JOINT NATURE CONSERVATION COMMITTEE

Coasts and seas of the United Kingdom

Region 7 South-east England: Lowestoft to Dungeness

edited by
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Foreword

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

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

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

The regional reports will be of value to all who live and work in the maritime areas of the UK, where informed management is the key to the sustainable use of resources. The reports should become indispensable reference sources for organisations shouldering new or expanded responsibilities for the management of Special Areas of Conservation under the EC Habitats & Species Directive. In addition, the reports will make an important contribution to the implementation of the UK Biodiversity Action Plan.

The Earl of Selborne
Chairman, Joint Nature Conservation Committee

How to use this book

These notes provide some general guidance about finding and interpreting the information in this book.

Structure

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

- **Introduction**: presents the important features of the topic as it relates to Region 7 and sets the region in a national context.
- **Important locations and species**: gives more detail on the features of the region in relation to the topic.
- **Human activities**: describes management and other activities that can have an effect on the resource in the region.
- **Information sources used**: describes the sources of information, including surveys, on which the section is based, and notes any limitations on their use or interpretation.
- **Acknowledgements**
- **Further sources of information**: lists references cited, recommended further reading, and names, addresses and telephone numbers of contacts able to give more detailed information.

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

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

Definitions and contexts

The word 'region' (as in 'Region 7') is used throughout this book to refer to the coastal and nearshore zone, broadly defined, between the two points given in the title of this book. The area covered varies between chapter sections, depending on the form in which data are available. Coverage is usually either coastal 10 km squares, sites within 1 km of Mean High Water Mark, or an offshore area that may extend out to the median line between the UK and neighbouring states.

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

The term 'North Sea Coast', as used here, means the coast of Britain from Cape Wrath (longitude 5°W) along the east and south coasts of Britain to Falmouth (again longitude 5°W), and including Orkney and Shetland.

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

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

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

Acknowledgements

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

Arco British Ltd[1]
Ards Borough Council
Avon County Council
Banff and Buchan District Council
Belfast City Council
BHP Petroleum Ltd[1]
Centre for Environment, Fisheries & Aquaculture Sciences
Ceredigion District Council
Cheshire County Council
Chevron UK Ltd[1]
Cleveland County Council
Clwyd County Council
Clyde River Purification Board
Colwyn Borough Council
Copeland Borough Council
Countryside Commission
Countryside Council For Wales
Cumbria County Council
Cunninghame District Council
Delyn Borough Council
Department of the Environment (DoE)
DoE (Northern Ireland) Environment & Heritage Service
DoE (Northern Ireland) Water Service
Derry City Council
Devon County Council
Dorset County Council
Down District Council
Dumfries and Galloway Regional Council
Dyfed County Council
Eastbourne Borough Council
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Forest of Dean District Council
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Newtownabbey Borough Council
Norfolk County Council
North Cornwall District Council
North East Fife District Council
Nuclear Electric plc
Preseli Pembrokeshire District Council
Restormel Borough Council
Samara Consulting
SCOPAC (Standing Conference on Problems Associated with the Coastline)
Scottish Natural Heritage
Scottish Office Agriculture, Environment and Fisheries Department
Scottish Salmon Growers Association Ltd
Sefton Borough Council
Shepway District Council
Solway River Purification Board
Somerset County Council
South Pembrokeshire District Council
Standing Conference on Regional Policy In South Wales
Stroud District Council
Tayside Regional Council
Torridge District Council
UK Offshore Operators Association[2]
Vale of Glamorgan Borough Council
Water Services Association
Welsh Office
World Wide Fund for Nature (UK)

Notes

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

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

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This collaborative project involved many other staff of the JNCC in addition to the project team listed on page 2. They were: Deirdre Craddock, Steve Gibson, Tim Hill, Keith Hiscock, Nick Hodgetts, Alan Law, Becci May, Sonia Palasiuk, Deborah Procter, Bill Sanderson, David Stroud, Mark Tasker, Andy Webb, Martin Wigginton and Lissie Wright. We thank them all for their help and support.

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Alexander Downie, Scottish Natural Heritage; Kathy Kennedy, English Nature; Jeremy Hindle, Suffolk County Council; Colin Taylor, Nuclear Electric; Peter Cranswick, Wildfowl & Wetlands Trust; David George, Natural History Museum; Peter Burrows, Environment Agency; Chris Vivian, Ministry of Agriculture, Fisheries and Food; P.R. Bloomfield, Department of the Environment; and Linda Davis, Kent County Council.

The gleaming silver expanse of shingle at Dungeness, Kent, is internationally important for lower plants, such as these slow-growing lichens, and is a candidate Special Area of Conservation under the EC Habitats & Species Directive. Much of the shingle now lies beneath Dungeness Nuclear Power Station and its associated infrastructure. Photo: Peter Wakely, English Nature.

Chapter 1 Overview

1.1 The Coastal Directories Project

Dr J.P. Doody

1.1.1 Introduction

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

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

This undertaking - the Coastal Directories Project - collates existing information on the United Kingdom and Isle of Man coastal zone to provide national and regional overviews of its natural resources and human activities, and indexes more detailed sources of information. The project uses a broad definition of the coastal margin that encompasses all the main habitats from offshore waters through to dry land, including any habitat forming part of the functioning coastal system; in addition areas of former tidal land now enclosed from the sea and lowland wet grassland alongside tidal rivers are included. At times it can be either unhelpful or impossible to set precise limits on the geographic areas that need to be covered, for example in the marine environment, such as when discussing fisheries or sources of contamination. However, where possible, coverage is of coastal 10 km squares, or sites within 1 km of Mean High Water Mark, or (for marine topics) from the landward limit of high tides out to the median line between the UK and neighbouring states. Areas inland of these limits are not included unless specifically stated.

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

1.1.2 Origins and early development of the project

The concept of providing integrated coastal information took a long time to evolve into the Coastal Directories Project. As early as 1984, the need for such data was acknowledged at the first International Conference on the Protection of the North Sea. In 1987, recognising the significant gaps that existed in the scientific understanding of the North Sea, the Second International Conference on the Protection of the North Sea established the North Sea Task Force (NSTF). Under the guidance of the International Council for the Exploration of the Sea (ICES) and the Oslo and Paris Commissions, the NSTF organised a programme of study with the primary aim of producing a (mainly marine) assessment of the North Sea (the *North Sea Quality Status Report* (QSR)) by 1993.

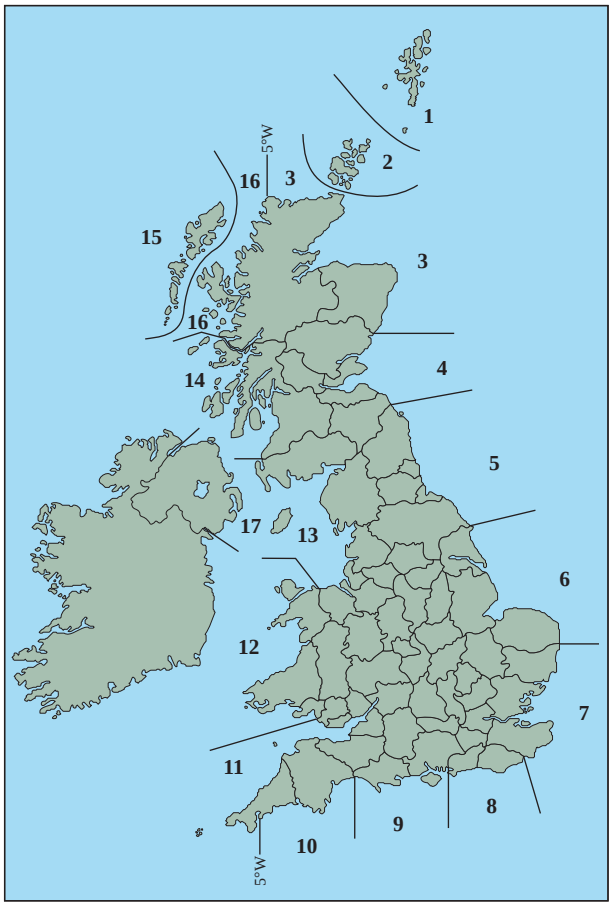
At the second meeting of the NSTF, in 1989, the UK suggested that the North Sea QSR should include consideration of terrestrial habitats and species. This was to involve the collection of information dealing with the coastal margin of the North Sea (defined as being east of longitude 5° West - i.e. from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

The principal aims of the *Directory* were to produce "a comprehensive description of the North Sea coastal margin, its habitats, species and human activities, as an example to other

North Sea states" (North Sea Task Force 1993), and thus to help to ensure that terrestrial habitats and species were considered in the QSR. In this it succeeded, and the QSR, also published in 1993, included descriptions of terrestrial habitats and species in several of the sub-regional reports, together with comments on the human impacts on the ecosystems.

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

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



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

1.1.3 Recent developments

These developments in coastal management fostered interest in the Coastal Directories Project and increased demand for information at a regional level, as well as at the level of whole seaboards (the approach adopted for the *Directory of the North Sea coastal margin*). In 1992, therefore, it was proposed to produce a *West Coast Directory* to cover the remainder of the coast of Great Britain, the Isle of Man and, by later agreement, Northern Ireland, as well as a series of regional volumes to cover the whole coast of the UK. Regions were defined, wherever possible, by the current local or national government coastal boundaries that most closely approximated to the limits of major coastal process cells (see section 2.4), to ensure that pragmatic management requirements were matched by an ecologically coherent information base. Volumes covering seventeen regions have been prepared: the areas that they cover are shown on Map 1.1.1. Regions 1 - 10 cover the area of the *Directory of the North Sea coastal margin*; Regions 11 - 17 deal with the west coast of the United Kingdom and the Isle of Man, including Northern Ireland. These regional volumes provide a more detailed level of information than the *Directory of the North Sea coastal margin*,

Table 1.1.1 Coastal Directories Project management structure

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

to help set each region in a national context and facilitate the preparation of regional plans. Discussions in the main steering group (see below) in January 1994 resulted in a decision to make the completion of the regional volumes the priority, rather than the overview *West Coast Directory*. At the meeting of the main steering group in February 1996 it was decided not to publish the *West Coast Directory* at all, as it would duplicate material already published in the regional volumes.

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

Interest in the project was reflected in the level of sponsorship that the project received and in the commitment shown by members of the steering groups, which met regularly. The main steering group met annually for a seminar: it considered the *Role of the Directories in the development of coastal zone management* (January 1994), the *Use of electronic storage and retrieval mechanisms for data publication* (February 1995) and *The tide turns for coastal zone management: Coastal Directories users report back on their experiences* (February 1996). The final meeting in February 1997 discussed future options for developing the project, including the possibility of providing access to the information in the form of a multi-media CD-ROM. Consideration is being given to producing a companion volume to the North Sea Directory, for the Celtic Seas. In addition the core steering group met at least annually.

1.1.4 The contribution of the project to coastal management

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

Increasingly, the regional volumes are seen as providing essential information to inform the development of coastal zone management policy at a national level. They provide information that complements the approach currently being promoted by a range of government reports. These include PPG 20: *Planning Policy Guidelines: coastal planning* (DoE/Welsh Office 1992), the *Policy guidelines for the coast* (DoE 1995) and the two consultation documents that followed up the House of Commons Environment Committee report: *Development below low water mark* (DoE/Welsh Office 1993a), *Managing the coast* (DoE/Welsh Office 1993b) (note that these reports do not cover Scotland, Northern Ireland or the Isle of Man) and *Scotland's coast: a discussion paper* (Scottish Office Agriculture, Environment and Fisheries Department 1996). MAFF too has promoted the setting up of flood and coastal defence 'coastal cell groups', to encourage sustainable shoreline management.

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

Table 1.1.2 Titles and publication dates of products of the Coastal Directories Project

Product	*Publication date*
Book editions	
Directory of the North Sea coastal margin	1993
Region 1. Shetland	1997
Region 2. Orkney	1997
Region 3. North-east Scotland: Cape Wrath to St. Cyrus	1996
Region 4. South-east Scotland: Montrose to Eyemouth	1997
Region 5. North-east England: Berwick-on-Tweed to Filey Bay	1995
Region 6. Eastern England: Flamborough Head to Great Yarmouth	1995
Region 7. South-east England: Lowestoft to Dungeness	1998
Region 8. Sussex: Rye Bay to Chichester Harbour	Due 1998
Region 9. Southern England: Hayling Island to Lyme Regis	1996
Region 10. South-west England: Seaton to the Roseland Peninsula	1996
Region 11. The Western Approaches: Falmouth Bay to Kenfig	1996
Region 12. Wales: Margam to Little Orme	1995
Region 13. Northern Irish Sea: Colwyn Bay to Stranraer including the Isle of Man	1996
Region 14. South-west Scotland: Ballantrae to Mull	1997
Regions 15 & 16. North-west Scotland: the Western Isles and west Highland	1997
Region 17. Northern Ireland	1997
Electronic editions	
Coastal and marine UKDMAP datasets: Version 1	1994
Regions 3, 5, 6, 9, 10, 11, 12, 13	1996
Regions 1, 2, 4, 7, 8, 14, 15 & 16, 17	Following book publication

1.1.5 Outputs

The regional volumes are published as hardback books. In addition a first release of coastal conservation data, covering national surveys of terrestrial habitats and coastal Sites of Special Scientific Interest (SSSIs), and a second release of marine conservation data, covering marine benthic surveys, have been published in electronic format (Barne *et al.* 1994) compatible with UKDMAP, the electronic atlas developed by the British Oceanographic Data Centre, Birkenhead (BODC 1992). Electronic editions of the published regional volumes are also being made available. The current position on the publication of book and electronic editions is shown in Table 1.1.2.

1.1.6 Further sources of information

A. References cited

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

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

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DoE/Welsh Office. 1993a. *Development below Low Water Mark - a review of regulation in England and Wales.* London, HMSO.

DoE/Welsh Office. 1993b. *Managing the coast: a review of coastal management plans in England and Wales and the powers supporting them.* London, HMSO.

Doody, J.P., Johnson, C., & Smith, B. 1993. *Directory of the North Sea coastal margin.* Peterborough, Joint Nature Conservation Committee.

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

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

Scottish Office Agriculture, Environment and Fisheries Department. 1996. *Scotland's coast: a discussion paper.* Edinburgh, HMSO.

B. Further reading

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

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Information about UKDMAP	*Coastal Data Custodian, JNCC, Peterborough, tel: 01733 562626
Sales outlet for book and electronic editions of the regional volumes, the Directory of the North Sea coastal margin, and other JNCC publications	NHBS Ltd, 2-3 Wills Road, Totnes, Devon TQ9 5XN, tel: 01803 865913

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

1.2 Introduction to the region

Dr J.P. Doody

1.2.1 Introduction

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

Region 7 covers the coast from the Norfolk/Suffolk border southwards, including the Thames Basin and the whole of Kent. The coastline is 1,174 km long, which is 21% of the total coastline of England and 6% of that of Great Britain. Much of the region is low-lying, with glacial and more recent (<10,000 years BP) sediments dominating the underlying geology. The estuaries of south Suffolk, Essex and Kent, including the coastal fringe of the Thames Basin, represent a major complex of soft sedimentary habitats in the predominantly flat alluvial landscapes of the region. In the north the low glacial cliffs, which dominate stretches of the east Norfolk coast (Region 6), continue into Suffolk, where they are interspersed with estuaries and lagoons. The Thames Basin is underlain by clay deposits, exposed in places and elsewhere overlain by recent estuarine sediments. In the south the estuarine shores give way to the chalk cliffs of Thanet and the south-facing Kent coast. Dungeness on the south coast is a major shingle formation.

Compared with other parts of the UK, this region is relatively sheltered from strong winds, although winter gales can severely affect different parts of the coast, according to its orientation and topography and the direction of the wind. Offshore the land shelves gently and the sea bed does not generally fall to 40 m depth until well offshore. An exception is the Dover Strait, where a depth of 40 m is reached within 10 km of the shore. Tidal range is wide and tide patterns and currents are complex because of the funelling effect of the North Sea. Tidal surges (extremely high tides) are relatively common. Wave conditions are choppy: waves are low and recur on a short period because of the short fetch of waves in the North Sea and the complexity of the coastline. The proximity of the continent and the shallowness of the North Sea lead to wide variations in sea surface temperatures, which are generally higher in the south of the region, where the influence of the North Atlantic Drift is most marked, especially in winter. In this region relative sea level is rising at a more rapid rate than anywhere else in the UK; this fact, the ongoing erosion of coastal habitats and the threat of flooding by tidal surges are major considerations for coastal zone management and have resulted in the construction of extensive sea defence and coast protection works.

The coastal hinterland is mostly in intensive agriculture and comprises some of the most productive and intensively cultivated land in Great Britain. Much coastal land was created by the enclosure of former intertidal areas. Industrial infrastructure in this region is mainly confined to the Thames Estuary, and London is one of the world's biggest commercial centres. The Port of Felixstowe in Suffolk is the biggest cargo port in the UK and the fourth largest in Europe. Tourist development is also significant in the region, and some towns, including Clacton and Southend in Essex, and Margate, Deal and Dover in Kent, are important coastal tourist centres. The proximity of the region to the continent has resulted in the development of ferry ports at Harwich, Dover and Folkestone, and the Channel Tunnel is a recent addition to Britain's growing links with the continent.

1.2.2 Structure and landscape

The solid geology of the region is largely composed of rocks of the Tertiary Period (<65 million years old) and, in the south, the Cretaceous Period (144-60 million years old). However, over much of the area this solid geology is obscured by more recent Pleistocene and Holocene deposits (<1.6 million years old), laid down during glacial periods. The shape of the coastline is determined largely by this 'drift' geology and the more recent movement of marine sediment, which continues to the present day. Sedimentary material is derived from offshore glacial deposits as well as terrestrial sources: its subsequent movement along the shore by waves, tides and winds helped to create the large areas of tidal flats and saltmarshes that are so much a feature of the Essex and north Kent coasts. Chalk cliffs dating from the Cretaceous Period outcrop in the south-east of the region and form the characteristic cliffed landscape around Dover. There are two internationally important shingle structures in the region: Orford Ness and Dungeness. The sequence of geological material offshore is similar to that onshore, with extensive and complex Pleistocene and Holocene deposits overlying the solid geology.

1.2.3 The natural environment

The sea and sea bed

The intertidal areas of the estuaries are important for marine communities that occur on or in soft sediments, which are dominated by dense populations of oligochaete worms, Baltic tellin *Macoma baltica* and ragworm *Hediste diversicolor.* A variety of other species, including dense populations of lugworm *Arenicola marina* and a small snail, *Hydrobia ulvae,* inhabit the soft, muddy intertidal sediments. The highly productive waters in these estuaries and their dense plant and animal communities provide food for many other species, amongst them the large populations of wintering birds. By contrast, on the open coast, as for example off Thorpeness, the unsheltered and unstable inshore sediments have a generally limited fauna.

There are only small areas of hard substrate along the region's coast. At Thorpeness, for example, small areas of rock support a community dominated by the hydroid *Sertularia argentea*. The chalk bedrock of the Thanet coast shoreline supports rich communities of seaweeds within the splash zone as well as populations of rock-boring bivalves, polychaete worms and sponges. In deeper water, coarse sand and gravel provide attachments for various hydroids,

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

bryozoan seamats and deadman's fingers *Alcyonium digitatum*. The lagoons of south Suffolk contain a number of rare and scarce invertebrate species.

112 fish species have been recorded in this region: two lampreys, ten sharks and rays and 100 bony fish. There are important near-shore populations of several exploited sea-bed species, especially brown shrimp, cockle and native oyster. The creeks and backwaters of the region are some of the few areas left in the UK that support a natural stock of the latter. Herring are abundant in the region: the North Sea stock spawns offshore in the autumn and uses the estuaries of the region as nursery grounds. Plaice are found on sandy areas of sea bed throughout the region; plaice and Dover sole have spawning and nursery areas inshore. Bass and grey mullet are seasonally abundant, the former spawning in the English Channel, the juveniles maturing inshore in creeks, backwaters, shallow bays and estuaries, including the Thames Estuary. Salmon and sea trout occur in small numbers throughout the region, especially in the Thames and Stour, and eels are common. All seven of Britain's protected fish species have been recorded in this region, the allis and twaite shad (*Alosa alosa* and *A. fallax*), lampern *Lampetra fluviatilis*, sea lamprey *Petromyzon marinus* and sturgeon *Acipenser sturio* being considered threatened in the UK and Europe also. Sturgeon are now recorded only very occasionally in the region.

Both grey and common seals occur in the region, although there are no major colonies comparable with those in Region 6 to the north. No species of cetacean is abundant, the most

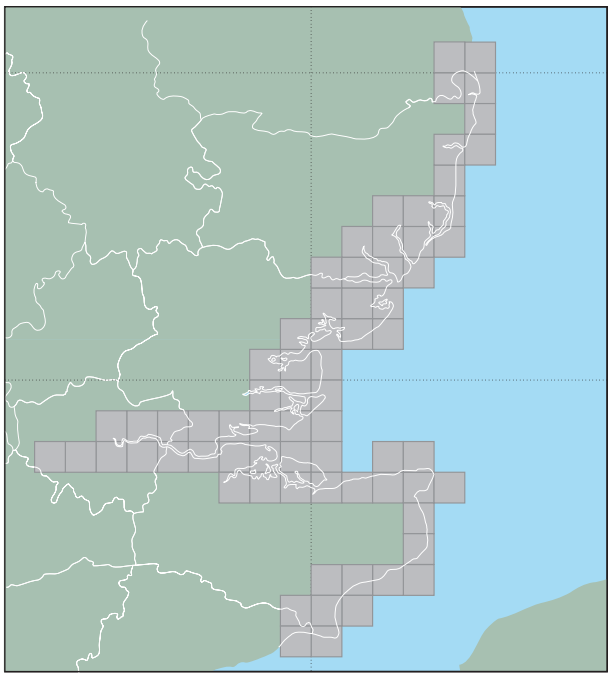
frequently observed in nearshore waters being the harbour porpoise and bottlenose dolphin, both of which are rare in the region.

Estuarine shores

Estuarine shores comprise the most important range of habitats on the region's coast, with eighteen estuaries occurring here. These include the complex of estuaries in Essex, the extensive flats of the Maplin Sands and the major estuary of the Thames, which together with the other smaller sites represent a significant 10% of Great Britain's estuarine resource; the 'Greater Thames Estuary', a composite of several estuaries, contains the second largest area of intertidal habitats in the UK. The region's estuarine habitats, particularly saltmarshes, wet grasslands and reedbeds, are important for several breeding bird species, including large numbers of waterfowl; especially important in the national context are the breeding populations of avocets *Recurvirostra avosetta* and bitterns *Botaurus stellaris*, both rare elsewhere in the UK, and the large populations of breeding shelduck *Tadorna tadorna*. The estuaries of the Thames Basin, on either side of the Thames Estuary itself, are of great importance for non-breeding waterfowl and, taken together, hold a significant proportion of the total UK populations of several species, either in the migration periods or in winter. In midwinter the region holds 388,500 waterfowl - about a quarter of the English total. All the region's estuaries are designated as Ramsar sites and Special Protection Areas as internationally important sites for birds, especially wintering waterfowl, and in spring and autumn they hold significant numbers of migrating birds on passage. The dark-bellied brent goose *Branta bernicla bernicla,* which breeds in arctic Russia and Siberia, is one of the most abundant species of wildfowl in the region, and the dunlin *Calidris alpina* is the most abundant wader. Seventeen species of waterfowl reach levels of international importance on at least one estuary and a further seventeen species occur at levels of national (i.e. GB) importance. For several non-breeding waterfowl species, sites within the region are the most important within the UK, either in migratory periods or in winter. The region can become even more important during periods of very cold weather further east in continental Europe, when there can be major influxes of dunlin and other species.

Saltmarshes are found within all the estuaries of the region, with the largest individual expanse being on the Dengie Peninsula. In total there are over 7,000 ha of saltmarsh in the region. The vigorous hybrid common cord-grass *Spartina anglica* is present throughout the region, although its total area is only about 10% of the saltmarsh area. At most sites it appears to have become an integral part of the early saltmarsh community, rather than a dominant species. Unlike at many sites in other regions, particularly in Wales and northern England, in this region it is not now treated as an invasive plant requiring control.

The region's saltmarsh invertebrate fauna is rich and varied and includes a number of species that are found only in this part of England, including the ground lackey moth *Malacosoma castrensis*, whose larvae feed on a wide range of saltmarsh plants. The saltmarshes and associated coastal wet grasslands of the Colne, Thames and Medway Estuaries and the Swale hold especially dense and diverse assemblages of breeding waterfowl, while the intertidal areas are particularly important for feeding waders. In areas where grazing



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

pressure is low, densities of breeding redshank *Tringa totanus* are amongst the highest in Britain (in total representing 10% of the British population). Other breeding species include nationally-important populations of oystercatcher *Haematopus ostralegus*, lapwing *Vanellus vanellus*, snipe *Gallinago galinago* and black-headed gull *Larus ridibundus,* as well as of wildfowl such as pintail *Anas acuta*, gadwall *Anas strepera* and mute swan *Cygnus olor*.

Saltmarshes in the region have been greatly altered over many years, as enclosure for agriculture has led to the progressive loss of upper saltmarsh communities and landward transitions. Unlike those in the Wash (Region 6), where accretion is the norm, saltmarshes in both Essex and Kent are known to be eroding over a wide area, and between 1973 and 1986 some sites have lost between 10% and 44% of the original area of marsh. Elsewhere in the region, some areas of coastal wet grassland have reverted to intertidal habitats, as collapsed sea walls have been left unrepaired.

There are nine natural lagoons or lagoon-complexes in the region, totalling 33 ha. The region, especially the county of Suffolk, is nationally important for lagoons, particularly those set within or behind longshore shingle bars or barrier beaches. Saline ponds left after the extraction of gravel and clay occur on the south side of the Thames Estuary in Kent. These often have very low salinities, but some are very large and those of Cliffe Marshes are considered to be of considerable conservation value. Several lagoons now have little or no saltwater ingress and extensive reedbeds have developed, as for example at Walberswick, one of the largest reedbeds in Britain.

The reedbeds of Suffolk (e.g. Benacre, Walberswick and Minsmere) support nationally important numbers of several rare breeding birds, including marsh harriers *Circus aeruginosus,* bearded tits *Panurus biarmicus* and nightjars *Caprimulgus europaeus*. Savi's warbler *Locustella luscinioides* also breeds at Minsmere. Reedbeds in the region also hold nationally important numbers of bitterns, a species whose numbers are currently at a critically low level in the UK.

Coastal lagoon systems are of particular importance for the increasing UK population of avocets, whose breeding in the UK centres on East Anglia. Minsmere, Havergate Island in the Ore/Alde/Butley Estuary (the stronghold of the species) and Elmley in the Swale Estuary hold the main concentrations of breeding avocets. Reedbeds at Walberswick are a stronghold of the white-mantled wainscot moth *Archanara neurica*, which feeds as a larva in the stems of common reed *Phragmites australis*.

Non-estuarine shores

The region includes only a small proportion (1%) of the total area of sand dune in Great Britain, representing 5% of the area of sand dune in England. Sandwich Bay is the more important of the two sites and has an exceptionally rich flora with high populations of a number of orchids. These dunes are also of national significance for invertebrate conservation. Vegetated thin sand over shingle is present in Suffolk, but this is generally regarded as a shingle habitat, of which the region contains over half the British resource. The most significant sites are Orford Ness and Dungeness, which are of international significance. At Orford Ness, much of the shingle ridge structure of the northern part of the site has been destroyed by military activity, but despite this it supports some of the most natural spray-drenched, lichen-rich shingle vegetation in Great Britain. There is also an internationally-important colony of lesser black-backed gulls *Larus fuscus* at Orford Ness, one of the few seabird colonies in the region.

In Essex, sandy shingle occurs at Colne Point and Shoeburyness, with shell gravel fronting the mid-Essex saltmarshes in between. Shell gravel is also found on the north Kent coast. The south-east coast of Kent has extensive fringing shingle beaches, and Dungeness, possibly the largest shingle cuspate foreland in Europe, contains over 42% by area of Britain's shingle. Despite the fact that this site has been extensively excavated for gravel and has had two nuclear power stations, a local airport and considerable housing built upon it, it remains one of the most important shingle sites in Europe. The undisturbed vegetation includes some of the best examples of lichen-rich grassland and scrub in the UK and there is an extensive and rich invertebrate fauna, as well as a nationally-important colony of Sandwich terns *Sterna sandvicensis*.

The region contains a significant proportion of the UK's resource of soft cliffs. The cliffs of Suffolk are predominantly of poorly-consolidated glacial material. They are relatively low (<20 m), with non-vertical faces subject to relatively rapid erosion and retreat: the cliff at Covehithe between Kessingland and Southwold is one of the fastest eroding pieces of coastline in Britain. Many of these soft cliffs have been artificially stabilised by a variety of coast protection structures, which often obscure important geological and palaeoenvironmental features, prevent natural movement of the cliffs and change the nature of the plant communities that grow there. There are also a few soft cliffs in Essex, for example at the Naze. On the Channel coast the only significant length (3.5 km) of soft cliff is at Folkestone Warren, an area of impressive landslides with the only large extent of undercliff vegetation in the region, considered to be of national importance. The only hard-rock cliffs in the region are those developed in the chalk; along the most spectacular stretches (e.g. Shakespeare Cliff, Dover) they have vertical faces and an undulating cliff-top at between 100 m and 130 m.

Two of the nine nationally rare (Red Data Book) higher plant species that occur predominantly on cliffs are found on chalk cliffs in the region. These are slender bird's-foot-trefoil *Lotus angustissimus* and early spider-orchid *Ophrys sphegodes*, plus the nationally scarce wild cabbage *Brassica oleracea* var. *oleracea*. Pockets of maritime vegetation occur on the cliffs, although they are restricted to the lower slopes, where species such as sea heath *Frankenia laevis* occur in the splash zone. A few cliffs in the region have very diverse invertebrates, including the 'soft' rock, slumping cliffs of Folkestone Warren and the chalk cliffs of Dover to Kingsdown and Shakespeare Cliff. There are no significant populations of cliff-nesting seabirds in the region.

Suffolk has a sequence of coastal heaths (the Suffolk Sandlings) that are of special interest as some of the few remaining areas of heathland near to the south-east coast, although the heaths are not maritime in character. Heathland birds such as linnet *Carduelis cannabina* and nightjar nest there, and the reptile fauna includes the rare slow-worm *Anguis fragilis*. The region also holds populations of all nine of Britain's widespread amphibians and reptiles, and the rare natterjack toad *Bufo calamita* is present at one site, where it has recently been introduced.

Seven bat species are present in the region, including the barbastelle *Barbastella barbastellus*, one of Europe's rarest bats. Coastal wet grasslands are important foraging areas for several of these species.

1.2.4 Landscape and nature conservation

The high nature conservation value of the many estuaries, tidal creeks and chalk cliffs in the region is reflected in the multitude of statutory site protection mechanisms operating. These include a quarter (seventeen) of the coastal Ramsar sites and a fifth (20) of the coastal Special Protection Areas designated in Britain. The region also contains >15% by area of the Areas of Outstanding Natural Beauty in England and Wales. In addition, there are several Country Parks, reflecting the importance of the rural areas for informal recreation. The voluntary conservation movement also has a high profile: the RSPB holds over 3,000 ha of land (8.5% of their total holdings in Great Britain) and a number of other sites are owned or managed by the local Wildlife Trusts and the National Trust, which recently took over Orford Ness. The area covered by the each of the main designations is given in Table 1.2.1, although it should be noted that sites frequently have more than one designation, whose boundaries are not necessarily the same.

1.2.5 Human activities, past and present

The archaeological record shows that humans have been present in the region for more than 250,000 years. Because the ice did not extend this far south, this region provides nationally important evidence for the activities of hunting groups that occupied the region in periglacial periods, evidence that elsewhere survives only in caves. These peoples roamed across the southern North Sea and eastern English Channel when they were still dry land.

Throughout the post-glacial period there have been episodes of both rising and falling sea level, and submerged forests and peat beds occur throughout the region. Even after

Table 1.2.1 Main landscape and nature conservation designations in Region 7

Designation	*No. of sites in region*	*Total area in this region (ha)*	*% of GB coast total in region*
Ramsar sites	17	49,671	14.5
Special Protection Areas (SPAs)	20	50,117	13.8
National Nature Reserves	10	7,104	8.1
Sites of Special Scientific Interest	79	68,491	9.6
National Parks	1	3,100	0.4
Local Nature Reserves (LNRs)	25	1,196	7.8
Country Parks	8	815	17.6
Areas of Outstanding Natural Beauty	3	137,100	15.2
Heritage Coasts	3	1 km	4.6
National Trust sites	17	1,531	2.4
Wildlife Trusts sites	52	2,683	10.3
RSPB reserves	9	3,298	8.5

the land-bridge between Britain and the continent was severed by post-glacial sea level rise, this region remained culturally close to Europe. By about 4,500 BC farming had been introduced in the south of the region. Evidence of seaborne transport about 3,300 years ago was provided by the discovery of the 'Dover Boat', the design of which shows that a sophisticated boat-building tradition had by then developed. Traces of the early saltmaking industry, dating from the Iron Age, have survived in the form of about 300 distinctive 'red hills', formed of fired clay or burnt earth, that have been identified in Essex. Saltmaking sites have also been found on the River Alde and at Lower Halstow.

The maritime history of the area is exceptional. Until the Norman conquest successive waves of peoples settled the region and used its foreshores and inlets to maintain communication and trade with their homelands in northern Europe. The area is exceptionally rich in Roman military remains: modern Rochester and Colchester overlie the Roman towns of Durobrivae and Camulodunum (the capital of Roman Britain). Dover was the base for the Roman fleet in Britian. Londinium (London) was created as an administrative centre and port, and the Thames become the main route for cross-channel trade. During the 12th century the four Cinque Ports in this region - Sandwich, Dover, Hythe and Romney - received trading privileges in return for providing ships and men for the Crown.

Much of the region is characterised by a history of coastal environmental change. Romney Marsh was probably tidal land in Roman times, but as the river channels silted up, and sea walls were built and drainage ditches dug, it developed into an extensive area of pasture and arable land that fronts an ancient cliff line now several kilometres inland. Coastal change was more dramatic in the 14th and 15th centuries, when the important port of Dunwich, Suffolk, once a major city, was gradually washed away. By contrast the Ore at Orford was closed by shingle movement, as Orford Ness gradually moved southwards, and Sandwich was blocked by the silting-up of the Stour. The region has more than 50% of its length fronted by some form of artificial sea defence or coast protection structure (in the districts of Southend and Canterbury this rises to >80% and >90% of the coastline respectively). Dymchurch, for example, has always been vulnerable and the practice of sea defence there began in the 13th century. The structures that were built then have been replaced several times, notably after 1953, when a storm surge flooded much of the coastline of East Anglia and Holland. Today, schemes involving beach-feeding with sand and the building of groynes with imported granite, as well as an upsurge of interest in 'soft' engineering solutions such as managed retreat and saltmarsh creation schemes, continue the battle with the sea. The Thames Barrier and its associated tidal defences comprise the most expensive and significant sea defence project in the region, designed to protect London even from storms of a severity that is expected only once every 1,000 years.

South Essex, London and north Kent are some of the most heavily populated parts of the UK, but the region also includes substantial areas of undeveloped coastline in Suffolk, Essex and Kent. The major industries of the region are mostly situated around the Thames Estuary. The Port of London handles 11% of the UK's waterborne trade and serves 30% of the population, but this represents a decline since the 1960s, when specialised container traffic and roll-on/roll-off ferries came into operation at Felixstowe, Harwich, Dover and Folkstone. Nuclear power stations require close proximity to cooling water and there are several in this region, at Sizewell (two), Bradwell and Dungeness (two). The presence of extensive nearshore and offshore sand and gravel deposits makes the region particularly attractive for marine aggregate dredging. The ports of the region, notably on the Thames, account for approximately 30% of the total quantity of aggregates landed in British ports. Most of the material dredged from near London is used locally or in south-east England, although an increasing proportion is exported. Navigational dredging to maintain deep water channels is an important activity, especially in the Thames. In 1994, 8,351,332 wet tonnes of dredged spoil (23% of the UK's tonnage) were disposed of at sea in this region.

The region has important local fisheries. Lowestoft is an major fishing port, although its importance has diminished since its heyday at the end of the last century. Fishing activity off the Essex coast includes trawling for cod, Dover sole, sprats, eels and brown shrimps, as well as fishing by smaller vessels, which set gill and trammel nets for sole, grey mullet, cod, flatfish and bass and dredge for oysters. The Thames Estuary offers good trawling for eels, Dover sole, plaice, whiting and cod. The largest cockle fishery in the UK is in the Thames Estuary and off the adjacent Essex coast. 'Whiteweed' (two fern-shaped species of hydroid, collected for making decorations) is taken using towed rakes. Pacific and native oysters, as well as Manila clams, are cultivated in many parts of the region.

Although the region's coastal tourist resorts are mostly not as large as those on the Sussex coast (Region 8), they are still notable on a national scale. Southend has benefited from its proximity to London, and Margate and Ramsgate on the Thanet coast have an important tourist industry. The region is one of the most important water-based recreation areas in the UK, with sailing, power boating, angling, canoeing and water ski-ing. Marinas and other mooring facilities are found in every estuary of the 'Greater Thames' area, especially in Essex. Recently there has been a dramatic increase in water-based recreation in the region, and extra berths and moorings for sail and power boats have been established along the north Kent and Essex coasts. Wildfowling takes place in many parts of the region.

To harmonise these activities and resources, a number of

coastal zone management plans are being developed for the area, for example for the Suffolk Coast and Heaths, the Suffolk Shoreline, the Stour/Orwell, the Colne, the Blackwater, the Thames and the Medway/Swale Estuaries.

1.2.6 Acknowledgements

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1.2.7 Further sources of information

A. Further reading

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Chalk overlies Gault Clay along a 5 km stretch of cliffed coast at Folkestone Warren, an SSSI and Local Nature Reserve in Kent, and landslips have long occurred. The slumped material, which would otherwise be swept north-east by the dominant waves, is held back by a series of groins to slow the rate of recession of the cliffs. Photo: Dr Pat Doody, JNCC.

Chapter 2 Geology and physical environment

2.1 Coastal geology

British Geological Survey & J. Sawyer

2.1.1 Introduction

The coastline of the region is dominated by relatively soft sedimentary rocks. The youngest of these are in Suffolk and they get progressively older around the coast towards Kent. The 'solid' geology is of early Quaternary, Tertiary and Cretaceous age (Table 2.1.1; Map 2.1.1) and, although the coastline is generally low-lying and the rocks are often overlain by superficial Quaternary deposits, the exposures offer excellent examples of the rocks of these periods. Two dominant structures underlie the region and have influenced the exposure of rocks at the coast: in the north is the London Basin, which dips gently towards the North Sea; in the south is the Wealden Anticline.

2.1.2 Stratigraphy

Lowestoft - Felixstowe

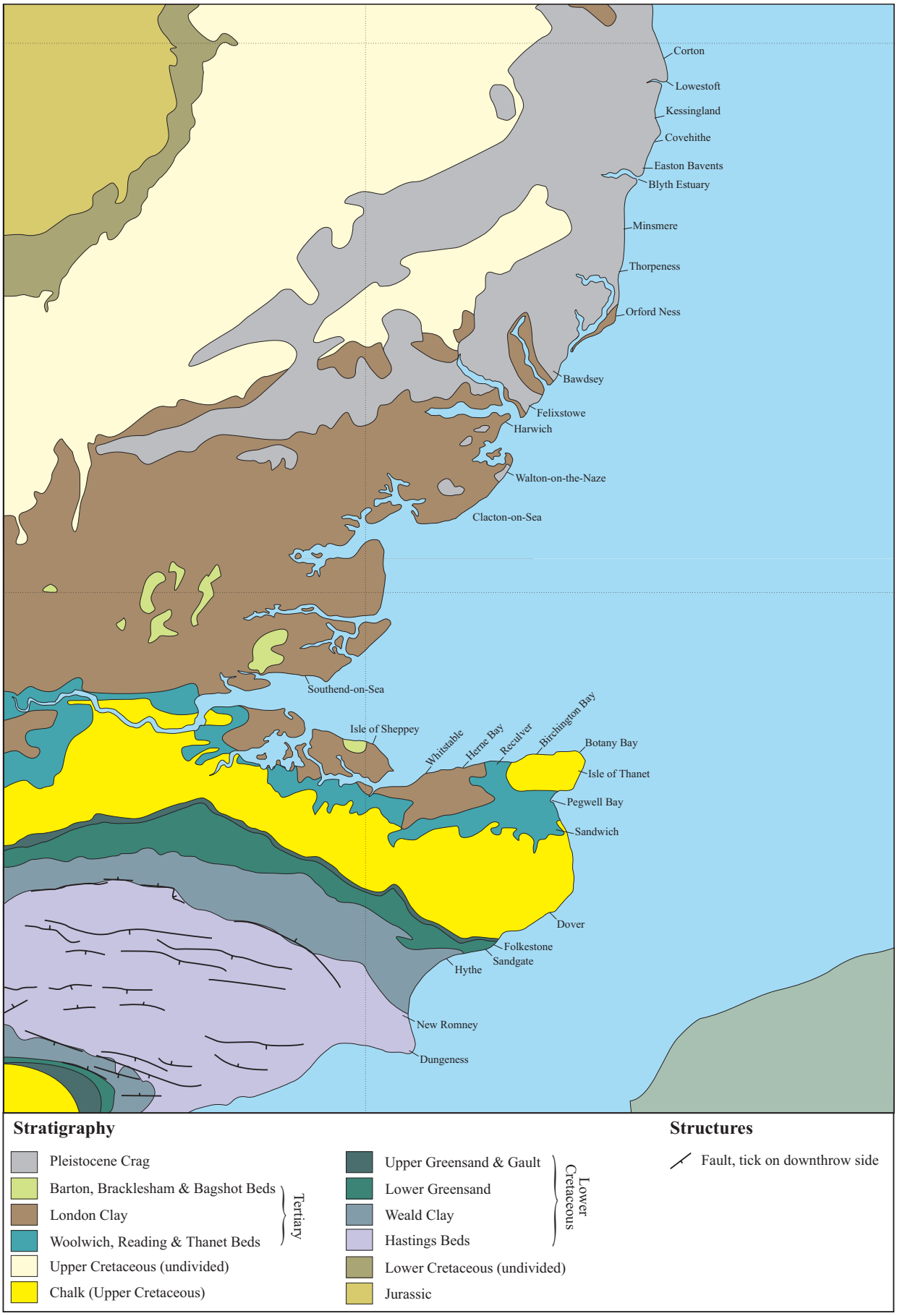
The coast of Suffolk is formed largely of Pliocene-Pleistocene 'Red Crag' formations dipping gently to the east and overlain by a drift cover of glacial tills and sands of variable thickness. Crag is an East Anglian name for the shelly sand that is so characteristic of these sedimentary rocks. Among the youngest marine rocks found in England, Crag is found only in East Anglia, so its exposures along the coast are of considerable geological interest. Between Lowestoft and Felixstowe there are cliffs up to 15 m high composed of this easily-eroded material and of other similarly unconsolidated Pleistocene sands and gravels.

The last major ice sheet (that of the late Devensian glaciation) reached no further south than the north Norfolk coast, but the earlier Anglian ice sheet (300,000 years BP) did encroach into this region. At Corton, north of Lowestoft, the exposed cliff section has been designated as the 'type section' for glacial deposits of Anglian age. It includes the Corton Formation, comprising red-brown till and sand, and the younger Lowestoft Formation, dominated by the chalky Lowestoft Till, which has a variety of pebble types and includes lenses of fluvio-glacial sand. Along the coast from

Table 2.1.1 Geological column

Era	*Period*	*Epoch*	*Age of start (million yrs)*	*Stratigraphic units mentioned in the text*	*Significant geological events*
Cenozoic	Quaternary	Holocene	0.01	Resgrave Formation Lowestoft Formation Corton Formation	Rapid rise in sea level Anglian ice sheet
		Pleistocene	1.6	'Red Crag'	Ice advances
	Tertiary (Neogene)	Pliocene	5.1	'Red Crag'	
		Miocene	25		Alpine Orogeny
	Tertiary (Palaeogene)	Oligocene	38		
		Eocene	55	London Clay	
		Palaeocene	65	Woolwich Beds Thanet Beds	
Mesozoic	Cretaceous		144	Chalk Gault Lower Greensand Weald Clay	
	Jurassic		213		
	Triassic		248		
Palaeozoic (Upper)	Permian		286		
	Carboniferous		360		
	Devonian		408		
Palaeozoic (Lower)	Silurian		438		
	Ordovician		505		
	Cambrian		590		
	Precambrian				

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



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

Lowestoft to Kessingland, Crag is overlain by Lowestoft Till.

Southwards from Kessingland the cliff line is interrupted by broad inlets such as Minsmere and the Blyth Estuary, now mostly infilled with Holocene estuarine sediments. In cliff sections at Bawdsey and Felixstowe, below the Red Crag, the most northerly outcrops of the London Clay (of Eocene age) are exposed.

Felixstowe - Reculver

The glacial drift seen in Suffolk is largely absent on this stretch of coast, as south Suffolk forms the approximate southern limit of the Pleistocene ice sheets on the east coast of England.

The coast from Felixstowe southwards to Herne Bay is underlain by gently-dipping London Clay, which occupies the core of the London Basin. In places the London Clay contains volcanic ash bands, which weather to a yellowish-grey colour: these are well exposed in the Stour Estuary at Wrabness, near Harwich. Further south, much of the coast of the Thames Estuary is low-lying, and where the London Clay is exposed, for example near Southend and on the Isle of Sheppey, it is prone to landslip. The Inner Thames Estuary is underlain by Palaeocene Thanet and Woolwich Beds (older than the London Clay) and locally chalk, although these sediments are overlain by estuarine deposits. Exceptionally, between Whitstable and Reculver, the London Clay forms cliffs up to 50 m high, characterised by mudflows and landslips.

At Walton-on-the-Naze London Clay is overlain unconformably by shelly sands of the Plio-Pleistocene Red Crag, preserved as an outlier in its most southerly occurrence.

During much of the Pleistocene the course of the Thames lay to the north of its present position and the river formed a series of terraces, covered by alluvial sediments, which now overlie much of the London Clay in Essex. The broad easterly-dipping terraces reach the coast at Clacton at a height of about 20 m to 30 m, and the associated gravel and sand deposits are termed the Kesgrave Formation. These deposits show cross-bedded channel-fill structures, with evidence of fossil soil development at some levels.

Reculver - Dungeness

Lower Tertiary and Cretaceous rocks underly this stretch of coast. They are generally well-exposed from Reculver to Hythe but are hidden under superficial deposits south-west of Hythe.

Palaeocene Thanet and Woolwich Beds underlie the London Clay and form the coastal cliffs at Reculver. The Thanet Beds comprise largely unconsolidated marine sands and silts with thin clay horizons and the basal 'Bullhead Bed' - a bed of flints enclosed within a clay matrix. The cliffs show horizontal bands of carbonate-cemented nodules, or 'doggers'. The overlying Woolwich Beds comprise coarser-grained pebbly sands.

The Isle of Thanet, between Reculver and Pegwell Bay, is an inlier of chalk resulting from minor folding within the succession. To the south, at Pegwell Bay, the softer Thanet Beds form low cliffs set back from the sea. These are capped in places with wind-blown deposits known as Brickearth.

Steeply-cliffed Upper Cretaceous chalk is exposed between Sandwich and Folkestone and forms the famous white cliffs of Dover. The cliffs mark the eastern limit of the North Downs, which form both the southern flank of the London Basin and the northern flank of the Wealden Anticline to the south. The 'hanging valleys' visible in the cliffs are an indication that they are subject to erosion, but the rate of retreat is uncertain. The North Downs chalk scarp reaches the sea at Folkestone and extends inland west of Hythe as a fossil coastline.

East of Folkestone, at Folkestone Warren, a succession of landslips has occurred where the Gault Clay underlies the chalk. This area represents the historic 'type section' for both the Gault Clay and the Folkestone Beds, which are part of the Lower Greensand. Other Lower Greensand beds form a series of low cliffs to the west of Folkestone, through Sandgate to Hythe.

From Hythe to Dungeness the alluvial deposits of Romney Marsh and the Dungeness shingles form a low-lying coast. Buried beneath these deposits, towards Dungeness, is Weald Clay of Lower Cretaceous age.

2.1.3 Structure

The two main structures of the region, the London Basin and the Wealden Anticline, meet at the North Downs, where the chalk forms both the northern scarp to the Weald and the southern limit of the London Basin. The chalk dips towards the north, briefly climbing to form the Isle of Thanet before dipping below the younger Tertiary deposits that form the London Basin. Further north the chalk starts to rise again but it is not exposed at the coast in Essex or Suffolk. The Tertiary rocks to the north and the Lower Cretaceous rocks to the south are similarly folded, with the Tertiary rocks forming a basin and the Cretaceous rocks forming an eroded anticline. This dominant structure is the result of tectonic movement associated with the Alpine Orogeny, which occurred during Tertiary times.

2.1.4 Further sources of information

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Geological information for region and the whole of Britain: 1:50,000 scale map sheets and memoirs.	Coastal Geology Group, British Geological Survey, Keyworth, Nottingham NG12 5GG, tel: 0115 936 3100.
Geological Conservation Review (GCR) sites: Suffolk	*English Nature Suffolk Team, Bury St Edmunds, tel: 01284 762218
GCR sites: Essex	*English Nature Essex, Hertfordshire and London Team, Colchester, tel: 01206 796666.
GCR sites: Kent	*English Nature Kent Team, Ashford, tel: 01233 812525

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

2.2 Offshore geology

British Geological Survey

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

2.2.1 Holocene sea-bed sediments

Sea-bed sediments are defined here as the unconsolidated sediments on the sea bed laid down since the sea transgressed across the area during the Holocene. The type and thickness of the sediments have been determined by sampling, high resolution seismic profiling and sidescan sonar. Sea-bed sediments are shown on Map 2.2.1.

The sea-bed sediments of this region are mostly relict. Carbonate gravels, which occur in the north-east part of the region, were probably reworked from Pliocene Crag deposits similar to those that outcrop onshore in north-east Essex and Suffolk. In the Thames Estuary the sea-bed sediments were derived by the erosion of beach gravels and fluvial terrace deposits (which mark the ancient courses of the Rivers Thames and Medway) or else from the erosion of underlying Tertiary deposits. In the Straits of Dover, flints and chalk pebbles were sourced from the Upper Cretaceous bedrock.

Offshore sediments are generally thin in the region, apart from the sandbanks located in the Thames Estuary. The Thames Estuary is a region of strong tidal currents, which have moulded the mobile sea-bed sediments into large sandbanks aligned approximately parallel to the coast, most of the intervening sea-floor being covered by winnowed 'lag' deposits. The sandbanks or sandwaves in the Thames Estuary area form a complex array and vary in size: sandwaves may reach 16 m in height, with wavelengths varying from 50 m to 500 m. In the mouth of the estuary large sandbanks are exposed at low tide, separated by narrow scoured channels. Narrower, linear banks oriented approximately north-south occur in deeper water north of the Dover Straits.

A discontinuous belt of gravel and sandy gravel extends offshore from Aldeburgh in Suffolk to the vicinity of Clacton-on-Sea in Essex. Shell fragments and whole shells may constitute 30% or more of the gravel fraction off the coast of Suffolk. More than 90% of the gravel fraction in the outer Thames is composed of flint, although quartzite, phosphorite, sandstone and carbonate pebbles are locally abundant.

Around the margins of the major estuaries, Holocene mudflats occur, with saltmarsh or sand forming the upper beaches. The muds often contain fragmented shell material.

2.2.2 Pleistocene geology

In the north of the region early Pleistocene deposits (Map 2.2.2) comprise shelly grey marine sands with thin silt layers of the Red Crag Formation, and grey marine clays and fine-grained sands of the Westkapelle Ground Formation (equivalent to the upper parts of the Red Crag Formation onshore). Early to Middle Pleistocene deposits comprise fluviatile or estuarine fine- and medium-grained sands with clay laminae and flint pebbles of the Yarmouth Roads Formation. A tongue of Late Pleistocene sediments extends down into the region from offshore Norfolk (the Brown Bank Formation). These sediments are laminated silty clays and fine sands, deposited in estuarine or fluviatile environments.

During the early Pleistocene the course of the River Thames was located north of the present estuary, resulting in terrace sands and gravels being deposited across southern and eastern Essex. During the Anglian glaciation the route of this ancient River Thames was blocked by ice, and the River Thames was diverted southwards, following several different courses over time as a result of convergence with early courses of the Rivers Medway and Stour. The Quaternary deposits confined to channel courses (Map 2.2.2) are the product of deposition within the ancient courses of this 'fossil' drainage network. Similar palaeovalleys also occur within the Straits of Dover, offshore from Dungeness.

2.2.3 Solid (Pre-Quaternary) geology

Rocks formed before the start of the Quaternary Period (1.6 million years BP) are included by geologists in the category of 'solid geology'. Offshore, most solid geology in Region 7 (Map 2.2.3) is concealed by sea-bed sediments and palaeovalley infill sediments, but isolated outcrops do occur at the sea bed.

Pliocene Crag deposits, consisting of bioclastic limestones and shelly sandstones deposited under strong tidal conditions in sandbanks and outer estuarine environments, occur off the Suffolk coast. Much of the Thames Estuary is underlain by the Eocene London Clay Formation, a monotonous sequence of mudstones with occasional beds of phosphatic and carbonate nodules, and volcanic ash bands. Other Palaeogene formations are thinner, with varied sedimentary rocks occurring offshore of Clacton and Harwich. A broad belt of Upper Cretaceous chalk with flint bands underlies the Straits of Dover, passing westward into Lower Cretaceous sediments.

2.2.4 Further sources of information

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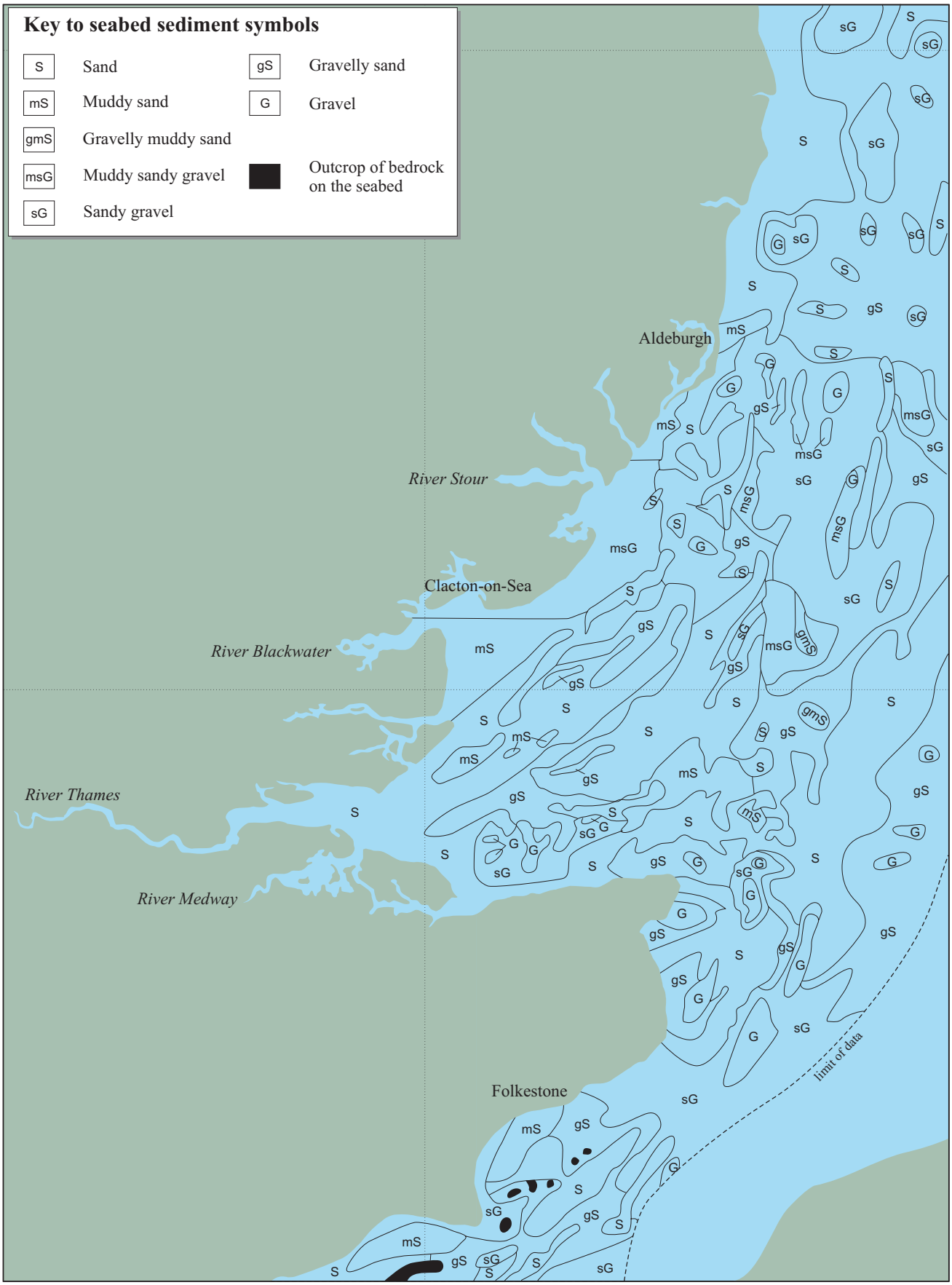
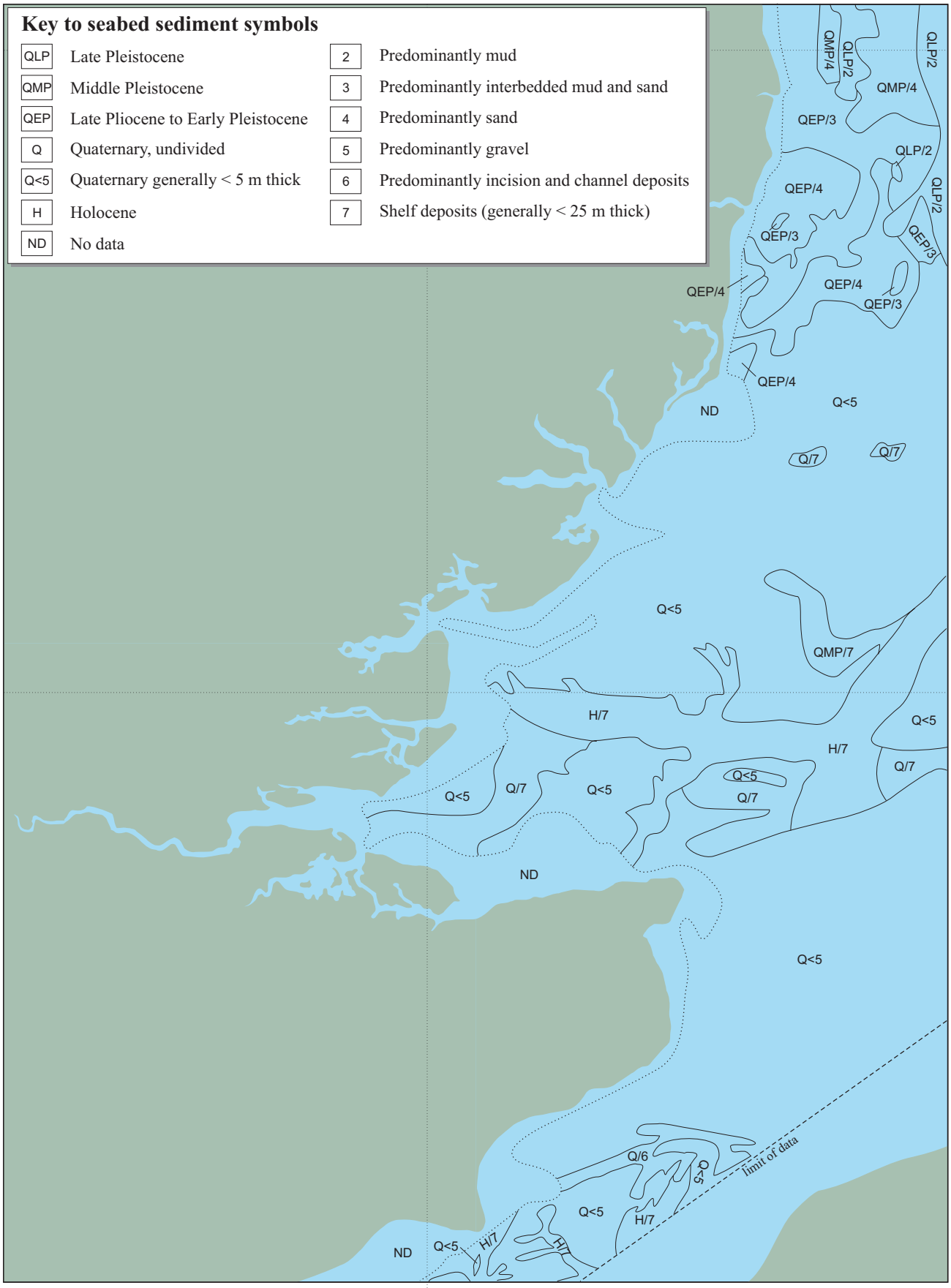


Map 2.2.1 Sea-bed sediments. Source: British Geological Survey (1987); sediment classification modified after Folk (1954).



Map 2.2.2 Offshore Pleistocene deposits. Source: Holmes *et al.* (1993).

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

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D. Contact names and addresses

Type of information	*Contact address and telephone no.*
Geological information for region and the whole of Britain	Coastal Geology Group, British Geological Survey, Keyworth, Nottingham NG12 5GG, tel: 0115 936 3100
UKDMAP 1992. Version 2. United Kingdom digital marine atlas. Oceanographic maps.	*British Oceanographic Data Centre, Birkenhead, tel: 0151 653 8633

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

2.3 Wind and water

British Geological Survey, D. Dales & K. Gilbert

2.3.1 Wind

Compared with other parts of the UK coastline, this region is relatively sheltered from strong winds (wind speeds exceed 15-16 m/s for only 0.1% of the time, compared with more than 18 m/s for 0.1% of the time in northern and western Britain). Under normal conditions wind speeds are similar to those over most of the UK coast, exceeding about 3.5 m/s for 75% of the time, consistently stronger than inland. Maps 2.3.1 and 2.3.2 show contours of the hourly wind speed values exceeded for 75% and 0.1% of the time respectively. Local topography can have a marked effect on local wind conditions, although gales occur throughout the region. In the north of the region and in the Thames Estuary the coast can be severely affected by easterly storms, which are most frequent from January to March, while strong northerly winds cause severe conditions along the north Kent coast. In the English Channel the form of the coastline diverts winds so that they tend to blow from either the south-west or the north-east, and during strong winds the Dover Strait can become very rough. Figure 2.3.1 shows the frequency of winds from different directions at Felixstowe and Margate.

2.3.2 Water depth

The morphology of the sea bed is influenced by the nature of its bedrock, the exposure of the area to wave attack and the supply of mobile sediment. Much of the inshore part of the region has shallow water, rarely exceeding 10 m in depth,

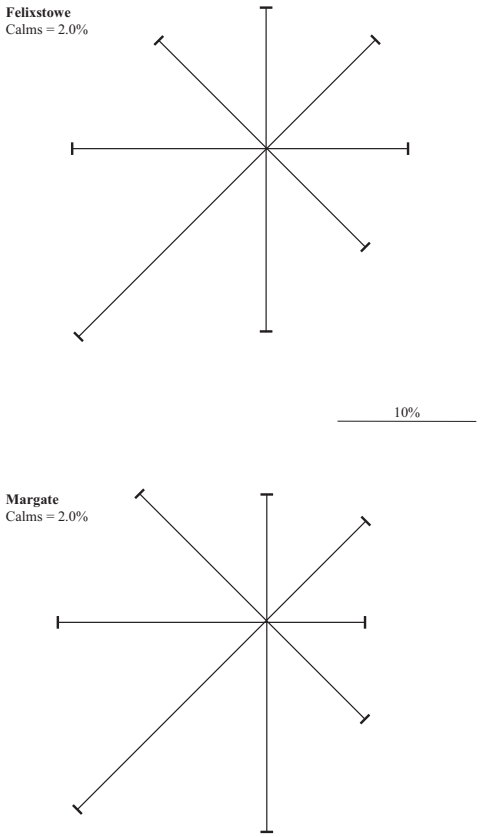
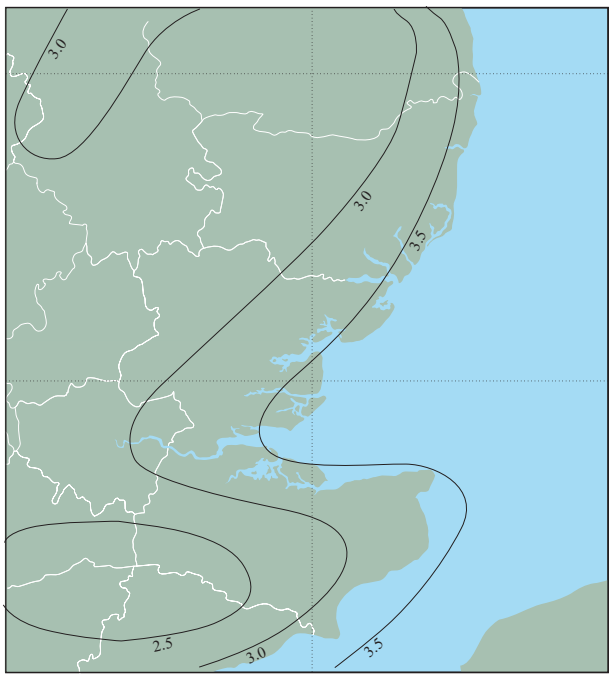
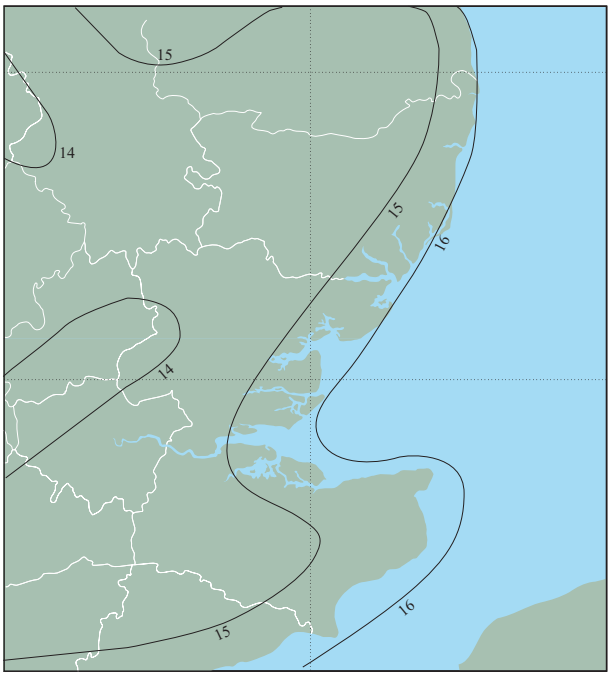


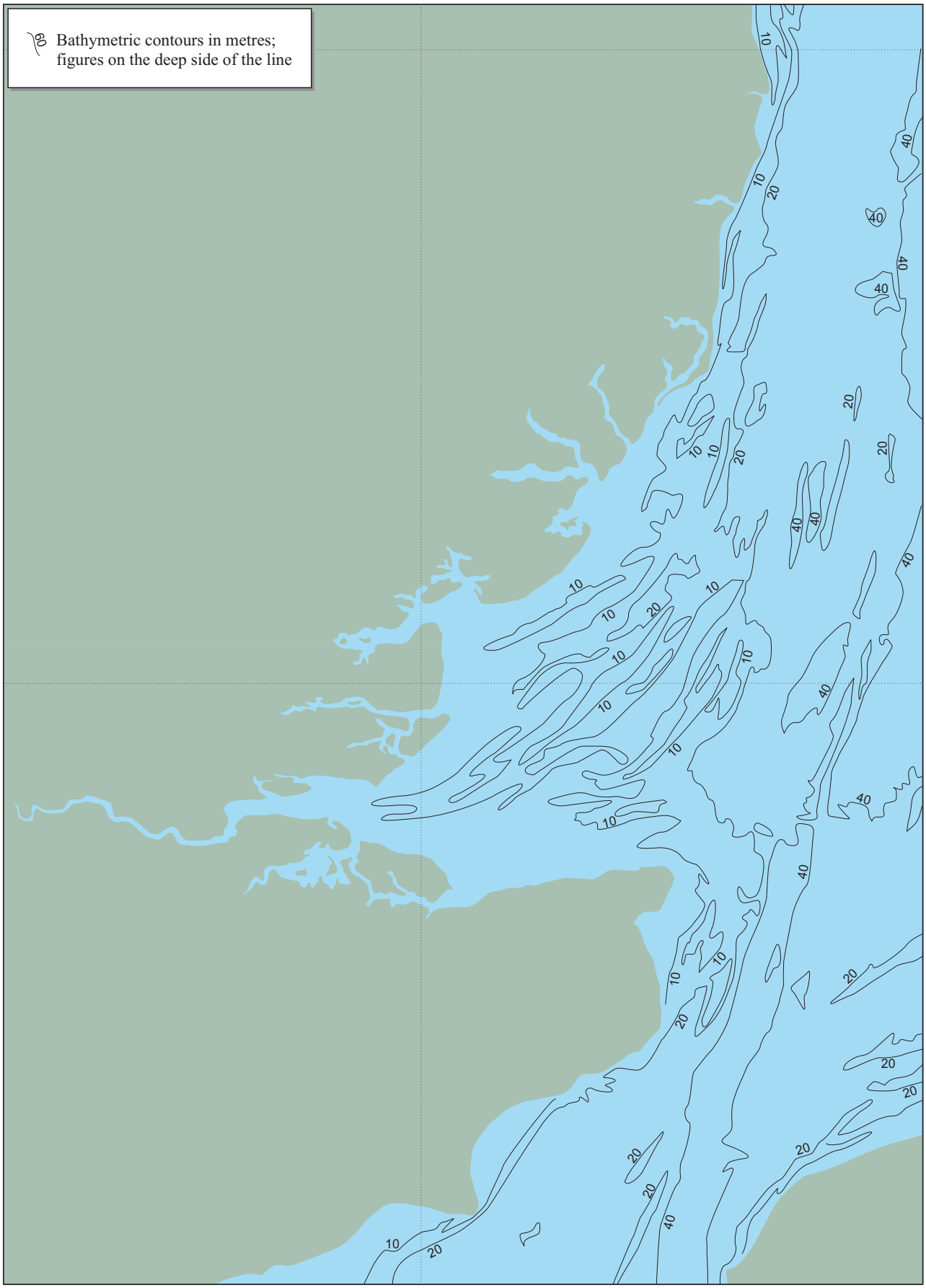
Figure 2.3.1 Frequency of wind directions at Felixstowe and Margate. Source: Hydrographic Department (1985).



Map 2.3.1 Hourly mean wind speed (in m/s) exceeded for 75% of the time: 1965-1973. Source: Caton (1976).



Map 2.3.2 Hourly mean wind speed (in m/s) exceeded for 0.1% of the time: 1965-1973. Source: Caton (1976).



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

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

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

although there are variations over both distance and time, reflecting the presence and movement of sand banks (Map 2.3.3). The outer Thames Estuary is an area of shallow water, generally less than 20 m, with a complex pattern of bathymetric contours aligned more or less parallel to the coast, reflecting the occurrence of sandbanks on the estuary floor. In the Dover Strait, water depths increase from the coasts of England and France to more than 40 m in the centre of the strait.

2.3.3 Tidal currents

Inshore tidal streams vary greatly, depending on the form of the coastline and the nearshore bathymetry (Map 2.3.4). Tidal currents over estuarine bars in Suffolk, for example in the River Alde and River Deben, can be relatively fast. In the Thames Estuary tidal current velocities reflect the increasing influence of the flood tide with distance upstream. This is partly due to the relationship of the dredged navigation channel to the overall channel width. Where the dredged channel forms a relatively deep, narrow channel there is a rapid advancement of flood crest and an increase in flood-dominance, causing a net sediment drift to landward. The effect of dredging has thus been the creation of an artificial sediment sink in the estuary, with sediments deposited from both marine and fluvial sources. Tidal current speeds in the eastern English Channel increase in the Straits of Dover, owing to the restriction of the channel and the presence of tidal sand ridges aligned with the direction of flow. The maximum speed of tidal streams at Dover is about 1.75 m/s.

2.3.4 Tidal range

Map 2.3.5 shows the tidal ranges at mean spring tides. Off the East Anglian coast the tidal stream floods south and ebbs north, with a weak south-flowing residual current. The range at Lowestoft is 2.0 m, increasing southwards to a range of 4.0 m in the outer Thames Estuary. Shallow water conditions amplify the tidal wave as it approaches the coast. The Thames is a macrotidal estuary with a tidal range at mean spring tide of 4.5 m at its mouth, increasing to 5.9 m inland.

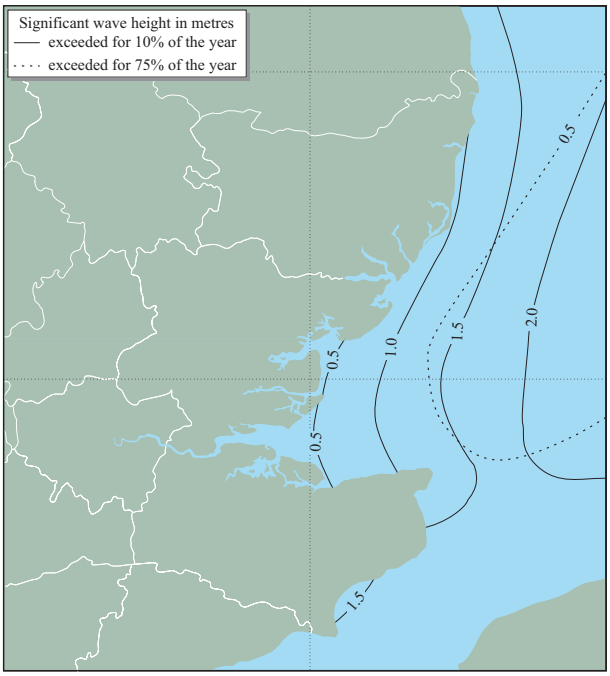
The greatest tidal ranges occur in estuaries and narrow channels where the natural period of oscillation is close to the tidal period of 12 hours 25 minutes. The eastern English Channel and the Straits of Dover, where the tidal range reaches 7.0 m, are an example of this.

Tidal conditions can be changed by fluctuations in atmospheric pressure, which can either raise or lower the water levels. Tidal surges of raised water levels occur fairly frequently in the North Sea and increase in height towards the south. The expected maximum 50-year surge between the Blackwater and Thames Estuaries is 2.5 m above normal tides, with similar levels elsewhere along the Suffolk and Essex coasts. The maximum 50-year surge levels along the east coast of Kent are 2.25 m at Ramsgate, falling to 2 m at Dungeness. If these surges coincide with high water spring tides, extreme wave conditions arise, which can cause problems along stretches of coast susceptible to flooding or erosion.

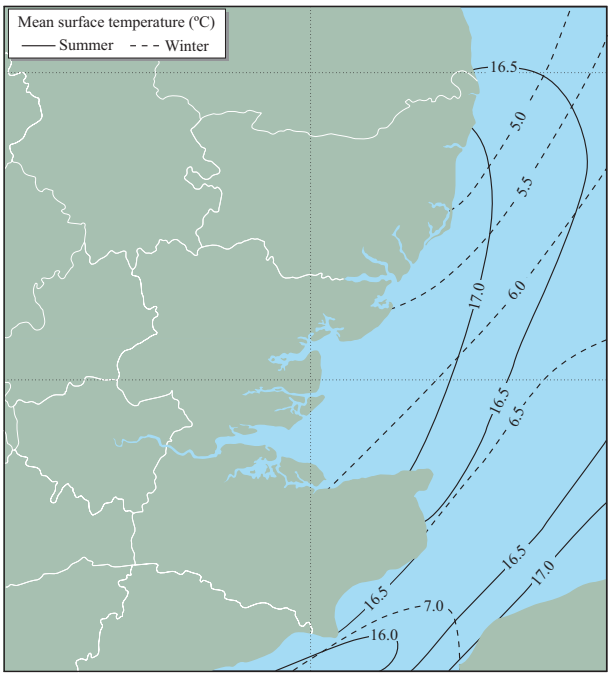
2.3.5 Wave exposure and sea state

In this region there are large variations in local wave conditions because of the complex sea bed morphology and the local currents. The estuaries of Suffolk have many sheltered inlets. Most of the Thames Estuary is relatively sheltered, but the north coast of Kent is exposed to north-easterly winds and waves.

Map 2.3.6 shows the significant wave heights that can be expected to be exceeded for 10% and 75% for the year. For example, the significant wave height near Orford Ness is 1 m or more for 10% of the year and approximately 0.5 m or more for 75% of the year. The significant wave heights in this



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



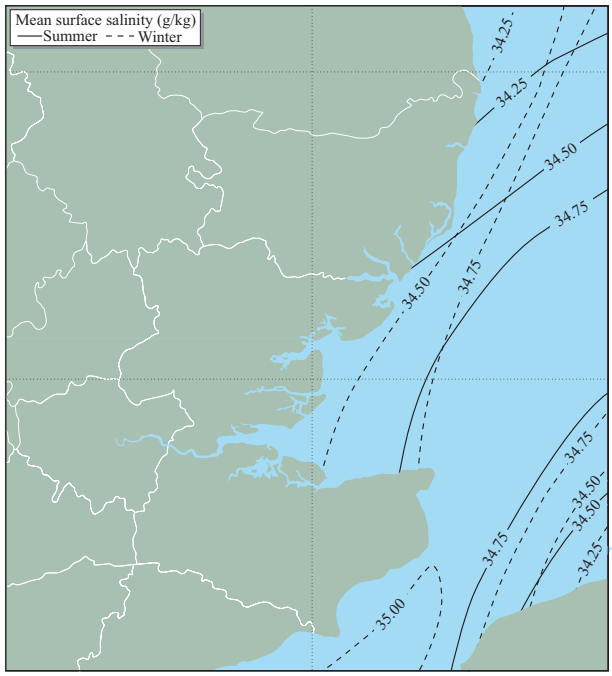
Map 2.3.7 Mean surface water temperature in summer and winter (°C). Source: Lee & Ramster (1981). © Crown copyright.

region, particularly in the Dover Strait, are some of the lowest values for open water in the British Isles, comparable with the sheltered North Channel between Northern Ireland and south-west Scotland.

2.3.6 Water characteristics

Water temperature

The mean sea surface temperatures for summer and winter



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

are shown on Map 2.3.7. The data are for August and February, the months of highest and lowest average sea temperatures. Significant variations in temperature occur across this region, especially in winter, when average sea surface temperatures increase progressively to the south-east. A wedge of relatively warm water extending up from the English Channel prevents water temperatures in this region dropping below 5°C under the cooling influence of the European continent during the winter season. In summer temperatures are more uniform, but the water is warmest in the Greater Thames Estuary.

Salinity

The salinity of the sea water off the coast of Region 7 is slightly below that of oceanic water (which has around 35.5 g/kg salt), owing to the mixing of Atlantic water with low-salinity coastal waters (Map 2.3.8). The mean surface salinity values for summer and winter shown are based on data for August and February respectively. Data are averaged for each month, which has the effect of smoothing out the salinity gradients in some areas. In both summer and winter salinity increases southwards down the coast of East Anglia from less than 34.25 g/kg to 34.75 g/kg.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
UKDMAP (United Kingdom digital marine atlas) Version 1. Oceanographic maps.	*British Oceanographic Data Centre, Birkenhead, tel: 0151 653 8633
Monthly, seasonal and annual windroses	Meteorological Office Marine Enquiry Service, Johnstone House, London Road, Bracknell RG12 2SY, tel: 01344 854979

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

The southward tidal current off the Suffolk coast carries a heavy burden of sand and shingle eroded from the soft cliffs. This house is temporarily protected by the remains of old cliff protection works, which break the power of the waves, and a groin parallel to the cliff, which retains sediment at its foot. Photo: Peter Wakely, English Nature.

2.4 Sediment transport

British Geological Survey, D. Dales & K. Gilbert

2.4.1 Introduction

Sediment transport is described within the context of coastal cells and sub-cells. These divide the coastline into sections within which sediment erosion and accretion are inter-related and largely independent of other cells (Motyka & Brampton 1993). Boundaries between sediment cells are usually either littoral drift divides or sediment sinks. Sub-cells are defined on the basis of lesser differences in the sediment transport regime within cells. Littoral drift divides usually occur at a point where the orientation of the coast changes abruptly and the beach material moves away from the point on both sides. Sediment sinks are points at which sediment transport paths meet, and so beach material tends to build up, usually in sheltered areas such as bays, tidal inlets and estuaries.

In this region there are parts of two coastal cells (Map 2.4.1): that from the Wash to the Thames (of which two sub-cells lie in the region) and that from the Thames to Selsey Bill (of which two sub-cells and part of a third lie in the region). Note that the sediment transport shown is of sand and gravel 'bed load', not suspended sediments.

Sub-cell 3c: Lowestoft - Harwich

The littoral drift is southward, with high sand transport and moderate shingle transport. Both waves and tidal currents play an important role in coastal change in this sector. Waves transport material southwards from eroding cliffs, providing an important sediment supply for downdrift beaches, and offshore banks are formed by tides. Coastal processes are complicated by the tidal flows at the mouths of the Deben, Orwell and Stour Estuaries.

In the north of the sub-cell there is cliff erosion at Covehithe, Easton Bavents and Dunwich. Accretion occurs at Benacre Ness and between Thorpeness and Aldeburgh. South of Aldeburgh and between Felixstowe and Landguard Point beach erosion is prevalent.

Sub-cell 3d: Harwich - Canvey Island

There is moderate southward littoral drift from the Naze to Colne Point, and from there low southward drift to the Thames. The river mouths in this sub-cell break up the coast into many small sediment transport units. Tidal currents appear to be active in the seaward dispersal of silts and muds eroded from the land.

The decline of the beaches between Walton-on-the-Naze and Jaywick can be attributed to the poor supply of sand and shingle from the north, as this material appears to be swept seawards into the approaches to Harwich Harbour. There is cliff erosion at Walton-on-the-Naze, beach erosion between the Naze and Colne Point and a general decline of saltmarshes in Hamford Water and to the south of the River Blackwater. Maplin Sands and other intertidal banks are probably accreting, but the erosion of the soft coast provides little beach-building material.

Sub-cell 4a: Isle of Grain - North Foreland

There is moderate, uni-directional westward drift which rapidly diminishes in strength west of Whitstable. There is no significant beach accretion and because of the inadequate supply of sand and shingle there is widespread beach erosion. Wave-induced erosion is widespread, with cliff slippage at the Isle of Grain, the Isle of Sheppey and at the east end of Herne Bay.

Sub-cell 4b: North Foreland - Dover Harbour

In Thanet the generally low rate of southward drift is due to rocky headlands interrupting the drift. Further south there is moderate northward shingle transport between Kingsdown and the entrance to the River Stour. Tidal currents bring in sand and silt as suspended load into Pegwell Bay, and transport sand in small quantities across Sandwich Bay to North Foreland. There is no perceptible sediment movement around South Foreland.

The only accretion is sand and silt build-up on the intertidal flats in Pegwell Bay. Erosion is limited to chalk cliff recession at a slow rate in Thanet and shingle ridge recession between Deal and Kingsdown.

Sub-cell 4c: Dover Harbour - Beachy Head

This is a large sub-cell where there is a general continuity in shingle drift. There is moderate eastward transport of sand and shingle by the dominant south-westerly waves, with local reversal on the east face of Dungeness foreland. As a result of offshore losses at Dungeness the coastline to the east is suffering from a deficit of beach material supply.

Dungeness is a major natural accretionary feature, although erosion is prevalent over the major part of this sub-cell, with coastal defences and harbour works affecting the littoral drift.

2.4.2 Acknowledgements

Thanks go to the following for comments on the draft: Kathy Kennedy (English Nature), Mark Tasker (JNCC) and David George (Natural History Museum).

2.4.3 Further sources of information

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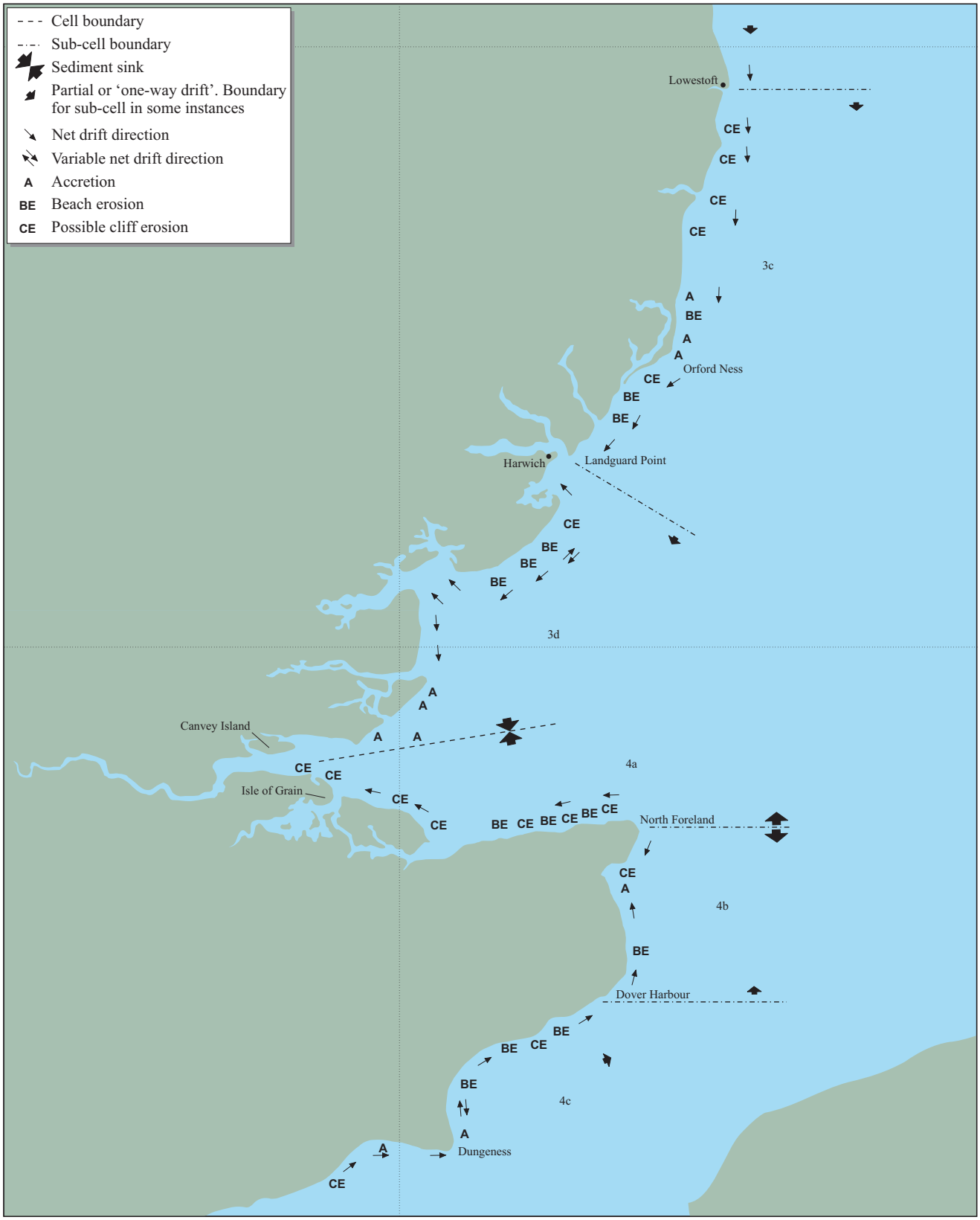

Map 2.4.1 Sediment transport and coastal cells (as numbered). Source: Motyka & Brampton (1993).

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Coast protection policy; sediment cells	*Ministry of Agriculture, Fisheries and Food (MAFF), Flood and Coastal Defence Division, London, tel: 0171 238 3000
Review of erosion, deposition and flooding in Great Britain (maps and database)	Minerals Division, Room C15/19, Department of the Environment, 2 Marsham Street, London SW1P 3EB, tel: 0171 276 0900
Sediment cells	HR Wallingford Ltd., Howbury Park, Wallingford, Oxfordshire OX10 8BA, tel: 01491 835381

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

2.5 Sea-level rise and flooding

British Geological Survey, D. Dales & K. Gilbert

2.5.1 Sea-level changes in the region

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

There is general agreement that relative sea levels are rising in this region. Shennan (1989) suggests a crustal subsidence rate of between 0.5 mm/year and 2.0 mm/year for the region. This subsidence, when combined with the current global rise in sea level, produces a net rise in sea level along the coast of 2-4 mm/year. As shown on Map 2.5.1, Emery & Aubery (1985) indicate a zero rate of relative sea level rise at Lowestoft, increasing to 4 mm/year at Dungeness. Woodworth (1987) using tidal data measured at Sheerness, shows there to be a relative sea level rise of 1-3 mm/year (Map 2.5.1). The Ministry of Agriculture, Fisheries and Food advise a predicted relative rate of sea-level rise of 6 mm/year in the region (MAFF pers. comm.).

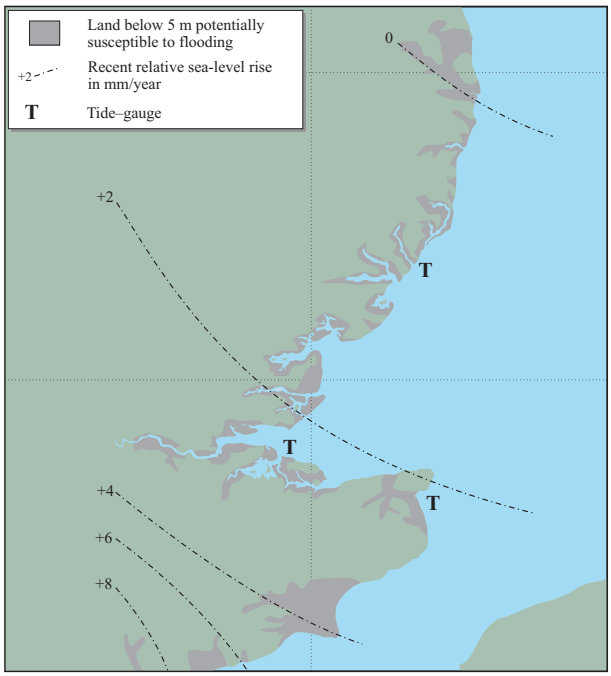
2.5.2 Flooding risk in the regions

The combination of rising relative sea levels and the storm surges caused by weather conditions in the North Sea means that a large proportion of this region is potentially at risk from flooding. The banks of most estuaries are susceptible to flooding (Map 2.5.1), and widespread sea defences protect low-lying land at such places as Lowestoft, Felixstowe, Ipswich, Colchester and the Thames Estuary. The low ground levels on the landward side of the Thames defences mean that a breach could flood a considerable area of the adjacent land, and the gradual narrowing of the Thames Estuary over the years as the tidal flood plain has been enclosed, developed and defended has raised water levels in times of high flow or high tide. The Thames Barrier and its associated tidal defences were built in response to this combination of circumstances. They were the most expensive and significant sea defence project every undertaken in the region and were designed to protect London from storm surges of a height that is expected to occur only once in 1,000 years.

Areas to the south of the River Thames at risk from flooding include much of the Isle of Sheppey, parts of north-east Kent and the marshes behind Dungeness.

2.5.3 Acknowledgements

Thanks go to Kathy Kennedy (English Nature) for comments on the draft.



Map 2.5.1 Areas below 5 m above OD and thus susceptible to flooding, and estimated rates of recent relative sea-level rise. Source: OS Landranger maps and after Emery & Aubrey (1985).

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Flood and coastal defence policy (see also section 8.4)	*Ministry of Agriculture, Fisheries and Food (MAFF), Flood and Coastal Defence Division, London, tel: 0171 238 3000
Review of erosion, deposition and flooding in Great Britain (maps and database)	Minerals Division, Room C15/19, Department of the Environment, 2 Marsham Street, London SW1P 3EB, tel: 0171 276 0900
Tide gauge data	*British Oceanographic Data Centre, Birkenhead, tel: 0151 653 8633

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

2.6 Coastal landforms

British Geological Survey & J. Sawyer

2.6.1 Description

The coast of this region is generally low-lying, characterised by mudflats, shingle bars and beaches, extensive saltmarshes and embanked grazing marshes, while the cliffs, with the notable exception of the chalk cliffs of Kent, are mostly low and prone to erosion. Broad estuaries and alluvium-filled river valleys reach many kilometres inland. The coastal hinterland varies from the sandy heaths of Suffolk to the low-lying marshes of Essex. Chalk cliffs ring the Isle of Thanet. South-west of the cliffs of Dover and Folkestone Warren lies the major shingle structure of Dungeness and the grazing marshes of Romney and Walland Marshes. Major coastal landforms are shown on Map 2.6.1.

Map 2.6.1 Major coastal landforms.

Lowestoft - Felixstowe

Lowestoft's sandy beaches are backed by a long urban frontage. To the west of the town the broad, alluvium-filled valley of the Waveney approaches the coast behind Oulton Broad before turning north to join the River Yare at Breydon Water. South of Pakefield the beach sediment becomes shingly and there are stretches of low cliff with a narrow beach at Kessingland, Covehithe and Easton, between the sections of lower coastline at Kessingland Level, Benacre Broad, Covehithe Broad and Easton Broad. At Kessingland there is a shingle ness. Parts of this coast, where the cliffs are formed of crag and glacial deposits, are undergoing rapid erosion.

Beyond Southwold and Walberswick, where the River Blyth reaches the sea through a narrow channel, a long shingle beach stretches to Dunwich, backed by marshes and reedbeds which mask old river courses. Coastal erosion, longshore drift and human modification have changed the configuration of the channels over the centuries, and Dunwich, one of the largest cities of medieval England, has all but disappeared. Cliffs at Dunwich Heath give way to shingle at Minsmere, where low-lying land behind the beach forms Minsmere RSPB reserve, with its reedbeds and wetlands. Shingle continues to Sizewell, Thorpeness and Aldeburgh, where the shingle spit of Orford Ness has diverted the Alde/Ore river system 17 km to the south, joining it up with the River Butley.

The same southward movement of sand and gravel along the shoreline has led to the formation of spits at the mouths of the Deben and Orwell/Stour Estuaries, sheltering the marshes on both sides of the Deben Estuary and at Trimley on the Orwell. There are low cliffs at Bawdsey and sand and shingle beaches at Felixstowe.

Felixstowe - Southend

Between Felixstowe and Harwich are the Orwell and Stour Estuaries, which, like the Deben and other estuaries further south such as the Colne, Blackwater and Crouch, reach deep into the low-lying East Anglian countryside. The Orwell Estuary is tidal to Ipswich, more than 15 km inland, while the Stour is of similar length but greater area, with extensive mudflats at low tide and sandflats near the mouth at Harwich. South of Harwich lies the wide, shallow, sheltered embayment of Hamford Water, which has large areas of saltmarsh and mudflats. It is sheltered by the headland of the Naze, which has low eroding cliffs of Red Crag overlying London Clay.

Beaches at Frinton-on-Sea and Clacton-on-Sea, backed at Clacton by low cliffs of Pleistocene interglacial deposits, give way at Colne Point to the mudflats and saltmarsh characteristic of sheltered estuarine conditions. The Colne Estuary is a large and complex system that includes many smaller channels and creeks, for example at Brightlingsea, Fingringhoe and around Mersea Island. Its mouth is adjacent to that of the Blackwater Estuary, a wide inlet formed, like others on this section of coast, in a river valley that was deepened and widened during the low sea levels that accompanied the late Devensian glaciation, but which has remained unfilled with sediment. There are extensive mudflats in the upper part of the Blackwater Estuary, and even larger areas along the shore between the Blackwater and the Crouch, as well as extensive offshore mud and sand banks. Along this comparatively featureless and remote coastline, where long embankments protect farmland from the sea, there is a 2-3 km wide strip of intertidal mud, while at Foulness and Maplin Sands, to the south of the long, narrow estuary of the River Crouch, the width of intertidal mudflats is over 5 km. The River Roach and its tributaries form a maze of creeks enclosing the islands of Foulness, Wallasea, Havengore, Potton and others. Long stretches of man-made embankments line the creeks, dividing mudflat and saltmarsh from grazing marsh and arable land.

Southend - Thanet

Shoeburyness may be said to mark the start of the Thames Estuary channel, with its associated residential and industrial development, making for an almost entirely man-made

coastal landscape. There are riverside marshes at Mucking and East Tilbury, and on the south side of the Thames small areas of marsh remain at Erith, Dartford and Swanscombe, and much larger areas, fronted by wide mudflats, between Gravesend and the Isle of Grain, which marks the outer limit of the Medway Estuary.

The River Medway is tidal up to the outskirts of Maidstone but is relatively narrow until it reaches Gillingham, where it opens out to form a wide, shallow basin with many islands and large areas of saltmarsh, before reaching its relatively constricted mouth at Sheerness. The tidal channel of the Swale separates the Isle of Sheppey from the mainland. Sheppey has low relief on its south side, but soft, slumped cliffs of up to 40 m height on the north. Sheerness has a sandy beach but elsewhere the intertidal zone is mainly formed of mud.

East of Sheppey, as the coast becomes less sheltered, the intertidal zone narrows to a strip of mixed sediments at Whitstable, where there are more cliffs of London Clay. From Reculver as far as Minnis Bay low-lying land marks the position of the Wantsum Channel, which, together with the channel now occupied by River Stour, used to isolate the Isle of Thanet. Much of the Thanet coast, from Birchington around to Cliffs End, Pegwell Bay, consists of low but vertical chalk cliffs, fronted by a wave-cut rock platform. Sea stacks and arches have formed in places such as Birchington and Botany Bay.

Pegwell Bay - Dungeness

To the south there are sandy beaches and mudflats around Pegwell Bay, where the mouth of the River Stour is deflected northwards by a series of curved spits, formed by tidal currents and covered in part by sand dunes. The sand and shingle beaches reach Deal, where the chalk cliffs start to rise once more behind a shingle beach, which becomes a rocky foreshore at Kingsdown. East of Dover the cliffs are sheer and reach a maximum height of about 80 m. The occurrence of the Gault Clay at the coast near Folkestone makes the area prone to landslip. The largest and most famous of these slips is Folkestone Warren, which forms the coast for some 5 km to the north-east of the town. This area has a long history of movement. West of Hythe the old shoreline heads inland, while the present coast curves southwards towards the prominent shingle foreland of Dungeness. The coast is low-lying, with sand and shingle beaches, behind which are the low-lying grazing marshes and arable land of Romney Marsh and Walland Marsh, formed by the human-assisted silting up of marshy and intertidal land in the lee of the accumulating shingle. Dungeness is a shingle foreland of international importance, whose flint shingle ridges stretch around the coast for 37 km and are still prograding.

2.6.2 Acknowledgements

Thanks are due to the following for comments on the draft: Kevin Page (English Nature) and Jeremy Hindle (Suffolk County Council).

2.6.3 Further sources of information

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B. Contact names and addresses

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

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

Shakespeare Cliff, where the Channel Tunnel emerges, is home to many rare and scarce terrestrial invertebrates. However the foreshore itself has changed dramatically since the tunnel's construction. Before, the shoreline had supported a wide range of marine plants and animals, but thousands of tonnes of mined rock were dumped behind a retaining wall here between 1987 and 1990, obliterating wildlife communities. Photo: Peter Wakely, English Nature.

Chapter 3 Terrestrial coastal habitats

3.1 Cliffs and cliff-top vegetation

Dr T.C.D. Dargie

3.1.1 Introduction

The coast of Suffolk, Essex and Kent contains a moderate length of cliff but has only a limited area of cliff and cliff-top habitats. Total cliff length in the region is 61 km (Table 3.1.1; Map 3.1.1), which represents 1.5% of the British resource and is therefore of modest importance in the national context. The most distinctive cliff types are consolidated (hard cliffs developed from resistant bedrock) and unconsolidated (soft cliffs developed in easily-eroded, predominantly Quaternary - Pleistocene and Holocene - deposits). The total extent of soft cliff in the region is moderately large (21 km) and represents a significant proportion (>8%) of this cliff type in England.

Geology and geological structure, together with past environmental history (past and present marine erosion and glacial processes) determine cliff form. Sea cliffs are generally steep slopes (>15°), but they can show great diversity of form, from very tall vertical or near-vertical cliff faces, through long, steep slopes with a vertical face restricted to the base, to low cliffs with a great variety of local slope forms, sometimes above an intertidal rock platform. Cliffs in this region are mostly either high, vertical cliffs, as in Kent, or low, non-vertical types, found mainly in Suffolk (Table 3.1.2).

The soils and vegetation of cliffs and cliff-tops are closely related to slope angle, soil type and salt spray deposition, with much local variation possible with changing exposure around headlands. The major natural and semi-natural cliff and cliff-top habitats in Great Britain are bare ground, spray-zone lichen-covered rock, rock crevice, cliff-ledge, sea-bird colony, perched saltmarsh, maritime grassland and maritime heath. Seabird colony, perched saltmarsh and maritime heath are absent or rare in the region. The full regional extent of cliff-top habitat has not been surveyed but the (albeit infrequent) exposure of the coast to very strong winds and heavy spray deposition probably allows only maritime grassland to develop, with most of this restricted to hard cliffs. Soft cliffs on sheltered coasts can develop an undercliff vegetation of scrub, tall herbs and rank grassland, often very close to the sea. Significant undercliff vegetation in the region is restricted to Folkestone Warren (Kent). The general absence of undercliff vegetation in the region is due to rapid erosion and removal of debris from the stretches of soft unprotected coast. Such cliffs are dominated by glacial till and fluvioglacial materials, which have a short cycle of four to five years

Map 3.1.1 'Hard' and 'soft' cliffs. Source: JNCC Coastal Database and OS Landranger maps.

Table 3.1.1 Cliff and maritime cliff grassland resource in context

	Soft cliffs		*All cliffs*		*Maritime cliff grassland*	
	Total length (km)*	*% of total in Region 7*	*Total length (km*)*	*% of total in Region 7*	*Area (ha*)*	*% of total in Region 7*
Suffolk	11	52.4	18	29.5	12	13.2
Essex	1	4.8	3	4.9	5	5.5
Greater London	0	0	0	0	0	0
Kent	9	42.9	40	65.6	74	8.1
Region 7	***21***	***100***	***61***	***100***	***91***	***100***
England	256	8.2	1,165	5.2	1,895	5
North Sea Coast	n/k	n/k	1,759	3.5	n/k	n/k
GB	n/k	n/k	4,059	1.5	n/k	n/k

Source: JNCC Coastal Database; Pye & French (1993) (soft cliff and maritime cliff grassland). Key: *to the nearest whole km/ha; n/k = not known.

Table 3.1.2 Lengths of cliff types

	Vertical >20 m height		*Vertical <20 m height*		*Non-vertical >20 m height*		*Non-vertical <20 m height*	
	Length (km)*	*% of total length in Region 7*	*Length (km*)*	*% of total length in Region 7*	*Length (km*)*	*% of total length in Region 7*	*Length (km*)*	*% of total length in Region 7*
Suffolk	0	-	0	-	2	-	16	-
Essex	0	-	0	-	1.5	-	1.5	-
Kent	18	-	7	-	13.5	-	1.5	-
Region 7	***18***	-	***7***	-	***17***	-	***19***	-
England	320	5.6	49	14.3	629	2.7	167	11.4
North Sea Coast	601	3.0	380	1.8	559	3.0	261	7.3
Great Britain	1,325	1.4	818	0.9	1,371	1.2	545	3.5

Source: JNCC Coastal Resources Database. Key: *to the nearest whole km.

between cliff failure, removal of material by erosion, cliff steepening and further failure (Pethick 1992).

The National Vegetation Classification (NVC) (Rodwell in press) covers twelve maritime cliff communities and 29 sub-communities, though almost all refer to hard cliff habitats. Ten NVC communities are recorded for England, the remaining two being confined to Scotland. No detailed NVC mapping is available for any cliff locality in the region. On the basis of species distribution and vegetation data, the MC1 rock samphire *Crithmum maritimum* maritime rock-crevice, MC4 wild cabbage *Brassica oleracea* maritime cliff ledge, MC5 thrift *Armeria maritima* - sea mouse-ear *Cerastium diffusum* subsp. *diffusum* maritime therophyte, MC8 red fescue *Festuca rubra* - thrift maritime grassland and MC11 red fescue - wild carrot *Daucus carota* subsp. *gummifer* maritime grassland types are all probably present in Kent on chalk. These types conform with the zonation of vegetation on limestone found elsewhere on the Channel coast, where south-facing cliffs and thin soils produce very dry conditions in which there is a seaward zone of MC1 rock-crevice vegetation. This is replaced inland by the MC11 type on thinner soils, MC8 on deeper and moister soil and MC5 on extremely thin and very dry soils around outcrops of bedrock (Rodwell in press). The weathered edges of cliffs tend to be the only places in the region with MC4 vegetation.

The scenic contribution of cliffs within the region, most notably the sheer chalk cliffs of Kent, is often outstanding (Gubbay 1988; Heritage Coast Forum 1993). The soft cliffs of Suffolk contribute to the overall diversity of the Suffolk coast, which is designated both as an Area of Outstanding Natural Beauty and as a Heritage Coast. Cliffs also contribute significantly to other Areas of Outstanding Natural Beauty (Kent Downs; High Weald; Sussex Downs) and Heritage Coasts (South Foreland; Dover - Folkestone; Sussex).

3.1.2 Important locations and species

Unconsolidated and poorly consolidated glacial and fluvioglacial materials are the predominant lithologies of soft cliffs in Suffolk and, rarely, Essex (The Naze). The eight short stretches present along the Suffolk and Essex coasts are dominated by relatively low (<20 m), non-vertical cliff faces subject to relatively rapid erosion and retreat. The only significant length (3.5 km) of soft cliff on the Channel coast is at Folkestone Warren, an area of impressive landslides (Jones & Lee 1994). Cliffs here are developed in Gault clay and rise to 150 m, forming complex slumped steps extending up to 600 m inland. Hard cliffs in the region are developed entirely in chalk, with vertical faces formed by cliff recession cutting across the grain of inland topography to create an undulating cliff-top with surfaces oscillating between 100 m and 130 m in the most spectacular stretches (e.g. Shakespeare Cliff, west of Dover).

In Great Britain nine nationally rare and four nationally scarce species or subspecies of higher plant are found mainly or exclusively on cliffs. Most are restricted to cliff habitats in the south and west of Britain. Two such nationally rare (Red Data Book) species occur in the region: slender bird's-foot-trefoil *Lotus angustissimus* and early spider-orchid *Ophrys sphegodes*, plus the nationally scarce wild cabbage *Brassica oleracea* var. *oleracea*. Seven nationally scarce species occur on chalk cliffs in the region: golden samphire *Inula crithmoides*, rock sea-lavender *Limonium binervosum (sensu stricto)*, yellow vetch *Vicia lutea*, bulbous meadow-grass *Poa bulbosa*, curved hard-grass *Parapholis incurva*, suffocated clover *Trifolium suffocatum* and sea-heath *Frankenia laevis* (at the foot of cliffs in the splash zone). Other nationally rare and scarce species more typical of other habitats also occur. Maritime heath is probably absent in the region owing to the predominance on cliff tops of calcareous bedrock without any superficial deposits of blown sand. The vegetation of the soft cliffs at Folkestone Warren (Kent) is regarded as nationally important, especially the plant succession on landslips involving chalk slipping over Gault clay (Doody *et al.* 1993).

There are no important cliff seabird colonies in the region warranting Special Protection Area status (Stroud *et al.* 1990). No systematic survey of invertebrates of cliff and cliff-top habitats has been carried out, but these environments often have a rich habitat diversity and are thus likely to support large numbers of species (Mitchley & Malloch 1991). A few cliffs in the region are recorded in the Invertebrate Site Register as nationally important for invertebrates, with Folkestone Warren SSSI, Dover to Kingsdown Cliffs SSSI and Shakespeare Cliff containing large numbers of notable (nationally scarce) and rare (Red Data Book) species. A small number of other cliffs have fewer notable and rare invertebrates.

3.1.3 Human activities

Cliffs are among the least modified of terrestrial habitats, although nationally the cliff-top zone, especially its inner

sectors, has been affected by a variety of human impacts, sometimes leading to major habitat loss. The most extensive influences upon hard cliff vegetation at a national scale are grazing and burning, the major management techniques for cliff-top habitat (Mitchley & Malloch 1991). However, these practices are very rare in the region, with arable agriculture and residential development being much more important influences on soft and hard cliffs respectively.

The impact of human activities on cliffs in the region has been very significant, affecting both soft and hard cliff sectors. The majority of the soft cliffs in the region are in Suffolk. Agriculture forms the major land use on the inner edge of soft coast, encroaching on cliff-top habitats. Targets for re-creating maritime cliff grassland from arable or improved pasture are discussed by Pye & French (1993), but there is probably limited scope in the region. Habitat loss has also been caused by residential development, caravan parks and camping grounds around holiday settlements (e.g. at Corton Cliffs and Kessingland Cliffs). Along unprotected stretches, especially of soft cliff, rapid erosion has further 'squeezed' natural and semi-natural cliff-top habitats (e.g. at Easton Bavents). However, most of the soft cliff base in Suffolk, and in Kent, has been protected by coastal defences, and hence natural coastal erosion is prevented or constrained. Groynes are present for stretches of the Suffolk cliffs and these have altered patterns of sediment transport along the Norfolk and Suffolk coast over the past century (Clayton 1989). Soft cliff on the Channel coast at Folkestone Warren carries a major railway line and a minor road. To avoid further slipping the cliff toe is protected and rotational slips upslope have been stabilised; natural processes in this area have therefore been severely constrained and open habitats are likely to decrease in extent, in the absence of further landslips.

Residential development is the major impact on hard cliff habitats in the region. The majority of the chalk cliff-top between Margate and Ramsgate carries either residential housing or roads (along a 14 km frontage). There has been much less development further south, but at Dover and St Margaret's at Cliffe housing encroaches on lower cliff tops. Access to land inland of cliffs west of Dover is restricted by military activity and the cliff-foot zone here carries a major railway line and has been developed as a recreational area, using spoil excavated for the Channel Tunnel. Long-distance walks are routed along cliff-tops either side of Dover (the North Downs Way to the west, and the Saxon Shore Way to the east), with some local erosion and much compaction of grassland turf. There is little caravan park development close to cliffs in Kent.

3.1.4 Information sources used

Cliff lengths are derived from the JNCC's Coastal Resources Database, which records lengths and areas of coastal habitats in 10 km squares, measured at 1:50,000 scale. No detailed NVC survey is available for the region and existing information is insufficient to detail the regional extent of individual cliff and cliff-top habitats apart from maritime cliff grassland.

3.1.5 Acknowledgements

Assistance with sources was kindly provided by Deborah Procter (JNCC). Thanks also go to Linda Davis (Kent County Council) and Jeremy Hindle (Suffolk County Council) for comments on the draft.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Flora, fauna, habitat information, site reports, site management	*Coastal Ecologist, EN HQ, Peterborough, tel: 01733 455000.
Advice on national and international policy and cliff conservation	*Geology/Coastal Advisor, JNCC, Peterborough, tel: 01733 562626
National Landslide Databank	Rendel Geotechnics, Norfolk House, Smallbrook Queensway, Birmingham B5 4LJ, tel: 0121 627 1777
Invertebrate fauna	*Invertebrate Site Register, Species Advisor, JNCC, Peterborough, tel: 01733 562626

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

There are only two sand dune systems in the region, at Romney Warren and Sandwich Bay. Both have been heavily modified by human use, the latter as the home of the Royal St George's Golf Club (pictured). Photo: Peter Wakely, English Nature.

3.2 Sand dunes

Dr T.C.D. Dargie

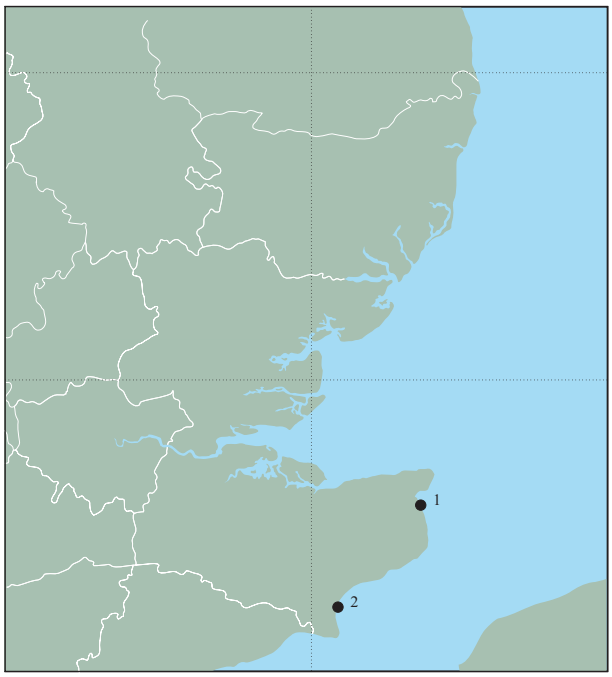
3.2.1 Introduction

Sand dunes in the region are confined to the Kent coast and have an overall extent of 499 ha. Vegetated thin sand over shingle is present in Suffolk, but this is generally regarded as a shingle habitat (see section 3.3). This small site set represents 5% of the English resource and 1% of dunes in Britain and the region is therefore of only modest importance in the national context (Table 3.2.1).

Table 3.2.1 Region 7 vegetated dune resource in context

	Total area (ha)*	*% of total in Region 7*
Suffolk	0	-
Essex	0	-
Kent	499	-
Region 7	***499***	***-***
England	9,282	5.4
North Sea Coast	25,356	2.0
GB	51,180	1.0

Sources: Dargie (1993), Dargie (1995), Radley (1994), JNCC Coastal Database. Key:*to the nearest whole hectare. Note: Scotland has not been fully surveyed, and therefore Great Britain totals are provisional estimates.



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

65 National Vegetation Classification (NVC) communities have been recorded for England (Radley 1994), with a total of 120 types for all communities and sub-communities combined, not all of them exclusive to dunes. The most extensive types in the region are neutral grasslands (SD8 red fescue *Festuca rubra* - ladies' bedstraw *Galium verum* fixed dune grassland, MG1 false oat-grass *Arrhenatherum elatius* coarse grassland, MG7 perennial rye grass *Lolium perenne* leys). There are only low extents of mobile (SD6 marram *Ammophila arenaria* community) and semi-fixed dunes (SD7 marram - red fescue community) and slack vegetation (influenced by the dune watertable) is almost absent. The extent of NVC dune vegetation types occurring in the region, including other land cover (e.g. bare ground, forest plantation, residential land, car park, caravan park), is given in Table 3.2.2.

Both dune systems in the region have been highly altered by a combination of agricultural improvement, afforestation, housing development and recreation, reducing their biological interest. Neither system is designated as a Site of Special Scientific Interest but the least altered parts of Sandwich Bay dunes are owned by the National Trust.

3.2.2 Important locations and species

The two sand dune systems in the region are listed in Table 3.2.3 and shown on Map 3.2.1. The spit dune system at Sandwich Bay is developed at the mouth of the River Stour, which supplies sediment for spit formation, with coastal currents and their sediments helping to further form and shape the system. Romney Warren is an example of a ness/foreland dune, a type that develops on shores with sediment supply from two directions, gradually extending (prograding) seawards. In this case the bulk of sediment is the shingle of Dungeness, with the dune system developed on its

Table 3.2.2 Areas of dune vegetation types (ha*)

	Strand and embryo dune	*Mobile and semi-fixed dune*	*Acidic fixed dune grass-land*	*Neutral and calcareous fixed dune grassland*	*Dune heath and bracken*	*Dune slack*	*Other dune wetland*	*Dune woodland and scrub*	*Transi-tions to saltmarsh*	*Transi-tions to maritime cliff*	*Other land cover*
Region 7	***10***	***25***	***41***	***315***	***0***	***<1***	***7***	***6***	***3***	***0***	***92***
England	179	2,484	671	2,710	197	487	150	1,189	141	30	1,044
North Sea Coast	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Great Britain	340	8,504	4,953	15,228	2,615	2,175	4,114	8,965	836	1,044	2,406

Sources: Dargie (1993), Dargie (1995), Radley (1994), JNCC Coastal Database. Key: *to the nearest whole hectare; n/a = not available. Note: Scotland has not been fully surveyed, and therefore Great Britain totals are provisional estimates.

Table 3.2.3 Sand dune sites in region

No. on Map 3.2.1	*Name*	*Grid ref.*	*Area (ha*)*	*Dune type*	*Conservation status*
1	Sandwich Bay Dunes	TR347625	431	Spit	CWT, Ramsar site, NT
2	Romney Warren	TR087269	69	Cuspate foreland	

Source: Radley (1994). Key: *to the nearest whole hectare; CWT = County Wildlife Trust reserve; NT = National Trust; Ramsar site = wetland of international importance.

eastern flank in a confined area with sand supply. No other dune types (bay dunes, climbing dunes or hindshore dunes) are present in the region, because there is a shortage of suitable embayments, winds are generally offshore and sand supply is poor.

In Great Britain, four nationally rare and thirteen nationally scarce higher plants are found mainly or exclusively on dunes (Radley 1994; Stewart *et al.* 1994). Two nationally rare dune species (fragrant evening-primrose *Oenothera stricta*, bedstraw broomrape *Orobanche caryophyllacea*) are present in the region. Sea-buckthorn *Hippophae rhamnoides*, rush-leaved fescue *Festuca arenaria*, and dune fescue *Vulpia fasciculata* are nationally scarce dune plants found in the region, together with the nationally rare grey hair-grass *Corynephorus canescens* on thin sand over shingle in Suffolk. Five other nationally scarce species more typical of other habitats also occur on regional dunes (sand catchfly *Silene conica,* Nottingham catchfly *Silene nutans*, bur medick *Medicago minima*, clustered clover *Trifolium glomeratum* and suffocated clover *Trifolium suffocatum*).

Detailed studies on animal populations have concentrated on birds: the Sandwich Bay dunes form part of a coastal Ramsar site for birds. Neither dune site is outstanding in terms of Invertebrate Site Register records, although the whole Sandwich Bay area is notable for its invertebrate species diversity.

3.2.3 Human activities

In general, sand dunes are among the least heavily modified of terrestrial habitats. However, because of their restricted extent and small number, the sites in this heavily populated region have experienced disproportionate habitat loss and conversion of dune vegetation to other types that are common and lack typical dune species. The history of this process has been documented for Sandwich Bay dunes by Henderson (1986). The dunes were formerly used for extensive stock grazing, and agricultural improvement transformed the vegetation extensively to neutral grassland. This in turn, together with additional dune grassland, has been converted to a British Open and two additional golf courses, with extensive modification to areas used for greens and fairways. Small areas have also been afforested. Recent NVC survey results suggest that there is a lack of grazing at present, with extensive areas of coarse neutral grassland, with rank, species-poor vegetation and small areas of invasive scrub. Much of the outer dune zone at Romney Warren has been converted to residential development and a golf course. Moderate damage due to trampling is present at both sites, with moderate to severe vehicle damage at Sandwich Bay dunes. Both sites also suffer from fly tipping. Sea defences are present to protect some golf course edges from erosion, with many groynes constructed between Romney Warren and Hythe, a coastal sector that is actively retreating. The most natural dunes remaining at Sandwich Bay dunes are managed as a nature reserve by Kent Wildlife Trust.

3.2.4 Information sources used

Both dune sites discussed here have been surveyed as part of the Sand Dune Vegetation Survey of Great Britain (Radley 1994), using the National Vegetation Classification (NVC) (Rodwell 1991a, 1991b, 1992, 1995, in press). The Sand Dune Vegetation Survey of Great Britain was initiated by the Nature Conservancy Council in 1987 and continued after 1992 by the Joint Nature Conservation Committee on behalf of country conservation agencies. Beardall & Casey (1995) found an additional 66 ha of marram and grassland on dunes on the Suffolk coast, although these are excluded from this section. The NVC surveys, all carried out in the summer months, use a consistent methodology yielding very detailed information. The vegetation is mapped and described, and information on coastal erosion and accretion, atypical vegetation and adjoining land use is also recorded. Individual site reports are available for sites covered in the Sand Dune Vegetation Survey of Great Britain.

The Suffolk Wildlife Trust has published a full audit of the county's natural habitats in *Suffolk's changing countryside* (Beardall & Casey 1995). The data come from Phase 1 survey of the county with follow-up Phase 2 surveys of semi-natural habitats.

3.2.5 Acknowledgements

Assistance with sources was kindly provided by Deborah Procter (JNCC). Thanks are also due to Julian Roughton (Suffolk Wildlife Trust) for comments on the draft.

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C. Contact names and addresses

Type of information	*Contact address & telephone no.*
Flora, fauna, habitat information, location of site reports, site management	*Coastal Ecologist, English Nature HQ, Peterborough, tel: 01733 455000
Invertebrate fauna	*Invertebrate Site Register, Species Advisor, Peterborough, tel: 01733 562626
Advice on national and international policy and dune conservation	*Coastal Advisor, JNCC, Peterborough, tel: 01733 562626

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

3.3 Vegetated shingle structures and shorelines

Dr R.E. Randall

3.3.1 Introduction

Shingle is the term applied to sediments coarser than sand but smaller than boulders: i.e., between 2-200 mm in diameter. Where the coast features shingle, it is often mixed with sand, or else sand dunes have developed on it. Shingle sites include both simple fringing beaches and more complex structures where the shingle is vegetated yet not buried by more than 20 cm of sand, the depth at which shingle ceases to influence the vegetation. Shingle sites where the sand cover is greater than 20 cm in depth are discussed in section 3.2.

The region contains over two-thirds of the total resource of vegetated shingle in England and over half of that for Great Britain as a whole (Table 3.3.1). The most significant sites are Orford Ness (Suffolk) and Dungeness (Kent), the largest shingle cuspate foreland in Great Britain (Ferry *et al.* 1990).

Table 3.3.1 Area of vegetated shingle in Region 7

	Area (ha)
Suffolk	859.0
Essex	47.9
Greater London	-
Kent (including all of Dungeness)	2,217.2
Region 7	***3,124.1***
England	4,353.1
North Sea Coast	4,472.3
Great Britain	5,129.1
% England total in region	71.0
% North Sea Coast total in region	69.9
% GB total in region	60.9

Source: Sneddon & Randall (1994); JNCC Coastal Database.

Shingle plant communities around Britain are distinctive (Sneddon & Randall 1993); some communities are widespread and others are limited to a particular region or substrate. The sandy nature of the substrate at some of the region's shingle sites is strongly reflected in the vegetation, but elsewhere pure shingle, the influence of saltmarsh or the south-eastern location of these sites give rise to distinctive plant assemblages.

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

3.3.2 Important locations and species

The vegetated shingle structures in the region are listed in Table 3.3.2 and shown on Map 3.3.1. The Suffolk shingle includes major structures at Orford Ness (Fuller & Randall 1988), Shingle Street (Randall 1973, 1988) and Landguard Common (Copping 1982), with somewhat smaller features and fringing beaches in the northern part of the county. In Essex sandy shingle occurs at Colne Point and Shoeburyness, with cockle shell 'shingle' fronting the mid-Essex saltmarshes in between. Shell 'shingle' also is found on the north Kent coast (Badmin 1977), but the south-east coast of Kent has extensive fringing shingle beaches with larger structures at Walmer and most importantly at Dungeness. Several shingle

Table 3.3.2 Vegetated shingle structures

Site name	*Grid ref.*	*Site type*	*Area surveyed (ha)*
Kessingland	TM540860	Apposition beach, high sand content	33.9
Dunwich to Walberswick	TM480710	Storm-ridge and shingle spreads	17.7
Sizewell	TM470610	Sandy ridge	6.1
Thorpeness	TM470600	Sandy apposition beach	20.5
Orford Ness	TM450490	Cuspate foreland and spit	504
Shingle Street	TM360420	Apposition beach	36.6
Landguard Common	TM285315	Sand and shingle spit	31.4
Colne Point	TM018123	Two shingle/sand spits, with parallel ridges	33.4
Bradwell Shell Bank	TM035081	Sandy shingle spit with cockle shells	8
Shoeburyness Old Ranges	TQ930842	Sandy shingle ridge system	6.5
Shellness	TR050680	Sandy shingle spit with cockle shells	10.2
Walmer	TR370500	Apposition banks	49
Dungeness	TR073183	Cuspate foreland	2,158

Source: JNCC Coastal Database.

sites also contain lagoons (see also section 3.4).

Table 3.3.3 lists fringing shingle beaches (Map 3.3.1).

The shingle habitats of the region support a large number of rare and scarce plants. Kessingland foreland is the most northerly natural site in England for the nationally scarce sea pea *Lathyrus japonicus*. Sea pea has significant colonies southwards along the Suffolk coast, with the largest population in the British Isles at Orford Ness/Shingle Street. The earliest record in the British Isles for this species is from this area (Caius 1570). Sea pea is also present in significant colonies at Walmer, Hythe and Dungeness, though the latter population has been much reduced as a result of the construction of the power station. Orford Ness is also an important location for sea kale *Crambe maritima*, which is now extinct in most of its previously-known locations further north and has declined drastically over much of its range (Scott & Randall 1976). However, it is still common at Thorpeness, Landguard Point, St Mary's Bay and Dungeness.

Rock samphire *Crithmum maritimum* is normally a plant of rocks and broken cliff, but it reaches its northern limits in eastern England on the Suffolk shingle. Hind (1899) recorded it on the sandy shingle foreshore at Shingle Street in a location where the same clone is still present. It also occurs on shingle shores in Kent. The shingle heath flora of Orford Ness has an extensive cover of lichens and mosses, within which a unique feature is the abundance on the ground of the normally epiphytic lichens *Parmelia caperata* and *Evernia prunaestre*. On the most stable areas of Orford Ness and Shingle Street, where the matrix includes a high percentage of fine particles and organic matter, there are two nationally scarce dwarf clovers: clustered clover *Trifolium glomeratum* and suffocated clover *T. suffocatum*. The nationally scarce yellow vetch *Vicia lutea* is also present.

The shingle/saltmarsh transition habitat is rare in Britain (Adam 1978) but is particularly well illustrated at Orford Ness and Shingle Street. Sea-heath *Frankenia laevis*, a classic south-eastern component of the shingle flora (Randall 1989), was once recorded in Suffolk in this habitat but is no longer extant there. It is still present, however, on shelly shingle in Essex and on the Channel coast of Kent. Similar muddy shingle habitats also contain the scarce curved hard-grass *Parapholis incurva*. The sandy shingle that occurs at Colne Point has considerable populations of the nationally scarce dune fescue *Vulpia fasciculata*.

Golden samphire *Inula crithmoides* is a southern component of the British flora, occurring on saltmarshes, shingle banks and sea cliffs. It reaches its northern limit in north Essex and is particularly well developed at Bradwell Shell Bank. This site is also significant for the rare shrubby seablite *Suaeda vera*, which has its major British populations on the Norfolk and Essex coasts at the junction between saltmarsh and shingle. The interior banks at Walmer support open mossy heathland, which contains the scarce wall bedstraw *Galium parisiense*, elsewhere known mainly from walls on the sides of chalk pits.

Dungeness contains over 40% of British coastal shingle and is particularly well documented (see section 3.3.4). Of particular interest are the freshwater marshes, the Open Pits, which are the finest examples of primary hydroseres on shingle in Britain, with a range of stages in plant succession from common reed *Phragmites australis* swamp to grey willow *Salix cinerea* subsp. *atrocinerea* carr and fen. Unique to British shingle is the holly *Ilex aquifolium* wood on Holmstone Beach, known to have been present since the sixteenth century

Table 3.3.3 Fringing beaches visited

Site name	*Grid ref.*	*Length of shoreline (km*)*	*Site type*
Pakefield	TM5390	1.0	Sandy shingle
Southwold	TM5074	1.0	Sandy shingle
Aldeburgh	TM4657	0.5	Silty shingle
Bawdsey	TM3438	3.5	Pure shingle
Dengie Shell Bank	TL0402	0.5	Cockle shell banks
Foulness Point	TQ0505	0.5	Cockle shell spits on marsh
Plumpudding Island	TR2769	1.0	Silty shingle
Dover	TR3240	2.0	Disturbed, sandy shingle
Hythe	TR1534	3.0	Pure shingle except in old 'drift' lines
St. Mary's Bay	TR0928	4.0	Pure shingle except in old 'drift' lines

Source: Randall (unpublished survey, early 1980s). Key: *to the nearest 0.5 km.

(Peterken & Hubbard 1972). Dungeness supports several rare and scarce plant species, including Nottingham catchfly *Silene nutans* and a wide range of *Cladonia* lichen species within the heathland vegetation; it is also the only site in Britain where stinking hawk's-beard *Crepis foetida* is found.

Owing to the uniqueness of the Dungeness habitat mix, it is a particularly important site for invertebrates, with six species of butterflies and moths, two flies, one bug and two spiders currently known in Britain only from there (Table 3.3.4). Allen (1983) and Williams & Lockett (1982) record other rare invertebrates from Dungeness. Morris & Parsons (1991a, b) made a detailed study of the invertebrate fauna of Orford Ness and Dungeness. At Dungeness over 1,300 species were recorded, 359 of which were new to Dungeness SSSI. The area of the proposed Dungeness 'C' nuclear power station is particularly rich in invertebrate species (Morris & Parsons 1991c). The invertebrates of Orford Ness/Shingle Street include the rare jumping spiders *Sitticus rupicola* and *Euophrys browningi* (first recorded at Shingle Street) and the spider *Trichonchus affinis*.

Table 3.3.4 Invertebrate species currently known in Britain only from Dungeness

Species
Lepidoptera (butterflies and moths)
Lasiocampa trifolii subsp. *flava*
Thalera fimbrialis
Eilema pygmaeola subsp. *pallifrons*
Clostera anachoreta
Coleophora otitae
Ethmia terminella
Diptera (flies)
Tachydromia terricola
Polyodaspis sulcicollis var. *anglicus* (not known outside Britain)
Hemiptera - Heteroptera (bugs)
Monosynamma bohemani
Araneae (spiders)
Apostenus fuscus
Pellenese tripunctatus

Source: JNCC Invertebrate Site Register

The bird populations of Dungeness have been recorded by the RSPB since 1907. Scott (1985) mentions 45 pairs of tufted duck *Aythya fuligula* and twelve pairs of great crested grebe *Podiceps cristatus*. Important declining species include wheatear *Oenanthe oenanthe*, which were still nesting around the lighthouse in 1984 but had become extinct elsewhere. Dungeness is also important for its migrant bird population.

Orford Ness supports an important little tern *Sterna albifrons* colony, and there are also colonies at Landguard Common, Colne Point, Bradwell Shell Bank and Shellness. Breeding oystercatcher *Haematopus ostralegus* and ringed plover *Charadrius hiaticula* are found at most of the major sites. Avocet *Recurvirostra avosetta* nest at Havergate Island and use the Orford shingle, and there are very large populations of lesser black-backed gulls *Larus fuscus* and herring gulls *Larus argentatus* in the northern part of Orford Ness. Rabbits are abundant at Orford Ness, and the very large populations at times have a major impact on the vegetation; rabbits and the very numerous hares (White 1967) may contribute to the exclusion of woody species. Rabbit grazing at Landguard has suppressed the growth of shingle flora but is unlikely to have long-term effects.

3.3.3 Human activities

Many of the major shingle sites of the region have some formal conservation status (Table 3.3.5) and a few are wardened for all or part of the year (during the breeding season for terns). However, the majority of the sites are subject to high levels of visitor pressure (except Bradwell Shell Bank and Shoeburyness Old Ranges), especially in summer, and trampling has a marked effect on shingle stability. At Kessingland vehicular access has damaged the rear of the beach and at Orford Ness past military activity has seriously influenced vegetation and wildlife. At Dungeness the shingle is disturbed by beaching fishing boats.

The Lydd Ranges, Dungeness, and, formerly, Shoeburyness have experienced extensive military use, and the lack of regeneration of Holmstone holly wood, Dungeness, has been attributed to this activity. The development of the container port at Felixstowe (Landguard Common) has affected both the area of coastal semi-natural habitats and coastal geomorphology. House construction at Thorpeness, Shingle Street and Dungeness and military construction at Orford Ness, Shoeburyness and Dungeness have affected the area of vegetated shingle. Gravel extraction has occurred in the past at Shingle Street and Colne Point and currently occurs at Dungeness. Sea defence works are increasingly important in south-eastern Britain and have affected the shingle from Dunwich to Walberswick and at Thorpeness, Orford Ness (especially near Slaughden), Landguard Common and Dungeness. Water abstraction and recharge from beneath Dungeness contribute to the reservoir system for Kent, having implications for the wetland and lower plant flora of the shingle. All shingle sites in the region are widely grazed by rabbits, but there is no grazing in this region by domestic stock.

3.3.4 Information sources used

The shingle structures of the region were surveyed between July 1988 and July 1990 as part of the Nature Conservancy Council's National Vegetated Shingle Structures Survey, which used the National Vegetation Classification (NVC) (see e.g. Rodwell in press). This survey did not include fringing beaches or unvegetated or minor sites. For full details of the methodology see Sneddon & Randall (1993). Dungeness was separately surveyed by Ferry *et al.* (1990). Orford Ness/Shingle Street has been studied over many years by researchers associated with the Field Studies Council and others (Beardall *et al*. 1988; Carr 1972, 1986; Randall 1973). Dungeness has been studied by geomorphologists over many years (e.g. Lewis 1932; Lewis & Balchin 1940; Gulliver 1897; Hey 1967; Reynolds 1986), and its flora and fauna have been more recently examined in relation to possible threats from construction and extraction (e.g. Ferry & Henderson 1984; Ferry & Pickering 1989; Ferry & Waters 1984, 1985, 1988; Henderson & Henderson 1985).

Many fringing shingle beaches were examined by the author in the early 1980s as part of a survey of shingle beaches sponsored by British Petroleum (BP). Beaches covered in this survey were only examined qualitatively; the information

Table 3.3.5 Human activities on shingle sites in Region 7

Site name	*Conservation status*	*Activities/management/disturbances*
Kessingland	-	Fishing, water recreation
Dunwich to Walberswick	NT, NNR, SPA, Ramsar site	Recreation, car-parking, sea defence, rabbit grazing
Sizewell	-	Power station
Thorpeness	-	Recreation, rabbit grazing
Orford Ness	SSSI, NNR, NT, SPA, Ramsar site	MoD activity (past), sea defence, motor bikes
Shingle Street	SSSI, SPA	Recreation, past gravel extraction, rabbit grazing, construction, vehicular damage
Landguard Common	SSSI, LNR	Fort, docks, recreation, sea defences, extraction, rabbit grazing
Colne Point	SSSI, EWT, SPA, Ramsar site, NNR	Past gravel extraction, recreation
Bradwell Shell Bank	SSSI	None
Shoeburyness Old Ranges	LNR, EWT	Past MoD activity, heavy rabbit grazing
Shellness	NNR	Recreation
Walmer	-	Recreation
Dungeness	RSPB, SSSI	MoD use, gravel extraction, fishing, water abstraction, power station, recreation, building, vehicular access, grazing, sea defence

Source: JNCC Coastal Database. Key: EWT = Essex Wildlife Trust reserve, LNR = Local Nature Reserve, NNR = National Nature Reserve, NT = National Trust land, RSPB = Royal Society for the Protection of Birds reserve, SPA = Special Protection Area, SSSI = Site of Special Scientific Interest.

generated became the basis of the geographical variation data published in Randall (1989).

The Suffolk Wildlife Trust has published a full audit of the county's natural habitats in *Suffolk's changing countryside* (Beardall & Casey 1995). The data come from Phase 1 survey of the county and the follow-up Phase 2 surveys of semi-natural habitats.

3.3.5 Acknowledgements

Thanks are due to the following for comments on the draft: Colin Taylor (Nuclear Electric), Julian Roughton (Suffolk Wildlife Trust) and Jeremy Hindle (Suffolk County Council).

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Shingle sites, Suffolk coast	*The Conservation Officer, Suffolk Wildlife Trust, Ashbocking, tel: 01473 890089
Shingle sites, Essex coast	*Essex, Hertfordshire and London Team, English Nature, Colchester, tel: 01206 796666
Shingle sites, Kent coast	*Kent Local Team, English Nature, Ashford, tel: 01233 812525
Essex Wildlife Trust sites	*Field Officer, Essex Wildlife Trust, Colchester, tel: 01206 729678
Kent Wildlife Trust sites	*Conservation Officer, Kent Wildlife Trust, Maidstone, tel: 01622 662012
Dunwich	National Trust, Coastguard Cottages, Dunwich Heath, Saxmundham IP17 3DJ, tel: 01728 648505
Sizewell	The Warden, Minsmere Reserve, Westleton, Saxmundham, Suffolk IP17 3BY, tel: 01728 648770
Colne Point	The Warden, 28 Kendall Road, Colchester, Essex CO1 2BN, or Colne Point Nature Reserve, Lee over Sands, Colchester, Essex, tel: 01255 820855
Essex Wildlife Trust records, Colne Point	Keeper, Natural History, Central Museum, Shoeburyness, Victoria Avenue, Southend-on-Sea SS22 6EX, tel: 01702 330214
Dungeness	Dungeness Bird Observatory, 11 Royal Naval Shore Signal Station, Dungeness TN29 9NA, tel: 01797 321309

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

Lagoons are a 'priority habitat type' under of the EC Habitats & Species Directive, and Minsmere RSPB Reserve, Suffolk, incorporates a small undisturbed natural lagoon behind the sea wall as well as a number of artificial lagoon-like 'scrapes' created for wading birds. Sizewell Nuclear Power Station forms an unlikely backdrop to this tranquil scene. Photo: Peter Wakely, English Nature.

3.4 Coastal lagoons

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

3.4.1 Introduction

Coastal lagoons are pond- or lake-like, virtually tideless bodies of saline water, either wholly or partially separated from the adjacent sea, but with some influx of sea water. The term is used here to include true physiographic lagoons (*sensu* Barnes 1988), i.e. those separated from the sea by a natural sedimentary barrier, as well as other lagoonal areas (*sensu* Thorpe *et al.* in prep.), e.g. isolated percolation pools, sluiced or culverted pools, silled inlets and artificial brackish ponds and coastal pools, of a similarly restricted tidal range and often containing a comparable lagoonal fauna and flora. Lagoons are commonly shallow, often with a varying salinity ranging from above to below normal sea-water levels (35 g/kg); freshwater systems are not considered here.

The contribution of the region's lagoons to the size of the British lagoon (*sensu* Barnes 1988) resource as a whole is shown in Table 3.4.1.

Other definitions of 'lagoon' and 'lagoonal' are also current. Using Thorpe *et al.* (in prep.)'s broad definition (but excluding the flooded marshes at Havergate Island, which contain some estuarine fauna), this region contains 247 ha of lagoonal habitat, approximately 9% of the GB total (Table 3.4.2). The region, especially the county of Suffolk, is therefore highly significant in the national context, particularly for lagoons set within or behind longshore shingle bars or barrier beaches.

Table 3.4.3 shows the areas of lagoons in the region considered by Barnes (1989) to be nationally noteworthy.

Lagoons as defined by the European Commission, whose definition differs from that used to compile the figures in Table 3.4.1 and Table 3.4.3 and more closely matches that used by Thorpe *et al.* (in prep.) (see Table 3.4.2), are a nationally rare habitat and a 'priority habitat type' under Annex I of the EC Habitats & Species Directive. Therefore examples of the habitat type in the region are of national and international importance.

3.4.2 Important locations and species

Map 3.4.1 shows the location of the lagoonal and other saline pools mentioned; Table 3.4.4 details their areas and physiography. Throughout Suffolk there are a number of small percolation pools and ponds retained behind sea walls. Some smaller natural lagoons have declined on isolation from the sea to freshwater ponds. Easton Broad, Suffolk, is a large example, now much reduced by reedswamp development, of a former lagoon that has recently evolved into a freshwater lake. The RSPB Reserve at Minsmere incorporates a number of artificial 'scrapes' of little lagoonal significance, although a small undisturbed lagoon persists behind the sea wall. Essex has no lagoonal habitats: a number of small and essentially freshwater pools with common reed *Phragmites australis* exist along the shores of the Stour Estuary, while the pond at Clacton has been lined with concrete to form a boating lake. In Kent there are a number of sites, particularly in the Thames Estuary, where gravel and clay extraction have left saline ponds, often of very low salinity, some of them very large.

Map 3.4.1 Coastal lagoons and other saline ponds.

Of these, the lagoon systems in Cliffe Marshes, Kent, are considered to be of considerable conservation value.

True lagoons support only three types of aquatic vegetation, namely stands of green algae (*Chaetomorpha* spp., *Ulva* spp. and *Enteromorpha* spp.), of sea-grasses and similar

Table 3.4.1 Lagoon⁺ areas* for region in context

Region	*Lagoonal area (ha*)*	*Overall % of GB total*	*% of GB total excl. The Fleet*
Suffolk	17.5	1.4	2.2
Essex	0	0	0
Kent	3.5	0.3	0.4
Region 7	***21.0***	***1.7***	***2.7***
North Sea Coast	1,163	92.2	87.5
Great Britain	1,261	100	100

Source: Barnes (1985, 1987, 1989). Key: ⁺*sensu* Barnes (1988); *to the nearest 0.5 ha.

Table 3.4.2 Lagoon⁺ areas* for region in context

Region	*Lagoonal area (ha*)*	*Overall % of GB total*	*% of GB total excl. The Fleet*
Suffolk	28.5	1	1
Essex	0	0	0
Kent	217	8	10
Region 7	***247***	***9***	***11***
North Sea Coast	1,819	68	62
Great Britain	2,658	-	-

Key: ⁺including areas classified as 'lagoonal' by Thorpe *et al.* (in prep.); *to the nearest 0.5 ha.

Table 3.4.3 Nationally noteworthy lagoonal* areas for region and country

Region	*Lagoonal area (ha*)*	*Overall % of GB total*	*% of GB total excl. The Fleet*
Region 7 (all in Suffolk)	***12***	***3***	***24***
North Sea Coast	521	96	63
Great Britain	545	-	-

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

plants (predominantly tasselweeds *Ruppia* spp.) and, much more rarely, stoneworts (especially *Lamprothamnium* spp.). Much of the area of their beds is in the form of bare sediment, devoid of vegetation cover. Fringing stands of common reeds, saltmarsh plants and/or sea club-rush *Scirpus maritimus* are usual. All these communities, with the exception of the stoneworts, occur in the region.

Lagoons possess a characteristic invertebrate fauna that shows little regional variation, even within Europe. In Britain, several of these species are very rare and are protected under the Wildlife and Countryside Act 1981. Of these, the nationally rare starlet sea anemone *Nematostella vectensis* and the lagoonal sand shrimp *Gammarus insensibilis* occur within the region. Other notable species in the region's lagoons are the lagoonal mysid shrimp *Paramysis nouveli*, the lagoonal isopod *Idotea chelipes*, the sea mat *Electra crustulenta*, the lagoon cockle *Cerastoderma glaucum*, the lagoonal mud snail *Hydrobia neglecta* and the nationally scarce tentacled lagoon worm *Alkmaria romijni*, as well as a full complement of classic lagoonal species. Other species rare for this part of Britain include the rissoid snail *Onoba aculeus* and shelled sea-slug *Akera bullata*. Lagoons in the region, as elsewhere, support numerous wading birds and wildfowl, including avocets *Recurvirostra avosetta*.

3.4.3 Human activities

Little or no active management is applied to the coastal lagoons themselves, although most are maintained as nature reserves, largely on account of the waders and wildfowl mentioned above and the terns *Sterna* spp., which nest on the enclosing barriers. The Cliffe Marshes system, Kent, is protected and managed by the North Kent Wildfowling and Conservation Association, and recently a partnership organisation (including English Nature and the RSPB) has been established for the conservation, commercial and recreational management of the site. The King's Marshes site is being managed for lagoonal conservation by the National Trust; management includes the creation of a further lagoon. The majority of the Suffolk lagoons are within possible Special Areas of Conservation (SACs) to be designated under the EC Habitats & Species Directive (see Chapter 7). The intensive management (notably of the salinity regime) of the scrapes at Minsmere creates a highly stressful environment for lagoonal species.

Table 3.4.4 Lagoonal areas surveyed

Name	*Grid ref.*	*Area (ha*)*	*Type*
Suffolk			
The Denes	TM536840	3	Natural, percolation
Benacre Broad	TM532828	8	Natural, isolated
Covehithe Broad	TM523808	1	Natural, isolated
Easton Broad	TM578793	2	Natural, percolation
Reedland Marshes (Dunwich/Walberswick)	TM486726	3	Natural, percolation
Minsmere Sea Wall Lagoon	TM478663	<1	Sluiced pond
Aldeburgh 'P8'	TM458527	0.5	Natural, percolation
Orford Ness	TM435495	7	Natural, percolation pools
Shingle Street	TM366422	4	Natural, percolation
Kent			
Cliffe Fort	TQ713760	44	Sluiced lake
Cliffe Lagoons	TQ720766	71	Sluiced ponds
Allhallows Lagoons	TQ850785	9	Percolation/sluiced
Stoke Marshes	TQ845754	6	Sluiced ponds
Queenborough	TQ908730	2	Isolated sea inlet
Sheerness/Minster Marsh	TQ921747	18	Sluiced ponds
Murston Claypits	TQ928660	42	Isolated ponds
Oare Marsh	TR010648	<1	Percolation pool
Plumpudding Island	TR253694	2.5	Natural, percolation
Great Stonar Lake	TV335590	21	Percolation pool
South Brooks Ponds	TR030174	1	Natural, percolation

Key: *to the nearest 0.5 ha.

3.4.4 Information sources used

All likely lagoons in the region were surveyed as part of the national lagoon survey undertaken on behalf of the Nature Conservancy Council in 1980-88. Surveys of the region's lagoons were carried out by Barnes from 1984 onwards, and by Sheader & Sheader in 1987. Detailed reports are available, including maps of the habitats and species lists. The data are summarised by Barnes (1985, 1987, 1989), Sheader & Sheader (1989) and Smith & Laffoley (1992), from which the data displayed here are derived. The lagoons of Suffolk have been the subject of surveys by CEGB's Fawley Aquatic Research Laboratories in 1989 and extensively (ongoing) by R.S.K. Barnes; those at Shingle Street have a long history of study dating back to Cobb (1958). Havergate Island was studied by Mason (1986) over four years in the 1980s. Downie (1996) summarises the conservation value of saline lagoons and lagoon-like saline ponds in England, including data from the recent English Nature surveys of proposed lagoonal Special Areas of Conservation in the region. Further data on Suffolk lagoons (including the only survey of Aldeburgh P8 lagoon) are contained in Sheader & Bamber (1989), on King's Marshes Lagoons, Orford Ness, in Barnes (1994) and on those of Kent in Sheader & Sheader (1985, 1988, 1993).

3.4.5 Acknowledgements

Thanks are due to Mark Tasker (JNCC), Colin Taylor (Nuclear Electric), Steve Gilbert (RSPB) and Alexander Downie (English Nature) for their comments on the draft text.

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B. Further reading

Further details of coastal habitat sites are available on the *Coastal & marine UKDMAP datasets* module disseminated by the JNCC (Barne *et al.* 1994). Further details of lagoons and quasi-lagoonal features are available on the *UKDMAP datasets* module disseminated by the British Oceanographic Data Centre (BODC 1992).

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JNCC. 1996. *Guidelines for selection of biological SSSIs: intertidal marine habitats and saline lagoons*. Peterborough, Joint Nature Conservation Committee.

C. Contact names & addresses

Type of information	*Contact address and telephone no.*
Brackish lagoons of the region	Dr R.S.K. Barnes, St Catharine's College, Cambridge CB2 1RL, tel: 01223 336606
Brackish lagoons of the region	Dr R.N. Bamber, Fawley Aquatic Research Laboratories, Marine & Freshwater Biology Unit, Fawley, Southampton SO45 1TW, tel: 01703 893513
Brackish lagoons of the region	Dr M. Sheader, Department of Oceanography, Southampton Oceanography Centre, University of Southampton, Empress Dock, European Way, Southampton SO14 3ZH, tel: 01703 595000
Minsmere	The Warden, Minsmere Reserve, Westleton, Saxmundham, Suffolk IP17 3BY, tel: 01728 648770
King's Marshes	The Warden, The National Trust, Quay Office, Orford Ness, Woodbridge, Suffolk IP12 2NU, tel: 01394 450900

3.5 Wet grassland

Dr H.T. Gee

3.5.1 Introduction

Wet grassland includes both coastal grazing marsh subject to maritime influence and lowland wet grassland adjacent to tidal reaches of estuaries. Coastal grazing marsh is a distinctive habitat consisting of lowland wet pasture drained by a series of ditches that may be either brackish or freshwater. No national survey exists of wet grassland as here defined, or indeed of coastal grazing marsh or lowland wet grassland separately, so detailed inter-region comparisons are not possible. The conservation interest of wet grassland can be in the pastures themselves or in the ditches. Some sites are of interest for both, but many sites are agriculturally improved and are of interest only for their ditch flora and fauna.

The coastal wet grassland of this region is mainly grazing marsh, much of it formed by the land claim of saltmarsh behind sea walls and its enclosure for agricultural use; it therefore includes some pastures that no longer show maritime influence in their vegetation. Smaller areas, mostly along the Suffolk coast, were formed by the conversion of freshwater marsh that had developed on the landward side of natural shingle barriers. Wet grassland sites may remain wet throughout the year and may be managed for stock grazing and/or as hay meadow.

The wet grassland resource of this region is the best studied and most comprehensively surveyed in Britain. It is widely distributed throughout the region, apart from the east coast of Kent. A desk study of the lowland wet grassland of England (Dargie 1993) (Table 3.5.1) found this region to contain almost one third of the English total of lowland wet grassland on marine sediments.

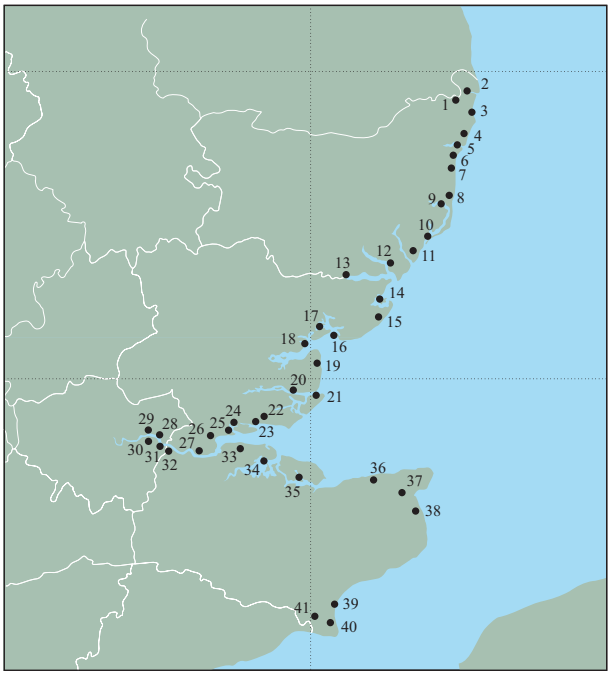
The high conservation value of the wet grassland in this region and the rapidity with which it has been lost in the last fifty years (Thornton & Kite 1990) have led to considerable protection being afforded to most of the remaining resource. Twenty-seven Sites of Special Scientific Interest (SSSIs) in the region, many included in Special Protection Areas (SPAs) and Ramsar sites, contain wet grassland.

3.5.2 Important locations and species

The wet grassland sites in this region are listed in Table 3.5.2 and shown on Map 3.5.1. An important resource of the Essex coastline are the 'foldings', the grassland between the sea wall and the 'borrow dyke' or back ditch. The foldings are grazed and typically comprise unimproved or semi-improved grassland. In view of the length of sea wall in the county, the foldings represent a large area of comparatively herb-rich coastal grassland that is of major conservation importance.

Wet grasslands, when not agriculturally improved, support widespread grassland types such as the National Vegetation Classification (NVC) MG5 crested dog's-tail *Cynosurus cristatus* - common knapweed *Centaurea nigra* grassland community (Rodwell 1992, 1995). Some pastures and foldings in this region support a rich and typical floral assemblage, including nationally scarce and nationally rare ('Red Data Book' - RDB) plant species. At some sites these include relict saltmarsh species, of which several are nationally scarce, such as stiff saltmarsh-grass *Puccinellia rupestris*, Borrer's saltmarsh-grass *Puccinellia fasciculata*, sea barley *Hordeum marinum*, bulbous foxtail *Alopecurus bulbosus*, marsh mallow *Althaea officinalis*, slender hare's ear *Bupleurum tenuissimum*, divided sedge *Carex divisa*, sea clover *Trifolium squamosum* and annual beard-grass *Polypogon monspeliensis*. Nationally rare grassland and relict saltmarsh species typical of the region's unimproved lowland wet grassland include saltmarsh goosefoot *Chenopodium chenopodioides*, least lettuce *Lactuca saligna* and hog's fennel *Peucedanum officinale*.

A feature of the least-modified areas of wet grassland is the presence of anthills of the yellow meadow-ant *Lasius flavus*. These form a well-drained microhabitat with a characteristic flora including lady's bedstraw *Galium verum*, common whitlowgrass *Erophila verna* and upright chickweed *Moenchia erecta*. Some areas of lowland wet grassland, such as Fingringhoe Ranges and Wivenhoe Marshes in the Colne Estuary, are ungrazed. These develop distinctive features and include fields dominated by the nationally rare dittander



Map 3.5.1 Coastal wet grassland (Table 3.5.2).

Table 3.5.1 Wet grassland in Region 7

Area	*Wet grasslands on marine sediments (ha*)*
Suffolk	1,122
Essex	4,184
Greater London	690
Kent	10,622
Region 7	***16,618***
England	51,770

Source: Dargie (1993). Key: *to the nearest whole hectare.

Table 3.5.2 Wet grassland in Region 7

No. on Map 3.5.1	*Location*	*Grid ref.*	*Conservation status*	*Notes*
	Suffolk			
1	Barnby Marshes	TM480910	SSSI	Part of Barnby Broad and Marshes SSSI
2	Oulton Broad	TM505940, TM498931, TM495920	Part SSSI	Oulton Marsh, Peto's Marsh and Share Marsh. Part included in Sprat's Water & Marshes SSSI.
3	Kessingland Level	TM530850	Undesignated	
4	Frostenden Valley	TM502790	SSSI, SPA	Included in Benacre to Easton Bavents SSSI
5	Blyth Estuary / Dunwich River	TM490760-TM470710	Part CWT	Several areas adjacent to the estuary, including Southwold Town Marshes (CWT), Dunwich Valley (CWT) and Dingle Marshes
6	Minsmere Level	TM470660	Part SSSI, part CWT, Ramsar site, part SPA	Some included in the Minsmere - Walberswick Heath and Marshes SSSI. Southern Minsmere Levels (CWT) is outside SSSI.
7	Sizewell Marshes	TM466638	SSSI	
8	North Warren	TM465577	RSPB Reserve	
9	River Alde	TM450540	Part CWT, part Ramsar site, part SPA	Extensive areas around the Alde, including Middle Alde Marshes CWT
10	River Ore	TM390460	Part SSSI, part CWT, part Ramsar site, part SPA	Some included in Orfordness Havergate SSSI & Havergate Island and Boyton Marshes. Cauldwell Hall Farm Marshes and Oxley Marshes are CWT.
11	Deben Estuary	TM330395, TM310387	Part CWT, Ramsar site, SPA	Upstream includes Ramsholt Marshes, Shottisham Creek, Kyson Meadows (Woodbridge) and Corporation Marshes, Falkenham (all CWT). Also includes wet grassland on both banks of estuary near mouth.
12	Orwell Estuary	TM265355, TM247350	Part SSSI, part Ramsar, part SPA	Includes Trimley and Shotley Marshes
	Essex			
13	Cattawade Marshes	TM090329	SSSI	At head of Stour Estuary
14	Horsey Island	TM235245	SSSI, Ramsar site, SPA	Improved pasture in Hamford Water SSSI
15	Holland Haven Marshes	TM211170	SSSI	
16	Upper Colne Marshes	TM022232	SSSI, Ramsar site, SPA	
17	Colne Estuary	TM075155	SSSI, Ramsar site, SPA	
18	Blackwater Estuary	TL982121, TL979100	Part SSSI, part RSPB Reserve, part Ramsar site, part SPA	Includes Old Hall Marshes and Tollesbury Wick Marshes
19	Bradwell Marshes, Dengie Marshes, Sandbach Meadows	TM020050, TR003996, TM021050-TM022057	Part SSSI, part Ramsar site, part SPA, part undesignated	Sea wall, folding and borrow dyke on Dengie are SSSI
20	North and South Fambridge Marshes	TQ865973-TQ832970, TQ868958-TQ913960	Part SSSI, part Ramsar site, part SPA	Includes River Crouch SSSI on north and south banks of the estuary
21	Foulness	TL030905	SSSI, Ramsar site, SPA	
22	Hadleigh Marsh	TR810853	Undesignated	
23	Benfleet Marshes	TR795857	Part SSSI, part Ramsar site	Some included in Benfleet & Southend Marshes SSSI
24	Pitsea Marsh	TQ740870	SSSI	
25	Vange and Fobbing Marshes	TQ730840 TQ725867	SSSI	
26	Mucking Marshes	TQ690800	Undesignated	Adjacent to Mucking Flats and Marshes SSSI
27	West Thurrock Marshes	TQ582767	Undesignated	Adjacent to W. Thurrock Lagoons SSSI
	Greater London			
28	Aveley, Wennington and Rainham Marshes	TQ531800	SSSI	Three areas of marshland comprising Inner Thames Marshes SSSI
29	Hornchurch Marshes	TQ505820	Undesignated	Partially developed site
30	Erith Marshes	TQ493803	Undesignated	
31	Crayford Marshes	TQ532776	Undesignated	
	Kent			
32	Dartford Marshes	TQ538764	Undesignated	
33a	Higham Marshes	TQ703747	SSSI	Part of the South Thames Estuary and Marshes SSSI

Table 3.5.2 Wet grassland in Region 7 (continued)

No. on Map 3.5.1	*Location*	*Grid ref.*	*Conservation status*	*Notes*
33b	Cliffe Marshes	TQ740780	SSSI	Part of the South Thames Estuary and Marshes SSSI
33c	Cooling Marshes	TQ770780	SSSI	Part of the South Thames Estuary and Marshes SSSI
33d	St Mary's Marshes	TQ805785	Undesignated	
33e	Allhallows Marshes	TQ850780	Part RSPB	Part included in Northward Hill RSPB Reserve
33f	North Level	TQ865780	Part RSPB	Part included in Northward Hill RSPB Reserve
34	Medway Estuary	TQ850720	Part SSSI, part Ramsar site, part SPA	Areas around the estuary, some included in Medway Estuary SSSI; includes Diggs Marshes on Sheppey
35	The Swale and Elmley Marshes	TR000670	SSSI, NNR, Ramsar site, part SPA	
36	Chislet Marshes	TR240680	Undesignated	
37	Stour Estuary	TR320633, TR300623	Undesignated	Minster Marsh and Ash Level
38	Lydden Valley	TR355565	Part SSSI	Part within Sandwich Bay and Hacklinge Marshes SSSI
39	Romney Marsh	TR050300	Undesignated	Extensive wet grasslands
		TR085262	Part SSSI	Includes Romney Warren SSSI
40	Denge Marsh	TR050200	Undesignated	Adjacent to Dungeness SSSI
41	Walland Marsh	TQ960240	Part SSSI	

Source: English Nature. Key: SSSI = Site of Special Scientific Interest; NNR = National Nature Reserve; Ramsar site = wetland of international importance; SPA = Special Protection Area; RSPB = Royal Society for the Protection of Birds reserve; CWT = County Wildlife Trust site.

Lepidium latifolium at Wivenhoe Marshes, and particularly rich invertebrate assemblages at Fingringhoe (see also section 5.3). Elsewhere on the region's wet grasslands, insect species of interest include the nationally scarce Roesel's bush cricket *Metrioptera roeselii*, whose British population is chiefly concentrated on the wet grasslands of this region, notably in the Thames Estuary.

Internationally important populations of waders and wildfowl winter on the estuaries and open coast of this region and use the wet grasslands for feeding and high-tide roosts. Some unimproved sites - notably the RSPB reserves - support nationally rare breeding species such as garganey *Anas querquedula*, pochard *Aythya ferina*, ruff *Philomachus pugnax*, Cetti's warbler *Cettia cetti* and black-tailed godwit *Limosa limosa*. Even improved areas may retain significant value for birds. The improved pasture on Horsey Island in Hamford Water is a feeding and roosting site for internationally important wintering populations of brent geese *Branta bernicla* and black-tailed godwit. In the winter the oil-seed rape *Brassica napus* fields on Walland Marshes are host to internationally important numbers of Bewick's swans. Sections 5.11 and 5.12 describe the importance of the region's wet grassland sites for birds.

The wet grasslands of this region hold some of the most floristically diverse ditch systems in Britain. Diversity is maintained by ditch management by, for instance, casting and vegetation cutting, which allow the growth of smaller emergent, floating and submerged plants. Nationally scarce plants found in freshwater ditches in the region's wet grasslands include the emergent greater water-parsnip *Sium latifolium*, the submerged plants whorled water-milfoil *Myriophyllum verticillatum*, fen pondweed *Potamogeton coloratus* and hairlike pondweed *Potamogeton trichoides*, and the floating species water-soldier *Stratiotes aloides* and rootless duckweed *Wolffia arrhiza*. Brackish ditches have a characteristic but less species-rich flora than the freshwater ditches, with the most botanically diverse sites such as Cliffe Marshes showing a range of salinities. The more saline ditches support typical saltmarsh plants, sometimes including the nationally scarce submerged species spiral tassleweed *Ruppia cirrhosa*. Good examples of saline ditches are present in the Blackwater Estuary SSSI and the borrow dyke at Dengie Marshes, and there are extensive brackish and saline ditches on the Isle of Grain, Chetney, Barksore and Elmley Marshes. On some sites the former saltmarsh creeks still form part of the wet grassland drainage system, e.g. at Sandbeach Meadows on the Dengie Peninsula, in the Blackwater Estuary SSSI and on parts of the North Kent Marshes.

The ditches tend to support a rich assemblage of invertebrate species, and wet grasslands in the outer Thames Estuary are among the most important sites for invertebrates in the UK. For example, over 100 nationally scarce invertebrate species have been recorded from the North Kent Marshes and 24 nationally scarce species of beetle have been recorded from Old Hall Marshes in Essex. Most of the British population of the RDB2 (vulnerable) damselfly *Lestes dryas* is found on wet grasslands in this region. Wet grassland also provides the only Essex site for the nationally scarce hairy dragonfly *Brachytron pratense* and important populations of the ruddy darter *Sympetrum sanguineum*. RDB species recorded for these marshes include the great silver diving beetle *Hydrophilus piceus*, the soldier fly *Oplodontha viridula*, the meniscus midge *Dixella attica* and a rare moth, the ground lackey *Malacosoma castrensis*. Several notable moth species with larval stages dependent on wetland plants are present on wet grassland sites in the region. These include the reed dagger *Simyra albovenosa*, silky wainscot *Chilodes maritimus* and Webb's wainscot *Archanara sparganii*.

3.5.3 Human activities

Much wet grassland in the region has been created by the activities of man over many centuries, dating back in Romney Marsh, for instance, to land claim by the Romans. In the past fifty years there has been widespread loss of wet grassland in this region through agricultural improvement, conversion to arable land and industrial and urban development

(Table 3.5.3), although figures relate to wet grassland/grazing marsh as variously defined by the authors of the studies.

Much land claim along the region's coasts occurred in medieval times (Pye & French 1993). Initially it was for pasture, but there have been periods of large-scale conversion to arable use, for example during the Napoleonic Wars, the Second World War and in the 1970s and 1980s under the Common Agricultural Policy (Institute of Estuarine and Coastal Studies 1992). Overall, most losses have been to arable use, except in the inner Thames, where the majority has been to urban, industrial and commercial development. The rate of loss both to arable use and to other development has slowed in recent years. This is mainly because of changes in agricultural grants and the establishment of three Environmentally Sensitive Area (ESA) schemes (Suffolk River Valleys, Essex Coast and North Kent Marshes), which cover much of the wet grassland in the region. A high percentage of the remaining resource is now afforded protection under SSSI, SPA and Ramsar designations (see also Chapter 7). In the 1990s, major development proposals on Coldharbour and Ridham Marshes and the Swale Estuary wet grasslands were refused planning permission, partly on conservation grounds.

Along the Essex coast, areas of wet grassland have been lost or have reverted to saltmarsh as a result of breaches in sea walls caused by storms. Examples include Bridgemarsh Island, Brandy Hole and North Fambridge Marsh, on the River Crouch, and areas around Hamford Water. In Essex, wet grassland is also being converted to saltmarsh in 'managed retreat' schemes: sections of sea wall are removed, allowing tidal flooding of the grassland and its reversion to saltmarsh. This has the benefit of improving natural sea defences and reducing the cost of maintaining the sea wall, as well as taking land out of agricultural production and recreating natural upper saltmarsh and transitional marsh, both of which are rare habitats in south-east England. An experimental scheme was first undertaken at Northey Island, Essex. The success of this small-scale scheme led to larger-scale schemes elsewhere on the Essex coast, for example at Tollesbury and elsewhere around the Blackwater Estuary. It has been recognised that managed retreat has conservation implications, since good quality wet grassland is also a rare habitat. Conversion of wet grassland to saltmarsh can also occur without removal of the sea wall. On grassland at Horsey Island in Hamford Water (and on arable land around the Blackwater Estuary), water is allowed onto a levelled area through a tidal sluice, thus leading to the creation of saltmarsh. To increase the naturalness of the saltmarsh, new creeks are being dug to replace the man-made ditch system.

Management for conservation is an important use of wet grassland in this region. However, in isolated or fragmented sites, water level management can pose problems, since maintaining high water levels on protected areas may not be compatible with the agricultural use of adjacent land. Within this region, English Nature, the Environment Agency, the National Trust, MAFF, the RSPB and local Wildlife Trusts all contribute resources to the management and enhancement of wet grassland. Traditional management of sites has persisted in some places and is now actively encouraged through the three ESA schemes. Many of the better sites are covered by management agreements that involve the retention of grazing and the maintenance of high water levels, and many areas have been bought by nature conservation organisations. For example, management at the North Warren Reserve on the Suffolk coast has led to much improved breeding and wintering bird populations. On Walland Marsh, conversion of arable land to wet grassland has been instigated by a private landowner, under a management agreement with English Nature, funded by the Countryside Stewardship Scheme. This has proved to be a success for birds, with breeding species such as redshank *Tringa totanus* benefiting from the raised water levels and new scrapes. Areas of grassland can be managed for the benefit of brent geese, which are increasingly using the improved coastal grasslands of the Essex Coast. For this reason, areas of improved grassland have been included in the Blackwater Estuary SSSI.

3.5.4 Information sources used

There are many sources for information on lowland wet grassland within this region, and there are survey data for many sites (see section 3.5.6). A number of studies have summarised the extent of coastal wet grassland within the region. The Suffolk Wildlife Trust has published a full audit of the county's natural habitats in *Suffolk's changing countryside* (Beardall & Casey 1995). The data come from Phase 1 survey of the county with follow-up Phase 2 surveys of semi-natural habitats. There is a full Phase I survey of habitats in Kent, which specifically identifies the extent of coastal grazing marsh. The County Wildlife Report for Kent (Kent Wildlife Habitat Survey Partnership 1995) estimated that there were 4,877 ha of coastal grazing marsh/wet grassland in the county; however this study used a more specific definition of coastal grazing marsh, which emphasised its affinity with saltmarsh and excluded both semi-improved and improved pasture with ditches (Delaney 1991). For example, Thornton & Kite (1990) recorded 7,675 ha of grazing marsh in the North Kent Marshes alone. Thornton & Kite (1990) collated data from a number of sources to describe the loss of wet grassland/grazing marshes in the Greater Thames Estuary,

Table 3.5.3 Loss of wet grassland resource in Region 7 (approx. areas)

Location	*Former area*		*Recent area*		*Loss*	*Reference*
	ha	*date*	*ha*	*date*	*%*	
East Essex Marshes	11,749	1938	2,083	1981	82	Williams & Hall (1987)
Thames Estuary	13,300	1935	4,600	1989	65	Thornton & Kite (1990)
Greater London					85	Thornton & Kite (1990)
Essex					25	Thornton & Kite (1990)
Kent					50	Thornton & Kite (1990)
North Kent Marshes	14,750	1935	7,675	1982	48	Williams *et al.* (1983)
Romney Marsh	16,083	1936	7,466	1988	54	Mountford & Sheail (1989)

Source: Thornton & Kite (1990).

which suggested that there are approximately 22,000 ha of wet grassland/grazing marsh in the region. All the wet grassland within SSSIs in Essex has been surveyed using the National Vegetation Classification (NVC) (Rodwell 1992, 1995). There are ornithological data (breeding and wintering birds) for most of the sites and many are counted under the Wetland Bird Survey (Waters *et al.* 1996). In Kent, a list of indicator species is used to distinguish coastal grazing marsh as a distinctive type of wet grassland (Kent Wildlife Habitat Survey Partnership 1995). In 1995, a ditch survey was undertaken on the North Kent Marshes and the plant communities of the ditches were classified using TWINSPAN analysis (English Nature 1996).

Coastal wet grassland has been the subject of much research, particularly on the impacts of changes in land use on its conservation value. Williams *et al.* (1983) examined the impact on birds of improved drainage and conversion to arable on the Chetney Peninsula in the Medway. This work showed that birds typical of wet grassland, and a number of other common countryside birds, bred in much lower numbers, if at all, on the arable areas, when compared with the remaining unimproved areas. Studies elsewhere, however, have shown that the flora and fauna of ditches on arable land converted from wet grassland may be as rich in conservation interest as those on pasture. This indicates the potential conservation interest of agriculturally improved wet grassland, especially of the aquatic habitats, which may have been under-estimated in this region.

3.5.5 Acknowledgements

Thanks are due to Steve Gilbert (RSPB), Linda Davis (Kent County Council) and Julian Roughton (Suffolk Wildlife Trust) for their comments on the draft text.

3.5.6 Further sources of information

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B. Further reading

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Lowland wet grassland in Suffolk	*English Nature Suffolk Team, Bury St. Edmunds, tel: 01284 762218
Lowland wet grassland in Essex, Hertfordshire and London	*English Nature Essex, Hertfordshire and London Team (Colchester), tel: 01206 796666, and (London) tel: 0171 831 6922
Lowland wet grassland in Kent	*English Nature Kent Team, Wye, tel: 01233 812525
Lowland wet grassland, national context	*English Nature HQ, Peterborough, tel: 01733 455000

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

3.6 Saltmarsh

Dr M.I. Hill

3.6.1 Introduction

This is one of the most important regions in Britain for saltmarshes. They are important not only because of their individual size and total extent, but also for the number of uncommon plants, insects and birds that they support. Saltmarshes also play a crucial role in the coastal defence of this low-lying region.

The total area of saltmarsh in this region recorded in the National Saltmarsh Survey (Burd 1989a, b, c) was 7,261 ha, representing approximately 23% of the resource in England and 33% of that on the North Sea Coast (Table 3.6.1). 590 km of the region's coast is fronted by saltmarsh, 44% of the total length. In Essex the figure is 59%, compared with 34% in both Suffolk and Kent and less than 2% in Greater London. In terms of area, Essex, with its deeply indented coastline, has the most saltmarsh, and the largest individual areas are found in the estuaries of the county, along with the Medway Estuary in Kent. In Greater London, only small fragments of saltmarsh remain, in the inner Thames.

Saltmarsh is also found around brackish lagoons, for example at Benacre and Easton Broads, between Dunwich and Walberswick and at Dungeness. It is widespread around brackish borrow dykes in reclaimed land and is found in the silt lagoons at Rainham Marshes. Saltmarsh can also be found some distance from the sea, notably in the Blyth Estuary, where breaching of sea walls has created an area of saltmarsh connected to the sea by a canalised section.

Map 3.6.1 Saltmarsh sites surveyed in National Saltmarsh Survey (Table 3.6.2). Source: JNCC Coastal Database.

3.6.2 Important sites and species

Sites surveyed during the national survey are listed in Table 3.6.2 and shown on Map 3.6.1. The largest areas of saltmarsh in the region are found in Hamford Water and in the Colne, Blackwater, Crouch and Medway estuaries.

A typical saltmarsh zonation in the region is from a pioneer zone of common cord-grass *Spartina anglica* or glasswort *Salicornia* spp. to a low marsh of common saltmarsh-grass *Puccinellia maritima*, often with a higher proportion of sea aster *Aster tripolium* than in other regions. The middle marsh zones are generally a mosaic of sea-purslane *Halimione portulacoides* and common saltmarsh-grass communities, often with abundant common sea-lavender *Limonium vulgare*, thrift *Armeria maritima* and sea arrowgrass *Triglochin maritima*. Sea wormwood *Artemisia maritima* is found in the higher marsh zones. Upper marsh communities are not well represented because of the region's history of land claim, which enclosed the higher saltmarsh with sea walls and converted it to agricultural use. The driftline, at the base of the sea wall, generally comprises common couch *Elymus repens* or sea couch *E. pycnanthus*.

Past land claim means that natural transitions from saltmarsh to other habitats are also of very limited extent in this region. In the Upper Colne and Deben Estuaries there are transitions from saltmarsh through upper marsh swamps to blackthorn *Prunus spinosa* scrub. In the Blackwater there are transitions to grassland on Ray Island and to freshwater

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

	Spartina	*Pioneer*	*Low-mid*	*Mid-upper*	*Drift-line*	*Upper swamp*	*Trans-ition*	*Wet depression*	*Total*	*% of region total in county*	*% of area total in region*
Suffolk	156	155	493	253	56	58	13	0	1,279	17.6	
Essex	211	342	2,368	1,571	104	41	0	0	4,637	63.9	
Kent	195	102	791	215	32	7	4	0	1,345	18.5	
Region 7	***562***	***600***	***3,652***	***2,038***	***191***	***107***	***17***	***0***	***7,261***	-	
England	5,166	2,641	10,299	9,948	1,493	686	833	0	31,533	-	23.0
North Sea Coast	3,461	2,130	8,194	4,772	1,350	1,066	342	2	21,788	-	33.3
GB	6,948	3,470	12,353	16,042	1,824	1,475	1,670	2	44,370	-	16.4

Source: National Saltmarsh Survey (Burd 1989a, b, c). Key: *to the nearest whole hectare. Note: sites not surveyed in detail (94 ha) are included in totals but not subdivided by communities.

Table 3.6.2 Saltmarsh sites surveyed

Location	*Grid ref.*	*Area (ha*)*
Suffolk		
River Alde	TM392576-TM460554	163
Orford Ness	TM464551-TM385435	117
Havergate Island	TM415475	29
Butley River	TM388518-TM402472	124
River Ore	TM491553-TM367440	130
River Deben	TM288503-TM310378	461
River Orwell	TM163420-TM265340	119
Essex		
River Stour - north	TM103325-TM236341	137
River Stour - south	TM109320-TM255319	160
Hamford Water	TM230255	863
Colne Estuary	TM075155	671
River Blackwater	TL858075-TM071154	1,103
Dengie	TM035040	405
Crouch Estuary (including Bridgemarsh Island)	TQ785949-TQ025963	468
Roach Estuary/Foulness	TQ966905	591
Greater London		
North Thames	TQ735875-TQ836856	377
South Thames	TQ700760-TQ865785	78
Kent		
Medway Estuary	TQ850710	754
Swale Estuary	TQ895725-TR052679	414
Pegwell Bay	TR339620-TR356643	37
River Stour	TR337606	62

Source: National Saltmarsh Survey (Burd 1989a, b, c); JNCC Coastal Database. Key: *to nearest whole hectare.

marsh on the West Mersea coast. Transitions to sand dune and shingle are found at Colne Point. Sea walls at the back of the saltmarsh harbour many species that would usually be found in the upper marsh zones.

Saltmarshes in this region contain many nationally scarce plants (Stewart *et al.* 1994), mainly in the mid-upper marsh zones, driftlines and transitions to other habitats. They include small cord-grass *Spartina maritima*, one-flowered glasswort *Salicornia pusilla*, perennial glasswort *Sarcocornia perennis*, lax-flowered sea-lavender *Limonium humile*, marsh-mallow *Althaea officinalis* and curved hard-grass *Parapholis incurva*, all plants of the mid-upper marsh zones. Other examples are shrubby sea-blite *Suaeda vera* and golden samphire *Inula crithmoides*, which are found as a characteristic community on the driftline at the base of the sea wall; a further nationally scarce plant, sea-heath *Frankenia laevis*, may be found with these two species, usually in transitions from saltmarsh to dune/shingle.

Some nationally scarce species that are mostly found on coastal wet grassland (see section 3.5) also occur on the saltmarsh at some sites. These include Borrer's saltmarsh-grass *Puccinellia fasciculata* and stiff saltmarsh-grass *Puccinellia rupestris*. Slender hare's-ear *Bupleurum tenuissimum*, sea clover *Trifolium squamosum* and sea barley *Hordeum marinum*, all brackish wet grassland and saltmarsh species, are particularly associated with sea walls in this region.

The three British species of eelgrasses, narrow-leaved eelgrass *Zostera angustifolia*, eelgrass *Z. marina* and dwarf eelgrass *Z. noltii*, all nationally scarce, are present in intertidal and subtidal zones in the region (see section 4.2). The Red Data Book (nationally rare) species pedunculate sea-purslane *Atriplex pedunculata* is found on the saltmarsh of the River Crouch Marshes, its only site in Britain.

Table 3.6.3 Erosion of saltmarsh at selected sites

Location	*Area in 1973 (ha*)*	*Area in 1988 (ha*)*	*% of 1973 area lost by erosion*
River Orwell	106	71	33
River Stour	268	150	44
Hamford Water	944	765	19
Colne Estuary	847	745	12
River Blackwater	961	740	23
Dengie	486	437	10
Crouch Estuary	475	347	27
North Thames	399	307	23
South Thames	90	74	18
Medway Estuary	957	756	21
Swale Estuary	442	376	15

Source: Burd (1992) Key: *to nearest whole hectare

Many rare and uncommon insects have been recorded from saltmarshes in this region. The moth fauna is of particular interest (see section 5.3) and includes the ground lackey moth *Malacosoma castrensis* and Fisher's estuarine moth *Gortyna borelii lunata*, which in Great Britain occur only on the saltmarshes of the region.

Saltmarshes in this region are high-tide roosting sites for waders and feeding areas for wildfowl such as pintail *Anas acuta*, wigeon *A. penelope* and dark-bellied brent geese *Branta bernicla bernicla* (see section 5.12). They also provide food for wintering flocks of twite *Carduelis flavirostris*, Lapland buntings *Calcarius lapponicus*, shore larks *Eremophila alpestris* and snow buntings *Plectrophenax nivalis*. The saltmarsh islands hold colonies of common terns *Sterna hirundo* and black-headed gulls *Larus ridibundus*. Saltmarshes are also breeding sites for waterfowl such as redshank *Tringa totanus* and shelduck *Tadorna tadorna* (Cook *et al.* 1994).

Saltmarshes in this region are experiencing erosion that is at least partly due to the relative rise in sea level and the associated changes in the wave climate. Erosion has been episodic for centuries, but many areas appeared to show an acceleration in the rate in the 1970s, which has continued up to the present (Pye & French 1993). Losses at selected sites in the region between 1973 and 1988 are shown in Table 3.6.3. Between 1973 and 1988, saltmarshes from the Orwell (Suffolk) to the Stour (Kent) showed substantial losses to erosion, averaging 20% of the original area (Burd 1992). The proportion of the marsh lost was highest in the Stour and Orwell Estuaries and lowest in the Colne and on the Dengie Peninsula. Most erosion was of the seaward face and of pioneer vegetation. New areas of erosion and disintegration were also found within the marshes and there was some evidence of headward erosion of creeks and an increase in the the area occupied by the creek drainage system. Over this period, the saltmarsh vegetation changed, with an increase in the proportion of low marsh types at the expense of mid and upper marsh communities.

Nearly all the remaining saltmarsh in this region is within SSSIs, and much is also within SPA/Ramsar sites (see section 7.2). SSSIs containing saltmarsh are listed in Table 3.6.4.

Table 3.6.4 SSSIs in region containing saltmarsh

Suffolk
Benacare to Easton Bavents
Minsmere - Walberswick Heath and Marshes
Orfordness - Havergate
Deben Estuary
Orwell Estuary

Essex
Stour Estuary
Hamford Water
Upper Colne Marshes
Colne Estuary
Old Hall Marshes
Blackwater Estuary
Dengie
Crouch and Roach Estuaries
Foulness
Benfleet and Southend Marshes
Pitsea Marsh
Vange and Fobbing Marshes
Mucking Flats and Marshes
West Thurrock Lagoons

Greater London
Inner Thames Marshes

Kent
South Thames Estuary and Marshes
Medway Estuary and Marshes
The Swale
Thanet Coast
Sandwich Bay and Hackling Marshes

Kent/East Sussex
Dungeness

Sources: English Nature; JNCC Coastal Database.

3.6.3 Human activities

Saltmarshes in this region have a long history of land claim for agriculture, which historically has been the main impact on saltmarshes in the region, having taken place on a large scale since medieval times. Some sites have gone through cycles of land claim and abandonment. In many estuaries in the region common cord-grass *Spartina anglica* was planted in the 1920s and 1930s to promote the formation of saltmarsh, ultimately for land claim. The species was effective in colonising mudflats for several decades, but in recent years has declined in area.

Much of the coastline is protected from flooding by sea defences, with saltmarsh on their seaward side. Saltmarsh plays an important part in sea defence by reducing the energy of waves reaching the sea wall and acting as a reservoir of sediment which can be released to the mudflats during storms. Where there is healthy saltmarsh, a simple clay embankment often provides a sufficient standard of defence; however, if the saltmarsh erodes it may be necessary to strengthen or raise the sea wall. For this reason, the loss of saltmarsh has considerable implications for the type and cost of sea defences. Activities such as dredging and past saltmarsh reclamations may exacerbate the problem of erosion due to sea-level rise.

Various options are being considered to slow saltmarsh erosion. These include offshore breakwaters or recharging with new sediment (Carpenter & Brampton 1996) to extend the seaward limit of saltmarsh. At many sites the old sea walls have failed and new saltmarshes have been formed to landward of them (IECS 1992, 1994a). In some locations, this is part of a planned process of managed retreat in which the sea defence line is set further to landward and tidal water is allowed to flood the pasture, which should then revert to saltmarsh. Sites where this has been carried out are at Northey Island, Orplands and Tollesbury Wick (IECS 1994c) in the Blackwater Estuary. At Horsey Island, Hamford Water, a sluice is being used in reverse to create saltmarsh behind a sea wall (Carpenter & Brampton 1996). Similarly at Abbots Hall saltings on the Blackwater, sea water is allowed in through a sluice, but here an artificial creek system has also been created.

Saltmarshes in the region are used for grazing, reed-cutting, turf-cutting and wildfowling. Other uses in the region include an MoD firing range, boat mooring and oyster pits. Many saltmarshes are within nature reserves and are managed for nature conservation. Port developments can cause the loss of saltmarsh: for example, the recent expansion of Felixstowe Dock removed 14.5 ha of saltmarsh, about 20% of the resource in the Orwell Estuary.

3.6.4 Information sources used

Saltmarshes in this region were covered by the National Saltmarsh Survey (Burd 1989a, b, c). For most of Suffolk and Kent and all of Essex, surveys were carried out in 1973 (Boorman & Ranwell 1977) and the areas of saltmarsh now present are significantly smaller. The national survey did not cover all sites (excluding, for example, the Blyth Estuary), or saltmarsh around some lagoons. Nevertheless, the national survey provides the most complete coverage and contains regionally-comparable data. More recent saltmarsh survey data are available for the coast between the Orwell and the Swale Estuaries, which were mapped from aerial photographs and surveyed using the National Vegetation Classification (NVC) in 1988/9 (Burd 1992; Rodwell in press). Detailed comparisons were made with the 1973 survey using a Geographic Information System (GIS) to find out the extent of saltmarsh erosion. Surveys of individual sites are available, e.g. that by Pardon (1985) for the marshes fringing the River Darent in Kent. There are many other studies of saltmarshes in this region. These include research projects on productivity and plant ecology, particularly in the Colne and Stour Estuaries (Hussey 1980; Hussey & Long 1982; Long & Woolhouse 1979; Othmann 1980); on erosion and sediments in the Medway Estuary (Kirby 1984); on tidal flows and sediments at Dengie (Reed 1988; Reed *et al.* 1985); and on metal contamination (O'Reilly Weise *et al.* 1995).

Detailed monitoring schemes are in place for managed retreat sites (e.g. Dagley 1995; IECS 1994b). Investigations including vegetation and sediment surveys have been carried out at sites of natural sea wall failure in Essex to inform the application of managed retreat (IECS 1992; 1994a).

The Suffolk Wildlife Trust has published a full audit of the county's natural habitats in *Suffolk's changing countryside* (Beardall & Casey 1995), which estimated the area of saltmarsh in the county to be 1,154 ha. The data come from Phase 1 survey of the county with follow-up Phase 2 surveys of semi-natural habitats.

3.6.5 Acknowledgements

The author is grateful to Fiona Burd for reviewing this section, and to staff of English Nature, who kindly provided information and reference material. Julian Roughton (Suffolk Wildlife Trust) also commented on the draft.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Data from National Saltmarsh Survey	*Coastal Data Custodian, JNCC, Peterborough, tel: 01733 562626
Saltmarsh sites in England	*Coastal Ecologist, English Nature HQ, Peterborough, tel: 01733 455000
Saltmarsh sites, Suffolk	*English Nature, Suffolk Team, Bury St. Edmunds, tel: 01284 762218
Saltmarsh sites, Essex, Greater London	*English Nature, Essex, Hertfordshire and London Team, Colchester, tel: 01206 796666
Saltmarsh sites, Kent	*English Nature, Kent Team, Wye, tel: 01233 81252
Coastal defence and managed retreat	Eastern Area Office, Environment Agency, Cobham Road, Ipswich, Suffolk IP3 9JE, tel: 01473 727712

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

Chalk on the foreshore around the Thanet coast is famous for its algal communities, including the kelp *Laminaria digitata* here at Fulsam Rock, Margate. The chalk is also home to millions of piddocks, a group of unusual rock-boring invertebrates, which give the surface its pock-marked appearance. Photo: Marine Nature Conservation Review, JNCC.

Chapter 4 Marine and estuarine environments

4.1 Estuaries

Dr N.C. Davidson

4.1.1 Introduction

Estuaries are "partially enclosed tidal areas at least partly composed of soft tidal shores, open to saline water from the sea, and receiving fresh water from rivers, land run-off or seepage" (Davidson *et al*. 1991). They comprise both aquatic (marine, brackish and fresh water) and terrestrial habitats, including adjacent sand dunes, coastal grasslands and maritime heaths. All the estuaries discussed here are covered by the NCC Estuaries Review (Davidson *et al.* 1991) and have at least 2 km of tidal channel or 2 km of shoreline over 0.5 km wide at low tide. Note that for the large and complex shoreline of Essex and north Kent the Estuaries Review treated each component estuary and intervening open soft shore separately, the whole area of contiguous estuarine coast combining to form the 'Greater Thames Estuary'. This section gives an overview of the main features of the estuarine resource in Region 7; for further details of habitats, species and human uses refer to relevant sections in Chapters 3, 5 and 9 respectively.

The predominantly low-lying and sedimentary coastline of this region is dominated by its estuaries, which together form one of the largest and most important areas of estuarine habitat in the UK and Europe. The total estuarine area in the region comprises almost 3% of the north-west European resource (Davidson *et al.* 1991). The topography of the region is dominated by the continuous soft shores of the Greater Thames Estuary, which, taken from Colne Point in the north to Whitstable in the south, covers 960 km of estuarine shoreline and, at over 32,300 ha of intertidal flats and saltmarshes, forms the second largest intertidal area in the UK (the largest being Morecambe Bay).

The contribution to the wider resource of the eighteen estuaries in Region 7 (Map 4.1.1) is summarised in Table 4.1.1. The 55,300 ha of the region's total estuarine area forms over

Map 4.1.1 Estuaries. Source: JNCC Estuaries Database.

21% of the North Sea resource and almost 10% of the UK resource. In this sediment-rich region the intertidal area of the estuaries forms an even larger component of the national resource: over 28% of the North Sea Coast and almost 12% of the UK intertidal area. The region is particularly notable for its large and diverse saltmarshes (see section 3.6), and fringing many parts of the estuaries in this low-lying landscape are important areas of coastal wet grassland (see section 3.5).

At almost 45,000 ha the ten component estuaries of the Greater Thames Estuary form over 80% of the region's

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

Resource	*Region 7 total (ha/km)*	*North Sea Coast total (ha/km)*	*% North Sea Coast*	*GB total (ha/km)*	*% GB*	*UK total (ha/km)*	*% UK*
Intertidal area	38,860	136,580	28.4	321,050	12.1	332,350	11.7
Saltmarsh area	7,360	20,650	30.5	48,380	13.0	+	+
Total estuarine area	55,300	258,100	21.4	525,650	10.4	581,290	9.5
Shoreline length	1,336	5,645	23.7	9,054	13.8	9,730	12.9
Longest channel length	384	1,484	25.9	2,461	14.5	2,640	13.6

Sources: Buck (1997a, b); Davidson & Buck (1997). Key: *to the nearest 10 ha/1 km; +areas of saltmarsh were not available for Northern Ireland or, consequently, the UK. Note: saltmarsh also occurs outside estuaries as defined in this section (see section 3.6).

estuarine area. The largest single site is Maplin Sands (11,500 ha), with elsewhere only the Blackwater (over 5,000 ha) and Medway (almost 6,500 ha) estuaries exceeding 5,000 ha in total area. Most of the other estuaries in the region are between 1,000-3,000 ha. Intertidal sediments are distributed proportionally, and most of the region's estuaries have substantial intertidal flats.

The region has had abundant supplies of sediments, largely reworked from offshore glacial deposits, and many of the estuaries are predominantly intertidal, with only narrow tidal channels remaining water-filled at low tide. Only in Oulton Broad, the Orwell Estuary and the Inner Thames Estuary is much of the estuary subtidal. Most of the tidal flats in the region are soft muds and silts deposited within the sheltered channels; sandflats are restricted to the more exposed and open coast parts of the Greater Thames Estuary and in Pegwell Bay.

Tidal ranges vary considerably across the region. They are smallest (around 2 m spring tide range) in north Suffolk and largest (4.6-6.5 m) in the estuaries of the Greater Thames, the largest range being in the Inner Thames where the tide is funnelled up the estuary. Eleven of the estuaries are macrotidal (>4 m spring tidal range), six are mesotidal (2-4 m tidal range) and one, Oulton Broad, is microtidal (<2 m tidal range), one of only six such estuaries in Britain.

Low-lying surrounding land and rising relative sea levels mean that almost all estuarine shores in the region are defended by sea walls, chiefly earth banks. Nevertheless many parts of most of the region's estuaries remain rural, providing important areas of wild landscape in the otherwise densely populated south-east of England.

The estuaries in this region have substantial geomorphological, wildlife and nature conservation interest, and all are wholly or largely notified as Sites of Special Scientific Interest. Their great national and international nature conservation significance is also indicated by nine estuaries containing one or more National Nature Reserves, fifteen being designated Ramsar sites and/or Special Protection Areas, and parts of the Ore-Alde-Butley, Pegwell Bay and several of the Essex estuaries falling within candidate Special Areas of Conservation (SAC). Many parts of the wet grasslands and other surrounding areas fall within four Environmentally Sensitive Areas, and the Suffolk estuaries lie within an Area of Outstanding Natural Beauty. All but three of the region's estuaries are individually internationally important for their wintering waterfowl populations, and the Greater Thames Estuary supports in excess of 200,000 waterfowl in midwinter, making it one of the most important parts of the UK and Europe for these birds (see section 5.12). In addition the region's estuaries are the centre of the small but now expanding British breeding population of avocets *Recurvirostra avosetta*.

Table 4.1.2 Physical characteristics of Region 7 estuaries

Estuary	*Centre grid ref.*	*Geomorphological type*	*Total area (ha*)*	*Inter-tidal area (ha*)*	*Saltmarsh (ha*)*	*Shoreline length (km)*	*Main channel length (km)*	*Spring tidal range (m)*	*Sub-tidal %*
Norfolk/Suffolk									
104. Oulton Broad	TM5192	Bar-built	129	30	0	6.8	20.1	1.9	76.7
Suffolk									
105. Blyth (Suffolk)	TM4776	Bar-built	311	235	79+	25.4	10.8	2.1	24.4
106. Ore-Alde-Butley	TM4357	Bar-built	1,821	1,332	562	73.2	28.0	2.2	26.9
107. Deben Estuary	TM2945	Coastal plain	1,007	687	461	49.8	19.7	3.2	31.8
108. Orwell Estuary	TM2338	Coastal plain	1,786	576	119	50.7	20.1	3.6	67.7
Suffolk/Essex									
109. Stour Estuary	TM1833	Coastal plain	2,531	1,637	297	48.1	19.6	3.6	35.3
Essex									
110. Hamford Water	TM2325	Embayment	2,377	1,570	863	54.0	8.3	3.8	34.0
111. Colne Estuary	TM0617	Coastal plain	2,335	2,002	671	89.6	16.2	4.6	14.3
112. Blackwater Estuary	TL9507	Coastal plain	5,184	3,315	1,103	107.5	21.2	4.6	36.1
113. Dengie Flat	TM0504	Linear shore	2,986	2,986	405	17.5	0	5.0	0
114. Crouch-Roach	TQ9694	Coastal plain	2,754	1,536	838	158.5	29.6	5.0	44.2
115. Maplin Sands	TR0087	Linear shore	11,519	9,443	221	18.2	0	4.6	18.0
116. Southend-on-Sea	TQ8984	Linear shore	2,737	2,528	395	71.7	8.8	5.2	7.6
Essex/Greater London/Kent									
117. Inner Thames Estuary	TQ6675	Coastal plain	4,745	1,126	0	232.0	82.5	6.5	76.3
Kent									
118. South Thames Marshes	TQ8180	Linear shore	2,487	2,439	78	30.6	4.7	5.2	1.9
119. Medway Estuary	TQ8471	Coastal plain	6,441	4,008	754	143.4	40.9	5.1	37.8
120. Swale Estuary	TR0066	Coastal plain	3,283	2,696	414	79.3	18.4	4.9	17.9
121. Pegwell Bay	TR3563	Embayment	863	709	99	79.9	35.1	4.5	17.8

Sources: Burd (1989a, b, c); Buck (1997a, b); JNCC Coastal Database. Key: *to the nearest whole hectare; +not covered by the National Saltmarsh Survey: this area calculated from 1991 aerial photographs (Buck 1997a). Notes: since Burd (1989) there have been substantial reductions in saltmarsh area in Essex and north Kent estuaries (see Burd 1992). Estuary numbers are those used in Davidson *et al.* (1991). 'Geomorphological type' relates to nine estuary categories, described further in Chapter 5.7 of Davidson *et al.* (1991). 'Spring tidal ranges' are for the monitoring station closest to the mouth of the estuary.

4.1.2 Important locations and species

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

On the northern border of the region Oulton Broad is a much modified estuary extending between the River Waveney and the narrow channel that passes through the docks of Lowestoft. The Blyth Estuary had become canalised by the early 19th century, with its intertidal flats claimed as wet grassland; however by the 1840s the sea walls had begun to breach and much of the former mid-estuary has now reverted to mudflats and saltmarshes. In the upper reaches and around the mouth there remains a narrow canalised tidal channel bordered by wet grassland. The inner part of the Ore-Alde-Butley is a broad, shallow basin of mudflats, which reaches within 100 m of the sea just south of Aldeburgh. Here, as the River Alde, it becomes a narrow tidal channel deflected southwards by the 17.5 km long Orford Ness shingle spit, now artificially defended at its narrowest point to prevent breaching. Over the last few centuries Orford Ness has progressively extended southwards, sheltering the small port of Orford by the 12th century, then enclosing the low-lying Havergate Island and extending beyond the formerly separate estuary of the Butley.

In south Suffolk are the sinuous estuaries of the Deben and the Orwell, both retaining much of their natural landscape. Each has a relatively narrow tidal channel fringed by soft mudflats and extensive saltmarshes. The Deben has been much modified by agricultural land-claim, although some claimed areas have now reverted to saltmarsh. The only urban part of the Deben is Woodbridge at the head of the estuary. The Orwell and the Stour Estuary to the south discharge through a joint mouth at Harwich Harbour. Like the Orwell, much of the Stour Estuary's extensive tidal flats and fringing saltmarsh lie in several broad bays. The diversity of habitats in the Stour is enhanced by wet grassland around its tidal limit and, unusually for this region, a natural transition from saltmarsh to ancient woodland.

Hamford Water has only limited freshwater inflows from streams and drains and is a mosaic of low-lying islands, mudflats, creeks and saltmarshes. Many of the islands are former saltmarshes embanked and converted to wet grassland, but some are now reverting to saltmarsh after sea walls have been breached. Hamford Water supports a diverse wintering waterfowl population and breeding gulls and terns; it also has many nationally scarce plants and a rich terrestrial invertebrate fauna, notably including Fisher's estuarine moth *Gortyna boreleii*, for which it is the only site in Britain.

The south Essex coast is a complex of estuaries, tidal creeks, saltmarshes and vast tidal mud and sandflats off the low-lying peninsulas and islands of the outer Thames Estuary. The central part of this estuarine complex, comprising the Blackwater and Crouch-Roach Estuaries separated by the Dengie Peninsula and Foulness Island, is largely rural and undeveloped. The very large intertidal mudflat and shingle bank system of Maplin Sands is particularly isolated since much of it has only very restricted access from the Ministry of Defence establishments on Foulness. Much of Foulness Island

Table 4.1.3 Human influences and water quality in Region 7 estuaries

Estuary+	*Centre grid ref.**	*Human use type*				*Water quality*
		urban	*industrial*	*rural***	*recreational*	
Norfolk/Suffolk						
104. Oulton Broad	TM5192	●	●	○	●	A
Suffolk						
105. Blyth (Suffolk)	TM4776			●	●	A
106. Ore-Alde-Butley	TM4357			●	●	A
107. Deben Estuary	TM2945	○		●	●	B,A
108. Orwell Estuary	TM2338	●	●	●	●	D,C,B,A
Suffolk/Essex						
109. Stour Estuary	TM1833	●	○	●	●	A
Essex						
110. Hamford Water	TM2325			●	●	A
111. Colne Estuary	TM0617	○	○	●	●	(B),A
112. Blackwater Estuary	TL9507	○	○	●	●	A
113. Dengie Flat	TM0504			●	●	-
114. Crouch-Roach	TQ9694	○		●	●	A
115. Maplin Sands	TR0087			●	○	-
116. Southend-on-Sea	TQ8984	●	●	●	●	A
Essex/Greater London/Kent						
117. Inner Thames Estuary	TQ6675	●	●	○	●	A,B
Kent						
118. South Thames Marshes	TQ8180	○	○	●	●	A
119. Medway Estuary	TQ8471	●	●	●	●	A
120. Swale Estuary	TR0066	○	○	●	●	B,C,B,A
121. Pegwell Bay	TR3563	○	○	●	●	B

Sources: Buck (1997a, b); National Rivers Authority (1991). Key: +estuary names and numbers are those used in Davidson *et al.* (1991); *central point; **includes natural resource exploitation; ● = major; ○ = minor. Water quality: A = good, B = fair, C = poor, D = bad; multiple water quality codes are in downstream sequence; brackets indicate a water quality found in only a small part of the estuary.

and the outer part of Dengie is former saltmarsh, now enclosed as wet grassland and arable farmland. In several places, such as Bridgemarsh Island in the Crouch Estuary, sea walls have failed and wet grassland has reverted to saltmarsh and mudflat; at Northey Island and elsewhere in the Blackwater sea walls have now been deliberately breached to permit saltmarsh re-establishment. The whole complex supports wintering waterfowl populations of major international importance.

The Thames Estuary is much more heavily populated and industrialised. A broad muddy sandflat fronts Southend-on-Sea, upstream of which lie the muddy creeks, saltmarshes and eelgrass *Zostera* beds around the industrial complexes of Canvey Island, and remnant areas of wet grassland. Much of the shoreline upstream is artificial and many intertidal areas have been claimed since Roman times; today much of the estuary is a narrow channel with only very narrow fringing mudflats. Formerly extensive wet grassland areas downstream of London have been much fragmented and have largely disappeared under industry, housing and infrastructure. Nevertheless some natural shorelines with grassland transitions remain in the upper reaches of the estuary. These and the large lagoons at Cliffe along the southern shore support a wide variety of plant and invertebrate species.

On the Kent shore of the Greater Thames Estuary there are three contiguous estuaries downstream from the Inner Thames Estuary: the South Thames Marshes and the Medway and Swale Estuaries. The muddy flats of Blythe Sands make up much of the intertidal area of the South Thames Marshes, with only narrow fringing saltmarshes. Former, more extensive, saltmarshes were embanked to yield a large area of coastal wet grassland, which, despite the coversion of some parts to arable, remains of great wildlife importance. Between the Medway towns and the mouth of the river at Sheerness is a broad basin of tidal creeks and much fragmented saltmarsh islands, some of which were formerly enclosed by sea walls. This is the largest area of tidal flats and saltmarshes on the Thames' southern shore. Saltmarsh fragmentation has been caused in part by extensive former clay diggings, and many parts have subsequently eroded. The Swale, linking with the outer Medway at its western end, separates the Isle of Sheppey from the Kent mainland. The estuary is a narrow channel fringed by extensive mudflats and saltmarshes and bordered by large and important areas of wet grassland, especially on south Sheppey. Towards Whitstable at its eastern end the flats become more exposed and sandier, and there is a sand and shingle spit at Shell Ness, which shelters an area of saltmarsh grading to grassland.

On the channel coast of Kent, Pegwell Bay is the outer estuary of the River Stour, a narrow tidal channel for most of its length. The river discharges through a broad area of sand and mudflats, which support a rich invertebrate fauna.

4.1.3 Human activities

The region's estuaries have been very substantially modified by land claim, which has been occurring for centuries. Much of the early land claim enclosed saltmarshes to create brackish and freshwater wet grasslands. As well as substantially reducing the intertidal areas of surviving estuaries, agricultural land claim in the late 17th/early 18th century also entirely removed one tidal estuary in the region: Holland Haven, between Frinton-on-Sea and Clacton-on-Sea. The formerly extensive wet grasslands in the region have been much fragmented by conversion to extensive arable and improved grassland, urbanisation and quarrying. Since the 1930s this 'secondary land claim' has removed about 70% of Thames Estuary wet grasslands, 82% of those bordering east Essex estuaries, and around half the wet grasslands in north Kent. Industrial and dock developments have contributed to land claim in many of the region's estuaries, notably the Inner Thames Estuary, and more recently in the Orwell (around Ipswich and Felixstowe), Stour (Bathside Bay, Harwich) and Medway (Lappel Bank) Estuaries. Overall about 10,000 ha (*c.* 70% of the former intertidal area) of Suffolk estuaries have been claimed since the 13th century, and almost 12% of the Thames Estuary has disappeared, mostly before the 19th century. In several places in the region areas of agricultural land-claim are, however, being returned to their tidal state through managed retreat.

The region's coasts and their hinterland are amongst the most densely populated in the UK. Some estuaries, such as the Orwell and Medway, have conurbations in their upper reaches, and some, notably the Inner Thames Estuary, are highly developed. There are large ports near the mouths of several of the region's estuaries, and many are used extensively for recreation. Water-based recreation, with its associated shore-based facilities such as marinas, is intensive, especially in the Essex estuaries. All the estuaries retain some undeveloped areas, often wet grasslands, although only four (Blyth, Ore-Alde-Butley, Dengie Flat and Maplin Sands) are still predominantly rural.

The region has a major economic role, especially in its provision of sheltered docks and ports in close proximity to continental Europe, at Lowestoft, Felixstowe (Orwell), Harwich (Stour), Tilbury (Inner Thames), and Grain and Sheerness (Medway). Many of these ports serve both continental ferry traffic and container shipping. The sheltered Orwell has a long history of shipping use: there are the major docks and the industries and urban areas of Ipswich at its head, and at its mouth the port of Felixstowe has developed, extending progressively further upstream during the last 20 years over the muddy sand bay of Fagbury Flats. Harwich Harbour is now deeply dredged to maintain access to the ferry and container ports of Felixstowe and Harwich. The northern shore of the Stour Estuary is rural, in contrast to the more developed southern shore, which has the small port of Mistley on its upper reaches as well as docks at Parkeston Quay and Harwich. There are small docks and ports on the Colne Estuary, which also has the major conurbation of Colchester at its head, and at the head of the Blackwater lies the historic port of Maldon. Upstream of Canvey Island the Inner Thames Estuary is one of the most intensively urbanised and industrialised estuaries in the UK, dominated by Greater London and its docks, manufacturing and chemical industries and housing. The Medway has the major conurbation of Rochester, Chatham and Gillingham in its upstream parts and the oil refineries and ports of the Isle of Grain and Sheerness at its mouth. Power generation to meet the demands of the large population and industry of south-east England is also a significant use of estuarine shores in the region, with power stations on the Blackwater, Inner Thames and Medway.

Estuarine water quality varies considerably in the region. Although rated good in the more rural estuaries, it is only fair or poor in the upper reaches of several (Deben, Orwell, Colne, Swale and Pegwell Bay), where there is substaintial sewage

and/or industrial discharge. Substantial improvements have been made to water quality in the Inner Thames over the last 30 years, although quality remains only fair in the outer parts. The worst water quality in the region remains around Ipswich in the upper part of the Orwell, where enrichment from sewage discharge is coupled with very low summer river flows.

There is considerable natural resource exploitation, notably shellfisheries in the Colne Estuary (see sections 9.1 and 9.2); shellfish farming occurs throughout the region, which is notably for its long history of oyster production. Parts of some saltmarshes are grazed, and bait-collection is very widespread. Wildfowling occurs on many parts of most estuaries

Many estuaries in the region, including the Stour, the Orwell, the Colne, the Blackwater, the Thames, the Medway and the Swale, are the subject of management plans; several others are incorporated in other integrated planning initiatives such as the Essex Coastal Strategy and the North Kent Marshes Initiative (see Chapter 10).

4.1.4 Information sources used

This section is summarised chiefly from JNCC's *An inventory of UK estuaries*, being published in six regional volumes along with an introductory and methods volume. Estuaries in Region 7 are included in *Volumes 5 and 6* (Buck 1997a, b). Data presented in the inventory are drawn largely from material collected during 1989-90 (updated to 1996 where appropriate) for the NCC's Estuaries Review (Davidson *et al.* 1991). Saltmarsh data come originally from Burd (1989a, b, c), whose surveys covered mostly saltmarshes of >0.5 ha. Catchment areas and river flows are summarised in a five-year catalogue of river flow gauging stations (Marsh & Lees 1993), but note that for whole estuary data further interpretation is usually necessary.

4.1.5 Acknowledgements

Thanks go to Dr Pat Doody, Jeremy Hindle (Suffolk County Council) and Steve Gilbert (RSPB) for helpful comments on drafts.

4.1.6 Further sources of information

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B. Further reading

Further details of estuaries are in the *Coastal & marine UKDMAP datasets* module (Barne *et al.* 1994), available from JNCC, Peterborough. A list of selected further reading for each estuary in the region is given in Buck (1997a, b) (above).

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Integrated Coastal Database: national database of estuaries; coastal habitats; statutory and non-statutory protected sites. Summary data available also on UKDMAP (see Barne *et al.* 1994).	*Coastal Data Custodian, Joint Nature Conservation Committee, Peterborough, tel: 01733 562626
Statutory protected sites; detailed wildlife site information; coastal geomorphology plans. Numerical and some digitised data.	*Estuarine Ecologist/Estuaries Initiative Officer/Marine Ecologist, English Nature HQ, Peterborough, tel: 01733 455000
RSPB Estuaries Inventory: mapped and numerical information on land use and selected human activities for 57 major UK estuaries. In Region 7 the inventory covers all estuaries from the Deben south to the Swale.	*Estuaries Inventory Project Officer, RSPB, Sandy, tel: 01767 680551
National River Flow Archive: catchments and river flows from upstream gauging stations; interpreted analyses or whole estuaries.	National Water Archive Manager, Institute of Hydrology, Maclean Building, Crowmarsh Gifford, Wallingford, Oxfordshire OX10 8BB, tel: 01491 838800

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

4.2 The sea bed

R.A. Irving

4.2.1 Introduction

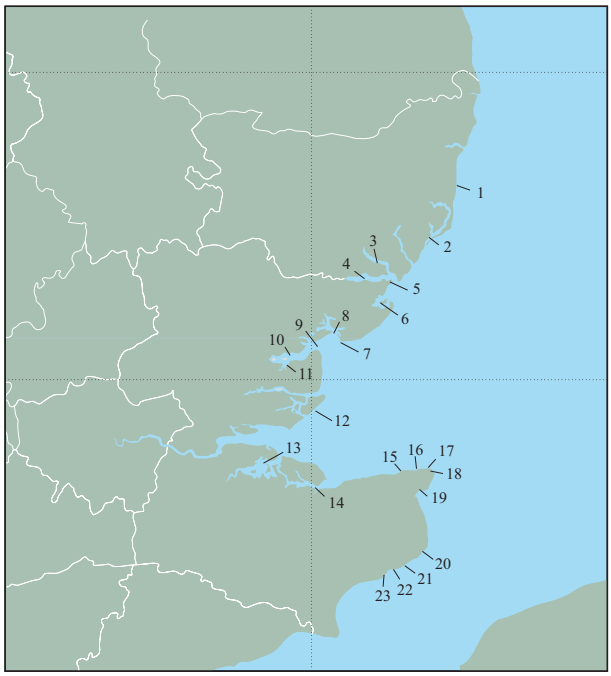
This section covers the occurrence and distribution of sea-bed habitats and groups of species that live on the sea bed (benthic communities, collectively called the benthos), both in the intertidal zone and on the sea bed; the distribution and occurrence of individually rare and scarce species is covered in section 5.4. Information on the precise extent of shore and sea-bed habitat types in a national context is not yet available.

There is a dearth of hard substrata in the region, and the presence of strong coastal currents makes the bottom sediments of the inshore waters of the East Anglian coast some of the most unstable substrata of British coastal waters, resulting in patchy distribution of the benthos. Furthermore, the shallow depths of the southern North Sea and its proximity to the continent result in greater extremes of sea temperatures than are generally found elsewhere around the British Isles.

Many estuaries indent the coast of Suffolk and Essex, with varying salinity regimes and areas of intertidal mud that range from small fringing flats to wide expanses. Vast numbers of polychaetes, oligochaetes, amphipods and bivalves are present within the mud, providing an important contribution to the overall biomass. There are few areas of hard substrata in the region. One notable exception occurs on the Harwich foreshore, and on Thanet there are chalk cliffs on the shore and in the subtidal zone. The Thanet cliffs are considered to be of international nature conservation importance as the best chalk cliffs and associated algal communities in Britain and possibly Europe (Fowler & Tittley 1993). A number of wrecks (ships, aircraft and other solid material) occur off the coast of this region (see also section 6.1). These objects offer hard substrata in areas that are largely sedimentary, thus providing discrete new habitats for opportunistic colonising species that otherwise would not be present. The region also contains extensive areas of intertidal clay, a rare habitat that supports its own characteristic communities.

Several non-native species are present in the sheltered waters of the region's inlets and have become part of the British marine fauna. Some of these are associated with the importing of oyster stock and were first recorded in Britain in the locality, while others have spread from adjacent parts of the coast. Examples include the slipper limpet *Crepidula fornicata* and the oyster drill *Urosalpinx cinerea* (both from the eastern USA), the barnacle *Elminius modestus* (New Zealand) and the stalked sea squirt *Styela clava* (west Pacific).

English Nature have identified three Sensitive Marine Areas (SMAs) within this region (English Nature 1994). These are at Orfordness (for the extensive shingle spit, the saline lagoons and the mudflats, which support important populations of wildfowl and waders); Thanet (for the chalk cliffs, their algal flora and the variety of birds present); and the Colne and Blackwater Estuaries and associated near-shore sandbanks (for their undeveloped character and international importance for wildfowl and waders).



Map 4.2.1 Locations of marine biological interest described in the text (numbers refer to Table 4.2.1).

4.2.2 Important locations and communities

Table 4.2.1 shows the locations of marine interest mentioned in the text (Map 4.2.1).

Table 4.2.1 Sites of marine interest mentioned in the text

No. on Map 4.2.1	*Location*	*Grid ref.*
1	Off Sizewell power station	TM4863
2	Ore, Alde & Butley river system (centre)	TM3946
3	Orwell Estuary (centre)	TM2238
4	River Stour (centre)	TM1833
5	Harwich foreshore	TM2632
6	Hamford Water (centre)	TM2325
7	Colne Point, R. Colne	TM1011
8	West of Brightlingsea, R. Colne	TM0815
9	East end of West Mersea, R. Blackwater	TM0211
10	South of Rolls Farm, R. Blackwater	TL9408
11	North of Stansgate Abbey Farm, R. Blackwater	TL9305
12	Maplin Sands (centre)	TR0389
13	Medway Estuary (centre)	TQ8573
14	The Swale	TR0265
15	Epple Bay	TR3070
16	Fulsam Rock, Margate	TR3571
17	Botany Bay	TR3971
18	Kingsgate Bay	TR3970
19	Pegwell Bay (north side)	TR3664
20	St Margaret's Bay	TR3644
21	Shakespeare Cliff	TR3139
22	Abbot's Cliff	TR2738
23	Copt Point	TR2436

Lowestoft to Clacton-on-Sea

The open coast of Suffolk, and in particular the sublittoral zone, has attracted little survey except for near-shore benthic studies off Southwold and at Sizewell power station. Much of the near-shore sea bed in the Sizewell area is of coarse sand and fine muddy sand with some clay deposits (Institute of Estuarine and Coastal Studies 1991). The dominant community features the bivalves *Nucula* spp. and *Macoma balthica,* together with the polychaete worm *Spiophanes bombyyx* and the heart urchin *Echinocardium cordatum*. Amphipod crustaceans are also common, reflecting the high energy conditions of these sites. A deep subtidal trench runs parallel to the coast from Sizewell northwards and contains a distinctive community associated with the fine, organically-rich sediments that have accumulated there. The less stable offshore Sizewell-Dunwich sandbank system supports a more species-poor community characterised by amphipods (Bamber & Batten 1989).

The rock outcrop that extends into the subtidal off Thorpeness is the only hard substrata in the near-shore on this stretch of coast; it supports a community dominated by the hydroid *Sertularia argentea*, the ascidian *Molgula manhattensis*, phoronid worms, bryozoans, anemones and the soft coral *Alcyonium digitatum* (Bamber 1995). The crevices, where not infilled by sedimentary material, support lobster *Homarus gammarus* and both edible crabs *Cancer pagurus* and velvet crabs *Necora puber*.

The four most common species in the intertidal sediments in the Suffolk and Essex inlets are the mud snail *Hydrobia ulvae*, two polychaete worms *Streblospio shrubsolii* and *Tharyx marioni*, and the oligochaete worm *Tubificoides benedeni* (Dyer *et al*. 1991). The northernmost of these inlets in the region, the River Blyth, has sandy mud dominated by the reduced-salinity community of the bivalve *Macoma balthica* and the polychaete worm *Manayunkia aestuarina* (Hill *et al*. 1996). The Ore/Alde/Butley Estuary extends 28 km from Snape to Orford Haven. Mid-shore areas of mixed substrata, such as east of Snape Maltings, are covered by a blanket of the ephemeral algae *Ulva lactuca* and *Enteromorpha* spp. (Hill *et al*. 1996). Further downstream, where the Alde joins the Butley, a tide-swept community is present on the low shore, featuring anemones *Sagartia* spp., the peacock worm *Sabella pavonina*, the slipper limpet *Crepidula fornicata* and red algae. Areas of well-sorted mud on the low shore throughout the estuary supported the polychaetes *Nephtys hombergii*, *Caulleriella killariensis*, *Tharynx marioni* and *Hediste diversicolor*. Along the shingle coastline around Orford Ness, the mobility of the rounded stones means that the intertidal zone is largely devoid of marine life, with the exception of amphipods feeding on strandline debris. Indeed, Bamber & Batten (1989) report the beach at Sizewell, representative of much of this coastline, as being effectively lifeless.

The River Deben is generally narrow, with no particularly large areas of mudflat or saltmarsh. Much of the intertidal zone consists of muddy substrata. In the upper- and mid-estuary, sandy mud is dominated by the bivalve *Macoma balthica*, the polychaete worm *Manayunkia aestuarina* and the oligochaete worm *Tubifex costatus* (Hill *et al*. 1996). Areas of well-sorted mud throughout the estuary are characterised by the polychaete worms *Nephtys hombergii* and *Caulleriella killariensis,* with ragworm *Hediste diversicolor* and the oligochaete worm *Tubificoides* spp. The seaward end of the Deben Estuary has noticeably low numbers of infaunal species and individuals, possibly owing to the lower levels of organic carbon found within sediments here (Dyer *et al*. 1991). Below low water, the bed of the central channel consists of pebbles and shell debris mixed with mud, which support a community of polychaete worms, crustacea and ascidians (Hill *et al*. 1996).

The Orwell Estuary supports a wide variety of intertidal communities. Some areas of hard, stable ground are colonised by a bladderwrack *Fucus vesiculosus* community, with knotted wrack *Ascophyllum nodosum* present in more sheltered areas. However, the most widespread habitat is mud and sandy mud, supporting high abundances of the bivalves baltic tellin *Macoma balthica*, cockles *Cerastoderma edule* and *Mya arenaria*. On the lower shore off Shotley Point, close to where the Orwell joins with the Stour, there is a rich community featuring the stalked sea squirt *Styela clava*, the anemone *Sagartia* sp. and foliose red algae such as *Mastocarpus stellatus* (Hill *et al*. 1996). Chains of the slipper limpet *Crepidula fornicata* are covered by the barnacle *Elminius modestus*. In the sublittoral, sandy mud supports a range of polychaetes (particularly *Scoloplos armiger*) and the horseshoe worm *Phoronis muelleri*. Less sandy areas feature the polychaete *Nephtys hombergii* with *Phoronis muelleri*; both of these communities contained few bivalves. Tide-swept mixed substrata feature a community of polychaetes, crustacea, hydroids, anemones (such as *Sagartia troglodytes*) and the brittlestar *Amphipholis squamata*.

The Stour Estuary forms a series of scalloped bays, each containing extensive mudflats. The headlands separating the bays have predominantly mixed sediment beaches of shingle, gravel, sand and mud. Hard substrata, such as sections of coast protection, have fucoid algae and the ephemeral green algae *Enteromorpha* spp. growing on them, with the brackish seaweed *Fucus ceranoides* occurring at places influenced by freshwater run-off (Hill *et al*. 1996). On the lower shore on the northern side (such as Erwarton Ness), areas of mixed substrata are colonised by a rich assemblage of red algae, sponges, ascidians and the slipper limpet *Crepidula fornicata*. Here the upper shore sandy slope, one of only a few areas of intertidal sand within the estuary, supports a range of polychaete worms such as *Malacoceros tetracerus*, with occasional lugworms *Arenicola marina* and amphipods. Further upstream at Stutton Ness, the low-shore community features dense aggregations of *Sagartia* spp. anemones, various hydroids, the peacock worm *Sabella pavonina* and the bryozoans *Walkeria uva* and *Anguinella palmata*. Narrow-leaved eelgrass *Zostera angustifolia* occurs in areas of sandy mud in Erwarton Bay (Hill *et al*. 1996), and beds of eelgrass *Zostera marina* have been reported in Holbrook Bay and Copperas Bay (Mann 1985). The sublittoral zone of the River Stour is very similar to that of the nearby River Orwell (Hill *et al*. 1996). The only rocky shore between Norfolk and Kent exists at Harwich: of particular note is the presence on the low shore of the kelp *Laminaria digitata*, which is absent from much of this region (Tittley *et al*. 1989).

Between Harwich and Walton-on-the-Naze lies Hamford Water, a convoluted shallow embayment. Around the entrance, the sediment is sandy with a marked spit each side of the channel; otherwise, there are extensive intertidal mudflats, tidal creeks and saltmarsh. To the north of Horsey Island, a number of sunken barges have been used as part of a coast protection and saltmarsh replenishment scheme, providing an interesting area of hard substratum. Within the barges, the flooded holds provide attachment points for the

peacock worm *Sabella pavonina* and the stalked sea squirt *Styela clava*. Elsewhere, much of the sublittoral zone is mud dominated by the polychaetes *Nephtys hombergii*, *Streblospio shrubsolii*, *Tharyx marioni*, *Tubificoides* spp., the baltic tellin *Macoma balthica* and the horseshoe worm *Phoronis muelleri* (Hill *et al*. 1996). A much sandier substratum occurs at the mouth of Hamford Water, supporting the polychaete *Nephtys cirrosa* and the amphipods *Bathyporeia tenuipes* and *Bathyporeia sarsi*.

Clacton-on-Sea to Whitstable

The intertidal fauna of the Colne Estuary is very similar to that of the estuaries to the north. Fine sandy mud on the mid-shore contains the peppery furrow shell *Scrobicularia plana*, with high abundances of the polychaetes *Nephtys hombergii*, *Eteone longa* and ragworm *Hediste diversicolor* (Hill *et al*. 1996). Areas of mixed substrata, such as cobbles, pebbles, gravel and mud, occur in the mid to lower reaches of the estuary, such as close to Brightlingsea. Mussels *Mytilus edulis* are also present here, helping to bind the sediments together and providing additional opportunities for colonisation by barnacles and algae. At two sites, Colne Point and west of Brightlingsea, mixed substrata on the lower shore support a relatively rich community of sponges, ascidians and red algae, with chains of slipper limpets *Crepidula fornicata* (Hill *et al*. 1996). At Stone Point, opposite Brightlingsea, low shore muddy sand has notably high densities of the sandmason worm *Lanice conchilega*.

The shore habitats of the Blackwater Estuary include saltmarsh, mud, sandy mud and mixed substrata. Of particular note are two extensive areas of intertidal clay, at Rolls Farm south of Tollesbury and at the east end of West Mersea. This rare habitat is extensively bored by the piddocks *Barnea candida* and *Petricola pholadiformis* (Hill *et al*. 1996). Dense beds of mussels *Mytilus edulis*, covered by barnacles, are present on areas of mixed substrata, a particularly extensive example being found in St Lawrence Bay. Rich low-shore communities influenced by tidal movement occur off Stansgate Abbey Farm (on the south shore) and off Rolls Farm (on the north shore). These feature sponges, particularly *Halichondria panicea* and *Halisarca dujardini*, with anemones *Sagartia* spp., the peacock worm *Sabella pavonina* and abundant quantities of the red alga *Griffithsia flosculosa*. In the sublittoral, the richest areas appear to be associated with mixed muddy substrata in the mid to low estuary, with a range of polychaetes, crustacea and ascidians. Polychaete species included *Exogone* spp., *Cirriformia tentaculata*, *Mediomastus fragilis* and *Tharyx marioni* and the tube-building *Sabellaria spinulosa*. Brittlestars *Amphipholis squamata* and *Ophiura* spp. are also present, together with the ascidians *Ascidiella aspersa*, *Ascidiella scabra* and *Dendrodoa grossularia* attached to larger pebbles (Hill *et al*. 1996).

The vast uninterrupted intertidal flats at Maplin Sands are of marine biological interest because of their extensive beds of dwarf eelgrass *Zostera noltii* (240 ha) and eelgrass *Zostera marina* (58 ha) (Wyer *et al*. 1977). Both species also occur on Leigh Marsh, just to the east of Two Tree Island, where in 1973 the eelgrass bed was reported as being particularly dense (Wyer *et al.* 1977). Maplin Sands also support unusually lush growths of fern-like hydroids *Sertulia argentea* and *S. cupressina* (known locally as 'whiteweed'), which also grow further up the Thames. Whiteweed is commercially exploited in this area, and is dried for decorative use.

The River Thames is tidal up to Teddington in south-west London, though the water upstream of London Bridge is largely fresh. Downstream of London Bridge, the water becomes brackish and estuarine species appear. Beyond Gravesend, marine organisms predominate. Intertidal areas are generally backed by walls and embankments, below which are areas of mud, silt, sand or shingle. The sea bed of much of the estuary consists of gravel, pebbles, clay or chalk, with silt and mud occurring in areas of deposition. Within the estuary, Andrews *et al*. (1982) lists all of the invertebrates and fish that were recorded between 1975-1981 from shore collecting, trawling and power station intake screens. The list includes 40 species of polychaete worm (the most frequently recorded being ragworm *Hediste diversicolor*); eleven species of oligochaete worm (mostly in the upper reaches); the barnacles *Balanus improvisus* (being the most widespread) and *Elminius modestus* (having an upriver penetration to Greenhithe); the brown shrimp *Crangon crangon* (fished commercially in the outer reaches) and the prawns *Palaemon longirostris* and *Pandalus montagui*; the shore crab *Carcinus maenas*; winkles *Littorina littorea* (the most abundant snail in the estuary and commercially fished in the outer estuary); several echinoderms including the starfish *Asterias rubens* and the sea urchin *Psammechinus miliaris*; and just one ascidian, *Molgula manhattensis*. There are distinct assemblages of algae associated with various habitats, including walls, mussel, shingle and shell banks, floating structures and saltmarshes (Tittley & Price 1977). Green algae characterise the upper reaches of the estuary, brown algae occurring only on hard substrata in the estuarine and marine sections.

In the Medway Estuary occasional patches of small boulders and cobbles on upper shores have a covering of the algae *Fucus spiralis*, the brown wrack *F. vesiculosus* and/or knotted wrack *Ascophyllum nodosum* (Hill *et al*. 1996). In the large embayment downstream of Short Reach, much of the mudflats have beds of the bivalve *Scrobicularia plana* on the mid-shore, whilst the polychaete worm *Nephtys hombergii* and the bivalve baltic tellin *Macoma balthica* occur on the low shore. Clumps of dwarf eelgrass *Zostera noltii* grow on sandy mud at Hoo Marina. Much of the sublittoral sediment consists of mixed shells, pebbles, sand and mud and supports a wide range of polychaetes, oligochaetes and bivalves. Species occurring in high densities included the polychaete worms *Scoloplos armiger*, *Nephtys hombergii* and *Exogone naidina*. The slipper limpet *Crepidula fornicata* is common, along with bivalves *Abra alba* and the American piddock *Petricola pholadiformis* (Hill *et al*. 1996).

At the eastern end of the Isle of Sheppey, the spit at Shell Ness is composed almost entirely of cockle *Cerastoderma edule* shells bound together by mud deposits. The shells originate from extensive beds of living cockles in the sublittoral zone. The north-west half of The Swale, a tidal channel separating the Isle of Sheppey from the Kent mainland, is relatively deep, with a shoreline of exposed clay where tidal scour is strongest. Deposits of soft mud are present in the middle reaches, becoming increasingly more sandy towards the eastern end. Near Whitstable, firm clay is also present on the mid and lower shore. In these mid-shore areas, dense mussel *Mytilus edulis* beds support barnacles, the brown wrack *Fucus vesiculosus* and a variety of red algae (Hill *et al*. 1996). Lower down the shore, the clay is bored by the piddock *Pholas dactylus*. However, much of the mid and lower shore consists of fine sandy mudflats characterised by the bivalve *Scrobicularia plana* and the polychaete worms ragworm *Hediste diversicolor*, *Nephtys hombergii* and the bivalve baltic tellin

Macoma balthica. At Cleve Marshes, north-east of Faversham, the upper shore contains a rich community of bivalves, including cockles *Cerastoderma edule*, with an overlying cover of dwarf eelgrass *Zostera noltii*. Much of the sublittoral of The Swale consists of tide-swept mixed shells, sand and mud, with a range of polychaetes, oligochaetes and bivalves. The slipper limpet *Crepidula fornicata* is common here (Hill *et al*. 1996). Beds of both dwarf eelgrass *Zostera noltii* and eelgrass *Z. marina* are present at the eastern end of The Swale (Wyer *et al*. 1977).

Whitstable to Dungeness

The chalk cliffs of the Isle of Thanet, at the north-east corner of Kent, encompass 12% of the European coastal exposure of chalk. The coastline is characterised by steep cliffs and extensive wave-cut platforms formed of chalk, which is a relatively soft, easily-eroded rock. However, the chalk is very variable: that on Thanet (largely Upper Chalk) has much faulting and jointing, eroding to form irregularly-shaped promontories, stacks, pillars, caves and arch formations. The basal regions of the white cliffs at Dover are of less-faulted Lower Chalk and soft grey chalk-marl clay (Tittley *et al*. 1986).

The cliffs support a characteristic flora and fauna that is of great nature conservation importance, particularly the specialised algal communities (Tittley 1985). The Thanet cliffs are recognised as being of exceptional biological interest as the type locality for one genus and five species of algae (Anand 1937, in Fowler & Tittley 1993). The unusual algal communities are best developed within Epple Bay and Pegwell Bay, where they show a distinctive vertical zonation. In places the bare chalk rock is tinged blue by chalk-boring blue-green algae. Within caves, unusual algal communities are well represented in Botany Bay, Kingsgate Bay and, in particular, Pegwell Bay (Tittley 1985). Some caves are large, extending over 30 m into the cliffs and reaching 6-10 m in height.

The chalk platform on the mid- to lower shore at Fulsam Rock, Margate, is surprisingly silt-free considering the location and is dissected by numerous pools and channels; Tittley *et al*. (1986) described it as probably the best fucoid-covered shore on Thanet. The site is particularly rich in the kelp zone (*Laminaria digitata* and *L. saccharina*), with a well developed crevice fauna. Many piddocks, including *Pholas dactylus*, *Barnea candida* and *Hiatella arctica*, were present in the chalk platform in 1986, their old burrows being colonised by the anemone *Sagartia elegans* or the honeycomb worm *Sabellaria alveolata*. However no evidence of piddocks was found here during a survey in 1995 (Northen in prep.).

Owing to the high turbidity of the waters around the Thanet coast, little light penetrates to the sea bed, limiting the depth to which algae can grow. The sublittoral fringe kelp zone is compressed into an extremely narrow band around chart datum, with no kelp below this depth (Northen in prep.). A low diversity of red algal species, including *Phyllophora pseudoceranoides, Plocamium cartlagineum* and *Griffithsia flosculosa*, extends to a maximum depth of only 4 m, with many plants being heavily encrusted by the bryozoan *Electra pilosa*. Shallow, low-lying chalk reefs, extensions of the shore platforms, are present from White Ness to Dumpton Gap and further south at East Cliff. As a result of the softness of the chalk and sand scouring, few animals are able to colonise this bedrock, other than those able to bore into it, such as piddocks *Barnea candida* and *B. parva* and the spionid worm *Polydora ciliata*. Scattered clumps of flint cobbles, by contrast, are well colonised, with dense mats of the ascidian *Molygula manhattensis*, the hydroids *Tubularia indivisa, Nemertesia antennina, Sertularia argentea* and *Abietina abietina* and the bryozoans *Flustra foliacea, Bicellariella ciliata* and *Alcyonidium diaphanum* (Northen in prep.).

Pegwell Bay contains the largest expanse of tidal sand flats in the Thanet area, with populations of lugworm *Arenicola marina* occurring throughout, although in greatest abundance on the higher shore (Northen in prep.). The lower shore contains populations of a polychaete *Nephtys* sp., with occasional cockles *Cerastoderma edule* and sandmason worms *Lanice conchilega*. The chalk foreshore at St Margaret's Bay has luxuriant growths of lower shore red algae and has the richest algal communities in south-east England (Tittley *et al*. 1986). However, its invertebrate fauna is less rich. In the sublittoral off South Foreland chalk boulders and flattish bedrock have been eroded into 1 m deep gullies, giving way beyond 300 m from the low water mark to a silty gravel plain with cobbles (Wood & Wood 1986). The commonest animal species recorded here included the sponge *Halichondria panicea*, the erect bryozoan *Flustra foliacea* and the soft coral *Alcyonium digitatum*.

In the vicinity of Shakespeare Cliff, near-shore sublittoral exposures of chalk and greensand bedrock and boulders support a rich biota (Wood & Wood (1986). Shallow upward-facing surfaces have a sparse cover of stunted *Laminaria digitata*, *L. saccharina* and *L. hyperborea* kelps, with some filamentous and foliose red algae. In some areas there are silty mats of the spionid worm *Polydora* sp. In deeper areas further offshore, where current action is stronger, a range of bryozoan and hydroid species form a low turf, with the sponge *Halichondria panicea* being common. Here too there are silted mats formed by the ascidian *Molgula manhattensis* and areas of muddy gravel with the brittlestar *Ophiura albida*.

The foreshore to the west of Shakespeare Cliff has changed dramatically since the construction of the Channel Tunnel, which passes directly below this site. The foreshore had supported a wide range of plant and animal assemblages (Tittley *et al*. 1986), but large amounts of mined rock were dumped behind a retaining wall here between 1987 and 1990. Further westwards, a gently sloping wave-exposed boulder shore of chalk, marl and clay is present at the base of Abbot's Cliff. This shore is typical of 'natural' Kent and Sussex coastlines, with a range of local algal communities providing distinct zonation and good faunal diversity (Tittley *et al*. 1986). Below a narrow band of green algae at the top of the shore is a band of barnacles *Semibalanus balanoides*, with the limpet *Patella vulgata* and the dogwhelk *Nucella lapillus* prominent. Below this, a band of *Fucus serratus* in the mid-shore shelters periwinkles *Littorina* spp., the sponges *Halichondria panicea* and *Hymeniacidon perleve* and the ascidian *Dendrodoa grossularia*. Occasional patches of the mat-forming red alga *Audouinella floridula* are present on the lower shore, with kelps *Laminaria saccharina* and *L. digitata* just above the sublittoral fringe (Tittley *et al*. 1986).

Further to the west, in East Wear Bay, there is clean sand with only a few species, such as lugworm *Arenicola marina*, sandmason worm *Lanice conchilega* and netted dogwhelk *Hinia reticulata*. At Copt Point, just east of Folkestone, there is a gently sloping foreshore of Lower Greensand ridges and boulders. The varied intertidal habitats here support algal assemblages more typical of northern and western Britain and a range of animals, some rarely seen east of the Isle of Wight (Tittley *et al*. 1986). The East Wear Bay - Copt Point shoreline

is one of the most important marine sites in south-eastern England (Tittley *et al*. 1986).

Between Folkestone and Dungeness, the shores are a mix of shingle and sand. Little marine biological information has been published on either the littoral or the sublittoral environment along this stretch of coast. The largest accumulation of shingle anywhere in Britain is found at Dungeness, though the marine biological interest of the area is limited owing to the mobile, and hence inhospitable, nature of the shingle.

The relatively shallow benthic sediments in the approaches to the Dover Strait are constantly affected by a high energy tidal regime, leading to movement of surface material; the Goodwin Sands, for example, are well known for periodically revealing and reburying shipwrecks. This movement creates an inhospitable environment for colonisation by all but the hardiest of burrowing organisms.

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

Far less information is available on benthic habitats and communities from offshore locations, other than that shown on Admiralty charts and British Geological Survey maps. According to Glémarec (1973), a shallow water zone extends far offshore in the southern North Sea, with an *Abra alba* (bivalve) community occurring extensively in the southern and south-eastern North Sea. Where there is an increased sand content in the sediment, the *Abra alba* community gives way via transitional communities to species of the bivalve *Venus* spp. communities. These have been widely recorded from the southern North Sea, occurring at depths of about 10-30 m. Where there is a transition from sands to muddy sands, often in depths greater than 15-20 m, *Venus* spp. communities give way to brittlestar *Amphiura filiformis* communities.

A 1972 study by MAFF of the sea bed around the sewage sludge disposal sites in the outer Thames Estuary was described by Talbot *et al.* (1982), who identified nine faunal and sediment associations, the most common ones being dominated by the polychaete worms *Nephthys* spp., *Spio* spp. and *Spiophanes* spp., bivalves *Tellina* spp. and amphipods. Further offshore, Frauenheim *et al.* (1989) sampled the larger benthic fauna such as crustaceans, echinoderms and molluscs as part of a study of the whole North Sea. The most common species included the echinoderms *Asterias rubens* and heart urchin *Echinocardium cordatum* and the polychaete worm *Aphrodite aculeata*.

4.2.3 Human activities

Some of the human activities that affect sea-bed habitats and communities in the region are described in greater detail in Chapter 9. The activities mentioned here all cause physical disturbance to the sea bed and/or its associated benthos, either directly (e.g. bottom trawling or maintenance dredging) or indirectly (e.g. elevated water temperatures close to outfall pipes). Fishing-relating activities, many of which occur in the sheltered estuaries within the region, include bait digging (in some areas on a commercial scale), winkle picking, fyke-netting for eels, seine netting, trawling and oyster *Ostrea edulis* cultivation. There is a large oyster hatchery at Whitstable. In addition, there is some small-scale hand-netting and large-scale hydraulic dredging for cockles *Cerastoderma edule*, particularly around the mouth of the Thames. A large amount of shipping activity takes place in and around certain ports, such as Felixstowe, Harwich, Ipswich, Canvey Island, Tilbury, Grain, Chatham, Sheerness, Ramsgate, Dover and Folkestone. Two nuclear power stations are present within this region: one at Sizewell, east of Leiston, and the other at Bradwell on the River Blackwater, both of which use large volumes of seawater as a coolant. Maplin Sands are used by the MOD as testing/firing ranges.

The River Orwell (on which are situated the ports of Ipswich, Felixstowe and Harwich) is the most industrialised inlet between the River Thames and the Humber, with frequent dredging maintaining the deep berths. The development of Felixstowe docks has involved loss of habitat through land claim of mudflats and saltmarsh. A study of the Orwell's intertidal fauna in 1986 by Beardall *et al*. (1990) found it to be dominated by annelids (polychaetes and oligochaetes), whereas in 1975 it had been dominated by molluscs (Kay & Knights 1975). Possible causes for the change include increased effluent discharge from a sewage works, hydrographic changes due to the enlargement of Felixstowe's port, and increased numbers and sizes of vessels using Felixstowe and Ipswich ports.

In many parts of Thanet the natural chalk coastline has been replaced by structures such as harbours or coast protection works, so that now only 2 km (less than 8% of the original length) of the natural chalk cliff remains, restricting the extent of semi-natural habitats available.

Tributyltin (TBT) antifouling paints have been shown to have serious effects on gastropod and bivalve mollusc populations, especially in the vicinity of harbours, marinas and moorings within shallow estuaries. Gibbs *et al*. (1991) studied a decline in populations of the American oyster drill *Urosalpinx cinerea* in the River Blackwater, associated with TBT-induced sterility.

Large amounts of sewage effluent are discharged from the major conurbations to estuaries and open coasts throughout the region. Up until the 1950s, the Thames in particular had suffered from severe pollution from both industrial and domestic effluents, resulting in large stretches of the river becoming completely deoxygenated. By 1967, following the implementation of a large-scale clean-up operation, recovery of fishes was noted (Gameson & Wheeler 1977).

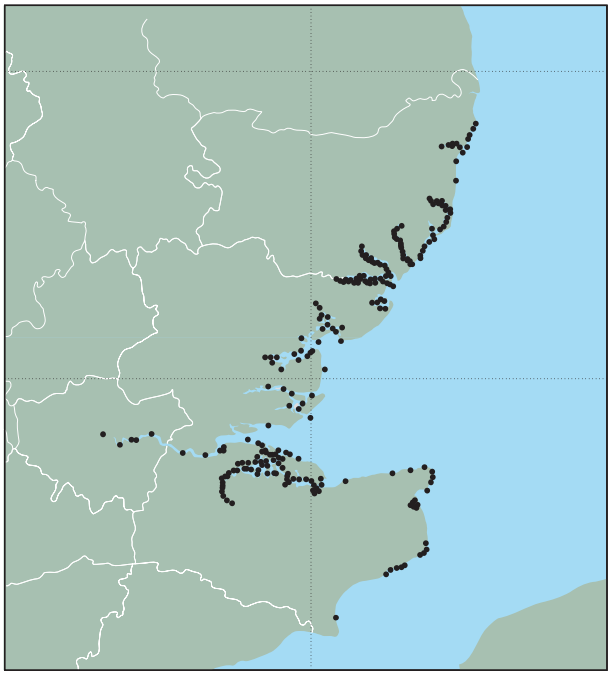
4.2.4 Information sources used

The JNCC's Marine Nature Conservation Review (MNCR) team (and their contractors) use a standard recording methodology for both littoral and sublittoral surveys, which includes descriptions of both habitats and their associated communities (Hiscock 1996). Survey information from other sources may vary considerably in its methodology and coverage. Table 4.2.2 shows the number of sites with marine benthic habitat and species information held on the JNCC's MNCR database, and Maps 4.2.2 and 4.2.3 show, respectively, littoral and near-shore sublittoral surveys recorded on the database.

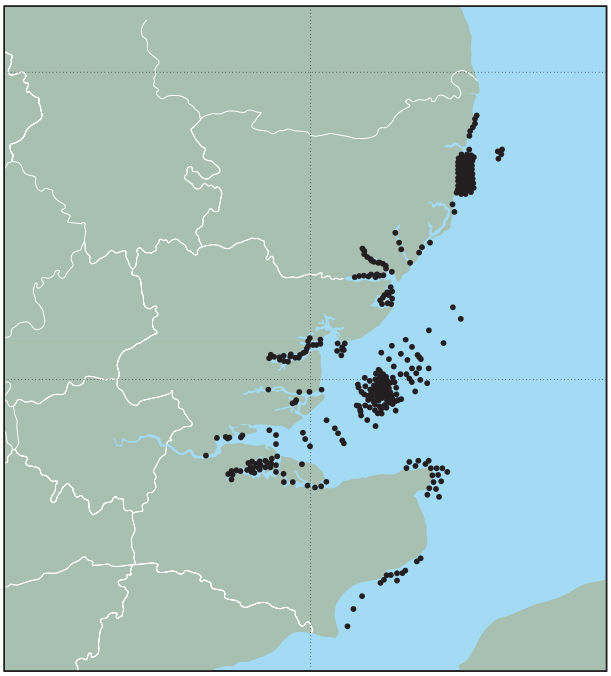
Table 4.2.2 Number of surveyed sites in the region recorded on the MNCR database

Littoral	*Near-shore sublittoral*	*Offshore*	*Total*
320	154	-	474

Source: MNCR database. Note: these figures are not comprehensive; additional records exist in sources that were not consulted.



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



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

The MNCR literature reviews by Roger Covey (in prep. a, b) have been widely consulted. In May 1992, the MNCR initiated a project to survey selected marine inlets from north Norfolk to the Isle of Sheppey, describing the range of marine biotopes present, their distribution and conservation importance (Hill & Emblow 1996; Hill *et al*. 1996). In addition, an MNCR diving survey of the near-shore sublittoral zone off the Thanet coast was undertaken in 1995 (Northen in prep.).

The estuaries of south-east England were included in the Nature Conservancy Council's Estuaries Review (Davidson *et al*. 1991). An intertidal survey of all the main estuaries in Suffolk and Essex was carried out in 1990 by UniCoMarine Ltd. on behalf of the National Rivers Authority (Dyer *et al*. 1991). The intertidal sediments of the Suffolk, Essex and north Kent coasts were investigated by both Kay & Knights (1975) and Boorman & Ranwell (1977), the latter in response to proposals for an airport at Maplin Sands.

The presence of nuclear power stations at Sizewell and Bradwell has led to a number of marine biological studies being undertaken in their vicinity. Bamber & Coughlan (1980) described the distribution of sublittoral communities close to Sizewell power station, sampled by dredge and grab in 1976; later surveys were undertaken by Bamber & Batten (1989) and the Institute for Estuarine and Coastal Studies (1991). In 1995, a benthic survey of the sea bed in the vincinity of Thorpeness was carried out by Bamber (1995), using RoxAnn remote mapping and diving, particularly related to the effects of thermal discharges from the power station. Other studies at and around Sizewell are listed in Covey (in prep. a). The Blackwater Estuary has been the subject of detailed survey, particularly since the construction of the power station at Bradwell in the 1960s, and a review of benthic studies since 1960 is provided by Bamber & Henderson (1981). The seaweeds of the Blackwater Estuary were studied by Milligan (1965) and the marine fauna by Davis (1967). The presence of the Centre for Environment, Fisheries and Aquaculture Sciences (CEFAS) (formerly MAFF Directorate of Fisheries Research) Fisheries Laboratory at Burnham-on-Crouch has ensured that a number of studies have been carried out on the Crouch Estuary, though much of this information remains unpublished.

The National Rivers Authority (Thames Region) instigated the Thames Estuary Benthic Programme in 1992, involving quarterly sampling of 22 littoral and sublittoral sites from Teddington Weir to the mouth of the Thames south of Shoeburyness (National Rivers Authority Thames Region 1992). The marine algae of the Thames Estuary were described by Tittley & Price (1977). The University of London used to run a field station at Whitstable, which led to the production of marine faunal lists for the area (e.g. Newell 1954). A marine environmental impact assessment study was undertaken in Pegwell Bay following development proposals for the port at Ramsgate (Environmental Resources Ltd. 1986). Detailed littoral and sublittoral surveys were undertaken between Dover and Folkestone prior to the construction of the Channel Tunnel (e.g. Institute of Offshore Engineering 1985; Tittley *et al*. 1986; Fincham & George 1986; George & Fincham 1989; Wood & Wood 1986).

4.2.5 Acknowledgements

The author acknowledges the considerable help of the JNCC's Marine Nature Conservation Review team (particularly Dr Tim Hill and Kate Northen) in compiling and presenting the information given here. Thanks also go to Jaime Plaza (JNCC), Alexander Downie (Scottish Natural Heritage), Jeremy Hindle (Suffolk County Council) and David George (Natural History Museum) for helpful comments on the draft.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Marine nature conservation issues in England	*Maritime Team, EN HQ, Peterborough, tel: 01733 455000
MNCR database	*MNCR Team, JNCC, Peterborough, tel: 01733 562626
Infauna of south-east inlets	N. Grist, UniCo Marine, 7 Diamond Centre, Works Road, Letchworth, Herts. SG6 1LW, tel: 01462 675559
Marine molluscs	I. Killeen, Malacological Services, 163 High Road West, Felixstowe, Suffolk IP11 9BD, tel: 01394 274618
Marine algae of Kent & Suffolk	I. Tittley, Department of Botany, Natural History Museum, Cromwell Road, London SW7 5BD, tel: 0171 938 9264
Benthic marine fauna of chalk substrata in Kent	Dr D. George, Dept. of Zoology, Natural History Museum, Cromwell Road, London SW7 5BD, tel: 0171 938 9431
Marine aggregate surveys, offshore sediment mapping	Coastal Geology Group, British Geological Survey, Keyworth, Nottingham NG12 5GG, tel: 0115 936 3100.
Publications by Nuclear Electric, National Power, Central Electricity Board, and Central Electricity Research Laboratories	C.J.L. Taylor, Nuclear Electric Ltd, Barnett Way, Barnwood, Gloucester GL4 3RS, tel: 01452 652791

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

4.3 Plankton

M. Edwards & A.W.G. John

4.3.1 Introduction

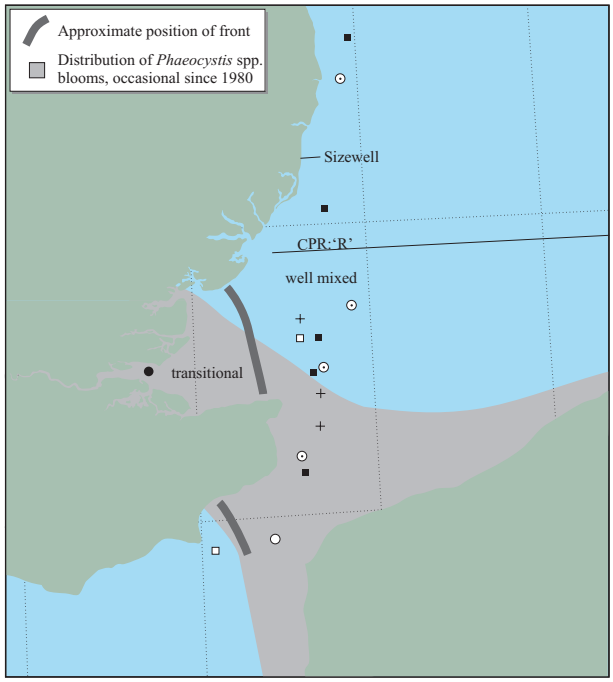
Plankton include the bacteria (bacterio-), plant (phyto-) and animal (zoo-) plankton. In temperate continental shelf seas, as in this region, the phytoplankton assemblage is dominated by diatoms and dinoflagellates, and the zooplankton, although containing representatives of most marine animal phyla at some stage, is dominated by crustaceans, principally copepods. The plankton's abundance is strongly influenced by factors such as depth, tidal mixing and temperature stratification, which determine the vertical stability of the water column. The distribution of species, here and elsewhere, is influenced directly by salinity, temperature and water flows into the area (section 2.3) and by the presence of local benthic (bottom-dwelling) and littoral (shoreline) communities. Many of the species of these communities, including commercially important fish and shellfish (see section 5.5 and 5.7), have temporary planktonic larval forms (meroplankton). Tidal fronts (boundary zones between stratified and well-mixed water masses) in this region are likely to be of significant biological importance, since they are usually rich in plankton, which attracts other marine life.

Phytoplankton blooms (transient, unsustainable growths, usually of a single species and often associated with a visible discolouration of the water) are a normal feature in the seasonal development of plankton. Some blooms may reach exceptional proportions (>10^6 cells/l) or contain species (principally dinoflagellates) that could be toxic to humans and possibly have an important economic impact on mariculture, fisheries and tourism.

In Region 7, as elsewhere, the plankton has a fundamental role in the food chain of both benthic (sea-bed) organisms and pelagic (water column) fauna and flora. For both ecosystems, the availability of food and nutrients, larval survival, maintaining populations and timing of egg production are highly dependent on the amount of phyto/zooplankton available. Any environmental stress imposed on the plankton will have consequences throughout the food chain and may affect the amount of food available to fish, birds, marine mammals etc. In coastal management, plankton can give early warnings of adverse human impacts (e.g. the effects of eutrophication) and highlight different water masses.

Mean surface temperature and salinity in the region vary (depending on season) between 5-17°C and 34-35 g/kg respectively. The water column is well mixed throughout the year, except towards the Thames Estuary, where the waters are transitional (Map 4.3.1).

Figure 4.3.1 shows the seasonal cycles of an index of phytoplankton colour (a visual estimate of chlorophyll) and numbers of copepods per sample (approximately 3 m^3 of water filtered) derived from Continuous Plankton Recorder (CPR) data for 1958-93 for Region 7. Estimated annual primary production in this region is low (79 g C m^{-2} y^{-1}), compared with the central North Sea (100-119 g C m^{-2} y^{-1}) and the continental coast (199-261 g C m^{-2} y^{-1}; Joint & Pomroy 1993). Krause & Martens (1990) sampled parts of this region



Map 4.3.1 Plankton surveys, 'fronts' and distribution of *Phaeocystis* blooms. See Table 4.3.1 for details of surveys.

in spring 1986 and winter 1987, finding zooplankton biomass around the Dover Strait of <10 mg C m^{-3} in winter and >100 mg C m^{-3} in spring. These spring figures can be considered to be reasonably high compared with other parts of the North Sea.

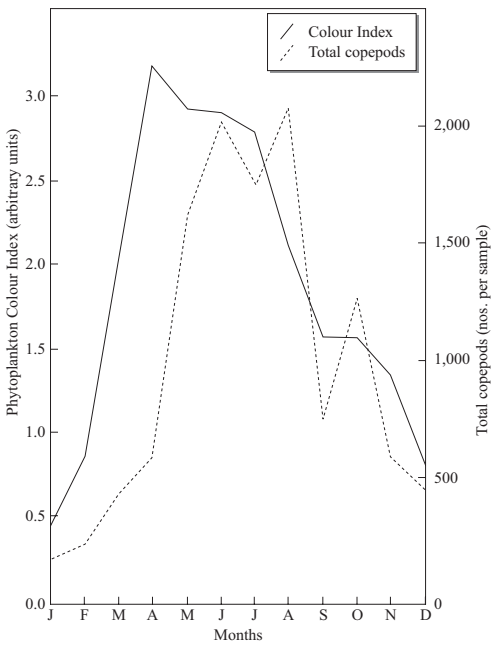


Fig. 4.3.1 Average seasonal cycles of an index of phytoplankton colour (a visual estimate of chlorophyll) and numbers of copepods per sample (approximately 3 m^3 of water filtered). Source: Continuous Plankton Recorder data for 1958-1992.

Table 4.3.1 Details of surveys

Identification on Map 4.3.1	*Frequency*	*Period*	*Reference*
CPR: 'R' route	Monthly	1932-1960, 1988 to present	Warner & Hays 1994
PS (■)	Monthly	1988-1989	Joint & Pomroy 1993
PS (●)	Monthly	1977-1982	Belcher & Swale 1986
PS (○)	Occasional	1976	Holligan *et al.* 1978
PS (⊙)	Occasional	Spring 1986, winter 1987	Krause & Martens 1990
PS (+)	Occasional	July 1987	Owens *el al.* 1990
Whole region	Occasional	1970-1984	Riley *et al.* 1986
PS (□)	Occasional	July 1977	Holligan *et al.* 1980
Sizewell	Monthly	1992-1993	Bamber *et al.* 1993

Key: CPR: Continuous Plankton Recorder; PS: plankton samples.

4.3.2 Important locations and species

The plankton of this region are typically neritic (species of coastal waters), although southern intermediate (mixed water) species can also be present (Adams 1987). The chaetognath *Sagitta setosa*, a species characteristic of oceanic water masses, enters this region with the English Channel water, along with possibly the calanoid copepod *Calanus helgolandicus*, and during the autumn a number of species more characteristic of the north-western North Sea may also be found in this region. The spring increase of zooplankton begins in March/April and peaks in March. Unusually, the increase is followed thereafter by a gradual decline to low winter levels, with no autumn increase (which usually happens in September in other parts of the North Sea). The dominant dinoflagellates are those of the *Scrippsiella* group, including species found by Holligan *et al.* (1980) to be characteristic of well-mixed conditions. Diatoms (responsible for the spring phytoplankton bloom) tend to predominate in inshore mixed waters, while dinoflagellates (particularly in summer/autumn) are more often abundant in stratified offshore areas (Adams 1987). The zooplankton communities of the southern North Sea are typically dominated by calanoid copepods such as *Temora longicornis*, *Pseudocalanus elongatus* and *Acartia clausi*. In the shallow coastal waters in summer, the copepods are occasionally outnumbered by meroplankton (organisms which spend part of their life cycle in the plankton), such as the larval forms of polychaete worms, bivalves and echinoderms.

4.3.3 Human activities

Phytoplankton are of particular importance to the coastal manager in this region because a number of *Phaeocystis* blooms (10^4-10^7 cells/l) have occurred (Map 4.3.1) (Oslo & Paris Commissions 1992). These blooms have been associated with eutrophication in Dutch coastal waters and may result in the accumulation on beaches of large banks of foam, which look and smell unpleasant.

The Sizewell power station in Suffolk abstracts large volumes of sea water for cooling purposes. During a twelve-month survey in 1992-93, Bamber *et al.* (1993) found that significant numbers of eggs and larvae (ichthyoplankton) of commercially-important fish species were lost due to entrainment. These losses are believed to have important implications for the local adult populations of exploited fish stocks.

4.3.4 Information sources used

The most recent surveys in this region have concentrated on the estimation of primary production and zooplankton biomass in relation to other parts of the North Sea (Krause & Martens 1990; Owens *et al.* 1990; Joint & Pomroy 1993). The Continuous Plankton Recorder (CPR) surveys in this region are important because they contain long-term plankton data, which can be used to assess the effects of environmental variability and climatic changes on the marine biota. Data for this region indicate a general decline in the abundance of plankton from 1960 to 1980, as in other shelf waters. Levels rose during the 1980s but have been decreasing again in the last few years. The Centre for Environment, Fisheries and Aquaculture Sciences (CEFAS, formerly MAFF Directorate of Fisheries Research) Fisheries Laboratory at Lowestoft undertook occasional surveys of this region during the 1970s and early 1980s, investigating the distribution of fish eggs and larvae in the plankton (Riley *et al.* 1990).

4.3.5 Acknowledgements

Thanks are due to consultees who commented on the draft.

4.3.6 Further sources of information

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Continuous Plankton Recorder (CPR) survey data	Director, Sir Alister Hardy Foundation for Ocean Science, The Laboratory, Citadel Hill, Plymouth PL1 2PB, tel: 01752 633100
Ichthyoplankton	*Director, Centre for Environment, Fisheries & Aquaculture Sciences (CEFAS), Lowestoft Laboratory, tel: 01502 562244
Phytoplankton	Head of Department, University of London, Queen Mary and Westfield College, Department of Biological Sciences, Mile End Road, London E1 4NS, tel: 0171 975 5555
Plankton research	Head of Department, Department of Oceanography, Southampton University, University Road, Southampton SO9 5NH, tel: 01703 595000 ext. 3642

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

Dune grassland in the region supports large numbers of rare and scarce higher plants, including the rare lizard orchid *Himantoglossum hircinum*, which looks like a mass of small green lizards and, surprisingly, smells strongly of goats. It is pictured here at Sandwich Bay. Photo: Dr Pat Doody, JNCC.

Chapter 5 Important species

5.1 Terrestrial lower plants

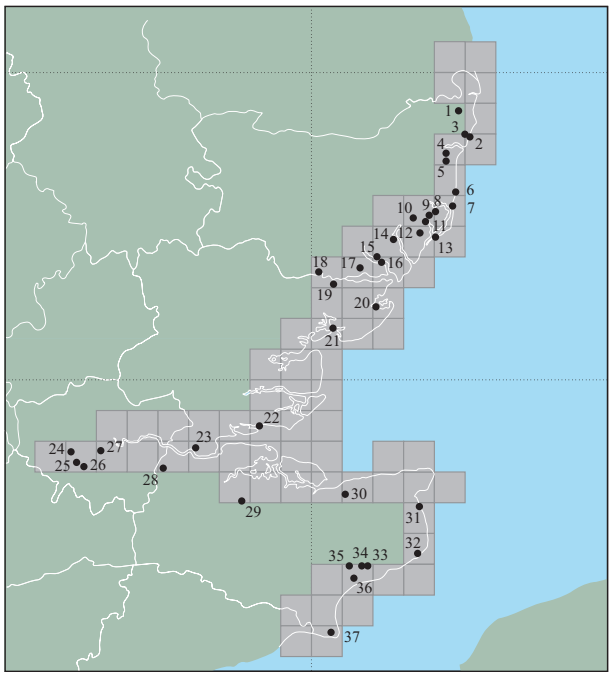
N.G. Hodgetts

5.1.1 Introduction

This section covers lichens, bryophytes (mosses and liverworts), stoneworts (a group of freshwater and brackish water algae - the latter are covered in section 5.4) and fungi occurring in the coastal 10 km squares within the region. About 34% of the British bryophyte flora and about 21% of the stonewort flora occur in the region. Similar figures are not available for other groups.

Region 7 encompasses the densely-populated south-east of England and much of it is characterised by intensive agriculture, with sites of natural interest for terrestrial lower plants being few, small and scattered. However, there are several large and important wetland areas on the Suffolk, Essex and Kent coasts that are notable for lower plants. Most of the coast is 'soft' and continually eroding, particularly in Suffolk. Essex and the Thames Estuary contain extensive saltmarshes and mud flats but these are of little interest for terrestrial lower plants, with one or two notable exceptions. The chalk cliffs and shingle of Kent are richer.

Many of the rare or scarce lower plants of the region are likely to be ephemeral species that are not necessarily associated for a long time with any one site: for example several calcareous grassland species are ephemeral colonisers, moving on when the sward becomes too dense for them. Other ephemeral species may be characteristic of woodland rides or the margins of arable fields. Some of the more interesting species found in this region are southern or Mediterranean species, here approaching the northern limits of their distribution.



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

5.1.2 Important locations and species

Table 5.1.1 lists all the sites in the region that are known to be important for lower plants and that have had at least some degree of survey work. Locations are shown on Map 5.1.1. Some of the sites contain rare and scarce species and qualify for SSSI status on the basis of their lower plant flora (Hodgetts 1992).

Like higher plants, lower plants tend to occur in characteristic assemblages that are found in particular habitats. Coastal (usually clifftop) grassland and heath with thin turf can frequently be rich in bryophytes, lichens and higher plants, the communities often forming complex mosaics. The chalk grassland on the Kent cliffs is important to some extent for rare and scarce bryophytes of this habitat, but less so than the Sussex cliffs of Region 8. Unstable areas are important for maintaining bare ground for colonisation by some of the uncommon ephemeral lower plants, as at some of the Suffolk landslip sites, where species of *Cladonia* and other lichens are effective colonisers. Exposed rocks in landslips are often good for southern warmth-loving species of bryophyte, but there are few of them in the region.

Shingle is an important habitat for lichens and is well represented in the region (see section 3.3). Small crustose species occur on the stones themselves, and at Dungeness, Kent, an epiphytic community has developed on scrub that has colonised the shingle. Dungeness is a particularly important lower plant site in an international context.

The region's woodland is of only limited value for bryophytes and lichens. However, some areas of parkland are regionally important for their epiphytic lichens growing on unshaded ancient trees. Many of the woods in the region are important for fungi, but little information is available on these at present. Coastal scrub is important for epiphytes, apparently increasingly so as sulphur dioxide pollution improves. Several interesting records of epiphytic bryophytes and species normally found in more oceanic areas have been made in recent years from coastal scrub in the Minsmere area, Suffolk.

Some areas of open water support stonewort communities. Other wetlands in the region tend to be of limited value for lower plants, many of them being very base-rich but not supporting the 'brown moss' communities found

Table 5.1.1 Lower plant sites in coastal 10 km squares

Site no. on Map 5.1.1	*Location*	*Grid ref.*	*Conservation status*
	Suffolk		
1	Barnby Broad & Marshes	TM4891	SSSI
2	Benacre to Easton Bavents	TM5282	SSSI, part NNR
3	Benacre Park	TM5083	Undesignated
4	Henham Park	TM4477	Undesignated
5	Toby's Walks	TM4474	Undesignated
6	Minsmere - Walberswick Heaths & Marshes	TM4764	SSSI, part NNR
7	North Warren & Thorpeness Mere	TM4659	SSSI
8	Snape Warren	TM4057	SSSI
9	Blaxhall Heath	TM3856	SSSI
10	Campsey Ash	TM3355	Undesignated
11	Tunstall Common	TM3754	SSSI
12	Staverton Park & The Thicks, Wantisden	TM3550	SSSI
13	Alde-Ore Estuary	TM4147	SSSI, part NNR
14	Nottcutt's Nurseries, Woodbridge	TM2648	Undesignated
15	Ipswich Heaths	TM2142	SSSI
16	Nacton	TM2240	Undesignated
17	Freston & Cutler's Woods	TM1538	SSSI
18	Gifford's Park	TM0137	Undesignated
19	River Stour, Dedham	TM0633	Undesignated
	Essex		
20	Hamford Water	TM2124	SSSI, part NNR
21	Colne Estuary (including Fingringhoe Wick Wildlife Trust Reserve)	TM0715	SSSI, part NNR
22	Benfleet & Southend Marshes	TQ8185	SSSI, part NNR
23	Grays Thurrock Chalk Pit	TQ6078	SSSI
	Greater London		
24	Richmond, R. Thames	TQ1877	Undesignated
25	Richmond Park	TQ2073	SSSI
26	Wimbledon Common	TQ2272	SSSI
27	Battersea Park	TQ2877	Undesignated
	Greater London/Kent		
28	Joyden's Wood	TQ4971	Undesignated
	Kent		
29	Wouldham to Detling Escarpment	TQ7560	SSSI
30	Ellenden Wood	TR1062	SSSI
31	Sandwich Bay to Hacklinge Marshes	TR3558	SSSI
32	Dover to Kingsdown Cliffs	TR3442	SSSI
33	Folkestone to Etchinghill Escarpment	TR1738	SSSI
34	Beachborough Park	TR1638	Undesignated
35	Gibbins Brook	TR1138	SSSI
36	Lympne Escarpment	TR1334	SSSI
37	Dungeness	TR0518	SSSI, part RSPB reserve

Sources: references listed in section 5.1.6 and JNCC's Protected Sites Database. Key: SSSI = Site of Special Scientific Interest; NNR = National Nature Reserve, RSPB = Royal Society for the Protection of Birds.

in the Norfolk fens.

Gravestones and walls in churchyards can form a substitute for natural rock exposures in the south-east and are usually colonised by a variety of saxicolous lichens and bryophytes, including uncommon species. Churchyards are therefore an important habitat for these species, in the absence of natural rock exposures. In London, the large amenity areas of Wimbledon Common and Richmond Park are important, the former for bryophytes, the latter for fungi.

The region contains a number of threatened lower plant species. Table 5.1.2 lists the Red Data Book species found in the region (out of a total of 139 bryophytes, eleven stoneworts and 177 lichens on the British Red Lists), excluding extinct species. For fungi there is insufficient information for a comprehensive count. In addition, the region contains 39 out of 375 Near Threatened and Nationally Scarce bryophytes and one of the ten Nationally Scarce stoneworts (figures for Nationally Scarce species are provisional). The lichen *Lecanactis hemisphaerica*, which is considered Near Threatened but is included on Schedule 8 of the Wildlife and Countryside Act, also occurs in the region, on the plaster of church walls. There is currently not enough information to provide even provisional regional lists of Nationally Scarce lichens and fungi.

5.1.3 Human activities

Current issues that may have a bearing on the lower plant flora of the region include road and industrial construction programmes, house building, forestry and holiday and leisure developments. Areas of natural importance may be under

Table 5.1.2 Red Data Book lower plants found in the region

Species	*Locations/habitat*
Liverworts	
Cephaloziella baumgartneri	Dover Cliffs, Kent
Pallavicinia lyellii	Staverton Park, Suffolk; Wimbledon Common, Greater London (probably now disappeared)
Sphaerocarpus texanus	Campsey Ash, Suffolk; Nacton, Suffolk; Nottcutt's Nurseries, Woodbridge, Suffolk
Mosses	
Atrichum angustatum	Untraced record from Kent
Bryum knowltonii	Fingringhoe Wick, Essex
Bryum warneum	Dungeness, Kent
Weissia tortilis	Langdon Bay (Dover to Kingsdown Cliffs), Kent
Lichens	
Cladonia mitis	Lydd Ranges, Dungeness
*Caloplaca luteoalba**	Gifford's Park, Suffolk; Campsey Ash, Suffolk
Cliostomum corrugatum	Skipper's Island (Hamford Water), Essex; Hadleigh Marsh (Benfleet & Southend Marshes), Essex
Parmelia quercina	Untraced record from Kent (may now have disappeared)
Stonewort	
Nitella mucronata	River Stour, Dedham, Suffolk

Key: *on Schedule 8 of the Wildlife & Countryside Act.

particularly intense pressure in and around the densely populated capital city and its suburbs. Land available for construction purposes is at a premium in this part of the country and therefore areas of interest for lower plants and other wildlife may be affected here more than elsewhere. Construction of golf courses can be an issue with regard to dune systems and areas of grassland. Pollution is a general problem but may be aggravated in some areas by oil spillages etc.

Gravel extraction is an economically important activity with implications for several lower-plant-rich shingle sites on the coast. Churchyard management activities may have an effect on the churchyard lichen and bryophyte floras, which are often important in this part of the country.

Some sites in the region are nature reserves managed for nature conservation. Many more are Sites of Special Scientific Interest (SSSIs), in which nature conservation considerations must be taken into account.

5.1.4 Information sources used

The computerised database at the Biological Records Centre (BRC), Monks Wood, and the Red Data Book database at the JNCC include recent records collected over decades by expert bryologists, as well as important historical records. Data for bryophytes and the larger lichens are generally quite good. Data for fungi, algae and the smaller lichens are less complete. Some important, or potentially important, coastal lichen sites have been identified in recent surveys (Fletcher 1984; James & Wolseley 1991), but as relatively few areas have been comprehensively surveyed, there may be more. Data collation for fungi is still at a relatively early stage. All British Mycological Society foray data are currently being put onto a computer database at the International Mycological Institute under a JNCC contract. Computerised stonewort data are held at BRC and JNCC. More information on freshwater algae may be available from the Freshwater Biological Association.

5.1.5 Acknowledgements

Thanks go to the following, who commented on the draft: Kathy Kennedy (English Nature) and Hilary Alison (Woodland Trust).

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Lichens (hard rock coasts)	T. Duke, Sandrock, The Compa, Kinver, Staffs DY7 6HS, tel: 01384 872798
Lichens (general coastal)	P.W. James, c/o Department of Botany, The Natural History Museum, Cromwell Road, London SW7 5BD, tel: 0171 938 9123
Lichens (woodland and general: British Lichen Society database)	Dr A. Fletcher, Leicestershire Ecology Centre, Holly Hayes, 216 Birstall Road, Birstall, Leicester LE4 4DG, tel: 0116 267 1950
Lichens (East Anglia)	P. Lambley, English Nature, 60 Bracondale, Norwich NR1 2BE, tel: 01603 620558
Bryophytes & lichens (general and epiphytic)	Dr F. Rose, Rotherhurst, 36 St. Mary's Road, Liss, Hampshire GU33 7AH, tel: 01730 893478
Bryophytes (BRC database)	*C.D. Preston, Biological Records Centre, ITE, Monks Wood, Huntingdon, tel: 01487 773381
Bryophytes (British Bryological Society herbarium)	A.R. Perry, Department of Botany, National Museum of Wales, Cathays Park, Cardiff CF1 3NP, tel: 01222 397951
Bryophytes (general)	D.G. Long, Royal Botanic Garden, 20a Inverleith Row, Edinburgh EH3 5LR, tel: 0131 552 7171
Fungi (general and sand dune)	M. Rotheroe, Conservation Officer, British Mycological Society, Fern Cottage, Falcondale, Lampeter, Dyfed SA48 7RX, tel: 01570 422041
Fungi (British Mycological Society database)	Dr P. Cannon, International Institute of Mycology, Bakeham Lane, Englefield Green, Egham, Surrey TW20 9TY, tel: 01784 470111
Lower plants (species status; Red Data Book Database; site register etc.)	*Species Advisor, JNCC, Peterborough, tel: 01733 562626

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

5.2 Flowering plants and ferns

V.M. Morgan

5.2.1 Introduction

This section describes the importance of the region for vascular plants (i.e. flowering plants and ferns) occurring in the region's coastal 10 km national grid squares, particularly species that are rare or scarce in Great Britain. The region is of national importance for its many rare and scarce species (Table 5.2.1).

Classic British botanical localities in the region include the Thames Estuary, Sandwich Bay, the coast between Kingsdown and Folkestone, and Dungeness. Centres of plant biodiversity such as these and the other areas shown on Map 5.2.1 result from a combination of climate, geology and history. A number of different elements, defined by Matthews (1955), are found in the flora. Continental (including northern and southern continental) species are well represented and include round-leaved wintergreen *Pyrola rotundifolia* subsp. *rotundifolia*, loose silky-bent *Apera spica-venti*, marsh sow-thistle *Sonchus palustris* and divided sedge *Carex divisa*. Oceanic species are also present, including some, such as curved hard-grass *Parapholis incurva*, sea barley *Hordeum marinum* and sea pea *Lathyrus japonicus*, that have their British stronghold in the region. The region holds the main British populations of a number of other species such as dittander *Lepidium latifolium*, slender hare's-ear *Bupleurum tenuissimum* and small cord-grass *Spartina maritima*.

Rare and scarce plants grow in a wide range of habitats, but of particular importance are dunes, shingle, saltmarshes and chalk grassland and cliffs. Ferns are poorly represented, owing to the relatively dry climate (Corke 1984).

5.2.2 Important locations and species

There is one internationally protected species, early gentian *Gentianella anglica*, which is listed for protection under the EC Habitats & Species Directive and the Bern Convention, and twelve others are amongst the 107 listed on Schedule 8 of the Wildife & Countryside Act 1981. In total, 21 Red Data Book (RDB) species occur in the region, out of approximately 290 extant species that are likely to be included in the next edition of the Red Data Book (Wigginton in prep.). Of the 254 scarce species (those known from between 16 and 100 10 km squares) in Great Britain, 93 occur in the region. There are only a few endemic (i.e. confined to Great Britain) species found in the region. They include the early gentian, which is endemic to England, and three sub-species of rock sea-lavender: *Limonium binervosum* subsp. *binervosum*, *L. b.* subsp. *cantianum* and *L. b.* subsp. *saxonicum*, all of which are endemic to the region. Five rare species in the region, bedstraw broomrape *Orobanche caryophyllacea*, hartwort *Tordylium maximum*, hog's fennel *Peucedanum officinale*, stinking hawk's-beard *Crepis foetida* and pedunculate sea-purslane *Atriplex pedunculata* are known from nowhere else in Great Britain, and a sixth, saltmarsh goosefoot *Chenopodium chenopodioides*, is almost confined to the region. Rare and protected species that occur in the region are listed in Table 5.2.2. Box *Buxus sempervirens*, field eryngo *Eryngium campestre*, ground pine *Ajuga chamaepitys*, rough marsh-mallow *Althaea hirsuta*, monkey orchid *Orchis simia*, dwarf milkwort *Polygala amarella* and greater hayrattle *Rhinanthus angustissimus* are also known from the region. Although growing in coastal 10 km squares, these species are confined in the region to chalk downs or to urban places far from tidal rivers. They are not maritime and are, at most, only indirectly affected by their proximity to the sea and are therefore omitted from Table 5.2.2.

Key localities that support important populations of rare species and/or 25 or more scarce species are listed in Table 5.2.3; their locations are shown on Map 5.2.1.

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

Table 5.2.1 Numbers of rare and scarce higher plant species in coastal 10 km squares of the region*

	Protected species	*Other rare (RDB) species*	*Scarce species*
Suffolk	2	1	64
Essex	3	4	60
Greater London	0	1	34
Kent	10	6	79
Region 7	***13***	***8***	***93***

Source: JNCC Rare Plants Database; Stewart *et al.* (1994); BRC database. Key: RDB = Red Data Book; *excludes known introductions and records from before 1970.

5.2.3 Human activities

Although the threat of botanical collecting has largely passed, the whereabouts of potentially collectable species such as

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

Species	*Recorded occurrence in:*			*Key localities*	*Habitat*
	no. of 10 km squares in GB	*no. of coastal 10 km squares in region*	*no. of sites in region approx.*		
Bedstraw broomrape *Orobanche caryophyllacea*[1]	4	4	5	Sandwich Bay; Kingsdown to Folkestone	Grassland on chalk and calcareous dunes; parasitic on hedge-bedstraw *Galium mollugo* and lady's bedstraw *G. verum*
Deptford pink *Dianthus armeria*	25	4	4	Thames Estuary area; Sandwich Bay	Dry, open grassland
Early gentian *Gentianella anglica*[1,2]	62	1		Kingsdown to Folkestone	Chalk and dunes
Early spider orchid *Ophrys sphegodes*[1]	14	4	13	Queen Down Warren; Kingsdown to Folkestone; Dungeness	Open calcareous grass land; vegetated shingle
Grey hair-grass *Corynephorus canescens*	12	3	5	Lowestoft; Benacre; Walberswick to Sizewell	Short turf on sand
Hartwort *Tordylium maximum*	1	1	2	Thames Estuary area	Rough grassland & scrub
Hog's fennel *Peucedanum officinale*	7	7	19	Southwold; Hamford Water area; Colne Estuary area; Faversham to Whitstable; Minnis Bay	Seawalls, clay cliffs, saltings, dykes and brackish grassland
Late spider-orchid *Ophrys fuciflora*[1]	5	2	3	Kingsdown to Folkestone	Grassland on south-facing chalk slopes
Least lettuce *Lactuca saligna*[1]	2	1	1	Thames Estuary area	Disturbed vegetation on shingle or sea-walls
Lizard orchid *Himantoglossum hircinum*[1]	18	3	5	Chatham; Sandwich Bay	Calcareous grassland
Meadow clary *Salvia pratensis*[1]	24	3	4	Medway Valley; Queen Down Warren; Kingsdown to Folkestone	Herb-rich chalk grassland
Military orchid *Orchis militaris*[1]	5	1	1	Kingsdown to Folkestone	Woods, scrub or grassland over chalk
Oxtongue broomrape *Orobanche loricata*[1]	3	1	3	Kingsdown to Folkestone	Chalk undercliff & slopes; parasitic on hawkweed oxtongue *Picris hieracioides*
Pedunculate sea-purslane *Atriplex pedunculata*[1]	1	1	1	Thames Estuary area, Crouch-Roach Estuary	Open areas of sand or mud in saltmarshes
Red star-thistle *Centaurea calcitrapa*	6	1	1	Chatham	Disturbed chalky grassland
Red-tipped cudweed *Filago lutescens*[1]	13	5	6	Walberswick to Sizewell; Snape; Hollesley; Stour & Orwell Estuaries area	Open vegetation on sand or gravel
Saltmarsh goosefoot *Chenopodium chenopodioides*	12	10		Thames Estuary area; Medway Estuary and the Swale; Faversham to Whitstable	Dry brackish mud
Sharp-leaved pondweed *Potamogeton acutifolius*	12	1	1	Preston Marshes	Fen dykes
Slender bird's-foot-trefoil *Lotus angustissimus*	27	1	1	Faversham to Whitstable	Sandy or gravelly places
Stinking goosefoot *Chenopodium vulvaria*[1]	6	2	2	Thames Estuary, Stour & Orwell Estuaries area; Isle of Sheppey; Sandwich Bay	Open vegetation on sand
Stinking hawk's-beard *Crepis foetida*[1]	1	1	1	Dungeness	Shingle

Source: JNCC Rare Plants Database and rare plant survey reports. Key: [1] listed on schedule 8 of the Wildlife & Countryside Act 1981; [2]listed on annexes IIb & IVb of EC Habitats & Species Directive and Annex I of the Bern convention.

certain orchids are still kept confidential. Some coastal populations of hog's fennel are thought to have been damaged by entomological collectors as it is the food plant of an uncommon moth; however, elsewhere in Essex the species is not considered threatened (Tarpey & Heath 1990; Adams 1995; Ford 1988).

A number of the most threatened species are the subject of recovery programmes. For example English Nature has reintroduced stinking hawk's-beard at Dungeness, and Plantlife has surveyed and managed sites of red-tipped cudweed, early gentian and meadow clary as part of their 'Back from the Brink' project (Rich 1993, 1994b, 1995, 1996; Rich & McNab 1996). A species extinct in the region, narrow-leaved cudweed *Filago gallica,* has been reintroduced to Essex (J. Roughton, Suffolk Wildlife Trust pers. comm.; Rich 1994a).

Some species and sites have been lost to urban,

Table 5.2.3 Key localities for nationally rare (RDB) and scarce species (records post 1970)

Locality	*Status*	*Species*
Walberswick to Sizewell	Part NNR, part SSSI, part undesignated	Red data book species: grey hair-grass *Corynephorus canescens*, red-tipped cudweed *Filago lutescens* Scarce species: marsh sow-thistle *Sonchus palustris*, milk parsley *Peucedanum palustre*, plus 25 other scarce species
Stour and Orwell Estuaries area	Part LNR, part SSSI, part undesignated	Red data book species: red-tipped cudweed, stinking goosefoot *Chenopodium vulvaria* Scarce species: bur medick *Medicago minima*, hoary mullein *Verbascum pulverulentum*, sickle medick *Medicago sativa* subsp. *falcata* plus 30 other scarce species
Hamford Water area	Part NNR, part SSSI, part undesignated	Red data book species: hog's fennel *Peucedanum officinale* Scarce species: rock sea-lavender *Limonium binervosum* subsp. *saxonicum* plus 24 other scarce species
Colne Estuary area	Part NNR, part SSSI, part undesignated	Red data book species: hog's fennel, saltmarsh goosefoot *Chenopodium chenopodioides* Scarce species: annual beardgrass *Polypogon monspeliensis*, marsh sow-thistle, rock sea-lavender *Limonium binervosum* subsp. *saxonicum,* sea-heath *Frankenia laevis*, plus 25 other scarce species
Thames Estuary area	Part NNR, part LNR, part SSSI, part undesignated	Red data book species: Deptford pink *Dianthus armeria*, hartwort *Tordylium maximum*, least lettuce *Lactuca saligna*, saltmarsh goosefoot, pedunculate sea-purslane *Atriplex pedunculata* Scarce species: annual beardgrass, autumn squill *Scilla autumnalis*, bur medick *Medicago minima*, mat-grass fescue *Vulpia unilateralis*, lady orchid *Orchis purpurea*, marsh sow-thistle, white mullein *Verbascum lychnitis* plus 32 other scarce species
Faversham to Whitstable	Part SSSI, part undesignated	Red data book species: hog's fennel, saltmarsh goosefoot, slender bird's-foot-trefoil *Lotus angustissimus* Scarce species: bur medick, lady orchid plus 20 other scarce species
Sandwich Bay	Part SSSI, part undesignated	Red data book species: bedstraw broomrape, Deptford pink, lizard orchid *Himantoglossum hircinum*, stinking goosefoot Scarce species: annual beardgrass, bur medick, common broomrape *Orobanche minor* var. *maritima*, rock sea-lavender *Limonium binervosum* subsp. *cantianum*, sand catchfly *Silene conica*, sharp rush *Juncus acutus* plus 28 other scarce species
Kingsdown to Folkestone	Part LNR, part SSSI, part undesignated	Red data book species: bedstraw broomrape, early gentian, early spider-orchid *Ophrys sphegodes*, late spider-orchid *Ophrys fuciflora*, meadow clary *Salvia pratensis*, oxtongue broomrape *Orobanche loricata*, military orchid *Orchis militaris* Scarce species: bur medick, lady orchid, common broomrape, rock sea-lavender *Limonium binervosum* subsp. *binervosum*, rock sea-lavender *Limonium binervosum* subsp. *cantianum*, sea-heath, slender bedstraw *Galium pumilum* plus 23 other scarce species
Dungeness	Part SSSI, part undesignated	Red data book species: early spider-orchid, stinking hawk's-beard *Crepis foetida* Scarce species: bur medick, sand catchfly, sea-heath, white mullein plus 22 other scarce species

Source: JNCC Rare Plants Database; Stewart *et al.* (1994); SSSI citation sheets; BRC database. Key: SSSI = Site of Special Scientific Interest; NNR = National Nature Reserve; LNR = Local Nature Reserve. Note: scarce species may occur near to rather within some localities.

recreational and industrial development, including ports and power stations (Jermyn 1974; Beardall *et al.* 1988). The use of pesticides and fertilisers (Firth 1984; Tarpey & Heath 1990) and the conversion of marshes to arable crops have affected some species (Beardall *et al*. 1988). Lack of management has adversely affected some sites (Tarpey & Heath 1990), and overgrazing or excessive mowing has damaged others (Adams 1995).

The history of flooding and erosion on the east coast, the sea defences that were built in response, new policies of managed retreat and the use of natural habitats for flood protection, as well as any future changes in sea level, have affected and will continue to affect plant species and habitats in both beneficial and damaging ways. The construction and upgrading of sea walls has truncated some marshes and the use of imported soil and seed may have affected native populations of some species (Tarpey & Heath 1990). Many habitats including marshes, dunes, shingle and woodland are vulnerable to erosion, which can be exacerbated by disturbance such as mechanical bait-digging and removal of banks of sand and gravel for building materials (Simpson 1982; Tarpey & Heath 1990).

5.2.4 Information sources used

All the counties in the region were covered by rare plant surveys between 1974 and 1987 and a series of detailed confidential reports were produced, now held by English Nature and the Joint Nature Conservation Committee (JNCC). Further work has been carried out by English Nature as part of their programme of monitoring. Records of Red Data Book species are kept in the JNCC's Rare Plants Database. Between 1990 and 1992 members of the Botanical Society of the British Isles (BSBI) collected records of scarce species; these data are held at the Biological Records Centre and have been summarised in *Scarce plants in Britain* (Stewart *et al*. 1994). BSBI vice-county recorders keep plant records and some have compiled reports on rare species.

5.2.5 Acknowledgements

Thanks are due to B. Banks, R. FitzGerald, M. Wigginton and staff at the Biological Records Centre. Thanks also go to J. Roughton, Suffolk Wildlife Trust, for his helpful comments on the draft text.

5.2.6 Further sources of information

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Species on SSSIs and NNRs, other protected areas, rare and scarce species, rare plant surveys, licensing and protected species	*Coastal Ecologist, Maritime Team, English Nature HQ, Peterborough, tel: 01733 455000
Database of rare and protected species	*Species Advisor, JNCC, Peterborough, tel: 01733 562626
Biological Records Centre for Suffolk	Biological Records Officer, Suffolk Biological Records Centre, Ipswich Museum, High Street, Ipswich, Suffolk IP1 3QH, tel: 01473 213761
Biological Records Centre for North-east Essex	Curator of Natural History, Colchester Museum's Biological Records Centre, Museum Resource Centre, 14 Ryegate Rd, Colchester, Essex CO1 1YG, tel: 01206 282936
Biological Records Centre for Greater London	Biological Records Officer, London Wildlife Trust, 80 York Way, London N1 9AG, tel: 0171 278 6612/3
Biological Records Centre for Kent	Keeper of Natural History, Kent Biological Records Centre, Maidstone Museum, Saint Faith's St., Maidstone, Kent ME14 1LH, tel: 01622 756405
Local BSBI vice-county recorders' records	*C.D Preston, c/o Biological Records Centre, ITE Monks Wood, tel: 01487 773381

*Starred contact addresses are given in full in the Appendix

5.3 Land and freshwater invertebrates

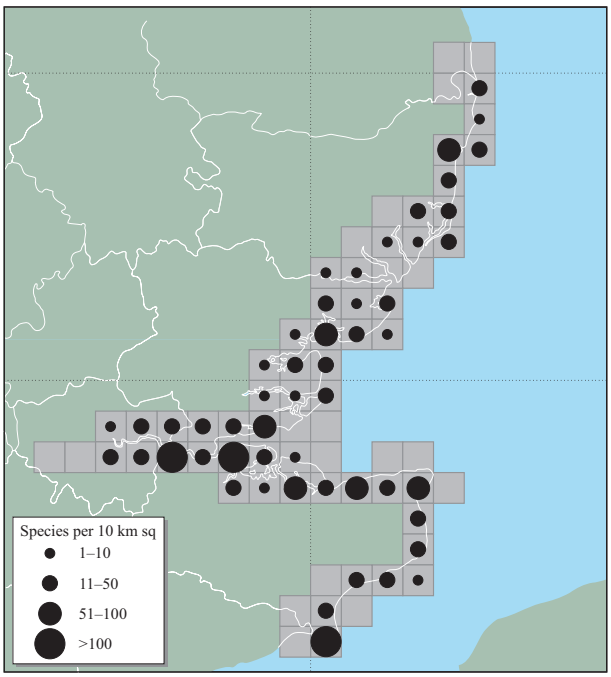
M.S. Parsons & A.P. Foster

5.3.1 Introduction

There are over 28,000 species in the better known groups of invertebrates in Great Britain (Kirby 1992). This section covers most orders, but not all families, of insects and a wide range of non-insect invertebrates, known from sites within the coastal 10 km grid squares of the region. Lagoonal species are covered in section 5.4.

The region has records of thirteen species of invertebrate that are listed in international directives or conventions or the Wildlife & Countryside Act 1981 (excluding 'sale only' section) (Table 5.3.1). However, several of these have not been recorded in the region in recent years, and one, the Essex emerald moth *Thetidea smaragdaria*, is probably now extinct in Britain.

Of the 358 Red Data Book (RDB = nationally rare) and 455 nationally scarce species listed by Kirby (1994a, b) as known to be associated with coastal habitats, very large numbers - 137 and 313 respectively - are recorded from this region. These totals include recent (since 1969) records for 22 RDB Coleoptera (beetles), eighteen RDB Lepidoptera (butterflies and moths) and twelve RDB Hymenoptera (bees, wasps and ants). Many additional rarities, not covered by Kirby (1994a, b), also occur, including for example species associated with woodland habitats and those confined to wetlands. Map 5.3.1 shows the numbers of all nationally rare (RDB) invertebrate species (including Kirby's 'coastal' species and all others) recorded in coastal 10 km squares in the region. Map 5.3.2 maps the recorded distribution of all nationally scarce invertebrates in the region, including those that are not strictly coastal in terms of their national distribution but which have populations on coastal sites. Note that survey effort has not been equal throughout the region, so actual occurrence may differ from recorded distributions.



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

5.3.2 Important locations and species

Table 5.3.2 lists coastal or freshwater RDB invertebrate species as defined by Kirby (1994a, b) that have been recorded recently in the region.

Several invertebrates are currently known only from this region: examples include the ground bug *Ischnodemus quadratus* (Kent), the froghopper *Aphrodes duffieldi* (Kent), the weevil *Baris scolopacea* (Essex and Kent), the fiery clearwing moth *Bembecia chrysidiformis* (Kent), the spider wasp *Evagetes pectinipes* (Kent) and the jumping spider *Heliophanes auratus* (Essex). Many other species have very restricted distributions and a substantial part of their range is within this region, e.g. the soldier fly *Stratiomys longicornis* (mainly south-east England but with records from the Isle of Wight to Lincolnshire). A few species, such as the scarlet tiger moth *Callimorpha dominula*, have populations on this part of the coast that are geographically isolated from the bulk of their British populations. This region also supports a very small number of subspecies or races of insect that are known to have very restricted distributions in Britain, e.g. the pigmy footman moth *Eilema pygmaeola pallifrons*. Subspecies *pascuea* of the feathered brindle moth *Aporophyla australis* does not appear to be known outside this country.

Many sites along this stretch of coast are important for the conservation of invertebrates, and a number support several species that are extremely scarce in Britain. The Invertebrate Site Register (ISR) has records for more than 520 coastal sites within this region, although some are subsites of larger areas or loosely defined localities. Many of these sites support RDB species along with a range of nationally scarce species. Table 5.3.3 lists those sites considered to be particulary important for invertebrate conservation. Site selection was based on the range and/or scarcity of species present, the species habitat associations and the amount of available habitat. Many of these sites are Sites of Special Scientific Interest (SSSIs) or National Nature Reserves (NNRs).

The region is nationally important not only for the number of scarcer species found, many of which for climatic reasons are at the edge of their range in Britain, but also for its species assemblages. For example, Marshall & Haes (1988) list Denge Marsh and Denge Beach (Dungeness) (fifteen species), Folkestone Warren (thirteen species) and Pegwell Bay and Sandwich Dunes (twelve species) as outstanding sites for Orthoptera (grasshoppers and crickets) and allied families, out of only 20 such sites listed for the country.

The sand dunes of Sandwich are known to be of national significance for invertebrate conservation. The sand dune succession provides a range of microhabitats that can be exploited by specialist species. For example, comparatively few invertebrates can tolerate the harsh conditions found along the extreme coastal edge of the fore dunes. The sand dart *Agrotis ripae* is a moth typical of this part of the

Table 5.3.1 Protected invertebrate species

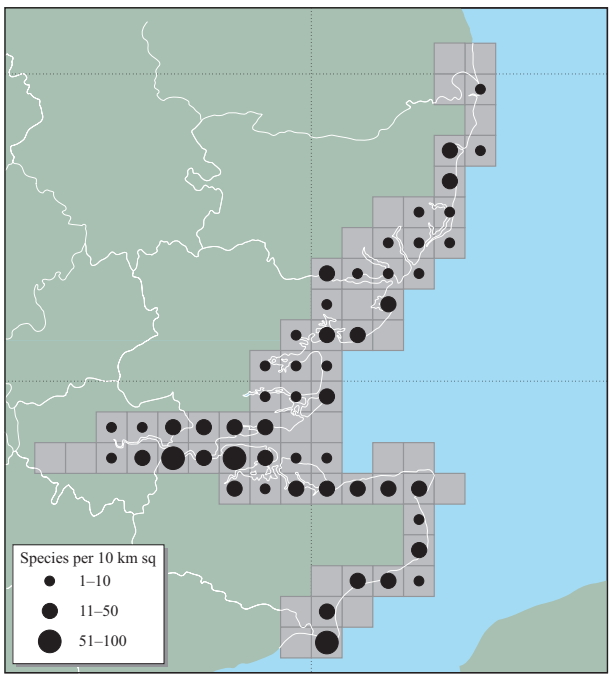
Species	*Counties*	*Protected status*
Norfolk aeshna dragonfly *Aeshna isosceles*	Suffolk	5
Field cricket *Gryllus campestris*	Essex (old record, possibly an introduction)	5
Wart-biter cricket *Decticus verrucivorus*	Kent (current status uncertain)	5
Heath fritillary butterfly *Mellicta athalia*	Essex and Kent (old records only)	5
Marsh fritillary butterfly *Eurodryas aurinia*	Essex (old record only); Greater London and Kent (19th century records only)	1, 3
High brown fritillary butterfly *Argynnis adippe*	Suffolk (old record only); Essex (no recent confirmed record); and Kent (no recent record)	5**
Sussex emerald moth *Thalera fimbrialis*	Kent	5**
Essex emerald moth *Thetidea smaragdaria*	Essex and Kent (probably now extinct in Britain)	5
A water beetle *Paracymus aeneus*	Essex	5**
Glutinous snail *Myxas glutinosa*	Kent (old records only)	5
Desmoulins' whorl snail *Vertigo moulinsiana*	Suffolk	1
Narrow-mouthed whorl snail *Vertigo angustior*	Suffolk	1
Medicinal leech *Hirudo medicinalis*	Kent	2, 4, 5*, 6

Source: JNCC Invertebrate Site Register. Key: 1 = Annex II, EC Habitats & Species Directive; 2 = Annex V, EC Habitats & Species Directive; 3 = Appendix II, Bern Convention; 4 = Appendix III, Bern Convention; 5 = Schedule 5, Wildlife & Countryside Act 1981 (excluding 'sale only'); 6 = Appendix II, Convention on International Trade in Endangered Species (CITES); *Variation of Schedule Order 1988; **Variation of Schedules 5 & 8 Order 1982.

succession. The moth *Nyctegretis lineana* is currently known from just five sites in Britain, all within this region. It is found on flat sandy ground behind sandhills. The larva of this moth inhabits a loose silken tube under the hostplant common restharrow *Ononis repens*. Areas of compacted sand, particularly those that are sheltered and with a southerly aspect, can be ideal for bees and wasps, providing nesting sites and an abundance of nectar sources. A number of scarcer species are known to frequent this sort of habitat and include the cuckoo bee *Coelioxys mandibularis*.

There are many areas of saltmarsh, brackish marsh and grazing levels along this stretch of coast. A number of these are known to be particularly significant for invertebrates and support many RDB species, e.g. Benfleet and Hadleigh Marshes and Stoke Saltings. The ground lackey *Malacosoma castrensis* is one of many saltmarsh moths found primarily in this part of England. The larvae inhabit a communal nest and feed on a wide range of saltmarsh plants. The weevils *Apion limonii* and *Baris scolopacea* are both known along this stretch of coast. The former is associated with sea-lavender *Limonium* spp., the latter's hostplant being sea-purslane *Halimione portulacoides*. The soldier fly *Stratiomys longicornis* has been recorded from saltmarshes, around highly brackish pools and along ditches on coastal levels. Larvae of this fly have been found in mud at the edges of brackish ditches. Brackish pools can support a small but interesting assemblage of water beetles, including *Enochrus halophilus*. The saltmarsh colletes *Colletes halophilus* frequents the upper margins of saltmarshes. This bee requires bare or sparsely vegetated soil, preferring south-facing slopes, in which to nest. Fisher's estuarine moth *Gortyna borelii lunata* has been found in Britain only in north-east Essex; it is associated with hog's fennel *Peucedanum officinale*.

Walberswick has one of the largest reedbeds in Britain and



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

Table 5.3.2 Coastal Red Data Book (RDB) species in Region 7, recorded since 1970

Species	*Description and notes on recorded occurrence in the region*
RDB1	
Agroeca lusatica	Brown spider up to 6 mm long recorded from Sandwich Dunes, Kent.
Apostenus fuscus	3 mm long spider so far known in Britain only from coastal shingle at Dungeness, Kent, despite being a woodland spider on the continent.
Fiery clearwing moth *Bembecia chrysidiformis*	Very local on sea-cliffs in Kent, also noted in Sussex, Hampshire and Essex. Larvae mine the roots of curled dock *Rumex crispus*, water dock *R. hydrolapathum* and common sorrel *R. acetosa*.
Cerceris quadricincta	Solitary wasp found in sparsely vegetated, sandy areas. Post-1969 records from two or three sites in Kent only.
Chocolate-tip moth *Clostera anachoreta*	Scarce: one locality in Kent, the larvae feeding on willow *Salix* spp. and poplar *Populus* spp.
Dibolia cynoglossi	Small (2-3 mm) flea beetle associated with various species of labiate, including hemp-nettles *Galeopsis* spp., mint *Mentha* spp., claries *Salvia* spp., woundworts *Stachys* spp., black horehound *Ballota nigra* and hound's tongues *Cynoglossum* spp. Extremely local and recorded recently only in East Sussex and East Kent.
Evagetes pectinipes	Very rare spider-hunting wasp recorded with certainty only from the Kent coast, where it was first seen in 1966; may be a recent colonist from the continent. Probably a cleptoparasite on the commoner spider-hunting wasp *Episyron rufipes*.
Marsh-mallow moth *Hydraecia osseola hucherardi*	Frequents riverbanks, ditches and marshy places. Larva feeds on the roots of marsh-mallow *Althaea officinalis*. Local, occurring in south-east Kent, East Sussex and north Kent.
Hypera pastinacae	Weevil recorded from Folkestone Warren, Kent. Frequents coastal cliffs and is associated with sea carrot *Daucus carota* subsp. *gummifer*.
Paracymus aeneus	Small brown water beetle with reddish legs. Rediscovered in 1991 at a site in the Essex saltmarshes, where it had not been seen since 1931. Otherwise known only from the Isle of Wight.
Pellenes tripunctatus	Infrequently recorded jumping spider found on sparsely vegetated shingle. Only recent records from Dungeness, Kent.
Pilophorus confusus	Only two records of this plant bug in Britain, one from a Surrey sandpit and one from Dungeness, Kent, both associated with creeping willow *Salix repens*. In Britain found largely on the ground, but may also occur on trees.
Pseudamnicola confusa	Small snail found on mud, often among common reeds *Phragmites australis*, in the weakly brackish regions of estuaries. Sussex, the Thames Estuary and localised areas in Suffolk and Norfolk. Though superficially suitable habitat remains widespread, the species has undergone a dramatic decline. Deteriorating water quality may be the main reason.
Segmentina nitida	Ramshorn snail that has undergone a marked decline this century. In ponds and marsh drains, particularly those that are well oxygenated and have lush vegetation. Formerly widespread in England as far north as Yorkshire but now restricted to a few unimproved grazing marsh sites in the south-east and East Anglia.
Sussex emerald moth *Thalera fimbrialis*	Known from shingle beaches in Kent and East Sussex, probably extinct at the latter site. Probably immigrant elsewhere. Larva feeds on wild carrot *Daucus carota,* common ragwort *Senecio jacobaea* and hoary ragwort *Senecio erucifolius*, possibly also on yarrow *Achillea millefolium*.
Essex emerald moth *Thetidea smaragdaria*	Inhabits the edges of saltmarshes, the larva feeding on sea wormwood *Artemisia maritima*. Formerly widespread in south-east Essex and also found in north Kent. Now believed to be extinct in the wild.
Narrow-mouthed whorl snail *Vertigo angustior*	Small snail found in permanently marshy grassland in dunes and lowland fens. Extremely rare; some colonies are under threat from natural changes to the habitat. Populations in southern Cumbria, South Wales and East Anglia. Flandrian fossil record shows it once to have been much more widespread.
RDB2	
Andrena rosae	Mining bee known from a variety of habitats, including coastal landslips, soft-rock cliffs and rough cliff tops. Extremely scarce throughout its range and has apparently declined considerably. Post-1969 records known from only a handful of sites in east Cornwall, north Devon, west Kent and Pembrokeshire.
Andrena simillima	Mining bee typically recorded from coastal sites. Probably needs patches of bare ground in warm, sunny situations for nesting. Southern England, very local from Kent to Cornwall.

Table 5.3.2 Coastal Red Data Book (RDB) species in Region 7, recorded since 1970 (continued)

Species	*Description and notes on recorded occurrence in the region*
RDB2 continued	
Erioptera (Mesocyphona) bivittata	Cranefly originally discovered in Britain in Kent 1966, since found more widely in coastal levels with mildly brackish ditches and ponds, favouring areas at the edges of ditches with sparse vegetation. Kent, Essex, Suffolk and Norfolk.
Fisher's estuarine moth *Gortyna borelii lunata*	Inhabits marshy fields and waste places; larvae live in the stems and roots of hog's fennel *Peucedanum officinale*. Confined to a small area in Essex.
White spot moth *Hadena albimacula*	Shingle beaches and chalk or limestone cliffs. Larvae feed on Nottingham catchfly *Silene nutans*. Very local on the southern coast in Kent, Hampshire and south Devon.
Heliophanus auratus	Jumping spider so far known only from the Colne and Blackwater Estuaries, Essex. On sparsely vegetated shingle or shell banks just below the line of spring tide litter.
Henestaris halophilus	Ground bug, confined to the upper levels of saltmarshes on the north Kent coast, where it is associated with sea-purslane *Halimione portulacoides*.
Bright wave moth *Idaea ochrata cantiata*	Coastal sandhills and shingle beaches. Larva possibly feeds on a variety of flowers of sandhill plants. Very local in south-east England, Kent, Essex and Suffolk.
Lejops vittata	Large hoverfly of brackish ditches. Closely associated with sea club-rush *Scirpus maritimus*, on which the adults feed. Scattered records from the coastal marshes of southern England including the Thames Estuary, Kent, Sussex and Somerset.
Miscophus ater	Solitary wasp recorded within the region from Sandwich Bay, Kent, on coastal dunes, nesting in light sandy soil.
Odontomyia ornata	Soldier fly; larvae develop in shallow water of ponds and rivers, the adults visiting flowers nearby. Locally frequent, though declining, in the coastal levels of Sussex, Somerset and Gwent. Known elsewhere from scattered localities as far north as north Norfolk; occasionally reported inland.
Oxyloma sarsi	Rare semi-aquatic snail found on emergent vegetation such as sweet-grass *Glyceria* spp. in fens and marshes. Modern records from East Anglia and the Hertfordshire/Essex border.
Philanthus triangulum	Yellow and black digger wasp found in lowland heaths, coastal sand dunes and cliffs, where it excavates nest burrows in sandy soil. Some trampling may benefit some sites by keeping the vegetation cover sparse. Recorded in southern England from Suffolk to the Isle of Wight.
Polistichus connexus	Very rare ground beetle, 8-10 mm long, very flattened, brown with pale markings. Lives on silt or clay soils by rivers and on the sea-shore. Probably a predatory species. Only one recent record from Sussex; previously known from Kent, Essex, Suffolk and Norfolk.
Sphaerophoria loewi	Rare small yellow and black hoverfly. Occurs in wetlands, particularly brackish coastal marshes with stands of sea club-rush *Scirpus maritimus* and common reeds *Phragmites australis*. Kent north to Elgin.
Stratiomys longicornis	Large soldier fly with aquatic larvae developing in strongly brackish pools and ditches. Extremely local, recorded from the Thames Estuary to Scotland.
Valvata macrostoma	Aquatic snail found mainly in well-oxygenated, richly-vegetated marsh drains. Extremely local and vulnerable to agricultural changes. Scattered populations from southern Lincolnshire to Hampshire.
RDB3	
Andrena proxima	Mining bee known from coastal landslips and soft-rock cliffs, and inland on heathland and disturbed situations. Reported also from chalk downland in Kent and Berkshire. Extremely scarce: about 20 post-1969 sites, mostly in south Devon, the Isle of Wight and Kent.
Rest harrow moth *Aplasta ononaria*	Coastal sandhills and chalk cliffs, the larva feeding on common restharrow *Ononis repens*. Resident only in Kent.
Atylotus latistriatus	Saltmarsh species of horsefly, confined to southern England. Males are attracted to flowers of sea-lavender *Limonium* spp.
Baris scolopacea	Rare weevil phytophagous on sea-purslane *Halimione portulacoides*, though it has also been reared from grass-leaved orache *Atriplex littoralis*. Apart from a single locality in Sussex, restricted to the saltmarshes of Kent and Essex.
Toadflax brocade moth *Calophasia lunula*	Shingle beaches, waste land and gardens. Larvae live on common toadflax *Linaria vulgaris* and occasionally other toadflax species. Resident in Kent and Sussex, also a suspected immigrant.

Table 5.3.2 Coastal Red Data Book (RDB) species in Region 7, recorded since 1970 (continued)

Species	*Description and notes on recorded occurrence in the region*
RDB3 continued	
Campsicnemus magius	Small dolichopodid fly of quite remarkable appearance in the male. Front legs strongly ornamented with processes and bristles which give the appearance of additional legs. Occurs on bare mud in coastal levels and upper saltmarsh. Most records from the Thames Estuary, especially the north Kent Marshes, but also East Anglia, Sussex and Yorkshire.
Clubiona similis	Rare spider occurring on dunes from Norfolk to Kent, usually found in marram tussocks.
Coelioxys mandibularis	Cuckoo bee confined in Britain to coastal dunes, where its probable hosts, *Megachile maritima* or *M. leachella,* occur. Very local, recorded from three discrete areas: the Merseyside and Wallasey area of south Lancashire and Cheshire; Glamorganshire, Camarthenshire and Pembrokeshire; and West Sussex and east Kent.
Pigmy footman moth *Eilema pygmaeola*	Two subspecies in Britain: subspecies *pygmaeola* is found on coastal sandhills in Kent
Euophrys browningi	Jumping spider; adult occurs from April to June and August to October. In tide litter and in empty whelk shells on shingle banks. Norfolk, Suffolk, Essex and Kent. Possibly endemic to Britain.
Pug moth *Eupithecia extensaria occidua*	Scarce; frequents saltmarshes. Larva feeds on sea wormwood *Artemisia maritima*. Yorkshire, Lincolnshire, Norfolk and Essex.
Graptodytes bilineatus	Water beetle of stagnant water close to the sea. Essex marshes; Dungeness, Kent; Chesil Beach, Dorset; and the Outer Humber.
Haematopota bigoti	Coastal blood-sucking cleg. Larvae live in soil in saltmarshes of the southern coastlands, north to Humber-Mersey. Very local.
Haematopota grandis	Blood-sucking cleg, recorded within the region from Walberswick, Suffolk and the Stour Estuary, Essex. Found in coastal marshes and along tidal rivers.
Haplodrassus minor	Rare spider found under tide litter or sparse vegetation and on shingle banks near the seashore. Southern England, East Anglia and Caernarvonshire.
Hybomitra ciureai	Horsefly recorded mostly from brackish coastal marshes or grazing levels. Larvae probably develop in damp soil. Kent, Sussex, Suffolk and Essex.
Hylaeus euryscapus	Rare yellow-faced bee, on soft-rock cliffs, landslips, open expanses of sand or shingle and coastal dunes, where a female has been seen entering a burrow in loose sand. Southern coastal counties, with about a dozen post-1969 localities.
Lathys stigmatisata	Small spider so far recorded only from Kent, East Sussex, Cornwall and Lundy Island. Coastal heath and shingle.
Leptothorax interruptus	Small ant of warm, sandy or stony areas such as dry heathland or coastal localities. It has been found nesting in peat and in moss. Confined to the extreme south of England: reasonably frequent in the New Forest, Hampshire, local on the Dorset heaths, and has been recorded from Rye Harbour, Sussex, and Dungeness, Kent.
Malachius vulneratus	Rare malachite beetle: adults found on flowers. Confined to saltmarshes around the Thames Estuary and elsewhere in Essex. Larvae are probably predatory in saltmarsh litter.
Ground lackey moth *Malacosoma castrensis*	Coastal and estuarine saltmarshes, the larvae feeding on common sea-lavender *Limonium vulgare,* sea wormwood *Artemisia maritima* and other saltmarsh plants. Very local in south-east England: confined to Kent, Essex, Suffolk and a single locality in Devon.
Monacha cartusiana	Pale disc-shaped snail with a brown lip, up to 17 mm in diameter. Occurs on chalk grassland and dunes in Kent, Sussex and Suffolk. Formerly protected under Schedule 5 of the Wildlife & Countryside Act but this degree of protection is no longer thought to be necessary.
Myopites eximia	Picture-winged fly occurring in saltmarshes and saline shingle banks where the larval foodplant golden samphire *Inula crithmoides* thrives. Scattered records from the southern coast of England from Dorset to Essex.
Myrmica specioides	Red ant nesting in dry sand in coastal positions. Discovered in Britain in 1962 on the sandhills at Deal; since found at a small number of other coastal sites, all in Kent. Probably native rather than a recent introduction, as it is easily confused with *M. scabrinodis*.

Table 5.3.2 Coastal Red Data Book (RDB) species in Region 7, recorded since 1970 (continued)

Species	*Description and notes on recorded occurrence in the region*
RDB3 continued	
Nomada fulvicornis	Nomad bee cleptoparasitic on the mining bees *Andrena bimaculata, A. pilpipes* and *A. tibialis*. Sandy areas of heaths and disturbed areas such as waste ground, soft-rock cliffs and coastal grassland. Formerly widely distributed in southern England, but with post-1969 records from only about 20 sites. Kent and Sussex account for about half the recent records.
Odontoscelis fuliginosa	Burrowing shieldbug found in coastal dunes and the East Anglian Breckland. Widely distributed around the coast up to Lancashire in the west and Norfolk in the east, but extremely localised and very rarely recorded.
Passaloecus clypealis	Digger wasp, mainly in fens and marshes. Several British specimens have been reared from old cigar galls caused by the fly *Lipara* sp. in stems of common reeds *Phragmites australis*. Other plant species may also be used as nesting sites. Known only from a few sites in East Anglia and south-east England.
Phlegra fasciata	Jumping spider found mainly on sand dunes and shingle along the south coast of England.
Podalonia affinis	Large black and red solitary sand wasp nesting in sandy soil. Preys on caterpillars. England north to Yorkshire/Lancashire, but nowhere common.
Tawny wave moth *Scopula rubiginata*	Confined to the Breckland district and coastal sandhills near Thorpeness, Suffolk, probably immigrant elsewhere. Larvae possibly feed on low-growing plants.
Smicronyx coecus	Weevil associated with dodder *Cuscuta epithymum* and greater dodder *C. europaea*. Found in grassland, heathland, coastal shingle and on cliff-tops. Very local in southern England; recorded from Lydd Ranges and Dungeness, Kent.
Sphecodes niger	Bee found in the south of England on chalk grassland and clay cliffs. A parasite of bees of the genus *Lasioglossum, L. morio* being the probable host species. Larvae of *S. niger* use the nest and larval food of the host. Adult females have been recorded from April to October.
Thereva strigata	Stiletto fly apparently associated with hot, south-facing coastal cliffs. Larvae probably occur in sandy to sandy-loam soils and are probably predators feeding on a variety of arthropods and earthworms. Kent, the Isle of Wight and Devon.
RDB K	
Lithobius lapidicola	Centipede only recently recorded in Britain from Sandwich Bay, Kent, but very similar to *L. borealis* and often confused with this species.
Placobdella costata	A large leech which feeds on the blood of vertebrates including frogs, water birds and mammals. In Europe, found in a variety of freshwaters usually where aquatic macrophytes are present. The mature leeches carry their young attached to the ventral surface. Known only from Kent and Sussex.
RDB I	
Brachida exigua	Rove beetle found on the banks of tidal rivers and on or near the coast. Castle Hill and Round Down, east Kent.
Neofriseria peliella	Micro-moth recorded from coastal shingle sites. Larvae feed in a silken tube at the base of sheep's sorrel *Rumex acetosella*. Often confused with *N. singula* and only recorded with certainty from East Sussex and east Kent.
pRDB1	
Caryocolum blandulella	Micro-moth of sandy coasts in southern England. Larvae feed on little mouse-ear *Cerastium semidecandrum*.
pRDB2	
Ethmia bipunctella	Black and white micro-moth. Larva feeds on the flowers and leaves of viper's-bugloss *Echium vulgare*, comfrey *Symphytum* spp. or other Boraginaceae, pupating in a dead stem or rotten wood. Very local, resident in Kent and East Sussex, occasionally occurs elsewhere on southern and eastern coasts.
Ethmia terminella	Small black and white moth. Larvae feed on the flowers and unripe seeds of viper's-bugloss *Echium vulgare*. Only reliably recorded from Kent and Sussex, on areas of coastal shingle and chalk cliffs.
Gelechia muscosella	Micro-moth recorded from fenland and amongst sallow *Salix* spp. scrub on coastal shingle. Larva feeds in catkins of poplar *Populus* spp. and sallow. Found at a very few sites in East Anglia and south-east England.

Table 5.3.2 Coastal Red Data Book (RDB) species in Region 7, recorded since 1970 (continued)

Species	*Description and notes on recorded occurrence in the region*
pRDB2 continued	
Hybomitra expollicata	Horsefly; adults occur in brackish coastal levels and possibly in saltmarshes at Studland, Dorset and some Essex sites. Recorded from only seven sites since 1900 in Dorset, Sussex, Kent and Essex.
Pediasia fascelinella	Pyralid moth on sandhills; larvae feed on various grasses. Coast of Lincolnshire, Norfolk, Suffolk, Essex, Kent and south Devon.
Ylodes reuteri	Caddisfly found on the Thames Marshes in north-west Kent and Essex, and various sites in Suffolk and Norfolk. Frequents brackish water, probably amongst vegetation, and possibly where there is a slight water movement.
pRDB3	
Agriotes sordidus	Rare click beetle of tidal rivers and coastal and estuarine habitats. Southern England north to Lancashire. Oakham Marsh and Hoo Saltings, Kent.
Anisodactylus poeciloides	Black ground beetle 10-13.5 mm long, plant-eating, saltmarshes. Very local and uncommon, southern England from Cornwall to Essex.
Apion rubiginosum	Local weevil of southern distribution, associated with sheep's sorrel *Rumex acetosella*, apparently preferring coastal habitats.
Ceutorhynchus verrucatus	Small weevil, in Britain apparently exclusively associated with yellow horned-poppy *Glaucium flavum*. Adults and larvae occur inside a cavity in the main tap-root. Coastal shingle, Sussex, Essex, Hampshire and Devon.
Cynaeda dentalis	Extremely local coastal pyralid moth. Larva feeds in the stem and on the leaf bases of viper's-bugloss *Echium vulgare*. Southern and south-eastern England, from Suffolk to Devon.
Dromius vectensis	3.5-4 mm long ground beetle, reddish-brown with conspicuous markings. Vegetation on sandy ground, most often on the coast. Widespread but rare along southern coastal counties.
Dryophilus anobioides	Small brown beetle. Larvae develop in the dead stems of broom *Cytisus scoparius* and the adults are usually found by beating dead broom. Woodlands, scrub and roadside verges in south-eastern England. Very few modern records.
Gelechia hippophaella	Micro-moth of coastal dunes with sea-buckthorn *Hippophae rhamnoides,* the larval foodplant. The moth's range, from Yorkshire to East Sussex, includes much of the foodplant's native distribution.
Harpalus cordatus	7.5-10 mm long dark brown-black ground beetle. Plant-eating, in dry open grassland, mainly in coastal dunes in southern Britain.
Harpalus parallelus	Rare 5.5-7.5 mm long black, plant-eating ground beetle, on open calcareous grassland. Oxfordshire, Norfolk, Kent, Sussex, the Isle of Wight and Dorset.
Hypocaccus metallicus	Predatory beetle, in dung and carrion on coastal sandhills. Sussex to Lincolnshire.
Limonia (Dicranomyia) danica	Cranefly, in marshland, usually in coastal areas but also inland. Larvae probably live in wet mud. Approx. 12 localities scattered throughout southern England and East Anglia, particularly around the Thames Estuary.
Melissoblaptes zelleri	Rare pyralid moth which flies from June to August; larvae feed on the moss *Brachythecium albicans*. Coasts of Norfolk, Suffolk and Kent, plus the Isle of Wight and possibly Gloucestershire.
Ochthebius exaratus	Water beetle, in mud by coastal ponds. Mainly south-eastern England. Dartford Marshes, Crayford Marshes, Corrinham Marshes, Benfleet and Hadleigh Marshes, Chislet Marshes and Higham Marshes, Kent.
Philonthus punctus	10 mm long shiny black predatory rove beetle, very conspicuously pitted back. Lives in litter below sea club-rush *Scirpus maritimus* in brackish ditches and dykes. Recently recorded along the coast from north Essex to east Kent.
Pima boisduvaliella	Pyralid moth. Larvae live in pods of sea-pea *Lathyrus japonicus*, kidney vetch *Anthyllis vulneraria*, bird's-foot-trefoil *Lotus* spp. or spiny restharrow *Ononis spinosa*. Very local, on sandhills and shingle banks from Kent to Norfolk and Lancashire.
Platytes alpinella	Pyralid moth on sandy coasts; larva feed on *Tortula* spp. and other mosses. Very local and rather uncommon, along the south coast from Devon to Kent, also East Anglia, Lincolnshire and Yorkshire.
Poecilobothrus ducalis	Small dancefly; larvae probably semi-aquatic. In mud beside saline pools and ditches. Adults recorded from July to September. All modern records are from the north Kent Marshes, although there are also old records from Hampshire and Somerset.

Table 5.3.2 Coastal Red Data Book (RDB) species in Region 7, recorded since 1970 (continued)

Species	*Description and notes on recorded occurrence in the region*
pRDB3 continued	
Trixagus elateroides	Rare small false click beetle with very few modern records. Apparently coastal in distribution, associated with saltmarshes and river estuaries. South-eastern species.
pRDB K	
Aphrodes duffieldi	Leafhopper, 3.7-5 mm. long, male brown with variably developed transverse white bands, female mottled brownish. On grasses; currently recorded only from Dungeness, Kent. Apparently endemic.
Astenus procerus	Rove beetle, in chalky or sandy places near the coast, although occasionally inland also. Southern England north to Leicestershire. Dungeness, Kent.
Hister quadrimaculatus	Carrion beetle with few records. On or near the coast, associated with dung and carrion. Recorded in the region from Clacton, Essex, Stoke Saltings, Kent, and Dungeness, Kent.
Olibrus flavicornis	Smut beetle, infrequently recorded, probably associated with grassland and coastal habitats. Erith and Belvedere Marshes and Ingrebourne Marshes, Kent.
Philonthus lepidus	Extremely local rove beetle, sandy districts inland and on the coast. Sandwich Bay, and Deal, Kent.
Stenus calcaratus	Rove beetle, in reedbeds at the edge of tidal river. Only recently added to the British fauna. Holborough to Burnham Marshes, Kent.

Source: JNCC Invertebrate Site Register (after Kirby 1994a, b). Key: Red Data Book categories: RDB1 = endangered; RDB2 = vulnerable; RDB3 = rare; RDB I = Indeterminate; RDB K = insufficiently known; pRDB = proposed species as categorised in e.g. Hyman & Parsons (1992), except pRDBK = proposed species as categorised in e.g. Hyman & Parsons (1994). For further description of RDB categories, see Shirt (1987) and Bratton (1991).

as a consequence supports a wide range of species. These reedbeds are a stronghold of the white-mantled wainscot moth *Archanara neurica*, which feeds as a larva in the stems of common reed *Phragmites australis*. Another locality with extensive reedbeds, Stodmarsh, is the only recorded site in Britain for the micro moth *Monochroa niphognatha*. Ditches in grazing levels can support an impressive assemblage of water beetles, which can include the great silver diving beetle *Hydrophilus piceus*.

There are several areas of coastal shingle of great importance for invertebrate conservation. Entomologically perhaps the best known of these is Dungeness. However, several other areas of shingle are known to support significant species assemblages, and yet others, such as Hythe Ranges and Orford Ness, are likely to support impressive faunas but are not as well known because of access difficulties. Viper's-bugloss *Echium vulgare*, which can be particularly frequent on disturbed shingle, supports an assemblage of scarce species including the moths *Ethmia terminella* and *E. bipunctella*. Scarcer plants can support even scarcer invertebrates: for example, Nottingham catchfly *Silene nutans* is the foodplant of the moth *Coleophora galbulipennella* (which in Britain is only known on Dungeness and Hythe Ranges) and the white spot moth *Hadena albimacula* (known from very few sites between Cornwall and Kent). Each type of intact shingle ridge on Dungeness has its own characteristic fauna; for example, those with broom *Cytisus scoparius* support an important community of beetles and bugs. A range of other hostplants colonise these broom ridges, e.g. dodder *Cuscuta epithymum*, which is host to two scarce weevils, *Smicronyx coecus* and *S. jungermanniae*. Wetlands, both natural and artificial, can support impressive faunas, but cold, deep shingle extraction sites are usually unproductive for invertebrates. Where pits are shallow, with sandy margins, an assemblage of ground beetles, including the endangered *Omophron limbatum*, can be found at or near the waters edge. The shallow water can support several scarcer species, such as the medicinal leech *Hirudo medicinalis*. Emergent vegetation can also be important for a large number of species. An unusual microhabitat on shingle sites are old whelk shells; the threatened spiders *Pellenes tripunctatus* and *Euophrys browningi* have both been found in these shells.

The calcareous cliffs of this stretch of coast provide a range of microhabitats for invertebrates. Short, sheltered, south-facing grassland provides warm microclimates. These conditions can be ideal for a wide range of species, including the ground bug *Ischnodemus quadratus*, the moth *Pempeliella ornatella*, the latter usually being found flying near wild thyme *Thymus polytrichus*, and the rare ground beetle *Harpalus parallelus*, which has been found under rocks on short turf. Many species are found in scrubby situations, for example the barred tooth-striped moth *Trichopteryx polycommata*, which is associated with wild privet *Ligustrum vulgare*. This moth has been recorded at Folkestone Warren. Cliff paths can provide suitable situations for invertebrates that rely on areas of bare ground, e.g. many bee and wasp species.

There are several areas of woodland along this part of the coast that support a wide range of species. The white-letter hairstreak *Strymonidia w-album* (a butterfly) has been recorded from several sites in the region. It is associated with elm *Ulmus procera* and wych elm *U. glabra* and usually occurs in discrete colonies occasionally based on just a single tree. The olive crescent moth *Trisateles emortualis* is an exceedingly scarce species in Britain and has been recorded at Stour and Copperas Woods. The larvae feed on the withered leaves of oak *Quercus* spp. and beech *Fagus sylvatica*. The beetles

Table 5.3.3 Sites important for invertebrate conservation

Location	*Grid ref.*	*Conservation status*
Suffolk		
Oulton Marshes	TM5093	CWT
Carlton Marsh	TM5092	SSSI, CWT
Benacre	TM5283	NNR
Southwold	TM5075	
Minsmere - Walberswick (including Dingle Marshes, Dunwich Beach and Dunwich Forest)	TM4873	Part SSSI, part NNR, Ramsar, SPA
Sizewell	TM4763	
Thorpeness (including North Warren and Thorpeness)	TM4760	Part SSSI, part RSPB
Aldeburgh	TM4657	
Hazelwood Marshes	TM4357	SSSI, SPA, Ramsar, CWT
Orford Ness - Havergate (including Shingle Street)	TM4148	SSSI, part NNR, part NT, SPA, part RSPB
Staverton Park	TM3551	SSSI
Lower Hollesley Common	TM3445	CWT, SSSI
Martlesham Creek	TM2647	SPA, SSSI, Ramsar
Shotley Marshes (part of Stour & Orwell Estuaries)	TM2435	Part SSSI, Ramsar, SPA
Essex/Suffolk		
Cattawade	TM0933	
Essex		
Stour and Copperas Wood	TM1931	SSSI, part RSPB
Hamford Water (includes Skippers Island)	TM2326	SSSI, NNR, Ramsar, SPA, part CWT
Riddles Wood	TM1218	SSSI
Roman River	TM0120	SSSI, CWT
Colne Estuary (including Brightlingsea, Colne Point, Fingringhoe Wick and Marsh and Langenhoe Hall Marshes)	TM0517	SSSI, part NNR, part CWT, part NT
Blackwater Estuary (includes Old Hall Marshes, Tollesbury Wick Marshes and Ramsey Marsh)	TL9407	NNR, part CWT, part NT, Ramsar, SPA
Sandbeach Meadows	TL0205	SSSI
Dengie (part of the Blackwater Flats and Estuary Ramsar Site)	TM0403	SSSI, part NNR, Ramsar, SPA, part CWT
Fambridge	TQ8796	
River Crouch Marshes (including South Woodham Ferrers)	TQ8297	SSSI
Foulness Island	TR0092	SSSI, part MoD
Benfleet Downs	TQ7986	
Benfleet and Hadleigh Marshes (Benfleet and Southend Marshes, includes part of Canvey Island, Hadleigh Downs, Leigh and Two Tree Island)	TQ8185	SSSI, part NNR, Ramsar, SPA, part CWT
Pitsea Marshes	TQ7486	SSSI
Vange Marshes (including Fobbing Marshes)	TQ7384	SSSI, part CWT
Mucking Marshes	TQ6881	
Mucking and Orsett Heath	TQ6580	
Tilbury Marshes (including East Tilbury Marshes and West Tilbury Marshes)	TQ6776	
Grays Chalk Pit	TQ6078	SSSI
Essex/Greater London		
Inner Thames Marshes (including Aveley Marshes, Rainham Marshes and Wennington Marshes)	TQ5380	SSSI, part MoD
Greater London		
Ingrebourne Marshes	TQ5383	
Barking Reach	TQ4782	
Creekmouth Park, Barking	TQ4682	
Erith and Belvedere Marsh	TQ4879	
Greater London/Kent		
Crayford and Dartford Marshes	TQ5377	
Kent		
Barnes Cray Pastures	TQ5275	
Dartford Heath	TQ5273	
Darenth Wood	TQ5873	SSSI
Shorne and Ashen Bank Wood	TQ6870	SSSI
Higham Marshes	TQ7074	SSSI
Cliffe and Cooling Marshes (including Halstow Marshes)	TQ7377	SSSI
Medway Estuary & Marshes (including Allhallows Marshes, Chetney Marshes, Grain Levels, Hoo Saltings, Oakham Marsh and Stoke Saltings)	TQ8577	SSSI, part NNR, part RSPB, part MoD

Table 5.3.3 Sites important for invertebrate conservation (continued)

Location	*Grid ref.*	*Conservation status*
Kent continued		
Chattenden Woods	TQ7473	SSSI
Holborough to Burnham Marshes	TQ7161	SSSI
Wouldham to Detling Escarpment (including Culand Pits)	TQ7361	SSSI, part CWT
Wouldham Marshes	TQ7166	MoD
The Swale (including Coldharbour Marshes, Elmley Marshes, Ham Marshes, Iwade Marshes, Murston, Nagden Marshes, Oare Marshes and Ridham Marshes)	TR0367	SSSI, part NNR, part RSPB, part CWT, Ramsar, SPA
Reculver to Minnis Bay (includes Bishopstone Cliffs) (part of Thanet Coast)	TR2569	Part SSSI
Chislet Marshes	TR2365	
Ash Level	TR3062	
Westbere Marshes (including Stodmarsh)	TR2161	SSSI, part NNR, Ramsar, SPA
Sandwich Bay and Hacklinge Marshes (includes Pegwell Bay)	TR3560	SSSI, part RSPB, part CWT, part NT
Dover - Kingsdown Cliffs (including Kingsdown Rifle Butts and St Margarets Bay)	TR3848	SSSI, part NT
Folkestone Warren (including Shakespeare Cliff)	TR2335	SSSI
Folkestone to Etchinghill (including Castle Hill, Seabrook Stream and Sugarloaf Hill)	TR2238	SSSI, part MoD
Hythe Ranges	TR1553	MoD
Romney Marsh	TR0630	Part SSSI
Kent/Sussex		
Dungeness (including Greatstone Dunes)	TR0718	SSSI, part RSPB, part MoD
Walland Marsh (including East Guldeford Level)	TQ9923	SSSI

Source: JNCC Invertebrate Site Register. Key: MoD = Ministry of Defence; NNR = National Nature Reserve; NT = National Trust; RSPB = Royal Society for the Protection of Birds; SPA = Special Protection Area; SSSI = Site of Special Scientific Interest; CWT = County Wildlife Trust reserve

Ischnomera cyanea and *Tetratoma ancora* have both been found in the region. The larvae of the former develops in dead and decaying wood of a range of trees; the larvae of the latter have been recorded from encrusting fungi on trees.

5.3.3 Human activities

The main threats to invertebrate communities include direct habitat loss or degradation, which can be caused by inappropriate management. Appropriate site management is vital for maintaining invertebrate interest, since many species require particular micro-habitats in a suitable condition, often using stable features of vegetation structure or areas of bare ground. Most invertebrates have life cycles lasting for one year or less, and the habitat feature they use must be present every year. This is compounded by the fact that many scarce species have poor powers of dispersal and are thus unable to colonise suitable habitat from afar. The management of coastal habitats for invertebrates is covered by Kirby (1992) and in the report by the Butterflies Under Threat Team (Butterflies Under Threat Team 1986), which discusses the management of chalk grassland for butterflies. For several sites in the region, e.g. selected Essex grazing levels (Drake 1988), selected Suffolk grazing levels (Drake 1989) and Dungeness (Morris & Parsons 1992), brief or generalised management recommendations, covering the invertebrate interest, have been produced. Llewellyn & Schackley (1996) discuss the effects of mechanical beach-cleaning on invertebrate populations in Swansea Bay. Their discussion is of relevance to other parts of the country.

5.3.4 Information sources used

Many of the data for this review are taken from the JNCC's Invertebrate Site Register (ISR), a computerised GB-wide database containing data from many sources, including specialists and surveys, as well as published literature (such as the entomological journals, the publications of local natural history societies etc.) and local Biological Records Centres. It is the most complete dataset available on scarcer species occurring in the region. Additional information was gleaned from a range of reports, reviews and specialists.

The invertebrate fauna of this stretch of coast is probably better known than any other region, in part owing to the number of invetebrate zoologists that have resided in this part of the country. Most groupings of invertebrates have been studied but to varying extents. The faunas of more popular groups, such as the butterflies and moths (Lepidoptera), grasshoppers and crickets (Orthoptera) etc., are probably the best known, but even within these groups new discoveries are regularly made.

The number of active invertebrate specialists in the region is highlighted in the lists of contributors to the various recent county lists and mapping schemes, e.g. Emmet & Pyman (1985), which covered the larger moths and butterflies of Essex, and Philp (1993), which covered the butterflies of Kent. Other publications that contain distribution maps pertinent to the region include Emmet & Pyman (1985) (butterflies of Essex), Plant (1987) (butterflies of the London area) and Mendel & Piotrowski (1986) (butterflies of Suffolk), Emmet (1981) (the smaller moths of Essex), Mendel (1992) (the Odonata (damselflies and dragonflies) of Suffolk) and Killeen (1992) (the Mollusca (snails and slugs) of Suffolk). Heath & Emmet (1979, 1983, 1990) map many Lepidoptera (butterflies

and moths) species on a national basis, including species that are important within this region.

Examples of extensive invertebrate surveys that have been conducted in the region include: Drake (1988, 1989), reporting on surveys of the aquatic invertebrate fauna of grazing marshes in Essex and Suffolk; Morris & Parsons' (1991, 1992) reports on a survey of the invertebrate faunas of two shingle sites in the region; and Parsons & Kirby (1991, 1993) and Kirby *et al.* (1993)'s reports on the autecological study of the Sussex emerald moth *Thalera fimbrialis*. The *Transactions of the Kent Field Club* contain entomologically related articles and the *Transactions of the Suffolk Naturalists' Society* include notes and papers on invertebrates, particularly Lepidoptera. The *South Essex Naturalist* contains some invertebrate records and the Essex Field Club produces an occasional series under the *Essex Naturalist*. Several of the publications of this latter series are entomologically related. The Essex Biological Records Centres produce an occasional series of reports, several of which have covered entomological topics. The British Entomological and Natural History Society has held regular field meetings in the region, particularly at sites such as Dungeness. Pollard *et al.* (1986) report on four butterfly transects operated as part of the Butterfly Monitoring Scheme. National recording schemes for a range of invertebrate groups also cover this part of the coast. Most of these schemes are co-ordinated by specialists with assistance from the Biological Records Centre.

Colvin & Reavey (1993) provide a comprehensive list of addresses for societies, individuals and national and local recording schemes.

5.3.5 Acknowledgements

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Waring, P. In prep. *A review of the scarce and threatened macrolepidoptera of Great Britain*. Peterborough, Joint Nature Conservation Committee.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Occurrence of invertebrates in the region: Invertebrate Site Register	*Biological Records Centre, Institute of Terrestrial Ecology, Monks Wood, tel: 01487 773381
Conservation of butterflies - Suffolk	J. Mann, Butterfly Conservation, Suffolk Branch, The Old School, The Street, Darsham, Saxmundham, Suffolk IP17 3QA, tel: 01728 668532
Conservation of butterflies - Essex	J. Green, Butterfly Conservation, Cambridgeshire and Essex Branch, Burleigh House, Mill Road, Baythorne End, Halstead, Essex CO9 4AJ, tel: 01440 785394
Conservation of butterflies - Kent	T. Steel, Butterfly Conservation, Kent Branch, 57 Westfield Road, Barnehurst, Kent BA7 6LR, tel: 01322 526888
Invertebrate data for north-east Essex	Colchester & Essex Museum, Assistant Curator (Natural History), Colchester Museum, High Street, Colchester CO1 1DN, tel: 01206 577475
Lepidoptera fauna of Kent	S.P. Clancy, Delhi Cottage, Dungeness Road, Dungeness, Romney Marsh, Kent TN29 9NE, tel: 01797 321458
South-east England regional Odonata (dragonflies and damselflies) recorder	A. Hold, 22 Brook Road, Fair Oak, Eastleigh, Hampshire SO5 7BA, tel: 01703 694309
Invertebrate site and species information, England	*Dr R.S. Key, Dr C.M. Drake and Dr D.A. Sheppard, English Nature HQ, Peterborough, tel: 01733 455000
Coleoptera, Odonata and Lepidoptera fauna of Suffolk	H. Mendel, Ipswich Borough Council Museums & Galleries, High Street, Ipswich, Suffolk IP1 3QH, tel: 01473 213761
Invertebrate interest of National Trust land	*The National Trust, Cirencester, tel: 01285 651818
Lepidoptera (butterflies and moths) and Neuroptera (lacewings)	C.W. Plant, 14 West Road, Bishops Stortford, Hertfordshire CM23 3QP, tel: 01279 507687
Invertebrate data for South Essex	Southend-on-Sea Museums Service, Central Museum, Victoria Avenue, Southend-on-Sea SS2 6EX, tel: 01702 330214
Records centre for Suffolk	Suffolk Biological Records Centre, Ipswich Borough Council Museums & Galleries, High Street, Ipswich, Suffolk IP1 3QH, tel: 01473 213761
Rare and scarce macro-moths of the region	Dr P. Waring, 1,366 Lincoln Road, Werrington, Peterborough PE4 6LS, tel: 01733 571917
National recording databank for aquatic Coleoptera (beetles) and specific survey information on scarce species in region	Balfour-Browne Club/ Dr G.N. Foster, 3 Eglinton Terrace, Ayr KA7 1JJ, tel: 01292 525294

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

5.4 Rare sea-bed species

J. Plaza

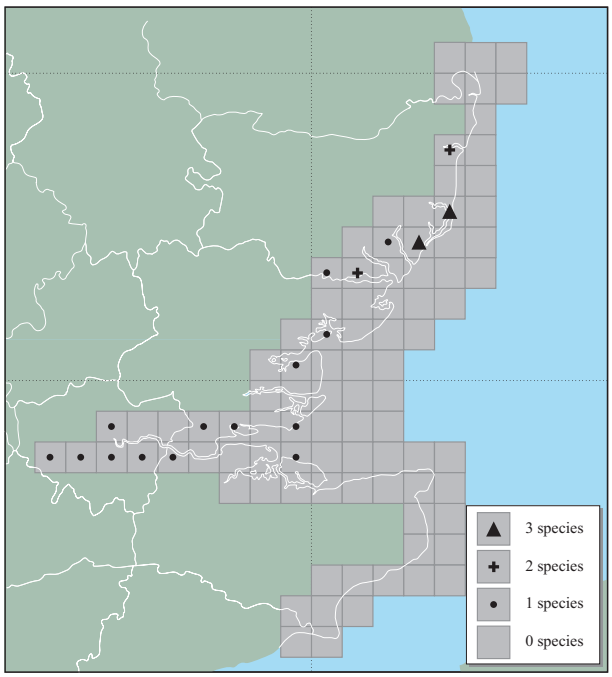
5.4.1 Introduction

This section considers rare and scarce marine benthic (sea-bed) species, excluding fish. 'Nationally rare' marine benthic species in this section are those that occur in eight or fewer of the 1,546 10 km by 10 km squares (of the Ordnance Survey national grid) that contain sea within the three-mile territorial limit for Great Britain. 'Nationally scarce' species are those that occur in nine to 55 such squares.

The development of the current criteria and the choice of study area for rarity assessment in the marine benthos of Great Britain are discussed in detail by Sanderson (1996, 1997) and are analogous to the criteria and methodologies used for other groups of organisms in British Red Data Books (e.g. Bratton 1991) and by the International Union for Conservation of Nature and Natural Resources (IUCN 1995). Species considered in this chapter are those that are conspicuous and readily identifiable in field surveys for the Marine Nature Conservation Review (MNCR) or using similar survey techniques, or for which taxonomic experts consider that sufficient data exist on a national basis to warrant their inclusion. Species that are likely to be grossly under-recorded or overlooked on a national scale have been avoided in the present work. None of the species from this region is known to be a common deep-water species, so it is unlikely that any appear rare because their distribution just extends into the generally shallower near-shore sea area that is the focus of this study.

Species at the limit of their global distribution (e.g. 'southern' or 'northern' species) may be rare within Great Britain's territorial seas but occur more commonly towards the centre of their biogeographic range. Species described here as 'nationally rare' or 'nationally scarce' are therefore not necessarily endangered globally and, although they are of national interest, their conservation importance needs to be carefully considered. In Britain, populations of many sessile (non-mobile) southern species are thought to be particularly sensitive to environmental impacts because as they approach the margins of their global distribution their capacity to recover from impacts and successfully reproduce after them is progressively diminished. As a result, communities of southern species have been considered important for monitoring the marine environment in the UK (Fowler & Laffoley 1993). An analogous argument may apply to northern species as they approach the southern limit of their biogeographical range. Other genetic, ecological and pragmatic arguments for the conservation of populations of species that are rare because they are at the margins of wider distributions are summarised by Hunter & Hutchinson (1994). The importance of genetic, species and habitat biodiversity in the UK has recently been the focus of *Biodiversity*: *the Steering Group report* (Anon. 1995), in which the starlet sea anemone *Nematostella vectensis*, one of the protected scarce species in this region, is targeted for action.

The analysis in this section forms part of the first attempt to quantify the rarity of marine benthic species and to summarise the known occurrence of rare and scarce species in Great Britain. As more data become available or populations change, the status of species listed in this chapter will require re-evaluation.



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

In common with other regions in the North Sea, Region 7 appears to contain comparatively fewer nationally rare and scarce species than western regions of Great Britain. One nationally rare and five scarce marine benthic species have been recorded from this region. Rare and scarce species appear to be concentrated around the well-studied lagoonal habitats in the southern part of Suffolk (Shingle Street and Orford Ness). Of the six rare and scarce species recorded in Region 7, three are currently protected under the Wildlife & Countryside Act 1981.

5.4.2 Important locations and species

Table 5.4.1 lists the rare and scarce marine benthic species that have been recorded in Region 7, together with their known areas of occurrence and other key information. Map 5.4.1 summarises their current known occurrence. As survey effort in this region has not been uniform (see Maps 4.2.2 and 4.2.3), assertions made as to the distribution of rare and scarce species in Region 7 are somewhat artificial and should be regarded with caution.

Three of the species in Table 5.4.1 occur in the British Red Data Book (Bratton 1991). Of these, the lagoon sand shrimp *Gammarus insensibilis* is exclusively lagoonal in the UK. The starlet sea anemone *Nematostella vectensis* was also thought to be a lagoonal specialist but has recently been recorded from an estuarine habitat - the River Stour (Hill *et al*. 1996) - and may therefore be more widespread than previously thought. The

Table 5.4.1 'Nationally rare' and 'nationally scarce' marine benthic species found in Region 7

Species	*Type of organism*	*Area(s) of occurrence*	*Habitat/associations*	*Comments*	*Useful reference*
Obelia bidentata *	A hydroid	Deben Estuary, Landguard Breakwater near Felixstowe	On a wide variety of substrata.	Temperate to warm water, global. Known also from warmer European coasts. Hydroids are often overlooked.	Hayward & Ryland (1990)
Nematostella vectensis#	Starlet anemone (Isle of Wight thread star)	Lagoons at Shingle Street, Orford Ness, and between Dunwich and Walberswick. River Stour.	Brackish water habitats. In fine soft mud with tentacles exposed. Sometimes attached to vegetation such as sea grasses or filamentous algae.	Also at a few sites in Canada and USA (Pacific and Atlantic coasts). Vulnerable habitat.	Bratton (1991); Smith & Laffoley (1992)
Alkmaria romijni#	Tentacled lagoon worm	River Stour Estuary, River Butley Estuary and Orford Ness	Lagoon-like habitats and other brackish water systems. In sediment. Low shore to shallow subtidal.	Also Netherlands, Baltic, Morocco. May yet be found in other brackish ditches and pools in GB.	Holthe (1986)
Corophium lacustre	An amphipod	River Thames up to Teddington, Thames Estuary and River Waveney	Found in shallow water and the lower intertidal zone in waters of low salinity. Constructs tubes in marshy banks and ditches and on submerged weeds or the hydroid *Cordylophora caspia.*	In both fresh and brackish water, hence parts of its distribution may be missed by exclusively marine or freshwater surveys.	Lincoln (1979); Bratton (1991)
Gammarus insensibilis#	Lagoon sand shrimp	Lagoons at Shingle Street, Orford Ness; Thames Estuary	Brackish water. In Britain from lagoon-like habitats. Part of weed-associated fauna.	Atlantic Europe to Mediterranean and Black Sea. In GB it is probably restricted to lagoonal habitats.	Bratton (1991)
Hydrobia neglecta	Lagoon snail	Orfordness, also in lagoons between Dunwich and Walberswick.	In hyposaline lagoons, although usually above 10 g/kg NaCl. Associated with green algae.	Small (*c.* 2 mm); could be under-recorded to some extent.	Cherril & James (1985)

Species names after Howson (1987); in the absence of a specific common name the nearest available group name has been used. Key: * = nationally rare; # protected by the 1981 Wildlife & Countryside Act. Note: some of the scarce species listed here are only a little more common than the rare species listed.

third species, *Corophium lacustre*, can range from fresh waters in the upper reaches of estuaries to brackish waters at their mouths. In Region 7 it has been found along the length of the Thames as far inland as Teddington, west London, the limit of tidal influence.

The majority of species described here as 'nationally rare or scarce' are brackish water species restricted to very specific habitat types that are themselves very limited (and in some cases threatened) in Great Britain. Coastal lagoons, well represented in Region 7, are a notable example and constitute a 'priority habitat type' under Annex 1 of the EC Habitats & Species Directive, owing to their susceptibility to both natural and anthropogenic changes. Barnes (1988) notes that brackish drainage ditches have not yet been adequately surveyed, and these may also contain rare lagoonal species.

Other rare habitats occurring in this region are chalk cliffs, which comprise only 0.6% of the coastline of Britain (Fowler & Tittley 1993), and intertidal clay. The biological communities found on such substrates are quite rare and of great scientific interest. However, no recent reliable records of rare or scarce species specific to these habitats have been found in the course of this study (see section 5.4.3).

5.4.3 Information sources used

An important starting point for the collection of information and literature on the distribution of rare and scarce species has been the MNCR database (McDonald & Mills 1996), which contains data on species from more than 10,500 sites around Britain. Most of the data reproduced here have been confirmed by critical appraisal of the available scientific literature and through liaison with many eminent marine biologists and experts in taxonomic fields.

Most of the sites of intertidal and subtidal benthic survey data utilised in this analysis are mapped in section 4.2. The area has been well studied because of its proximity to areas with high population densities and its accessibility. Furthermore, because of the considerable pressures to which the coastline of this region has been subjected, several surveys of the coastal biology of the area have been undertaken, particularly since the 1960s. Examples are reports commissioned by the Central Electricity Generating Board in relation to the construction and operation of power stations at Sizewell and Bradwell and reports arising from the construction of the Channel Tunnel (see section 4.2.4). Although it has not been possible in this section to list all the available literature on which the present analysis has been based, the information reviews and recent papers listed in sections 4.2.6 and 5.4.5 should allow access to the majority of the available information.

Some areas in Region 7 have a long history of study (e.g. Fitch 1891; Crouch 1892; Batters 1894). Whereas every effort has been made to obtain biogeographic data for rarity assessment, in the interest of representing current known occurrence, data have not been used from reports prior to 1965 in this study. There are, however, additional records for various rare/scarce species in Region 7 that are not included in Table 5.4.1 because they are old, or fall just outside the study area. These include records for the sponge crab *Dromia personata*, the burrowing bivalve *Pholadidea loscombiana* and the red alga *Chondria coerulescens*. The shrimp *Alphaeus macrocheles* has been recorded offshore of the study area (Adema *et al.* 1982).

Despite the absence of marine algae in Table 5.4.1, the area contains several old or unconfirmed records of these organisms. Two chalk cliff specialist algae, *Kuetzingiella holmesii* and *Pleurocladia lacustris*, were recorded from this region by Anand (1937a, b) but have not subsequently been recorded from Britain (Fowler & Tittley 1993). The green seaweed *Derbesia tenuissima*, the red seaweed *Polysiphonia foetidissima*, and the Peacock's tail *Padina pavonica* have also been recorded from the region, and it would be valuable to reconfirm these old records. The Natural History Museum is currently working with naturalists' societies from south-east England to produce a comprehensive atlas of the distribution of algal species in the area (Tittley pers. comm.).

The marine inlets in Region 7 have been studied as part of the Marine Nature Conservation Review (Hill *et al.* 1996), and survey effort within these areas has been relatively uniform. Open stretches of coast have been less well studied and consequently assertions made as to the distribution of rare and scarce species in these areas may be somewhat artificial.

MNCR survey work uses a consistent methodology to record conspicuous species (Connor & Hiscock 1996). Not all the data available from surveys in this region are as broad in scope as MNCR surveys and they may not include less common species or those less familiar to a specialist worker. The MNCR of Great Britain is at present incomplete but nevertheless has already substantially increased the quality and evenness of distribution of the available data. Combined with other surveys, completion of the MNCR will almost certainly expand our knowledge of the 'nationally rare' and 'scarce' species in Region 7. Consequently, the nationally rare and scarce status of the organisms presented here may require re-evaluation, and species may be added to the list for this region in the future. Populations of species with short life histories, such as ephemeral algae and sea slugs, may require more regular re-evaluation of their occurrence than others.

5.4.4 Acknowledgements

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C. Contact names and addresses

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Lagoons & Lagoon-type habitats	Dr R.S.K. Barnes, Department of Zoology, Downing Street, Cambridge CB2 3EJ, tel: 01223 336606
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Amphipods	Prof. P.G. Moore, University Marine Biological Station, Millport, Isle of Cumbrae KA28 0EG, tel: 01475 350581
Crabs	P.F. Clark, Department of Zoology, Natural History Museum, Cromwell Road, London SW7 5BD, tel: 0171 938 9123
Molluscs	Ian Killeen, 163 High Road, Felixstowe, Suffolk IP11 9BD, tel: 01394 274618
Red seaweeds	Dr C.A. Maggs, School of Biology & Biochemistry, Queen's University of Belfast, Belfast BT7 1NN, tel: 01232 245133
Brown seaweeds	Dr R.L. Fletcher, University of Portsmouth, Marine Laboratory, Ferry Road, Hayling Island, Hants. PO11 0DG, tel: 01705 876543

5.5 Exploited sea bed species

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

5.5.1 Introduction

This section describes the distribution of large populations of species that live on, near, or in the sediments of the sea bed (collectively called 'the benthos') and that are routinely exploited, mainly for human food. The exploitation itself is described in sections 9.1 and 9.2. Many of these species also provide an essential food source for other species, such as fish and birds, for example seabirds, waders and wildfowl. Most of the species discussed have planktonic larvae (see section 4.3). The dispersal of planktonic larvae and the interrelation between populations of the same species can only be inferred from studies on movements of water masses. Their distributions are also determined by factors such as water temperature (see section 2.3) and available habitat/substrate type (see also section 4.2). The species described may also be found elsewhere in the region, but in smaller numbers.

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

There are important populations of cockles, mussels, native oyster, whelks, brown shrimp, lobsters, spider crabs and edible crabs in the region, and periwinkle, scallop, queen scallop, octopus, squid and cuttlefish, lugworm ragworm and whiteweed are also present. There are no known exploitable quantities of velvet crabs, *Nephrops*, deep water prawns, pink prawns, or crawfish in the region.

5.5.2 Important locations and species

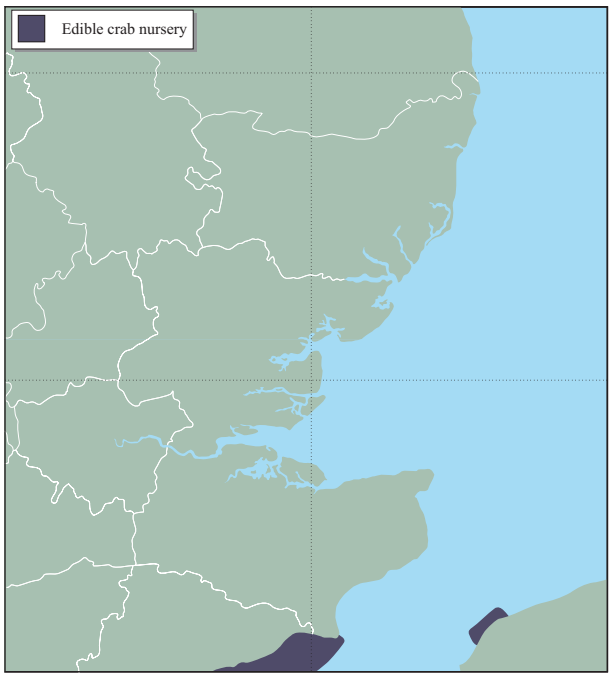
Crustacea

The broad-scale distribution of lobsters in the region is shown on Map 5.5.1. Their abundance is relatively low, but they are present wherever there is suitable habitat, both close inshore and offshore out into the English Channel and North Sea. Brown shrimp are found throughout the region, occurring at highest densities in the Thames Estuary, off the Essex coast and in the north of the region off Suffolk (Map 5.5.1). Edible crabs are often found on softer sediments than lobsters. Juvenile edible crabs tend to be found inshore and adults further offshore (Rees & Dare 1993). Map 5.5.2 shows edible crab nursery areas in and adjacent to the region.

Molluscs

The main locations where exploitable populations of native oysters, cockles, mussels and periwinkles are found in this region are shown on Map 5.5.3. The creeks and backwaters of the region are some of the few areas left in the UK that support a natural stock of native oysters, which were almost wiped out by the protozoan parasite *Bonamia ostreae* (see section 5.5.3). There has been some natural regeneration, supplemented by the cultivation of hatchery-reared spat of both native and Pacific oysters and the relaying of half-size native oysters from the Solent. Cockles are abundant in the intertidal and subtidal zones of many sandy estuaries and other sheltered sites in the Greater Thames Estuary, and are of national importance in this region. Mussels are found in some

Map 5.5.1 Distribution of lobster and brown shrimp. © Shellfish Resource Group, CEFAS (Lowestoft).



Map 5.5.2 Distribution of edible crab nursery areas. © Shellfish Resource Group, CEFAS (Lowestoft).

Table 5.5.1 Species names

Common name	*Scientific name*
Lobster	*Homarus gammarus*
Edible or brown crab	*Cancer pagurus*
Velvet crab	*Necora puber*
Dublin Bay prawn, scampi, Norway lobster or langoustine	*Nephrops norvegicus*
Brown shrimp	*Crangon crangon*
Spider crab	*Maja squinado*
Crawfish, spiny lobster	*Palinurus elephas*
Deep water prawn (or shrimp - referred to as both)	*Pandalus borealis*
Pink prawn (or shrimp - referred to as both)	*Pandalus montagui*
Cockle	*Cerastoderma edule*
Mussel	*Mytilus edulis*
Native oyster	*Ostrea edulis*
Periwinkle	*Littorina littorea*
Scallop	*Pecten maximus*
Queen scallop	*Aequinpecten opercularis*
Whelk	*Buccinum undatum*
Cephalopods including octopus, squid and cuttlefish	*Eledone cirrhosa, Loligo* spp. & *Sepia officinalis*
Lugworm	*Arenicola marina*
Ragworm/king ragworm	*Neanthes virens* & *Hediste diversicolor*
Whiteweed (a fern-like hydroid)	*Sertularia argentea* & *S. cupressina*

coastal sites in the region, from the mid shore to the subtidal zone, in water of variable salinity, and in areas exposed to strong currents. They attach themselves using 'byssus threads' to sand, gravel or pebble substrata or other mussels and empty shells, and have the effect of binding the substratum. The main locations where they are found are in the Blackwater Estuary, the Crouch/Roach Estuary and the Swale Estuary. Periwinkles live on algae growing in rocky areas, such as in the Stour and Blackwater Estuaries.

The broad-scale distributions of scallops and whelks in and adjacent to the region are shown in Map 5.5.4. Scallops live on sandy/gravely areas of sea bed and are present in an area in the eastern English Channel that extends into the region off Dungeness. Whelks are widely distributed throughout the region, particularly off the Essex and North Kent coasts.

Polychaetes

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

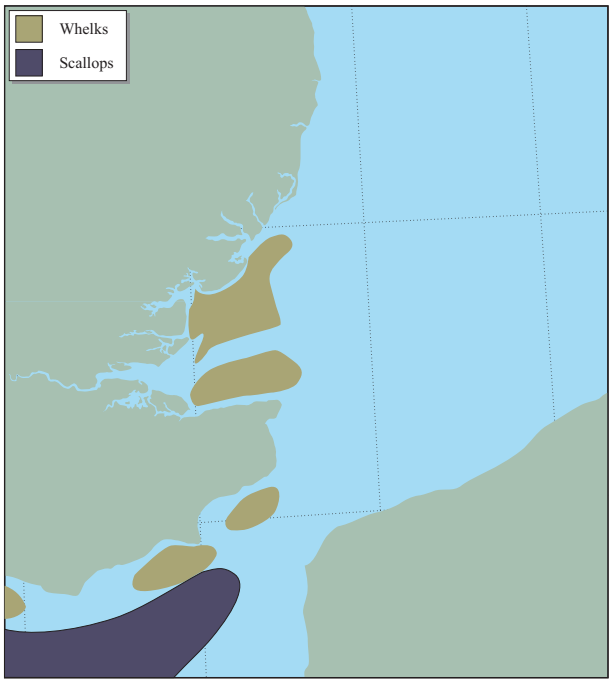
Others

Two species of hydroid that grow in a fern-like shape, known locally as 'whiteweed', grow in large quantities on the seabed of estuaries in the region and are particularly dense in the Thames and Medway Estuaries. Whiteweed is commercially exploited in this region; it is dredged from the sea bed and dried for decorative use.

5.5.3 Human activities

The exploitation by fisheries of the species covered in this section is described in section 9.1, and by mariculture in section 9.2. Issues relating to exploited sea-bed species are commonly associated with the method by which they are exploited and the amounts taken. Restrictions are imposed by the authorities who manage the resource, and include minimum landing sizes and catch quotas. There are EC and

Map 5.5.3 Main locations of native oysters, periwinkles, mussels and cockles. © Shellfish Resource Group, CEFAS (Lowestoft).



Map 5.5.4 Main locations of scallops and whelks. © Shellfish Resource Group, CEFAS (Lowestoft).

national statutory Minimum Landing Size (MLS) limits for edible crab, lobster, spider crab, scallops and velvet crab. The actual size limits may vary, and Sea Fisheries Committees' (SFC) bylaws may set size limits above those specified by EC or national regulations.

Native oyster beds are now quite rare, and their decline around Britain has been attributed to various factors, including overfishing, the failure of spatfall, cold winters (Waugh 1964) and the parasite *Bonamia*. In the early 1980s many adult native oysters died, owing to *Bonamia*. However, cultivation continues under a controlled regime involving native oysters relaid from other sources and lifted for harvesting quickly enough to avoid further substantial mortality. The Pacific oyster has been introduced and is now cultivated alongside the native oyster (see section 9.2), and benefits from a faster growth rate to marketable size and resistance to *Bonamia* (Spencer 1990). The Pacific oyster cannot survive naturally in the region, but some small spatfalls of Pacific oyster have been recorded elsewhere around the UK, probably owing to the warm summers of 1989 and 1990 (Spencer *et al.* 1994).

Much of the region's coast has been subjected to localised navigational dredging and marine aggregate extraction licence applications, but production licences for marine aggregate extraction in the region are currently limited to offshore from Suffolk and North Essex (see also section 9.4). All dredging activities have short-term, localised effects, such as the removal of material and organisms, but long-term effects on, for example, shellfish stocks are much more difficult to assess, owing to the difficulty of determining which effects are the result of dredging and which the result of the many other factors operating (Doody *et al*. 1993). Short- or long-term changes in sediment deposition can result from dredging, as well as inevitable changes in the topography of the bed. Lobsters are potentially vulnerable to sanding from tidal flows and from siltation from harbour dredgings.

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

5.5.4 Information sources used

The maps in this section show schematically those parts of the broad-scale distributions of the main species of interest that support fisheries, based on current knowledge from the Centre for Environment, Fisheries and Aquaculture Sciences (CEFAS), Sea Fisheries Inspectorate officers and the local Sea Fisheries Committees on the locations of the species and their fisheries. There is supporting information in the form of landing statistics and biological samples of crustacea, collected at the main ports and some secondary ports (see sections 9.1 and 9.2), plus intertidal surveys for molluscs in selected areas. These data provide some information about the location of spawning and nursery areas, but to establish the links between individual areas for spawning, nursery and adults would require specific investigations on the planktonic stages, the hydrography and the movement (or otherwise) of juveniles and adults. Barring substantial climate change or over-exploitation, these distributions and relationships are likely to remain stable over several decades. The seaward boundaries on the maps are only indicative, and because only large, exploitable populations are described, the species may also be found elsewhere in the region, but in smaller numbers.

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

5.5.5 Acknowledgements

The authors thank R.C.A. Bannister (Shellfish Resource Group, CEFAS Lowestoft Laboratory) for his helpful comments and additional written sections and Mark Tasker and Jaime Plaza (JNCC) and Alexander Downie (Scottish Natural Heritage) for comments on the text.

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Assessment and provision of advice on the conservation of commercial fish and shellfish stocks	*Director, Centre for Environment, Fisheries & Aquaculture Sciences, Lowestoft laboratory, tel: 01502 562244
Benthic surveys: Marine Nature Conservation Review Database	*Marine Nature Conservation Review, JNCC, Peterborough, tel: 01733 562626
Marine conservation issues and fisheries	*Fisheries Liaison Officer, English Nature HQ, Peterborough, tel: 01733 455000
Marine Fisheries Task Group papers; marine conservation	*Marine Advisory Officer, JNCC, Peterborough, tel: 01733 562626
Marine conservation and issues	*Conservation Officer, RSPB, Sandy, tel: 01767 680551
Marine conservation and issues	*Fisheries Officer, Marine Section, WWF-UK, Godalming, tel: 01483 426444
Marine conservation and issues	*Conservation Officer, Marine Conservation Society, Ross-on-Wye, tel: 01989 566017
Marine conservation and issues	*Honorary Secretary, The Marine Forum for Environmental Issues, Scarborough, tel: 01723 362392

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

5.6 Amphibians and reptiles

Dr M.J.S. Swan

5.6.1 Introduction

This region supports all nine of the widespread species of amphibians and terrestrial reptiles (common frog *Rana temporaria*, common toad *Bufo bufo*, smooth newt *Triturus vulgaris*, palmate newt *T. helveticus*, great-crested newt *T. cristatus*, slow-worm *Anguis fragilis*, common lizard *Lacerta vivipara*, grass snake *Natrix natrix* and adder *Vipera berus*). Recently, the natterjack toad *Bufo calamita* has been re-introduced at a protected site on the Suffolk coast as part of English Nature's Species Recovery Programme (Whitten 1990; Denton & Beebee 1992, 1993, 1994). Two alien amphibian species are also reported in this region - the edible frog *Rana esculenta* and the marsh frog *Rana ridibunda*. There are no recent records of marine turtle sightings or strandings in the region.

All of the above species are subject to some degree of protection under national or international law (Table 5.6.1). The great-crested newt and natterjack toad are fully protected under UK legislation and are also of international conservation significance.

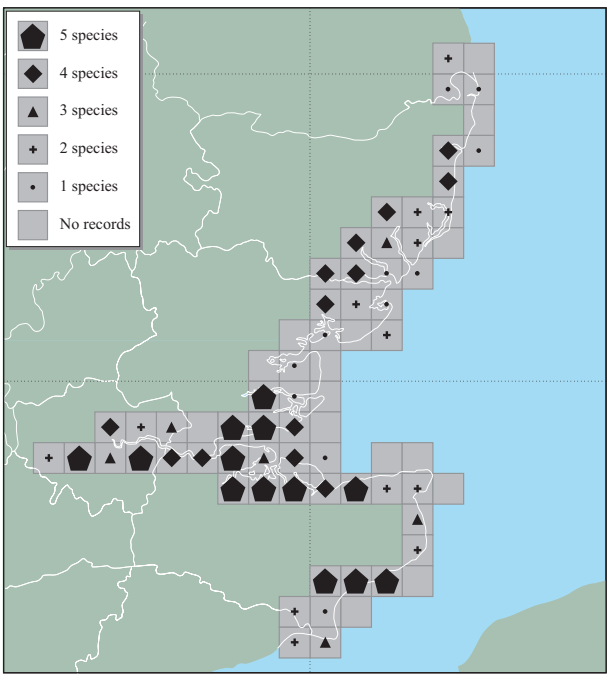
In terms of both the extent of survey coverage (numbers of 10 km squares recorded) and the thoroughness of recording within surveyed areas (number of records per 10 km square), this region has been well surveyed (Table 5.6.2). Compared with coverage of the east coast of Britain and of Great Britain as a whole, every county in the region is well recorded.

The numbers of amphibian and reptile species recorded in coastal 10 km squares are shown on Maps 5.6.1 and 5.6.2 respectively. For most of the species, but especially the reptiles, the coastal strip contains vital habitats such as non-intensively farmed land, sand dunes, coastal heathland, undisturbed river banks, derelict urban and industrial land, marshes, ditch systems and cliffs. Although important individual great-crested newt breeding sites are found in this region, the strongholds for this species in each of the counties are somewhat inland. Within coastal 10 km squares in the region there are two nationally important and one

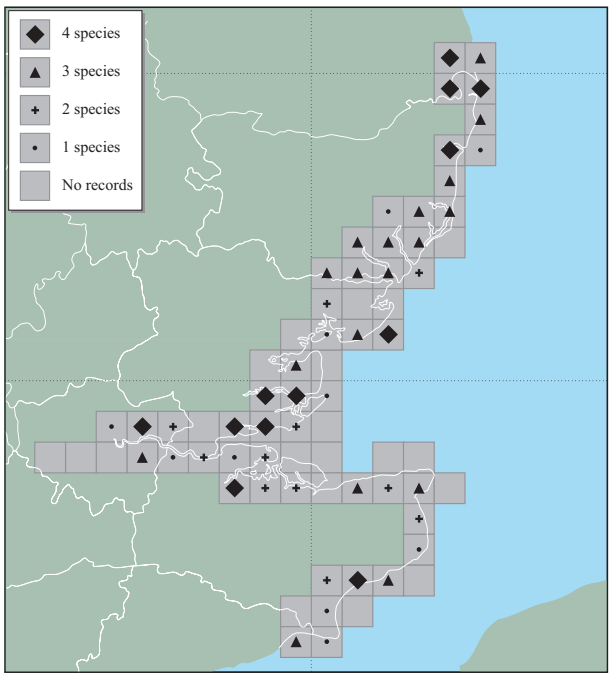
Table 5.6.1 Protected status of amphibians and reptiles occurring in region

Species	*Protection (see footnote)*
Amphibians	
Common frog *Rana temporaria*	1, 2, 3
Common toad *Bufo bufo*	1, 2
Smooth newt *Triturus vulgaris*	1, 2
Palmate newt *Triturus helvetica*	1, 2
Great-crested newt *Triturus cristatus*	1, 2, 3
Edible frog *Rana esculenta*	1
Marsh frog *Rana ridibunda*	1
Natterjack toad *Bufo calamita*	1, 2, 3
Reptiles	
Slow-worm *Anguis fragilis*	1, 2
Common lizard *Lacerta vivipara*	1, 2
Grass snake *Natrix natrix*	1, 2
Adder *Vipera berus*	1, 2

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



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



Map 5.6.2 Numbers of reptile species recorded in coastal 10 km squares. Distribution may reflect differences in recording effort. Source: Biological Records Centre, ITE Monks Wood. Note: not all rare species data are held by BRC and therefore some records may not be shown.

Table 5.6.2 Records of amphibians and reptiles related to survey effort

	Total no. of 10 km squares	*% 10 km squares surveyed for:*			*Total no. of individual records*		*Mean no. of individual records per surveyed 10 km square*	
		any herp. species	*amphibians*	*reptiles*	*amphibians*	*reptiles*	*amphibians*	*reptiles*
Suffolk	18	94	89	94	83	97	5.2	5.7
Essex	26	69	62	62	221	164	13.8	10.3
London	8	100	100	63	263	48	32.9	9.6
Kent	29	83	83	69	390	133	16.3	6.7
Region 7	71	83	79	72	957	442	14.9	7.6
North Sea Coast	504	76	66	49	4,141	1,602	12.5	6.5
GB coast	1,124	69	59	49	7,524	3,138	11.3	5.7
Great Britain (coast and inland)	2,862	84	79	66	27,182	8,803	12.1	4.7

Source: Biological Records Centre, Monks Wood.

internationally important great-crested newt breeding sites and one and thirteen locations with, respectively, nationally and regionally important amphibian species assemblages.

5.6.2 Important locations and species

Table 5.6.3 lists sites and areas that are known to have important amphibian assemblages (Swan & Oldham 1989, 1993a) or in which reptiles are considered to be abundant in a regional context (Swan & Oldham 1993b); this list is not exhaustive.

All of the native species listed, except the palmate newt, occur on the Suffolk coast. The most important area here for herpetofauna is the coastal heathland between the Rivers Blyth and Deben (Jones 1989). Large populations of both frogs and toads are found in the coastal marshes and other wetlands within the coastal strip. The main breeding areas for the smooth and great-crested newts, however, tend to be further inland, on clay, rather than on the sandy substrate of the coast. The great-crested newt is virtually absent from the coastal strip, but the smooth newt is reported to breed in the coastal marshes. In Suffolk both lizards and adders find strongholds on the coastal heaths, and a high proportion of slow-worm records are also coastal. In contrast, the grass snake is more prevalent in the lusher habitats of the river valleys: it is quite common in the Waveney Valley, for example (Jones 1989; Beckett *et al.* 1990). The natterjack toad re-introduction site is within heath and dunes on the east coast (Beebee pers. comm.).

Few amphibians are thought to breed on the Essex coastal wet grasslands, as many of these are brackish. However, all five species breed in artificial water-bodies within coastal 10 km squares. Frogs, toads, great-crested and smooth newts utilise clay and gravel pits; the palmate newt has a more restricted distribution than any of these species, breeding mainly in gravel ponds. The frog is thought to be particularly common in garden ponds. All four reptile species occur on the Essex coast, with many reported from around the estuaries of the Rivers Colne, Blackwater and Crouch (Swan & Oldham 1993b). Adders and slow-worms have colonised older sea walls, particularly those that support dry, rank grass, as on Mersea Island. Grass snakes are more common further inland.

Excepting the common frog, smooth newt and, to some extent, the common toad and slow-worm, which have colonised gardens, the amphibians and reptiles of Greater London survive only where wasteland, industrial sites, wetland and river banks remain undisturbed. The majority of frog, and probably smooth newt, breeding sites are within gardens. Toads and great-crested newts, however, require deeper lakes and reservoirs and well-vegetated fish-free sites, respectively. Palmate newts occur in the London area but confirmation of their distribution is problematic because identification has been unreliable (Langton 1991). Common lizards and slow-worms are often abundant on railway embankments and allotments. Grass snakes are found in the moister habitats of the river marshes and corridors. The adder is by far the rarest herpetofaunal species in London, with only one thriving population currently recorded (Herbert pers. comm.).

Amphibians are most prevalent on low-lying parts of the Kent coast and are generally uncommon in the chalk and downland areas. However, all four native species breed in chalk pits in the coastal hinterland, such as Peter's Pit. Smooth newts are reported to be widespread in the North Kent Marshes, but newts are generally more common within areas of clay substrate further inland (Davis & Frazer 1991). Frogs and smooth newts have colonised gardens in the coastal towns. Common lizards and slow-worms occur in small populations in undisturbed scrubby but sunny sites, such as old rubbish dumps, the edges of marshland and obsolete mineral extraction sites, all around the coast. These two species are also found on cliffs. In seaside towns, numerous small populations of common lizards and slow-worms survive along ageing, and sometimes ramshackle, sea fronts. Dilapidated buildings, bathing huts, embankments, wasteland, sea walls, overgrown rubbish dumps and piles of debris provide ample cover and important habitats for these species. On the more extensive and less accessible cliffs, for example at South Foreland, adders are locally abundant. The adder apparently requires larger areas of suitable habitat than the common lizard and the slow-worm and is also more vulnerable and prone to human disturbance and persecution. Slow-worms and, to a lesser extent, grass snakes have colonised domestic gardens.

The two introduced frog species are found in Essex and Kent. The edible frog is reported to be established in marsh and ditch systems near the River Orwell (Suffolk), near Southend in Essex, and in the North Kent Marshes. The marsh frog is more abundant and widespread and is established principally in the North Kent and Romney

Table 5.6.3 Important areas for amphibians and reptiles

Location	*Grid ref.*	*Species present/site significance*
Suffolk		
Coastal heath and dunes between Rivers Blyth and Deben coastal marshes	TM5075-TM3337	Common lizard, slow-worm, adder. Common frogs and common toads; smooth newt; natterjack toad re-introduction site
Essex		
Great Holland Pits Nature Reserve	TM2019	Slow-worm, grass snake, adder
Little Clacton	TM1517, TM1615, TM1619	Common lizard, grass snake
Colne Pit Nature Reserve	TM1012	Common lizard, adder
Rowhedge Gravel Pits	TM0221	Grass snake
Pete Tye Common	TM0018	Adder
Ramsey Island	TL9405	Adder
St Lawrence Bay	TL9705	Adder
Tillingham	TL9803	Common lizard
Borrow Dyke	TL9806	Grass snake
Wallasea Island	TQ9693	Common lizard, adder
Paglesham	TQ9392	Common lizard, slow-worm, adder
Hawkwell Brick Pits	TQ8691, TQ8692	Common lizard, slow-worm, grass snake
Ashingdon, Rochford	TQ8692, TQ8693	Slow-worm, adder
Hockley	TQ8493	Common frog, common toad, smooth newt and palmate newt. Regionally important amphibian species assemblage
Beckney Woods	TQ8495	Common lizard, slow-worm, grass snake, adder
Rayleigh Mount	TQ8090	Regionally important amphibian species assemblage
Benfleet Downs	TQ7786, TQ7785, TQ7885, TQ7986	Common lizard, slow-worm, grass snake, adder
Felmores Park	TQ7189	Regionally important amphibian species assemblage
Greater London		
The Chase Nature Reserve	TQ5186	Grass snake
Dagenham Side Pond	TQ5085	Grass snake
Dagenham Thames-side Park	TQ4682	Common lizard, slow-worm, grass snake, adder
Creek Mouth Ponds	TQ4682	Grass snake
Epping Forest	TQ4595	Common lizard, slow-worm, grass snake, adder
Priory Road	TQ3088	Regionally important amphibian species assemblage
Sheen Mount	TQ2075	Regionally important amphibian species assemblage
Sundridge Park Road	TQ4070	Regionally important amphibian species assemblage
Lessa	TQ4274	Regionally important amphibian species assemblage
Royal Blackheath Golf Course	TQ4373	Common frog, common toad, smooth newt, palmate newt. Nationally important great-crested newt site.
Footscray	TQ4771	Regionally important amphibian species assemblage
Home Wood and Dower Ponds	TQ4871	Nationally important great-crested newt site
River Cray	TQ5074	Grass snake
Kent		
Joydens Wood	TQ5071	Nationally important amphibian species assemblage
Northfleet	TQ6274	Grass snake
Gravesend	TQ6473	Slow-worm, grass snake
Cliffe, Shorne	TQ6974	Grass snake
Allhallows	TQ8278	Grass snake
Peter's Pit	TQ7162	Grass snake. Regionally important amphibian species assemblage.
Starkey Castle	TQ7161	Slow-worm
Bamber Pit	TQ7460	Grass snake
Lower Rainham Nature Reserve	TQ8267	Grass snake
Thanet Way	TR1165	Regionally important amphibian species assemblage
Well Court	TR1361	Regionally important amphibian species assemblage
Reculver Road Nature Reserve	TR2068	Common lizard, slow-worm
Warren, East Wear Bay	TR2437	Regionally important amphibian species assemblage
Creteway Down	TR2238	Adder
Royal Military Canal	TR1534, TR1635	Slow-worm, grass snake
Hamstreet NNR	TR0033	Regionally important amphibian species assemblage; grass snake
Dungeness Pits	TR0620, TR0621	Common lizard. Internationally significant populations of great-crested newts.

Sources: Swan & Oldham (1993a, b); Jones (1989).

Marshes but is also found in Essex near Southend and Dagenham (Arnold 1983).

5.6.3 Human activities

Intensive arable farming, often to the edge of the coast, has removed and fragmented amphibian and reptile habitat throughout much of the region. Where the cultivated land stops short of the coast, such as in Suffolk, the coastal strip provides a vital habitat refuge. The adder, in particular, has suffered severe declines, owing to the loss and fragmentation of heathland and grassland and to human recreational pressure. Whereas slow-worm and common lizard populations can continue to be viable in small and isolated patches of habitat, the adder requires large tracts of undisturbed terrain (Jones 1989; Beckett *et al.* 1990; Herbert pers. comm; Langton 1991). Even their sea wall habitats may be under threat in the event of managed retreat from low-lying coastal areas.

In Greater London, land values ensure that any vacant area is under potential threat of development and many valuable habitats, such as wasteland or allotments, have been lost to buildings and infrastructure. A particular, insidious, threat to lizards and slow-worms is the abandonment of railway lines and sidings, after which rank grassland reverts to dense scrub with the loss of essential basking sites. The great-crested newt in Greater London has suffered a 42% loss in numbers of breeding populations during the last 20 years, caused mainly by introductions of fish and pond loss through lack of management (Herbert 1995).

Habitat is lost to industrial and recreational developments around ports and seaside towns, which also often increase levels of disturbance to the species. The agricultural improvement and ploughing-up of wet grassland has caused dykes to become overgrown and nutrient-enriched. These effects, coupled with the development of dense vegetation on the banks, a consequence of removing sheep grazing from the marshes, have caused a decline in amphibians, especially the marsh frog, in many former wet grasslands.

5.6.4 Information sources used

National distribution data for the widespread amphibians and terrestrial reptiles were provided by the Biological Records Centre (BRC) at Monks Wood (Arnold 1983; Arnold 1995). These comprise post-1970 species records held by BRC and include all the data collected during the National Amphibian and Reptile Surveys (NARS) undertaken by De Montfort University on behalf of English Nature. The NARS formed the focus of national amphibian and reptile recording during the 1980s and early 1990s (Oldham & Nicholson 1986; Swan & Oldham 1989, 1993a, 1993b). Most of these data were collected through a volunteer, mainly amateur, recorder network.

Natterjack toad breeding sites are regularly monitored by Nature Reserve staff, whose reports are incorporated into the Natterjack Toad Site Register for the UK (Beebee 1989), which is updated annually. The site register also contains current listings of site-, area- and region-specific published and unpublished research and monitoring papers.

Suffolk Wildlife Trust and Suffolk County Council have listed great-crested newt sites throughout the county in a County Wildlife Site register, which is updated annually. Essex data are held at the Biological Records Centres in Colchester, Stratford and Southend. The London Amphibian and Reptile Group has developed a site database for amphibians and reptiles, covering the whole of Greater London and neighbouring parts of Essex. Kent Reptile and Amphibian Group is currently compiling a database of Kent sites. Lists of recorded great-crested newt breeding sites are also held by English Nature and the Wildlife Trusts in each county.

5.6.5 Acknowledgements

The author wishes to thank the following for providing information: Henry Arnold, Clive Herbert, Elizabeth Holdsworth, Adrian Knowles, Peter Lawson, Tina Pirson, Betty Platenberg, David Scott and Graham Walters.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Conservation and captive breeding of amphibians and reptiles, nationally	The British Herpetological Society, c/o The Zoological Society of London, Regent's Park, London NW1 4RY, tel: 0181 452 9578
Conservation of threatened reptiles and amphibians in Britain; priority species in Europe	Conservation Officer, The Herpetological Conservation Trust, 655A Christchurch Road, Boscombe, Bournemouth, Dorset BH1 4AP, tel: 01202 391319
National secretariat to local amphibian and reptile groups	Common Species Co-ordinator, Herpetofauna Groups of Britain and Ireland, c/o HCIL, Triton House, Bramfield, Halesworth, Suffolk IP19 9AE, tel: 01986 84518
National recording schemes and biological data from throughout UK	*Environmental Information Centre, ITE, Abbots Ripton, Huntingdon, tel: 01487 773381
Natterjack toads	Dr Trevor Beebee, University of Sussex, Falmer, Brighton, East Sussex BN1 9RH, tel: 01273 606755
Species Recovery Programme	*Lowlands Team, English Nature HQ, Peterborough, tel: 01733 455000
Amphibians and reptiles - Suffolk	*English Nature, Bury St Edmunds, tel: 01284 762218
Amphibians and reptiles - Suffolk	*Suffolk Wildlife Trust, Ashbocking, tel: 01473 890089
Amphibians and reptiles - Essex	*English Nature, Colchester, tel: 01206 796666
Amphibians and reptiles - Essex	*Essex Wildlife Trust, Colchester, tel: 01206 729678
Amphibians and reptiles - Essex	Essex County Amphibian and Reptile Recorder, c/o Court Hill, Church Lane, Little Leighs, Chelmsford, Essex CM3 1PG, tel: 01245 361475
Essex Biological Records Centres:	Natural History Department, Colchester Museum, High Street, Colchester CO1 1DN, tel: 01206 577475, Epping Forest Field Centre, High Beach, Loughton, Essex IG10 4AF, tel: 0181 508 7714, and Southend-on-Sea Central Museum, Victoria Avenue, Southend-on-Sea SS2 6EX, tel: 01702 330214
Amphibians and reptiles - Greater London	*English Nature, London, tel: 0171 831 6922
Amphibians and reptiles - Greater London	London Amphibian & Reptile Group, c/o 67a Ridgeway Avenue, East Barnet, Hertfordshire EN4 8TL, tel: 0181 440 6314
Amphibians and reptiles - Kent	*English Nature, Wye, tel: 01233 812525
Amphibians and reptiles - Kent	Kent Reptile & Amphibian Group, The Mount, Studmarsh Road, Canterbury, Kent CT3 4AQ, tel: 01227 767700 ext 7657
Amphibians and reptiles - Kent	*Kent Trust for Nature Conservation, Maidstone, tel: 01622 662012

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

5.7 Fish: exploited sea fish

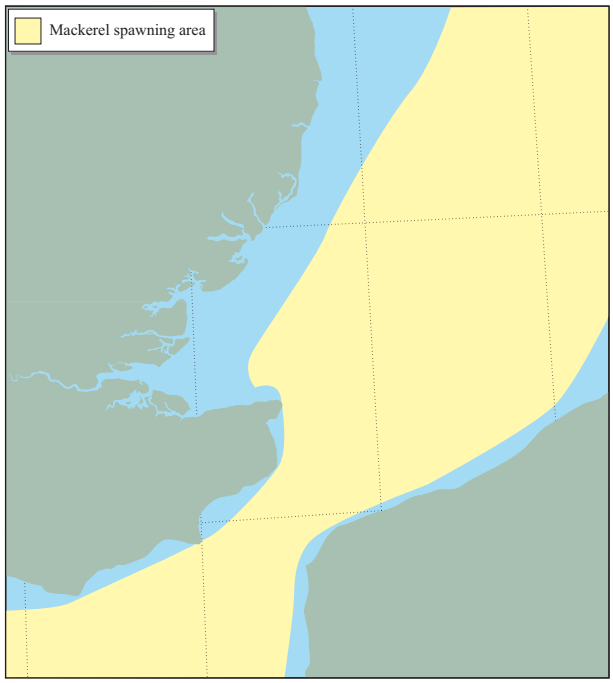
Dr M.G. Pawson & C.F. Robson

5.7.1 Introduction

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

The distribution of exploited sea fish species can be mapped from analysis of catch data from commercial fisheries and resource surveys. This description of their distribution covers their occurrence at identifiable locations in the region during particular phases of their life history, and Maps 5.7.1 - 5.7.7 show the known spawning and nursery areas of key species. Barring substantial climate change, or stock collapse, these distributions and relationships will remain stable over several decades.

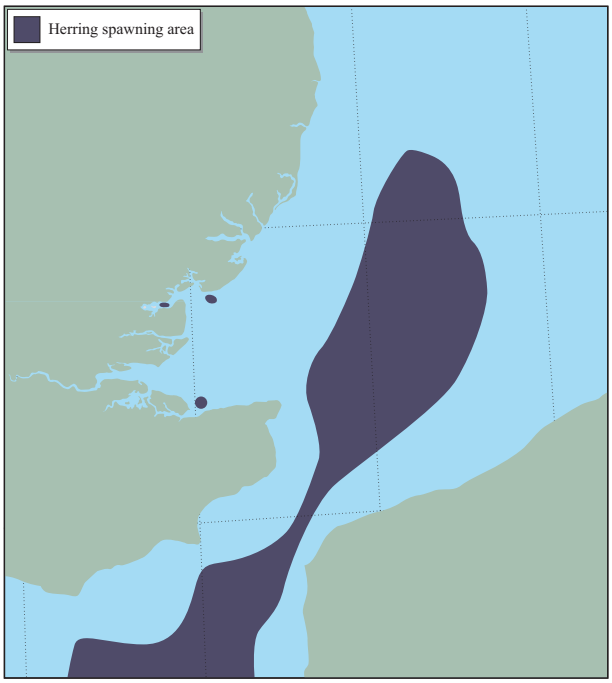
Table 5.7.1 lists the important pelagic and demersal species occurring in the region and give examples of protection measures in this region.



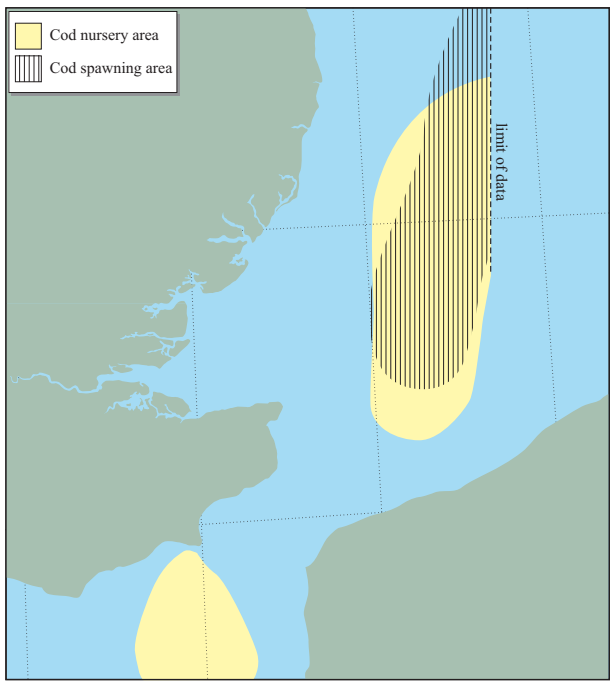
Map 5.7.1 Mackerel spawning areas. Source: Lee & Ramster (1981). © Crown copyright.

5.7.2 Important locations and species

Of the pelagic species, mackerel are widely distributed around Britain and are present in the region during their migration between spawning and overwintering areas. Some of the stock spawning in the central North Sea in June and July has



Map 5.7.2 Herring spawning areas. Source: Lee & Ramster (1981). © Crown copyright.



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

Table 5.7.1 Pelagic and demersal species and examples of measures for their protection

Species	*Protection measures*
Pelagic species	
Mackerel *Scomber scombrus*	MLS/QM
Herring *Clupea harengus*	MLS/QM
Sprat *Sprattus sprattus*	QM
Demersal species	
Elasmobranchs	
Spurdog *Squalus acanthias*	No limitation
Thornback ray *Raja clavata*	MLS*
Lesser spotted dogfish *Scyliorhinus canicula*	No limitation
Cuckoo ray *Raja naevus*	MLS*
Tope *Galeorhinus galeus*	No limitation
Gadoids	
Cod *Gadus morhua*	MLS/QM
Whiting *Merlangius merlangus*	MLS/QM
Ling *Molva molva*	No limitation
Pollack *Pollachius pollachius*	MLS/QM
Flatfish	
Plaice *Pleuronectes platessa*	MLS/QM
Dab *Limanda limanda*	MLS
Dover sole *Solea solea*	MLS/QM
Lemon sole *Microstomus kitt*	MLS
Turbot *Psetta maxima*	MLS
Brill *Scophthalmus rhombus*	MLS
Flounder *Platichthys flesus*	MLS
Other demersal fish	
Bass *Dicentrarchus labrax*	MLS
Grey mullets *Chelon labrosus*, *Liza ramada* and *L. aurata*	MLS
Sandeels *Ammodytes* spp.	No limitation

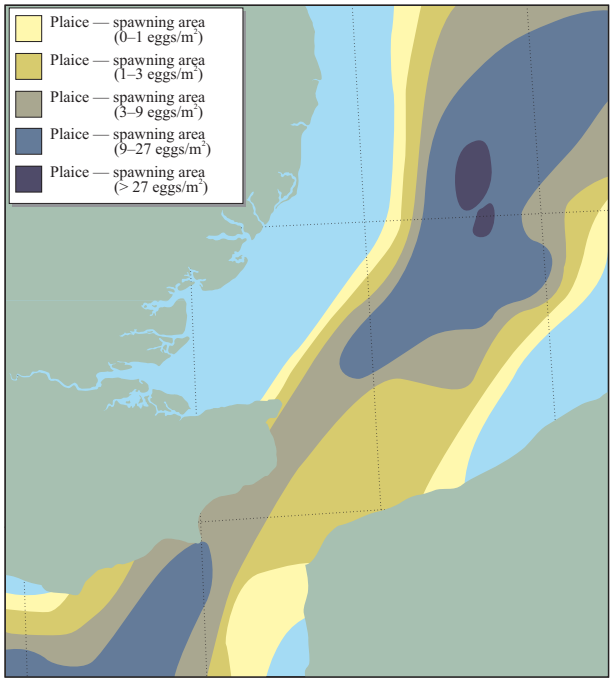
Source: European Council (1986, 1995); Kent and Essex Sea Fisheries Committee (pers. comm.). Key: MLS = minimum landing size; QM = catch quota management; *set by the Kent and Essex Sea Fisheries Committee (other MLS are those set for ICES fishing areas in the region).

migrated eastwards through the English Channel; the rest come from the stock overwintering in the North Sea (Map 5.7.1).

Herring are locally abundant in the autumn and winter in feeding and spawning areas. The North Sea herring stock occurs in the southern part of the Thames Estuary and along the Kent coast during autumn and winter. Herring spawning occurs in spring on the Eagle Bank in the River Blackwater, and also in an area within the Blackwater estuary and off Hern Bay in Kent. The locations of these herring spawning areas are shown on Map 5.7.2.

Sprats are widely dispersed throughout the shallower areas of the region, and especially inshore during autumn and winter. The whole region is used for spawning, which occurs mainly from February to June and is temperature-dependent. No clearly-defined nursery areas have been identified, but juvenile sprat are often found mixed with young herring in inshore areas, when they are known as 'whitebait'.

Elasmobranch species produce relatively small numbers of live young (10-100 per year, but can be fewer in big sharks) or lay eggs on the sea bed close to their nursery areas. Rays such as the thornback ray and the cuckoo ray are present in the region, and several species of shark occur sporadically, such as the spurdog, tope and lesser spotted dogfish.

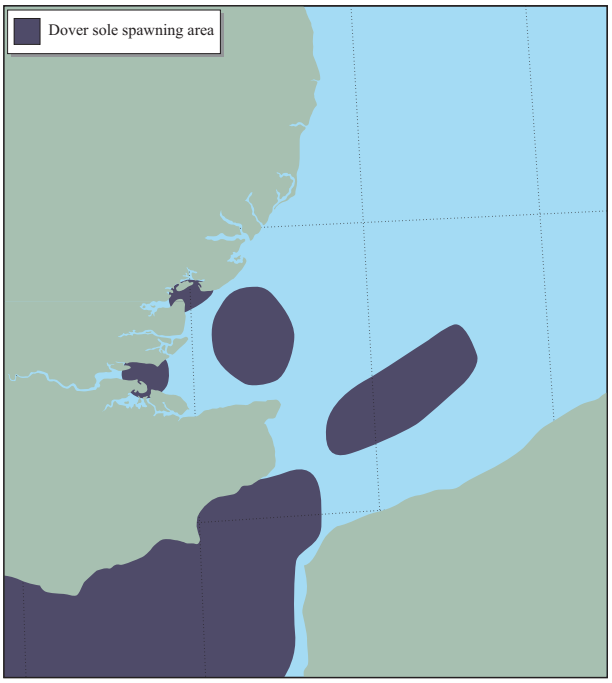


Map 5.7.4 Plaice spawning areas. Source: Lee & Ramster (1981). © Crown copyright.

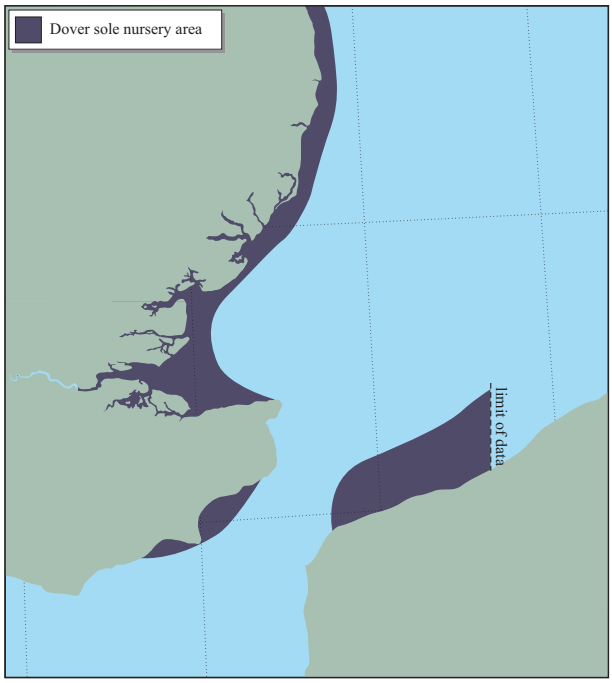
Of the gadoids, cod are widely distributed in the region, and there are pronounced aggregations of spawning and juvenile cod in the southern North Sea. Map 5.7.3 shows the location of cod spawning and nursery areas in the region. Whiting are widely distributed around Britain and are common in the region, especially in inshore waters. Whiting spawn from January to May, and although there are no identifiable spawning areas, large aggregations occur off the south Kent coast and offshore from Suffolk in the North Sea. Ling and pollack are more locally distributed and are found in particular around areas of stony ground, reefs and wrecks.

Plaice and dab are the most abundant flatfish species; much more is known about the life history of the commercially-exploited plaice. Plaice spawn from December to March, the spawning peak being in January and February. Knowledge of plaice spawning areas is obtained from the distribution of newly spawned eggs in spring, determined by plankton surveys (Lee & Ramster 1981) (Map 5.7.4). Plaice are found on sandy areas of sea bed throughout the region, and juveniles live close to the shore in the same nursery areas as Dover sole, gradually moving to deeper water as they grow. There is some interchange of plaice between spawning stocks and nursery grounds in the eastern Channel and the North Sea and *vice versa*. In contrast, a more local distribution is recorded for the Dover sole; the adults spawn in the early summer (April to June) where they are found (Map 5.7.5) and probably do not make extensive migrations. Juvenile Dover sole may spend up to two years in inshore nursery areas (Map 5.7.6). Dab spawn from January to June and juveniles move to coastal nurseries in the autumn and migrate to deeper water as they grow. Turbot and brill have a similar lifestyle to plaice, dab and Dover sole but are much less abundant. Flounders migrate between inshore, estuarine and even riverine nursery areas all along the coast of the region to spawn up to 20 or 30 miles offshore in late winter, and there appears to be little long-shore coastal movement other than in the egg or larval phase.

Bass and grey mullet species are seasonally abundant



Map 5.7.5 Dover sole spawning areas. Source: Pawson (1995). © Crown copyright.



Map 5.7.6 Dover sole nursery areas. Source: Pawson (1995). © Crown copyright.

inshore and in estuaries in the region and arrive at the region's coast in the early spring from warmer areas further west. Bass spawn in the region from April to June in the eastern English Channel (Map 5.7.7) and some may also spawn within the Thames Estuary. Recently there has been a strong recruitment of bass stocks that is thought to be linked to warm sea temperatures in spring (Pawson 1992). From June onwards juvenile bass are found extensively in the creeks, estuaries, backwaters and shallow bays that border the region (Map 5.7.7). The Thames Estuary is an important bass nursery area (Kelley 1988), and three areas around coastal power stations in the region are designated by MAFF as Bass Nursery Areas, in which fishing restrictions are imposed (Map 5.7.7; Table 5.7.2).

Sandeels are common in the shallow harbours and bays and provide an important food source for many other exploited fish species. They burrow in coarse sand at night and during the winter; their distribution is thus influenced by that of coarse sand.

Table 5.7.2 MAFF/WO designated bass nursery areas in the region

Name of area	*Duration of closed season*
Bradwell Power Station Outfall, Blackwater Estuary	1 May - 31 October
Grain Power Station Outfall, Medway Estuary	All year
Kingsnorth Power Station Outfall, Medway Estuary	All year

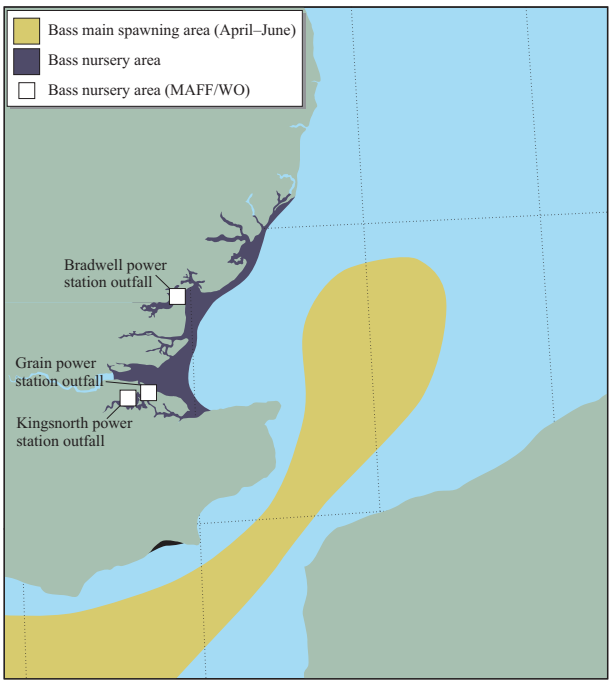
Source: Ministry of Agriculture, Fisheries and Food & Welsh Office Agriculture Department (1990)

5.7.3 Human activities

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

Efforts are made to conserve stocks of pelagic and demersal species by implementing a variety of management measures, including minimum landing sizes (MLS), minimum mesh size regulations and quantitative controls on catches (through catch quota management by the setting of annual Total Allowable Catches (TAC), explained further in section 9.1). Two such protection measures are listed in Table 5.7.1: MLS, and catch quota management (QM), which indicates that the UK has been allocated a quota in ICES Divisions IVc (southern North Sea) and/or VIId (English Channel, East), which cover Region 7. Their implementation means that fish caught below MLS or for which the quota is exhausted must be discarded at sea, and this may affect the exploited species fish stocks, as well as other fish species, birds and species that live on the sea bed. There are also national quota restictions for herring, and specific bylaws made by the Kent and Essex Sea Fisheries Committee to restrict and protect the Thames herring fishery.

In order to safeguard the bass fishery in UK coastal waters, 34 areas have been designated as statutory Bass Nursery Areas under the Bass (Specified Sea Areas) (Prohibition of Fishing) Order 1990: SI 1990 No. 1156 (Ministry of Agriculture, Fisheries and Food & Welsh Office Agriculture Department 1990). These areas are where juvenile bass are abundant and are most easily caught, particularly during the summer months. There are three Designated Bass Nursery Areas in the region (Table 5.7.2; Map 5.7.7). The legislation prohibits fishing for bass from any vessel for the duration of the closed



Map 5.7.7 Distribution of bass spawning and nursery areas. Sources: MAFF & WO (1990); Pawson (1995).

season, and although fishing from the shore is not covered, anglers are expected to return to the sea any bass caught within nursery areas.

Elasmobranch species are vulnerable to exploitation as a result of the relatively long time they take to reach reproductive maturity and the small numbers of young that they produce.

Spawning and nursery areas for all species may be vulnerable to other activities, such as aggregate extraction, sewage sludge dumping, dredging and dredge material disposal and the development of infrastructure such as barrages and pipelines. MAFF is a statutory consultee for, or licenses, activities such as these, in which the distributions of exploited fish populations and their identifiable spawning and nursery areas have to be taken into account. Much of the region's coast has been subject to localised navigational dredging and marine aggregate extraction. All dredging activities have short-term, localised effects, such as the removal of material and organisms, but long-term effects on fish stocks are much more difficult to assess, owing to the difficulty of determining which effects are the result of dredging and which the result of the many other factors operating (Doody *et al*. 1993). Short- or long-term changes in sediment deposition can result, as well as inevitable changes in the topography of the bed. Disturbance of muddy material in order to access underlying aggregate can destroy feeding grounds for flatfish through the displacement of muddy sand fauna. Other activities, such as sea angling (see section 9.1.2) and seismic activity for oil and gas exploration (Turnpenny & Nedwell 1994), may also have a localised effect on fish populations.

5.7.4 Information sources used

Whereas the life history of most exploited crustacean and mollusc species can be observed at or near the sites at which they are harvested, the distributions of fish populations can change considerably between juvenile and adult phases and with seasonal migrations. Therefore, the information used in this section is based on the distribution and relative abundance of fish species revealed by fisheries catch statistics from recorded commercial landing figures. In addition, information is used from research vessel catch data and data from biological sampling during fishing surveys. Data from these surveys on the occurrence of spawning fish and juveniles can be used to identify spawning and nursery areas. However, this information is sometimes limited, and there may be other areas in addition to those described or shown on the maps where the particular species might also occur. Research surveys involving plankton sampling, hydrographic studies, fishing and tagging are required to establish the links between spawning groups and specific nursery areas, and between growing juveniles and the adult populations to which they eventually recruit. The *Atlas of North Sea fishes* (Knijn *et al.* 1993) gives details of the distribution of fish from otter trawl surveys over three years. Wheeler (1979) describes the history of the River Thames and its fishes. Lee & Ramster (1981) has been used as a source for the maps. Pawson (1995) shows distribution maps of selected fish and shellfish species around the north-east Atlantic and the British Isles and has a species-specific bibliography.

European Council Regulations detailing the Total Allowable Catches (TACs) and the national catch quotas for fish and shellfish species for all European countries, and certain conditions under which the species can be fished, are published in Luxembourg in the Official Journal of the European Communities. These regulations are updated annually and the regulations for 1996 are given in European Council (1995).

5.7.5 Acknowledgements

The authors thank the following for their comments on draft text: Paul Knapman (English Nature), Jos Wiggins and John Stroud (Kent and Essex Sea Fisheries Committee) and Mark Tasker (JNCC).

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Advice to assist with management and policy for the coastal zone; marine conservation issues	*Head of Laboratory, Centre for Environment, Fisheries & Aquaculture Sciences, Conwy, tel: 01492 593883
Assessment and provision of advice on the conservation of exploited fish stocks. MAFF Databases e.g. young fish and ground fish surveys	*Director, Centre for Environment, Fisheries & Aquaculture Sciences Lowestoft Laboratory, tel: 01502 562244
UKDMAP software with maps showing distributions of selected sea fish species and spawning areas	*Project Manager, BODC, Birkenhead, tel: 0151 653 8633
Marine conservation issues and fisheries	*Fisheries Liasion Officer, English Nature HQ, Peterborough, tel: 01733 455000
Marine Fisheries Task Group papers and advice on marine conservation issues	*Marine Advisor, JNCC, Peterborough, tel: 01733 562626
Marine conservation issues	*Conservation Officer, RSPB, Sandy, tel: 01767 680551
Marine conservation issues	*Fisheries Officer, Marine Section, WWF-UK, Godalming, tel: 01483 426444
Marine conservation issues	*Conservation Officer, Marine Conservation Society, Ross-on-Wye, tel: 01989 566017
Marine conservation issues	*Honorary Secretary, The Marine Forum for Environmental Issues, Scarborough, tel: 01723 362392

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

5.8 Fish: salmon, sea trout and eels

Dr M. Aprahamian & C.F. Robson

5.8.1 Introduction

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

5.8.2 Important locations

Salmon, sea trout and eels have a widespread distribution in British rivers and coastal seas. The distribution of salmon and sea trout is controlled by natural factors, such as river levels, by man-made barriers that may limit the extent to which they can go upstream, and by pollution levels. They are present in rivers and the coastal seas of this region. The main areas for salmon are the Thames and Stour rivers; the latter also contains sea trout. Eels are probably found in all river systems in the region, as elsewhere in Britain, and are most common in the Blyth, Alde, Ore, Stour and Orwell Estuaries and in many of the Essex rivers and the Thames.

5.8.3 Human activities

Under the Environment Act 1995, the functions of the NRA under the Water Resources Act 1991 were transferred to the Environment Agency on 1 April 1996. The Anglian, Thames and Southern Regions of the Environment Agency have a responsibility to regulate, protect and monitor salmon, sea trout and eel fisheries from rivers to coastal waters out to 6 nautical miles from baselines. The two Sea Fisheries Committees (SFCs) of the region have powers to support the conservation of salmonid fisheries while exercising their responsibilities towards the regulation of sea fisheries (see section 9.1). The Environment Agency uses a variety of techniques, such as netting, electric fishing and monitoring of commercial and angling catches, to assess stocks of salmon and sea trout. All licences issued by the Environment Agency in the region are subject to seasonal and weekly closure times.

A small number of salmon and sea trout are caught from the River Thames, where improvements in water quality are being made to encourage the salmonids to return and spawn in the river again. The Thames Water Authority began a programme to restore a salmon population to the River Thames in 1978 (Thames Estuary Project 1996). The Environment Agency, with the Thames Salmon Trust, are continuing this work as part of the 'Salmon Rehabilitation Scheme'. This is done by placing salmon smolts in the lowest, freshwater part of the Thames in spring. The smolts migrate out of the Thames and after several years at sea migrate back up the Thames in the summer and autumn. Significant numbers of returning salmon were first reported in 1983 and subsequently the maximum reported in any one year has been 330 individuals.

The effects of exploitation, especially by different catch methods (rod-and-line or nets), is an issue for salmon and sea trout stocks (MAFF/SO 1991). The use of coastal fixed nets and drift nets to target sea fish close to the coast and in estuaries is a potential barrier to migrating salmonids. Sea trout in the region support a coastal net fishery, which operates from Norfolk and Suffolk. Fyke nets, used to catch eels, are often set in a series across a river, with bars fixed over the entrance of the net to prevent otters being trapped. Fyke nets are used in the Blyth, Alde, Ore, Stour and Orwell Estuaries and in many of the Essex rivers and estuaries and the upper reaches of the Thames. There are also fisheries for eel in the Medway Estuary and at Dungeness. The traditional and once prosperous Thames Estuary eel fishery, which involved the use of trawls, has attracted less interest over the years as catches and markets have declined and fish have succumbed to the lethal red spot virus *Vibrio anguillarum*.

Maitland & Campbell (1992) summarise the possible effects of various issues of relevance to freshwater fish. Issues mentioned of relevance in the region include the effects on salmonids of poor water quality, changing land use, such as the change in flow of rivers from canalisation, and increased siltation.

5.8.4 Information sources used

The distribution of Atlantic salmon in England and Wales is described in Russell (1989). The information on the salmon and sea trout caught in the region has been derived from published catch statistics of the Environment Agency (see section 9.1.2). The Institute of Freshwater Ecology (part of the Natural Environment Research Council) conducts a programme of research into freshwater habitats and species. Their 'fish counters' yield information on various species of fish, and other studies involve sampling salmon, sea trout and eels from rivers in the UK.

5.8.5 Acknowledgements

The authors thank the following for their comments on the draft text: Mike Pawson (CEFAS Lowestoft Laboratory) and Mark Tasker (JNCC).

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Regional scientific information and advice	*Regional Fisheries Manager, Environment Agency Anglian Region, Peterborough, tel: 01733 371811
Regional scientific information and advice	*Regional Fisheries Manager, Environment Agency Thames Region, Reading, tel: 01734 535000
Regional scientific information and advice	*Regional Fisheries Manager, Environment Agency Southern Region, Worthing, tel: 01903 832000
Scientific advice and policy	*Head of Department, Environment Agency Fisheries Department, Bristol, tel: 01454 624400
General enquiries	*Public Relations Officer, Environment Agency - Public Relations Department, Bristol, tel: 01454 624400
Research programme into freshwater habitats and species	Director, Institute of Freshwater Ecology - Head Office, Windermere Laboratory, Far Sawrey, Ambleside, Cumbria LA21 0LP, tel: 015394 42468
Conservation of wild salmon; salmonid research	Director, The Atlantic Salmon Trust, Moulin, Pitlochry PH16 5JQ, tel: 01796 473439
Inter-government convention regulating salmon fishing on the high seas	Secretary, North Atlantic Salmon Conservation Organisation, 11 Rutland Square, Edinburgh EH1 2AS, tel: 0131 228 2551

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

5.9 Fish: other species

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

5.9.1 Introduction

The fish fauna of this region has been well studied, particularly that of the Thames Estuary, and the estuaries and coastal waters of this region contain a diverse range of fish species. 112 species of marine or estuarine fish have been recorded in this region, including two lampreys (Agnatha), ten sharks and rays (elasmobranchs) and 100 bony fish (teleosts).

This region has confirmed records of all seven British marine and estuarine species protected under national, European and international legislation (Table 5.9.1). These include lampern *Lampetra fluviatilis*, sea lamprey *Petromyzon marinus*, sturgeon *Acipenser sturio*, allis shad *Alosa alosa* and twaite shad *A. fallax*. These species are considered threatened in the UK and Europe (Potts & Swaby 1993a) (the common goby *Pomatoschistus microps* and the sand goby *P. minutus* are both very abundant in the UK).

5.9.2 Important locations and species

Map 5.9.1 shows the distribution of sea lamprey and lampern records in the region. The lampern fishery in the Thames was once substantial, but declined until only a single lampern was recorded there in 1899. However, the species was recorded from West Thurrock power station in 1964 and 1967 (Wheeler 1969). The sea lamprey has never been common in the Thames and was never exploited, although at times it was recorded as abundant (Murie 1903). Recent records are very few. The sturgeon occurred regularly in the Thames up to the early nineteenth century, but has declined since then (Wheeler 1958) and is now rarely recorded.

Map 5.9.2 shows the records of allis and twaite shad in the region. In 1836, shad were reported to be abundant in the Greenwich area and were fished commercially. The twaite shad was more common in the lower Thames than the allis shad. Twaite shad were reported as abundant in the Thames by Murie (1903), but were later reported to be in decline. However, they were still caught further down the estuary, possibly breeding in creeks in Southend (Wheeler 1958, 1969). There have been occasional records of one or two twaite shad from the West Thurrock intake screens since the 1960s, and a single specimen was caught off Blackwell Point in 1976

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

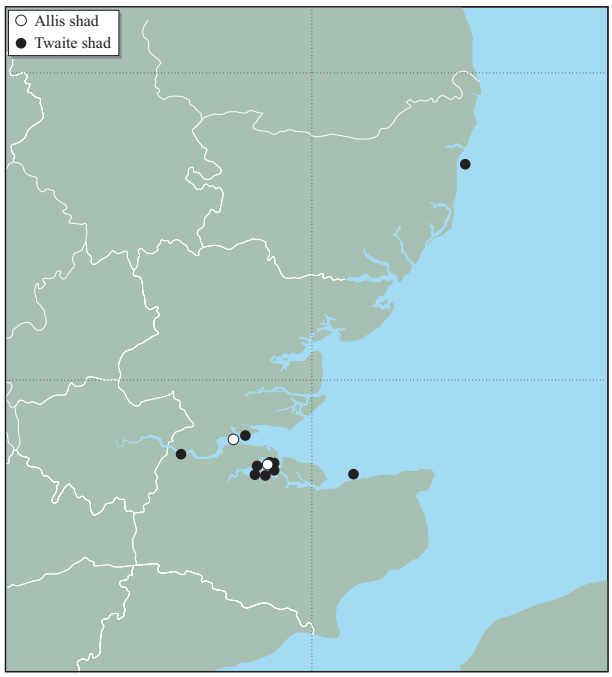
(Wheeler 1969; Andrews & Wheeler 1985; Thomas pers. comm. 1992). It was recorded as 'occasionally caught on rod and line' in the Marine Fauna of Whitstable (Newell 1954) but is now often caught within the Thames Estuary (Kent and Essex Sea Fisheries Committee pers. comm.). Allis shad were recorded singly from West Thurrock, Blackwell Point and Richmond in the 1970s (Andrews & Wheeler 1985).

The Orwell Estuary has undergone changes in character through urbanisation, industrialisation and the construction of the large dock complex. The resulting pollution is thought to have reduced the fish fauna, and only eleven fishes have been recorded recently. The Bradwell power station on the Blackwater Estuary has yielded records of over 60 species of fish. There is no fish list for the Colne Estuary, but it is not expected to differ significantly from that for the Blackwater Estuary. However, the warmer waters around the power

Table 5.9.1 Scheduled species and protected status

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

Source: after Potts & Swaby (1993a). Key: †the sand and common gobies are both very abundant in UK.



Map 5.9.2 Distribution records on the British Marine Fishes Database of allis shad and twaite shad. Source: after Potts & Swaby (1993c).

station at Bradwell are attracting large numbers of bass and sprat *Sprattus sprattus*. The estuaries of the Crouch and Roach are typical for the region, with characteristic species being the lemon sole *Microstomus kitt*, sardine *Sardina pilchardus* and black sea bream *Spondyliosoma cantharus*.

The River Thames and its estuary is one of the best studied areas in the UK, and the Environment Agency maintain a list of all the fish species recorded. The current total, including freshwater species, is 118, of which 99 are estuarine or marine (R.M. Thomas, Environment Agency, pers. comm.), the remainder being freshwater species. Fish populations have been studied in the Medway Estuary, as it is an important flatfish nursery and supports a stable community of fish, and seasonal distributions of numbers and abundance of fishes have been studied from monthly samples from Kingsnorth Power Station (van den Broek 1978, 1979a).

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

5.9.3 Human activities

Human activities affecting estuaries and adjacent coasts are summarised in Buck (in prep. a, b); they can affect the abundance and distribution of fish. The southern North Sea area is one of the most heavily industrialised areas of Europe and has a variety of effluents being deposited into the rivers, estuaries and coastal waters. Urbanisation and the disposal of untreated sewage in estuaries result in a reduction in dissolved oxygen, to which fish are particularly sensitive. The result is that fish leave the area and do not return until treatment plants reduce the amount of sewage and oxygen levels increase (Potts & Swaby 1993b). Some rivers are heavily polluted, particularly the Orwell and Stour, and this is thought to have affected fish populations. Other rivers such as the Thames have suffered this in the past (Wheeler 1969, 1979) but are now becoming cleaner and fishes are returning. Smelt *Osmerus eperlanus* are sensitive to poor water quality: they used to abundant in the lower Thames and supported a fishery, but none was recorded in the years after 1958. However by 1968 they had been taken on West Thurrock intake screens and were reported from other sites, implying that their population has been recovering (Wheeler 1969).

The effects of contaminants such as chlorinated hyrdocarbons and heavy metals on fish in the Medway Estuary are discussed in Wharfe & van den Broek (1977) and van den Broek (1979b). The possible effects of fisheries on fish species is discussed in sections 5.7 and 9.1. Sea angling occurs in many places throughout the region (Orton 1996) (see also section 9.1.2 and 9.7.2). Other activities such as oil exploration and seismic surveying activity can have an adverse impact on individual fish (Turnpenny & Nedwell 1994). Dams and weirs can injure or impede migratory fish, which are then unable to reach spawning and feeding grounds. Power station water intakes trap large numbers of fish, but modern stations such as Sizewell B have 'return systems', which allow them to escape. Records may be kept of the numbers and species involved (e.g. Turnpenny & Henderson 1993; Fleming *et al.* 1994).

5.9.4 Information sources used

The information on and lists of the fish of Kent, Essex, and Suffolk come from the larger estuaries rather than adjacent coasts. In particular, the fishes of the Thames Estuary have been well documented (Wheeler 1969; Environment Agency pers. comm.). There are also lists of fish species for the Blackwater, Colne, Stour, Crouch/Roach and Medway Estuaries and Whitstable (e.g. Beardall *et al.* 1991; Howard 1976).

The atlas of the North Sea fishes (Knijn *et al.* 1993) gives details of the distribution of fish in this region between 1985 and 1987. However, these data were collected using commercial trawls and records of coastal and inshore fishes were incidental to this.

The review of estuarine fish in selected English estuaries (Potts & Swaby 1993c), carried out by the Marine Biological Association for English Nature, is included in the British Marine Fishes Database and covers fish in the UK and individual records for this area. Information is being gathered from a variety of sources, including the Environment Agency, the Natural History Museum, Sea Fisheries Committees, anglers and fishermen. The data include published literature, unpublished reports and personal communications from fish biologists.

5.9.5 Acknowledgements

Thanks go to staff of the Environment Agency, Thames Region, for providing information for this section.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
British Marine Fishes Database	Dr G.W. Potts/S.E. Swaby, Marine Biological Association UK, Citadel Hill, Plymouth PL1 2PB, tel: 01752 633100/600301
Marine conservation issues and fisheries	*Fisheries Liaison Officer, English Nature HQ, Peterborough, tel: 01733 455000
Fish conservation - UK	*Marine Advisor, JNCC, Peterborough, tel: 01733 562626
Fisheries	*Director, Centre for Environment, Fisheries & Aquaculture Sciences Lowestoft Laboratory, tel: 01502 562244

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

5.10 Seabirds

M.L. Tasker

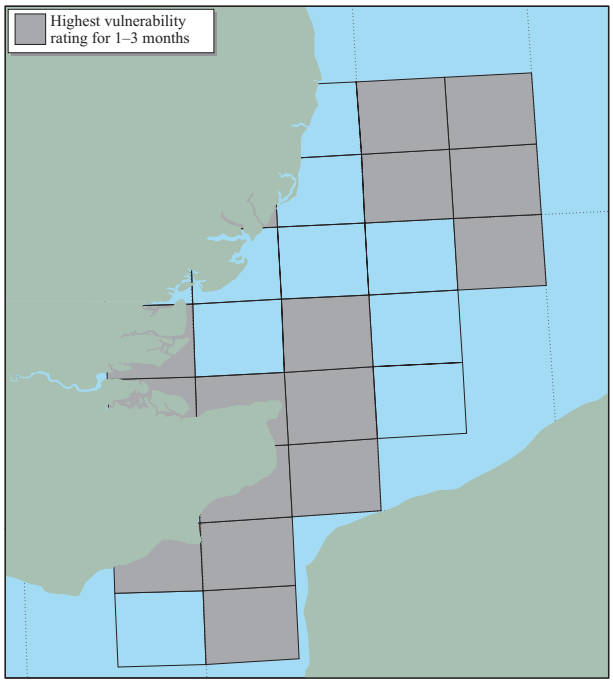
5.10.1 Introduction

This section deals with seabirds, both at their colonies on land and while at sea. It covers not only those species usually regarded as seabirds, but also divers, grebes, cormorant and seaduck: species that are reliant for an important part of their life on the marine environment. (Section 5.12.2 includes information on those waterfowl species where they occur close inshore, especially within estuaries.) Scientific names of most species are given in Table 5.10.1.

This region is of international importance for six breeding seabird species (cormorant, black-headed and lesser black-backed gull, Sandwich, common and little tern), which are present in numbers greater than 1% of the European Union population; the population in the region of one further species (herring gull) numbers more than 1% of the GB total and is hence of national importance. Table 5.10.1 summarises the importance of the region for breeding seabirds.

Eleven seabird breeding colonies are of importance in the national context, two of them holding internationally important numbers. Several further sites are of intermittent national importance because terns may nest at different sites in successive years.

Numbers of birds at sea off the region are generally low compared with more northern waters in the United Kingdom. The greatest concentrations of birds at sea occur in this region outside the breeding period. Numbers of offshore waterfowl do not reach international importance at any one site, although total numbers of red-throated divers *Gavia stellata* scattered in the Greater Thames Estuary are likely to be of international significance (Barton *et al.* 1993). Numbers of offshore waterfowl reach national importance at eleven locations in the region. Map 5.10.1 shows the importance of areas offshore of the region for seabirds.



Map 5.10.1 Relative importance of region and adjacent seas for seabirds. Grid is of 15'N x 30'W rectangles; see text for explanation of vulnerability ratings. Sources: JNCC Seabirds at Sea Team, Carter *et al.* (1993) and Webb *et al.* (1995).

5.10.2 Important locations and species

Breeding seabirds require habitat that is free or safe from predatory mammals; there are few isolated cliffs in the region, so most colonies are on saltmarshes, remote beaches or offshore sandbanks. The cormorant colony in trees at Abberton Reservoir is of international importance; although it is located a few kilometres inland, it is included here as many of the birds feed on nearby estuaries. Apart from Abberton, the only other colony of international importance is that of lesser black-backed gulls at Orfordness (Table 5.10.2; Map 5.10.2). Nine other colonies are of national importance. The little tern population of the region is small compared with that recorded in the recent past. Several sites additional to those shown in Table 5.10.2 have held populations exceeding 1% of the GB total within the past five years; these include Kessingland, Benacre, Covehithe, Easton Bavents, Trimley and Felixstowe Docks in Suffolk; Little Oakley, the Naze, Colne Point and Packingshed Island in Essex; and Sheerness Docks and Dungeness in Kent. Numbers of Sandwich terns at

Table 5.10.1 Overall importance of seabirds breeding in the region

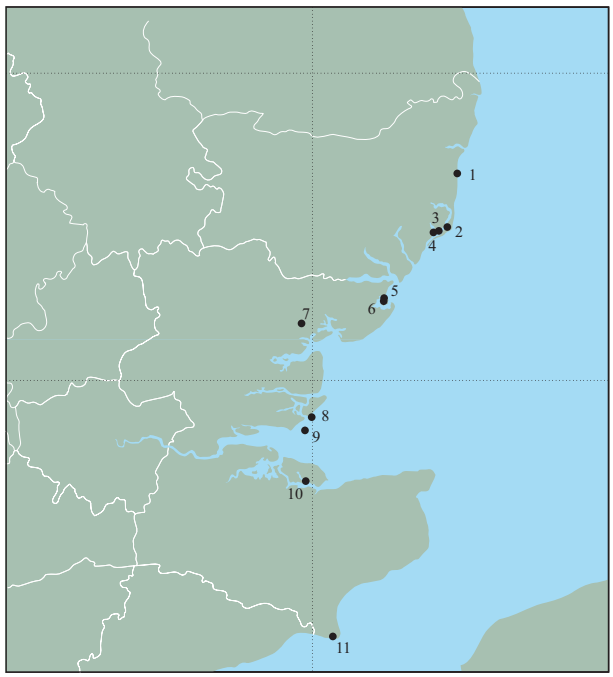
Species	*Total*	*% GB*	*% Europe*
Fulmar *Fulmarus glacialis*	325	<1.0	<1.0
Cormorant *Phalacrocorax carbo*	559	8.2	4.3
Black-headed gull *Larus ridibundus*	14,300	8.6	1.8
Common gull *Larus canus*	30	<1.0	<1.0
Lesser black-backed gull *Larus fuscus*	8,234	10.0	7.1
Herring gull *Larus argentatus*	4,782	3.2	<1.0
Kittiwake *Rissa tridactyla*	3,081	<1.0	<1.0
Sandwich tern *Sterna sandvicensis*	598	4.3	1.2
Common tern *Sterna hirundo*	1,022	8.0	2.1
Little tern *Sterna albifrons*	227	9.4	1.4

Sources: regional totals are compiled from the most recent available good-quality counts up to 1995; figures for Great Britain from Walsh *et al.* (1995), for Europe from Lloyd *et al.* (1991), with some minor updating. Note: counts are all of pairs.

Dungeness averaged 148 (>1% GB) in the years between 1986 and 1995, but none nested there in 1994 or 1995.

At sea, seabird food ranges from zooplankton to small fish and waste from fishing fleets. Habitats that concentrate any of these foods are preferred. Zooplankton can be concentrated in zones where water masses meet or where tides converge around headlands or over some sea-bed features. Most of the breeding seabirds in this region feed comparatively close inshore. The most important parts of the sea for offshore wintering birds (the larger auks (mostly guillemots *Uria aalge*) and red-throated divers) are the inner parts of the Greater Thames Estuary, and areas near Dungeness (Davenport 1992) and, on some occasions, North Foreland, Thanet (Lock & Slade 1996). The latter two areas are most important during the winter months (December - February). There are no protected sites at sea in the region.

There is considerable immigration of waterfowl to the region in winter. For instance, large numbers of red-throated divers, great crested grebes *Podiceps cristatus*, little grebes *Tachybaptus ruficollis*, goldeneye *Bucephala clangula* and common scoter *Melanitta nigra* use the Greater Thames Estuary. Total numbers of these species wintering in the region are not known: most of the scoter occur out of sight of land, as do substantial numbers of divers, cormorants and gulls, and may only be detected by aerial surveys (Barton *et al*. 1993). Table 5.10.3 shows the relative importance of locations in the region for marine-wintering waterfowl.



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

5.10.3 Human activities

The vulnerability of seabirds at sea to the effects of human activities is calculated from the abundance of birds in the rectangles shown on Map 5.10.1 and a factor derived from the amount of time spent on the water, the overall population size and the rate at which the species recruits new individuals to the population. For a discussion of vulnerability see Carter *et al*. (1993), Williams *et al*. (1994) or Webb *et al*. (1995).

Seabirds can be particularly affected by marine oil pollution. Spills near the main colonies during the breeding season can be catastrophic. The Thames holds a number of oil terminals, which have had spillages in the past. Spills can also occur from non-tanker shipping movements. The major shipping routes in the Dover Straits pass the region. Some birds may become entangled in fishing nets in the region, particularly on the English Channel coast of Kent, but the scale at which this occurs is not believed to be large overall. Little terns nest on beaches and are susceptible to disturbance from humans and predators. A number of the more important colonies in the region are guarded by wardens.

5.10.4 Information sources used

All seabird colonies in the region were counted or reappraised between 1984 and 1987. Many have also been counted since then. These counts, and all others made since 1979, are held on the JNCC/Seabird Group Seabird Colony Register. Numbers and breeding performance of terns are evaluated annually at 37 colonies in the region, and monitoring of other

Table 5.10.2 Seabird colonies of at least national importance for particular species

Site no. on Map 5.10.2	*Colony*	*Grid ref.*	*Species*	*Year*	*Count*	*≥1% EU/GB population*
1	Minsmere	TM475665	Little tern	1995	26	GB
2	Orfordness	TM440490	Lesser black-backed gull	1990	8,223	EU
3	Havergate	TM415475	Sandwich tern	1994	250	GB
4	Orford Beach	TM400472	Little tern	1995	25	GB
5	Hamford Water	TM240260	Black-headed gull	1990	>6,000	GB
6	Horsey Island	TM240255	Little tern	1995	35-40	GB
7	Abberton Reservoir	TL970180	Cormorant	1995	503	EU
8	Foulness/Maplin	TR0087	Sandwich tern	1995	330	GB
9	Maplin Bank	TQ985831	Common tern	1993	143	GB
10	Flanders Mere	TQ988668	Black-headed gull	1994	4,000	GB
11	Dungeness	TR070180	Common tern	1995	150	GB

Source: JNCC Seabird Colony Register. Key: GB = nationally important; EU = internationally important. Notes: counts are all of pairs.

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

Species	*5 yr mean peak nos.**	*1% GB*	*1% NW Europe*
Off Minsmere			
Red-throated diver	120	50	750
Stour Estuary			
Great crested grebe	234	100	n/a
Cormorant	179	130	1,200
Colne Estuary			
Great crested grebe	212	100	n/a
Cormorant	314	130	1,200
Blackwater Estuary			
Cormorant	295	130	1,200
Goldeneye	274	170	3,000
Dengie Flats			
Red-throated diver	120	50	750
Great crested grebe	119	100	n/a
Cormorant	200	130	1,200
Thames Estuary			
Cormorant	214	130	1,200
Little grebe	251	50	n/a
Swale Estuary			
Cormorant	203	130	1,200
Little grebe	128	50	n/a
Lade Sands			
Great crested grebe	429	100	n/a
Medway Estuary			
Great crested grebe	116	100	n/a
Little grebe	53	50	n/a
Cormorant	252	130	1,200
NE Kent/Thanet			
Great crested grebe	323	100	n/a
Cormorant	157	130	1,200
Dungeness			
Red-throated diver	482	50	750

Sources: mean peak numbers from Cranswick *et al.* (1997), 1% GB from Waters & Cranswick (1993), 1% NW Europe from Rose & Scott (1994). Key: *1991/2 - 1995/6; n/a = not available. Notes: counts are of individuals. Some of these populations occur within estuaries and are also discussed in section 5.12.

species occurs at six other sites (Thompson *et al*. 1996). Surveys of birds at sea off this coast have been carried out by JNCC's Seabirds at Sea Team (SAST); survey effort from ships has been greatest off the north of the region, and off the Channel coast of Kent. Effort in the inner Thames Estuary has been very poor. Waters at 2 km and 5 km from the shore have been surveyed from the air by SAST on a bi-monthly basis over one year. There has been no systematic coverage from the land, but the Essex, Kent and Suffolk Bird Reports include records of sightings from the coast.

5.10.5 Acknowledgements

Kate Thompson abstracted the Seabird Colony Register records and summarised the information presented here. Many volunteers carried out the counting on which the register is based. Julian Roughton of the Suffolk Wildlife Trust and the RSPB commented on a draft of this section.

5.10.6 Further sources of information

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Seabird colonies	*Coordinator, Seabird Colony Register, JNCC, Aberdeen, tel: 01224 655703
Seabirds at sea	*Seabirds and Cetaceans Team, JNCC, Aberdeen, tel: 01224 655702
Birds database	*Birds Advisor, JNCC, Peterborough, tel: 01733 562626
Nearshore waterfowl	*Wildfowl and Wetlands Trust, Slimbridge, tel: 01453 890333

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

The large areas of mudflats and saltmarsh in the region, such as those on the Essex and north Kent coasts, are important feeding grounds for many wintering waterfowl. Of these, the dark-bellied brent goose *Branta bernicla bernicla* (pictured here on the Blackwater Estuary, Essex) is the most abundant species. Photo: Peter Wakely, English Nature.

5.11 Other breeding birds

R.T. May & A.B. Law

5.11.1 Introduction

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

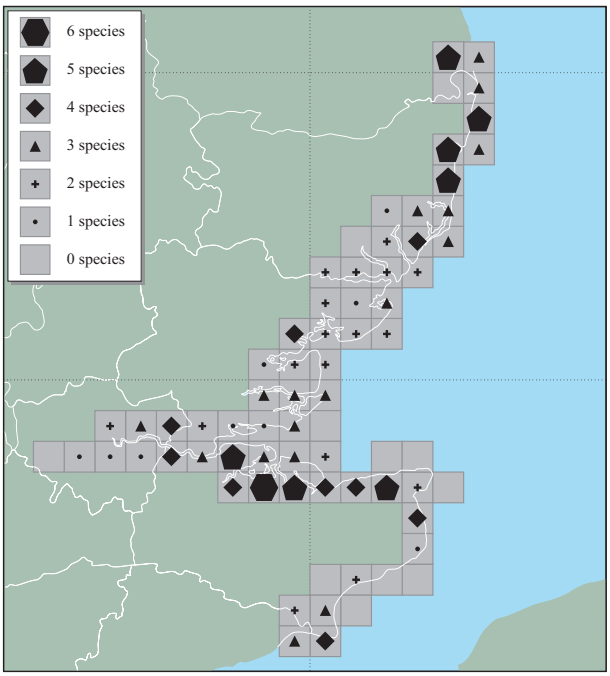
Nearly all the coastline in this region is estuarine or 'soft' coast, habitats that support very high densities of breeding waterfowl, especially waders. The estuarine saltmarshes and coastal wet grasslands are of significance in the national context (Smith 1983; Davidson 1991; Davidson *et al.* 1991). Together they form a significant UK network of breeding sites. The region's estuaries and associated habitats are noted for the diversity (Map 5.11.1) and density of their breeding waterfowl assemblages. In addition to the region's large areas of saltmarsh and coastal wet grassland, habitat for breeding birds is augmented by Orford Ness and Dungeness, two of the largest areas of vegetated shingle in Britain, and Walberswick, which has one of the largest continuous areas of freshwater reedbeds in the country (Pritchard *et al.* 1992). The heathlands of the Suffolk coast and the important lagoonal resource of the region (see section 3.4) offer further habitat variety.

Oystercatcher *Haematopus ostralegus*, redshank *Tringa totanus*, lapwing *Vanellus vanellus* and snipe *Gallinago gallinago* all have major strongholds in this area, and the region holds nationally important numbers of wildfowl such as shoveler *Anas clypeata*, pochard *Aythya ferina*, gadwall *Anas strepera* and teal *Anas crecca*. The highest densities of lapwing in the UK are found in East Anglia and Kent (Davidson *et al.* 1991). The region is the centre of the UK breeding distribution of several rare wetland species, holding nationally important populations of avocet *Recurvirostra avosetta*, bittern *Botaurus stellaris* (although their population is at a critically low level, with only 15-16 calling males in Britain in 1994), nightjar *Caprimulgus europaeus* and marsh harrier *Circus aeruginosus*.

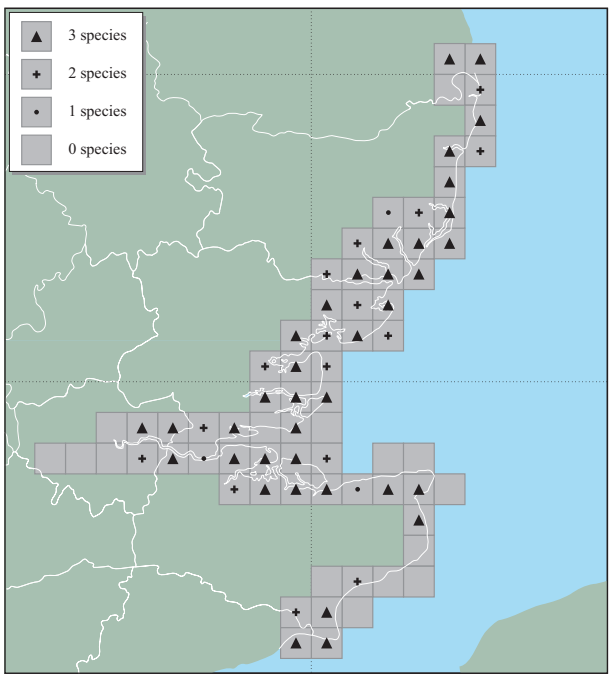
5.11.2 Important locations and species

Densities of selected breeding wader species on a sample of saltmarshes in the north of the region surveyed in 1985 are shown in Table 5.11.1. Saltmarshes on the River Colne hold particularly dense and diverse assemblages of waders. The Suffolk and Essex coast is one of the major areas in Britain for saltmarsh-breeding redshank, Colne Point having particularly high breeding densities, while the Swale has one of the highest densities of wet grassland-breeding redshank (Davidson *et al.* 1991). The saltmarshes and associated coastal wet grasslands of the Thames and Medway Estuaries and the Swale are together of international importance for their breeding waterfowl (Pritchard *et al.* 1992). In this region there are greater numbers and densities of lapwing on coastal grassland than on saltmarsh, the Swale being a major breeding site. Map 5.11.2 shows the incidence of confirmed breeding in coastal 10 km squares of selected species characteristic of wet grassland (teal, lapwing, redshank, mallard *Anas platyrhynchos*, snipe and pintail *Anas acuta*). Garganey *Anas querquedula*, tufted duck *Aythya fuligula*, moorhen *Gallinula chloropus* and coot *Fulica atra* also contribute to the high breeding bird species diversity on wetlands in the region.

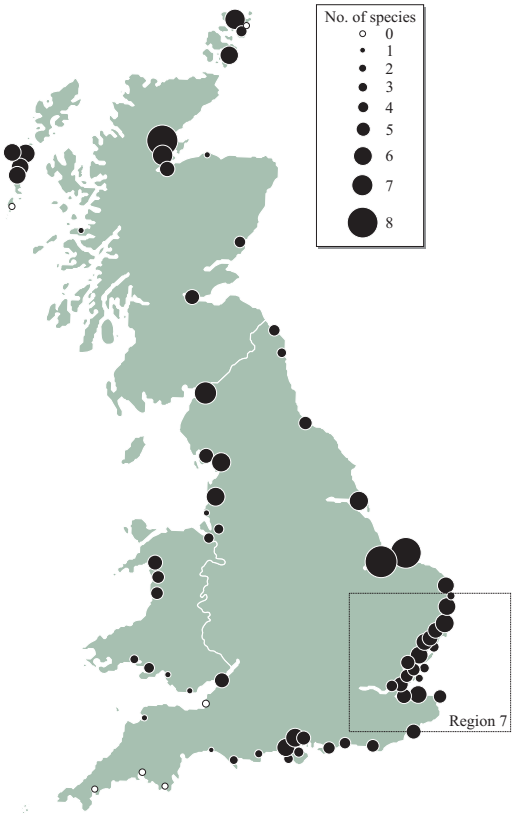
Map 5.11.3 shows the incidence of confirmed breeding in coastal 10 km squares of selected waterfowl species



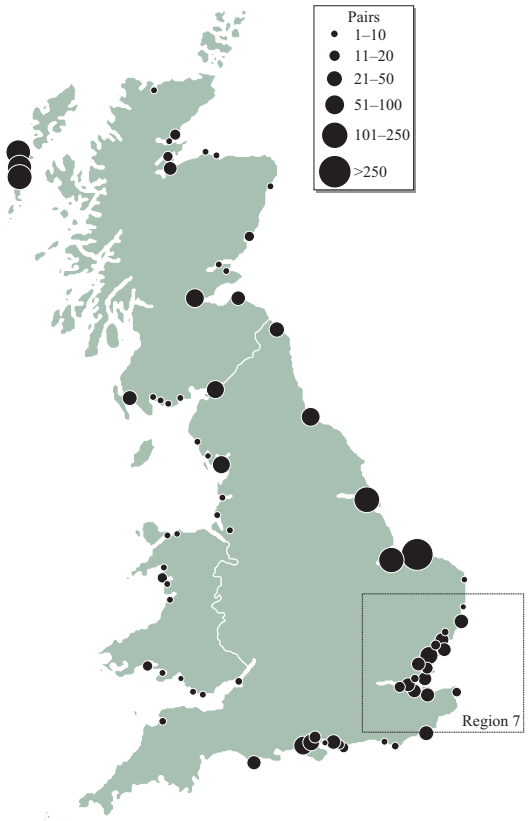
Map 5.11.1 Numbers of different breeding wader species on estuaries in Britain (waders also breed elsewhere along the coast). Source: Davidson *et al.* (1991).



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



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



Map 5.11.4 Numbers of pairs of breeding ringed plover on estuaries in Britain (species also breeds elsewhere along the coast). Source: Davidson *et al.* (1991), from data in Prater (1989).

characteristic of shingle, sand dunes and other dry grassland (ringed plover *Charadrius hiaticula*, oystercatcher and shelduck *Tadorna tadorna*). Breeding ringed plovers nest in sandy areas along the coast (Davidson *et al.* 1991; Prater 1989; Table 5.11.2, Map 5.11.4), especially on the mid-Essex coast, which is a major breeding site in a national context for both this species and oystercatcher.

There are many important breeding areas for shelduck in the region, the Orwell and Thames Estuaries and the Swale having particularly high numbers (Table 5.11.3).

The reedbeds along the Suffolk coast support nationally important numbers of breeding marsh harriers, and bearded tits and nightjars are found on surrounding heathlands.

Many of Britain's remaining breeding bitterns, which have undergone a massive and long-term decline (Everett 1989), are at Minsmere (Pritchard *et al.* 1992). Breeding garganey, redshank and Savi's warbler *Locustella luscinioides* are also notable at this site. Minsmere is noted for its complex range of habitats and has an outstanding diversity of breeding bird species (Pritchard *et al.* 1992): these include nationally important numbers of bittern, gadwall, teal, shoveler, avocet, nightjar, bearded tit *Panurus biarmicus* and marsh harrier. A number of other raptors breed in this region, including hobby *Falco subbuteo*, kestrel *Falco tinnunculus* and sparrowhawk *Accipiter nisus.*

Coastal lagoon systems are of particular importance for

Table 5.11.1 Densities of three breeding wader species on a sample of saltmarshes surveyed in 1985*

Site	*Oystercatcher pairs/km²*	*Ringed plover pairs/km²*	*Redshank peak nests**/km²*	*Total pairs/km² (these 3 species)*
Suffolk				
Deben	11	n/a	78	89
Essex				
Hamford Water	3	10	74	87
Colne Point	5	n/a	102	107
Ray Island	7	3	38	48
Dengie	3	n/a	73	76

Source: Allport *et al.* (1986). Key: *other saltmarshes in the region were not surveyed, so this is not a comprehensive listing; **redshank nest densities approximate to pairs densities; n/a = not available.

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

	Pairs (coastal) counted in survey	*% GB total counted in survey*
Suffolk	176	2.4
Essex	249	3.5
Kent	136	1.9
Region 7	***561***	***7.8***
England	1,984	27.5
GB total	7,207	100

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

the increasing UK population of avocets, which have the centre of their national breeding distribution in East Anglia. Minsmere, Havergate Island (the stronghold), Trimley Marshes on the Orwell and Elmley on the Swale have the main breeding concentrations (Gibbons *et al*. 1993).

5.11.3 Human activities

Many important areas of breeding bird habitat in the region lie within designated sites (for example National Nature Reserves (NNRs), Sites of Special Scientific Interest (SSSIs), Special Protection Areas (SPAs) and Ramsar sites), although the sites were not always chosen principally for their breeding bird interest. Almost all the coastal NNRs in the region (Walberswick, Orfordness - Havergate, Hamford Water, the Colne and Blackwater Estuaries, Dengie, and the Swale) contain habitats important for breeding birds. The RSPB has many reserves along the coast (see section 7.5.2), and there are also many Wildlife Trust Reserves. Management of these specifically for bird populations provides ideal breeding habitat for a number of threatened species, including bittern (Everett 1989) and marsh harrier (Day 1988). The main colonies of avocets are on reserves, where there is protection from human disturbance (Gibbons *et al*. 1993).

Active land management for conservation in many coastal areas in the region has increased populations of breeding waterfowl, for example at Havergate Island NNR, where shallow lagoons have been created to encourage avocets. The management of coastal reedbeds is of key importance for the continued survival of their characteristic bird assemblage, whose needs are outlined by Everett (1989) and Sills (1988). In this region bitterns have been indirectly affected by nutrient enrichment, primarily by phosphates derived from sewage treatment works rather than agricultural pollution (John Sharpe pers. comm.).

In this region any incremental land claim along the soft coasts of estuaries and sand dune systems has the potential to affect breeding waterfowl populations through loss of nesting and feeding habitat, although at important sites SSSI designation can limit such activity. During the breeding season human disturbance, including jet-skis, sailing and increased recreational use, may have significant effects on breeding success (Pienkowski 1992), although for the birds discussed in this section there are few good assessments of the scale of the problem for this region. The appropriate agricultural and other management (e.g. by winter flooding) of wet grassland in the region (see e.g. Coleshaw 1995; Scholey 1995; Thomas *et al.* 1995 and papers in Hötker 1991) is of crucial importance for their wader populations. Likewise, different grazing regimes on saltmarshes can significantly alter the density and nesting success of breeding waders through their effects on vegetation composition and structure (Cadbury *et al.* 1987). Numbers of lowland breeding waders, especially those associated with wet grassland areas and saltmarshes, have been declining, not only nationally but also internationally (Hötker 1991), because of habitat loss or degradation. Sites in the region play an increasingly important role in maintaining their ranges.

Table 5.11.3 Sites holding at least 45 shelduck in 1992

Site name	*Total including non-breeding birds*	*Breeding pairs*
Westwood Marsh - Walberswick NNR	59	14
Blyth Estuary - Walberswick	421	123
Inner Alde Estuary	194	27
Alde Estuary	498	176
Deben Estuary	795	310
Orwell Estuary	1,069	244
Stour Estuary	577	153
Hamford Water	147	30
Colne Estuary	147	22
Old Hall Marshes	284	34
Blackwater Estuary	451	78
Dengie Coast	47	8
Crouch Estuary	185	67
Roach Estuary	65	2
Foulness & Potton Island	208	59
Thames Estuary	1,265	54
Medway Estuary	485	14
Swale Estuary & Emley Marsh	1,105	280
Pegwell Bay/Shellness Point	97	12

Source: WWT (unpubl.).

5.11.4 Information sources used

The most recent and comprehensive overview of the status of breeding birds throughout Britain and Ireland is provided by Gibbons *et al.* (1993). This summarises the results of a national breeding bird census undertaken between 1988 and 1991 and compares distributions at the 10 x 10 km square level with those recorded in the first breeding bird atlas of 1968-1972 (Sharrock 1976). Whilst these data are one of the best sources for comparisons at county, regional or national scales, care should be taken with their use to assess individual sites or 10 km squares. This is because the tetrad coverage of each 10 km square was not always the same, and since the atlas survey period (1988-1991) distributions of some breeding species may have changed. Between- and within-region comparisons of precise distributions and densities based on coastal 10 km squares should be undertaken with caution, as there may be greatly varying amounts of land within each square.

For a number of species, extensive survey work has been undertaken by volunteers. Usually these surveys have been organised as part of wider British surveys (e.g. for ringed plover (Prater 1989) and shelduck (Delany pers. comm.)).

5.11.5 Acknowledgements

Thanks are due especially to D.A. Stroud and D.M. Craddock (JNCC) for their help with information, and to Peter Cranswick and Simon Delany (WWT), Mark Tasker (JNCC), Steve Gilbert (RSPB) and Julian Roughton (Suffolk Wildlife Trust) for their comments on the draft text.

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Self, M., O'Brien, M.C., & Hirons, G. 1994. Hydrological management for waterfowl on RSPB lowland wet grassland reserves. *RSPB Conservation Review, 8:* 45-56.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Breeding bird atlas data and breeding wader data	*Development Unit, The British Trust for Ornithology, Thetford, tel: 01842 750050
Breeding bird surveys; coastal habitat management	*RSPB HQ, Sandy, tel: 01767 680551
Coastal breeding wildfowl data	*Wildfowl & Wetlands Trust, Slimbridge, tel: 01453 890333
Site designations	*English Nature HQ, Peterborough, tel: 01733 455000

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

5.12 Migrant and wintering waterfowl

R.T. May & A.B. Law

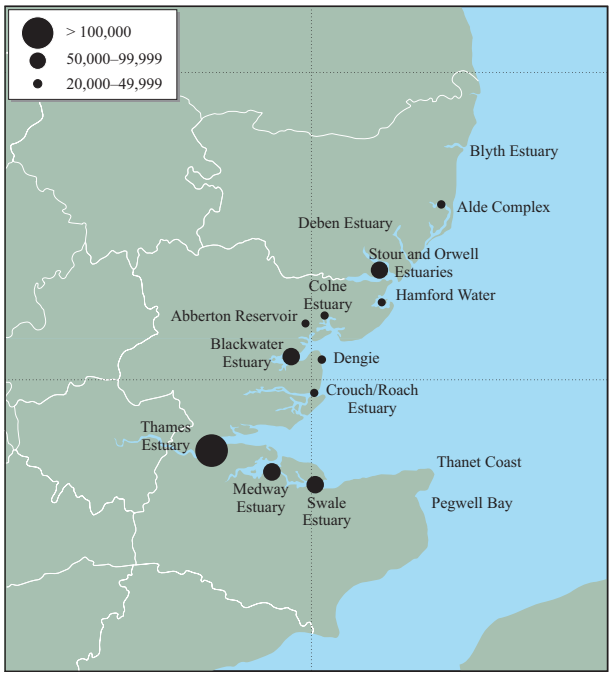
5.12.1 Introduction

This section describes the importance of the region for waterfowl, defined as waders and wildfowl (divers, grebes, ducks, geese and swans together with coot). The importance of offshore areas for wintering divers, grebes, seaducks and cormorant is outlined in section 5.10. Abberton Reservoir is included in this section since it lies very close to coastal habitats and is used by the same birds at different times. Names of species mentioned in the text are given in Table 5.12.1.

The region is of great importance for wintering waterfowl in UK and international contexts and holds, in mid-winter, approximately 388,540 waterfowl - about one quarter of the English total. For several non-breeding waterfowl species, sites within the region are the most important within the UK either in migratory periods or in winter. Table 5.12.2 gives the total January 1993 waterfowl count for this coastal region as a proportion of the coastal total for both England and Great Britain. Such comparisons can give only a rough approximation of relative regional importance, since some areas are better counted than others and the data are uncorrected for coverage.

This region is perhaps the most important in the UK for wintering waterfowl. Thirteen sites (Alde Complex; Deben Estuary; Stour & Orwell Estuaries; Hamford Water; Colne Estuary; Abberton Reservoir; Blackwater Estuary; Dengie; Crouch/Roach Estuary; Thames Estuary; Medway Estuary; Swale Estuaries; and Thanet Coast) are of international importance for their waterfowl populations. As well as supporting more than 1% of the international wintering population of at least one species of waterfowl, all but two of these sites (Deben Estuary and Thanet Coast) qualify as being of international importance by virtue of each holding over 20,000 waterfowl.

Seventeen wintering waterfowl species occur in internationally important numbers on one or more of the estuaries of this region and a further seventeen occur in nationally important numbers. Among the most important are redshank (eight sites are of international importance and one of national importance), dark-bellied brent goose (seven and two sites), grey plover (six and one sites), shelduck (five and five sites), black-tailed godwit (four and six sites), dunlin (four and four sites), ringed plover (four and two sites), avocet (one and six sites) and cormorant (nine sites of national importance).



Map 5.12.1 Distribution of main estuarine concentrations of wintering intertidal waterfowl (note: waterfowl also winter elsewhere on the coast and offshore). Size of circle proportional to 5-year mean of waterfowl numbers. Source: Waters & Cranswick (1993).

Table 5.12.1 Names of species mentioned in the text

Common name	*Scientific name*
Avocet	*Recurvirostra avosetta*
Bar-tailed godwit	*Limosa lapponica*
Black-tailed godwit	*Limosa limosa*
Canada goose	*Branta canadensis*
Coot	*Fulica atra*
Cormorant	*Phalacrocorax carbo*
Curlew	*Numenius arquata*
Dark-bellied brent goose	*Branta bernicla bernicla*
Dunlin	*Calidris alpina*
European white-fronted goose	*Anser albifrons albifrons*
Gadwall	*Anas strepera*
Golden plover	*Pluvialis apricaria*
Goldeneye	*Bucephala clangula*
Great-crested grebe	*Podiceps cristatus*
Greenshank	*Tringa nebularia*
Green sandpiper	*Tringa ochropus*
Grey plover	*Pluvialis squatarola*
Hen harrier	*Circus cyaneus*
Knot	*Calidris canutus*
Lapwing	*Vanellus vanellus*
Little grebe	*Tachybaptus ruficollis*
Merlin	*Falco columbarius*
Mute swan	*Cygnus olor*
Oystercatcher	*Haematopus ostralegus*
Pintail	*Anas acutus*
Pochard	*Aythya ferina*
Redshank	*Tringa totanus*
Ringed plover	*Charadrius hiaticula*
Ruddy duck	*Oxyura jamaicensis*
Ruff	*Philomachus pugnax*
Sanderling	*Calidris alba*
Shelduck	*Tadorna tadorna*
Short-eared owl	*Asio flammeus*
Shoveler	*Anas clypeata*
Slavonian grebe	*Podiceps auritus*
Spotted redshank	*Tringa erythropus*
Teal	*Anas crecca*
Tufted duck	*Aythya fuligula*
Turnstone	*Arenaria interpres*
Whimbrel	*Numenius phaeopus*
Wigeon	*Anas penelope*

The region's estuaries provide one of the most important complexes of habitats for wildfowl in north-west Europe (Owen *et al*. 1986). The main estuarine concentrations of wintering waterfowl are shown on Map 5.12.1. The large areas of mudflats and saltmarsh in the region, such as those on the Essex and north Kent coasts, are important feeding grounds for many wintering waterfowl. Dark-bellied brent goose is the most abundant species of wildfowl on estuaries in the region and dunlin is the most abundant estuarine wader species (Figure 5.12.1).

The non-estuarine shores of the region do not provide such rich and diverse feeding habitats as the estuaries and have, in general, only a moderate density of waders in a UK context, although a relatively high density in the English context, particularly in Kent (Table 5.12.3) (Moser & Summers 1987). On the open coast of the region the golden plover is the most common wader species, followed by oystercatcher, grey plover, knot and turnstone (Figure 5.12.1) (Moser & Summers 1987).

This coastline is of major importance for migrant waterfowl in spring and autumn. The region lies on the principal migratory flyway of the east Atlantic, and many birds moving to and from wintering areas on the African, Mediterranean and south-west European coasts to northern and arctic breeding grounds pass through and stage here. The region is of considerable significance during spring and autumn migration periods for dunlin, knot, spotted redshank and greenshank, amongst others.

The region can increase in importance during periods of severe cold weather further east in continental Europe. Under these conditions, there may be influxes of waterfowl from continental Europe and other UK coastal regions or inland areas (Ridgill & Fox 1990), as shown by the major influxes of dunlin to the Orwell, coincident with the onset of severe weather in continental Europe (Davidson & Evans 1985). Some sites act as local cold weather refuges, as parts of the estuarine system freeze more slowly than other coastal and inland wetlands and so can provide open-water feeding when other sites are unavailable (Owen *et al.* 1986).

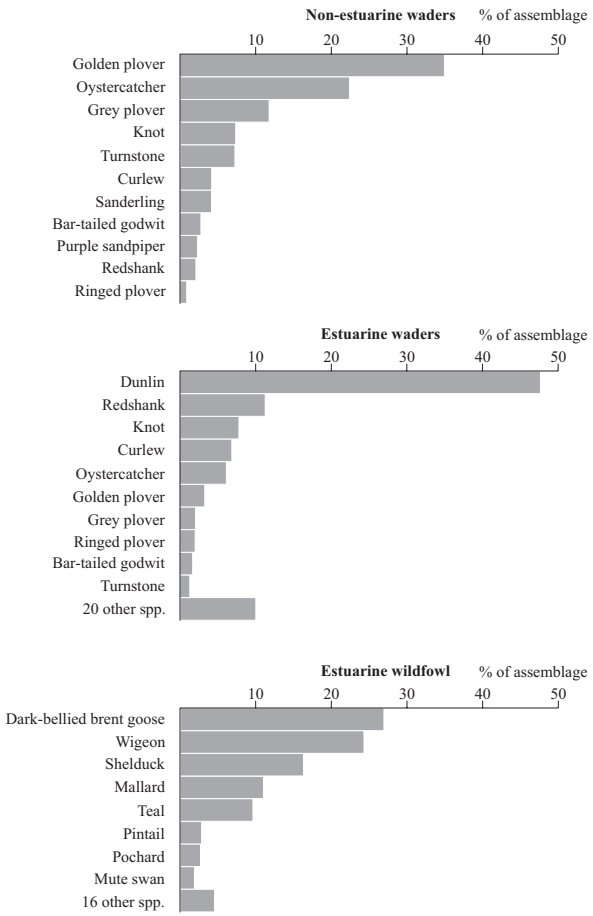


Figure 5.12.1 Relative species composition of non-breeding waterfowl assemblages on coastal areas of the region. Source: estuarine waterfowl data from Prater (1981), non-estuarine wader data from Moser & Summers (1987).

5.12.2 Important locations and species

Wintering waterfowl assemblages occurring in the region are determined by habitat characteristics. Sites with extensive areas of saltmarsh or wet grassland in close proximity to intertidal areas, such as the Thames Estuary, Medway Estuary and the mid-Essex coast (Blackwater, Colne, Crouch/Roach, Dengie and Foulness), typically have large populations of dark-bellied brent geese and shelduck (Mitchell *et al*. 1994). Such areas are also attractive to grey plover, black-tailed godwit, dunlin and knot, as well as to many other waterfowl, as they provide a wide range of feeding and roosting opportunities. Sandier estuaries and embayments hold very large numbers of knot, oystercatcher and curlew.

Ringing studies have shown that many species (e.g. dunlin and, on non-estuarine shores, grey plover) demonstrate complex patterns of interchange between sites during the course of a winter, which means that individual sites cannot be considered in isolation (Davidson *et al*. 1991). There are a number of specific examples of this, such as the movement of oystercatchers that feed on the Stour Estuary to roosts on the Orwell Estuary (Davidson & Evans 1985). Dark-bellied brent geese congregate in autumn on the tidal flats of Maplin Sands and Southend-on-Sea before dispersing to over-winter on sites throughout southern and eastern England (Davidson *et al.* 1991). Table 5.12.4 shows the numbers of wintering waterfowl on monitored sites in the region.

Table 5.12.2 Waterfowl counts for the region, England and Great Britain in January 1993

	Total waterfowl count in January 1993	*No. of sites counted*	*% of count in Region 7*
Coastal sites in Region 7	***388,540***	***23***	**-**
All counted English coastal sites	1,577,388	106	24.6
All counted British coastal sites	2,060,961	214	18.9

Source: Rose & Taylor (1993). Care should be taken in interpretation as count coverage varies from county to county and the data have not been corrected.

Table 5.12.3 Overall densities of wintering waders on non-cliff, non-estuarine coasts

	No. of wader species recorded	*Total no. of non-estuarine waders*	*Extent of non-cliff, non-estuarine coast in county (km)*	*Extent of coast surveyed (km)*	*Overall wader density (birds/km survyed coast)*
Suffolk	11	969	25.6	20.4	47.5
Essex	6	63	71.2	64.4	1
Kent	11	9,839	120.2	111.2	88.5

Source: Winter Shorebird Count - Moser & Summers (1987).

The Thames supports the fifth largest total of wintering waterfowl of any estuary in the UK, with an average winter peak of nearly 153,000 birds (Waters *et al.* 1996). It holds ten species at internationally important levels and a further twelve at nationally important levels. The Thames represents the most important area in this region in terms of waterfowl diversity and contributes to the importance of other areas, for example by providing a roosting area for wigeon that travel to feed in the Blackwater Estuary. The other estuaries that hold more than 50,000 birds are the Stour and Orwell, the Blackwater, the Medway and the Swale. The Stour Estuary is the British stronghold of wintering black-tailed godwits (Davidson *et al*. 1991), with an average winter peak of 1,859 (Cranswick *et al.* 1995). The Medway Estuary and marsh areas are important for wintering merlin, hen harrier and short-eared owl. Abberton Reservoir is an important roosting and feeding area (Owen *et al*. 1986), and also holds important moulting concentrations of mute swan, gadwall, shoveler, pochard and tufted duck (Pritchard *et al*. 1992). Hamford Water, the mid-Essex coast, the Swale and the Medway Estuary support important numbers of passage waterfowl, such as spotted redshank, greenshank, curlew, green sandpiper, whimbrel, oystercatcher, ringed plover, grey plover, dunlin, black-tailed godwit, redshank and ruff (Pritchard *et al.* 1992).

5.12.3 Human activities

Incremental land claim, including for barrage schemes, has the potential to affect waterfowl populations through loss of feeding habitat (Goss-Custard 1977; Goss-Custard & Yates 1992), although at important sites SSSI designation provides a planning control mechanism that can be used to limit such activity. Many parts of the region's coast lie within designated sites (for example National Nature Reserves and Sites of Special Scientific Interest) (see Chapter 7), many of which were selected wholly or partly for their migrant and wintering waterfowl interest. Internationally important sites include several Ramsar sites and Special Protection Areas important for wintering waterfowl. The RSPB has several reserves along the coast and on marshes associated with the coast and tidal rivers, as do local Wildlife Trusts. An Area of Special Protection (Havergate Island) is also found within this region.

Wintering waterfowl are potentially affected, either directly or indirectly, by a wide range of human activities. For example, the importance of saltmarsh and wet grassland for wintering waterfowl can be greatly increased by appropriate management. Wildfowling is practised across the UK and especially in estuaries and is a potential cause of disturbance to waterfowl, although it is generally well regulated (see also section 9.7). The impacts and regulation of wildfowling on National Nature Reserves (NNRs) have been reviewed by Owen (1992). There is generally close liaison in the regulation of wildfowling between local shooting clubs, the British Association for Shooting and Conservation (BASC) and English Nature local staff. Owen (1992) made a number of recommendations for improving the operation of existing schemes to regulate shooting on NNRs.

Bait-digging and shellfish collection from intertidal sediments, as well as recreational activities such as jet-skiing, which are more intensive in the heavily populated parts of the region, are potentially disruptive and can prevent waterfowl using feeding areas. The significance of these activities varies not only from site to site (in relation to the intensity of the activity and the size/topography of the site) but also according to the time of year (Davidson & Rothwell (1993) and papers therein). Disturbance can be a particular problem if it occurs in cold periods, when wintering waterfowl need to feed almost continuously in order to survive.

Other human activities to be noted include the loss of wet grassland through agricultural change and conversion to arable land or landfill, as at Benfleet and Southend Marshes. Since 1930, 64% of wet grassland in the Greater Thames was lost owing to agricultural change and development (Ekins 1990). Human population pressure is a constant threat in the Greater Thames area, through development and recreation (Clarke *et al*. 1991). Oil pollution is well known as a serious potential threat to wintering waterfowl in areas where high densities of birds occur. Oil pollution affected many waterfowl in the Medway Estuary in the 1970s (Davidson *et al*. 1991). Coastal windfarm developments in sensitive areas also have the potential to be highly disruptive to wintering waterfowl (Crockford 1992).

5.12.4 Information sources used

As with other areas of the UK, migrant and wintering waterfowl are well surveyed by the Wetland Bird Survey (WeBS - organised by the British Trust for Ornithology, The Wildfowl & Wetlands Trust, the Royal Society for the Protection of Birds and the Joint Nature Conservation Committee). This volunteer-based survey collates monthly counts from coastal and inland wetlands through the UK. Coastal coverage is generally good for estuaries, although the open coast is not thoroughly surveyed on an annual basis (Waters & Cranswick 1993). The WeBS count scheme publishes an extensive annual summary report of species trends, based on counts at wetlands throughout the UK. It also tabulates counts of total waterfowl numbers at all counted estuaries, as well as inland sites. It is the primary source of information on wintering and migrant waterfowl in the UK. Copies are available from either of the WeBS National

Table 5.12.4 Wintering waterfowl numbers on monitored sites in the region

Site	*Conservation status*[+]	*Five year means nos wintering waterfowl*	*1994/95 peak total waterfowl nos*	*1994/95 peak wildfowl nos*	*1994/95 peak wader nos*	*Species occurring at levels of national or international* importance*
Blyth Estuary		10,591	14,044	2,895	11,149	Avocet, black-tailed godwit
Alde complex (includes Orfordness - Havergate)	SPA & Ramsar	**23,751	27,455	11,787	15,668	Avocet*, redshank*, shelduck, wigeon, teal, lapwing, Canada goose, black-tailed godwit
Deben Estuary	SPA & Ramsar	15,731	15,985	6,105	9,880	Redshank*, dark-bellied brent goose, shelduck, avocet, little grebe, black-tailed godwit
†Stour & Orwell Estuaries	SPA & Ramsar	**59,845	65,015	16,872	48,143	Grey plover*, dunlin*, black-tailed godwit*, redshank*, dark-bellied brent goose*, ringed plover*, turnstone*, shelduck*, wigeon*, pintail*, great crested grebe, cormorant, green sandpiper, golden plover, curlew, knot, goldeneye
Hamford Water	SPA & Ramsar	**39,058	41,565	13,511	28,054	Dark-bellied brent goose*, ringed plover*, grey plover*, black-tailed godwit*, shelduck, avocet, redshank, dunlin, little grebe, golden plover
Colne Estuary	SPA & Ramsar	**37,564	42,969	7,733	35,236	Dark-bellied brent goose*, redshank*, great crested grebe, cormorant, mute swan, shelduck, goldeneye, grey plover, lapwing, dunlin, black-tailed godwit, ringed plover
Abberton Reservoir	SPA & Ramsar	**39,344	46,900	32,267	14,633	Gadwall*, teal*, shoveler*, great crested grebe, cormorant, mute swan, pintail, pochard, tufted duck, goldeneye, coot, Canada goose, ruddy duck
Blackwater Estuary	SPA & Ramsar	**74,980	78,832	24,377	54,455	Dark-bellied brent goose*, shelduck*, grey plover*, redshank*, dunlin*, black-tailed godwit*, cormorant, teal, goldeneye, ringed plover, golden plover, lapwing, pintail, curlew, Slavonian grebe
Dengie	SPA & Ramsar	**31,826	33,338	3,053	30,285	Grey plover*, knot*, bar-tailed godwit*, great crested grebe, cormorant, dark-bellied brent goose, dunlin
Crouch/Roach Estuary	SPA & Ramsar	**27,021	24,486	9,391	15,095	Dark-bellied brent goose*, lapwing, shelduck, shoveler
Thames Estuary	SPA & Ramsar (part)	**152,696	163,600	33,065	130,535	Dark-bellied brent goose*, shelduck*, oystercatcher*, ringed plover*, grey plover*, knot*, dunlin*, bar-tailed godwit*, redshank*, turnstone*, cormorant, European white-fronted goose, gadwall, teal, shoveler, avocet, golden plover, lapwing, sanderling, curlew, little grebe, black-tailed godwit
Medway Estuary	SPA & Ramsar	**69,918	66,284	15,757	50,527	Dark-bellied brent goose*, shelduck*, ringed plover*, dunlin*, redshank*, great crested grebe, cormorant, wigeon, teal, shoveler, avocet, black-tailed godwit, curlew, little grebe, turnstone
Swale Estuary	SPA & Ramsar	**67,985	85,743	32,251	53,492	Wigeon*, grey plover*, knot*, black-tailed godwit*, redshank*, shelduck*, pintail*, cormorant, European white-fronted goose, teal, shoveler, avocet, golden plover, lapwing, dunlin, little grebe, curlew
Thanet Coast	SPA & Ramsar	9,749	12,681	2,740	9,941	Turnstone*, sanderling, great crested grebe, cormorant
Pegwell Bay		7,464	7,511	1,619	5,892	

Sources: WeBs data from Waters *et al.* (1996) and Cranswick *et al.* (1995); †WeBs data for Stour and Orwell obtained through WWT and BTO. Key: [+]international protection status follows Pritchard *et al.* (1992); *species occurring at levels of international importance; **internationally important site by virtue of holding at least 20,000 waterfowl; SPA = Special Protection Area; Ramsar = site classified as internationally important under the Ramsar Convention. Note: the winter season used by WeBS is November to March for waders and September to March for wildfowl.

Organisers listed in section 5.12.6. The annual report can only summarise what are very detailed data, and in summary form such counts may be subject to misinterpretation for a number of reasons. Detailed count data for sites can be provided by WeBS, and inspection of these data is recommended for any planning-related activity. WeBS counts are generally undertaken at high tide, when waterfowl gather in high densities on traditional roosting areas. To complement this information, at selected estuaries WeBS organises low-tide counts to give information on the feeding distributions of waterfowl during the intertidal period. Sites in the region for which such information is already available include the Orwell, Colne and Blackwater Estuaries and Pegwell Bay.

The whole UK coastline was surveyed for wintering waders during the Winter Shorebird Count of 1984/85 (Moser & Summers 1987) and and again in 1995/6 (Moser & Summers 1997). Information on the wintering waterfowl of non-estuarine shores is important for placing annual estuaries counts in a wider perspective.

There have been a number of more detailed studies of the wintering waterfowl of this region. Beardall *et al*. (1988) studied the Suffolk estuaries; Henderson (1986) studied shorebirds in north-east Kent; Ecosurveys have carried out winter waterfowl feeding area studies (Gibbs 1993a-e) on the Stour, Colne, Orwell and Deben Estuaries and Hamford Water; and the Blackwater Project (Maldon District Council 1995) has information on waterfowl and contains further references.

Although now becoming slightly dated, Owen *et al.* (1986) give a thorough and comprehensive account of the wildfowl and wetlands of the region, summarising data available up to the mid-1980s. The volume is an invaluable source of initial information on sites and species, although this should now be supplemented by more recent count information available from WeBS and Davidson *et al.* (1991). Prater (1981) gives useful descriptive accounts of the birds of British estuaries, as well as placing these in a wider national and international context, using data from the period 1969-1975. As in Owen *et al.* (1986), much of the numerical information is dated and the site accounts should be supplemented by the more recent reviews of Davidson *et al.* (1991).

For sites of international importance (either proposed or designated), *Important bird areas in the UK,* jointly published by RSPB and the country nature conservation agencies (Pritchard *et al.* 1992), provides further information. Data on the important bird populations of each site are summarised, together with information on location and habitats.

5.12.5 Acknowledgements

We would like to thank D.A. Stroud and D.M. Craddock (JNCC), Peter Cranswick (WWT) and Julian Roughton (Suffolk Wildlife Trust) for their useful comments on the draft text.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
High tide and low tide counts of wintering and migrant wildfowl (WeBS)	*WeBS National Organiser (Wildfowl), The Wildfowl & Wetlands Trust, Slimbridge, tel: 01453 890333
High tide counts of wintering and migrant waders (WeBS)	*WeBS National Organiser (Waders), The British Trust for Ornithology, Thetford, tel: 01842 750050
Low tide counts of wintering and migrant waders (WeBS)	*WeBS National Organiser (Low Tide Counts), The British Trust for Ornithology, Thetford, tel: 01842 750050
Site designations	*Designations Team, English Nature HQ, Peterborough, tel: 01733 455000
Birds in Essex and Suffolk	*RSPB East Anglia Office, Norwich, tel: 01603 660066
Birds in Greater London and Kent	*RSPB South-East England Office, Shoreham-by-Sea, tel: 01273 463642

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

The delightful common dormouse is a declining and locally endangered species in the UK. In this region isolated populations of dormice persist in small woodlands near the coast of Essex, and the Kent woods are a stronghold for the species. Photo: © John Robinson.

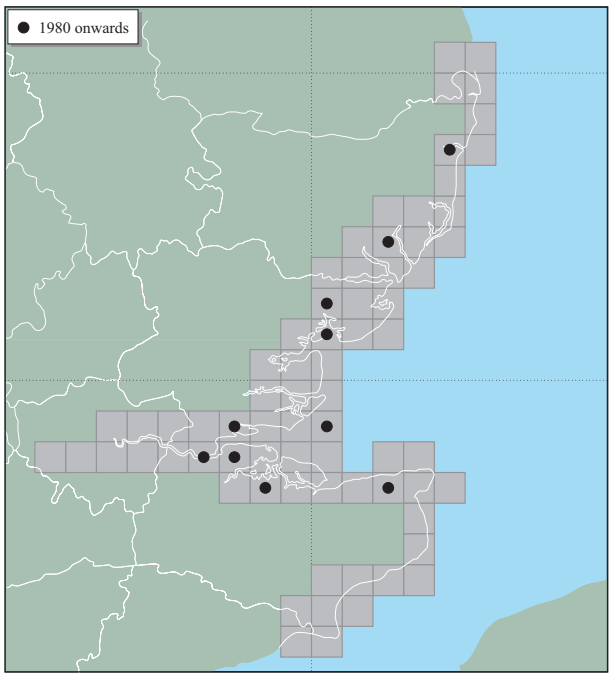
5.13 Land mammals

Dr C.E. Turtle & K.D. Meakin

5.13.1 Introduction

This section covers land mammals that occur in the coastal 10 km squares within the region, concentrating on those that are truly coastal, such as otters *Lutra lutra*, and those that occur on the coast for reasons of shelter and foraging, such as some bats. Other mammals - common and widespread throughout Britain, feral or recently introduced - have not been considered.

The region is important for some of the nationally important mammal species, most of which are vulnerable and declining (Morris 1993). Seven of the fourteen species of British bat are recorded for this region (Arnold 1993), of which the serotine bat *Eptesicus serotinus* is the most important, owing to its scarcity in Britain and its south-easterly distribution. All species of bat are protected under Schedule 5 of the Wildlife & Countryside Act 1981 and under Schedule 2 of the Conservation (Natural Habitats etc.) Regulations 1994. Other protected species recorded from the region include the dormouse *Muscardinus avellanarius* and the otter. All British bats are listed under Appendix II of the Bern Convention, whereas the dormouse is listed under Appendix III. Table 5.13.1 summarises the distribution of protected species in the region.



Map 5.13.1 Recorded distribution of the serotine bat by coastal 10 km square. Records from 1980 - 1992. Source: Arnold (1993).

Table 5.13.1 Recorded distribution of protected species

Protected species	*Estimate of occurrence in region*
Natterer's bat *Myotis nattereri*	Occasional
Daubenton's bat *M. daubentonii*	Occasional
Serotine bat *Eptesicus serotinus*	Frequent
Noctule bat *Nyctalus noctula*	Occasional
Pipistrelle bat *Pipistrellus pipistrellus*	Common
Barbastelle bat *Barbastella barbastellus*	Rare Suffolk & Essex, absent elsewhere
Brown long-eared bat *Plecotus auritus*	Frequent Suffolk & Kent, Essex occasional
Dormouse *Muscardinus avellanarius*	Occasional Kent & Essex, south Suffolk
Otter *Lutra lutra*	Occasional Suffolk coast, rare elsewhere

Source: Arnold (1993)

5.13.2 Important locations and species

The otter is the terrestrial mammal that uses the coast most frequently. During the 1984-86 otter survey of England, two sites on the River Minsmere were found to have positive records following releases of otters there (Jefferies & Hanson 1988; Strachan *et al.* 1990). There have since been at least three generations of otters, which have spread north along the coast as far as Southwold and south as far as Aldeburgh (Miller pers. comm.). There have been a number of unconfirmed sightings of otters along the Essex coast around the high waters of the Colne and Blackwater Estuaries and the Stour (Bridges pers. comm.). No evidence of otters was found in Essex during the 1984-86 otter survey of England (Strachan *et al.* 1990), although suitable habitat was identified along the Colne and Blackwater. There have been three records of otters on the Kent coast since 1975 (Arnold 1993), but it is very unlikely that otters are still present (Waite pers. comm.). The 1984-86 otter survey of England (Strachan *et al.* 1990) found evidence of a small but wide-ranging population of otters on the middle reaches of the River Medway, and it seems likely that reports of otters on the Thames Estuary are of transient otters from the Medway Estuary (Strachan *et al.* 1990.)

The serotine bat is a vulnerable species in Britain (Stebbings 1988). It feeds mainly on large insects in open, sheltered urban and park land areas. It is heavily dependent on buildings (Stebbings & Griffith 1986) and there are widespread records from the region's coastal towns, reflecting its strongly south-easterly distribution in Britain (Arnold 1993). Its recorded distribution in coastal 10 km squares in the region between 1980 and 1992 is shown on Map 5.13.1.

The national bat habitat survey (Walsh & Harris 1996) shows that bats utilise the coast for foraging where there is suitable habitat. Noctule bats and pipistrelles have been observed feeding over coastal marshes in Suffolk (Miller pers. comm.). Coastal foraging territory for bats has been enhanced in some areas by the creation of 'borrow dykes' during the construction of sea defences, especially where these water-filled channels are well sheltered and connected by tree and hedge cover (Dobson pers. comm.). Historic military coastal defences may provide important roost sites for a number of bat species. Small numbers of bats are known to roost in undisturbed parts of Dover Castle (Thompson pers. comm.).

In Britain the dormouse is on the western edge of its range in Europe (Corbet & Harris 1991) and is classified as vulnerable and locally endangered (Morris 1993). Dormice are associated with ancient semi-natural woodland and edge habitats such as broadleaved trees on the edge of forestry plantations or mature, diverse hedgerows and scrub. Isolated areas of suitable habitat are unlikely to hold viable populations if they are less than 20 ha in extent (Bright *et al.* 1994). Isolated populations of dormice persist near the coast of Essex in small woodlands such as those of the Malden - Danbury complex (Bridges pers. comm.). Kent is a stronghold for dormice, although records tend not to be coastal: they occur throughout the Blean and Thornden woodlands, about 4 km inland (Thompson pers. comm.).

5.13.3 Human activities

Large areas of Essex and Suffolk are intensively farmed and much of the traditional coastal wet grassland has been turned over to arable farming. The consequent loss of hedgerows results in habitat fragmentation, which affects bats and dormice. Changes to sea walls as a result of rising sea levels and coastal erosion may lead to the removal or alteration of borrow dykes in some areas, making them less suitable as foraging sites for bats (Gibson pers. comm.).

The water quality of much of the region is fair to poor (NRA 1994), largely a result of agricultural run-off and sewage effluent. Together with disturbance from recreational activities, this may have contributed to the decline of the otter in the region and its failure to recolonise (Miller pers. comm.).

Some areas of the coast, especially around the Thames Estuary, are under heavy pressure from urban and industrial expansion. Away from the industrialised areas, the high population density puts the coast under increasing pressure from recreation (Bridges pers. comm.), with water-borne activities having the biggest impact on wildlife (Gibson pers. comm.). Opening up old buildings to visitors may deter bats from using them as roost sites, as has happened at Dover Castle (Thompson pers. comm.).

5.13.4 Information sources used

There are no reliable estimates of the numbers of mammals in the region that could be used to assess the relative importance of the region in national terms. Using data from Arnold (1993) (although these records are incidental rather than systematic), an estimate has been made of the frequency of their occurrence in the region. As a general observation, mammal surveys are not recorded with the same intensity as botanical ones and the occurrence of mammals within 10 km squares is not enough to establish the status of species (Morris 1993).

There have been no specifically coastal mammal surveys within this region, and even comprehensive national surveys have their limitations when assessing the importance of the coast. There have been no comprehensive surveys for any of the bats, although there are records for those species listed in Table 5.13.1. Information from English Nature's Bat Sites Register may confirm further records.

5.13.5 Acknowledgements

Thanks are due to all those people mentioned in the text for contributing information and time.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
National site and species information	*Mammal Ecologist, English Nature HQ, Peterborough, tel: 01733 455000
Local site and species information	*Chris Gibson, English Nature, Colchester, tel: 01206 796666
Mammal sites in Essex	*Duncan Bridges, Essex Wildlife Trust, Fingringhoe, tel: 01206 729298
Mammal sites in Suffolk, Suffolk Bat Group	*Alan Miller, Suffolk Wildlife Trust, Ashbocking, tel: 01473 890089
Mammal sites in Kent	*Anne Waite, Kent Trust for Nature Conservation, Maidstone, tel: 01622 662012
Bats in Essex	John Dobson, Essex Bat Group, 16 The Westerlings, Bicknacre, Danbury CM3 4ND, tel: 01245 224408
Bats in Kent	Shirley Thompson, Kent Bat Group, 5 Manor Road, Whitstable, Kent CT5 2JT, tel: 01227 275439
Otters	The Otter Trust, Earsham, nr. Bungay, Suffolk NR35 2AF, tel: 01986 893470
General mammal information	The Mammal Society, Unit 15, Cloisters House, Cloisters Business Centre, 8 Battersea Park Road, London SW8 4BG, tel: 0171 498 4358
Biological Records Centre: records of mammal distributions	*ITE Monks Wood, Huntingdon, tel: 01487 773381

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

5.14 Seals

C. D. Duck

5.14.1 Introduction

Common (or harbour) seals *Phoca vitulina* are sparsely distributed through the region, which held approximately 0.3% of common seals counted in Great Britain in August 1995 (Table 5.14.1). Although grey seals *Halichoerus grypus* do not regularly breed or haul-out in the region, very small numbers are occasionally seen. The closest regular haul-out site is on Scroby Sands in Norfolk (Region 6).

5.14.2 Important locations

The biggest group of common seals in this region can be found on Foulness Sands and Buxey Sands at the mouth of the River Crouch. Smaller groups occur in Hamford Water, Pyefleet Channel and on sandbanks off Herne Bay and Margate (Map 5.14.1; Table 5.14.2). Occasionally seals can be seen in the Thames Estuary on the Isle of Grain off Allhallows-on-Sea, in the mouths of the Medway and Swale Estuaries and at the mouth of the River Stour in Sandwich Bay.

5.14.3 Human activities

Seal-watching cruises operate in the Rivers Crouch and Roach and out of Herne Bay during the summer months. The seals on Foulness and Buxey Sands are subject to disturbance from small recreational boats, particularly during summer weekends. Seals off Herne Bay and Margate suffer similar disturbance, primarily from jet-skis. Seals in the vicinity of the Ministry of Defence Ranges at Foulness and off Shoeburyness are afforded some protection during the week, when ranges are operational.

5.14.4 Information sources used

The data presented here were obtained during an aerial survey of the region carried out by the Sea Mammal Research Unit (SMRU) in August 1995. These surveys form part of the Natural Environment Research Council's statutory obligation under the Conservation of Seals Act 1970, to provide the Home Office and Scottish Office with information and advice on UK seal populations. Additional observations were provided by seal cruise operators, local fishermen and naturalists, and staff from local nature reserves, English Nature and the Marine Conservation Society.

5.14.5 Acknowledgements

Thanks are due to Brian Dawson, Brett Lewis and Trevor Taylor (tour boat operators), Ian Black, Sandy Toy and Teresa Bennett (English Nature), Graeme Smith (University of Greenwich), Fred Booth (Kent Marine Group), John McAllister (Kent Trust for Nature Conservation) and Steve Clark for

Map 5.14.1 Distribution of common seals in the region in August. Area of circle is proportional to the number of seals at each location (Table 5.14.2). Source: Sea Mammal Research Unit.

Table 5.14.1 Numbers of common seals breeding in the region in relation to the rest of GB

	Common seals	
	No. of seals	*% of GB total*
Suffolk	0	0
Essex	78	0.3
Kent	10	<0.1
Region 7	***88***	***0.3***
England	1,900	6.7
GB total	28,350	100

Source: Sea Mammal Research Unit (SMRU)

Table 5.14.2 Common seal numbers in areas regularly surveyed

Area surveyed	*Grid ref.*	*No. of seals*	*% of region total*
Hamford Water	TM234258	12	13.5
Pyefleet Channel	TM035165	3	3.4
Foulness Sands	TR075985	40	44.9
East Barrow	TR180925	23	25.8
Isle of Grain	TQ900770	1	1.1
South Shingles	TR240750	2	2.2
Margate Hook	TR261723	8	9.0

Source: SMRU; August 1995.

providing information and for commenting on an earlier draft. Special thanks go to Kim Hudson for information on the Foulness seals and comments on the manuscript and for assisting during the 1995 aerial survey.

5.14.6 Further sources of information

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McGillivray, D. 1995. Seal conservation legislation in the UK: past, present and future. *International Journal of Marine and Coastal Law, 10*: 19-52.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Seal numbers and distribution around the UK	Callan Duck, Sea Mammal Research Unit, Gatty Marine Laboratory, University of St. Andrews, Fife KY16 8LB, tel: 01334 476161
Seals in Essex	*Essex Wildlife Trust, Colchester, tel: 01206 729678
Seals in Essex	*English Nature, Essex, Hertfordshire and London Team, Colchester, tel: 01206 796666
Seal sightings, Suffolk	*Suffolk Wildlife Trust, Ashbocking, tel: 01473 890089
Seals in Kent	*English Nature, Kent Team, Wye, tel: 01233 812525
Seals in Kent	*Kent Trust for Nature Conservation, Maidstone, tel: 01622 662012
Licences to kill seals	E Division, Home Office, Queen Anne's Gate, London SW1H 9AT, tel: 0171 273 3000

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

5.15 Whales, dolphins and porpoises

Dr P.G.H. Evans

5.15.1 Introduction

The cetacean fauna (whales, dolphins and porpoises) of the southernmost North Sea is relatively poor, both in numbers of animals and diversity of species. Since 1980, thirteen species of cetacean have been recorded along the coasts of the region or in its nearshore waters (within 60 km of the coast), and six of these are known only from strandings. Only two species (out of a UK total of 27) are either present throughout the year or recorded annually as seasonal visitors to the region, and another two species occur on a more casual basis. No species is abundant, the most frequently observed in nearshore waters being the harbour porpoise *Phocoena phocoena* and bottlenose dolphin *Tursiops truncatus*, both of which are nevertheless rare in the region. Offshore, long-finned pilot whale *Globicephala melas* is recorded annually and the common dolphin *Delphinus delphis* occurs occasionally.

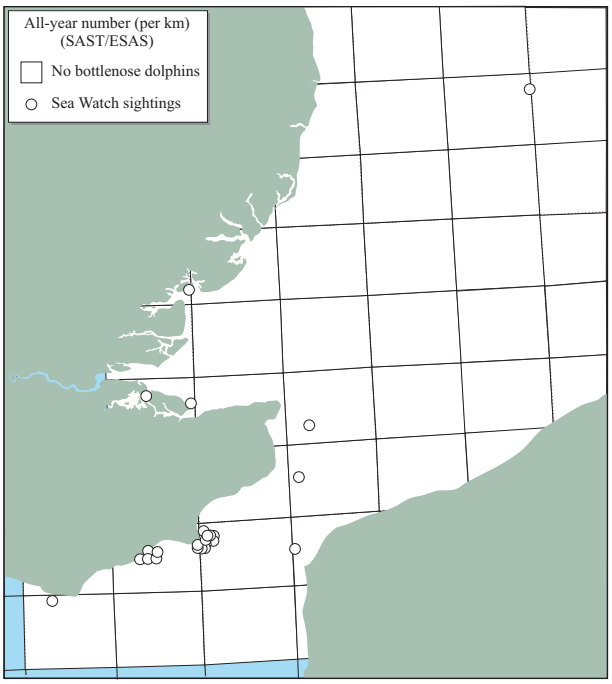
The harbour porpoise and bottlenose dolphin are listed in Annex II of the EC Habitats & Species Directive as species whose conservation requires the designation of Special Areas of Conservation.

5.15.2 Important locations and species

The occurrence of cetacean species regularly recorded in the region is summarised in Table 5.15.1.

The distribution of bottlenose dolphin, pilot whale and harbour porpoise is shown on Maps 5.15.1, 5.15.2 and 5.15.3 respectively. The coastline of the region has few, generally low-lying, promontories, affording little opportunity for observing cetaceans, except when they come close inshore. Dungeness, on the Kent coast, is the most prominent headland and most cetacean records obtained from the coast come from the bird observatory there. Offshore, the relativly uniform and shallow sea bed of the eastern English Channel and southernmost North Sea probably lagely accounts for the low cetacean diversity in the region and the absence of specific favoured locations (Evans 1990a).

Bottlenose dolphins have been reported near the shore in most months, but particularly between April and August. Harbour porpoises are also reported occasionally, mainly between May and October, with no particular location favoured. The Thames Estuary was once used frequently by harbour porpoises but now receives only isolated visits from vagrants that are either stranded or washed ashore dead.



Map 5.15.1 Bottlenose dolphins: all-year number sighted per kilometre of Seabirds at Sea survey (source: JNCC: SAST/ESAS); and sightings reported to the Sea Watch sighting system. Source: Evans (1992).

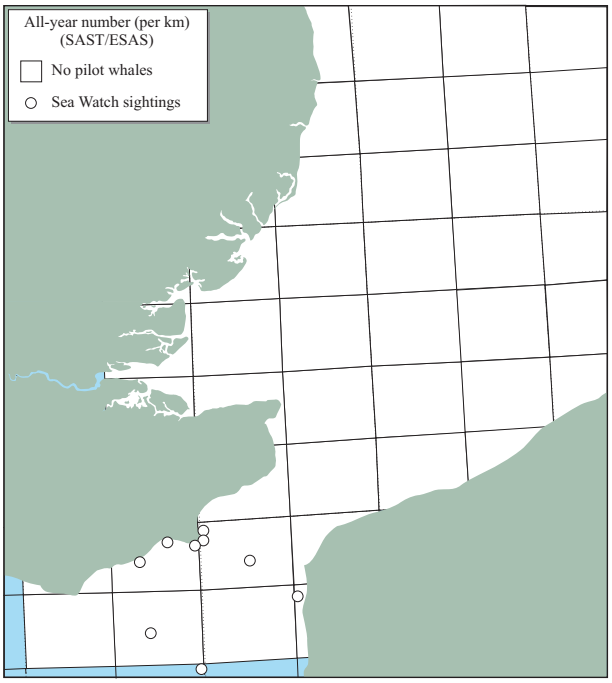
Offshore in the eastern English Channel, long-finned pilot whale and common dolphin are the most frequently recorded species, though both are nevertheless rare in the region. They range widely, and no specific location is favoured. In the southernmost North Sea white-beaked dolphins occur rarely, mainly in the north-eastern portion of the region towards the Dutch coast.

5.15.3 Human activities

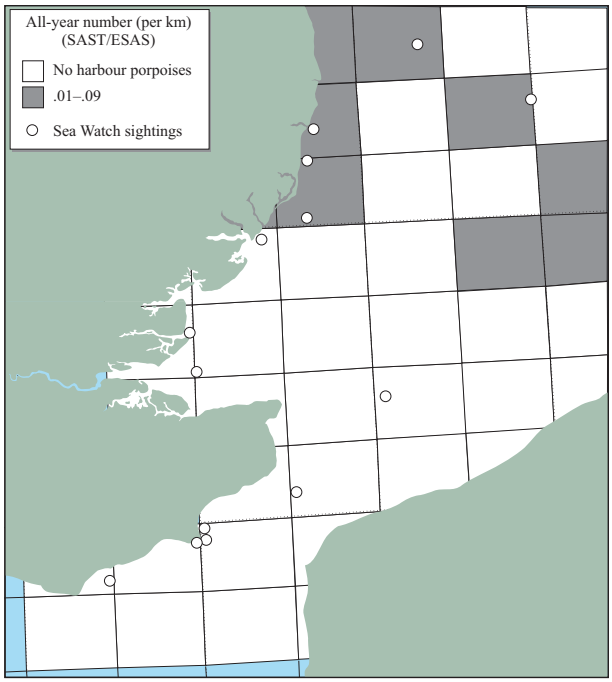
Cetaceans in the region face three main pressures from human activities: conflicts with fisheries (either by competition for a common food resource or accidental capture in fishing gear), habitat degradation (mainly by pollution) and disturbance (from underwater sounds).

Table 5.15.1 Cetacean species regularly recorded in the region since 1980

Species	*Status, distribution and seasonal occurrence*
Harbour porpoise *Phocoena phocoena*	Rare in nearshore waters; occurs mainly between April and October. Sightings offshore come mainly from the north-east of the region.
Bottlenose dolphin *Tursiops truncatus*	Rare in nearshore waters, occurring in small groups usually of less than ten individuals. Most sightings come from the south-east coast of Kent between April and December, with a peak between August and September.
Common dolphin *Delphinus delphis*	Casual offshore visitor to the eastern Channel, recorded between August and December.
Long-finned pilot whale *Globicephala melas*	Rare seasonal offshore visitor recorded between April and November



Map 5.15.2 Pilot whales: all-year number sighted per kilometre of Seabirds at Sea survey (source: JNCC: SAST/ESAS); and sightings reported to the Sea Watch sighting system . Source: Evans (1992).



Map 5.15.3 Harbour porpoises: all-year number sighted per kilometre of Seabirds at Sea survey (source: UKDMAP); and sightings reported to the Sea Watch sighting system. (Source: Evans 1992).

Several ports in the region have fishing fleets, though most are small (see section 9.1). A variety of fisheries can result in the accidental capture of cetaceans, but the greatest impact in UK waters appears to come from bottom set gill nets, including tangle nets and nets set around wrecks, most frequently affecting harbour porpoises and common dolphins. Purse seine and midwater trawling can also lead to bycatches, whilst creel lines sometimes entangle minke whales.

In the early years of this century, Harmer (1927) attributed the stranding of numerous porpoises on the East Anglian coast to bycatches from the large local herring fishery. There are no recent reports of cetacean bycatches in the region, possibly because of the collapse of the local herring fishery and the comparative scarcity of cetaceans in recent times.

Contaminant levels in cetaceans from the region are poorly known, since the number of studied strandings is very low; most samples from the English North Sea coast derive from animals stranded further north than East Anglia (Regions 6 and 7). Mean total PCB (for 25 congeners) levels of 32 harbour porpoises sampled from the east coast of England (Kent to Northumberland) between 1988 and 1992 amounted to 19 ppm - a low level compared with some other regions of the UK (Kuiken *et al.* 1994). However, mean total PCB levels for the eight porpoises sampled from the counties of Suffolk, Essex and Kent gave a higher value of 30 ppm, with a range of 5.78 to 76.89 ppm.

Recreational activities (speedboats, jet skis etc.) are important at several locations in the region, notably Lowestoft, Felixstowe, Harwich, Clacton-on-Sea, the Blackwater, Southend-on-Sea, the Medway Estuary, Sheerness, Herne Bay, Margate, Sandwich Bay, Dover and Folkestone. Such vessels pose threats of direct physical damage from collisions as well as disturbance from the high frequency noise they generate (Evans *et al.* 1992). Heavy shipping may also disturb cetaceans, but most of the sound produced by vessels with large engines is at frequencies below 1 kHz, thus overlapping more with baleen whales than with dolphins and porpoises (Evans 1987, 1996). However, vessels can also generate high-frequency (>1 kHz) sound overlapping the frequencies used by small cetaceans, and vessel avoidance and increased dive times by bottlenose dolphins and harbour porpoises have been reported by Evans *et al.* (1992, 1994).

Underwater sounds from seismic activities involve low frequencies (20-500 Hz) and are therefore most likely to affect baleen whales. Nevertheless recent studies indicate that other cetaceans may also be disturbed by seismic surveying, as they are sighted less frequently, either acoustically or visually, during seismic surveys (Goold 1996). It is possible that porpoises are affected (Baines 1993), perhaps indirectly by changing the distribution of their fish prey (Evans 1996).

Codes of conduct for boat users have been produced, for example by Sea Watch Foundation (Sea Watch Foundation 1992; Evans 1995).

5.15.4 Information sources used

For geographical comparisons of sightings rates for various cetacean species in UK waters, see Evans (1990b, 1992) and Northridge *et al.* (1995). Information on cetacean status and distribution comes primarily from the national sightings database (1973 - present) maintained by the Sea Watch Foundation and the strandings monitoring scheme organised by the Natural History Museum in London (1913 - present). Systematic land-based watches have been carried out at Dungeness (Kent), and less regularly at Southwold/Walberswick (Suffolk) and at Aldeburgh/Orford Ness. Sea-based coverage is generally poor in the southernmost North Sea and eastern English Channel,

although watches have been made from ferries operating to continental Europe out of Harwich and Dover, the MAFF Fisheries Research (now CEFAS) vessels and the Channel Fisheries Protection vessel. Opportunistic sightings effort has been highest between the months of April and September, when sea conditions are also usually best, so winter sightings may be under represented.

Offshore effort-related data derive from the following sources: Sea Watch Foundation systematic surveys, the JNCC's Seabirds at Sea Team (as part of seabird surveys), and Dutch ship-based (C.J. Camphuysen & M. Leopold) and aerial (H. Baptist) surveys. Most recently a major international collaborative programme, the Small Cetacean Abundance in the North Sea (SCANS) project, has aimed to provide a baseline assessment of abundance from intensive survey work in July 1994 (Hammond *et al.* 1995); however, it recorded no cetaceans in this region.

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

5.15.5 Acknowledgements

Thanks are due to I. Grant and J. Heimlich-Boran for help in the preparation of the maps, and to all those persons who have contributed valuable sightings data, particularly the systematic observations provided by H. Baptist, P. Dare, M.L. Tasker, B. Vallance, D. Walker and A. Webb.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Cetacean strandings	Dr D. George & Mr A. Muir, Natural History Museum, Cromwell Road, London SW7 5BD, tel: 0171 938 8861
Cetacean sightings & surveys	Dr P.G.H. Evans, Sea Watch Foundation, c/o Dept. of Zoology, University of Oxford, South Parks Road, Oxford OX1 3PS, tel: 01865 727984
Cetacean systematic watches	B. Vallance, 12 Chesterfield Close, Rainham, Gillingham, Kent ME8 7DR, tel: 01634 364715
Cetacean systematic watches, Dungeness	D. Walker, Dungeness Bird Observatory, No. 11 RNSSS, Dungeness, Romney Marsh, Kent TN29 9NA, tel: 01679 21309
Cetacean sightings & surveys	*Seabirds & Cetaceans Team, JNCC Aberdeen, tel: 01224 655702
Cetacean organochlorine & heavy metal levels	*Dr R.J. Law, Centre for Environment, Fisheries & Aquaculture Sciences, Burnham-on-Crouch Laboratory, tel: 01621 787200
SCANS Project	*European Wildlife Division, Department of the Environment, Bristol, tel: 0117 987 8000
Cetacean pathology	Veterinary Pathology Group, Institute of Zoology, Regents Park, London NW1 4RY, tel: 0171 449 6691

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

This region has had a long and colourful maritime history, reflecting its commercial, military and political importance and now also its use for recreational boating. The distinctive Thames barges were once built throughout the area at places such as Maldon (pictured), Sittingbourne and Rochester for use in the region's shallow rivers and estuaries. In the last two centuries many barges were owned by riverside industries; now they belong mainly to leisure sailors. Photo: Bill Sanderson, Countryside Council for Wales.

Chapter 6 History and archaeology

A. Gale & V. Fenwick

6.1 Introduction

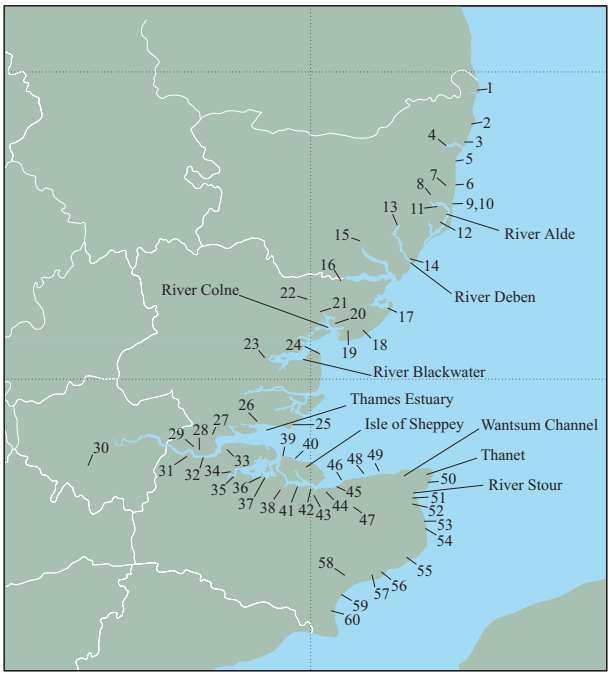
6.1 Introduction

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

During the Pleistocene glacial episodes, sea levels were lower and the southern North Sea and the eastern English Channel were dry land. In most of Britain evidence of the earliest humans has survived only in caves, because unprotected sites were scoured away by the ice sheets; this southerly region, however, into which the ice only just reached, provides nationally important evidence for the activity of the hunting groups that roamed across the then-exposed plains. This region remained culturally close to Europe as, from prehistory to the Norman conquest, successive migrant peoples settled the region and used its foreshores and inlets to maintain communication and trade with their homelands in northern Europe. The region is the source of the most important prehistoric boat find in Northern Europe and of three vessels illustrative of a pre-Viking clinker boat-building tradition.

Cultural material from the early history of this region is often markedly distinctive, suggesting political or economic divisions between the region and other areas. Once London became the political centre of an increasingly unified country the region's coastal towns gained new status as embarkation ports for monarchs and assembly points for their fleets. The capital's growth as a major international port made the Thames a route for foreign and coastal trade, while a multitude of locally-built coastal craft worked the region's rivers and creeks. Whenever centralised authority, be it Roman, Tudor, Hanoverian or later, faced hostility from mainland Europe, the defence of island Britain depended on fortifying this region as the front line.

This region has nationally important archaeological sites of many periods, surviviving in varying states of preservation. Ancient land surfaces in the Essex intertidal zone have special potential, as they can contain intact soil profiles and organic artefacts that do not survive on dry land. Similarly, the analysis of samples from the Medway Tunnel site has provided new evidence of the changing



Map 6.1.1 Archaeology: locations mentioned in the text.

coastline, its environment and its use by man (Allen *et al.* 1995; Pine *et al.* 1995). The discoveries of man-made structures in the intertidal zone show the potential for evidence from earlier periods and associated palaeo-environmental remains to survive entirely submerged on the sea bed.

Further innovative work has recorded the remains of boats in estuarine areas of the region. Shipwrecks are the most commonly recognised sea-bed site. Written accounts tell of many ship losses, especially on the Goodwin Sands, and the discovery of the *Stirling Castle* demonstrates the survival of wooden hulls. Records of ship losses are comprehensive for the 19th century, relatively complete for the 18th, and patchy for the 14th to 17th centuries. For earlier periods it is necessary to examine documentary evidence for sea-borne trade and extrapolate the extent of ship losses by considering hazards to navigation. This process can be extended into the prehistoric period by looking at archaeological evidence for trade and seafaring.

Table 6.1.1 Locations mentioned in the text

Site no. on Map 6.1.1	*Location*	*Grid ref.*	*Site no. on Map 6.1.1*	*Location*	*Grid ref.*
1	Lowestoft	TM5493	31	Swanscombe	TQ6074
2	Covehithe	TM5282	32	Gravesend	TQ6574
3	Southwold	TM5076	33	Cliffe	TQ7376
4	Blythburgh	TM4475	34	Rochester	TQ7469
5	Dunwich	TM4770	35	Chatham	TQ7567
6	Leiston	TM4462	36	Upchurch	TQ8467
7	Sizewell	TM4762	37	Lower Halstow	TQ8567
8	Snape	TM3959	38	Sittingbourne	TQ9063
9	Aldeburgh	TM4656	39	Sheerness	TQ9174
10	Slaughden	TM4656	40	Minster-in-Sheppey	TQ9573
11	Iken	TM4155	41	Conyer	TQ9664
12	Orford	TM4250	42	Oare	TR0063
13	Sutton Hoo	TM2849	43	Faversham	TR0161
14	Goseford	TM3238	44	Graveney	TR0562
15	Ipswich	TM1644	45	Seasalter	TR0864
16	Manningtree	TM1031	46	Whitstable	TR1066
17	Walton	TM2522	47	Canterbury	TR1457
18	Clacton-on-Sea	TM1715	48	Herne Bay	TR1768
19	St Osyth	TM1215	49	Reculver	TR2269
20	Brightlingsea	TM0817	50	Ramsgate	TR3865
21	Wivenhoe	TM0321	51	Minnis Bay	TR3360
22	Colchester	TL9925	52	Sandwich	TR3358
23	Maldon	TL8506	53	Deal	TR3752
24	Bradwell-on-Sea	TM0066	54	Walmer	TR3750
25	Shoeburyness	TQ9385	55	Dover	TR3141
26	Hadleigh	TQ8187	56	Folkestone	TR2336
27	Mucking	TQ6881	57	Sandgate	TR2035
28	Tilbury	TQ6476	58	Lympne	TR1135
29	Little Thurrock	TQ6277	59	Dymchurch	TR1029
30	London	TQ2871	60	Old Romney	TR0325

6.2 History and archaeology of the region

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

Early humans first visited Britain more than 450,000 years ago. Individual flint tools are often the only evidence for human presence, but this region has provided important stratified material (Wessex Archaeology 1993). Clacton-on-Sea gives its name to a style of flint tool dating back to Late Anglian or Early Hoxnian times (around 400,000 years ago). The tools were recovered from a one-time river valley, the campsite of nomads who probably hunted deer, bison, horse, elephant and rhino. Similar waterside sites have been found at Little Thurrock and Swanscombe: extensive study at the latter site has provided information on the changing environment and developing tool technologies, as well as uncovering the skull of an early human, which, with a date of 400,000 BC, was until recently the earliest discovered in Britain.

By 12,000 BC the ice sheet on the northern fringe of this region was retreating and the area was recolonised by plants and animals suited to the improving climate. Flint tools and waste are the most common artefactual evidence for this Mesolithic period, in which waterside sites, with their diverse food resources, were occupied seasonally. The prevalence of coastal material, particularly intertidal finds such as those in the Blackwater Estuary, is a reminder that the present sea level cuts across the landscape that was available to the hunting and gathering groups of the time. Our knowledge of the resource now on the sea bed is largely confined to flint tranchet axes dredged from the Thames Estuary, especially off Thurrock and Herne Bay.

By about 4,500 BC farming had been introduced in the south of the region. Excavation near Folkestone has shown that soils were eroding as a result of forest clearance. The polished stone axes used for this work and scatters of other tools and pottery are the most common artefactual evidence. Standing communal burial monuments, whose distribution is often used as an indicator of settlement pattern, have rarely survived on the coast of this region, although they may be apparent as cropmarks. Axes reveal wide cultural contacts: for example, southern Suffolk has axes of Cornish origin and northern Suffolk some of Lakeland stone. Intertidal peat beds and associated Neolithic wooden structures in the intertidal zone in Essex and Kent were once much further inland but were abandoned owing to rising sea level.

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

New funerary practices, including burials in cists (stone-lined chambers) or pots beneath round barrows, are often attributed to the arrival or influence of people from mainland Europe. There are concentrations of barrows near fertile land, such as between the Colne and Deben Estuaries and on Thanet. The use of sea-borne transport was unequivocally demonstrated by the discovery of the 3,300-year-old Dover Boat, whose complex design demonstrates the existence of a developed boat-building tradition. The precision tooling provides evidence unmatched elsewhere that superbly-crafted woodwork of all kinds was carried out with the bronze tools. Examples of such objects have not survived on dry land sites. The dynamics of contemporary manufacturing, trade and transport are apparent from a cargo of scrap bronze tools and weapons, mostly of French origin, found on the sea bed of Langdon Harbour, Dover. From the 6th century BC iron supplemented copper and tin as the material for metal implements.

The incidence of Iron Age artefacts on Bronze Age sites may indicate continuity of settlement, while the density of farmsteads shows an increased population. The extraordinary quantities of coins found in the region are evidence for extensive trade, much of which was conducted by tribes who had migrated from Belgium. Exports in the 1st century BC included corn and slaves, financing imports of wine and luxuries. A group of Kentish coins feature native ships, but an actual vessel has yet to be discovered. Similarly elusive are the wrecked Roman ships and the site of the bridgehead of Julius Caesar's invasions of 55 and 54 BC, which included a fort with ship repair facilities. Many coastal sites have been found in the intertidal zone, as at Covehithe and Minnis Bay, but others may already be fully submerged or lost to erosion. Evidence for the important coastal salt-making industry has survived: some 300 distinctive 'red hills', formed from red earth and briquetage (primitive fired clay or burnt earth), have been identified in Essex (Fawn *et al.* 1990). Other salt-making sites of comparable age have been found, for example on the River Alde and at Lower Halstow.

6.2.3 The Roman province

The region is exceptionally rich in military remains from the Roman period. The invasion bridgehead of AD 43 was established at Richborough at the south end of the Wantsum Channel, a navigable route to the Thames; subsequently the north end was controlled by a fort at Reculver. The fleet was based at Dover, where the remains of its lighthouse still stand 18.6 m high. At Folkestone a villa has been eroded from the cliff, while the port at Lympne now lies inland. Modern Rochester and Colchester overlie the Roman towns of Durobrivae and Camulodunum. Londinium was created as an administrative centre and port, the Thames becoming the main shipping route from the English Channel and the Rhine. Shipwrecks of the period have been excavated in London, and imported pottery from a wreck site at Pudding Pan is occasionally dragged up. A large local pottery industry existed nearby, in the area that is now Upchurch Marshes. Seaborne raids in the 3rd century AD led to the construction of a string of huge coastal forts and signal stations: the walls of Burgh Castle (Suffolk) are 3 m thick and still stand to 6 m high. Other surviving remains range from the massive walls at Richborough and Lympne to the less visible site at Bradwell-on-Sea, while Walton Castle lies in the sea.

6.2.4 Roman departure to Norman conquest

Following the official Roman withdrawal in AD 410 the coast was increasingly vulnerable to raids. Mercenaries, the earliest recorded entering Kent, became influential, and immigrants from the Low Countries gradually took control by forming petty kingdoms. Germanic graves of the 5th century have been excavated in a settlement commanding the Thames at Mucking. There were Christians in Romanised Britain and the faith may have survived: nonetheless, in AD 597 the Pope sent 40 missionaries to Britain, who created sees (dioceses), first in Canterbury, then in Rochester, London and Dunwich. Coastal sites chosen for monasteries included Blythburgh, Iken, Bradwell-on-Sea, Tilbury, Shoebury, Minster-in-Sheppey, Reculver and Folkestone.

Kent was very prosperous. From the 6th century, grave goods from cemeteries, such as at Dover and Faversham, include imports form the Mediterranean. London was a centre for trade and Ipswich became a thriving port. The Suffolk cemeteries of Snape and Sutton Hoo contained remains of Anglo-Saxon ships, and a 9th century merchant ship was uncovered on Graveney Marshes. The havoc caused by Viking raids has left little trace, but towns such as Maldon are the descendants of Saxon burghs. The famous battle at Maldon is considered by many to have taken place at Northey Island.

6.2.5 The medieval period

For the invading Normans, castles were a mark of authority and a means of subjugating the native population. Their strategic locations and construction in stone have meant that examples such as Rochester survive. The most impressive, with innovative designs, are those funded from the Royal purse: Orford and Dover. New connections with the Continent encouraged trade and prosperity. By the end of the 12th century Ipswich and Sandwich were exporting wool to the cloth industry in Flanders, a trade joined by Dunwich and Brightlingsea. The English cloth industry emerged in East Anglia and provided further exports for the region. French wine was imported, especially through the Kentish ports, and Sandwich received luxury Mediterranean goods brought annually by Venetian galleys.

Warfare and diplomacy drew on the resources of the ports. At Harwich, Edward III assembled his fleet for the Battle of Sluys (1340), and at Dover, Henry VIII and his ostentatious entourage embarked for the Field of the Cloth of Gold in 1520. Ipswich as a shipbuilding centre had constructed a barge for the king in 1294/5. The Cinque Ports, in this region Sandwich, Dover, Hythe and Romney, received trading privileges in return for providing ships and men for the Crown. Proximity to the continent brought vulnerability: for example, the French raided Harwich in 1339 and Sandwich in 1497. A fort was built at Queenborough in 1361 to protect the Thames; towns such as Rochester, Dover and Sandwich constructed walls in the 14th century; and in the 1540s Henry VIII established a formidable system of defence from Hull to Cornwall, including castles at Harwich, Colchester and Hadleigh. The core of the defence of the capital was a line of castles at Sandown, Deal, Walmer, Dover and Sandgate.

There was dramatic coastal change in the 14th and 15th centuries. Dunwich, once a major East Anglian city, was gradually washed away; the Ore at Orford was closed by shingle movement; Sandwich was blocked by silting of the Stour; and a priory at Leiston was forced by erosion to move inland. The remains of once significant ports and shipbuilding centres, such as Covehithe, Slaughden, Goseford and Smallhithe, are now concealed in rural backwaters. Sea walls built to protect marshlands, and the remains of foreshore fish traps, may be the only surviving evidence of monastic estates.

6.2.6 Post-medieval and modern times

This region remained the chief maritime area of England well into the 17th century. London's rise as an economic centre and international port was paralled by a decline in the trade and status of the outports in the region. Few coastal towns had the resources, let alone the expertise, necessary to improve their harbour facilities. Some, like Sandwich, succumbed to silting and are now entombed inland. The Colchester to Wivenhoe cut stands out as an early example of river engineering (1698). Harwich and Dover retained their position as embarkation points for the Continent: the former has important maritime structures, including the high and low lighthouses and a rare man-powered crane; the latter combated longshore drift with early pier works, even attracting finance from Henry VIII. The remains of these and successive structures may survive beneath the Western Docks.

The massive growth of London's population created a huge demand for foodstuffs and animal fodder. Much was supplied by this region: in the 17th and 18th centuries the outward coastal trade of its ports, havens and creeks went almost wholly to London. Goods were also exchanged within the region, including raw materials for growing industries. Rochester in 1683/4, for example, shipped 965 loads of fuller's earth (used in cloth dyeing), of which 772 loads went to Colchester, Manningtree and Maldon. London's demand for ale in the 18th century required foreign imports: barley was landed in the outports, malted and then re-shipped to the capital. Surviving maltings include the complex at Snape.

The shipbuilding industry, particularly in Suffolk, declined after Dutch prizes flooded the 17th century market. However, distinctive local craft - barges - were developed for the region's shallow rivers and estuaries. These were built at places such as Ipswich, Harwich, Maldon, Wivenhoe, Faversham, Conyer, Sittingbourne and Rochester. In the last two centuries many barges were owned by riverside industries, such as breweries and manufacturers of gunpowder, bricks and cement. The boatbuilding yards and industrial sites are a little-recorded aspect of the region's archaeology. The extraction of raw materials, for example the digging of clay, physically altered the riverine scene.

Fishing was an important industry. Herring boosted the economy of Lowestoft, for example, and prompted the construction of the fishmarket, trawler basin, Waveney Dock (1883) and Hamilton Dock (1903). Oyster cultivation thrived in 18th and 19th century Essex and continues in Kent at Whitstable. Pits and wooden structures can survive as indicators of this activity (Leech 1994). Apart from preserved or derelict vessels, physical evidence of working

dredges, pots, trawls or drift nets is often ephemeral, but buildings such as the Fisherman's Chapel at Gravesend are a tangible link with the fishing communities.

Vast numbers of ships passed down the east coast or around the North Foreland from the English Channel. In 1795 London received 11,964 ships from the coastal trade alone. As a result the region has one of the greatest concentrations of recorded wrecks in Britain, in spite of the shore-based lighthouses and efforts made to mark offshore shoals. The foundations of an ambitious new lighthouse on the Goodwin Sands are, presumably, still within the sands. Ramsgate Harbour was built with government support as a harbour of refuge in 1749 and was made workable by Smeaton's addition of an inner sluicing dock.

The region includes three naval dockyards, at Woolwich, Sheerness and Chatham. The huge acreage of Dover Harbour, only completed in the present century, was also intended as a naval refuge. Coastal fortifications in the region have long been the key to Britain's defence and the surviving structures preserve many nationally important examples of military engineering. In this period they range from the 17th century Tilbury Fort; Harwich redoubt and the forts at Coulhouse and Beacon Hill; Medway defences for Chatham Dockyard; the Martello Towers strung out from Aldeburgh to Dymchurch; the Palmerstonian works on Dover's Western Heights; and the defences of the 1914-18 and 1939-45 wars.

6.3 Human activities

6.3.1 Integrated management

The growing number of coastal zone management initiatives provide opportunities for the integrated management of land, shore and sea-bed archaeological sites. Coastal zone management enables research projects, providing baseline information on the archaeological resource, to be set in a wider context. Kent County Council, for example, has embraced the recording of maritime sites as part of a programme of broader coastal research within a cross-Channel project, *Coastal management in the Transmanche Region*. The Essex Coastal Strategy includes archaeological policies (Essex County Council 1995). At a local level information on archaeology is incorporated into management plans such as those for the Colne and Blackwater Estuaries (Maldon District Council 1995) and the Thames Estuary (Kent County Council 1995).

Other bodies with responsibility for the coast have also incorporated archaeology in their consideration of management issues. The National Rivers Authority (now the Environment Agency), for example, commissioned a review of the potential archaeological interest as part of its shoreline management plan in Essex (Leech 1994).

6.3.2 Activities and processes affecting the archaeological resource

Processes affecting archaeological sites on land are the most easily recognised. Regeneration of urban and industrial waterfronts requires skilful planning to maintain the fabric and setting of historic maritime buildings and facilities. Building work can be designed to seal remains intact, but where development requires activity such as earth-moving or the sinking of piles it can directly destroy sites. Construction work can reveal the buried remains of earlier quayside facilities: elements of the ports of Anglo-Saxon Ipswich and Roman Dover were found in this way. The remains of ports of all periods may be also be found in quiet creeks and backwaters that were not developed during the heyday of Victorian engineering.

Changes in water level may cause archaeological losses through desiccation, as was a concern for the unrecovered portion of the Dover Boat. In undeveloped areas drainage, for example of marshland, will damage previously waterlogged remains, particularly palaeo-environmental evidence. The Graveney Boat (Fenwick 1978) and medieval boat timbers in Buss Creek (Allen 1992) were revealed by mechanical ditch clearance. Ploughing has damaged 'red hills' in Essex and barrows in Suffolk. The light soils of Suffolk are vulnerable to erosion, which destroys archaeological evidence.

The number of sites that have been discovered in cliff exposures demonstrates the large-scale impact of coastal erosion. Many sites are now in the intertidal zone but will be eroded without record unless they are surveyed ahead of destructive erosion. Hulls in shallow water or lying aground are vulnerable to the effects of boat wash, which can contribute to erosion.

Archaeology on the foreshore can be threatened by developments such as road, bridge or tunnel construction, coastal defence, sewage outfalls and land claim. Managed retreat also has archaeological implications: at Tollesbury a 'red hill' has been protected by modifying the proposed scheme. Derelict vessels, now considered of archaeological value, have sometimes been cleared in order to improve the amenity value of the waterways.

Natural processes can affect subtidal sites. The massive movements of sediment in the Thames Estuary have turned over large metal ships, while similar movements on the Goodwin Sands uncover and re-cover old wooden hulls. The impact of human activities offshore is known about but not yet quantified. Spoil disposal can obscure sites (Bacon 1974). Fishing nets have frequently pulled up artefacts ranging from pottery to guns and masonry (Redknap 1990a; Bacon 1982), and snagged nets have led to the discovery of wrecks. The recovery by fishermen of two medieval side rudders off Southwold led to the conclusion that the fishing gear had pulled the rudders from ships lying on the sea bed in what had once been a river channel prior to extensive coastal erosion (Hutchinson 1995). Dredgers making sea-bed channels for Sizewell B power station cut through wreck timbers (Bacon 1990); on the Goodwin Sands, sand dredgers have brought up wreck cargo; and archaeological information has been lost through the salvage of historic hulls (Redknap 1990a, b). Salvage divers and today's numerous sports divers may strip wreck sites of all moveable objects and valuable metals.

Lack of resources is impeding the survey of archaeological sites, which is a prerequisite to the development of informed management strategies. Archaeological sites are of public interest, but restricted access and lack of public information or interpretation has been noted as a problem: "even nationally prestigious sites like Sutton Hoo are inadequately managed in these respects" (Suffolk Coasts & Heaths Joint Advisory Committee 1994).

6.3.3 Protection of sites, monuments and wrecks

Three statutory designations are applied specifically to protect *in situ* remains of archaeological or historic importance. The Ancient Monuments & Archaeological Areas Act (AMAA) 1979 provides for Scheduled Ancient Monuments (SAMs). The AMAA definition of monument includes sites both on land and in UK territorial waters, including remains of vehicles, vessels and aircraft. In practice, however, scheduling in England has been applied only above low water mark (Firth 1993). There is a presumption against the destruction of SAMs, and prior consent is necessary for any works that will destroy, damage, repair or remove such a monument. There is a published list of criteria for determining the national importance of a monument (DoE 1990). The number of

SAMs is being increased as a result of a review (the Monuments Protection Programme). SAMs in this region include monuments of a maritime character such as Martello Towers and buildings within Chatham Dockyard.

The Town & Country Planning (Listed Buildings and Conservation Areas) Act 1990 provides for the protection of Listed Buildings (buildings considered of special architectural or historic importance) and Conservation Areas (historic environments, particularly in urban settings). There is now a presumption in favour of the preservation of Listed Buildings and their settings, and consent is required prior to any demolition, alteration or extension (DoE/DNH 1994).

The Protection of Wrecks Act 1973 provides for the designation of any shipwreck considered of importance for its archaeological, historical or artistic interest. There are no standard criteria for designation but the Department of National Heritage (DNH) receives guidance from the Advisory Committee on Historic Wreck. Archaeological investigation is only permitted under licence from DNH. Designation usually applies to an area of sea bed in which the wreck is considered to lie, and within the designation area it is illegal to tamper with or remove material, to use diving or salvage equipment or to deposit anything that may damage or obliterate the wreck (Archaeological Diving Unit 1994). Table 6.3.1 lists the designated wreck sites in this region; however, as fewer than 45 wrecks have been designated in the whole of Britain, their distribution cannot be accepted as a reasonable guide to the total sea-bed resource. The Suffolk Underwater Studies Unit, the SMRs and the National Monuments Record - Maritime Sites (NMR-MS) contain information on many more wreck sites.

Designations to protect the natural environment can also safeguard archaeological sites. The find area for the Swanscombe skull and associated Acheulian industries is within the first geological National Nature Reserve to be designated in the UK (Bridgland 1994).

6.3.4 Key organisations and their responsibilities

English Heritage is responsible for maintaining the Schedule of Ancient Monuments (SAMs) and the Listed Buildings list. It inspects the monuments, directly manages those in guardianship and assists owners of others in drawing up management agreements supported by grants. It also funds archaeological survey and excavation, as 71both rescue and research projects.

The Department of National Heritage is responsible for designated wreck sites. Inspection is carried out on their behalf by the Archaeological Diving Unit.

The Royal Commission on the Historical Monuments of England (RCHME) has national responsibility for the survey and inventory of archaeological sites and historic buildings. It maintains a database of archaeological sites known as the National Monuments Record (NMR), which combines the computerised National Archaeological Record, the National Buildings Record and the National Library of Air Photographs. In 1992 a new Royal Warrant extended the Commission's responsibility to territorial seas. RCHME has since added a Maritime Section to the NMR, and has recently published *The national inventory of maritime archaeology for England* (RCHME 1996). The RCHME is the lead agency responsible for overseeing data standards in local archaeological databases, the Sites and Monuments Records (SMRs).

SMRs constitute the key source of information on local archaeological sites and areas of archaeological potential; in this region Suffolk, Essex and Kent County Councils maintain SMRs. Kent County Council and RCHME have worked together to extend the SMR for Kent beyond the low water mark. County Archaeology Officers, or Specialist Development Control Officers, fulfil a 'curatorial' role in respect of archaeological sites, primarily through the planning system. Their responsibilities may include wider aspects of management and interpretation.

The Suffolk Underwater Studies Unit is a voluntary group engaged in coastal and underwater survey. Since the 1970s it has built up a computerised database of coastal finds.

6.3.5 Development control

To landward of low water mark archaeology is considered within the unified system of development control provided by the planning system. Planning Policy Guidance Note 16 (Department of the Environment 1990) explains the regard that should be accorded to archaeological remains. In essence there is a presumption in favour of preservation *in situ* because "the desirability of preserving an ancient monument and its setting is a material consideration in determining planning applications, whether that monument is scheduled or unscheduled". Stress is laid on early consultation between planning authorities and developers, with information and advice from the SMR, in order to reconcile the needs of archaeology and development. If

Table 6.3.1 Historic wreck sites designated in the region

Site name	*Location*	*Grid ref.*	*Description*	*Designation order*
Dunwich Bank	Dunwich Bank	n/av	Unidentified 17th century wreck, possibly Battle of Sole Bay casualty	1994 No. 1; 1994/1842
South Edinburgh Channel	Thames Estuary	TR252861	Unidentified 18th century merchantman	1977 No. 1; 1977/764
Stirling Castle	Goodwin Sands	TR446586	70 gun 3rd rate warship, lost 1703	1980 No. 1; 1980/645
Northumberland	Goodwin Sands	TR443568	70 gun 3rd rate warship, lost 1703	1989 No. 1; 1989/2089
Restoration	Goodwin Sands	TR443570	70 gun 3rd rate warship, lost 1703	1989 No. 1; 1989/2089
Admiral Gardiner	Goodwin Sands	TR451504	English East Indiaman, lost 1809	1989 No. 3; 1989/2295
Langdon Bay	Langdon Bay, Dover	TR341417	Bronzes, probably part of Bronze Age cargo of scrap	1978 No. 4; 1978/764

Source: Archaeological Diving Unit (1994). Note: conversions from latitude and longitude by RCHME. Key: n/av = not available.

preservation *in situ* is not justified, planning authorities may require the developer to make "appropriate and satisfactory provision for excavation and recording of remains". The presumption in favour of preservation *in situ* has been extended to Listed Buildings and their settings (DoE/DNH 1994).

Planning decisions should take into account the more detailed policies that appear in Development Plans. County Structure Plans and the Local Plans of constituent districts contain archaeological policies. Essex and Kent are within the SERPLAN area, for which policy guidance has been issued concerning maritime archaeology, highlighting the need for local authorities to compile Maritime SMRs (SERPLAN 1993).

Further policies and information related to archaeology and the built heritage appear in a variety of management plans (e.g. Suffolk Coasts & Heaths Joint Advisory Committee 1994). Archaeological topic papers have contributed to strategic documents compiled for other coastal initiatives, including the East Thames Corridor (Oxford Archaeological Unit 1995) and the North Kent Marshes Study (Kent County Council 1991).

To seaward of low water mark there is a sectoral approach to development control (DoE 1993). Regulation, including the requirement for environmental assessment, is divided between a range of government departments and agencies. Until recently, the lack of information on the extent of the resource and the absence of a management structure for archaeology in the subtidal zone had precluded its consideration by many local authorities. However, growing awareness of marine archaeology, the development of the NMR-MS and the addition of maritime sites to SMRs are encouraging closer consideration of the marine resource. In Kent, Southern Water has incorporated offshore archaeological survey into their preparatory work for the Dover and Folkestone Waste Water Treatment Scheme. This procedure is aided by a *Code of practice for seabed developers* (Joint Nautical Archaeology Policy Committee 1995).

6.3.6 Reporting archaeological information

The Royal Commission on the Historical Monuments of England (RCHME) and the Sites and Monuments Records (SMRs) are the accepted reporting points for new archaeological information, although there is a legal requirement to report archaeological and historical artefacts only when the objects fall within the laws on either Treasure Trove or Salvage. The law of Treasure Trove is used to secure important treasures for the nation (Longworth 1993). Objects of gold or silver found on land must be reported to the police, the Coroner or the British Museum. Should a Coroner's inquest declare the objects Treasure Trove, the British Museum may retain them and, in return, provide an *ex gratia* payment to the finder. The museum may waive its right in favour of another museum.

The old common law of Treasure Trove was due to be replaced in late 1997 by the Treasure Act, which would set out a new definition of treasure: (a) all hoards of coins at least 300 years old (if the coins have a precious metal content of less than 5% then the hoard must consist of at least 10 coins); (b) objects at least 300 years old with a minimum precious metal content of 5%, and (c) objects found with an association with treasure. Finds of potential treasure must be reported to the coroner within fourteen days. A code of practice has been drawn up, providing guidance to finders of treasure and setting out the policy on rewards.

The Merchant Shipping Act 1894 requires any recovered wreck to be reported to the Receiver of Wreck. Wreck is defined as any ship, aircraft, hovercraft or parts of these, their cargo, or equipment, found in or on the shores of the sea or any tidal water. The Receiver advertises reported wreck, regardless of age, in order that owners may claim their property. After one year, unclaimed wreck becomes the property of the Crown and is disposed of in order to pay the expenses of the Receiver and any salvage awards. During the statutory year, historic items may be lodged with a museum or conservation facility with suitable storage conditions. There is a policy of offering wreck of historic, archaeological or artistic interest to registered museums. The responsibility of the Receiver to the finder, with regard to salvage awards, remains regardless of the historic character of the wreck. The Receiver has prepared new forms for reporting wreck, including one that finders may use to volunteer information to RCHME on the identity and condition of wreck sites.

Information and enquiries concerning designated wrecks should be directed to the Department of National Heritage, those concerning SAMs to English Heritage, and those concerning listed buildings to local planning departments. The Suffolk Underwater Studies Unit receives information on sea-bed and intertidal finds. Local archaeological societies, especially in Kent, play an important role in liaising with metal detectorists.

6.4 Information sources

6.4.1 Information gathering and collation

The intial compilation of the National Monuments Record - Maritime Sites (NMR-MS) was completed in 1995 (RCHME 1996). RCHME drew records from the historical accounts of shipping losses and the Hydrographic Department Wreck Index, which contains mainly 20th century shipwrecks and unidentified sea-bed obstructions located by remote sensing surveys (Table 6.4.1).

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

	Documented ship losses	*Named wrecks*	*Unidentifed obstructions*
Suffolk	570	361	106
Essex	725	132	268
Kent	2,987	337	151
Region 7	***4,282***	***830***	***525***

Source: RCHME (1995); named wrecks and unidentified obstructions are drawn from the Hydrographic Department Wreck Index; documented ship losses are drawn from historic accounts of shipping casualties.

The NMR-MS for Kent was developed in partnership with Kent County Council. A search of aerial photographs produced 296 entries for derelict vessels, primarily on the North Kent Marshes (Gale 1994b). Where possible these were correlated with entries drawn from a list of nearly 500 barges reported as derelict in Kent (Gale 1994a). The national list of derelict vessels has around 900 entries for England and includes 42 in Suffolk and 126 in Essex (Wood & Wood 1987). A study of derelict vessels in Whitewall Creek, undertaken ahead of their destruction during road tunnel construction, formed the basis of a report for RCHME on recording in the intertidal zone (Milne & Goodburn 1993).

Suffolk County Council plans to extend their SMR to maritime sites. The intertidal area, where erosion is a major threat, is currently under-represented in the records, and funding is being sought for essential survey in specific river valleys. In addition to compiling a database of foreshore and sea-bed finds, the Suffolk Underwater Studies Unit is active in diver surveys of the sea bed. As well as work at Dunwich, they have carried out surveys at Southwold, Aldeburgh and Sizewell (Bacon 1974, 1982, 1990).

Essex County Council carried out extensive intertidal survey in the Hulbridge Basin between 1982 and 1988 (Wilkinson & Murphy 1995). An extensive programme of aerial photography is extending the mapping coverage of the coast. A programme of work in the Blackwater Estuary is combining the results of such survey with documentary records and field work (Gale 1996; Strachan 1996). A survey of the county's 1939-1945 war defences has included a number of coastal installations. The Colchester Archaeological Group has surveyed many of the 'red hills' of the county (Fawn *et al.* 1990).

In Kent some coastal survey has arisen in response to development, for example along the route of the A20 and in areas associated with the Channel Tunnel, in Chatham ahead of the Medway crossing and at Folkestone with regard to sewage outfall works. RCHME has undertaken surveys of specific sites and riverine installations, including gunpowder works at Oare (Faversham), Brennan torpedo launching bays at Cliffe Fort, and Ravelin Battery, Sheerness. In addition to this work, the commission has identified five areas that need survey (RCHME 1993, 1995).

The North Kent Marshes have attracted the attention of individuals and societies, including the Lower Medway and Upchurch Archaeological Groups, which have undertaken survey of the intertidal zone in their respective areas. The Kent Oyster Coast Environmental Survey Project has been set up to coordinate research to identify and map archaeological sites on the foreshore of Seasalter Parish (Wren & Harrison 1995).

Particular types of coastal installation in this region have been covered by nationwide projects. These include the ongoing survey of Royal Naval Dockyards (Coad 1983), which features Chatham Dockyard, and a survey of 20th century defences, The Defence of Britain Project. The latter was a collaborative project between the Council for British Archaeology and the Fortress Study Group (Morris 1993; Lowry 1995).

The sea bed of this area was targeted by Marine Archaeological Surveys, a group that undertook pioneering work in dedicated remote sensing surveys. Areas covered by their work included Southwold, seeking the side-rudder sites (Hutchinson 1995), the Thames Estuary and the Goodwin Sands (Redknap 1990a).

6.4.2 Acknowledgements

Thanks are due to the staff of all the organisations mentioned in the text who gave their time to provide information.

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B. Contact names and addresses

Type of information	*Contact address and telephone no.*
Scheduled Ancient Monuments, Listed Buildings	Chief Archaeologist, English Heritage, 23 Savile Row, London W1X 2HE, tel: 0171 973 3000
Maritime archaeological sites in England; code of practice for sea bed developers (published by the Joint Nautical Archaeology Policy)	Head of Recording (Maritime), Royal Commission on the Historical Monuments of England, National Monuments Record Centre, Kemble Drive, Swindon SN2 2GZ, tel: 01793 414600
Archaeological sites in England (general)	National Monuments Record, Royal Commission on the Historical Monuments of England, National Monuments Record Centre, Kemble Drive, Swindon SN2 2GZ, tel: 01793 414600
Designated Historic Wrecks	The Secretary, Advisory Committee on Historic Wreck Sites, Department of National Heritage, Room 306, 2-4 Cockspur Street, London SW1Y 5DH, tel: 0171 211 6369/6367
Sites and Monuments Record, managing the archaeological resource and development in Suffolk	*County Archaeologist, Archaeology Section, Suffolk County Council, Bury St Edmunds, tel: 01284 352445
Sites and Monuments Record, managing the archaeological resource and development in Essex	*County Archaeologist, Archaeology Section, Planning Department, Essex County Council, Chelmsford, tel: 01245 492211
Sites and Monuments Record, managing the archaeological resource and development in Kent	*Group Manager of Heritage Conservation, Planning Department, Kent County Council, Maidstone, tel: 01622 696055
Suffolk Underwater Studies Unit	The Director, Front Street, Orford, Suffolk IP12 2LN, tel: 01394 450678
The Kent Oyster Coast Environmental Survey Project	The Administrator, c/o C.R. Wren, Mortimer House, 160-164 Mortimer House, Herne Bay, Kent CT6 5DU, tel: 01227 740913
Reporting of recovered wreck in Britain	Receiver of Wreck, Coastguard Agency, Spring Place, 105 Commercial Road, Southampton SO15 1EG, tel: 01703 329474
Reporting of Treasure Trove in England	British Museum, Bloomsbury, London WC1B 3DG, tel: 0171 323 8454 (prehistoric & Romano-British) or 0171 323 8629 (medieval - present)
Reporting of wreck sites of artistic, archaeological or historical importance	The Secretary, Advisory Committee on Historic Wreck, Department of National Heritage, Room 306, 2-4 Cockspur Street, London SW1Y 5DH, tel: 0171 211 6369 or 6367

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

Benacre National Nature Reserve (Suffolk) has a suite of wildlife habitats that range from shingle and sandy beaches, through brackish lagoons and freshwater reedbeds to broadleaved woodland. Reflecting this richness, the site is also a designated Special Protection Area for birds and a candidate Special Area of Conservation under the EC Habitats & Species Directive. However the whole site is threatened by sea-level rise and coastal erosion, and clay banks have been constructed right across the broad to protect inner areas from saltwater flooding. Photo: Peter Wakely, English Nature.

Chapter 7 Coastal protected sites

J. Plaza & R. Keddie

7.1 Introduction

7.1.1 Chapter structure

This chapter incorporates statutory and non-statutory site protection mechanisms operating at international, national and local level, including those administered by voluntary bodies and other organisations who own land. It covers only the various types of site protection mechanisms currently found within this region, giving a brief explanation for each category. For the purposes of this chapter, any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as 'coastal'. Where a site straddles the boundaries of two Coastal Directories Project regions and there is no easy way of calculating the percentage of the site lying in each, the site area has been halved, one half being included in each region. National data included in this section have been collated since 1994 and are as up to date as practicable; regional data are correct as at January 1997, unless otherwise stated.

Statutory protected sites are those notified, designated or authorised under European Directives and/or implemented through British legislation (most notably the Wildlife & Countryside Act 1981) by a statutory body, thereby having recognised legal protection. 'Non-statutory sites' include a wide variety of sites that are not directly protected by legislation but which are recognised by statutory bodies and/or owned, managed or both by non-statutory organisations for their nature conservation or aesthetic value. Note that the categories of conservation protection (e.g. National Nature Reserve, RSPB Reserve) are not mutually exclusive. In many localities several different types of protected site overlap, since they have been identified for different wildlife and landscape conservation purposes. Patterns of overlap are often complex, since site boundaries for different categories of site are not always the same.

Further explanation of the various site protection mechanisms can be found in Davidson *et al.* (1991). Planning Policy Guidance Note (PPG) 9 - Nature Conservation (DoE 1994) also gives useful summaries of existing site protection mechanisms. It sets out the Government's objectives for nature conservation and provides a framework for safeguarding the natural heritage under domestic/international law, emphasises the importance of both designated sites and undesignated areas for nature conservation, advises that potential Special Protection areas (SPAs) and candidate Special Areas of Conservation (SACs) should be treated similarly to classified SPAs and designated SACs, and deals with the treatment of nature conservation issues in development plans. It also includes copies of the Ramsar Convention, the EC Birds Directive and the EC Habitats & Species Directive (including lists of important species and habitat types).

The following types of protected site have not been included in this chapter:

- archaeological designations and protected sites (covered in Chapter 6);
- 'Sites of Importance for Nature Conservation' (SINCs), a general term for the variously-named non-statutory sites identified by local authorities and wildlife trusts as having special local value for nature conservation but not currently managed for nature conservation; in this region the most commonly used term is Site of Nature Conservation Importance. For more information, see Collis & Tyldesley (1993);
- sites designated for fisheries purposes, e.g. areas covered by Several Orders and Regulating Orders (discussed in sections 5.7, 9.1 and 9.2).

Non-site based measures contained in conventions and directives aimed at broad species and habitat protection, such as the Bonn Convention, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), parts of the EC Birds Directive and parts of the EC Habitats & Species Directive, are also not covered. For further information, see references in section 7.1.3.

This chapter is divided into five sections. A regional summary of all categories of site is given in Table 7.1.1. Section 7.2 covers those site-based protection measures falling under international conventions or European directives. Sites identified under national statutes are discussed in section 7.3, whereas section 7.4 covers sites without statutory protection but which are identified, owned or managed by statutory bodies; and finally, other types of site (i.e. those identified, owned or managed by charities, trusts etc.) are described in section 7.5. For each category of protected site, a list of coastal sites is given (clockwise around the coast), showing their type, area/length and location, with an accompanying map. Each section concludes with further information sources and contact points relevant to the region.

7.1.2 Importance of the region

Owing to the presence of large areas of estuaries, tidal creeks and chalk cliffs, Region 7 contains important proportions by area of the coastal protected wildlife sites in Britain. These include 28% and 20% respectively of coastal Ramsar sites and Special Protection Areas. The region also contains a high proportion by area of Britain's Areas of Oustanding Natural Beauty (15%), Country Parks (18%) and Ministry of Defence sites (31.5%). The RSPB holds over 3,000 ha of land in Region 7 (8.4% of their total holdings in

Table 7.1.1 Summary of site protection in Region 7

	Number of protected sites					*Area** covered by site protection*				
	Region	*North Sea Coast*	*% of North Sea Coast total in region*	*GB coast*	*% of GB coast total in region*	*Region (ha**)*	*North Sea Coast (ha**)*	*% of North Sea Coast total in region*	*GB coast (ha**)*	*% of GB coast total in region*
Ramsar sites	17	37	45.9	61	27.9	49,671	189,145	26.3	343,524	14.5
Special Protection Areas	20	60.5	33.1	99	20.2	50,117	199,727	25.2	363,103	13.8
Possible Special Areas of Conservation	8	49	16.3	112	7.1	n/av	n/av	n/av	n/av	n/av
Environmentally Sensitive Areas	3.5*	7	50.0	17	20.6	93,700*	279,478	33.5	1,397,545	6.7
National Nature Reserves	10	43	23.3	80	12.5	7,104	35,830	19.8	87,916	8.1
Sites of Special Scientific Interest	79	557	14.2	1,208	6.5	68,491	335,607	20.4	716,548	9.6
Local Nature Reserves	25	73	34.2	98	25.5	1,196	10,710	11.2	15,279	7.8
Areas of Special Protection	1	14	7.1	23	4.3	n/av	n/av	n/av	n/av	n/av
Areas of Outstanding Natural Beauty	3	14.5	20.7	24	12.5	137,100	714,800	19.2	899,900	15.2
National Parks	1	2	50.0	6	16.7	3,100	173,900	1.8	745,000	0.4
Country Parks	8	24	33.3	38	4.8	815	3,130	26.0	4,628	17.6
Geological Conservation Review sites	67	551	12.2	1,098	6.1	n/ap	n/ap	n/ap	n/ap	n/ap
Heritage Coasts[a]	3	17.5	17.1	45	6.7	71	649	10.9	1,539	4.6
Sensitive Marine Areas	3	16.5	18.2	27	11.1	n/av	n/av	n/av	n/av	n/av
The National Trust[b]	17	191	8.9	453	3.8	1,531	18,610	8.2	64,127	2.4
Royal Society for the Protection of Birds reserves	9	53	17.0	82	11.0	3,298	24,594	13.4	38,719	8.5
The Wildlife Trusts reserves	52	145	35.6	241	21.6	2,683	11,588	23.0	25,898	10.3
Ministry of Defence	8	65	12.3	110	7.3	16,821	34,449	48.8	53,410	31.5
Woodland Trust properties	3	36	8.3	71	4.2	60	1,104	5.5	1,584	4.1

Source: JNCC (October 1996 Ramsar/SPA data). Key: n/ap = not applicable, n/av = not available; *site(s) overlap boundary with adjacent region(s); half the total number has been included here; **to the nearest whole hectare; [a]Heritage Coast data in these columns refer to length in kilometres; [b]includes National Trust for Scotland sites. Notes: site types not currently found in the region: World Heritage (Natural) Sites, Biogenetic Reserves, Biosphere Reserves, National Scenic Areas, Wildfowl & Wetlands Trust sites, Voluntary Marine Nature Reserves, Marine Nature Reserves, John Muir Trust sites. In this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

Great Britain), while 7% of Britain's Local Nature Reserves are found in the region. These figures demonstrate the major conservation importance of the region. Table 7.1.1 summarises site protection in the region, showing the numbers and areas of each type of site and comparing these with North Sea Coast and British (whole country coast) totals.

7.1.3 Further sources of information

A. References cited

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B. Further reading

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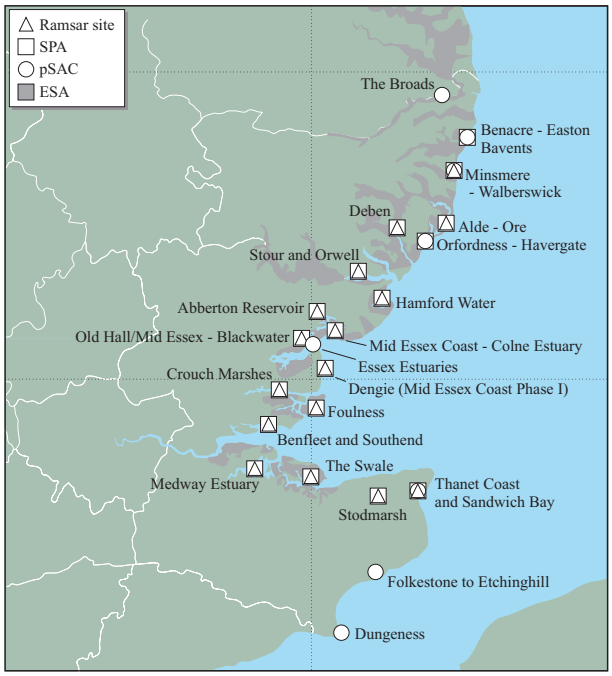
7.2 Sites designated under international conventions and directives

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

7.2.1 Wetlands of international importance (Ramsar sites)

Ramsar sites are statutory areas designated by the UK government on the advice of the conservation agencies under the Ramsar Convention (the Convention on wetlands of international importance especially as waterfowl habitat). Contracting parties (of which the UK is one) are required to designate at least one wetland of international importance and to promote their conservation and 'wise use'. Ramsar sites are designated for their waterfowl populations, their important plant and animal assemblages, their wetland interest or a combination of these. All Ramsar sites have first to be designated as Sites of Special Scientific Interest (SSSIs) (see section 7.3.2). Seventeen coastal Ramsar sites, totalling 49,671 ha, lie entirely within Region 7 (Table 7.2.1; Map 7.2.1). Some of the older sites are wholly contained within newer sites; however, they retain their status and are therefore included in the figures. Sections 5.11 and 5.12 describe the importance of the site for the region's birds.



Map 7.2.1 Coastal Ramsar sites (May 1996), Special Protection Areas (SPAs) (May 1996), 'possible' Special Areas of Conservation (SACs) (November 1995) and Environmentally Sensitive Areas. Note: a single symbol may represent more than one site, either overlapping or in close proximity. Sources: JNCC, English Nature.

7.2.2 Special Protection Areas

The 1979 EC Directive on the Conservation of Wild Birds (the Birds Directive) requires member states to take conservation measures particularly for certain rare or vulnerable species and for regularly occurring migratory species of birds. In part this is achieved through the designation of statutory Special Protection Areas (SPAs) by the UK government on the advice of the statutory conservation agencies. This designation is implemented through the Wildlife & Countryside Act 1981; all SPAs have first to be notified as Sites of Special Scientific Interest. There are twenty coastal SPAs lying entirely within Region 7, with a total area of 50,117 ha (Table 7.2.2; Map 7.2.1). Some of the older sites are wholly contained within newer sites; however, they retain their status and are therefore included in the figures. Sections 5.10, 5.11 and 5.12 describe the importance of these sites for the region's birds.

7.2.3 Special Areas of Conservation

The Special Areas of Conservation (SAC) designation is one of the main mechanisms by which the EC Habitats & Species Directive (1992) will be implemented. SACs are areas identified as outstanding examples of selected habitat types or areas important for the continued well-being or survival of selected non-bird species. The protection measures are based around a series of six annexes: Annexes I and II list the habitats and species that require the designation of SACs; Annex IV prohibits the taking of certain species; Annex V requires the taking of certain species to be monitored; and Annex VI prohibits some means of capture or killing of mammals and fish. In the UK the Directive is implemented through the Conservation (Natural Habitats etc.) Regulations 1994. The Government announced a first list of sites on 31 March 1995 and a second list on 1 October 1997; further sites may be added to the list. In Great Britain there are a total of 112 coastal possible SACs (see JNCC (1995) and Brown *et al.* (1997) for more information). Seven possible SACs lie entirely within Region 7, whilst another two lie partially within the region (Map 7.2.1; Table 7.2.3).

7.2.4 Environmentally Sensitive Areas

European Community authorisation for Environmentally Sensitive Areas (ESAs) is derived from Article 19 of Council Regulation (EEC) No. 797/85 - National Aid in Environmentally Sensitive Areas. ESAs are statutory areas in which the Government seeks to encourage environmentally sensitive farming practices, prevent damage that might result from certain types of agricultural intensification, and restore traditional landscapes, for which

Table 7.2.1 Ramsar sites

Site name	*No. of sites*	*Grid ref.*	*Area (ha*)*	*Date designated*	*Qualifying interest*
Suffolk	**3**				
Minsmere - Walberswick		TM465662	2,004	1976, extended 1992	Representative wetland; rare species
Alde - Ore Estuary		TM432487	2,437	1996	Rare species; substantial numbers of individual waterfowl indicative of wetlands; 1% of a waterfowl species population
Deben Estuary		TM295504	976	1996	Rare species; 1% of a waterfowl species population
Suffolk/Essex	**1**				
Stour and Orwell		TM169331	3,428	1994	Rare species; regularly supports over 20,000 waterfowl and 1% of a waterfowl species population
Essex	**9**				
Hamford Water		TM235255	2,179	1993	1% of a waterfowl species population
Mid-Essex Coast - Colne Estuary		TM075155	2,701	1994	Representative wetland; rare species; genetic and ecological diversity; regularly supports over 20,000 waterfowl and 1% of a waterfowl species population
Abberton Reservoir		TL970180	1,228	1981	Regularly supports 20,000 waterfowl and 1% of a waterfowl species population
Mid-Essex Coast - Blackwater		TL975125	3,657	1995	Representative wetland; rare species; genetic and ecological diversity; regularly supports 20,000 waterfowl and 1% of a waterfowl species population
Old Hall Marshes[a]		TL975125	627	1992	Representative wetland; rare species; 1% of a waterfowl species population
Dengie (Mid-Essex Coast Phase 1)		TM040030	3,127	1994	Representative wetland; rare species; genetic and ecological diversity; regularly supports 20,000 waterfowl; 1% of a waterfowl species population
Crouch Marshes		TQ895967	906	1995	Representative wetland; rare species; regularly supports over 1% of a waterfowl species' population
Foulness (Mid-Essex Coast)		TR000930	10,968	1996	Representative wetland; rare species; genetic and ecological diversity; regularly supports over 20,000 waterfowl and 1% of a waterfowl species' population
Benfleet & Southend		TQ854847	2,251	1994	Regularly supports over 20,000 waterfowl and 1% of a waterfowl species population
Kent	**4**				
Medway Estuary & Marshes		TQ861709	4,682	1993	Rare species; regularly supports over 20,000 waterfowl and 1% of a waterfowl species population
The Swale		TR000670	5,835	1985, extended 1993	Regularly supports 20,000 waterfowl and 1% of a waterfowl species population
Thanet Coast and Sandwich Bay		TR360630	2,183	1994	Rare species; 1% of a waterfowl species population
Stodmarsh		TR220610	481	1993	Rare species; 1% of a waterfowl species population
Region 7	***17***		***49,671****		
North Sea Coast	37		189,145**		
GB coast	61		343,524**		
GB whole country	103		357,911**		

Sources: JNCC October 1996 data; English Nature. Key: *to the nearest whole hectare; **includes areas of all Ramsar designations, whether or not they relate to discrete areas; [a]part of the Blackwater Estuary. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

Table 7.2.2 Special Protection Areas (SPAs)

Site name	*No. of sites*	*Grid ref.*	*Area (ha*)*	*Date designated*	*Qualifying interest*
Suffolk	**5**				
Benacre - Easton Bavents		TM537855	517	1996	Regularly supports Annex 1 species (bittern *Botaurus stellaris*, marsh harrier *Circus aeruginosus* and little tern *Sterna albifrons*). Avocet *Recurvirostra avosetta* and common tern *S. hirundo* occasional. The site also supports wintering and breeding wildfowl, waterfowl, raptors and passerines.
Minsmere - Walberswick		TM465662	2,000	1992	Nationally important numbers of seven species of wintering wildfowl and raptors; breeding raptors, waterfowl and passerines
Alde - Ore Estuary		TM432487	2,437	1996	Nationally important numbers of Annex 1 species (marsh harrier, avocet, ruff *Philomachus pugnax*, Sandwich tern *Sterna sandvicensis*, little tern); internationally important numbers of redshank *Tringa totanus* and lesser black-backed gull *Larus fuscus*
Orfordness - Havergate		TM400470	117	1982	Internationally important numbers of breeding lesser black-backed gulls; nationally important numbers of breeding and wintering waterfowl
Deben Estuary		TM330378	976	1996	Internationally important numbers of wintering and passage redshank; nationally important numbers of dark-bellied brent goose *Branta bernicla bernicla*, shelduck *Tadorna tadorna* and black-tailed godwit *Limosa limosa*
Suffolk/Essex	**1**				
Stour and Orwell		TM169331	3,334	1994	Internationally important numbers of six wintering waterfowl species; nationally important numbers of six wintering waterfowl species; regularly supports over 20,000 wintering waterfowl
Essex	**9**				
Hamford Water		TM235255	2,179	1993	Internationally and nationally important numbers of wintering waterfowl; regularly supports over 20,000 waterfowl
Mid-Essex Coast - Colne Estuary		TM075155	2,701	1994	Internationally important numbers of wintering dark-bellied brent geese and redshank; regularly supports over 20,000 waterfowl; nationally important numbers of breeding little tern, pochard *Aythya ferina* and ringed plover *Charadrius hiaticula*; nationally important numbers of wintering hen harrier *Circus cyaneus* and a further ten species
Abberton Reservoir		TL970180	716	1991	Internationally important numbers of wintering wigeon *Anas penelope*, gadwall *A. strepera* and shoveler *A. clypeata*; nationally important numbers of wintering wildfowl and breeding cormorants *Phalacrocorax carbo*
Blackwater Estuary (Mid-Essex Coast Phase IV)		TL975125	3,657	1995	Internationally important numbers of two wintering waterfowl species; nationally important numbers of six wintering waterfowl species, two breeding species
Old Hall Marshes[a]		TL975125	627	1992	Internationally important numbers of two wintering waterfowl species; nationally important numbers of six wintering waterfowl species, two breeding species
Dengie (Mid-Essex Coast Phase I)		TM040030	3,127	1994	Internationally important numbers of wintering dark-bellied brent geese, grey plover *Pluvialis squatarola*, knot *Calidris canutus*; regularly supports over 20,000 waterfowl; nationally important population of wintering hen harrier, dunlin *Calidris alpina*, black-tailed godwit and bar-tailed godwit *Limosa laponica*

Table 7.2.2 Special Protection Areas (SPAs) (continued)

Site name	*No. of sites*	*Grid ref.*	*Area (ha*)*	*Date designated*	*Qualifying interest*
Essex (continued)					
Benfleet & Southend		TQ854847	2,251	1994	Internationally important numbers of wintering waterfowl; nationally important numbers of wintering waders; regularly supports over 20,000 wintering waterfowl
River Crouch Marshes (Mid-Essex Coast Phase (III)		TQ895967	906	1995	Internationally important numbers of wintering dark-bellied brent geese; nationally important population of wintering hen harrier
Foulness (Mid-Essex Coast)		TR000930	10,968	1996	Nationally important numbers of Annex 1 species (Sandwich tern, common tern, little tern, avocet and hen harrier); nationally important populations of regularly occurring migratory species. Regularly supports over 20,000 wintering waterfowl, and nationally important numbers of shelduck, dunlin and curlew *Numenius arquata*.
The Swale		TR000670	5,835	1982, 1985	Internationally important numbers of five species of wintering waterfowl; nationally important numbers of twelve species of wintering waterfowl; five breeding species; regularly supports over 20,000 wintering waterfowl
The Swale (Phase II)		TR000670	422	1993	Internationally important numbers of five species of wintering waterfowl; nationally important numbers of twelve species of wintering waterfowl; five breeding species; regularly supports over 20,000 wintering waterfowl
Thanet Coast and Sandwich Bay		TR360630	2,183	1994	Internationally important numbers of wintering turnstone *Arenaria interpres*; nationally important numbers of six wintering species
Stodmarsh		TR220610	481	1993	Nationally important numbers of wintering hen harrier and wildfowl; breeding wildfowl and passerines
Region 7	***20***		***50,117***		
North Sea Coast	60.5**		199,727**		
GB coast	99		363,103		
GB whole country	133		495,843		

Sources: JNCC October 1996 data; English Nature; Pritchard *et al.* (1992). Key: *to the nearest whole hectare; **one site overlaps the boundary between the West Coast and North Sea Coast of Britain: half the site/area are included here; [a]part of the Blackwater Estuary. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

member states are allowed to make payments to farmers. There are three whole and part of one other ESA (93,700 ha) that include land in Region 7 (Table 7.2.4; Map 7.2.1).

7.2.5 Acknowledgements

Thanks are due to John Gibson and other staff of the JNCC, Alan Law and Siâron Hooper (English Nature) and the Ministry of Agriculture, Fisheries and Food (MAFF).

7.2.6 Further sources of information

A. References cited

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Pritchard, D.E., Housden, S.D., Mudge, G.P., Galbraith, C.A., & Pienkowski, M.W., *eds.* 1992. *Important bird areas in the UK including the Channel Islands and the Isle of Man.* Sandy, RSPB.

Table 7.2.3 Possible Special Areas of Conservation (SACs)

Site name	*No. of sites*	*Qualifying interest*
Norfolk/Suffolk	**0.5***	
The Broads*		Fen orchid *Liparis loeselii*, Desmoulin's snail *Vertigo moulinsiana*, alkaline fens; calcareous fens with *Cladium mariscus* and *Carex davalliana*; natural eutrophic lakes with *Magnopotamion-* or *Hydrocharition*-type vegetation; residual alluvial forests (*Alnion glutinoso-incanae*); transition mires and quaking bogs
Suffolk	**3**	
Benacre to Easton Bavents Lagoons		Lagoons
Minsmere to Walberswick Heaths and Marshes		Annual vegetation of drift lines; dry heaths (all subtypes)
Orfordness-Shingle Street		Annual vegetation of drift lines; lagoons; perennial vegetation of stony banks
Essex	**1**	
Essex Estuaries		Atlantic salt meadows *(Glauco-Puccinellietalia)*; estuaries; Mediterranean and thermo-Atlantic halophilous scrubs (*Arthrocnemetalia fruticosae*); mudflats and sandflats not covered by seawater at low tide; *Salicornia* and other annuals colonising mud and sand; *Spartina* swards *(Spartinion)*
Kent	**3**	
Thanet Coast		Reefs; submerged or partly submerged sea caves
Sandwich Bay		Dunes with *Salix arenaria*; embryonic shifting dunes; fixed dunes with herbaceous vegetation (grey dunes); shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)
Folkestone to Etchinghill Escarpment		Semi-natural dry grasslands and scrubland facies: on calcareous substrates (*Festuco-Brometalia*); important orchid sites
East Sussex/Kent	**0.5***	
Dungeness*		Annual vegetation of drift lines; perennial vegetation of stony banks.
Region 7	*8**	
North Sea Coast	49	
GB	112	

Sources: JNCC, English Nature. Key: *site overlaps boundary with adjacent region; half the site has been included in the regional total. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

B. Further reading

Department of the Environment. 1995. *The Habitats Directive: how it will apply in Great Britain*. London, Department of Environment, The Scottish Office and the Joint Nature Conservation Committee.

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Stroud, D.A., Mudge, G.P., & Pienkowski, M.W. 1990. *Protecting internationally important bird sites. A review of the EEC Special Protection Area network in Great Britain*. Peterborough, Nature Conservancy Council.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Ramsar sites, SPAs, Special Areas of Conservation (Suffolk)	*Conservation Officer, English Nature Suffolk Local Team, Bury St Edmunds, tel: 01284 762218
Ramsar sites, SPAs, Special Areas of Conservation (Essex)	*Conservation Officer, English Nature Essex, Herts. & London Local Team, Colchester, tel: 01206 796666
Ramsar sites, SPAs, Special Areas of Conservation (Kent)	*Conservation Officer, English Nature Kent Local Team, Wye, tel: 01233 812525
Ramsar sites, SPAs (Suffolk & Essex)	*Regional Officer, RSPB, East Anglia Office, Norwich, tel: 01603 660066
Ramsar sites, SPAs (Kent)	*Regional Officer, RSPB, South East England Office, Shoreham-by-Sea, tel: 01273 463642
Special Areas of Conservation	*Department of the Environment, Transport and the Regions (DETR), European Wildlife Division, Bristol, tel: 0117 987 8811 ext. 8341

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

Table 7.2.4 Environmentally Sensitive Areas (ESAs)

Site name	*No. of sites*	*Area (ha)**	*Date designated*	*Interest*
Norfolk/Suffolk	**0.5***			
The Broads*		8,900	1987	Lowland river valley grassland wetland: system of broads, waterways, reed swamps, fens, carr woodland and drained grazing marsh
Suffolk	**1**			
Suffolk River Valleys		43,600	1988	Grassland and associated reedbeds, ditches, hedgerows and trees which contrast with surrounding arable land. River valleys and coastal marshes provide wildlife habitat important for wetland bird populations. Archaeological interest.
Essex	**1**			
Essex Coast		27,500	1994	Coastal wet grasslands supporting internationally important numbers of overwintering and breeding waterfowl; greatest density of Iron Age and Roman salt production sites
Kent	**1**			
North Kent Marshes		13,700	1993	Coastal wet grasslands supporting internationally important numbers of overwintering and breeding waterfowl; freshwater and brackish ditches and dykes with aquatic flora; saltworking mounds and old field systems
Region 7	***3.5****	***93,700***		
North Sea Coast	7	279,478		
GB coast	17	1,397,545		

Sources: MAFF, SOAEFD, English Nature. Key: *the majority of The Broads (27,200 ha) is in Norfolk (Region 6): half the site is included in the Region 7 total number of sites. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

7.3 Sites established under national statute

Included in this section are the types of site identification made under national legislation relating to wildlife, landscape and amenity value. Identifications are made by the statutory nature conservation agencies (in this region English Nature), local authorities or the government acting on advice from these bodies.

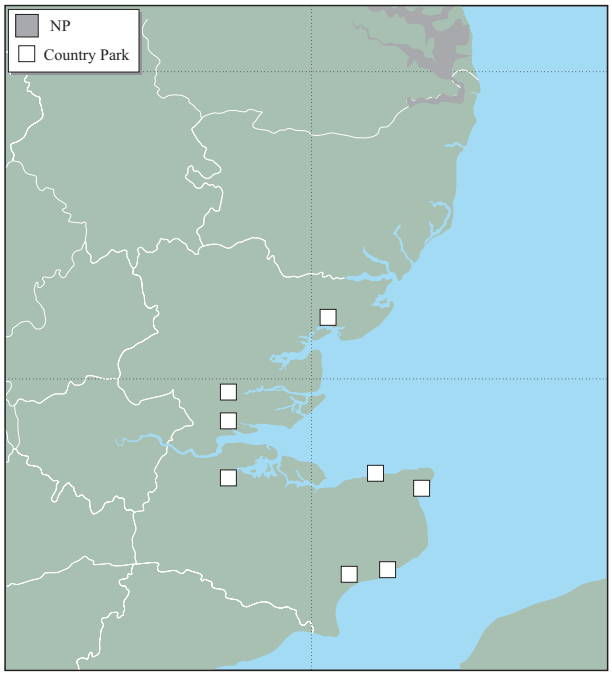
7.3.1 National Nature Reserves

National Nature Reserves (NNRs) contain examples of some of the most important natural and semi-natural ecosystems in Great Britain. They are managed to conserve their habitats, providing special opportunities for scientific study of the habitats, communities and species represented within them (Marren 1994). They are declared by the country agencies under section 19 of the National Parks and Access to the Countryside Act 1949, or section 35 of the Wildlife & Countryside Act 1981. All NNRs are also Sites of Special Scientific Interest (SSSIs). There are ten coastal NNRs (7,104 ha) in Region 7 (Table 7.3.1; Map 7.3.1).

7.3.2 Sites of Special Scientific Interest

Sites of Special Scientific Interest (SSSIs) are notified under the Wildlife & Countryside Act 1981. They are intended to form a national network of areas, representing in total the parts of Britain in which the natural features, especially those of greatest value to wildlife and earth science conservation, are most highly concentrated or of highest quality. Each SSSI represents a significant fragment of the much-depleted resource of wild nature remaining in Britain. Within the area of an SSSI the provisions of the Wildlife & Countryside Act 1981 and its 1985 amendments aim to limit or prevent operations that are potentially damaging to the wildlife interest of the area. There are 79 coastal SSSIs (68,491 ha) in Region 7, as at January 1997 (Table 7.3.2; Map 7.3.1). Around 8% of the total land area of Britain is within SSSIs.

Over half of the SSSIs in the region (63%) have some intertidal land, while only 37% are purely terrestrial. Three-quarters of the SSSIs were selected at least partly for their biological interest and over half (52%) at least partly for their earth science (geological or geomorphological) interest. Of the total, one fifth (20%) have both biological and earth science interest. Examples of a wide range of habitats and species occur within the SSSIs in this region, the most frequently occurring habitats being tidal flats, open water, saltmarshes, wet grasslands/grazing marsh, dry grasslands, woodland and reed beds, these habitats occurring in 25-51% of sites. SSSIs in the region include several sites of interest for their reptiles (52%), terrestrial invertebrates (48%), waders (25%) and wildfowl (27%). Further details of SSSIs may be found in the UKDMAP datasets module disseminated by the JNCC (BODC 1992; Barne *et al.* 1994).



Map 7.3.1 Coastal National Nature Reserves (NNR) and Sites of Special Scientific Interest (SSSI). Note: a single symbol may represent more than one site in close proximity. Sources: English Nature; JNCC; Marren (1994).

7.3.3 Local Nature Reserves

Local Nature Reserves (LNRs) are designated by local authorities under section 21 of the National Parks & Access to the Countryside Act 1949, for the same purposes as NNRs but because of the local rather than the national interest of the site and its wildlife. Under this Act local authorities have the power to issue bylaws to protect the LNR. There are 25 LNRs (1,196 ha) in Region 7 (Table 7.3.3; Map 7.3.2).

7.3.4 Areas of Special Protection

'Area of Special Protection' (AoSP) is a designation replacing Bird Sanctuary Orders made under the 1954 to 1967 Protection of Birds Acts, which were repealed and amended under the Wildlife & Countryside Act 1981. Designation aims to prevent the disturbance and destruction of the birds for which the area is identified, by making it unlawful to damage or destroy either the birds or their nests and in some cases by prohibiting or restricting access to the site. There is one AoSP in Region 7 (Table 7.3.4; Map 7.3.2).

7.3.5 Areas of Outstanding Natural Beauty

The primary purpose of the Area of Outstanding Natural Beauty (AONB) designation is to conserve natural beauty, but account is taken of the need to safeguard agriculture, forestry and other rural industries, and of the economic and social needs of local communities (Countryside Commission 1994). In England, AONBs are designated by the

Table 7.3.1 National Nature Reserves (NNRs)

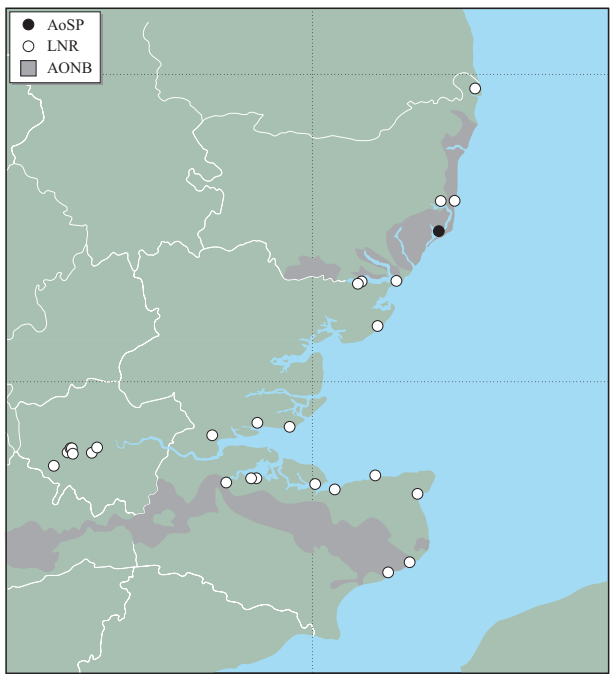
Site name	*No. of sites*	*Grid ref.*	*Area (ha*)*	*Date last declared*	*Habitats*
Suffolk	**3**				
Benacre		TM525830	232	1987-1993	Brackish pools, lagoon, reedbed, sand dunes, shingle beaches and broadleaved woodland
Walberswick		TM470733	582	1972-1973	Heath, grazing marsh, reedbed, woodland, intertidal mudflats, saltmarsh and shingle
Orfordness - Havergate		TM410483	228	1954-1972	Tidal mudflats, saltmarsh, shingle and brackish lagoons
Essex	**5**				
Hamford Water		TM230250	1,449	1983-1996	Foreshore, mudflats, shingle and shell banks, saltmarsh, low dunes, coastal grassland
Colne Estuary		TM060130; TM099134	576	1983	Grazing marsh, saltmarsh and mudflats, shingle spit
Blackwater Estuary		TL960080	1,031	1983	Remote mudflats, grazing marsh, fresh and brackish pools and ditches
Dengie		TM050030	2,366	1983-1994	Tidal mudflats, shell-gravel beaches and saltmarsh
Leigh		TQ835845	257	1974	Saltmarsh, mudflats and grazing marsh
Kent	**2**				
The Swale		TR038677	220	n/a	Freshwater grazing marsh, saltmarsh and mudflats
Stodmarsh		TR220617	163	n/a	Flood meadow, reedbed, shallow lagoons and alder carr
Region 7	***10***		***7,104***		
North Sea Coast	43		35,830		
GB coast	80		87,916		
GB whole country	288		196,292		

Source: English Nature, JNCC, Marren (1994). Key: *to the nearest whole hectare. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

Countryside Commission, under the National Parks & Access to the Countryside Act 1949. There are three AONB (137,100 ha) in Region 7 (Table 7.3.5; Map 7.3.2). In 1995 the total area covered by AONBs was just over 14% of the countryside of England and Wales.

7.3.6 National Parks

National Parks in England and Wales were designated by the National Parks Commission and confirmed by the Government between 1951 and 1957. The purpose of National Parks is to preserve and enhance the most beautiful, dramatic and spectacular expanses of countryside in England and Wales (Countryside Commission 1992), while promoting public enjoyment of them, and having regard for the social and economic well-being of those living within them. The Countryside Commission (England) and the Countryside Council for Wales advise government on National Parks, each of which is administered by a Park Authority. One area with similar status to National Parks, The Broads, was established in 1989 and occupies 3,100 ha in Region 7 and 27,200 ha in Region 6 (Table 7.3.6; Map 7.3.3).



Map 7.3.2 Coastal Area of Special Protection (AoSP), Local Nature Reserves (LNR) and Areas of Outstanding Natural Beauty (AONB). Sources: Countryside Commission; DoE European Wildlife Division.

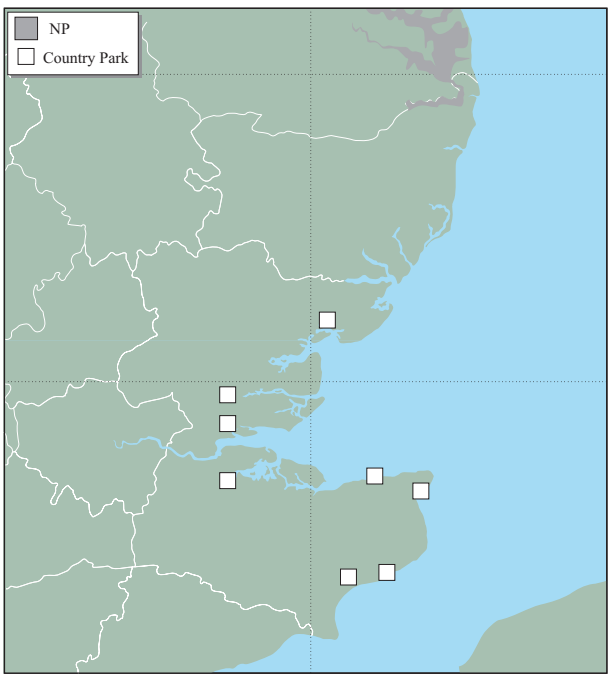
Table 7.3.2 SSSIs in Region 7

Site name	*No. of sites*	*Grid ref.*	*Area (ha)**	*Date last notified*
Suffolk	**28**			
Corton Cliffs		TM545971	6	1987
Sprat's Water & Marshes		TM507921	56	1986
Barnby Broad & Marshes		TM480910	190	1990
Benacre to Easton Bavents		TM537855	526	1989
Minsmere - Walberswick Heath & Marshes		TM465662	2,326	1987
Sizewell Marshes		TM466638	104	1992
North Warren & Thorpeness Mere		TM460594	130	1986
Aldeburgh Brick Pit		TM452573	1	1990
Round Hill Pit, Aldeburgh		TM444573	1	1987
Snape Warren		TM404577	47	1989
Iken Wood		TM396566	5	1986
Crag Pit, Aldeburgh		TM458580	<1	1987
Aldeburgh Hall Pit		TM453566	1	1986
Chillesford Church Pit		TM383523	1	1986
Richmond Farm Pit, Gedgrave		TM412492	1	1985
Gedgrave Hall Pit		TM405485	1	1985
Orfordness - Havergate		TM400472	602	1985
Alde - Ore Estuary		TM398452	2,554	1985
Buckanay Farm Pit, Alderton		TM356424	1	1988
Rockhall Wood Pit, Sutton		TM305440	5	1986
Ferry Cliff, Sutton		TM278486	3	1986
Deben Estuary		TM295504	976	1991
Ramsholt Cliff		TM298428	2	1987
Bawdsey Cliff		TM338380	23	1987
Landguard Common		TM285315	31	1984
Stoke Tunnel Cutting, Ipswich		TM160434	2	1990
Orwell Estuary		TM170415	1,293	1985
Freston and Cutlers Wood with Holbrook Park		TM150386; TM162395	142	1986
Essex	**31**			
Cattawade Marshes		TM090329	88	1988
Stour Estuary		TM180330	2,150	1985
Stour & Copperas Woods		TM190313	77	1984
Harwich Foreshore		TM263320	11	1986
Hamford Water		TM235255	2,130	1987
The Naze		TM266237	22	1985
Holland Haven Marshes		TM211170	209	1992
Clacton Cliffs & Foreshore		TM146128	26	1986
Holland-on-Sea Cliff		TM211167	1	1992
St Osyth's Pit		TM119170	0.1	1987
Upper Colne Marshes		TM022232	114	1992
Colne Estuary		TM075155	2,915	1989
Roman River		TM000210	276	1987
Tollesbury Wick Marshes		TL979100	128	1990
Old Hall Marshes		TL975125	627	1991
Abberton Reservoir		TL970180	716	1988
Maldon Cutting		TL842068	<1	1986
Blackwater Estuary		TL940070	5,800	1983
Sandbeach Meadows		TM021050	30	1987
Dengie		TM045030	3,105	1985
The Cliff, Burnham-on-Crouch		TQ922967	4	1986
Crouch and Roach Estuaries		TQ870970	1,776	1996
Foulness		TR030905	11,027	1993
Benfleet & Southend Marshes		TQ854847	2,099	1987
Pitsea Marsh		TQ740870	95	1987
Vange & Fobbing Marshes		TQ730840	165	1987
Mucking Flats & Marshes		TQ696785	323	1991
Grays Thurrock Chalk Pit		TQ609789	17	1993
Lion Pit		TQ598781	3	1986
West Thurrock Lagoons		TQ585766	81	1991
Purfleet Chalk Pits		TQ566785; TQ569786; TQ560784	10	1986
London	**3**			
Inner Thames Marshes		TQ531800	479	1986
Syon Park		TQ176766	22	1984

Table 7.3.2 SSSIs in Region 7 (continued)

Site name	*No. of sites*	*Grid ref.*	*Area (ha)**	*Date last notified*
London (continued)				
Gilbert's Pit, Charlton		TQ418786	5	1985
Kent	**16**			
Bakers Hole		TQ612741	7	1989
Tower Hill to Cockham Wood		TQ765714	47	1987
Peter's Pit		TQ717629	24	1986
Holborough to Burham Marshes		TQ712618	149	1990
South Thames Estuary & Marshes		TQ770785	5,449	1991
Medway Estuary & Marshes		TQ850720	6,840	1992
Warden Point		TR020725	107	1984
The Swale		TR000670	6,569	1984
Tankerton Slopes		TR121673	2	1986
Thanet Coast		TR132675	819	1987
Stodmarsh		TR222618	604	1984
Sandwich Bay & Hackling Marshes		TR353585	1,743	1985
Dover to Kingsdown Cliffs		TR332419	300	1987
Folkestone Warren		TR276386	300	1987
Folkestone to Etchinghill Escarpment		TR171394; TR235376	270	1985
Romney Warren		TR085262	115	1987
Kent/E.Sussex	**1****			
Dungeness**		TR050180	3,172	1988
Walland Marsh**		TQ960240	5	1986
Region 7	***79****		***68,491***	
North Sea Coast	557		335,607	
GB coast	1,208		716,548	
GB whole country	6,095		1,940,843	

Source: English Nature. Key: *to the nearest whole hectare; **sites overlap boundary with Region 8; half the number and total area have been included here. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.



Map 7.3.3 Coastal National Park (NP) and Country Parks. Source: Countryside Commission.

7.3.7 Country Parks

Country Parks are primarily intended for recreation and leisure opportunities close to population centres and do not necessarily have any nature conservation interest. Nevertheless, many are in areas of semi-natural habitat and so form a valuable network of locations at which informal recreation and the natural environment co-exist. They are statutorily declared and managed by local authorities under section 7 of the Countryside Act 1968. There are eight coastal Country Parks (815 ha) in Region 7 (Table 7.3.7; Map 7.3.3).

7.3.8 Acknowledgements

Thanks are due to Roger Bolt (JNCC), Phillip Biss (English Nature), Sylvia Way (JNCC) and Neale Oliver (DETR) in particular, and to Paul Johnson and Ray Woolmore (Countryside Commission).

Table 7.3.3 Local Nature Reserves (LNRs)

Site name	*No. of sites*	*Grid ref.*	*Area (ha)**	*Date last designated/ opened*
Suffolk	**4**			
Gunton Warren & Corton Woods		TM547959	30	1993
The Haven, Aldeburgh		TM467577	22	1994
Leathes Ham		TM420570	5	1993
Landguard		TM283315	24	1979
Essex	**6**			
Wrabness		TM160315	21	1993
Pickers Ditch Meadow		TM178178	3	1992
Holland Haven		TM220173	31	1992
Gunners Park, Shoeburyness		TQ930842	7	1987
Belton Hills		TQ830859	20	1990
Grove House Wood		TQ686818	2	1993
Greater London	**6**			
Chiswick Eyot		TQ219779	1	1993
Leg of Mutton Reservoir		TQ218777	8	1990
Duke's Hollow		TQ213763	<1	1993
Ham Lands		TQ165720	65	1992
Barnes Common		TQ225760	47	1992
Battersea Nature Area		TQ285771	2	1993
Kent	**9**			
Baty's Marsh		TQ730672	5	1987
Berengrove Lane Chalk Pit		TQ820670	11	1984
Oare Marshes		TR012645	69	1983
South Bank of Swale		TR021660	20	1969
Seasalter Levels		TR080640	72	1984
Bishopstone Cliffs		TR215690	30	1991
Pegwell Bay - Sandwich Bay		TR350630	610	1994
Western Heights		TR310409	51	1994
Folkestone Warren		TR250380	40	1990
Region 7	***25***		***1,196***	
North Sea Coast	73		10,710	
GB coast	98		15,279	
GB whole country	398		21,632	

Source: English Nature. Key: *to the nearest whole hectare. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

Table 7.3.4 Areas of Special Protection (AoSPs)

Site name	*No. of sites*	*Date designated*
Suffolk	**1**	
Havergate Island		1961
Region 7	***1***	
North Sea Coast	14	
GB coast	23	
GB whole country	38	

Source: DoE (DETR) European Wildlife Division. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

Table 7.3.5 Areas of Outstanding Natural Beauty (AONBs)

Site name	*No. of sites*	*Area (ha*)*	*Date designated*
Suffolk	**1**		
Suffolk Coast and Heaths		40,300	1970
Essex and Suffolk	**1**		
Dedham Vale		9,000	1970-91
Kent	**1**		
Kent Downs		87,800	1968
Region 7	***3***	***137,100***	
North Sea Coast	14.5	714,800	
GB coast	24	899,900	
GB whole country	41	2,123,700	

Source: Countryside Commission. Key: *to the nearest 100 ha. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

Table 7.3.6 National Parks

Site name	*No. of sites*	*Area (ha*)*	*Date designated*
Norfolk/Suffolk	**1**		
The Broads		3,100**	1989
Region 7	***1***	***3,100***	
North Sea Coast	2	173,900	
GB coast	6	745,000	

Source: Countryside Commission. Key: *to the nearest 100 ha; ** area of site in Region 7. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

Table 7.3.7 Country Parks

Site name	*No. of sites*	*Grid ref.*	*Area (ha*)*	*Date designated*
Essex	**3**			
Cudmore Grove		TM067146	14	1979
Marsh Farm		TQ810960	96	1981
Hadleigh Castle		TQ805860	141	1987
Kent	**5**			
Riverside (Eastcourt Meadows)		TQ805687	376	1978
Reculver		TR225691	37	1990
Pegwell Bay		TR350630	28	1981
Brockhill (Hythe)		TR175355	22	1986
Folkestone Cliff and Warren		TR250380	100	1992
Region 7	***8***		***815***	
North Sea Coast	24		3,130	
GB coast	38		4,628	
GB whole country	285		35,337	

Source: Countryside Commission. Key: *to the nearest whole hectare. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

7.3.9 Further sources of information

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
NNRs, SSSIs, LNRs, AoSPs (Suffolk)	*Conservation Officer, English Nature Suffolk Local Team, Bury St. Edmunds, tel: 01284 762218
NNRs, SSSIs, LNRs, AoSPs (Essex & London)	*Conservation Officer, English Nature Essex, Herts. & London Local Team, Colchester, tel: 01206 796666 or 0171 831 6922
NNRs, SSSIs, LNRs, AoSPs (Kent)	*Conservation Officer, English Nature Kent Local Team, Wye, tel: 01233 812525
LNRs, Country Parks (Suffolk)	*Suffolk County Council, Ipswich, tel: 01473 583000
LNRs, Country Parks (Essex)	*Essex County Council, Chelmsford, tel: 01245 492211
LNRs, Country Parks (Kent)	*Kent County Council, Maidstone, tel: 01622 671411
AONB, National Parks	*Countryside Commission (CC) Cheltenham, tel: 01242 521381
Areas of Special Protection	*European Wildlife Division, DETR, Bristol, tel: 0117 987 8811
The Broads National Park	Broads Authority, Norwich, tel: 01603 610734
Coastal and marine UKDMAP datasets	*Coastal Data Custodian, JNCC, Peterborough, tel: 01733 562626

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

7.4 Sites identified by statutory agencies

This section covers sites which, although not protected by statute, have been identified by statutory agencies as being of nature conservation or landscape importance.

7.4.1 Nature Conservation Review sites

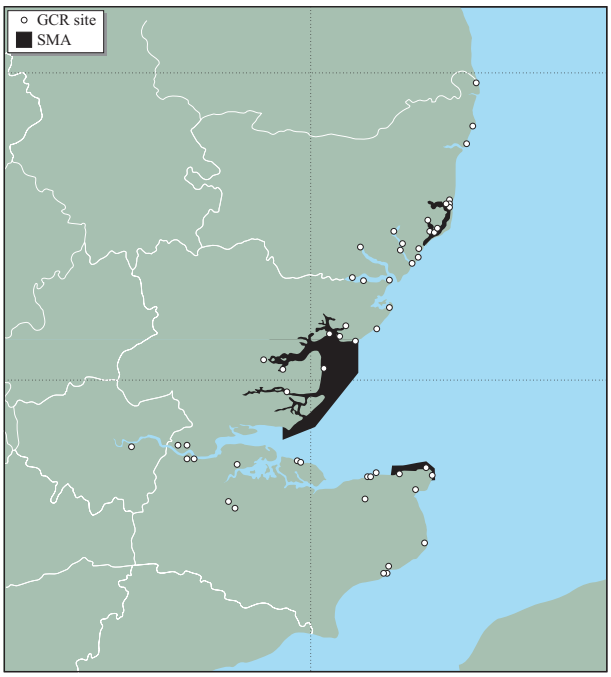
Nature Conservation Review (NCR) sites are non-statutory sites that are the best representative examples of wildlife habitat; for some coastal sites, for example estuaries, all sites that were above a critical standard of nature conservation importance were selected. Ratcliffe (1977) related this particularly to migrant and wintering waterfowl populations and breeding bird assemblages. The NCR helps to identify sites that may qualify for declaration as National Nature Reserves. There are 953 NCR sites (approximately 1,500,000 ha) in Britain. 149 of them (approximately 360,000 ha) are coastal as defined by Ratcliffe (1977), but his definition of 'coastal' differed from that adopted in this chapter.

7.4.2 Geological Conservation Review sites

Geological Conservation Review (GCR) sites are non-statutory sites identified as having national or international importance for earth science. It is intended that all GCR sites will eventually be notified as SSSIs. The GCR selection process describes and assesses key sites in the context of their geology, palaeontology, mineralogy or geomorphology; GCR sites are the earth science equivalent of NCRs (see section 7.4.1). There are 67 coastal GCR sites in Region 7 (Table 7.4.1; Map 7.4.1). Detailed scientific accounts of coastal and inland GCR sites are contained in 22 volumes, published or in preparation at the time of writing, of a planned 42-volume *Geological Conservation Review* series (see e.g. Ellis *et al.* 1995).

7.4.3 Heritage Coasts

A Heritage Coast is an area selected for having a coastline of exceptionally fine scenic quality exceeding 1 mile in length, substantially undeveloped and containing features of special significance and interest. This non-statutory protection is agreed between local authorities and the Countryside Commission, as an aid to local authorities in planning and managing their coastlines. There are three Heritage Coasts (71 km) in Region 7 (Table 7.4.2; Map 7.4.2). Of the English coastline encompassed by Heritage Coasts, 39.5% is protected by the National Trust (Heritage Coast Forum 1993).



Map 7.4.1 Geological Conservation Review (GCR) sites and Sensitive Marine Areas (SMA). Note: a single symbol may represent more than one site in close proximity. Sources: English Nature; JNCC.

Map 7.4.2 Heritage Coasts. Source: Countryside Commission.

Table 7.4.1 GCR sites

Site name	*No. of sites*
Suffolk	**23**
Corton	
Benacre Ness	
Easton Bavents (2 sites)	
Craig Pit Nursery	
Round Hill	
Aldeburgh Hall	
Richmond Farm	
Gedgrave Hall	
The Cliff, Gedgrave	
Buckanay Farm Pit	
Orfordness	
Ferry Cliff	
Stoke Tunnel (2 sites)	
Aldeburgh Brick Pit	
Chillesford Church	
Ramsholt Cliff	
Bawdsey Cliff	
Rockhall Wood (2 sites)	
Stutton (2 sites)	
Essex	**17**
Wrabness	
Harwich	
Walton-on-the-Naze (3 sites)	
Clacton	
St Osyth	
Holland-on-Sea Cliff	
St Osyth Marsh, Colne Point	
East Mersea	
Maylandsea	
Dengie	
Burnham-on-Crouch (2 sites)	
Lion Pit	
Essex (continued)	
Purfleet	
Maldon Cutting	
Greater London	**1**
Gilberts Pit	
Kent	**26**
Lower Upnor	
Sheppey (2 sites)	
Warden Point (3 sites)	
Herne Bay (2 sites)	
Walpole Bay Cliffs and Grenham Bay Cliffs	
Foreness Point	
North Cliff, Broadstairs	
Thanet Coast	
Pegwell Bay (2 sites)	
Bakers Hole	
Allington Quarry	
East Wear Bay	
Barnfield Pit	
Aylesford	
Sturry Gravel Pits	
Kingsdown - Dover	
Folkestone Warren	
Bishopstone Cliffs	
East Wear Bay	
Dover - Kingsdown Cliffs	
Folkestone	
Region 7	*67*
North Sea Coast	551
GB coast	1,098
GB whole country	3,023

Sources: JNCC, English Nature. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

Table 7.4.2 Heritage Coasts

Site name	*No. of sites*	*Grid ref.*	*Length (km*)*	*Date designated*
Suffolk	**1**			
Suffolk		TM537845-TM325365	57	1973
Kent	**2**			
South Foreland		TR340432-TR382482	7	1975
Dover-Folkestone		TR243372-TR308398	7	1975
Region 7	*3*		*71*	
North Sea Coast	17.5		649	
England & Wales	45		1,539	

Source: Countryside Commission. Key: *to the nearest whole kilometre. Note: all Heritage Coasts are completely defined (i.e. also have a defined landward boundary).

7.4.4 Sensitive Marine Areas

Sensitive Marine Areas (SMAs) are non-statutory marine areas that are nationally important and notable for their marine animal and plant communities or which provide ecological support to adjacent statutory sites. They are identified by English Nature with the aim of raising awareness and disseminating information to be taken into account in estuarine and coastal management planning. These areas rely on the co-operation of users and local communities for sustainable management, with the help of grant aid. SMA is the term used for areas described in previous technical documents (e.g. English Nature 1994a) as 'Important Areas for Marine Wildlife' under English Nature's initiative '*Managing England's marine wildlife*' (English Nature 1994b). There are three Sensitive Marine Areas are in Region 7 (Table 7.4.3; Map 7.4.1): all were identified in 1994.

Table 7.4.3 Sensitive Marine Areas (SMAs)

Site name	*No. of sites*
Suffolk Orfordness	**1**
Essex Colne/Blackwater Estuaries to Maplin Sands	**1**
Kent Thanet	**1**
Region 7 North Sea Coast GB coast	***3*** 16.5 27

Source: English Nature (1994a)

7.4.5 Acknowledgements

Thanks are due to Ray Woolmore and Paul Johnson (Countryside Commission), Roger Bolt and the Earth Sciences Branch (JNCC), and Paul Gilliland and Peter Lambley (English Nature).

7.4.6 Further sources of information

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Smith, D.B. 1995. *Marine Permian of England.* London, Chapman & Hall. (Geological Conservation Review series, No. 8.)

C. Contact names and addresses

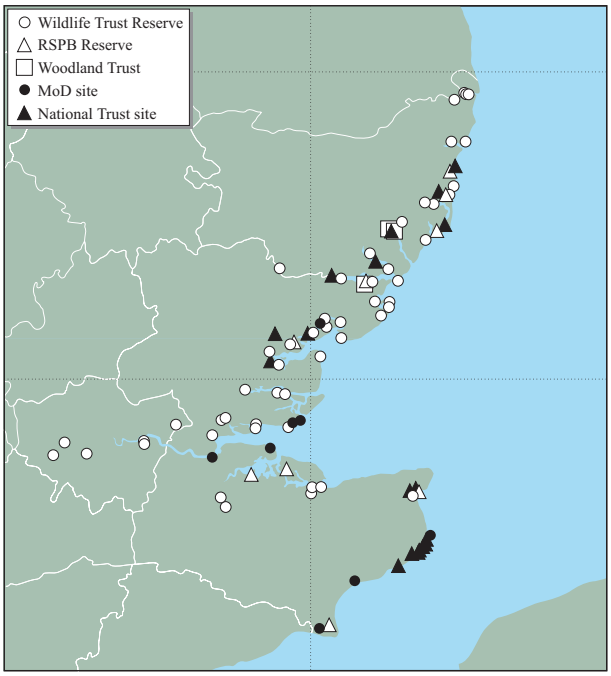
Type of information	*Contact address and telephone no.*
NCR sites, GCR sites, SMAs (Sussex)	*Conservation Officer, English Nature Suffolk Local Team, Bury St Edmunds, tel: 01284 762218
NCR sites, GCR sites, SMAs (Essex)	*Conservation Officer, English Nature Essex, Herts. & London Local Team, Colchester, tel: 01206 796666
NCR sites, GCR sites, SMAs (Kent)	*Conservation Officer, English Nature Kent Local Team, Wye, tel: 01233 812525
Heritage Coasts (Kent)	*Countryside Commission South East, London, tel: 0171 831 3510
Heritage Coasts (Suffolk)	*Countryside Commission Eastern Region, Cambridge, tel: 01223 354462

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

7.5 Other types of protected site

7.5.1 The National Trust

The National Trust is an independent charity that is currently the largest private landowner in Britain. The National Trust owns around 240,000 ha of land in England, Wales and Northern Ireland, and over 200 buildings of outstanding importance. It has also accepted or bought covenants that protect against development for a further 48,000 ha of land and buildings. Many of the tenanted properties have individual intrinsic value; together they protect large areas of unique landscape and countryside. The National Trust has statutory powers to protect its properties, under an Act of Parliament (1907) which declares its holdings of land and buildings inalienable; these properties cannot be sold or mortgaged. In addition, National Trust properties can be protected by bylaws. In 1985 the National Trust relaunched its 1965 campaign 'Enterprise Neptune' to raise funds for the purchase of coastal areas. A total of 900 km of coast are now owned or managed by the National Trust (National Trust 1996). There are seventeen National Trust sites (1,531 ha) in Region 7 (Table 7.5.1; Map 7.5.1).



Map 7.5.1 Other types of coastal protected site. Sources: National Trust; RSPB; Wildlife Trusts; Ministry of Defence (MoD); Woodland Trust.

Table 7.5.1 National Trust sites*

Site name	*No. of sites*	*Grid ref.*	*Area (ha**)*	*Date acquired*	*Landform*
Suffolk	**5**				
Dunwich Heath		TM475683	87	1968-1987	Sandy cliffs, beach, foreshore, heathland
Kyson Hill		TM269477	2	1934	Coastal parkland
Orford Ness		TM489449	627	1993	Shingle spit, important bird population, saltmarshes
Pin Mill		TM214380	35	1979-1987	Natural and planted coastal woodland
Flatford Mill, Judas Gap, and Valley Farm		TM077332	7	1943-1987	Grazing land, marsh, historical buildings and Field Studies Centre
Essex	**3**				
Ray Island		TM005145	41	1970	Salting
Copt Hall		TL891146	162	1989	Saltmarshes, sea walls and coastland
Northey Island and South House Farm		TL872058	122	1978	Island with saltmarsh
Kent	**9**				
Pegwell Bay		TR343627	145	1981	Saltmarsh, mudflats and coastline
Sandwich Bay		TR347620	78	1968-1975	Coastal saltings, sand dunes and foreshore
Kingsdown Leas and The Leas		TR380470	9	1978	Clifftop
Bockhill Farm		TR370455	116	1974-1986	Clifftop, farmland and common land
Bockell Hill		TR370451	5	1985	Grazing land
Lighthouse Down		TR366437	4	1978	Cliffland
Langdon Hole		TR344425	43	1992	Lighthouse and garden
Dover: Langdon Cliffs and Foxhill Down		TR335423	21	1988	Cliff, chalk downland and scrub
Dover: Great Farthingloe		TR292393	27	1979	Cliff and farmland
Region 7	***17***		***1,531***		
North Sea Coast[a]	191		18,610		
GB whole coast[a]	453		64,127		

Source: National Trust (1996). Key: *includes only sites that are of natural heritage interest; **to the nearest whole hectare; [a] includes National Trust for Scotland sites. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

7.5.2 The Royal Society for the Protection of Birds

The Royal Society for the Protection of Birds (RSPB) currently manages over 130 reserves (84,000 ha) in Britain (RSPB 1993). Wherever possible, reserves are purchased, so that the level of safeguard for the wildlife and their habitats is high. Where reserves are leased, the RSPB aims to acquire long leases (longer than 21 years) with appropriate management rights. There are nine RSPB reserves (3,298 ha) in Region 7 (Table 7.5.2; Map 7.5.1).

7.5.4 The Wildlife Trusts

The Wildlife Trusts were established to promote non-statutory nature conservation at a local level. They own, or lease and manage, by agreement with owners, over 1,800 nature reserves (more than 52,000 ha). There is usually one Trust covering a whole county or group of counties. The Trusts with sites in the region are the Suffolk Wildlife Trust, London Wildlife Trust, Essex Wildlife Trust and Kent Trust for Nature Conservation. There are 52 coastal Wildlife Trust sites (2,683 ha) in Region 7 (Table 7.5.3; Map 7.5.1).

Table 7.5.2 Royal Society for the Protection of Birds reserves

Site name	*No. of sites*	*Grid ref.*	*Area (ha*)*	*Date acquired*	*Interest*
Suffolk	**3**				
Minsmere		TM465670	796	1977	Shallow brackish water, mudflat, islands, reedbeds, mere, heathland, woodland, grazing marsh and dunes, breeding terns *Sterna* spp., avocets *Recurvirostra avosetta*, bitterns *Botaurus stellaris*, passerines, migrating waders, overwintering wildfowl, otters *Lutra lutra*
North Warren		TM455592	212	1939	Coastal grazing marshes, reedbeds, woodland and acid grassland, heath, breeding wildfowl, waders and passerines, migrating waders, wintering wildfowl
Havergate Island & Boyton Marshes		TM416475	179	1949	Island with shingle and lagoons; coastal grazing marsh, ditches and saltmarsh, breeding passerines, terns, waders, waterfowl and wintering wildfowl
Essex	**2**				
RSPB Stour Wood Reserve		TM189309	392	1980	Mudflats, saltmarsh, woodland, reedbeds and scrubby fields, passerines, wintering waders and wildfowl
Old Hall Marshes		TL950117	452	1984	Grazing marshes, brackish water fleets, reedbeds, saltings and islets, wintering and breeding waterfowl, wintering seabirds, breeding and migrating waders, breeding and migrating passerines, raptors
Kent	**4**				
Nor Marsh & Motney Hill		TQ812689	102	1985	Saltmarsh and intertidal mud, nesting terns, wintering waterfowl and waders
Elmley Marshes		TQ926705	282	1974	Coastal grazing marsh, freshwater fleets and floods, saltmarsh, wintering waterfowl, waders and raptors, breeding waders and waterfowl
Sandwich Bay		TR351623	9	1980	Intertidal mud and sand, wintering, migrating and roosting waders
Dungeness		TR063196	874	1931	Shingle with flooded pits, marsh, gorse and bramble, nesting terns, wintering waterfowl, small migrant birds
Region 7	***9***		***3,298***		
North Sea Coast	53		24,594		
GB coast	82		38,719		

Sources: RSPB (1994; *in litt*.). Key: *to the nearest whole hectare. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

Table 7.5.3 Wildlife Trusts sites

Site name	*No. of sites*	*Grid ref.*	*Area (ha*)*	*Date acquired*
Suffolk	**15**			
North Cove		TM471906	16	1982
Oulton Marshes		TM505934	14	1983
Carlton Marshes		TM505920	50	1991
Town Farm Marsh		TM508768	1	1985
Norman Gwatkin		TM463767	9	1975
Sizewell Belts		TM460630	95	1993
The Haven		TM470585	16	1989
Hazelwood Marshes		TM435575	62	1991
Snape Saltings		TM402573	7	1989
Alde Mudflats		TM420570	122	1991
Bromeswell Green		TM298507	12	1978
Simpsons Saltings		TM385455	15	1991
Levington Lagoon		TM239385	0.3	1988
Trimley Marshes		TM265352	86	1989
Landguard		TM285315	16	1976
Essex	**25**			
Daw's Hall		TL887366	8	1983
Hogmarsh		TM104324	5	1976
Copperas Wood		TM204316	14	1980
Skippers Is./Saltings		TM216246	94	1972
John Weston Reserve		TM262245	6	1971
Barnes Spinney		TM258227	1	1984
Witton Wood Spinney		TM235204	0.2	1977
Colne Point		TM100134	276	1968
Howlands Marsh		TM115169	75	1989
Fingringhoe Wick		TM047195	51	1961
Rat Island		TM056171	14	1964
Ray Island		TM004144	45	1970
Tollesbury Wick Marshes		TL970104	242	1994
Essex (continued)				
Bonners Saltings		TM011150	24	1970
Chigborough Lakes		TL873087	19	1981
Bradwell Cockle Spit		TM035071	81	1968
Woodham Fen		TQ798975	8	1994
Lower Raypits		TQ923948	47	1992
Lion Creek		TQ922949	5	1986
Shoebury Old Ranges		TQ935845	7	1986
Two Tree Island		TQ826851	26	1961
Canvey Point		TQ827836	28	1964
Vange Marsh		TQ729869	3	1983
Fobbing Marsh		TQ716845	76	1989
Stanford Warren		TQ686814	12	1981
London	**6**			
Cranham Marsh		TQ569854	13	1986
Gunnersbury Triangle		TQ201786	3	1985
Tump 53		TQ467804	1	1985
Battersea Park		TQ285773	3	1976-1992
The Ripple		TQ467824	5	1994
Isleworth Alt		TQ167754	3	1985
Kent	**6**			
Holborough Marshes		TQ707626	34	1996
Burham Marsh		TQ714615	36	1964
Oare Meadow		TR007627	2	1964
Oare Marshes		TR012645	69	1983
South Swale		TR035647	413	1967
Sandwich Bay		TR350630	413	1970
Region 7	***52***		***2,683***	
North Sea Coast	145		11,588	
GB coast	241		25,898	

Source: Wildlife Trusts (1996 data). Key: *to the nearest whole hectare. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

7.5.5 The Ministry of Defence

As at August 1994, the Ministry of Defence (MoD) owned, leased or used under licence landholdings covering some 320 km of coastline around the UK, not all of it significant for its nature conservation value. The MoD gives high priority to nature conservation on the Defence Estate, subject to the overriding importance of military training. The restrictions to public access on some sites mean that they can be amongst the most pristine areas of wildlife habitat in the region. There are eight coastal MoD sites (16,821 ha) in Region 7 (Table 7.5.4; Map 7.5.1).

7.5.6 The Woodland Trust

The Woodland Trust was established in 1972 with the aim of conserving, restoring and re-establishing trees (particularly broad-leaved) and woodland plants and wildlife in the United Kingdom. There are three Woodland Trust sites (60 ha) in Region 7 (Table 7.5.5; Map 7.5.1).

7.5.7 Acknowledgements

The authors wish to thank Andrea Firth (MoD), Jo Burgon and Richard Offen (The National Trust), Bob Scott (RSPB), Dr A. Somerville (Scottish Wildlife Trust), Sarah Hawkswell (The Wildlife Trusts), Matthew Frith (London Wildlife Trust), Mike Harding and Julian Roughton (Suffolk Wildlife Trust), Andrew Craven (Kent Trust for Nature Conservation), Duncan Bridge (Essex Wildlife Trust) and the Woodland Trust for providing information.

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Table 7.5.4 MoD sites

Site name	*No. of sites*	*Area (ha)**	*Habitats*	*Protected status*
Essex	**3**			
Fingringhoe		679	Coastal pasture, saltmarsh	Part SSSI
Shoeburyness & Foulness		13,498	Saltmarsh, mudflats	Part SSSI, part LNR, Ramsar
Shoeburyness		742	Saltmarsh, mudflats	Part SSSI, part LNR, Ramsar
Kent	**5**			
Gravesend		228	Grassland, coastal defences	SSSI
Yantlet		159	Grassland, coastal defences	SSSI
Kingsdown		8	Scenic cliffed coast	SSSI, AONB
Hythe		174	Sand dune/saltmarsh	SSSI
Lydd		1,334	Saltmarsh	SSSI
Region 7	***8***	***16,821***		
North Sea Coast	65	34,449		
GB coast	110	53,410		

Source: Ministry of Defence. Key: *all areas are approximate and include land leased or used under licence; SSSI = Site of Special Scientific Interest; LNR = Local Nature Reserve; AONB = Area of Outstanding Natural Beauty. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

Table 7.5.5 The Woodland Trust sites

Site name	*No. of sites*	*Grid ref.*	*Area (ha*)*
Suffolk	**2**		
Porters Wood		TM264483	4
Harrison's Wood		TM268477	2
Essex	**1**		
Stour Wood		TM190315	55
Region 7	***3***		***60***
North Sea Coast	36		1,104
GB coast	71		1,584

Source: Woodland Trust (1996). Key: *to the nearest whole hectare. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
National Trust sites (England and Wales)	*Coast and Countryside Adviser, The National Trust, Cirencester, tel: 01285 651818
National Trust sites (Suffolk and Essex)	*Regional Land Agent, The National Trust, Blickling, tel: 01263 733471
National Trust (Kent)	Regional Director, Scotney Castle, Lamberhurst, Tunbridge Wells, Kent TN3 8JN, tel: 01892 890651
RSPB sites (Suffolk and Essex)	*Regional Officer, RSPB, East Anglia Office, Norwich, tel: 01603 660066
RSPB sites (Kent)	*Regional Officer, RSPB, South East England Office, Shoreham-by-Sea, tel: 01273 463642
Wildlife Trust sites (Suffolk)	*Conservation Officer, Suffolk Wildlife Trust, Ashbocking, tel: 01473 890089
Wildlife Trust sites (Essex)	*Conservation Officer, Essex Wildlife Trust, Colchester, tel: 01206 729678
Wildlife Trust sites (London)	*Conservation Officer, London Wildlife Trust, London, tel: 0171 278 6612/3
Wildlife Trust sites (Kent)	*Conservation Officer, Kent Trust for Nature Conservation, Maidstone, tel: 01622 662012
The Woodland Trust sites	Information Officer, Woodland Trust, Autumn Park, Dysart Road, Grantham, Lincolnshire NG31 6LL, tel: 01476 581111
MOD sites	Conservation Officer, MoD Conservation Office, DEO, Blandford House, Farnborough Road, Aldershot, Hants. GU11 2HA, tel: 01252 348989

*Starred contact addresses are given in full in Appendix.

Chapter 8 Land use, infrastructure and coastal defence

S.L. Fowler & S.J. Everett

8.1 Introduction

This chapter is divided into three sections: (rural) land use, covering agriculture (especially as it affects important coastal wildlife habitats) and woodland; infrastructure, covering population distribution, industry, ports, harbours, ferries and power generation; and coastal defence, including sea defence and coast protection.

The coastline of Suffolk consists largely of undeveloped agricultural land, with major ports located at Lowestoft, Felixstowe and Ipswich. Outside the ports, significant industry is represented only by the Sizewell nuclear power stations near Thorpeness. Associated with the scenic and wildlife attractions of the villages, coastal heaths and wetlands there is a tourist industry of moderate proportions, with water-based leisure activities along the coast (see section 9.7).

Essex is a major area for tourism, with well-known holiday centres at Frinton-on-Sea, Clacton-on Sea and Southend-on-Sea, as well as many smaller seaside resorts. There are ports at Harwich, Brightlingsea, Colchester and Burnham-on-Crouch. Bradwell nuclear power station lies near the mouth of the Blackwater, and there are oil terminals at Canvey Island and Coryton and substantial area of docks and associated industry along the Thames at Tilbury, Grays, Thurrock and Purfleet. In Greater London, development is more or less continuous upstream of Rainham and Erith.

Kent has a long coastline with several major seaside resorts. The county has extensive road and rail networks, reflecting its importance as a crossing point to the continent. The ports of Sheerness, Ramsgate, Dover and Folkestone all operate cross-channel ferry services. The Channel Tunnel, with its entrance inland from Folkestone, was completed in 1994. Kent has major areas of industry located along its north coast, especially between Dartford and Gravesend, in the Medway towns (Rochester, Chatham and Gillingham) and at Grain, Sheerness and Sittingbourne. Power stations are situated at Dartford, in the Medway Estuary at Grain and Kingsnorth, and at Dungeness.

This is the most populous coastal region in the country, and conflicts between industrial development, amenity use and conservation are inevitable. In the late 1980s proposals to extend the docks at Felixstowe caused a storm of protest, and other coastal developments have been equally hard fought. Today, potential for conflict is averted as far as possible through the operation of local coastal zone management initiatives. Photo: Peter Wakely, English Nature.

8.2 Land use

S.L. Fowler & S.J. Everett

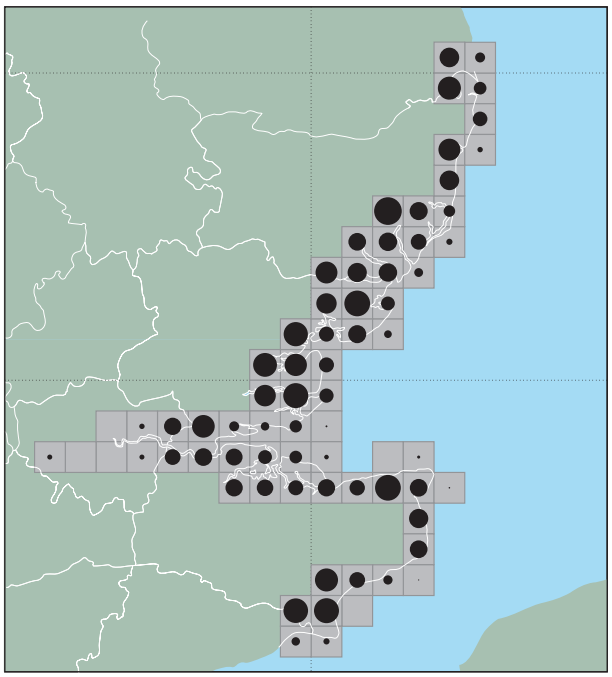
8.2.1 Agriculture

Much of the narrow coastal fringe of Suffolk consists of either Grade 4 agricultural land or 'other land primarily in non-agricultural use'. Most of the latter lies within the Suffolk Coast and Heaths Area of Outstanding Natural Beauty and is designated an Environmentally Sensitive Area (see Chapter 7), where there are financial incentives for farmers to use sensitive farming practices and avoid agricultural intensification. The land that is in agricultural use is grazed or used for hay and silage, with arable cultivation on drier land and on drained marshes. Inland, intensive arable farming predominates. As elsewhere in Britain, a range of national agri-environment schemes funded partly by the EC, such as the Stewardship Scheme and the Habitats Scheme, aim to encourage wildlife-sensitive farming practices. Large areas of former coastal wet grassland in the region, particularly in Essex and north Kent, have been drained over the centuries and converted to arable farming or intensive pasture, although this practice has now largely ceased. The majority of the coastal wet grassland in Essex and North Kent is now within Environmentally Sensitive Areas.

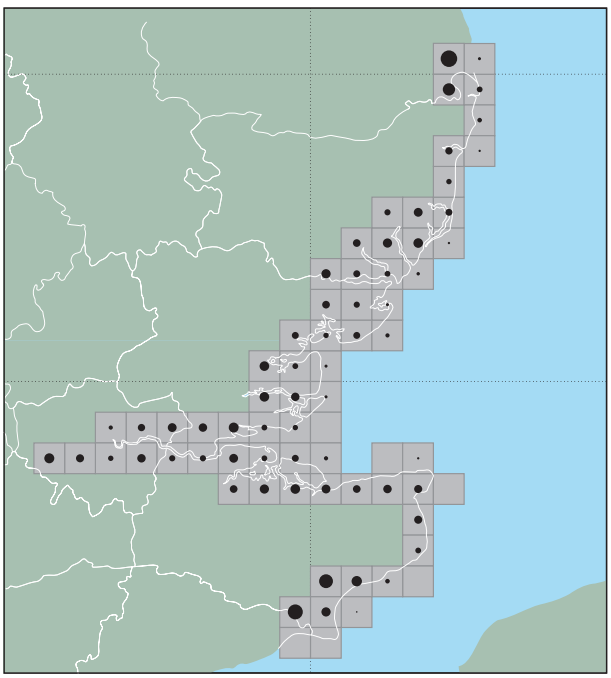
Significant areas of high quality (Grades 1 and 2) agricultural land are found along the Essex and Kent coasts, for example on the Dengie Peninsula (north of Southend), the Hoo Peninsula (north of Rochester), on Thanet and around the Stour Estuary (Kent). In north Kent there is a wide belt of intensive horticulture north of the North Downs, stretching from the Medway to Faversham, Canterbury and Sandwich. Much of Thanet is used for vegetable growing. In the south of the region Romney Marsh forms a large block of Grades 1 and 2 agricultural land, partly grazing marsh and partly arable. Maps 8.2.1, 8.2.2 and 8.2.3 show the distributions of widespread land cover types in the region: tilled land, mown or grazed grassland and meadow or semi-natural grassland. It can be seen that arable farming is the dominant land use across most of the region. Map 8.2.4 shows the incidence of stock grazing on the sand dunes and saltmarshes of the region, according to the national surveys of those habitat types. Sand dunes are few in the region (see section 3.2), but grazing of saltmarsh was recorded at a few sites, although much less commonly than in north and west Britain (e.g. Region 13) (Burd 1989).

8.2.2 Woodland and forestry

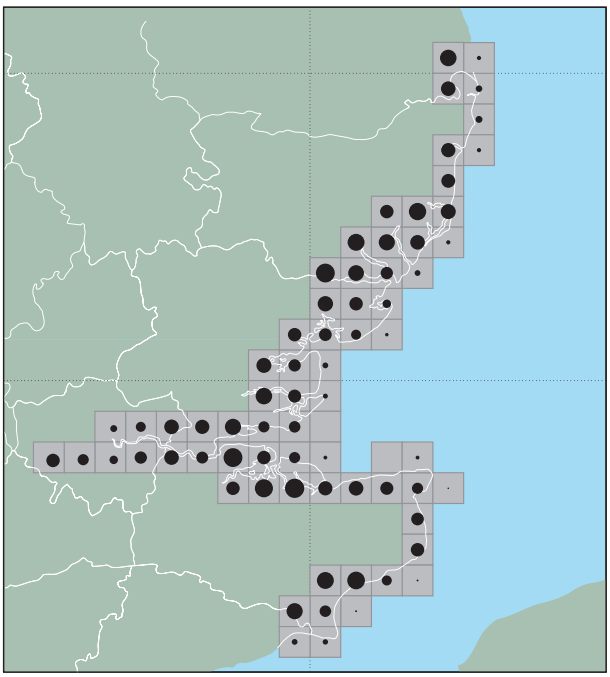
This region has only small areas of woodland, many of them situated along the sheltered estuaries of the Blyth, Alde, Deben, Orwell, Stour, Colne and Medway. The Suffolk coast has a number of small woods, such as around Benacre Broad, at Easton Wood and scattered along the coast between Walberswick and Thorpeness, often associated with heathland. The substantial plantations of Dunwich Forest lie just behind Westwood and Dingle Marshes, and further south, Rendlesham Forest and Tunstall Forest lie a few kilometres inland. Woodland is less well represented



Map 8.2.1 Tilled land in coastal 10 km grid squares. Note: area of circle indicates the area of this land cover type in the 10 km square. Source: Countryside Survey (1990); ITE Monks Wood.



Map 8.2.2 Pastures and amenity swards, mown or grazed to maintain a short turf throughout the year. Note: area of circle indicates the area of this land cover type in the 10 km square. Source: Countryside Survey (1990); ITE Monks Wood.



Map 8.2.3 Meadows, verges and low intensity amenity grasslands and semi-natural cropped swards, not maintained as short turf. Note: area of circle indicates the area of this land cover type in the 10 km square. Source: Countryside Survey (1990), ITE, Monks Wood.

Map 8.2.4 Saltmarshes and sand dunes with recorded grazing. See Maps 3.6.1 and 3.2.1 for distribution of saltmarsh and sand dune sites. Source: JNCC Coastal Database.

on the Essex coast, although natural transitions from woodland to saltmarsh occur at Copperas Bay (Stour Estuary) and Fingringhoe Wick (Colne Estuary). South Essex is almost entirely devoid of coastal woodland, although Benfleet and Vange Creeks near Canvey Island have small woods in their upper reaches. In Kent, scattered woodlands, for example at Lower Upnor, fringe parts of the Medway Estuary, but elsewhere on the county's coast only small fragments are to be found, such as those near the south coast, west of Folkestone. The large woods of Thornden and Blean lie some 4 km inland, south of Whitstable and Herne Bay. The few ancient woodland sites on the coast are largely located away from the open coast, along the sheltered banks of the region's estuaries (Table 8.2.1; Map 8.2.5).

Table 8.2.1 Ancient woodland sites with semi-natural area >5 ha, <500 m from the coast

No. on Map 8.2.5	*Site name*	*Grid ref.*	*Semi-natural area (ha*)*
	Suffolk		
1	Easton Wood	TM519802	15
2	Iken Wood	TM396566	7
3	Strattonhall Wood	TM245385	5
4	Freston Wood	TM172398	10
	Essex		
5	Stour Wood	TM190314	56
6	Copperas Wood	TM203316	20
7	Wivenhoe Wood	TM035222	14
8	Donyland Wood	TM014207	21
	Kent		
9	Cockham Wood	TQ768713	14
10	Lock Wood	TQ747580	8

Source: English Nature Ancient Woodland Inventory. Key: *to the nearest whole hectare.

Map 8.2.5 Areas of coastal ancient woodland and other locations mentioned in the text. Sources: English Nature Ancient Woodland Inventory; Ordnance Survey Landranger maps. © Crown copyright.

8.2.3 Information sources used

Maps 8.2.1, 8.2.2 and 8.2.3 were drawn using data held in the DoE Countryside Information System, a database derived from the Countryside Survey 1990 (ITE 1993), which was based primarily on high resolution satellite images. These images show the dominant land cover for each 25 m x 25 m area (pixel) of Great Britain, classified into seventeen key types (including tilled land and managed grassland); field surveys of randomly selected areas were used to check the results. The main limitations of these data are derived from errors in classifying areas covered by a mixture of land types. The Countryside Information System can provide data on a 1 km square framework, but this level of detail was not considered appropriate here. Information on agricultural land grades comes from Ministry of Agriculture, Fisheries and Food and the Welsh Office (1979). Sand dune and saltmarsh grazing information for Map 8.2.4 comes from the JNCC's Coastal Database. Woodland information (Map 8.2.5) was obtained from English Nature's Ancient Woodland Inventory Geographic Information System and from the 1:50,000 scale Ordnance Survey Landranger maps.

8.2.4 Acknowledgements

Thanks are due to Jeremy Hindle, Suffolk County Council, and Kathy Kennedy, English Nature, for their useful comments on the draft text.

8.2.5 Further sources of information

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B. Further reading

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Suffolk County Council. 1994. *Suffolk Coast and Heaths management plan*. Ipswich, Suffolk County Council.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Agriculture, agri-environment schemes	Ministry of Agriculture, Fisheries and Food, Government Buildings, Brooklands Avenue, Cambridge CB2 2DR, tel: 01223 462727
Farming and wildlife	Farming and Wildlife Advisory Group, National Agricultural Centre, Stoneleigh, Kenilworth, Warwickshire CV8 2RX, tel: 01203 696699
ITE Countryside Survey 1990	*Department of Rural Affairs, DoE, Bristol, tel: 0117 921 8811
Soil surveys in England and Wales	John Hazelden, Soil Survey and Land Research Centre, Cranfield University, Silsoe, Bedford MK45 4DT, tel: 01525 863000
Forestry, including woodland grants	The Forestry Authority, East Anglia Office, Santon Downham, Brandon, Suffolk IP27 0TJ, tel: 01420 23337 The Forestry Authority, Kent and East Sussex, Goudhurst, Cranbrook, Kent TN17 2SL, tel: 01580 211123

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

8.3 Infrastructure

S.L. Fowler, S.J. Everett & Scott Wilson Resource Consultants

8.3.1 Introduction

This section summarises the infrastructure of the region, including population distribution, industry (including oil refining), ports, harbours, ferries and power generation, and land claim for these developments. Oil and gas exploration and development are covered in section 9.5. In this section, power producing plants are included as coastal if they are less than 2 km inland.

This region extends over some of the most heavily populated parts of the UK, notably the Thames Estuary and the Medway towns of north Kent, but also includes substantial areas of undeveloped coastline. The Thames is heavily developed downstream as far as Tilbury and Gravesend; further east are the oil terminals of Canvey Island, Coryton and the Isle of Grain. Some parts of the region have suffered economic decline: in these areas, traditional industry has been replaced by a broad range of commercial activities, including recreation and tourism (see section 9.7).

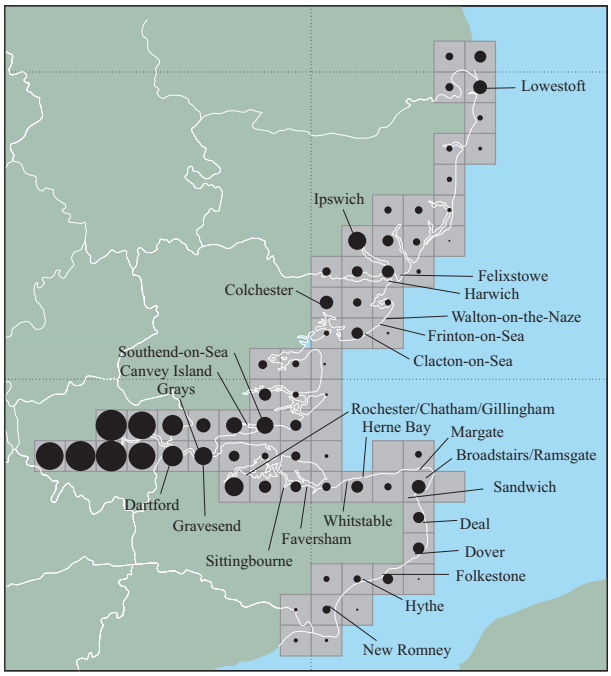
Competition in the electricity generating industry has been intense since privatisation in 1990. This has stimulated some diversification, which has been further encouraged by guidelines such as the government's Non Fossil Fuel Obligation (NFFO), and the 1988 EC Directive on Large Combustion Plants. Although the number of power producers has increased since privatisation, conventional power production is still largely controlled by two companies: PowerGen and National Power. UK power stations owned by National Power and PowerGen have a combined capacity of 36,500 MW: approximately 90% of conventional power production in the UK (40,555 MW) (PowerGen pers. comm.). The remainder is produced by a number of smaller companies. Power is produced on the region's coast by conventional and nuclear processes. In the NFFO Third Renewables Order, 141 projects with a combined output capacity of 630 MW were awarded contracts in England and Wales, although none in this region. There are no renewable energy projects currently operating on the coast in this region.

8.3.2 Important locations

Residential development

Map 8.3.1 shows the distribution of residential development in the region, and Table 8.3.1 lists the populations of coastal districts. More than four million people live in the coastal districts of the region, including the riverside London Boroughs downstream of Tower Bridge.

The open coast of Suffolk has little residential development, with the exception of Lowestoft and Felixstowe and the small seaside towns of Kessingland, Southwold and Aldeburgh. Ipswich, the largest town in the county, is situated some 12 km from the open coast at the head of the Orwell Estuary, and Woodbridge is a similar



Map 8.3.1 Distribution of urban land cover and suburban and rural development. Note: area of circle indicates the area of this land cover type in the 10 km square. Source: Countryside Survey (1990), ITE, Monks Wood.

distance from the sea up the Deben Estuary.

The port of Harwich and the coastal holiday resorts of Walton-on-the-Naze, Frinton-on-Sea and Clacton-on-Sea are the major settlements of the open coast of north Essex. Colchester is situated at the head of the Colne Estuary: Brightlingsea, Wivenhoe, West Mersea and Maldon are smaller towns sited around the Colne and Blackwater Estuaries. Burnham-on-Crouch is the only significant town on the River Crouch, with the exception of the recently-expanded settlements of South Woodham Ferrers and Hullbridge upstream near the tidal limit. Southend is a major seaside town, with 10 km of sea frontage, and is the closest resort to the east side of London. Here begins the highly developed northern coast of the Thames Estuary, extending westwards to Tilbury, Grays and Canning Town, although waterside development between Canvey Island and Docklands is overwhelmingly industrial. Development planning for this area falls under the Thames Gateway regional planning initiative. The London Docklands have been the location of residential development over the last few years by the London Docklands Development Corporation.

On the south bank of the Thames are Greenwich, Thamesmead, Erith and Gravesend. The Medway towns of Rochester, Chatham, Gillingham and Sheerness form an important population centre, along with Sheerness on the Isle of Sheppey. Further east lie Sittingbourne, Faversham and the resort towns of north-east Kent: Whitstable, Herne Bay, Margate, Broadstairs and Ramsgate, which have suffered from the decline in the manufacturing sector and the domestic tourist industry.

Map 8.3.2 Areas of industrial infrastructure.

Map 8.3.3 Ports, harbours and Traffic Separation Scheme. Sources: Walker (1996), Marine Safety Agency and others.

Table 8.3.1 Estimated populations* of districts in Region 7

District	*Population***
Suffolk	
Waveney	107,600
Suffolk Coastal	113,200
Ipswich	114,100
Babergh	78,800
Essex	
Tendring	130,900
Colchester	149,600
Maldon	53,500
Rochford	75,800
Southend-on-Sea	169,900
Castle Point	85,900
Basildon	162,100
Thurrock	131,400
Greater London	
Havering	231,700
Barking and Dagenham	155,000
Newham	226,900
Tower Hamlets	170,500
Southwark	228,800
Lewisham	242,500
Greenwich	212,300
Bexley	220,400
Kent	
Dartford	83,400
Gravesham	92,900
Rochester-upon-Medway	145,500
Gillingham	96,200
Swale	117,200
Canterbury	133,900
Thanet	125,300
Dover	106,900
Shepway	96,500

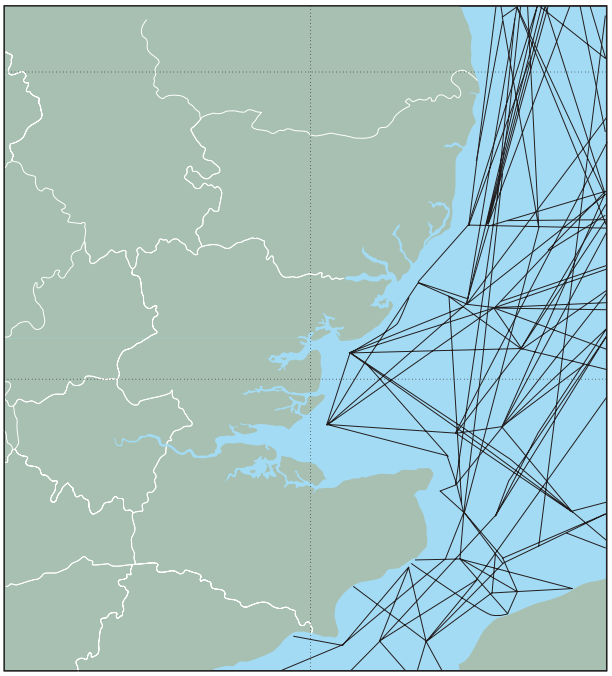
Source: Craig (1997). Key: *1994 estimates; **to the nearest 100.

Sandwich is a small town on the River Stour, while to the south Deal, Dover, Folkestone and Hythe are significant local population centres. Economic expansion is planned here, reflecting its the prime location for travel to the continent and the impact of the Channel Tunnel. A string of small holiday villages lines the coast between Hythe and Dungeness: the largest are Dymchurch, St Mary's Bay and Littlestone-on-Sea.

Industry

The region's main centres of industrial development (Map 8.3.2; Table 8.3.2) are concentrated within estuaries, although open coast infrastructure includes the nuclear power stations of Sizewell, Bradwell and Dungeness. A chemical works is sited at the top of the Stour Estuary at Cattawade. In Essex there is a light engineering works and a boat-building/repair yard at Brightlingsea and some light engineering on the Blackwater Estuary. On Canvey Island and at Coryton to the west there are two oil refineries, and a major area of industrial infrastructure stretches along the Thames Estuary, encompassing Tilbury, Grays, Thurrock, Purfleet and, in Greater London, Rainham, Dagenham and Creekmouth. Along the south side of the Thames lies the Millennium Exhibition site at Greenwich, substantial areas of industrial infrastructure at Erith and chemical industries and an oil-fired power station at Dartford. There are engineering and manufacturing sites at Swanscombe, Northfleet and Gravesend. Subregional planning in north-west Kent is conducted within the framework of the 'Kent Thames-side' initiative under the regional Thames Gateway planning framework (Kent Thames-side 1995).

Further downstream there is an oil terminal on the Isle of Grain and two coal/gas-fired power stations, at Grain and Kingsnorth. Rochester, Chatham and Sheerness have industrial areas alongside the River Medway, and there is a large paper mill at Sittingbourne and a pharmaceutical



Map 8.3.4 Shipping routes. Reproduced from the COAST database, with permission from Dovre Safetec Ltd.

works at Great Stonar, near Sandwich. Dungeness has two nuclear reactors.

The planned route of the Channel Tunnel Rail Link runs along the north side of the River Thames, passing Rainham Marshes next to the existing railway. It then passes the former settlement lagoons for pulverised fuel ash at Thurrock, before entering a tunnel beneath the river. It emerges in Swanscombe Marshes and runs south-east into Kent. Construction is planned to begin in 1998 and continue for five years.

In many industrial areas around the coast of Britain there has been a recent decline in heavy industries such as construction and shipbuilding. Attempts to regenerate industrial areas are now being pursued in some regions, for example through the use of Enterprise Zones. An Enterprise Zone designation lasts for ten years and aims to restore private sector activity by providing automatic planning permission for a range of industrial uses, removing tax burdens, relaxing various administrative controls and providing special capital allowances for the construction of buildings. The North West Kent Enterprise Zone was designated in two parts in October 1983 and October 1986 and lasted for ten years. Seven separate sites were involved, stretching from lower Thames-side to the Medway towns.

Table 8.3.2 Major areas* of coastal industrial development and power generation

Site/area	*Grid ref.*	*Details*
Suffolk		
Lowestoft	TM5492	Food processing plants, base for North Sea gas production
Sizewell	TM4763	Two nuclear power stations: one Magnox (420 MW), one Pressurised Water Reactor (350 MW)
Ipswich	TM1644	Diesel engine manufacturing
Cattawade	TM1032	Chemical works
Essex		
Colchester	TM0025	Varied light industry
West Mersea	TM0012	Light engineering, boat-building and repair yards
Bradwell	TM0008	Nuclear power station (246 MW)
Southend-on-Sea	TQ8785	Varied light industry
Canvey Island, Coryton	TQ7582	Radio components, bookbinding, iron and wire works, oil and liquid gas terminals, chemical works and oil and gas-related industries
Tilbury	TQ6675	Coal/oil power station (1,344 MW)
West Thurrock, Grays, Purfleet	TQ5777	Oil refinery, metal refining, cement works, paper/board works; power station
Greater London		
Barking, Dagenham	TQ4882	Diverse industry including large vehicle manufacturing works
Greenwich	TQ4581	Millennium Exhibition site; Thames tidal barrage
Erith	TQ5079	Decommissioned power station, industrial works, mill
Kent		
Dartford, Swanscombe	TQ5576	Engineering and chemical works, paper works; Littlebrook power station (2,000 MW)
Northfleet, Gravesend	TQ6474	A number of large industrial sites, including paper and cement works
Grain	TQ8875	Coal/gas power station (2,068 MW)
Kingsnorth	TQ8072	Coal/gas power station (1,954 MW), ship-building yard
Rochester, Chatham, Gillingham	TQ7568	Aeronautical, electronic and mechanical engineering, paint and varnish manufacturing, cement works; light industry; former naval dockyards
Sheerness	TQ9075	Electronics, furniture, coach building; recent land claim at Lappel Bank
Sittingbourne	TQ9166	Paper mills
Richborough	TR3361	Decommissioned coal-fired power station; decommissioned wind turbine
Great Stonar	TR3359	Pharmaceutical works
Dover	TR3039	Channel Tunnel land claim (Shakespeare Cliff)
Dungeness	TR0816	Two nuclear power stations: one Magnox (440 MW), one Advanced Gas Cooled Reactor (1,100 MW)

Key: *includes only significant industries occupying large areas of land.

Power generation

Table 8.3.2 lists the region's coastal power installations. There are four conventional power stations in the region, at Tilbury, Dartford, Grain and Kingsnorth, with a total capacity of around 7,300 MW, although they do not always run at full power, depending on the varying requirements of the National Grid. The coal/oil fired station at Tilbury accounts for approximately 3% of the UK's conventionally produced power, as would Littlebrook Power Station at Dartford, running at full capacity, whilst the combined output of the two plants at Kingsnorth and Grain accounts for slightly less than 10%. Nuclear generated power provided about one quarter of all the electricity consumed in the UK in 1994/1995. This is produced by thirteen power stations, of which five, with a combined output of 2,556 MW, are located in the region, at Sizewell (A and B), Bradwell and Dungeness (A and B). The 1MW wind turbine at Richborough in Kent, owned by PowerGen, was decommissioned in 1996. There are plans to upgrade and relocate it, although the location of the new site had not been finalised by 1996 (PowerGen pers. comm.).

Ports and harbours

The major estuaries and natural harbours of the region were the original locations for most port and harbour developments. Some, particularly in the industrial parts of the region, have become important for trade, shipbuilding and land-based industry, while others started out primarily as fishing ports and remain as such, or else are now used principally for recreation. Most have minor boat-building and boat-repair industries. Many traditional ports in the area have fallen into decline or disuse over the past few decades, owing to the diversion of passengers to air transport and of freight to road or rail routes, as well as the redirection of commercial shipping to newer harbours. Some disused docks and warehouses close to city centres have undergone redevelopment schemes incorporating office use, light industry, housing and recreation, the latter occasionally including marinas. Some of the biggest redevelopment schemes of this nature have already taken place on former dockland sites in London (Canary Wharf and the Docklands redevelopment, and Tower Hamlets) and at the former Royal Naval Dockyard at Chatham, although other docks (for example at Newham) remain derelict.

The Suffolk, Essex and north Kent coasts have a number of estuaries that lie close to London and are strategically situated for international trade. Consequently a number of the UK's premier port facilities lie along the coast of this region. These include the ports of Felixstowe, Ipswich, Harwich, the tidal Thames ports, the Medway ports (including Sheerness), Ramsgate, Dover and Folkestone. Present-day commercial ports (Map 8.3.3) and their facilities are listed in Table 8.3.3.

Lowestoft is an important fishing port; it handles shipping that supports North Sea oil and gas operations as well as general cargoes such as grain, steel and timber. Felixstowe is the UK's largest container handling port, as well as having extensive roll-on/roll-off and other cargo-handling facilities. It has recently been enlarged through large-scale channel dredging and intertidal land claim. Ipswich, situated at the head of the Orwell Estuary, is a large container port. There are plans to expand Cliff Quay and the West Bank Terminal areas of the dock. Ipswich is the UK's second largest wheat exporting port, also handling bulk liquids and timber. The small port at Mistley, situated near the head of the Stour Estuary, accounts for 5% of the shipping traffic on the Stour and Orwell Estuaries.

There are two port areas at Harwich: Parkeston Quay and Harwich Dock. Harwich was once important for shipbuilding but now operates as a trade and continental ferry port.

The Port of London is the most important port in the UK by volume of cargo (Thames Estuary Project 1996). The area of influence of the Port of London Authority comprises the tidal Thames from Teddington in the west to a line joining Margate to Clacton in the outer Thames Estuary. Tilbury Docks is owned by Forth Ports and possesses some of the the largest handling and storage facilities of any port in the region, with over 4,000 m of berthing and 300 ha of land dedicated to cargo storage. There are numerous jetties and wharves serving oil refineries and the petrochemical installations (for example at Canvey Island and Coryton) and for the import and export of motor vehicles. The former India and Milwall Docks on the Isle of Dogs have been largely infilled and redeveloped as Canary Wharf and the London Docklands, while the old Royal Docks to the east remain derelict.

There are docks and a container port at the Isle of Grain. Private river wharves at Rochester and Swale handle general bulk cargoes. The Port of Sheerness includes part of Chatham Docks. The open storage area for cargo (particularly for car imports) has recently been expanded at Sheerness following the infilling of 65 ha of mudflat on the Lappel Bank. The Faversham Creekside Study undertaken for Swale Borough Council in 1993 identified development and recreational opportunities and recommended channel dredging as well as environmental enhancement. Whitstable specialises in handling roadmaking aggregates, stone, timber and building materials and is a major fishing port specialising in oysters and whelks (see section 9.1). Ramsgate is a general cargo port with roll on-roll off (ro-ro) and load on-load off (lo-lo) facilities, and is a major continental ferry and jetfoil port to Dunkirk and Ostend. It handles timber, cars, refrigerated goods and oil. The Port of Ramsgate has invested in substantial modernisation and is actively marketing itself as a gateway for freight movements to and from Britain. The Port of Dover is one of the UK's major passenger and cargo ports with extensive ro-ro ferry berths at its Eastern Docks, where it handles on average 3,000 commercial vehicles a day. Ferry and hovercraft services operate to Calais, Dunkirk, Ostend and Zeebrugge. The port has recently diversified through the construction of its General Cargo Terminal, and it is also visited by many yachts and cruisers. Major developments are planned to enhance its attractiveness as a cruising destination. Folkestone is also strategically positioned to handle the cross-Channel trade and is a continental ferry port with a catamaran service to Boulogne.

8.3.3 Information sources used

Sources of information for this section were Cook (1993), Buck (1997 a, b), Craig (1996), District and Borough Council staff and Ordnance Survey Landranger 1:50,000 maps. The Office of Population Censuses and Surveys publishes 1991

Table 8.3.3 Ports and harbours

Port	*Facilities, cargo and turnover (tonnes)*
Suffolk	
Lowestoft	North Sea fishing port; support industries for North Sea oil and gas operations; general cargoes including grain, steel and timber
Felixstowe	18 berths, 4,008 m length; 22,000,000 tonnes p.a.; 14,321 sq m open storage; 86,180 sq m covered storage; lo-lo (crane load on and off), ro-ro (roll-on, roll-off), vehicles/wheeled cargoes, passengers, dry bulks, grain/feedstuffs, fruit/vegetables, hazardous cargoes, refrigerated products, forest products, oil/petroleum and other liquid bulk, general cargo, heavy lift. Continental ferry port.
Ipswich	11 berths, 1,000 m length; 4,700,000 tonnes p.a.; 400,000 sq m open storage; 46,000 sq m covered storage; lo-lo, ro-ro, vehicles/wheeled cargoes, dry bulks, grain/feedstuffs, refrigerated products, hazardous cargoes, forest products, oil/petroleum, other liquid bulk, general cargo, heavy lift
Essex	
Mistley Quay	4 berths, total length 650 m; 300,000 tonnes p.a.; 55,500 sq m open storage; dry bulks, grain/feedstuffs, forest products, general cargo
Harwich (Parkeston Quay)	5 ro-ro berths, container terminal with 2 berths/total length 214 m; containers, passengers, liquid bulk
Harwich (Navy Yard)	3 ro-ro berths, 160 m, 90 m and 160 m; containers/vehicled/wheeled cargoes, forest products, general cargoes
Brightlingsea	Small commercial and leisure port owned by Brightlingsea Harbour Commissioners and operated by Brightlingsea Dock and Wharfage. 3 berths, total length 450 m; 100,000 tonnes p.a. Dry bulks, grain/feedstuffs, forest products, general cargo, livestock, fish.
Colchester (Rowhedge Wharf and Wivenhoe Quay)	5 km downstream of Colchester. 2 berths, 150 m total length; 250,000 tonnes p.a.; 5,000 sq m open storage; dry bulks, grain/feedstuffs, hazardous cargoes, forest products, general cargo.
Wallasea, River Crouch	Forest products and steel; load on/load off
Coryton	Serves oil refinery
Holehaven Wharf	3 jetties serving oil refinery/petrochemical plants at Canvey Island
Shell Haven Oil Refinery	9 berths on 5 jetties; 8,000,000 tonnes p.a.; oil/petroleum and other liquid bulk
Tilbury Docks	30 berths, 4,000 m total length; 7,000,000 tonnes p.a.; 280 ha open storage; 20 ha covered storage; lo-lo, ro-ro, vehicles/wheeled cargoes, passengers, dry bulks including scrap metal, grain/feedstuffs, fruit/vegetables, refrigerated products, hazardous cargoes, forest products, general cargo, project cargo (heavy lift), livestock; lay-up berths
Purfleet: Powell Duffryn main jetty/ Harrison's Wharf	7 berths, total length 800 m; 750,000 tonnes p.a.; 13 pipelines connected to 270,000 cu m storage tanks; oil/petroleum and other liquid bulk
Purfleet Thames Terminal	2 ro-ro berths, total length 500 m; 3,000,000 tonnes p.a.; open storage 280,000 sq m; ro-ro, vehicles/wheeled cargoes
Greater London	The Port of London is a Trust Port, all cargo handling facilities being privately owned and operated. Many other wharves and terminals exist in addition to those noted below.
River Thames, Gravesend to Teddington	21 Port of London drawdocks; harbours: Chelsea, St Katherine's, Gravesend
Thunderer Jetty, Dagenham	50 m length of berths; 150,000 tonnes p.a.; 4 ha open storage; 3,500 sq m covered storage; oil/petroleum and other liquid bulk, 250 tanks for liquid storage
Welbeck Wharf, Barking	2 berths, total length 175 m; 250,000 tonnes p.a.; 15,725 sq m covered storage; steel products
Seabright Wharf, Barking	1-2 berths, total length 150 m; 120,000 tonnes p.a.; 10,000 sq m open storage; 800 sq m covered storage; dry bulks
Thames Refinery, Silvertown	2 berths, 48 and 160 m length; 1,040,000 tonnes p.a.; dry bulks (operated by Tate & Lyle Sugars)
The London Steel Terminal	1 x 110m berth; 250,000 tonnes p.a.; steel
Thames Wharf, Canning Town	2 berths, 200 m length; 250,000 tonnes p.a.; dry bulks and scrap metal
Convoy's Wharf, Deptford	3 berths; total length 245 m jetty plus 180 m on moorings; 550,000 tonnes p.a.; 61,000 sq m open storage; ro-ro, vehicles/wheeled cargo, forest products
Victoria Deep Water Terminal, Greenwich	2 berths, 259 m length; terminal non-operational
Kent	
Thames Europort, Dartford	2 berths, 200 m length; 160,000 sq m open storage; additional covered storage planned; ro-ro, vehicles/wheeled cargoes, hazardous cargoes
Tower Wharf, Northfleet	2 jetties; 750,000 tonnes p.a.; 2 ha open storage, 3 ha covered storage; forest products, general cargo, project cargo (heavy lift), ferrous and non-ferrous metals, steel products
Northfleet	500,000 tonnes p.a.; marine aggregates; 1 berth; operated by Hall Aggregates
Northfleet Hope Terminal	Operated by Tilbury Container Services
Clubb's Marine Terminal, Denton (Gravesend)	350,000 tonnes p.a.; open storage 10,000 sq m; marine aggregates
Thamesport, Isle of Grain	2 berths, 550 m length; 3,000,000 tonnes p.a.; 32 ha open storage; 17,500 sq m covered storage; containers, dry bulks, hazardous cargoes

Table 8.3.3 Ports and harbours (continued)

Port	*Facilities, cargo and turnover (tonnes)*
Kent (continued)	
Cliffe Alpha Jetty, Cliffe, Rochester	78 m length of berths; lo-lo, marine-dredged aggregates
Port of Sheerness, including the Medway ports; Swale & Grain	Lo-lo, ro-ro, sto-ro (roll-on, roll-off through same entrance), container facilities; bulk general cargo, fresh fruit, perishables, bulk wine, forest products, meat and vehicles; passenger and freight service. Sheerness: 7 berths including two dedicated car carrier ro-ro berths; 1,500,000 tonnes p.a.; 80 ha open storage; 9 ha covered storage; shiprepair/graving.
Medway (Chatham) Dock	8 berths, total length: 1,200 m; 700,000 tonnes p.a.; lo-lo, ro-ro, vehicles/wheeled cargoes, forest products, general cargo; shiprepair/graving docks, lay up berths
Ridham	Located on Swale Estuary. 4 berths; 1,230,000 tonnes p.a.; open storage 6 ha; covered storage 11,000 sq m; dry bulks, hazardous cargoes, forest products, other liquid bulk, general cargo, project cargo (heavy lift); ship repair
Whitstable	Roadmaking aggregates, stone, timber, other building materials and fish. Major fishing port specialising in oysters and whelks.
Ramsgate	1 x 110 m length of berths plus 500 leisurecraft berths; general cargo port; ro-ro, lo-lo, timber, cars, refrigerated goods and oil. Major continental ferry and jetfoil port; shiprepair/graving.
Richborough (Sandwich)	Small commercial port at Pegwell Bay; oil/petroleum
Dover	Major continental passenger and cargo port; extensive ro-ro ferry berths; general cargo terminal handles fruit and vegetables, timber, newsprint, grain and bulk commodities such as coal, coke, limestone and pumice; berths: 850 m; 13,000,000 tonnes p.a.; lo-lo, ro-ro, vehicles/wheeled cargoes, passengers, dry bulks, hazardous cargoes, refrigerated products, general cargo, project cargo (heavy lift); shiprepair/graving; lay-up berths; hoverport
Folkestone	Cross-Channel ferry port; ro-ro, car ferry and passenger facilities; 1 berth: 130 m length; open storage: 12,000 sq m; covered storage: 1,000 sq m; ro-ro, hazardous cargoes, fish (fishing fleet and quay)

Sources: Walker (1996); local authority planning documents (various). Note: most of the larger leisure harbours and commercial ports have supporting industries such as chandlery and boat-repair/maintenance yards.

census data on a district basis and population estimates for subsequent years based on those data (e.g. Office of Population Censuses and Surveys 1994). Cook (1993) presents town and city data from population censuses from a number of dates, including the 1981 census, and is therefore somewhat out of date. Map 8.3.1 is adapted from the ITE (1993) Countryside Survey database, which is derived from 1990 satellite imagery. Areas represent land cover types 'urban' and 'suburban/rural development'.

Information on industry was obtained primarily from the Ordnance Survey 1:50,000 Landranger map series and from Cook (1993). For ports and harbours, information was derived from Walker (1996), British Ports Association (1994) and D'Oliveira & Featherstone (1994). Data regarding output capacity of power stations in the region was obtained from the Electricity Association and Corporate Information Officers at National Power, PowerGen, and Nuclear Electric.

Lord Donaldson records that there is virtually no clear information available on where ships go within UK waters (Donaldson 1994). The Department of Transport, UK Offshore Operators Association and the Health and Safety Executive have addressed this issue by jointly funding a project to produce a ship traffic database (COAST), which provides details of 3,500 shipping routes across the UK continental shelf, giving the number of vessels and their distribution by ship type, age and flag. An extract from this database is plotted on Map 8.3.4.

Under MARPOL (the United Nations' International Convention on the Prevention of Pollution from Ships), the UK must provide port facilities that are "adequate to meet the needs of ships using them and do not cause undue delay to ships". The UK government has commissioned a survey of all UK port reception facilities for the disposal of ship's wastes (Waste Regulation Council 1995).

8.3.4 Acknowledgements

Thanks are due to Compass Publications for permission to use information from their Ports Directory. Dovre Safetec Ltd. are thanked for permission to reproduce an extract from their COAST Database. Thanks are also due to Kathy Kennedy (English Nature), Steve Gilbert (RSPB), Mark Tasker (JNCC), Colin Taylor (Nuclear Electric), Nick Evans (SERP) and Jeremy Hindle (Suffolk County Council) for their useful comments on the draft text.

8.3.5 Further sources of information

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Planning developments	
Existing and planned residential developments	*Local authorities
Population statistics (Office of Population Censuses and Surveys)	Information Branch (Dept. M), OPCS, St Catherine's House, 10 Kingsway, London WC2B 6JP, tel: 0171 396 2208
Enterprise Zones	*Department of Environment, London, tel: 0171 276 6166
Development of London Docklands	London Docklands Development Corporation, Thames Quays 191, Marsh Wall, London E14 9TJ, tel: 0171 512 3000
Thames-side development in Dartford and Gravesham Districts	Kent Thames-side, Stone Castle, 307 London Road, Greenhithe, Dartford, Kent DA9 9JG, tel: 01322 380380
Ports	
British Ports Association	Africa House, 64-78 Kingsway, London WC2B 6AH, tel: 0171 242 1200
The UK Major Ports Group Ltd	150 Holborn, London EC1N 2LR, tel: 0171 404 2008
International Maritime Organisation	4 Albert Embankment, London SE1 7SR, tel: 0171 735 7611
Port reception facilities	Marine Safety Agency, Spring Place, 105 Commercial Road, Southampton SO15 1EG, tel: 01703 329100
Lowestoft	*Associated British Ports, Lowestoft, tel: 01502 572286

Type of information	*Contact address and telephone no.*
Ports (continued)	
Felixstowe	*Felixstowe Dock & Railway Company, Felixstowe, tel: 01394 604500
Ipswich	*Ipswich Port Authority, Ipswich, tel: 01473 231010
Mistley Quay	*Mistley Quay & Forwarding, Manningtree, tel: 01206 394431
Harwich (Parkeston Quay)	*Harwich Haven Authority (Operator: Stena Sealink Ports), Harwich, tel: 01255 242000
Harwich (Navy Yard)	*Harwich Haven Authority (Operator: Harwich Dock Co. Ltd.), Harwich, tel: 01255 243030
Brightlingsea	*Brightlingsea Harbour Commissioners (Operator: Brightlingsea Dock and Wharfage), Brightlingsea, tel: 01206 302200
Colchester Dock Transit Co Ltd	*Colchester Borough Council (Operator: Associated British Ports), Colchester, tel: 01206 861422
Colchester Port	*Colchester Borough Council, Wivenhoe, tel: 01206 827316
Coryton	*Port of London Authority (Operator: Mobil), Stanford-le-Hope, tel: 01375 673310
Holehaven Wharf, Canvey Island	*Port of London Authority (Operator: Oikos Storage Ltd), Canvey Island, tel: 01268 682206

C. Contact names and addresses (continued)

Type of information	*Contact address and telephone no.*
Ports (continued)	
Shell Haven Oil Refinery, Coryton	*Operated by Shell UK Ltd (Downstream Oil), Stanford-le-Hope, Essex, tel: 01375 673333
Tilbury	*Port of Tilbury London Ltd, Tilbury, tel: 01375 852200
Purfleet, Powell Duffryn Jetty & Harrison's Wharf	*Powell Duffryn Terminals Ltd, Purfleet, tel: 01708 865701
Purfleet Thames Terminal	*Purfleet Thames Terminal, Purfleet, tel: 01708 865522
Thunderer Jetty, Dagenham	*Pinnacle Bulk Liquid Storage, Dagenham, tel: 0181 593 7211
Welbeck Wharf, Barking	*Welbeck Steel Service Centre Ltd, Barking, tel: 0181 594 7733
Seabright Wharf, Barking	*Seabright Industries Limited, Barking, tel: 0181 594 4074
Thames Refinery	*Tate and Lyle Sugars, London, tel: 0171 476 4455
The London Steel Terminal	*Seacon Terminals Ltd, London, tel: 0171 987 1291
Thames Wharf	*European Metal Recycling Ltd, London, tel: 0171 476 3100
Convoys Wharf	*Port of London Authority (Operator: Convoys Ltd), London, tel: 0181 692 1212
Thames Europort, Dartford	*Thames Europort Ltd, Dartford, tel: 01322 293344
Tower Wharf, Northfleet	*Seacon Terminals Ltd, Northfleet, tel: 01474 321061
Clubb's Marine Terminal, Denton	*Port of London Authority (Operator: J Clubb Ltd.), Dartford, tel: 01322 225431
Imperial Wharf, Gravesend	*Port of London Authority (Operator: Imperial Wharf & Shipping), Gravesend, tel: 01474 536371
Cliffe Alpha Jetty, Cliffe, Rochester	Port of London Authority (Operator: Blue Circle Industries), Crossways Business Park, Anchor Boulevard, Dartford, Kent DA2 6QH, tel: 01322 294422
Thamesport, Rochester	*Thamesport (London) Ltd, Rochester, tel: 01634 271511
Port of Sheerness, including the Medway ports; Swale & Grain	*Port of Sheerness, tel: 01795 561234
Chatham	*Medway Ports Ltd. (Operator: Medway (Chatham) Dock Co Ltd.), Sheerness, tel: 01634 814936
Ridham	*Medway Ports Ltd. (Operator: Ridham Sea Terminals Ltd.), Sittingbourne, tel: 01795 470881
Ramsgate	*Ramsgate Harbour Authority, tel: 01843 592277
Dover	*Dover Harbour Board, tel: 01304 240400

Type of information	*Contact address and telephone no.*
Ports (continued)	
Folkestone	*Folkestone Properties Ltd, Folkestone Harbour, tel: 01303 220544
Power generation	
Conventional power production, further details of power stations	Corporate Communications Officer, PowerGen plc, Westwood Way, Westwood Business Park, Coventry CV4 8LG, tel: 01203 424000
Conventional power production - Tilbury and Littlebrook power stations	Public Information Officer, National Power plc., Senator House, 85 Queen Victoria Street, London EC4V 4DP, tel: 0171 454 9494
Conventional power production general	Electricity Association, Business Information Centre, 30 Millbank, London SW1P 4RO, tel: 0171 963 5700
Renewable energy	Secretary, Energy Technology Support Unit (ETSU), Renewable Energy Enquiries Bureau, Harwell, Oxfordshire OX11 0RA, tel: 01235 432450
Wind energy	The Administrator, British Wind Energy Association, 42 Kingsway, London WC2B 6EX, tel: 0171 404 3433
Wave and hydro power	Project Director, Energy Systems Group, Coventry Polytechnic, Dept of Electrical, Electronic and Systems Engineering, Priory Street, Coventry CV1 5FB, tel: 01203 838861
Nuclear power production - Magnox reactors: Sizewell A, Bradwell and Dungeness A	Magnox Electric Ltd, Berkeley Centre, Gloucestershire GL13 9PB, tel: 01453 810451
Nuclear power production - Sizewell B and Dungeness B	Public Information Officer, British Energy Ltd, Barnett Way, Barnwood, Gloucester GL4 7RS, tel: 01452 652222
Nuclear issues - general	Secretary-General, British Nuclear Forum, 22 Buckingham Gate, London SW1E 6LB, tel: 0171 828 0166
Radioactive discharges	Information Officer, National Radiological Protection Board (NRPB), Chilton, Didcot, Oxfordshire OX11 0RQ, tel: 01235 831600
Radioactive monitoring reports	*Centre for Environment, Fisheries & Aquaculture Sciences, Lowestoft Laboratory, tel: 01502 562244
Energy production general	Department of Trade and Industry, 1 Victoria Street, London SW1H 0ET, tel: 0171 215 5000
Energy production general	Secretary, Institute of Energy, 18 Devonshire Street, London W1N 2AU, tel: 0171 580 7124

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

8.4 Coastal defence

S.L. Fowler

8.4.1 Introduction

Coastal defence covers two types of works: coast protection and sea (or flood) defence. Coast protection works prevent or slow the erosion of land and encroachment by the sea. Sea defences protect low-lying land against flooding. Their most important role now is to preserve human life and property in coastal settlements and industrial areas, but many were built in the past to protect low-lying agricultural land from flooding by the sea and to secure agricultural improvement and drainage. It is sometimes difficult to differentiate between coast protection and sea defence works, particularly where they protect against both erosion and flooding, or are owned and maintained privately or by bodies that are not usually responsible for coastal defences (e.g. the Ministry of Defence).

Coast protection works in Britain are most widely distributed along eroding coasts formed of relatively soft rocks and along urban and industrial coastlines, although some border farmland. The Ministry of Agriculture, Fisheries and Food (MAFF) has published a detailed assessment of the extent and state of repair of coast protection works on the English coast (MAFF 1994). According to this report, more coastal works (32% of the total) are found on the coasts of south and east England (which are gradually sinking following the end of the ice age) than anywhere else in England. Table 8.4.1 also shows that 47% of the region's coast has some coastal works, ranging from simple wooden groynes installed on beaches to control coastal sediment movement, through soft engineering options such as beach recharge, to major concrete engineering works (berms and seawalls). Some of these forms of coast protection can provide vital 'toe' support to the base of coastal cliffs. Coastal works in the region are most extensive in Essex and Kent (Map 8.4.1).

The Sea Defence Survey of the National Rivers Authority (NRA - now the Environment Agency) found extensive sea defences in its Anglian and Southern regions (Table 8.4.2).

Table 8.4.3 summarises the condition of coast protection works on the region's coast.

Much of the low-lying coastline of this region is considered to be at risk from sea-level rise. Storm surges, particularly when combined with high spring tides and/or heavy rain causing peak river flows, are a major flooding threat. Rising sea levels and wave heights in the Atlantic, along with an increasing frequency of storm conditions, are a projected result of climate change (Irish Sea Forum 1992). These would increase the likelihood of coastal flooding and erosion and decrease the expected useful life of sea defences and coast protection works. Some coastal defences in the region have a residual life of less than five years (MAFF 1994).

Map 8.4.1 Locations of major coastal works. Sources: MAFF (1994), NRA (1992) and Ordnance Survey maps. © Crown copyright.

8.4.2 Important locations

Table 8.4.4 lists the main locations of coastal defence works in the region, by district.

A number of sea defence/coast protection initiatives in the region are featured in the MAFF *Guide to good practice* (1993). These include a low-cost sea defence/managed retreat scheme at Benacre Broad, intended to reduce the penetration of saline water into the brackish lagoon; the construction of low impact flood embankments at Sizewell; a hard engineering scheme at Aldeburgh; upgraded embankments at Dovercourt to Bramble Island, south of Harwich; sediment recharge at Hamford Water, where saltings are eroding; the construction of rock breakwater headlands between Clacton and Jaywick to retain beach recharge material; the construction of a storm surge barrier at Wivenhoe on the Colne Estuary; experimental managed

Table 8.4.1 Lengths* of coast with and without coast protection in the region

Coastline covered	*Total length (km)*	*Undeveloped length (km)*	*Coast protection length (km)*	*% protected*
Region 7	129	147	276	47
England coastline	2,925	2,065	860	2

Source: MAFF 1994 database. Key: *surveyed length, i.e. excluding estuary and harbour shorelines, to nearest whole km.

Table 8.4.2 Lengths* of sea (flood) defences in Region 7** and England & Wales

*NRA Region**	*Length (km) owned by*			
	NRA	*Local authority*	*Privately owned*	*Total*
Anglian	363	1	51	426
Southern	144	41	11	195
England & Wales	***805***	***242***	***212***	***1,259***

Source: NRA (now the Environment Agency) (1992). Key: *to the nearest whole km; **Region 7 includes part of Anglian and Southern regions; figures for Region 7 alone were not available.

Table 8.4.3 Condition of coast protection works and state of coastal erosion

Survey area	*Total length of coast**	*Coast protection*		*% requiring work*		*Length of coast experiencing significant erosion*	
	*km***	*km***	*%*	*Significant repairs*	*Moderate repairs*	*km***	*%*
Cambridge area (Wash to Thames)[a]	466	98	21	5	21	17	4
Tunbridge Wells (Thames to Hants.-Dorset border)[b]	830	389	47	6	44	23	3
England	***3,763***	***860***	***23***	***6***	***29***	***134***	***4***

Source: MAFF (1994). Key: [a]includes parts of Regions 6 and 7; [b] includes part of Region 7 and the whole of Regions 8 and 9; figures for Region 7 alone were not available; *estimated whole coast length including estuaries and harbours; **to nearest whole km.

Table 8.4.4 Lengths* of coast protection works (against erosion) in local authority districts in Region 7

Council	*Total length (km)*	*Undeveloped length (km)*	*Coast protection length (km)*	*% protected*
Waveney	26	13	13	51
Suffolk Coastal	41	33	8	20
Tendring	31	12	189	60
Colchester	2	1	1	47
Maldon	3	2	1	26
Rochford	24	22	2	7
Southend-on-Sea	16	2	14	87
Rochester	9	8	1	13
Swale	20	14	6	30
Canterbury	17	1	15	92
Thanet	31	11	21	66
Dover	30	15	15	49
Shepway	27	13	14	52
Region 7	***276***	***147***	***129***	***47***
England	2,925	2,065	860	29
% of England total in Region 7	9	7	15	-

Source: MAFF (1994). Key: *to the nearest whole km.

retreat at Northey Island on the Blackwater (Burd 1995); and cliff stabilisation through the construction of a trial drain at Tankerton, Whitstable. In addition, a new approach to reducing coastal erosion rates has been developed at the Naze, Essex (Macklin 1991). This involved building strong points or artificial headlands along the base of the cliffs to slow erosion within a series of bays. The geological SSSI remains exposed while cliff-top erosion is substantially reduced.

'Coastal squeeze', where natural intertidal habitats are reduced in width by a combination of artificial embankments on the landward side and rising relative sea level, has become an issue of concern in recognition of the nature conservation importance of many areas of coastal habitat and the role they play in absorbing wave energy. The high cost of maintaining traditional coastal defences (particularly along relatively low-value, rural coastlines) has meant that alternative strategies are now being developed. These include 'managed retreat', when the existing line of defence is moved landwards, allowing new saltmarsh to develop between the old banks and the new line of defence. Experimental schemes of managed retreat have been successfully carried out on the Blackwater Estuary, for example at Tollesbury and Northey Island.

Storm surge barriers are designed to allow natural tidal movement under normal conditions but to form a complete barrier when closed against storm surges or unusually high tides. They are very expensive to construct and generally are used to protect low-lying areas of very high value land. The Thames Barrier, located on the Woolwich Reach, is

presently the largest barrier in the UK. A storm surge barrier is also under construction in the Colne Estuary, downstream of Wivenhoe. This is similar in concept to the Thames Barrier and will prevent storm surges of a magnitude expected only once in 1,000 years from reaching the river upstream. It is intended be closed only four times a year, and has been designed for minimum visual and ecological impact.

The coastline of southern Kent, between East Wear Bay, Folkestone and Lydd ranges (west of Dungeness), suffered considerable erosion as a result of the storms of the 1980s. To improve coastal defences and avoid further erosion and flooding, a scheme was undertaken involving the construction of two rock groynes and the recharge of the beaches between Sandgate and Dymchurch Redoubt with shingle from an offshore site. The construction works were completed in September 1996, but owing to the removal of shingle by longshore drift it is expected that further replenishment will be required every ten years.

8.4.3 Management

Departmental responsibility for coast protection and sea defence in England and Wales lies with the Ministry of Agriculture, Fisheries and Food (MAFF). Operational responsibility for coast protection works (to combat erosion) lies generally with district councils under the Coast Protection Act (1949), although other bodies may maintain some stretches of coastal defence, for example Railtrack (formerly British Rail) and the Ministry of Defence. Flood or sea defences in England and Wales are the responsibility of the Environment Agency under the Water Resources Act 1991 and the Land Drainage Act 1994, although Internal Drainage Boards and local authorities are also empowered to undertake flood defence works.

Co-ordination between coastal defence agencies in the region is undertaken through two coastal defence groups, the Anglian Coast Authorities Group and South East Coastal Group (see Chapter 10). These groups are made up of the coastal planning authorities (including port authorities), MAFF and the Environment Agency.

Five Shoreline Management Plans for coastal defence, based on coastal sedimentary sub-cells, cover this region (see section 10.2.3). MAFF has initiated these plans, which are implemented by coastal local authorities. The plans follow government guidelines on assessing the environmental impacts of proposals, including soft defence and 'do nothing' options (MAFF 1995).

SERPLAN (1993) supports the maintenance of coastal defences where they protect existing communities, commercial and industrial assets, port facilities, high grade agricultural land, irreplaceable habitats and coastal aquifers. However, where the cost of maintenance outweighs the property or environmental costs of flooding or erosion, SERPLAN advises that managed retreat should be considered and that development should not normally be permitted if new coastal defences would be required.

8.4.4 Information sources used

The *Coast protection survey of England* (MAFF 1994) assessed the extent, adequacy and state of repair of coast protection works and noted defence requirements over the next three to five years. The survey also identified lengths of unprotected coast that were significantly eroding and where works might be necessary during the next ten years. These detailed data are held on a GIS database by the contractors (Sir William Halcrow & Partners) and MAFF. The information in this section (Tables 8.4.1 and 8.4.4) was provided by the contractors with the agreement of MAFF. It may have become out of date since the survey was conducted.

The Environment Agency holds details of sea defence works in England and Wales on a proprietary database cross-referenced to maps, which may be viewed at regional Environment Agency offices by prior arrangement. No detailed information from the database was available at the time of writing, so the tables provided above are from published summaries. However, the database is an accurate and detailed source of information.

Summaries of the extent of coast protection and sea defence works in estuaries are also available for those sites covered by coastal processes reports commissioned by English Nature's Estuaries Initiative (e.g. Institute of Estuarine and Coastal Studies 1993, 1994a, b, c).

8.4.5 Acknowledgements

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Posford Duvivier Environmental. 1991. *Environmental opportunities in low-lying areas under a scenario of climate change. Final report.* Peterborough, English Nature. (English Nature Research Reports, No. 16.)

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Departmental responsibility for flood defence and coast protection policy, provision of grants towards capital expenditure by the responsible bodies. Coast Protection Survey of England.	*Ministry of Agriculture, Fisheries and Food (MAFF), Flood and Coastal Defence Division, London, tel: 0171 238 3000
Departmental responsibility for flood defence and coast protection policy	The Regional Engineer, MAFF, Block B, Government Buildings, Cambridge CB2 2DR, tel: 01223 462727 The Regional Engineer, MAFF, Merevale House, 42-46 London Road, Tunbridge Wells, Kent TN1 1HE, tel: 01892 518044
Coast protection and prevention of the flooding of non-agricultural land	*District Councils
Storm tide warning service	Meteorological Office, Johnstone House, London Road, Bracknell, Berkshire RG12 2SZ, tel: 01344 420242
Flood defence	*Environment Agency (EA) HQ, Bristol, tel: 01454 624400 *EA Anglian Region, Peterborough, tel: 01733 371811 *EA Southern Region, Worthing, tel: 01903 832000
Co-operation between parties responsible for coastal defences	*English Coastal Groups Forum, MAFF Flood and Coastal Defence Division, tel: 0171 238 3000
Co-ordination and liaison between agencies undertaking coastal works	*Anglian Coast Authorities Group, The Chief Engineer, Waveney District Council, Lowestoft, tel: 01502 562111 *South East Coastal Group, The Chief Engineer, Swale Borough Council, Sittingbourne, tel: 01795 424341
Coastal Engineering Advisory Panel	Anne-Marie Ferguson, Institute of Civil Engineers, Great George Street, London SW1P 3AA, tel: 0171 222 7722
National Landslide Databank	Rendel Geotechnics, Norfolk House, Smallbrook Queensway, Birmingham B5 4LJ, tel: 0121 627 1777
Coastal Engineering Research Advisory Committee	International Council for the Exploration of the Sea, Palægade 2-4, DK-1261, Copenhagen K, Denmark, tel: 00 45 33 15 42 25

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

Chapter 9 Human activities

9.1 Fisheries

C.F. Robson

9.1.1 Introduction

This section gives an overview of the main fishing activities in the coastal waters and rivers of the region. There are fisheries for pelagic and demersal fish and several marine shellfish species (demersal fish live on or near the sea bed; pelagic fish tend to be found in midwater) and diadromous species - in this section salmon, sea trout and eels - which spend part of their lives in fresh water and part at sea. The section also covers sea angling and bait collection. For more information about the species concerned, see sections 5.5, 5.7 and 5.8.

In 1992, 6.8% of all recorded landings of fish and shellfish species in Britain and the Isle of Man were made in this region, which is above the average for all seventeen coastal directories regions of 5.9%. The total tonnages of pelagic, demersal and shellfish species landed in the region in 1992 represent 2.5%, 4.5% and 23% respectively of the British and Isle of Man totals. Shellfish species, notably cockles and whelks, dominate the landings in the region (43% of the region all-species total), with respectively 73.5% and 16.8% of the British and Isle of Man combined totals for the species. The tonnage of sprats landed in the region represents 60.3% of the British and Isle of Man total and there are also significant landings of demersal species such as skates and rays (11.3%) and certain flatfish species: brill (15.1%), Dover sole (17.5%), flounder (14.3%), plaice (30.7%) and turbot (23.7%). A summary of the total landings in 1992 for pelagic, demersal and shellfish species is given in Table 9.1.1.

Lowestoft is the single 'major' fishing port (as defined by the Ministry of Agriculture, Fisheries and Food (MAFF)) in the region. Other MAFF defined ports where fish and shellfish are landed are shown on Map 9.1.1. Approximately a quarter of all fish landed in the region in 1992 was landed in the main port of Lowestoft. Table 9.1.2 summarises landings to this main port in the four years from 1991 to 1994, showing trends in landings in relation to 1992, the year on which the more detailed landings data analysis in Table 9.1.1 was based.

Three diadromous species - salmon (including grilse - young salmon that have spent only one winter at sea before maturing), sea trout and eel - support licensed net and limited rod-and-line fisheries in the region. The single river where a rod-and-line catch was recorded between 1989-1993 is the River Thames. The majority of the region's catch is recorded from drift and gill netting for sea trout from Norfolk and Suffolk. As shown in Table 9.1.3, a relatively small percentage of the salmon and grilse recorded as caught by net fishing in Great Britain are from this region, although the percentage is higher for sea trout.

9.1.2 The fisheries

The sandy bays, estuaries and extensive mudflats along the Suffolk, Essex and Kent coastline, bordering the southern part

Table 9.1.1 Species group landings in 1992 (tonnes)

Species group	*Region 7*	*North Sea Coast*	*England & Wales*	*Britain and Isle of Man*	*% of North Sea Coast total landed in region*	*% of combined British and Isle of Man total landed in region*
Pelagic	6,279	184,309	23,809	252,335	3.4	2.5
Demersal	12,364	228,056	81,237	275,460	5.4	4.5
Shellfish	24,150	61,933	55,360	104,917	39.0	23.0
All species	***42,793***	***474,298***	***160,406***	***632,712***	***9.0***	***6.8***

Source: Ministry of Agriculture, Fisheries and Food (1994); Scottish Office Agriculture and Fisheries Department (1993); Isle of Man Department of Agriculture, Fisheries & Forestry (pers. comm.). Notes: amounts landed are rounded up to the next whole tonne. Figures are given in 'nominal live weight' i.e. weight of the whole fish. Calculating the figures in this table was a complex process: refer to section 9.1.4.

Table 9.1.2 Landings* of all fish species to Lowestoft 1991 - 1994 (thousands of tonnes)

	1991	*1992*	*1993*	*1994*
Lowestoft	10.8	10.2	9.7	8.1
England & Wales	169.0	160.6	165.5	178.7
% of England & Wales total landed in Lowestoft	6.4	6.4	5.9	4.5

Sources: Ministry of Agriculture, Fisheries and Food (1995c). Key: *landings totals relate to 'nominal live weight', i.e. weight of the whole fish. Note: calculating the figures in this table was a complex process: refer to section 9.1.4.

Map 9.1.1 MAFF-defined fisheries landing ports and places.

of the North Sea and the eastern English Channel, support important fisheries. Lowestoft has a daily fish market and supports a full-time fleet of around 60 boats plus an additional 20 or so part-time boats. Lowestoft is known for its substantial beam trawler fleet, consisting of around 30 beam trawlers 15-40 m in length, which fish throughout the southern North Sea. A dozen inshore boats use either beam or otter trawls. Fishing activity off the Essex coast includes larger boats (which trawl for cod, Dover sole, sprats, eel and brown shrimp), cockle dredgers, oyster dredgers and smaller boats, which set gill and trammel nets for Dover sole, cod, flatfish and bass. The Thames Estuary offers good trawling for eels, Dover sole, plaice, whiting and cod. The largest cockle fishery in the UK takes place in the Thames Estuary and off the Essex coast. Herring are exploited using drift nets and mid-water trawls, in autumn and winter, although in the Blackwater and North Thames herring fishery only drift netting is allowed. Otter trawlers operate along the Kent coast, landing a mixed catch of demersal species throughout the year. Smaller boats set fixed nets and drift nets from low water mark out to 20 miles offshore.

Table 9.1.3 Average catch (numbers of fish) of salmon and grilse and sea trout 1989 - 1993

	Salmon & grilse	*Sea trout*
Region 7	16	2,659
North Sea Coast	196,247	104,789
England & Wales	67,347	76,337
GB	***254,829***	***141,813***
% of North Sea Coast total in region	<0.1	2.5
% of GB total in region	<0.1	1.9

Source: Scottish Office Department of Agriculture and Fisheries (1990); National Rivers Authority (1991, 1992, 1993, 1994a, b) and Scottish Office (1991, 1992, 1993, 1994). Note: calculating the figures in this table was a complex process: refer to section 9.1.4.

Pelagic species

Some inshore trawlers based at Lowestoft use mid-water trawling gear to catch herring and sprat, with mackerel caught as a by-catch. Herring are exploited virtually all year round, using drift nets and mid-water trawls, although they are of best quality in autumn to winter. Sprats are landed by mid-water trawlers in large quantities in winter and are used mainly for fishmeal products. Additional amounts are also landed to 'Klondykers' (east European factory fishing boats). Market forces limit fishing effort despite the relative abundance of sprats in the region. Nevertheless, 60.3% of all British sprat landings are made to this region. Table 9.1.4 gives the quantities of various pelagic species landed in 1992 in the region, compared with landings nationally.

Demersal species

Table 9.1.5 gives the quantities of various demersal species landed in 1992 in the region, compared with landings nationally. The winter cod fishery is carried out by otter trawlers and smaller boats that use nets and lines. Reported catches have fallen since the mid-1980s, partly owing to a scarcity of cod inshore and the introduction of quotas. Flatfish species are targeted from spring onwards. Dover sole are caught very close inshore using drift, trammel and tangle nets, and other species of flatfish, such as plaice, turbot, brill, flounder and dab, are caught depending on location. Larger-

Table 9.1.4 Pelagic species landings (tonnes) for 1992

Species	*Region 7*	*North Sea Coast*	*England & Wales*	*Britain and Isle of Man*	*% of North Sea Coast total landed in region*	*% of combined British and Isle of Man total landed in region*
Herring	218	74,706	915	85,650	0.3	0.3
Horse mackerel	2	1,374	1,026	1,499	0.1	0.1
Mackerel	2	95,366	9,142	150,726	<0.1	<0.1
Pilchard	0	4,244	4,244	4,244	0	0
Sprat	6,053	8,478	8,478	10,032	71.4	60.3
Whitebait	1	1	1	1	100	100
Others	3	140	3	183	2.1	1.6
Total	***6,279***	***184,309***	***23,809***	***252,335***	***3.4***	***2.5***

Source Ministry of Agriculture, Fisheries and Food (1994); Scottish Office Agriculture and Fisheries Department (1993); Isle of Man Department of Agriculture, Fisheries & Forestry (pers. comm.). Note: amounts landed are rounded up to the next whole tonne. Figures are given in 'nominal live weight' i.e. weight of the whole fish. Calculating the figures in this table was a complex process: refer to section 9.1.4.

Table 9.1.5 Demersal species total landings (tonnes) in 1992

Species	*Region 7*	*North Sea Coast*	*England & Wales*	*Britain and Isle of Man*	*% of North Sea Coast total landed in region*	*% of combined British and Isle of Man total landed in region*
Elasmobranchs						
Dogfish	285	7,449	3,625	13,348	3.8	2.1
Skates and rays	886	3,816	4,142	7,827	23.2	11.3
Gadoids						
Cod	1,683	53,440	23,530	59,524	3.1	2.8
Haddock	74	49,221	3,706	53,586	0.2	0.1
Hake	5	589	1,621	3,620	0.8	0.1
Ling	36	4,594	1,708	6,027	0.8	0.6
Pollack (lythe)	19	1,921	1,734	3,023	1.0	0.6
Saithe	9	11,032	2,284	12,602	0.1	0.1
Whiting	172	36,733	5,088	41,055	0.5	0.4
Whiting, blue	0	6,531	P	6,531	0	0
Flatfish						
Brill	67	317	392	443	21.1	15.1
Dab	82	1,017	456	1,215	8.0	6.7
Dover sole	502	2,021	2,812	2,876	24.8	17.5
Flounder	39	167	269	273	23.4	14.3
Halibut	2	166	80	194	1.2	1.0
Halibut, Greenland	0	119	117	137	0	0
Lemon sole	325	5,004	3,000	5,573	6.5	5.8
Megrim	P	1,379	1,471	4,037	-	-
Plaice	7,325	20,749	15,970	23,887	35.3	30.7
Turbot	176	561	545	742	31.4	23.7
Other species						
Catfish	133	1,896	557	1,935	7.0	6.9
Conger eel	P	99	403	510	-	-
Gurnard	10	368	589	627	2.7	1.6
Monkfish/angler	350	9,813	3,102	14,678	3.6	2.4
Redfish	P	718	581	774	-	-
Sand eels	0	4,152	P	4,152	0	0
Torsk (tusk)	0	165	13	207	0	0
Witch	31	1,405	192	1,981	2.2	1.6
Others	143	2,419	3,151	3,833	5.9	3.7
Fish roes	10	195	99	243	5.1	4.1
Total	***12,364***	***228,056***	***81,237***	***275,460***	***5.4***	***4.5***

Source: Ministry of Agriculture, Fisheries and Food (1994); Scottish Office Agriculture and Fisheries Department (1993); Isle of Man Department of Agriculture, Fisheries & Forestry (pers. comm.). Key: P = species landed in the region in small quantities (here <0.5 tonnes); - = % not calculated. Note: amounts landed are rounded up to the next whole tonne. Figures are given in 'nominal live weight' i.e. weight of the whole fish. Calculating the figures in this table was a complex process: refer to section 9.1.4.

mesh tangle nets are used to catch turbot and rays. Lemon sole, caught further offshore than Dover sole, have become increasingly important to the Kent trawler fleets as plaice have become increasingly scarce and quotas often prevent them from targeting Dover sole. Lines are used to catch rays, dogfish and bass from spring until autumn. Despite falling catches of bass since the 1980s the net and line fishery still attracts a significant amount of effort during the summer months. Fixed or drifted gill nets or trammel nets are used close inshore and often take a by-catch of grey mullet, which is also caught using beach seine nets.

Shellfish species

Table 9.1.6 gives the quantities of various shellfish species landed in 1992 in the region, compared with landings nationally.

The majority (73.5%) of recorded landings of cockles to British ports are made to this region. The largest cockle fishery in the UK takes place along the north shore of the Thames Estuary and its outer reaches off the Essex coast. The cockles are harvested from spring through to the end of the year. Often used is a 'solids handling pump system', which is more efficient and does less damage to the cockles and other species than methods used elsewhere, such as hydraulic jet pump dredgers or tractor dredges. A rotating riddle sifts the substrate, separating out the cockles, which are pumped into the boat.

Small lobster and crab fisheries are locally distributed along the coast in areas with suitable habitat. Lobsters are targeted all year but mostly from spring to autumn. Crabs, which are caught in pots set for lobsters, are also targeted during the summer. Pots are also set for whelks. Visiting shrimp vessels from King's Lynn periodically base themselves in this region and join local boats trawling for brown shrimp along the coast between Pakefield and Kessingland. Small beam trawls are also used to catch brown shrimps in the estuaries and shallow bays along the Essex coast and at the mouth of the Thames Estuary.

Table 9.1.6 Shellfish landings* in 1992 (tonnes)

Species	*Region 7*	*North Sea Coast*	*England & Wales*	*Britain and Isle of Man*	*% of North Sea Coast total landed in region*	*% of combined British and Isle of Man total landed in region*
Cockles	23,542	26,199	29,501	32,047	89.6	73.5
Crabs	32	9,117	9,453	16,970	0.4	0.2
Lobsters	30	622	504	1,069	4.8	2.8
Mussels	37	4,865	3,488	6,555	0.8	0.6
Nephrops	1	8,368	1,918	19,639	<0.1	<0.1
Periwinkles	0	315	70	1,907	0	0
Queen scallops	0	2,207	2,989	11,273	0	0
Scallops	0	4,519	2,589	8,290	0	0
Shrimps	6	615	563	743	1.0	0.8
Squids	3	1,382	919	2,005	0.2	0.1
Whelks	401	1,905	1,535	2,393	21.0	16.8
Others	98	1,819	1,831	2,026	5.4	4.8
Total*	***24,150***	***61,933***	***55,360***	***104,917***	***39.0***	***23.0***

Source: Ministry of Agriculture, Fisheries and Food (1994); Scottish Office Agriculture and Fisheries Department (1993); Isle of Man Department of Agriculture, Fisheries & Forestry (pers. comm.). Key: *excluding landings of farmed shellfish - see section 9.2. Note: amounts landed are rounded up to the next whole tonne. Calculating the figures in this table was a complex process: refer to section 9.1.4.

Native oyster beds have been exploited off Suffolk, Essex and the north Kent coast for many centuries, and in the first half of the century a large natural fishery was coupled with a thriving fishery based on re-laying. A combination of overfishing and the cold winter in 1963 then greatly reduced stocks, and up to 1980 the fishery was increasingly dependent on harvesting cultivated native oysters, purchased from Cornwall and The Solent and relaid in the region for ongrowing. The practice was severely disrupted in the 1980s with the introduction of *Bonamia ostreae* (a parasite that infects the blood cells of native oysters), which caused extensive mortality of the native oysters. In recent years controlled relaying of native oysters for only a limited period of time has revived this fishery and the industry persists. Various husbandry techniques are used to increase the yields of known native oyster beds, and in some cases both native and Pacific juvenile oysters are re-laid onto on-growing beds during spring (see section 9.2). Naturally settled native oysters continue to be dredged in small quantities in the Deben, Colne, Blackwater and possibly other estuaries such as the Crouch/Roach, but the stocks are nowhere near the levels found at the end of the last century. The season varies but falls mainly between September and April. Boats from around Faversham and Whitstable dredge for native oysters off the Whitstable flats in the Swale Estuary. Vessels based around Queenborough, on the Isle of Sheppey in the Medway Estuary, traditionally trawled for species such as cod during the winter, but the poor state of stocks in recent years has diverted effort towards dredging for whiteweed and native oysters in the Swale Estuary. Whiteweed is a fern-like hydroid that is dredged from the sea bed of estuaries in the region, including the Thames, for decorative use. Many fishermen in the region are dependent on this fishery.

The River Deben supports a mussel fishery, and mussels are dredged from natural beds around West Mersea. A local shellfish purification plant has been constructed in compliance with new EC Hygiene Directives.

Diadromous species

The distribution of diadromous fish species in rivers in the region is discussed in section 5.8. Sea trout and a few salmon support an offshore coastal net fishery, which operates from Norfolk and Suffolk. A small number of salmon and sea trout are caught from the River Thames, where improvements in water quality are being made in the hope that salmonids will start returning in larger numbers to spawn again. Table 9.1.7 shows the average numbers of salmon and grilse and sea trout caught in the region's rivers and fisheries in the five years between 1989 and 1993, the methods used to catch them, and the numbers of net licences issued in 1993.

Fyke nets are used to catch eels in the Blyth, Alde, Ore, Stour and Orwell estuaries and in many of the Essex rivers and estuaries and the upper reaches of the Thames Estuary. They are often set in a series across a river, with bars fixed over the entrance of the net to prevent otters being trapped. The traditional and once prosperous Thames Estuary eel fishery, also involving the use of trawls, has attracted less interest over the years as catches and markets have declined

Table 9.1.7 Region 7 salmon & grilse and sea trout five-year (1989 - 1993) average catch (numbers of fish reported), catch methods used and numbers of net licences issued in 1993

River/fishery	*Salmon & grilse*	*Sea trout*	*Method used/no. net licences issued in 1993*
Anglian coastal*	12	2,626	Drift nets (54) and various other nets (39)
River Thames	4	33	Rod-and-line
Region 7	***16***	***2,659***	***93***

Source: National Rivers Authority (1991, 1992, 1993, 1994a, b). Key: *Environment Agency Anglian Region (includes part of Region 6). Notes: 'nets' are defined as instruments other than rod and line; rivers with very small recorded catches have been excluded from this table, so the distribution of rod-and-line fishing may be more widespread than appears here.

and fish have succumbed to the lethal red spot virus *Vibrio anguillarum*.

Sea angling

Sea angling is distinguished from two other types of sport fishing: game fishing for salmon, sea trout, brown and rainbow trout (the first two are covered here) and coarse fishing, which is for freshwater fish species and so is not covered here. Sea angling has three main forms: angling from the shore, inshore fishing within about 5 km of the shore and deep sea fishing. It is a popular sport practised by over two million people in Great Britain (Fowler 1992). Its governing body in England is the National Federation of Sea Anglers, which has approximately 570 affiliated clubs with some 33,000 individual members. Orton (1996) lists contact addresses for fishing clubs in the region and national organisations.

Sea angling occurs in many places in the region, both from the shore and at sea from chartered and private angling boats. The catches constitute a significant proportion of the total landings of the most popular sport angling species, e.g. cod and bass. Around Lowestoft there are good sloping beaches for sea angling, such as at Hopton, Pakefield and Kessingland, where cod and whiting are targeted in autumn and winter. Bass is the main species targeted from the shore or harbour at Southwold in the summer. Cod fishing from the pier at Walton-on-the-Naze and along Frinton sea front is popular from September to March. Many sea angling charter boats operate from around the pier at Southend-on-Sea. Excellent boat and beach sea angling can be had from the area around Dover, with good shore angling from Shakespeare Beach. Other main locations where sea angling occurs in the region are in and around Felixstowe, Harwich, Dovecourt, Clacton-on-Sea, Whitstable, Sheerness, Tankerton, Herne Bay, Margate, Broadstairs, Ramsgate, Sandwich, Deal, Folkstone, Sandgate, Hythe and Dungeness. Orton (1996) lists further details of popular sea angling locations, such as the facilities available and potential catch species.

Bait collection

Bait collection for sea angling occurs in many areas in the region; the more productive areas may attract commercial collectors. Anglers mostly collect their own bait locally, while commercial collectors travel further afield. Ragworm, lugworm, peeler crabs (moulting shore crabs), mussels, cockles, limpets and razor shells are collected. Different bait species are targeted according to the species of fish being caught as well as the location and time of year. The main collecting techniques on the shore are digging and boulder turning. Bait digging, especially for lugworms, is carried out over the lower part of muddy and sandy shores around the time of low water. Fowler (1992) found that the exploitation of bait species was taking place at many locations in the region. Areas such as Orford Ness, River Orwell, Stour Estuary, Colne Point, Blackwater Estuary, Dengie Flats, Shoebury, Southend-on-Sea, Canvey Island, Grain, Swale Estuary, Seasalter, Birchington and Pegwell Bay experience varying levels of digging, either by commercial collectors or by individuals for their own use, and some problems have been encountered (see section 5.5.3).

9.1.3 Management and issues

Responsibility for the management of fisheries in coastal waters rests with the Commission for the European Union (EU), who delegate it to member states under the Common Fisheries Policy (CFP). European Council regulations are implemented through UK law (see Gray (1995) for a brief description), usually by means of statutory instruments, which define limits and restrictions and set down powers of enforcement and penalties. All national regulation measures, including local sea fisheries bylaws, must conform with the requirements of the CFP, not the least being that they are non-discriminatory.

The CFP seeks to manage stocks of fish in EU waters on a biological basis (MAFF 1994), principally by implementing catch quota management measures, by setting agreed annual Total Allowable Catches (TACs) for particular stocks. The policy came into effect in 1983 and was subject to a mid-term review in 1993, with a full review planned for 2002. The CFP is described in Coffey (1995), which sets out the basic elements of the policy and contributes to the debate on fisheries and the environment. A central principle of the policy is the rule of 'equal access' - that all member states of the EU have equal access to all community waters and all fishing resources. However, this rule is subject to the principle of 'relative stability', which takes account of established practice, and consequently a number of exceptions have been adopted, based on various precedents and historic fishing patterns. There is no access for vessels from other member states inside the 6 nautical mile fishery limit. Between 6 and 12 nautical miles from baselines (low water mark) (the limit of the British Territorial Seas), fishing is limited to UK registered vessels and to ones from members states with historic fishing rights. Beyond 12 nautical miles, access by vessels from other member states is limited to those that have been allocated quotas, based on historic fishing rights, and by vessels from non-member countries by reciprocal agreements within the European Union.

For the purpose of stock assessment, Northern European waters have been designated by the International Council for the Exploration of the Sea (ICES) into statistical areas. The UK coastal seas around this region are part of Divisions IVc (Southern North Sea) and VIId (English Channel, East). ICES provides scientific advice on the management of all the important commercial species of fin fish and some shellfish stocks in all areas of the north-east Atlantic. This work is summarised in the annual report of the Advisory Committee for Fisheries Management, which is responsible for providing scientific advice on TACs and other conservation measures to the international fisheries commissions, including the EU. The TAC is a fishery management tool which may, amongst other management needs, take account of the maximum level of exploitation that a given stock can sustain. Precautionary TACs are applied to important stocks where there are not enough scientific data to make an analytical assessment. Once the TACs are set for each stock they are divided between member states in the form of catch quotas. European Council Regulation No. 3074/95 (European Council 1995) fixed, for 1996, the national catch quotas for fish and shellfish species for all European countries and certain conditions under which the species could be fished. The annual TACs, UK quotas and 'uptake' for each species in the ICES statistical divisions in the region are given in Ministry of Agriculture, Fisheries and Food (1994, 1995b, c, 1996b). European Council Regulation No.

3760/92 (European Council 1992) summarises the CFP, including the proportions by which TACs are allocated as national quotas. Minimum landing sizes and whether an annual quota applies in the region for the important pelagic and demersal species are listed in Table 5.7.1.

In this region the Eastern Sea Fisheries Joint Committee (ESFJC) and the Kent and Essex Sea Fisheries Committee (KESFC) manage the sea fisheries from the high water mark out to 6 nautical miles from UK baselines (as defined by the Territorial Waters Order in Council 1964, as amended). The boundary between these two Sea Fisheries Committees is at the county border between Suffolk and Essex, which runs down the middle of the Stour Estuary (Map 9.1.1). The Sussex Sea Fisheries Committee also covers a small amount of Kent: their boundary with the KESFC is at the old lighthouse at Dungeness. Local MAFF Sea Fisheries Inspectorate officers deal with quota management, enforcement of UK and EC fisheries legislation and licensing of fishing vessels. Fisheries managers have been given environmental responsibilities under the Environment Act 1995 and the Conservation (Natural Habitats etc.) Regulations 1994.

The Environment Agency (EA)'s Anglian, Thames and Southern Regions have responsibility to regulate, protect and monitor salmon, sea trout and freshwater eel fisheries from rivers to coastal waters out to the 6 nautical mile limit. The two Sea Fisheries Committees also have powers to support the conservation of salmonid fisheries whilst exercising their responsibilities towards the regulation of sea fisheries. All licences issued by the EA are subject to seasonal and weekly closure times.

In England and Wales MAFF's Sea Fisheries Inspectorate is responsible for collecting information on principal fish stocks exploited by UK vessels and the Centre for Environment, Fisheries and Aquaculture Sciences (CEFAS) Laboratory at Lowestoft is responsible for its collation. The CEFAS Fisheries Laboratory at Conwy assesses the implications of non-fisheries activities and coastal zone usage on fish stocks and fisheries. CEFAS fisheries databases are described in Flatman (1993).

Regulating Orders are granted in England by MAFF to a responsible body to enable it to regulate the fishery for particular wild stocks of molluscan shellfish species. The specified shellfish stock may be fished only in accordance with the terms of the order and any regulations made under it. There is one Regulating Order in this region, the Thames Estuary Cockles Fishery Order 1994 (Table 9.1.8), the largest out of nine in Britain, covering approximately 215,889 ha (as at July 1995).

Issues relating to the fisheries for pelagic, demersal and shellfish species and sea angling and bait collection are closely linked to wildlife conservation in several ways. Issues include the effects on target species as major components in marine ecosystems, the changed availability of food for predators, the effects on non-target species, and effects on species and habitats of nature conservation interest. Fishermen's organisations represent fishermen's and boat owners' interests in the fishing industry and are consulted on fisheries management issues and other fisheries-related issues. Further information on issues concerning fisheries can be found in references such as Commission of the European Communities (1995), and concerning the species targeted in references given in sections 5.5.3, 5.7.3 and 5.8.3.

9.1.4 Information sources used

The coastal fisheries of England and Wales (Gray 1995) has been used in compiling this section. It describes the different types of fishing gear used inshore to catch specific species. Its 'Regional' section gives details of the numbers of boats operating from ports in the region, the amount of fishing effort involved by various methods and which species or species groups are targeted during the different seasons. Shellfish News (Ministry of Agriculture, Fisheries & Food 1996a) includes information on shellfish harvesting (and figures on the total shellfish landings in the UK in 1994) and is published twice yearly. Brady (1995) lists details of all fishing vessels, their base ports and main fishing methods. The key GB statutes relating to fisheries are described in Eno & Hiscock (1995). Figures given in Tables 9.1.1 - 9.1.8 come from various sources: MAFF, NRA (now the Environment Agency), the Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD) and the Isle of Man Department of Agriculture, Fisheries and Forestry (IoM DAFF); their interpretation is described below.

Pelagic, demersal and shellfish species

Statistics given in this section are for landings recorded in the region, as distinct from fish catches taken. Some fish caught in the region may not be landed in the region's ports or even in the UK; other fish are landed in the region but are caught outside it; and until 1993, boats under 10 m were not obliged to register their landings. The data presented give an indication of the economic importance of the species that were landed in the region in 1992 (used as a reference year), compared with the rest of Britain and the Isle of Man. Data for 1993, 1994 and 1995 for England and Wales have also been published in Ministry of Agriculture, Fisheries and Food (1995b, c, 1996b).

The tonnages of various pelagic, demersal and shellfish species (fresh and frozen) landed by UK vessels at the major ports in England and Wales, including Lowestoft, the single 'major port' in the region, come from *UK sea fisheries statistics for 1991 and 1992* (Ministry of Agriculture, Fisheries & Food 1994). A total for the 'other', smaller, ports was provided by the MAFF Fisheries Statistics Unit. These data have been combined to give the figures in the 'Region 7' column for

Table 9.1.8 Regulating Orders in the region

Title	*Species*	*Location*	*Grid ref.*	*Grantee*	*Approximate area (ha)*	*Expiry date*
Thames Estuary Cockles Fishery Order 1994	Cockles	Thames Estuary	TR050800	Kent and Essex Sea Fisheries Committee	116,000	2024

Source: Ministry of Agriculture, Fisheries and Food (1995a). Note: Several Orders are listed in Table 9.2.2.

Tables 9.1.1 and 9.1.4 - 9.1.6.

The figures in the 'North Sea Coast' columns in Tables 9.1.1 and 9.1.4 - 9.1.6 were calculated by adding together all the landings data for the ten regions on the North Sea Coast of Great Britain, as defined in section 1.1.

The figures in the 'England & Wales' column were obtained by adding together all of the MAFF data for England and Wales, and those in the 'Britain and the Isle of Man' column were obtained by combining MAFF, SOAEFD and IoM DAFF data. Because these organisations do not use the same categories, landings in some of their categories have been added to the 'Others' rows in the tables in this section. Also, SOAEFD publish the weight of fish as 'standard landed weight' (gutted fish with head on), whereas MAFF and IoM DAFF provide them as 'nominal live weight' (whole fish). These two are the same for pelagic and shellfish species, but converted data from SOAEFD were used for all demersal species, apart from sandeels (which are not gutted), so that all the data presented are in 'nominal live weight'.

Diadromous species

National Rivers Authority (now the Environment Agency) reported catches for salmon, grilse and sea trout vary in accuracy from year to year, as they represent only declared catches by individuals with a net or rod licence; in addition, catches themselves fluctuate, and so the relationship between catch and stock is not straightforward. Further, in 1992, the introduction of changes to the catch recording system may have resulted in a temporarily reduced level of recording. Therefore the figures given in Table 9.1.7 should be used only as an indication of the pattern of the catch in the region. The annual publication *Salmonid and freshwater statistics for England and Wales* (National Rivers Authority 1991, 1992, 1993, 1994a, b) contains more detailed information.

Sea angling

In the 85th edition of *Where to fish*, Orton (1996) lists much useful information relating to angling, including the locations from which various species of fish can be caught.

Bait collection

Bait collection is discussed by Fowler (1992), who presents results from a survey around the coast of Britain in 1985.

9.1.5 Acknowledgements

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Scientific aspects of managing important fish and shellfish stocks	General Secretary, International Council for the Exploration of the Sea, Palaegade 2 - 4, DK-1261 Copenhagen K, Denmark, tel: 00 45 33157092
Central contact for the local Sea Fisheries Committees; general policy issues	Chief Executive, Association of Sea Fisheries Committees, Buckrose House, Commercial Street, Norton, Malton, North Yorkshire YO17 9HX, tel: 01653 698219
Local inshore fisheries information and advice on bylaws National and EC legislation - Suffolk	Clerk and Chief Fishery Officer, Eastern Sea Fisheries Joint Committee, 6 North Lynn Business Village, Berger Way, King's Lynn, Norfolk PE30 2JG, tel: 01553 775321
Local inshore fisheries information and advice on bylaws, National and EC legislation - Kent and Essex	Clerk, Kent and Essex Sea Fisheries Committee, County Hall, Maidstone, Kent ME14 1XP, tel: 01622 694270
Assessment of implications of non-fisheries activities and coast usage on fish stocks and fisheries; advice to assist with management and policy decisions for the coastal zone. Interaction between fisheries and non-fisheries conservation issues.	*Head of Laboratory, Centre for Environment, Fisheries & Aquaculture Sciences, Conwy, tel: 01492 593883

Type of information	*Contact address and telephone no.*
Assessment and advice on the conservation of fish stocks exploited by UK vessels	*Director, Centre for Environment, Fisheries & Aquaculture Sciences Lowestoft Laboratory, tel: 01502 562244
Additional statistics other than those in publications available from HMSO	MAFF Fisheries Statistics Unit, Nobel House, 17 Smith Square, London SW1P 3JR, tel: 0171 238 6000
Local fisheries, quota management, licensing of fishing vessels and enforcement, UK and EC legislation, from Donna Nook to the Thames.	District Inspector, MAFF Sea Fisheries Inspectorate, Eastern District Fishery Office, 'Seaview', Battery Green Road, Lowestoft, Suffolk NR32 1DD, tel: 01502 573149
Local fisheries, quota management, licensing of fishing vessels and enforcement, UK and EC legislation - Region 7	District Inspector, MAFF Sea Fisheries Inspectorate, South Eastern District Fishery Office, Breeds Place, Hastings, East Sussex TN34 3AA, tel: 01424 424109
Environment Agency (EA) fisheries policy and projects; salmonid and freshwater statistics for England and Wales.	Head of Department, Fisheries Department, EA Head Office, Rivers House, Waterside Drive, Aztec West, Almondsbury, Bristol BS12 4UD, tel: 01454 624400
Regional information and advice on diadromous fisheries; salmonid and freshwater statistics	*Regional Fisheries Manager, EA Anglian Region, Peterborough, tel: 01733 371811

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Type of information	*Contact address and telephone no.*
Regional information and advice on diadromous fisheries; salmonid and freshwater statistics	Regional Fisheries Manager, EA Thames Region, Reading RG1 8DQ, tel: 01734 535000
Regional information and advice on diadromous fisheries; salmonid and freshwater statistics	*Regional Fisheries Manager, EA Southern Region, Worthing, tel: 01903 820692
Research and development, marketing and training for the fishing industry	Technical Director, Sea Fish Industry Authority, Seafish Technology Division, Sea Fish House, St Andrew's Dock, Hull, North Humberside HU3 4QE, tel: 01482 27837
UKDMAP software; mapped fishing areas of selected species, ICES Statistical Division boundaries etc.	*Project Manager, BODC, Birkenhead, tel: 0151 653 8633
National representation of fishermen's and boat owners' interests in the fishing industry	Honorary Secretary, National Federation of Fishermen's Organisations, Marsden Road, Fish Docks, Grimsby DN31 3SG, tel: 01472 352141
Shellfish production (commercial)	Director, Shellfish Association of the UK, Fishmongers' Hall, London Bridge, London EC4R 9EL, tel: 0171 626 3531
Affiliated angling clubs	Secretary, National Federation of Sea Anglers, 51a Queens Street, Newton Abbot, Devon TQ12 2QJ, tel: 01626 331330
Game fishing	Director, Salmon and Trout Association, Fishmongers' Hall, London Bridge, London EC4R 9EL, tel: 0171 2835838
Interaction between fisheries and non-fisheries conservation issues	*Fisheries Liaison Officer, English Nature HQ, Peterborough, tel: 01733 455000
Marine Fisheries Task Group paper; interaction between fisheries and non-fisheries conservation issues	*Fisheries Officer, JNCC Peterborough, tel: 01733 562626
Interaction between fisheries and non-fisheries conservation issues	*Marine Policy Officer, RSPB HQ, Sandy, tel: 01767 680551
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Interaction between fisheries and non-fisheries conservation issues	*Conservation Officer, Marine Conservation Society, Ross-on-Wye, tel: 01989 566017
Interaction between fisheries and non-fisheries conservation issues	Honorary Secretary, The Marine Forum for Environmental Issues, c/o University College Scarborough, Filey Road, Scarborough YO11 3AZ, tel: 01723 362392
Interaction between fisheries and non-fisheries conservation issues	*Suffolk Wildlife Trust, Ashbocking, tel: 01473 890089
Interaction between fisheries and non-fisheries conservation issues	*Essex Wildlife Trust, Colchester, tel: 01206 729678
Interaction between fisheries and non-fisheries conservation issues	*Kent Trust for Nature Conservation, Maidstone, tel: 01622 662012
Seals and fisheries	Sea Mammal Research Unit, Gatty Marine Laboratory, University of St Andrews, Fife KY16 8LB, tel: 01334 476161
Seals and fisheries	Co-ordinator, Wildlife & Countryside Link Seals Group, 105 Halsford Park Road, East Grinstead, West Sussex RH19 1PR, tel: 01342 315440

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9.2 Mariculture

C.F. Robson

9.2.1 Introduction

Mariculture is the cultivation of marine species. In this region the cultivation of shellfish occurs in the estuaries of Suffolk, Essex and Kent.

9.2.2 Locations and species

Map 9.2.1 shows the location of commercial mariculture areas and the species that are cultivated in the region. Table 9.2.1 lists the main species that are under commercial cultivation in the region and in Great Britain and the Isle of Man. There is currently no cultivation of salmonids, non-salmonid fish or polychaetes in this region.

Pacific oysters are cultivated in the region in the Blyth, Ore-Alde-Butley, Colne, Blackwater, Crouch-Roach and Swale estuaries and at Hamford Water (Horsey Island). Pacific oysters are grown from spat from commercial hatcheries, and a variety of methods are used in their cultivation. Some Pacific oysters are put into bags and placed on racks or trestles in the intertidal zone. Othes are grown to a certain size in bags then scattered at the begining of each year directly onto the substrate - 'lays' - for ongrowing. They are left to grow until they reach marketable size and are harvested in rotation throughout the year, but mainly during the end of the summer. Holding pits have been constructed in Butley Creek (in the Ore-Alde-Butley Estuary) for the storage of shellfish prior to sale. Various husbandry techniques are used to increase the yields of native oyster beds, and in some cases juvenile native oysters are re-laid onto on-growing beds during spring, as for Pacific oysters. The cultivation of native oysters in this way occurs in the same areas as Pacific oysters, with the exception of the Ore-Alde-Butley Estuary.

Map 9.2.1 General location of mariculture areas and the species in culture. Sources: MAFF; The Crown Estate; Sea Fisheries Committees; La Tene Maps (1995). © Crown copyright.

Table 9.2.1 Main species cultivated in the region and in Great Britain and the Isle of Man

Species	*Species status*	*Cultivated in region?*
Salmonids		
Atlantic salmon *Salmo salar*	Native	
Sea trout *Salmo trutta*	Native	
Non-salmonids		
Turbot *Psetta maxima*	Native	
Halibut *Hippoglossus hippoglossus*	Native	
Shellfish: bivalve molluscs		
Common mussel *Mytilus edulis*	Native	✓
Native oyster *Ostrea edulis*	Native	✓
Pacific oyster *Crassostrea gigas*	Un-established introduction	✓
Hard shelled clam *Mercenaria mercenaria*	Non-native	
Manila clam *Tapes philippinarum*	Un-established introduction	✓
Palourde *Tapes decussatus*	Native	
Scallop *Pecten maximus*	Native	
Queen scallop *Aequipecten opercularis*	Native	
Polychaetes		
King ragworm *Neanthes virens*	Native	

Source: Ministry of Agriculture, Fisheries and Food, The Crown Estate & La Tene Maps (1995). Note: for the JNCC's Marine Nature Conservation Review (MNCR), non-native species are those introduced species that are established in the wild; other introduced species are described as un-established introductions.

In order to improve the quality of naturally-occurring stocks of mussels, young mussels - 'seed' - are transplanted from natural beds to man-made 'lays', usually in sheltered, inshore waters. For optimum growth they are laid in the sub-tidal zone. This occurs in the Ore-Alde-Butley, Colne, Blackwater, Crouch-Roach and Swale estuaries. The mussels are collected in the winter months.

Manila clams are being cultivated at Ore-Alde-Butley, Colne, Blackwater, Crouch-Roach and Swale estuaries. The hatchery-reared clams are 'seeded' into the intertidal zone and covered with mesh to protect them from predators. Once they have reached marketable size they are collected using rakes.

Shellfish News (Ministry of Agriculture, Fisheries & Food 1996) includes information on shellfish cultivation (and figures on total shellfish production in the UK in 1994) and is published twice yearly.

9.2.3 Management and issues

The Food Safety (Live Bivalve Molluscs) Regulations (which implement European Council Directives) require that all waters from which bivalve molluscs are taken for human

consumption are classified by MAFF, following sampling carried out by the Port Health Authority or Local Authority. Samples of live shellfish are submitted to the Public Health Laboratory Service for bacteriological examination, and depending on the resulting category (A - D), restrictions and further treatment may apply before human consumption is permitted. Samples are taken regularly and the classification can change. Shellfish must also meet the 'End Product Standard', with which all live bivalves intended for immediate consumption must comply. A database of the current hygiene status of shellfish harvesting areas is maintained by MAFF (Fisheries Division, Nobel House, and DFR Fish Diseases Laboratory, Weymouth). Shellfish purification plants have been constructed in the region in compliance with EC Hygiene Directives.

The introduction of non-native shellfish species for cultivation has caused concern over their potential to establish self-sustaining populations, which may affect marine ecosystems. Since January 1993 there have been new requirements for the control of shellfish disease in Great Britain and for the 'deposit' and importation of molluscan shellfish and lobsters, under the EC Fish Health Directive (Directive 91/67). The Directive lists diseases on which national authorities will take action and those animals that are susceptible to notifiable diseases. The lists may be amended with changing circumstances. In Great Britain two shellfish diseases are now notifiable: *Bonamia* and *Marteilia*, both of which are of serious economic importance and are present in one or more EU member states. The agents of the diseases, *Bonamia ostreae* and *Marteilia refringens*, are parasites that cause high mortalities in susceptible species, notably the native oyster. Movements of species susceptible to these diseases can be made only from areas of equal or better health status, and imports of Pacific oysters are subject to screening for species contamination. Importation from non-EU countries is permitted only under licence, and imports must enter through designated border inspection posts. Shellfish and fish farms have to be registered with MAFF under the Fish Farming and Shellfish Farming Business Order 1985. Registration is designed to assist MAFF in dealing with any outbreaks of pests and diseases.

The Crown Estate owns 55% of the foreshore and the same proportion of the beds of tidal rivers between mean high and low water in Great Britain, together with virtually the entire territorial sea bed. Of the remainder of the foreshore in this region the majority is owned by private landowners, local authorities and port authorities. The Colne Estuary is owned by Colchester Borough Council, which leases the fishery rights to Colchester Oyster Fishery. The consent of the owners or managers of the sea bed is required and a lease may be needed, applications for which must go through an extensive consultation process, before structures for mariculture can be erected on the sea bed. In many areas consent must be sought from the Crown Estate. If the proposed mariculture structures are potentially hazardous to navigation, the Department of Transport must authorise their construction, and if they are to be above mean low water mark, planning permission must be sought from the local authority. In this region much of the coast is protected by national and international designations, including Site of Special Scientific Interest (SSSI), Heritage Coast and AONB (Area of Outstanding Natural Beauty), as well as local and voluntary conservation measures, so nature conservation and landscape considerations also apply.

Several Orders are granted under section 1 of the Sea Fisheries (Shellfish Act) 1967 and are administered in England by MAFF. They are granted to an individual, a co-operative or a responsible body to enable cultivation on the sea bed within a designated area of water and to conserve and develop named molluscan species of shellfish. Sea Fisheries Committees may sub-let the rights of a several fishery, subject to the consent of MAFF. There are five Several Orders in this region (Table 9.2.2), out of 22 in Britain covering a total of approximately 3,299 ha (as at July 1995). The existence of a Several Order does not necessarily mean that mariculture is actively occurring at the location covered. For example, mariculture activities occurring in the area covered by the Several Order at Falkenham have ceased.

Issues relating to the cultivation of marine species are closely linked to marine nature conservation interests, particularly the possible effects on species and habitats of nature conservation interest. These issues for mariculture in general are under consideration by the 'Marine Fisheries Task Group', an inter-agency team of the statutory nature conservation organisations (the Countryside Council for Wales, English Nature, Scottish Natural Heritage and the Department of the Environment for Northern Ireland, together with the JNCC). A consultation paper prepared by the group, entitled *Developing an action programme for sea fisheries and wildlife* (Marine Fisheries Task Group 1994), identifies the main areas where marine fisheries (broadly defined to encompass the exploitation of all living marine resources and therefore including mariculture) affect wildlife and identifies any action needed.

Table 9.2.2 Several Orders in the region

Title	*Species covered*	*Grid ref.*	*Location*	*Grantee*	*Approx. area (ha)*	*Year of expiry*
Falkenham Creek Reach Oyster Fishery Order 1976	Oysters	TM307397	Falkenham, Suffolk	Mr R. Brinkley	22	2006
Horsey Island Oyster Fishery Order 1963	Oysters	TM228235	Horsey Island, near Walton-on-the-Naze	Mrs C. Backhouse	25	2023
Tollesbury and Mersea (Blackwater) Fishery Order 1938	Oysters	TR974114	River Blackwater, Essex	The Tollesbury and Mersea Native Oyster Fishery Co. Ltd	894	1998
Old Hall Farm Creek Oyster Fishery 1972	Oysters	TL965119	Old Hall Creek, Nr. Tollesbury, Essex	Mr M.V. Frost	5	2002
The River Roach Oyster Fishery Order 1992	Oysters	TR960925	River Roach, Essex	The Kent and Essex Sea Fisheries Committee	2.5	2012

Source: Ministry of Agriculture, Fisheries and Food (1995). Note: Regulating Orders are listed in Table 9.1.8.

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9.2.5 Further sources of information

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B. Further reading

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Spencer, B.E., Edwards, D.B., & Millican, P.F. 1991. *Cultivation of Manila clams.* Lowestoft, MAFF. (Directorate of Fisheries Research, Laboratory Leaflet No. 65.)

C. Contact names and addresses

Type of information	Contact address and telephone no.
Central contact for the local Sea Fisheries Committees; general Sea Fisheries Committees policies	Chief Executive, Association of Sea Fisheries Committees, Buckrose House, Commercial Street, Norton, Malton, North Yorkshire YO17 9HX, tel: 01653 698219
Several Orders; mariculture activities and local bylaws	Clerk and Chief Fishery Officer, Eastern Sea Fisheries Joint Committee, 6 North Lynn Business Village, Berger Way, King's Lynn, Norfolk PE30 2JG, tel: 01553 775321
Several Orders; mariculture activities and local bylaws	Clerk, Kent and Essex Sea Fisheries Committee, County Hall, Maidstone, Kent ME14 1XP, tel: 01622 694270
Fisheries and mariculture in England, including Several Orders	MAFF (Aquaculture Division), Nobel House, 17 Smith Square, London SW1P 3JR, tel: 0171 238 5940
Scientific advice: marine fish and shellfish cultivation; advice on management and policy issues for the coastal zone. Interaction between mariculture activities and marine nature conservation issues.	*Head of Laboratory, Centre for Environment, Fisheries & Aquaculture Sciences, Conwy, tel: 01492 593883
Bivalve mollusc production areas; classification of shellfish waters and shellfish diseases	Head of Laboratory, Centre for Environment, Fisheries & Aquaculture Sciences, Fish Diseases Laboratory, Barrack Road, The Nothe, Weymouth, Dorset DT4 8UB, tel: 01305 206600
Technical advice on shellfish depuration (purification)	Sea Fish Industry Authority, Sea Fish House, St Andrews Dock, Hull, North Humberside HU3 4QE, tel: 01482 27837
Leases	The Crown Estate, Marine Estates, 16 Carlton House Terrace, London SW1Y 5AH, tel: 0171 210 4377
Salmon farming	Director, Scottish Salmon Growers Association, Drummond House, Scott Street, Perth PH1 5EJ, Scotland, tel: 01738 635420
Commercial advice on shellfish	Director, Shellfish Association of the UK, Fishmongers Hall, London Bridge, London EC4R 9EL, tel: 0171 6263531
Polychaete cultivation	Manager, Seabait Ltd., Woodhorn Village, Ashington, Northumberland NE63 9NW, tel: 01670 814102
Interaction between mariculture activities and marine nature conservation issues	*Fisheries Liaison Officer, EN HQ, Northminster House, Peterborough PE1 1UA, tel: 01733 455000
Marine Fisheries Task Group paper; interaction between mariculture activities and marine nature conservation issues	*Fisheries Officer, JNCC Peterborough, tel: 01733 562626
Interaction between mariculture activities and marine nature conservation issues	*Coastal Policy Officer, RSPB HQ, Sandy, Beds., tel: 01767 680551
Interaction between mariculture activities and marine nature conservation issues	*Fisheries Officer, WWF-UK, Godalming, tel: 01483 426444
Interaction between mariculture activities and marine nature conservation issues	*Conservation Officer, Marine Conservation Society, Ross-on-Wye, tel: 01989 566017
Interaction between mariculture activities and marine nature conservation issues	Honorary Secretary, The Marine Forum for Environmental Issues, c/o University College Scarborough, Filey Road, Scarborough YO11 3AZ, tel: 01723 362392
Interaction between fisheries and non-fisheries conservation issues - Suffolk	*Suffolk Wildlife Trust, Ashbocking, tel: 01473 890089
Interaction between fisheries and non-fisheries conservation issues - Essex	*Essex Wildlife Trust, Colchester, tel: 01206 729678
Interaction between fisheries and non-fisheries conservation issues - Kent	*Kent Trust for Nature Conservation, Maidstone, tel: 01622 662012
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*Starred contact addresses are given in full in the Appendix.

9.3 Quarrying and landfilling

S.L. Bell & K. Gilbert

9.3.1 Introduction

In this section, quarries are included as coastal if they are less than 2 km inland and landfill sites if they are in a coastal 10 km square. In Region 7 the minerals quarried on a commercial basis include chalk, sand and gravel, and clay and shale. Table 9.3.1 presents production levels by whole county, compared with British levels, for the main minerals quarried in the region.

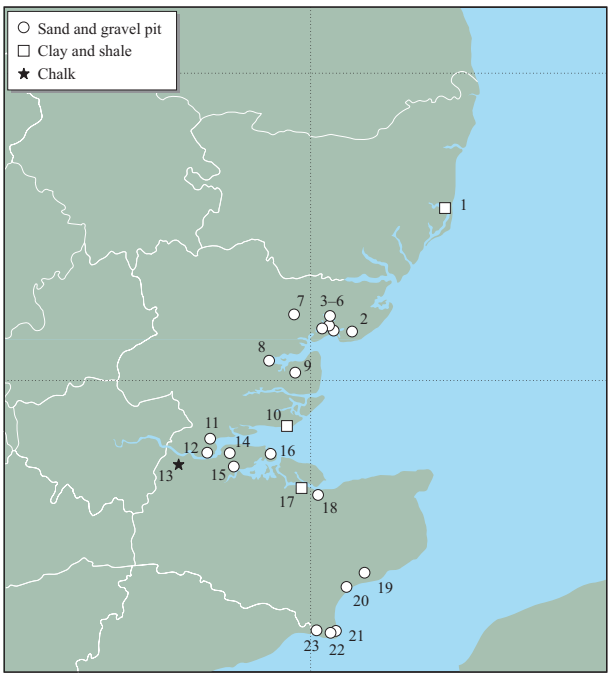
9.3.2 Important locations

In this region there are 23 coastal quarries extracting one or more minerals (Table 9.3.2; Map 9.3.1). Of these quarries, one extracts chalk, three extract clay and shale and the remainder extract sand and gravel. Chalk extraction is confined to Kent.

Map 9.3.2 shows the location of the region's currently used coastal landfill sites, according to Aspinwall's Sitefile Digest (Aspinwall & Co. 1994); the status codes are defined in Table 9.3.3. There are fourteen landfill sites located in the Suffolk coastal zone, eighteen in Essex, none in Greater London and 25 in Kent. In the Thames area all disposal of waste to land occurs on the surface as landraising. Two landraising operations along the Thames receive all of central London's riverborne waste exports. They are located at Rainham in Havering and Mucking in Thurrock.

9.3.3 Management

Planning for mineral extraction in England is guided by *Minerals Planning Guidance Note 6: guidelines for aggregate provision in England* (Department of the Environment 1994). This predicts that the demand for primary aggregates will rise to 5.9 - 6.4 billion tonnes by 2011. It identifies a general need for the south-east to supply a total of some 29-30 million tonnes of sand and gravel to the south-west over the period up to the year 2006. There are a number of Minerals Local Plans in force. Essex has a County Minerals Subject Plan (sand and gravel) that was adopted in 1991, with a review currently in preparation. A Deposit Draft plan covering all minerals has been prepared for the period 1995-2001. The



Map 9.3.1 Coastal quarries. Source: British Geological Survey (1994). © Crown copyright.

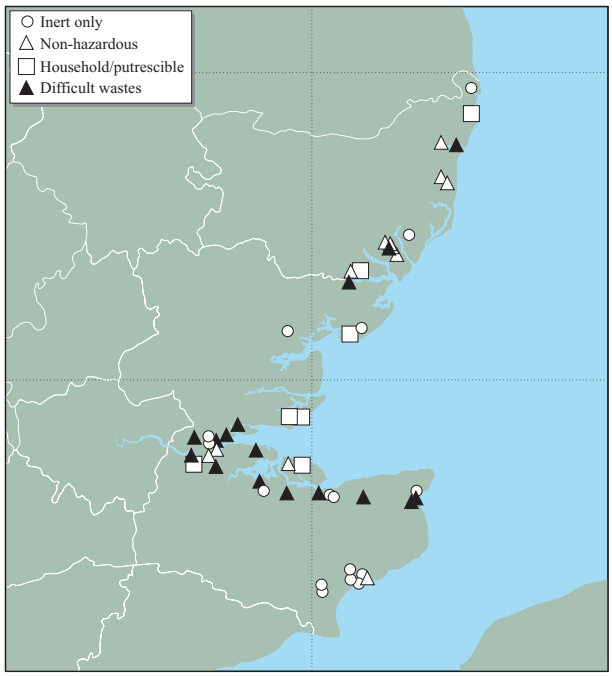
Minerals Local Plan for Kent is being developed in stages by mineral type. The Suffolk Deposit Draft Minerals Local Plan was due to be subject to inquiry in spring 1997.

In April 1996 the Environment Agency came into force, under the 1995 Environment Act. It integrates the functions of Her Majesty's Inspectorate of Pollution (HMIP), the local Waste Regulation Authorities (WRAs) and the National Rivers Authority (NRA). In general terms the agency's regional boundaries follow council, district or national administrative boundaries, to facilitate local accountability. The activities of the Environment Agency are grouped under two broad headings: pollution prevention and control, including waste regulation, the work of HMIP and the NRA's work on water quality; and water management, covering the NRA's other functions. However, there is a strong link between these two sets of functions, to ensure the continuing integrity of estuarine and coastal management. Also within the

Table 9.3.1 Minerals production (thousands of tonnes^{+}) in Region 7 in 1993

	Chalk		*Sand & gravel*		*Clay & shale*	
	Tonnes	*% of GB total*	*Tonnes*	*% of GB total*	*Tonnes*	*% of GB total*
Suffolk	473	5.2	1,586**	2.0	*	*
Essex	*	*	4,382**	5.5	*	*
Greater London	0	0	419	0.5	0	0
Kent	2,085	23.0	2,872	3.6	235	2.2
Region 7	2,558	28.1	9,259	11.7	235	2.2
England	9,076	100	66,320	83.5	9,883	90.7
Great Britain	9,076	100	79,380	100	10,891	100

Sources: Central Statistical Office (1994). Key: *withheld for commercial reasons; **includes marine dredged material; $^{+}$amounts rounded up to the next whole thousand tonnes.



Map 9.3.2 Coastal landfill sites. Note: a single symbol may represent more than one site in close proximity. Source: Aspinwall & Co. (1994).

Environment Act 1995 is the requirement for mine operators to give the Environment Agency at least six months' notice of their intention to abandon a mine, in order that steps can be taken to avoid pollution from minewater. Provisions relating to producer responsibility for waste will provide a mechanism to ensure that business initiatives on re-using, recovering and recycling waste are not undermined by those seeking to avoid their obligations. Landfill site licensing is also the responsibility of the Environment Agency.

9.3.4 Information sources used

Data on quarrying were obtained from the British Geological Survey's *Directory of mines and quarries* (British Geological Survey 1994) and are the most up to date and comprehensive available. Nevertheless these data were up to three years old in 1994 and may therefore include information on some operations that have now ceased. In a very small number of cases, exact addresses of quarries were not listed and therefore it was not known if they were coastal. Information for aggregate production for the south-east is collated by the South East Regional Aggregates Working Party (1995).

The data for landfilling were provided by Aspinwall & Co. from their Sitefile Digest on waste treatment and disposal (Aspinwall & Co. 1994). This contains regularly updated information from the Environment Agency and represents the most up-to-date publicly available collection of waste management statistics in Great Britain.

9.3.5 Acknowledgements

Thanks go to Dr Ron Moore and Susan Morley (Aspinwall and Co.) for providing information from the Sitefile Digest. Thanks are also due to Nick Evans (SERP) and Jeremy Hindle (Suffolk County Council) for comments on the draft text.

Table 9.3.2 Coastal quarries in Region 7

*Site no.**	*Location*	*Operator*	*Mineral*
	Suffolk		
1	Aldeburgh	W. Reade of Aldeburgh Ltd	Clay and shale
	Essex		
2	Wellwick	RMC - St Albans Sand & Gravel	Sand and gravel
3	Wivenhoe	Alresford Sand & Ballast Co. Ltd.	Sand and gravel
4	Colchester	RMC - St Albans Sand & Gravel	Sand and gravel
5	Brightlingsea	Alresford Sand & Gravel	Sand and gravel
6	Colchester	Thames & Colne River Aggregates Ltd.	Sand and gravel
7	Wivenhoe	Redland Aggregates	Sand and gravel
8	Maldon	RMC - St Albans Sand & Gravel	Sand and gravel
9	Curry	Bradwell Earth Moving Co. Ltd.	Sand and gravel
10	Southend	Butterley Brick Ltd.	Clay and shale
11	Thurrock	Cory Environmental Ltd.	Sand and gravel
12	Thurrock	Aylett Gravel Co. Ltd.	Sand and gravel
	Kent		
13	Dartford	Blue Circle	Chalk
14	Isle of Grain	Grain Ballast	Sand and gravel
15	Rochester	Medway Brick & Stone Co. Ltd.	Sand and gravel
16	Isle of Grain	J. Clubb Ltd.	Sand and gravel
17	Sheppey	Taylor Bros. Plant Hire Ltd.	Clay and shale
18	Canterbury	Brett, Robert & Sons Ltd.	Sand and gravel
19	Folkestone	Nickolls Quarries Ltd.	Sand and gravel
20	Romney Marsh	Nickolls Quarries Ltd.	Sand and gravel
21	Lydd	RMC - Hall Aggregates (South East)	Sand and gravel
22	Dungeness	RMC - Hall Aggregates (South East)	Sand and gravel
23	Romney Marsh	Brett, Robert & Sons Ltd.	Sand and gravel

Source: British Geological Survey (1994). Key: *shown on Map 9.3.1.

Table 9.3.3 Status of the region's coastal landfill sites

*Status code**	*Definition*	*No. in region*
1 Inert only	Uncontaminated excavated natural earth materials, and uncontaminated brick rubble and concrete with similar properties to natural earth materials.	19
2 Non-hazardous	Mainly uncontaminated and industrial wastes such as packaging materials, wood and plastic. Some of these wastes are biodegradable but not rapidly so.	14
3 Household/putrescible	Typical contents of a household dustbin and similar wastes of industrial origin e.g. food processing wastes.	7
4 Difficult wastes	Any wastes which require particular handling techniques at the disposal site, e.g. vehicle tyres, dry feathers, animal carcasses. They are not the same as Special Wastes, which are toxic and require pre-notification of disposal to the Waste Regulation Authority.	17
Total		*97*

Source: Aspinwall & Co. (1994). Key: *on Map 9.3.2.

9.3.6 Further sources of information

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Thames Estuary Project. 1996. *Thames Estuary management plan. Consultation draft.* London, Thames Estuary Project/English Nature.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Landfill database and Sitefile Digest	Ron Moore/Susan Morley, Aspinwall & Co., Walford Manor, Baschurch, Shrewsbury SY4 2HH, tel: 01939 262200
Aggregates extraction (land-based) in the region	South East Regional Aggregates Working Party, 14 Buckingham Gate, London SW1E 6LB, tel: 0171 931 8777
Local minerals data, Suffolk	*Suffolk County Council, Ipswich, tel: 01473 583000
Local Minerals Plans, Essex	*Essex County Council, Colchester, tel: 01245 492211
Local Minerals Plans, Kent	*Kent County Council, Maidstone, tel: 01622 671411
Mines and quarries (British Directory of Mines and Quarries)	British Geological Survey, Keyworth, Nottingham NG12 5GG, tel: 0115 936 3100

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

9.4 Marine aggregate extraction, dredging and solid waste disposal at sea

S. L. Bell & K. Gilbert

9.4.1 Introduction

Sand and gravel on the sea bed are important sources of industrial aggregate for concrete production, road construction, building and, increasingly, for beach replenishment and soft coastal defences. The national demand for aggregate from all sources increased steadily during the 1980s. Aggregates from terrestrial sources are insufficient to meet the rising total demand for sand and gravel in Britain (Doody *et al.* 1993), and marine aggregates satisfy an increasing proportion of the requirement, now roughly 8% of aggregate production and 22% of sand and gravel (BMAPA pers. comm.).

Marine sand and gravel are extracted by commercial mineral companies under licence from the Crown Estate. Marine aggregates extracted in England and Wales reached a peak of 28 million tonnes in 1989. Amounts dredged have fluctuated slightly year by year, with a larger proportion now being exported or used in coastal protection schemes. In 1995, a total of 20,953,622 tonnes of aggregate (excluding contract fill and beach nourishment) were dredged from the bed of the territorial sea and continental shelf of England and Wales (Table 9.4.1). This figure includes approximately 6.8 million tonnes of aggregate that were dredged in Great Britain but exported to landing ports abroad. The 11,576,677 tonnes of marine aggregate landed in the east Thames and south coast represent 44% of the total dredged in Great Britain in 1995 (Table 9.4.1) (Crown Estate 1996).

Navigational dredging is of two types: capital dredging and maintenance dredging. Capital dredging refers to the one-off removal of sediment, chiefly when deepening shipping channels and during the construction of new dock facilities. Thereafter, maintenance dredging is the regular dredging of existing ports and their approaches to maintain safe navigation. The majority of dredged material, which can range in composition from silts to boulder clay and rock, is deposited at sea, although dredged material is used for land claim and increasingly for beach recharge. During the NCC's Estuaries Review surveys, carried out in 1989, out of a total of 155 estuaries around Great Britain, capital dredging was taking place in fifteen and maintenance dredging in 72 - 9.7% and 46.5% respectively of the estuaries surveyed (Davidson *et al.* 1991).

Between 1988 and 1993 there was a downward trend in the wet tonnage of dredged material deposited in the seas around the UK, from 44,303,955 tonnes in 1989 to 29,866,206 tonnes in 1993. However this trend was reversed in 1994 when 35,962,835 tonnes were deposited around the UK (Table 9.4.2). The amount of dredged material deposited in the region in 1994 (8,351,332 tonnes) constituted 23% of the total dredged material deposited around the UK as a whole (MAFF pers. comm.). However, this figure was abnormally high because of a very large capital dredging project in 1993/94. Since 1985, the amount of dredged material deposited in this region has varied between 4.4 and 26.9% of the national total and is usually around 10%, excluding large capital projects. In 1994, there were 10 MAFF licensed disposal sites used within the region.

Other wastes deposited under licence from MAFF include sewage sludge and solid industrial waste. In terms of sewage disposal, the UK produces some 1.1 million tonnes of dry solids (tds) annually and disposes of approximately 300,000 tds (equivalent to about 11,000,000 wet tonnes) to the sea. A total of 4,479,361 wet tonnes of sewage sludge were deposited at the Roughs Tower and Barrow Deep sites in 1994. UK sewage sludge production is set to increase dramatically over the next decade, to a predicted 3.3 million tds by 2006. Under the Urban Waste Water Treatment Directive (91/271/EEC), all sewage sludge disposal by marine vessels is set to be phased out by 1998. It will have to be replaced by disposal on land,

Table 9.4.1 Marine dredged aggregates and contract fill/beach nourishment material licensed, extracted and landed in the region and Great Britain in 1995

	Aggregates[1]		*Contract fill/beach nourishment extracted (tonnes)*	*Total aggregates and contract fill/beach nourishment landed (tonnes)*
	licensed (tonnes)	*extracted (tonnes)*		
East Coast[2]	13,025,000	10,497,352		1,112,874
Felixstowe			498,000	
Purfleet			23,227	
Thames Estuary	6,850,000	1,661,324		6,752,262
Rainham			51,879	
West India Dock			2,268	
South Coast[3]	13,545,400	4,428,356		3,711,541
Hythe			514,600	
Region 7	***33,420,400***	***16,587,032***	***1,089,974***	***11,576,677***
England and Wales[4]	42,068,599	20,953,622	5,169,135	26,122,758

Source: Crown Estate (1996). Key: [1]excludes contract fill/beach nourishment material; [2]including all of the Crown Estate's 'East Coast' region; [3]including all of the Crown Estate's 'South Coast' region, which includes Region 7 south of the Thames Estuary and all of Regions 8 and 9; [4]no marine aggregates are dredged off Scotland.

Table 9.4.2 Dredged material licensed and disposed of at sea in 1994

	Licences issued	*Sites under licence*	*Sites used*	*Wet tonnage deposited*
Region 7	15	9	10	8,351,332
England and Wales	106	84	71	34,049,468
UK	***134***	***120***	***98***	***35,962,835***

Source: C. Vivian, MAFF (pers. comm., 1996). Note: licences may commence at any time and generally last for one year.

by tipping or incineration.

Solid industrial waste is waste rock from mining operations, and disposal at sea occurs chiefly in north-east England. There are no licensed disposal sites for industrial waste in this region.

9.4.2 Important locations

Marine aggregates dredging

Map 9.4.1 shows the areas in the region that are licensed by the Crown Estate for marine aggregate dredging (Crown Estate 1996). Table 9.4.3 lists ports in the region landing marine aggregates and their annual tonnages landed. Aggregates normally come from the extraction areas closest to the landing port concerned, but it is not always possible to specify where the aggregate landed at specific ports was dredged, owing to the movement of aggregate to different markets. Occasionally a cargo may have come from a completely different licence, as the dredger may have moved from one licensed area to another, but the amounts involved will be small in overall terms.

Map 9.4.1 Licensed dredging areas for marine aggregates. Source: Crown Estate (1996).

Table 9.4.3 Total tonnages of marine dredged aggregates landed in the region (1995)

Landing port	*Tonnes*
Suffolk	
Ipswich	143,744
Essex	
Harwich	2,727
Purfleet	385,998
Greater London	
Angerstein	706,738
Ridham	779,559
Dagenham	440,630
Blackwall	433,492
Canary Wharf	9,933
Greenwich	1,060,399
Charlton	50,400
Erith	282,208
Kent	
Greenhithe	457,520
Northfleet	385,998
Denton	186,182
Rochester	804,962
Cliffe	506,320
Dover	254,820
Region 7	***6,891,630***

Source: Crown Estate (1996)

Navigational dredging

Table 9.4.4 lists locations in the region at which navigational dredging occurs. This is at the discretion of local harbour authorities and is mainly the result of the regular maintenance of shipping channels for ports, for example Lowestoft, Felixstowe, Ipswich, the Medway, Ramsgate and Dover. Capital dredging is required during the construction of marinas and the extension of port facilities, for example the recent enlargement of Felixstowe Docks.

Dredged material and sewage sludge disposal

Table 9.4.5 lists the main sites used for the disposal of dredged material and sewage sludge in 1994 and the quantities of material disposed of at each site (Map 9.4.2).

Navigational dredgings from within the Port of London area are disposed of at Rainham and Cliffe Pools.

9.4.3 Management and issues

In response to the increase in demand for aggregate in the 1980s, the aggregate industry invested in new ships, which allowed more efficient exploitation of licence areas and new, deeper waters to be dredged (Kenny & Rees 1994). These factors expand the area of sea bed affected by aggregate dredging and potentially intensify the effects. All dredging activities have short-term, localised effects, such as the removal of material and organisms, but long-term effects on, say, fish stocks or morphology are much more difficult to assess, owing to the difficulty of determining which effects are the result of dredging and which the result of the many other factors operating (Doody *et al*. 1993).

Table 9.4.4 Locations in the region where dredging occurs

Source	*Dredging area*
Suffolk	
Suffolk coast	Lowestoft Docks
River Orwell	Felixstowe Harbour
River Orwell	Fox's Marina
River Orwell	Ipswich Port
Essex	
Essex coast	Harwich Harbour, approach channel
River Stour	Harwich Harbour, approach channel
River Stour	Harwich Harbour, Mistley
River Stour	Harwich Harbour, Parkstone Quay
Blackwater Estuary	Maldon Harbour
River Crouch	Essex Marina
Kent	
River Thames	Medway approach channel, Sheerness Small Ships Anchorage
River Thames	Medway approach channel
River Medway	Sheerness Harbour
Kent coast	Ramsgate, Winterstoke outfall
Kent coast	Ramsgate Harbour, outer approach channel
Kent coast	Ramsgate Harbour
Kent coast	Ramsgate Inner Harbour
Kent coast	Ramsgate Royal Harbour
River Stour	Richborough Quay
Kent coast	North Deal
Kent coast	Dover Harbour and Docks

Source: MAFF

Map 9.4.2 Sites used for the disposal of dredged material and sewage sludge. Source: MAFF (pers. comm. 1996).

Marine aggregates dredging

Government policy for the provision of aggregates, formulated in 1982 and 1989, has encouraged marine extraction of sand and gravel: Minerals Planning Guidance Note 6 (Department of the Environment 1992) states that "it has a very important role to play in maintaining supplies of aggregate and, as far as possible, its use is to be encouraged". The government has announced its intention (as at November 1995) to change the system whereby approval is given for the issuing of licences for aggregate extraction. The current system involves obtaining a favourable 'Government View', through a non-statutory analysis and consultation process co-ordinated by the Department of the Environment. The government intends that, in future, applications for marine aggregate extraction licences should be subject to the same type of process as terrestrial planning applications under the Town and Country Planning Acts, regardless of the ownership of the sea bed. The interim position is described in policy guidelines (Department of the Environment 1995), which recommend that "the dredging industry will find it helpful to produce a formal Environmental Statement to support most applications for a production licence".

The government promotes environmentally sustainable coastal defences, and, as a result, the use of sand and gravel for beach recharge is predicted to grow substantially (NERC undated; see also section 8.4).

The biological implications of extraction depend upon the characteristics of the individual area concerned. If an area is used by fish for spawning, for which a stable bed is required, egg laying can be disrupted. Short- or long-term changes in sediment deposition can result, as well as inevitable changes

Table 9.4.5 Amounts of dredged material and sewage sludge disposed of at each licensed site in the region in 1994

Site	*MAFF code (on Map 9.4.2)*	*Waste type*	*Deposited tonnage*
Lowestoft Circular	HU160	Maintenance dredging	144,040
Roughs Tower 'L'	TH040	Maintenance dredging	6,102
Roughs Tower	TH042	Sewage sludge	225,592
Roughs Tower 'D'	TH039	Capital and maintenance dredging	2,567,000
Roughs Tower 'A'	TH044	Capital dredging	3,391,600
Roughs Tower 'C'	TH041	Maintenance dredging	916,564
Upper Blackwater Estuary	TH048	Maintenance dredging	1,180
Barrow Deep'B'	TH050	Sewage sludge	3,294,509
Barrow Deep	TH051	Sewage sludge	959,260
Bridgemarsh Island	TH065	Maintenance dredging	24,900
South Falls	TH070	Capital and maintenance dredging	192,686
Pegwell Bay	TH140	Capital and maintenance dredging	157,006
Dover	DV010	Capital and maintenance dredging	950,254

Source: MAFF.

in the topography of the bed. Disturbance of muddy material in order to access underlying aggregate can destroy feeding grounds for flatfish through the displacement of muddy sand fauna. In general, the principal biological impact of marine aggregate extraction is the disturbance and removal of benthic infauna and epifauna and alteration of the substrate upon which colonisation depends. Where the remnant substrate is identical to the superficial sediments, disturbance is unlikely to be permanent and the extraction area will be recolonised. Licences are generally granted only where these conditions are fulfilled (Campbell 1993).

Navigational dredging

Navigational dredging is the responsibility of individual harbour authorities, although a licence from MAFF is required for disposal of the dredged material offshore.

Dredged material and sewage sludge disposal at sea

The primary legislation in force to control the disposal of dredged material at sea in the UK is the Food and Environmental Protection Act (1985) (deposition at sea and in intertidal areas). Also, the Oslo Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft and the London Convention on the Dumping of Wastes at Sea include within their scope disposal of dredged material at sea. In this region, licences to deposit dredged material are issued by MAFF. Each licence is subject to conditions, which have become more stringent in the last few years. Illegal dumping of material may occur: for instance, in 1993, MAFF investigated three alleged cases of licence infringement within England and Wales.

Blanketing of the sea bed is the main impact of the disposal of dredged material. If the input rate is significantly greater than the natural sedimentation rate, benthic flora and fauna may be killed through the prevention of respiration and feeding. Other impacts include the localised elevation of levels of metals originating in industrial waste and effluent discharged into the rivers from which the material was dredged. Localised increases in water column turbidity, which are often caused by dredged material disposal, may interfere with fish migration for as long as the increase lasts. Changes in sediment particle size can result in changes in benthic flora and fauna which, whilst not damaging *per se*, may affect the distribution of higher animals by altering the food chain. Shallows over banks of sediment may also be created, which could be a navigation hazard.

9.4.4 Information sources used

The statistics on marine aggregate extraction relate to royalty returns to the Crown Estate (as owners of the foreshore and sea bed) for 1995. The information on the disposal of dredged material, sewage sludge and solid industrial waste is derived from licences granted by MAFF.

9.4.5 Acknowledgements

Thanks are due to Andrew Morrison of the Crown Estate for information on marine aggregate extraction in the region, Dr Chris Vivian of MAFF Fisheries Laboratory, Burnham-on-Crouch, for providing information on waste disposal at sea, and navigational dredging.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Marine sand and gravel extraction in the UK (BMAPA & BACMI)	British Marine Aggregate Producers Association/British Aggregate Construction Materials Industries, 156 Buckingham Palace Road, London SW1 9TR, tel: 0171 730 8194
Marine resource management (Managing Agents for the Crown Estate)	Posford Duvivier, Eastchester House, Harlands Road, Haywards Heath, West Sussex RH16 1PG, tel: 01444 458551
Marine aggregate extraction licensing	Business Manager, Marine Estates (Offshore), Crown Estate, 16 Carlton House Terrace, London SW1Y 5AH, tel: 0171 210 4377
Offshore geoscience data including 1:250,000 maps of geology of coastline	British Geological Survey, Keyworth, Nottingham NG12 5GG, tel: 0115 936 3100.
Disposal of dredge spoil at sea- international	The Oslo and Paris Commissions, New Court, 48 Carey Street, London WC2A 2JE, tel: 0171 242 9927
Disposal of dredged material at sea - international	London Convention Secretariat, International Maritime Organisation (IMO), 4 Albert Embankment, London SE1 7SR, tel: 0171 735 7611
Scientific assessments of dredging and waste disposal, and database of licensed disposal operations at sea	*Dr C. Vivian, Marine Environment Protection Division, Centre for Environment, Fisheries & Aquaculture Sciences Burnham-on-Crouch Laboratory, tel: 01621 787200
Disposal of pulverised fuel ash as artificial reefs	Oceanography Centre, Southampton University, University Road, Southampton SO9 5NH, tel: 01703 595666

*Starred contact addresses are given in full in the Appendix

9.5 Oil and gas developments

S.L. Bell & K. Gilbert

9.5.1 Introduction

This section describes oil and gas exploration and related development in the region; oil and gas infrastructure is described in section 8.3.

Map 9.5.1 shows sedimentary basins and structural 'highs" around the UK Continental Shelf, which determine the distribution of oil and gas deposits. Total UK Continental Shelf (UKCS) oil and gas production in 1995 was a record 220 million tonnes of oil equivalent and accounted for some 2% of Gross Domestic Product (DTI 1996). A total of 98 exploration and appraisal wells were drilled in 1995, and seven significant discoveries were announced, although none in this region. Gas production was a record 75.4 billion m^3 from 77 fields, including twelve new ones. Total UK oil consumption in 1993, including imports, was 84.6 million tonnes (Department of Trade and Industry 1994). The Gross National Product arising within the UK oil and gas production sector was £7.7 billion in 1993 (1.4% total UK GNP).

In the 17th Offshore Oil and Gas Licensing Round (1997), no blocks in this region were awarded exploration licences. In July 1995 the 7th Landward Round for oil and gas exploration was announced, under which applications were invited for licences covering both land and certain inshore 'watery areas'. Results were announced in March 1996, when 74 blocks were awarded, although none in this region. The 8th Landward Round is imminent.

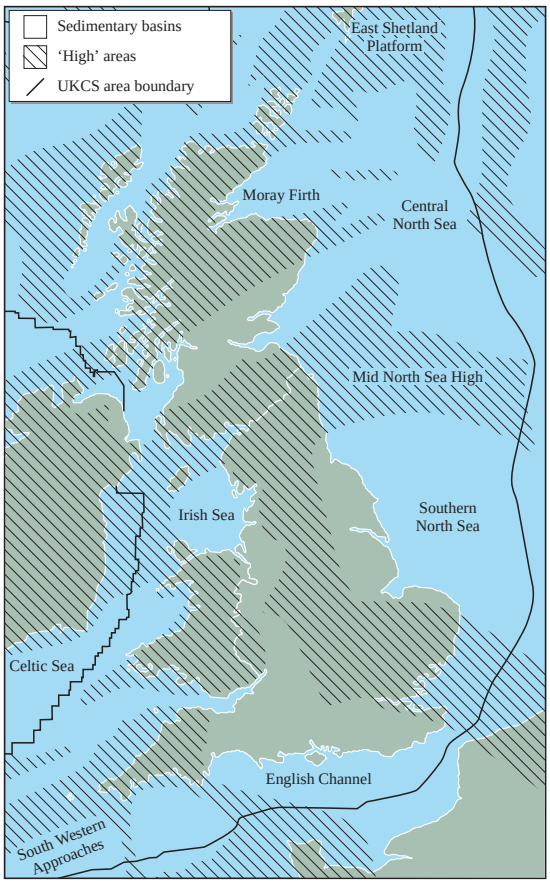
This region is not important for oil and gas production, and there are no production fields in the region.

9.5.2 Important locations

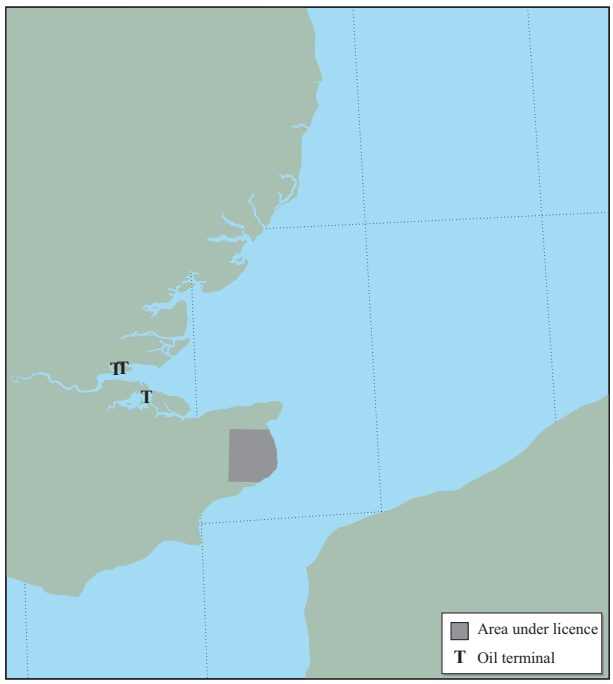
An onshore area in Kent is under licence, awarded in the 5th onshore round in 1992 (Department of Trade and Industry 1996) (Map 9.5.2). There are major oil terminals at Coryton and Shellhaven in Essex and on the Isle of Grain in Kent (Map 9.5.2).

9.5.3 Management and issues

Licences for both offshore and onshore oil and gas exploration are awarded by the Department of Trade and Industry, in consultation with a wide range of organisations, including government departments, environmental agencies, local groups, local authorities, fishermen's federations and other non-governmental organisations. A range of conditions may be applied, according to the environmental sensitivity of the block (Davies & Wilson 1995). The potential for oil spills to harm birds and marine and coastal wildlife is well known, especially in sheltered embayments and estuaries.



Map 9.5.1 UK Continental Shelf (UKCS) exploration. Source: DTI (1996). © Crown copyright.



Map 9.5.2 Oil and gas exploration and production in the region. Source: DTI (1996). © Crown copyright.

9.5.4 Information sources used

The data used here come from the DTI's 'Brown Book' (Department of Trade and Industry 1994, 1996), which should be referred to for further explanation. It is updated annually.

9.5.5 Acknowledgements

Thanks are due to Mark Tasker (JNCC), Steve Gilbert (RSPB), Alexander Downie (Scottish Natural Heritage) and Colin Macduff-Duncan (Esso Exploration and Production UK Ltd) for their comments on the draft text.

9.5.6 Further sources of information

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United Kingdom Offshore Operators Association (UKOOA). 1995. *Environmental guidelines for exploration operations in near-shore and sensitive areas.* London, UKOOA.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Oil and gas developments	Public Relations Officer, Department of Trade and Industry, 1 Victoria Street, London SW1H 0ET, tel: 0171 215 5000
Oil and gas industry issues	Public Relations Officer, UK Offshore Operators Association (UKOOA), 3 Hans Crescent, London SW1X 0LN, tel: 0171 589 5255
Oil transportation and terminals	Technical Adviser, Oil Companies International Marine Forum (OCIMF), 15th Floor, 96 Victoria Street, London SW1E 5JW, tel: 0171 828 7966
General information on the oil industry	Librarian, Institute of Petroleum Library and Information Service, 61 New Cavendish Street, London W1M 8AR, tel: 0171 467 7100
Gas industry	Director and Secretary, Society of British Gas Industries, 36 Holly Walk, Leamington Spa, Warwickshire CV32 4LY, tel: 01926 334357
Oil spillages: government body carrying out pollution control at sea	Marine Pollution Control Unit, Spring Place, 105 Commercial Road, Southampton SO15 1EG, tel: 01703 329484
Response (privately-funded) to oil spills: world-wide	Oil Spill Response, Oil Spill Service Centre, Lower William Street, Northam, Southampton SO14 5QE, tel: 01703 331551
Research into oil pollution	Oil Pollution Research Unit, Environmental Science and Interpretation, 3 Dolphin Court, Brunel Quay, Neyland, Pembrokeshire SA73 1PY, tel: 01646 691000
Advice on oil pollution strategies world-wide	International Tanker Owner's Pollution Federation Ltd, Staple Hall, Stonehouse Court, 87-90 Houndsditch, London EC3A 7AX, tel: 0171 621 1255
Advice on oil spill control equipment	British Oil Spill Control Association (BOSCA), 4th Floor, 30 Great Guildford Street, London SE1 0HS, tel: 0171 928 9199
Licensing of drilling muds and oil spill dispersants	MAFF Marine Environment Protection Division, Nobel House, 17 Smith Square, London SW1P 3JR, tel: 0171 238 6000
Toxicological assessment of drilling muds and oil spill dispersants	*Head of Laboratory, Centre for Environment, Fisheries & Aquaculture Sciences, Burnham-on-Crouch, tel: 01621 787200
Information on the environmental effects of exploration and production	Marine Advisor, Joint Nature Conservation Committee, HQ Monkstone House, Peterborough, tel: 01733 562626
Information on the environmental effects of exploration and production	*WWF - UK, Godalming, tel: 01483 426444

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

9.6 Water quality and effluent discharges

S.L. Bell & K. Gilbert

9.6.1 Introduction

This section summarises information about water quality and effluent discharge from a number of sources. Sewage sludge disposal is covered in section 9.4. Full interpretation of the information base on pollutants and water quality is complex and beyond the scope of this book.

Waste products and effluents containing contaminants reach the marine environment in this region in a number of ways: sewage, agricultural run-off and trade effluents are discharged from outfalls into rivers or directly into the sea, and contaminants can reach the sea by airborne means, for example aerosols and rain. Industrial pollutants can enter the marine environment under licensed discharge or by accidental release. Discharges occurring outside the region may also have a detrimental effect on coastal water quality. Water abstraction can adversely affect water quality and quantity in rivers, estuaries and inshore waters.

In Region 7, the main areas of industrial development and associated effluent discharge are around the Thames Estuary. This area supports a wide variety of industry, including power production and oil refining. Its densely populated coastline can experience contamination through sewage discharge, from both direct outfalls and rivers. Table 9.6.1 shows the numbers of sewage (Map 9.6.1) and trade (Map 9.6.2) outfalls in the region with a consented dry weather flow greater than 6,000 m^3 per day.

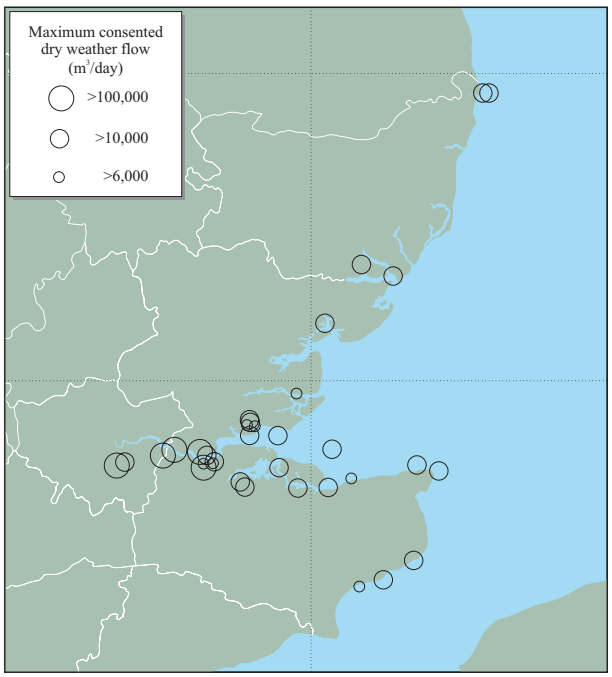
There are 37 bathing waters in this region identified under the EC Bathing Water Directive (76/160/EEC), of which 34 complied with mandatory standards in 1996, two fewer than in 1995 (Table 9.6.2). However, analysis of faecal coliform values suggests that an improvement in water quality has been maintained over the last four years. The Environment Agency expects further increases in compliance after the majority of capital schemes being undertaken by the Water Service companies are completed (Environment Agency 1996).

Overall, beach quality in the region is slightly better than average for Great Britain, with only 33% of beaches rated as polluted, compared with the GB average of 50% (Table 9.6.3). In Kent, however, only 4% of the beaches were rated as excellent, compared with a regional figure of 6% and a national total of 7%. There are four Blue Flag beaches in the region (one in Suffolk and three in Kent), representing 12.9% of the UK total of 31 for 1996. The nineteen Tidy Britain Group Seaside Award beaches in the region (six in Suffolk, three in Essex and ten in Kent) in 1996 represented 8.8% of the UK total of 203.

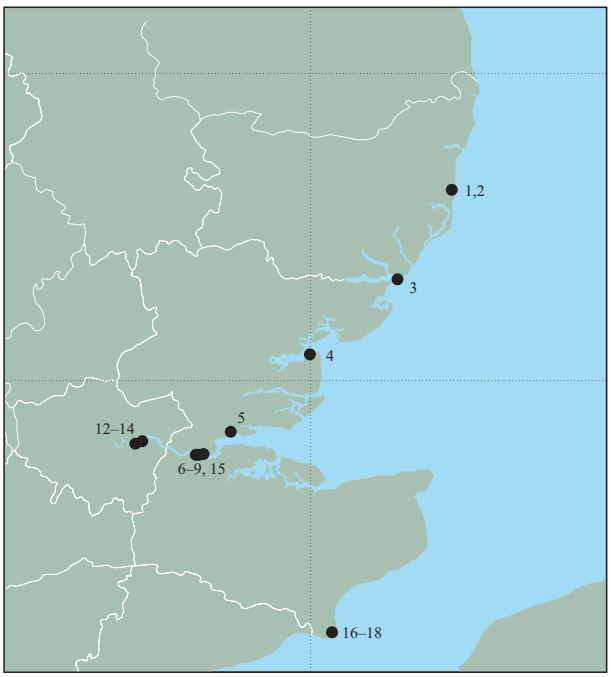
9.6.2 Important locations

All sewage outfalls to the tidal waters of the region with consented dry weather flows greater than 6,000 m^3 per day are shown on Map 9.6.1 and listed in Table 9.6.4. Most of these discharge effluent from sewage treatment works into the River Thames or the Thames Estuary, although untreated sewage is discharged at a few places on the open coasts of Suffolk and Kent.

Table 9.6.5 lists the larger trade effluent outfalls in the region, i.e. those with a consented dry weather effluent flow in excess of 6,000 m^3 per day (Map 9.6.2). Large quantities of cooling water are used by the power stations at Sizewell,



Map 9.6.1 Consented sewage outfalls. Map shows all outfalls with consented flows greater than 6,000 m^3/day. Trade effluent outfalls not shown (see Map 9.6.2). Source: Environment Agency databases



Map 9.6.2 Consented trade effluent outfalls. Source: Environment Agency databases

Table 9.6.1 Numbers of trade and sewage outfalls to tidal waters with maximum consented dry weather flows >6,000 m^3 /day

	Sewage	*Trade*	*Total*
Suffolk	4	3	7
Essex	11	6	17
Greater London	4	5	9
Kent	29	18	47
Region 7	**48**	**32**	**80**

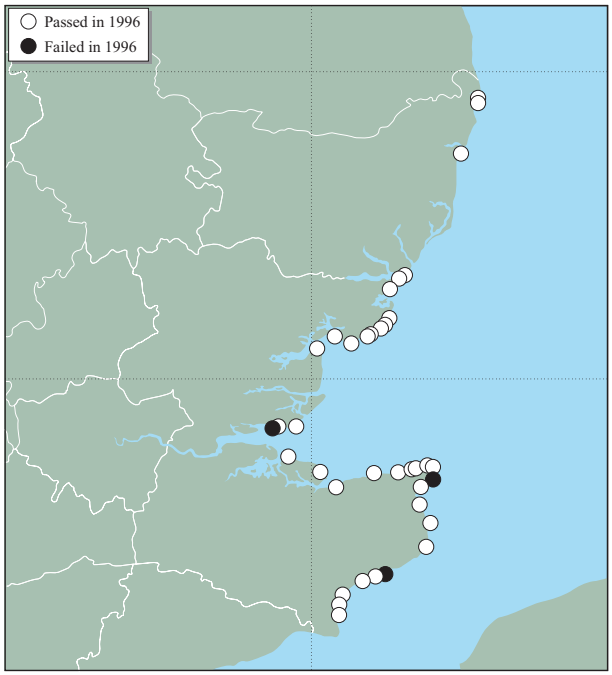
Sources: Environment Agency databases (Anglian, Thames and Southern Regions)

Bradwell, Tilbury and Dungeness; most other large trade discharges come from industrial sites on the Thames Estuary.

Bathing waters in the region in 1996 identified under the EC Bathing Water Directive (76/160/EEC) were: Lowestoft North, Lowestoft South, Southwold, Felixstowe North, Felixstowe South*, Dovercourt, Walton, Frinton, Holland*, Clacton*, Clacton Groyne 41, Jaywick, Brightlingsea*, West Mersea, Shoebury East*, Southend Thorpe Bay, Southend Westcliff Bay (failed), Sheerness*, Leysdown*, West Beach, Herne Bay, Minnis Bay, St Mildred's Bay, Margate (The Bay), Margate Fulsam Rock, Joss Bay*, Broadstairs (failed), Ramsgate, Sandwich Bay*, Deal Castle*, St Margaret's Bay*, Folkestone (failed), Sandgate, Hythe*, Dymchurch, St Mary's Bay, Littlestone (*starred beaches reached the more stringent 'guideline' water quality standard) (Map 9.6.3).

In 1994 an improvement over the previous year in a number of general beach litter categories in Suffolk was offset by corresponding increases in Essex and Kent. The main items of litter found were plastics, paper, sewage and sanitary items, with plastic fishing gear a particular problem in Kent. Medical waste, including syringes and needles, is an increasing problem (McGilvray 1994). Tidy Britain Seaside Award beaches in 1996 were Lowestoft South, Kessingland, Southwold, Sizewell, Thorpeness, Aldeburgh, Southend-on-Sea Shoeburyness East, Southend-on-Sea Three Shells, Southend-on-Sea Leigh Bell Wharf, Sheerness Beach Street, Sheerness Minster Leas, Leysdown Grove Avenue, Birchington Minnis Bay, Margate Main Sands, Joss Bay, Broadstairs Viking Bay, Ramsgate Main Sands, Dymchurch and Greatstone Romney Sands.

The four Blue Flag beaches in the region in 1996 were at Southwold, Sheerness Beach Street, Leysdown Grove Avenue and Birchington Minnis Bay.



Map 9.6.3 EC bathing waters: results of 1995 sampling. Source: Environment Agency.

9.6.3 Management

In April 1996 the new Environment Agency (EA) became operational. It integrates the functions of Her Majesty's Inspectorate of Pollution, the local waste regulatory authorities and the National Rivers Authority (NRA). Its activities are grouped under two broad headings: pollution prevention and control, including waste regulation and water quality; and water management. However, a strong link is maintained between pollution prevention and control and water management, to ensure continuing integrity of estuarine and coastal water quality management.

A range of legislation is in force to control discharges to the aquatic environment. In England the primary statute is the Water Resources Act 1991. The Environment Agency has overall responsibility for the control of discharges and the maintenance of water quality. It authorises sewage discharges to the sea by issuing 'consents', with MAFF as a statutory consultee to safeguard fisheries' interests. Trade effluent discharges involving scheduled (hazardous) substances must be authorised by the Environment Agency under the Environmental Protection Act 1990. The substances are listed in the Trade Effluents (Prescribed Substances and Processes)

Table 9.6.2 EC designated bathing waters surveys (1993, 1994 & 1995)

	Pass			*Fail*			*Total*		
	1994	*1995*	*1996*	*1994*	*1995*	*1996*	*1994*	*1995*	*1996*
Suffolk	5	5	5	0	0	0	5	5	5
Essex	9	12	11	2	0	1	11	12	12
Kent	15	19	18	5	1	2	20	20	20
Region 7	***29***	***36***	***34***	***7***	***1***	***3***	***36***	***37***	***37***
England & Wales	345	379	386	72	45	47	418	425	433
Scotland	16	19	21	7	4	2	23	23	23
N. Ireland	15	15	16	1	1	0	16	16	16
UK	**376**	**413**	**423**	**80**	**50**	**49**	**457**	**464**	**472**

Sources: DoE (1996); NRA(1995); NRA(1996). Note: Pass denotes compliance with Bathing Water Directive (76/160/EEC): Coliform standards.

Table 9.6.3 Beach quality in the region compared with national standards in 1994

Area	% of beaches rated as excellent	moderate	polluted
Suffolk	6	74	20
Essex	7	53	40
Kent	4	57	39
Region 7	***6***	***61***	***33***
England	6	50	44
Wales	7	39	55
Scotland	10	41	49
Great Britain	7	43	50

Source: Coastwatch UK (1995).

Regulations 1989, 1990 and 1992. Environmental Quality Standards (EQSs) are set for many of the substances in the Surface Water (Dangerous Substances) (Classification) Regulations 1989 and 1992. The booklet on *Discharge consents and compliance* (NRA 1994) contains details on national and European discharge regulations. Sewage disposal on land is also controlled by the Environment Agency (see section 9.3).

In 1990 all disposal of liquid industrial waste at sea in this region ceased, in accordance with the Ministerial Declarations of the 2nd and 3rd North Sea Conferences. In common with other parts of the UK coast, coastal waters in the region receive sewage and trade effluent directly from both large and small outfalls. In addition other outfalls, both large and small, discharge into rivers a short distance from the coast. Cumulatively, these discharges are capable of affecting the maritime environment, both in this region and beyond. Under the Urban Waste Water Treatment Directive (91/271/EEC), except in 'High Natural Dispersion Areas'

Table 9.6.4 Sewage outfalls to tidal waters in the region with consented 'dry weather flows' > 6,000 m^3/day

Name of outfall	Location	Grid ref.	Max. consented dry weather flow (m^3/day)	Discharge type	Comments
Suffolk					
Ness Point Short Sea Outfall	Lowestoft	TM556937	24,328	Crude sewage discharge	From sewers/pumping stations
Ness Point Sea Outfalls	Lowestoft	TM566937	24,328	Crude sewage discharge	From sewers/pumping stations
Docks Outfall	Felixstowe	TM281328	*11,760	Crude sewage discharge	From sewers/pumping stations
Cliff Quay	Ipswich	TM172419	33,000	STW final effluent	
Essex					
Colchester (Haven) STW	Colchester	TM023236	25,000	STW final effluent	
Rochford (Stambridge)	Rochford	TQ929912	8,630	STW final effluent	
Southend Sewage Works	Southend-on-Sea	TQ906819	43,000	STW final effluent	Discharges to Thames Estuary
Benfleet STW	Benfleet	TQ770861	6,138	STW final effluent	Discharges to Benfleet Creek
Basildon Sewage Works	Nevenden	TQ737874	*65,700	STW final effluent	Discharges to Pitsea Creek
Basildon Sewage Works	Nevenden	TQ737874	28,400	STW final effluent	Discharges to Pitsea Creek
Pitsea STW	Pitsea	TQ736868	6,060	STW final effluent	Discharges to Timbermans Creek
Canvey STW	Canvey Island	TQ788819	13,000	STW final effluent	Discharges to Thames Estuary
Tilbury STW	Tilbury	TQ656753	32,000	STW final effluent	Discharges to Thames Estuary
W. Thurrock Pumping Station	W. Thurrock	TQ571765	*185,760	Undefined	Discharges to River Thames
Riverside STW	Dagenham	TQ515819	250,000	STW final effluent	Discharges to River Thames
Greater London					
Beckton STW	Beckton	n/av	2,730,000	STW final effluent	Discharges to River Thames
Mogden STW	Mogden	TQ168759	420,000	STW final effluent	Discharges to River Thames
Kew STW	Richmond	TQ198768	65,500	STW final effluent	Discharges to River Thames
Crossness STW	Abbey Wood	TQ490808	982,000	STW final effluent	Discharges to River Thames
Kent					
Long Reach STW	Dartford	TQ554769	9,000	STW final effluent	Discharges to River Thames
Long Reach STW	Dartford	TQ555770	170,000	STW final effluent	Discharges to River Thames
Northfleet STW	Northfleet	TQ617749	9,300	Secondary treated	Discharges to River Thames
Gravesend STW	Gravesend	TQ669743	12,700	Primary treated	Discharges to River Thames
Motney Hill STW	Gillingham	n/av	42,000	Primary treated	Discharges to River Thames
Aylesford STW	Aylesford	n/av	22,000	Secondary treated	Discharges to River Medway
Queenborough STW	Queenborough	n/av	9,200	Primary treated	Discharges to the Swale
Sittingbourne STW	Sittingbourne	n/av	11,800	Secondary treated	Discharges to the Swale
Faversham STW	Faversham	n/av	7,000	Secondary treated	Discharges to the Swale
Swalecliffe Long Sea Outfall	Swalecliffe	TR141695	**9,600	Preliminary treated	
Margate Long Sea Outfall	Margate	TR388734	25,200	Preliminary treated	
Broadstairs Long Sea Outfall	Broadstairs	TR433712	11,200	Preliminary treated	
Dover Sea Outfall	Dover	TR315398	48,815	Preliminary treated	
Copt Point Outfall	Folkestone	TR247364	**16,600	No treatment	
Hythe Long Sea Outfall	Hythe	TR167314	8,640	Preliminary treated	

Sources: Environment Agency databases (Anglian, Thames and Southern Regions). Key: *maximum daily flow; **dry weather flow designed capacity; STW = sewage treatment works; n/av = not available.

Table 9.6.5 Trade effluent outfalls to tidal waters with a consented daily flow >6,000 m³/day

*Site no.**	*Outfall*	*Owner*	*Grid ref.*	*Max. consented daily effluent flow (m³/day)*
	Suffolk			
1	Sizewell B power station, Leiston	Nuclear Electric Ltd.	TM478636	**151,000
2	Sizewell A power station, Leiston	Magnox Electric plc	TM478630	**151,000
3	Dock Road, Felixstowe	British Fermentation Prod.	TM279329	26,000
	Essex			
4	Bradwell nuclear power station	Nuclear Electric Ltd.	TM997087	**151,000
5	Coryton Refinery	Mobil Oil Company Ltd.	TQ746825	90,920
6	Tilbury power station	National Power Plc.	TQ660755	**4,600,000
7	West Thurrock	Procter & Gamble Ltd.	n/av	13,650
8	Purfleet	Vand Den Berghs & Jurgens Ltd.	TQ567768	40,000
9	Purfleet	BPB Paper & Packaging Ltd.	TQ557776	6,000
	Greater London			
10	Empire Paper Mills (discharges to River Thames)	Reed Paper & Board (UK) Ltd.	n/av	11,500
11	Shell Centre (discharges to River Thames)	Shell UK Administrative Services	n/av	14,500
12	Discharges to River Thames	The Post Office	TQ319807	23,000
13	Battersea Works (discharges to River Thames)	Thames Water Utilities Ltd.	TQ291776	16,000
14	Greenwich, Blackwall Reach (discharges to River Thames)	Tunnel Refineries Ltd.	TQ390791	6,000
	Kent			
15	Lagoon Outlet, Northfleet Site	Cory Hall Aggregates Ltd.	n/av	23,273
16	Dungeness A power station	Nuclear Electric plc	TR083164	**2,320,000
17	Dungeness B power station	Nuclear Electric plc	TR081164	**4,000,000
18	Dungeness B power station	Nuclear Electric plc	TR081164	**3,800,000

Sources: Environment Agency databases (Anglian, Thames and Southern Regions). Key: *shown on Map 9.6.2; **cooling water.

(HNDAs), all significant sewage discharges (thus including all those in Table 9.6.4) to coastal waters, where the outfalls serve populations >10,000 (roughly equivalent to 1,800 m³ per day), and to estuaries, where they serve populations >2,000 (roughly 360 m³ per day), will require at least secondary treatment, to be phased in by 2005. However, some outfalls will be permitted to discharge sewage with a minimum of primary treatment, provided that comprehensive studies, currently being carried out by the relevant water companies, show that there will be no adverse effects on the environment. In this region HNDAs have been declared at Lowestoft, Shotley/Felixstowe, Clacton, Jaywick, Swalecliffe, Margate/Broadstairs and Dover/Folkestone/Hythe.

A new management tool, the General Quality Assessment (GQA) classification scheme for estuaries and coastal areas, is to be introduced by the Environment Agency. This scheme is intended to enable a consistent and quantitative comparison of water quality to be made, both over time and between geographic areas. The proposed components to be used in this classification are basic water chemistry (estuaries only), nutrient levels and aesthetic, sediment and biological quality. The basic chemistry, nutrient and aesthetic components will be implemented and tested in 1996, although further research is required to determine appropriate criteria to establish sediment and biological quality (NRA 1996).

There are currently several schemes (statutory and non-statutory) for assessing the quality of beaches and their waters in relation to waste disposal. First, there is the EC Bathing Water Directive (76/160/EEC), with its associated monitoring of identified bathing waters for levels of coliforms (bacteria that indicate sewage presence). Monitoring is carried out by the Environment Agency and beaches are tested regularly to assess whether they meet the mandatory or more stringent 'guideline' standards. Under the terms of the Environmental Protection Act 1990, ensuring the quality of bathing beaches is the responsibility of district councils. Any measures required to improve the quality of the waters are the responsibility of the dischargers of industrial effluent or the sewerage authorities. Secondly, there is the European Blue Flag Award Scheme for beaches that meet the EC guideline standards of beach and water quality, as well as certain land-based criteria. To qualify for consideration as a European 'Blue Flag' beach, a site must reach the 'guideline' water quality standards during the bathing season (May to September inclusive). The Blue Flag is awarded anually and is valid for one year. Thirdly, there is the Tidy Britain Group Seaside Award Scheme, designed to complement the Blue Flag scheme, for beaches that meet minimum standards of beach and water cleanliness and selected land-based criteria but not the Blue Flag standard. Finally there are the annual litter surveys of Coastwatch UK and Beachwatch, both of which employ volunteers to survey lengths of coastline for litter and other signs of pollution. Coastwatch UK is organised by Farnborough College of Technology and Beachwatch by Reader's Digest and the Marine Conservation Society.

9.6.4 Information sources used

Monitoring of water quality in the region is carried out by the Environment Agency and MAFF, with the Environment Agency concerned mainly with point sources of contamination from outfalls in the nearshore environment.

The interests of MAFF lie with the the disposal of sewage sludge and dredge spoil further offshore, and their possible effects on fisheries, and they carry out a wide range of sampling work associated with this. The Environment Agency and MAFF contribute to the National Marine Monitoring Plan, which monitors a wide range of listed chemicals in water, biota and sediments, at a range of frequencies which decrease from the estuarine to the offshore environment.

The Department of the Environment (DoE) Environmental Protection Statistics Division publishes an annual *Digest of environmental statistics* (DoE 1996), which provides detailed national statistics on aspects of environmental protection, including coastal and marine waters, radioactivity, waste and recycling, and wildlife.

Schemes such as the Tidy Britain Group Seaside Award and the European Blue Flag monitor beaches during the year previous to the publication of their results. Monitoring of the EC Bathing Waters and other beaches under schemes such as Coastwatch UK and Beachwatch take place over one or two days. The results may therefore be skewed by heavy rain or localised effects at the time of survey. Coastwatch UK and Beachwatch do not sample the whole coastline in their region, owing to a shortage of volunteers. The results may therefore sometimes be unrepresentative because of the small sample size.

Other information sources available include the NRA's Water Quality Series reports (e.g. NRA 1995) and its quarterly ship- and air-borne National Coastal Baseline Survey, which monitors a large number of water quality parameters in coastal waters, including metals, nutrients and turbidity (Boxall *et al.* 1993). A national database of consented sewage outfalls in England and Wales is maintained at the Centre for Environment, Fisheries & Aquaculture Sciences (CEFAS) at Burnham-on-Crouch. Further information on discharges can be obtained from the local offices of the Environment Agency, who issue discharge consents and authorisations.

9.6.5 Acknowledgements

Thanks are due to staff of the Environment Agency's Anglian, Thames and Southern Regions for providing information from their databases for this section. Thanks also go to Jeremy Hindle (Suffolk County Council), Dr Chris Vivian (MAFF) and Richard Clayton (Southern Water Services) for their helpful comments on the draft text.

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C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Discharge consents - Anglian Region	*Environment Agency, Public Register Department, Anglian Region, Peterborough, tel: 01733 371811
Discharge consents - Thames Region	*Environment Agency, Public Register Department, Thames Region, Reading, tel: 01734 535000
Discharge consents - Southern Region	*Environment Agency, Public Register Department, Southern Region, Worthing, tel: 01903 832000
Beachwatch	*Marine Conservation Society, Ross-on-Wye, tel: 01989 566017
Coastwatch UK	Project Officer, Coastwatch UK, Farnborough College of Technology, Boundary Road, Farnborough, Hampshire GU14 6SB, tel: 01252 377503
Tidy Britain Group Seaside Award and European Blue Flag beaches	Lion House, 26 Muspole Street, Norwich NR3 1DJ, tel: 01603 762888
Aquatic environmental research and monitoring related to water quality and waste disposal at sea; consented outfalls database	*Head of Laboratory, Centre for Environment, Fisheries & Aquaculture Sciences, Burnham-on-Crouch Laboratory, tel: 01621 787200

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

9.7 Leisure and tourism

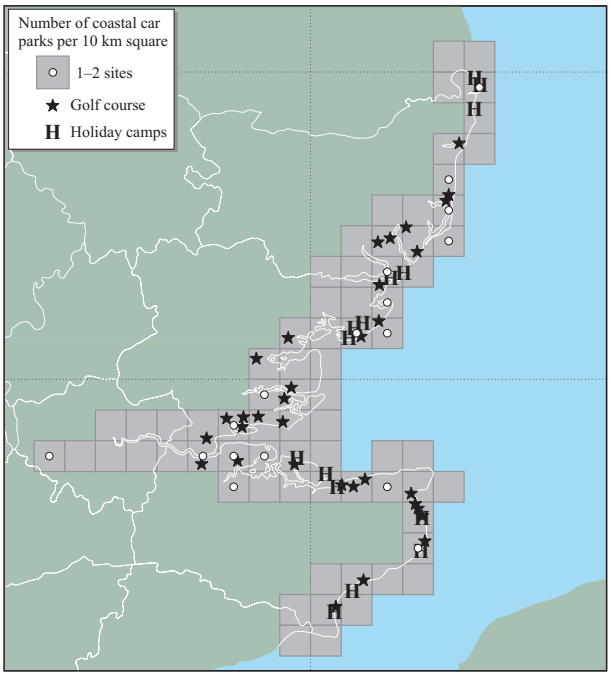
S.L. Fowler & S.J. Everett

9.7.1 Introduction

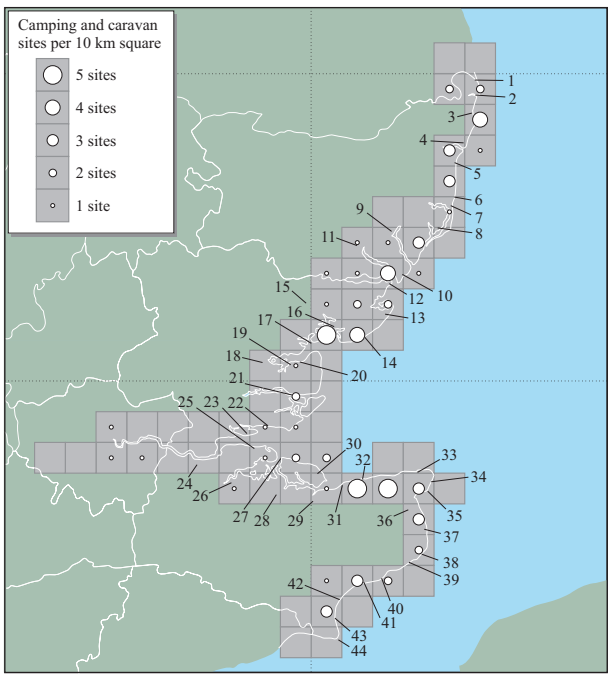
This region is close to the most affluent and populous part of the UK. As a consequence, there is a highly-developed traditional seaside tourist industry in certain locations, particularly in north Essex, at Southend and in north-east Kent. Smaller-scale resorts are located in Suffolk and along the south-east Kent coast. In between these areas, along parts of the Suffolk, mid-Essex and Kent coastlines, the focus for leisure activities is the natural environment itself, in such pursuits as wildfowling, birdwatching and walking. There is a significant boating industry in certain areas, notably within the Essex estuaries, such as the Blackwater and the Crouch, along the Thames Estuary and off the more popular beaches.

Among the most important examples of land-based leisure infrastructure on the coast are golf courses, caravan parks, campsites, holiday camps and car parks, which are concentrated near centres of population and provide the access points for most of the land and water-based leisure activities. Eighty-three caravan parks and/or campsites are shown on OS Landranger maps in the coastal 10 km squares in the region. There are many coastal golf courses, including the championship course at Sandwich. Locations of land-based leisure and tourism and water-based leisure activities are shown on Maps 9.7.1, 9.7.2 and 9.7.3.

The decline in UK seaside tourism has taken its toll on the major resorts but many are now being reinvigorated by new initiatives. Nationally, the seaside resorts' share of the domestic holiday market for stays of four nights or more has fallen steadily from 82% in 1972 to 58% in 1993. This long-term decline and loss of revenue has led to social, economic



Map 9.7.2 Numbers of coastal car parks in coastal 10 km squares in the region and locations of golf courses and holiday camps. Source: Ordnance Survey Landranger maps. © Crown copyright.



Map 9.7.1 Numbers of camping/caravan sites in coastal 10 km squares in the region; important locations (numbered) for tourism and land-based recreation (Table 9.7.1). Source: Ordnance Survey Landranger maps. © Crown copyright.

Map 9.7.3 Important locations for water-based leisure. Sources: Tourist Offices.

Table 9.7.1 Land-based leisure infrastructure

Site no. on Map 9.7.1	*Location*	*Grid ref.*	*Notes*
	Suffolk		
1	Corton	TM5497	Holiday parks
2	Lowestoft	TM5492	Tourist information, ancient monument, museum, piers
3	Kessingland	TM5386	Museum, wildlife park, holiday park
4	Southwold	TM5076	Tourist information, museum
5	Dunwich	TM4770	Nature reserve, museum, picnic site
6	Thorpeness	TM4759	Nature reserves
7	Aldeburgh	TM4656	Tourist information, museum
8	Orford	TM4249	Castle
9	Woodbridge	TM2748	Tourist information centre, museum, picnic sites
10	Felixstowe	TM3034	Tourist information, picnic site, holiday park, pier
11	Ipswich	TM1644	Tourist information centre, museum, gardens
	Essex		
12	Harwich	TM2530	Tourist information, museum, holiday camp
13	Walton-on-the-Naze; Frinton-on-Sea	TM2521	Tourist information, nature reserve, museum, picnic site; pier, country park
14	Clacton-on-Sea	TM1714	Tourist information, priory, pier, holiday parks
15	Brightlingsea	TM0817	Nature reserve, priory (St Osyth)
16	Colchester	TL9925	Tourist information, museum, castle
17	West Mersea	TM0012	Abberton Reservoir, country park, museum
18	Maldon	TL8506	Tourist information, museum
19	Maylandsea	TL9002	Chalets, beach facilities
20	Ramsey Island	TL9505	Chalets, beach facilities
21	Burnham-on-Crouch	TQ9595	Museum
22	Southend-on-Sea Leigh-on-Sea	TQ8785	Castle, museums, tourist information, country park, 9 km of sea front
23	Canvey Island	TQ8083	Zoo, country parks, museum
	Kent		
24	Gravesend	TQ6473	Ancient monument, tourist information
25	Allhallows-on-Sea	TQ8378	Chalets, beach facilities
26	Rochester, Chatham	TQ7567	Tourist information, country parks, castle, cathedral, museums, historic dockyard, North Downs Way
27	Sheerness, Minster	TQ9175	Nature reserve, tourist information, abbey, holiday park
28	Leysdown-on-Sea	TR0370	Country park, holiday camps, nature reserve
29	Sittingbourne	TQ9063	Museum, light railway
30	Faversham	TR0161	Nature reserves, tourist information, museum
31	Whitstable	TR1166	Holiday park, tourist information
32	Herne Bay	TR1768	Museum, tourist information, wildlife park
33	Westgate-on-Sea, Margate	TR3570	Major seaside resort with seafront hotels, aquarium, tourist information, caves, grotto
34	Broadstairs	TR3967	Museums, tourist information
35	Ramsgate	TR3864	Museum, model village, tourist information
36	Sandwich	TR3258	Museum, Richborough Castle, bird observatory, golf courses
37	Deal	TR3752	Holiday park, tourist information, nature reserve, Deal Castle, Walmer Castle, museum, gardens
38	St Margaret's	TR3644	Holiday park, gardens
39	Dover	TR3241	Castle, museums and large areas of National Trust open access land
40	Folkestone	TR2336	Tourist information, castles
41	Hythe	TR1634	Museum, tourist information, zoo, racecourse
42	Dymchurch, St Mary's Bay	TR1029	Holiday park, light railway
43	Littlestone-on-Sea, Greatstone-on-Sea	TR0823	Holiday camp, light railway
44	Dungeness	TR0916	Nature reserve, light railway

Sources: Ordnance Survey & Hamlyn (1995); tourist brochures.

and environmental deterioration in resorts (Hutchings 1995). Increasingly, local authorities are seeking new sources of funds for coastal regeneration projects, such as the European Union and the National Lottery. For example there is a major development initiative at Pegwell Bay, where a leisure complex is planned on the former hoverport.

9.7.2 Important locations

The region has a thriving tourist industry, owing to its accessibility from London, warm summer temperatures and stretches of scenic coastline and beaches. Suffolk's tourist industry is oriented around its small towns, villages and coastal camp sites. Lowestoft is the only major seaside resort in the county and it is also a focus for a busy leisure boating

industry which links up with the Broads. Essex is a major area for tourism, with resorts at Frinton, Clacton, Southend and Canvey Island as well as many smaller holiday resorts and numerous campsites and caravan parks. Kent has a long coastline with several major seaside resorts. These include the Whitstable/Herne Bay area, the Isle of Thanet (Margate, Broadstairs and Ramsgate), Sandwich Bay and Deal, Dover and Folkestone and the coast of Romney Marsh.

Major holiday parks are situated at Corton, Kessingland, Felixstowe, Harwich, Clacton, Sheerness, Whitstable, Kingsdown, St Margarets, Dymchurch and Littlestone-on-Sea. These parks occupy significant areas of land and comprise chalets and/or mobile homes with centralised facilities such as bars, entertainment complexes, swimming pools and sports facilities. Some of the caravan and camping sites listed in Table 9.7.1 are also quite large, occupying up to 10 ha of land.

Nature conservation tourism is becoming increasingly important in the region and is already notable along the Suffolk coast, where significant land holdings are owned or managed by conservation bodies such as English Nature (at Walberswick), the National Trust (Dunwich Heath) and the RSPB (at Minsmere, Aldeburgh and Thorpeness). The RSPB reserve at Minsmere is internationally important and a new visitor centre has recently been built. Tourist boat trips go from Orford to Havergate Island and Orfordness. Further south, there are visitor centres at Fingringhoe (Essex Wildlife Trust) and Reculver (Kent Wildlife Trust) and bird observatories at Oare Marshes (near Faversham), Sandwich Bay and Dungeness.

The Suffolk Coastal Path runs for 50 miles from Lowestoft to Felixstowe. Around the Kent coast the Saxon Shore Way runs from Gravesend to Rye and there are many other areas of open public access along sections of the region's coast. The North Downs Way follows the cliff top between Dover and Folkestone. Country Parks (see section 7.3.7) provide valuable centres for informal recreation to relieve pressure on more sensitive areas. Table 9.7.1 lists the main locations of land-based leisure infrastructure in the region (Maps 9.7.1 and 9.7.2).

Sidaway (1991) records that in April 1990 there were six marinas and 28 areas of moorings in Suffolk, eleven marinas, 54 areas of moorings and three additional unspecified boat facilities in Essex, and twelve marinas and sixteen areas of moorings in Kent. Estimate numbers of berths and moorings on the coast of the region are 1,800 berths, 1,800 estuarine moorings and 375 unspecified moorings in Suffolk; 2,122 berths, 7,615 estuarine moorings and 1,740 unspecified moorings in Essex; and 1,403 berths, 902 estuarine moorings and 1,508 unspecified moorings in Kent.

The Royal Harwich Yacht Club is one of the oldest in Britain, and sailing activities are still expanding in the Orwell Estuary, with a 30% increase in the number of marina berths over the past ten years. There are now four marinas, four other sailing clubs and seven areas of non-marina moorings on this estuary, and one sailing club and five areas of moorings on the Stour Estuary.

According to the RSPB (1992), Essex has more marinas and associated developments than any other county in southern England. There are at least sixteen marinas and other mooring areas on the Blackwater Estuary and eight on the Crouch. The River Crouch is one of the leading yachting centres in the country and sailing remains the dominant form of recreation there. However there is a changing pattern of demand, reflected in the rapid growth of dinghy sailing and the increasing use of power boats. Parts of the River Crouch are already congested by moorings and this congestion is expected to increase, a trend echoed in other locations on this coast.

There has been a dramatic increase in water-based recreation in the region in the last 15 years and yachting facilities are now found in every estuary of the Greater Thames area. Between 1980 and 1990 nearly 2,000 extra berths and moorings for sail and power boats were established along the north Kent and Essex coasts. Kent has a high proportion of developed berths with the Medway and the Swale being under particular pressure from new proposals. There has been a recent move from swinging moorings to marinas in the Thames and Medway Estuaries for reasons of safety and convenience as well as to avoid vandalism. In Greater London, the Docklands and other waterfront redevelopments have resulted in a considerable increase in recreational boat traffic within the tidal Thames and further similar schemes are planned. Table 9.7.2 lists the locations of water-based leisure and tourism facilities in the region (Map 9.7.3).

Windsurfing and water-skiing take place off suitable beaches throughout the region, for example at Clacton, St Osyth Creek, the lower reaches of the River Colne, the Blackwater Estuary, the upper Crouch Estuary, Allhallows-on-Sea, the Medway Estuary, Whitstable, Herne Bay, Birchington, Margate, Folkestone and Romney Sands.

Lowestoft, Southwold and Felixstowe are good for angling, especially for cod, bass, tope and skate, with the best sport from boats and piers. The coastal towns in Essex with good sport angling are Harwich, Walton, Clacton and Southend-on-Sea, with bass, mullet, garfish and stingray being the main catches. On the Kent coast Whitstable, Herne Bay, Margate, Ramsgate and Deal are all good for mixed catches, with excellent boat and beach fishing at Dover (Orton 1996).

This region - particularly Essex - is one of the most important areas in Britain for wildfowling, with shooting taking place on nearly all the major estuaries (although there is relatively little on, for example, the Inner Thames). There are many clubs and syndicates involved, as well as individual wildfowlers, who work the large areas of saltmarshes, mudflats and grazing marsh. Punt-gunning (wildfowling from punts with a mounted gun) takes place on a few estuaries. Some clubs have entered into management agreements with English Nature to ensure compatibility of their activities with nature conservation objectives, as for example at Hamford Water. On some estuaries wildlife refuges are identified in which no shooting is permitted. Target species include mallard, teal and wigeon, plus a range of other duck and goose species.

9.7.3 Management and issues

Planning policies recognise the need to support and develop the range of leisure facilities currently available within the major resorts. As in other tourist areas there is pressure to provide heritage centres, wet-weather tourist attractions and other facilities to retain the interest of British holidaymakers. However planning guidance also recognises the need to conserve the natural qualities of the undeveloped coast. In recognition of this, further urban development will not normally be permitted where this would erode undeveloped gaps between settlements.

Table 9.7.2 Water-based leisure and tourism facilities

Site	*Grid ref.*	*Description**
Suffolk		
Lowestoft	TM5492	Yacht clubs, moorings in harbour
Southwold	TM5076	Moorings in harbour
River Ore/Alde	TM4553	Aldeburgh: quay, yacht club, boatyard; moorings in river around Havergate Island; Orford Quay
River Deben	TM3040	Woodbridge: two harbours, two yacht clubs, moorings on river
River Orwell (Felixstowe-Ipswich)	TM2038	Suffolk Yacht Harbour, Levington; two marinas at Ipswich; marina at Woolverstone: 200 berths, clubhouse, 146 river moorings; three yacht clubs; total moorings and berths for the River Orwell in 1991: 2,100 comprising 1,200 marina berths, 900 river moorings. One of the largest marinas is at Shotley Point (440-berth). Ipswich: Oysterworld Watersports Centre and Wherry Quay, Ipswich Sail Training Centre with berths for 50 visiting boats.
Essex		
River Stour	TM1832	Moorings off Erwarton Ness, Wrabness Pt, Holbrook Creek, Sutton Ness; three sailing clubs; marina; boatyard
Bathside, Harwich	TM2532	650-berth marina, 1,250 houses or flats, school, business park and industry
Walton-on-the-Naze	TM2521	Moorings in backwaters; marina and yacht basin; yacht club
River Colne	TM0616	Moorings in river and creeks; Brightlingsea Harbour: 3 yacht clubs; boatyard
River Blackwater	TL9306	Many moorings (*c.* 1,000) and 16 'marinas', including at Tollesbury and Bradwell; pontoons at Maylandsea; West Mersea: pile moorings; berths at Hebridge Basin; three yacht clubs; boatyard
Burnham-on-Crouch	TQ99	6 marinas/yacht harbours; 4 yacht clubs
River Roach/Havengore (Foulness)	TQ9595	Moorings in creeks; one yacht club; two boatyards
Southend-on-Sea, Leigh-on-Sea	TQ8385	Part of Port of London Authority Area. Moorings at Leigh-on-Sea; 6 yacht clubs; Southend Pier; two leisure harbours at Southend.
Holehaven Harbour	TQ7483	Moorings
River Thames between Teddington & Thames Barrier	TQ4179	18 landing piers between Teddington and Thames Barrier; 21 Port of London Authority drawdocks and 9 marinas (includes harbours such as Chelsea Harbour); two yacht clubs
Kent		
River Medway & associated creeks	TQ7869	9 marinas; 7 yacht and cruising clubs; total 800 moorings
The Swale	TQ9566	Moorings (*c.* 300) along 14 miles of channel between Isle of Sheppey and north Kent coast; three yacht clubs; 3 boatyards; 3 marinas
Whitstable	TR1066	Yacht club; moorings outside port
Herne Bay	TR1668	Marina proposed
Margate	TR3571	Small harbour; marina proposed
Ramsgate	TR3864	Marina (400+100 visitors); yacht club
Pegwell Bay	TR3463	Moorings
Deal	TR3752	Public boat launching
Dover	TR3241	Marina (250+300 visitors); two yacht clubs
Folkestone	TR2335	Yacht club; slipway
Hythe	TR1634	Hythe and Saltwood Sailing Club; slipways at Princes Parade and Marine Parade
Dymchurch	TR1029	Slipway
St Mary's Bay	TR0927	Slipway

Source: Sidaway (1991). Key: *yacht clubs = yacht clubs and sailing clubs

Nature conservation tourism is also expanding, for example along the Suffolk coast and around Pegwell Bay, but poses some dilemmas in terms of the generation of traffic, car parking and visitor impact in sensitive areas. Following the adoption of new environmental management initiatives agreed by members of national and European golfing organisations, conflicts between nature conservation and golfing interests (for example at Sandwich) are being resolved by a partnership approach.

Pressure for the expansion of watersports is expected to continue. This has been particularly significant in the Essex estuaries and the inner Thames. In some locations, the pressure from recreational boating has built up to the extent that sections of rivers and their creeks are congested by moorings. Power boating, water-skiing and jet-skiing cause concern in many coastal locations as they often conflict with environmental objectives as well as with traditional beach activities. Plans are under way in many estuaries to address such issues through the implementation of coastal strategies and management plans. These will include education, zoning and the management of points of access to the water.

9.7.4 Information sources used

Most of the above information is derived from materials received from Tourist Information Centres (up to date, but of varying detail within the region), from Ordnance Survey 1:50,000 Land Ranger maps, Ordnance Survey & Hamlyn (1995), Admiralty Charts and a nautical almanac (D'Oliveira & Featherstone 1993). The maps and tables are only indicative of the distribution of leisure and tourism in the region.

9.7.5 Acknowledgements

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Williams, G., & Hall, M. 1987. The loss of coastal grazing marshes in South and East England with special reference to east Essex, England. *Biological Conservation, 39:* 243-253.

C. Contact names and addresses

Type of information	Contact address and telephone no.
Tourism information service - Britain	Commercial Information Library, British Tourist Authority/English Tourist Board, Thames Tower, Black's Road, Hammersmith, London W6 9EL, tel: 0181 846 9000 x 3011/3015
Tourist Information Centres	
Beccles (seasonal)	The Quay, Fen Lane, Suffolk NR34 9BH, tel: 01502 713196
Lowestoft	East Point Pavilion, Royal Plain, Lowestoft NR33 0AP, tel: 01502 523000
Southwold (seasonal)	Town Hall, Market Place, Southwold, Suffolk IP18 6EF, tel: 01502 724729
Aldeburgh (seasonal)	The Cinema, High Street, Aldeburgh, Suffolk IP15 5AU, tel: 01728 453637
Woodbridge	Station Buildings, Woodbridge, Suffolk IP12 4AJ, tel: 01394 382240
Felixstowe	Leisure Centre, Undercliff Road West, Felixstowe, Suffolk IP11 8AB, tel: 01394 276770
Harwich	Essex County Council, Parkston Quay, Harwich, Essex CO12 4SP, tel: 01255 506139
Colchester	1 Queen Street, Colchester, Essex CO1 2PJ, tel: 01206 282920
Maldon	Coach Lane, Maldon, Essex CM9 7UH, tel: 01621 856503
Southend-on-Sea	19 High Street, Southend-on-Sea, Essex SS1 1JE, tel: 01702 215120
Redbridge	Town Hall, High Road, Ilford, Essex IG1 1DD, tel: 0181 478 3020 x 2126/7
Hackney	Central Hall, Mare Street, Hackney E8 1HE, tel: 0181 985 9055
Central London	British Travel Centre, 12 Regent Street, Piccadilly Circus, London SW1Y 4PQ (personal callers only)
Lewisham	Lewisham Library, 199-201 Lewisham High Street, Lewisham SE13 6LG, tel: 0181 297 8317
Greenwich	46 Greenwich Church Street, Greenwich SE10 9BL, tel: 0181 858 6376
Bexley	Central Library, Townely Road, Bexleyheath, Kent DA6 7HJ, tel: 0181 303 7872
Dartford	The Clocktower, Suffolk Road, Dartford, Kent DA1 1EJ, tel: 01322 343243
Gravesend	10 Parrock Street, Gravesend, Kent DA12 1EL, tel: 01474 337600
Rochester	Eastgate Cottage, High Street, Rochester, Kent ME1 1EW, tel: 01634 843666
Faversham	Fleur de Lis Heritage Centre, 13 Preston Street, Faversham, Kent ME13 8NS, tel: 01795 534542
Whitstable	7 Oxford Street, Whitstable, Kent CT5 1BB, tel: 01227 275482
Herne Bay	12 William Sreet, Herne Bay, Kent CT6 5EJ, tel: 01227 361911
Margate	22 High Street, Margate, Kent CT9 1DS, tel: 01843 220241
Broadstairs	6B High Street, Broadstairs, Kent CT10 1LH, tel: 01843 865650
Ramsgate	19 Harbour Street, Ramsgate, Kent CT11 8HA, tel: 01843 591086
Deal	Town Hall, High Street, Deal, Kent CT14 6BB, tel: 01304 369576
Dover	Townwall Street, Dover, Kent CT16 1JR, tel: 01304 205108
Folkstone	Harbour Sreet, Folkestone, Kent CT20 1QN, tel: 01303 258594
Sandwich (seasonal)	The Guildhall, Cattle Market, Sandwich, Kent CT13 9AH, tel: 01304 613565
Hythe (seasonal)	En Route Building, Red Lion Square, Hythe CT21 5AU, tel: 01303 267799
New Romney (seasonal)	Town Hall House, High Street, New Romney TN28 8BT, tel: 01797 364044
Leisure activities	
Sports and recreation - GB	Sports Council Headquarters, 16 Upper Woburn Place, London WC1H 0QP, tel: 071 388 1277
Sports and recreation - Thames Region and Kent	Sports Council. South East Region, PO Box 480, Crystal Palace National Sports Centre, Ledrington Road, London SE19 2BQ, tel: 0181 778 8600
Sports and recreation - Eastern Essex and Suffolk	Sports Council, Eastern Region, Crescent House, 19 The Crescent, Bedford MK40 2QP, tel: 01234 345222
Water quality of bathing beaches - UK	*Marine Conservation Society, Ross-on-Wye, tel: 01989 566017
Wildfowl and wetlands	*Publicity Officer, Wildfowl & Wetlands Trust, Slimbridge, tel: 01453 890333
Wildfowling (general, including details of affiliated clubs)	Information Officer, British Association for Shooting and Conservation, Marford Mill, Rossett, Wrexham, Clwyd LL12 0HL, tel: 01224 570881
Wildfowling (general information on wildfowl, habitats and conservation)	*Enquiry Officer, RSPB HQ, Sandy, tel: 01767 680551
Severe weather wildfowling bans	*Licensing Officer, English Nature HQ, Peterborough, tel: 01733 455000

C. Contact names and addresses (continued)

Type of information	*Contact address and telephone no.*
Canoeing	British Canoe Union, Agbolgon Lane, West Bridgford, Nottingham NG2 5AS, tel: 0115 982 1100
Cycling	Cyclist's Touring Club, Catterell House, 69 Meadrow, Goldalming, Surrey GU7 3HS
Diving	British Sub Aqua Club, Telfords Quay, Ellsmere Port, South Wirral, Cheshire L65 4FY, tel: 0151 357 1951
Golf	P. Baxter, English Golf Union, 1-3 Upper King Street, Leicester, Leics. LE1 6XF, tel: 0116 255 3042
Jet skiing	British Water Ski Federation, 390 City Road, London EC1Z 2QA, tel: 0171 833 2855
Horse riding	British Horse Society, British Equestrian Centre, Stoneleigh, Kennilworth CV8 2LR, tel: 01203 696697
Sailing, windsurfing and powerboating	Royal Yachting Association (RYA), RYA House, Romsey Road, Eastleigh, Hants. SO5 4YA, tel: 01703 629962
Walking	Ramblers Association, 1-5 Wandsworth Road, London SW8 2XX, tel: 0171 582 6878
Water skiing	British Water Ski Federation, 390 City Road, London EC1Z 2QA, tel: 0171 833 2855
Wildfowling (the sport)	Press and Information Officer, British Field Sports Society, 59 Kennington Road, London SE1 7PZ, tel: 0171 928 4742
Severe weather wildfowling bans	*Licensing Officer, English Nature HQ, Peterborough, tel: 01733 455000
Wind surfing - Britain	British Windsurfing Association, 86 Sinah Lane, Hayling Island, Hampshire PO11 9JX, tel: 01705 468182
Board sailing	UK Board Sailing Association, PO Box 28, Fareham, Hants PO14 3XD, tel: 01329 664779
Yacht harbours	The Yacht Harbour Association, Hardy House, Somerset Road, Ashford, Kent TN24 8EW, tel: 01303 814434
Marine leisure industries	British Marine Industries Federation, Meadlake Place, Thorpe Lea Road, Egham, Surrey TW20 8HE, tel: 01784 473377
Harbour Masters	See Appendix A2

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

Chapter 10 Coastal management

S.L. Fowler & S.J. Everett

10.1 Introduction

This chapter describes national (section 10.2) and local and regional (section 10.3) coastal zone management initiatives taking place wholly or partly within Region 7. GB and UK national initiatives without a specific regional focus, notably those led by non-governmental agencies and user groups, are outside the scope of this chapter. However, as the whole chapter concludes with a list of contacts with a wider involvement or interest in coastal zone management (section 10.3.5), contact points for some of these organisations are included there. In addition, names and addresses of many contacts are given in Table 10.3.1.

10.1.1 Coastal zone management in the UK

This section outlines the direction of national policy-making, within which many of the regional initiatives operate. Many, frequently competing, issues and activities affect the coastal environment and inshore waters, making the task of coastal planning and management a very complex one, particularly as numerous different authorities are responsible for particular statutory duties. Coastal zone management promotes an inter-disciplinary approach to multiple use and conflict resolution between interest groups, "to ensure the long-term future of the resources of the coastal zone through environmentally sensitive programmes, based on the principle of balanced, sustainable use" (Gubbay 1990). Coastal zone management ensures that all land and sea use issues are co-ordinated, including development, conservation, waste disposal, fisheries, transport, and coastal protection and flood defence. The advantages of this have been recognised by coastal planners in many areas, and several local authorities and other bodies now promote coastal management. However, approaches differ from area to area, with overlap in some places and patchy coverage elsewhere (Earll 1994; King & Bridge 1994).

The House of Commons Environment Committee Second Report (House of Commons 1992) made recommendations for the planning and implementation of coastal zone management that have had policy and practical implications throughout the UK. Amongst the Environment Committee's recommendations were:

- the endorsement of an integrated approach to coastal management, incorporating maritime land, sea and intertidal areas;
- a review of existing legislation;
- the need for international (EU-wide) policy initiatives;
- clearer responsibilities for planning and action in the coastal zone, based on a national strategic framework;
- appropriate funding for accountable bodies with responsibilities;
- research into the physical functioning of the coastal zone and associated protection and conservation measures;
- a review of planning mechanisms to allow effective safeguard of the coastal resource;
- monitoring and environmental assessment of coastal activities to assess their impacts;
- the involvement of local communities in coastal zone management planning;
- the integration of responsibility for coast protection and sea defence under one body;
- better statutory protection for sites of nature conservation importance;
- better provisions for control of marine pollution;
- the need for fisheries activities to take account of marine conservation issues.

Later in 1992, the Department of the Environment (DoE) and the Welsh Office (WO) issued *Planning Policy Guidance: coastal planning* (DoE/WO 1992), which clarified the requirement for planning decisions to take account of environmental and conservation issues.

The Environment Select Committee's recommendations were followed up, in 1993, by the publication of *Development below low water mark: a review of regulation in England and Wales* (DoE/WO 1993a), in parallel with the discussion paper *Managing the coast: a review of coastal management plans in England and Wales and the powers supporting them* (DoE/WO 1993b). That same year, The Ministry of Agriculture, Fisheries and Food (MAFF) and the Welsh Office brought out their *Strategy for flood and coastal defence in England and Wales* (MAFF/WO 1993). In this their policy is spelled out: ". . . reducing the risks to people and the developed and natural environment from flooding and coastal erosion by encouraging the provision of technically, environmentally and economically sound and sustainable defence measures."

In December 1994 the DoE launched a standing forum on coastal management for England (the Coastal Forum), which meets twice a year (see section 10.2.2). In 1995 the department published national policy guidelines for the coast (DoE 1995). These guidelines do not replace existing documents but provide a concise digest, pointing out common themes and principles. Public and private bodies are asked to have close regard to them in taking forward their coastal zone management functions. In 1994 the department also undertook to highlight good practice in coastal zone management plans, clarify the interaction of the different elements of coastal zone management and review relevant bylaw powers. *Coastal Zone Management, towards best practice*, a report prepared for the DoE (DoE 1996a), has been published recently. It sets out the basic principles and objectives relating to coastal zone management plans, helping to define the respective roles of key players, taking account of the diverse uses of the coastal zone and giving examples of best practice in helping to resolve competing pressures on the coast and help make clearer how the different elements of coastal zone management interact, including relationships with other strategies. The *Review of bylaw-making powers for the coast* (DoE 1996b) is examining the bylaw powers available to bodies with responsibilities for the coast and aims to assess whether they meet modern needs. It is also considering the broader relationship between the voluntary principle and other regulatory mechanisms.

The European Commission was asked by the Council of the EU to propose a strategy for the whole of the Community coast before the end of 1994. The initial response was to adopt the *Communication on integrated management of coastal zones* (COM/511/95), which sets out proposals for EU funding for demonstration programmes of coastal zone management. The strategy is to be based on the principles of sustainability and sound ecological and environmental practice, but will have no legal standing.

In 1994, the UK Government published its regulations to implement the EC Habitats Directive (DoE/WO 1994). As they relate to the coast, these regulations provide for single management groups to be set up for whole sites, making the production of unified management plans a practical proposition. Where these sites are of European importance for their nature conservation interest, the conservation of that interest must be the primary consideration of the management plan. For this, the regulations require all relevant authorities to exercise a general duty of care for their long-term conservation.

In 1995 the European Commission adopted the *Communication on integrated management of coastal zones* (COM/511/95), which sets out proposals for EU funding for demonstration programmes of coastal zone management. The strategy is to be based on the principles of sustainability and sound ecological and environmental practice, but will have no legal standing. In February 1996 the European Commission published a *Demonstration programme on integrated management of coastal zones* (European Commission Services 1996), intended as a spur to urgent co-operative action for Europe's coast.

The UK government published a Rural White Paper in October 1995, which was to have included a statement on coastal policy, although in the event only sea fishing was addressed. In 1995 the Local Government Management Board (LGMB) issued *Roundtable Guidance* on the implementation of Local Agenda 21 on the coast (LGMB 1995).

10.2 National coastal initiatives with regional elements

10.2.1 Introduction

Partly as a result of developments at a UK and international level, many national bodies, including several with no direct management role through a statutory remit or ownership of coastal land, are now becoming involved in the promotion of coastal management initiatives. These include non-governmental organisations with a particular interest in the conservation of the coastal zone, such as CoastNET (the Coastal Heritage Network), the Marine Conservation Society, World Wide Fund for Nature (UK) and the Royal Society for the Protection of Birds (see section 10.2.5). Only national initiatives that have distinct local elements in the region are described here. Many other diverse interest groups and organisations, for example the British Association for Shooting and Conservation and the Royal Yachting Association, now have national policies with regard to coastal management and estuaries management, and their representatives are involved in most local or regional groups or fora (Table 10.3.1). For further information on regionally-led coastal zone management initiatives, see section 10.3.

10.2.2 National coastal fora

The Coastal Forum

The Coastal Forum was launched in December 1994; it is chaired and serviced by the DoE and meets twice yearly. It brings together key bodies with interests in the coast, from commerce and industry to leisure and environmental bodies, and includes representatives of central and local government. It provides for an exchange of views, by a wide range of interested bodies, on issues related to the coastal zone in England. In particular, it seeks to promote understanding of coastal zone initiatives; build on existing liaison arrangements and regional and local level; assist evaluation of action to implement coastal zone initiatives and monitor preparation of a guide to good practice; complement the work of other bodies with interests in coastal issues; and liaise with other relevant initiatives elsewhere in the United Kingdom. Forum proceedings are reported to government ministers.

English Coastal Groups Forum

Established in 1991, the English Coastal Groups Forum has a remit to promote the formation of coastal groups, including bodies with responsibilities for coastal defence and management and the strategic and local planning functions that would influence coastal defence; to further co-operation between those bodies; to act as a link between centrally-based organisations and coastal groups; to facilitate the development of a coastal zone appraisal and management approach, ensuring that the most environmentally consistent practice is adopted in relation to physical development in the coastal zone; to promote common standards of approach; and to identify policy, administrative and research requirements. Forum members include one representative from each coastal group, the Environment Agency, Local Authority Associations, English Nature, Railtrack and the Department of the Environment, Transport and the Regions.

CoastNET: the Coastal Heritage Network

Launched in 1996, the Coastal Heritage Network (CoastNET) (formerly the Heritage Coast Forum) provides contact between those individuals and groups concerned with the management of the undeveloped coastline in England; proposals have been put forward to broaden this forum to the

whole of the UK. CoastNET is jointly funded by the Countryside Commission, English Nature and Scottish Natural Heritage.

10.2.3 Shoreline management plans

Shoreline management plans set out a strategy for coastal defence for a specified length of coast, taking account of natural processes and human and other environmental influences and needs (MAFF *et al.* 1994). They are based on coastal sub-cells and are compiled in accordance with government guidelines on assessing the environmental impacts of proposals, including soft defence and 'do nothing' options, to be produced in association with and grant aided by MAFF. Five Shoreline Management Plans cover this region (Table 10.2.1).

10.2.4 English Nature

English Nature organises or participates in a number of national coastal zone management initiatives; some major examples are described below (see also section 10.2.7).

The Estuaries Initiative

The Estuaries Initiative for achieving the sustainable management of estuaries is described in *Caring for England's estuaries: an agenda for action* (English Nature 1992); estuary projects are listed in Grabrovaz (1995). Out of a national total of 36 estuary projects, there are estuary plans completed in this region for the Stour and Orwell, the Blackwater and the Thames. The Medway/Swale plan is not completed. English Nature's involvement in these projects can vary from full involvement in the management committee through participation in a topic group to responding to consultation drafts.

Sensitive Marine Areas

English Nature's Sensitive Marine Areas (SMA) initiative is set out in *Managing England's marine wildlife* (English Nature 1994). Under the initiative, which is modelled on the Estuaries Initiative, English Nature and the managers and users of the marine environment are, with joint funding, developing ways of managing areas of marine wildlife importance, based on voluntary measures used in conjunction with existing regulatory controls. There are three SMAs in Region 7: Orford Ness, The Colne/Blackwater Estuaries to Maplin Sands, and Thanet.

Maritime Natural Areas

English Nature has, through consultation, identified 23 proposed Maritime Natural Areas around the coast of England (described in *Conserving England's maritime heritage - a strategy* (English Nature 1993)). These non-statutory areas represent coherent maritime wildlife systems based on major sediment cells and other coastal features. The seaward boundary of each is the 12 mile limit, and the landward boundary the limit of coastal habitats. The Natural Areas approach is being tried out at one Maritime Natural Area (Lyme Bay in Region 9), and will be applied in future to the Maritime Natural Areas within this region, which include those from Lowestoft to Landguard Point, Landguard Point to Whitstable, Whitstable to North Foreland, North Foreland to Folkestone and Folkestone to Selsey Bill.

10.2.5 The Royal Society for the Protection of Birds

In 1990, the Royal Society for the Protection of Birds (RSPB) launched a national campaign to promote the importance of estuaries in the UK and the need for coordinated management (Rothwell & Housden 1990). The campaign ran for three years. The RSPB Estuaries Inventory project compiled mapped and numerical information on land use and selected human activities for 57 major UK estuaries, including fourteen in this region. In 1994, the RSPB launched its 'Marine Life' campaign, which aims to increase awareness of the problems facing the marine environment and its wildlife, including pollution, fisheries and shipping safety. It has recently published a *Review of coastal zone management powers* (RSPB 1995), which reviews strategic planning and management initiatives in part of the region. RSPB regional staff also participate in estuary and coastal management projects.

10.2.6 Local Environment Agency Plans

River catchments, including estuaries and coastal waters, are the Environment Agency's basic water management units (Map 10.2.1). The Environment Agency is building on the success of the former NRA Catchment Management Plans (CMPs) to provide an integrated strategy for each catchment area - a Local Environment Agency Plan (LEAP). These deal with a wide range of environmental issues, including environmental protection and the enhancement of water, land and air. Table 10.2.2 gives a list of catchments in the region where CMPs have been completed, or consultation reports have been issued.

Table 10.2.1 State of progress of Shoreline Management Plans (SMPs) in the region

Coastal cell	*Coastal cell no.*	*Status of SMP*	*Lead authority*
Lowestoft to Harwich	3c	In progress	Suffolk Coastal District Council
Harwich to Canvey Island	3d	In progress	Tendring District Council
Isle of Grain to North Foreland	4a	Completed 1996	Canterbury District Council
North Foreland to Dover Harbour	4b	Completed 1996	Canterbury District Council
Dover Harbour to Beachy Head	4c	Completed 1996	Shepway District Council

Source: MAFF

Map 10.2.1 River catchment areas for Catchment Management Plans (Table 10.2.2). Source: Environment Agency.

Table 10.2.2 Catchment Management Plans

No. on Map 10.2.1	*Catchment*	*Current state of CMP*
1	Blyth, Alde & Deben	In preparation
2	Gipping & Stour	CMP published
3	Blackwater including Colne & Chelmer	CMP published
4	South Essex	CMP published
5	Roding	In preparation
6	Lower Lee	CMP published
7	Thames Tideway	In preparation
8	Darent	CMP published
9	Medway	CMP published
10	North Kent	In preparation
11	Stour	CMP published
12	Eastern Rother	CMP published

Key: CMP = Catchment Management Plan

In order to avoid duplication of effort the LEAP for the Thames Estuary is being subsumed into the Estuary Management Plan. The aim is to produce a widely acceptable management plan for the Thames that also fulfils LEAP requirements. The Environment Agency is providing funding to the Thames Estuary Project for this work.

10.2.7 Designated sites

Site designations are discussed in detail in Chapter 7. However, several statutory and non-statutory designations are also relevant here because they provide a degree of coastal management through their area or site management plans. These often tend to focus strongly on the conservation of landscapes, buildings and/or habitats and species, rather than on wider and more integrated coastal issues, although in management planning for some sites a focus on visitor use and community involvement is important. Designated sites include nature reserves managed by English Nature, wildlife trusts, local authorities, the RSPB or other bodies for nature conservation objectives, Heritage Coasts (see below) and proposed marine Special Areas for Conservation (see also section 7.1). The National Trust, which has extensive coastal land holdings in the region, has recently been carrying out a complete review of its Coastal Strategy Plans and has an ongoing review of coastal site management plans.

Heritage Coasts

The defined areas of Heritage Coasts include only the finest sections of undeveloped coast (section 7.4.3), although much larger coastal areas are frequently covered by local authority Coastal or Countryside Management Services plans. Most Heritage Coast Services (management teams working from within local authorities) are producing or implementing management plans through their respective local authorities and associated Steering Groups. There are three Heritage Coasts in the region: the Suffolk Heritage Coast, which extends along the coast from Kessingland to Felixstowe, the South Foreland Heritage Coast (north-east of Dover) and the Dover/Folkestone Heritage Coast.

Marine Special Areas of Conservation (SACs)

Under the EC Habitats & Species Directive 1992, a list of marine Special Areas of Conservation (SACs) to be designated in the UK must be agreed by the UK Government and the European Commission by 1998 (see section 7.2.3). Marine SACs may include intertidal areas and/or subtidal areas; terrestrial SACs may include important coastal maritime habitats such as lagoons, saltmarshes or sand dunes. A list of 280 possible marine and terrestrial sites was published in March 1995; of these 112 were coastal and 37 were selected, in whole or in part, for their marine habitats and/or species. Consultations are being carried out for all possible sites; meanwhile, all sites on the published list should be managed, on a voluntary basis, as though they were already designated. Under the Directive, marine and terrestrial SACs will have to be managed in a way that secures their 'favourable conservation status'. A range of bodies and individuals will be involved, including all 'relevant and competent authorities', e.g. local authorities, the Environment Agency, ports and harbour authorities, Sea Fisheries Committees and English Nature, as well as owners and occupiers of foreshore land and representatives of those who rely on marine areas for their livelihood or for recreation. Management will be coordinated through an agreed management scheme, backed by existing statutory measures. The Department of the Environment and Welsh Office have drafted guidance (DoE/WO 1996) on the preparation and application of management schemes for SACs. A European marine sites handbook is being prepared by the UK nature conservation agencies to provide guidance on all aspects of developing management schemes within marine SACs.

10.3 Regional coastal management groups and initiatives

10.3.1 Introduction

In March 1994, the Department of the Environment issued *Regional Planning Guidance for the South East* (RPG9), which recognises the importance of the sensitive areas of the region's coastline, and particularly the estuaries of the Essex coast.

In April 1993 SERPLAN issued coastal guidelines for the south-east. In general, the overall strategy aims to guide development that requires a coastal location to areas of developed coast and to protect all stretches of the undeveloped coast against development. SERPLAN suggests that the guidelines should be implemented through Structure Plans and Local Plans together with Shoreline Management Plans, Coastal Strategies and coastal zone management plans prepared in cooperation with interested bodies and adjoining authorities.

There are currently numerous regional coastal management initiatives arising around the coastline under the leadership of local planning, harbours and ports authorities. All local authorities in the region have policies within their structure and local plans relative to the coast and have issued more specific guidance for certain areas of the coast (e.g. Suffolk Coast and Heaths). A Coastal Protection Belt has been identified for the Essex estuaries, extending from the Stour to the Thames at Grays. Other locally-based coastal management initiatives, although not strictly integrated as defined in section 10.1.1, are also under way. These include coastal engineering groups (see section 10.3.2), which are primarily concerned with promoting coordination and liaison between organisations undertaking coastal works (section 8.4). Table 10.3.1 lists regional coastal zone management initiatives, in many of which local authorities are involved or take a leading role.

10.3.2 Coastal (engineering) groups

Two non-statutory coastal groups, the Anglian Coast Authorities Group and South East Coastal Group, have been established in this region to improve co-ordination and liaison between agencies undertaking coastal works (Table 10.3.1; see also section 8.4). Their main aim is to seek a co-ordinated approach to all coastal engineering works by member authorities; reduce the risk of works adversely affecting the neighbouring coastline; and improve their understanding of coastal processes. They work within the framework of the Shoreline Management Plans (see section 10.2.3). The geographical coverage of these groups is based on natural coastal sediment cells (see section 2.4).

10.3.3 Local planning authority and ports/harbours initiatives

The maritime local planning authorities are involved in most, if not all, of the major coastal management initiatives described in this chapter (Table 10.3.1). Their own planning documents - county structure plans and local plans - usually pay particular attention to coastal matters, particularly when produced following PPG20 (DoE/WO 1992). Local authority planning departments hold details of county structure plans, local plans and accompanying documention.

Port and Harbour Authorities also have a statutory remit to control activities within their areas of authority, which may include coastal waters, and will have additional responsibilities in the management of marine Special Areas of Conservation, under the EC Habitats & Species Directive (see section 10.2.7.)

10.3.4 Acknowledgements

Thanks are due to the following for their useful comments on the draft text: Alexander Downie (Scottish Natural Heritage), Kevin Page (English Nature), Steve Gilbert (RSPB), Jeremy Hindle (Suffolk County Council), Linda Davies (Kent County Council), Peter Burrows (Environment Agency), Ray Woolmore (Countryside Commission), Colin Taylor (Nuclear Electric), David Illsley (Shepway District Council), Nick Evans (SERP), Jackie Noble (Essex County Council) and P.R. Bloomfield (Department of the Environment, Transport and the Regions).

Table 10.3.1 Regional coastal management initiatives

Initiative name	*Scope/aims*	*Organisations involved*	*Contact details*
The London and South East Regional Planning Conference (SERPLAN)	*Coastal planning guidelines* (SERPLAN 1993) propose protection and enhancement of the region's coastal landscapes, wildlife habitats and recreational opportunities, and balanced sustainable development	Essex CC, Kent CC, East Sussex CC, West Sussex CC, Hampshire CC, Isle of Wight Joint Planning Unit and SERPLAN	Director, SERPLAN, 14 Buckingham Gate, London SW1E 6LB, tel: 0171 931 8777
Suffolk Coast and Heaths Partnership and Project	To promote an integrated approach to management of the Heritage Coast and AONB. Specific management initiatives for the River Orwell, the Heritage Coast, Shotley Peninsula and Suffolk Estuaries. Produced the Suffolk Coast and Heaths AONB Management Plan (1994)	Local authorities, countryside agencies, other statutory agencies, conservation, farming and forestry organisations, Crown Estate Commissioners	Suffolk Coast and Heaths Project Manager, Suffolk County Council, Dock Lane, Melton, Woodbridge, Suffolk IP12 1PE, tel: 01394 384948
Waveney District Council Shoreline Strategy	Study by Babtie Dobbie Ltd with DC engineering staff. Recommends maintaining existing defences for main settlements, presume against extensions to protected coastline, use traditional and soft techniques.	Waveney District Council, grant aided by MAFF	Project Officer, Waveney District Council, Town Hall, High Street, Lowestoft, Suffolk NR32 1HS, tel: 01502 523331
Stour and Orwell Estuaries Management Plan	Stour and Orwell Estuaries Management Plan produced in 1996 (published by the Suffolk Coast and Heaths Project)	Suffolk and Essex CC, Ipswich BC, Babergh and Suffolk Coastal DC, Harwich Haven Authority, English Nature, Environment Agency, Ipswich Port Authority, Royal Yachting Association. Managed by Steering Group (above plus many other user groups).	*Countryside Manager, Environment and Transport Department, Suffolk County Council, Ipswich, tel: 01473 583172, and *Stour and Orwell Estuaries Project Officer, English Nature, Bury St Edmunds, tel: 01284 762218
The Essex Coastal Strategy	Encourages sustainable use of the coast, stringent restrictions on development on the rural and undeveloped coastline outside built up areas (see SERPLAN). Publictions: *Coastal Issues Report* (Essex County Council 1994), *Essex Coastal Strategy* (Essex County Council 1994) and annual *Coastal Monitoring Report* (Essex County Council).	Steering Group: Essex County Council and Maritime District Councils.	*Essex County Council, Planning Department, Chelmsford, tel: 01245 437584
The Blackwater and Colne Estuaries Project	Blackwater Estuary Management Plan launched June 1996 (Blackwater Estuary Management Project (1996). Part of English Nature's Estuaries Initiative. Colne Estuary Management Plan. Issues report for Colchester area produced in March 1996.	Maldon DC, Tendring DC, Colchester BC, Essex CC and English Nature. Managed by Maldon DC Steering Group and Technical Working Group comprising local authorities, statutory agencies, conservation, farming, fishing organisations	*Blackwater and Colne Estuaries Project Officer, Maldon District Council, Maldon, tel: 01621 854477, or *D. Cookson or Sandra Scott, Colchester Borough Council, Colchester, tel: 01206 282222
Crouch Harbour Management Plan	Prepared by the Crouch Harbour Authority. Deals only with those areas of activity that fall within the remit of the Harbour Authority.	Crouch Harbour Authority	Harbour Master, Burnham-on-Crouch, tel: 01621 783602
Thames Estuary Project	Scoping report published 1994. Issued papers and consultation draft of management plan published July 1996 (Thames Estuary Project 1996).	English Nature and many participating organisations in Steering Group	*Thames Estuary Project Manager, English Nature, London, tel: 0171 831 6922

Table 10.3.1 Regional coastal management initiatives (continued)

Initiative name	*Scope/aims*	*Organisations involved*	*Contact details*
Thames Gateway: Planning Framework (RPG9a)	A supplement to Regional Guidance for the South East (RPG9). The Planning Framework Principles aim to: make the most of the Thames Gateway Opportunity; create a vibrant and sustainable pattern of communities; closely relate transport and land use opportunities; bring life to the river and river-front, and set a new environmental standard.	Department of the Environment, Transport and the Regions, Govt Offices for London and South East, Kent and Essex County Councils, London Boroughs of Barking & Dagenham, Bexley, Greenwich, Hackney, Lewisham, Newham, Tower Hamlets and Waltham Forest. Borough Councils of Dartford, Gillingham, Rochester-upon-Meday, Swale, Thurrock and various other partnerships.	Thames Gateway Regeneration Directorate, Department of the Environment, Transport and the Regions (DETR), Zone 4/G9, Eland House, Bressenden Place, London SW1E 5DU, tel: 0171 890 3745
North Kent Marshes Initiative	Topic Papers on all relevant issues. Swale and Medway Estuary Management Plan in preparation and due 1997 (North Kent Marshes Initiative in prep.). Part of English Nature's Estuaries Initiative.	Steering Group of 15 public and private bodies, including English Nature, Environment Agency, RSPB, Country Landowners Association, Sea Fisheries Committee, National Farmers' Union, Tourist Board, Sports Council, local authorities, Thamesport (London) Ltd., Port of Sheerness Ltd.	*Project Officer, North Kent Marshes Initiative, Swale Borough Council, Sittingbourne, tel: 01795 424341
Isle of Thanet Coastal Strategy	Local Plan and Local Nature Reserve (LNR) submission 1994: recommends improving understanding of coastal processes; develop long term conservation management techniques; sensitive use of the coast for tourism/recreation initiatives. Implementation through management of proposed LNR and later through coastal zone management plan.	Thanet DC, English Nature, Environment Agency, National Trust, RSPB, Kent Trust for Nature Conservation. Managed by Thanet DC Planning Department.	*Thanet District Council, Planning Department, Margate, tel: 01843 225511
Deal Coastal Defence Plan	Feasibility study of coastal defence strategy, to study solutions to coastal defence problems	Dover District Council, Environment Agency, MoD, British Rail, Dover Harbour Board, Sandwich Bay Estate	*Director of Planning and Technical Services, Dover District Council, Dover, tel: 01304 821199
White Cliffs Countryside Project	Manages the South Foreland and Dover-Folkestone Heritage Coasts, and part of the Kent Downs AONB inland. Heritage Coast Management Plans in preparation.	Dover DC, Shepway DC and Kent CC Planning Departments. Steering Group has wide local authority and non-governmental membership.	Project Manager, White Cliffs Countryside Project, 6 Cambridge Terrace, Dover CT16 1JT, tel: 01304 241806
Romney Marsh Countryside Project	Manages parts of Dungeness and the Romney/Walland Marshes	Shepway DC, English Nature, Environment Agency, Nuclear Electric, Magnox Electric, Rural Development Association, RSPB	Romney Marsh Countryside Project Officer, Romney Marsh Resource Centre, Mountfield Road, New Romney, Kent TN28 8LH, tel: 01797 367934
Coastal Management in the Transmanche Region	Recommends undertaking comprehensive audit of Transmanche coastal and marine resource; develop policies for sustainable use; animate and promote joint actions. Broad rolling programme through Interreg 2 (1995 onwards), specific management plans and action on ongoing basis.	Kent CC, Conseil Regional Nord-Pas de Calais, EC Directorate General XVI. Managed by Joint Steering Group and sub-groups.	*Environment Programme, Kent County Council, Maidstone, tel: 01622 696180
nglian Coast Authorities Group	Coordinates coastal defence works north of Thames Estuary	MAFF, local authorities, Environment Agency	*The Chief Engineer, Waveney District Council, Lowestoft, tel: 01502 523301
South East Coastal Group	Coordinates coastal defence works from Thames Estuary southwards	MAFF, local authorities, Environment Agency	*The Chief Engineer, Swale Borough Council, Sittingbourne, tel: 01795 417338

*Starred contact addresses are given in the Appendix

10.3.5 Further sources of information

A. References cited

Blackwater Estuary Management Project. 1996. *Blackwater Estuary Management Plan*. Maldon, Blackwater Estuary Management Project.

Crouch Harbour Authority. 1994. *Crouch Estuary Draft Management Plan.* Burnham-on-Crouch, Crouch Harbour Authority.

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Department of the Environment/Welsh Office. 1993a. *Development below low water mark: a review of regulation in England and Wales.* London, HMSO.

Department of the Environment/Welsh Office. 1993b. *Managing the coast: a review of coastal management plans in England and Wales and the powers supporting them.* London, HMSO.

Department of the Environment/Welsh Office. 1994. *The conservation (natural habitats etc.) regulations.* London, HMSO. (SI 2716.)

Department of the Environment/Welsh Office. 1996. *European marine sites in England and Wales. A guide to the conservation (Natural Habitats & C.) Regulations 1994 and to the preparation and application of management schemes.* London, Department of Environment and the Welsh Office. Draft for consultation.

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English Nature. 1993. *Conserving England's maritime heritage - a strategy.* Peterborough, English Nature.

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Essex County Council (Coastal Working Group). 1994. *Final coastal issues report*. Chelmsford, Essex County Council.

Essex County Council.(Coastal Working Group). 1994. *Essex coastal strategy*. Chelmsford, Essex County Council.

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Grabrovaz, M. 1995. *Review of estuary projects*. Peterborough, English Nature.

Gubbay, S. 1990. *A future for the coast? Proposals for a UK coastal zone management plan*. Ross-on Wye, unpublished report to WWF - UK by the Marine Conservation Society.

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Ministry of Agriculture, Fisheries and Food, Welsh Office, Association of District Councils, English Nature & National Rivers Authority. 1994. *Shoreline management plans: a guide for coastal defence authorities.* London, MAFF (PB2197).

North Kent Marshes Initiative. In prep. *Swale and Medway Estuary Management Plan - a consultation draft*. Sittingbourne, Swale Borough Council.

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Royal Society for the Protection of Birds. 1995. *Review of coastal zone management powers.* Sandy, RSPB.

SERPLAN. 1993. *Coastal planning guidelines for the south-east.* London, SERPLAN. (Coastal Policies Working Party, RPC 2460.)

Suffolk Coast and Heaths Project. 1996. *Stour and Orwell Estuaries management Plan*. Woodbridge, Stour and Orwell Estuaries Group.

Suffolk Coast and Heaths Joint Advisory Committee. 1994. *Suffolk Coast and Heaths Management Plan.* Ipswich, Coast and Heaths Joint Advisory Committee.

Thames Estuary Project. 1996. *Thames Estuary Management Plan. Consultation draft*. London, Thames Estuary Project/English Nature.

B. Further reading

Included in the following list of references are items relating to Scotland and Wales but which may be of interest to individuals and organisations involved in coastal management in England.

Bown, D. 1988. *Coastal development: a planner's view.* Paper presented to Council for the Protection of Rural Wales Annual Study Conference (unpublished).

Countryside Commission. 1995. *Heritage Coasts: a guide for councillors and officers.* Cheltenham, Countryside Commission.

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World Wide Fund for Nature. 1995. *Integrated coastal zone management UK and European initiatives.* Godalming, World Wide Fund for Nature UK. (Marine Update No. 19.)

Newsletters

Many national statutory, non-governmental and scientific bodies are now producing publications or newsletters on the subject of coastal management. These provide either information on particular local or national initiatives (such as the statutory or non-governmental organisations' estuaries and firths initiatives) or general information on a range of coastal news (for example the newsletters of Eurocoast UK and the European Union for Coastal Conservation). Some of these publications are listed below. Addresses of those publishing the newsletters are given in section 10.3.5C.

Coastline UK. Newsletter of the National Coasts and Estuaries Advisory group (NCEAG). Aimed at local authority planners. Published by NCEAG.

Coastline. Quarterly magazine of the European Union for Coastal Conservation (EUCC). Intended to establish a pan-European forum on coastal issues, including coastal management. Published by EUCC.

Coastline. The Bulletin of the Parliamentary All-Party Coastal Group. Provides information summaries for MPs. Published by the All Party Coastal Group.

CoastNET. The Bulletin of the Coastal Heritage Network. Published quarterly and covers all matters concerned with coastal management in the UK.

CZM News. Occasional Newsletter of Eurocoast UK, reporting on projects and developments in the field of coastal zone management. Published by Eurocoast UK.

Marine Scene. Occasional marine newsletter of the statutory conservation agencies in UK. Aimed at marine scientists, and users and regulators of the sea. Published by JNCC.

Marine Update. A briefing to highlight World Wide Fund for Nature's work in marine conservation. Published by WWF.

Wavelength. The Coastal Forum newsletter. Reports the work of the Forum to a wider audience. Published by the Department of the Environment, Transport and the Regions.

National planning/management publications

DoE/Welsh Office. 1992. *Planning policy guidance - coastal planning*. London, HMSO. (PPG 20.) (Recognises the need to define a coastal zone incorporating areas affected by natural near-shore processes. Advises local authorities to consider the impacts of off-shore and on-shore developments within the full coastal zone. Endorses the precautionary approach.)

DoE/Welsh Office. 1993. *Development below Low Water Mark - a review of regulation in England and Wales*. London, HMSO. (Rejects the 1992 Environment Committee's recommendations for the extension of development controls off-shore. Seeks to strengthen existing arrangements to overcome limitations and draw-backs in the present land-use planning system.)

DoE/Welsh Office. 1993. *Managing the coast: a review of coastal management plans in England and Wales and the powers supporting them*. London, HMSO. (Includes proposals for coastal management plans to be based on a voluntary, multi-agency approach, generally led by local authorities.)

Department of the Environment. 1995. *Policy guidelines for the coast.* London, HMSO. (Highlights government coastal policy and summarises essential guidance.)

House of Commons Environment Committee. 1992. *Second report - coastal zone protection and planning*. London, HMSO. (Recommended that coastal zone management be adopted as the framework for all coastal zone planning and management practice in the United Kingdom. Called for a national coastal strategy, a review of the many organisations responsible for the coast, the extension of planning controls offshore, and the establishment of a Coastal Zone Unit in Department of the Environment.)

MAFF. 1994. *Shoreline management plans. (*A procedural guide for operating authorities. 4th draft, July 1994.)

Local authority planning documents

Local planning authorities in the region have published regional, district and local plans, which provide the statutory planning frameworks for development control purposes. In most cases these plans are supplemented by regular reviews, monitoring documents and survey reports covering a variety of topics, as well as the plans themselves. For current information and a publications list contact the appropriate authority (see Appendix A2).

C. Contact names and addresses

(See also Table 10.3.1.)

Organisation/group	*Activities*	*Contact address and telephone no.*
British Association for Shooting and Conservation	Work alongside government statutory nature conservation advisors to further the development of sporting shooting's contribution to local and national biodiversity, both inland and on the coast.	The British Association for Shooting and Conservation, National Headquarters, Marford Mill, Rossett, Wrexham LL12 0HL, tel: 01244 573000
Cambridge Coastal Research Unit (CCRU)	Research in coastal, estuarine and floodplain geomorphology and sedimentology; intertidal and marine biology; coastal ecology and habitat survey; through environmental baselines and impact assessments; and including coastal zone management	CCRU, Department of Geography, University of Cambridge, 62 Sidney Street, Cambridge CB2 3JW, tel: 01223 339775
Coastal Forum	Launched in 1994 by the DoE, the Coastal Forum provides for an exchange of views on issues related to the coastal zone in England by a wide range of interested bodies, including central and local government, and conservation, commercial and recreation organisations. Forum proceedings are reported to government ministers.	*Secretariat: Department of the Environment, Transport and the Regions, Bristol, tel: 0117 987 8003
CoastNET (The Coastal Heritage Network)	An independent Charitable Trust and membership organisation. Established in 1995 by the Countryside Commission, English Nature and Scottish Natural Heritage with a part-time secretariat. Links individuals and organisations working for the sustainable management of the coastal and marine environment.	Coastal Heritage Network, The Manchester Metropolitan University, St Augustines, Lower Chatham Street, Manchester M15 6BY, tel: 0161 247 1067, fax: 0161 247 6390
Coastal Technical Officers Group	The coastal group of the statutory conservation agencies (English Nature, Scottish Natural Heritage, Countryside Council for Wales, Department of the Environment for Northern Ireland, Joint Nature Conservation Committee and the Countryside Commission)	*Coastal Technical Officers Group: English Nature, Maritime Team, Peterborough, tel: 01733 455000 (secretariat)
Countryside Commission	Promotion of policies for Heritage Coasts, and coastal management generally	*National Parks & Planning Branch, Countryside Commission, Cheltenham, tel: 01242 521381
English Coastal Groups Forum	Established by MAFF in 1991. Co-ordinates the work of the English Coastal Groups (see 10.2.2); promotes the formation of coastal groups; acts as a link between centrally-based organisations and coastal groups; promotes sustainable coastal management and common standards. Forum members include one representative from each coastal group, the National Rivers Authority, Local Authority Associations, English Nature, British Rail/Railtrack and Department of the Environment.	*R. Hathaway, Head of Flood and Coastal Defence Division, MAFF, London, tel: 0171 238 3000
English Nature	Management of designated coastal sites; nature conservation and development planning, Estuaries Initiative, Sensitive Marine Areas, Maritime Natural Areas	*English Nature HQ, Peterborough, tel: 01733 455000
Environment Agency	Catchment management planning, 5-year programme, sea defences, shoreline management plans	*Environment Agency HQ, Bristol, tel: 01454 624400 *Environment Agency Anglian Region, Peterborough, tel: 01733 371811 *Environment Agency Thames Region, Reading, tel: 01734 535000 *Environment Agency Southern Region, Worthing, tel: 01903 832000

C. Contact names and addresses (continued)

(See also Table 10.3.1.)

Organisation/group	*Activities*	*Contact address and telephone no.*
Eurocoast UK	The Eurocoast Association aims to improve the basis for protection, development and management of the coastal zone. Primarily a communication network.	Eurocoast UK Secretariat, Dept of Maritime Studies & International Transport, UWCC, PO Box 907, Cardiff CF1 3YP, tel 01222 874271
European Union for Coastal Conservation (EUCC)	International grouping of organisations and individuals with an interest in coastal nature conservation matters, including coastal management.	European Union for Coastal Conservation (EUCC) Secretariat, P.O. Box 11232, NL-2301 EB Leiden, tel: +31 71 122900/123952
European Union for Coastal Conservation - United Kingdom (EUCC-UK)	UK membership network affiliated to EUCC, providing focus for information exchange about European-level coastal conservation issues	EUCC, c/o 5 Green Lane, Brampton, Huntingdon, Cambridgeshire PE18 8RE, tel: 01480 457624
JNCC Coastal Advisor	Advice on coastal conservation	*JNCC, Peterborough, tel: 01733 562626
JNCC Marine Nature Conservation Review	Project to extend knowledge of benthic marine habitats, communities and species in Great Britain and identify sites and species of nature conservation importance; producing a series of 15 reports *(Coasts and seas of the United Kingdom. MNCR series.)* on a coastal sector basis, as well as more detailed area summaries.	*JNCC, Peterborough, tel: 01733 562626
Les Esturiales Environmental Study Group	International programme for co-operation, the exchange of experience on estuarine management and personal contacts between local authority practitioners in Europe.	Esturiales Environmental Study Group, Professor Graham King, Swansea Institute of Higher Education, Faculty of Leisure and Tourism, Mount Pleasant Campus, Swansea SA1 6ED, tel: 01792 456326
Marine Conservation Society	Provides advice and supports local coastal management initiatives: runs grant-aided coastal management workshops and courses for coastal managers; promotes the establishment of voluntary coastal groups.	*Marine Conservation Society, Ross-on-Wye, tel: 01989 566017
Marine Forum	National network provides forum for discussion of marine issues relating to the seas around UK. Members include governmental and non-governmental organisations and individuals. Occasional seminars are held, covering a range of topics including coastal management.	*Honorary Secretary, The Marine Forum for Environmental Issues, Scarborough, tel: 01723 362392
Ministry of Agriculture, Fisheries and Food (MAFF) Flood & Coastal Defence Division	Shoreline Management Plans (mainly aimed at formulating a coast protection strategy)	*MAFF, Flood and Coastal Defence Division, Eastbury House, London, tel: 0171 238 3000
MAFF, Marine Environment Protection Division	Policy advice on marine environmental management	MAFF, Marine Environment Protection Division, Nobel House, 17 Smith Square, London SW1P 3HX, tel: 0171 238 6433
MAFF, Directorate of Fisheries Research	Scientific advice on marine environment and living resources management	*Head of Laboratory, Centre for Environment, Fisheries & Aquaculture Sciences, Conwy, tel: 01492 593883
National Coasts and Estuaries Advisory Group (NCEAG)	Provides advice to local authorities on sustainable management of coastal and estuarine environments; published guide to good practice (NCEAG 1993)	Alan Inder, Secretary, National Coasts and Estuaries Advisory Group (NCEAG), Hampshire County Council, The Castle, Winchester SO23 8UJ, tel: 01962 846749
National Trust	Has extensive coastal land holdings in the region (see section 7.5.1). Recently carried out a complete review of its Coastal Strategy Plans; has an ongoing review of coastal site management plans.	*National Trust HQ, Cirencester, tel: 01285 651818 *National Trust East Anglia Regional Office, Blickling, tel: 01263 733471

C. Contact names and addresses (continued)

(See also Table 10.3.1.)

Organisation/group	*Activities*	*Contact address and telephone no.*
Royal Society for the Protection of Birds	Launched national campaign in 1990 to promote the importance of estuaries in the UK. Monitors the development of coastal zone initiatives around the UK. In 1994, launched Marine Life campaign, to increase awareness and to promote integrated coastal and marine management. Manages some coastal nature reserves. Produced a regional strategy.	*Coastal Policy Officer, RSPB HQ, Sandy, tel: 01767 680551
World Wide Fund for Nature - UK	Provides funding for research, local voluntary policy development and local initiatives, and publications on integrated coastal management. Draws on considerable international experience with coastal management initiatives.	*World Wide Fund for Nature - UK, Godalming, tel: 01483 426444

Addresses and telephone numbers of local planning authorities are given in full in the Appendix, as are *starred contact addresses.

Appendix

A.1 Frequently cited contact organisations and addresses

Name	*Contact address and telephone no.*
Statutory bodies	
British Oceanographic Data Centre - NERC (BODC), Proudman Oceanographic Laboratory	Bidston Observatory, Birkenhead, Merseyside L43 7RA, tel: 0151 653 8633
Centre for Environment, Fisheries & Aquaculture & Sciences Conwy Laboratory	Benarth Road, Conwy, Gwynedd LL32 8UB, tel: 01492 593883
Centre for Environment, Fisheries & Aquaculture Sciences Lowestoft Laboratory	Pakefield Road, Lowestoft, Suffolk NR33 OHT, tel: 01502 562244
Centre for Environment, Fisheries & Aquaculture Sciences Burnham-on-Crouch Laboratory	Remembrance Avenue, Burnham-on-Crouch, Essex CM0 8HA, tel: 01621 787200
Countryside Commission (CC), HQ	John Dower House, Crescent Place, Cheltenham, Gloucestershire GL50 3RA, tel: 01242 521381
CC, Eastern Region	Ortona House, 110 Hills Road, Cambridge CB2 1LQ, tel: 01223 354462
CC, South-east Region	4th floor, 71 Kingsway, London WC24 6ST, tel: 0171 831 3510
Department of the Environment, Transport and the Regions (DETR), European Wildlife Division/ Dept. of Rural Affairs	DETR, Room 9/03B, Tollgate House, Houlton Street, Bristol BS2 9DJ, tel: 0117 987 8811
DETR, Water Resources and Marine	Romney House, 43 Marsham Street, London SW1P 3PY, tel: 0171 276 0900
English Nature, HQ	Northminster House, Peterborough PE1 1UA, tel: 01733 455000
English Nature, Suffolk Team	Norman Tower House, 1-2 Crown Street, Bury St Edmunds, Suffolk IP33 1QX, tel: 01284 762218
English Nature, Essex, Hertfordshire and London Team, Colchester Office	Harbour House, Hythe Quay, Colchester, Essex CO2 8JF, tel: 01206 796666
English Nature, Essex, Hertfordshire and London Team, London Office	Ormond House, 26-27 Boswell Street, London WC1N 3JZ, tel: 0171 831 6922
English Nature, Kent Team	The Countryside Management Centre, Coldharbour Farm, Wye, Ashford, Kent TN25 5DB, tel: 01233 812525

Name	*Contact address and telephone no.*
Statutory bodies (continued)	
Environment Agency (EA) HQ	Rio House, Waterside Drive, Aztec West, Almondsbury, Bristol BS12 4UD, tel: 01454 624400
EA Regional Office, Anglian Region	Kingfisher House, Goldhay Way, Orton Goldhay, Peterborough PE2 5ZR, tel: 01733 371811
EA Regional Office, Thames Region	Kings Meadow House, Kings Meadow Road, Reading RG1 8DQ, tel: 01734 535000
EA Regional Office, Southern Region	Guildbourne House, Chatsworth Road, Worthing, Sussex BN11 1LD, tel: 01903 832000
Institute of Terrestrial Ecology (ITE), Monks Wood	Abbots Ripton, Huntingdon, Cambridgeshire PE17 2LS, tel: 01487 773381
ITE, Merlewood	Windermere Road, Grange-over-Sands, Cumbria LA11 6JU, tel: 01539 532264
Joint Nature Conservation Committee (JNCC), HQ	Monkstone House, City Road, Peterborough, Cambridgeshire PE1 1JY, tel: 01733 562626
JNCC, Seabirds and Cetaceans Team	Seabirds and Cetaceans Team, JNCC, 11 Dunnet House, 7 Thistle Place, Aberdeen AB10 1UZ, tel: 01224 655702
MAFF Flood and Coastal Defence Division	Eastbury House, 30/34 Albert Embankment, London SE1 7TL, tel: 0171 238 3000
Wildlife Trusts	
Essex Wildlife Trust	Fingringhoe Wick Nature Reserve, Fingringhoe, Colchester, Essex CO5 7DN, tel: 01206 729678
Kent Trust for Nature Conservation	Tyland Barn, Sandling, Maidstone, Kent ME14 3DB, tel: 01622 662012
London Wildlife Trust	80 York Way, London N1 9AG, tel: 0171 278 6612
Suffolk Wildlife Trust	Brooke House, The Green, Ashbocking, Ipswich IP6 9JY, tel: 01473 890089
National voluntary bodies	
British Trust for Ornithology	The Nunnery, Nunnery Place, Thetford, Norfolk IP24 2PU, tel: 01842 750050
Marine Conservation Society	9 Gloucester Road, Ross-on-Wye, Herefordshire HR9 5BU, tel: 01989 566017

Name	*Contact address and telephone no.*
National voluntary bodies (continued)	
National Trust, HQ	33 Sheep Street, Cirencester, Gloucestershire GL7 1QW, tel: 01285 651818
National Trust, East Anglia Regional Office	Blickling, Norwich, Norfolk NR11 6NF, tel: 01263 733471
Royal Society for the Protection of Birds (RSPB), HQ	The Lodge, Sandy, Bedfordshire SG19 2DL, tel: 01767 680551
RSPB, South-east England Office	8 Church Street, Shoreham-by-Sea, West Sussex BN43 5DQ, tel: 01273 463642
RSPB, East Anglia Office	Stalham House, 65 Thorpe Road, Norwich, Norfolk NR1 1UD, tel: 01603 660066

Name	*Contact address and telephone no.*
National voluntary bodies (continued)	
Wildfowl & Wetlands Trust (WWT), HQ	Slimbridge, Gloucestershire GL2 7BXT tel: 01453 890333
Worldwide Fund For Nature - UK (WWF-UK)	Panda House, Weyside Park, Cattershall Lane, Godalming, Surrey GU7 1XR, tel: 01483 426444
Marine Forum for Environmental Issues	c/o University College of Scarborough, Filey Road, Scarborough, Yorkshire YO11 3AZ, tel: 01723 362392
Others	
British Geological Survey	Keyworth, Nottingham NG12 5GG, tel: 0115 936 3100

A.2 Local planning authorities, port and harbour authorities

Name	*Address and telephone no.*
Babergh District Council	Council Offices, Corks Lane, Hadleigh, Ipswich IP7 6SJ, tel: 01473 822801
Basildon District Council	Council Offices, The Basildon Centre, Pagel Mead, Basildon SS14 1DL, tel: 01268 533333
Canterbury City Council	Military Road, Canterbury CT1 1YW, tel: 01227 763763
Castle Point Borough Council	Council Offices, Kiln Road, Benfleet, Essex SS7 1TF, tel: 01268 882200
Colchester Borough Council	PO Box 884, Town Hall, Colchester CO1 1FR, tel: 01206 282222
Dover District Council	Council Offices, White Cliffs Business Park, Dover CT16 3PG, tel: 01304 821199
Dartford Borough Council	Civic Centre, Home Gardens, Dartford DA1 1DR, tel: 01322 343434
Essex County Council	County Hall, Chelmsford, Essex CM1 1LF, tel: 01245 492211
Kent County Council	County Hall, Springfield, Maidstone, Kent ME14 2LX, tel: 01622 671411
Gillingham Borough Council	Municipal Buildings, Canterbury Street, Gillingham, Kent ME7 5LA, tel: 01634 281414
Gravesham Borough Council	Civic Centre, Windmill Street, Gravesend DA12 1AU, tel: 01474 564422
Lewisham Borough Council	Town Hall, Catford, London SE6 4RU, tel: 0181 6956000
London Borough of Barking and Dagenham	Civic Centre, Dagenham, Essex RM10 7BN, tel: 0181 5924500
London Borough of Bexley	Bexley Civic Offices, Broadway, Bexley Heath DA6 7LB, tel: 0181 303 7777
London Borough of Greenwich	Town Hall, Wellington Street, London SE18 6PW, tel: 0181 854 8888
London Borough of Havering	Town Hall, Main Road, Romford, Essex RM1 3BD, tel: 01708 772222
London Borough of Southwark	Town Hall, Peckham Road, London SE5 8UB, tel: 0171 525 5000
London Borough of Tower Hamlets	Mulberry Place, 5 Clove Crescent, London E14 2BG, tel: 0171 512 4200
London Docklands Development Corporation	Thames Quay, 191 Marsh Wall, London E14 9TJ, tel: 0171 512 3000
Maldon District Council	Council Offices, Princes Road, Maldon CM9 5DL, tel: 01621 854477
Newham Council	Town Hall, Barking Road, East Ham, London E6 2RP, tel: 0181 472 1430
Rochester-upon-Medway Council	Civic Centre, Strood, Rochester, Kent ME2 4AW, tel: 01634 727777
Rochford District Council	Council Offices, South Street, Rochford, Essex SS4 1BW, tel: 01702 546366
Shepway District Council	Civic Centre, Castle Hill Avenue, Folkestone CT20 2QY, tel: 01303 850388
Southend-on-Sea Borough Council	Civic Centre, Victoria Avenue, Southend-on-Sea, Essex SS2 6ER, tel: 01702 215000
Suffolk Coastal Council	Council Offices, Melton Hill, Woodbridge, Suffolk IP12 1AU, tel: 01394 383789
Suffolk County Council	St Edmund House, County Hall, Ipswich IP4 1LZ, tel: 01473 583000
Swale Borough Council	Swale House, East Street, Sittingbourne, Kent ME10 3HT, tel: 01795 424341
Tendring District Council	Town Hall, Station Road, Clacton-on-Sea, Essex CO15 1SE, tel: 01255 425501
Thanet District Council	Council Offices, Cecil Street, Margate, Kent CT9 1XZ, tel: 01843 225511
Thurrock Council	Civic Offices, New Road, Grays RM17 6SL, tel: 01375 390000
Waveney District Council	Rectory Road, Lowestoft, Suffolk NR33 0BX, tel: 01502 562111
Ports and harbour authorities	
Lowestoft	Associated British Ports, Port House, Lowestoft, Suffolk NR32 1BG, tel: 01502 572286
Felixstowe	Felixstowe Dock & Railway Company, Tomline House, Felixstowe, Suffolk IP11 8SY, tel: 01394 604500
Ipswich	Ipswich Port Authority, Old Custom House, Key Street, Ipswich, Suffolk IP4 1BY, tel: 01473 231010
Mistley Quay	Mistley Quay & Forwarding, High Street, Mistley, Manningtree, Essex CO11 1HB, tel: 01206 394431
Harwich (Parkeston Quay)	Harwich Haven Authority, Stena Sealink Ports, Harwich, Essex CO12 4SR, tel: 01255 242000

Name	*Address and telephone no.*
Ports and harbour authorities (continued)	
Harwich (Navy Yard)	Harwich Haven Authority, Harbour House, The Quay, Harwich, Essex CO12 3HH, tel: 01255 243030
Brightlingsea	Brightlingsea Harbour Commissioners, Harbour Office, 4 Copperas Road, Brightlingsea, Essex CO7 0AP, tel: 01206 302200
Colchester Dock Transit Co. Ltd	Colchester Borough Council, New Quay, Colchester, Essex CO2 8HZ, tel: 01206 861422
Colchester Port	Colchester Borough Council, Municipal Port, Walter Radcliffe Way, Wivenhoe, Essex CO7 9JR, tel: 01206 827316
Crouch	Crouch Harbour Authority, Harbour Office, The Quay, Burnham-on-Crouch, Essex, CN0 8AS
Coryton	Port of London, Coryton Refinery, Stanford-le Hope, Essex SS17 9LL, tel: 01375 673310
Holehaven Wharf	Port of London, Holehaven Wharf, Haven Road, Canvey Island, Essex SS8 0NR, tel: 01268 682206
Shell Haven Oil Refinery	Shell UK Ltd (Downstream Oil), Shell Haven Refinery, The Manorway, Stanford-le-Hope, Essex SS17 9LD, tel: 01375 673333
Purfleet, Powell Duffryn Jetty & Harrison's Wharf	Powell Duffryn Terminals Ltd, London Road, Purfleet, Essex RM19 1PR, tel: 01708 865701
Purfleet Thames Terminal	Purfleet Thames Terminal, London Road, Purfleet, Essex RM19 1RP, tel: 01708 865522
Tilbury	Port of Tilbury London Ltd, Leslie Ford House, Tilbury Freeport, Tilbury, Essex RM19 7EH, tel: 01375 852200
Thunderer Jetty	Pinnacle Bulk Liquid Storage, Choats Road, Dagenham Dock Estate, Dagenham, Essex RM8 6PU, tel: 0181 593 7211
Welbeck Wharf	Welbeck Steel Service Centre Ltd, River Road, Barking, Essex IG11 0HF, tel: 0181 594 7733
Seabright Wharf	Seabright Industries Limited, Seabright House, 72-76 River Road, Barking, Essex IG11 0DY, tel: 0181 594 4074
Thames Refinery	Tate and Lyle Sugars, Thames Refinery, Silvertown, London E16 2EW, tel: 0171 476 4455
The London Steel Terminal	Seacon Terminals Ltd, 38 West Ferry Road, London E14 8LW, tel: 0171 987 1291

Name	*Address and telephone no.*
Ports and harbour authorities (continued)	
Thames Wharf	European Metal Recycling Ltd, Thames Wharf, Dock Road, Canning Town, London E16 1AF, tel: 0171 476 3100
Convoy's Wharf	Port of London (Operator: Convoys Ltd), Convoys Wharf, Prince St., Deptford, London SE8 3JH, tel: 0181 692 1212
Thames Europort	Thames Europort Ltd, Stone Marshes, Dartford, Kent DA2 6QB, tel: 01322 293344
Cliffe Alpha Jetty, Cliffe, Rochester, Kent	Port of London Authority, Crossways Business Park, Anchor Boulevard, Dartford, Kent DA2 6QH, tel: 01322 294422
Clubb's Marine Terminal, Denton	Port of London Authority, Church Hill, Wilmington, Dartford, Kent DA2 7DZ, tel: 01322 225431
Tower Wharf	Seacon Terminals Ltd, Tower Wharf, Lower Road, Northfleet, Kent DA11 9BD, tel: 01474 321061
Imperial Wharf	Port of London Authority, The White House, Imperial Business Estate, Clifton Marine Parade, Gravesend, Kent DA11 0EA, tel: 01474 536371
Thamesport	Thamesport (London) Ltd, Isle of Grain, nr Rochester, Kent ME3 0EP, tel: 01634 271511
Chatham	Medway Ports Ltd, Medway (Chatham) Dock Co. Ltd, Dockyard House, Sheerness Docks, Sheerness ME12 1RX, tel: 01634 814936
Port of Sheerness, including The Medway ports; Swale & Grain	Port of Sheerness, Archway House, Sheerness Docks, Sheerness, Kent ME12 1RX, tel: 01795 561234
Ridham	Medway Ports Ltd, Ridham Dock, Iwade, Sittingbourne, Kent ME9 8SR, tel: 01795 470881
Queenborough	Swale Borough Council, Swale House, East Street, Sittingbourne, Kent ME10 3HT, tel: 01795 424341
Whitstable	Whitstable Harbour Office, East Gate, Harbour Street, Whitstable, Kent CT5 1AB, tel: 01227 274086
Broadstairs	Thanet District Council, c/o Town Clerk's Office, Pierremont Hall, Broadstairs, Kent CT10 1JH, tel: 01843 868718
Ramsgate	Harbour Offices, Military Road, Ramsgate, Kent CT11 9LG, tel: 01843 592277
Folkestone	Folkestone Properties Ltd, The Port Office, Folkestone Harbour, Kent CT20 1QH, tel: 01303 220544
Dover Harbour Board	Harbour House, Dover, Kent CT17 9BU, tel: 01304 240400

A.3 Core reading list

There are a number of publications that either provide information on a variety of topics covered in the series (and so are frequently referred to) or give a good overview of regional and national information on coasts and seas. They are listed below.

Alabaster, J. 1994. *An inventory of existing environmental information concerning the Stour Estuary.* Canterbury, Ecology Research Group. (Report for Pfizer Ltd, Sandwich.)

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

British Oceanographic Data Centre. 1992. *UKDMAP (United Kingdom Digital Marine Atlas).* Birkenhead, BODC. (Computer software.)

Brown, A. 1992. *The UK environment*. London, HMSO.

Buck, A.L. 1997. *An inventory of UK estuaries. 5. Eastern England.* Peterborough, Joint Nature Conservation Committee.

Buck, A.L. 1997. *An inventory of UK estuaries. 6. Southern England.* Peterborough, Joint Nature Conservation Committee.

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

Doody, J.P., Johnston, C., & Smith, B. 1993. *The directory of the North Sea coastal margin.* Peterborough, JNCC.

Edgar, R.D.M. 1995. *South-east England habitat resources survey*. Peterborough, English Nature.

Eno, N.C., *ed*. 1991. *Marine conservation handbook.* 2nd ed. Peterborough, English Nature.

Environment Agency. 1996. *The environment of England and Wales: a snapshot.* Bristol, Environment Agency.

Gubbay, S. 1988. *A coastal directory for marine conservation.* Ross-on-Wye, Marine Conservation Society.

Lee, A.J., & Ramster, J.W. 1981. *Atlas of the seas around the British Isles.* Lowestoft, MAFF.

Local Government Management Board. 1995. *Local agenda 21 roundtable guidance: action on the coast*. Luton, Local Government Management Board.

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

North Sea Task Force. 1993. *North Sea quality status report 1993. Report on Subregion 3b.* Lowestoft, Ministry of Agriculture Fisheries and Food Fisheries Laboratory.

Robinson, A., & Millward, R. 1983. *The Shell book of the British coast*. Newton Abbot, David and Charles.

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

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