	Intertidal area (ha)	Intertidal flats (ha)	Saltmarsh (ha)	Shoreline (km)	Channel length (km)
164,387	44,771	119,616	106,184	13,432	1,797.4	461.3

Estuaries) contain nationally important saltmarshes. That is, they support a full and representative sequence of plant communities covering the variation found in Great Britain. The total area of saltmarsh in the region (13,432 ha) is over 30% of the British saltmarsh resource.

In the northern part of the region, there has been much less human interference with saltmarshes, and these northern marshes are important for the presence of natural transitions to non-tidal vegetation, notably grasslands. Transitional grassland communities occur on twelve estuaries in this region, which total 63% of British estuaries with this feature.

The cord-grass *Spartina anglica* is now found in estuaries in the Liverpool Bay and Solway Firth areas, and in two estuaries (Rough Firth and Auchencairn Bay and Water of Fleet) *Spartina* now forms over half the saltmarsh area. In contrast to some estuaries in southern England where areas of *Spartina* are now decreasing, *Spartina* is still spreading in many of these places although it forms a much smaller proportion of saltmarsh area than in the south. On at least seven estuaries in the region *Spartina* was deliberately planted between 1921 and 1951 to encourage dune stabilisation. Now attempts to control *Spartina* are occurring on four estuaries. However, in most of the estuaries on the Scottish coast there is little or no *Spartina* present.

There are particularly extensive sand dune systems on the west coast of Britain, where the high-energy environment and the conditions of prevailing and dominant winds combine to form large accumulations of sand. Sixteen estuaries in North-west Britain have associated sand dune systems, of which eight are of national importance. These include the Sefton Coast dune system which extends from the Alt to the Ribble Estuary, North Walney and Sandscale on the Duddon Estuary, Ravenglass on the Esk Estuary, Torrs Warren on Luce Bay, Killinallan Dunes on Loch Gruinart, Baleshare Machair to the west of Oitir Mhór and Northton Bay on Scarista. Overall nineteen estuaries have at least a small area of sand dunes within their habitat mosaic.

There is only one substantial shingle structure associated with estuaries in North-west Britain, namely Walney Island which lies between the Duddon Estuary to the north and Morecambe Bay to the south. Walney Island is a barrier island, a product of erosion and the reworking of glacial boulder clay, and has become vegetated towards its southern end. A sand dune system has developed over the north of the island. Many other estuaries within North-west Britain have patches of bare intertidal shingle, and shingle is found on over half (nineteen) of the estuaries in this region.

Coastal saline lagoons are scarce in North-west Britain, and associated with only two estuaries in the region. Within Morecambe Bay there is a saline lagoon system at the southernmost tip of Walney Island; and on the Duddon Estuary, Hodbarrow Lagoon is a large pool separated from the sea by an artificial sea wall.

The largest areas of coastal grazing marshes and other lowland grasslands are outside the North-west Britain area covered in this volume, but twelve of the estuaries have some associated grazing marsh remaining. The grazing

marshes of those estuaries within the Liverpool Bay area are often sited on former intertidal areas of the estuary which have undergone land-claim, for example large areas on the Dee & North Wirral and Ribble Estuaries. In contrast, the grasslands associated with the estuaries on the north-west coasts of Scotland are chiefly areas of machair. These form part of the very extensive mosaic of dune grasslands and wetlands especially along the western shores of the Outer Hebrides, most of which are not directly associated with estuaries.

The aquatic estuarine benthic communities of many of the estuaries within this North-west Britain region have been recorded and several sites are known to be of great marine biological and conservation importance. The diversity of both soft substrate and hard substrate communities within this region is generally lower than that of estuaries in South and South-west England, with the largest recorded diversity (more than five communities) in the Duddon Estuary, Inner Solway Firth, Rough Firth and Auchencairn Bay and Dee Estuary (Dumfries and Galloway). In general the estuaries on the west coast of Scotland and the Western Isles support lower numbers of aquatic estuarine communities, but these sites include Tràigh Cill-a-Rubha within the Loch Indaal Marine Consultation Area, and Bagh nam Faoilean, which supports a rich example of the sand/muddy sand community and rocky shore communities considered to be of national marine biological importance.

Plant and animal species

At least four estuaries within the North-west Britain region support nationally rare species of vascular plants. The extensive sand dune systems associated with the Ribble and Duddon Estuaries support two of the four estuarine populations of the nationally rare endemic dune helleborine *Epipactis dunensis*; Morecambe Bay supports a population of goldilocks *Aster linosyris* on coastal grassland; and holy-grass *Hierochloa odorata* and sticky catchfly *Lychnis viscaria* have been recorded on the Inner Solway Firth.

The nationally scarce endemic Isle of Man cabbage *Rhynchosinapis monensis* is locally common on sandy beaches in the North-west of Britain. All of the six estuaries on which it occurs are in this North-west Britain region, from the Alt Estuary northwards to the Garnock Estuary. Other nationally scarce plants have also been recorded on Loch Gruinart and the Duddon Estuary, and at least seven species have been found on the Inner Solway Firth. In addition, a site within the Dee Estuary and North Wirral is the only known site in England where Mackay's horsetail *Equisetum x trachyodon* has been found.

The terrestrial invertebrate faunas of saltmarshes on estuaries in North-west Britain are generally rather poorly known compared with those of southern and eastern England. However, the Altcar sand dunes of the Alt Estuary, the Ainsdale and Formby Dunes of the Alt and Ribble Estuaries, and the Sandscale Haws dunes of the Duddon Estuary are of note for their invertebrate assemblages. The variety of habitats on South Walney within Morecambe Bay are also known to support a number of coastal moths, and the saltmarshes and shingle of the Solway Estuary are of note for a number of beetles and flies.

The estuaries of North-west Britain support a variety of adult fish species and are spawning and nursery areas for others. Tràigh Luskentyre supports a good salmon fishery and the tidal creeks of the Duddon and Mersey Estuaries are the most northerly nurseries in Britain for sea bass *Dicentrarchus labrax*. The Cree Estuary is also of importance for smelt *Osmerus eperlanus* which uses the estuary for spawning, one of only three locations in Scotland. There are also recent records of smelt in the upper parts of the Dee Estuary and North Wirral.

The extensive dune and marsh systems of North-west Britain are the major stronghold for the natterjack toad *Bufo calamita*. The dunes associated with five of these estuaries (Inner Solway Firth, Esk, Duddon, Ribble and Alt Estuaries) together support at least 81% of the British population. There are also smaller populations on the dunes association with Morecambe Bay and the Dee Estuary and North Wirral. In addition the sand dunes of the Sefton Coast (Ribble and Alt Estuaries) support an isolated population of the nationally rare sand lizard *Lacerta agilis*, amounting to an estimated 5% of the British population.

Many estuaries in the UK are of great importance to migratory and wintering waterfowl (waders and wildfowl), and the habitat mosaics of estuaries in this part of North-west Britain provide feeding and roosting sites for many waterfowl species. Many of these birds, which come from a vast area of arctic and boreal breeding grounds between Canada and Siberia, are wholly or largely dependent on estuaries during their non-breeding period. The estuaries from the Liverpool Bay area north to the Solway Firth region generally support large waterfowl populations, while the smaller, sandier estuaries along the more northern shores support smaller total numbers of waterfowl. Overall the estuaries in North-west Britain hold over 527,000 waterfowl in midwinter (January), some 30% of the British estuarine population in that month. The relatively mild winter weather on these west coast estuaries can be of critical importance to the survival of wintering waterfowl during periods of severe weather. At such times waterfowl move west to estuaries, including those in the Liverpool Bay area, to escape freezing weather in continental Europe and eastern Britain.

Since migratory waterfowl depend on a network of estuaries during their year, many birds move between estuaries, even during the winter period, so that the total number of individuals using a site is considerably higher than those present at any one time. Average peak winter counts of waterfowl suggest that at least 870,000 birds may be using the estuaries covered by this volume during the winter period, and as the bird populations of several sites in the extreme north-west of this region are not regularly counted sites, this figure is an underestimate.

Eleven of these estuaries in North-west Britain attain international importance by supporting over 1% of the flyway population of at least one waterfowl species. Seven of these estuaries are currently also of international importance for supporting over 20,000 waterfowl during winter. Numbers of wintering waterfowl exceed 100,000 on four of these estuaries (Dee Estuary & North Wirral, Ribble Estuary, Morecambe Bay and Inner Solway Firth), making this one of the most important parts of the British coastline for waterfowl.

There is over 1% of the flyway population of at least 20 species or biogeographic populations of waterfowl on some of the estuaries in North-west Britain. These species are: whooper swan *Cygnus cygnus*, pink-footed goose *Anser brachyrhynchus*, Greenland white-fronted goose *Anser albifrons flavirostris*, barnacle goose *Branta leucopsis* (both Greenland- and Svalbard-breeding populations), shelduck *Tadorna tadorna*, wigeon *Anas penelope*, teal *Anas crecca*, pintail *A. strepera*, oystercatcher *Haematopus ostralegus*, grey plover *Pluvialis squatarola*, lapwing *Vanellus vanellus*, knot *Calidris canutus*, sanderling *C. alba*, dunlin *C. alpina*, black-tailed godwit *Limosa limosa*, bar-tailed godwit *L. lapponica*, curlew *Numenius arquata*, redshank *Tringa totanus* and turnstone *Arenaria interpres*. A further two estuarine sites in North-west Britain (Clwyd Estuary and Garnock Estuary) support nationally important populations of waterfowl. Of particular interest is the entire Svalbard-breeding population of barnacle geese wintering on the Solway Firth, and the two estuaries on Islay (Tràigh Cill-a-Rubha and Loch Gruinart) are of great importance as roosting sites for many of the Islay-wintering populations of Greenland white-fronted goose and barnacle goose. Many of the other estuaries in the region contribute to the geographical network upon which waterfowl depend, and together provide wintering grounds for at least 49,000 birds.

Outside the wintering period, many estuaries throughout the North-west Britain region have additional importance as staging and moulting areas in autumn and spring for migratory waterfowl populations. During these periods birds pass through rapidly so that many more individuals depend on these estuaries than are present at any one time. Overall this part of the estuarine resource, especially from the Dee Estuary and North Wirral to the Inner Solway Firth, may be the most important in Britain for spring migrant waders, especially sanderling, ringed plover, turnstone, knot and Iceland-breeding dunlin. In autumn some of the largest concentrations of migrant and moulting waders in Europe occur on this coast, particularly in Morecambe Bay, the Ribble Estuary and the Dee Estuary and North Wirral.

The saltmarshes, shingle banks and coastal grazing marshes around the estuaries also support breeding populations of waders (chiefly redshank, oystercatcher, lapwing and ringed plover *Charadrius hiaticula*). The most diverse assemblages are on the Inner Solway Firth (seven species), Morecambe Bay, Bagh nam Faoilean, Oitir Mhór, Tràigh Vallay and Oronsay (six species). The machair grasslands and marshes associated with these latter four estuaries on the Uists in the Western Isles support particularly large numbers of breeding waders, including internationally important breeding populations of ringed plover.

Groups of grey seals *Halichoerus gryphus* regularly use several estuaries within the region. A non-breeding group using the Dee Estuary and North Wirral has increased in number to over 300 individuals in the 1980s, and smaller numbers of seals are regularly recorded in the Mersey, Ribble, Morecambe Bay and Duddon Estuaries. Otters *Lutra lutra* are common on estuaries in North-west Britain, and are known to live on 20 of the 25 estuaries north of the Inner Solway Firth. In the Liverpool Bay area they have been recorded upstream of the tidal limit on the

Clwyd Estuary, Dee Estuary and North Wirral and Morecambe Bay only.

Conservation status

The important and diverse wildlife and landscape features of much of the UK estuarine resource has been recognised by many parts of estuaries and their surroundings being designated under a variety of local, national and international measures, both statutory and non-statutory. The estuaries of North-west Britain are typical of this pattern in which there are often many overlapping site designations covering parts of an estuary. In addition to this site-based approach through which much of estuarine conservation has traditionally been delivered, some of the estuaries covered in this report (Dee Estuary and North Wirral, Mersey and Ribble Estuaries, Morecambe Bay, Duddon Estuary and Inner Solway Firth) are now also included in a variety of coastal zone planning and management initiatives.

Sites of Special Scientific Interest (SSSIs), the major statutory designations for the delivery of site-based wildlife conservation, cover many parts of the intertidal and associated terrestrial areas of North-west Britain. At least one SSSI is associated with all but four (Clwyd Estuary, Loch Gilp, Bagh nam Faoilean, and Camus Uig) of the estuaries covered by this volume, although SSSIs, like most other designations, cover only parts of each estuary. On some estuaries, such as the Dee Estuary (Dumfries & Galloway) and Water of Fleet, SSSIs cover little of the core estuary area.

In all there are 60 SSSIs in this region, 18% of estuarine SSSIs in Great Britain. Morecambe Bay currently has the largest number of SSSIs (thirteen) associated with an estuary in this area. SSSIs on Morecambe Bay are typical of those on many estuaries – a mixture of small SSSIs notified for their geological and geomorphological features and a few larger sites of biological or mixed interest covering tidal flats, saltmarshes and associated terrestrial habitats. Other estuaries in the region covered by four or more SSSIs are the Dee Estuary and North Wirral, the Ribble Estuary and the Inner Clyde Estuary. SSSIs associated with estuaries in this region cover a total of 138,998 ha (36% of the British estuarine SSSI area), with by far the largest areas of SSSI being on Morecambe Bay, the Inner Solway Firth, the Dee Estuary and North Wirral, and the Ribble Estuary.

Seven of the 42 declared estuarine National Nature Reserves (NNRs) in Britain are on the intertidal or terrestrial habitats of the estuaries covered by this volume. These include several areas of intertidal flats or saltmarshes, e.g. Ribble Marshes (Ribble Estuary), Caerlaverock (Inner Solway Firth) and North Walney (Duddon Estuary). Others include the extensive Ainsdale Sand Dunes (Alt and Ribble Estuaries), Roudsea Woods and Moss (Morecambe Bay) and Moine Mhor adjacent to the upper reaches of Loch Crinan.

One estuary within the region also falls within the non-statutory Marine Consultation Areas (MCAs), namely Tràigh Cill-a-Rubha which lies at the head of Loch Indaal MCA.

Local Nature Reserves are statutory designations made by

local authorities (in consultation with country conservation agencies) with objectives similar to those of NNRs but in the local interest of the site and its wildlife. Of the 33 designated LNRs which occur on estuaries, four lie within the region: Hilbre Island (Dee Estuary and North Wirral), Ravenmeols Hills (Alt Estuary), Ainsdale and Birkdale Hills, Lytham St Anne's Dunes (Ribble Estuary) and Drigg Dunes & Gullery (Esk Estuary).

Two international designations are particularly relevant to estuarine habitats and their birds. The Ramsar Convention designates wetlands of international importance especially as waterfowl habitat (Ramsar sites) and Special Protection Areas (SPAs) designated under the EC Directive on the conservation of wild birds. For estuarine waterfowl populations both designations often apply. Parts of the Dee Estuary and North Wirral, Alt Estuary, Inner Solway Firth, Tràigh Cill-a-Rubha and Loch Gruinart have been designated as Ramsar sites and SPAs, and the Ribble is also a designated SPA. There are proposals for Ramsar/SPA sites which would include parts of the Mersey Estuary, Morecambe Bay, Duddon, Esk and Cree Estuaries, Luce Bay, Inner Clyde Estuary, Tràigh Mhór, Bagh nam Faoilean, Oitir Mhór, and Oronsay. There are proposals for a single Ramsar/SPA site incorporating both the Ribble and Alt Estuaries, for single Ramsar/SPA sites can include more than one estuary since international site boundaries are set to cover areas linked by known movements of bird populations.

Other wildlife conservation sites include County Wildlife Trust reserves on six estuaries, RSPB reserves on or adjacent to the Dee Estuary and North Wirral, Morecambe Bay, Duddon Estuary, Inner Clyde Estuary and Loch Gruinart, and the Wildfowl and Wetlands Trust reserve at Caerlaverock on the Inner Solway Firth.

There are, in addition, several landscape conservation designations that partly cover estuaries in North-west Britain. The Lake District National Park overlaps with three estuaries (Morecambe Bay, Duddon and Esk Estuaries) and parts of Morecambe Bay and the Inner Solway Firth fall within Areas of Outstanding Natural Beauty. Twelve of the fifteen estuaries within National Scenic Areas (a Scottish landscape designation) are within the North-west Britain region. In addition there are Country Parks adjacent to three estuaries in North-west Britain (Dee Estuary and North Wirral, Mersey Estuary and Morecambe Bay) and there are National Trust properties on eight estuaries in the North-west Britain region.

Features of human use

Many parts of the coastline of North-west Britain are largely natural and little affected by damaging human activities. Rather few people live close to many of the estuaries covered in this volume. A major exception is the Mersey Estuary (> 500,000 population). Elsewhere, only the Liverpool Bay estuaries of the Dee Estuary and North Wirral, Ribble Estuary and Morecambe Bay and the Inner Clyde Estuary have nearby urban populations exceeding 50,000 people, and the majority of the remaining estuaries have nearby populations of less than 5,000 people. Hence there are few parts of the estuarine resource in North-west Britain that have been subjected to the major urban and industrial pressures characteristic of estuaries close to

large conurbations. The more typical human uses of many estuaries in North-west Britain are the exploitation of natural resources and recreation.

Few estuaries in North-west Britain have been subjected to substantial sea defence measures such as construction of sea walls. This is due, in part, to land areas rising relative to sea level (isostatic rebound after the last ice age), particularly in North-west Scotland. As a result, the erosion problems which often lead to the construction of major sea defences are not as significant in North-west Britain as they are, for example, in South-east England. Also, as many estuaries are incised steeply into hard rock systems, they are not surrounded by substantial low-lying areas that need defending. Only four estuaries in the region have artificial sea defences along more than 50% of their shoreline, namely the Dee Estuary and North Wirral, Ribble Estuary, Hunterston Sands and the Inner Clyde Estuary. In many areas there are long stretches of natural transitions from intertidal to terrestrial habitats.

Despite this overall pattern of low-intensity use of estuaries, there are a number of places where intensive human use occurs and where there has been substantial loss and damage to the estuarine resource. For example, there have been very extensive areas of historical land-claim on some estuaries such as the Dee Estuary and North Wirral, where around 6,000 ha have been claimed since 1730 (some 27% of the former total area of the estuary), and the Ribble Estuary, where 2,230 ha have been claimed since 1800 (16 % of the former total area). Substantial further land-claim of saltmarshes for agricultural use has historically created coastal grazing marshes on a number of estuaries e.g. the Ribble Estuary, but as has occurred on many sites considerable parts of the resource have been subsequently further altered through intense agricultural use or urban spread.

Heavy industrial activities are concentrated on the larger estuaries, notably the Mersey Estuary where extensive dock systems, power stations and a series of industrial sites stretch along both shores of the estuary; Morecambe Bay where there are large industries at Barrow-in-Furness, Ulverston, Heysham and Brine Wells; and the Inner Clyde Estuary, the shores of which are dominated by industry, large ports and oil terminals. At least twelve other estuaries have small ports and harbour facilities. In the past, several of these more industrial estuaries in North-west Britain have suffered chronic pollution from sewage and industrial discharges. The Mersey and Garnock Estuaries are typical examples, with both recently showing signs of improvement.

Other urban and infrastructure developments have, and are, altering estuarine features. Three of the estuaries on which housing and car-park developments were taking place in 1989 were in North-west Britain: the Mersey Estuary, in association with re-development of some of the now disused docks, the Duddon Estuary and the Inner Solway Firth. There have also been a number of further proposals for such developments in this region.

The coastlines of North-west Britain are largely undeveloped, and are popular spots for tourism and recreation. A wide variety of leisure pursuits, from general beach use and bathing to water-based recreation, take place on parts of these estuaries, especially during the

summer months. This is particularly true for the estuaries of the Liverpool Bay area which are easily accessible and close to large population centres, and recreational pursuits along these shores can be intensive in some areas. On some sites these activities can be detrimental to the habitats and wildlife of the estuary. For example attention has been focused recently on damage to dune systems on the Sefton Coast by recreational activities, and on disturbance to waterfowl on the Dee Estuary and North Wirral. To avoid this, on some sites, such as the Sefton Coast, the use of the sand dunes and beaches for leisure pursuits has to be carefully managed. Further north, along the coast of Scotland, estuaries are still used for recreation, but this is usually at much lower intensity.

Alongside recreation there are a variety of traditional land uses which exploit the natural plant and animal resources of these west coast estuaries. Stock grazing of saltmarshes, especially by sheep, is widespread, as is grazing of stable sand dunes. Other resource use includes fish-netting, shrimping, dredging for mussels, mollusc cultivation and cockle fisheries, e.g. on Morecambe Bay and the Inner Solway Firth. There are also fish farms on two estuaries within the region (Oitir Mhór and the Ruel Estuary).

As in South-west Britain, the high tidal ranges of estuaries in the southern part of this North-west Britain region have focused attention on the possibilities of creating tidal power barrages across the mouths of these estuaries. In 1989 potential for tidal power generation had been identified on the Duddon Estuary, the Wyre Estuary of Morecambe Bay and the Mersey Estuary, and an earlier proposal for a barrage on the Inner Solway Firth had not been dropped entirely. There was also a proposal for a leisure barrage associated with housing and marina development on Loch Gilp. Active investigations for the tidal power barrages on the Duddon and Mersey Estuaries were continuing in 1992.

Whilst this is only a brief overview of some of the key features of the estuaries of North-west Britain and their human uses, it is clear that this network of estuaries is both of great interest and value for wildlife and has a wide variety of human uses. Despite some areas of considerable degradation and past land-claim, and some proposals such as barrages that would further alter the ecosystem processes on important parts of the resource, many estuaries in this part of Britain have been subject to largely sustainable human exploitation. There is great opportunity therefore for all those involved in using and managing these estuaries to collaborate, through such approaches as integrated coastal zone management. Such future management can ensure that this wild and beautiful part of Britain's estuarine heritage continues to be used in sustainable ways that allow for the retention of its varied wildlife.

4 Using the inventory

A.L. Buck

This section provides some brief descriptions and keys to interpreting the presentations of information in the site reports. Full descriptions of the methodology, information sources and presentations are given in Volume 1 (Introduction) of the inventory.

The rationale for site definition and selection follows that developed by Davidson *et al.* (1991). It should be noted that some of the information collated by Davidson *et al.* (1991) has been updated and corrected in some instances, and that the core estuary sites as presented in the inventory now include some adjacent intertidal areas treated separately in the Estuaries Review (also see below).

A short key to the inventory

Inventory sites are numbered and presented in clockwise sequence from Land's End. Note, however, that the numbering of estuaries in Northern Ireland follows on from those in Great Britain. Where data was collected or measured from sources other than the Estuaries Review or Coastal Review Unit, these sources are identified below. Information refers to the period 1988-1990 unless otherwise stated.

Site map

Sites were selected for inclusion in the Estuaries Review and inventory using a definition of an estuary based on that developed by NERC (1975): a partially enclosed area 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.

For the inventory only sites with a tidal channel longer than 2 km or sites with a shore width of over 0.5 km at low water along a shoreline greater than 2 km are included. The upstream limit is normally taken as the Normal Tidal Limit (NTL), the upper shoreline limit is an interpreted high water mark approximating to the highest astronomical tides (EHWS), and seaward limits are set as either a 'bay closing line' or 'across mouth' (XM) or an 'along shore' (AS) set by the low water mark. On sites that are not isolated from their neighbours, an arbitrary boundary 'between adjacent estuaries' (BAE) has been set, usually at the mid-point of the shore between the sites, or where the intertidal zone is at its narrowest. Note that the low water mark is that shown on 1:50,000 O.S. maps - mean low water in England and Wales, low water spring tides in Scotland.

The approach used for the Estuaries Review and inventory has been to locate a 'core site' of intertidal and subtidal habitats. The core site boundary is shown on the site map. For a few estuaries we have, in addition, defined adjacent areas of 'associated intertidal' habitat where this is outside the inventory estuary mouth but has a functional link to the estuary, for example where the area forms part of an estuarine structure when considered at larger scale, or where there are links through area use by mobile wildlife.

It is difficult to define standard geographical zones for the inclusion of terrestrial habitats associated with estuaries. For this reason we have followed the Estuaries Review in collating information for an 'associated terrestrial' zone that varies in extent between sites, but which includes functional units of maritime-influenced wildlife habitat and areas of human use that closely affect the core estuary.

Estuary size characteristics and description

Measurements of *total area* and *intertidal area* have been rounded to the nearest 1 ha.

Shore length and *channel length* measurements have been rounded to the nearest 0.1 km.

Tidal ranges have been derived from High and Low Water for Mean Spring Tides for the site closest to the defined estuary mouth, from Hewitt & Lees-Spalding. (1988).

Human population gives numbers of people living in towns reaching within 1 km of the tidal shore, from the results of the 1981 population census. Population figures greater than 5,000 have been rounded off to the nearest 1,000.

Water quality descriptions are from the DoE River Quality in England and Wales Survey 1991, (National Rivers Authority 1991) and the Water Quality Survey of Scotland 1985 (Scottish Development Department 1987).

Wildlife features

All *coastal habitat* areas are rounded to the nearest 1 ha. Areas for sandflats and mudflats were not measured separately, and are given as a combined figure. Saltmarsh areas are derived from NCC's *Saltmarsh survey of Great Britain* (Burd 1989).

Aquatic estuarine communities. The classification of aquatic estuarine communities - subtidal and intertidal marine communities of substrates not vegetated by higher plants - was prepared by the Estuaries Review using methodology developed by the Marine Nature Conservation Review (MNCR). The Estuaries Review classification was prepared before completion of all relevant survey work by MNCR so this classification should be treated as preliminary. It is being developed further by MNCR. Information on the presence of these benthic communities (rather than the substrates on which they occur) was not available during the review for all sites, although further work is in progress. The benthic plant and animal communities are divided into two broad categories: those on soft substrates and those on hard substrates, and are further divided into communities describable largely on their physico-chemical characteristics. Some of the communities occur on both the intertidal and subtidal parts of estuaries. Communities are as follows:

Soft substrates

1. Gravel/shell gravel community
2. Maerl beds
3. Exposed sand community
4. Clean sand community
5. Common mussel beds
6. Horse mussel beds
7. European oyster beds
8. Surface algal community
9. Current-swept sand community
10. Sand/muddy sand community
11. Muddy gravel community
12. Muddy 'offshore' sand community
13. Normal/variable salinity muddy community
14. *Zostera* and *Ruppia* beds
15. Variable/reduced salinity mud community
16. Reduced salinity mud community

Hard substrates

17. Exposed rocky shore community
18. Moderately exposed rocky shore community
19. Sheltered rocky shore community
20. Variable salinity rocky shore community
21. Reduced (variable) salinity rocky shore community
22. Reduced salinity rocky shore community
23. *Sabellaria* reef community
24. Current-exposed sheltered rocky shore community
25. Exposed rock community
26. Sheltered rock community
27. Hydrozoan/bryozoan turf community
28. Slipper limpet beds
29. Artificial substrata community
30. Variable salinity rock community
31. Variable salinity clay community
32. Reduced (variable) salinity rock community
33. Reduced salinity rock community

Birds. Major sources of information on wintering waders and wildfowl are the BTO/JNCC/RSPB Birds of Estuaries Enquiry (BoEE) co-ordinated by the British Trust for Ornithology, and the National Wildfowl Count (NWC) operated by the Wildfowl and Wetlands Trust. Information in the inventory is calculated from five year peak monthly counts for waterfowl for the winters 1986/87 - 1990/91. The proportions of international and national populations of individual species are shown where these are of national or international importance ($\geq 1\%$ of the relevant population except where this value is < 50 birds).

Information for some estuaries or parts of estuaries not regularly covered by the BoEE is included from the BTO/WSG Winter Shorebird Count from midwinter 1984/85. Breeding bird data comes from the JNCC/Seabird Group's Seabird Colony Register and a variety of other national, regional and local surveys (see Volume 1 for details).

Additional wildlife features. Information presented here includes: nationally rare plants i.e. those found in fifteen or fewer 10 km squares in Great Britain (from the Rare Plants Database); Red Data Book (RDB) terrestrial invertebrates (from JNCC's Invertebrate Site Register - ISR); and a variety of other recorded features of conservation interest, for example rare fish, amphibians, reptiles and mammals. Note that 'recently recorded' species of terrestrial invertebrate have been recorded since 1970.

Conservation status

The presence of both statutory and non-statutory wildlife and landscape conservation sites is shown. Known proposals for Sites of Special Scientific Interest, National Nature Reserves, Local Nature Reserves, 'Ramsar' sites and Special Protection Areas are also indicated where these were in their final stages of preparation for designation during completion of the inventory.

Abbreviations to the designations are as follows:

NCR	Nature Conservation Review site
GCR	Geological Conservation Review site
SSSI (B)	Site of Special Scientific Interest (biological)
SSSI (G)	Site of Special Scientific Interest (geological and/or geomorphological)
SSSI (M)	Site of Special Scientific Interest (mixed biological and geological/geomorphological)
NNR	National Nature Reserve
LNR	Local Nature Reserve
Ramsar	Wetland of International Importance (Ramsar Convention)
SPA	Special Protection Area (EC Directive on the conservation of wild birds)
AONB	Area of Outstanding Natural Beauty (Countryside Commission)
CWT	County Wildlife Trust reserve
RSPB	Royal Society for the Protection of Birds reserve
ESA	Environmentally Sensitive Area (MAFF)
NP	National Park (England and Wales only)
WWT	Wildfowl and Wetlands Trust centre/reserve
NT	National Trust land
NSA	National Scenic Area (Scotland only)
HC	Heritage Coast (Countryside Commission)
Other	Marine Nature Reserves, Areas of Special Protection, Country Parks etc.

Human use

Features of human use data were collected and collated largely between February and June 1989 (from a wide variety of sources chiefly through members of NCC's regional staff with responsibility for conservation management for each estuary). Activities listed as 'Present' and/or 'Proposed' indicate that status only during that period. Proposals include both those developments subject to consent applications and those subject to less formal public discussion and/or investigation. When more recent information is available, changes since 1989 in present activities or the status of proposals are noted in the text, as are major proposals that have arisen since 1989.

Categories of human use. The bar chart shows, for each broad use category, the percentage of activity types in that category known to occur in 1989. For a fuller explanation of this analysis see the introductory volume of the Inventory.

Further reading

Further reading lists selected references containing further information on the estuary and its wildlife. Note that not all this further reading refers to detailed scientific studies: some sources are general or are historical descriptions of life on these estuaries or are even part of the extensive fictional literature that describes estuaries.

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5 The estuaries

A.L. Buck

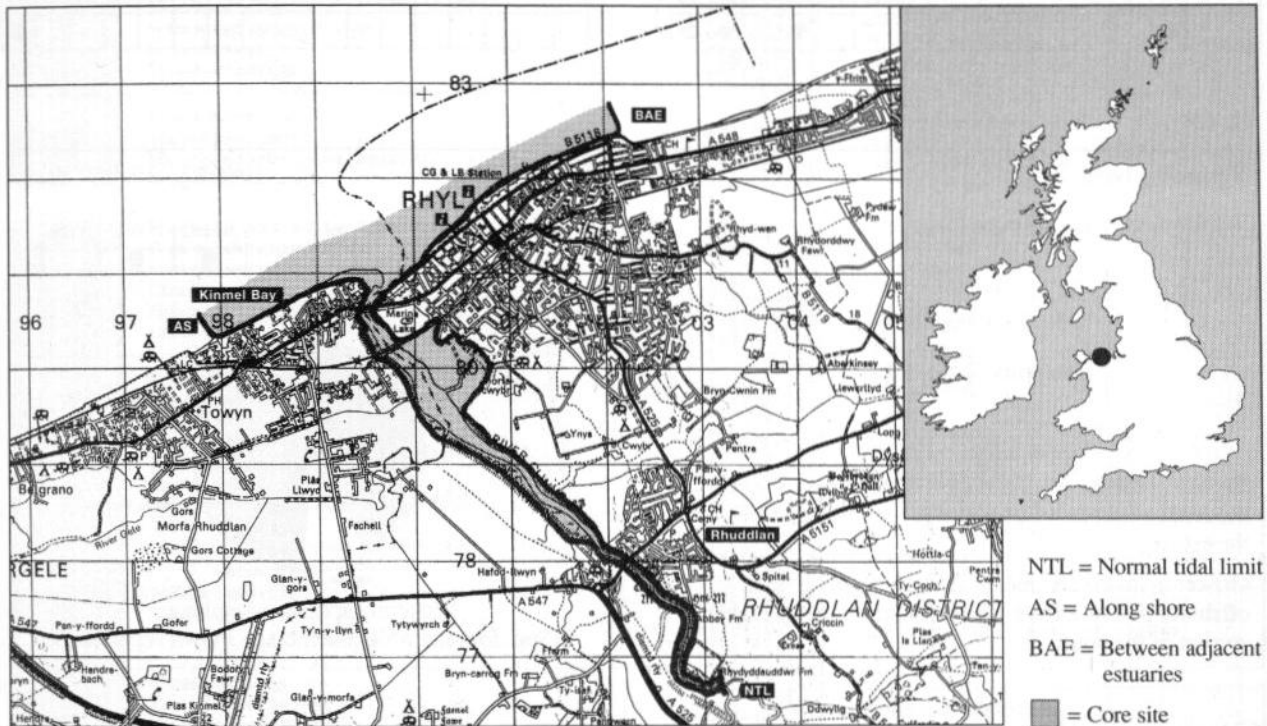


Upper Solway Flats and Marshes. The geomorphology of the saltmarshes within the Solway Estuary is outstanding. (Peter Wakely, English Nature)

Centre grid: SJ0080
County: Clwyd

District: Colwyn, Rhuddlan
CCW region: North Wales

Review site location



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
422	386	19.2	8.2	6.7	Coastal plain	23,000

Description

The Clwyd is a small estuary on the north coast of Wales, and is contiguous with the Dee Estuary and North Wirral review site to the east. The Clwyd has a long history of land-claim and flood prevention works, and the entire length of the tidal channel is canalised with flood prevention embankments. Water quality has been classified as grade A.

The mouth of the estuary at Rhyl is restricted and displaced north-eastwards by a small spit, behind which the estuary drains almost completely at low tide to expose narrow mudflats. On either side of these mudflats there are small areas of saltmarsh, which have a diverse vegetation.

The mouth of the estuary opens out into a large expanse of sand beaches along Kinmel Bay and Rhyl. These beaches once graded into an extensive sand dune system, but buildings now cover most of this.

Wintering bird populations on the estuary are dominated by waders, and the Clwyd regularly supports nationally important populations of sanderling. The marine lake at Rhyl (adjacent to the review site) is filled from the estuary and is a good feeding ground for waders when it is drained in winter.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●						
Area (ha)	36	43	343							

● = major habitat ● = minor habitat

Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		●										●		●	●

Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
																●


Birds

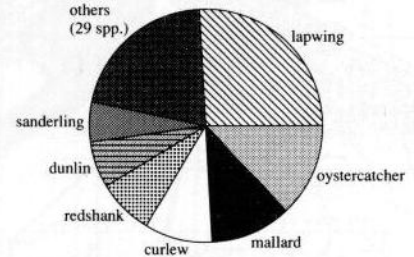
Wintering birds

Total waterfowl: 5,370

1986/87 – 1990/91 data

BoEE	NWC	WSC
●	●	

% National population
sanderling  1.2%



Wintering species assemblage
(Spp. forming >5% assemblage shown separately)

Breeding birds: small numbers of herring gull and moderate numbers of little tern are known to breed on the estuary.

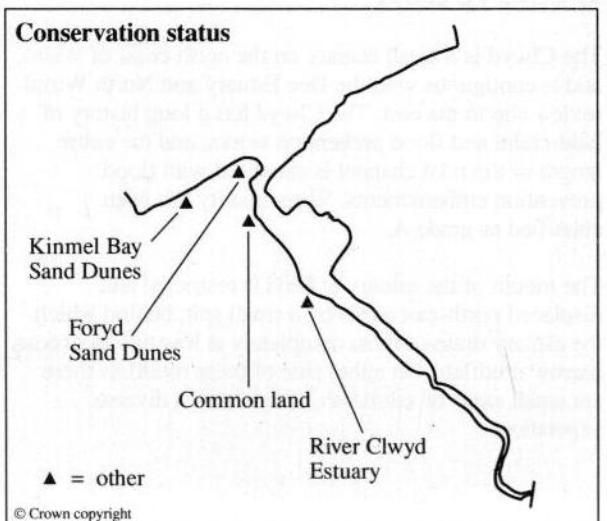
Other: up to 80 common scoter are regularly seen offshore, part of a flock which frequents the Abergele section of the coast.

Conservation status

● = designated ● = proposed

No.	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other		
																				●	
																					4

There are no statutory designations present on the estuary, but the River Clwyd Estuary, Foryd Sand Dunes and Kinmel Bay Sand Dunes have been notified as Sites of Nature Conservation Importance to the District and Borough Council, and are afforded protection under Local and County Structure Plans. There is also an area of common land on the western shore of the estuary.



Human activities

Present	Proposed	
●		Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
●		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
●		Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
		Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
		Military activities Overflying by military aircraft Others
●		Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
●	●	Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
		Urbanisation Land-claim for housing & car parks
		Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

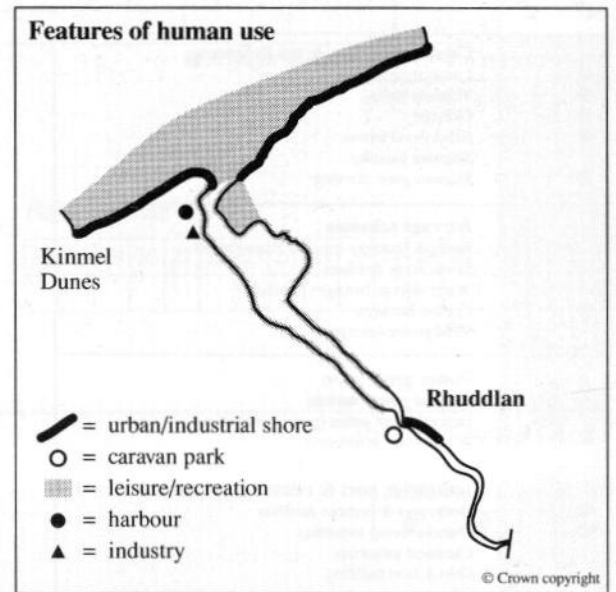
Present	Proposed	
●		Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
●		Wildfowling & hunting Wildfowling Other hunting-related activities
●		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
●		Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
●		Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
●		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
●		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
		Others

Features of human use

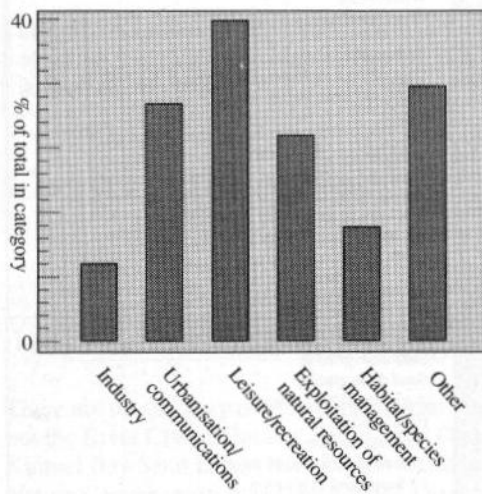
Most activities are of a recreational nature and as the town of Rhyl, which dominates the mouth of the estuary, is a seaside and holiday resort, these activities are most intensive during the summer months. Angling, fishing, sailing and wind-surfing are concentrated along the coast, and water-skiing occurs in the marine lake and inside the estuary mouth. Walkers and horse-riders use the sea front and the embankments on either side of the river, and trial-biking occurs on a small area of Kinnel dunes.

Exploitation of the natural resources includes fixed- and gill-netting and trawling for fish, fyke-netting for eels, trawling for Crustacea, shrimping and bait-digging. The saltings on either side of the estuary are grazed by sheep and cattle, and wildfowling occurs on the river downstream of Rhuddlan.

Industrial activity on the estuary is limited, with the one harbour just inside the estuary mouth used mainly by fishing and pleasure craft. There is also a scrapyard on the west bank which has encroached on 1 ha of the intertidal area.



Categories of human use



Further reading

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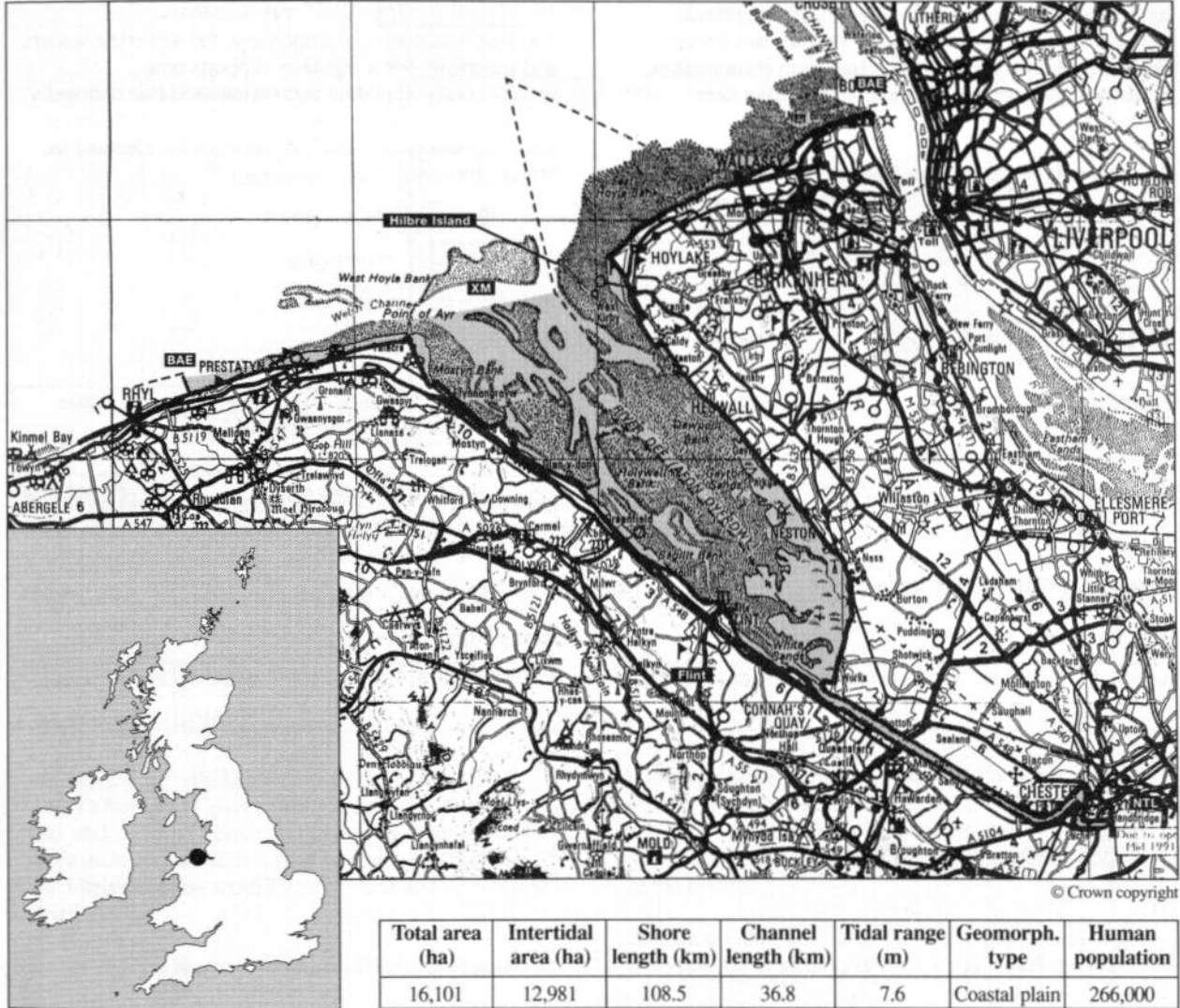
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Parsons, N., & Pugh-Thomas, M. 1979. Notes on the ecology of the Clwyd Estuary, North Wales. *Journal of Natural History*, 13: 725-734.

Centre grid: SJ2674
 Counties: Merseyside, Cheshire, Clwyd

Districts: Wirral, Ellesmere Port, Neston, Chester,
 Alyn & Deeside, Delyn
 EN/CCW regions: West Midlands, North-west
 England, North Wales

Review site location



NTL = Normal tidal limit

BAE = Between adjacent estuaries

XM = Across mouth

■ = Core site

Description

The Dee Estuary lies between the Wirral peninsula and the North Wales coast, and is adjacent to the Mersey Estuary and the Clwyd Estuary review sites. The Dee is a large, funnel-shaped, sheltered estuary, and its upper reaches have been canalised from Flint to Chester. Water quality within the estuary has been classified largely as grade A, apart from a small section on the eastern shore north of Neston which was grade B.

Much of the estuary consists of a large intertidal sand and mudflat, rich in invertebrates, and extensive areas of saltmarsh where the canalised Dee broadens out into the main body of the estuary. Much of the saltmarsh is dominated by pioneer and low-mid marsh vegetation communities, and *Spartina* is also a significant feature. There are relatively few areas of transition communities, as much of the former upper saltmarshes have been subject to land-claim.

On either side of the mouth of the estuary there are long stretches of sandy beaches, behind which there are areas

of sand dunes. To the east the dunes grade into brackish dune slacks and reed-bed, where the wet slacks form important breeding grounds for amphibians, and to the western shore the dune ridges and slacks grade into brackish marsh, and support a varied invertebrate fauna which is particularly rich in moths.

The Dee Estuary also has a stretch of cliffs along its eastern shore from Hoylake to Heswall. Rising to 15 metres high, these clay cliffs and banks have a rich flora and fauna. The estuary also includes the rocky shores of Hilbre Island, lying 1.5 km from the north-west corner of the Wirral peninsula.

The Dee is of particular importance for wintering waders and waterfowl, for it regularly supports nine internationally important populations and five nationally important populations of waterfowl. There is, however, some movement of waterfowl between the Dee and the Mersey Estuary.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●	●	●		●		●
Area (ha)	3,120	2,108	10,873							

● = major habitat ● = minor habitat

Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
												●		●	

Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33

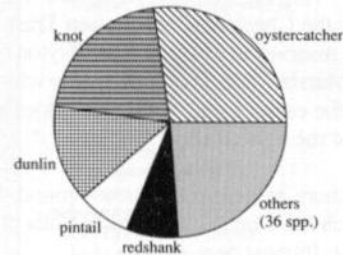
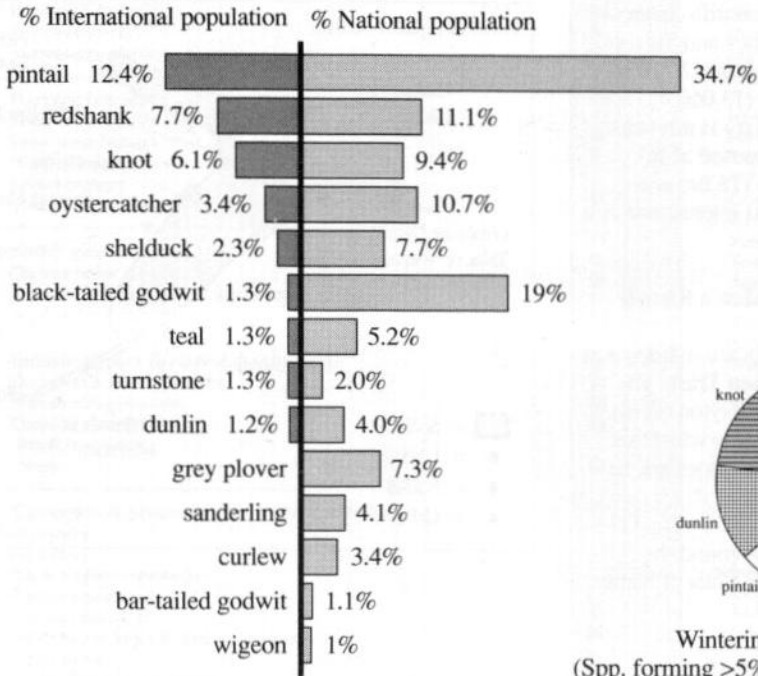
Birds

Wintering birds

1985/86 – 1990/91 data

Total waterfowl: 118,800

BoEE	NWC	WSC
●	●	



Wintering species assemblage
(Spp. forming >5% assemblage shown separately)

Breeding birds: there are small breeding colonies of black-headed gull and little tern, and a moderate-sized colony of common tern on the estuary. Moderate numbers of lapwing also breed on the grasslands adjacent to the estuary, and small numbers of redshank breed on the saltmarshes.

Other: many migrating waders use the Dee Estuary in spring and autumn, and it is also a moulting ground in autumn.

Additional wildlife features

Red Rocks is the only known site in England where Mackay's horsetail *Equisetum x trachydon* has been found, and the invertebrate fauna recently recorded on the estuary includes the RDB 3 fly *Thereva valida*, the RDB 3 belted beauty moth *Lycia zonaria* and 12 Notable species.

The Dee Estuary is a major sea bass *Dicentrarchus labrax*

nursery and smelt *Osmerus eperlanus* occur in the estuary. There are also recent records of the rare allis shad *Alosa alosa* in the Dee. There is also a small breeding population of the natterjack toad *Bufo calamita* adjacent to the estuary.

In addition around 15% of the Welsh population of grey seals use the sandbanks of the Dee as a haul-out site.

Conservation status

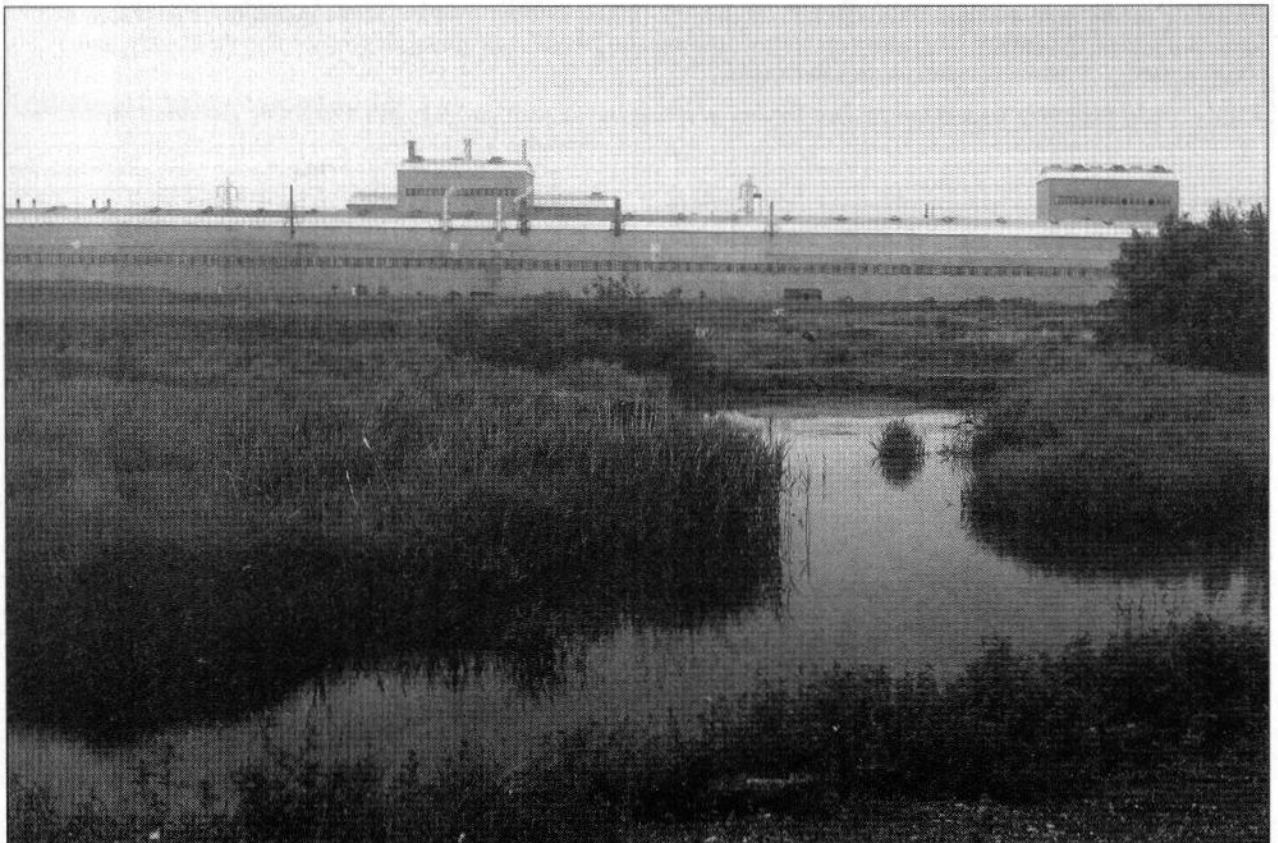
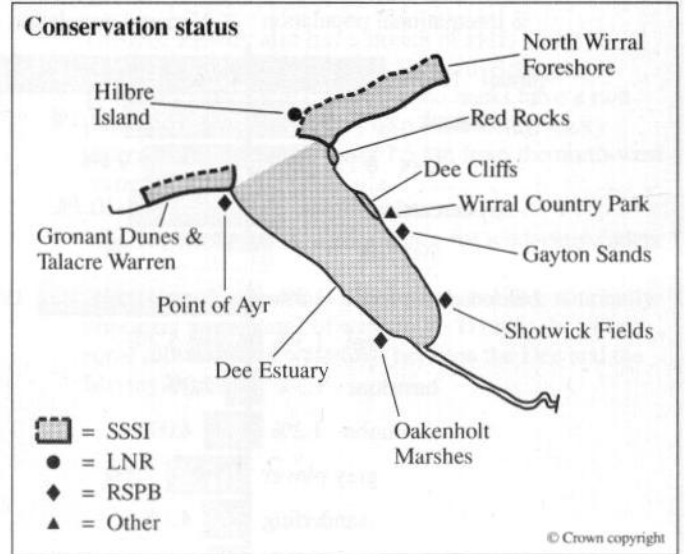
● = designated ● = proposed

No.	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other	
	●	●	●		●	●	●	●	●			●								●
No.	1	1	4		1	1	1	1	1			4								4

There are several Sites of Special Scientific Interest within the Dee Estuary. Gronant Dunes and Talacre Warren (470 ha), North Wirral Foreshore (2,110 ha), Red Rocks (11 ha) and Dee Estuary (13,060 ha) are biological SSSIs, of which Dee Estuary is a Nature Conservation Review site and is proposed as a National Nature Reserve. Dee Cliffs (18 ha) is an SSSI for its biological and geological interest and is a Geological Conservation Review site.

The Dee Estuary has been designated as a Ramsar site and a Special Protection Area. Hilbre Island is a Local Nature Reserve and Red Rocks are managed as a reserve by the Cheshire Conservation Trust. The RSPB have reserves at Point of Ayr, Gayton Sands, Oakenholt Marshes and Shotwick Fields which are adjacent to the estuary, and Wirral Country Park lies along part of the eastern shore.

In addition there are numerous areas around the estuary which have been identified as Sites of Nature Conservation Interest (not shown).



A steelworks in the upper reaches of the estuary. Industry is a major feature of the Dee. (Pat Doody, JNCC)

Human activities

Present	Proposed	
●		Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
●	●	Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
●		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
●		Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
●	●	Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
●		Military activities Overflying by military aircraft Others
●		Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
●		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
●	●	Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
		Urbanisation Land-claim for housing & car parks
●		Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

Present	Proposed	
●		Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
●		Wildfowling & hunting Wildfowling Other hunting-related activities
●		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
●		Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
●		Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
●		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
●	●	Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
●		Others

Features of human use

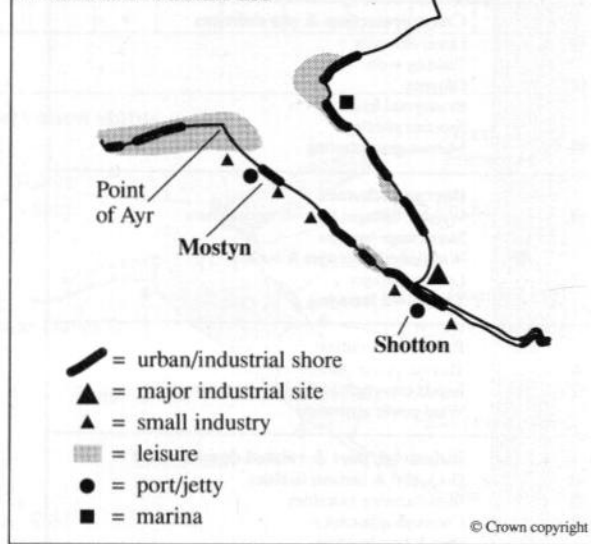
There are a large number of leisure activities on the Dee, particularly water-sports with three yacht clubs, seven sailing clubs and a marina at various locations over the estuary. Land-based pursuits are centred on the sands at the estuary mouth, with 4WD, trial-biking and horse-riding. Beach recreation is widespread along the sandy beaches, and is most intensive where there is road access to the beach.

Industry is a major feature of the Dee Estuary with docks at Mostyn and jetty facilities at Shotton, and at least five chemical industries concentrated along the shores of the inner estuary. There is also a steelworks and paper mill at Shotton, and coal mining occurs at the Point of Ayr.

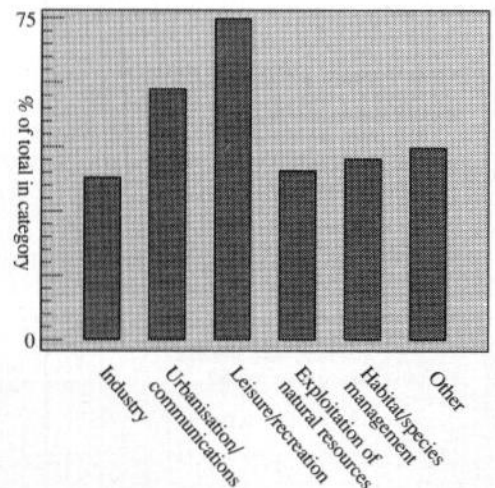
Exploitation of the natural resources includes saltmarsh grazing, sand dune grazing, seine-, trammel and drift-netting for fish, trawling for shrimps, cockling and bait-digging, which is not intensive. A wildfowling club shoots over the marshes, but there are some no-shooting areas within the estuary.

In 1989 there were proposals for a water storage barrage, the Flint By-pass road scheme, urbanisation for the Deeside Waterfront Development which may involve some land-claim, sand-yachting and *Spartina* control. Since then sand-yachting has begun on the North Wirral foreshore and the proposals for a water storage barrage have been dropped. There have been more recent proposals for an oil and gas terminal at Point of Ayr, and three proposals for gas-fired power stations at Shotton/Connah's Quay which would involve thermal discharges into the estuary.

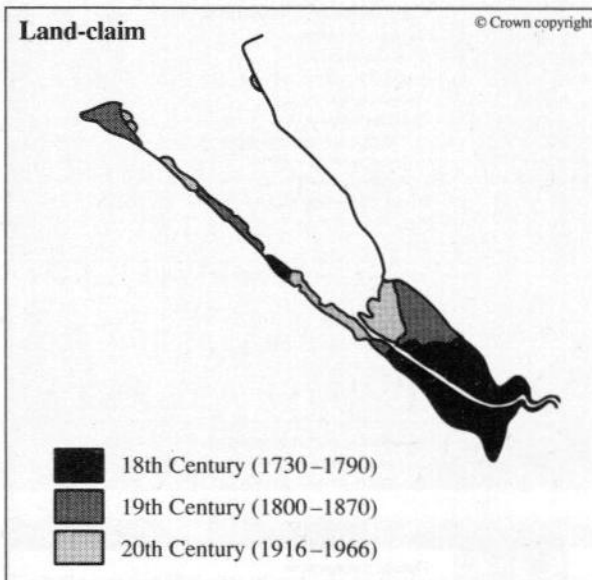
Features of human use



Categories of human use



Land-claim



Land-claim

On the Dee there has been a history of land-claim, principally for agriculture, and since 1730 there has been a loss of 6,000 ha, 27% of the total area of the estuary. This has extensively altered the pattern of saltmarsh accretion on the estuary, causing the growth of new saltmarsh out over the upper parts of the remaining tidal flats.

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Centre grid: SJ4180
 Counties: Merseyside, Cheshire

Districts: Liverpool, Sefton, Wirral, Ellesmere Port,
 Halton, Vale Royal, Warrington
 EN regions: North-west England, West Midlands

Review site location



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
8,914	5,607	102.9	15.6	8.9	Coastal plain	834,000

NTL = Normal tidal limit

BAE = Between adjacent estuaries

XM = Across mouth

■ = Core site

Description

The River Mersey has a large, sheltered estuary, flanked by the extensive conurbations of Runcorn, Birkenhead and Liverpool and with industrial complexes along much of its shoreline. Water quality of the estuary has been classified as grade C for most of its length, but upstream of Runcorn it has been classified as grade D.

A large proportion of the estuary is intertidal flats, which are sandy in the upper reaches and muddy downstream of Hale. The most extensive areas of intertidal flats are in the central, wider parts of the estuary and support a rich and abundant invertebrate fauna. On the northern shore of this central section there are generally narrow saltmarshes, and on the southern shore the Ince and Stanlow Banks form extensive areas of saltmarsh. At Oglet Bay on the northern shore the saltmarsh is accreting, while on the southern shore it is eroding as the river shifts course southwards. The continued migration of the deep-water channel is an important feature of the inner basin where

little mature saltmarsh is allowed to develop. Historically, large areas of saltmarsh have been claimed behind the Manchester Ship Canal, and these areas of coastal grasslands are now used by birds as feeding and roosting sites.

In addition some parts of the northern shore are formed of boulder clay cliffs, which have freshwater seepages and periodically sections are exposed by slumping. A number of unusual plants grow on these cliffs. The Mersey Estuary also has some areas of rocky shore at Garston Rocks, Bromborough, and on the southern side of the estuary mouth at Preston Rocks. Behind these latter rocks there is a narrow shingle beach.

The Mersey is of particular importance for wintering waterfowl, regularly supporting five internationally important populations and four nationally important populations.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other (cliffs)
	●	●	●	●		●	●	●		●
Area (ha)	3,307	848	4,759							

● = major habitat ● = minor habitat

Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
												●		●	

Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
			●													

Additional wildlife features

The invertebrate fauna recently recorded on the estuary includes two Notable species. Small numbers of grey seals are regularly recorded in the estuary.

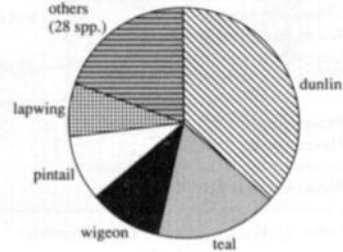
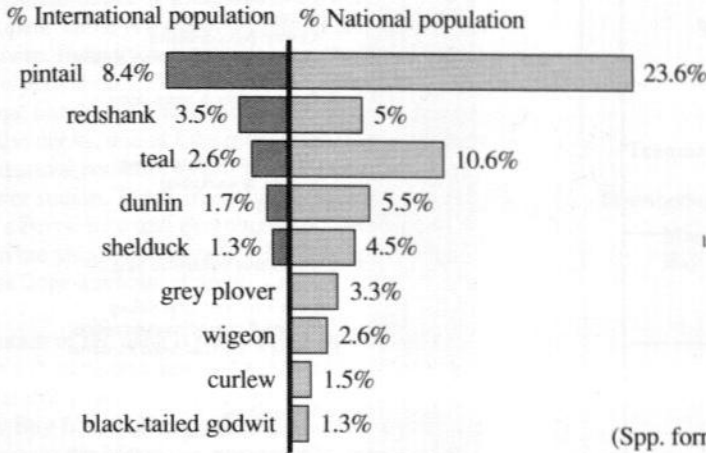
Birds

Wintering birds

1986/87 – 1990/91 data

Total waterfowl: 64,300

BoEE	NWC	WSC
●	●	



Wintering species assemblage
(Spp. forming >5% assemblage shown separately)

Breeding birds: small numbers of redshank, lapwing and snipe breed on the grasslands, and small numbers of ringed plover also breed within the estuary.

Other: the Mersey Estuary is an important staging post for migrating birds in spring and autumn.

Conservation status

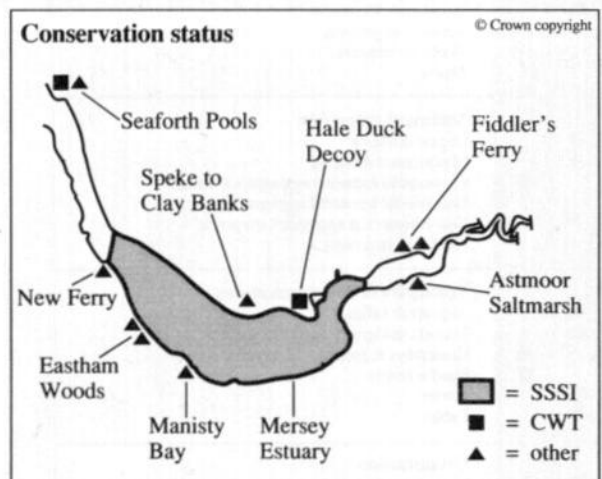
● = designated ● = proposed

No.	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other	
	●		●					●	●		●									●
	1		1					1	1		2									9

A large proportion of the estuary is covered by the Mersey Estuary (6,700 ha) biological Site of Special Scientific Interest, which is also a Nature Conservation Review site. The Mersey Estuary is also a proposed Special Protection Area and Ramsar site.

There are two County Wildlife Trust reserves on the estuary, Hale Duck Decoy managed by the Cheshire Wildlife Trust and Seaforth Pools, a Lancashire Trust for Nature Conservation reserve. Manisty Bay is managed by the Merseyside Naturalist's Association, and there is a private reserve at Fiddler's Ferry power station.

In addition there are several areas that have been identified as Sites of Local Biological Interest, namely New Ferry, Seaforth Pools, Astmoor Saltmarsh, Fiddler's Ferry Saltmarsh, Speke to Clay Banks and Eastham Woods which is also a Country Park. A number of these sites are afforded protection under the Merseyside Structure Plan.



Human activities

Present	Proposed	
●		Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
●	●	Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
●		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
●		Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
●	●	Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
		Military activities Overflying by military aircraft Others
●	●	Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
●	●	Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
●	●	Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
●		Urbanisation Land-claim for housing & car parks
●	●	Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

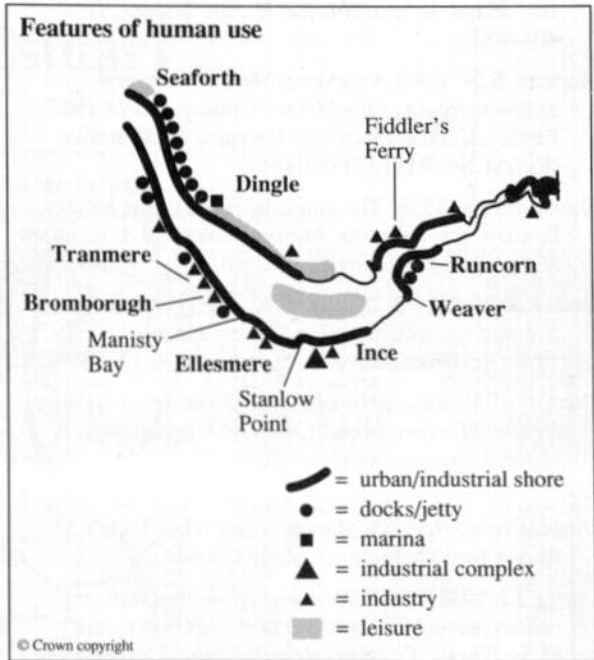
Present	Proposed	
●		Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
●		Wildfowling & hunting Wildfowling Other hunting-related activities
		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
		Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
●		Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
●		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
●		Others

Features of human use

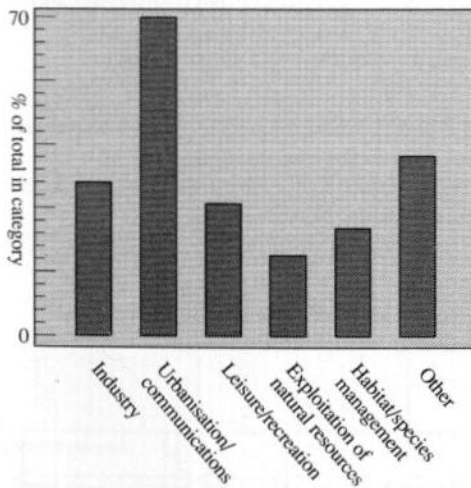
The Mersey is a highly industrialised and urbanised estuary with strong communication links. The dock system is extensive and stretches from Seaforth to Dingle, and the southernmost of these docks are being redeveloped. There is a major oil import and export jetty at Tranmere. Industry is extensive along both the Wirral and Liverpool shores. From Runcorn Gap to Weaver there are a large number of chemical industries, many lying behind the docks, and at Ellesmere there is an extremely large industrial complex which includes an oil refinery and power station. There are further power stations at Fiddler's Ferry, Ince and Bromborough. Dredging to maintain the shipping channels is a major activity that produces large amounts of spoil.

Exploitation of the natural resources is limited, and includes saltmarsh grazing and wildfowling, the latter from Stanlow Point to Weaver on the south shore. Manisty Bay is a wildfowl refuge. Few leisure activities take place on the Mersey as access to the estuary is limited. Those pursuits that do occur include sailing in the central area of the estuary, and walking along the Mersey Way on the north shore.

In 1989 there were proposals for oil and gas exploration, a sewage treatment works and a tidal power barrage that would also be used for leisure. More recently there have been proposals for road crossings and expansion of the airport.



Categories of human use



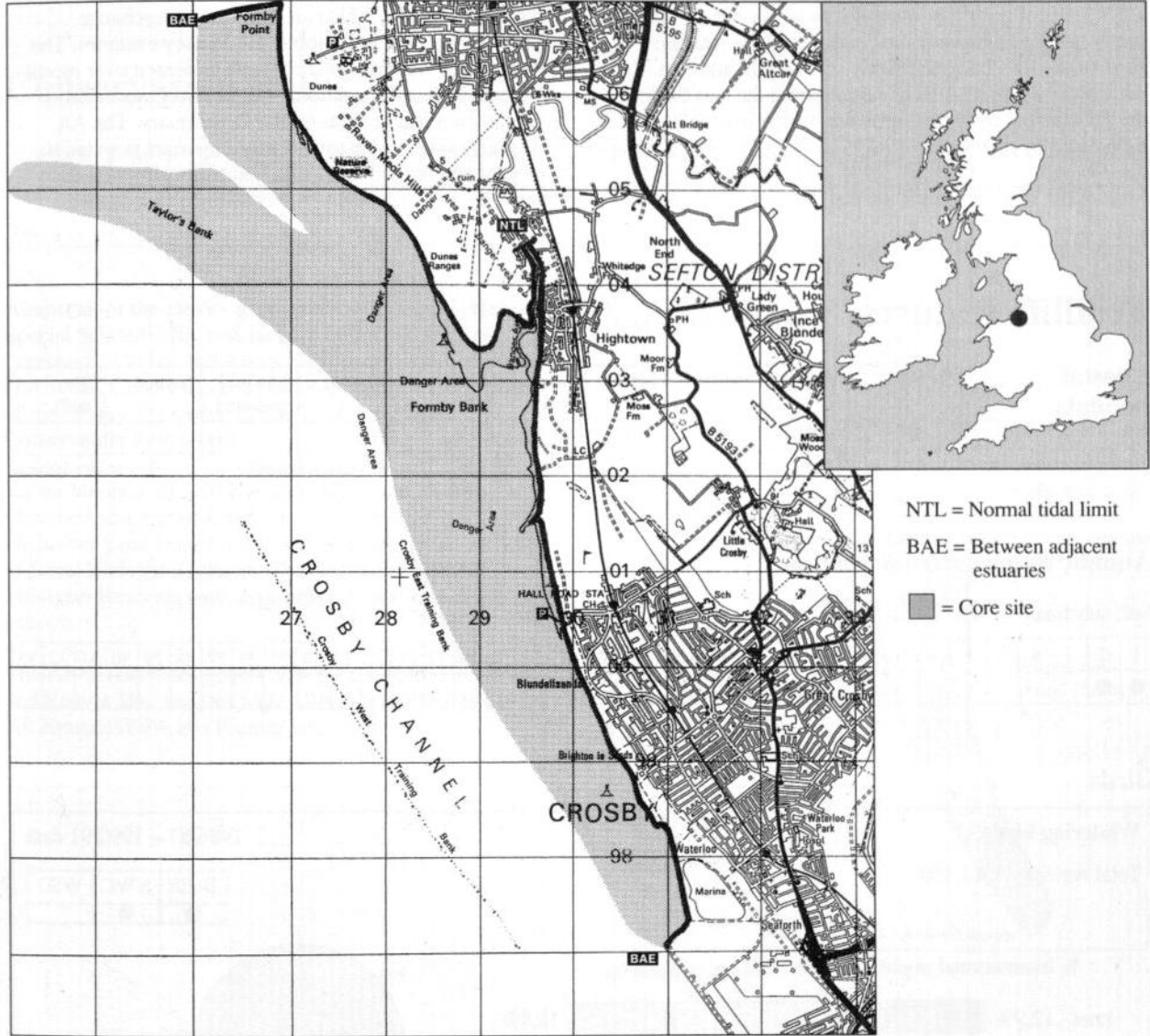
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Alt Estuary

Centre grid: SD2903 District: Sefton
 County: Merseyside EN region: North-west England

Review site location



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
1,413	1,413	14.0	5.2	8.0	Coastal plain	81,000

Description

The Alt Estuary is contiguous with two other review sites, the Ribble Estuary to the north and the Mersey Estuary to the south. The estuary receives a very limited freshwater input from the River Alt, and offshore the water flow is trained southwards by a stony investment. The River Alt is heavily polluted, and the water quality of the estuary has been classified as grade D.

The sandflats are the most extensive feature of the estuary and are contiguous with those of the Ribble, where in the north they are predominantly sandy, with wet gullies and a thin layer of mud. The central flats of the Alt are also sandy but with a higher mud content, and the southern parts of the flats become muddy offshore. In addition there is a very small area of saltmarsh on the east bank of the Alt channel south of Hightown, which is largely dominated by *Spartina*.

Inshore the sandflats grade into sand dunes, and form an

integral part of the calcareous dune system which extends northwards beyond the estuary to Southport. The Alt is an area of dune accretion, with extensive embryo, yellow and grey dunes up to 40 metres wide, and on the flatter land behind the dune ridges there are areas of dune pasture and wet slacks. The fauna here is varied and extremely rich in invertebrates, particularly butterflies, and the dunes are also home to natterjack toads and sand lizards.

The Alt Estuary regularly supports very large numbers of wintering waders, which are known to interchange between the Dee, Alt, Ribble and Mersey estuaries. The numbers of wintering waders have increased over recent years, which is thought to be due to disturbance and decline in roosting areas on the Dee Estuary. The Alt regularly supports internationally important populations of knot and bar-tailed godwit, and nationally important populations of grey plover, sanderling and redshank.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other (cliff)
	●	●	●	●	●					
Area (ha)		1	1,412							

● = major habitat ● = minor habitat

Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
●	●							●							

Hard substrate

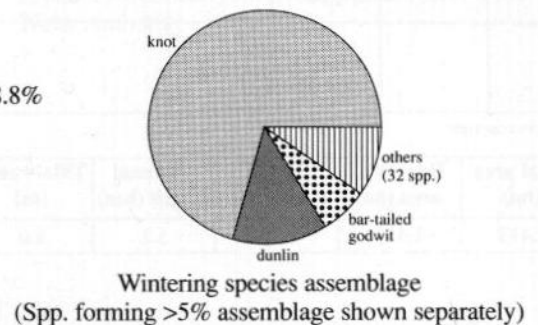
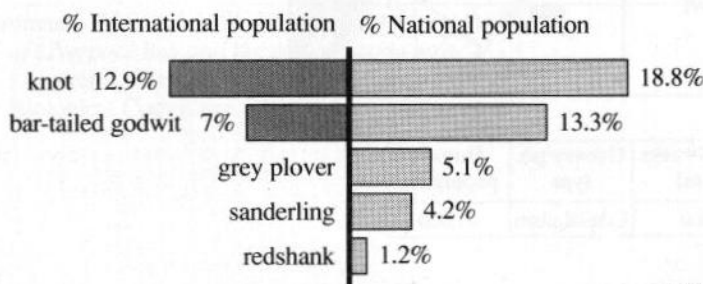
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33

Birds

Wintering birds

Total waterfowl: 61,100

1986/87 – 1990/91 data



Breeding birds: small numbers of ringed plover are known to breed on the estuary.

Other: in autumn large flocks of common and arctic terns and kittiwakes feed and roost off Formby Point.

Additional wildlife features

The nationally rare Isle of Man cabbage *Rhynchosynapis monensis* grows within the estuary.

The invertebrate fauna of the dunes is extremely rich with several Red Data Book species recently recorded: the RDB 1 beetle *Aegialia rufa*, the RDB 2 beetle *Hypocaccus rugiceps*, the RDB 3 beetles *Dryocoetinus alni*, *Cicindela hybrida* and *Dryops griseus*, the RDB 3

bees *Colletes cunicularius* and *Stelis ornatula*, the RDB 3 wasps *Podalonia affinis* and *Psen littoralis*, and 55 Notable species.

The dunes also support a population of sand lizards *Lacerta agilis*, and up to 20% of the British breeding population of natterjack toad *Bufo calamita*.

Conservation status

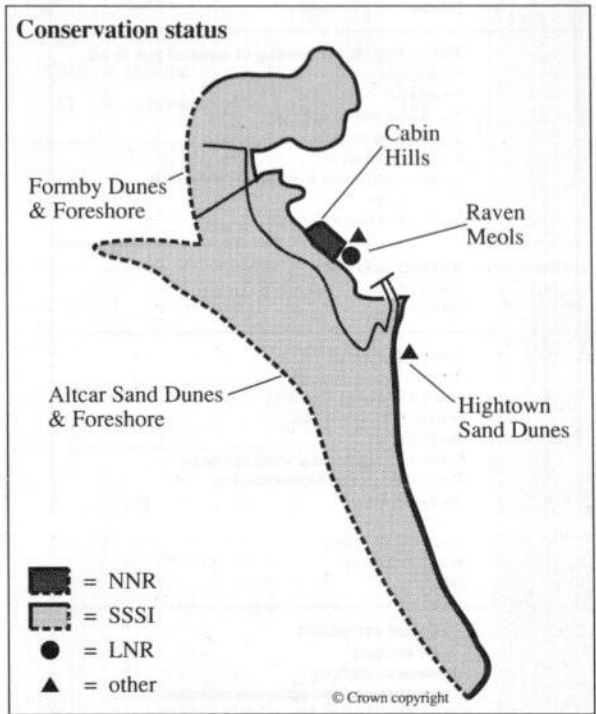
● = designated ● = proposed

No.	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other	
	●		●			●	●	●	●											●
	1		2			1	1	1	1											2

Almost all of the estuary is covered by biological Sites of Special Scientific Interest, namely Formby Dunes and Foreshore (430 ha) and Altcar Sand Dunes and Foreshore (1,470 ha). Cabin Hills is a National Nature Reserve. Part of the estuary lies within the Sefton Coast Nature Conservation Review site.

Raven Meols is a Local Nature Reserve and has been identified as a Site of Local Biological Interest, and Hightown Sand Dunes is a proposed LNR and also a Site of Local Biological Interest. The Territorial Army Volunteer Reserves own large areas of land around the estuary.

The Alt has been designated as a Special Protection Area and Ramsar site, and lies within the proposed Ribble and Alt Estuaries SPA and Ramsar site.



Human activities

Present	Proposed	
●		Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
		Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
	●	Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
●		Military activities Overflying by military aircraft Others
●		Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
●		Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
●		Urbanisation Land-claim for housing & car parks
●		Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

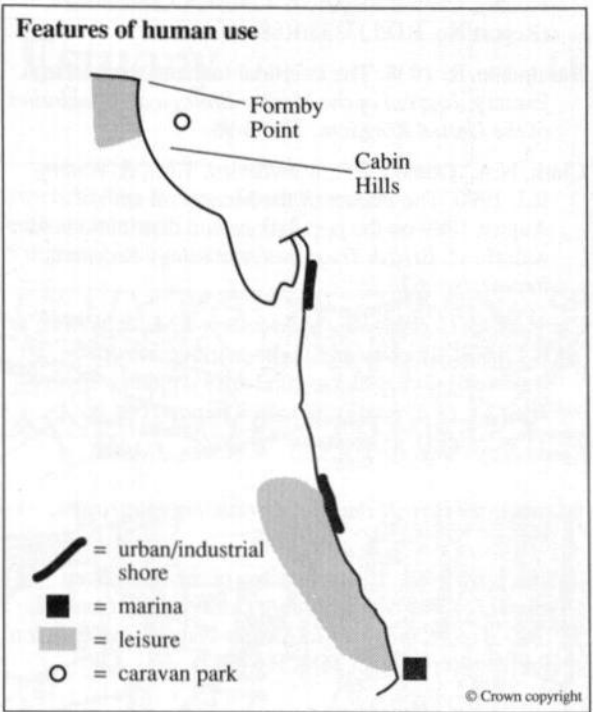
Present	Proposed	
●		Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
	●	Wildfowling & hunting Wildfowling Other hunting-related activities
		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
		Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
	●	Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
●		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
		Others

Features of human use

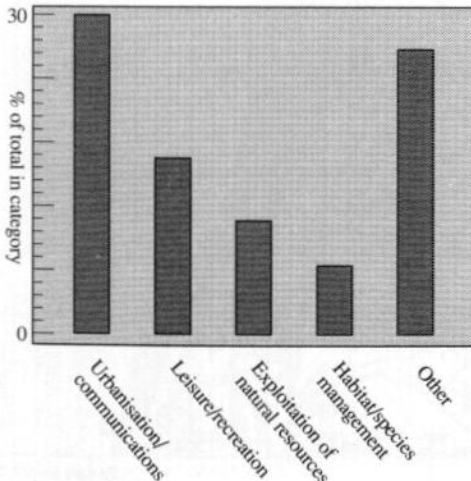
Very few activities occur on the estuary and most are not intensive. Leisure pursuits include sailing, beach recreation on both north and south beaches, and walking mainly along the northern beach around Formby Point. There is also a marina isolated from the estuary in the south of the site.

Exploitation of the natural resources involves grazing the sand dunes at Cabin Hills, and there are nature trails within the Local Nature Reserve. Habitat management techniques include scrub clearance and marram grass planting on the dunes, and the clearance and creation of scrapes for natterjack toads.

In 1989 there were proposals for housing on the dunes, for a golf course which would surround the NNR, for wildfowling to shoot on the Alt Estuary and for an exploratory oil well.



Categories of human use



Further reading

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Ribble Estuary

Centre grid: SD3424
 Counties: Merseyside, Lancashire

Districts: Fylde, Preston, South Ribble,
 West Lancashire
 EN region: North-west England

Review site location



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
11,920	10,670	107.5	28.4	7.9	Coastal plain	441,000

- NTL = Normal tidal limit
- BAE = Between adjacent estuaries
- AS = Along shore
- = Core site

Description

The Ribble is a large estuary on the north-west coast of England, adjacent to the Alt estuary review site which lies to the south. The normal tidal limit of the Ribble reaches as far inland as Preston, and the estuary flows past the towns of Lytham St Anne's and Southport. Water quality has been classified as grade B, apart from the upper tidal reaches of the River Douglas which are grade C.

The narrow upper tidal flats of the Ribble Estuary are a mixture of mud and sand, while the outer shores are sandy. The inner flats are fringed with saltmarshes, and the Ribble has one of the largest areas of unbroken saltmarsh in Britain. This consists mainly of a sward of mid-upper marsh vegetation with a belt of *Spartina* at the seaward edge. Historically, large areas of saltmarsh were embanked and much of this marsh has become freshwater with parts used for grazing. This unimproved grazing marsh is uncommon in North-west England and maintains a variety of saltmarsh plants in the more brackish parts near the sea and in the creeks. This area is of particular importance to waterfowl.

The calcareous dunes that extend northwards and southwards along the coast are an important feature of the Ribble. The southern dunes are eroding and to the north they are accreting with sediment from the tidal flats. The dunes show a complete succession from strandline vegetation through embryo, yellow and grey dunes, with numerous wet slacks that are extensive in places. Further inland the flora becomes more varied, and to the south of the site a layer of windblown sand covers peat of former peatbog. The sand here has leached unevenly, producing both acidic and neutral conditions and leading to the development of dune heath and dune pasture. This is the only surviving habitat of this kind which once extended along the inland side of Merseyside dune system.

The Ribble Estuary has a varied fauna, and the dunes are rich in invertebrates and home to the natterjack toad and sand lizard. The estuary regularly supports ten internationally important populations and ten nationally important wintering populations of waterfowl, and is the main centre in England for pink-footed geese.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●	●			●		
Area (ha)	1,250	2,184	8,490							

● = major habitat ● = minor habitat

Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
												●		●	

Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33

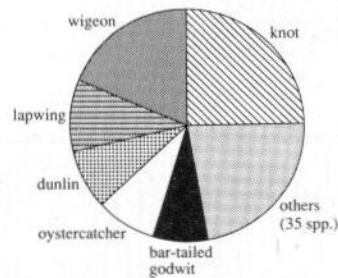
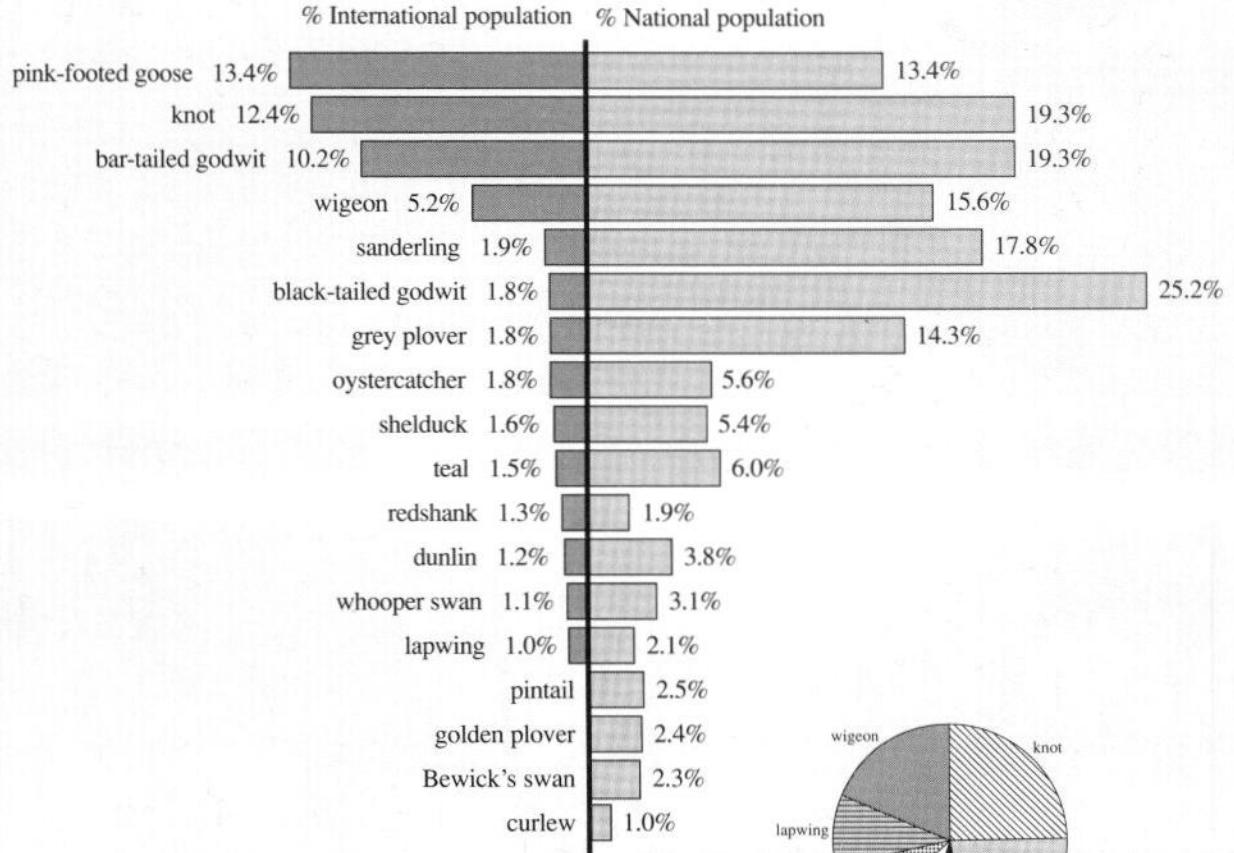
Birds

Wintering birds

1986/87 – 1990/91 data

Total waterfowl: 198,000

BoEE	NWC	WSC
●	●	



Wintering species assemblage (Spp. forming >5% assemblage shown separately)

Final sentence on page 37.2 should read:

The Ribble Estuary regularly supports fourteen internationally important wintering populations and a further four nationally important wintering populations of waterfowl, and is the main centre in England for pink-footed geese.

Breeding birds: there are large breeding colonies of common tern and black-headed gull and a small colony of arctic tern, and large numbers of redshank, moderate numbers of lapwing and oystercatcher and small numbers of ringed plover are known to breed on the estuary.

Other: from August to October the Ribble is an important site for moulting waders.

Additional wildlife features

The nationally rare plant dune helleborine *Epipactis dunensis* is found on the dunes adjacent to the estuary, and the invertebrate fauna recently recorded on the Ribble includes the proposed RDB 2 cranefly *Nephrotoma quadristriata* and thirteen Notable species.

Over 10% of the British population of natterjack toad *Bufo calamita* breed on the dunes at Ainsdale, which also

support the most north-westerly population of the sand lizard *Lacerta agilis* in Europe.

Small numbers of grey seals regularly use the Ribble Estuary.

Conservation status

● = designated ● = proposed

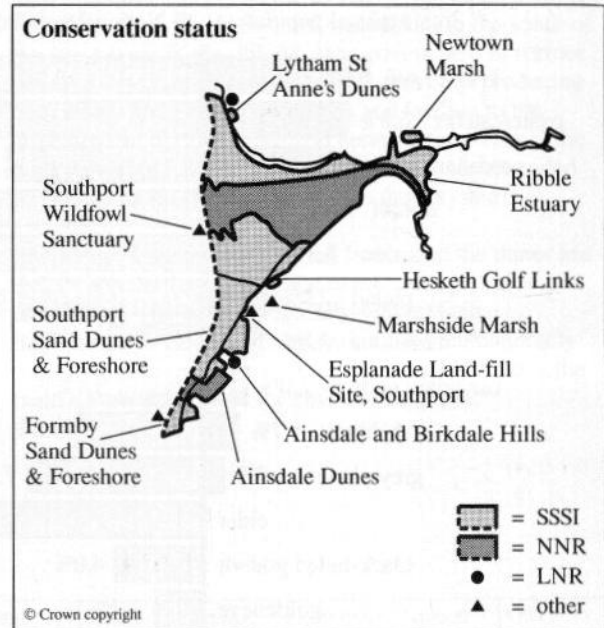
	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other
	●	●	●		●	●	●	●	●							●			●
No.	2	2	6		1	2	2	1	1							1			3

There are several Sites of Special Scientific Interest within the Ribble Estuary. Formby Sand Dunes and Foreshore (428 ha), Southport Sand Dunes and Foreshore (1,680 ha), Lytham St Anne's Dunes (25 ha) and the Ribble Estuary (9,230 ha) are biological SSSIs, together with Newton Marsh (65 ha) and Hesketh Golf Links (15 ha) which are adjacent to the estuary.

Ainsdale Dunes (480 ha) is an SSSI for its biological and geomorphological interest and is a Geological Conservation Review site. Lytham St Anne's is also a GCR site.

The Ribble Estuary and Ainsdale Sand Dunes are National Nature Reserves, and the Ribble Estuary and Ainsdale Dunes are Nature Conservation Review sites. There are Local Nature Reserves at Ainsdale and Birkdale Hills and Lytham St Annes, and the estuary is a Special Protection Area and forms part of the proposed Ribble and Alt Estuaries SPA and Ramsar site.

In addition part of Formby Sand Dunes and Foreshore is National Trust land and part of the outer central area of the estuary forms Southport Wildfowl Sanctuary. Adjacent to the estuary Marshside Marsh and Esplanade Land-fill Site have been identified as Sites of Local Biological Interest under the Merseyside Structure Plan.



Ribble Marshes National Nature Reserve. The Ribble Estuary regularly supports internationally important populations of wintering waterfowl. (Peter Wakely, English Nature)

Human activities

Present
Proposed

●		Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
●		Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
●	●	Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
●		Military activities Overflying by military aircraft Others
●	●	Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
●		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
●		Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
	●	Urbanisation Land-claim for housing & car parks
●		Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

Present
Proposed

●	●	Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
●		Wildfowling & hunting Wildfowling Other hunting-related activities
●		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
●		Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
●	●	Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
●		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
●		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
●		Others

Features of human use

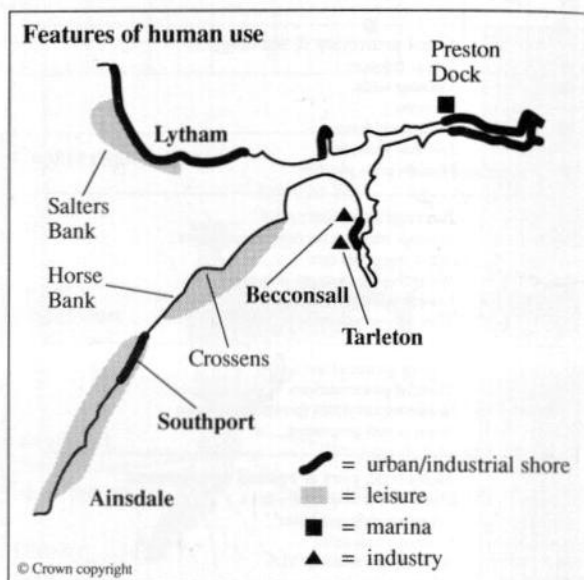
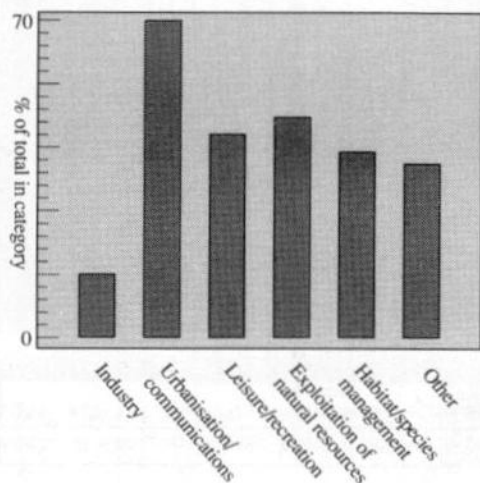
A large number of activities on the Ribble Estuary involve exploitation of the natural resources, including seine-netting, trawling and gill-netting for fish, fyke-netting for eels, shrimping, hand-gathering and dredging for mussels, and digging and dredging for cockles. Around 98% of the saltmarsh is grazed, and around 10 ha of saltmarsh are affected by *Salicornia* picking.

Leisure activities are fairly widespread and water-based pursuits are centred on the main river channel as the southern shores of the estuary are shallow. There is a marina at Preston Docks and moorings at Lytham, Becconsall on the River Douglas, and at Southport where there are also two sailing clubs and a dinghy park. Other activities, such as trial-biking, various forms of sand-racing and horse-riding, occur on the sand dunes and sandflats in the south of the estuary, and sand-yachting occurs at Lytham.

There is little industrial activity on the estuary apart from gas exploration, a gas pipeline which crosses the estuary and commercial sand extraction at Salters Bank and Horse Bank. There are also boatyards at Tarleton and Becconsall on the Douglas River. Species and habitat management activities include *Spartina* control, culling of foxes, rabbits, and gulls, and habitat management to protect the dunes and sandflats from various forms of recreation and to promote an increase in the natterjack toad population.

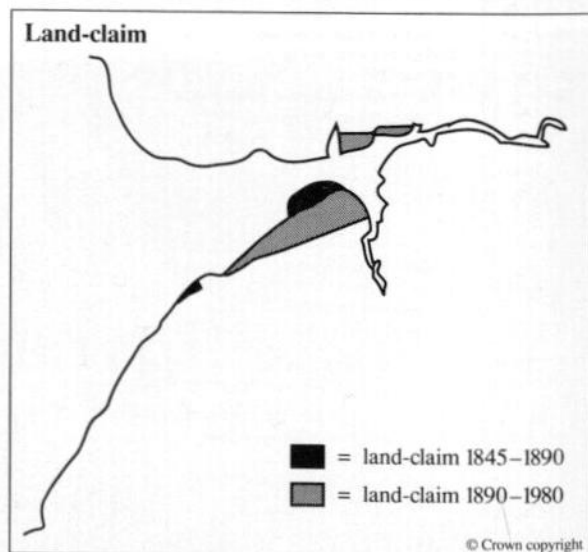
In 1989 there were proposals for a second gas/oil well, for sewage outfall construction, for marinas at Lytham and Southport and for an expansion of the existing marina at Preston and sand dune grazing at Ainsdale. There were also proposals for domestic waste disposal on Hesketh Out Marsh, and to move a clay-pigeon shoot closer to the estuary. More recently part of the sand dunes at Ainsdale have been grazed by sheep, jet-skiers have been using the estuary and there is a major proposal to divert sewage outfalls at Southport to Crossens, which would involve constructing a tunnel under grazing marshes.

Categories of human use



Land-claim

The map shows the areas of the Ribble Estuary lost to land-claim (predominantly for agriculture) in the last century, which amounts to around 1,960 ha. The effects of this land-claim have been disproportionate to a simple loss of saltmarsh, as the area of intertidal flats was reduced as new saltmarsh extended seawards. This process was amplified by the planting of *Spartina anglica* in 1932.



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Morecambe Bay

Centre grid: SD3668
Counties: Cumbria, Lancashire

Districts: Barrow-in-Furness, South Lakeland,
Lancaster, Wyre
EN region: North-west England

Review site location



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
45,462	34,339	266.5	40.3	8.4	Embayment	117,000

NTL = Normal tidal limit
BAE = Between adjacent estuaries
AS = Along shore
■ = Core site

Description

Morecambe Bay is a very large estuary, adjacent to the Duddon Estuary review site to the north. Morecambe Bay is the joint estuary of five rivers, namely the Wyre, Lune, Keer, Kent and Leven. Water quality within the estuary has largely been classified as grade A, apart from Walney Channel and a stretch of water close to the shore from Grange-over-Sands to Humphrey Head, which were grade B.

At low water Morecambe Bay forms a vast expanse of intertidal sandflat, with only small areas of mudflat around Walney Island and the Lune channel. There are also exceptionally large mussel beds on the stony outcrops (scars or skeers) which are found off Heysham and Walney Island.

A large area of saltmarsh fringes the bay, which has phases of erosion and accretion. Many of the saltmarshes are dissected by creeks and channels, and as many are also heavily grazed the vegetation is dominated by low, dense swards. *Spartina* is spreading through the lower marsh, particularly along the shore from the River Lune to the River Wyre. On the River Wyre Burrows Marsh and Barnaby Sands Marsh are the only extensive areas of

ungrazed saltmarsh, and show the full range of saltmarsh vegetation communities. These areas are unique in Lancashire in not having been influenced by sea defences or land-claim for agriculture. In addition, Morecambe Bay has a series of low limestone cliffs rising from the saltmarsh, with cliff-top grassland.

South Walney at the western extremity of the estuary is formed of sand and shingle ridges and bars, and has a rich shingle flora and a range of sand dunes of differing ages and varied vegetation. At its southern end, there is a series of artificial freshwater and brackish lagoons.

The fauna of Morecambe Bay is diverse, with a varied invertebrate population and a breeding population of natterjack toads. Morecambe Bay is also one of the most important British estuaries for wintering waterfowl, for it regularly supports over 200,000 birds and internationally important populations of ten species and nationally important populations of a further ten species. Morecambe Bay is one of the few sites in England where eider breed in large numbers.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●	●	●	●	●	●	
Area (ha)	11,123	3,253	31,086							

● = major habitat ● = minor habitat

Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
				●								●	●	●	

Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
				●												

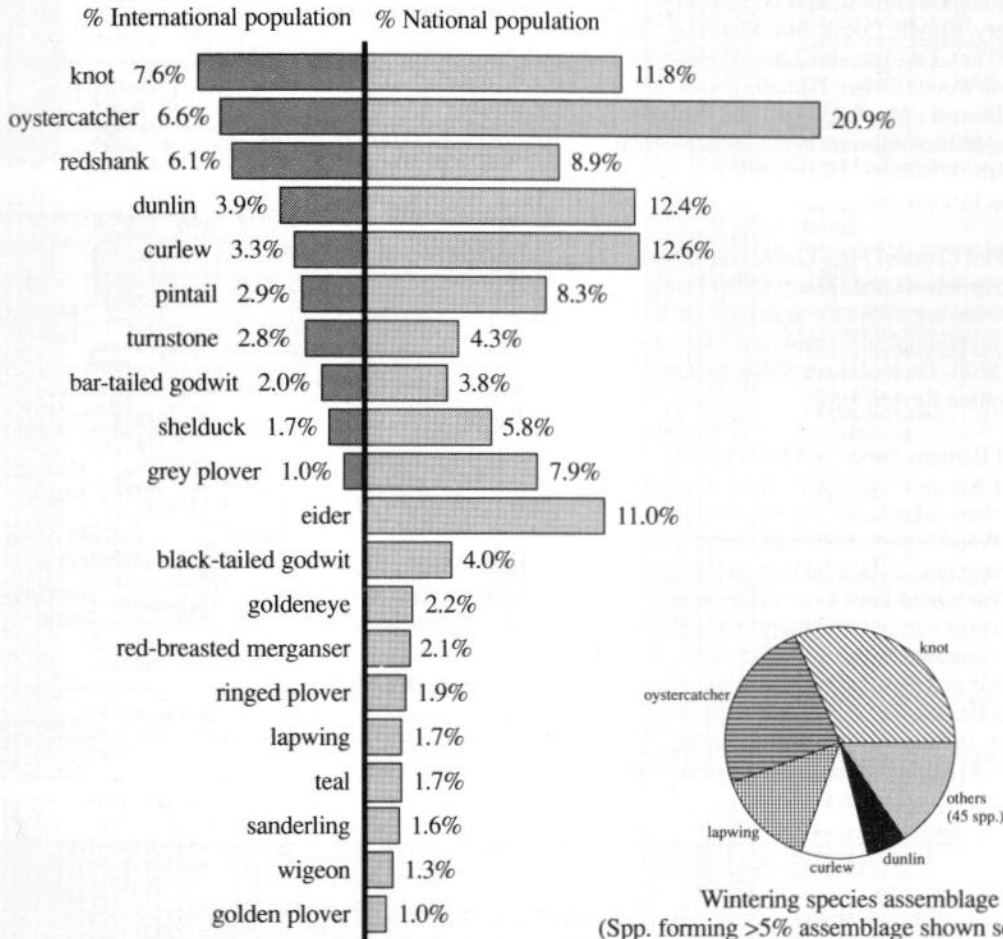
Birds

Wintering birds

1986/87 – 1990/91 data

Total waterfowl: 206,000

BoEE	NWC	WSC
●	●	



Breeding birds: there are large breeding colonies of black-headed gull, sandwich tern, common tern, herring gull and lesser black-backed gull, moderate sized colonies of little tern and arctic tern and small colonies of great black-backed gull and cormorant. High densities of redshank, moderate densities of oystercatcher and lapwing and low densities of curlew breed on the saltmarshes, and moderate numbers of oystercatcher and lapwing and small numbers of redshank, curlew, snipe and dunlin breed on the grasslands adjacent to the estuary. In addition there are moderate numbers of breeding ringed plover and eider and large numbers of breeding shelduck.

Other: Morecambe Bay is an important staging post for the spring and autumn passage of sanderling, and the spring passage of ringed plover and dunlin.

Additional wildlife features

The nationally rare plant Goldilocks *Aster linosyris* grows on the coastal grassland and the endemic nationally scarce Isle of Man cabbage *Rhynchosynapis monensis* can be found on the estuary. In addition the invertebrate fauna recently recorded on the estuary includes the RDB 2 high brown fritillary *Argynnis adippe*, the RDB 3 least minor moth *Photedes captiuncula*, the belted beauty moth *Lycia zozania*, and fourteen Notable species.

Morecambe Bay is a major nursery for sea bass *Dicentrarchus labrax*, plaice *Pleuronectes platessa* and flounder *Platichthys flesus*. The dunes adjacent to the estuary support small numbers of the natterjack toad *Bufo calamita*.

Small numbers of grey seals regularly use the estuary.

Conservation status

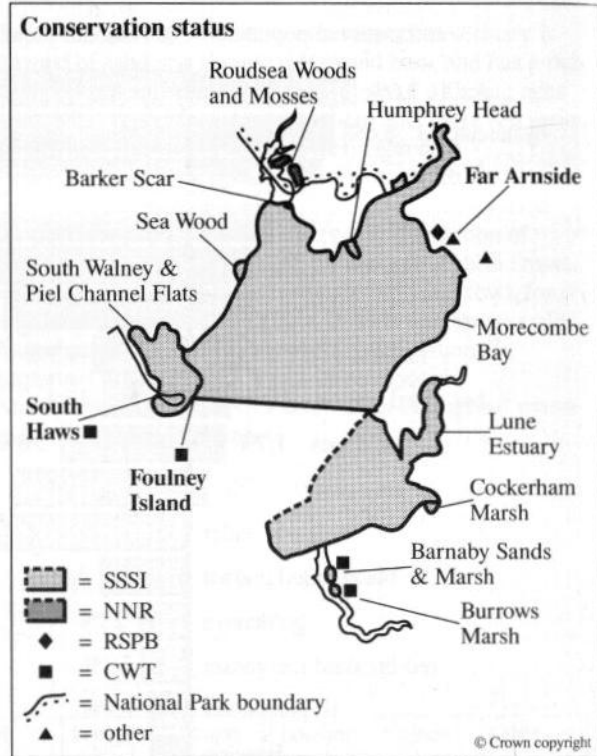
● = designated ● = proposed

No.	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other	
	●	●	●	●	●	●		●	●	●	●	●		●		●				●
No.	1	5	8	1	4	1		1	1	1	4	1		1		1				3

There are several biological Sites of Special Scientific Interest on the estuary, namely Cockerham Marsh (10 ha), Lune Estuary (6,980 ha), Far Arnside (2 ha), Morecambe Bay (30,290 ha), Sea Wood (25 ha), Barnaby Sands and Marsh (67 ha) and Burrows Marsh (36 ha); and Roudsea Woods and Mosses (480 ha) adjacent to the estuary which is also a National Nature Reserve. Morecambe Bay is a Nature Conservation Review site.

South Walney and Piel Channel Flats (2,490 ha), Barker Scar (18 ha), Meathop Woods and Quarry (50 ha) and Humphrey Head (30 ha) are SSSIs for their biological, geological and geomorphological interest, and Skelwith Hill is a geological SSSI. Each of these SSSIs contain Geological Conservation Review sites.

Burrows Marsh and Barnaby Sands and Marsh are Lancashire Trust for Nature Conservation reserves, and South Haws and Walney Island are Cumbria Wildlife Trust reserves. Sea Wood is part of Bardsea Country Park, the National Trust have land at Jack Scout Land at Silverdale, and the Woodland Trust have a reserve at Crag Wood. The northernmost part of the estuary falls within the Lake District National Park, and part of the estuary lies within the Arnside and Silverdale Area of Outstanding Natural Beauty. The RSPB has a reserve north of Morecambe, and the estuary is subject to an Oystercatcher Order. Morecambe Bay is also proposed as a Special Protection Area and Ramsar site.



Morecambe Bay has the largest intertidal area of any estuary in Great Britain. (Peter Wakely, English Nature)

Human activities

Present
Proposed

● ● ●		Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
●	● ● ●	Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
●		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
● ● ● ●		Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
● ● ● ●	●	Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
		Military activities Overflying by military aircraft Others
● ● ● ● ●	●	Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
● ● ● ●		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
● ● ● ●	● ● ●	Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
	●	Urbanisation Land-claim for housing & car parks
● ● ●		Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

Present
Proposed

●	●	Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
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● ● ●		Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
● ● ●		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
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		Others

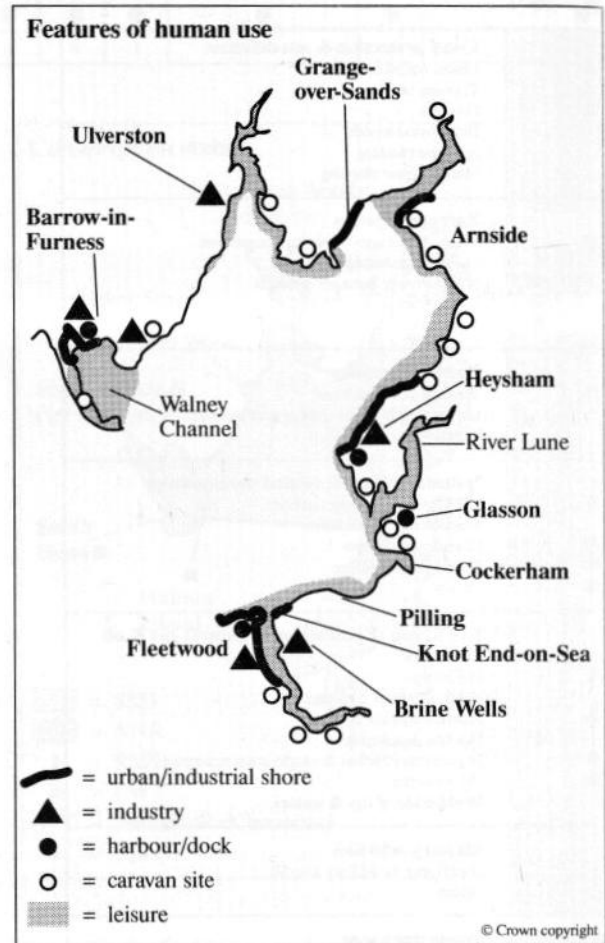
Features of human use

Morecambe Bay is a very large estuary with many on-going activities. There are several large industrial complexes present which include a nuclear power station at Heysham, chemical industries at Ulverston, Fleetwood and Brine Wells, ship- and boat-building, a gas production site and an oil refinery at Barrow-in-Furness. Sediment extraction involves capital dredging along training walls, maintenance of shipping channels and sand extraction south of Barrow-in-Furness. There are also ports and docks at Barrow, Heysham, Glasson and Fleetwood.

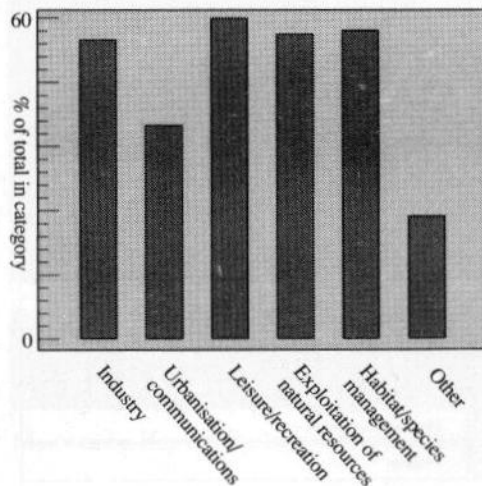
Leisure pursuits occur over most of the shoreline, with moorings and water-based recreation centred around the River Lune, the Walney Channel, Arnside, Morecambe, Bardsea, Knot End-on-Sea and Heysham and angling is widespread. 4WD, trial-biking and sand-racing are centred on the shore west of Pilling. Microlite aircraft also fly over the southern parts of the River Lune.

Exploitation of the natural resources includes grazing over most of the saltmarsh, sand dune grazing at Walney, cultivation of shellfish, and dredging for mussels and cockles. Three wildfowling clubs shoot over the estuary, and in some areas land-claim for agriculture has recently taken place such as between Pilling and Cockerham. Habitat and species management activities include restoration of shingle, management of the lagoons for natterjack toads, and control of birds and mammals for agricultural purposes.

In 1989 there were proposals for barrage schemes for water storage, leisure and tidal power; a marina which would include some land-claim for housing and car-parking at Cavendish Dock, Barrow-in-Furness; an extension to the existing docks for the nuclear power station at Heysham; and an extension to the existing gas pipeline.



Categories of human use



Further reading

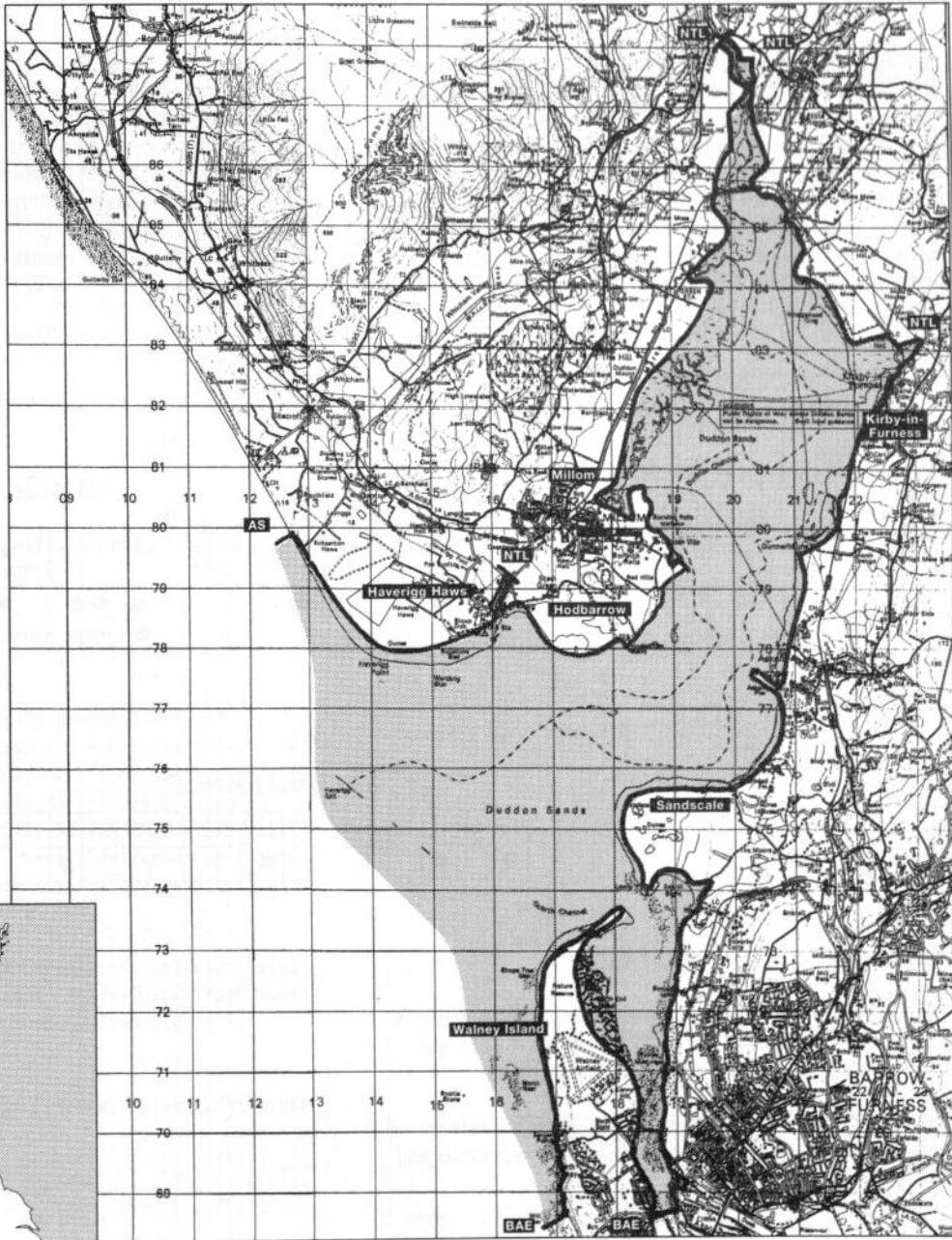
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Duddon Estuary

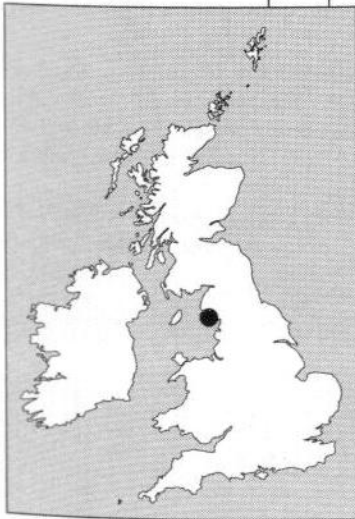
Centre grid: SD1977
County: Cumbria

Districts: Copeland, South Lakeland,
Barrow-in-Furness
EN region: North-west England

Review site location



NTL = Normal tidal limit
BAE = Between adjacent estuaries
AS = Along shore
■ = Core site



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
6,092	5,056	65.5	22.6	8.1	Coastal plain	56,000

Description

The Duddon is a large, sandy estuary adjacent to the Morecambe Bay review site to the south. Water quality in the Duddon Estuary has been classified as grade A. At low water the estuary is an extensive tract of sand and silt, dissected by narrow channels of water. The Duddon Estuary has extensive areas of saltmarsh particularly in its upper reaches north of Millom and Kirkby-in-Furness. There is much local variation in the saltmarshes, and at least twelve saltmarsh vegetation communities have been identified within them, including large areas of lower and upper marsh vegetation. In some areas, such as at Sandscale, the saltmarsh grades to sand dunes.

At Sandscale there is an extensive system of dunes which are quite wet and calcareous and rise sharply from underlying shingle. The vegetation includes saltmarsh, freshwater marsh, pools and wet grassland, and supports a wide range of plants and animals which includes a rich invertebrate fauna. At Haverigg Haws the dunes are drier, rising from sandflats, and become less mobile and more vegetated further inland progressing to maritime heath in the north-west. The dune system at Haverigg Haws is crescent-shaped due to the formation of a succession of shingle ridges, and supports a wide range of plant

communities which include a transition from shingle to dunes.

The south-east corner of the estuary mouth is bounded by Walney Island, a barrier island unusual in that it is the product of erosion and reworking of glacial boulder clay rather than the result of coastal deposition. North Walney is a complex of habitats with dunes and dune slacks on a major shingle system, with both exposed and vegetated shingle. The flora is particularly rich with a number of locally rare species. In addition there is a large coastal lagoon at Hodbarrow, formed on the site of old mine workings and separated from the coast by a seawall. The lagoon is a focus for wintering, migrating and breeding birds.

The Duddon Estuary has a varied flora and fauna, which is rich in invertebrates with many scarce or rare species, and the dunes support a number of amphibians including large populations of the natterjack toad. Wintering bird populations are predominantly waders and include three species of international importance and eight species of national importance. There is also a breeding colony of little terns.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●	●		●	●	●	
Area (ha)	1,030	540	4,520				● = major habitat		● = minor habitat	

Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		●		●								●		●	

Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
	●						●									

Additional wildlife features

The nationally rare dune helleborine *Epipactis dunensis* and the endemic nationally scarce Isle of Man cabbage *Rhyncosynapis monensis* grow within the dunes.

The invertebrate fauna recently recorded on the estuary includes the RDB 3 mining bee *Colletes cunicularius* and 23 Notable species.

The estuary holds over 20% of the British breeding population of natterjack toad *Bufo calamita*, and is regularly used by small numbers of grey seals.

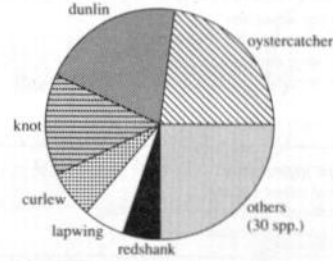
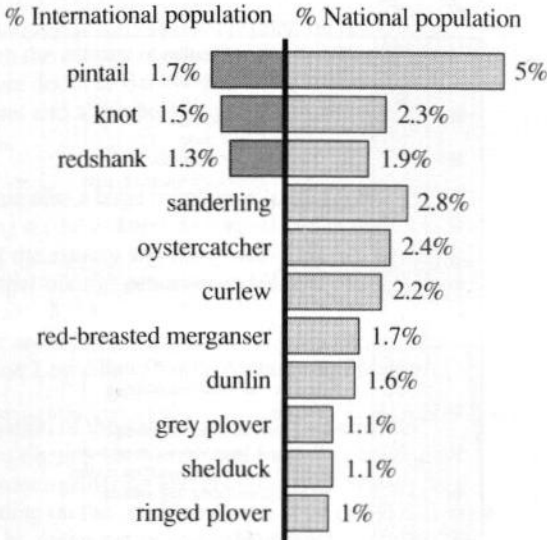
Birds

Wintering birds

1986/87 – 1990/91 data

Total waterfowl: 47,400

BoEE	NWC	WSC
●	●	



Breeding birds: there is a moderate-sized colony of little tern, and small colonies of lesser black-backed gull and black-headed gull. In addition moderate numbers of lapwing, redshank and oystercatcher and low numbers of curlew breed on the saltmarshes, and low numbers of lapwing and redshank breed on the grasslands adjacent to the estuary. Low numbers of ringed plover also breed within the Duddon Estuary.

Other: there is a large spring passage of sanderling through the estuary.

Conservation status

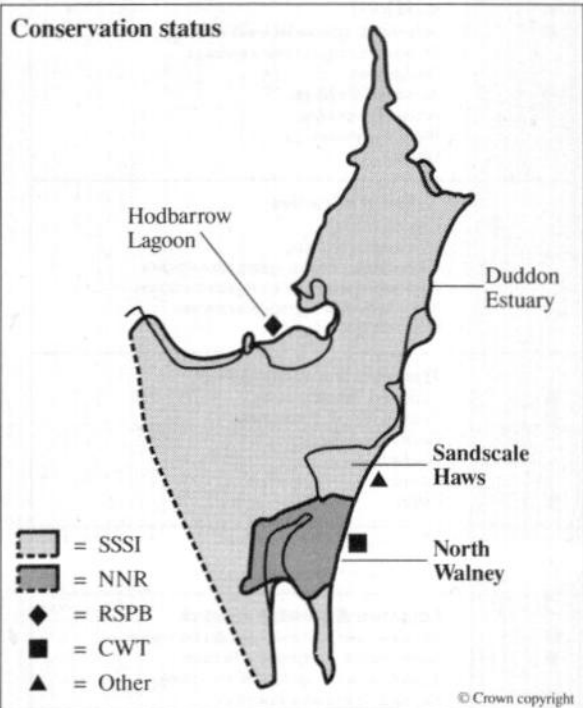
● = designated ● = proposed

	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other
No.	2	1			1	1		1	1		1	1				1			

The Duddon Estuary formerly consisted of five Sites of Special Scientific Interest and was notified with extensions as a single SSSI (6,814ha) in 1991, for its biological and geomorphological interest. North Walney is also a National Nature Reserve and contains a Geological Conservation Review site. Walney and Sandscale Haws, and the Duddon Estuary are Nature Conservation Review sites.

Hodbarrow Lagoon is an RSPB reserve, and a large area of Sandscale Haws is owned by the National Trust. North Walney National Nature Reserve is managed by the Cumbria Wildlife Trust.

The Duddon Estuary is also a proposed Special Protection Area and Ramsar site.



Human activities

Present	Proposed	
●	●	Coast protection & sea defences Linear defences Training walls Groyne Brushwood fences <i>Spartina</i> planting Marram grass planting
	●	Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
●		Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
		Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
		Military activities Overflying by military aircraft Others
●		Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
	●	Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
●		Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
●		Urbanisation Land-claim for housing & car parks
●		Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

Present	Proposed	
●	●	Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
●		Wildfowling & hunting Wildfowling Other hunting-related activities
●		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
●		Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
●		Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
●		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
●	●	Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
		Others

Features of human use

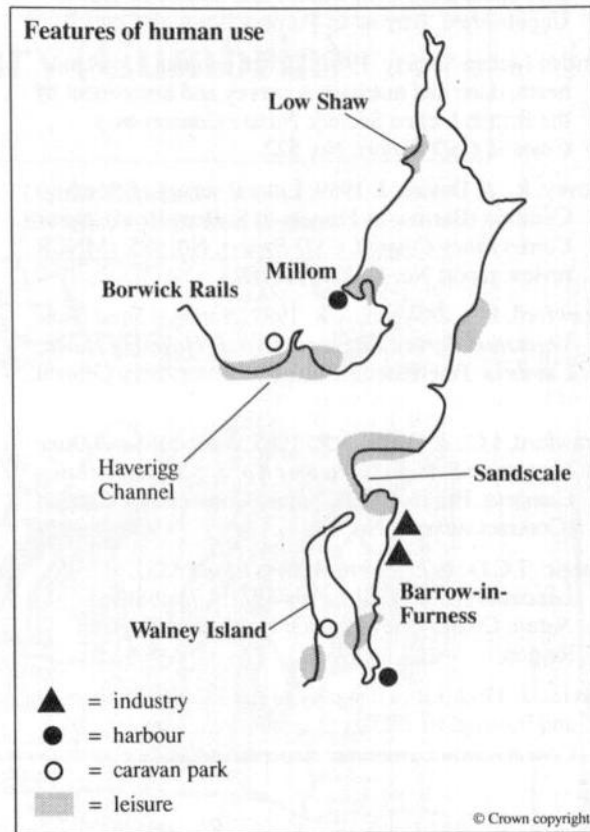
Many industrial activities are present on the Duddon although the estuary is not extensively industrialised. There are docks at Barrow and Millom and chemical industries and a shipbuilding/repair yard at Barrow-in-Furness.

There are also a large number of leisure activities occurring on the estuary. Sailing occurs in the southern parts of the estuary and many activities (wind-surfing, 4WD, trial-biking) occur around Walney Island. Sandscale, Walney Island and Haverigg Haws are also popular areas for bathing and beach recreation, and horse-riders use Low Shaw, North Walney and Sandscale.

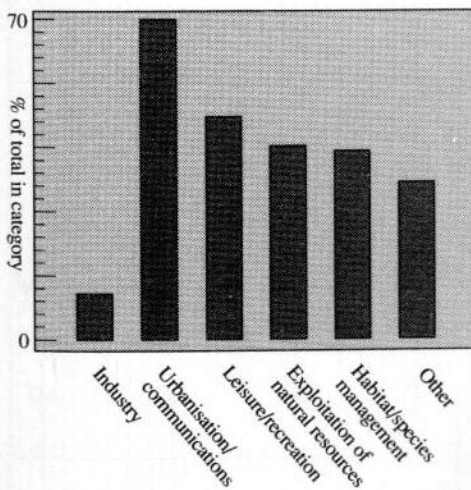
Exploitation of the natural resources is varied and includes digging for worms and mussel-collecting for bait, mussel-gathering and cockling near Walney, and turf-cutting on the southern shore. Most of the dunes are grazed by sheep and/or cattle apart from North Walney, and most of the saltmarshes are grazed by livestock. Two Wildfowl Association Clubs shoot over the estuary.

There is also a high number of habitat and species management with control of *Spartina* at Sandscale, and various habitat management techniques for the benefit of natterjack toads. Shingle banks are also managed for nesting terns.

Proposals in 1989 included a leisure and tidal power barrage, dredging to reopen Haverigg channel, a marina at Borwick Rails on the western shore, and a golf course.



Categories of human use



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- Tonkin, J.M. 1989. Historical review of land-use at North Walney, Cumbria. *Nature Conservancy Council, CSD Report*, No. 934.

Esk Estuary (Cumbria)

Centre grid: SD0896
County: Cumbria

District: Copeland
EN region: North-west England

Review site location



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
1,134	1,049	42.2	11.4	7.7	Bar built	< 5,000

NTL = Normal tidal limit

AS = Along shore

■ = Core site

Description

This estuary is the confluence of three rivers, the Irt, Mite and Esk, which discharge through a mouth that has been narrowed by large sand and shingle spits. The large expanse of sandflats and dunes of the estuary extend along the shore to Barn Scar in the north and Tam Bay in the south. Water quality within the estuary has been classified as grade A.

At low tide a large area of intertidal flats are exposed, which are muddy in the Rivers Irt and Mite. The River Esk has a mixture of sandflats on the southern shore with vegetated shingle on both shores towards the mouth. There are areas of saltmarsh in all three river channels, with a broad range of saltmarsh communities. Towards the head of the rivers some areas of marsh show transition to freshwater communities including stands of reeds.

The sand dunes on either side of the estuary mouth are extensive and relatively undisturbed, with a range of sand dune vegetation that includes strandline, fixed and mobile dunes, dune slacks, and fixed dune grassland. The well-developed and extensive dune heath of northern Drigg is the largest example of this rare habitat on the English and Welsh coast. The dunes of Eskmeals and Ravenglass are considered to be of national importance for their lichen flora.

Within the estuary there is a diverse fauna, for invertebrates are well represented and include many scarce species, and several amphibians are to be found including great-crested newts and a large population of natterjack toads. Adders are also present. Wintering bird populations are dominated by waders.

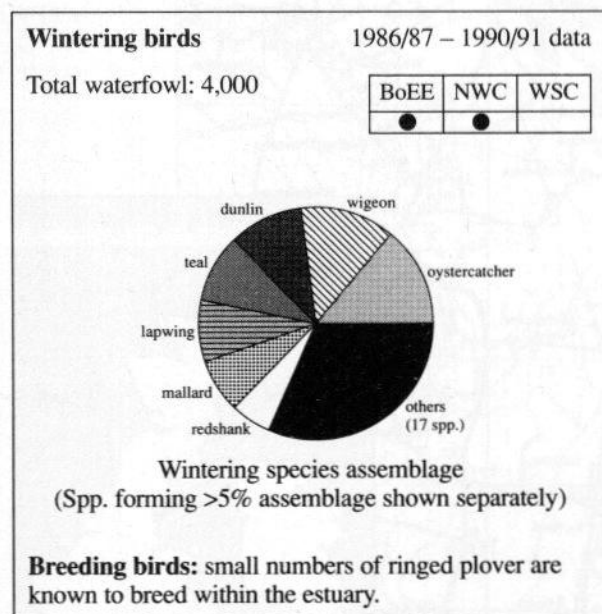
Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●	●		●			
Area (ha)	85	158	891							

● = major habitat ● = minor habitat

Birds



Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		●		●								●		●	

Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33

Additional wildlife features

The nationally scarce endemic Isle of Man cabbage *Rhynchosinapis monensis* is found within the Esk estuary.

The terrestrial invertebrates recently recorded on the estuary include the RDB 2 beetle *Cicindela hybrida* and 38 Notable species.

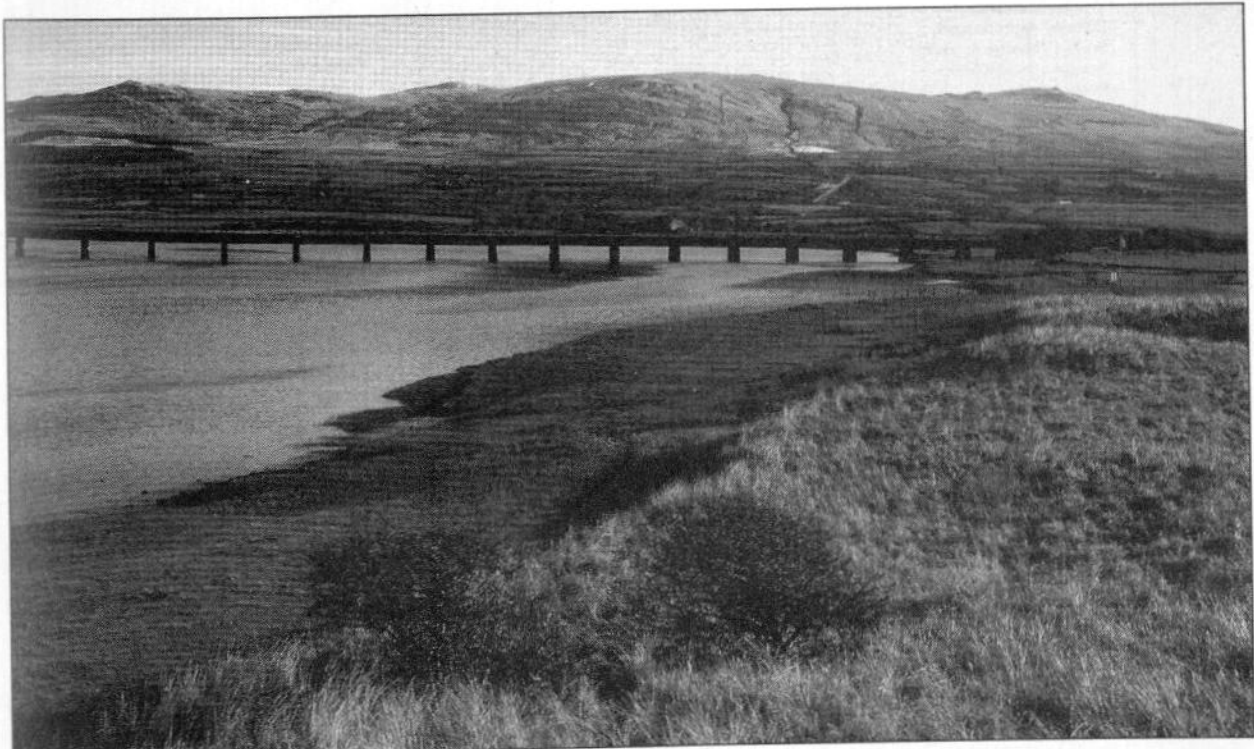
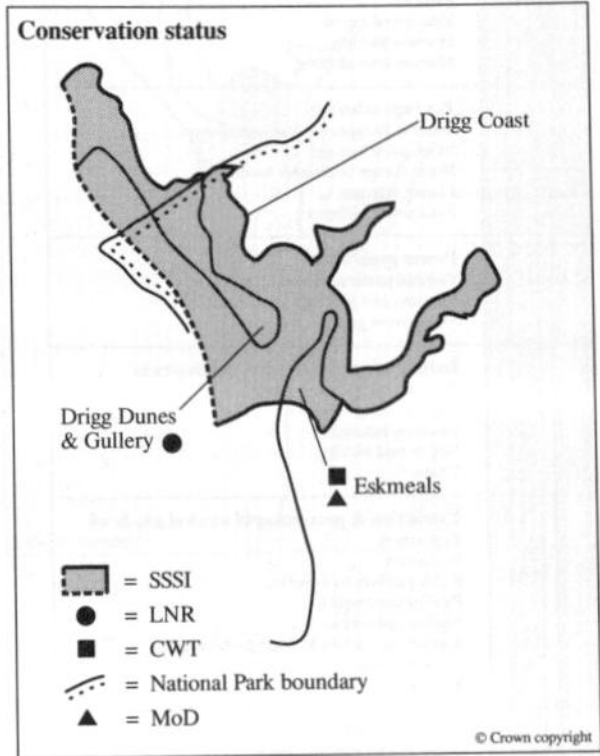
Over 20% of the British population of natterjack toad *Bufo calamita* breeds within the dunes.

Conservation status

● = designated ● = proposed

No.	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other	
	●		●				●	●			●			●						●
1	1		1				1	1			1			1						1

Much of the northern parts of the estuary are covered by Drigg Coast biological Site of Special Scientific Interest (1,413 ha), which is also a Nature Conservation Review site. Drigg Dunes and Gullery is a Local Nature Reserve, and Eskmeals is a Cumbria Wildlife Trust reserve and MoD land. The Esk Estuary lies within the Lake District National Park, and Ravenglass is proposed as a Ramsar site.



The Esk Estuary, showing both low- and high-level saltmarsh. (Pat Doody, JNCC)

Human activities

Present	Proposed	
●		Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
		Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
		Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
●		Military activities Overflying by military aircraft Others
●	●	Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
●	●	Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
		Urbanisation Land-claim for housing & car parks
●	●	Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

Present	Proposed	
●		Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
●		Wildfowling & hunting Wildfowling Other hunting-related activities
●		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
		Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
●	●	Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
●		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
		Others

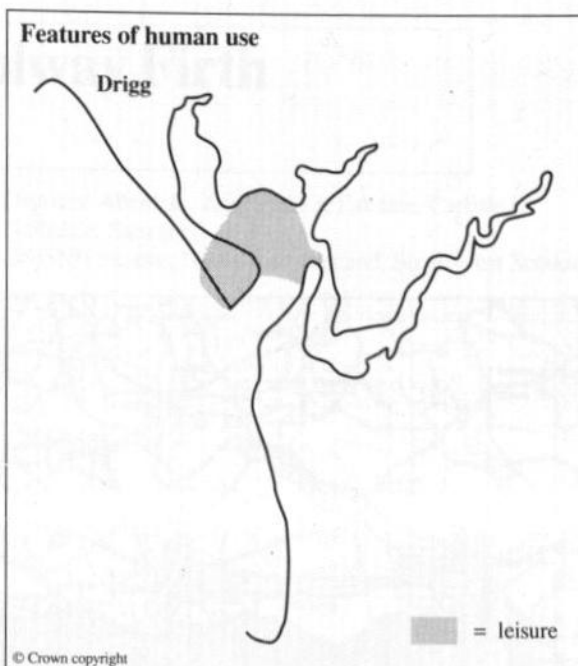
Features of human use

In 1989 there were few on-going activities on this estuary. Leisure activities are limited to the estuary mouth west of Ravenglass where there are small numbers of moorings. Such pursuits include sailing, wind-surfing, angling and bird-watching, but are not intensive.

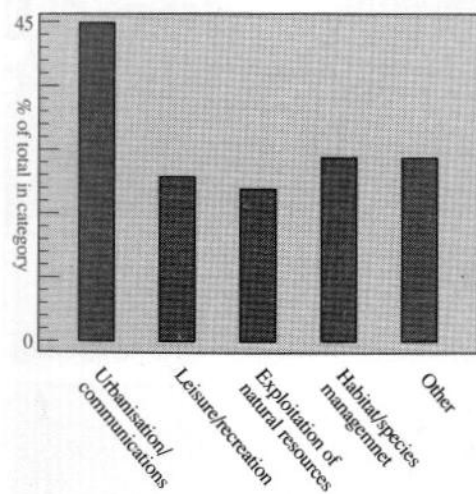
Exploitation of the natural resources includes saltmarsh and sand dune grazing by livestock and some wildfowling on small areas of the saltmarsh. There are also a number of habitat and species management techniques used on the estuary with fox and deer culling, and habitat management and creation for the natterjack toad population.

There is no industrial activity present on the estuary, although low-level radioactive wastes are discharged from Drigg depot into the estuary.

More recently hand-gathering of molluscs and culling of adult fish-eating birds has occurred and seismic studies have been undertaken on the estuary.



Categories of human use



Further reading

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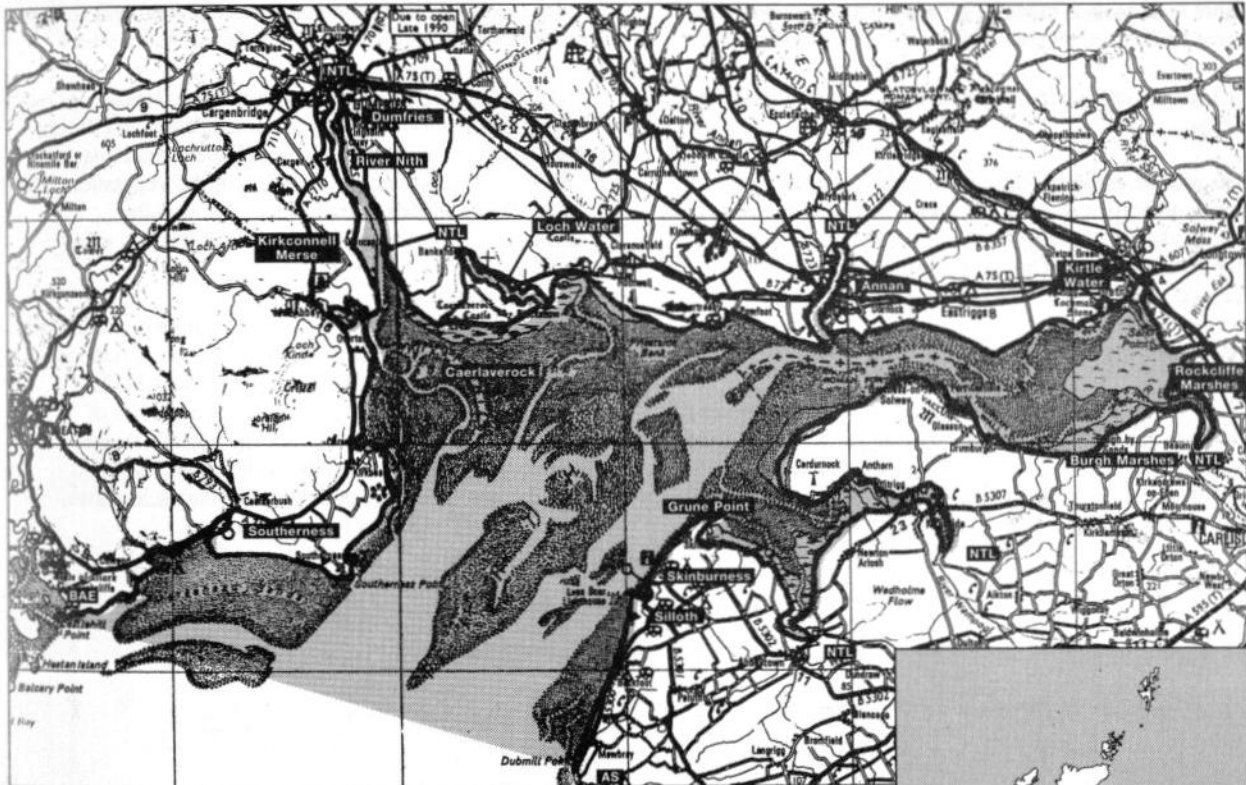
Woolven, S.C., & Radley, G.P. 1989. *National sand dune vegetation survey. Site report No. 19, Eskmeals dunes.* Peterborough, Nature Conservancy Council. (Contract surveys, No. 44)

Inner Solway Firth

Centre grid: NY2762
 Counties: Cumbria, Dumfries & Galloway

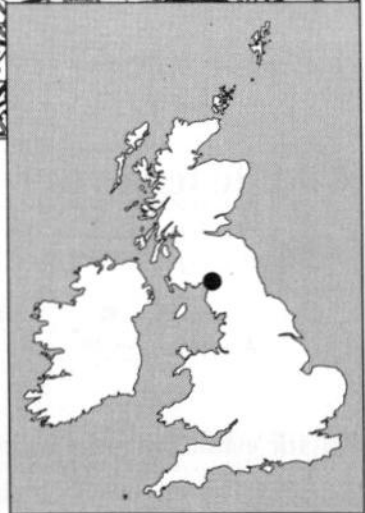
Districts: Allerdale, Annandale & Eskdale, Carlisle,
 Nithsdale, Stewartry.
 EN/SNH regions: North-west England, South-west Scotland

Review site location



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- NTL = Normal tidal limit
- BAE = Between adjacent estuaries
- AS = Along shore
- = Core site



Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
42,056	27,550	213.6	46.3	8.4	Complex	8,000

Description

The Solway Firth lies on the border between Scotland and England and is adjacent to Rough Firth and Auchencairn review site to the west. It is the joint estuary of the Rivers Nith, Annan, Esk, Eden, Waver, Wampool and Lochar Water, and water quality within the estuary has been classified as grade 1, except for Kirtle Water and Lochar Water which are grade 2.

The intertidal flats of the Solway form one of the largest continuous intertidal areas in Britain. The northern shores of the Solway are largely boulders and cobbles with occasional sand or shingle, while much of the southern shore is of mobile muddy fine sand. The inflowing rivers carry little suspended load and so the sediments within the estuary are derived mainly from the Irish Sea, and tend to be highly mobile particularly in the lower reaches of the estuary.

The aquatic estuarine communities of the Solway are predominantly soft substrate-based and include a *Spisula solida* variant of the gravel/shell gravel community and horse mussel beds. The hard substrate communities include an intertidal *Sabellaria* reef which is at the northern limit of its distribution, and a hydrozoan/bryozoan turf community.

There are extensive areas of saltmarsh along the shores of the Solway. The most extensive areas are Rockcliffe and Burgh Marshes on the innermost parts of the estuary, Caerlaverock and Kirkconnell Merses on the northern shores and Moricambe Bay on the southern shores.

The geomorphology of the marshes is outstanding with well-developed creek systems, saltmarsh cliffs up to 3 metres high caused by erosion, and marsh terraces formed by creek migration and isostatic uplift. The vegetation of the saltmarshes shows good transitions through to mature upper marsh and to brackish communities in the upper parts of the rivers, and in several areas there are tidal reed-beds, which are an uncommon feature in Scotland. The Solway marshes provide a link between northern and southern plant species and vegetation communities.

On the southern shore there are areas of sand and shingle and a sand-covered shingle spit at Grune Point which extends from Skinburness into the River Waver. There is also an extensive sand dune system that extends southwards from Silloth beyond the estuary, and these dunes have a wide range of soil pH over small distances which is reflected in clear zonation of the vegetation. The Solway has a further variation in habitat on the Southernness Coast, where there are cliffs rising up to 40 metres.

The Solway Firth supports a varied fauna which includes a large proportion of the British population of natterjack toads. The estuary regularly supports over 120,000 wintering waterfowl which include nine species of international importance and ten species of national importance. Of particular note is the entire Svalbard (Spitzbergen) breeding population of barnacle goose, which winters exclusively on the Solway.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●	●	●	●	●		●
Area (ha)	14,506	2,925	24,625							

● = major habitat ● = minor habitat

Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
●	●				●						●	●		●	●

Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
						●				●						

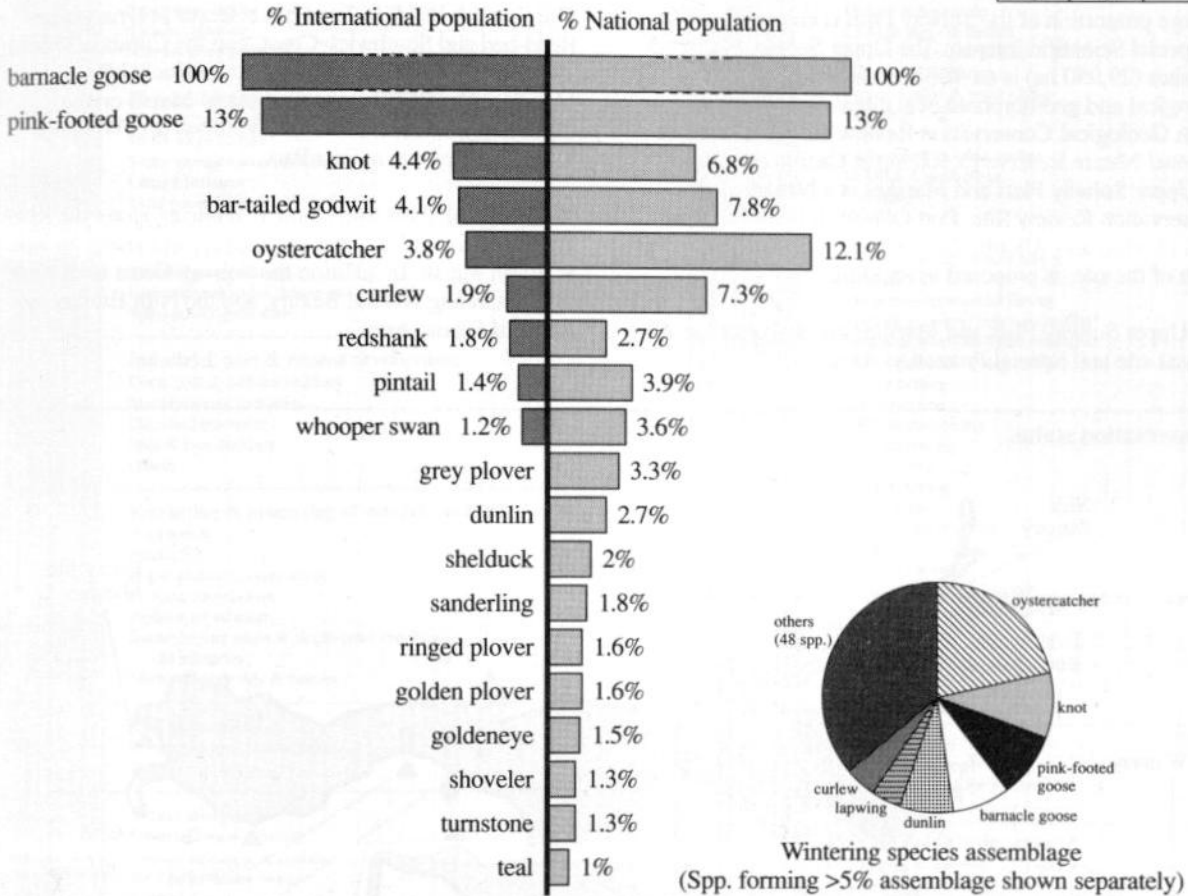
Birds

Wintering birds

1986/87 – 1990/91 data

Total waterfowl: 120,000

BoEE	NWC	WSC
●	●	



Breeding birds: low numbers of redshank and curlew, moderate numbers of lapwing and high numbers of oystercatcher breed on the saltmarshes of the Solway, and low numbers of lapwing, curlew, snipe and dunlin, moderate numbers of redshank and high numbers of oystercatcher breed on the grasslands around the estuary. Moderate numbers of ringed plover are known to breed on the Solway, and there is a moderate-sized colony of common tern and a small colony of little tern on the estuary. In addition around 1% of the British population of cormorant (3.5% Scottish population) breed on the shores of the estuary.

Additional wildlife features

The nationally rare plants holy-grass *Hierochloa odorata* and sticky catchfly *Lychnis viscaria* and seven nationally scarce plants, including the endemic Isle of Man Cabbage *Rhynchosynapis monensis*, grow within the estuary. The invertebrate fauna recently recorded from the Inner Solway Firth includes three proposed Red Data Book species and 31 Notable species.

More than 10% of the British population of the natterjack toad *Bufo calamita* breeds in the extensive marsh and sand dune system, dispersed between several colonies. The Solway Firth is the northern limit of their range. Otters are also recorded on the estuary.

Conservation status

● = designated ● = proposed

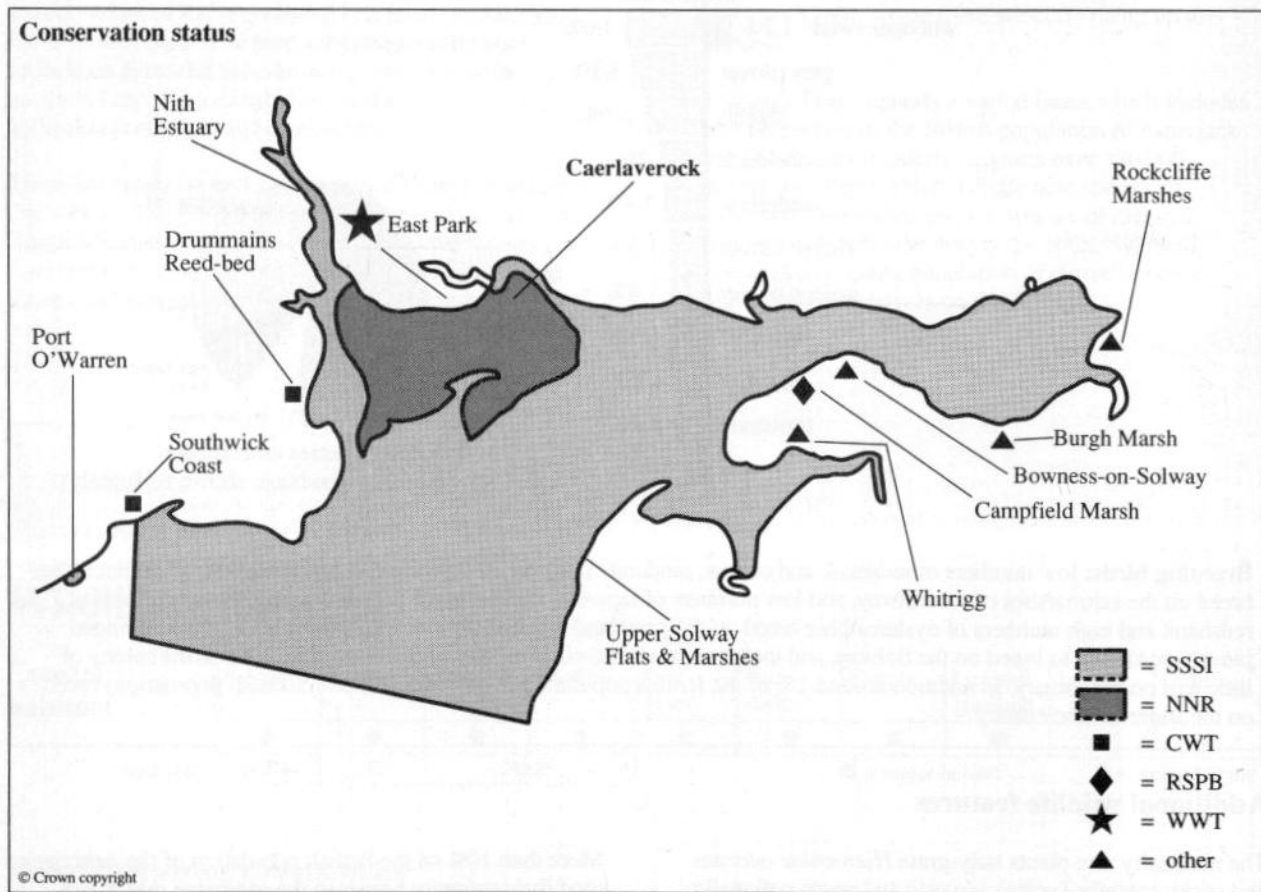
	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other	
	●	●	●		●	●		●	●	●	●	●			●	●	●			●
No.	1	7	1		1	1		1	1	1	2	1			1	1	1			1

A large proportion of the Solway Firth is covered by Sites of Special Scientific Interest. The Upper Solway Flats and Marshes (29,950 ha) is an SSSI for its biological, geological and geomorphological interest and contains seven Geological Conservation Review blocks. There is a National Nature Reserve (5,500 ha) at Caerlaverock and the Upper Solway Flats and Marshes is a Nature Conservation Review Site. Port O'Warren is a biological SSSI (5.9 ha) and Allonby Bay, which extends to the south of the site, is proposed as an SSSI.

The Upper Solway Flats and Marshes are designated as a Ramsar site and Special Protection Area.

The Scottish Wildlife Trust has reserves at Drum mains Reed-bed and Southwick Coast, and the Cumbria Wildlife Trust have a wardening agreement on Rockcliffe Marshes. The RSPB owns Campfield Marsh on the Cardurnock Peninsula and the Wildfowl and Wetlands Trust has a reserve at East Park.

The National Trust owns land at Whitrigg along the River Wampool and at Bowness-on-Solway, and leases an area at Burgh Marsh. In addition the Solway Coast is an Area of Outstanding Natural Beauty, and the Nith Estuary is a National Scenic Area.



Human activities

Present	Proposed	
●		Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
●	●	Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
●		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
●		Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
		Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
●		Military activities Overflying by military aircraft Others
●		Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
●		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
●		Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
●	●	Urbanisation Land-claim for housing & car parks
●		Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

Present	Proposed	
●		Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers
●	●	Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
●		Wildfowling & hunting Wildfowling Other hunting-related activities
●		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
●	●	Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
●	●	Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
●		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
●	●	Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
		Others

Features of human use

The towns of Dumfries, Silloth and Annan are the only urban areas around the estuary, and industrial activities are concentrated in these areas. At Annan there are metal and chemical industries, a boat-building and repair yard and a small fishing harbour, and at Silloth there is a small dock. North-east of Annan there is a power station that discharges into the estuary.

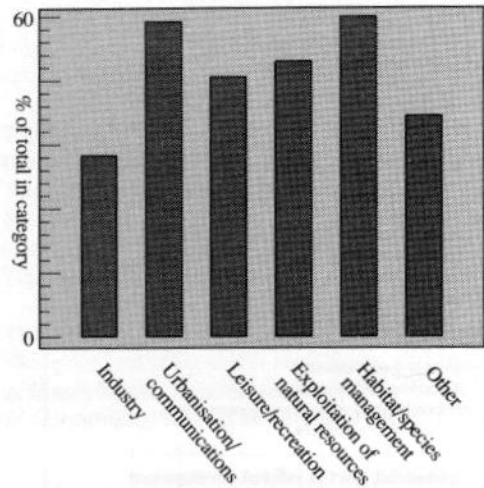
Leisure pursuits are not intensive and are confined to small areas. Beach recreation occurs at Southernness and Powfoot, which are also used by sailors and wind-surfers. 4WD occurs from Southernness to Mersehead Sands.

Exploitation of the natural resources is widespread and includes grazing over many of the saltmarshes, turf-cutting, fish-netting, shrimp trawling and bait-digging. Dredging for molluscs is widespread throughout the estuary. Two wildfowling clubs shoot over 90% of the saltmarsh and punt-gunning is also known to occur.

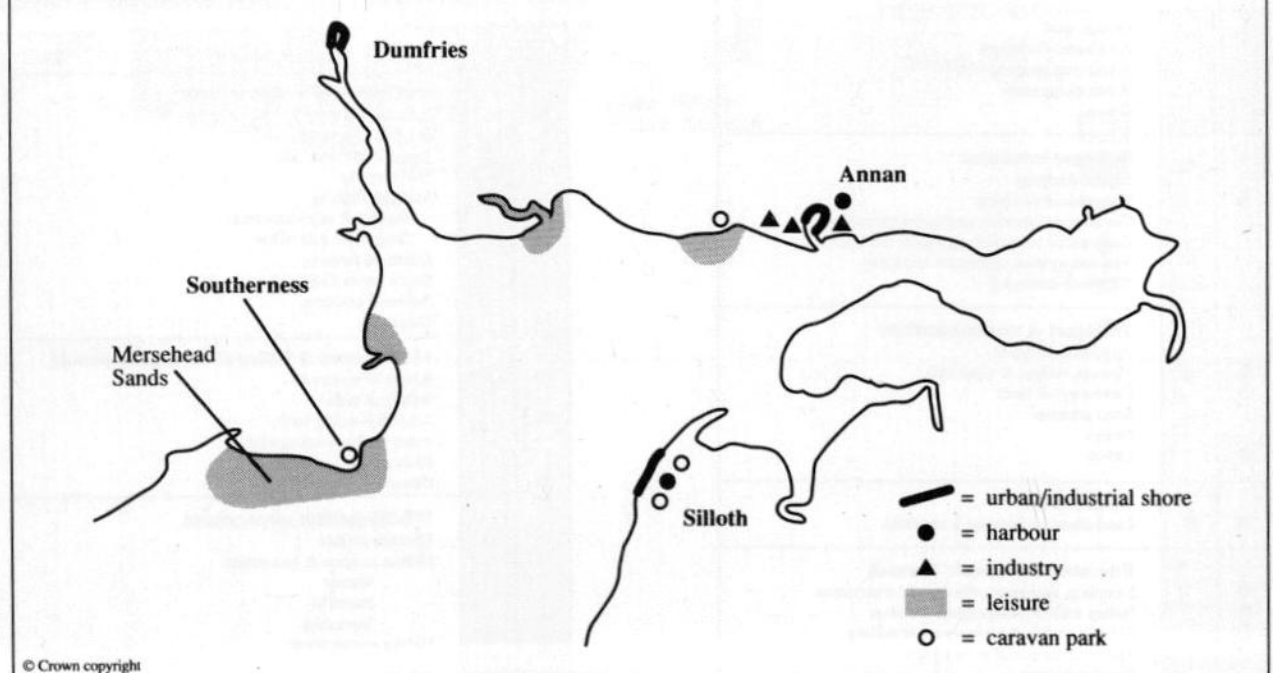
Species and habitat management also occurs on the estuary and includes culling of rabbits and birds, including geese, and habitat restoration and management. There is low-level flying by RAF jets, which from September to May observe an avoidance area.

In 1989 there were proposals for a tidal power barrage from Southernness to Grune Point; for interpretative facilities at Erskine Bridge; and for small areas of land-claim for housing and car parks. By 1992 there had been no action taken on the proposal for a tidal barrage or for a proposed leisure centre. By 1992 there were further proposals for linear sea defences, for two power stations that would involve thermal discharges into the estuary and an import/export jetty, and for exploration for natural gas.

Categories of human use



Features of human use



Further reading

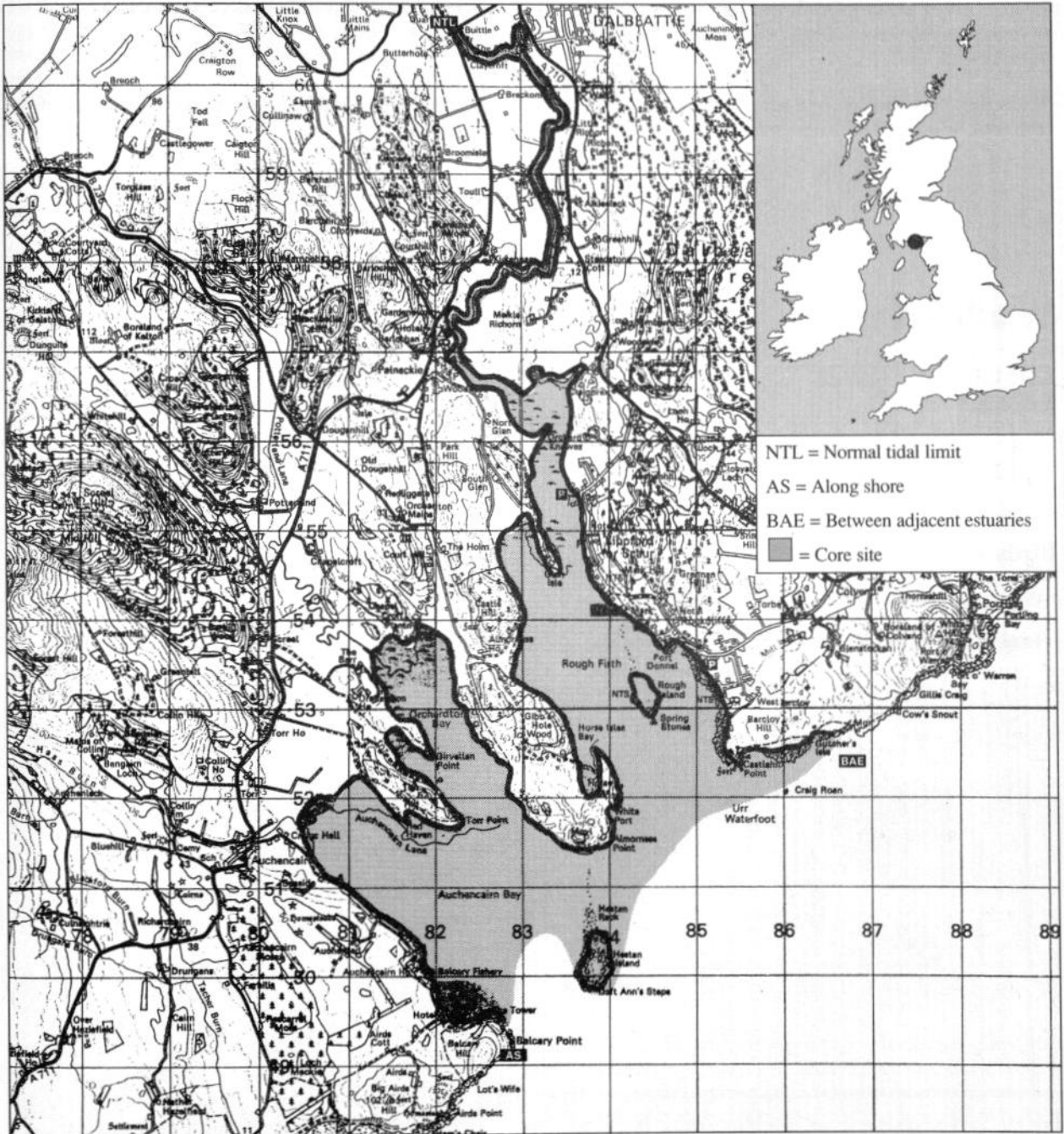
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Rough Firth & Auchencairn Bay

Centre grid: NX8451
Region: Dumfries & Galloway

District: Stewartry
SNH region: South-west Scotland

Review site location



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
1,290	1,289	44.4	14.4	6.7	Fjord	< 5,000

Description

The Rough Firth and Auchencairn Bay lies within a very broken coast and forms two shallow bays cut back into granite bed-rock. This estuary is adjacent to the Inner Solway Firth review site to the east, and the water quality within the Rough Firth and Auchencairn Bay has been classified as grade 1.

At low tide the estuary is an expanse of intertidal flats, with only a very small subtidal channel. The outermost flats of Auchencairn and Orchardton Bays are sandy, while the more sheltered inner flats of the Rough Firth are muddy. Beds of the eelgrass *Zostera* that were present in Auchencairn Bay have declined after cockle dredging was carried out in 1988.

Within the upper parts of the estuary there are areas of saltmarsh, which contain a number of plant species at the northern limit of their range and a variety of plant

communities representing succession to alder carr. In Auchencairn and Orchardton Bays there has been a marked progressive colonisation by *Spartina*, which now accounts for 50% of the total saltmarsh area.

The coast on the south-western shore of Auchencairn Bay, which extends beyond the estuary, supports a large number of local and rare plant species on vegetated shingle, maritime grassland, swamps and flushes, hard cliffs and cliff crevices. There is also considerable invertebrate interest here that includes rare and local species, a rich fauna at the limit of its northern distribution.

The Rough Firth and Auchencairn Bay is frequented by wintering waders and wildfowl, and is of importance for its seabirds, for Almorness Point supports colonies of lesser black-headed gull and great black-headed gull.

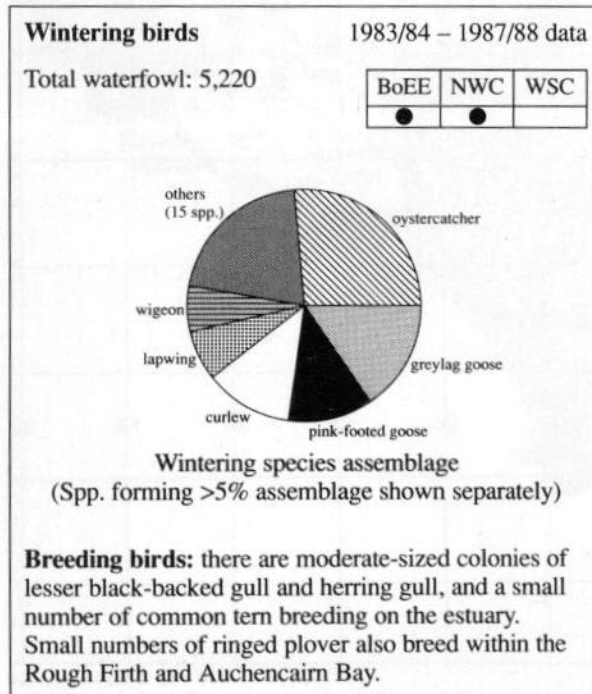
Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
Area (ha)	1	135	1,154							

● = major habitat ● = minor habitat

Birds



Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	●											●	●	●	●

Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
		●								●			●			

Additional wildlife features

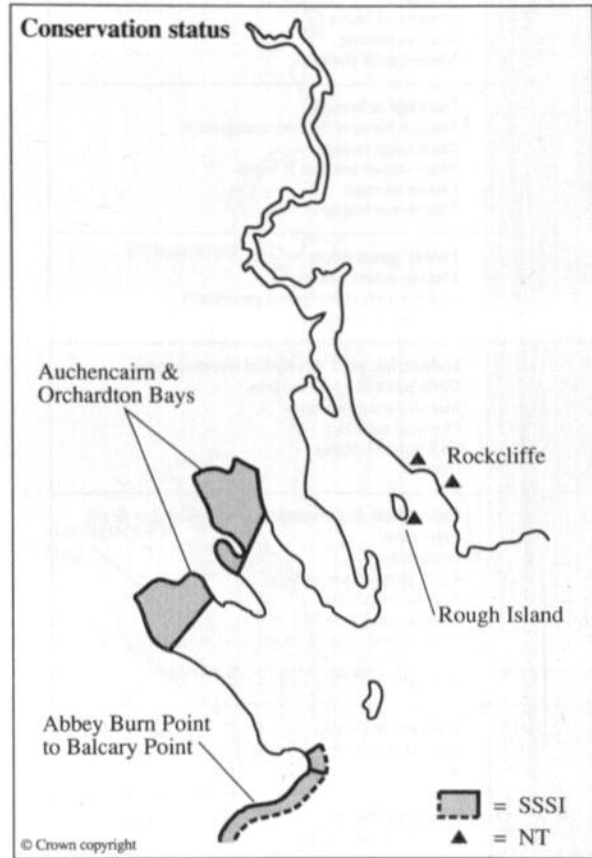
The invertebrate fauna recently recorded on the estuary includes seven Notable species. Otters are also frequently recorded.

Conservation status

● = designated ● = proposed

	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other
			●										●			●	●		
No.			2										1			3	1		

Small areas of the estuary are covered by biological Sites of Special Scientific Interest, namely Auchencairn and Orchardton Bays (442 ha) and Abbey Burn Foot to Balcony Point (531 ha), which extends beyond the westernmost boundary of the estuary. The National Trust for Scotland own land at Rough Island, Rockcliffe, and the Merse, Rockcliffe. In addition the estuary lies within the Stewartry Environmentally Sensitive Area and National Scenic Area.



In Auchencairn Bay (above) and Orchardton Bay there has been a marked colonisation by the cordgrass *Spartina anglica*, which now accounts for 50% of the total saltmarsh area. (Pat Doody, JNCC)

Human activities

Present	Proposed	
●	●	Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
●		Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
		Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
		Military activities Overflying by military aircraft Others
●		Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
		Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
		Urbanisation Land-claim for housing & car parks
●		Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

Present	Proposed	
●	●	Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
●		Wildfowling & hunting Wildfowling Other hunting-related activities
●		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
●		Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
●		Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
●		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
●		Others

Features of human use

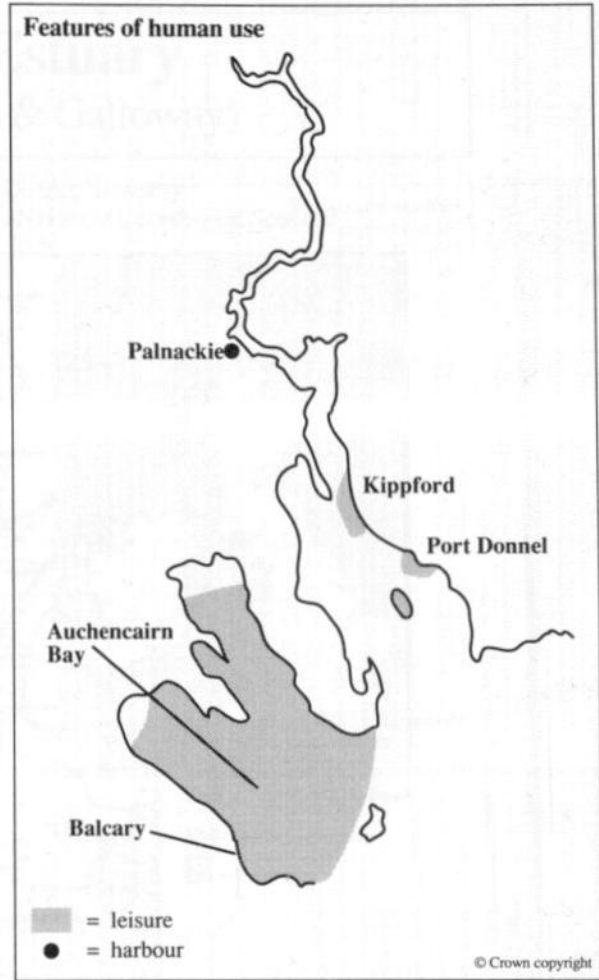
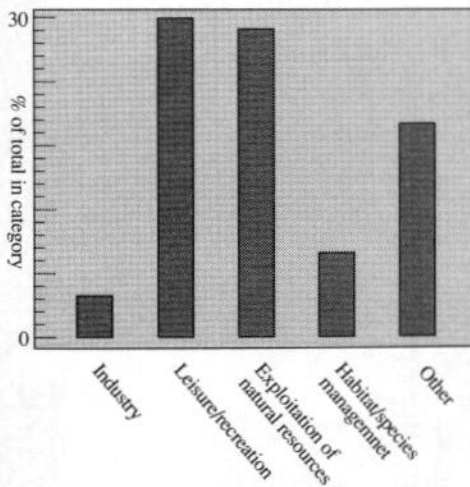
This estuary is largely unspoilt with little human activity. Those activities present are mainly low-level recreational pursuits, with sailing as the most intensive pursuit and centred around the moorings at Kippford. Walking and horse-riding occur over the sandier parts of the bays, i.e. in the lower reaches, and small numbers of people use the beach at Port Donnel.

Exploitation of the natural resources is varied but not intensive. Salmon nets are used south-west of Balcary, bait-collecting occurs in the south-west of Auchencairn Bay, and hydraulic dredging for cockles also occurs. Wildfowlers shoot from along the shores. At Palnackie there is a small harbour, which is used for landing cockles caught in the Solway Firth.

Other features of human use on the estuary include coastguard rescue exercises off Balcary Point.

In 1989 there were proposals in the Stewartry Local Plan to develop Kippford as a marina, which would include a number of floating moorings. By 1992 this were under construction.

Categories of human use



Further reading

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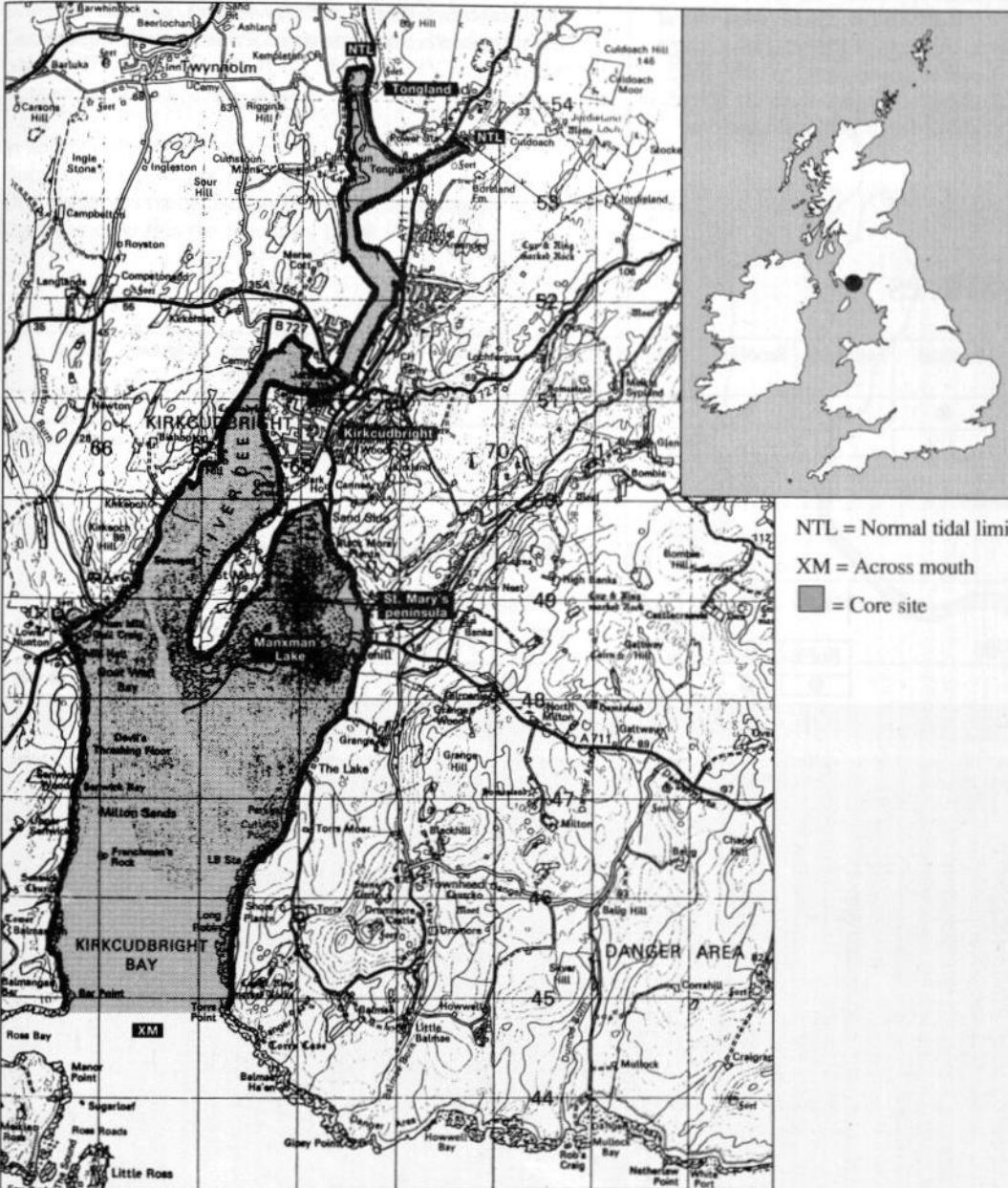
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Dee Estuary (Dumfries & Galloway)

Centre grid: NX6747
Region: Dumfries & Galloway

District: Stewartry
SNH region: South-west Scotland

Review site location



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
1,144	825	28.6	11.7	6.7	Fjord	< 5,000

Description

This site is the estuary of the River Dee which flows past the town of Kirkcudbright and opens out into Kirkcudbright Bay. It includes Manxman's Lake which lies to the east of St Mary's Bay peninsula. Water quality in the Dee has been classified as grade 2 as far downstream as the tip of St Mary's peninsula, while the rest of the estuary is class 1.

At low tide the Dee is a narrow channel that flows across extensive mudflats, with a small freshwater input from the Buckland Burn that meanders across Manxman's Lake. The innermost flats are made of fine muddy silts, and at Manxman's Lake there are areas of the eelgrass *Zostera noltii*. Towards the mouth of the estuary the intertidal sediments become coarse-grained, and there are fringes of exposed shingle around St Mary's peninsula and the eastern shore.

Saltmarshes have developed in the upper reaches of the estuary and in the shelter of Manxman's Lake, with the largest continuous area of saltmarsh extending up the channel of the Dee towards Tongland. The vegetation here shows extensive transition from saline to freshwater communities, with reed-beds and freshwater-flushed communities.

Further downstream towards Kirkcudbright Bay and extending beyond the estuary boundaries there are long stretches of rocky shore which are interspersed with boulder-strewn shores, cliffs, grasslands, machair and maritime heath, and these areas are botanically highly varied.

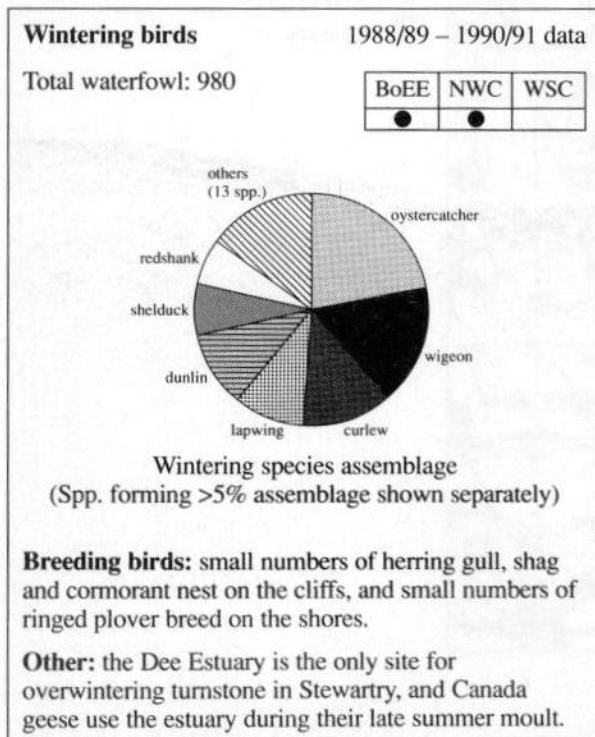
Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●		●	●			
Area (ha)	319	77	748							

● = major habitat ● = minor habitat

Birds



Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	●											●	●	●	●

Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
		●			●	●										

Additional wildlife features

Otters are regularly recorded on the estuary.

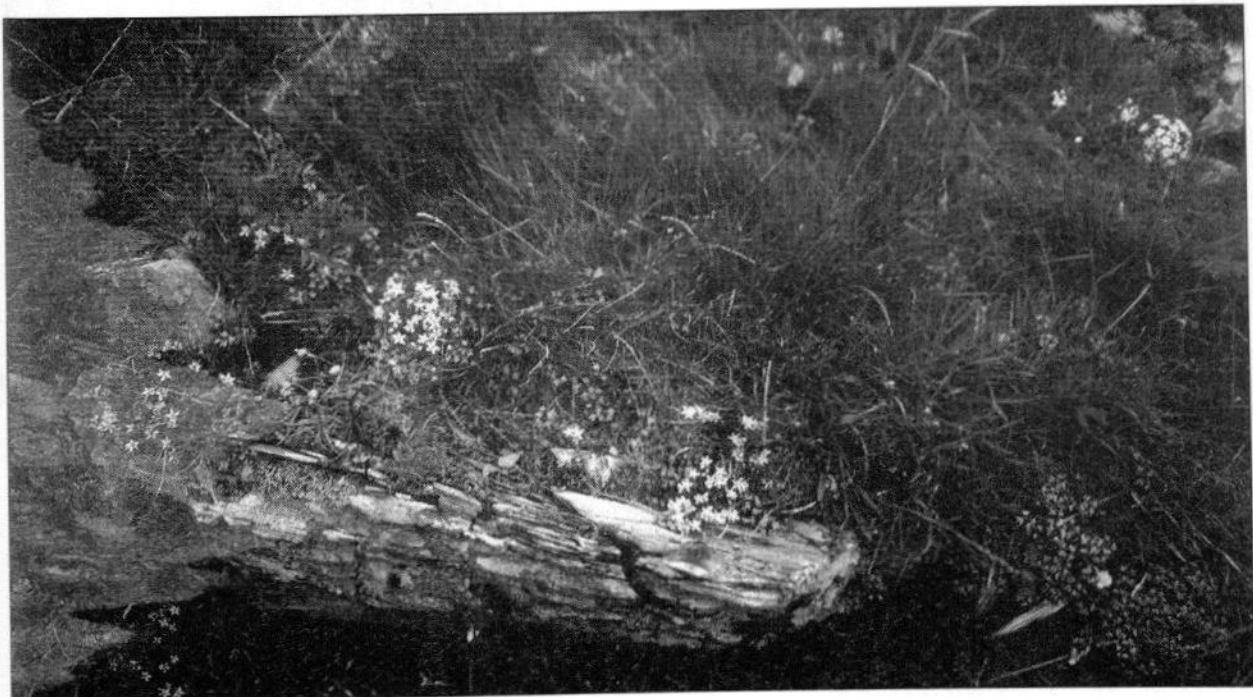
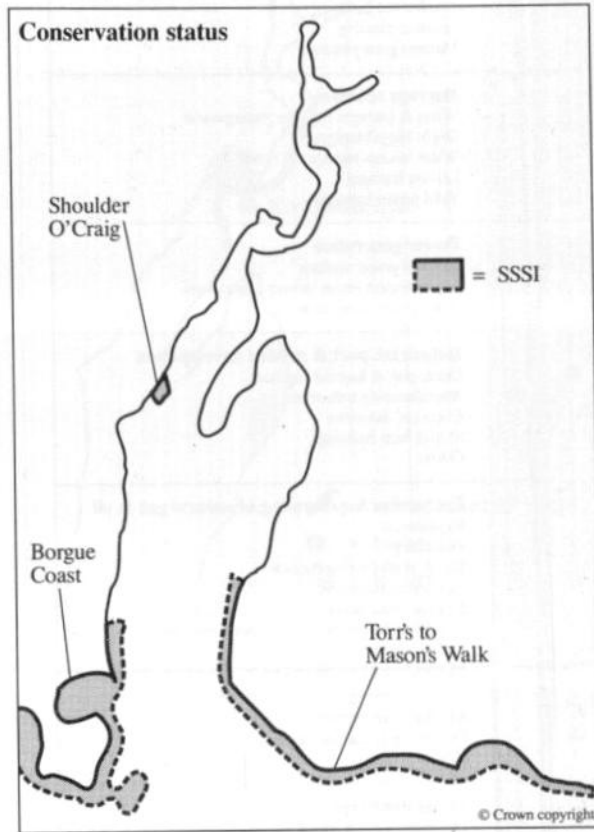
Conservation status

● = designated ● = proposed

No.	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other	
	●	●		●	●															●
	1	4		1	2															1

Only small areas of the estuary have been designated as Sites of Special Scientific Interest. Shoulder O’Craig (0.5 ha) is a geological SSSI, Borgue Coast (1,892 ha) and Torr’s to Mason’s Walk (168 ha) are SSSIs for their biological and geological interest, both of which extend along the coast beyond the estuary. There are also four Geological Conservation Review sites on the estuary, namely Torr’s to Mason’s Walk, Shoulder O’Craig, Borgue Coast and Meikle Ross.

In addition the western shore of the estuary lies within the Borgue Coast Nature Conservation Review site, and the Dee Estuary is recognised as having regional scenic significance within the Stewartry Local Plan.



The cliffs of the Dee Estuary and the Borgue Coast support a varied flora. (Pat Doody, JNCC)

Human activities

Present	Proposed	
●		Coast protection & sea defences Linear defences Training walls Groyne Brushwood fences <i>Spartina</i> planting Marram grass planting
		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
●	●	Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
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●		Military activities Overflying by military aircraft Others
●	●	Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
●	●	Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
		Urbanisation Land-claim for housing & car parks
		Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

Present	Proposed	
●	●	Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
●		Wildfowling & hunting Wildfowling Other hunting-related activities
●		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
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●		Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
		Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
●		Others

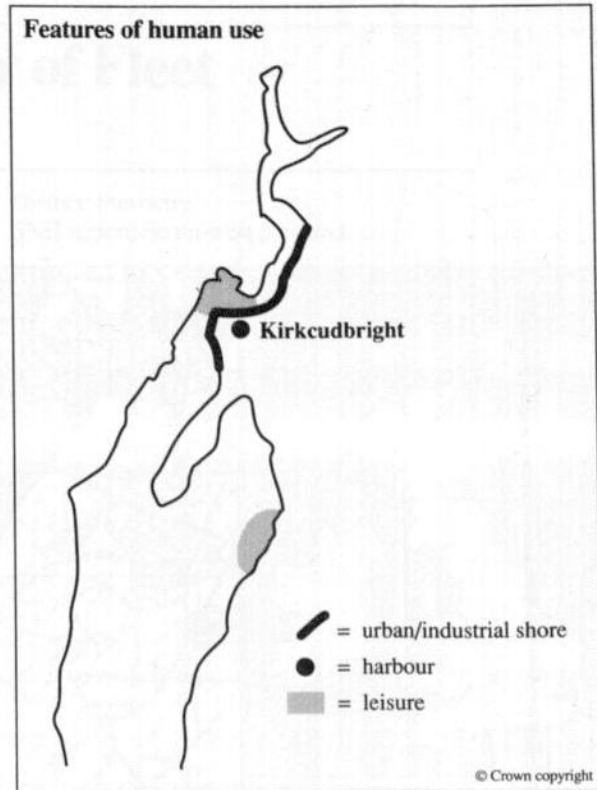
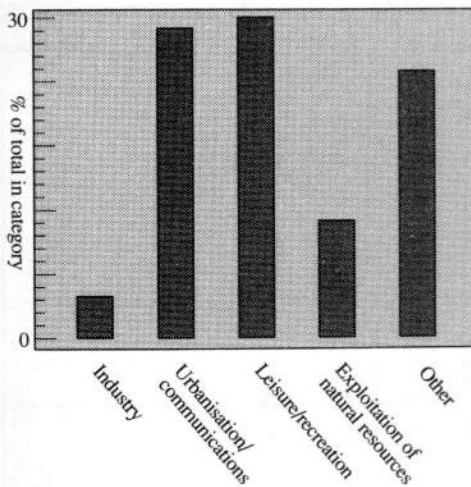
Features of human use

Most activities present on the estuary are recreational. There are moorings and a dinghy and boat park at Kirkcudbright, and there is an active sailing club. Other leisure pursuits are not intensive and include occasional power-boating, canoeing and angling. A clay-pigeon shooting club shoots over an area on the south-eastern shore of the estuary.

The only industrial activity present is the small wharf at Kirkcudbright which is used primarily for fishing boats which operate outside the estuary, but it is also used as a landing point for coal, timber and oil.

In 1989 there were proposals for the construction of an industrial estate in the upper reaches of the estuary, and for a marina and moorings at Kirkcudbright to replace the existing jetty. By 1992 the marina was under construction, and there had been a more recent proposal for mineral exploitation within Kirkcudbright Bay.

Categories of human use



Further reading

- Burd, F., & Fojt, W. 1987. *Saltmarsh survey of Great Britain. Scotland regional report, South-west*. Unpublished, Nature Conservancy Council.
- Covey, R. 1990. Littoral survey of the north coast of the outer Solway (Mull of Galloway to Auchencairn). *Nature Conservancy Council, CSD Report, No. 1,074*. (Marine Conservation Review Report No. MNCR/SR/011.)
- Covey, R. 1992. Sublittoral survey of the north coast of the outer Solway (Mull of Galloway to Auchencairn). *Nature Conservancy Council, CSD Report, No. 1,193*. (Marine Nature Conservation Review Report No. MNCR/SR/15.)
- Covey, R., & Emblow, C.S. 1992. Littoral survey of the the Inner Solway Firth and additional sites in Dumfries and Galloway. *Joint Nature Conservation Committee Report, No. 33*. (Marine Nature Conservation Review Report No. MNCR/SR/20)
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- Wilkinson, M. 1975. Intertidal algae of some estuaries in Galloway. *The Western Naturalist, 4*: 42-50.

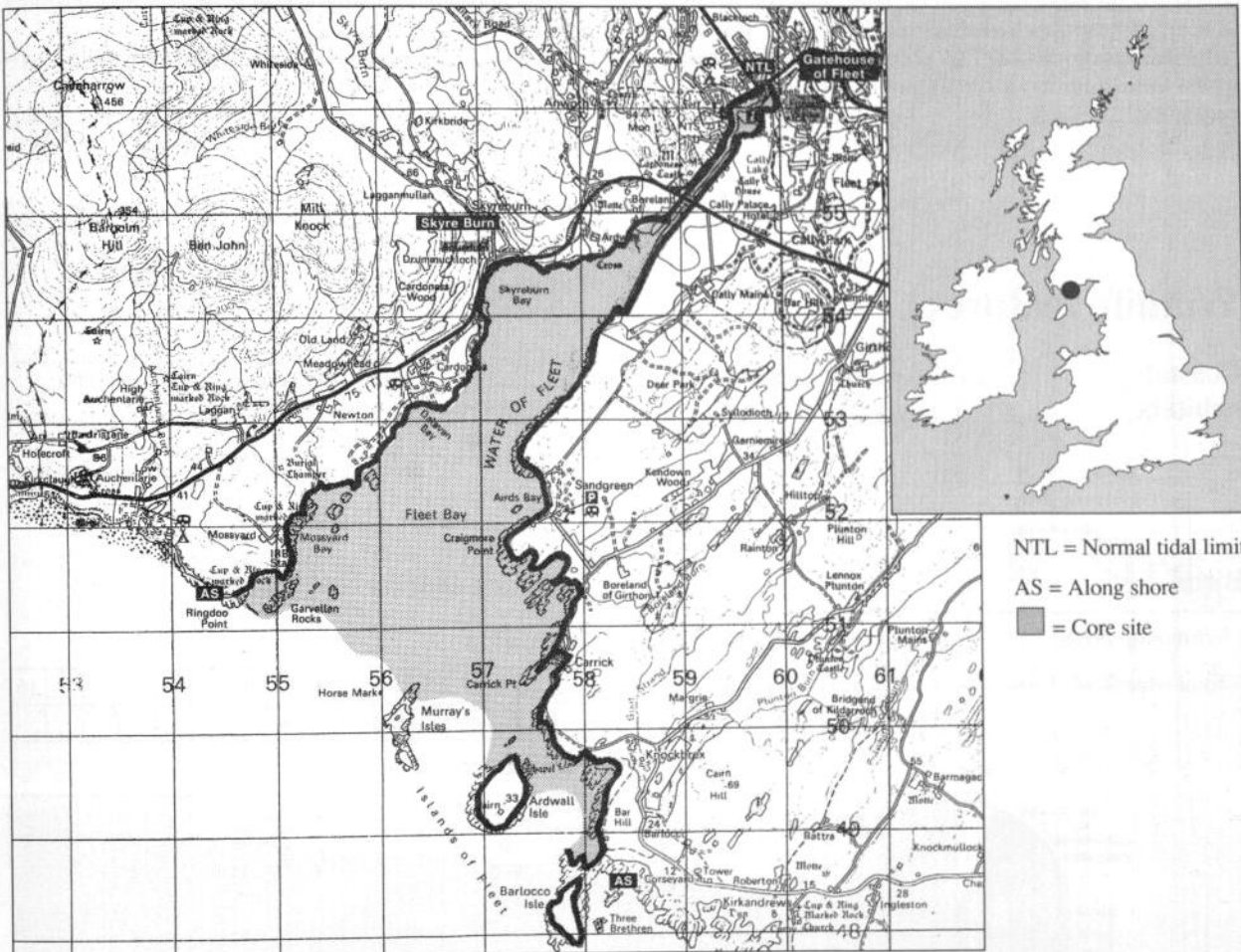
Centre grid: NX5753

District: Stewartry

Region: Dumfries & Galloway

SNH region: South-west Scotland

Review site location



© Crown copyright

Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
790	790	19.9	7.2	6.7	Fjord	< 5,000

Description

The Water of Fleet flows through a sandy bay and into the south-east of Wigtown Bay. At low tide the freshwaters of the Water of Fleet and the Skyre Burn form very narrow channels which meander across the expanse of intertidal flats, and the estuary is shallow enough for the islands of Ardwall and Borlacco in the mouth of the site to be reached on foot. Water quality of the estuary has been classified as grade 1.

The lower parts of the bay are largely intertidal sandflats, which become more muddy in the upper parts of the estuary. In these upper, muddier reaches a small area of saltmarsh has developed. This is dominated by *Spartina* which forms approximately 50% of the saltmarsh vegetation.

Much of the western and northern shore is a raised beach which extends as far upstream as the Gatehouse of Fleet. The most seaward shores of the estuary are predominantly rocky, and the aquatic estuarine communities recorded on the estuary include a sheltered rocky shore community and a current-swept sand community. The rocky shores of the Borgue Coast extend eastwards from the estuary and have a varied flora associated with the pattern of soils, for basic outcrops occur within a generally acidic environment, with varying degrees of exposure. This vegetation includes maritime heath, machair and cliff species.

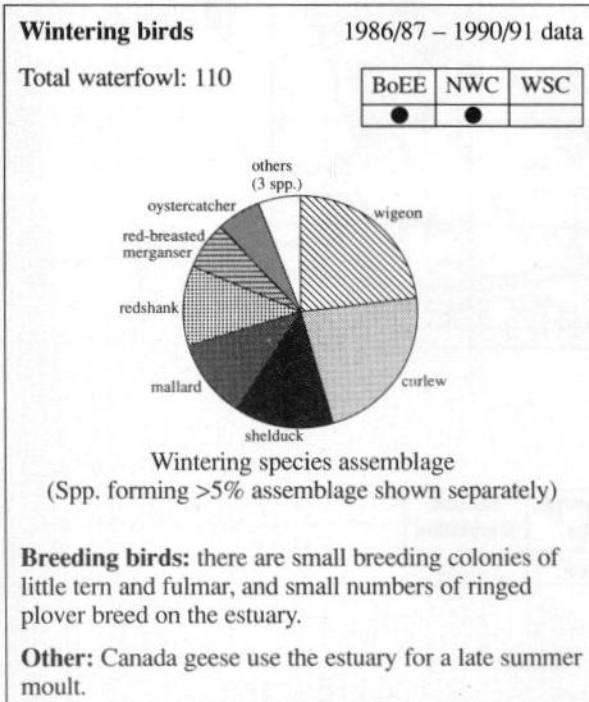
Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●		●				
Area (ha)		28	762							

● = major habitat ● = minor habitat

Birds



Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
								●							

Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
		●														

Additional wildlife features

Otters regularly use the estuary.

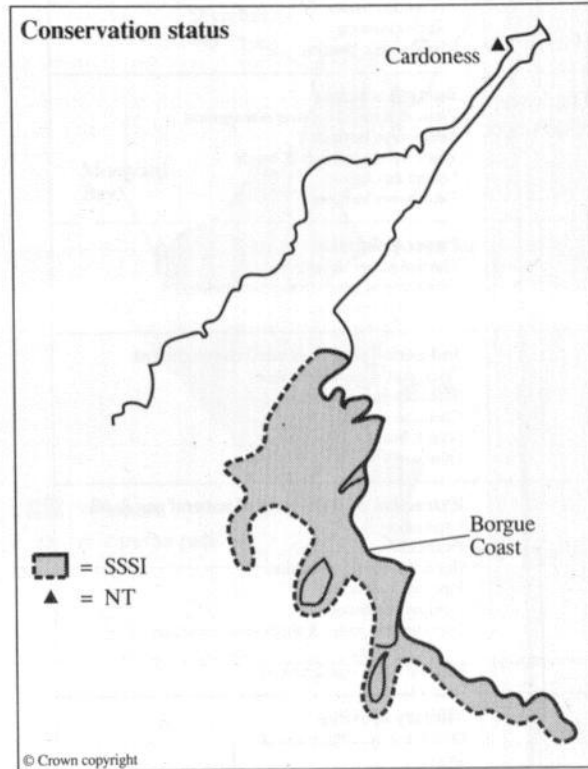
Conservation status

● = designated ● = proposed

No.	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other
	●	●			●											●	●		
1	1	2			1											1	1		

The south-eastern shores of the estuary are part of the Borgue Coast (1,892 ha) Site of Special Scientific Interest which is an SSSI for its biological and geological interest. The Borgue Coast and Barlocco Isle are Geological Conservation Review sites.

The National Trust have land in the upper reaches of the estuary at Cardoness, and the Water of Fleet is a National Scenic Area.



Carrick Shore, Water of Fleet. The seaward shores of the Water of Fleet are predominantly rocky. (Pat Doody, JNCC)

Human activities

Present	Proposed	
●		Coast protection & sea defences Linear defences Training walls Groynes Brushwood fences <i>Spartina</i> planting Marram grass planting
		Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation
		Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others
		Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers
●		Military activities Overflying by military aircraft Others
●	●	Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others
		Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying
●	●	Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries Cables
		Urbanisation Land-claim for housing & car parks
		Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting

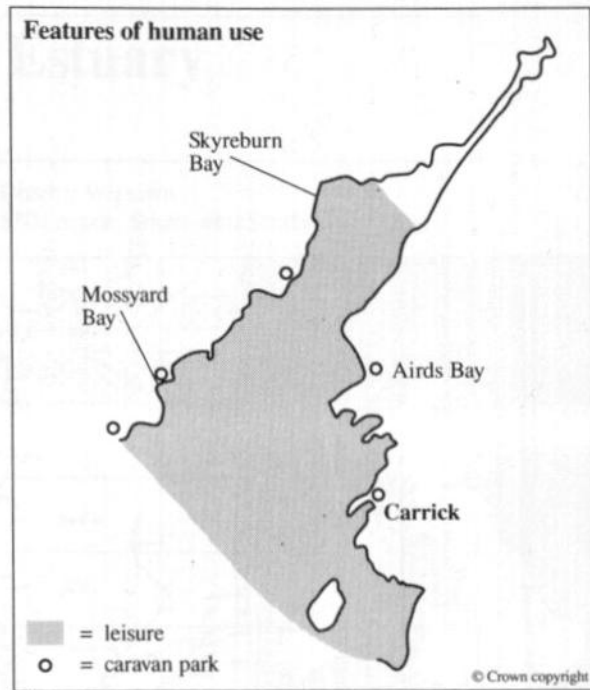
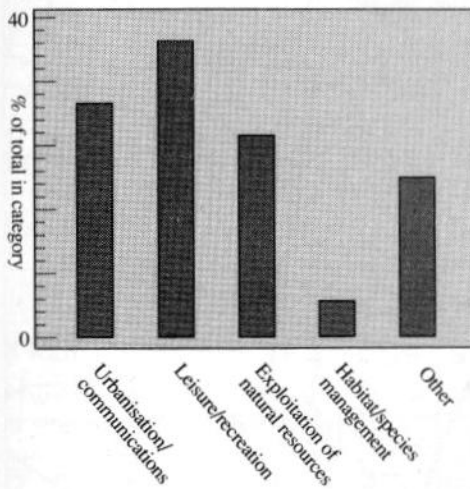
Present	Proposed	
●	●	Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
●		Wildfowling & hunting Wildfowling Other hunting-related activities
●	●	Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
●	●	Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
●	●	Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing <i>Salicornia</i> picking Others
●	●	Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
		Wildlife habitat management <i>Spartina</i> control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
		Others

Features of human use

Most activities on Water of Fleet are recreational and occur over most of the estuary as far upstream as Skyreburn Bay. At the height of the summer season there are up to 50 moorings in Mossyard Bay, Airds Bay and Carrick, and these areas are subject to pressure all year round from the launching of power-boats, sailboards and dinghies. Beach recreation is centred around the caravan sites and land-based pursuits are not intensive.

Exploitation of the natural resources includes fish-netting, saltmarsh grazing, bait-digging, collecting crabs, mussels and limpets for bait, and occasional wildfowling.

Categories of human use



Further reading

- Covey, R. 1990. Littoral survey of the north coast of the outer Solway (Mull of Galloway to Auchencairn). *Nature Conservancy Council, CSD Report, No. 1,074.* (Marine Nature Conservation Review Report MNCR/SR/011.)
- Covey, R., & Emblow, C.S. 1992. Littoral survey of the the Inner Solway Firth and additional sites in Dumfries and Galloway. *Joint Nature Conservation Committee Report, No. 33.* (Marine Nature Conservation Review Report No. MNCR/SR/20)
- Perkins, E.J. 1973. The marine fauna and flora of the Solway Firth. *Transactions of the Dumfriesshire and Galloway Natural History and Antiquarian Society, 45:* 15.
- Wilkinson, M. 1975. Intertidal algae of some estuaries in Galloway. *The Western Naturalist, 4:* 42-50.
- Wilkinson, M. 1980. The marine algae of Galloway. *British Phycological Journal, 85:* 265-273.

Cree Estuary

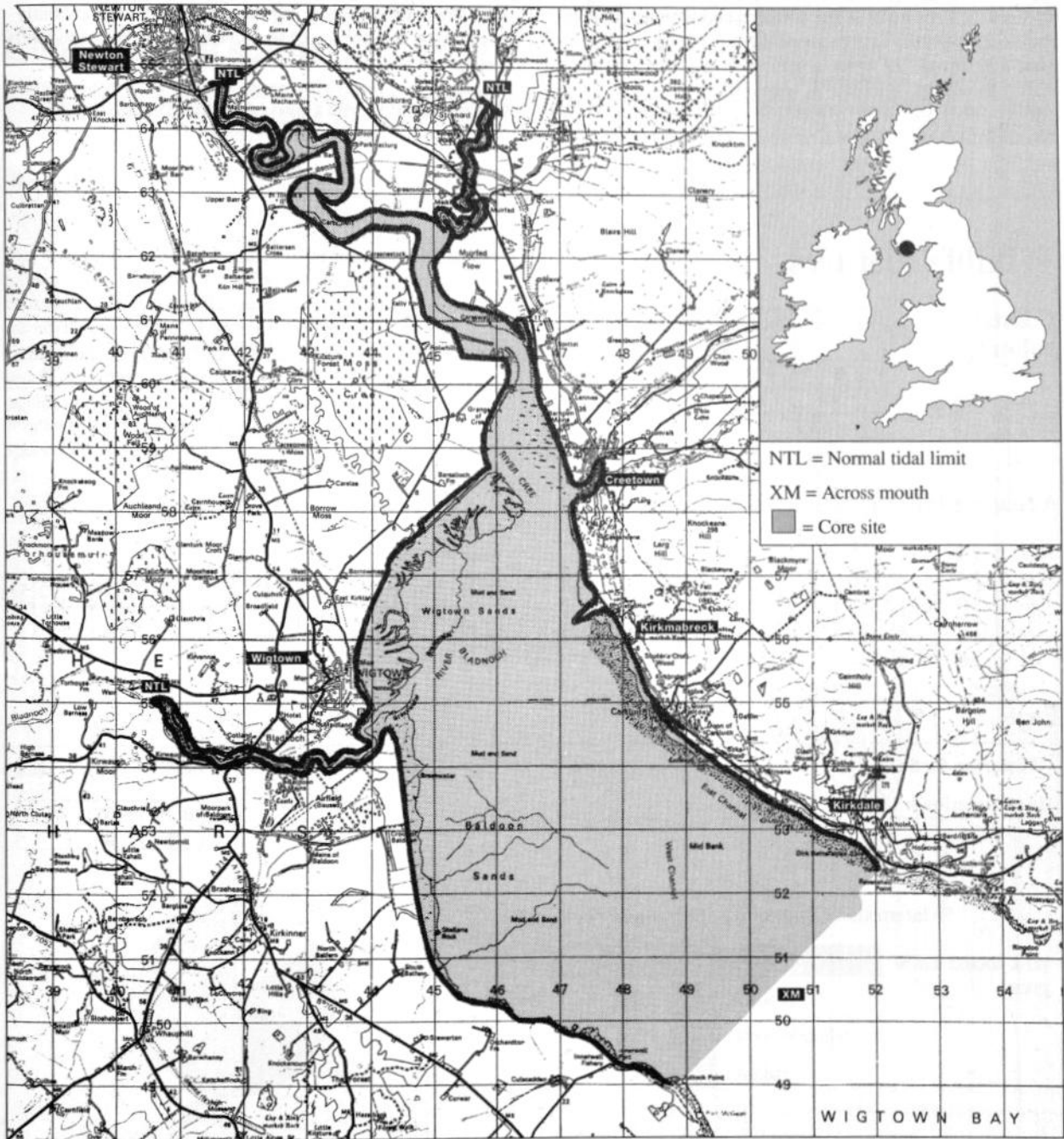
Centre grid: NX4655

District: Wigtown

Region: Dumfries & Galloway

SNH region: South-west Scotland

site location



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Total area (ha)	Intertidal area (ha)	Shore length (km)	Channel length (km)	Tidal range (m)	Geomorph. type	Human population
4,728	3,340	24.3	63.2	6.7	Fjord	< 5,000

Description

This is one of the largest estuaries on the south-west coast of Scotland, with river inflows from the Rivers Cree and Bladnoch, and the Palnure Burn and Moneypool Burn. Water quality within the estuary has been classified as grade 1, apart from the River Bladnoch which is grade 2.

At low tide the estuary is an extensive intertidal flat of mud and sand, rich in invertebrates. Much of the western shore is fringed with saltmarsh or merse, which is particularly extensive north of Wigtown. The vegetation is typical of closely grazed saltmarsh, and includes species that are locally rare or at the northern and western limit of their range. On the eastern shore there is a long ridge of sand and shingle, of which a narrow strip of shingle from Kirkmabreck and Kirkdale is vegetated.

On the east coast south of Creetown, a narrow belt of maritime oakwood extends southwards along the shore.

The strong influence of wind and salt-spray has produced stunted trees, and within the wood there is a specialised assemblage of lichens (including ten nationally scarce species) and invertebrates (including a large number of beetles). Closer to the shore there are also patches of strandline vegetation, maritime grassland and hard-cliff communities, and around spring lines there is willow carr and reedbed.

The Cree Estuary is one of the few estuaries on this part of the Scottish coast to support large numbers of wintering waterfowl. It regularly supports internationally important populations of pink-footed goose and nationally important populations of curlew, whooper swan and pintail. The Cree is also one of the few sites in Scotland where smelt (locally known as sparring), once a fairly common fish, are known to spawn.

Wildlife features

Coastal habitats

	Subtidal	Saltmarsh	Sandflats	Mudflats	Sand dunes	Rocky shores	Shingle	Lowland grassland	Lagoon	Other
	●	●	●	●		●	●			●
Area (ha)	1,388	445	2,895							

● = major habitat ● = minor habitat

Aquatic estuarine communities

Soft substrate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
												●		●	

Hard substrate

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
	●															

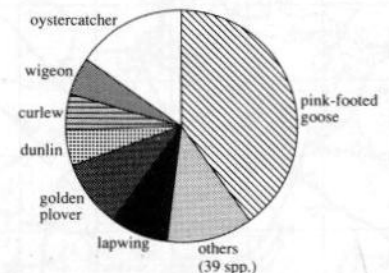
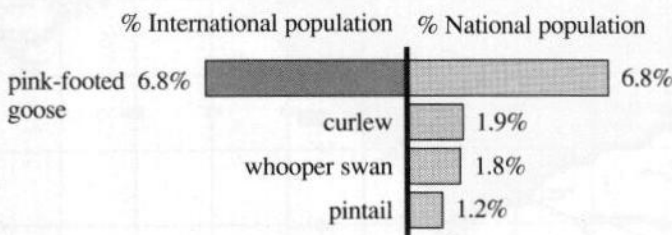
Birds

Wintering birds

Total waterfowl: 18,700

1986/87 – 1990/91 data

BoEE	NWC	WSC
●	●	



Breeding birds: there is a small colony of common tern and small numbers of ringed plover breed on the estuary.

Additional wildlife features

The nationally rare plant holy-grass *Hierochloa odorata* has been found on the estuary. The invertebrate fauna recently recorded on the Cree Estuary includes seven Notable species.

The nationally rare fish smelt *Osmerus eperlanus* spawns in the estuary, here in one of only three locations in Scotland. Otters regularly use the estuary

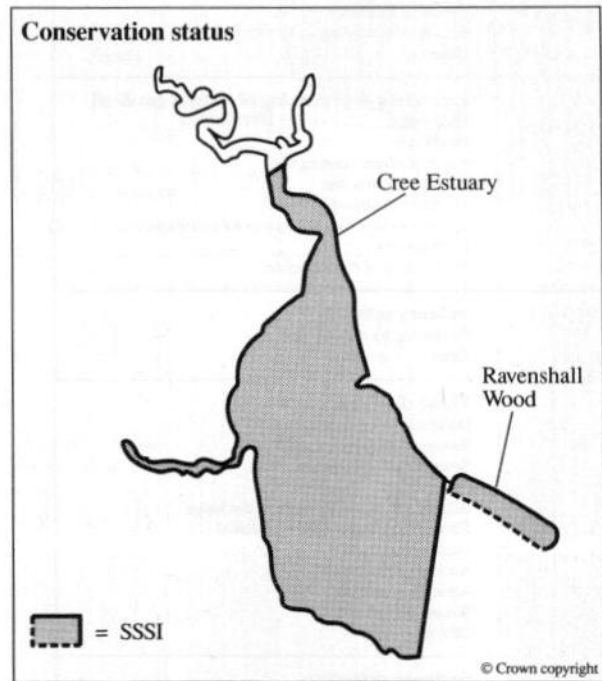
Conservation status

● = designated ● = proposed

	NCR	GCR	SSSI (B)	SSSI (G)	SSSI (M)	NNR	LNR	Ramsar	SPA	AONB	CWT	RSPB	ESA	NP	WWT	NT	NSA	HC	Other
	●		●				●	●	●										
No.	2		2				1	1	1										

Two biological SSSIs encompass a large proportion of the estuary Site of Special Scientific Interest, the Cree Estuary (3,456 ha) and Ravenshall Wood (44 ha). Both are also Nature Conservation Review sites. There is a proposal to designate the Lower Cree estuary as an SSSI, and to designate Wigtown Bay as a Local Nature Reserve.

Wigtown Bay is proposed as both a Ramsar site and a Special Protection Area.



Human activities

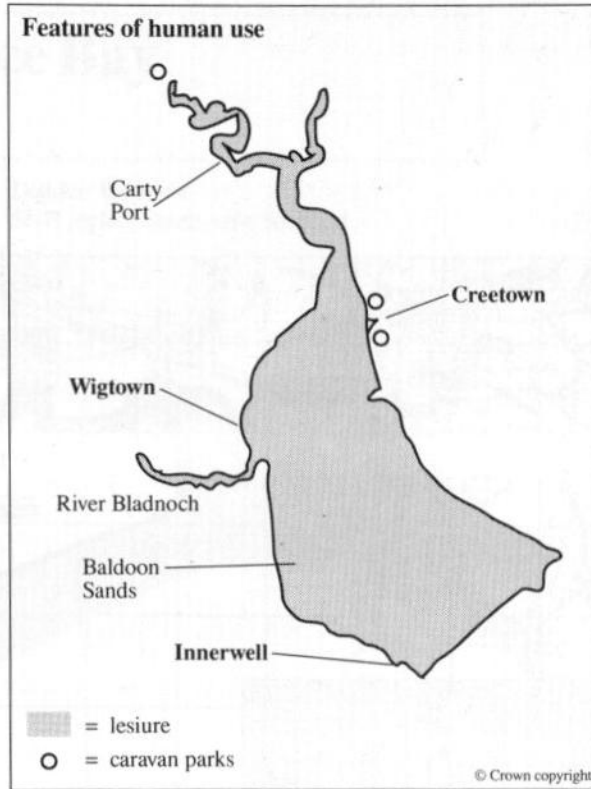
Present	Proposed		Present	Proposed	
●		Coast protection & sea defences Linear defences Training walls ● Groyne ● Brushwood fences Spartina planting Marram grass planting	●		Tourism & recreation Infrastructure developments Marinas Non-marina moorings Dinghy & boat parks Caravan parks & chalets Leisure centres, complexes & piers ● Aquatic-based recreation Power-boating & water-skiing Jet-skiing Sailing Sailboarding & wind-surfing SCUBA & snorkelling Canoeing Surfing Rowing Tourist boat trips/leisure barges Angling Other non-commercial fishing Bathing & general beach recreation Terrestrial & intertidal-based recreation Walking, including dog walking Bird-watching Sand-yachting 4WD & trial-biking Car sand-racing Horse-riding Rock-climbing Golf courses Clay-pigeon shooting Others Airborne recreation Overflying by light aircraft Radio-controlled model aircraft Others
	●	Barrage schemes Weirs & barrages for river management Storm surge barrages Water storage barrages & bunds Leisure barrages Tidal power barrages		●	
		Power generation Thermal power stations Import/export jetties (power generation) Wind-power generation		●	
	●	Industrial, port & related development Dock, port & harbour facilities Manufacturing industries Chemical industries Ship & boat building Others	●		
		Extraction & processing of natural gas & oil Exploration Production Rig & platform construction Pipeline construction Pipeline installation Import/export jetties & single-point moorings Oil refineries Mothballing of rigs & tankers			
●		Military activities Overflying by military aircraft Others	●		Wildfowling & hunting Wildfowling Other hunting-related activities
●		Waste discharge Domestic waste disposal Sewage discharge & outfalls Sewage treatment works Rubbish tips Industrial & agricultural waste discharge Thermal discharges (power stations) Dredge spoil Accidental discharges Aerial crop spraying Waste incinerators Others	●		Bait-collecting Digging & pumping for lugworms & ragworms Hydraulic dredging for worms Others
	●	Sediment extraction Capital dredging Maintenance dredging Commercial estuarine aggregates extraction Commercial terrestrial aggregates extraction Non-commercial aggregates extraction Hard-rock quarrying	●		Commercial fisheries Fish-netting & trawling Fyke-netting for eels Fish traps & other fixed devices & nets Crustacea Molluscs – Hand-gathering Dredging Hydraulic dredging
●		Transport & communications Airports & helipads Tunnels, bridges & aqueducts Causeways & fords Road schemes Ferries ● Cables	●		Cultivation of living resource Saltmarsh grazing Sand dune grazing Agricultural land-claim Fish-farming Shellfish farming Bottom & tray cultivation Suspended cultivation Crustacea farming Reeds for roofing Salicornia picking Others
●		Urbanisation Land-claim for housing & car parks		●	Management & killing of birds & mammals Killing of mammals Killing of birds Adult fish-eating birds Adult shellfish-eating birds Gulls Geese
●		Education & scientific research Sampling, specimen collection & observation Nature trails & interpretative facilities Seismic studies & geological test drilling Marine & terrestrial archaeology Fossil collecting		●	Wildlife habitat management Spartina control Habitat creation & restoration Marine Intertidal Terrestrial Habitat management
					Others

Features of human use

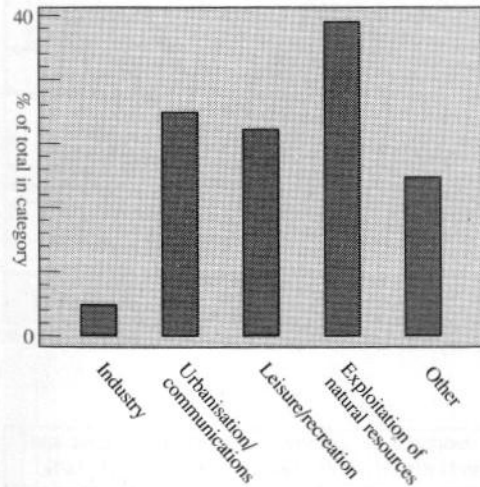
Most activities involve exploitation of the natural resources. Commercial fishing includes seine-netting for salmon and sea trout, stake nets, lobster- and crab-potting, and mussel- and cockle-gathering. Bait-digging for worms takes place on Baldoon Sands, and wildfowling occurs throughout the estuary.

Leisure activities are widespread but not intensive. There are small numbers of moorings at Wigtown, Creetown and Innerwell Port which are used for fishing boats, and sailing is not intensive but occurs throughout the bay. Walking is centred around Wigtown and Creetown, and horse-riders use the southern parts of Baldoon Sands.

In 1989 there were proposals to build a cement works at Carty Port; for a leisure barrage and artificial island complex at Creetown; for the creation of grazing marsh at the mouth of the River Bladnoch with brushwood fences to enhance accretion; and for culling of geese for agricultural reasons. By 1992 goose culling was under way and hydraulic dredging for cockles was a large-scale activity within the estuary. The proposal for a leisure barrage had been dropped.



Categories of human use



Further reading

Covey, R. 1990. Littoral survey of the north coast of the outer Solway (Mull of Galloway to Auchencairn). *Nature Conservancy Council, CSD Report, No. 1,074.* (Marine Nature Conservation Review Report No. MNCR/SR/011)

Covey, R., & Emblow, C.S. 1992. Littoral survey of the the Inner Solway Firth and additional sites in Dumfries and Galloway. *Joint Nature Conservation Committee Report, No. 33.* (Marine Nature Conservation Review Report No. MNCR/SR/20)

Perkins, E.J. 1973. *The marine fauna and flora of the Solway Firth.* Dumfries, Dumfriesshire and Galloway Natural History and Antiquarian Society.