



Coasts and seas of the United Kingdom

Region 1 Shetland

edited by
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on behalf of the project Steering Group.

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Contents

Foreword		5
How to use this book		6
Acknowledgements		7
Chapter 1 Overview	Dr J.P. Doody	9
1.1 The Coastal Directories Project		9
1.2 Introduction to the region		13
Chapter 2 Geology and physical environment		19
2.1 Coastal geology	British Geological Survey & Scott Wilson Resource Consultants	19
2.2 Offshore geology	British Geological Survey & Scott Wilson Resource Consultants	23
2.3 Wind and water	British Geological Survey & Scott Wilson Resource Consultants	27
2.4 Sediment transport	British Geological Survey & Scott Wilson Resource Consultants	31
2.5 Sea-level rise and flooding	British Geological Survey	32
2.6 Coastal landforms	British Geological Survey & Scott Wilson Resource Consultants	34
Chapter 3 Terrestrial coastal habitats		37
3.1 Cliffs and cliff-top vegetation	Dr T.C.D. Dargie	37
3.2 Sand dunes	Dr T.C.D. Dargie	40
3.3 Vegetated shingle structures and shorelines	Dr R.E. Randall	45
3.4 Coastal lagoons	Dr R.S.K. Barnes & Dr R.N. Bamber	48
3.5 Wet grassland	Dr H.T. Gee	51
3.6 Saltmarsh	Dr M.I. Hill	54
Chapter 4 Marine and estuarine environments		57
4.1 Estuaries	Dr N.C. Davidson	57
4.2 The sea bed	R.A. Irving	58
4.3 Plankton	M. Edwards & A.W.G. John	70
Chapter 5 Important species		75
5.1 Terrestrial lower plants	N.G. Hodgetts	75
5.2 Flowering plants and ferns	V.M. Morgan	79
5.3 Land and freshwater invertebrates	M.S. Parsons & A.P. Foster	83
5.4 Rare sea-bed species	J. Plaza	87
5.5 Exploited sea-bed species	C.F. Robson	91
5.6 Amphibians and reptiles	Dr M.J.S. Swan	95
5.7 Fish: exploited sea fish	C.F. Robson	97
5.8 Fish: salmon, sea trout and eels	C.F. Robson	103
5.9 Fish: other species	S.E. Swaby & Dr G.W. Potts	105
5.10 Seabirds	M.L. Tasker	108
5.11 Other breeding birds	R.T. May & A.B. Law	114
5.12 Migrant and wintering waterfowl	R.T. May & A.B. Law	117
5.13 Land mammals	Dr C.E. Turtle	120
5.14 Seals	C.D. Duck	122
5.15 Whales, dolphins and porpoises	Dr P.G.H. Evans	126

Chapter 6 History and archaeology	A. Gale & V. Fenwick	131
Chapter 7 Coastal protected sites	J. Plaza & R.G. Keddie	141
7.1 Introduction		141
7.2 Sites designated under international conventions and directives		143
7.3 Sites established under national statute		146
7.4 Sites identified by statutory agencies		149
7.5 Other types of protected site		151
Chapter 8 Land use, infrastructure and coastal defence		153
8.1 Introduction	S.J. Everett	153
8.2 Land use	S.L. Fowler & S.J. Everett	154
8.3 Infrastructure	S.L. Fowler, S.J. Everett & Scott Wilson Resource Consultants	157
8.4 Coastal defence	S.L. Fowler & S.J. Everett	163
Chapter 9 Human activities		167
9.1 Fisheries	D. Murison & C.F. Robson	167
9.2 Mariculture	C.F. Robson	176
9.3 Quarrying and landfilling	Scott Wilson Resource Consultants	180
9.4 Marine aggregate extraction, dredging and solid waste disposal at sea	Scott Wilson Resource Consultants	184
9.5 Oil and gas development	Scott Wilson Resource Consultants	187
9.6 Water quality and effluent discharges	Scott Wilson Resource Consultants	190
9.7 Leisure and tourism	S.J. Everett	193
Chapter 10 Coastal management	S.J. Everett & S.L. Fowler	197
10.1 Introduction		197
10.2 National coastal initiatives with regional elements		198
10.3 Regional coastal management groups and initiatives		200
Appendix		205
A.1 Frequently cited contact names and addresses		205
A.2 Local planning authorities; port and harbour authorities		206
A.3 Core reading list		206
A.4 Contributing authors		207

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, 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 1 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 1') is used throughout this book to refer to the coastal and nearshore zone, broadly defined, for the area 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 and complete as reasonably practicable at the time of publication (September 1997). 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.

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Ards Borough Council
Avon County Council
Banff and Buchan District Council
Belfast City Council
BHP Petroleum Ltd¹
Centre for Environment, Fisheries & Aquaculture Sciences
Ceredigion District Council
Cheshire County Council
Chevron UK Ltd¹
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
English Nature
Environment Agency
Essex County Council
Fife Regional Council
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Newry and Mourne District Council
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 Association²
Vale of Glamorgan Borough Council
Water Services Association
Welsh Office
World Wide Fund For Nature (UK)

Notes

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

²The 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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Rumblings, Muckle Flugga. This island, one of the most northerly of the British Isles, is formed of great slabs of some of the oldest rocks in the country - Dalradian metamorphic schists. These have been heaved up into a mighty sloping wall on which seabirds make their precarious nests. Photo: Marine Nature Conservation Review, JNCC.

Chapter 1 Overview

1.1 The Coastal Directories Project

Dr J.P. Doody

1.1.1 Introduction

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

This problem is widely recognised. Nevertheless the solution - amassing the 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). 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 (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).

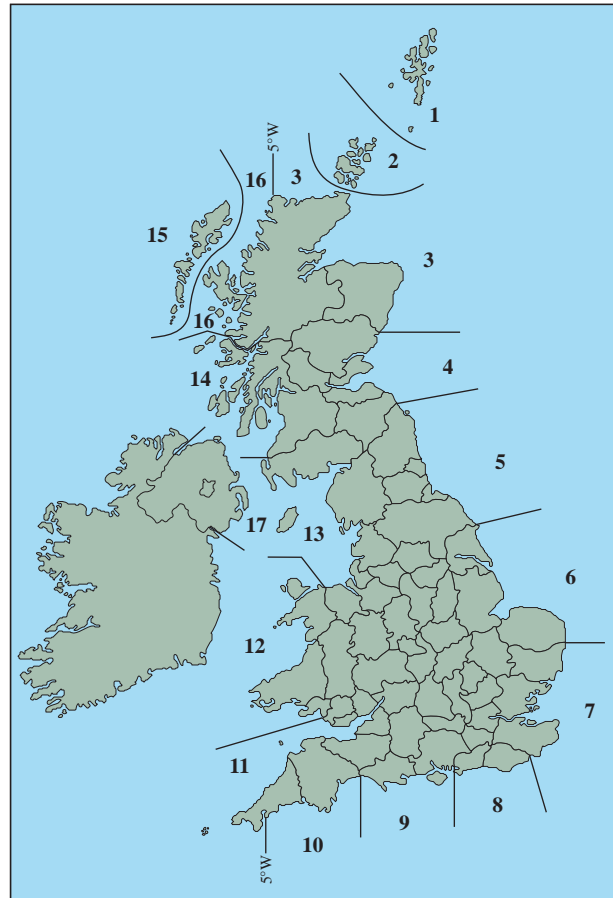
The principal aims of the *Directory* were to produce “a comprehensive description of the North Sea coastal margin, its habitats, species and human activities, as an example to other North Sea states” (North Sea Task Force 1993), and thus to help to ensure that terrestrial habitats and species were considered 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 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.

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 seaboard (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 in **Map 1.1.1**. Regions 1 - 10 cover the area of the *Directory of the North Sea coastal margin*; Regions 11 - 17 deal with the west coast of the United Kingdom and the Isle of Man. These regional volumes provide a more detailed level of information than the *Directory of the North Sea coastal margin*, to help set each region in a national context and facilitate the



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

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 has been reflected in the level of sponsorship that the project has received and in the commitment shown by members of the steering groups, which have 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*

Table 1.1.1 Coastal Directories project management structure

<i>Group</i>	<i>Role</i>	<i>Undertaken by</i>
JNCC Coastal Directories Project	Day to day management	Head of Coastal Directories Project 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

turns for coastal zone management: *Coastal Directories users report back on their experiences* (February 1996). In addition the core steering group has also 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) and *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

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

<i>Product</i>	<i>Publication date</i>
Book editions	
Directory of the North Sea coastal margin	1993
Region 1. Shetland	1997
Region 2. Orkney	Due 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	Due 1997
Region 8. Sussex: Rye Bay to Chichester Harbour	Due 1997
Region 9. Southern England: Hayling Island to Lyme Regis	1996
Region 10. South-west England: Seaton to 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 2	1994
Regions 3, 5, 6, 9, 10, 11, 12, 13	1996
Regions 14, 15 & 16	1997
Other regions	Following book publication

most of the potential licensing areas in the 16th Offshore Oil and Gas Licensing Round in 1994.

1.1.5 Outputs

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

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B. Further reading

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C. Contact names and addresses

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

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



Shetland comprises an archipelago of sparsely-populated islands set in seas teeming with fish - a paradise for seabirds. Hermaness & Saxa Vord Special Protection Area (SPA), on the northernmost tip of Unst, holds internationally important numbers of breeding gannet *Sula bassana* (pictured), shag *Phalacrocorax aristotelis* and great skua *Stercorarius skua* and nationally important numbers of fulmar *Fulmarus glacialis*, guillemot *Uria aalge* and puffin *Fratercula arctica*. Photo: Pat Doody, JNCC.

1.2 Introduction to the region

Dr J.P. Doody

1.2.1 Introduction

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

Region 1 includes all of Shetland, which comprises over 100 separate islands, including Foula and Fair Isle, sixteen of them inhabited, although only six have populations of more than 100 people. The highly indented coastline is 1,400 km long - 11.9% of the total coastline of Scotland and 7.4% of that of Great Britain. The whole region is exposed to North Atlantic gales and most of the land lies within 3 km of the coast, so the influence of the sea is all-pervading. The geology is varied and includes metamorphosed Precambrian rocks more than 544 million years old, which form the hilly backbone of the islands. On either side of these hills there are exposures of Old Red Sandstone rock of Devonian age. The region has a rugged and open character with rocky shores and cliffs dominating the coastal environment. In this respect it is more similar to Region 3 (north-east Scotland) than to Region 2 (Orkney), which has a much gentler topography.

The Shetland economy, based on fishing and crofting, was augmented by the arrival of the oil industry in the 1970s, which increased the total population to its present-day level of just over 22,500. Most of the area, except that associated with the oil industry, is relatively free from man-made infrastructure development, the major town being Lerwick on Mainland. There is continuous use by tankers of Sullom Voe, one of the UK's major sites for handling North Sea oil. Fishing and mariculture are also important industries. The predominant land use, occupying around 90% of the land area, is rough grazing for sheep and cattle rearing. Scenery and wildlife, particularly the spectacular seabird colonies, attract visitors and there is a small tourist industry.

1.2.2 Structure and landscape

The characteristic topography of the region is determined by the underlying structure, which on East Mainland and Yell is dominated by at least four north-south trending faults through steeply inclined, layered rocks. Elsewhere in Shetland the influence of igneous intrusions and extrusions has produced a more irregular underlying structure. Shetland is composed of rocks similar in age to those on parts of the Scottish mainland. They include Dalradian rocks from the Precambrian era and sandstones of Devonian age. Both these rock groups are resistant to erosion and give rise to the rocky shores and sometimes spectacular coastal cliffs of the region. The age and nature of the rock, together with the more recent glacial features and the relatively thin deposits of glacial till, provide the basis for the present-day landscape, which is of undulating, open aspect with extensive areas of peat bog and heath interspersed with numerous small lochs and pools.

Offshore, the underlying sea-bed geology is dominated by Precambrian, Devonian and Permo-Triassic rocks. Holocene (recent) sands and muds occur in the more sheltered bays and firths, although supplies of new sedimentary material from the land are very limited. Close to the islands there are shell-rich deposits. Offshore there are deposits of sand and gravel, but they are thin and patchy in places; off Mainland, along the Foula Ridge, bedrock is commonly exposed on the sea floor. Elsewhere significant Pleistocene clay deposits occur in distinct basins in which sediments may reach a thickness of 60 m. The sea bed slopes steeply away from the islands to about 80 m depth and then more gently, so that 10 km from shore the sea bed lies at roughly 100-120 m depth. Further offshore, to the north-west, the Faeroe/Shetland channel reaches depths of more than 1,500 m.

Overall, the coastline is among the most wave-exposed in Britain, although conditions vary from the very sheltered shores at the heads of voes to high west-facing vertical cliffs exposed to Atlantic storms. The wind direction is predominantly from the south-west, from which direction the average wind speed during the year is more than 8.5 m/s. Southerly wind speeds range from 1.8 to 8 m/s during the year. Gales occur on an average of 58 days per year. Tidal range is relatively low: mean spring tides are in the micro-tidal range (approximately 1.5 m). Tidal surges of between 0.75 m and 1.0 m occur on average once in every 50 years. Relative sea level is thought to be rising, although insufficient data exist to quantify the rate of rise.

These conditions have created a coastline of great drama in Shetland, shifting abruptly from magnificent cliffs (the 'outer' coast) to narrow inlets known as voes, which form the 'inner coast'. Numerous stacks and islets lie just offshore, some of them connected to the islands by thin stretches of sand or shingle, known as tombolos. In places the shoreline is composed of uninterrupted sandy beaches; elsewhere cliffs descend steeply into the sea.

1.2.3 The natural environment

The sea and sea bed

The highly indented and predominantly rocky coastline of the Shetland Islands and the clear, unpolluted waters create a variety of marine habitats in both the littoral and sublittoral zones. These range from cliffs exposed to extreme wave action, such as those of the west-facing coasts of the islands of Foula and Fair Isle, to extremely sheltered sedimentary conditions at the heads of the numerous voes. Strong tidal streams run through the sounds between the islands and around headlands. Although there are no true estuaries or lagoons in the islands, there are many tidal inlets (voes) and sheltered, brackish tidal ponds (houbs or vadills).

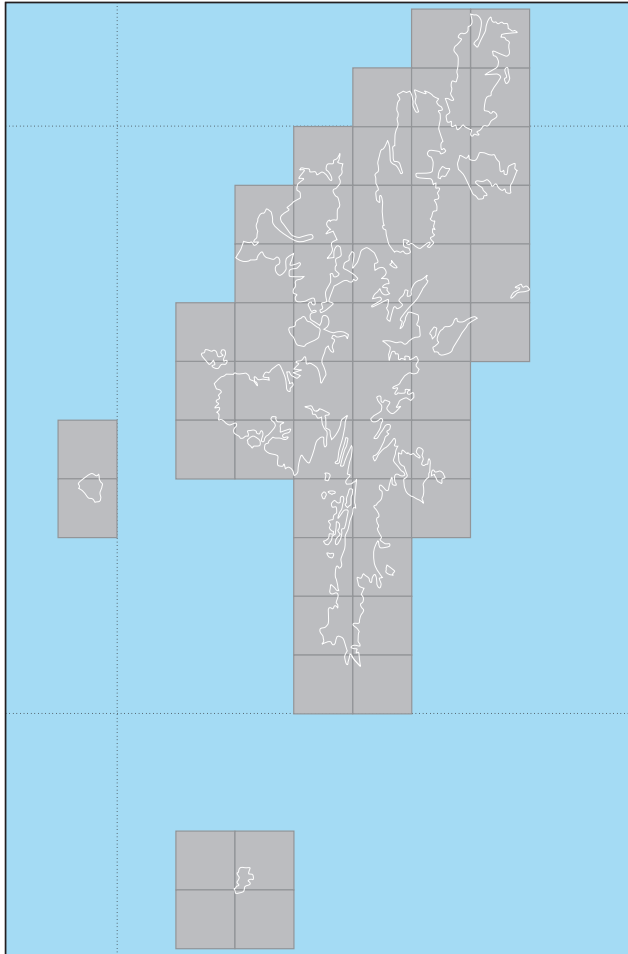
The structure of the sea-bed communities is determined by a combination of exposure to wave action, the nature of the substratum and the depth and strength of tidal streams.



Map 1.2.1 Major towns, islands and other locations

Rocky shores are dominated by attached animals, particularly barnacles and limpets, on the wave-exposed coasts and by seaweed beds in the sheltered voes. Clean sand beaches have a sparse fauna, whilst muddier shores in the voes have populations of lugworms *Arenicola marina* and cockles *Cerastoderma edule*. Subtidally, rock in shallow water supports kelp forests, the species composition of which varies according to the degree of wave exposure. Below the water line, cliffs on the open coast have rich communities of

sponges, ascidians and anemones, whilst the tide-swept sounds have dense beds of maerl, soft corals, brittlestars and horse mussels *Modiolus modiolus*. The sea bed in the steep-sided sheltered voes consists largely of mixed, muddy sediment, with beds of horse mussels and sea-pens *Virgularia* spp., and diverse infaunal communities. A feature of the Shetland sublittoral environment is the large stands of single species that occur at several sites. Eelgrass *Zostera marina* beds are found in the brackish tidal ponds.



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

Shetland's northern latitude is reflected in the presence of species with a predominantly northern distribution that are uncommon elsewhere in the British Isles. These include the fucoid alga *Fucus distichus*, found on exposed rocky shores, the sea cucumber *Cucumaria frondosa*, the sea urchin *Strongylocentrotus droebachensis* and the starfish *Hippasteria phrygiana*.

There are 159 fish species recorded from the region; these comprise 132 bony fishes, 26 sharks and rays, and the lamprey *Petromyzon marinus*. Populations of several commercially-important fish and shellfish species occur in the region, including lobster *Homarus gammarus*, edible crab *Cancer pagurus*, velvet crab *Necora puber*, Norway lobster ('scampi') *Nephrops norvegicus*, scallop *Pecten maximus* and queen scallop *Aequipecten opercularis*. There are important spawning areas in the region for the following exploited fish species: mackerel *Scomber scombrus*, herring *Clupea harengus*, haddock *Melanogrammus aeglefinus*, Norway pout *Trisopterus esmarkii* and saithe *Pollachius virens*. Salmon *Salmo salar* and, more commonly, sea trout *Salmo trutta* are present in the coastal waters and voes of the region.

Common (or harbour) seals *Phoca vitulina* can be found throughout Shetland, particularly in areas of sheltered water, at all times of the year. Approximately 22% of common seals counted in Britain during August occur in Shetland, making this the second most important region in Great Britain for this species. Grey seals *Halichoerus grypus*

are also to be seen throughout the region, although they are more common on the exposed west coast than in the east, and Shetland produces an estimated 3% of grey seal pups born in Britain each year. The cetacean fauna (whales, dolphins and porpoises) of the Shetland Islands is one of the richest in Britain. Eighteen species of cetaceans have been recorded since 1980, and of these, eight species (30% of the 27 UK species) are either present throughout the year or are recorded annually. The commonest species in nearshore waters are the harbour porpoise *Phocoena phocoena*, white-beaked dolphin *Lagenorhynchus albirostris*, white-sided dolphin *Lagenorhynchus acutus*, Risso's dolphin *Grampus griseus*, killer whale *Orcinus orca*, long-finned pilot whale *Globicephala melas* and minke whale *Balaenoptera acutorostrata*. Between one and three humpback whales *Megaptera novaeangliae* have been recorded annually in summer since 1992, suggesting a small increase in the population, which was once hunted extensively. Leatherback turtles *Dermochelys coriacea* are occasionally recorded swimming off the Shetland coast, where they are now considered to be regularly resident at certain times of the year.

Coastlines

The coast of Shetland between Muckle Flugga in the north and Fair Isle in the south contains large, diverse and spectacular lengths of cliff and cliff-top habitat. The region has a total cliff length of 483 km, representing 12% of the British resource, of high importance in the national context for both landscape and nature conservation value. The highest vertical cliffs reach 370 m at The Kame of Foula on the west coast of the island, and the next highest are the spectacular cliffs at Fitful Head (south Mainland). Clifed coast is very extensive for a comparatively small island group and is the result of the drowned glaciated landscape with its many indentations. Tall vertical cliffs, steep non-vertical types, headlands, caves, geos, blowholes, arches and stacks are all common. In all but a few places the cliffs are exposed to Atlantic gales and storms throw salt spray a considerable distance inland; as a consequence the cliff-top grassland on both west- and east-facing slopes includes typically maritime communities, with sea thrift *Armeria maritima*, sea campion *Silene maritima* and spring squill *Scilla verna*. Although salt spray may not influence the vegetation directly on some of the highest cliffs, the air is frequently laden with salt and maritime heath is very extensive. The hard rock cliffs of the region also support characteristic lichen assemblages, the species composition of which varies according to geology. Cliffs in the region are internationally important for nesting seabirds; nesting colonies on them are relatively safe from predation. Numbers are sufficiently high at eight sites to warrant Special Protection Area (SPA) status: Hermaness & Saxa Vord, Ramna Stacks & Gruney, Fetlar, Foula, Noss, Mousa, Sumburgh Head and Fair Isle.

No estuaries were identified in Shetland in the Estuaries Review (Davidson *et al.* 1991). The shorelines of sheltered coastal sites in the region are characterised by rocky substrates and narrow shingle shores. Saltmarshes are mostly less than 0.5 ha in area and their combined areas represent <0.1% of the Great Britain total. Although upper marsh communities and transitions to non-tidal vegetation are present, areas are small and these vegetation types are limited to a few voe-head saltmarshes, where they occur in

virtually sediment-free locations on rocky shores and boulder beaches. Despite the paucity of sediment, a sequence of typical saltmarsh plants occurs, grading into peat. The upper saltmarsh turf includes numbers of important species with a northern distribution, such as saltmarsh flat-sedge *Blysmus rufus*.

Because this region lacks significant areas of 'soft' shoreline it has, in general, a very low density of wintering waders compared with the rest of Scotland or the UK, although the assemblage of species is reasonably diverse. However, Shetland is important for migrant waterfowl in spring and autumn. It lies on the migratory flyway for birds of the east Atlantic moving between wintering areas on the African, Mediterranean and south-west European coasts and their northern breeding grounds. For example, in autumn migrating greylag geese *Anser anser*, barnacle geese *Branta leucopsis*, goldeneye *Bucephala clangula*, pink-footed geese *Anser brachyrhynchus* and whooper swans *Cygnus cygnus* are all present in some numbers. They occur mainly on agricultural land and freshwater sites.

The region includes a very small proportion (<1%) of the total area of sand dune in Great Britain, at 41 sites. Dunes are small and few because of the steeply shelving offshore sea bed, which limits sand supply, and great exposure to gales, which restricts opportunities for it to accumulate. Vegetated blown sand occurs at scattered locations around the archipelago within bay dunes with a local sand supply. There are no nationally rare dune higher plant species present in the region and only one nationally scarce species, curved sedge *Carex maritima*, which has an arctic-alpine distribution. The oysterplant *Mertensia maritima*, more typical of shingle shores, is also found on a small number of sand beaches. At Quendale the highly calcareous shell-sand dunes are very rich in lower plants, particularly bryophytes in the wetter areas.

Shingle shorelines occur extensively around the coasts of the islands, and the region contains a number of significant shingle features, including tombolos, bay-head, mid-bay, and bay-mouth spits (ayres), barriers and bars, most of which are found within the confines of the voes. For example, St Ninian's tombolo is the largest feature of its type in the British Isles and the Ayres of Swinister is a triple tombolo feature, recognised as of exceptional coastal geomorphological importance by its selection as a Geological Conservation Review (GCR) site. From a land form perspective the diversity of shingle ayres in the region is very significant. Many of the shingle beaches are exposed

to a high energy environment; pioneer vegetation is sparse, except where there is some protection, where the oyster plant *Mertensia maritima* occurs. The extensive shingle shores of Shetland, especially the ayres and tombolos, are important breeding sites for arctic tern *Sterna paradisaea* and ringed plover *Charadrius hiaticula*. On boulder shores where there are suitable crevices between the stones black guillemots *Cephus grylle* frequently nest.

The region has numerous internationally important sites for breeding seabirds: 23 colonies hold more than 1% of one or more species' total EU population. There are a further five colonies that are important at the Great Britain level. In total there are thirteen species that exceed 1% of the European population and a further four with nationally important numbers. Fulmar *Fulmarus glacialis* (>200,000 pairs), puffin *Fratercula arctica* (200,000 pairs), guillemot *Uria aalge* (>150,000 individuals), kittiwake *Rissa tridactyla* (50,000 pairs) and gannet *Morus bassanus* (>20,000 pairs) are the most numerous species. In addition to cliff-nesting birds, Shetland is of major importance for other seabirds nesting on open ground. These include the arctic skua *Stercorarius parasiticus* (around 2,000 pairs) and great skua *Catharacta skua* (>6,000 pairs), which are particularly abundant on the islands of Foula and Noss and at Hermaness, Unst. A few pairs of Manx shearwater *Puffinus puffinus* nest on Fetlar and possibly also on Foula, and a few pairs of Leach's petrel *Oceanodroma leucorhona* on Gruney and Foula. Storm petrel *Hydrobates pelagicus* nest on several islands, including Fetlar and Mousa.

The invertebrate fauna of Shetland is not well studied and is thought to be impoverished compared with that of many other parts of Great Britain, although several arctic species are found here at sea level that on the Scottish mainland are only encountered at greater heights on the mountains. Only about 220 species of Lepidoptera (moths and butterflies) have been recorded, from a British fauna of approximately 2,500 species, although records may increase with the formation of the Shetland Lepidoptera Group.

Many of Britain's common mammals, such as the badger *Meles meles*, are absent in Shetland. The otter *Lutra lutra* is the most significant terrestrial mammal found here; it is commonly found on both coastal and inland waters on many of the islands. The introduced common frog *Rana temporaria* is the only amphibian species reported in this region, and recent attempts to introduce common toads *Bufo bufo* have been unsuccessful. There are no terrestrial reptiles.

Table 1.2.1 Summary of main designations

Designation	No. of sites in region	Total area in region (ha)	% of GB coast total in region
Special Protection Areas (SPAs)	8	6,113	1.7
Possible Special Areas of Conservation (SACs)	7	n/av	n/av
National Nature Reserves (NNRs)	3	1,307	1.5
Sites of Special Scientific Interest (SSSIs)	72	15,582	2.2
National Scenic Areas	1	11,600	1.6
Marine Consultation Areas	4	531	0.5
National Trust for Scotland sites	1	1,089	1.7*
RSPB reserves	5	2,720	6.8

Source: JNCC (November 1996 SPA data). Key: n/av = not available; *includes National Trust sites for England and Wales. 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.

Generally the region is rich in higher plant species. The most important higher plant habitats include the exposed fellfields (areas of debris of granite or serpentine rocks), such as the Keen of Hamar. Several floral elements are represented, including Atlantic and continental species as well as representatives of northern-montane and arctic-subarctic species (Norwegian sandwort *Arenaria norvegica* subsp. *norvegica*) and arctic-alpine elements (northern rock-cress *Cardaminopsis petraea*, alpine clubmoss *Diphasiastrum alpinum* and dwarf willow *Salix herbacea*). The islands are also rich in endemic species, including certain eyebrights *Euphrasia* spp. and hawkweeds *Hieracium* spp.

1.2.4 Landscape and nature conservation

The total numbers of sites and the areas of the main designations are given in Table 1.2.1. The value of the area for landscape and nature conservation is not well reflected in the number of sites with official designations, such as Sites of Special Scientific Interest (SSSIs) and National Nature Reserves (NNRs). For example, there are no designated Biogenetic Reserves, Biosphere Reserves, Ramsar sites, Marine Nature Reserves, Local Nature Reserves or Country Parks, and of the voluntary conservation bodies only the National Trust for Scotland and the RSPB have reserves or properties in the region. Equally, owing to its small size (approximately 0.7% of Great Britain's land surface area), the region contains only a small proportion by area of the statutory protected coastal wildlife sites of Great Britain. However, the whole region is an Environmentally Sensitive Area, and approximately one tenth of it is also protected as SSSIs. The region contains a relatively large area of sea in Marine Consultation Areas, compared with other regions. Internationally important coastal sites include eight designated Special Protection Areas (SPAs) for birds and seven possible Special Areas of Conservation (SACs). Approximately 7% by area of Great Britain's RSPB reserves are in the region, at Fetlar, Lumbister and Black Park, Ramna Stacks and Gruney, Loch Spiggie, and Sumburgh Head, where management measures have provided good breeding habitat for a number of bird species. There is also one National Scenic Area (NSA) in Shetland, divided into seven sites with a total area of 11,600 ha.

1.2.5 Human activities, past and present

Human occupation of the region may date back at least 7,000 years, although there is no direct evidence of human occupation from that time. The first known habitation sites date from 3,000 BC, although their distinctive character and relative sophistication show that the occupants' ancestors had arrived in Shetland some time earlier. These and other remains combine to give Shetland probably the densest and most remarkable concentration of prehistoric monuments in Britain. From about 1,500 BC the climate became wetter and cooler, causing peat to form on higher ground; as it extended onto the lower slopes it slowly buried the Neolithic settlements and field systems. The population was forced into the lower areas, where, owing to sea level rise, the coastal plain itself was shrinking. Effectively, Shetland became unable to support the size of its

population. In the mid-1st millennium BC, possibly as a response to insecurity emanating from land-pressure, buildings reflect a concern for defence. Defensive structures from the Iron Age (500 BC - 500 AD), most notably brochs (circular dry-stone towers), indicate the social instability of the times. Shetland has over 75 brochs, including Mousa, the best preserved broch in Scotland. The tribes that occupied Shetland in the Roman period had contact with the Romans, probably by sea. By about 600 AD Shetland was part of the 'Pictish' cultural area. It is possible that the inhabitants of Shetland were converted to Christianity by Pictish clerics rather than missionaries from west Scotland or Ireland.

The Norse-derived place-names (almost all place names on the islands are Norse in origin) suggest that the 8th century Norse invaders swept away Pictish culture. However, lack of investigation and the paucity of archaeological remains make it difficult to assess the impact of the raids and subsequent settlement. Such evidence as does exist from the excavations at Underhoull and Jarlshof, which are the only published investigated sites of early Viking settlement, show no continuity of Pictish artefacts into the Viking Age. Evidence from Jarlshof and Sandwick suggests that deep-sea fishing was conducted on a large or even commercial scale, forming the basis for overseas trade. The combination of fishing and trade remained a key feature of the Shetland economy in the ensuing centuries.

Like Orkney (Region 2), Shetland did not pass out of Norwegian control until the 1460s, but by 1700 most of Shetland was in the hands of a few Scottish lairds. In the 19th century huge herring shoals attracted fishing vessels from the Scottish mainland and Scandinavia, and by the early 20th century hundreds of boats gathered in the harbours of Baltasound and Lerwick. Relics of this immense fishing industry remain in the numerous derelict piers and herring stations around the coast. As with other parts of northern Scotland, there was a whaling industry, which began around the mid 18th century, travelling to hunting grounds around Greenland and in the Arctic. From the mid 19th century seals were also taken. Between 1903, when a whaling station was built by the Norwegians at Ronas Voe, and 1914, the Shetland whale fishery took 49 humpback whales, but only two between 1920 and 1929, when whaling resumed after World War I. By 1928, however, whaling had all but ceased, as whales had become so scarce that it was no longer profitable to hunt them.

Shetland is remarkable for the large number of located shipwrecks, a reflection of its island status and the hazardous sea conditions. The majority of these wrecks are modern, including the *Oceanic*, sister ship of the *Titanic*, on a reef off Foula. However, the 16th - 19th centuries are also well represented, compared with many other areas of Britain.

The region is one of the most sparsely populated in Scotland, with a few crofts and small fishing villages, mostly located at or near the coast. The largest settlement is Lerwick. Nearly a fifth of the population of Shetland is involved in fishing and fishing-related industries, which generate nearly a quarter of the region's income. Mainland (the main Shetland island) has two principal fishing ports, Lerwick and Scalloway, plus additional smaller ports and recognised landing places. Other islands supporting fishing boats include Whalsay, Out Skerries, Yell and Unst. However, the majority of all fish and shellfish landings are

made to Lerwick. Until recent years, at the height of the herring and mackerel fishing season a large fleet of about 40 eastern European fish processing vessels ('klondykers') anchored off Lerwick. Their numbers reached a peak of 100 vessels in 1994 but are now much reduced owing to an increase in costs and the introduction of more stringent regulations.

Despite a general decline in fisheries productivity in the North Sea during the latter half of this century, in 1992, 19% of all recorded landings of fish and shellfish species in Britain and the Isle of Man were made in this region, more than three times the average for regions in the UK. Total landings of pelagic species in the region, approaching 100,000 tonnes, account for nearly 40% of the British and Isle of Man and more than half (53%) of the Scottish totals. Landings of herring and mackerel are the most significant in terms of tonnage and proportion of the combined Britain and Isle of Man species totals: the 60,000 tonnes of mackerel landed in the region in 1992 represents 40% of the British and Isle of Man total and the roughly 40,000 tonnes of herring represent 44% of that total. Landings of demersal and shellfish species in the region are lower, representing 7.3% and 1.1% respectively of the combined British and Isle of Man totals; significant landings are made of species such as blue whiting, monkfish (angler), edible crabs and scallops. The coastline provides good shelter and adequate water exchange, and salmon farms have become an important feature of the local economy. In 1995 Shetland supplied about 22% of the farmed salmon produced in Scotland. Mussels and, less frequently, sea trout, native and Pacific oysters and scallops and queen scallops are also cultivated around the region's coast.

The decline of the North Sea fisheries and the loss of fisheries-related employment led to serious economic difficulties in the region by the 1960s, but the expansion in oil-related industry consequent upon the North Sea oil boom and development of Sullom Voe as an important oil terminal have greatly improved the economic outlook. In the last 20 years Shetland has become a major UK centre for hydrocarbons trans-shipment, responsible for handling over 30% of the UK's total oil production in 1995. Sullom Voe oil terminal is Europe's largest oil and liquefied gas exporting terminal, with a throughput of 40,569,604 tonnes of oil in 1992, and 350,497 and 248,164 tonnes of propane and butane respectively in 1991. Shetland Islands Council monitors the terminal and tankers passing through Yell Sound for oil spillages. The only notable spillage of oil at Sullom Voe occurred in late December 1978, when the *Esso Bernicia* struck jetties and was holed. In January 1993 the *MV Braer* was wrecked on the southern tip of Mainland, releasing 80,000 tonnes of light crude oil into the sea. Fortunately it appears that the very rough weather helped to disperse the oil naturally, with little obvious lasting impact on surface fauna, although there is a possibility of long-term effects, particularly on lobsters and razorshells.

The region's ports, industrial developments, harbours and settlements have been associated with land claim and the construction of coast protection or sea defence works. At Sullom Voe the inlet of Orca Voe was substantially infilled when the oil terminal was constructed. Other human activities in the region include limestone quarrying: quarries on Unst and Mainland together produced 5,000 tonnes of talc, the region's most important mineral product, in 1993, representing the entire UK talc production

for that year. Effects of human activities in the region are few. All household and putrescible waste is shipped to Lerwick for incineration, and there are only two liquid waste outfalls discharging more than 1,000 m³ to the sea; no aggregates are dredged from the sea bed in the region and no dredged material or sewage sludge is currently deposited there. Tourism, a growing industry in Shetland, relies on the islands' reputation for unspoiled landscapes and coasts, spectacular seabird colonies and numerous well-preserved historical sites. For this reason, the tourist industry is highly specialised and still relatively small, having only limited impacts on coastal habitats and wildlife. Sailing, sea angling and diving are the major water-based recreational activities.

Unusually for Scotland, Shetland Islands Council is able to undertake integrated coastal zone management on a statutory basis, rather than simply in voluntary co-operation with other statutory organisations. The council has the power, as a Harbour Authority under the Zetland County Council Act 1974, to regulate physical developments within three miles of the coast through a system of Works Licences. It has policies for controlling a variety of coastal developments, including marine fish farming and aggregate extraction, which provide the statutory planning framework for development control purposes. The council is strongly involved in initiatives that aim to minimise the risk of oil pollution and which would provide a rapid response should such an incident occur.

1.2.6 Further sources of information

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Chapter 2 Geology and physical environment

2.1 Coastal geology

British Geological Survey & Scott Wilson Resource Consultants

2.1.1 Introduction

Shetland consists of an array of metamorphic, igneous intrusive, igneous extrusive and sedimentary rocks. The foundation rocks which make up large parts of Shetland are regional metamorphosed Precambrian sediments, along with igneous rocks, which were intruded into them during the Caledonian Orogeny. The coastline provides key sections through a great variety of igneous and metamorphic rocks, including the most complete ophiolite complex (an upthrust section of oceanic crust) in the British Isles. There are also cliffs exposing Devonian sandstones and volcanic rocks. The geology is summarised on [Map 2.1.1](#) and [Table 2.1.1](#).

Shetland is divided into two geologically distinct parts by a major north-south trending fault, the Walls Boundary Fault, which is thought to be the northward continuation of the Great Glen Fault. Excellent exposures of the fault zone occur on the shores of Yell Sound. In this section the parts of Mainland on either side of the fault are termed East and West Mainland.

Unst, Yell, Fetlar and East Mainland consist mainly of Precambrian (Dalradian and Moinean) metasediments with a few intrusive igneous complexes including the ophiolite complex of Fetlar and Unst. The thin sheets of

metasediments are inclined along a north-south axis, except in the east of Unst and Fetlar. On the south-eastern part of Mainland and the adjacent islands (including Fair Isle), Devonian sediments overlie the older metamorphic rocks. West Mainland has smaller areas of metasediments intruded by a series of igneous complexes, which may be related in origin. These are overlain by fairly extensive sediments and volcanic deposits of Devonian age.

Thin Quaternary (Late Devensian) deposits, mainly of till, occur at the top of cliffs throughout Shetland, and similar deposits can be found at sea level along the shores of the voes. Earlier glacial deposits have been recorded at only two localities, at Sel Ayre and Fugla Ness, both on West Mainland.

2.1.2 Stratigraphy

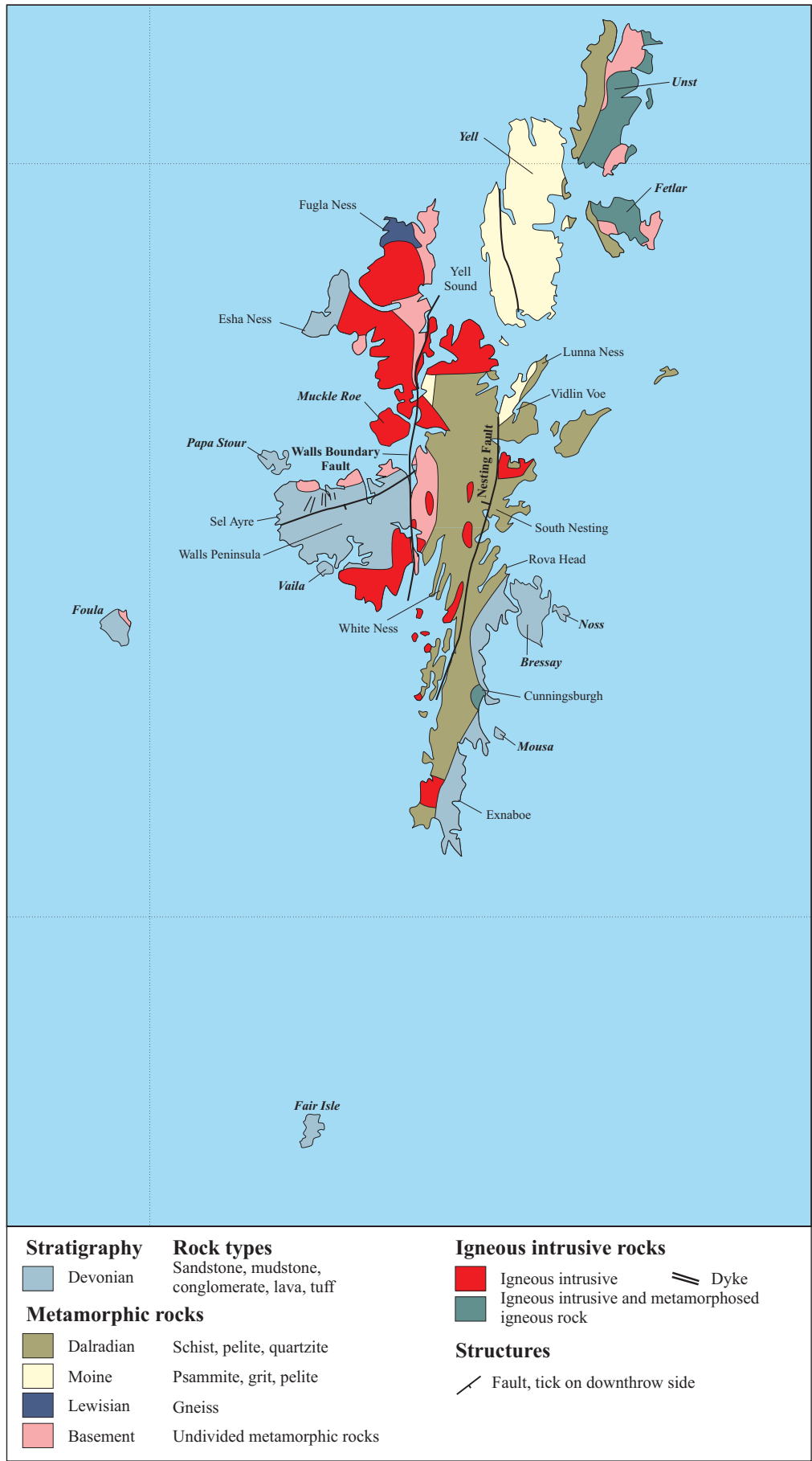
Yell, Unst and Fetlar

The rocky coast around the north of Unst is formed of very coarse-grained granite, which has a very striking layered appearance. Excellent, accessible sections through the ophiolite complex along the coast of Unst and Fetlar show

Table 2.1.1 Geological column

<i>Era</i>	<i>Period</i>	<i>Epoch</i>	<i>Age of start (million yrs)</i>	<i>Stratigraphic units mentioned in the text</i>	<i>Significant geological events</i>
Cenozoic	Quaternary	Holocene	0.01	Devensian	Rapid rise in sea level
		Pleistocene	1.8		Series of ice sheets cover the region
	Tertiary (Neogene)	Pliocene	5		
		Miocene	23		
	Tertiary (Palaeogene)	Oligocene	38		
		Eocene	54		Early Tertiary opening of the North-east Atlantic; volcanism
Mesozoic	Cretaceous	Palaeocene	65		
			146		
			208	Sedimentation	
Palaeozoic (Upper)	Triassic		245		
			290		
			360	Variscan Orogeny	
Palaeozoic (Lower)	Permian		410	Old Red Sandstone	
			440	Caledonian Orogeny	
			505	Folding, faulting, volcanic activity, metamorphism	
Precambrian	Cambrian		544	Dalradian, Moine, Lewisian	

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).

Dalradian rocks thrust against folded lavas, and coarse-grained igneous rocks, including gabbros, resting on a mixture of metasediments, which contain lava debris. An extremely good example of a deformed conglomerate, consisting of abundant cigar-shaped pebbles set in a finer grained matrix, can be seen along the cliffs in the eastern part of Fetlar.

The gneisses (rocks that have suffered partial melting) visible along the coast of Yell provide evidence about how they have been formed, as many of them can be correlated with other Moine metasediments that have not undergone partial melting. Within the gneisses are inliers of basement rock, probably Lewisian, and on the north coast of the island there is a large mass of granitic gneiss, which represents an early intrusion into the Moinean rocks prior to the main metamorphic episode.

East Mainland

Dalradian metasediments and Devonian sediments are exposed on the coast of East Mainland. The Dalradian rocks can be studied along, for example, the easily accessible shorelines of Lunna Ness and South Nesting Bay. Copper mineralisation confined to certain strata within the Dalradian rocks is exposed along the shore of Vidlin Voe. South of Rova Head the coast, including the cliffs of Bressay and Noss, is formed largely of Devonian Old Red Sandstone. The Old Red Sandstone is interrupted intermittently by Dalradian rocks, for instance at Cunningsburgh, where serpentinite (an altered ultrabasic rock) and pillow lavas (lavas extruded underwater) can be seen in the low cliffs, suggesting the presence of another ophiolitic fragment. Devonian limestone and calcareous siltstone, locally with fossil fish remains, are exposed on the shore of Mousa and at Exnaboe. At White Ness there are thick units of Dalradian marble.

West Mainland

The cliffs on the west side of Foula comprise moderately-dipping buff-weathering Devonian sandstones with lesser amounts of shale and siltstone.

On the south side of the Walls Peninsula there are cliffs formed of granite and diorite intruded into Devonian sandstone. The thermal aureole (a distinctive band in the sandstone where it has been affected by the arrival of the hot granite and diorite) is exposed in the cliffs of Vaila, and numerous thick veins of sodium-rich minerals provide mineralogical interest. Devonian strata containing flows of rhyolite (silica-rich lava) and ignimbrite (volcanic ash 'welded' together into a flow) are well displayed in the cliffs of Papa Stour and Esha Ness. Devonian granophyre (a type of granite), cut by many silica-rich dykes, gives rise to the impressive coastal scenery of Muckle Roe. Gneisses at least 2,900 million years old and correlated with the Lewisian rocks of the Western Isles are well exposed near Fugla Ness. The shear zone forming the eastern limit of the gneiss represents the western limit of the Caledonian fold belt in Shetland and is thus equivalent to the Moine Thrust Zone of north-west Scotland.

At Sel Ayre, early Devensian peat occurs below till and periglacial deposits, filling what is probably a pre-glacial or interglacial valley. On the west coast of Fugla Ness, a bed of interglacial peat lies between two layers of till.

2.1.3 Structure

The characteristic structure of Shetland is produced by at least four north-south faults and the north-south trending, steeply inclined metasediments of East Mainland and Yell. This characteristic structure is not, however, found throughout the islands. In the east of Unst and Fetlar, as well as in West Mainland, the presence of basement rock and igneous intrusions has resulted in a more irregular structure. The Old Red Sandstone on West Mainland has in places been subject to significant tectonic movement, resulting in tight folds with a northerly or north-easterly trend. On East Mainland, by contrast, the Old Red Sandstone dips gently to the east.

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	*Coastal Geology Group, British Geological Survey, Nottingham, tel: 0115 936 3100
Geological Conservation Review (GCR) sites in the region	*SNH Northern Isles Area, Shetland Office, Lerwick, tel: 01595 693345

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



The centre of Yell Sound is more than 80 m deep. Tidal currents sweep through the sound at up to 4 m per second, scouring the sea bed, which is a mixture of bedrock outcrops, cobbles and pebbles, with coarse sand in between. The marine plants and animals that make up the typical community of such conditions include the brittlestars *Ophiocomina nigra* and maerl *Lithothamnion coralloides* (an unusual coralline seaweed). Photo: Marine Nature Conservation Review, JNCC.

2.2 Offshore geology

British Geological Survey & Scott Wilson Resource Consultants

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. 'Solid geology' refers to rocks of pre-Quaternary age, which in Britain are separated from the overlying Quaternary sediments by a marked dividing line. The Quaternary Period covers the last 1.6 million years and is divided into the Holocene (the last 10,000 years) and the Pleistocene. Holocene sediments form a more superficial and locally mobile veneer over the relatively immobile Pleistocene sea-bed sediments.

2.2.1 Holocene sea-bed sediments

These are the unconsolidated sediments at sea bed laid down since the sea transgressed across the area following the early Holocene rise in sea level. The lithology (types) and thickness of the sediments have been determined by sampling, high resolution seismic profiling and sidescan sonar. Sea-bed sediments in the region are shown on [Map 2.2.1](#). Muddy sands and sandy muds occur in the more sheltered bays and firths around the islands. The largest deposits occur in St Magnus Bay Basin, Fetlar Basin and Unst Basin. Close to the islands, carbonate or shell-rich gravels and gravelly sands occur, reflecting the rich nearshore marine fauna living around these islands. Further offshore sands predominate.

2.2.2 Pleistocene geology

Pleistocene deposits are thin and patchy to the east and west-south-west of Mainland ([Map 2.2.2](#)), where it is not uncommon for bedrock to outcrop on the sea floor. The more significant Pleistocene deposits tend to occur in distinct basins and locally reach considerable thicknesses, up to 60 m. Deposits in the St Magnus Bay Basin and Fetlar Basin consist predominantly of soft, olive-grey clays rich in hydrogen sulphide, underlain by grey till. The soft clays are probably post-glacial. In the West Fair Isle and Unst Basins compact grey clays with scattered pebbles are the dominant sediment type. Elsewhere in the West Shetland Basin and to the north of the Unst Basin Pleistocene deposits consist mainly of compact grey clays, with scattered pebbles throughout, which are probably tills. These deposits thicken to the north-west and north-east respectively. Occasionally soft red muds, thought to be slightly older than the soft grey sulphide-rich muds, occur on the East Shetland Platform.

2.2.3 Solid (pre-Quaternary) geology

Offshore much of the solid geology of the sea bed ([Map 2.2.3](#)) is concealed by sediments, but in areas where these are thin, rocky outcrops do occur. Precambrian metamorphic rocks dominate the sea bed closest to the islands, as they do onshore. However, younger sedimentary rocks such as Devonian and Permo-Triassic sandstones and shales overlie the metamorphic rocks further offshore, especially to the east

and south. To the north-west of Shetland a north-east trending fault creates a sharp boundary between the ancient basement rocks and young Tertiary sediments.

2.2.4 Further sources of information

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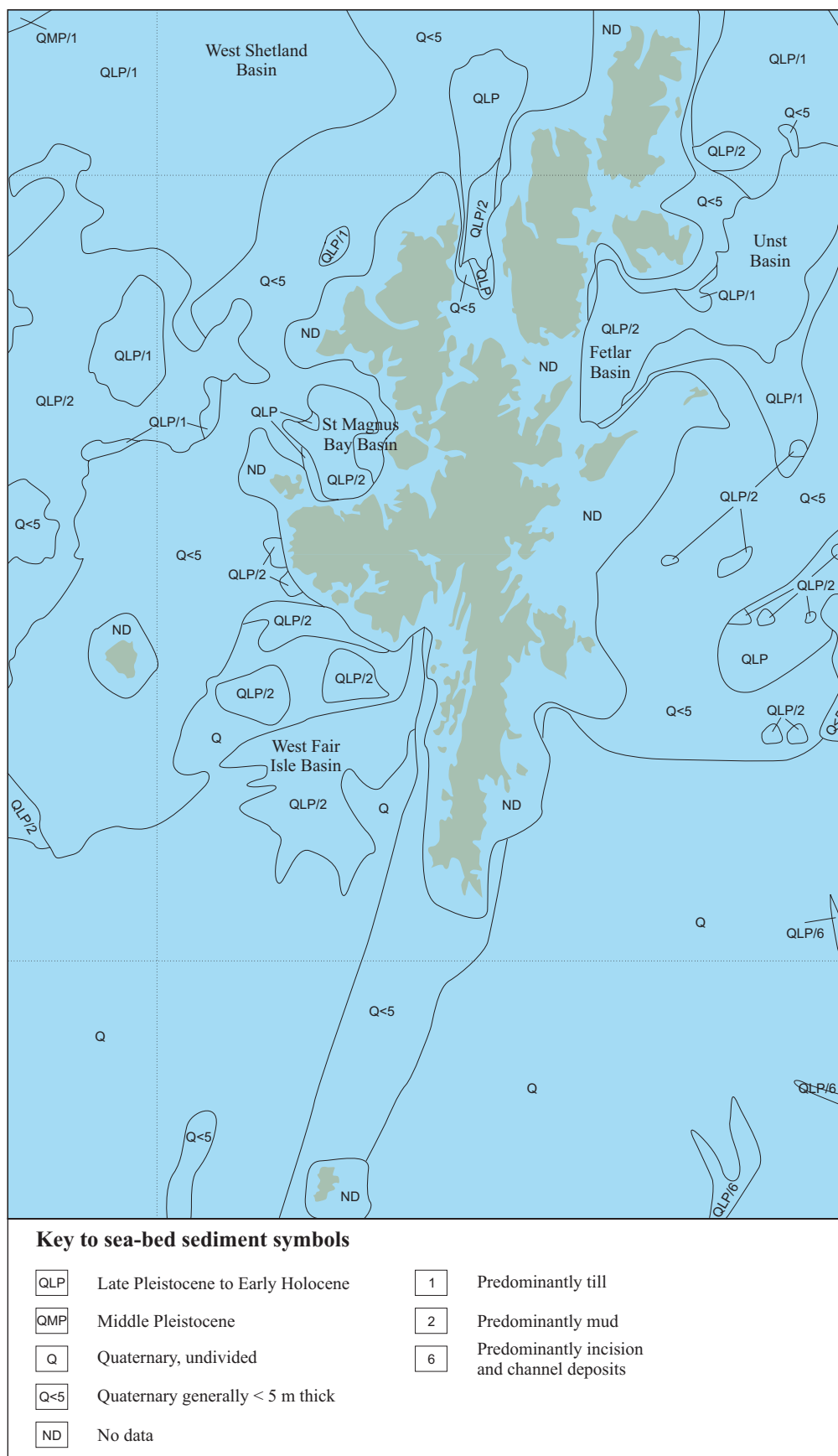
D. Contact names and addresses

Type of information	Contact address and telephone no.
Geological information for region and the whole of Britain	*Coastal Geology Group, British Geological Survey, Nottingham tel: 0115 936 3100
Geological information for region	*SNH, Earth Science Branch, Edinburgh, tel: 0131 446 2400
UKDMAP 1992. Version 2. United Kingdom digital marine atlas. Oceanographic maps.	*British Oceanographic Data Centre, Birkenhead, tel: 0151 653 8633

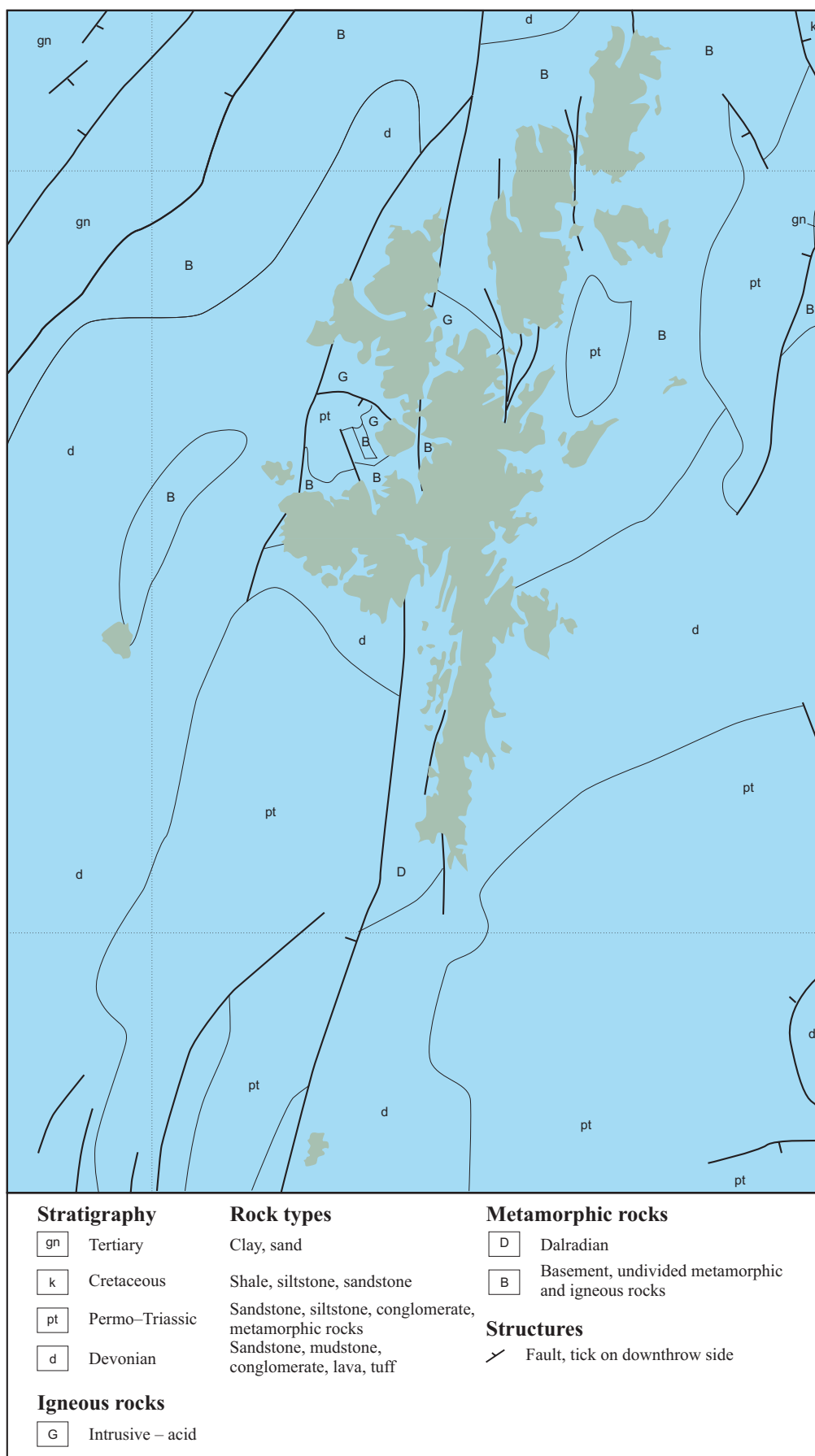
*Starred contact addresses are given in full in the Appendix.



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: British Geological Survey (1994), Holmes *et al.* (1993).



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

2.3 Wind and water

British Geological Survey & Scott Wilson Resource Consultants

2.3.1 Wind

The most characteristic feature of the Shetland climate is the frequency of strong winds. The mean wind speed during the year is 6.5-7.5 m/s and gales occur on an average of 58 days per year. Wind contour maps for the region are not available. However, during the period 1965-1973, for 75% of the time the hourly mean wind speed was more than 4.25 m/s, and for 0.1% of the time it was more than 21.5 m/s (Caton 1976). These are among the highest values in Britain. The highest mean wind speed and the strongest gusts in Britain have both been recorded in Shetland.

Winds from the south and west predominate and there is a pronounced minimum for easterly winds (Figure 2.3.1). Strong winds (>8.5 m/s) are most frequently from the south-west whilst less strong ones (of 1.8-8 m/s) are most commonly from the south. Northerly winds are commonest in summer and southerly winds in winter.

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. The sea floor slopes steeply away from Mainland and the northern islands of Shetland to 80 m depth, marking the base of the submerged Shetland hillsides and the limit of the islands as a feature on the continental shelf (Map 2.3.1) (Flinn 1974). Beyond 10 km from most of the islands the sea floor lies more than 100 m below mean sea level, with local depressions or deeps where water depths exceed 140 m. Approximately 50 km north-west of the Shetland Islands water depths increase more quickly at the edge of the Faeroe-Shetland channel.

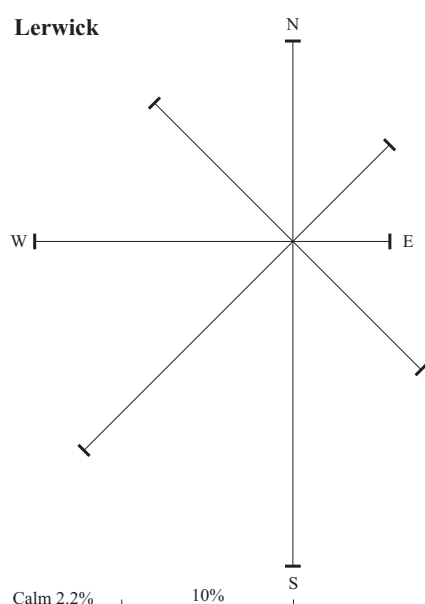


Figure 2.3.1 Wind directions at the Lerwick Observatory. Source: Meteorological Office, Edinburgh.

2.3.3 Tidal currents

In the Atlantic Ocean tidal streams are very weak, but as tides reach the shallower areas of the United Kingdom continental shelf their speeds increase greatly. In general, tidal streams around the Shetland Islands move southwards on the flood tide, and northwards on the ebb, at speeds ranging from 0.5 to 1.25 m/s (Map 2.3.2). In certain places, notably near Muckle Flugga, in Yell Sound, Linga Sound, Bluemull Sound and near Sumburgh Head, tidal streams reach considerably higher velocities - between 3.5 m/s and 4 m/s.

2.3.4 Tidal range

The tides in the Shetland Islands are the result of interaction between the two independent tidal systems in the North Atlantic and the North Sea. Map 2.3.3 shows the tidal ranges for mean spring tides and therefore the greatest ranges to be found in calm conditions. The tidal range at mean spring tides in the Shetland Islands is approximately 1.5 m. Variations occur in the tidal bays and enclosed areas partially separated from the sea by sills. In certain conditions the interaction of atmospheric pressure, wind and tide can lead to a tidal surge, causing unusually high tidal ranges. Tidal surges of between 0.75 m and 1 m occur in the region once in every 50 years on average. Smaller surges may occur more frequently.

2.3.5 Wave exposure and sea state

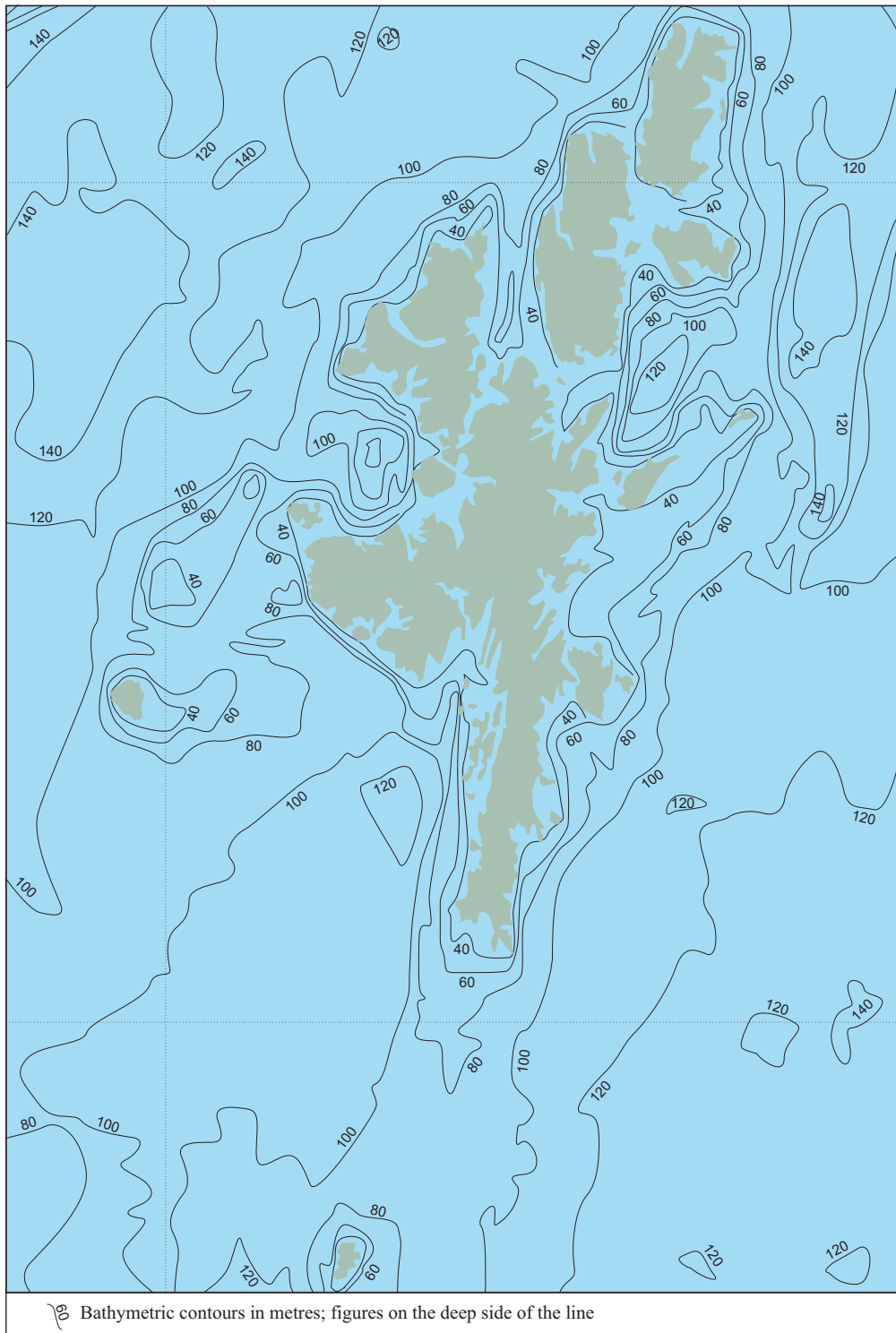
The coastline of Shetland exhibits a wide range of exposures, from the very sheltered shores at the heads of the voes to the sheer high cliffs facing the prevailing wind. The shore and sea bed on the west coast of Shetland are exposed to much stronger wave action than most other Scottish coasts because of the long Atlantic fetch (distance travelled over deep, open water), resulting in longer, higher waves, the deep water close to shore and the frequent strong winds.

Map 2.3.4 shows the significant wave heights that can be expected to be exceeded for 10% and 75% of the year. Immediately east of Shetland, for example, the significant wave height for 10% of the year is more than 2.5 m while immediately to the west of Shetland it is more than 3 m.

2.3.6 Water characteristics

Water temperature

The mean monthly sea surface temperatures for summer and winter are shown on Map 2.3.5. The summer isotherms are for August, which is the month of highest average surface sea temperatures. The winter isotherms are for February, the month of lowest average temperatures. Sea surface temperatures around the Shetland Islands are

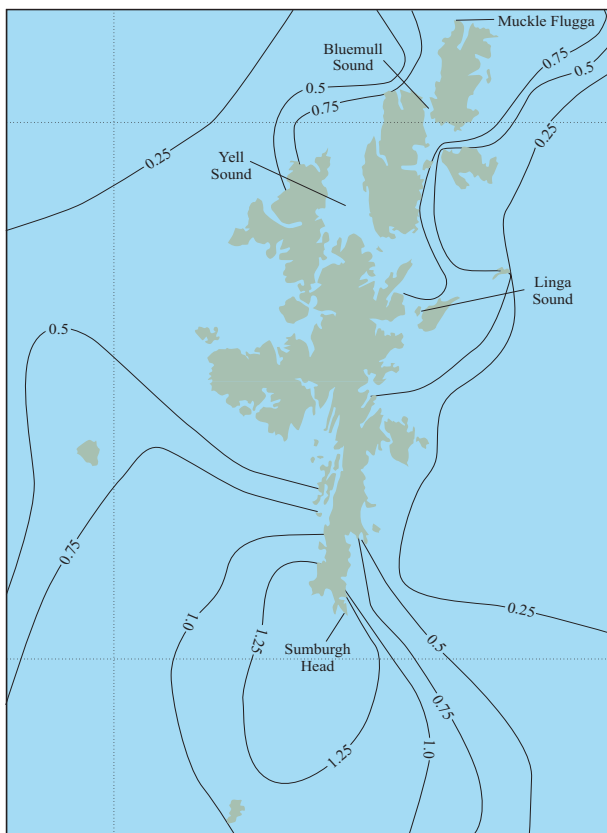


Map 2.3.1 Bathymetry. Source: British Geological Survey (1987).

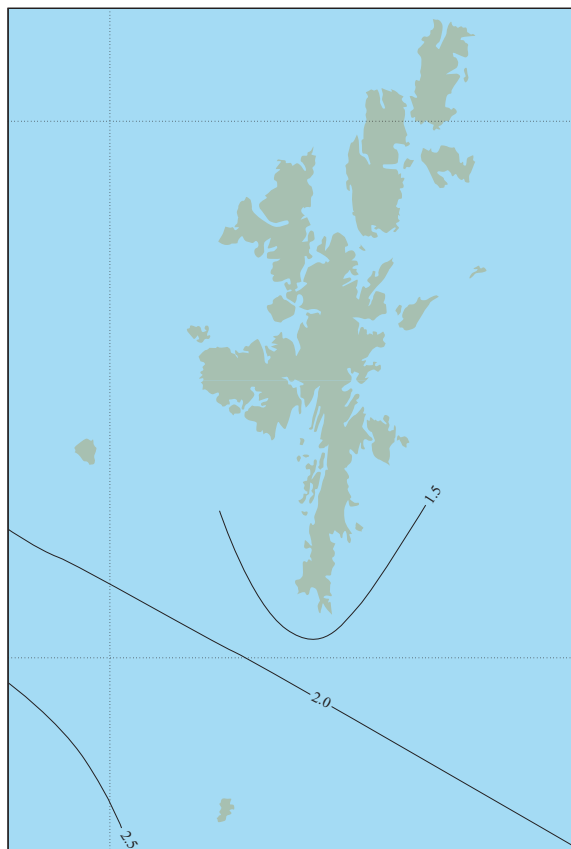
influenced by the flow of Atlantic waters into the North Sea through the Fair Isle Channel, between the Shetland and Orkney (Turrell 1992). During the winter, sea temperatures around Shetland remain relatively mild, averaging 7-7.5°C under the moderating influence of North Atlantic waters. In summer, Atlantic influences wane, but Shetland is too distant from the European continental land mass to benefit from summer warming. Average summer temperatures are therefore not much higher than winter temperatures, averaging 12-13°C during August.

Salinity

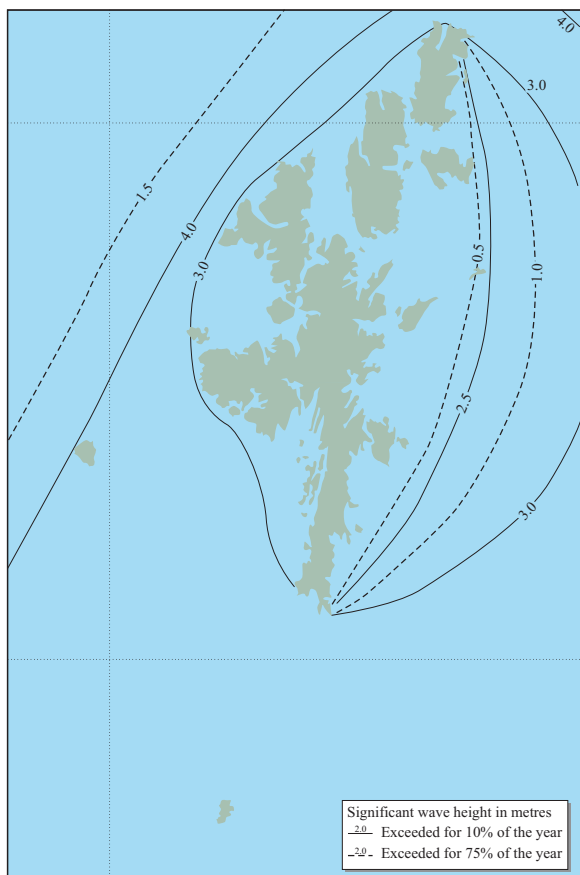
The mean surface salinities for summer and winter, based on data for August and February respectively, are shown on [Map 2.3.6](#). The Shetland Islands are surrounded by waters with salinity in excess of 35 g/kg in both winter and summer, reflecting the Atlantic Ocean origin of waters throughout the year (Turrell 1992). The land area of the islands is too small for there to be significant freshwater runoff, so salinity is diluted significantly only in the surface waters of enclosed areas during periods of heavy rain.



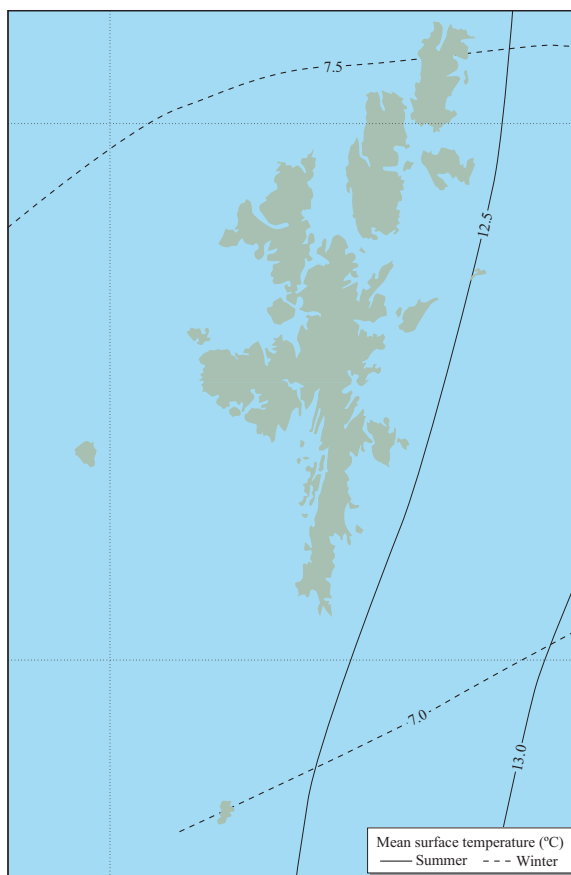
Map 2.3.2 Maximum tidal current speeds (in m/s) at mean spring tides. Source: Sager & Sammler (1968).



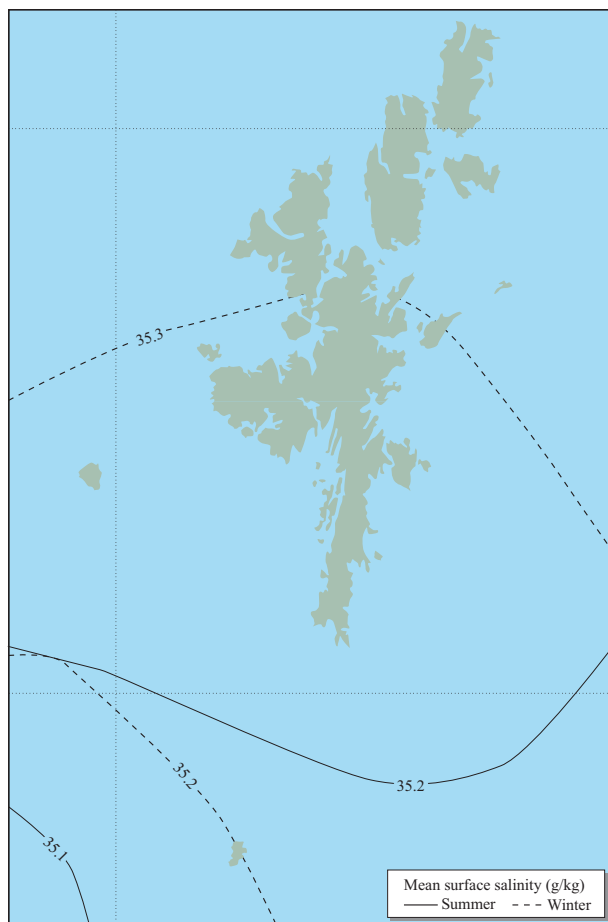
Map 2.3.3 Tidal ranges (m) at mean spring tides. Source: Lee & Ramster (1981). © Crown copyright.



Map 2.3.4 Significant wave heights (m) exceeded for 10% and 75% of the year. Source: Draper (1991).



Map 2.3.5 Mean surface water temperatures in summer and winter (°C). Source: Lee & Ramster (1981). © Crown copyright.



Map 2.3.6 Mean surface salinity of seawater in summer and winter in g/kg of total dissolved salt. Source: Lee & Ramster (1981). © Crown copyright.

2.3.7 Further sources of information

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C. Contact names and addresses

Type of information	Contact address and telephone no.
UKDMAP (United Kingdom digital marine atlas) Version 2. Oceanographic maps.	*British Oceanographic Data Centre, 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.

2.4 Sediment transport

British Geological Survey & Scott Wilson Resource Consultants

2.4.1 Introduction

Sediment transport is described in the context of coastal cells and sub-cells (Motyka & Brampton 1993; HR Wallingford 1995). These divide the coastline into sections within which sediment erosion and accretion are inter-related and largely independent of other cells. The coast of Shetland is very complex, with numerous enclosed and deeply indented bays in which sediment movement is independent of that in other bays; each could therefore be identified as a separate sub-cell. However, for practical purposes HR Wallingford (in prep.) has grouped the small bays together and defined the sub-cells with consideration of the general orientation of the coastline, its physical character and hydraulic environment. Thus, two sub-cells have been identified covering the Shetland Islands: sub-cell 11a - Shetland East and sub-cell 11b - Shetland West. Both sub-cells have a rocky, natural coastline with few developed areas. Deep water extends close to the shoreline, and given the severity of the wave climate, the coastline is exposed to high energy conditions. Sediment transport is thus governed by wave action. Both beach material and sediment from eroding cliffs can be readily moved offshore under destructive wave conditions, and as the offshore sea bed is steep, this material is lost as a source of future natural beach nourishment. Erosion occurs along much of the 'soft' beach frontage, and there are varying degrees of cliff erosion depending on the rock type. There is little significant accretion.

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C. Contact names and addresses

Type of information	Contact address and telephone no.
Coast protection policy; sediment cells	*SOAEFD, Edinburgh, tel: 0131 244 6015
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
Coastal defence, sediment cells, erosion and deposition	*SNH, Earth Science Branch, Edinburgh, tel: 0131 554 9797
Sediment cells	HR Wallingford Ltd., Howbury Park, Wallingford, Oxfordshire OX10 8BA, tel: 01491 835381

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

2.5 Sea-level rise and flooding

British Geological Survey

2.5.1 Sea-level changes in the region

Apparent changes in sea level are 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 southern England is sinking) and global rises in sea level.

There are a number of detailed studies of the evidence for sea-level rise and crustal movement in Britain (e.g. Shennan 1989; Carter 1989; Woodworth 1987; Emery & Aubrey 1991). Tide gauge measurements made over the last few decades suggest that sea level is rising globally due to global warming by 1-2 mm/year, but on a national scale the evidence can be contradictory and difficult to interpret (Woodworth 1987). There is considered to be a net rise in sea level in Shetland (G. Lees pers. comm.), although insufficient data exist to quantify the rate of rise.

2.5.2 Flooding in the region

The potential for flooding in the region is low and is confined to low ground likely to be affected by high sea levels during storm surges and spring tides, for example bays and voe heads. In addition, the two main settlements, Lerwick and Scalloway, are susceptible to flooding during storm surges (Map 2.5.1).

2.5.3 Acknowledgements

Thanks are due to Keith Hiscock (JNCC), George Lees (SNH) and Austin Taylor (Shetland Islands Council) for comments on the draft.

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C. Contact names and addresses

Type of information	Contact address and telephone no.
Flood defence	*Shetland Islands Council, Lerwick, tel: 01595 693535
Flood warning	*SEPA, Northern Region, Dingwall, tel: 01349 862021
Flood and coastal protection policy (see also section 8.4)	*SOAEFD, Edinburgh, tel: 0131 244 6015
Sea-level rise and flooding information for region	*SNH, Earth Science Branch, Edinburgh, tel: 0131 447 4784
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 & Scott Wilson Resource Consultants

2.6.1 Introduction

The Shetland Islands are a partly drowned range of hills rising from a depth of about 80 m below sea level. Their submergence, and therefore their present coastline, is relatively recent and many of their characteristics are typical of a 'young' coast. The coastline of Shetland is perhaps more varied and more involuted than anywhere else in the British Isles except the west coast of Scotland. This variation in coastal landform contributes to a range of coastal landscape character zones, recently described by Scottish Natural Heritage (in prep.). Steers (1973) commented that 'to describe in any detail the coasts of Shetland would require a volume'. Equally, this description picks out only a few of the many interesting features of Shetland's coast.

2.6.2 Description

The coastline changes abruptly, from magnificent cliffs to the narrow drowned valleys known as voes. This has led commentators to ascribe to Shetland two coastlines: the 'outer' coast, formed largely of high cliffs, and the inner coast, formed of the voes. Often on the 'outer' coast there is no beach and cliffs descend steeply below the waves, their profile unmodulated by shelf, beach or wave-cut platform. Numerous stacks and islets lie just offshore, sometimes connected to the islands by thin stretches of sand, known as tombolos. Uninterrupted sandy beaches are uncommon, although typical of the islands are the freshwater lochs formed behind accumulations of beach material. [Map 2.6.1](#) shows the distribution of cliffs, sandy beaches and blown sand. The voes in Shetland differ from fjords, as the majority have no sill, although Ronas Voe, exceptionally, has a well-developed sill enclosing a deep basin.

Yell, Unst, Fetlar

On all three of these northern islands much of the exposed coast is formed of high cliffs. The north-west coast of Unst is formed of steep cliffs with numerous geos (narrow rocky inlets), stacks and islets such as Muckle Flugga. The inlet of Burra Firth is crossed by a mid-bay bar of accumulated beach material, south of which lies the freshwater Loch of Cliff. Unst's east coast is cliffed and involuted as far as Harold's Wick, south of which the cliffs are lower. On Yell, the east coast is more involuted than the largely cliffed west coast, and there are limited areas of intertidal sand and mud at Mid-Yell and Hamnavoe. Fetlar has cliffs on all sides, but also a relatively sheltered sandy beach at Tresta.

East Mainland

Much of the north-east coastline of Mainland is involuted by voes. Many of them trend to the north or north-east, reflecting the orientation of the underlying Precambrian rocks, although others further south, such as Dury Voe and Wadbister Voe, cut across the trend of the rocks. As is typical of a recently drowned coast, accumulations of sand

and shingle have formed many spits and bars around the inner coast. Examples of these can be seen in Swining Voe and Dury Voe. Within the voes there is often a low bedrock cliff below the peat soil, a wave-cut platform and a gently shelving beach of shingle or sand. At North Voe (Whalsay) and Dury Voe peat is found exposed at the shoreline, while at Lerwick peat is covered by about a metre of gravel. Such deposits provide evidence of the rate of relative sea-level rise. South of Lerwick the coastline, formed of Old Red Sandstone, is less indented, while on the peninsula that leads to Sumburgh Head there are a number of dunes or deposits of blown sand, for example at Pool of Virkie, West Voe of Sumburgh and Bay of Quendale.

West Mainland

To the west, metamorphic rock forms the impressive west-facing cliffs at Fitful Head, which descend more than 274 m, to the north of which the wide expanse of the Loch of Spiggie is separated from the sea by only a low neck of land. One of Shetland's classic young accumulations of sand is superbly displayed at St Ninian's Isle, where a tombolo creates a causeway between the isle and Mainland. North of here the rest of the coastline has the characteristic involuted pattern, which tends to follow the orientation of the rock, as for example at Clift Sound, West Voe and Lang Sound, Whiteness Voe, Stromness Voe and Weisdale Voe. The coastline around the Walls Peninsula is characterised by penetrating voes and cliffs cut in Devonian rock. Many of the cliffs have wave-cut benches at their base. Sandy beaches have accumulated on some of these, for example, on the south coast of Vaila. The arms of Sandsound Voe and Gruting Voe reach far inland. The magnificent cliffs to the south-east of Walls and on the island of Muckle Roe are formed of granite. North of Muckle Roe there are a number of interesting features. The Drongs (south-west of Hillswick) are stacks cut in metamorphic rock, and there are more fine examples of cliffs and stacks along the coast as far as Brae Wick. The lavas around Esha Ness give rise to a rugged coastline, and at the Grind of the Navir a ridge of large boulders and rock slabs is piled up on the volcanic cliffs. Close by are the Holes of Scraada - blowholes where the sea has tunnelled into the cliff along a line of weakness. Further north granitic rocks produce magnificent cliffs around the igneous complex of Ronas Hill.

2.6.3 Further sources of information

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Map 2.6.1 Major coastal landforms. Source: after Flinn (1974).

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C. Contact names and addresses

<i>Type of information</i>	<i>Contact address and telephone no.</i>
Coast protection policy; sediment cells	*SOAEFD, Edinburgh, tel: 0131 244 6015
Sea defence	*Shetland Islands Council, Lerwick, 01595 693535
Geomorphology of the region	*SNH, Earth Science Branch, Edinburgh, tel: 0131 447 4784
Coastal geomorphology, 1:50,000 scale 'solid' and 'drift' maps	*British Geological Survey, Coastal Geology Group, Nottingham, tel: 0115 936 3100

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



In many of Shetland's more sheltered bays there are small sandy beaches. At Quendale Bay SSSI, Mainland, however, the exposure of the site to near-constant very strong winds has resulted in the build up of the largest area of sand dune in Shetland, at over 200 ha. A variety of dune forms are displayed: in addition to the outer foredune ridge, backed by a wet depression with its own distinctive wildlife, sand is blown inland for up to a kilometre, creating a machair plain, while in other places it is blown up over steep rock surfaces as climbing dunes. Photo: Pat Doody, JNCC.

Chapter 3 Terrestrial coastal habitats

3.1 Cliffs and cliff-top vegetation

Dr T.C.D. Dargie

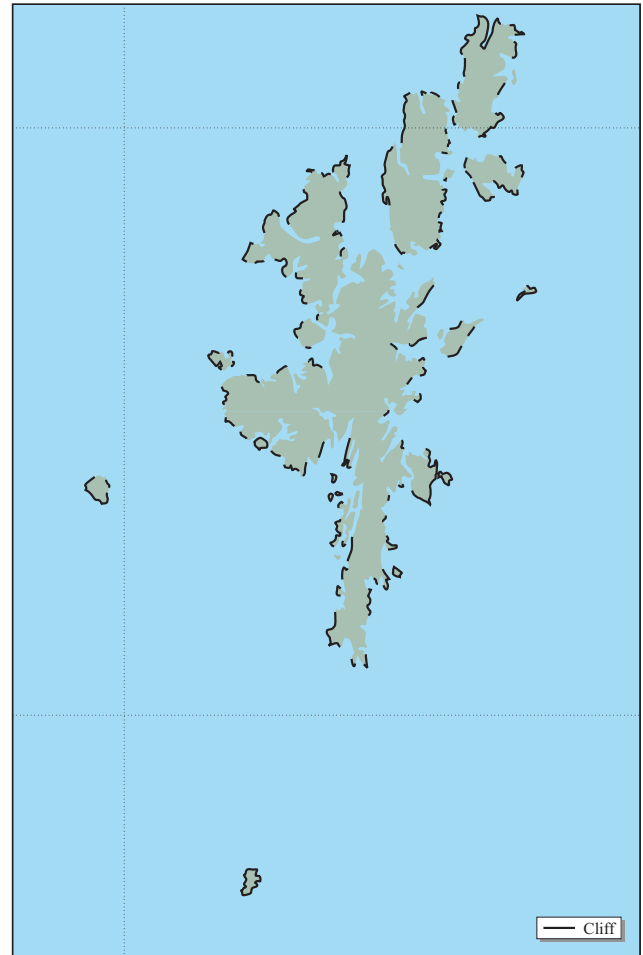
3.1.1 Introduction

Geology and geological structure, together with environmental history (past and present marine erosion and glacial processes), determine cliff form. Sea cliffs are generally steep slopes ($>15^\circ$), 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 above an intertidal rock platform. The most distinctive cliff types are consolidated (hard cliffs developed from resistant bedrock) and unconsolidated (soft cliffs developed in easily-eroded materials, including Quaternary deposits such as till (Doody *et al.* 1993).

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

The cliffed coast in this region is very extensive for a comparatively small island group, because the coastline of Shetland reflects a drowned glaciated landscape, with many indentations. The region has a total cliff length of 483 km (Table 3.1.1). This represents 12% of the British resource and is therefore of high importance in the national context. Hard cliffs predominate in the region and there are relatively few examples of soft types, apart from cases of glacial till overlying cliffed bedrock.

The scenic contribution of cliffs within the region is outstanding: tall vertical cliffs, steep non-vertical types, headlands, caves, geos, blowholes, arches and stacks are all



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

common. The distribution of lengths of cliffed coast in the region is shown on Map 3.1.1. The coast between Muckle

Table 3.1.1 Lengths (km*) of cliff types in Region 1

Area	Vertical >20 m height		Vertical <20 m height		Non-vertical >20 m height		Non-vertical <20 m height		Total	
	Length (km)	% of total length in region	Length (km)	% of total length in region	Length (km)	% of total length in region	Length (km)	% of total length in region	Length (km)	% of total length in region
Region 1	163	34	228	47	61	13	31	6	483	-
Scotland	677	29	724	30	633	27	340	14	2,373	20
North Sea Coast	601	33	380	21	559	31	261	15	1,799	27
Great Britain	1,325	33	818	20	1,371	34	545	13	4,059	12

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

Flugga and Fair Isle contains a large, diverse and spectacular length of cliff and cliff-top habitat. The various separate parts of the Shetland National Scenic Area, from Fair Isle in the south to Herma Ness on Unst, including Foula, are dominated by cliffed coastline, which forms a dramatic landscape of great beauty.

3.1.2 Important locations and species

The cliffs of the region are composed of several rock types. Old Red Sandstone is particularly important as it forms the highest cliffs and notable precipices, ledges, gullies and stacks. Elsewhere, metamorphic types are dominant and there are significant lengths of granite. Vertical forms are most extensive, with many outstanding lengths along the western coast of Fair Isle, Foula and Mainland. The highest vertical cliffs reach 370 m at The Kame on the west coast of Foula, followed by equally spectacular cliffs at Fitful Head (south Mainland). The large extent and great diversity of cliff and cliff-top habitats make the region also of great biological interest. A total of 60 biological and geological Sites of Special Scientific Interest (SSSI) contain some cliff length, though only twelve of these have biological interest related directly to cliff habitats.

The National Vegetation Classification (NVC) (Rodwell in press) covers twelve maritime cliff communities and twenty-nine sub-communities, all of hard cliff habitats. Vegetation on Scottish cliffs is strongly zoned according to sea spray deposition, soil depth, soil moisture and the influence of grazing. The exposure of the coast of Region 1 to winds and heavy spray deposition allows maritime cliff grassland and heath to develop extensively. The overall extent of these habitats is perhaps amongst the largest of any region in Britain. Maritime heath is an important national feature of cliff-top habitat and is probably very extensive on most cliffed coast in the region. Only one SSSI is designated for this habitat (Papa Stour). No lichen heath of national or regional importance is recorded for the region's cliffs (Fletcher *et al.* 1984); however, the full regional extent of cliff-top habitat in the region has not been surveyed. However, two distinctively northern community types (MC2 thrift *Armeria maritima* - Scots lovage *Ligusticum scoticum* maritime rock-crevice and MC3 thrift - roseroot *Sedum rosea* maritime cliff-ledge) are confined to Scotland, and both are recorded for the region, although they are probably rare. Three further communities occur that are also widespread on cliffs elsewhere in Britain: MC8 red fescue *Festuca rubra* - thrift maritime grassland, MC9 red fescue - Yorkshire-fog *Holcus lanatus* maritime grassland and MC10 red fescue - plantain *Plantago* spp. maritime grassland. The MC8 type tends to occupy much of the outer heavy spray zone; further inland either MC9 (ungrazed cliffs) or MC10 (grazed cliffs) is dominant, according to stock management. Still further inland there is a zone of maritime heath (H7 heather *Calluna vulgaris* - spring squill *Scilla verna* heath, changing inland to H10 heather - bell heather *Erica cinerea* heath), which grades into more typical inland habitats with little evidence of salt spray influence. Cliff-top areas receiving heavy salt spray deposition can also have a form of perched saltmarsh (SM16 red fescue saltmarsh) with saltmarsh rush *Juncus gerardi* and sea-

milkwort *Glaux maritima*, for example at Eshaness (Mainland). These vegetation types are confined to exposed sea cliffs receiving sea spray inputs and are absent from more sheltered cliff lengths. Undercliff vegetation is probably absent from the region, given the scarcity of soft cliffs.

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 and none is present in the region, partly because of the isolation of the archipelago.

The region's cliff bird fauna is outstanding and of national and international importance. Seabird numbers, either in total or for individual species, are sufficiently high at eight sites to warrant designation as Special Protection Areas (SPAs): Hermaness & Saxa Vord, Fetlar, Noss, Mousa, Sumburgh Head, Ramna Stacks & Gruney, Foula, and Fair Isle. No systematic national survey of invertebrates in cliff and cliff-top habitats has been carried out, but these environments have a rich habitat diversity and thus can support large numbers of species (Mitchley & Malloch 1991), although this is mainly true of the south of Britain. No cliffs in the region have a good invertebrate list that includes many notable and rare (Red Data Book) species, although small numbers are recorded for Fair Isle, Hermaness and Foula.

3.1.3 Human activities

Cliffs are among the least modified of terrestrial habitats, although the cliff-top zone, especially its inner sectors, has been affected by a variety of human impacts, sometimes leading to major habitat loss in parts of Britain. This has not occurred in Shetland and the cliff resource is almost all in excellent condition. Few footpaths have heavy usage, and no local erosion is present. Much of the cliffed coast is used for extensive sheep grazing, and this might have resulted in the conversion of some coastal heath into grassland and other changes to the vegetation of cliff-top areas. At a national scale the most extensive influences on hard cliff vegetation are grazing and burning, the major management techniques for cliff-top habitat (Mitchley & Malloch 1991). There is very little burning of cliff-top habitats in Shetland. There are no coastal settlements on cliffs and the only major buildings and structures are the very few lighthouses and transmission masts. Apart from sheep grazing, impacts from human activities are therefore minimal in the region, although long lengths of cliffed coast in the south of the islands were affected temporarily by oil and dispersants associated with the wreck of the *Braer* in 1993. Virtually none of the region's cliff base has been protected by coastal defences and hence natural coastal erosion is prevalent.

3.1.4 Information sources used

No site in the region has been mapped using the NVC system, and so no detailed survey information exists, apart from simple habitat extents for SSSIs. Existing information is insufficient to detail the regional extent of individual cliff and cliff-top habitats.

3.1.5 Acknowledgements

Thanks are due to Deborah Procter (JNCC) and Andrew Douse and John Uttley (SNH).

3.1.6 Further sources of information

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B. Further reading

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- Stroud, D.A., Mudge, G.P., & Pienkowski, M.W. 1990. *Protecting internationally important bird sites*. Peterborough, Nature Conservancy Council.

C. Contact names and addresses

Type of information	Contact address and telephone no.
Flora, fauna, habitat information, site management	*Coastal Ecologist, Advisory Services, SNH, Edinburgh, tel: 0131 554 9797
Flora, fauna, habitat information, site management	*Conservation Officer, SNH, Lerwick, tel: 01595 693345
Cliff conservation	*Geology/Coastal Advisor, JNCC, Peterborough, tel: 01733 62626
National Landslide Databank	Rendel Geotechnics, Norfolk House, Smallbrook Queensway, Birmingham B5 4LJ, tel: 0121 627 1777
Invertebrate fauna	*Species Advisor, JNCC, Peterborough, tel: 01733 62626

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

3.2 Sand dunes

Dr T.C.D. Dargie

3.2.1 Introduction

The region contains a small but varied set of sand dune systems, largely associated with bays. There are 41 dune sites in the region (Map 3.2.1), containing an estimated 487 ha of vegetated sand and other land cover (JNCC Coastal Resources database). Together they represent 1% of the British vegetated sand dune resource (Table 3.2.1), for which the region is therefore of only modest importance. The precise size of most sites is unknown, but most are small. Vegetated blown sand (Map 3.2.2) is scattered around the archipelago within bay dunes with a local sand supply. The restricted extent of dune in the region is due to steep offshore profiles, rising sea level and great exposure, which all contribute to poor sand supply to beaches (Mather & Smith 1974). The habitat is thus rare in the region and sand dunes are of great local importance.

The major dune habitats are strand and embryo dune; mobile and semi-fixed dune; acidic fixed dune grassland; neutral and calcareous fixed dune grassland; dune heath; dune slack; other dune wetland; dune woodland and scrub; transitions to saltmarsh; transitions to maritime cliff; other vegetation; and other land cover (e.g. bare ground, car park,

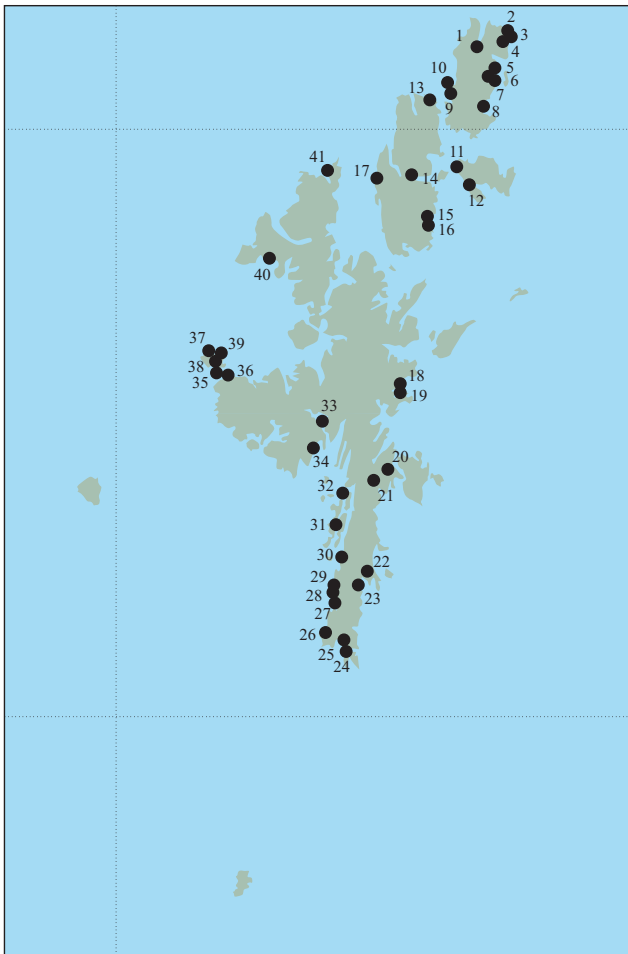
Table 3.2.1 Region 1 vegetated dune resource^a in context

	Total area (ha)	% of total in region
Region 1	487*	-
Scotland	31,540 ⁺	2
North Sea Coast	25,356 ⁺	2
GB	50,200⁺	1

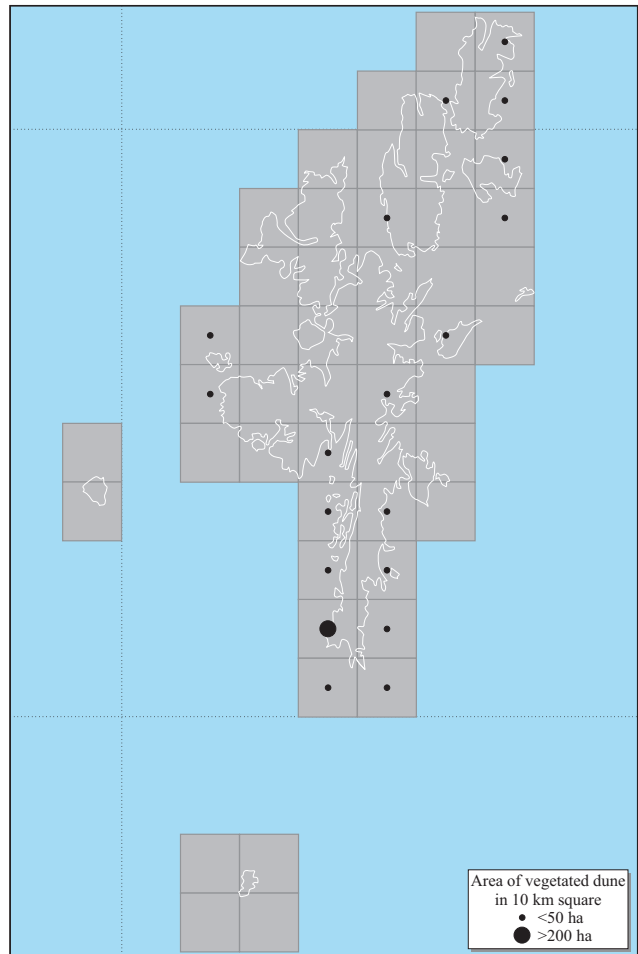
Sources: Dargie (1993a, 1995), Radley (1994), JNCC Coastal Database. Key: ^ato the nearest whole hectare; *provisional estimate based on a sample of dunes representing 44.6% of the regional resource; ⁺totals for Scotland and thus Great Britain are provisional estimates.

caravan park). All, apart from dune woodland and scrub, are present in the region. On the basis of a survey of a sample of dune sites in the region (Dargie 1993a), an estimate of their extent in the region is used here to allow some form of GB context to be indicated (Table 3.2.2).

There are four sites within SSSI designations and all sites lie within the Shetland Environmentally Sensitive Area; ten dune sites are within the Shetland National Scenic Area.



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



Map 3.2.2 Areas of vegetated sand dune in coastal 10 km squares. Source: JNCC Coastal Database.

Table 3.2.2 Areas (ha)* of dune vegetation types in the region

	<i>Strand and embryo dune</i>	<i>Mobile and semi-fixed dune</i>	<i>Acidic fixed dune grassland</i>	<i>Neutral and calcareous fixed dune grassland</i>	<i>Dune heath and bracken</i>	<i>Dune slack</i>	<i>Other dune wetland</i>	<i>Dune woodland and scrub</i>	<i>Transitions to saltmarsh</i>	<i>Transitions to maritime cliff</i>	<i>Other land cover</i>
Region 1*	0	90	94	271	0	25	0	0	0	7	0
Scotland	61	4,059	4,125	10,513	2,113	1,095	3,817	5,500	217	41	neg
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
GB ⁺	340	8,504	4,953	15,228	2,615	2,175	4,114	8,965	836	64	2,406

Sources: Dargie (1993a, 1995), Radley (1994), JNCC Coastal Database. Key: *provisional estimates (to the nearest whole hectare) based on a sample of dunes representing 44.6% of the regional resource; n/a = not available; neg = negligible; ⁺totals for Scotland and thus the North Sea Coast and Great Britain are provisional estimates.

3.2.2 Important locations and species

Sand dune sites in the region are summarised in Table 3.2.3. Areas of dune at the sites are not known, except at Quendale Bay (217 ha). Bay dunes are the dominant type in the region, developed upon sand trapped within the shelter of rock headlands. Climbing dunes are sand blown up onto terrain inland and on the edge of the main dune system, forming a variable but often thin sand layer over bedrock. This is present at the most exposed of Shetland sites (Quendale Bay, Sands of Meal and Breakon). The largest British dunes are hindshore types, developed above beaches with a good sand supply and an onshore prevailing wind, which drives sand inland as one or more dune ridges or as mobile parabolic dunes. This type is absent from the region. However, Scotland has a distinctive hindshore variant termed machair (Ritchie 1976), and in Shetland this term is used to describe an inland dune plain of variable extent and form (see e.g. Mather & Smith 1974), which can extend inland for up to 1 km (e.g. at Quendale Bay, the largest site in the region). The climbing dune type is often called 'climbing machair' or 'hill machair'. The machair plain is the result of the highest average windspeeds to affect British coastal dunes, conditions that apply at many sites in the region.

Two types of dune are largely absent from the region: ness/foreland systems, which develop on shores with sand supply coming from two directions (gradually extending seawards), and spit dunes, which generally develop at the mouths of estuaries. A hybrid form between these two types occurs as a very small pair of spit-like forelands at Huney on the east coast of Unst.

The dune systems in the region develop a watertable, which influences the vegetation of depressions, forming a distinctive and nationally rare type of wetland termed dune slack. This is commonest in depressions behind an outer foredune ridge (most notably at Quendale Bay) or shingle beach with a thin blown sand cover. Dunes are a sufficient barrier to drainage in places to form small areas of standing water termed machair lochs, and there are good regional examples at Quendale Bay (Loch of Hillwell, Loch of Huesbreck) and Scousburgh (Loch of Spiggie).

Some 85 National Vegetation Classification (NVC) communities have been recorded for surveyed Scottish dunes, with 116 types of communities and sub-communities combined (Dargie 1993a). In this region, strandlines are usually characterised by the SD2 sea rocket *Cakile maritima* - sea sandwort *Honkenya peploides* community. Further up the beach occasional areas of SD4 sand couch *Elymus farctus*

embryo dunes are found, often merging with SD5 lyme-grass *Leymus arenarius* and SD6 marram *Ammophila arenaria* mobile dunes. These are rapidly stabilised in a moist climate with moderate inblow of beach sand, forming SD7 marram - red fescue *Festuca rubra* semi-fixed dune. Northern and western Scotland are particularly notable for very large extents of species-rich grazed dune, SD8 red fescue - lady's bedstraw *Galium verum* fixed grassland, which replaces SD7 semi-fixed dune under grazing on calcareous sands and can extend inland for a great distance. Scotland is also distinctive because a wide variety of wetland types (mire, swamp, wet neutral grassland) replace most of the types of dune slack vegetation found in England and Wales. Only the SD17 silverweed *Potentilla anserina* - common sedge *Carex nigra* slack community is moderately common. Several NVC sub-communities are largely restricted to northern and western Scotland and reflect a cool oceanic climate with high rainfall. It is also important to note that Scottish NVC dune surveys have encountered vegetation that does not closely resemble published NVC types and which may represent potential new NVC sub-communities. Strandline, semi-fixed dune, fixed dune, mire and scrub cases are involved (Dargie 1993a), with evidence drawn from the semi-fixed dunes of Quendale Bay.

In Great Britain, four nationally rare and thirteen nationally scarce higher plants are found mainly or exclusively on dunes. However, most are species restricted to sites in southern Britain. No nationally rare dune species is present in the region, and only one nationally scarce species is present: curved sedge *Carex maritima*, which has an arctic-alpine distribution. One other nationally scarce species more typical of other habitats (shingle) also occurs on dunes in the region: oysterplant *Mertensia maritima*. The lichen flora has not been closely examined (Fletcher *et al.* 1984).

There have been no detailed studies on the animal populations of regional sand dune systems. No dune site is outstanding in terms of Invertebrate Site Register records, with only a single notable record, from Sumburgh.

3.2.3 Human activities

In general, sand dunes are among the least heavily modified of terrestrial habitats. Very little of the regional dune resource has been affected by human impacts leading to major habitat loss or conversion to common vegetation lacking dune species. The primary use of most sites is as extensive grazing for sheep and cattle; in a few cases

Table 3.2.3 Sand dune sites in region

No. on Map 3.2.1	Location	Grid ref.	Dune type	Conservation status	Survey type
1	Burra Firth	HP615141	Bay dune, machair	ESA	CCS
2	Wick of Skaw	HP661166	Bay dune	ESA	CCS
3	Inner Skaw	HP663158	Bay dune	ESA	CCS
4	Norwick	HP652147	Bay dune, machair	ESA, SSSI	CCS
5	Balta Island	HP658080	Bay dune, machair, climbing dune	ESA, SSSI	CCS
6	Skeo Taing	HP645084	Bay dune	ESA, SSSI	CCS
7	Huney	HP648065	Hybrid spit - ness/foreland type	ESA	CCS
8	Sandwick (Unst)	HP620022	Bay dune, machair	ESA	CCS
9	Lunda Wick	HP570040	Bay dune, machair	ESA	CCS
10	Burga Sand	HP572042	Bay dune	ESA	CCS
11	Sand of Sand	HU580924	Bay dune	ESA	CCS
12	Wick of Tresta	HU606903	Bay dune	ESA	CCS
13	Breakon	HP527053	Bay dune, machair, climbing dune	ESA, SSSI	CCS, ITE
14	Mid Yell	HU506920	Bay dune	ESA	CCS
15	Swarister	HU527838	Bay dune	ESA	CCS
16	Gossabrough	HU530833	Bay dune	ESA	CCS
17	West Sandwick	HU445890	Bay dune, machair	ESA	CCS
18	Lingness	HU485545	Bay dune, machair	ESA	CCS
19	Eswick	HU493538	Bay dune	ESA	CCS
20	Sand of Sound	HU464399	Bay dune	ESA	CCS
21	Gulberwick	HU443388	Bay dune	ESA	CCS
22	Sandwick (South Mainland)	HU433237	Bay dune	ESA	CCS
23	Levenwick	HU414214	Bay dune, machair	ESA	CCS
24	Sumburgh	HU395103	Bay dune, machair	ESA	CCS
25	Pool of Virkie	HU395115	Bay dune	ESA, SSSI	CCS
26	Quendale Bay	HU378129	Bay dune, machair, climbing dune	ESA, SSSI	CCS, ITE, SDVSGB
27	Scousburgh	HU373181	Bay dune, machair	ESA, NSA	CCS, ITE
28	Rerwick	HU375199	Bay dune	ESA, NSA	CCS
29	St Ninians	HU372207	Tombolo	ESA, NSA, SSSI	CCS
30	Maywick	HU377247	Bay dune	ESA, NSA	CCS
31	Banna Minn	HU365306	Tombolo	ESA, NSA	CCS
32	Sands of Meal	HU374354	Bay dune, machair, climbing dune	ESA, NSA	CCS
33	Sand Voe (West Mainland)	HU349475	Bay dune	ESA, NSA	CCS
34	Reawick	HU330447	Bay dune	ESA, NSA	CCS
35	Melby	HU184576	Bay dune	ESA	CCS
36	The Crook	HU195578	Bay dune	ESA	CCS
37	Kirk Sand	HU179598	Bay dune, machair	ESA	CCS
38	Tussleby Sand	HU175595	Bay dune, machair	ESA	CCS
39	Housa Voe	HU182605	Bay dune	ESA	CCS
40	West Ayre Hillswick	HU279772	Tombolo	ESA, NSA	CCS
41	Sand Voe (North Roe)	HU365909	Bay dune	ESA, NSA	CCS

Sources: Dargie (1993a); Mather & Smith (1974); Shaw *et al.* (1983); Scottish Natural Heritage (pers. comm.). Key to conservation status: ESA = Environmentally Sensitive Area; NSA = National Scenic Area; SSSI = Site of Special Scientific Interest. Key to survey type: CCS = Countryside Commission for Scotland (University of Aberdeen Beach Reports); ITE = Institute of Terrestrial Ecology Scottish Coastal Survey; SDVSGB = Sand Dune Vegetation Survey of Great Britain (NCC/JNCC).

overgrazing has contributed to wind erosion and blowout development, reported in the early 1970s by Mather & Smith (1974) at Sands of Meal, Kirk Sand and Balta Island. Industrial development on dunes is restricted to the large airfield at Sumburgh, which has been developed on a machair plain. Several sites have been affected by sand and shingle extraction, with severe impacts at very small locations with poor sand replenishment (Sand of Sound, Lingness). Natural sources of building sand are rare in Shetland and initial heavy extraction occurred between 1939 and 1945 for military defences, with a second phase in the early 1970s for oil development at Sullom Voe. In the early 1970s extraction was reported from four sites, with damage from past excavation recorded from a further five (Mather & Smith 1974). Extraction at the Quendale Bay SSSI has switched from a pit immediately behind the outer dune

ridge, in the early 1970s, to a quarry in climbing dunes further inland, which poses no threat to breaching of the foredune edge. Beach sand and shingle extraction in Shetland has been on only a small scale, although it has caused serious erosion elsewhere (Carter *et al.* 1992).

Recreational pressure on the region's dunes is low, with the only areas recorded with any impact located at Sumburgh, close to the Jarlshof Viking settlement site. Formal car parks, caravan and camp sites are rare and damage due to visitor trampling and erosion is virtually absent (Mather & Smith 1974). Golf courses have not been developed on the region's dunes. Coastal erosion by storm waves is very widespread and there is much anecdotal evidence of a slow retreat inland of the outer dune edge. Notable retreat is mentioned at Quendale Bay, Scousburgh, Breakon, Lundawick, Sandwick (Unst) and Balta Island

(Mather & Smith 1974). Most of the dune edge is unprotected, although attempts at sand trapping had been made at Inner Skaw in the early 1970s (Mather & Smith 1974). Coastal protection is being considered to protect Sumburgh Airport from sandblow caused by eroding dunes in the West Voe of Sumburgh. The dune system at Quendale Bay was affected by oil in the *Braer* incident, but survey in late summer 1993 and comparison with quadrat and mapping results from detailed survey in 1991 revealed no serious damage and only a probable temporary reduction in the amount of bryophyte cover in dune grasslands (Dargie 1994).

3.2.4 Information sources used

Comprehensive survey of dunes in Scotland is still in progress and it is not possible to give precise figures on extent of habitats for either the North Sea Coast or Great Britain. Site coverage in completed surveys is indicated in [Table 3.2.1](#). Three main sets of surveys cover the region. Dune geomorphology is covered in Aberdeen University beach reports sponsored by the Countryside Commission for Scotland (Mather & Smith 1974). 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. One site (Quendale Bay) was surveyed in 1991 as part of the Sand Dune Vegetation Survey of Great Britain (Dargie 1993a, b). The survey was used as a baseline to consider the impacts of the *Braer* incident on dune vegetation (Dargie 1994). This study used the National Vegetation Classification (NVC) (Rodwell 1991a, 1991b, 1992, 1995, in press). Additional NVC survey of other dunes was initiated in 1996, covering all remaining unsurveyed areas in Shetland. The NVC surveys, all carried out in the summer months, are very detailed and use a consistent methodology. 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, as well as a national report covering a sample set of sites (Dargie 1993a). Completion of the Sand Dune Survey of Scotland is funded by Scottish Natural Heritage and is scheduled to finish in 1998. In addition, vegetation has been examined by the Institute of Terrestrial Ecology (ITE) (Shaw *et al.* 1983) for selected areas covering two sites. The vegetation categories employed are broad and are not easily related to the finer detail available in the NVC (Dargie 1992).

No other comprehensive surveys exist for dune sites in the region, though a small number of sites have specific information on invertebrates (Institute of Terrestrial Ecology 1979).

3.2.5 Acknowledgements

Assistance with sources was kindly provided by Andrew Douse (SNH), Kathy Duncan (SNH) and Deborah Procter (JNCC).

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Ritchie, W., & Mather, A.S. 1984. *The beaches of Scotland*. Perth, Countryside Commission for Scotland.

C. Contact names and addresses

Type of information	Contact address and tel no.
Flora, fauna, habitat information, site management	*Coastal Ecologist, Advisory Services, SNH, Edinburgh, tel: 0131 554 9797
Flora, fauna, habitat information, site management	*Conservation Officer, SNH, Northern Isles Area, Shetland Office, Lerwick, tel: 01595 693345
National and international policy and advice on dune conservation	*Geology/Coastal Advisor, JNCC, Peterborough, tel: 01733 62626
Invertebrate fauna	*Invertebrate Site Register, Species Advisor, JNCC, Peterborough, tel: 01733 62626

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



Characteristic of Shetland's many firths and voes are the banks of sand and shingle - ayres - that often stretch right across the inlet. In Dales Voe on Mainland, the ayres at South Ayre are complemented by an ayre at the back of Swinister Voe, between them enclosing a quasi-lagoonal stretch of water known as a houb, another common feature at the heads of Shetland's bays and firths. The Ayres of Swinister are a Site of Special Scientific Interest and a Geological Conservation Review Site. Photo: Pat Doody, JNCC.

3.3 Vegetated shingle structures and shorelines

Dr R.E. Randall

3.3.1 Introduction

Shingle means sediments larger than sand but smaller than boulders: that is, between 2-200 mm in diameter. Where the coast features shingle, it is often mixed with large amounts of sand, or else sand dunes (see section 3.2) have developed on it. Shingle sites include both simple fringing beaches and also more complex structures where the shingle is vegetated yet not buried by more than 20 cm of sand. Shingle sites where the sand cover is greater than 20 cm in depth are discussed in section 3.2.

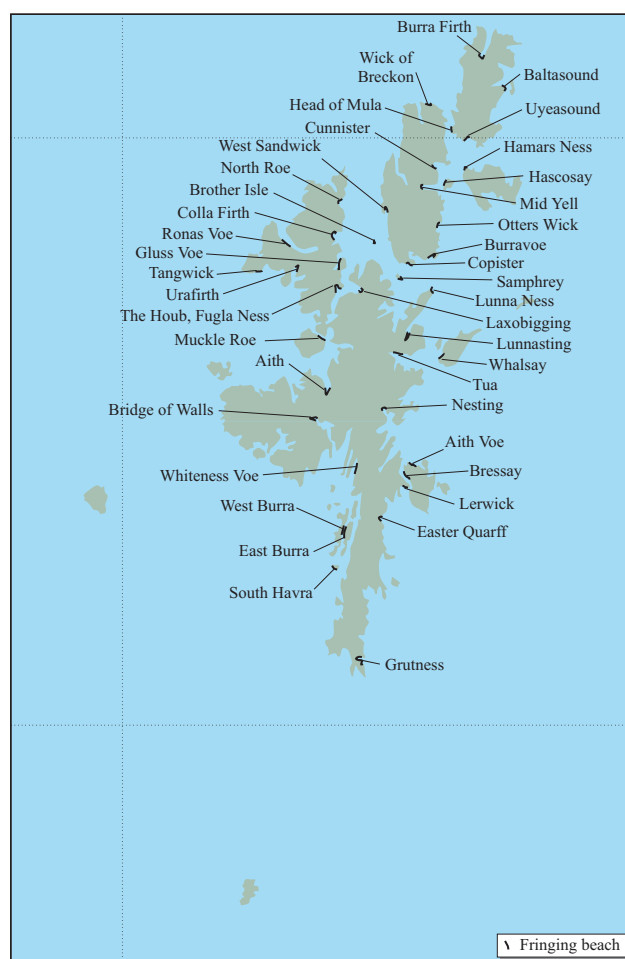
Shingle plant communities vary considerably from region to region in Britain (Sneddon & Randall 1993, 1994), with some communities being widespread and others limited to a particular region or substrate. Shetland has considerable lengths of shingle shoreline, including tombolos, bay head and mid-bay spits (ayres), bay head barriers, and bars (Flinn 1974). Many of the shingle and pebble features occur in drowned valleys (voes) (Berry & Johnston 1980; Goodier 1974). This region contains some of the wettest and coolest shingle sites in Britain. Many of the sites are classic geomorphic examples of depositional features on a steep, indented coastline. Fringing shingle beaches (loosely defined) on the exposed west coast of Shetland have some of the best examples in Britain of large sized shingle merging to boulders. The more sheltered, lower energy, sites frequently have good examples of wrack matrix in shingle, on which plant colonisation occurs. The sandy nature of the matrix at several Shetland sites is strongly represented in the vegetation, as is the wrack and guano enrichment of some fringing beaches (Roper-Lindsay & Say 1986).

Despite their great interest and importance, shingle sites in Shetland were not covered in the GB survey of vegetated shingle structures (Sneddon & Randall 1993, 1994), mainly because of their small size. Consequently no comparisons can be made between the extent of the resource in the region and that in Scotland, the North Sea Coast or Great Britain as a whole.

3.3.2 Important locations and species

The fringing shingle beaches in Shetland are shown on Map 3.3.1 and detailed in Table 3.3.1.

As many of the shingle beaches of this region are exposed to a high energy environment, pioneer vegetation is sparse except where there is some protection. In more sheltered sites a northern community is often present, with Babington's orache *Atriplex glabriuscula*, early orache *A. praecox* (Taschereau 1977) or *A. x kattegatensis*, sea mayweed *Tripleurospermum maritimum* (Kay 1972) and cleavers *Galium aparine*, virtually confined to this habitat in Shetland. On sandy shingle beaches sea sandwort *Honkenya peploides* and silverweed *Potentilla anserina* are frequent and sea rocket *Cakile maritima* sometimes occurs. In the neighbourhood of villages and crofting areas shingle beaches and spits may contain weeds of disturbed ground, particularly nettle *Urtica dioica*, northern knotgrass *Polygonum boreale* and



Map 3.3.1 Fringing shingle beaches. Source: Randall (unpublished).

equal-leaved knotgrass *P. arenastrum*, common chickweed *Stellaria media*, field forget-me-not *Myosotis arvensis*, pineappleweed *Matricaria matricarioides*, creeping thistle *Cirsium arvense*, toad rush *Juncus bufonius*, common couch *Elymus repens* and false oat-grass *Arrhenatherum elatius*. On the crests of many gravelly and shingly spits the presence of nesting and roosting seabirds results in a community of common mouse-ear *Cerastium fontanum*, procumbent pearlwort *Sagina procumbens*, white clover *Trifolium repens*, sea plantain *Plantago maritima*, red fescue *Festuca rubra* and annual meadow-grass *Poa annua*.

The most important plant species on shingle in this region is the nationally scarce oysterplant *Mertensia maritima*, which grows on damp, wrack-rich shingle foreshores (e.g. Easter Quarff, Tangwick, Cunnister) (Randall 1988; Scott & Palmer 1987). This species is fast declining in most parts of Great Britain. Other plants of note on shingle include Scots lovage *Ligusticum scoticum*, which is restricted in the UK to Scottish and Northern Irish cliffs and shingle; it is found on the most stable areas of shingle and cobbles on Whalsay. The two species of orache noted above, *Atriplex praecox* and *A. x kattegatensis*, are

Table 3.3.1 Fringing shingle beaches

Site name	Grid ref.	Length of shore (km*)	Site type
Burra Firth	HP6114	0.5	Sandy shingle
Baltasound	HP6208	1.0	Sand and shingle saltmarsh
Uyeasound	HP5901	0.5	Shingle barrier bar
Head of Mula	HU5699	0.5	Fringing shingle beach
Wick of Breakon	HP5205	1.0	Shingle with shell sand matrix
Cunnister	HU5296	0.5	Shingle ayres (mid-bay spits) in Basta Voe
Hascosay	HU5491	0.5	Barrier beach
Hamars Ness	HU5894	0.5	Gneissic shingle with serpentine
Mid Yell	HU5091	0.5	Barrier beach
Otterswick	HU5285	0.5	Fringing beach
Burravoe	HU5279	0.5	Barrier beach
Copister	HU4878	1.0	Bay-mouth bar, barrier beach, tombolo
West Sandwick	HU4487	0.5	Shingle with shell sand matrix
Brother Isle	HU4281	0.5	Bouldery shingle
Samphrey	HU4676	0.5	Bouldery shingle
Fora Ness	HU4472	0.5	Double tombolo and barrier beach
Lunna Ness	HU5173	0.5	Tombolos and bay-mouth bar
Lunnasting	HU4865	2.0	Bay-head bar, mid-bay bar, bay-mouth bar
Whalsay	HU5462	0.5	Three sand/shingle tombolos
Tua	HU4663	0.5	Shingle foreshore at stream mouth
Nesting	HU4454	0.5	Shell sand/shingle
Aith Voe	HU5044	0.5	Barrier beach
Bressay	HU4842	0.5	Shingle below cliffs of sandstone
Easter Quarff	HU4335	0.5	Coarse breccia shingle (sharp fragments) foreshore
Grutness	HU4010	0.5	Sandy, disturbed boulder-shingle beach
South Havra	HU3627	0.5	Fringing sandy shingle
East & West Burra	HU3732	1.0	Sandy shingle, shingle barrier
Whiteness Voe	HU3944	1.0	Tombolo
Bridge of Walls	HU2651	0.5	Sandstone shingle, mid-bay bars
Aith	HU3456	1.0	Coarse granite shingle
Muckle Roe	HU3366	0.5	Shingle below granite cliffs
Urafirth	HU3078	0.5	Shingle barrier with wrack and quartz sand
Tangwick	HU2377	1.0	Shingle among rocks at stream mouth
Ronas Voe	HU2783	0.5	Looped bars, mid-bay bar
North Roe	HU3689	1.0	Barrier beaches
Colla Firth	HU3583	1.0	Barrier beaches
Gluss Voe	HU3577	1.0	Sandy shell shingle spit with cobbles
The Houb, Fugla Ness	HU3674	1.5	Composite sand/shingle and mud/shingle tombolo and bars
Garths Voe	HU4073	2.0	Bay mouth bars

Source: Randall (1988, and unpublished survey data). Key: *to the nearest 0.5 km.

Scandinavian species not found elsewhere in Britain. Grass-leaved orache *Atriplex littoralis* only occurs, in Shetland, in muddy shingle at Boddam. Sea pea *Lathyrus japonicus* (Randall 1977; Scott & Palmer 1987) has been recorded in both its forms (var. *glaber* and var. *acutiformis*) in Shetland. It was recorded from the shingle at Easter Quarff in 1966 (Scott 1968) and at Burra Firth during the last century. The northern dune form, var. *acutiformis* (Pedersen 1966), still exists in the low dunes at Nor Wick.

The more extensive boulder beaches of Shetland, especially the ayres and tombolos, are important breeding sites for arctic tern *Sterna paradisaea* (e.g. The Houb, Fugla Ness) and ringed plover *Charadrius hiaticula*. On boulder beaches on some of the smaller islands, black guillemot *Cephus grylle* and storm petrel *Hydrobates pelagicus* often nest where there are suitable crevices between the stones, Mousa being the best example.

3.3.3 Human activities

White Ness (which forms part of the shoreline of Whiteness Voe) is part of an SSSI designated for its limestone outcrops, but most of the fringing shingle beaches of Shetland have no form of conservation status. Virtually all sites are widely grazed by rabbits. Some grazing and trampling by domestic stock occurs on many sites and this may be one reason for the reduction in oyster plant populations. More significant, however, is shingle extraction, which has occurred at Easter Quarff and Tangwick, and coastal defence or construction works, as at Urafirth and Grutness. The latter site was deleteriously affected, in the short term, by the *Braer* incident.

3.3.4 Information sources used

The fringing shingle beaches in the region were examined by the author in 1986-1987 as part of the Nature Conservancy Council (NCC)'s rare species monitoring scheme (unpublished data and Randall (1988)). The beaches were only examined qualitatively, with the exception of quantitative data on oysterplant, and target notes were used to describe physical and biological features of interest. This information became the basis of an analysis of the geographical variation in British shingle vegetation (Randall 1989). The area has also been described geomorphologically by Mather & Smith (1974) and Steers (1973).

3.3.5 Acknowledgements

Thanks are due to John Uttley and Kathy Duncan (SNH) and Mark Tasker (JNCC) for comments on the draft.

3.3.6 Further sources of information

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

3.4 Coastal lagoons

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

3.4.1 Introduction

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 (Barnes 1988). The term coastal lagoons is used here to include true lagoons, i.e. those wholly or partially separated from the sea by a natural sedimentary barrier, and also artificial brackish ponds and coastal pools of a similarly restricted tidal range and often containing comparable lagoonal wildlife. Lagoons are commonly shallow, often with a varying salinity ranging from above to below normal sea-water levels (35 g/kg). Freshwater systems are not considered here, nor are fully flushed tidal pools. There are no true lagoons (*sensu* Barnes 1988) in the region, and the habitat is rare throughout Britain (Table 3.4.1).

Other definitions of 'lagoon' and 'lagoonal' are also current. Throughout the islands there are a significant number of physiographically diverse silled inlets and small saline pools at the heads of voes. These are known as houb (pools with a shingle ridge across the mouth) and vadills (bays with narrow rocky entrances), and many of these inlets support lagoonal flora and fauna. Examples include the Vadills, at the head of Brindister Voe, which is a complex lagoonal system of silled basins and sea inlets, and the Houb of Haggrister. The Vadills supports a range of undisturbed habitats and communities, with a gradation from brackish to fully marine conditions. Such sites have recently been described as 'lagoonal' by Thorpe *et al.* (in prep.). Table 3.4.2 indicates the relative importance of the region if these lagoonal areas (*sensu* Thorpe *et al.* in prep.) are included.

Exceptionally for the North Sea Coast, there are no nationally noteworthy (*sensu* Barnes 1989) lagoonal areas in the region (Table 3.4.3).

Lagoons are a nationally rare habitat and a 'priority habitat type' under Annex 1 of the EC Habitats & Species Directive. Therefore, although the region's lagoonal resource is not significant nationally in terms of its extent, the habitat type is of national and international importance wherever it occurs and in whatever quantity. In addition, Shetland has no large estuaries, and the brackish habitats provided by the houb and vadills are an important part of the islands' natural heritage.

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.

Lagoons support only three types of specialist aquatic vegetation, namely stands of green algae (*Chaetomorpha* spp., *Ulva* spp. and *Enteromorpha* spp.), stands of sea-grasses and similar plants (predominantly tasselweeds *Ruppia* spp.) and, much more rarely, stands of stoneworts (especially *Lamprothamnium* spp.). Much of the area of their beds, however, is in the form of bare sediment, devoid of



Map 3.4.1 Coastal lagoonal areas and silled inlets (see also Table 3.4.2).

Table 3.4.1 Lagoonal areas for region in context

Region	Lagoonal area (ha) ^a	Overall % of GB total	% of GB total excl. The Fleet
Region 1	0	0	0
North Sea Coast	1,163	92	87
Great Britain	1,261	-	-

Source: Barnes (1988). Key: ^aareas have been rounded to the nearest whole hectare.

Table 3.4.2 Lagoonal areas⁺ for region in context*

Region	Lagoonal area (ha)	Overall % of GB total
Region 1	329	18
North Sea Coast	1,819	68
Great Britain	2,658	-

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

Table 3.4.3 Nationally noteworthy lagoonal areas for region and country

	Lagoonal area (ha) ⁺	Overall % of GB total	% of GB total excl. The Fleet
Region 1	0	0	0
North Sea Coast	521	96	63
Great Britain	545	-	-

Source: Barnes (1989). Key: ⁺to the nearest whole hectare.

vegetation cover. Fringing stands of common reed *Phragmites australis*, saltmarsh plants and/or sea club-rush *Scirpus maritimus* are usual. Stands of green algae are common in Shetland's lagoonal habitats and tasselweeds occur in some of the larger houbes, in The Vadills and in some small percolation pools (in association with *Chaetomorpha* spp. in the Houb of Haggriester), but *Lamprothamnium* species are absent from Shetland. The Vadills is one of only two locations in Shetland where the unattached form of the fucoid alga *Ascophyllum nodosum* f. *mackaii* is known to occur.

In general, lagoons possess a characteristic invertebrate fauna which shows little regional variation, even within Europe. Several lagoonal species are very rare in Britain and are protected under the Wildlife & Countryside Act 1981. However none of these protected species occurs in the region; all have a southerly distribution in the UK (Bamber *et al.* 1992). The invertebrate fauna of the houbes and smaller voes is of low diversity, characterised by cockles *Cerastoderma edule*, baltic tellins *Macoma balthica* and periwinkles *Littorina* spp. The bubble shell *Akera bullata*, sparsely recorded from lagoonal habitats, occurs in the Loch of Strom. The Vadills supports a high diversity of predominantly marine invertebrate species, including maerl *Lithothamnion corallioides* and unusual beds of the sea cucumbers *Leptopentacta elongata* and *Leptosynapta inhaerens*, the only known location of these species in Shetland. Some larger silled inlets, for example the Houbes of Fugla Ness and Fora Ness, have a more diverse fauna and support waders and wildfowl together with occasional seals. Otters are common in most lagoonal habitats in Shetland.

Table 3.4.4 Lagoons surveyed

Location	Grid ref.	Area (ha*)	Type
Wick of North Garth, Yell	HP548003	1	Percolation pool
Houb at Gutchter, Yell	HU548994	4	Culverted pool
Ness of Galtagarth Pool, Yell	HU495801	11	Silled inlet
Houb of Fora Ness, Mainland	HU448723	17	Silled inlet
Laxo Voe Pool, Mainland	HU447634	4	Silled inlet
Vadill of Garth Pool, Mainland	HU470538	9	Silled inlet
Loch of Strom, Mainland	HU400482	127	Silled inlet
Loch of Hellister, Mainland	HU390500	26	Silled inlet
The Vadills, Brindister Voe, Mainland	HU292557	69	Sea inlet and silled basin complex
Saltness Pool, Mainland	HU363667	<1	Silled inlet
Minn, Mainland	HU335684	18	Silled inlet
Houb of Haggriester, Mainland	HU348702	2	Percolation pool
Houb of Fugla Ness, Mainland	HU363747	23	Silled inlet
Loch of Queyfirth, Mainland	HU355818	16	Silled inlet
Loch of the North Haa, Mainland	HU365892	1	Percolation pool

Sources: Barnes (1988, 1989); Thorpe *et al.* (in prep.). Key: *to the nearest whole hectare.

3.4.3 Human activities

No known ecological management exists for the saline ponds in the region. The Houbes of Fora Ness and Fugla Ness are within Sites of Special Scientific Interest, and these and The Vadills are Marine Consultation Areas. The Vadills is also proposed as a Special Area of Conservation (see also Chapter 7). There is insufficient water exchange in most lagoonal habitats to permit salmon farming (see section 9.2), which is therefore not a threat to water quality, although some sites receive minor sewage inputs (see section 9.6).

3.4.4 Information sources used

The region was not surveyed as part of the national lagoon survey undertaken on behalf of the Nature Conservancy Council in 1980-88. Marine sedimentary habitats, including houbes and voes around Sullom Voe, were surveyed by Jones & Jones (1981); selected sites, principally houbes and voes, were studied briefly in 1989 by Bamber & Davies (1990) for their environmental conditions and their barnacle and molluscan fauna. The saline pools and The Vadills system were comprehensively surveyed recently by Bunker *et al.* (1994) and the Joint Nature Conservation Committee's Marine Nature Conservation Review (MNCR) team (Thorpe in prep.), who looked in some detail at sub-habitats within the lagoons. Earlier survey expeditions by the MNCR team also visited sites in the region (e.g. Howson 1988).

3.4.5 Acknowledgements

We are grateful to Roger Covey for discussions on the sites and to David Connor and Kath Thorpe of the MNCR for permission to use information from Thorpe (in prep.). Thanks are also due to Christine Howson for comments on the draft text.

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3.5 Wet grassland

Dr H.T. Gee

3.5.1 Introduction

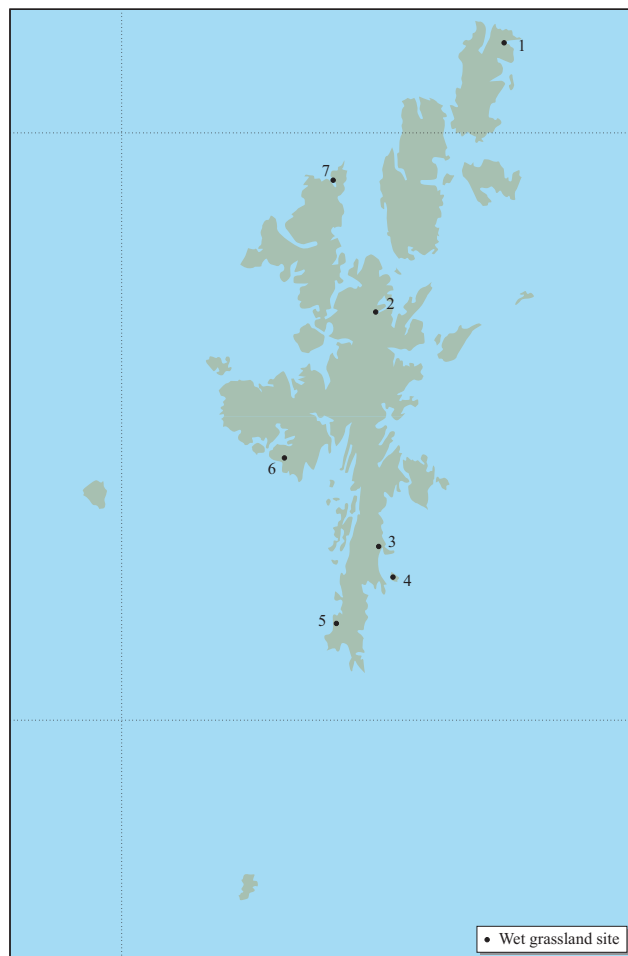
Wet grassland includes both coastal grazing marsh subject to maritime influence and lowland wet grassland adjacent to tidal reaches of estuaries. Coastal grazing marsh is a distinctive habitat consisting of low-lying grassland drained by a series of ditches that may be either brackish or freshwater. Much grazing marsh was formed by the enclosure of saltmarsh behind sea walls. Smaller areas of freshwater marsh have been created landward of natural barriers such as sand dunes or shingle beaches. Wet grassland sites may remain wet throughout the year and may be managed for stock grazing and/or as hay meadow. 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.

Much of the coastline of Shetland is cliffed and thus low-lying wetland is limited in extent, being restricted to the heads of voes, bays and other inlets. Much of the natural freshwater marshland in these areas has been lost to agricultural improvement and the boundary between the natural intertidal vegetation and agricultural land is sharp. Elements of the natural wet grassland vegetation are, however, widespread on the farmed land, particularly around ditches and in boggy field corners, as agricultural improvement has not been intensive. Where the natural fen and swamp remains, it is of high conservation value in the context of Shetland.

3.5.2 Important locations and species

Wet grassland sites in the region are listed in [Table 3.5.1](#) and shown on [Map 3.5.1](#).

The lowland wet grassland site at Aith Meadows, on the east coast of Mainland, is the most important in Shetland in terms of conservation interest. It comprises unenclosed, traditionally-managed hay meadow, and is floristically rich, with 80 species of flowering plant having been recorded. The habitats at Aith Meadows vary from dry grassland to wet fen and the site supports a mosaic of different plant communities.



Map 3.5.1 Wet grassland sites (see [Table 3.5.1](#)). Sources: SNH; Scott & Law (1984); Scott (1985).

Norwick Meadows on Unst includes areas of freshwater marsh next to the Burn of Norwick. An important area of semi-natural marsh has survived at Culswick Marsh on the west coast of Mainland, where 7.9 ha of freshwater marsh and fen have been impounded behind a shingle storm beach. The adjacent land has been ditch-drained for agricultural purposes, forming a sizeable area of wet

Table 3.5.1 Wet grassland and other wetlands in Region 1

No. on Map 3.5.1	Site	Grid ref.	Conservation status	Notes
1	Norwick Meadows	HP646138	SSSI	Fen and ditch-drained pasture associated with the Burn of Norwick
2	Dales Voe	HU408687	Adjacent to SSSI	Wet grassland
3	Aith Meadows	HU440293	SSSI	Unenclosed, traditionally-managed hay meadow and fen
4	Mousa	HU460240	SSSI	Includes ditch-drained pasture
5	Lochs of Spiggie and Brow	HU374160	SSSI	Includes areas of marsh
6	Culswick Marsh	HU273445	SSSI	Fen and adjacent ditch-drained pasture
7	Glums Meadow	HU368908	-	Wet coastal pasture

Source: SNH. Key: SSSI = Site of Special Scientific Interest.

grassland. The marshes of Culswick and Norwick are dominated by tall herb fen vegetation such as sedges *Carex* spp., bogbean *Menyanthes trifoliata*, marsh cinquefoil *Potentilla palustris*, marsh-marigold *Caltha palustris*, cottongrasses *Eriophorum* spp. and common spike-rush *Eleocharis palustris*. Norwick marshes support the largest beds of mare's-tail *Hippuris vulgaris* on Shetland, while Culswick is noted for its iris *Iris pseudacoris* - water horsetail *Equisetum fluviatile* community.

Macintosh (1984) surveyed and classified many of the grassland communities in the meadows on Shetland. The dominant National Vegetation Classification (NVC) community was the MG5 crested dog's-tail *Cynosurus cristatus* - common knapweed *Centaurea nigra* grassland community, which is typical of moderately species-rich, semi-improved meadows (Rodwell 1995). Similar NVC communities are present on lowland wet grasslands throughout the UK. Macintosh's survey also recorded a number of the wetter mesotrophic grassland NVC communities. Few species of limited distribution are associated with the wet grasslands of Shetland, but the nationally scarce curved sedge *Carex maritima* has been recorded from the lower end of Norwick Burn, and the locally uncommon white sedge *Carex curta* is frequent on Norwick Marsh.

Areas of wet grassland in Shetland, e.g. the Loch of Spiggie RSPB Reserve, are of ornithological value, particularly for breeding waders. Surveys of the islands (Gill *et al.* 1994) have shown that many coastal sites support good populations of breeding waders. In addition to the relatively common species such as oystercatcher *Haematopus ostralegus*, lapwing *Vanellus vanellus*, snipe *Gallinago gallinago*, curlew *Numenius arquata* and redshank *Tringa totanus*, the coastal wet grassland sites also support breeding golden plover *Pluvialis apricaria*, ringed plover *Charadrius hiaticula*, dunlin *Calidris alpina*, common gull *Larus canus*, arctic tern *Sterna paradisaea* and arctic skua *Stercorarius parasiticus*.

In addition, otters use the lowland coastal wetlands of Shetland and are present on most of the sites discussed here. It is likely that these sites also support interesting invertebrate species assemblages, but little information is available.

3.5.3 Human activities

As with other semi-natural habitats in the UK, lowland wet grassland and associated habitats have been affected by agricultural improvement. There has been a general reduction of vegetation species diversity and conservation interest as sites are drained, fertilised and reseeded. Although the low profitability of crofting on Shetland has limited the extent of agricultural improvement of wetlands there, grant aid for reseeded has, over the years, led to a reduction in the extent and conservation interest of coastal lowland wetlands in Shetland. These grant schemes, formerly funded under the Crofting Counties Agricultural Grant Scheme, have now been discontinued, thus reducing the likelihood of further loss of this habitat.

The coastal lowland wet grasslands on Shetland are included in the Shetland Environmentally Sensitive Area (ESA). This scheme provides payment for managing wet and species-rich grassland to safeguard their wildlife

interest. In practice, this generally means the relaxation/abandonment of summer grazing to allow flowering, followed by autumn/winter grazing. All crofts entering the ESA scheme that have lowland wet grasslands are obliged to protect the resource by restricting further agricultural improvement, and a proportion have to be actively managed for nature conservation. Take-up of this scheme is currently low but is expected to increase, which should prevent further damage to good sites through draining and reseeded.

3.5.4 Information sources used

Lowland wet grassland sites on Shetland were surveyed by Macintosh (1984) to provide NVC descriptions of each site. Comprehensive breeding bird survey data were produced by Gill *et al.* (1994) for lowland sites in Shetland. The study covered a total of 61 one km² sites and surveyed each for common breeding waders, with additional records of other breeding species.

3.5.5 Acknowledgements

Thanks are due to the regional and area staff of Scottish Natural Heritage for their help in providing information for this region.

3.5.6 Further sources of information

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

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C. Contact names and addresses

<i>Type of information</i>	<i>Contact address and telephone no.</i>
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*Starred contact addresses are given in full in the Appendix.

3.6 Saltmarsh

Dr M.I. Hill

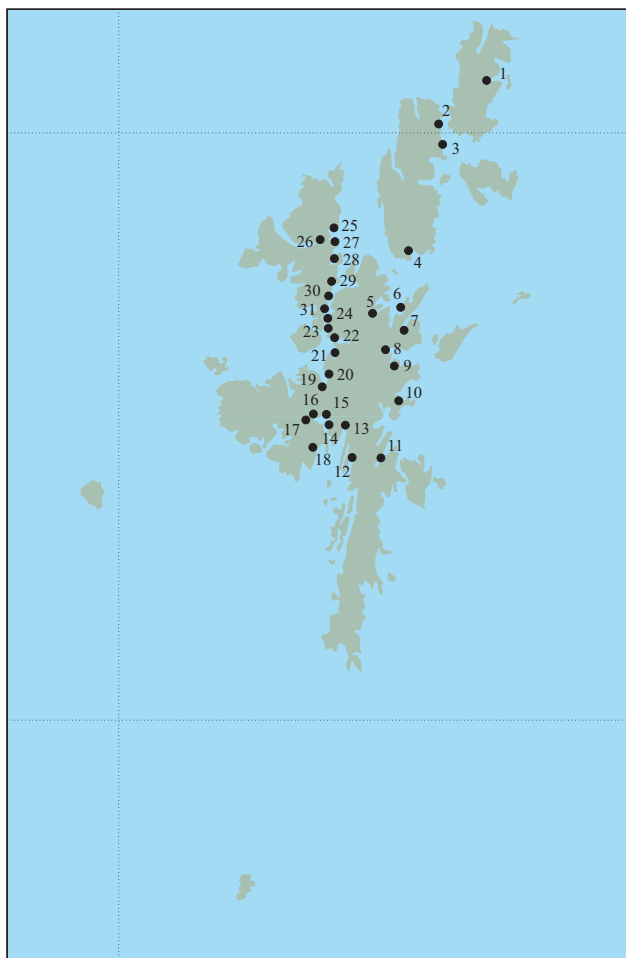
3.6.1 Introduction

There are 16 ha of saltmarsh in Shetland, representing approximately 0.26% of the resource in Scotland, 0.07% of that on the North Sea coast of Britain and 0.04% of the British total (Table 3.6.1). A survey of saltmarshes in Shetland identified 90 sites (Dalby 1986), all of them small (<5 ha) and only three >1 ha. Many sites consist of fragments of saltmarsh vegetation scattered along the shoreline. Only 2.5 km of Shetland’s coastline (at mean high water) supports saltmarsh, less than 0.2% of its length (JNCC Coastal Database).

Saltmarshes are found mainly at the heads of voes and other inlets. Most are on Mainland, but there are a few sites on Unst and Yell. The most extensive saltmarshes are formed in sheltered places behind ayres (shingle/sand bars at an angle to the shoreline), in houbs (lochs with shingle ridge across mouth), or in vadills (bays with narrow rocky entrances). The substrates on which saltmarsh has formed vary from peat to shingle, and most sites receive little tide-borne sediment.

British saltmarshes have been grouped into three types based on their vegetation (Adam 1978, 1990). Saltmarshes of Shetland are characterised by having a limited number of plant communities, coupled with a high species diversity in the upper marsh due to the influence of freshwater seepage, plus some natural transitions to non-tidal areas. Several widespread British saltmarsh species are absent, since Shetland lies beyond the northern limit of their distribution; these include sea-purslane *Halimione portulacoides*, sea wormwood *Artemisia maritima*, common sea-lavender *Limonium vulgare* and all species of cord-grass *Spartina*.

Most of the saltmarsh vegetation is in the higher saltmarsh zones. Table 3.6.1 shows that, in the national survey, nearly all Shetland saltmarsh was classed as being mid-upper marsh, with limited low marsh and pioneer zones. In some places there is a clear boundary between saltmarsh and pasture, particularly where the upper fringes of saltmarsh have been affected by agricultural improvement or road building. Elsewhere, more natural and gradual transitions to moorland and wet grassland are found. There are also transitions to dry grassland on the ayres. Freshwater seepage from adjacent land is an important factor influencing the vegetation.



Map 3.6.1 Saltmarsh sites (see Table 3.6.2). Source: JNCC Coastal Database.

Shetland is thought to be experiencing a continuing rise in relative sea level. Studies around Sullom Voe have shown that most marshes are experiencing slow erosion of the seaward edge, although there are areas of localised accretion, especially in the lower marsh. However, compared with elsewhere in Britain, changes in the extent and morphology of the marshes are slow.

Table 3.6.1 Area (ha) of saltmarsh communities in region compared with national totals

	<i>Spartina</i>	<i>Pioneer</i>	<i>Low-mid</i>	<i>Mid-upper</i>	<i>Driftline</i>	<i>Upper swamp</i>	<i>Transition</i>	<i>Wet depression</i>	<i>Total</i>	<i>% of region total</i>	<i>% in region</i>
Mainland	0	0	0.1	11.1	0	0	0	0.2	11.4	69	-
Yell	0	0	<0.1	0.5	0	0	0	0	0.5	6	-
Unst	0	0.1	<0.1	3.9	0	0	0	<0.1	4.1	25	-
Region 1	0	0.1	0.2	15.5	0	0	0	0.2	16	-	-
Scotland	102	361	499	3,608	63	587	748	2	6,089	-	0.26
North Sea Coast	3,461	2,130	8,194	4,772	1,350	1,066	342	2	21,788	-	0.07
Great Britain	6,948	3,470	12,353	16,042	1,824	1,475	1,670	2	44,370	-	0.04

Source: National Saltmarsh Survey (Burd 1989a, b).

3.6.2 Important sites and species

Sites with more than 0.1 ha of saltmarsh are listed in Table 3.6.2 (Map 3.6.1). In Shetland, the more important saltmarsh sites, in nature conservation terms, are the larger examples which have a wider range of habitats and plant communities: examples include Dales Voe (Delting), Whiteness Voe, Balta Sound, Burravoe (Busta Voe), Dury Voe and Garderhouse (Seli Voe). Most of the saltmarsh lies outside designated sites and only two SSSIs are known to contain saltmarsh: Dales Voe and South Whiteness.

A typical saltmarsh in the region is a grazed turf comprising species such as sea plantain *Plantago maritima* (commonly the dominant species), thrift *Armeria maritima*, sea-milkwort *Glaux maritima*, sea arrowgrass *Triglochin maritima*, common saltmarsh-grass *Puccinellia maritima* and red fescue *Festuca rubra*. Often the proportion of grasses in the turf is smaller than on most Scottish saltmarshes. Fucoid algae ('seaweeds'), particularly *Fucus muscoides*, can be an important component of the vegetation. Most Shetland saltmarshes have little pioneer vegetation. Where it is present, common saltmarsh-grass is usually the primary colonist and main constituent of low-mid marsh vegetation. Glasswort *Salicornia* spp. and annual seablite *Suaeda maritima* are the pioneer species at only a few sites. On gravel substrates, where the saltmarsh often comprises isolated fragments, common saltmarsh-grass, sea-plantain and greater sea-spurrey *Spergularia media* are the main species. On the higher parts of the marsh, saltmarsh rush *Juncus gerardi*, red fescue and creeping bent *Agrostis stolonifera* become the dominant species. The characteristic driftline species is silverweed *Potentilla anserina*. Upper marsh swamps are uncommon and where present mostly comprise reed canary-grass *Phalaris arundinacea*. On the upper levels of the saltmarsh, in wet depressions and where it is flushed with freshwater, there are stands of saltmarsh flat-sedge *Blysmus rufus*, slender spike-rush *Eleocharis uniglumis* and few-flowered spike-rush *Eleocharis quinqueflora*. Saltmarsh flat-sedge and slender spike-rush are both northern elements in the British saltmarsh flora, found mainly on the west coast of Britain from mid-Wales northwards; whilst neither is a nationally scarce species, their extent as vegetation types on British saltmarshes is very limited.

3.6.3 Human activities

The Shetland saltmarshes have experienced less human interference and land claim for agriculture than those in much of Britain. In many places, however, agricultural improvement (such as digging drainage ditches and reseeded) and road building have truncated the natural transition from saltmarsh to non-tidal habitats.

Nearly all the saltmarshes are grazed by sheep and this limits the diversity of the vegetation. In botanical terms, the better sites are those that are ungrazed or lightly grazed. Saltmarsh vegetation has been damaged by activities such as tipping and excavation of shingle. Since plant growth rates are slow in Shetland and the sediment supply is small, the saltmarsh turf is slow to recover from damage. Many of the saltmarshes are found in situations where flooding by tidal waters is through some narrow or restricted entrance, as in vadills, houb, or artificial lagoons. These sites are

Table 3.6.2 Saltmarsh sites >0.1 ha in the region

Site no.	Location	Grid ref.	Area (ha)
3.6.1			
Unst			
1	Baltasound	HP620088	4.1
Yell			
2	Cullivoe	HP543024	0.12
3	Gutcher	HU547992	0.11
4	Hamna Voe	HU495802	0.33
Mainland			
5	Dales Voe, Delting	HU408686	1.59
6	Boatsroom Voe, Lunna Ness	HU497709	0.35
7	Vidlin	HU480653	0.19
8	Laxo, Dury Voe	HU448633	0.19
9	Dury Voe	HU460602	0.85
10	Trowie Loch, Garth	HU470538	0.4
11	Dales Voe, Lerwick	HU435432	0.58
12	Vadill, Whiteness Voe	HU393460	1.0
13	Weisdale Voe	HU392521	0.13
14	Tresta	HU360508	0.1
15	East of Ness of Bixter	HU342519	0.35
16	Bridge of Twatt, Bixter Voe	HU322527	0.13
17	Effirth, Bixter Voe	HU314523	0.37
18	Garderhouse, Seli Voe	HU335483	1.68
19	Aith, Aith Voe	HU347558	0.15
20	East Burrarfirth, Aith Voe	HU364578	0.2
21	South Voxter, Gon Firth	HU366612	0.17
22	Foula Wick, Olna Firth	HU369650	0.3
23	Burravoe, Busta Voe	HU362668	0.4
24	Brae	HU357680	0.4
25	Housetter	HU366843	0.38
26	Leon, Loch of Queyfirth	HU351817	0.33
27	Main Ayre, Hillswick	HU281768	0.2
28	Gluss Voe	HU355774	0.37
29	Houb, Fugla Ness	HU360748	0.11
30	Houb, Sullom	HU355729	0.12
31	Haggrister	HU347700	0.31

Source: National Saltmarsh Survey (Burd 1989 a, b).

particularly vulnerable to changes in their tidal regime through drainage works and the construction of culverts or embankments.

Studies around Sullom Voe have shown differences between sites in terms of the vigour of common saltmarsh-grass plants. The cause of this variation has not been established and it has not proved possible to distinguish the potential effects of oil contamination from other factors.

3.6.4 Information sources used

Saltmarshes in the region were surveyed in 1985 and ninety saltmarsh sites were identified. The survey report (Dalby 1986) provides detailed site maps and descriptions. A description and analysis of the vegetation types is given in Dalby (1985). Data from 31 sites exceeding 0.1 ha in area were incorporated into the national saltmarsh survey; the areas of plant communities for these sites are summarised in Burd (1989a, b). Data presented here are derived from that data set.

The national saltmarsh survey (Burd 1989a, b) provided an intermediate level of detail between Phase 1 habitat survey and the National Vegetation Classification (NVC -

Rodwell in press). It did not include areas of saltmarsh vegetation in non-tidal areas and, in Shetland, did not identify areas of transitions to other habitats.

Between 1978 and 1990 saltmarsh surveys were carried out for sites around Sullom Voe and selected control sites, commissioned by Shetland Oil Terminal Environmental Advisory Group (SOTEAG) (Dalby 1981; Dalby *et al.* 1986; Dalby & Large 1989; Scott & Tibbetts 1990). The work covered vegetation recording in quadrats along transects and mapping the extent of saltmarsh and its constituent vegetation types to identify areas of loss and gain. Comparisons of the health and vigour of saltmarsh plants were made and sediment samples taken for hydrocarbon analysis. In 1989, permanent markers were established to monitor rates of recession or seaward spread.

3.6.5 Acknowledgements

Thanks are due to Staff of Scottish Natural Heritage who kindly provided information and reference material.

3.6.6 Further sources of information

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B. Further reading

- Barne, J., Davidson, N.C., Hill, T.O., & Jones, M. 1994. *Coastal and marine UKDMAP datasets: a user manual*. Peterborough, Joint Nature Conservation Committee.
- British Oceanographic Data Centre. 1992. *United Kingdom digital marine atlas. User guide. Version 2.0*. Birkenhead, Natural Environment Research Council, British Oceanographic Data Centre.
- Dalby, K. 1990. The saltmarsh environment in Shetland. *Porcupine Newsletter*, 4(8): 175-176.

C. Contact names and addresses

Type of information	Contact address and telephone no.
Data from National Saltmarsh Survey	*Geology/Coastal Advisor, JNCC, Peterborough, tel: 01733 62626
Flora, fauna, habitat information, site management	*Coastal Ecologist, Advisory Services, SNH, Edinburgh, tel: 0131 554 9797
Flora, fauna, habitat information, site management in Shetland	*Conservation Officer, SNH, Northern Isles Area, Shetland Office, Lerwick, tel: 01595 693345
Research and publications	Shetland Oil Terminal Environmental Advisory Group (SOTEAG), AURIS Business Centre, 23 St Machar Drive, Aberdeen AB24 3RY, tel: 01224 272884

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

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. Estuaries covered by the NCC Estuaries Review (Davidson *et al.* 1991) have at least 2 km of tidal channel or 2 km of shoreline over 0.5 km wide at low tide, either now or historically.

None of the inlets in Shetland has sufficient soft shoreline to qualify as an estuary under the above definition. In the UK as a whole 581,290 ha are within estuaries, of which 258,100 ha are on the North Sea Coast (JNCC Coastal Database).

4.1.2 Further sources of information

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B. Further reading

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Buck, A.L. 1993. *An inventory of UK estuaries. 4. North and east Scotland*. Peterborough, Joint Nature Conservation Committee.

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

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

C. Contact names and addresses

Type of information	Contact address and telephone no.
Integrated Coastal Database: national database of estuaries; coastal habitats; statutory & non-statutory protected sites. Summary data available also in Coastal Directories UKDMAP display version.	*Marine & Coastal Data Custodian, JNCC, Peterborough, tel: 01733 62626
Statutory protected sites; detailed wildlife site information; coastal geomorphology. Numerical and some digitised data.	*Coastal Ecologist, Advisory Services, SNH, Edinburgh, tel: 0131 554 9797

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

4.2 The sea bed

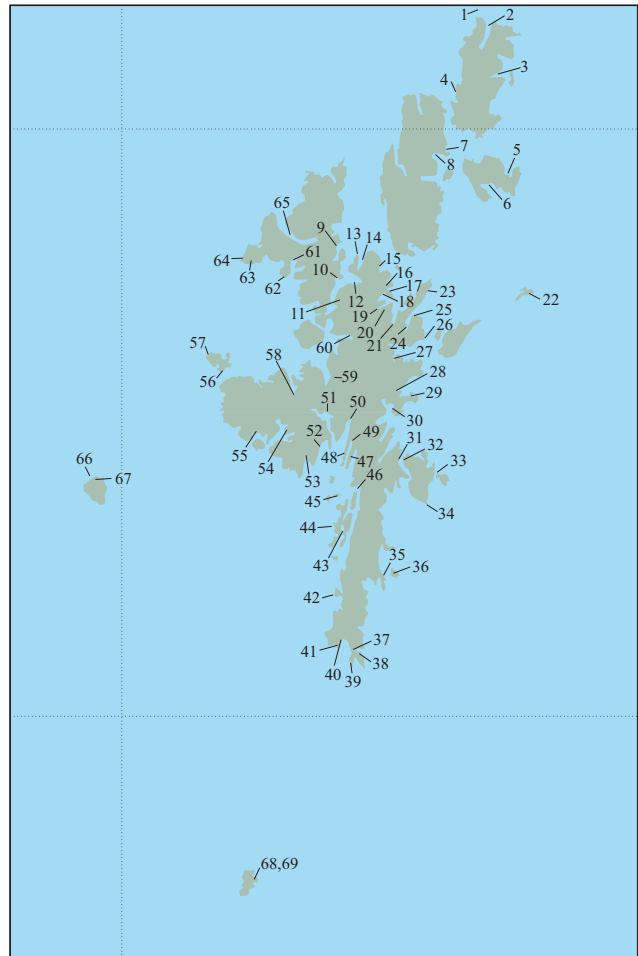
R.A. Irving

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 subtidally; the distribution and occurrence of individually rare and scarce species is covered in [section 5.4](#). Information on the precise extent of shore (littoral) and sea-bed (sublittoral) types in a national context is not yet available.

The numerous large and small islands that make up the Shetland archipelago display a highly indented, predominantly rocky coastline approximately 1,450 km in length. Some of the most spectacular wave-exposed coastal scenery in the British Isles is to be found here, with high cliffs, caves and long, steep-walled narrow inlets called 'geos'. Deep water occurs close inshore, particularly along the east coast, where the 80 m depth contour follows the coastline at a distance of less than 3 km in places (Howson in prep.). The few areas of littoral sediment include shingle at the heads of the voes (drowned river valleys), pocket beaches on sheltered parts of the coast, and more extensive sandy beaches backed by dunes on sections of the more exposed coastline. Shetland voes, like the sea lochs of the Scottish west coast, are long, narrow and steep-sided, often with one or two sills. Characteristic features at the heads of voes are the lagoon-like structures known as 'houbs' or 'vadills' (see [section 3.4](#)). Voes, houbs and vadills provide sheltered sublittoral habitats, the sea bed grading from rock to coarse shelly sand to mud. By contrast, strong wave action affects open coast areas, particularly those exposed to the south and west. There are also strong tidal streams in places, particularly in the channels between islands and across sills. The benthic communities present in these inshore areas are also diverse.

There has been a long history of marine biological studies in Shetland, dating back to the beginning of the 19th century, summarised by Howson (in prep.). It was apparent from these early studies that there was a high species diversity, though this has not always been borne out in more recent studies: for example, inshore rocky habitats have been found to be of low species diversity, although sublittoral sediments are often very rich. However, the islands' high marine habitat diversity does contribute to an overall rich environment. At several sites, a single species of plant or animal may dominate the biota. For instance, Earll (1982) recorded loose-lying mats of algae consisting almost entirely of *Phyllophora crista* or *Trailiella* on sediment; and some tide-exposed surfaces are blanketed by the soft coral *Alcyonium digitatum* or the keel worm *Pomatoceros triquetra* (Howson 1988). These single species stands appear to be a feature of the Shetland sublittoral environment (Howson in prep.). Several species are notable for their characteristic growth forms or for the communities they support. For instance, in the shelter of the voes, the kelp *Laminaria saccharina* often grows in a 'cape' form in shallow water, and sometimes has hollow stipes. At the most exposed sites, kelp can occur as deep as 31 m where there is minimal grazing by the urchin *Echinus esculentus*. However, in less



Map 4.2.1 Locations of marine biological interest described in the text ([Table 4.2.2](#))

exposed conditions grazing pressure may be intense, with few foliose algae being present and the lowest limit of kelp apparently being restricted by urchins. On sheltered muddy sand and gravel below 5 m dense beds of the horse mussel *Modiolus modiolus* occur, particularly in tide-swept areas.

[Table 4.2.1](#) gives a sediment community classification for Shetland, adapted from Pearson *et al.* (1994).

A Boreal (northern) - Arctic marine flora and fauna is present in Shetland, with the Shetland-Orkney channel representing both a northern and an eastern boundary for many southern species. The distribution of the urchin *Strongylocentrotus drobachiensis* is believed not to extend further south than Shetland (Earll & Farnham 1983). Maggs (1986) listed 281 species of macroalgae as occurring in the islands: seventy-one southern species reach their northern limits here, whilst only two species reach their southern limits. The most important floristic discontinuity in the area was considered to be that between Shetland and Faeroe, with a secondary one between Shetland and Orkney, both being related to environmental factors.

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 may be

Table 4.2.1 Sediment communities in Shetland

Code	Community name	Situation	Characterising species
SH1	<i>Modiolus</i> community	Widespread at all depths on sheltered and semi-sheltered sediments. Particularly abundant in Swarbacks Minn and Sullom Voe.	Horse mussel <i>Modiolus modiolus</i>
SH2	Shell-sand and gravel community	Widely distributed in moderately exposed deeper parts of the outer voes, sounds and bays, and typically on the west coast	Polychaete worm <i>Pisione remota</i> , bivalve <i>Abra prismatica</i> and urchin <i>Echinocyamus pusillus</i> (on west coast)
SH3	Muddy sand and gravel community	Most widely distributed in intermediate depths	Polychaete <i>Scoloplos armiger</i> and phoronid <i>Phoronis</i> spp.
SH4	Shallow muddy sand community	Sheltered inner areas of voes	Polychaete <i>Scoloplos armiger</i> , bivalve <i>Abra alba</i> and amphipods <i>Dexamine</i> spp.
SH5	Silt/clay community	At inner ends of longer voes and in very sheltered sounds and firths	Polychaete <i>Glycera alba</i> , bivalves <i>Thyasira</i> spp. and the chiton <i>Chaetoderma nitidulum</i>
SH6	Littoral sand communities	(1) In sediments with a high shell content (2) In sediments with more fine sand	(1) Bivalve <i>Macoma balthica</i> , polychaetes <i>Fabricia sabella</i> & <i>Tubificoides benedeni</i> . (2) Bivalve <i>Macoma balthica</i> , polychaete <i>Travisia forbesii</i> , bivalve <i>Crenella decussata</i> & isopod <i>Eurydice pulchra</i>

Source: adapted from Pearson *et al.* (1994). Note: up to four variants of each community were identified, each with its own characterising species.

largely sedimentary, thus providing discrete new habitats for opportunistic colonising species.

There are four Marine Consultation Areas (MCAs) in the region (see also section 7.4). This is a non-statutory designation for areas identified by Scottish Natural Heritage (and prior to 1991 by the Nature Conservancy Council (NCC 1990)) as being of particular importance on account of the quality and sensitivity of the marine environment within them (see also section 7.4.3). They are: Swinister Voe, including the Houb of Fora Ness; the Houb at Fugla Ness; Brindister Voe and the Vadills; and Whiteness Voe.

4.2.2 Important locations and communities

Table 4.2.2 shows the locations of marine interest mentioned in the text (Map 4.2.1).

Unst, Fetlar and Yell

The northern and western shores of Unst and Yell are very exposed, while those of Fetlar, together with the east coasts of Unst and Yell, are less exposed. Most shores are rocky and backed by high cliffs, though there are numerous small sandy beaches. There are several voes in these islands, including Whale Firth on the west coast of Yell, which is amongst the longest in Shetland but reaches a maximum depth of only 27 m. Strong tides of up to 6 knots (3 m/s) sweep around Muckle Flugga (the most northerly point of the British Isles, on Unst), the headland of Herma Ness and through the major sounds - Colgrave (between Yell and Fetlar) and Bluemull (between Yell and Unst).

At Muckle Flugga, the very exposed rocky shores support relatively few species, with animals dominant. Thongweed *Himanthalia elongata*, usually present in such exposed conditions, is absent, though *Porphyra* spp., *Fucus distichus* and *Fucus spiralis* f. *nana* are characteristic. The mid-shore zone here is dominated by the alga *Mastocarpus stellatus*, with limpets *Patella vulgata* and barnacles *Chthamalus stellatus*, while the lower shore and sublittoral fringe are dominated by dabberlocks *Alaria esculenta* and

coralline algae (Institute of Terrestrial Ecology 1975a).

Steep bedrock extends into the sublittoral, with dense kelp *Laminaria hyperborea*, sugar kelp *Laminaria saccharina* and the red alga *Delesseria sanguinea* progressively dominant and foliose algae abundant beneath the kelp canopy and on the kelp stipes. Beds of jewel anemones *Corynactis viridis*, the soft coral *Alcyonium digitatum* and colonial ascidians cover vertical rock and open parts of the kelp forest, whilst the anemone *Urticina felina* is common on gully floors (Howson 1988). Several long, narrow sea caves are present at the entrance to, and within, the voe of Burra Firth, with rich sponge, ascidian, bryozoan and tube-worm *Salmacina dysteri* communities in their middle reaches. Steep, moderately exposed bedrock at the entrance to the voe gives way to boulders and shelly sand and a ripple-marked barren sand plain. Owing to a higher level of urchin grazing, the only foliose alga present in any abundance at this site is *Dictyota dichotoma* (Howson 1988).

On the east coast of Unst, the bay of Nor Wick has coarse, clean sediments with shell-gravel and pebbles, supporting razor shells *Ensis arcuatus*, the brittlestar *Ophiura affinis* and the sea pen *Virgularia mirabilis*. Similar communities were also present in Harold's Wick and Sand Wick further south. On the rocky shores of the more sheltered east coasts of both Unst and Yell, fucoid algae become more dominant, with bladder wrack *Fucus vesiculosus* characterising semi-exposed shores and knotted wrack *Ascophyllum nodosum* very sheltered ones. Winkles *Littorina* spp., barnacles *Semibalanus balanoides* and mussels *Mytilus edulis* are often found on the mid-shore where there is some shelter. At Swinna Ness an extensive boulder plain on the lower shore supports dense beds of the kelps *Laminaria digitata* and *L. hyperborea*. The lower shore in Balta Harbour has a rich infauna of large bivalves, polychaete worms, nemertean worms and worm-like sipunculans and the anemone *Edwardsia claparedii* (Howson 1988). Outside the voe in South Balta Sound, fine sand with maerl is present.

The strong currents that race through Bluemull Sound give rise to a variety of tide-swept habitats and communities, including the largest maerl bed in Shetland. At the northern end, deep rock is dominated by extensive

Table 4.2.2 Locations of marine interest mentioned in the text

No. on Map 4.2.1	Location	Grid ref.	No. on Map 4.2.1	Location	Grid ref.
	Unst, Fetlar & Yell				
1	Muckle Flugga, Unst	HP6019	36	Masti Geo, Mousa	HU4623
2	Burra Firth, Unst	HP6216	37	Pool of Virkie, Sumburgh	HU3911
3	Balta Harbour, Unst	HP6308	38	Grutness Voe, Sumburgh	HU4010
4	Bluemull Sound, Unst/Yell	HP5503		South-west Mainland	
5	Wick of Gruting, Fetlar	HU6592	39	Scatness	HU3809
6	Wick of Tresta, Fetlar	HU6289	40	Bay of Quendale	HU3712
7	Burra Ness, Yell	HU5595	41	Garth's Ness	HU3611
8	Basta Voe, Yell	HU5296	42	St Ninian's Isle	HU3520
	Sullom Voe and Yell Sound		43	South Voe, East Burra	HU3732
9	Bay of Ollaberry	HU3680	44	West Burra	HU3532
10	The Houb, Fugla Ness, Sullom Voe	HU3674	45	Papa Skerry	HU3738
11	Voxter Ness, Sullom Voe, Mainland	HU3669	46	East Voe of Scalloway	HU4038
12	Voe & Houb of Scatsta	HU3973	47	Whiteness Voe	HU3945
13	Calback Ness, Sullom Voe	HU3978	48	Stromness Voe	HU3845
14	Orka Voe, Yell Sound	HU4077	49	Loch of Strom	HU3947
15	Tofts Voe, Yell Sound	HU4375	50	Houb at Hellister, Weisdale Voe	HU3950
16	Firths Voe, Yell Sound	HU4473	51	The Firth	HU3450
17	Swinister Voe	HU4572	52	Sand Voe	HU3446
18	The Houb of Fora Ness	HU4472	53	Skelda Voe	HU3144
19	Dales Voe, Yell Sound	HU4169	54	Gruting Voe	HU2647
20	Colla Firth, Yell Sound	HU4369	55	Vaila Sound	HU2347
21	Swining Voe, Yell Sound	HU4667		North-west Mainland	
	East Mainland		56	Sound of Papa	HU1758
22	Out Skerries	HU6871	57	Fugla Skerry, Papa Stour	HU1461
23	Lunna Ness	HU5171	58	The Vadills, Brindister Voe	HU2955
24	Vidlin Voe	HU4866	59	East Burra Firth, Aith Voe	HU3557
25	Catta Ness	HU4967	60	Olna Firth	HU3864
26	Lunning Sound	HU5164	61	Ura Firth	HU2977
27	Ayre of Dury, Dury Voe	HU4660	62	Ness of Hillswick	HU2774
28	West Voe of Skellister, South Nesting Bay	HU4655	63	Esha Ness (south)	HU2277
29	Lingness, South Nesting Bay	HU4854	64	Esha Ness (west)	HU2078
30	Cat Firth	HU4552	65	Ronas Voe	HU2981
31	Lerwick Harbour	HU4741		Foula and Fair Isle	
32	Bressay Sound, Mainland/Bressay	HU4841	66	Arva Skerry, Foula	HT9541
33	Noss Sound, Bressay/Noss	HU5341	67	Da Ness, Foula	HT9641
34	Giants Leg, Bressay	HU5135	68	North Gavel, Fair Isle	HZ2272
35	Mousa Sound, Mainland/Mousa	HU4523	69	North Haven, Fair Isle	HZ2272

stands of the soft coral *Alcyonium digitatum*, with a rich associated fauna and flora (Howson 1988). In weaker currents, a plain of mixed substrata is covered with horse mussels and the brittle star *Ophiocomina nigra*. In the centre of the sound, boulders on sand support a kelp forest with *Laminaria hyperborea*, *L. saccharina* and *Saccorhiza polyschides*. In deeper water, pebbles and cobbles are covered by the hydroid *Sertularia argentea*, which itself supports amphipods (Moss & Ackers 1987). A tide-swept cobble and bedrock slope is present in the southern entrance, with the horse mussel, soft coral *Alcyonium digitatum* and the brittlestar *Ophiothrix fragilis* (Howson 1988).

In the Wick of Gruting, on the northern side of Fetlar, a horse mussel community on mixed sediment with stones and shells features the polychaete worms *Magelona mirabilis* and *Chaetozone setosa*, the bivalve *Chamelea gallina* and the amphipod *Perioculodes longimanus* (Pearson *et al.* 1994). A similar community is present in the Wick of Tresta, on the southern side of the island. Coarser sediments of shell, pebble and maerl, also with horse mussel, feature the nut crab *Ebalia tuberosa*, the brittlestar *Ophiopholis aculeata* and the polychaete *Nephtys ciliata* (Pearson *et al.* 1994). Coarse, clean

sediments with maerl fragments are present in the centre of the sounds around Hascosay, between Fetlar and Yell.

The inner part of Basta Voe on Yell's east coast has a shore of muddy sand and shingle, which extend into the sublittoral. Besides the presence of bootlace weed *Chorda filum* in shallow water, loose mats of unattached algae are present, including *Phyllophora crispa*, *Trilliella*, *Enteromorpha* spp. and *Asperococcus* spp. (Howson 1988). The rarely-seen snake blenny *Lumpenus lampretaeformis* was also observed here. Coarse sediments support beds of the horse mussel in slightly deeper water, while clean sand has lugworm *Arenicola marina*, razor shells and the echinoderms *Astropecten irregularis*, *Trachythione elongata* and *Amphiura brachiata* within it (Hiscock 1986). Maerl beds are present on the south and east sides of Burra Ness and the area was noted by Howson (1988) as having particularly rich muddy shell-gravel communities. On shallow muddy sand in Mid Yell Voe, a horse mussel community featuring the polychaete worm *Scoloplos armiger*, the bivalve *Abra alba* and the amphipod *Dexamine* spp. was recorded by Pearson *et al.* (1994). A surge gully at the entrance to Whale Firth on the west coast of Yell was found to have a rich sponge *Clathrina*

and ascidian *Dendrodoa* community (Berryman 1981). Razor shells occur on sandy sediments in the outer arm of the voe, whilst the mud of the inner voe supports the anemone *Sagartiogeton laceratus* and the polychaete *Myxicola infundibulum*.

Sullom Voe and Yell Sound

The marine biology of Yell Sound and Sullom Voe is perhaps better known than that of any other part of Shetland. There are numerous small islands and rocks along the rocky coastline lining Yell Sound, with strong tides of up to 7 knots (3.5 m/s), particularly in the eastern section. Rocky shores in Yell Sound and Sullom Voe range from steep exposed bedrock to more gradually sloping and extremely sheltered bedrock, boulders and cobbles in the heads of voes and houbes. There are fewer soft sediment shores, generally situated at the heads of voes and houbes, with a preponderance of coarse sand, gravel, shell debris and in places a surface peat layer as much as 5 cm deep (Jones 1981).

On rocky shores, the most exposed sites are dominated by barnacle species and mussels in the mid-shore, with patches of red algae, such as *Callithamnion* spp., *Ceramium* spp. and *Laurencia pinnatifida*. The sublittoral fringe has the kelps *Alaria esculenta* and *Laminaria digitata*, while many areas support the fucoid alga *Fucus vesiculosus* f. *linearis*. With increasing shelter, fucoids and winkles become more abundant on the mid and lower shore. Channelled wrack *Pelvetia canaliculata* and toothed wrack *Fucus serratus* are found on both semi-exposed and sheltered shores, while knotted wrack is confined to the most sheltered situations. Steep bedrock in sheltered conditions, such as found at Vaxter Ness in Sullom Voe, supports large mussels, whereas more gradually sloping rock has a dense cover of algae (Hiscock 1981). Shingle and boulder shores, generally found in sheltered conditions, are dominated by knotted wrack *Ascophyllum nodosum* and have large numbers of winkles and amphipods. Intertidal bedrock communities have been found to be inherently stable over the fifteen years of the Field Studies Council Oil Pollution Research Unit (OPRU) monitoring programme (Moore *et al.* 1995) (see also section 4.2.4.), and indeed they were broadly similar in 1992 to those described by Børgesen in 1903.

Houbes are unusual geomorphological features, with a shallow covering of water at low tide. The Houb at Fugla Ness has been designated a Marine Consultation Area as a good example of such a feature (Nature Conservancy Council 1990). There is a small rapids system over boulders at the mouth of the Houb. In the more open Voe of Scatsta and Bay of Ollaberry, exposed sediment shores of clean sand support the bivalves *Angulus tenuis*, *Fabulina fabula*, *Ensis siliqua* and *Ensis arcuatus*, the polychaete worm *Magelona mirabilis* and the holothurian *Leptosynapta inhaerens* (Scottish Marine Biological Association 1975). More sheltered and muddier sand, such as in the Houb of Scatsta, holds species such as the bivalves Baltic tellin *Macoma balthica*, cockle *Cerastoderma edule*, and *Mya arenaria*, and the lugworm *Arenicola marina*. Although there are relatively few species present, the muddier sediment is a particularly productive environment, with large quantities of cockles (Barnett *et al.* 1974). These cockle populations are an unusual feature of the houbes as they live on the sediment surface (Jones & Jones 1981). Stonier sediments generally support little infauna but sometimes have fucoids and mussels on the surface.

Most subtidal macroalgae found in Sullom Voe occur throughout the voe, although some species are restricted to the entrance and others, particularly those associated with unstable substrata, to the inner voe. Tittley *et al.* (1976) recognised five characteristic algal associations that were judged to be very stable (Tittley *et al.* 1985). A wide variety of seaweed species occur as deep as 15 m, with a few, such as *Polysiphonia elongata*, *Phycodryis rubens*, *Phyllophora crispa* and *Lomentaria clavellosa*, growing as deep as 22 m. Around Calback Ness, where the oil terminal diffuser site is situated, kelp *Laminaria hyperborea* dominates bedrock to a depth of 10 m, where it is replaced by *Saccorhiza polyschides* at the rock-sand boundary, and by the kelp *Laminaria saccharina* with increasing shelter in the inner voe. The deep inner basin of the voe has a high organic content and is subject to intermittent periods of anoxic conditions. This is reflected in the low diversity of the fauna in the deepest parts and the dominance of the polychaete worms *Capitella capitata*, *Scalibregma inflatum* and *Pectinaria forenti*, species characteristic of organic enrichment (Pearson & Eleftheriou 1981).

The horse mussel is one of the commonest epifaunal organisms in the Voe, as it is in similar situations throughout Shetland (Pearson *et al.* 1994). They occur on all substrata at all depths. Their shells provide a stable, hard substratum for a great variety of other organisms, such as the brittlestars *Ophiothrix fragilis*, *Ophiocomina nigra* and *Ophiopholis aculeata*, sponges such as *Cliona celata*, ascidians (particularly *Ascidia aspersa*), and various species of hydroid, bryozoan and mollusc, particularly queen scallops *Aequipecten opercularis* (Pearson & Eleftheriou 1981). A burrowing sea cucumber *Thyone fusus* is often associated with the horse mussel beds. Pearson & Eleftheriou (1981) found communities present among the horse mussels in shallow water to be dominated by the polychaete worms *Apistobranchius tullbergi* and *Tubificoides benedeni* and the bivalves *Corbula gibba*, *Thyasira flexuosa* and *Abra alba*.

In the sugar kelp forest at the head of Sullom Voe, boulders and coarse sediment support the urchin *Psammechinus miliaris*, the bryozoan *Scrupocellaria scruposa* and the ascidian *Ascidia mentula* (Hiscock 1986). Howson (1988) noted large numbers of the urchin *Echinus esculentus* grazing within the shallow kelp forests in the outer parts of Sullom Voe and adjacent areas of Yell Sound. Bedrock and boulders below the kelp were also heavily grazed, with dominant species including encrusting coralline algae, the tube worms *Pomatoceros triqueter* and *Salmacina dysteri*, the bryozoan *Parasmittina trispinosa* and the soft coral *Alcyonium digitatum* (Howson in prep.). In the centre of Yell Sound there was a mixed substrata of bedrock outcrops, cobbles, pebbles and coarse sand, dominated by horse mussels and brittlestars *Ophiocomina nigra*, with other echinoderms and hydroids (Howson 1988). At the southern entrance to Yell Sound tidal streams are less strong than in the centre and there is more exposure to wave action, but communities are broadly similar.

Along the north Mainland shoreline of the southern part of Yell Sound, the Voes of Orka, Tofts and Firths have coarse sand and gravel at their heads, while Dales and Swining Voes and Colla Firth are more sheltered and muddier. Sandy areas typically feature queen scallops, hermit crab *Pagurus bernhardus* and the starfish *Asterias rubens*, together with the brittlestars *Ophiura albida* and *O. ophiura* and the burrowing starfish *Astropecten irregularis*. The burrowing fauna within the muddier sediment of Swining Voe includes

the bivalves *Fabulina fabula*, *Dosinia lupinus* and *Thracia* spp. This voe has the greatest variety of surface-dwelling animals of any voe in this area, the species present including the spider crab *Hyas coarctatus*, the gastropod *Neptunea antiqua* and the anemone *Sagartiogeton laceratus* (Barnett *et al.* 1974). The sheltered boulder and shingle shore of Swinister Voe has a generally rich lower shore fauna, with a variety of sponges, echinoderms and ascidians. The Houb of Fora Ness is connected to Swinister Voe by a rapids system, regarded as the best (perhaps the only) example of gravel rapids within Shetland. The Voe and Houb together are included within a Marine Consultation Area (Nature Conservancy Council 1990).

East Mainland (including Out Skerries)

The east coast of Mainland, from Lunna Ness to Sumburgh Head, is highly indented with several large voes and offshore islands. The coastline is exposed, though less so than the west coast. Strong tidal streams flow through the sounds separating the islands from Mainland and also around headlands, particularly Sumburgh Head. A storm beach at Grutness, just north of Sumburgh Head, is one of the biggest boulder beaches in Shetland and has boulders over 2 m in diameter (Nature Conservancy Council 1976).

Out Skerries have some of the most exposed rocky shores within this sector, supporting relatively few species. Most conspicuous are limpets *Patella vulgata* and barnacles *Chthamalus stellatus* and *Semibalanus balanoides* on the mid and upper shore, and the algae *Alaria esculenta* and *Corallina officinalis* at the sublittoral fringe. Below this, a *Laminaria hyperborea* kelp forest extends to 28 m depth, with overhangs supporting a well developed sponge-ascidian community. Deeper rock is covered by coralline algae and the encrusting bryozoan *Parasmittina trispinosa* (Howson 1988). In the extreme shelter of West Voe, there are bedrock outcrops surrounded by soft mud, with the cape form of sugar kelp and the bubble shell *Akera bullata* (Earll 1982). In other less sheltered areas there is sand with lugworms and razor shells (Hiscock 1986).

The rocky shore along the Lunna Ness peninsula is exposed, with similar communities to those present on Out Skerries. By contrast, the sheltered shore at Vidlin Voe has a dense cover of knotted wrack (Institute of Terrestrial Ecology 1975a). Hiscock *et al.* (1978) reported a 'sizeable' population of the immigrant Australasian barnacle *Elminius modestus* at this site. In the sublittoral, a shell-gravel slope was recorded at the entrance to the voe, with the sea pens *Virgularia mirabilis* and *Pennatula phosphorea*, the anemone *Peachia hastata* and the circular crab *Atelecyclus rotundatus*. Further into the Voe the species diversity decreases, with muddy sand supporting scallops *Pecten maximus* and the topshell *Gibbula magus* (Howson 1988).

Off nearby Catta Ness, bedrock and boulders are present to 27 m. *Laminaria hyperborea* grows to 20 m, below which the urchin *Echinus esculentus*, brittlestars and the featherstar *Antedon bifida* are the dominant species. Deeper still a barren plain of pebbles and cobbles was encountered at 36 m (Howson 1988). Strong tidal streams flow through Lunning Sound and unbroken bedrock was found to a depth of 42 m here (Howson 1988). In the deeper water, the rock is blanketed by the soft coral *Alcyonium digitatum* with a band of horse mussels. Maerl is present at a nearby sheltered location on a mixed sea bed consisting largely of

clean shelly sand. The associated community contains the northern urchin *Strongylocentrotus droebachiensis* and the ascidian *Molgula oculata* (Howson 1988).

In Dury Voe, intertidal sand at the Ayre of Dury is covered by a layer of peat and the infauna holds a polychaete/oligochaete worm assemblage (Howson 1988). A population of cockles was also recorded from here (Jones & Jones 1981). Dury Voe itself is relatively shallow, with gradually sloping sides and a sea bed of mixed rock and sand (Earll 1982). Well-drained white sand is present in small embayments in South Nesting Bay at Lingness and West Voe of Skellister, though only a sparse intertidal fauna was described by the Institute of Terrestrial Ecology (1975b), including the polychaete worms lugworm and *Nephtys hombergii*, the bivalves *Chamelea gallina* and *Angulus tenuis* and the sea cucumber *Leptosynapta inhaerens*.

The furoid alga *Fucus evanescens*, a northern species with a limited distribution in the British Isles, grows on the sheltered walls of Lerwick Harbour, forming a mid-shore band between *Fucus spiralis* and *F. serratus*. By contrast, the rocky shores at the foot of the cliffs at the southern end of Bressay are exposed, with little more than limpets and barnacles on the mid-shore. The cliffs at Giant's Leg continue below low water mark to a depth of 20 m or so, with vertical walls, arches and overhangs. Foliose algae are abundant in amongst the kelp, reflecting the lower level of urchin grazing at more exposed sites. Further round in Noss Sound, sand-covered rock at 12 m supports a band of sand-tolerant algae including *Halidrys siliquosa* (Howson 1988). Below 14 m, there are heavily grazed large boulders and bedrock outcrops. Similar shallow water communities are present in Bressay Sound, though there are also mixed sediments at this site, supporting horse mussels in the central section (Howson 1988) and soft sandy mud at the northern end with lugworms (Scottish Marine Biological Association 1975).

At Masti Geo on the southern end of Mousa, there is a sea cave 150 m in length (Howson 1988). The outer walls hold communities similar to nearby exposed shores, dominated by barnacles and mussels, whilst the inner walls support the soft coral *Alcyonium digitatum*, the anemone *Sagartia elegans* and the urchin *Echinus esculentus*. Mousa's shores have a good range of rock pools, with those on the lower shore holding a rich variety of species. There is also a series of large tidal pools, connected to the sea by shallow rapids, which contain an array of algae including *Fucus serratus*, *Himantalia elongata* and *Laminaria saccharina* (Howson 1988). In the sublittoral, steep and vertical bedrock extends to 30 m depth where it becomes a level floor of bedrock and boulders. The communities here are similar to those found at the southern end of Bressay (Howson 1988). Beyond 30 m, the brittlestar *Ophiocomina nigra* dominates the sea bed.

A sheltered intertidal mudflat, a rare habitat in Shetland, occurs at the Pool of Virkie, just north of Sumburgh Head. Shores in the vicinity consist of pebbles and cobbles overlying muddy gravel and are covered by dense furoid algae, with mussels, barnacles *Semibalanus balanoides* and winkles (Howson 1988).

South-west Mainland

The coastline from Sumburgh Head to the western point of the Walls Peninsula is fully exposed to the south and west.

A series of voes and islands, which run more or less north/south, break up the coastline, leading to large stretches of the central part of this sector of coast being more sheltered than those in the southern or western parts.

The very exposed rocky shores on the west side of Scatness, the promontory on the west side of Sumburgh Head, have mixed stands of the fucoids *Fucus distichus* and *Fucus spiralis* f. *nana*, the latter also forming a dense bed above the *F. distichus* (Russell 1974). The main associated species here include the algae *Porphyra umbilicalis* and *Blidingia minima*. Below low water there are well developed surge communities, with sponges such as *Oscarella lobularis* and *Clathrina coriacea* and ascidians such as *Polyclinum aurantium* (Earl 1982). In deeper water, characterising organisms on bedrock include the soft coral *Alcyonium digitatum*, coralline algal crusts, the encrusting bryozoan *Parasmittina trispinosa*, the keelworm *Pomatoceros triquetus* and the hydroids *Thuiaria thuja* and *Abietinaria abietina*.

The largest area of intertidal sand on Shetland is at Bay of Quendale. Howson (1988) found the exposed beach to have few species, with none obviously dominant, recording the presence of the isopod *Eurydice pulchra* and the amphipods *Talitrus saltator* and *Echinogammarus pirloti*. Several rocky shores were surveyed in the aftermath of the Braer oil spill in January 1993 (Covey & Hill 1993; Fuller & Donan 1993; Environmental & Resource Technology Ltd. 1994), with the most obvious effects being at Garth's Ness. Here, grazing molluscs, particularly limpets and winkle species such as *Littorina littorea*, were absent immediately after the spill.

Further north, the sea bed close to St Ninian's Isle consists of exposed bedrock with communities similar to those found around Papa Stour, Foula, Fair Isle and Muckle Flugga (Howson 1988). Foliose algae, particularly *Odonothalia dentata* and *Delesseria sanguinea*, extend to approximately 25 m depth and vertical walls support growths of the soft coral *Alcyonium digitatum* and the tubeworm *Salmacina dysteri*. On the sheltered side of the island, bedrock and boulders change to shell gravel at 12 m depth, which supports no obvious fauna (Howson 1988).

On an exposed stretch of rocky shore on West Burra, Russell (1974) found the seaweed *Fucus distichus* in coralline rock pools together with the algae *Mastocarpus stellatus*, *Ceramium rubrum* and *Enteromorpha* spp. Eelgrass *Zostera marina* occurs on sheltered sediment in South Voe, between West and East Burra (Howson 1988) and is also recorded from an area of shallow muddy sand to the north of here off the small island of Papa (Scott & Palmer 1987). The eelgrass leaves provide a surface for small grazing gastropods and shelter for two-spot gobies *Gobiusculus flavescens* and swarms of mysids. The alga *Chorda filum* is also abundant at this site (Hiscock 1986).

Whiteness Voe is a Marine Consultation Area (Nature Conservancy Council 1990), chosen particularly for its representative habitats and communities and for the seagrass beds it contains. The voe is deepest at its entrance (37 m), with most of the sea bed remaining fairly level at between 10-16 m. Limestone bedrock occurs in the sublittoral at the entrance to the voe, though the communities it supports are broadly similar to those found at other rocky sites (Howson 1988). Sand and shell gravel in this area feature scallops, the anemone *Cerianthus lloydii* and the sea cucumbers *Thyone fusus* and *Thyone roscovita*. The head of the voe has been studied in some detail (Hiscock

1989; Rostron 1989). Algae dominate the shallow edges to the basin, attached to pebbles and cobbles, and include sugar kelp, *Chorda filum* and *Cystoclonium purpureum*. The centre of the basin contains mud with a mat of the alga *Trailiella*, the burrowing anemone *Edwardsia claparedii*, bubble shell and the sea cucumber *Leptosynapta inhaerens*, with snake blenny. Eelgrass occurs in several small beds here, forming the most extensive beds present in Shetland and giving the voe a high conservation value (Hiscock 1989).

Stromness Voe runs parallel to Whiteness Voe and has a very narrow silled entrance to the open sea. At its head is Loch of Strom, which joins the voe via small rocky rapids. Despite its simple elongate shape and large size, Loch of Strom is comparable with a vadill or houb (Howson in prep.). Mud and sandy mud here support algal mats, bubble shells and many dead shells of mussels. The rapids are dominated by live mussels, the barnacle *Balanus crenatus*, dwarf individuals of the anemone *Metridium senile* and sugar kelp (Hiscock 1986). Further to the north, the large houb at Hellister on Weisdale Voe is reported to support eelgrass and beaked tasselweed *Ruppia maritima* (Howson in prep.).

Sheltered shingle shores are present at the East Voe of Scalloway and Skelda Voe (Institute of Terrestrial Ecology 1975b) and The Firth (Howson 1988). At these sites, boulders and cobbles on sediment support fucoids (including knotted wrack) and mussels, with lugworms in open areas of sediment. The brackish water brown alga *Fucus ceranoides* is found in streams running across the shore (Howson in prep.). The floor of the tide-swept narrows in The Firth slopes gradually, with sugar kelp in shallow water and a dense bed of horse mussels below. Further in to The Firth, a muddy shell gravel slope supports a *Trailiella* algal mat from 3-10 m, with sparse horse mussels to 17 m. Scallops, the sea pen *Virgularia mirabilis* and the sea cucumber *Cucumaria frondosa* are all found on the sediment (Howson 1988).

At the top end of nearby Sand Voe, a wide, clean sand beach has a sparse fauna with the bivalves *Angulus tenuis* and cockles and the polychaete worm *Scolecopsis squamata* (Institute of Terrestrial Ecology 1975b). Sandy gravel at low water in Skelda Voe contains the polychaetes *Nephtys hombergii*, *Polycirrus* spp. and ragworm *Hediste diversicolor*, cockles and the bivalve *Mya arenaria* (Institute of Terrestrial Ecology 1975b).

The sheltered rocky shores lining Vaila Sound and Gruting Voe are dominated by knotted wrack (Institute of Terrestrial Ecology 1975b). Both of these areas also contain good examples of the horse mussel community in the sublittoral, as described by Pearson *et al.* (1994). Areas with an increased silt loading are characterised by the presence of the molluscs *Turritella communis* and *Hiatella arctica* and the polychaete worm *Notomastus latericeus*. Other areas have a substrate of muddy sand and gravel characterised by a community featuring a polychaete worm *Myrichèle* sp., the bivalve *Clausinella fasciata* and the amphipod *Urothoe elegans*.

North-west Mainland (including Papa Stour)

The western coastline of Mainland, from the northern tip of North Roe to the western point of the Walls Peninsula, is extremely varied. The open rocky coast is very exposed and includes the impressive volcanic cliffs of the headland at

Esha Ness. The coastline of Papa Stour is considered to have some of the best examples in Britain of geos, stacks, blowholes, cliffs and sea caves (Nature Conservancy Council 1976). There are also several major voes within this section: Ronas Voe in the north is one of the longest in Shetland, while Aith Voe, south of Papa Little, is the deepest at 68 m. The island of Vementry separates Swarbacks Minn from the Voe of Clousta and Brindister Voe, at the head of which is an extremely sheltered system of shallow basins known as the Vadills. There are strong tides around the headlands and through the Sound of Papa (Howson in prep.).

As a result of the inaccessible and exposed nature of much of the open coast, littoral surveys in this area have been restricted. The west-facing coasts of Esha Ness, the Walls Peninsula and Papa Stour rank amongst the most exposed in Shetland, and the rocky shore communities are comparable with those of Muckle Flugga, Foula and Fair Isle (Institute of Terrestrial Ecology 1975a; Hiscock 1988; Howson 1988). Even in calm weather, these shores are subject to a continuous large swell, and intertidal zones extend to a considerable height above high water mark (Howson in prep.). The algae *Alaria esculenta* and *Corallina officinalis* blanket the lower shore up to mid-tide level and *Fucus distichus* occurs in the upper mid-shore. The algae *Porphyra umbilicalis*, *Enteromorpha* spp. and the barnacle *Semibalanus balanoides* provide almost 100% cover in the upper mid-shore, and there is a scattered occurrence of the barnacle *Chthamalus stellatus* (Institute of Terrestrial Ecology 1975a; Hiscock 1981; Howson 1988).

Sheltered rocky shores within the sector, i.e. those in voes or in the lee of islands, tend to be dominated by fucoid seaweeds, with *Fucus vesiculosus* on the mid-shore closer to the voe entrances often mixed with knotted wrack, the latter often dominating shores at the heads of voes (Institute of Terrestrial Ecology 1975a). There are few published descriptions of soft sediment shores in this sector. Shingle on sand was found at East Burra Firth in Aith Voe, together with sand and peat fragments on the lower shore. The shingle supports fucoids and mussels, whilst the sand contains lugworms, a polychaete/oligochaete worm assemblage and the bivalves *Mya arenaria* and cockles (Howson 1988).

Howson (1988) found the very exposed west coast of Papa Stour to have the kelp *Alaria esculenta* to 5 m depth, with *Laminaria hyperborea* forming a dense forest. Below this, bedrock surfaces are dominated by the soft coral *Alcyonium digitatum*, the featherstar *Antedon bifida*, encrusting coralline algae and keelworms. Caves on Fogla Skerry are very exposed, having a rich turf of ascidians, sponges, hydroids and bryozoans lining the inner walls. The Sound of Papa, which has strong tidal streams, has boulders and gravel at about 18 m with the hydroid *Abietinaria abietina* on the sides of the boulders and the urchins *Ophiocoma nigra* and *Antedon bifida* also common on a sea bed that is heavily grazed by urchins *Echinus esculentus* (Howson 1988).

Similar sublittoral communities exist on the fringes of St. Magnus Bay, as reported by Moss & Ackers (1987). They describe a rugged terrain with cliffs, gullies and boulder slopes reaching depths greater than 26 m. The kelp *Laminaria hyperborea*, which dominates shallow depths, is usually replaced by *Saccorhiza polyschides* and sugar kelp in deeper water, extending to 24 m. Many sites are influenced by urchin grazing, though deep water gullies off the Ness of

Hillswick appear less heavily grazed. The numerous crevices here support squat lobsters *Galathea strigosa*, brittlestars *Ophiopholis aculeata* and edible crabs *Cancer pagurus*, whilst the walls are covered by growths of the soft coral *Alcyonium digitatum*, jewel anemones *Corynactis viridis* and the tube worm *Filograna implexa*. Earll (1982) found a gully in shallow water on the south side of Esha Ness to feature large numbers of ascidians, particularly *Dendrodoa grossularia* and *Polyclinum aurantium*, and bryozoans.

More information is known about the sheltered communities within this sector (e.g. Earll 1982; Hiscock 1986; Howson 1988; Institute of Terrestrial Ecology 1975c). Bunker *et al.* (1994) recently mapped sublittoral communities within Brindister Voe and the Vadills, a Marine Consultation Area (Nature Conservancy Council 1990), while The Vadills is a candidate Special Area of Conservation (SAC). Brindister Voe has a maximum depth of 20 m and a sea bed of silty mud with stones and shells. Its communities are representative of Shetland voes. The structure of The Vadills system, with numerous basins and connecting channels and sills, has led to a great variety of habitats and communities being present within a small area. Of particular interest here are several small beds of the unattached form of knotted wrack *Ascophyllum nodosum* f. *mackaii*, in embayments, the only known location of this growth form in Shetland (Bunker *et al.* 1994). The shallow basins are filled with soft mud and contain the sea cucumbers *Leptosynapta inhaerens* and *Leptopentacta (Trachythyone) elongata* and, around the fringes, the alga *Furcellaria lumbricalis*. Although eelgrass had been recorded in Marlee Loch at the head of the Vadills earlier this century ('marlie' is the Shetland name for eelgrass), Bunker *et al.* (1994) could find no sign of it.

Ronas Voe is extremely sheltered along most of its length and the deep inner basin is subject to periods of anoxic conditions (Hiscock 1986). The inner basin of this voe and of Olna Firth further to the south has a mud plain with occasional bedrock outcrops. In shallow water, the cape form of sugar kelp is present (indicating extreme shelter), together with bootlace weed. In deeper water, the ascidian *Asciidiella aspersa*, the featherstar *Antedon bifida*, the anemone *Sagartiogeton laceratus* and the polychaete worm *Myxicola aesthetica* are present (Hiscock 1986; Howson 1988). Many of the other large voes have broadly similar communities. Beds of horse mussels are almost ubiquitous on muddy sand and gravel throughout these voes, being most abundant at depths around 15 m, with an associated fauna featuring the ascidian *Asciidiella aspersa* and queen scallops (Earll 1982; Moss & Ackers 1987). However, where cleaner, coarser, more exposed sediment is found, such as in Ura Firth, horse mussels are far less abundant, or absent (Comely 1981).

Foula and Fair Isle

The island of Foula has an impressive coastline dominated by cliffs, stacks, caves and geos. The cliffs of the most exposed north and west coasts are 347 m high (among the highest in Britain) and drop vertically to the sea below. The east coast is lower-lying, with cliffs rarely more than 40 m in height. The shores of the west and north coasts are inaccessible except by boat, and no biological data are available for them. Other shores have been described by Penny *et al.* (1982) and by Howson (1988). The upper shores

have a band of the red alga *Porphyra umbilicalis*, often with the barnacles *Semibalanus balanoides* and *Chthamalus stellatus*, limpets and the green alga *Cladophora rupestris*. A distinct band of barnacles *Semibalanus balanoides*, mussels and limpets is normally present in the mid shore. Winkles and dogwhelks *Nucella lapillus* are found in crevices.

Thongweed is often present on the lower shore, together with the algae *Alaria esculenta* and *Corallina officinalis* at the sublittoral fringe. Communities on boulder beaches (such as at Da Ness in the north) might be prone to damage in winter and so may be variable from year to year.

Around much of the island, bedrock reaches 30-35 m, where it is replaced by boulders (Howson 1988). However, off Arva Skerry on the north coast, bedrock and boulders extend to beyond 50 m. There is very little sediment. At most sites, below a zone of kelp, which extends to 30 m depth, there is a luxuriant growth of foliose algae, particularly *Kallymenia reniformis*, *Delesseria sanguinea* and *Plocamium cartilagineum*. Beyond 26 m depth, the effects of grazing by urchins *Echinus esculentus* became apparent and crustose algal species dominate the rock surfaces. Other conspicuous species include the soft coral *Alcyonium digitatum*, the tubeworm *Pomatoceros triqueter*, the bryozoan *Flustra foliacea* and jewel anemones *Corynactis viridis* on vertical walls and overhangs. At several sites, massive house-sized boulders were found. These provide a variety of horizontal and vertical surfaces, gullies, overhangs and tunnels. In depths shallower than 27 m, kelp plants grow on the tops of these boulders, whilst their sides are covered by an animal turf of sponges, bryozoans and tubeworms. Several caves and gullies were surveyed and found to support similar communities to those found on Fair Isle.

Extensive pebble, cobble and gravel beds were found off the east coast of Foula (Howson 1988). These are tide-swept and very rich in species, particularly urchins. Species rarely recorded elsewhere include the brittlestars *Amphiura securigera* and *Ophiura robusta*, the sea cucumber *Neopentadactyla mixta* and the gastropod *Melanella alba*. Where boulders mix with patches of shell gravel, sparse beds of the brittlestar *Ophiocomina nigra* occur and scour-tolerant species such as the hydroid *Abietinaria abietina* and the bryozoans *Securiflustra securifrons* and *Flustra foliacea* are common (Howson 1988).

Fair Isle has an exposed rocky coastline with numerous promontories, geos and stacks. The tidal range is about 2 m, but on the exposed shores bands of macroalgae are found up to 8 m above sea level (Burrows *et al.* 1954). The dominant algae on an exposed rocky headland at North Gavel on the east side of the island are *Blidingia minima*, *Porphyra umbilicalis* and *Fucus spiralis* f. *nana* on the upper shore, *Fucus distichus* in the mid shore, and *Mastocarpus stellatus*, *Alaria esculenta* and coralline crusts on the lower shore and in the sublittoral fringe. The mid shore is animal-rather than plant-dominated, with barnacles *Semibalanus balanoides*, mussels and limpets *Patella aspersa* (Howson in prep.). In the shelter of the adjacent North Haven, algae more characteristic of sheltered shores are present.

In the sublittoral around Fair Isle, steep bedrock drops to 38 m on the north and west coasts, where it is replaced by rippled shell gravel with bedrock outcrops and boulders (Howson 1988). The brown alga *Alaria esculenta* extends to a depth of 12 m, with laminarian kelps extending to 22 m depth off the east coast and to at least 30 m elsewhere. The fauna is similar to that described for exposed west coast sites on

Shetland. Caves, arches and gullies are particular features of the shallow sublittoral around Fair Isle, with a range of associated surge-tolerant organisms (Howson 1988). Within caves there is a dense sponge, bryozoan and ascidian turf on the upper parts of the walls, whilst the lower parts are abraded clean. Gullies are similar in many respects to caves, although there is no horizontal zonation and boulders on the gully floor usually hold a forest of the kelp *Laminaria hyperborea*.

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

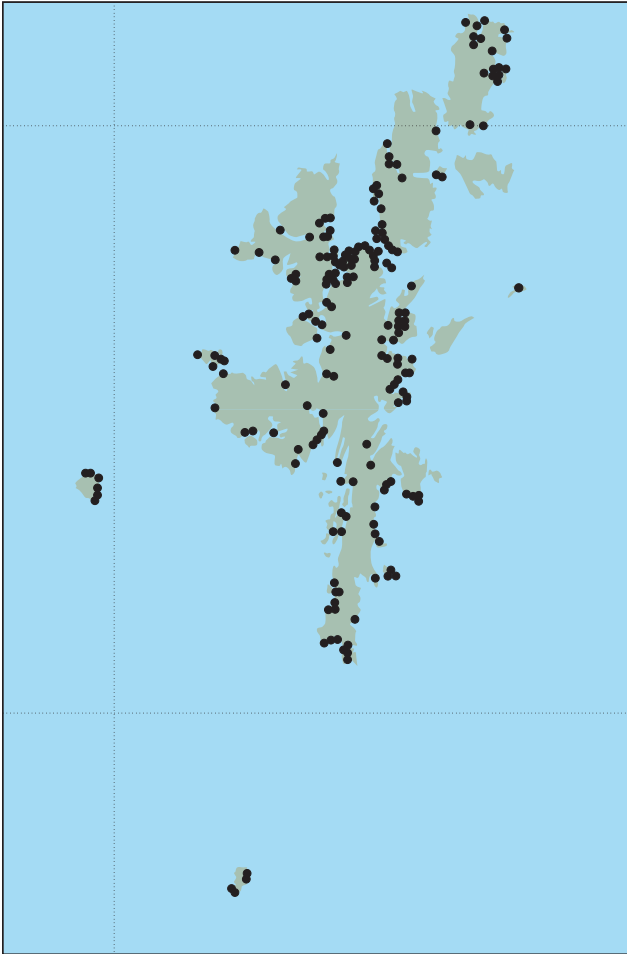
Far less information is available on benthic habitats and communities at offshore locations, other than that shown on Admiralty charts and British Geological Survey maps.

Off the east coast of Mainland, the 80 m depth contour follows the coastline close inshore south of Bressay, though there is a shallower area between Bressay and Out Skerries. There is deep water again between Out Skerries and Lunna Ness with a basin reaching 140 m to the north-east. In open areas of Swarbacks Minn and St. Magnus Bay, off the west side of Mainland, clean shell-sand and gravel in depths beyond 70 m contain a community characterised by the polychaete worm *Pisione remota*, the bivalve *Abra prismatica* and the urchin *Echinocyamus pusillus* (Pearson *et al.* 1994). Muddy sand and gravel, which is widespread between 11-95 m depth in Swarbacks Minn, contains the bivalves *Mysella bidentata* and *Crenella decussata*, the polychaetes *Prionospio malmgreni* and *Ophiodromus flexuosus* and a phoronid *Phoronis* sp.

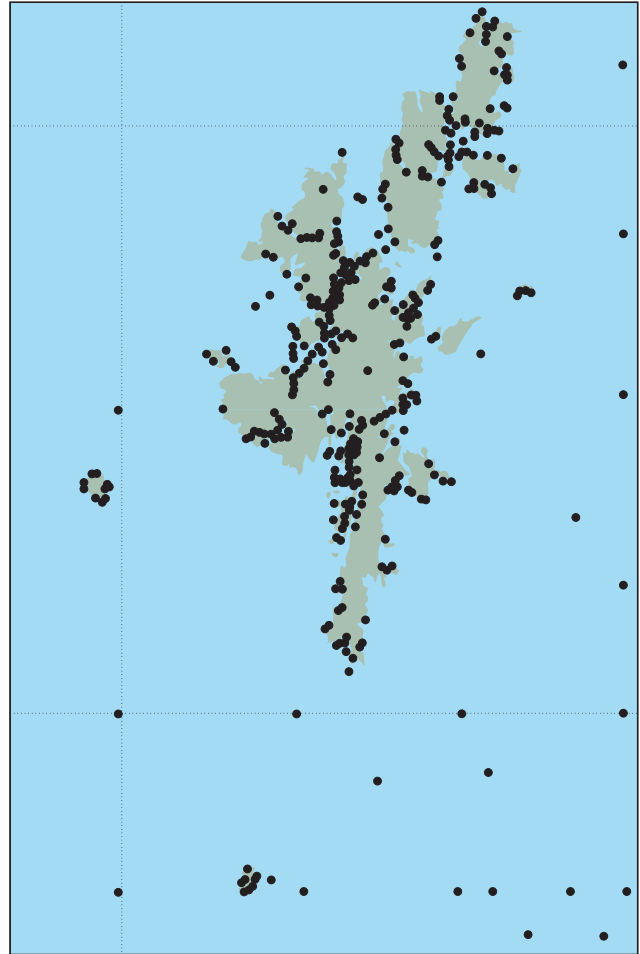
A few kilometres off the east coast of Foula lies Shaalds Reef, an area of shallow water with a strong tidal flow (Howson in prep.). Further offshore, Dyer *et al.* (1982, 1983) analysed the distribution of benthic invertebrates sampled during five annual ground fish surveys in the North Sea. Cranmer *et al.* (1984) used photography to identify a total of 62 benthic invertebrate species and offered estimates of their abundance. Frauenheim *et al.* (1989) sampled the larger offshore benthic fauna, such as crustaceans, echinoderms and molluscs, as part of a study of the whole North Sea.

4.2.3 Human activities

Comprehensive monitoring programmes began at the Sullom Voe oil terminal in 1974, overseen initially by the Sullom Voe Environmental Advisory Group (SVEAG) and from 1977 by the Shetland Oil Terminal Environmental Advisory Group (SOTEAG). A large oil-spill in Sullom Voe at the end of 1978 from the *Esso Bernicia* and the resultant clean-up operations necessitated further work to look at the recovery of habitats in the area. More recently, the wreck of the *Braer* oil tanker in January 1993 on the rocky headland of Garth's Ness, to the west of the Bay of Quendale near Sumburgh Head, resulted in the release of over 84,000 tonnes of fuel and bunker oil. Scottish Natural Heritage produced a series of bulletins providing details of initial impacts of this spill (Anon 1993a, b, c), a report on rocky shores in the area (Fuller & Donan 1993), a report on the sublittoral benthos soon after the spill (Covey & Hill 1993), and an assessment some ten months later (Environmental & Resource Technology Ltd. 1994). A summary report detailing the results of environmental studies on the impact of the *Braer* spill was published by the Scottish Office (Ritchie & O'Sullivan 1994).



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



Map 4.2.3 Sublittoral surveys recorded on the MNCR database. Source: JNCC.

Several investigations into the effects of salmonid farming in a number of Shetland voes were undertaken during the 1980s. Changes in the infauna were apparent at many of the 25 sites inspected in 1986. Although there was no evidence of widespread stagnation caused by salmon cages, the comparatively rapid deterioration of the sea bed at sites with little water movement was apparent. Effects such as bacterial mats on the sediment and of gassing were apparent within a 15 m radius of the cages. Studies of dogwhelks *Nucella lapillus* in the Sullom Voe area revealed a level of up to 90% imposex (changes to external sex organs) in the population, related to TBT anti-fouling paint, the highest incidence being in the region of the oil terminal (Bailey & Davies 1988; Taylor *et al.* 1992). There is now some evidence of possible recovery in the dogwhelk population, matching a reduction in tanker traffic in recent years (J. Uttley pers. comm.).

4.2.4 Information sources used

Much of the information used in this section comes from the JNCC’s Marine Nature Conservation Review (MNCR) reports, and indeed the only surveys to have been undertaken in the sublittoral around Foula and Fair Isle are MNCR surveys reported by Howson (1988). Shetland was one of the first areas surveyed following the establishment of the MNCR in 1986 (Hiscock 1986, 1988; Howson 1988).

The 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 varies considerably in its methodology and coverage. Table 4.2.3 shows the number of sites with marine benthic habitat and species information held on the MNCR database; and Maps 4.2.2 and 4.2.3 show, respectively, littoral and near-shore sublittoral surveys recorded on the MNCR database. Note that although some sites are shown on Maps 4.2.2 and 4.2.3, detailed information for these sites may not be held on the MNCR database.

A major multidisciplinary survey of Shetland was conducted by the Institute of Terrestrial Ecology (ITE). The marine elements of this work, undertaken with the

Table 4.2.3 Number of sites with marine benthic habitat and species information held on the MNCR database

<i>Littoral</i>	<i>Near-shore sublittoral</i>	<i>Offshore</i>	<i>Total</i>
228	500	0	716

Source: MNCR Field Database 1994. Note: these figures are not comprehensive; additional records may exist in sources that were not consulted. Littoral and sub-littoral records at the same place are counted only once in the total.

assistance of the Scottish Marine Biological Association, incorporated studies of rocky and sedimentary shores and the sublittoral biota (Institute of Terrestrial Ecology 1975a, b, c). A comprehensive summary of marine biological studies within Shetland's waters is given by Howson (in prep.), with a full bibliography.

The development of the oil terminal at Sullom Voe in the 1970s and the growth of fish farming in the 1980s led to a large number of ecological studies being carried out. The Field Studies Council Oil Pollution Research Unit (OPRU) was commissioned by the Sullom Voe Environmental Advisory Group (SVEAG) in 1976 to survey the rocky shores, and 34 sites in Sullom Voe, Yell Sound and reference areas were described (Baker *et al.* 1976). Repeat surveys were carried out in subsequent years, with work being reviewed by Hiscock (1981). Modifications to the monitoring programme were incorporated and a more recent review of the work, including a discussion of the changes observed, has recently been published (Moore *et al.* 1995). Much of the information on the marine environment of Sullom Voe and the impact of oil developments was drawn together in a symposium volume (Pearson & Stanley 1981). The marine algal communities of Sullom Voe are well known, being first described by Irvine (1974) and resurveyed by Tittley *et al.* (1985) and again by Tittley in 1993.

A number of shores have been surveyed at scattered locations along this part of the coast (Howson 1988; Institute of Terrestrial Ecology 1975a, b). There have also been extensive sublittoral surveys along east Mainland, although there is little information for Whalsay, the north of Bressay and the coast south of Mousa (Earll 1982; Hiscock 1986; Howson 1988; Moss & Ackers 1987). A general diving survey was carried out by the Marine Conservation Society (Moss & Ackers 1987), in addition to those undertaken on behalf of the MNCR. More recently, work has been carried out as a result of the wreck of the *Braer* oil tanker in January 1993. An extensive botanical survey in 1973, centred on Sullom Voe but with collections being made from as wide a variety of environmental conditions and localities as possible, recorded over 300 species of algae (Irvine 1980). Pearson *et al.* (1994) analysed infaunal data sets featuring a range of sediments from a variety of sources, in order to identify the community types present. Six sediment communities were described within the structures of the MNCR community classification (Hiscock & Connor 1991). These were primarily related to the presence of the horse mussel, or to a particular range of sedimentary particle sizes.

4.2.5 Acknowledgements

The author acknowledges the help of JNCC's Marine Nature Conservation Review team (particularly Dr Tim Hill and Kate Northen) in compiling and presenting the information given here. The MNCR literature review prepared by Christine Howson (in prep.) has proved invaluable and has been widely consulted. Thanks are also due to Christine Howson for comments on the draft text.

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C. Contact names and addresses

Type of information	Contact address and telephone no.
Marine nature conservation issues in Scotland	*Maritime Unit, SNH Advisory Services, Edinburgh, tel: 0131 554 9797
Marine nature conservation issues in Shetland	*SNH, Northern Isles Area, Shetland Office, Lerwick, tel: 01595 693345
MNCR database	*MNCR Team, JNCC, Peterborough, tel: 01733 62626
Coastal water quality and surveys	*SEPA Northern Region HQ, Dingwall, tel: 01349 862021

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

4.3 Plankton

M. Edwards & A.W.G. John

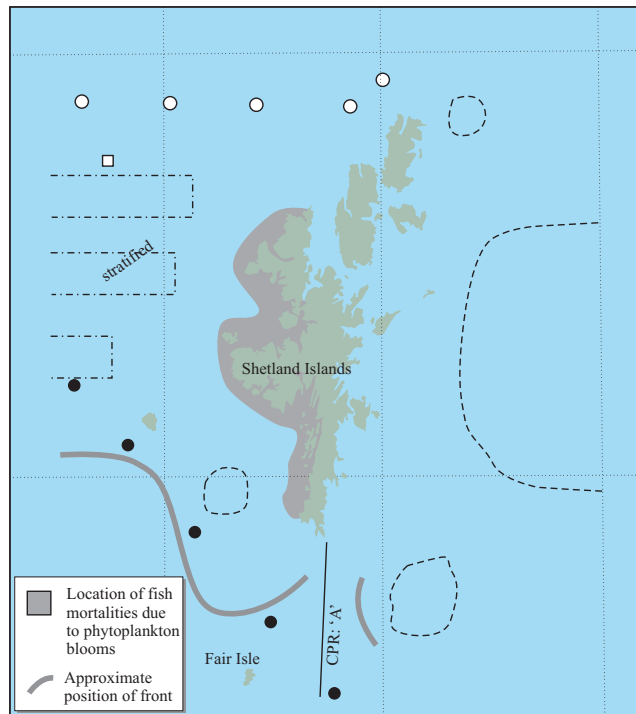
4.3.1 Introduction

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 and temperature, by water flows into the area 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, have temporary planktonic larval forms (meroplankton). Tidal fronts (boundary zones between stratified and well-mixed water masses) in this region are 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^{-1}) 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 1, as elsewhere, the plankton has a fundamental role in the food web of both benthic (sea-bed) and pelagic (water column) wildlife. 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 plankton available. The plankton are a vital link in the food chain of the internationally important concentrations of breeding seabirds in the region. 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.

Region 1 includes the Shetland shelf area (100-200 m in depth) and the northern part of the North Sea. Mean surface temperature and salinity vary (depending on season) between 7-13°C and 34.9-35.4 g/kg, respectively. North Atlantic (oceanic) water is directly and indirectly introduced to the area by a continental slope current and mixed with coastal water by the Fair Isle current. The slope current sometimes flows around the north and west of the Shetland Islands and, as a consequence, may introduce warmer Atlantic, cold Arctic and Norwegian Sea planktonic species. Most of the water column in this area is thermally stratified during the summer months, except for the southern part, where a number of frontal features are found along boundaries between well-mixed and stratified water



Map 4.3.1 Plankton surveys (see Table 4.3.1 for key to symbols) and 'fronts' (Pingree & Griffiths 1978), and phytoplankton blooms (Bruno *et al.* 1989).

(Map 4.3.1). The fronts form in the summer months and begin to break down in autumn when weather conditions worsen.

Total zooplankton biomass was measured at 5 mg C m^{-3} in winter, compared with spring values ranging from <20 mg C m^{-3} in the Faeroe-Shetland channel to >200 mg C m^{-3} over the shelf (Krause & Martens 1990). High phytoplankton standing stock is often found in the south and west of this region associated with the increased nutrient supply to near-surface waters. 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 cubic metres of water filtered) derived from Continuous Plankton Recorder (CPR) data for 1958-93 for Region 1.

4.3.2 Important locations and species

Intermediate (mixed water) species are quite abundant, while neritic (coastal water) planktonic species are relatively scarce, compared with in the central and southern North Sea (Adams 1987). Although some southern intermediate species can be found, the predominant intermediate species tend to be of northern origin, while during the autumn months a considerable number of oceanic species can be carried into this area (e.g. the herbivorous salp *Salpa fusiformis*). Evidence from CPR data shows that the average seasonal pattern of phytoplankton abundance begins to rise around March/April and peaks in May. After the

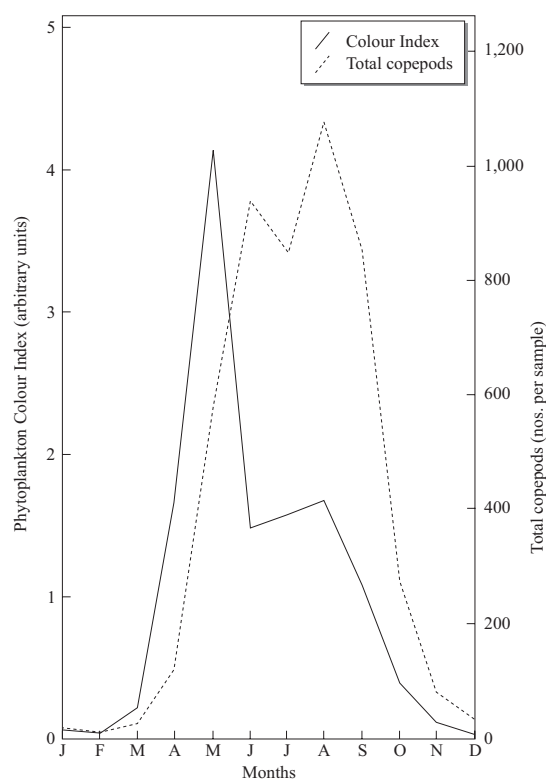


Figure 4.3.1 Average seasonal cycles of an index of phytoplankton colour (a visual estimate of chlorophyll) and numbers of copepods per sample (approximately 3 m³ of water filtered). Source: SAHFOS, Continuous Plankton Recorder data for 1958-1992.

phytoplankton bloom (mainly diatoms, e.g. *Chaetoceros* spp. and *Rhizosolenia* spp.), there is a decline in June to steady levels until a small peak in September. While diatoms are mainly involved in the peaks in May and September, the dinoflagellates (particularly *Ceratium* spp.) are most abundant during the summer months. The recently discovered importance (in terms of overall primary production) of microflagellates and cyanobacteria, collectively known as picoplankton, was highlighted by Owens *et al.* (1990).

The main components of the zooplankton of the region in spring and summer are the copepod *Calanus finmarchicus* and euphausiid species, although *Calanus helgolandicus* can be abundant in autumn. The seasonal pattern evident in the CPR data shows that the total copepod numbers increase in March and peak in June, remain at high levels until

September and decrease to low numbers in winter. The *Calanus finmarchicus* populations start to increase in spring as a result of migrations from deep water winter hibernation areas off the shelf edge. Numbers of this species start to increase earlier than the smaller intermediate and neritic copepods, such as *Pseudocalanus elongatus*, *Acartia clausi* and *Temora longicornis*, which are most abundant over the shelf. While the populations of *Calanus* spp. begin to decline from July (due to migrations into deeper waters), the small copepods remain abundant into September and October. The zooplankton of this region are critical to the survival of important fish species (e.g. herring), which spawn in this region or migrate through the area as larvae and pelagic adults. Studies by Nellen & Schadt (1992) found that fairly large fluctuations in zooplankton taxa occur in this region, indicating that environmental conditions differ from year to year. However, overall variability in the zooplankton biomass is low, indicating a relatively stable ecosystem.

4.3.3 Links with human activities

Within this region between June and July 1988, there were a number of fish mortalities attributed to the contact of fish with phytoplankton blooms (Map 4.3.1) (Bruno *et al.* 1989). In this incident there were very high numbers of diatom species, particularly *Chaetoceros debile* and *Thalassiosira nordenskioldii*, and the silicoflagellate *Distephanus speculum*. This combination of species was considered to have been the cause of severe irritation of the gills of farmed salmon and in some cases respiratory failure. Planktonic jellyfish have also been known to cause injury or death to caged salmon, particularly when the jellyfish form swarms (Hay 1984). Another bloom in this area in late June 1991 contained the coccolithophore *Emiliania huxleyi*; however, blooms of this species are harmless, not infrequently recorded for this area and generally only last a few days. More recently, a red tide caused by a dinoflagellate bloom appeared briefly around Scalloway and south-west Mainland in 1996 (D. Okill pers. comm.), which resulted in a voluntary ban on foreshore shellfish collection until the area was judged to be clear.

4.3.4 Information sources used

The Marine Laboratory (Aberdeen) has undertaken numerous plankton surveys of this region. Plankton data

Table 4.3.1 Details of surveys

Identification on Map 4.3.1	Frequency	Period	Reference
CPR: 'A' route	Monthly	1938 to present	Warner & Hays 1994
North North Sea (MLA)	±Monthly	1961-1974	Adams <i>et al.</i> 1976
PHD (----)	Occasional	1930-1934	Hardy 1939
PS (○)	Occasional	June - July 1987	Malin <i>et al.</i> 1992
PS (□)	Occasional	July 1987	Howard & Joint 1989
PS (●)	Occasional	Spring 1986 and winter 1987	Krause & Martens 1990
PS (-●-●-●-)	Occasional	May - June 1973	Aiken <i>et al.</i> 1977
Shetland	Weekly	1957-1974	Bainbridge <i>et al.</i> 1978
Whole region	Occasional	1967-1989	Nellen & Schadt 1992
PS (shaded area)	Occasional	June - July 1988	Bruno <i>et al.</i> 1989

Key: CPR: Continuous Plankton Recorder; MLA: Marine Laboratory, Aberdeen; PHD: plankton - herring data; PS: plankton samples.

have been collected since the 1920s on indicator species and the variability and productivity of plankton assemblages. This region has received particular attention, owing to the plankton's importance to the herring fishery, particularly *C. finmarchicus*, which constitutes a high percentage of the herring's diet (Bainbridge *et al.* 1978). The CPR surveys in this region are particularly 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. Since 1967 the larval herring stock (ichthyoplankton) has been investigated by various European countries. During the early 1980s these data were further analysed to include overall zooplankton abundance and taxonomic composition (Nellen & Schadt 1992).

4.3.5 Acknowledgements

Thanks are due to Dave Okill (SEPA) for information on phytoplankton blooms and to Steve Hay (SOAEFD) for useful comments on the manuscript.

4.3.6 Further sources of information

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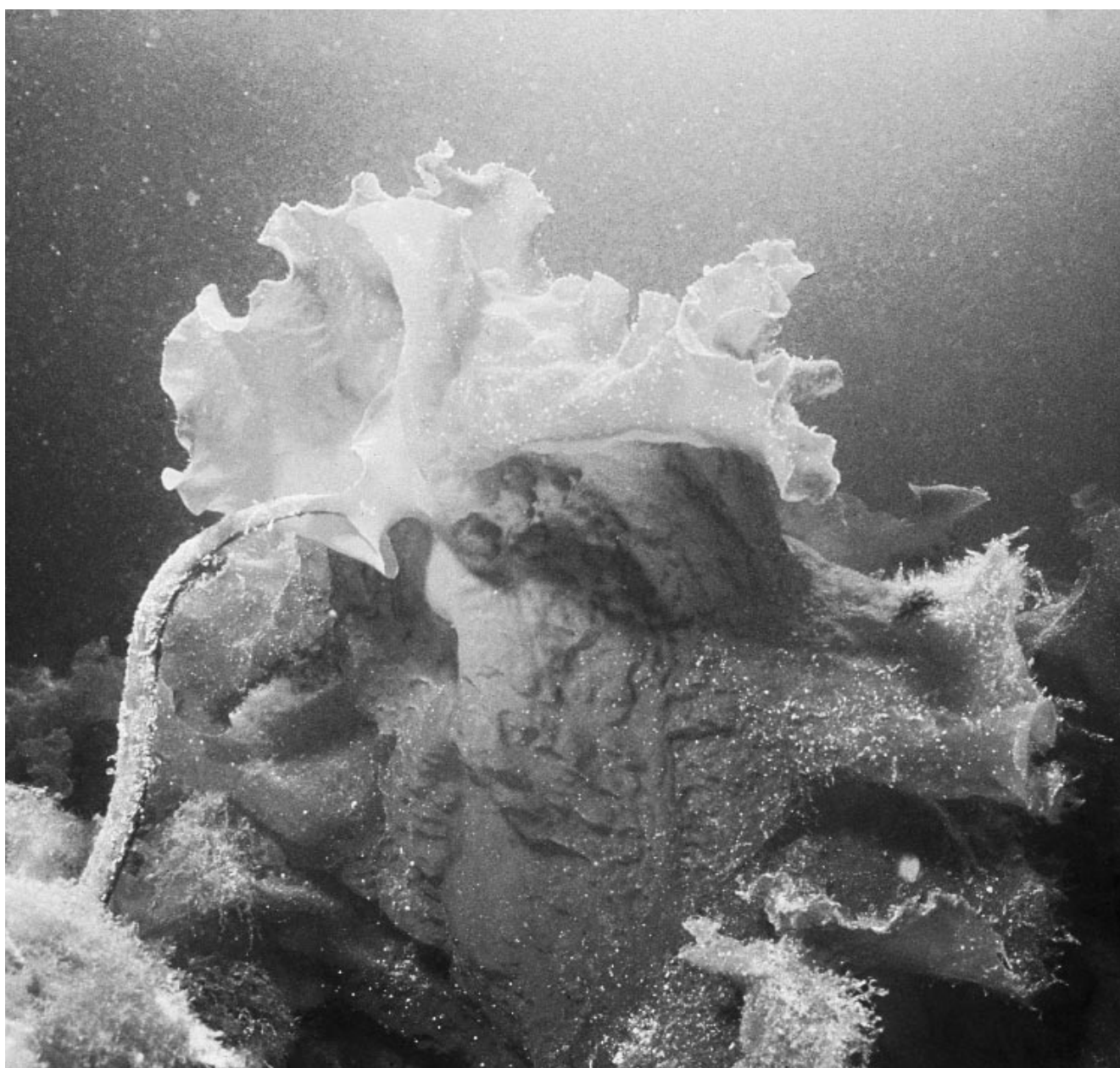
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C. Contact names and addresses

<i>Type of information</i>	<i>Contact address and telephone no.</i>
CPR survey data	Director, Sir Alister Hardy Foundation for Ocean Science, The Laboratory, Citadel Hill, Plymouth PL1 2PB, tel: 01752 633130
Plankton research	Director, Dunstaffnage Marine Laboratory, PO Box 3, Oban, Argyll PA34 4AD, tel: 01631 562244
Ichthyoplankton	Director, Centre for Environment, Fisheries and Aquaculture Sciences, Pakefield Road, Lowestoft, Suffolk NR33 OHT, tel: 01502 562244
Information on plankton in Scotland	*SNH, Maritime Unit, Advisory Services, Edinburgh, tel: 0131 554 9797
Marine research	*Director, SOAEFD Marine Laboratory, Aberdeen, tel: 01224 876544

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



Shetland's high marine habitat diversity supports a rich array of wildlife, some of it locally distinctive. Several species are notable for their characteristic growth forms. For instance, in shallow water in the shelter of the voes there are dense forests of sugar kelp *Laminaria saccharina*, often growing in a 'cape' form (pictured), rather than the usual strap-like form. Photo: Marine Nature Conservation Review, JNCC.

Chapter 5 Important species

5.1 Terrestrial lower plants

N.G. Hodgetts

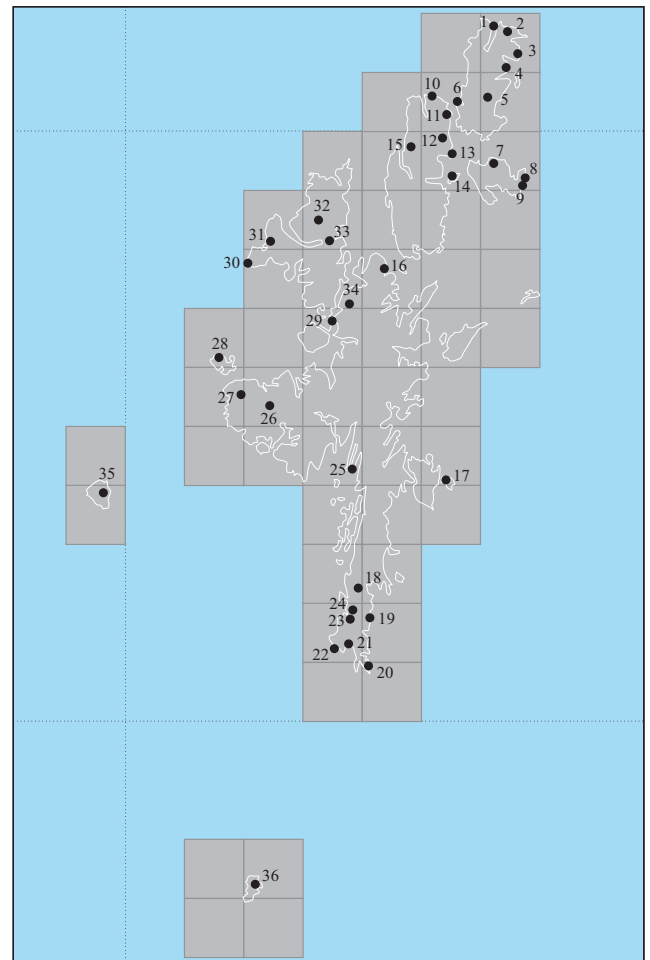
5.1.1 Introduction

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 of the region. About 38% of the British bryophyte flora and about 21% of the stonewort flora occur in Shetland. Similar figures are not available for other groups. Much of the lower plant interest is centred on exposures of base-rich rock, including limestone, serpentine and schist, and associated vegetation, such as base-rich flushes. The more widespread acid habitats are not without interest, however, and the acid rocks, heathland and mire communities support some valuable lower plant communities, often with a good representation of oceanic species. However, in general, the oceanic flora is less rich than in western Scotland (Regions 14, 15 and 16).

5.1.2 Important locations and species

[Map 5.1.1](#) shows the locations of sites in the region that are known to be important for lower plants and that have had at least some degree of survey work: they are listed in [Table 5.1.1](#). Some are large, in which case the grid reference refers to a reasonably central point. Most of the sites are listed on the basis of their bryophyte and lichen interest. Some of the sites contain rare and scarce species and qualify for SSSI status on the basis of their lower plant flora alone (Hodgetts 1992).

Like higher plants (see [section 5.2](#)), lower plants tend to occur in characteristic assemblages that are found in particular habitats. The extensive coastal hard rock cliffs of the region support characteristic lichen assemblages, the species composition of which varies according to geology. Base-rich flushes often occur in areas of calcareous rock, and these, though often very small, usually support rich lower plant communities. Exposures of limestone and serpentine are particularly valuable for their lower plant communities, as at the Keen of Hamar and the surrounding area. Coastal (usually cliff-top) grassland and heath with thin turf can often be rich in bryophytes, lichens and higher plants, the communities often forming complex mosaics. Unstable areas are important in maintaining bare ground for colonisation by some of the uncommon ephemeral lower plants. Exposed rocks in this habitat often support bryophyte species. *Sanionia orthothecoides*, a mainly arctic moss known in Britain only from Shetland, St Kilda and one mainland site in northern Scotland, occurs at several sites in mossy turf and in an old quarry. This species is locally abundant in the vicinity of Sumburgh Head and on Fair Isle (Long 1993). Sand dunes are generally of rather small extent



Map 5.1.1 Sites known to be important for lower plants ([Table 5.1.1](#)). Source: JNCC Red Data Book database.

and limited value, but at Quendale there is a system of highly calcareous shell-sand dunes that are very rich in lower plants, particularly bryophytes in the wetter areas.

Wet heathland and bogs are frequent in Shetland and are often rich in lower plants, particularly oceanic species. There is occasionally a limited development of the 'mixed hepatic mat' community (Ratcliffe 1968), as on Ronas Hill, where the large, oceanic leafy liverworts *Mastigophora woodsii* and *Plagiochila carringtonii* have been found. Shetland also abounds in freshwater lochs and these often contain rich communities of aquatic plants. Stoneworts are particularly characteristic of these communities.

There is hardly any woodland and little scrub on Shetland, but where it does occur it can support a limited epiphytic flora of mosses and lichens that are generally common on the west coast of Scotland.

Table 5.1.1 Lower plant sites in coastal 10 km squares

Site no.	Site name	Grid ref.	Protected status
on Map			
5.1.1			
Unst			
1	Saxa Vord	HP6217	SSSI
2	Burn of Skaw	HP6416	Not protected
3	Hill of Clibberswick	HP6512	Not protected
4	Keen of Hamar	HP6409	NNR
5	Hill of Colvadale & Sobul	HP6105	SSSI
6	Lunda Wick	HP5604	Not protected
Fetlar			
7	North Fetlar	HU6293	Part SSSI
8	Trona Mires	HU6791	SSSI
9	Funzie, East Fetlar	HU6690	Not protected
Yell			
10	Breakon	HP5205	SSSI
11	Ness of Cullivoe	HP5502	Not protected
12	Black Park	HU5398	SSSI
13	North Sandwick & Burra Ness	HU5596	Not protected
14	Hascosay	HU5592	SSSI
15	Lochs of Lumbister	HU4896	Not protected
Mainland			
16	Burn west of Booth of Toft	HU4376	Not protected
17	Noss	HU5440	NNR
18	Red Burn, Channerwick	HU3921	Not protected
19	Dalsetter	HU4016	SSSI
20	Sumburgh Head	HU4009	SSSI
21	Quendale	HU3713	SSSI
22	Garth Ness & Noup	HU3512	Not protected
23	Lochs of Spiggie & Brow	HU3716	SSSI
24	Ward of Scousburgh & Spiggie	HU3818	Not protected
25	South Whiteness	HU3845	SSSI
26	Loch of Voxterby	HU2553	Not protected
27	The Burns, Sandness	HU2055	Not protected
28	Papa Stour	HU1661	SSSI
29	Cliva Hill	HU3467	Not protected
30	Eshanness Coast	HU2077	Not protected
31	Villians of Hamnavoe	HU2481	Not protected
32	Ronas Hill - North Roe	HU3285	SSSI
33	The Sneuie, Queyfirth	HU3481	Not protected
34	Burn of Valayre	HU3769	SSSI
35	Foula	HT9638	SSSI
36	Fair Isle	HZ2172	Part SSSI, NTS

Sources: references listed in section 5.1.6, JNCC's protected sites database and JNCC's Red Data Book database. Key: SSSI = Site of Special Scientific Interest; NNR = National Nature Reserve; NTS = National Trust for Scotland.

The region contains only one threatened species, out of a total of 137 bryophytes, twelve stoneworts and 179 lichens on the British Red Lists (as at September 1996), excluding extinct species. The slender green feather-moss *Drepanocladus vernicosus*, a moss listed on Schedule 8 of the Wildlife & Countryside Act 1981, Appendix 1 of the Bern Convention and Annex II of the EC Habitats & Species Directive, occurs in the region. It is in the Data Deficient category of the Red List pending a review of its distribution in the UK. For fungi there is insufficient information for a comprehensive count.

In addition, the region contains 33 out of 375 near-

threatened and nationally scarce bryophytes (figures for nationally scarce species are provisional). There is one nationally scarce stonewort in the region, *Nitella confervacea*, at Loch of Voxterby. There is currently not enough information to provide even provisional regional lists of near-threatened and nationally scarce lichens and fungi. However, a number of uncommon lichens are known to occur in the islands, including *Acarospora macrospora*, *Anaptychia ciliaris* subsp. *mamillata* (Fair Isle); *Cladonia zopfii* (Ronas Hill - North Roe); *Dermatocarpon meiophyllizum*, *Gyalecta foveolaris* (Hill of Clibberswick); *Lecanora straminea* (Noss and Spiggie); *Pertusaria chiodectionoides* (Ward of Scousburgh and Burnside, Unst); *P. xanthostoma* (Cliva Hill and Ronas Hill - North Roe) and *Placidiopsis cartilaginea* (Dalby 1991).

5.1.3 Human activities

Current issues that may have a bearing on the lower plant flora of this region include agricultural development, road construction, fish farming and industrial development associated with sea-based oil and gas projects. Projects in isolated areas such as Shetland are often funded by the EU, and it is important to ensure that such projects contain an environmental component that does not overlook the lower plants. Overgrazing has an effect on lower plants in Shetland, as it does throughout Scotland. For example, one of the localities for the rare moss *Sanionia orthothecioides* is threatened by over-grazing, which is destroying the heathland on which it grows (Long 1993; L. Farrell pers. comm.).

The threat of oil pollution is a serious issue on Shetland. A bryophyte survey of the Sumburgh area took place soon after the oil spill from the *Braer* tanker in 1993 (Long 1993). This study concluded that oil damage to bryophytes following the incident was limited to the 10 m band above the high tide mark. There have been a number of surveys associated with the environmental impact of the Sullom Voe oil terminal, including lichen surveys. Other forms of agricultural and industrial pollution can seriously affect lower plants, particularly epiphytes.

Some sites in the region are National Nature Reserves (NNRs) and are therefore managed for nature conservation, while many more are SSSIs, for which positive management agreements may be entered into.

5.1.4 Acknowledgements

Thanks are due to Jonathan Swale and Lynn Farrell (SNH) for comments on the text.

5.1.5 Information sources used

Owing to the isolation of the Shetland islands, survey work has been patchy and incomplete, although many sites of interest for lower plants have been found. Data are generally good for bryophytes and the larger lichens but are less complete for fungi, algae and the smaller lichens. The computerised database at the Biological Records Centre (BRC), Monks Wood, and the Red Data Book database at JNCC include recent records collected over decades by

expert bryologists as well as important historical records. The study by Hill & Paton (1975) is an important source of bryophyte data. Some important, or potentially important, coastal lichen sites have been identified in recent surveys (Fletcher 1984; James & Wolseley 1991), but few have been comprehensively surveyed, and there are likely be many more rich sites waiting to be discovered. 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.

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C. Contact names and addresses

Type of information	Contact address and telephone no.	Type of information	Contact address and telephone no.
Information on lower plants of the region	*Conservation Officer, SNH, Lerwick, tel: 01595 693345	Bryophytes & lichens (general and epiphytic)	Dr F. Rose, Rotherhurst, 36 St. Mary's Road, Liss, Petersfield, Hampshire GU33 7AH, tel: 01730 893478
Lichens (hard rock coasts)	T. Duke, Sandrock, The Compa, Kinver, Staffs. DY7 6HS, tel: 01384 872798	Bryophytes (BRC database)	*C.D. Preston, Biological Records Centre, ITE Monks Wood, tel: 01487 773381
Lichens (general coastal)	P.W. James, c/o Department of Botany, The Natural History Museum, Cromwell Road, London SW7 5BD, tel: 0171 938 9123	Bryophytes (British Bryological Society herbarium)	A.R. Perry, Department of Botany, National Museum of Wales, Cardiff CF1 3NP, tel: 01222 397951
Lichens (woodland and general: British Lichen Society database)	Dr A. Fletcher, Leicestershire Ecology Centre, Holly Hayes, 216 Birstall Road, Birstall, Leicester LE4 4DG, tel: 0116 267 1950	Bryophytes (general)	D.G. Long, Royal Botanic Garden, Inverleith Row, Edinburgh EH3 5LR, tel: 0131 552 7171
Lichens (Shetland)	Dr D.H. Dalby, 132 Gordon Road, Camberley, Surrey GU15 2JQ, tel: 01276 21230	Bryophytes (lowland)	A.B.G. Averis, 2 Traprain Cottages, Traprain, Haddington, East Lothian EH41 4PY, tel: 01620 860029
Fungi (general and sand dune)	M. Rotheroe, Fern Cottage, Falcondale, Lampeter, Dyfed SA48 7RX, tel: 01570 422041	Bryophytes (upland)	G.P. Rothero, Stronlonag, Glenmassan, Dunoan, Argyll PA23 8RA, tel: 01369 706281
Fungi (general)	Dr R. Watling, Royal Botanic Garden, Inverleith Row, Edinburgh EH3 5LR, tel: 0131 552 7171	Freshwater algae	Freshwater Biological Association, The Ferry House, Far Sawry, Ambleside LA22 0LP, tel: 015394 42468
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.)	*N.G. Hodgetts, JNCC, Peterborough, tel: 01733 62626

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



No nationally rare and only one nationally scarce flowering plant (oysterplant *Mertensia maritima*) is found in Shetland - but that is to be expected at these high latitudes, as numbers of rare and scarce species decline northwards in the UK. A characteristic plant of beaches, sea rocket *Cakile maritima* (pictured) is an early coloniser of sand just above high tide level, as here at Norwick Bay SSSI, Unst. Photo: Pat Doody, JNCC.

5.2 Flowering plants and ferns

V.M. Morgan

5.2.1 Introduction

This section describes the importance of Shetland for vascular plants (i.e. flowering plants and ferns), particularly species that are rare or scarce in Great Britain. The flora of Shetland is distinctly restricted compared with that of the rest of Scotland, probably as a consequence of the islands' geographic isolation. The climate is cool, damp, cloudy, windy and very changeable, with some of the windiest winters and the coolest summers on the coast of Britain (Spence 1979). Although the winters are mild, compared with those on parts of mainland Scotland, and relatively snow-free, they are extremely windy, with frequent gales of salt-laden winds. The extreme exposure to high winds has led to wind-contouring of heath vegetation and of bare soil and fellfield (Spence 1979). The complex geology includes a number of basic substrates such as calcareous schists, limestone, shell sand and ultra-basic serpentinite, all of which typically carry a rich flora. The long history of often heavy grazing has had a profound influence on the modern distribution of many species (Spence 1979). Habitats of particular importance for rare and scarce vascular plants are freshwater lochs, fellfields (areas of debris of granite or serpentinite rocks) and the remaining scraps of ungrazed vegetation on freshwater islets and steep rocks. 'Classic' British botanical localities in this region include the fellfields of Ronas Hill and north Unst. The latter are considered to be the finest fellfield sites in Britain. These and other key localities for rare and scarce higher plants in the region are shown on [Map 5.2.1](#).

There are relatively few rare and scarce species, but the region is of national importance for the plant communities of exposed fellfields and for the large number of microspecies of hawkweeds *Hieracium* spp. The numbers of rare and scarce species in the region are shown in [Table 5.2.1](#).

A number of different elements, defined by Goode (1974), are found in the region's flora. Atlantic species include saltmarsh flat-sedge *Blysmus rufus*, and sub-Atlantic species include allseed *Radiola linoides*, sea pea *Lathyrus japonicus* and hazel *Corylus avellana*. Continental species include Shetland pondweed *Potamogeton rutilus*, bog-sedge *Carex limosa* and grass-of-Parnassus *Parnassia palustris*. Also well-represented are northern-montane species such as chickweed wintergreen *Trientalis europaea*, green spleenwort *Asplenium viride* and fir clubmoss *Huperzia selago*. Arctic-subarctic species found in the region include oysterplant *Mertensia maritima*, arctic sandwort *Arenaria norvegica* subsp. *norvegica* and dwarf cornel *Cornus suecica*; while arctic-alpine elements are represented by northern rock-cress *Cardaminopsis petraea*, alpine-clubmoss *Diphasiastrum alpinum* and dwarf willow *Salix herbacea*, among others.

The exposure, dampness and coolness also lead to the occurrence of some species outside the habitats to which they are restricted in most other parts of Britain. For example, Wilson's filmy-fern *Hymenophyllum wilsonii* is frequent in the open at high altitudes on Foula, although on the Scottish mainland it usually grows in damp, shaded places such as wooded ravines. A number of species usually restricted to high altitudes grow here at sea level.



Map 5.2.1 Key localities for rare and scarce higher plants.

Table 5.2.1 Numbers of rare and scarce higher plant species in the region

	Protected species	Other rare (RDB) species	Scarce species
Hawkweeds (microspecies)	3	10	No data
Other vascular plants	1	3	20
Region 1	4	13	20

Source: JNCC rare plants database; Stewart *et al.* (1994); BRC database; Scott & Palmer (1987); Palmer & Scott (1995). Note: species counts exclude known introductions and records from before 1970.

Examples include purple saxifrage *Saxifraga oppositifolia*, moss campion *Silene acaulis* and alpine bistort *Polygonum viviparum*. At least eighteen species, including aspen *Populus tremula*, hazel, wild angelica *Angelica sylvestris* and royal fern *Osmunda regalis*, which are common further south, are here restricted to the very few ungrazed sites (Spence 1979).

There are no internationally protected species in the region, but four are among the 107 listed on Schedule 8 of

the Wildlife & Countryside Act (1981): arctic sandwort and the hawkweed microspecies *Hieracium attenuatifolium*, *H. northroense* and *H. zetlandicum*. Four of the approximately 290 nationally rare species that are likely to be included in the next edition of the *British Red Data Book of vascular plants* (Wigginton in prep.) occur in the region, in addition to the ten rare microspecies of hawkweed, out of around 75 such species that are likely to be included in the Red Data book. Of the 254 scarce species in Great Britain (i.e. species known from 16-100 ten km squares), 20 occur in the region.

5.2.2 Important locations and species

Rare and protected species are listed in Table 5.2.2, together with a list of their key localities and a note of the habitats in which they are found. Key localities that support important populations of rare species are listed in Table 5.2.3 and their locations shown on Map 5.2.1. In addition to these key localities, there are a number of sites with small populations of a single rare species or with species-rich vegetation.

The islands are rich in endemic (i.e. confined to Great Britain) microspecies of apomictic (asexually reproducing) plant groups such as eyebrights *Euphrasia* spp. (for which Foula is notable) and hawkweeds *Hieracium* spp. Endemic hawkweeds are listed in Table 5.2.4: all are members of the mainly Scandinavian *Alpestris* section and are found only in Shetland. The endemic eyebrights are *E. heslop-harrisonii* and the taxonomically difficult *E. marshallii*. The endemic Scottish scurvygrass *Cochlearia scotica* is now widely considered to be a variant or subspecies of common scurvygrass *C. officinalis*, rather than a species in its own right.

5.2.3 Human activities

Scott & Palmer (1987) consider that heavy grazing by sheep is the most significant factor contributing to the reduction of rare species in Shetland, including some, such as the hawkweed *Hieracium obesifolium*, that are now extinct. Other factors that have affected the distribution of species or habitats are agricultural improvements such as drainage, reseeding and the use of fertilisers; extraction of sand or shingle; construction of roads and an airport extension. A number of the lochs contain interesting plant communities and are at risk from agricultural and other discharges.

The islands are now designated as an Environmentally Sensitive Area (ESA) by the Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD), which may help conserve and improve the wildlife interest of their agricultural land.

5.2.4 Information sources used

Most of the information in this section comes from Scott & Palmer (1987), which is a comprehensive and authoritative text. Monitoring of the condition and management regimes of Sites of Special Scientific Interest (SSSIs) and National Nature Reserves is conducted by Scottish Natural Heritage (SNH). The Joint Nature Conservation Committee (JNCC) maintains a database of nationally rare plant species that includes site records. Members of the Botanical Society of the British Isles (BSBI) have recently finished collecting up-to-date records of scarce species; these data are held at the Biological Records Centre and have been summarised in *Scarce plants in Britain* (Stewart *et al.* 1994). Plant records are also collected by the BSBI vice-county recorder.

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

Species	Recorded occurrence in:			Key localities	Habitat
	total no. of 10 km squares in GB	no. of coastal 10 km squares in region	no. of sites in region (approx.)		
Arctic mouse-ear <i>Cerastium arcticum</i> subsp. <i>edmondstonii</i>	2	2	2	North Unst	Sparsely to moderately covered serpentine debris
Arctic sandwort <i>Arenaria norvegica</i> subsp. <i>norvegica</i> *	10	2	6	North Unst; Sobul	Bare, loose serpentine debris
Shetland mouse-ear hawkweed <i>Pilosella flagellaris</i> subsp. <i>bicapitata</i>	3	3	**	Ronas Voe, Ronas Hill and Urafirth; Papa Stour to Brindister; White Ness	On limestone, granulitic gneiss and feldspathic rocks adjoining granite
Shetland pondweed <i>Potamogeton rutilus</i>	11	3	4	Lochs of Tingwall and Asta; Lochs of Kirkigarth and Bardister	Eutrophic and mesotrophic lochs

Source: JNCC rare plants database; Scott & Palmer (1987). Key: *listed on Schedule 8 of the Wildlife & Countryside Act 1981; **no information available. Notes: figures are for numbers of 10 km squares in GB in which species have been recorded since 1970, excluding known extinctions. Eyebrights *Euphrasia* spp. are excluded from this table as up-to-date information about their status is not available.

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

Locality	Status	Species
North Unst	Part NNR, part SSSI, part undesignated	RDB species: Arctic mouse-ear <i>Cerastium arcticum</i> subsp. <i>edmondstonii</i> , arctic sandwort <i>Arenaria norvegica</i> subsp. <i>norvegica</i> , hawkweeds <i>Hieracium australius</i> , <i>H. gratum</i> Scarce species: curved sedge <i>Carex maritima</i> , eyebrights <i>Euphrasia foulaensis</i> , <i>E. ostenfeldii</i> , Northern knotgrass <i>Polygonum boreale</i> , northern rock-cress <i>Cardaminopsis petraea</i> , sea pea <i>Lathyrus japonicus</i>
Okraquoy and Cunningsburgh areas	Undesignated	RDB species: hawkweeds <i>Hieracium difficile</i> and <i>H. pugsleyi</i>
White Ness	SSSI	RDB species: Shetland mouse-ear hawkweed Scarce species: the eyebright <i>Euphrasia foulaensis</i> , spiral tasselweed <i>Ruppia cirrhosa</i>
Lochs of Tingwall and Asta	SSSI	RDB species: Shetland pondweed
Lochs of Kirkigarth & Bardister	SSSI	RDB species: Shetland pondweed <i>Potamogeton rutilus</i>
Foula	SSSI	Rare/scarce species: eyebrights <i>Euphrasia foulaensis</i> , <i>E. heslop-harrisonii</i> , <i>E. marshallii</i> , <i>E. ostenfeldii</i> , <i>E. arctica</i> subsp. <i>arctica</i> , <i>E. confusa</i> , <i>E. frigida</i> , <i>E. micrantha</i> , <i>E. nemorosa</i> and <i>E. scottica</i>
Papa Stour to Brindister	Undesignated	RDB species: hawkweeds <i>Hieracium dilectum</i> , <i>H. northroense</i> , <i>H. spenceanum</i> , <i>H. vinicaule</i> , <i>H. zetlandicum</i> , Shetland mouse-ear hawkweed Scarce species: curved sedge, early orache <i>Atriplex praecox</i> , the eyebright <i>Euphrasia foulaensis</i>
Ronas Voe, Ronas and Urafirth	Part SSSI, part undesignated	RDB species: hawkweeds <i>Hieracium australius</i> , <i>H. breve</i> , <i>H. praethulense</i> , <i>H. subtruncatum</i> , Hill <i>H. vinicaule</i> , <i>H. zetlandicum</i> , Shetland mouse-ear hawkweed <i>Pilosella flagellaris</i> subsp. <i>bicapitata</i> Scarce species: Alpine bearberry <i>Arctostaphylos alpinus</i> , bog hair-grass <i>Deschampsia setacea</i> , the eyebright <i>Euphrasia foulaensis</i> , downy willow <i>Salix lapponum</i>
North Roe to Fethaland	Part SSSI, part undesignated	RDB species: hawkweeds <i>Hieracium northroense</i> , <i>H. zetlandicum</i> Scarce species: the eyebright <i>Euphrasia foulaensis</i>

Sources: Rare Plants Database; Stewart *et al.* (1994); SSSI citation sheets; BRC database; Scott & Palmer (1987); Palmer & Scott (1995); Barkham *et al.* (1981). Key: SSSI = Site of Special Scientific Interest; NNR = National Nature Reserve.

Table 5.2.4 Recorded occurrence of rare and protected hawkweeds in Region 1, excluding known extinctions

Endemic hawkweeds (<i>Hieracium</i> spp.)	Total no. of 10 km squares
<i>H. attenuatifolium</i> * ¹	1
<i>H. australius</i> ¹	4
<i>H. breve</i> ¹	2
<i>H. difficile</i> ¹	1
<i>H. dilectum</i>	3
<i>H. gratum</i> ¹	2
<i>H. northroense</i> * ¹	2
<i>H. praethulense</i> ¹	4
<i>H. pugsleyi</i> ¹	3
<i>H. spenceanum</i> ¹	1
<i>H. subtruncatum</i>	9
<i>H. vinicaule</i>	9
<i>H. zetlandicum</i> * ¹	4

Source: Scott & Palmer (1987); Palmer & Scott (1995); W. Scott pers. comm.; draft list of Red Data Book species from JNCC. Key: *listed on schedule 8 of the Wildlife & Countryside Act 1981; ¹species likely to be included in the third edition of the Red Data Book; the criterion for including hawkweeds is occurrence in five or fewer 10 km squares in Great Britain.

5.2.5 Acknowledgements

Thanks are due to W. Scott, I. Tape, M. Wigginton and staff at the Biological Records Centre.

5.2.6 Further sources of information

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C. Contact names and addresses

<i>Type of information</i>	<i>Contact address and telephone no.</i>
Species on SSSIs and NNRs, other protected areas, data on rare and scarce species, rare plant surveys, licensing and protected species	*SNH, Northern Isles Area Office, Lerwick, tel: 01595 693345
The Walter Scott Herbarium	The Curator, Shetland Museum, Lower Hillhead, Lerwick, Shetland ZE1 0EL, tel: 01595 695057
Local BSBI vice-county recorders' records	c/o Dr P. Macpherson, Hon. Secretary, Scotland Committee, Botanical Society of the British Isles, 15 Lubnaig Road, Glasgow G43 2RY

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

5.3 Land and freshwater invertebrates

M.S. Parsons & A.P. Foster

5.3.1 Introduction

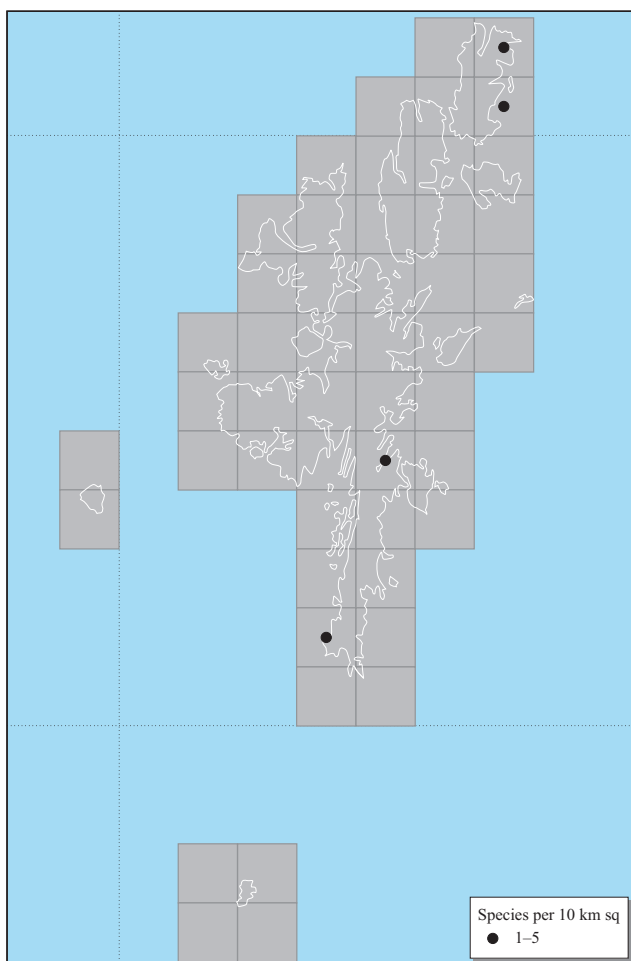
There are over 28,000 species in the better known invertebrate groups in Great Britain (Kirby 1992). This section deals with most insect orders, though not all families, together with a wide range of non-insect invertebrates, known from sites in Shetland. Lagoonal species are covered in [section 5.4](#).

The coast of Shetland, because of its latitude and geographic isolation, generally has an impoverished invertebrate fauna compared with that of many other parts of Great Britain. For example, only between 217 and 232 species of moths and butterflies and 36 species of hoverfly have been recorded, from British faunas of approximately 2,500 and 250 species respectively (Pennington 1995; Jensen & Pennington 1995). Ashmole (1979) reports 90 species of spider from Shetland, which is approximately 15% of the British spider fauna, and Milner (1996) reports records of only 78 spider species from Fair Isle.

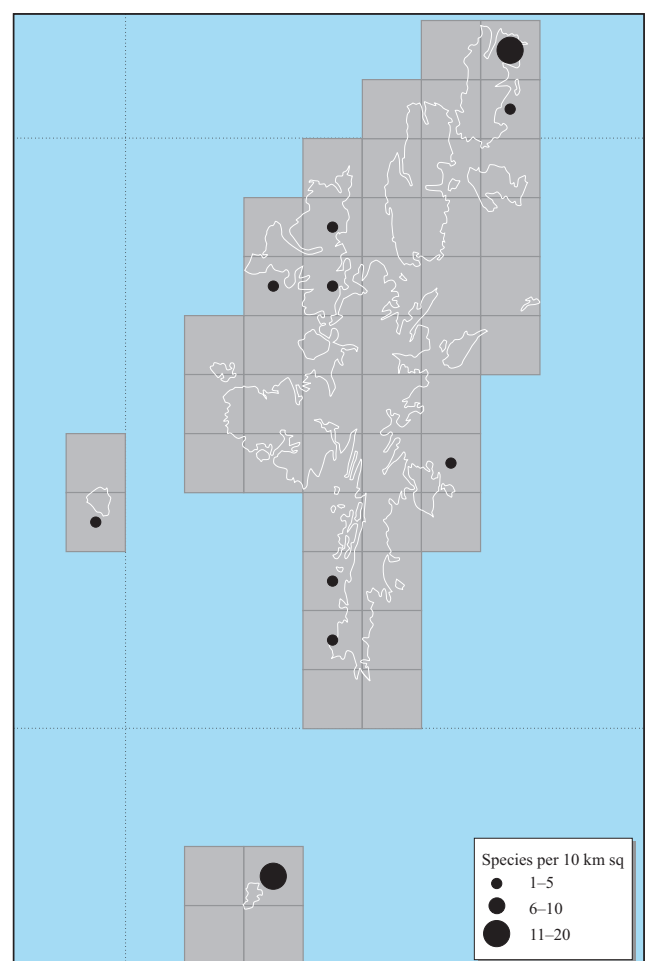
Nationally, 358 RDB and 455 nationally scarce species listed as known to be associated with coastal habitats by

Kirby (1994a, b). In Shetland, only a very few sites are known to support Red Data Book (RDB) species, although several sites are the habitats of nationally scarce species. The JNCC's Invertebrate Site Register (ISR) (now held at the Biological Records Centre) has records of four RDB and 24 nationally scarce species from coastal localities in Shetland (although the species are not necessarily 'coastal' by Kirby's (1994a, b) definition). These totals include fourteen nationally scarce beetles and seven nationally scarce moths. [Map 5.3.1](#) shows the numbers of all nationally rare (RDB) invertebrate species (including Kirby's 'coastal' species and all others), and [Map 5.3.2](#) shows the numbers of all nationally scarce invertebrates, including those that are not strictly coastal in terms of their national distribution but which have populations on coastal sites, recorded in Shetland. Note that survey effort has not been equal throughout the region, so actual occurrence may differ from recorded distribution.

Despite the impoverished fauna, Shetland is considered to be important for the conservation of a number of species. For example, much of the British distribution of the click



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



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

Table 5.3.1 Coastal* Red Data Book (RDB) and nationally scarce species in Region 1

Species	Description and notes on recorded occurrence in the region
pRDB2	
<i>Chrysolina crassicornis</i>	A leaf beetle of cliff tops, dry grassland and sandy hills in maritime situations. Plant-eating, associated with plantains <i>Plantago</i> spp. and perhaps toadflaxes <i>Linaria</i> spp. Egg-laying onto sea plantain <i>P. maritima</i> has been observed. Larvae feed externally on the foodplant during summer. Known only from Scotland: recorded in region from Keen of Hamar.
Nationally scarce	
Coast dart moth <i>Euxoa cursoria</i>	Frequents coastal sandhills, the larva feeding on various sand dune plants. Coastal, Essex to Northumberland, Cheshire to Cumberland, widespread in Scotland. Recorded in this region from Norwick Sandhills and Burrafirth.
<i>Bombus distinguendus</i>	A bumble bee nesting mainly below ground. Primarily a northern and western species. Nowhere common but rare in the south. An old (1926) record from Bressay.

Source: JNCC (after Kirby 1994a, b). Key: *as defined by Kirby (1994a, b); Red Data Book categories: RDB2 = vulnerable; pRDB = proposed species as categorised in e.g. Hyman & Parsons (1992). For further description of RDB categories, see Shirt (1987) and Bratton (1991).

beetle *Athous subfuscus* is centred on Shetland (Mendel 1990). A few scarcer species with a primarily northern distribution in the UK have also been found. These include the ground beetle *Patrobus septentrionis* and the moths *Eudonia alpina* and *Catoptria furcatellus*. All three of these species occur at lower elevations in Shetland than they do over much of the rest of their British distribution. These coasts are also known to support several subspecies or races that are known mainly from this part of the British Isles, e.g. subspecies *thulensis* of the ghost moth *Hepialus humuli* and subspecies *thulei* of the ingrained clay moth *Diarsia mendica*. The exile moth *Apamea zeta* subsp. *marmorata* is known only from Shetland (where it has been recorded from several sites) and parts of Scandinavia, where it is found on rocky tundra beyond the tree line (Mikkola & Goater 1988). This subspecies shows a range of forms on Shetland, from blackish examples on north Mainland to the pale honey-coloured examples found on Unst. It is also worth noting that the only British examples of the hoverflies *Metasyrphus lundbecki* and *Helophilus affinis* and the centipede *Geophilus proximus* have occurred in this region.

None of the invertebrates recorded from the region is protected under international directives or conventions or the Wildlife & Countryside Act 1981.

5.3.2 Important locations and species

Table 5.3.1 lists the coastal RDB species and nationally scarce species (as defined by Kirby (1994a, b)) that have been recorded recently from the region.

The ISR has records from approximately 25 sites within the region, although some of these are subsites of much larger statutory nature conservation areas. Sites in **Table 5.3.2** are those that are considered to be particularly significant in Shetland for invertebrate conservation, based on data from the ISR and the Newsletter of the Shetland Entomological Group (SEG). Site selection was largely based on the range and/or scarcity of species present, the species habitat associations and the amount of the available habitat. However, some of the localities listed in this table are included on the strength of the records from the SEG's newsletter, and it is possible that some, or all, of these sites may be gardens by the coast. In the absence of further, more site-specific data these localities are included as the species recorded are likely to have come from good quality habitat nearby.

Table 5.3.2 Sites important for invertebrate conservation

Site	Grid ref.	Status
Hermaness	HP6016	NNR, SSSI, SPA
Burrafirth	HP6114	Undesignated
Norwick Sandhills	HP6514	Undesignated
Keen of Hamar	HP6409	NNR, SSSI, pSAC
Baltasound	HP6208	Undesignated
Ronas Hill - North Roe	HU3184	SSSI, pSAC
Eswick	HU4953	Undesignated
Toab	HU3811	Undesignated
Fair Isle	HZ2172	SSSI, SPA, NTS

Source: JNCC ISR. Key: NNR = National Nature Reserve, SSSI = Site of Special Scientific Interest; pSAC = proposed Special Area of Conservation; SPA = Special Protection Area; NTS = National Trust for Scotland.

Many invertebrate species are restricted in their distribution to particular microhabitats and microclimates, such as those found on the cliffs, skerries and the other rocky formations that dominate the outer coastline of Shetland. Species associated with these habitats include the leaf beetle *Chrysolina crassicornis*, which occurs in dry grassland on cliff-tops and has recently been recorded from Keen of Hamar; it is associated with plantains *Plantago* spp. It is considered vulnerable. The brindled ochre *Dasypolia templi* (a moth that is known from a number of sites) also frequents rocky coasts, the larvae feeding on members of the carrot family.

Examples of invertebrates of grassland include the click beetle *Athous subfuscus*, which, as a larva, probably develops at the roots of plants. The early stages of the moth *Catoptria furcatellus* are not known, although the adult has been found flying over areas of sparse turf. The exile *Apamea zeta* subsp. *marmorata* and the Manchester treble-bar *Carsia sororiata* are examples of moths that primarily inhabit peat moorlands. The larva of the former species is not known in the wild; those of the latter feed on various species of *Vaccinium*. Along this stretch of coast, the coast dart moth *Euxoa cursoria* is confined to localities behind sandy beaches, where the larva feeds on a variety of plants that grow in sandy situations.

5.3.3 Human activities

The full range of coastal microhabitats found in Shetland support invertebrate assemblages. Many species use subtle features of vegetation structure, others areas of bare ground. These features are often overlooked, even in site management, many species surviving by chance. Invertebrates generally have annual life cycles and, hence, the habitat features they require must be present in the right condition in each and every year. The general principles of management of coastal habitats for invertebrates are covered by Kirby (1992).

5.3.4 Information sources used

The invertebrate fauna of Shetland is less well documented than that of many other regions in the UK. The level of recording varies along the coast and also between the various invertebrate groups. A substantial proportion of the data used here come from the JNCC's Invertebrate Site Register (ISR), a computerised GB-wide database based on literature searches of entomological journals and those of local naturalist societies, collation of data from local biological record centres and the Biological Records Centre, Monks Wood, and consultation with invertebrate specialists and non-governmental organisations.

Other data are available through invertebrate specialists and a range of published sources. Smith & Smith (1983) list a large number of references to the entomology of Shetland, a significant proportion of which are from the 19th century. Currently, Shetland has several entomologists active under the auspices of the Shetland Entomological Group (SEG), which was formed in 1993, and there is still the occasional visit to the islands by invertebrate specialists from mainland Britain. The newsletter produced by the SEG contains a substantial and growing amount of invertebrate data that are not yet included in the ISR. Provisional distribution maps are available for a wide range of invertebrates, including many that are found within this region. For example, Heath & Emmet (1979, 1983) map many species of moths. The SEG also produces an annual report on butterflies and moths and these reports have included distribution maps for some species, e.g. the exile moth *Apamea zeta* subsp. *marmorata* and the brindled ochre moth *Dasypolia templi* (Pennington 1994).

The butterflies and moths are perhaps the best documented invertebrate group along this stretch of coast, but even here recording is largely restricted to static trapping sites. However, there is potential for new discoveries to be made; indeed, several additions to the list of Shetland's butterflies and moths were made in 1994 and reported in Pennington (1995).

5.3.5 Acknowledgements

Thanks are due to D. Procter and Dr S. Ball (JNCC) for providing raw data from the ISR. Thanks are also due to M. Honey (Natural History Museum).

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C. Contact names and addresses

Type of information	Contact address and telephone no.
National recording databank for aquatic Coleoptera	Balfour-Browne Club / Dr G.N. Foster, 3 Eglinton Terrace, Ayr KA7 1JJ, tel: 01292 525294
Occurrence of invertebrates in Britain	*Biological Records Centre, ITE Monks Wood, tel: 01487 525294
Conservation of butterflies and moths	British Butterfly Conservation Society, Glasgow Art Gallery & Museum, Kelvingrove, Glasgow G3 8AG, tel: 0141 305 2660
ISR: computerised national inventory of sites of significance to invertebrate conservation; contains localised records of scarce and threatened species of all groups of non-marine invertebrates	*Invertebrate Site Register, JNCC, Peterborough, tel: 01733 62626
Databank of literature-based Scottish insect records	Scottish Insect Records Index, c/o Dr M.R. Shaw, National Museums of Scotland, Chambers Street, Edinburgh EH1 1JF, tel: 0131 225 7534
Invertebrate site and species information	*Invertebrate Ecologist, SNH, Advisory Services, Edinburgh, tel: 0131 554 9797
Species on SSSIs and NNRs, other protected areas, distribution of data on rare and scarce species, rare plant surveys, licensing and protected species in Shetland	*SNH Northern Isles Area, Shetland Office, Lerwick, tel: 01595 693345
Invertebrates in Shetland	The Secretary, Shetland Entomological Group, 9 Daisy Park, Baltasound, Unst, Shetland ZE2 9EA, tel: 01957 711307

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

5.4 Rare sea-bed species

J. Plaza

5.4.1 Introduction

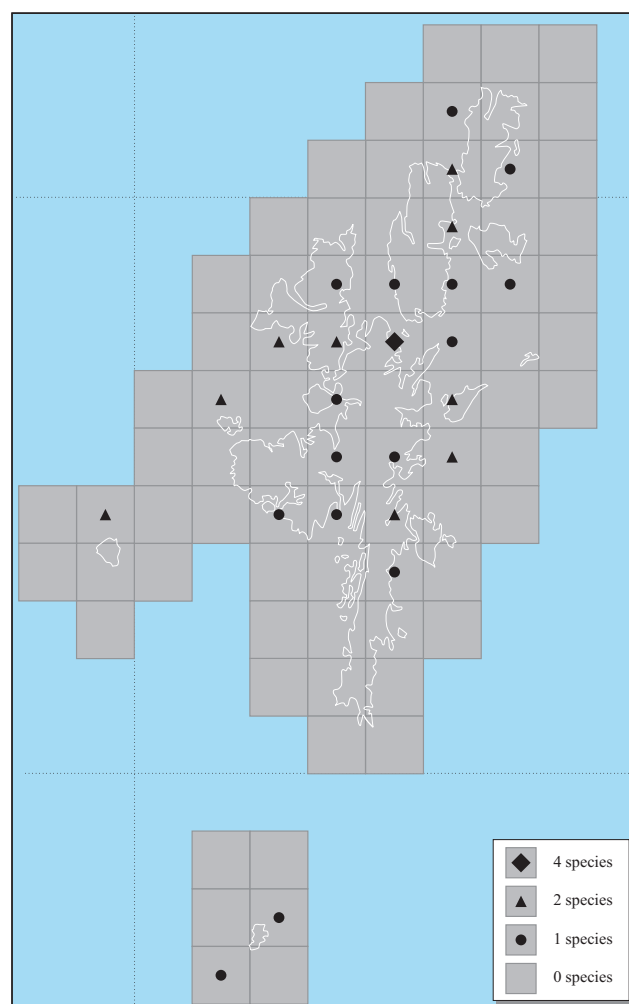
This section considers rare and scarce marine benthic (sea-bed) species, excluding fish. The occurrence and distribution of benthic communities is discussed in [section 4.2](#). 'Nationally rare' marine benthic species in this section are those that occur in eight or fewer of the 1,546 10 km by 10 km 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 by 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 on a national scale have been avoided in the present work.

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 such 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.

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 in Shetland. 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).

Three nationally rare and five nationally scarce marine benthic species have been recorded from Shetland. The well studied areas of Sullom Voe and its approaches, especially



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.

around the island of Little Roe, appear to contain more of these species than elsewhere. Of the eight rare and scarce species recorded in Shetland, none is 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 Shetland, together with their known areas of occurrence and other key information ([Map 5.4.1](#)). In addition, several stonewort species are confined to slightly brackish lochs. The Loch of Spiggie, in south Mainland, is an important site for these plants. One such species, *Chara baltica*, which is found in the Loch of Spiggie, is considered to be threatened and is included in the UK Red Data Book (Stewart & Church 1992). 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 Shetland are somewhat artificial and should be regarded with caution.

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

Species	Type of organism	Area(s) of occurrence	Habitat/associations	Comments	Useful reference
<i>Austrosyrrhoe fimbriatus</i> *	An amphipod	Yell Sound	Habitat poorly known. May be characteristic of maerl substrata in SW Britain.	Known only from a few British localities.	Lincoln (1979)
<i>Cylindroporella tubulosa</i> *	A sea mat	Sullom Voe	Encrusting shells, stones and algae within a wide depth range.	Circumpolar species at southern limit of range in GB.	Hayward & Ryland (1979)
<i>Strongylocentrotus droebachiensis</i>	A sea urchin	Bressay Sound, Bluemull Sound, Gletness, Fetlar, Unst and Lunning Sound	Generalist grazer on rocky subtidal areas in the UK. Also often found on maerl beds and cobbles.	A northern taxon. Confirmed in the British Isles only from Shetland, where it is not uncommon.	Picton (1993)
<i>Cucumaria frondosa</i>	A sea cucumber	Fetlar, Unst, Bluemull Sound, Yell, Lunning Sound, Whiteness Voe, Hildasay and West Burra, Wester Sound, Sandsound Voe and Gon Firth	In rocky areas attached to elevated rock surfaces, often just below low water mark. Also on mixed ground and on beds of horse mussels <i>Modiolus modiolus</i> .	A northern species thought to extend as far south as the Clyde. Locally common in Shetland. Range may have retracted northwards this century.	Picton (1993)
<i>Gelidiella calcicola</i> *###	A red seaweed	North Bressay	Normally confined to maerl.	Localised in restricted habitat.	Maggs & Guiry (1987)
<i>Schmitzia hiscockiana</i>	A red seaweed	Papa Stour and St Magnus Bay	Sublittoral on tide-swept cobbles.	Scattered distribution in GB. Restricted habitat. Common at few sites of occurrence. Recorded only in the British Isles and Sweden.	Maggs & Guiry (1985)
<i>Fucus evanescens</i> (as <i>Fucus distichus edentatus</i>)	A brown seaweed	Lerwick Harbour & Foula	Occasionally on the upper shore in rock pools, more often from the mid-shore to subtidal. Sheltered to exposed coasts.	Northern species that has undergone taxonomic reassessment. Its exact distribution is therefore unclear.	Rice & Chapman (1985)
<i>Fucus distichus</i> (as <i>Fucus distichus anceps</i>)	A brown seaweed	Esha Ness, Fair Isle, Foula and Papa Stour	Inhabits the upper part of very exposed shores.	Northern species that has undergone taxonomic reassessment. Its exact distribution is therefore unclear.	Rice & Chapman (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; ###species associated with maerl. Note: some of the scarce species listed here are only a little more common than the rare species listed.

A high proportion (around half) of the species listed in Table 5.4.1 are northern taxa limited to the northernmost parts of the British Isles. Some of these, e.g. the urchin *Strongylocentrotus droebachiensis* and the sea cucumber *Cucumaria frondosa*, are locally common in Shetland but remain scarce at a national level. These two species alone account for half of the species occurrences noted on Map 5.4.1 and help demonstrate the existence of a significant biogeographical barrier between Shetland and the rest of Great Britain (*c.f.* Maggs 1986; Howson in prep.).

None of the species included above is known to be a common deep-water species, and so it is unlikely that any appear rare simply because their distribution barely extends into the shallower near-shore area that is the focus of this study. Some of them, however, will occur to some extent in the waters of Great Britain outside the scope of this report.

5.4.3 Information sources used

The MNCR database (McDonald & Mills 1996), which contains data on species present from more than 10,500 sites around Britain, has been an important starting point for the collection of information and literature on the distribution of rare and scarce species. The bulk 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. It has not been possible in this section to list all the available literature on which this analysis has been based, but the information reviews and recent papers listed in sections 5.4.5 and 4.2.6 and in Howson (in prep.) should allow access to the majority of the available information.

Shetland has been extensively surveyed (as evidenced by Maps 4.2.2 and 4.2.3), largely as a result of the development of the oil industry in the mid 1970s.

Sullom Voe has been particularly well covered since 1978 as part of a long-term monitoring programme commissioned by the Shetland Oil Terminal Environmental Advisory Group (Dunnet 1995). Wider coverage of Shetland has been achieved since the Nature Conservancy Council (later the Joint Nature Conservation Committee) commissioned a number of ecological surveys as part of the Marine Nature Conservation Review (e.g. Howson 1988). These two initiatives have yielded the majority of records for the species in Table 5.4.1. In addition, reports from studies arising as a result of the growth of the salmon farm industry in the 1980s (e.g. Dixon 1987) and survey work conducted following the Braer oil spill in 1993 (e.g. Newey & Seed 1995) have contributed records.

At the northernmost extremity of the British Isles, Shetland has long attracted naturalists and consequently has a long history of study (e.g. Forbes 1851; Norman 1869). Whereas every effort has been made to obtain biogeographic data for rarity assessment, in the interest of representing current known occurrence, in this study data have not been used from reports prior to 1965. There are, however, additional rare/scarse species in Shetland that are not included in Table 5.4.1 because the location of records was unspecified (e.g. the red alga *Aglaothamnion priceanum*), or because records predate 1965. Examples of the latter are the sponge *Sycandra utriculus*, the snail *Alvania cancellata*, the sea slug *Flabellina* (= *Coryphella*) *pellucida*, the fan mussel *Atrina* (= *Pinna*) *fragilis* and the bryozoans *Palmicellaria elegans* and *Ragionula rosacea* (although the last two could be offshore species). Several sponge species were also identified by Bowerbank last century (e.g. Bowerbank 1882) but have not been recorded since. Finally, records of the northern hatchet-shell *Thyasira gouldi* exist from Sullom Voe; however, there is some doubt over their identity, which awaits confirmation.

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, the complete MNCR will almost certainly expand our knowledge of the 'nationally rare' and 'scarce' species in Shetland. Consequently, the nationally rare and scarce status of the organisms presented here may require re-evaluation and in future species may be added to the list for this region. 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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J.J. Moore, Dr S. Scott, Dr S. Smith and I. Tittley; their assistance is much appreciated. Dr R.N. Bamber, Dr R.S.K. Barnes, Dr P.G. Hayward and I.J. Killeen also contributed information. The author would also like to thank the Shetland Oil Terminal Environmental Advisory Group (SOTEAG), especially Ms Lynda Kingham, for making available the results of two decades of monitoring in and around Sullom Voe commissioned by them and funded by the Sullom Voe Association (SVA). Without these, the analysis for Shetland would not have been complete. Access to the MNCR Database at the Joint Nature Conservation Committee, the NIBESRC Database at the Ulster Museum and the ERICA database run by the Cornish Biological Records Unit has been invaluable for the overall analysis.

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C. Contact names and addresses

Type of information	Contact address and telephone no.
Amphipods	Prof. P.G. Moore, University Marine Biological Station, Millport, Isle of Cumbrae KA28 0EG, tel: 01475 350581
Molluscs	Ian Killeen, 163 High Road, Felixstowe, Suffolk IP11 9BD, tel: 01394 274618
Bryozoans	Dr P.J. Hayward, School of Biological Sciences, University College Swansea, Singleton Park, Swansea, West Glamorgan SA2 8PP, tel: 01792 205678
Echinoderms	Dr J.D. Mackenzie, Dunstaffnage Marine Science Laboratory, Scottish Association for Marine Science, PO Box 3, Oban, Argyll PA34 4AD, tel: 01631 562244
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

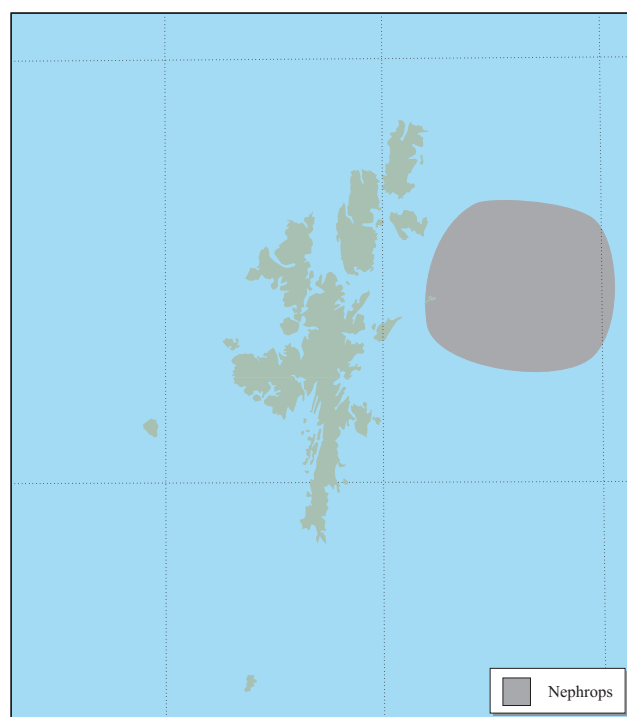
C.F. Robson

5.5.1 Introduction

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

This region is characterised by distributions of exploited species such as lobster, edible crab, velvet crab, squat lobster, *Nephrops*, crawfish, cockles, mussels, scallops and



Map 5.5.1 Distribution of *Nephrops*. © SOAEFD.

Table 5.5.1 Species names

Common name	Scientific name
Lobster	<i>Homarus gammarus</i>
Edible or brown crab	<i>Cancer pagurus</i>
Velvet crab	<i>Necora puber</i>
Squat lobster	<i>Munida rugosa</i>
Dublin Bay prawn, scampi, Norway lobster or langoustine	<i>Nephrops norvegicus</i>
Whip prawn (or shrimp - referred to as both)	<i>Dichelopandalus bonnieri</i>
Pink prawn (or shrimp - referred to as both)	<i>Pandalus montagui</i>
Brown shrimp	<i>Crangon crangon</i>
Spider crab	<i>Maja squinado</i>
Crawfish, spiny lobster	<i>Palinurus elephas</i>
Deep-water prawn (or shrimp - referred to as both)	<i>Pandalus borealis</i>
Cockle	<i>Cerastoderma edule</i>
Mussel	<i>Mytilus edulis</i>
Native oyster	<i>Ostrea edulis</i>
Periwinkle	<i>Littorina littorea</i>
Scallop	<i>Pecten maximus</i>
Queen scallop	<i>Aequipecten opercularis</i>
Whelk	<i>Buccinum undatum</i> & <i>Neptunea antiqua</i>
Razor shell	<i>Ensis</i> spp. & <i>Solen marginatus</i>
Cephalopods (octopus and squid)	<i>Eledone cirrhosa</i> & <i>Loligo forbesii</i>
Lugworm	<i>Arenicola marina</i>
Ragworm/king ragworm	<i>Neanthes virens</i> & <i>Hediste diversicolor</i>
Algae, for example knotted wrack & kelp	<i>Ascophyllum nodosum</i> & <i>Laminaria</i> spp.

queen scallops. There are no known exploitable quantities of whip prawns, pink prawns, brown shrimp, spider crab, deep water prawn or native oyster in the region.

5.5.2 Important locations and species

Crustacea

Lobster, edible crab and velvet crabs are distributed inshore throughout the region where there is suitably rocky habitat. Edible crabs are more often found on softer sediments - ranging from sand/gravel to rock - than lobsters. Juveniles tend to be found inshore and adults further offshore (Rees & Dare 1993). Crawfish are a westerly species and are found in the region, but are less common than lobster and crab. Squat lobsters are most common in the region on coarser substrates. The broadscale distribution of *Nephrops* is shown on Map 5.5.1. The distribution of *Nephrops* is determined by its preference for a sea bed of mud and muddy sand, into which it burrows; in this region there are populations in deeper waters east of the mainland.

Molluscs

Cockles are found in the intertidal mud and sandflats of sheltered sites in this region. Mussels are found around most of Shetland's coasts, from the mid shore to the subtidal zone in water of normal or variable salinity, and in areas exposed to water currents. On wave-exposed rocky shores

mussels are generally small, whereas larger sized (thus more exploitable) mussels are confined mainly to sheltered inlets such as voes. Mussels 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. There is little information on the specific location and size of cockle and mussel populations in the region. Periwinkles are found in abundance on rocky shorelines throughout the region, wherever suitable habitat is present. The native oyster does not occur in exploitable quantities in the region.

Scallops and queen scallops live on sandy/gravelly areas of sea bed. Important populations of scallops and queen scallops are present in many areas of the region; however, queen scallops are not as widely distributed as scallops. The broad scale distributions of scallops and queen scallops in the region are shown in Maps 5.5.2 and 5.5.3 respectively. Whelks are widely distributed throughout the region. Concentrations of squid occur seasonally in the region and octopus are also present. Razor shells occur in inshore areas where the sea bed is clean sand.

Polychaetes

The intertidal and subtidal zones in sheltered areas of the region support populations of polychaetes, such as the lugworm and ragworm. Lugworms are common in less exposed areas where there is a higher organic content in the substratum. They occur elsewhere in a wide range of sediment types from almost pure mud to clean sand (Davidson *et al.* 1991).

Others

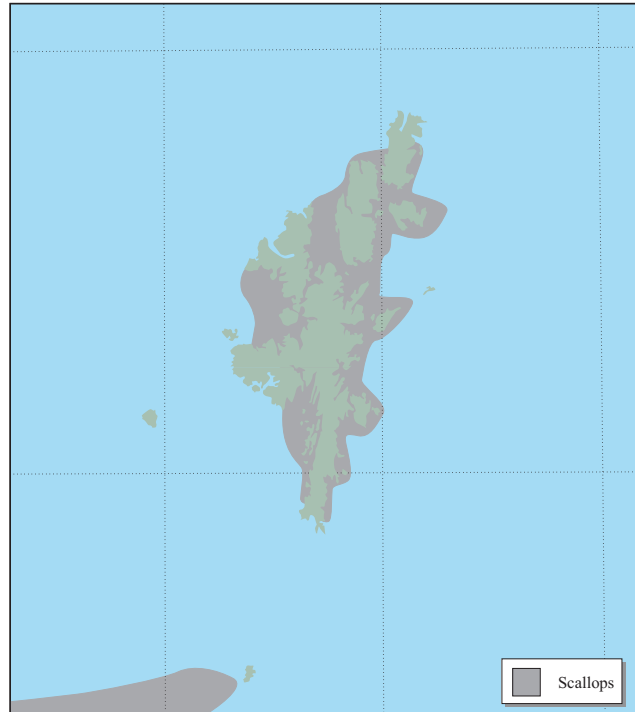
Seaweeds such as the knotted wrack and kelp are common on the sheltered shores of the region, especially in the voes (Maggs 1986).

5.5.3 Human activities

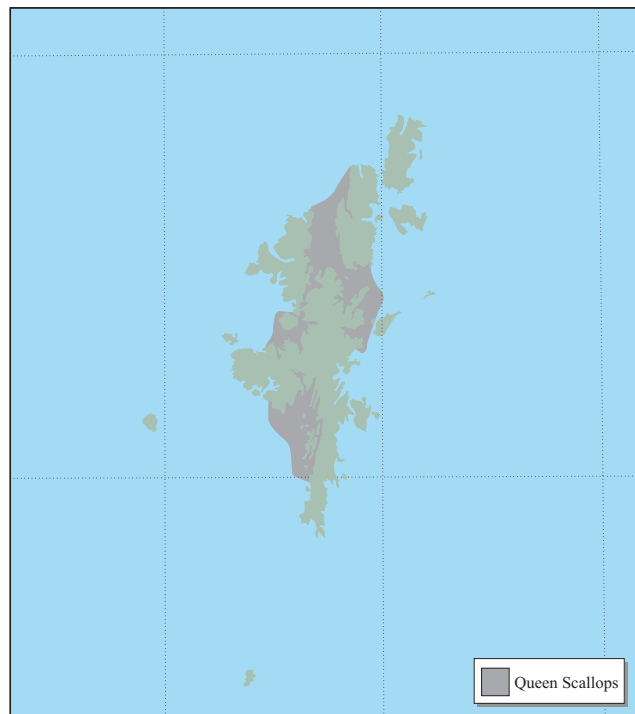
The exploitation by fisheries of the species covered in this section is described in detail in section 9.1, and by mariculture in section 9.2. The major issues relating to the exploited sea-bed species in this region are the state of the stocks in relation to the level of exploitation, possible effects of harvesting on non-target species and competition of fisheries with other predators such as birds.

Nephrops is considered to be a 'pressure stock', which means that it is perceived to be over-exploited (Anon. 1995). It is subject to catch quota management by the setting of an annual precautionary Total Allowable Catch (TAC), which limits landings (see section 9.1.3). The TAC for *Nephrops* effective in Region 1 covers ICES Division IVa (Northern North Sea).

There are no full year or seasonal closures on the use of mobile fishing gear (trawl, seine net, dredge - including suction dredging - etc.) made under the Inshore Fishing (Prohibition of Fishing and Fishing Methods) (Scotland) Order 1989 in this region. Lobster, edible and velvet crabs, *Nephrops* and scallops all have minimum landing sizes (see section 9.1.3). SOAEFD conducts triennial reviews of inshore fishing legislation under the Inshore Fishing



Map 5.5.2 Distribution of scallops. © SOAEFD.



Map 5.5.3 Distribution of queen scallops. © SOAEFD.

(Scotland) Act 1984. The most recent review was completed in 1996. The Shetland Fishermen's Association are attempting to gain a form of local control of shellfisheries in the region. A Committee has been formed with the aim of setting up a Regulating Order for Shetland. The Regulating Order would allow the Committee to impose restrictions, if necessary, on the commercial fishing of shellfish.

The MV *Braer* was grounded at Garths Ness at the southern end of Shetland on 5 January 1993. The resulting spill of 85,000 tonnes of oil meant that a temporary

exclusion zone for fish and shellfisheries was introduced. The shellfish ban has been progressively lifted; first crabs and lobsters were given the all-clear, then scallops, queen scallops and *Nephrops*. However the ban on taking whelks and mussels in the worst affected area - west Shetland - had not been lifted as at January 1997. Further information on the environmental impact of the *Braer* can be found in Ritchie & O' Sullivan (1994).

Scallop fishing in Scotland is the subject of a consultation by SOAEFD. An assessment of the main scallop stocks at the end of 1994 concluded that there was concern over the state of the stocks, in particular the sustainable rate of exploiting the fisheries in the east and north-east of Scotland. A weekend ban on fishing for scallops from May until September has been proposed in all inshore waters, to prevent fishing effort from increasing. The possible effects on the benthos, feeding birds and shellfish stocks of harvesting shellfish species are discussed in some of the publications in section 5.5.6B.

Bait collection, especially the digging of polychaetes, can have major localised effects on intertidal habitats and communities and can also cause disturbance to birds when they are concentrated in estuaries and embayments (see sections 5.11.3 and 5.12.3 and publications in section 5.5.6B). However, bait collection is not an intensive activity in the region (see section 9.1.2).

Stranded kelp plants, such as *Laminaria hyperborea*, are traditionally collected for agricultural use such as fertilising crofts and as animal feed. There is currently no harvesting of kelp from the sea. The impact of kelp harvesting is detailed in Wilkinson (1995).

5.5.4 Information sources used

The maps in this section show schematically the known broad-scale distributions of the main species of interest, based on information from the SOAEFD Marine Laboratory on the locations of the species and their fisheries. There is supporting information in the form of commercial landing statistics, samples and surveys (see sections 9.1 and 9.2). These data provide some information about the location of spawning and nursery areas. To establish the links between individual areas for spawning, nursery and adults would require specific research vessel investigations on the planktonic stage, 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.

Information was also used from Lee & Ramster (1981) and Pawson (1995); the latter contains distribution maps of scallops, lobster, edible crab and spider crab around the British Isles and has a species-specific bibliography.

5.5.5 Acknowledgements

The author thanks David McKay (SOAEFD Marine Laboratory), who provided maps and information for this

section, and also Austin Taylor (Shetlands Islands Council), Keith Hiscock (JNCC), John Uttley and David Donnan (Scottish Natural Heritage), Christine Howson, Peter Ellis (RSPB Shetland Officer), Daniel Owen and Euan Dunn (RSPB).

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C. Contact names and addresses

Type of information	Contact address and telephone no.
Marine and estuarine research on exploitable species	*SOAEFD Fisheries Research Services, Marine Laboratory, Aberdeen, tel: 01244 876544
Benthic surveys; MNCR Database	*MNCR Team, JNCC, Peterborough, tel: 01733 62626
Marine conservation issues	*Maritime Unit, Advisory Services, SNH, Edinburgh, tel: 0131 554 9797
Marine conservation issues	*Fisheries Officer, JNCC, Peterborough, tel: 01733 62626
Marine conservation issues	*Conservation Officer, RSPB, Sandy, tel: 01767 680551
Marine conservation issues	*Conservation Officer, WWF Scotland, Aberfeldy, tel: 01887 820449, and *Fisheries Officer, WWF-UK, Godalming, tel: 01483 426444
Marine conservation issues	*Conservation Officer, Marine Conservation Society, Ross-on-Wye, tel: 01989 566017

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

5.6 Amphibians and reptiles

Dr M.J.S. Swan

5.6.1 Introduction

The common frog *Rana temporaria*, is the only one of the amphibian and terrestrial reptile species native to the UK that is found in this region. Leatherback turtles *Dermochelys coriacea* are occasionally recorded off the Shetland coast, mostly in summer.

Both the common frog and the leatherback turtle are protected under the Wildlife & Countryside Act 1981, the Bern Convention 1979 and the EC Habitats & Species Directive 1992. The leatherback turtle is also included in the CITES Convention. The leatherback turtle, in particular, is of international conservation significance.

5.6.2 Important locations and species

Shetland has not been extensively surveyed for frogs and few data for the islands are archived at the national Biological Records Centre at Monks Wood. However, information from local naturalists suggests that frogs are more abundant and widely distributed than the national data indicate (Map 5.6.1). The common frog was probably introduced onto Mainland in the early 1900s and is now widespread there. More recently, it has been introduced onto Yell, where it is currently much less common, and it may also occur on Foula (M. Tasker pers. comm.). The species breeds in shallow marshy pools and other flooded areas, such as old quarries.

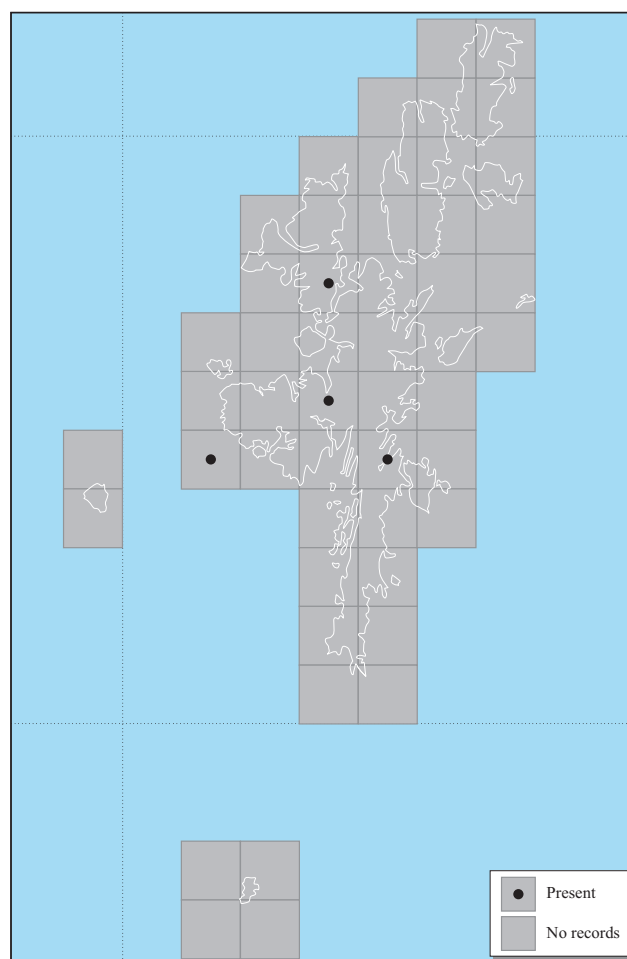
The leatherback turtle, previously considered a vagrant in Scottish waters, is thought by some to be resident at certain times of the year (Brongersma 1972; Langton *et al.* 1996). In common with much of the Scottish west coast, the seas around Shetland may constitute an important habitat for some populations of this globally threatened species.

5.6.3 Human activities

The presence of Shetland's only terrestrial amphibian is due to the artificial introduction of the species during the twentieth century. Many of the resulting populations are apparently viable, although climatic conditions and the low productivity of the freshwaters probably act as natural checks to frog abundance. Recent attempts to introduce the common toad *Bufo bufo* have been unsuccessful.

The extent to which marine turtles are threatened by human activities is largely unquantifiable. Only those stranded, injured by propellers or entangled in fishing gear are seen and few carcasses are investigated by post-mortem examination to establish the cause of death. Elsewhere, turtles are known to have died as a result of ingesting marine debris (e.g. plastic bags, oil, tar etc.) (Langton *et al.* 1996). The leatherback turtle is subject to a Scottish Natural Heritage 'Species Action Programme', which aims to maintain or enhance the conservation status of the species.

Concise information on turtle identification, reporting of sightings, UK legislation and instructions on what to do



Map 5.6.1 Records of common frogs in 10 km squares in Shetland. Distribution may reflect difference in recording effort. Source: Biological Records Centre, ITE Monks Wood.

with turtles caught in fishing gear are contained in the *Turtle Code*, an advice sheet available from Scottish Natural Heritage (SNH 1996). All sightings at sea and strandings should be reported to Scottish Natural Heritage in Edinburgh and to the Natural History Museum in London.

5.6.4 Information sources used

National distribution data were provided by BRC at Monks Wood (Arnold 1983, 1995). However, little herpetofaunal recording has been undertaken on Shetland (Table 5.6.1), so most of the information presented for the common frog was provided by local, informed sources, including the SNH local office and the Shetland Bird Club. Information on turtle distribution was supplied by the Natural History Museum in London and from Langton *et al.* (1996). Locally, turtle data are collated by the Shetland Cetacean Group and by the Shetland Bird Club.

Table 5.6.1 Records of amphibians and terrestrial reptiles related to survey effort.

	% 10 km squares surveyed for:				Total no. of individual records		Mean no. of individual records per surveyed 10 km square	
	Total no. of 10 km squares*	Any herp. species	Amphibians	Reptiles	Amphibians	Reptiles	Amphibians	Reptiles
Region 1	50	8	8	0	5	0	1.3	0
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

5.6.5 Acknowledgements

The author wishes to thank the following people for providing information: Henry Arnold, Martin Gaywood, Colin McCarthy, Kevin Osborne and Jonathan Swale.

5.6.6 Further sources of information

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C. Contact names and addresses

Type of information	Contact address and telephone no.
Conservation and captive breeding of amphibians and reptiles, nationally	British Herpetological Society, c/o The Zoological Society of London, Regent's Park, London NW1 4RY, tel: 0181 452 9578
Conservation of threatened reptiles and amphibians in Britain; priority species in Europe	Conservation Officer, The Herpetological Conservation Trust, 655A Christchurch Road, Boscombe, Bournemouth, Dorset BH1 4AP, tel: 01202 391319
National secretariat to local amphibian and reptile groups	Common Species Co-ordinator, Herpetofauna Groups of Britain and Ireland, c/o HCIL, Triton House, Bramfield, Halesworth, Suffolk IP19 9AE, tel: 01986 84518
National recording schemes and biological data from throughout UK	*Environmental Information Centre, ITE Monks Wood, Huntingdon, tel: 01487 773381
Turtles	Dr C. McCarthy, Natural History Museum, Cromwell Road, London SW7 5BD, tel: 0171 938 9123
Turtles	Dept. of Oceanography, Southampton University, Highfield, Southampton SO9 5NH, tel: 01703 595000
Amphibians and reptiles in Scotland, including turtles	*Scottish Natural Heritage, Advisory Services, Edinburgh, tel: 0131 554 9797
Amphibians and marine reptiles in region	*Shetland Cetacean Group, SNH Lerwick Office, tel: 01595 693345
Collation of turtle data	Shetland Bird Club, c/o 20 Nederdale, Shetland Office, Lerwick ZE1 0SA, tel: 01595 696926

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

5.7 Fish: exploited sea fish

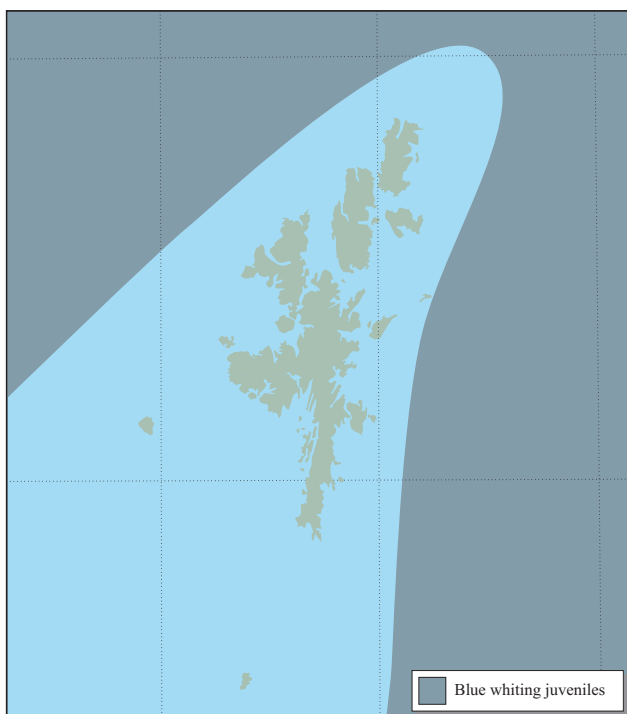
C.F. Robson

5.7.1 Introduction

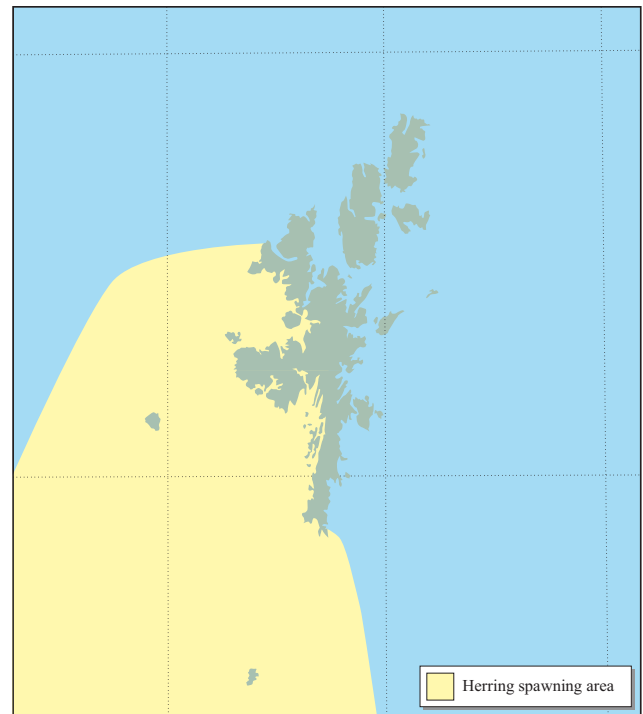
This section describes the distribution of sea fish that are of interest because they are exploited by people, mainly for food. Their exploitation by fisheries is described in [section 9.1](#). Sea fish described as pelagic are most commonly found in shoals swimming in midwater; they typically make extensive seasonal movements or migrations between sea areas. Demersal fish are those found living at or near the bottom of the sea. For this section, all sea fish that are not 'pelagic' are termed 'demersal'. 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 in some cases may recruit to inshore nursery grounds.

The distribution of exploited sea fish species can be mapped from analysis of catch data. This description of their distribution covers their occurrence at identifiable locations in the region during particular phases of their life history, and [Maps 5.7.1-5.7.5](#) show the known spawning and nursery areas of key species. Barring substantial climate change, stock collapse or other factors, these distributions and relationships will remain stable over several decades.

[Table 5.7.1](#) lists the main pelagic and demersal species occurring in the region and give examples of protection measures in this region.



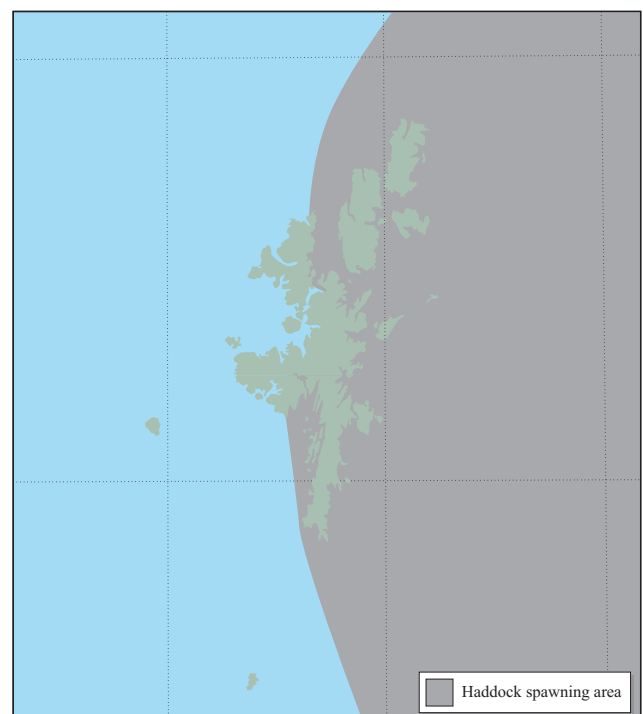
Map 5.7.2 Distribution of blue whiting juveniles. Source: Lee & Ramster (1981). © Crown copyright.



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

5.7.2 Important locations and species

Of the pelagic species, mackerel are widely distributed



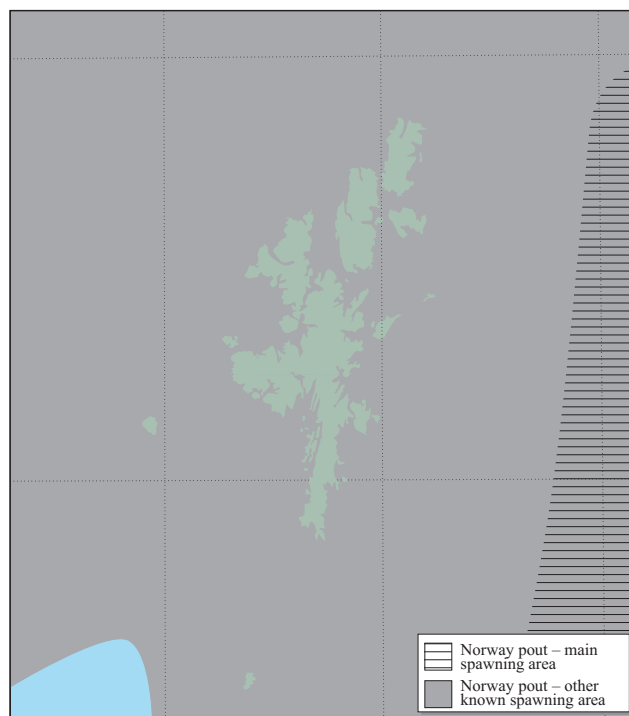
Map 5.7.3 Haddock spawning area. Source: Lee & Ramster (1981). © Crown copyright.

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

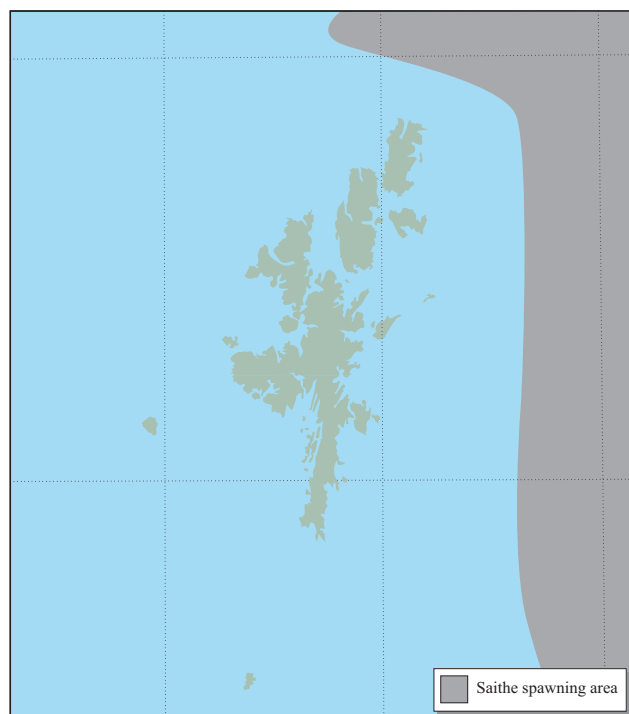
Species	Protection measures
Pelagic species	
Mackerel <i>Scomber scombrus</i>	MLS/QM
Horse mackerel <i>Trachurus trachurus</i>	MLS/QM
Herring <i>Clupea harengus</i>	MLS/QM
Sprat <i>Sprattus sprattus</i>	QM
Demersal species	
Elasmobranchs	
Spurdog <i>Squalus acanthias</i>	No limitation
Lesser spotted dogfish <i>Scyliorhinus canicula</i>	No limitation
Thornback ray <i>Raja clavata</i>	No limitation
Cuckoo ray <i>Raja naevus</i>	No limitation
Gadoids	
Cod <i>Gadus morhua</i>	MLS/QM
Whiting <i>Merlangius merlangus</i>	MLS/QM
Blue whiting <i>Micromesistius poutassou</i>	QM
Haddock <i>Melanogrammus aeglefinus</i>	MLS/QM
Norway pout <i>Trisopterus esmarkii</i>	QM
Ling <i>Molva molva</i>	MLS
Pollack <i>Pollachius pollachius</i>	MLS/QM
Saithe <i>Pollachius virens</i>	MLS/QM
Flatfish	
Plaice <i>Pleuronectes platessa</i>	MLS/QM
Dab <i>Limanda limanda</i>	MLS
Long rough dab <i>Hippoglossoides platessoides</i>	No limitation
Dover sole <i>Solea solea</i>	MLS/QM
Lemon sole <i>Microstomus kitt</i>	MLS
Turbot <i>Psetta maxima</i>	MLS
Brill <i>Scophthalmus rhombus</i>	MLS
Megrim <i>Lepidorhombus whiffiagonis</i>	MLS
Witch <i>Glyptocephalus cynoglossus</i>	MLS
Halibut <i>Hippoglossus hippoglossus</i>	MLS
Flounder <i>Platichthys flesus</i>	MLS
Other demersal fish	
Monkfish (angler) <i>Lophius piscatorius</i>	No limitation
Conger eel <i>Conger conger</i>	MLS
Gurnards <i>Triglidae</i> spp.	No limitation
Sandeels <i>Ammodytes</i> spp.	QM

Sources: European Council (1986, 1995); SOAEFD (pers. comm.).
 Key: MLS = minimum landing size; QM = catch quota management.

around Britain and are present in the seas off the region, more commonly in the summer. Mackerel found in this region originate from both North Sea and western stocks. Following the decline of the former in the late 1960s and early 1970s, however, the mackerel found here have originated predominantly from the western stock. During the northward feeding migration the main bulk of the population generally follow the course of the shelf edge to the west and north of Shetland to feeding grounds in the North and Norwegian Sea. A small proportion, however, enter coastal waters in June and remain there throughout the summer. More rarely - notably in the late 1970s - the main migration penetrate less far to the north and east and large quantities of mackerel are found feeding in this region in July and August. In more recent years mackerel have been at their most abundant in Shetland coastal waters during their return migration, when most of the population pass through or near the area. The timing of this annual



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



Map 5.7.5 Saithe spawning area. Source: Lee & Ramster (1981). © Crown copyright.

migration has become progressively later over the last 20 years, its peak having shifted from August in the early 1980s to January in the mid 1990s. In the 1990s the main migration route has been around the north and west of the Shetlands.

Herring are locally abundant in the summer and autumn in feeding areas throughout the region. The spawning areas east and south of Shetland are shown on Map 5.7.1. Herring larvae drift to shallow nursery areas in sheltered sea lochs.

Sprat are found around Shetland when they migrate inshore to overwinter between October and March. However, recently sprat have occurred around Shetland only in some years, rather than every year. Sprat spawning takes place in waters south of Shetland, mostly between May and July (Lee & Ramster 1981).

Elasmobranch species produce relatively small numbers of live young (10-100 per year, but can be fewer in large shark species) or eggs on the sea bed close to their nursery areas. Several species of elasmobranch occur sporadically, such as the spurdog, lesser-spotted dogfish, thornback ray and cuckoo ray.

Of the gadoids, cod are widely distributed in the region in the summer and spawning peaks during February. Whiting are abundant and widely distributed in the region, especially in inshore waters. The spawning season is prolonged - from January to September, depending on the latitude - and although there are no distinct spawning areas in the region there are likely to be spawning areas that have not been identified. Blue whiting are generally found beyond the continental shelf edge of the British Isles. In February considerable quantities of blue whiting occur in the deep channel between Shetland and the Faeroes. They migrate south for spawning, which peaks in mid-April, and in May they start to move northwards again. Juvenile blue whiting occur in the North Sea east off Shetland and between Shetland and the Faeroes (Map 5.7.2).

Haddock are widely distributed in the region and are present in large numbers in the summer and autumn. Spawning takes place from March to mid-May; the main spawning areas are found throughout the region, though mainly to the east (Map 5.7.3). There are no recognised nursery areas, as juvenile haddock are widely distributed. Norway pout are found throughout the region. Spawning takes place between January and April. The area to the east of Shetland has a main spawning concentration of Norway pout and the waters around Shetland are a known spawning area (Map 5.7.4). Ling and pollack are less abundant than haddock and Norway pout and more locally distributed, particularly around rocky reefs and wrecks. Saithe spawn in the deeper parts of the northern North Sea, north and east of Shetland (Map 5.7.5), mainly between January and March. Juvenile saithe migrate to inshore areas around Shetland for a year or two, after which they move offshore to deeper waters.

Plaice, dab and long rough dab occur on sandy areas of sea bed throughout the region, with juveniles living close to the shore in nursery areas, gradually moving to deeper water as they grow. Much more is known about the life history of the commercially-exploited plaice than the dab. Plaice are fairly abundant in some coastal waters of Shetland (Rae 1970). There are no known plaice spawning areas in the region, as revealed by plankton surveys (Lee & Ramster 1981). Dab spawn from January to June and the juveniles move to coastal nurseries in the autumn and migrate to deeper water as they grow. Long rough dab are widespread in the region and are most common south-east of the Shetland Isles (Rae 1970).

Dover sole have a similar lifestyle to plaice and dab but are more confined to areas with higher sea temperatures; they are therefore extremely scarce in the region. Turbot and brill are as scarce and have a similar lifestyle to plaice, dab and Dover sole. Turbot spawn from May to August (Rae & Devlin 1972). None of the flatfish species exhibits

extensive migrations, though the larvae can drift for several weeks from offshore spawning grounds to sandy inshore nursery areas. There may be some interchange, either way, between spawning stocks and nursery grounds in this and adjacent regions. Lemon sole are widespread in the northern North Sea, including Shetland, and favour deeper water than plaice, where rocky or boulder-strewn sea bed alternates with rough gravel (Rae 1970). It is assumed that lemon sole spawn wherever they are found, beginning in May and ending in October. Megrim are found at a greater depth than most other flatfish species and are found mainly along the edge of the deeper water to the north, east and west of Shetland. In the North Sea the principal areas for witches includes the area south and east of Shetland. There are no separate megrim or witch nursery or spawning areas recognised in the region. Halibut are a comparatively rare, deep-water flatfish species that is most frequent in the northern North Sea, including off Shetland. Flounders migrate in the summer between inshore nursery areas in the region to spawn offshore in late winter, and there appears to be little long-shore coastal movement other than in the egg or larval phase.

Monkfish (angler) spawn in deep water along the continental shelf edge, mainly between March and June, but juveniles and non-spawning adults can be found throughout the region. Other exploited demersal species of minor importance are conger eel and gurnards. Sandeels are present in the region (Lee & Ramster 1981) and provide an important food source for many exploited species. Their distribution is associated with the coarse sand that they burrow into. The sandeels around Shetland comprise locally spawned fish and ones that spawned north-west of Orkney and were brought into the region by currents.

5.7.3 Human activities

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

In Scottish inshore waters (to 6 nautical miles from baselines) the principal tools of fisheries management are the Inshore Fishing (Scotland) Act 1984 and orders issued under it. These give the Secretary of State powers to regulate fishing in specified inshore waters and to prohibit the carriage of specified types of net and the use of mobile gear near fixed salmon nets. There are no closures on the use of such methods under this Act in the region. SOAEFD conducts triennial reviews of inshore fishing legislation under the Inshore Fishing (Scotland) Act 1984. The most recent review was completed in 1996.

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, gear restrictions, bycatch restrictions and quantitative controls on catches of 'pressure stock' species (through catch quota management by the setting of annual Total Allowable Catches (TACs, further explained in section 9.1). Two such protection measures are presented in Table 5.7.1: MLS and catch quota management

(QM), which indicates that the UK has been allocated a TAC in the ICES Division that covers Region 1 - Division IVa. 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 fish species stocks, as well as other fish species, birds and species that live on the sea bed.

The economy of Shetland is largely dependent on the fishing industry and the surrounding seas have important spawning areas for many species. Fishing effort is restricted by the European Union in an area known as the 'Shetland Box'. The number of visiting boats allowed to fish within this area is limited through the 'Shetland Box licensing scheme', which limits the activity of vessels >26 m long fishing for demersal species. It is designed to help Shetland as a fisheries-dependent area by restricting access by non-UK vessels to a greater degree than anywhere else in UK waters. 128 licences are allocated - 62 to UK, 52 to France, twelve to Germany and two to Belgium. The 'Norway Pout Box' includes the waters to the south and east of Shetland. Here the use of small mesh net (16 mm minimum) for Norway pout is prohibited, thus protecting juvenile stock of other demersal species.

The sandeel fishery around Shetland, which was mainly fished by local boats, peaked in 1982, but since then landings have declined considerably. It is thought that the decline was due to a combination of low market prices and a decline of the stock. The fishery was closed in June 1990, partly in response to pressure from conservation groups, who maintained that the sandeel fishery may have been adversely affecting the breeding success of seabirds such as puffins (Bailey 1991; Monaghan 1992). Subsequent research has indicated that this was not the case (Wright & Bailey 1993; Wright 1996). Studies indicated that there was reduced recruitment to the Shetland area of sandeels that spawned on unfished grounds north of Orkney. The fishery was re-opened at the start of 1995, under restrictive management measures. These include a precautionary Total Allowable Catch of 3,000 tonnes, a requirement that all landings be made to Lerwick, a restriction on the length of the season (from March to the end of June), a limit to the number of licences issued, based on track records, and, if monitoring shows that the spawning stock biomass has fallen below a certain level, the closure of the fishery. In addition the management of the fishery is undertaken in consultation with the Shetland Fishermen's Association, which has recommended that only small boats (20 m or under) be permitted to participate in this fishery. These restrictions do not specifically limit access to sensitive wildlife areas, such as the seabird feeding grounds around south Shetland. Instead SOAEFD have indicated that they would prefer voluntary arrangements to be reached on such issues. Currently monitoring of sandeel populations in Shetland is sub-contracted by SOAEFD to the North Atlantic Fisheries College at Scalloway. Approximately 1,000 tonnes of sandeels were caught in each of the years 1995 and 1996 (P. Ellis, RSPB, pers. comm.).

Elasmobranch species do not have any protected status in the region. As a result of the relatively long time they take to reach reproductive maturity and the small numbers of young that they produce, they are held to be particularly vulnerable to exploitation.

Spawning and nursery areas may be vulnerable to other activities such as effluent discharge, sewage sludge dumping, dredging and dredge spoil dumping and

development of infrastructure such as pipelines. All dredging activities have short-term, localised effects, such as the removal of material and organisms, but long-term effects on 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). Short- or long-term changes in sediment deposition can result, as well as inevitable changes in the topography of the sea bed. SOAEFD is a statutory consultee for, or licenses, activities such as these, in which the distributions of exploited fish populations and their identifiable spawning and nursery areas have to be taken into account. Other activities, such as seismic activity for oil and gas exploration (Turnpenny & Nedwell 1994), may also have an effect on populations.

The *MV Braer* was grounded at Garths Ness at the southern end of Shetland on 5 January 1993. The resulting spill of 85,000 tonnes of oil meant that a temporary exclusion zone for fish and shellfisheries was introduced. The shellfish ban has been progressively lifted for crabs, lobsters, scallops, queen scallops and *Nephrops*; however the ban on taking whelks and mussels in the worst affected area - west Shetland - had not been lifted as at January 1997. Further information on the environmental impact of the *Braer* can be found in Ritchie & O' Sullivan (1994).

5.7.4 Information sources used

Whereas the life history of the exploited crustacean and mollusc species can be observed at or near the sites at which they are harvested, the distributions of fish populations can change considerably between juvenile and adult phases and with seasonal migrations. Therefore the information used in this section is based on the distribution and relative abundance of fish species as revealed by fisheries catch statistics obtained from recorded commercial landing figures. In addition, information is used from research vessel catch data and data from biological sampling during fishing surveys. Data from these surveys on the occurrence of spawning fish and juveniles can be used to identify spawning and nursery areas. However, this information is sometimes limited, and there may be other areas in addition to those described or shown on the maps where the species might also occur. Research surveys involving plankton sampling, hydrographic studies, fishing and tagging are required to establish the links between spawning groups and specific nursery areas, and between growing juveniles there and the adult populations to which they eventually recruit. The *Atlas of North Sea fishes* (Knijn *et al.* 1993) gives details of the distribution of fish from otter trawl surveys over two years. 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 author wishes to thank the following people for providing information and for commenting on drafts: John Hislop, Stuart Reeves and Martin Walsh (SOAEFD), Austin Taylor (Shetlands Islands Council), John H. Goodlad (Shetland Fishermen's Association), John Uttley and David Donnan (Scottish Natural Heritage), Peter Ellis (RSPB Shetland Officer) and Daniel Owen and Euan Dunn (RSPB).

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C. Contact names and addresses

<i>Type of information</i>	<i>Contact address and telephone no.</i>
Assessment and provision of advice on fish stocks in Scotland; marine conservation issues	*SOAEFD Fisheries Research Services, Marine Laboratory, Aberdeen, tel: 01224 876544
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	*Maritime Unit, Advisory Services, SNH, Edinburgh, tel: 0131 554 9797
Marine conservation issues	*Fisheries Officer, JNCC, Peterborough, tel: 01733 62626
Marine conservation issues	*Conservation Officer, RSPB, Sandy, tel: 01767 680551
Marine conservation issues	*Conservation Officer, WWF Scotland, Aberfeldy, tel: 01887 820449, and *Fisheries Officer, 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

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 this region. (Twaite shad *Alosa fallax* and alis shad *A. alosa* 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 rivers and coastal seas of Britain. 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. There are no main, large rivers in Shetland where salmon can spawn and so they are not abundant. However, the many sea lochs, such as the Loch of Spiggie, Loch of Cliff and Loch of Strom, as well as burns (streams) and surrounding coastal seas, are known to contain populations of sea trout. Eels can be found throughout Shetland, as elsewhere in Britain.

5.8.3 Human activities

Rod-and-line are used to catch salmon and sea trout in Shetland (Scottish Office 1996). No net methods are used and drift netting has been an illegal salmon fishing method in Scotland since 1962. Specific concern relating to the state of wild salmon and sea trout stocks has focused on a wide range of potential anthropogenic and natural impacts, such as the impact of oil-related activity in Shetland and predation by aquatic mammals and birds. Maitland & Campbell (1992) describe the possible effects of various other issues of relevance to freshwater fish.

There is now compelling evidence that salmon may belong to different genetic populations, each associated with its natal river, and that, in larger rivers at least, sub-stocks may be associated with different parts of the river system (Verspooor *et al.* 1991; Scottish Office Agriculture & Fisheries Department 1992). This aspect of salmonid stock definition is significant for the management of salmon fisheries because of concern regarding genetic interactions between wild stocks and escaped farmed fish, and fish deliberately introduced for re-stocking purposes (Webb 1991; Webb *et al.* 1991). There is also concern that sea trout stocks have declined and that the numbers of sea lice supported by

salmon farms may be in some way to blame. There is concern that these will impact on natural wild fish stocks and negatively affect salmon- and sea trout-fishing tourism in the region.

5.8.4 Information sources used

Under the provisions of the Salmon and Freshwater Fisheries (Protection) (Scotland) Act 1951, data are collected on catches of salmon and sea trout for each salmon fishery. The SOAEFD Montrose Field Station of the Freshwater Fisheries Laboratory collects, collates and publishes these data annually as a *Statistical bulletin* (Scottish Office 1996). The 'returns' are made through an annual questionnaire sent to proprietors and occupiers of salmon fishings.

5.8.5 Acknowledgements

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C. Contact names and addresses

<i>Type of information</i>	<i>Contact address and telephone no.</i>
Wild salmon and freshwater fisheries policy; contact details of the Clerks of the District Salmon Fishery Boards	*SOAEFD Division K2, Pentland House, Edinburgh, tel: 0131 244 6230
Collation of salmon and sea trout catch statistics in Scotland	SOAEFD, Freshwater Fisheries Laboratory, Montrose Field Station, 16 River Street, Montrose DD10 8DL, tel: 01674 677070
Research into freshwater fish species, habitats, behaviour and exploitation in Scotland	SOAEFD, Freshwater Fisheries Laboratory, Faskally, Pitlochry, Perthshire PH16 5LB, tel: 01796 472060
Additional fisheries data to that published in the Statistical Tables. Marine and estuarine fisheries research.	*SOAEFD Fisheries Research Services, Aberdeen, tel: 01224 876544
Conservation of wild salmon; salmonid research	Director, The Atlantic Salmon Trust, Moulin, Pitlochry PH16 5JQ, tel: 01796 473439
Conservation issues	*Maritime Unit, Advisory Services, SNH, Edinburgh, tel: 0131 554 9797
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

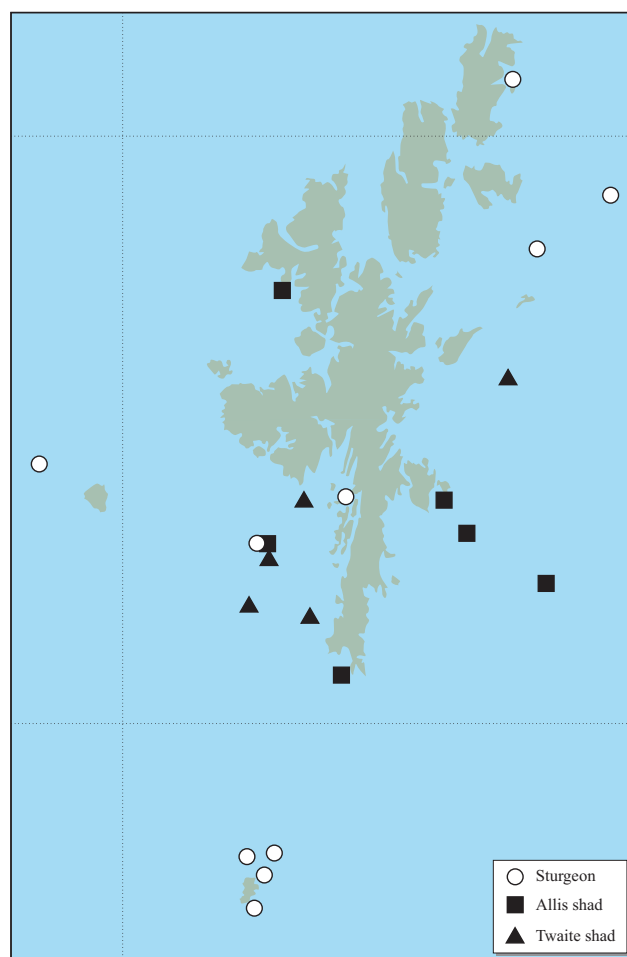
5.9.1 Introduction

There are 159 species of exploited and unexploited fish (out of a national total of 336) recorded from this region, comprising the lamprey (a jawless fish -Agnatha), 26 sharks and rays (elasmobranchs) and 132 bony fish (teleosts). The species regional total is not definitive: some groups, such as the skates and rays (Rajidae) and dragonets (Callionymidae), have not been identified to species level and the list must be considered incomplete.

This region has records of five of the seven British marine and estuarine species protected under national, European and international legislation (Table 5.9.1). These have mostly been individual records of allis and twaite shads *Alosa alosa* and *Alosa fallax*, sturgeon *Acipenser sturio* and sea lamprey *Petromyzon marinus*, (only recently confirmed for Shetland). The lampern *Lampetra fluviatilis* has not been recorded. The sand goby *Pomatoschistus minutus* has been recorded, but its relative the common goby *Pomatoschistus microps* has not. These species are considered threatened in European waters and, except for the gobies, in UK waters also (Potts & Swaby 1993a).

5.9.2 Important locations and species

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 type (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



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

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 <i>Lampetra fluviatilis</i>		Ia, Va	III	
Sea lamprey <i>Petromyzon marinus</i>		Ia	III	
Sturgeon <i>Acipenser sturio</i>	5	Ia, Va	III	I
Allis shad <i>Alosa alosa</i>	5	Ia, Va	III	
Twaite shad <i>Alosa fallax</i>		Ia, Va	III	
Common goby <i>Pomatoschistus microps</i> *			III	
Sand goby <i>Pomatoschistus minutus</i> *			III	

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

occupy several habitats during different phases of their life-cycles.

Reports of protected species in Shetland are few. The sea lamprey was previously reported in the region as 'probably . . . confined to larger accessible rivers' (Flinn 1974), but was only recently confirmed in Shetland waters when a specimen was taken about 10 miles north-west of Uyea Island (west Shetland) (Henderson pers. comm.). Only single records exist for the sturgeon and allis and twaite shads, in rare fish reports (Map 5.9.1). The current status of these species has yet to be fully determined.

Some fish species have been recorded in reports of the diet of other animals on Shetland. Fish that feature in the diet of otter *Lutra lutra* are given in Kruuk *et al.* (1987) and include the viviparous blenny *Zoarces viviparus*, the butterflyfish *Pholis gunnellus*, the five-bearded rockling *Ciliata mustela* and, less commonly, the northern, shore and three-bearded rocklings (*Ciliata septentrionalis*, *Gaidropsarus mediterraneus* and *Gaidropsarus vulgaris* respectively), together with the sea scorpion *Taurulus bubalis*, bull rout *Myoxocephalus scorpius* and eel *Anguilla anguilla*. If single records are included, a total of eleven fish species have been recorded. The fish in the diet of the great skua *Catharacta skua* were identified by Furness & Hislop (1981) by pellet examination. Seven species were recorded, with sandeel the largest dietary component. Other species included redfish *Sebastes viviparus* and blue whiting *Micromesistius poutassou*. Porbeagle sharks gather to give birth south of Sumburgh Head (P. Ellis pers. comm.).

5.9.3 Human activities

The sandeel population crash, which resulted in a seabird breeding failure in Shetland, is detailed in Monaghan (1992). Possible effects of fisheries on species are discussed in Coull *et al.* (1979), Berry & Johnston (1980), Bailey (1994) and in sections 5.7 and 9.1. The cultivation of shellfish and fish species in the region is discussed in Dixon (1986, 1987) and in section 9.2. Sea angling occurs in many places throughout the region (Orton 1996) (see section 9.1.2).

5.9.4 Information sources used

The British Marine Fishes Database contains data on the marine and estuarine fishes of Scotland. The data include published literature, unpublished reports and personal communications from fish biologists, covering aspects of fish biology and ecology, conservation status and fish records. The Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD) holds information on marine and estuarine fishes. Other important sources of information on Shetland fish species include Berry & Johnston (1980), Evans & Buckley (1899) and Knijn *et al.* (1993).

5.9.5 Acknowledgements

The authors would like to acknowledge the help of Gordon Henderson, Derek Rushton and Jill Blackadder. Thanks are also due to Peter Ellis (RSPB).

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C. Contact names and addresses

<i>Type of information</i>	<i>Contact address and telephone no.</i>
British Marine Fishes Database	Dr G.W. Potts/S.E. Swaby, Marine Biological Association of the UK, Citadel Hill, Plymouth PL1 2PB, tel: 01752 633100/600301
Fisheries - Scotland	*SOAEFD Fisheries Research Services, Marine Laboratory, Aberdeen, tel: 01224 876544
Fish conservation - UK	*Fisheries Officer, JNCC, Peterborough, tel: 01733 62626
Fish conservation - Scotland`	*Maritime Unit, SNH HQ, Edinburgh, tel: 0131 554 9797

*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 and seaduck: in other words those species reliant for an important part of their life on the marine environment. (Section 5.12 includes information on these waterfowl species where they occur close inshore.) Scientific names of seabird species are given in Table 5.10.1.

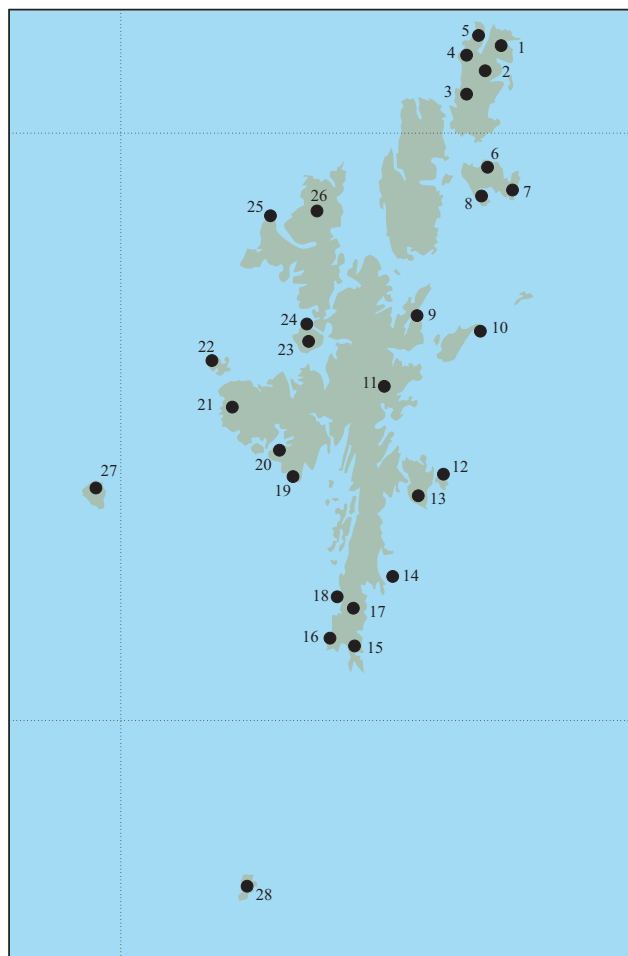
This region is internationally important for seabirds and is amongst the most important for offshore seabirds in Europe. The region is especially important for its cliff-and island-nesting seabirds, particularly fulmar, gannet, shag, arctic skua, great skua, great black-backed gull, kittiwake, common and arctic tern, guillemot, razorbill, black guillemot and puffin, whose Shetland populations all exceed 1% of the European population (Table 5.10.1). The populations of gannet and great skua are particularly important in a world context.

The greatest concentrations of birds at sea in this region are near the colonies during the breeding season. When feeding conditions are favourable, most feeding occurs comparatively close inshore. Sheltered areas of the east and

Table 5.10.1 Overall importance of seabirds breeding in Shetland

Species	Total	% GB	% Europe
Fulmar <i>Fulmarus glacialis</i>	234,500	43.6	4.0
Manx shearwater <i>Puffinus puffinus</i>	c. 200	<1	<1
Storm petrel <i>Hydrobates pelagicus</i>	1,000	>1	<1
Leach's petrel <i>Oceanodroma leucorhoa</i>	10	<1	<1
Gannet <i>Morus bassanus</i>	20,879	10.4	8.8
Cormorant <i>Phalacrocorax carbo</i>	215	3.2	<1
Shag <i>Phalacrocorax aristotelis</i>	6,810	18.7	5.4
Arctic skua <i>Stercorarius parasiticus</i>	1,878	58.6	10.7
Great skua <i>Catharacta skua</i>	6,196	72.9	45.5
Black-headed gull <i>Larus ridibundus</i>	337	<1	<1
Common gull <i>Larus canus</i>	2,509	3.7	<1
Lesser black-backed gull <i>Larus fuscus</i>	500	<1	<1
Herring gull <i>Larus argentatus</i>	5,000	3.3	<1
Great black-backed gull <i>Larus marinus</i>	3,175	17.2	3.8
Kittiwake <i>Rissa tridactyla</i>	50,100	10.2	2.9
Common tern <i>Sterna hirundo</i>	1,050	8.3	1.1
Arctic tern <i>Sterna paradisaea</i>	9,800	22.8	3.5
Guillemot <i>Uria aalge</i>	162,650	15.5	2.7
Razorbill <i>Alca torda</i>	14,960	10.2	1.2
Black guillemot <i>Cepphus grylle</i>	12,008	32.0	6.0
Puffin <i>Fratercula arctica</i>	c. 200,000	22.3	1.4

Sources: regional totals compiled from the most recent available good quality counts up to 1995. Many of these counts derive from 1985-86 and monitoring indicates some changes since then. Figures for Great Britain from Thompson *et al.* (1996), those for Europe from Lloyd *et al.* (1991). Note: counts are of pairs, except for guillemots, razorbills and black guillemots, which are counted individually.



Map 5.10.1 Colonies holding at least 1% of the GB population of any seabird species. Sites are listed in Table 5.10.2. Source: JNCC Seabird Colony Register.

north-east coasts of the islands are important for wintering birds, especially eiders and black guillemots. Several colonies qualify as Special Protection Areas under the European Birds Directive; their associated feeding areas are equally important.

5.10.2 Important locations and species

Much of the coastline of this region is colonised by seabirds. Some sections of coastline, such as north-west Mainland and western Unst, have several contiguous colonies. Boundaries between colonies in these areas are imprecise, making evaluation difficult. Table 5.10.2 shows the seabird colonies of at least national importance for particular species in the region; their locations are shown on Map 5.10.1.

Of the colonies in the region, 23 hold numbers of seabirds at or above 1% of the individual species' total populations in the European Union. A further five colonies are important at the Great Britain level. Hermaness, north-east Unst, Fetlar, Noss, Fair Isle and Foula each hold more than one population of international importance. Most

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

Site no. on Map 5.10.1	Colony	Grid ref.	Species	Count	Count date	>1% GB/EU population	Protected status
Unst							
1	North-east Unst	HP640140	Fulmar	15,810	1986	EU	
			Arctic skua	56	1986	EU	
			Great skua	353	1986	EU	
2	Crussa Field	HP610110	Arctic skua	49	1986	EU	SSSI
			West Unst	HP585070	Arctic skua	41	1986
3	West Unst	HP585070	Arctic skua	41	1986	EU	
4	North-west Unst	HP580130	Great skua	203	1986	EU	
5	Hermaness	HP605160	Fulmar	12,970	1986	EU	SPA, NNR, SSSI
			Gannet	11,994	1994	EU	
			Great skua	896	1989	EU	
			Guillemot	16,958	1991	EU	
			Puffin	25,413	1987	EU	
Fetlar							
6	Central & north-east Fetlar	HU630930	Arctic skua	118	1986	EU	SPA, SSSI
			Great skua	101	1986	EU	
7	East Fetlar	HU660900	Black guillemot	494	1983	EU	
8	South-west Fetlar	HU610885	Arctic skua	46	1985	EU	SPA, SSSI
			Great skua	139	1985	EU	
			Black guillemot	417	1983	EU	
Mainland & Islands							
9	Lunnasting & Lunna Ness	HU500690	Black guillemot	433	1983	EU	
10	Whalsay & Out Skerries	HU600650	Arctic tern	470	1989	GB	
			Black guillemot	823	1983	EU	
11	North Nesting	HU440570	Arctic skua	35	1986	EU	
12	Noss	HU545405	Fulmar	5,871	1986	EU	SPA, NNR, SSSI
			Gannet	7,310	1994	EU	
			Great skua	424	1992	EU	
			Guillemot	38,967	1991	EU	
			Arctic skua	45	1986	EU	
13	South-east Bressay	HU510380	Great skua	95	1986	EU	
14	Mousa	HU460240	Storm petrel	c. 6,000	1995	GB	SPA, SSSI
15	South Mainland	HU395130	Great black-backed gull	260	1986	EU	
			Guillemot	10,731	1991	GB	
			Fulmar	15,245	1986	EU	
16	Fitful Head	HU350140	Arctic tern	500	1993	GB	
17	Ward of Scousburgh	HU387188	Arctic tern	500	1993	GB	
			Guillemot	38,967	1991	EU	
18	St Ninian's coast	HU370210	Fulmar	8,586	1986	EU	SSSI
			Great black-backed gull	202	1986	GB	
19	Clett Stacks	HU292414	Cormorant	108	1995	GB	
20	Ward of Culswick	HU273458	Arctic skua	46	1986	EU	SSSI
21	West Mainland	HU190540	Fulmar	5,720	1986	EU	SSSI
22	Papa Stour	HU160610	Arctic skua	101	1992	EU	SSSI
23	Muckle Roe	HU320650	Black guillemot	203	1994	GB	SSSI
24	West Muckle Roe	HU310675	Cormorant	65	1995	GB	SSSI
25	Tingon	HU255855	Arctic skua	38	1985	EU	SSSI
26	North Roe	HU325865	Arctic skua	78	1985	EU	SSSI
			Great skua	114	1985	EU	
27	Foula	HT965400	Fulmar	46,800	1986	EU	SPA, SSSI
			Storm petrel	ND		GB	
			Shag	2,400	1987	EU	
			Arctic skua	126	1995	EU	
			Great skua	2,174	1993	EU	
			Arctic tern	1,000	1995	EU	
			Guillemot	37,500	1987	EU	
			Razorbill	6,200	1987	EU	
			Puffin	48,000	1987	EU	

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

Site no. on Map 5.10.1	Colony	Grid ref.	Species	Count	Count date	>1% GB/EU population	Protected status
28	Fair Isle	HZ210720	Fulmar	35,210	1986	EU	SPA, SSSI
			Shag	946	1993	EU	
			Arctic skua	87	1995	EU	
			Great skua	130	1995	EU	
			Kittiwake	19,340	1988	EU	
			Arctic tern	1,200	1995	EU	
			Guillemot	37,563	1994	EU	
			Razorbill	3,053	1988	EU	
			Puffin	17,386	1995	EU	

Source: JNCC/Seabird Group Seabird Colony Register. Note: counts are of pairs, except for guillemots, razorbills and black guillemots, which are counted individually. ND = no data.

colonies are located on the cliffs that characterise much of the coast of the area, and adjacent moorland is also important for ground-nesting seabirds.

Numbers of a total of thirteen species breeding throughout the region as a whole each exceed 1% of their European populations (Table 5.10.1). Numbers of a further four species exceed nationally important levels. Of special note are the great and arctic skua populations, whose numbers exceed 10% of their European populations. Gannet, shag and black guillemot are also present in numbers exceeding 5% of this level. Around 424 pairs of red-throated divers nest in Shetland (P. Ellis pers. comm.), representing about half of the Great Britain population (there is currently no estimate for the European or EU population). Shetland supports large numbers of eiders: about 7,000 birds were present around the islands in late summer 1993 (Dunnet & Heubeck 1995).

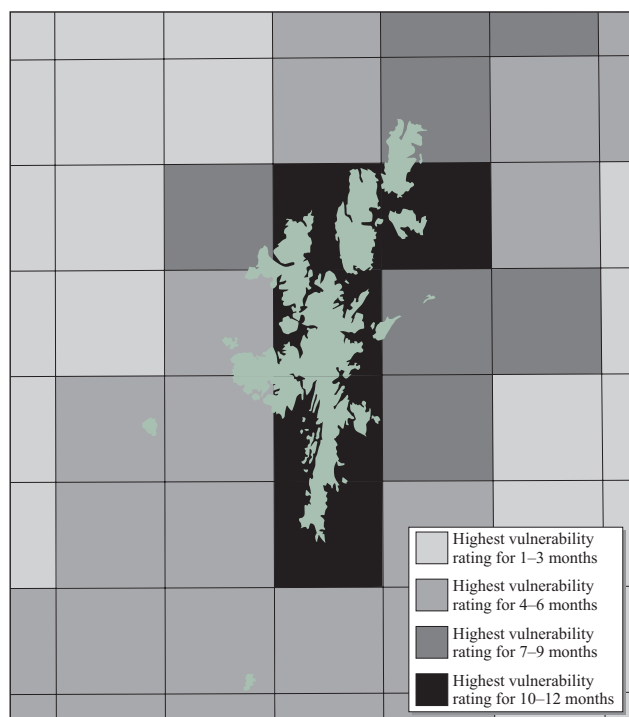
Offshore, seabirds require food; natural foods range from zooplankton to small fish and waste from fishing fleets. Habitats that concentrate any of these foods are preferred. Zooplankton can be concentrated in zones where water masses meet, or where tides converge around islands or over some seabed features. Many of the species for which the region is important feed on sandeels and other small fish in the summer. Sandeels require well-oxygenated sandy sediment to live in; such conditions occur in several areas in the region. The seaduck and nearshore birds need relatively sheltered waters and feed on a variety of benthic organisms including fish, shellfish and invertebrates. In general, divers and seaduck tend to occur in areas with less than about 20 m water depth.

Areas at sea are of great importance to seabirds. The nearshore waters of Shetland hold vulnerable concentrations of birds virtually throughout the year (Carter *et al.* 1993; Stone *et al.* 1995). Map 5.10.2 shows the relative importance of region and adjacent seas for seabirds in terms of vulnerability. In winter the main species concerned are eiders, black guillemots, shags and great northern divers. Species that feed further offshore, such as kittiwake, guillemot, puffin and razorbill, tend to leave Shetland waters outside the breeding season. This is probably due to the relative lack of food in Shetland waters in winter, compared with areas south and eastwards in the North Sea. These northern offshore waters support high densities of fulmars for much of the year, although in winter it seems likely that many birds are reliant on waste from fisheries.

Research has been carried out around Sumburgh Head

comparing feeding ranges in years with poor food availability with years of improved conditions (Hamer *et al.* 1993). In poor years, surface-feeding birds such as kittiwakes would travel 50 km or more in search of food (or abandon their breeding attempts), while in good years feeding occurred within 5 km of the colony. Birds that dive beneath the water to forage, such as shags and guillemots, fed closer to the colony in all years, but there was evidence that they had to work harder to find sufficient food (Uttley *et al.* 1994). Studies showed similar feeding distances for diving birds near Fair Isle.

The waterfowl using sites in the region during winter are also of considerable importance. There is no regular survey of the whole region, but counts of numbers in Yell and Bluemull (extended to Fetlar) Sounds are carried out on an annual basis by the Shetland Oil Terminal Environmental Advisory Group (SOTEAG). Surveys were also carried out



Map 5.10.2 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. Source: JNCC Seabirds at Sea Team.

by the Nature Conservancy Council/Nature Conservancy Council for Scotland in February-March 1991 and over winter 1991/92, covering most of the remaining suitable coastlines of Shetland (Suddaby 1991, 1992). Eiders *Somateria mollissima* are the most abundant species recorded on nearshore surveys. They move to long-established sites all around the islands to moult following the breeding season. Approximately 15,500 were found in August 1977, 8,000-9,000 in 1980-82; 7,200 in 1992 and 5,900 (about 7% of the GB population) in 1996 (Heubeck 1987, 1993, pers. comm.). In terms of overall importance in a British context, Shetland holds some 300 great northern divers *Gavia immer* (about 10% of GB population) and 2,500-3,000 long-tailed duck *Clangula hyemalis* (about 12% of GB population). Great northern divers tend to be scattered around the coasts, with many individuals returning to the same wintering sites between years. Long-tailed ducks tend to be found in sheltered sea areas, with a concentration usually present in the Bluemull - Fetlar area. Importance levels used above are taken from Waters *et al.* (1996).

There are, at present, no protected sites at sea in the region, but seven colonies lie within Special Protection Areas and sixteen are within Sites of Special Scientific Interest.

5.10.3 Human activities

Seabirds can be particularly affected by marine oil pollution, and spills near the main colonies during the breeding season could be catastrophic. Inevitably there were concerns that offshore oil exploration near the region would add to the risks of oil spill but so far there have been no major offshore incidents. Exploration and production to the west (upwind) is still in its infancy, so the risks have not abated. Sullom Voe supports a large oil transshipment terminal. In 1978, early in its operation, a collision between a tanker and the jetties led to a large fuel oil spill, which damaged many species in Yell Sound (Heubeck & Richardson 1980). Some, but not all, species in Yell Sound have recovered (Heubeck 1989), and enhanced anti-pollution surveillance and tanker-handling procedures have meant that there have been no major incidents subsequently (Richardson *et al.* 1982). However, tankers on passage past Shetland still pose a threat to seabirds in the area, as was illustrated by the wreck of the oil tanker *Braer* in south Shetland in January 1993 (e.g. Heubeck *et al.* 1993). Luckily rather few birds were in the area, and the type of oil and weather conditions meant that the oil did not linger long on the water surface. Spills can also occur from non-tanker shipping movements, and the majority of samples of oil collected from Shetland beaches appear to come from wastes from the bilges or fuel tanks of ships.

Most breeding seabirds require habitat that is free from predatory mammals, hence nearly all colonies are on islands, cliffs or remote areas of moorland. However, the arrival of feral ferrets on Sumburgh Head (having escaped from captivity) led to a decline in some species there, and there are concerns about the impacts of feral cats at Hermaness and Sumburgh Head. Elsewhere, introduced hedgehogs have been seen preying on tern eggs (Uttley *et al.* 1989). The large gulls and skuas appear to be able to tolerate more disturbance by mammals than the smaller seabird species.

Seabird breeding numbers are likely to be affected by changes in fish stocks and fisheries activities. Some fish stocks have declined greatly, owing to fisheries activities. Populations of scavenging seabirds may increase if amounts of waste discarded increase. Conversely it is possible, although not demonstrated, that direct fisheries on small fish that are also consumed by seabirds, such as sandeels, might in turn lead to decreases in seabird populations. If populations of scavenging birds have increased in the past, then they might be expected to decrease should fisheries produce less waste. If the scavenging species can take other foods, then they may switch over to these foods; this may be occurring in Shetland with great skuas, some of which are feeding on kittiwakes.

5.10.4 Further sources of information

In Table 5.10.2, colonies are those defined by the counters who contributed to the JNCC/Seabird Group Seabird Colony Register, or that have been subsequently used in analysis (Lloyd *et al.* 1991). The location of a colony may not correspond to any statutory designated site. All seabird colonies in the region were counted between 1984 and 1987; many areas have been re-counted since. These counts, and all those made since 1969, are held on the JNCC/Seabird Group Seabird Colony Register. Numbers and breeding performance of several species at a number of colonies on Mainland, Yell and Noss are evaluated annually by Aberdeen University under contract to the Shetland Oil Terminal Environmental Advisory Group (SOTEAG). Studies on Fair Isle are carried out by Fair Isle Bird Observatory, while those on Foula are undertaken by Glasgow University. The Royal Society for the Protection of Birds co-ordinates annual monitoring of skua and tern colonies. Annual assessments of breeding performance and population changes are made at many colonies. Surveys of birds at sea off the region have been carried out by JNCC's Seabirds at Sea Team (SAST) since 1979. Survey effort by this team from ships off the region has been relatively even: 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. Surveys of nearshore waters in the region have been carried out by SOTEAG/Aberdeen University and RSPB; coverage has been generally good.

5.10.5 Acknowledgements

Thanks are due to Peter Ellis (RSPB), Martin Heubeck, who organised most of the recent counts on which the Seabird Colony Register is based, Kate Thompson, who abstracted the Seabird Colony records and summarised the information presented here, and many others, who carried out the counting.

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C. Contact names and addresses

<i>Type of information</i>	<i>Contact address and telephone no</i>
Seabird colonies	*Co-ordinator, Seabird Colony Register, JNCC, Aberdeen, tel: 01224 655700
Seabirds at sea	*Seabirds at Sea Team, JNCC, Aberdeen, tel: 01224 655700
Birds database	*Species Data Custodian, JNCC, Peterborough, tel: 01733 62626
Information on seabirds in Scotland	*SNH, International and Biodiversity Branch, Edinburgh, tel: 0131 554 9797
Information on seabirds in Shetland area	*Conservation Officer, SNH, Northern Isles Area, Shetland Office, Lerwick, tel: 01595 693345
Nearshore waterfowl	*Wildfowl and Wetlands Trust, Slimbridge, tel: 01453 890333
Shetland seabirds	RSPB Shetland Office, East House, Sumburgh Head Lighthouse, Virkie, Shetland ZE3 9JN, tel: 01950 460800
Shetland seabirds	Martin Heubeck, Aberdeen University / Shetland Oil Terminal Environmental Advisory Group, East House, Sumburgh Head Lighthouse, Virkie, Shetland ZE3 9JN, tel: 01950 460760

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

5.11 Other breeding birds

R.T. May & A.B. Law

5.11.1 Introduction

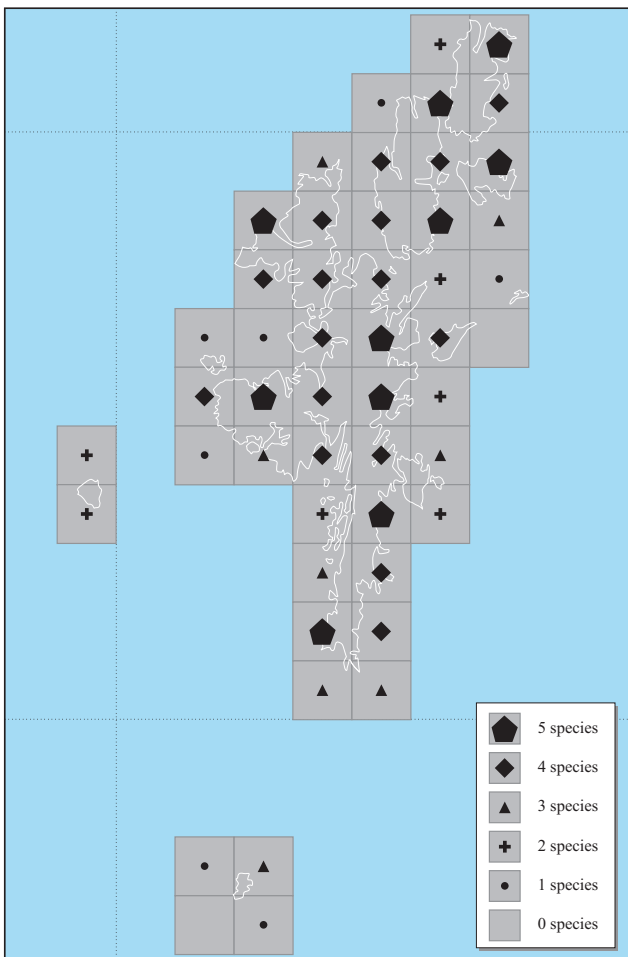
This section outlines the importance of the region to breeding birds other than seabirds. Because of their distinctive ecology and mixed-species breeding colonies, seabirds (including the importance of offshore areas for them) are described separately in section 5.10. The occurrence of marine waterfowl (divers, grebes and seaducks) is noted here, where it is of particular importance in the region.

Many of the Shetland islands have rocky coastlines and the inland habitats are predominantly moorland, bog and heathland. These habitats are important areas for breeding birds. This region is a major stronghold of the whimbrel *Numenius phaeopus* and red-necked phalarope *Phalaropus lobatus* (Gibbons *et al.* 1993). Fetlar holds 90% of the British population of red-necked phalarope (P. Ellis pers. comm.) and about 95% of Britain's breeding whimbrel are found on Shetland (Pritchard *et al.* 1992). The breeding waterfowl assemblages in Shetland are diverse (Maps 5.11.1 and 5.11.2), and densities of breeding birds are high.

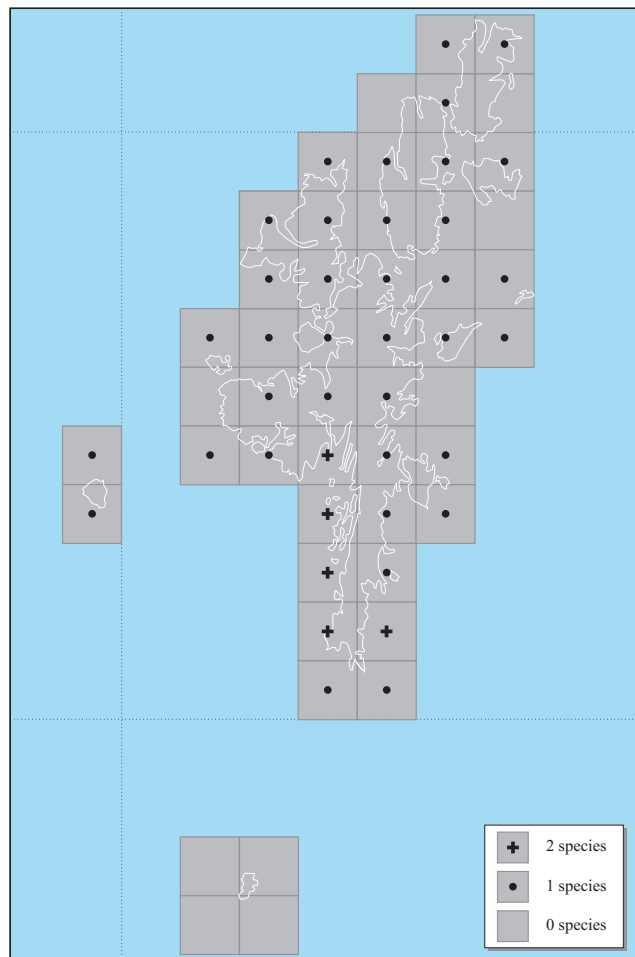
Numbers of lowland breeding waders, especially those associated with wet grassland areas and saltmarshes, have been declining, not only nationally but also internationally (Hötker 1991), because of habitat loss or degradation. Although there are few large areas of saltmarsh and coastal wet grassland in Shetland (see sections 3.6 and 3.5 respectively), sites in the region play an important role in maintaining the ranges of these breeding birds. The importance of the region for these birds is thus likely to increase further.

5.11.2 Important locations and species

Shetland has a diverse breeding waterfowl assemblage: Map 5.11.1 shows the incidence of confirmed breeding in 10 km squares in Shetland of selected species characteristic of wet grassland (teal *Anas crecca*, lapwing *Vanellus vanellus*, redshank *Tringa totanus*, mallard *Anas platyrhynchos*, snipe *Gallinago gallinago*, pintail *Anas acuta*). The large areas of bog and moorland provide suitable breeding habitat for



Map 5.11.1 Number of confirmed breeding species characteristic of wet grassland (teal, lapwing, redshank, mallard, snipe and pintail) in 10 km squares in Shetland. Source: based on Gibbons *et al.* (1993).



Map 5.11.2 Number of confirmed breeding species characteristic of shingle, sand dunes and other dry grassland (ringed plover, oystercatcher and shelduck) in 10 km squares in Shetland. Source: based on Gibbons *et al.* (1993).

these species. Pintail do not breed regularly in this region. Dunlin *Calidris alpina* are found in nationally important numbers on the island of Fetlar, on the moorland and upland mire areas (Pritchard *et al.* 1992). Areas of marsh/wet grassland also support a very small population of the Icelandic race of black-tailed godwit *Limosa limosa islandica*, rather than the nominate race, which breed in more southern areas of Britain.

Map 5.11.2 shows the incidence of confirmed breeding in 10 km squares in Shetland of selected waterfowl species (wildfowl and waders) characteristic of shingle, sand dunes and other dry grassland (ringed plover *Charadrius hiaticula*, oystercatcher *Haematopus ostralegus*, shelduck *Tadorna tadorna*). The island of Papa Stour is nationally important for ringed plover (Pritchard *et al.* 1992) and Shetland as a whole holds 12.5% of the British species' total (Table 5.11.1). Shingle shores are the main habitat for this species. Oystercatcher are very abundant in Shetland, where they breed in a variety of non-cliff habitats (P. Ellis pers. comm.). Other species, such as the rock pipit *Anthus petrosus petrosus*, raven *Corvus corax*, wren *Troglodytes troglodytes fridariensis* and twite *Carduelis flavirostris*, favour rocky coastlines and cliffs.

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

Area	Pairs (coastal)	% GB total counted in survey
Shetland	900	12.5
Scotland	5,796	80.4
GB total	7,207	100

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

Shetland has many boggy moorland areas with small lochans and pools, which support about half the British breeding population of red-throated diver (Gibbons *et al.* 1993). There is some association between these and coastal areas, as they feed in nearby coastal waters (Gibbons *et al.* 1993). The birds regularly commute several kilometres between nesting and feeding areas (Gomersall *et al.* 1984). Breeding merlin *Falco columbarius*, red-necked phalarope, golden plover *Pluvialis apricaria*, greylag goose *Anser anser*, greenshank *Tringa nebularia* and curlew *Numenius arquata* are also notable (Pritchard *et al.* 1992).

There are a number of rare breeding species, such as whimbrel and red-necked phalarope, which are restricted in their British breeding range to northern Scotland and therefore have important populations in Shetland. About 98% of Britain's whimbrel are found on the exposed heathlands and moorlands of Shetland (Dore *et al.* 1996). Fair Isle supports an endemic race of wren *Troglodytes troglodytes fridariensis*.

Some areas of important breeding bird habitat in the region lie within designated sites, for example National Nature Reserves (NNRs) and Sites of Special Scientific Interest (SSSIs), although the sites were not always chosen principally for their breeding bird interest.

5.11.3 Human activities

In this region any incremental land claim along the coastal bays 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. Human disturbance during the breeding season 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.

Active land management for conservation in many coastal areas has increased populations of breeding waterfowl. The RSPB has five reserves in Shetland (see section 7.5.2), where management specifically for their bird populations provides ideal breeding habitat for a number of species. At Fetlar, active management of some mires and the creation of open water bodies surrounded by fen communities has ensured the continued survival of red-necked phalarope.

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 also been undertaken by volunteers. Usually these surveys have been organised as part of wider British surveys (e.g. for ringed plover (Prater 1989)).

5.11.5 Acknowledgements

Thanks are due to D.A. Stroud and D.M. Craddock (JNCC), M. Heubeck and P. Ellis.

5.11.6 Further sources of information

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C. Contact names and addresses

Type of information	Contact address and telephone no.
Breeding atlas data and breeding wader data	*Development Unit, British Trust for Ornithology, Thetford, tel: 01842 750050
Coastal breeding wildfowl data	*Wildfowl & Wetlands Trust, Slimbridge, tel: 01453 890333
Site designations and breeding bird information	*SNH, International and Biodiversity Branch, Edinburgh, tel: 0131 554 9797
Site designations and breeding bird information in Shetland area	*Conservation Officer, SNH, Northern Isles Area, Shetland Office, Lerwick, tel: 01595 693345
Breeding bird surveys; coastal habitat management	*RSPB HQ, Sandy, tel: 01767 680551
Shetland birds	RSPB Shetland Office, East House, Sumburgh Head Lighthouse, Virkie, Shetland ZE3 9JN, tel: 01950 460800

*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 *Fulica atra*), during their non-breeding period. The importance of offshore areas for wintering divers, grebes, seaducks and cormorant *Phalacrocorax carbo* is outlined in section 5.10.

The region is not of major importance to wintering waterfowl and the coastal region holds, in mid-winter, relatively small numbers of waterfowl (Table 5.12.1). Note, however, that such figures give only a rough guide to the relative importance of the region, since the data are uncorrected for coverage: some areas are better counted than others.

Although this region has a reasonably diverse wader assemblage, the shoreline of the region has, in general, a very low density of waders in relation to the UK and the rest of Scotland in winter (Table 5.12.2) (Moser & Summers 1987). Much of the coastline is rocky, with low densities of waders, while the sandy/cobble shores support higher densities (Summers *et al.* 1988).

The coastline is of importance for migrating 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 extent to which this is undertaken varies between species but it emphasises the international responsibility for the conservation of these areas and their migrant waterfowl populations.

5.12.2 Important locations and species

Turnstone *Arenaria interpres* and redshank *Tringa totanus* are the most abundant wintering wader species (Figure 5.12.1) (Summers *et al.* 1988) and eider *Somateria mollissima* and long-tailed duck *Clangula hyemalis* are the most common species of wintering duck (Prater 1981; Heubeck 1993). The distribution of wintering waterfowl species occurring on the coastal areas and nearby lochs in the region is determined by habitat characteristics. The mainland was found to have the largest number of waders in surveys during the winter of 1984-85 (Summers *et al.* 1988). Yell had the second largest number of waders. Ringing studies have shown that many species demonstrate complex patterns of interchange



Map 5.12.1. Main concentration of wintering waterfowl (note: waterfowl also winter elsewhere on the coast and offshore). Source: Waters & Cranswick (1993).

between sites during the course of a winter, which means that individual sites cannot be considered in isolation (Davidson *et al.* 1991).

The main concentrations of wintering waterfowl in Shetland occur at Loch of Spiggie and Loch Brow (Map 5.12.1). The Loch of Spiggie is of international importance for its wintering whooper swan populations (Cranswick *et al.* 1995), whose five year mean numbers between September and March are 636. The voes of Shetland, such as Sullom Voe, support redshank and a few dunlin, which use the sandy and muddy substrates. Shetland also

Table 5.12.1 Waterfowl counts in Region 1, Scotland and Great Britain in January 1993

	Total waterfowl count in Jan 1993	Number of sites counted	% of count in Region 1
Region 1	180	3	-
All counted Scottish coastal sites	299,676	78	0.06
All counted British coastal sites	2,060,961	214	<0.01

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

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

	Number of wader species recorded	Total number of waders	Extent of non-cliff coast (km)	Extent of coast surveyed (km)	Overall wader density (birds/km coast)
Shetland	13	11,602	1149.1	1,082.5	10.7

Source: data from the Winter Shorebird Count (Moser & Summers 1987).

supports notable numbers of autumn passage greylag geese *Anser anser*, barnacle geese *Branta leucopsis*, goldeneye *Bucephala clangula* and pink-footed geese *Anser brachyrhynchus* (Owen *et al.* 1986).

On non-cliff shores in the winters of 1984-85, turnstone and redshank were found to be the most common wader species, followed by purple sandpiper *Calidris maritima* and curlew *Numenius arquata* (Summers *et al.* 1988; [Figure 5.12.1](#)). Several waders are strongly associated with particular habitats. The muddy shores provide suitable habitat for lapwing *Vanellus vanellus* and redshank, while the sandier areas are suitable for ringed plover. Purple sandpiper and golden plover *Pluvialis apricaria* are associated with shallow, sloping bedrock. Large flocks of turnstone were found on the Houb on Whalsay, Out Skerries and at Sullom Voe (sandy/cobble shores and shallow bedrock). All the wader species wintering in Shetland avoid steep shores and cliffs, which make up over half of the coastal habitat.

Some of Shetland's designated sites (e.g. National Nature Reserves (NNRs), Sites of Special Scientific Interest (SSSIs) and Special Protection areas (SPAs)) were selected partly for their migrant and wintering waterfowl interest, although most of the SPAs are of importance mainly for breeding seabirds. The one area of international importance for wintering waterfowl is Loch of Spiggie, an SSSI and RSPB reserve. The RSPB also has reserves at Fetlar, Lumbister and Black Park, Ramna Stacks and Gruney, and Sumburgh Head.

5.12.3 Human activities

The impact of human activities on migrant and wintering wildfowl is relatively low in Shetland. There may be some disturbance from shooting and fish farm operations.

5.12.4 Information sources used

As with other areas of the UK, migrant and wintering waterfowl are 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 (Cranswick *et al.* 1995). The WeBS waterfowl count scheme publishes an extensive annual summary report, the most recent being Cranswick *et al.* (1995), covering the winter season 1993/94. This report summarises species trends, based on counts at wetlands throughout the UK. It also

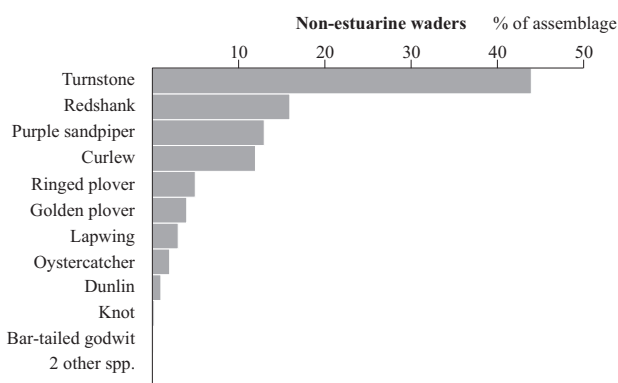


Figure 5.12.1 Relative species composition of non-breeding waterfowl assemblages in Shetland. Source: Summers *et al.* (1988).

tabulates counts of total waterfowl numbers at all counted estuaries. It is the primary source of information on wintering and migrant waterfowl in the UK. Copies are available from either of the WeBS National Organisers listed in [section 5.12.6](#). The annual report can only summarise what are very detailed data, and in summary form such counts may be subject to misinterpretation for a number of reasons. Detailed count data for sites can be provided by WeBS, and inspection of these data is recommended for any planning-related activity. WeBS counts are generally undertaken at high tide, when waterfowl gather in high densities on traditional roosting areas. To complement this information, at selected estuaries, WeBS organises low-tide counts to give information on the feeding distributions of waterfowl during the intertidal period.

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

There have been a number of more detailed studies of the wintering waterfowl of this region, including a shorebird survey on the Shetland coastline in the winter of 1984-85 (Summers *et al.* 1988).

5.12.5 Acknowledgements

We would like to thank D.A. Stroud and D.M. Craddock (JNCC) and M. Heubeck and P. Ellis (RSPB).

5.12.6 Further sources of information

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B. Further reading

- Galbraith, C.A. 1992. *Mussel farms: their management alongside eider ducks*. Edinburgh, Scottish Natural Heritage.

C. Contact names and addresses

Type of information	Organisation
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 wader (WeBS)	*WeBS National Organiser (Waders), The British Trust for Ornithology, Thetford, tel: 01842 750050
Low tide counts of wintering and migrant wader (WeBS)	*WeBS National Organiser (Low Tide Counts), The British Trust for Ornithology, Thetford, tel: 01842 750050
Site designations and waterfowl information in Scotland	*Advisory Services, SNH, Edinburgh, tel: 0131 554 9797
Shetland birds	RSPB Shetland Office, East House, Sumburgh Head Lighthouse, Virkie, Shetland ZE3 9JN, tel: 01950 460800
Site designations and waterfowl information in Shetland	*SNH, Northern Isles Area, Shetland Office, Lerwick, tel: 01595 693345

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

5.13 Land mammals

Dr C.E. Turtle

5.13.1 Introduction

This section covers mammals that occur in Shetland, concentrating on those that are truly coastal, such as the otter *Lutra lutra*, and those that occur on the coast for reasons of shelter and foraging, such as the pipistrelle bat *Pipistrellus pipistrellus*. Other mammals - common and widespread throughout Britain, feral or recently introduced - have not been considered in detail.

Geographical isolation and the exposed upland habitats are dominant factors determining the occurrence of terrestrial mammals in Shetland. Many of Britain's common mammals, such as the badger *Meles meles*, are absent, although the fox *Vulpes vulpes* has been recorded (J. Uttley pers. comm.). Few nationally important species have been reported from the region, and many of those that have been reported are only records of individual animals. In conservation terms the otter is the most significant terrestrial mammal in Shetland; it is commonly found on both the coastal and inland waters of many of the islands, and is the only mammal with a significant and breeding population. The otter is classed as endangered and is absent from many areas of England (Morris 1993). Other species recorded from this region include the pipistrelle bat, Leisler's bat *Nyctalus leisleri*, the parti-coloured bat *Vespertilio murinus* and the black rat *Rattus rattus*.

All bats occurring in Britain and the otter are protected under Schedule 5 of the Wildlife & Countryside Act. The black rat, although classified as endangered, and one of Britain's rarest mammals (Morris 1993), is not. Otters and bats are also protected under Annex IV of the EC Habitats & Species Directive. All bats occurring in Britain are also listed under Appendix III of the Bern Convention. Table 5.13.1 summarises the recorded distribution of protected mammals in the region.

Table 5.13.1 Recorded distribution of protected mammals in Region 1

Species	Estimate of importance in region
Leisler's bat	Rare
Pipistrelle	Rare
Parti-coloured bat	Rare
Otter	Common
Black rat	Rare

Source: Arnold (1993)

5.13.2 Important locations and species

In the mid-1980s, there was an estimated British otter population of 7,350 animals, 6,600 of them living in Scotland (Harris *et al.* 1995). The Scottish population estimate was divided into 3,600 animals on the mainland and 3,000 on the islands. At an estimated 700-900 animals, the Shetland population represents a substantial proportion of the British population, and is both nationally and internationally important (Kruuk *et al.* 1989). More recent surveys indicate

that the otter is very widespread on Shetland. Of 121 sites surveyed between 1991 and 1994, 98% had signs of otter presence (Green & Green 1997). The population has also increased significantly between 1988 and 1993 in all areas of the archipelago except south Mainland (Conroy & Kruuk 1995). Otter holts are strongly associated with the presence of fresh water (Conroy & Kruuk 1995), and they are least common in the largely agricultural area of Mainland and along the cliff coasts. Intertidal and shallow sublittoral coastal seaweed beds are particularly important as foraging habitats for otters.

The bat records are of single animals, the Leisler's and pipistrelle from Mainland and the parti-coloured bat from Whalsay (Arnold 1993). Corbett & Harris (1991) note three records of the parti-coloured bat. There is no record of breeding and it is believed that the records are of migrant animals that have been blown off course (J. Swale pers. comm.). It is a strongly migratory species that is not a native of Britain; the nearest known colonies are in southern Scandinavia (Stebbing & Griffith 1986). The Leisler's is also a migratory species and the nearest colonies are in Ireland and England.

There are only two known records, although no dates, of the black rat, from Whalsay and Mainland (Arnold 1993). It is one of Britain's rarest mammals (Morris 1993) and is believed to have been introduced in Roman times via trade routes. The animals are always associated with ports and are mainly restricted to buildings and warehouses nearby. The present status of the black rat in Shetland is unknown, but it may be extinct.

5.13.3 Human activities

Oil spills have occurred in this region and can cause otter mortalities; the *Esso Bernicia* spill killed at least thirteen otters (Richardson 1979) and the *Braer* incident killed six (Conroy & Kruuk 1995). Any changes in the quality of either fresh or saline waters may result in a decline in otter numbers. Although no threat to otter populations from fish farming has been established (J. Green & R. Green pers. comm.), there is concern that there may be long-term effects to the coastal ecosystem from chemicals used to maintain the health of the fish stocks and organic enrichment by fish food (A. Somerville pers. comm.; Morris 1993). The use of lobster creels still causes fatalities in otters (Jeffries *et al.* 1984), although eel fyke nets have been successfully modified (J. Green & R. Green pers. comm.). The effect of disturbance on otter distribution is relatively unstudied at present. It is known, for example, that otters forage for food in the vicinity of Sullom Voe oil terminal (J. Uttley pers. comm.); however it is believed that excessive disturbance can deter otters from using areas, particularly for breeding.

5.13.4 Information sources used

There have been no specifically coastal mammal surveys in Britain, apart from otter surveys (Conroy & Kruuk 1995;

Green & Green 1997; Harris *et al.* 1995; Kruuk *et al.* 1989). Other than for otters, there are no reliable estimates of the numbers of mammals in the region that could be used to quantify the resource. An estimate has been made of their occurrence in the region using data from Arnold (1993), although the records are incidental rather than comprehensive. As a general observation (Morris 1993), mammals are not recorded with the same intensity as botanical species and the occurrence of mammals within 10 km squares is not enough to establish the status of species.

5.13.5 Acknowledgements

The author would like to thank all those people cited in the text for their valuable information and their time.

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C. Contact names and addresses

Type of information	Contact address and telephone no.
General mammal information, Biological Records Centre	*Institute of Terrestrial Ecology, Monks Wood, Huntingdon, tel: 01487 773381
Species information; Bat Sites Register	*SNH, Advisory Services, Edinburgh, tel: 0131 554 9797
Local site and species information in Shetland	*SNH Northern Isles Area Office, Lerwick, tel: 01595 693345
Local site and species information	*Dr A. Somerville, Conservation Officer, Scottish Wildlife Trust, Edinburgh, tel: 0131 312 7765
Bats	Prof. P. Racey, Dept. of Zoology, Tilydrone Avenue, Aberdeen AB9 2TN, tel: 01224 272858
Otters	Jim and Rosemary Green, The Vincent Wildlife Trust, Otter Rehabilitation Centre, Barjarg, Girvan, Ayrshire KA26 0RB, tel: 01465 821225
General mammal information	The Mammal Society, Unit 15, Cloisters House, Cloisters Business Centre, 8 Battersea Park Road, London SW8 4BG, tel: 0171 498 4358

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

5.14 Seals

C.D. Duck

5.14.1 Introduction

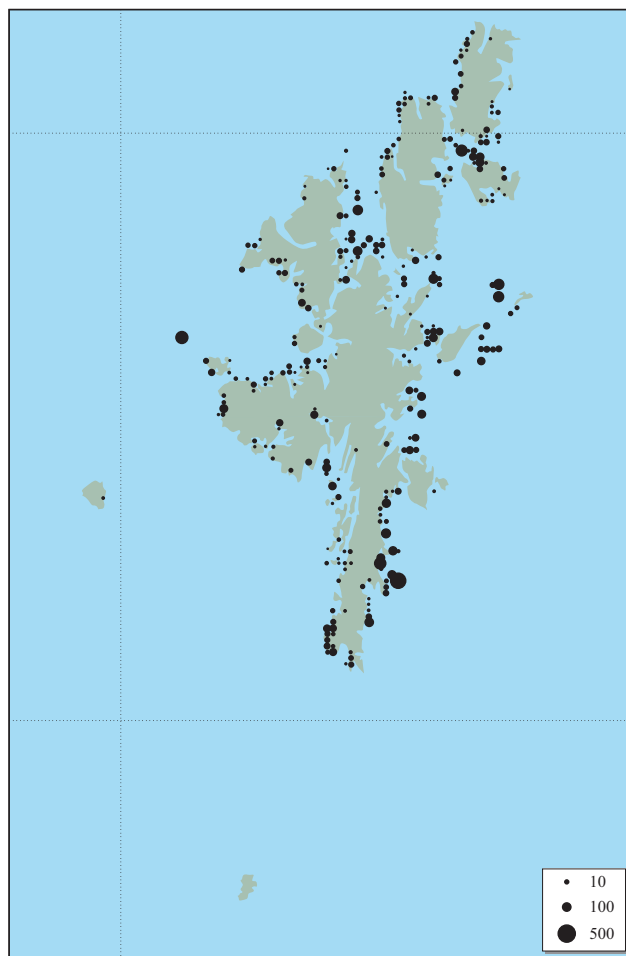
Common seals *Phoca vitulina* can be seen throughout the region, particularly in areas of sheltered water, at all times of the year (Map 5.14.1). Approximately 22% of common seals counted in Britain during August occur in Shetland, making this the second most important region for this species in Britain. Grey seals *Halichoerus grypus* are less abundant but may also be seen throughout the region (Map 5.14.2), although their main concentrations are in the west. Shetland produces an estimated 3% of grey seal pups born in Britain each year. Table 5.14.1 gives seal numbers in the region in context.

5.14.2 Important locations

Although common seals occur throughout the islands, the main areas where they haul-out in August are around Mousa and south-east Mainland (20%), Yell Sound (15%), north-west Fetlar and Hascosay (9%) and on the Ve Skerries in St Magnus Bay (4%) (Table 5.14.2).

Grey seal summer haul-out and breeding sites are concentrated in the west of the region (Map 5.14.2). Individual grey seals from the Farne Islands (Northumberland), Orkney and the Monach Islands (Western Isles) have been tracked by satellite to haul-out sites off Sumburgh Head and the Ve Skerries (McConnell *et al.* 1994; SMRU unpublished data). Numbers at haul-out sites outside the breeding season are unpredictable and can vary greatly from day to day. In August, important grey seal haul-out sites are on islands around Sumburgh Head (Horse Island, Ladies Holm and Fitful Head) and at the Ve Skerries. The main breeding sites in the region are on North Roe around Uyea, Lang Clodie Wick and Ronas Voe, Papa Stour, Fair Isle and Fetlar. Pup production for each breeding site in 1993 is given in Table 5.14.3.

Extreme weather conditions and high seas in the region may significantly affect grey seal pup production as many breeding beaches are narrow and exposed to the prevailing westerly winds. In some years, pup mortality at such sites has been estimated to be as high as 40% (Anderson 1981; Brown 1995).



Map 5.14.1 Distribution of common seals at haul-out sites in Shetland in August 1993. Area of circle is proportional to the number of seals in each 1 km by 1 km square. Source: SMRU.

5.14.3 Human activities

There are numerous salmon farms in the region, particularly in the sheltered waters west of Scalloway, east of Muckle Roe, between Yell, Unst and Fetlar and along the east coast between Yell Sound and Lerwick. Although seals that persistently visit fish farms are liable to be shot, improvements in cage design, anti-predator systems and an

Table 5.14.1 Number of common and grey seals in the region in relation to the rest of GB

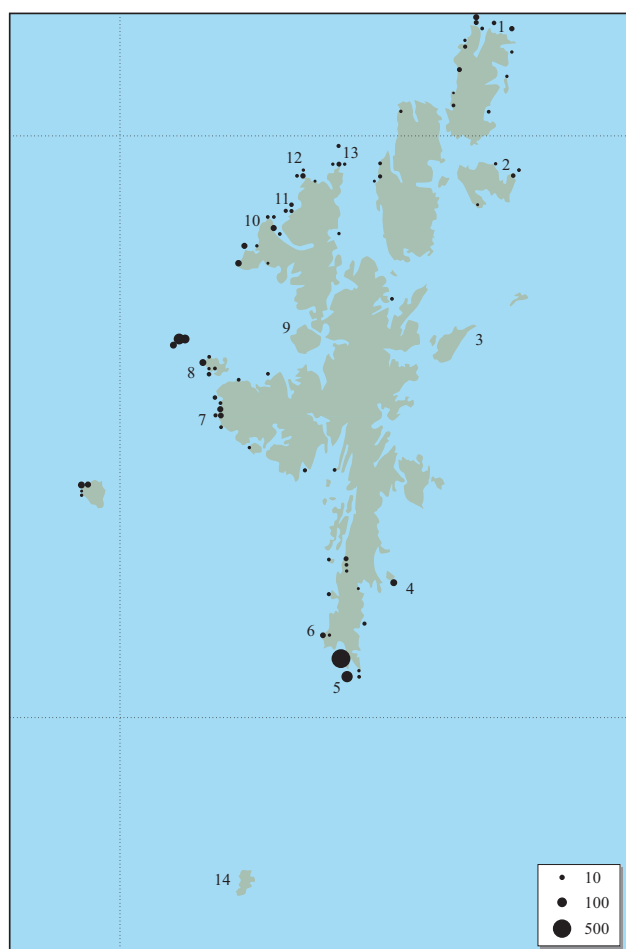
Location	Common seals		Pup production ¹	Grey seals	
	Number of seals*	% of GB total		% of GB total	Associated population >=1 year old*
Region 1	6,200	21.9	1,000 ¹	3.0	3,400
Scotland	26,400	93.1	31,000	91.6	105,300
GB	28,350	100	33,850	100	115,000

Source: SMRU. Key: *to nearest 50; ¹ pup production for the region is estimated from 1977 and 1983 survey data. Recent evidence suggests production has changed at a number of breeding sites.

Table 5.14.2 Numbers of common seals counted in the region

Location	Grid ref.	No. of seals	% of region total
Unst	HP600100	288	4.6
Fetlar and Hascosay	HU620920	568	9.1
Yell	HU480890	338	5.4
Yell Sound: Point of Fethaland to Land Taing plus skerries	HU379952-HU524744	929	15.0
Out Skerries	HU680710	326	5.2
East Mainland: Land Taing to Horse of the Knabb, Lerwick	HU524744-HU480402	335	5.4
South-east Mainland: Horse of the Knabb, Lerwick to Sumburgh Head	HU480402-HU406076	807	13.0
Whalsay and West Linga	HU560640	512	8.2
Bressay and Noss	HU500400	83	1.3
Mousa	HU460240	455	7.3
South-west Mainland: Sumburgh Head to Fugla Ness	HU406076-HU363360	385	6.2
The Deeps: Fugla Ness to Spoot-hellier	HU363360-HU299403	273	4.4
West Mainland: Spoot-hellier to Quilva Taing	HU299403-HU170571	185	3.0
St Magnus Bay including the Ve Skerries: Quilva Taing to Esha Ness	HU170571-HU202782	660	10.6
North-west Mainland: Esha Ness to Point of Fethaland	HU202782-HU379954	65	1.0
Foula	HT960400	3	0.05

Source: SMRU aerial survey data 1993



Map 5.14.2 Distribution of grey seals at haul-out sites in Shetland in August 1993. Area of circle is proportional to the number of seals in each 1 km by 1 km square. Numbers refer to the locations of the main breeding sites (see Table 5.14.3). Sources: SMRU; E. Brown, SNH.

increase in human activity around fish farms has led to a reduction in the amount of damage caused by seals and a consequent decrease in the level of action taken against them.

Shetland supports nationally important inshore and offshore fisheries. Recently, lobster and crab fishermen have reported seals playing with and twisting ropes to marker buoys, resulting in the loss of some pots. This interference has also been reported in Orkney (Crossley 1994). During the summer months a tour boat operates out of Sand Lodge, taking visitors to Mousa, an important common seal site which is proposed as a Special Area of Conservation (SAC - see section 7.2.2). Elsewhere in the region, local boats may be chartered to visit seal haul-out sites. There is no evidence of any significant disturbance resulting from these operations.

There is an important oil terminal at Sullom Voe on Mainland, which introduces a risk of oil spillage, either from the terminal or from tankers passing through Yell Sound. The only notable spillage of oil in this area occurred in late December 1978. Although a number of common seals were seen to be contaminated, no casualties were recorded. In 1993 there was a substantial common seal haul-out on Ungam, some 500 m from the terminal, and seals do not appear to be affected by operations at the terminal site. The *Braer* was wrecked on the southern tip of Mainland in January 1993, releasing 80,000 tonnes of light crude oil into the sea. This did not have a detectable effect on either the common or grey seal populations in the region. New hydrocarbon extraction sites are being prospected and exploited to the west and south-west of Shetland. The likely effects of these developments, and any associated seismic activity, on seals in the region are unknown.

5.14.4 Information sources used

Data on the numbers and distribution of seals in the region were collected by SMRU as part of the Natural Environment Research Council's statutory obligation under the Conservation of Seals Act (1970) to provide the Scottish and Home Offices with information on the size and status of common and grey seal populations in Britain.

Table 5.14.3 Grey seal pup production at main breeding sites in 1993

Site no. on Map 5.14.2	Location	Grid ref.	No. of pups born	% of region total
1	North Unst	HP600180-HP670170	10	1.2
2	Fetlar	HU620950-HU670930	82	9.6
3	Whalsay and Out Skerries	HU605606-HU626734	60	7.1
4	Mousa	HU460240	12	1.4
5	Horse Island and Lady's Holm	HU383073-HU375095	35	4.1
6	Fitful Head	HU360120-HU350150	*	*
7	Dale of Walls	HU165522-HU165555	20	2.4
8	Papa Stour	HU160610	125	14.7
9	Muckle Roe	HU300660	**40	4.7
10	Ronas Voe	HU262840-HU280820	53	6.2
11	Lang Clodie Wick	HU280850-HU305891	60	7.1
12	North Roe, Uyea	HU310930-HU344922	243	28.6
13	Gruney	HU382967	10	1.2
14	Fair Isle	HZ210720	**100	**11.8

Sources: SMRU aerial survey data 1993; Brown (1995); SNH. Key: *included in total for site 5; **estimated.

Prior to 1988, common seals were surveyed from inflatable boats during their breeding season in June and July (Bonner *et al.* 1973). In Shetland, they were first surveyed using a thermal imaging camera mounted in a helicopter in August 1991, as part of a survey covering the whole of Scotland. Common seals moult during August and the largest and most consistent numbers of animals are thought to haul-out at this time. To maximise the numbers of seals counted, surveys were restricted to early August and to within two hours of low tides occurring in the early afternoon. To determine the impact of the oil spilled from the wrecking of the tanker *Braer* in January 1993 on Shetland's common seals, the islands were resurveyed in August 1993. The data presented here are the results of the August 1993 survey.

Information on grey seal populations is dated, with the most recent all-island breeding site survey carried out by helicopter in 1983 (Anderson 1983). Until 1994, total pup production was derived from single counts of pups at each breeding site. This and earlier boat-based surveys estimated the annual grey seal pup production in Shetland to be 1,000 (Anderson 1981; 1983). Scottish Natural Heritage have counted pups on the north coast of Fetlar in most years and, during the 1993 breeding season, at a number of additional sites. A detailed survey of three breeding sites was carried out in 1994 (Brown 1995). These recent data show that the numbers of pups born at most sites have changed between 1977 and 1983. At most sites counts of pups have increased, while at a minority of sites, notably Fetlar, they have decreased. Grey seals breed in caves, deep geos and on isolated beaches and islands scattered round the exposed Shetland coast. Consequently, surveying the numbers of pups born and estimating overall pup production is extremely difficult.

Although the estimate of total pup production for the region remains at 1,000 (Table 5.14.1), the detailed data presented here (Table 5.14.3) come from the most recent surveys described by Brown (1995). A complete survey of the region is required to determine current pup production.

5.14.5 Acknowledgements

Thanks go to Ed Brown, John Watkins (Conservation Research Ltd), Paul Harvey, John Uttley and John Baxter (SNH), Magnus Flaws (Shetland Salmon Farmers Association), Dave Clem and PLM Helicopters, and Ailsa Hall (SMRU), for providing information and for commenting on the draft.

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- Tickell, W.L.N. 1970. The exploitation and status of the common seal (*Phoca vitulina*) in Shetland. *Biological Conservation*, 2: 179-184.

C. Contact names and addresses

<i>Type of information</i>	<i>Contact address and telephone no.</i>
Seal numbers and distribution around GB	Sea Mammal Research Unit, Gatty Marine Laboratory, University of St. Andrews, Fife KY16 8LB, tel: 01334 476161
Seals in the region	*SNH, Maritime Unit of Advisory Services, Edinburgh, tel: 0131 554 9797
Seals in Shetland	*Conservation Officer, SNH Northern Isles Area Office, Lerwick, tel: 01595 693345
Seals in Scotland	*Scottish Wildlife Trust, Edinburgh, tel: 0131 312 7765
Seals on Fair Isle	The Fair Isle Bird Observatory, Fair Isle, Shetland ZE2 9JU, tel: 01595 760258
Seal rescue and rehabilitation in Shetland	The Hillswick Wildlife Centre, The Booth, Hillswick, Shetland ZE2 9RW, tel: 01806 503348
Seals and salmon farms	Shetland Salmon Farmers Association, Shetland Seafood Centre, Stewart Building, Alexandra Wharf, Lerwick, Shetland ZE1 0LL, tel: 01595 695579

*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 Shetland is one of the richest in Britain. Headlands and the sounds between islands are the most favoured localities for cetaceans in coastal waters of the region, along with offshore fishing banks. Eighteen species of cetaceans have been recorded along the coasts or in nearshore waters (within 60 km of the coast) of the region since 1980. Of these, eight species (30% of the 27 UK species) are either present throughout the year or recorded annually as seasonal visitors to the region. The commonest species in nearshore waters are the harbour porpoise *Phocoena phocoena*, white-beaked dolphin *Lagenorhynchus albirostris*, white-sided dolphin *Lagenorhynchus acutus*, Risso's dolphin *Grampus griseus*, killer whale *Orcinus orca*, long-finned pilot whale *Globicephala melas* and minke whale *Balaenoptera acutorostrata*, with one to three humpback whales *Megaptera novaeangliae* recorded annually in summer since 1992.

Other cetacean species recorded in the region since 1980 include fin whale *Balaenoptera physalus*, sei whale *B. borealis*, sperm whale *Physeter macrocephalus*, Sowerby's beaked whale *Mesoplodon bidens*, Cuvier's beaked whale *Ziphius cavirostris*, northern bottlenose whale *Hyperoodon ampullatus*, striped dolphin *Stenella coeruleoalba*, common dolphin *Delphinus delphis*, bottlenose dolphin *Tursiops truncatus* and false killer whale *Pseudorca crassidens*. Of recent unusual live sightings, a fin whale was observed off the east coast of Noss in August 1994; a sei whale was seen along with two minke whales off Muckle Skerry, Out Skerries, in August 1993; a striped dolphin came into Tresta Voe in July 1993, eventually stranding; and a beluga *Delphinapterus leucas* was seen in Hoswick in September 1996. For geographical comparisons of sightings rates for various cetacean species in UK waters, see Evans (1990a, 1992) and Northridge *et al.* (1995).

The harbour porpoise and bottlenose dolphin are listed in Annex II of the Habitats & Species Directive as species whose conservation requires the designation of Special Areas of Conservation (SACs - see [section 7.2.2](#)).

5.15.2 Important locations and species

Table 5.15.1 summarises the recorded occurrence of resident and regularly-visiting cetacean species in Shetland.

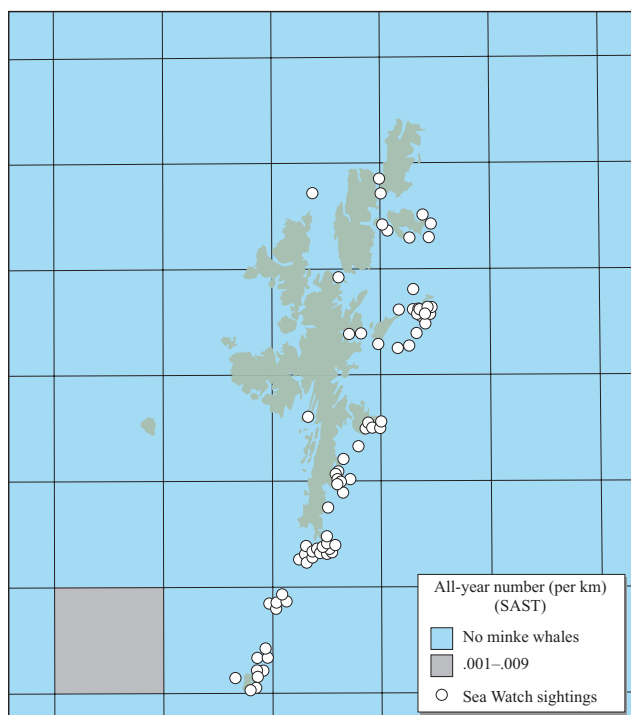
The edge of the continental shelf to the north and west of Shetland is closer to land than in most regions of Britain, with depths in the Norwegian Sea exceeding 1,700 m. Although this deepwater region north and west of Shetland has been surveyed only infrequently, there have been sightings of deepwater species including fin whale, sperm whale, northern bottlenose whale, long-finned pilot whale, killer whale and white-sided dolphin.

The minke whale is the most common baleen whale species recorded in Shetland waters. In summer, minke whales occur regularly all along the eastern coasts of Shetland, particularly east of Whalsay and around Out Skerries, between Noss and Sumburgh Head, and from Sumburgh Head south to Fair Isle ([Map 5.15.1](#)). Humpback whales became very rare after commercial exploitation in Shetland waters in the early years of this century. Since 1992, one to three humpback whales have been seen annually between May and September, particularly in June and July. Most sightings have been from the vicinity of Sumburgh Head.

Harbour porpoises are widespread and common in nearshore waters, particularly on the eastern side of Shetland ([Map 5.15.2](#)), occurring in all months of the year, but with a strong peak in numbers between July and October, when singles or family groups of 2-3 may form

Table 5.15.1 Summary of cetacean species regularly recorded in the region

Species	Status, distribution and seasonal occurrence
Minke whale <i>Balaenoptera acutorostrata</i>	Widespread and common July - September, singly or groups of <15
Humpback whale <i>Megaptera novaeangliae</i>	Rare; 1-3 seen annually, May - September, around southern tip of Shetland
Harbour porpoise <i>Phocoena phocoena</i>	Widespread and common, particularly east Shetland, especially between July and October, singly, or in groups of 2-3 or 100-200
White-beaked dolphin <i>Lagenorhynchus albirostris</i>	Widespread and common all year, especially May - September, in groups of <50 individuals, particularly east Shetland and between Sumburgh Head and Fair Isle.
White-sided dolphin <i>Lagenorhynchus acutus</i>	Infrequent in nearshore waters, generally in groups of 100-1,000 individuals, mostly June - November.
Risso's dolphin <i>Grampus griseus</i>	Widespread nearshore, especially east Shetland; groups of 5-20, mainly April - September.
Long-finned pilot whale <i>Globicephala melas</i>	Infrequent nearshore, more common offshore (usually in groups of 10-25), mainly north and east of Shetland. All year; most frequent nearshore September - March.
Killer whale <i>Orcinus orca</i>	Regular but uncommon, singly or in groups of 2-10; widespread, all year but most nearshore sightings April - September.

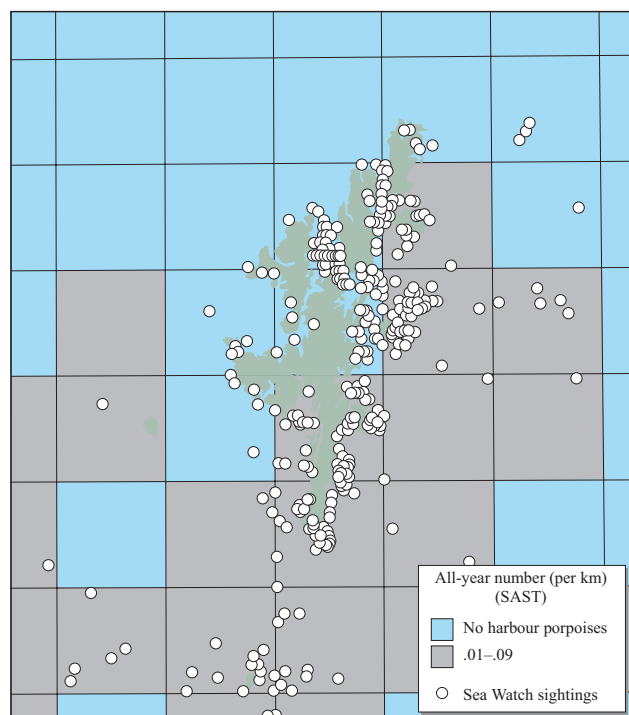


Map 5.15.1 Minke whales: all-year number sighted per kilometre of Seabirds at Sea survey (source: JNCC: SAST/ESAS); and sightings reported to the Sea Watch sighting system (source: Evans 1992).

aggregations numbering up to 100-200 individuals. Important localities for the species include the waters between Whalsay and Out Skerries, Bressay and Noss, and between Aithwick and Sumburgh Head in the south-east, with less heavily used sites including Quendale Bay, St Ninians, and Scalloway, and until recently, Yell Sound and Bluemill Sound. The majority of the above sites coincide with important sandeel fishing grounds, and recent studies show significant associations between porpoises and this fish species (rather than other fish taxa) (Evans 1995; Evans & Borges 1995).

The white-beaked dolphin is common and widely distributed, particularly on the eastern side of Shetland and between Sumburgh Head and Fair Isle (Map 5.15.3). It occurs in the region throughout the year, but with peak numbers and frequency of sightings between May and September. The white-sided dolphin is a more pelagic, deepwater species, occurring infrequently in nearshore waters, though generally in large herds numbering up to a thousand individuals. Sometimes nearshore movements have led to mass strandings, particularly in the vicinity of Scalloway on the south-west coast. Most coastal sightings occur east of Shetland and between Sumburgh Head and Fair Isle, although the species occasionally enters the voes at White Ness and Clift Sound near Scalloway. Most sightings occur in summer and autumn, between June and November. Risso's dolphins are widely distributed between April and September in groups of 5-20 usually nearshore around Shetland, with most sightings along the eastern coasts of Shetland, particularly off North-east Unst, in Bluemull (between Yell and Unst) and Colgrave Sounds (between Yell and Fetlar), between Whalsay and Out Skerries, and around the islands of Noss, Mousa and Fair Isle.

The long-finned pilot whale is a pelagic species, visiting nearshore waters only infrequently. Coastal sightings are



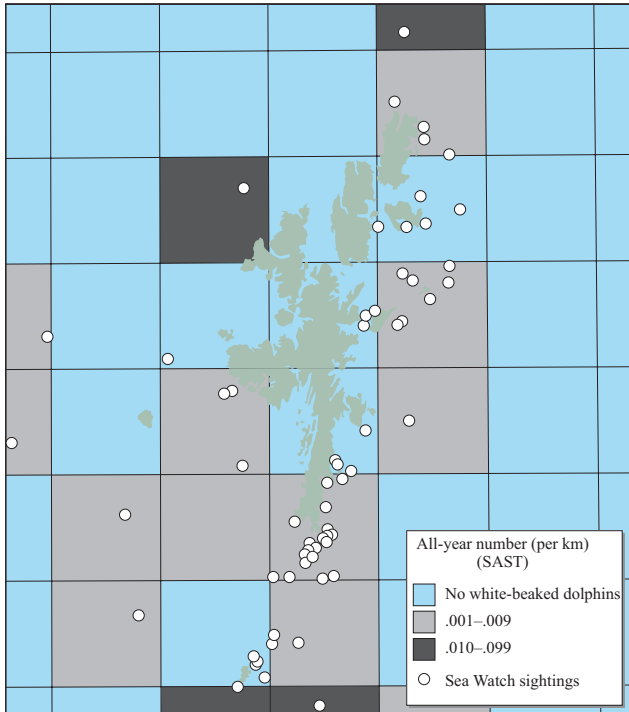
Map 5.15.2 Harbour porpoises: all-year number sighted per kilometre of Seabirds at Sea survey (source: JNCC: SAST/ESAS); and sightings reported to the Sea Watch sighting system (source: Evans 1992).

widely distributed but mainly north and east of Shetland. Although recorded in most months of the year, sightings occur mainly between September and March, when strandings have also been most frequent. The killer whale is observed more frequently in Shetland waters than anywhere else in Britain. However, despite the regularity of sightings, the species is uncommon, most sightings involving small groups and probably the same individuals in many cases. Killer whales occur in coastal waters in all months of the year (Map 5.15.4), but with peak frequency of sightings between April and September. During winter months (November to March), the species is frequently observed offshore 80-150 km north of Shetland, closely associated with the mackerel purse-seine fishery (Couperus 1993; Shetland fishing fleet pers. comm.).

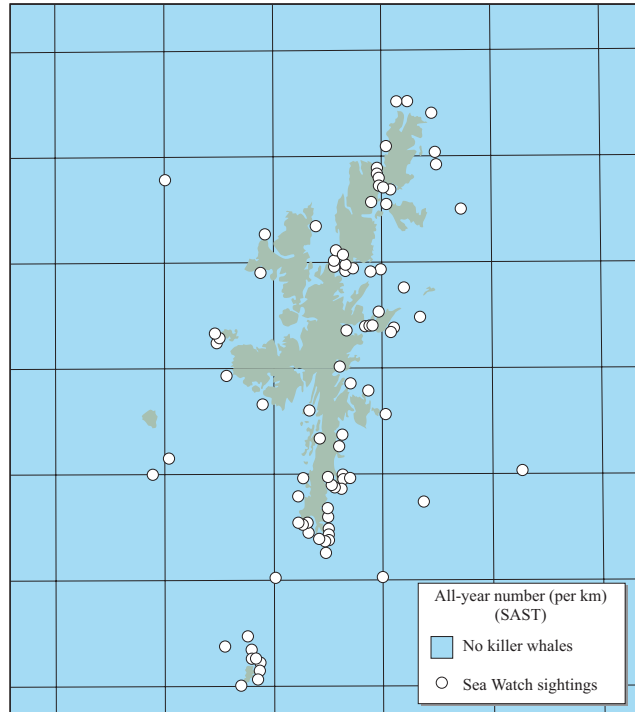
5.15.3 Human activities

In the early part of this century, the Shetland commercial whale fishery yielded high catches of several large whale species in the region adjacent to the edge of the continental shelf (Evans 1990b). Although Shetland appears to have been a traditional feeding area for humpback whales, the population must have been low when modern commercial whaling in the region started. Between 1903 and 1914, the Shetland whale fishery took 49 humpback whales, but only two between 1920-29, when whaling resumed after World War I. For sixty years from 1930, there were no records of the species, but since 1992 one or two have been seen every year.

A drive fishery for the long-finned pilot whale persisted for centuries in Shetland waters, similar to that which continues in the Faeroe Islands. The largest catch recorded was of 1,540 animals in Quendale Bay in September 1845



Map 5.15.3 White-beaked 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).



Map 5.15.4 Killer 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).

(Evans & Buckley 1899). The last organised drive took place in February 1903 when 83 pilot whales were killed in Weisdale Voe (Venables & Venables 1955).

Cetaceans in the region today face three potential pressures from human activities: conflicts with fisheries (either by competition for a common food resource or accidental capture in fishing gear), habitat degradation (mainly by pollution) and disturbance (e.g. from underwater sound such as ship propellers and seismic survey).

During the 1980s, sandeel recruitment and total biomass reached very low levels, leading to widespread breeding failure of several species of seabirds (Heubeck 1989). Over the same period, surveys conducted at three locations indicated a marked decline in summer coastal populations of porpoises (Evans 1995).

There have been several reports of small cetaceans (mostly harbour porpoise) in the region being killed accidentally in fishing gear (Northridge 1988; Evans 1993). During a 12-month period, when at least seven Shetland fishing boats co-operated in a bycatch reporting scheme, a minimum of twelve adult harbour porpoises were captured in midwater trawls (Evans 1993). Two dolphins, thought to be white-sided, were landed and brought into Lerwick in 1987 (Northridge 1988), and local fishermen reported accidentally capturing fourteen killer whales in mid-winter whilst purse-seining for mackerel north of Shetland. Fortunately they were able to release all unharmed. The close association between killer whales and the purse-seine mackerel fishery appears to be more than just an isolated occurrence. Several fishermen have reported seeing groups of killer whales feeding upon discards from their trawlers, and between 22 October and 2 November 1992, about forty killer whales were counted in the immediate vicinity of

trawlers purse-seining for mackerel in deep waters north-east of Shetland (Couperus 1993). One killer whale which live-stranded in November 1994 and then died was found to contain a two-inch fish hook embedded in the lining of its gut (H. Ross pers. comm.).

Concentrations of organochlorine compounds (OCs) such as chlorobiphenyls (CBs) and organochlorine pesticides (OCPs) in cetaceans are highly dependant upon age, nutritional condition, diet and, particularly for females, reproductive status. For these reasons, and the wide-ranging mobility of these animals, marine mammals are poor biological indicators for environmental contaminants and care must be taken when making comparisons between OC levels in stranded animals from different locations. OC concentrations in 22 harbour porpoises stranded around Shetland were measured by Kuiken *et al.* (1994). The mean total CB concentration (25 congeners) was 5.48 ppm, with a range from 0.12 to 15.05 ppm. These concentrations are similar to those recorded from other stranded animals of the same species from elsewhere in the UK.

There are no major holiday resorts in the region but recreational activities occur out of Lerwick and Scalloway, and sometimes in Mousa Sound. These sometimes involve the use of speedboats. Recreational 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, 1995). 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 therefore are 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 1995).

Codes of conduct for boat users have been produced (e.g. Sea Watch Foundation & UK Mammal Society 1992), and Scottish Natural Heritage (SNH) has a dolphin awareness scheme for Scotland, although this currently concentrates on the Moray Firth.

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.

5.15.4 Information sources used

Information on cetacean status and distribution comes primarily from the national sightings database (1973-present) maintained by the Sea Watch Foundation (SWF) (Evans 1990a, 1992), the strandings scheme organised by the Natural History Museum in London (1913-present) (Sheldrick *et al.* 1994), and dedicated surveys throughout the region conducted by Sea Watch Foundation every summer from 1992 to the present (Evans 1994, 1995). Porpoises were also recorded systematically during August boat surveys for seabirds around the Scalloway Islands, around Whalsay and Out Skerries, and in Mousa Sound over several years between 1977 and the present. Systematic land-based watches have been carried out by Sea Watch Foundation at fifty sites around Shetland mainland every August since 1990, with more intensive watches at Noss, Mousa, Sumburgh Head and Quendale Bay since 1992. Other observations are provided by fishing vessels, the inter-island ferries particularly the MV *Good Shepherd* between Grutness and Fair Isle, members of the Shetland Bird Club and the Shetland Cetacean Group. Sea-based coverage of the entire region is good; however, most effort is concentrated in the months of April to October when sea conditions are good. Winter sightings may be under-represented.

A major international collaborative programme, the Small Cetacean Abundance in the North Sea (SCANS) project, aims to provide a baseline assessment of abundance from intensive survey work in July 1994 (Hammond *et al.* 1995).

5.15.5 Acknowledgements

Thanks are due to I. Grant, J. Heimlich-Boran and H. Nice for help in the preparation of the maps, and to all those persons who have contributed valuable sightings data, particularly C. Barton, P.J. Ewins, R. Gallagher, C. Guy, H. Harrop, P. Harvey, M. Heubeck, P.K. Kinnear, R. Leask, R. Limer, H. Loates, E. Nisbet, K. Osborn, M. Richardson, N. Riddiford, D. Suddaby, M.L. Tasker, N. Thompson, R.J. Tulloch and A. Webb. Thanks are also due to H. Ross, C. McKenzie (SOAEFD) and volunteer members of Sea Watch Foundation Shetland Porpoise Project teams, particularly P. Barnett, L. Borges, D. Brady, Q. Carson, H.J. Cluley, J. Denkinger, J. Farrell, P. Fisher, L. Gilbert, D. Hoogerheide, L. Kendrick, T. Newman, H. Nice, I. Rees, J. Wainwright, C. Weir and K. West, and to the wardens of Fair Isle bird Observatory and Noss National Nature Reserve. Thanks also go to crews of the Shetland fishing fleet and inter-island ferries, particularly the MV *Good Shepherd*.

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C. Contact names and addresses

Type of information	Contact address and telephone no.
Cetacean strandings	Dr D. George & A. Muir, Natural History Museum, Cromwell Road, London SW7 5BD, tel: 0171 938 8861
Cetacean strandings, Scotland	R.J. Reid, SAC Veterinary Investigation Centre, Stratherrick Road, Inverness IV2 4JZ, tel: 01463 243030
Cetacean sightings, surveys & photo-ID	Dr P.G.H. Evans, Sea Watch Foundation, c/o Dept. of Zoology, University of Oxford, South Parks Road, Oxford OX1 3PS, tel: 01865 727984
Cetacean sightings & surveys	*Seabirds & Cetaceans Team, JNCC, Aberdeen, tel: 01224 655702
Cetacean sightings & strandings, Shetland	P. Harvey, Shetland Cetacean Group, 29 Brentfield Place, Sandwick, Shetland ZE2 9HS, tel: 01950 431480
Bird & cetacean sightings	RSPB, East House, Sumburgh Head Lighthouse, Virkie, Shetland ZE3 9JN, tel: 01950 460801
General information	*SNH, Maritime Unit of Advisory Services, Edinburgh, tel: 0131 554 9797
General information in Shetlands area	*SNH, Northern Isles Area Office, Lerwick, tel: 01595 693345
Cetacean organochlorine & heavy metal levels	Dr R.J. Law, Centre for Environment, Fisheries and Aquaculture Sciences, Remembrance Avenue, Burnham-on-Crouch, Essex CM0 8HA, tel: 01621 787200

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

Chapter 6 Archaeology

A. Gale & V. Fenwick

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 be unwittingly destroyed. The distribution of known sites is biased by the uneven spread of survey work, and the discovery and scientific investigation of new sites is vital to developing a full picture of the past. This chapter provides an introduction to the history and archaeology of the region, gives information on the provisions for safeguarding known and unknown sites, and describes the extent of survey work and how to report new finds. **Map 6.1.1** shows archaeological locations mentioned in the text.

The greater part of Shetland's past is undocumented, with even the Viking Age being classed as largely prehistory. Its history has to be derived using information recovered by archaeological investigation of the many sites that survive in the islands. The information comes from diverse archaeological material: stray finds; scatters of artefacts such as pottery and flint tools; middens; monuments such as standing stones or burial chambers; buried settlements; and environmental deposits such as peat. The slow drowning of the Shetland coast means that sites formerly on land can be anticipated on the sea bed. Organic remains, such as worked timber, preserved in waterlogged conditions, provide the best possible environmental data from which to reconstruct the landscape and its use by humans.

Shipwrecks, however, are a more commonly recognised type of sea-bed site. Shetland's wrecks are of international importance. Some 1,500 vessels are known to have been wrecked, and both written and remarkable oral accounts tell of losses in the hostile waters that separate Shetland from Orkney and others off Shetland's numerous islands. The records 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



Map 6.1.1 Archaeology: locations mentioned in the text.

navigation. This process has then to be extended into the prehistoric period by looking at archaeological evidence for trade and seafaring. The cold, unpolluted waters provide an exceptional environment for preservation, despite the apparently hostile environment: even paper and vellum survive from a wreck of 1729 off Unst (Stenuit 1977).

6.2 History and archaeology of the region

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

The first known inhabitants of Scotland are recognised from remains of their seasonal hunting camps: flint tools, bone debris and traces of temporary shelters. The earliest sites, dated to 7,500 BC, are on Hebridean Islands. No settlement sites of this date have yet been found in Shetland. However, analyses from two separate locations have identified changes in the pollen population which show heavy grazing in the surrounding area as early as 7,000 BC. Since it is considered that large grazing animals only reached Shetland through human efforts, this is the first potential evidence for the arrival of Mesolithic groups (V. Turner pers. comm.). It is possible that their camps, known from other areas to be coastal, may have been submerged by the rise in relative sea level.

Nothing is known of the boats that brought first Mesolithic hunter-gatherers and later the Neolithic knowledge of farming. Seaworthy dugouts, improved by planking, or large skin boats may be inferred.

As the first known habitation sites date to 3,000 BC, it is clear from the established and distinctive nature of the culture that the occupants' ancestors, with knowledge of farming technology, had reached Shetland some time earlier. Their dry-stone houses are oval rather than round, but the arrangement of hearths, bed recesses and alcoves echoes those in Orkney. Examples include Scord of Brouster and Ness of Gruting. The division of land by large stone dykes, the best example being Funzie Girt in Fetlar, suggests not only social organisation but a level of population that demanded demarcation. In addition, there are field boundaries, which, with the clearance cairns that they often adjoin, served as dumps for stones lifted from cultivated ground. All these monuments combine to give Shetland probably the densest and most remarkable concentration of prehistoric monuments in Britain.

Cairns were also constructed over chambered burial monuments. Heel cairns, so-called in reference to their shape, are the most numerous and are unique to Shetland. Some, like Pettigarth's Field, Whalsay, are only 4 m across, while others may be as much as 20 m. The acid soils leave few surviving bones from which to learn about the population.

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

Many of the prehistoric monuments cannot be closely dated by typology. Excavation, for example of stone houses, has shown that, even well into the 1st millennium BC, their form had changed little from that of earlier examples. Many of the artefacts first seen in the Neolithic period also seem to have enjoyed a long currency. Local rocks with different properties met various needs. Sandstone was used for hard points for ploughs, and steatite was carved into bowls and used to temper pottery. Igneous rocks, particularly felsite,

were shaped and polished into axes and maces similar to those found in other parts of Britain, while the fine, discoid 'Shetland Knives' are unique to the islands. Objects of wood, leather, wool and other organic materials rarely survive.

Few of the bronze implements that were available on mainland Scotland from about 1,800 BC seem to have reached Shetland. Some stone axes appear to copy bronze forms, which suggests that Shetlanders had knowledge of the new commodity if not the wherewithal or need to secure its possession. Direct evidence of metalworking is known from Jarlshof but this dates to the 7th century BC, the very end of the so-called Bronze Age. In Shetland, as elsewhere, the period is distinguished by social changes. From the last half of the second millennium BC the climate became wetter and cooler, causing peat to form on higher ground. Its progress downslope buried Neolithic settlements and field systems. The population was forced into the lower areas, where, due to sea-level rise, the coastal plain itself was shrinking. By the start of the first millennium BC, with less agricultural land and lower productivity, Shetland was, in effect, over populated.

A new and very numerous site type, the burnt mound, belongs to the Bronze Age. These are also found in Orkney. The piles of burnt stone, associated with stone troughs and small buildings, are generally interpreted as communal cooking facilities in which the trough was used for simmering. The period also saw the introduction of new pottery styles and burial methods. The latter used large pottery 'urns' to contain or cover cremations. The pottery is locally made but shows new influences in design. Many of the standing stones that characterise the Shetland landscape probably date to this period. While some may have featured in ritual, others were possibly more functional, marking boundaries or, like a pair at Clivocast near Uyeasound, serving as seamarks.

In the mid-1st millennium BC, possibly as a response to insecurity emanating from land-pressure, buildings reflect a concern for defence. Forts, for example Aywick in Yell, Ness of Garth in Sandness and Hog Island Sound in North Nesting, were constructed by building banks or stone walls to enhance the natural defences of promontories or islets. In cases such as Scatness and Ness of Burgi the defences were improved by a stone gate or blockhouse. Although the typology and chronology of the various forms of fortification are not cut and dried, one form, the broch, symbolises the period. Brochs are dry-stone towers, with guard cells at their entrances and stairways and galleries in the thickness of the walls. Shetland has over 75 brochs, including Mousa, the best preserved in Scotland. Many in Shetland have outer works, and in some cases, these pre-date the broch. These strong buildings were used, and re-used, for many centuries, although it is not known if the brochs were permanently inhabited.

The uneven distribution of brochs throughout Shetland and the excavation of a contemporary small stone house at Underhoull suggests that other, undefended, buildings also served domestic and farming needs.

6.2.3 The Picts and the Viking Age

Just as tools familiar in the Neolithic persisted in use through the Bronze and Iron Age, so the everyday objects of Iron Age Shetland probably remained in use until well after AD 400. There is a lack of culturally distinctive material that can be unequivocally linked with the Picts. The name Picts was used by the Romans to describe combinations of hostile tribes on their northern frontier. The term Pict was later applied to the occupants of Orkney and Shetland and to the peoples who lived on the east coast of Scotland. The relationship of Shetlanders to the Roman province to the south is not known, but Roman-style artefacts found in brochs suggest at least passing maritime contact.

Symbol stones inscribed with complex designs are assigned to Pictish craftsmen or artists. A small number have been found in Shetland. The later ones, as elsewhere in Scotland, show Christian influence in their symbolism. It is possible that the inhabitants of Shetland were converted to Christianity by Pictish clerics rather than missionaries from west Scotland or Ireland. Most Christian symbol stones come from sites where a small church might have served the local community. The extraordinary hoard of silver from St Ninian's Isle suggests that the local communities possessed considerable wealth, and fragments of imported stones may be evidence of the wider maritime contacts exercised by the church. There are also many groups of small, probably monastic, buildings in remote parts of the islands, such as Kame of Isbister, Birrier of West Sandwick and even desolate rocks such as Freya Stack, off Foula. The physical isolation which provided austerity has aided preservation but also impeded study.

The lack of archaeological investigation of Pictish and early Viking Shetland makes it difficult to assess accurately the impact of 8th-century Norse raids and subsequent settlement there. Pictish domestic buildings are known only from the excavated sites at Underhoull and Jarlshof. These are also the only investigated sites of early Viking settlement. They do not show the continuity of Pictish artefacts into the Viking Age that has been traced in Orkney. The dominance of Norse-derived place-names (some 99% of the total) certainly suggests that the incomers swept away Pictish culture.

The Viking Age buildings are architecturally distinctive, rectilinear plans replacing earlier round and oval buildings. The existence of extended families is evidenced by remains of characteristic stone-built hall houses with timber posts supporting the roof, and a central hearth with surrounding benches. Outhouses, particularly byres, reveal the pastorally based economy of farming settlements. Underhoull's location, which is mirrored by Viking sites in other regions, was at the centre of resources: on a rising slope with grazing behind, fertile land below and overlooking a sheltered bay. Fish would have been a necessary dietary supplement to agricultural produce.

Graffiti from Jarlshof include two illustrations of boats. Highly developed ships, capable of ocean voyages, made raiding and migration on a large scale from southern Norway possible. Wrecks from this maritime tradition, of comparable quality to the warships and cargo craft found in Denmark, might be anticipated from the Shetland coast. A legacy of Norse settlement is the traditional clinker-built double-ended fishing boat.

6.2.4 Late Norse to Modern Times

Jarlshof and Sandwick provide examples of later Norse farms. The hall houses persisted but were modified by extensions and internal divisions to provide separate rooms. At Biggings, Papa Stour, the range of surviving structures and artefacts has been extended by waterlogged and peaty conditions. In addition to a late Norse wooden floor, the site contained wooden artefacts and woven cloth. Analysis of faunal remains from Jarlshof and Sandwick suggests that deep-sea fishing was conducted on a large or even commercial scale (Ritchie 1993). The artefact assemblages show that local materials were exploited but also that goods were obtained from overseas. The combination of fishing and trade remained a key feature of the Shetland economy in the ensuing centuries.

The ruined church in St Ninian's Isle is 12th or 13th century and overlies an earlier rectangular chapel possibly of Pictish date. The difficulty of tracing Viking and Late Norse domestic settlements may arise from the continuous occupation of well-chosen farm sites, so that Post Medieval and modern crofts overlie original homesteads. The problem of continuity and rebuilding is also demonstrated by horizontal water mills, whose ancient origin was confirmed by excavation of a Norse example in Orkney (Batey 1993). Housed in small stone buildings, and placed in sequence on burns, these remain a feature of Shetland's agricultural landscape, although they have not been in use since the 1939-1945 War.

Like Orkney, Shetland did not pass from Norwegian control until the 1460s. The castles of Muness (1598) and Scalloway (1600) were the defended residences respectively of the powerful controlling family, the Stewarts, and their adherents, the Bruces. By 1700 most of Shetland was in the hands of a few Scottish lairds.

The continued focus on fishing gave Shetland contacts with northern Europe. Since the 15th century Hanseatic merchants had brought luxury goods to trade for fish, which they dried and salted on open beaches such as Colla Firth. Hollanders' Knowe perpetuates the name of an early market close to the island's former capital of Scalloway. In the 17th century Lerwick developed on the east side of Mainland as a settlement servicing the foreign traders who came to settle in Bressay Sound. The sound was protected by a coastal fort and battery built in 1652-3, rebuilt and renamed Fort Charlotte in 1781. From the early 18th century the lairds took the place of foreign merchants in organising the industry and providing capital for boats. In the 19th century huge herring shoals around Shetland attracted fishing vessels from the Scottish mainland and Scandinavia. The industry reached immense proportions in the 20th century with hundreds of boats gathering in the harbours of Balta Sound and Lerwick. Relics of the fishing industry remain in numerous derelict piers and herring stations around the coast. Burra, Whalsay and Out Skerries, with larger fishing vessels, have managed to maintain the island industry.

Shetland is remarkable for its large numbers of located shipwrecks. The majority of these are modern, including the *Oceanic*, sister ship of the *Titanic*, on a reef off Foula. However, in comparison with many other areas of Britain the 16th - 19th centuries are also well represented. An Armada flagship *El Gran Grifon* was wrecked on Fair Isle while fleeing from Drake's navy in 1588; it was located in

1970. Seventy years later it was Dutch merchants who were required to take the hazardous sea route round Shetland to avoid interception by the Royal Navy in the English Channel. A number did not succeed, the earliest being the flutship *Lastdrager*, wrecked in 1653 off Yell. Her discovery in 1974 shed new light on the trade of the Dutch East India Company (VOC). Other VOC shipwrecks located were the *Kennermerland*, wrecked at Stoura Stack in Out Skerries in 1664, *de Liefde*, wrecked there in 1711, the *Curaçao*, a warship guarding a convoy, off Unst in 1729, and the *Wendela*, lost in 1737 off Fetlar. Many others are known to have been lost in

the area, but have yet to be found. Not only Dutch ships chose this route: an imperial Russian transport wrecked in 1711 off Griff Skerry was located in 1972, and a Danish warship, the *Wrangels Palais*, wrecked on Out Skerries, was found in 1990 (see also [section 6.3.3](#)).

Onshore lighthouses completed under the direction of the Stevenson family, engineers to the Northern Lighthouse Board, include Muckle Flugga and Sumburgh Head (1821), Whalsay and North Unst (built at the beginning of the Crimean War, the latter in an incredible 26 days) and Bressay (1858) (Muir 1978).



Some 1,500 vessels are known to have been wrecked in the hostile waters that separate Shetland from Orkney and around Shetland's numerous islands, a legacy of Shetland's long tradition of seafaring and its strategic position in relation to Europe. The cold, unpolluted waters preserve remains in exceptionally fine condition, and wrecks, both visible and as yet unlocated, litter the shores and sounds, as here off the south coast of the Walls Peninsula, Mainland. Photo: Coastwatch, JNCC.

6.3 Human activities

6.3.1 Integrated management

The archaeological resource is now being considered within mechanisms for the management of the Scottish coastal zone. The man-made heritage is included in *Scotland's coast: a discussion paper* (Scottish Office 1996). The survey strategies of Historic Scotland and the Royal Commission on the Ancient and Historic Monuments of Scotland (RCAHMS) have been linked with the Focus on Firths initiative led by Scottish Natural Heritage to ensure that archaeological information is gathered within the wider sphere of management activity.

The importance of including the archaeological resource in all data-gathering to inform management plans was brought home by the recent *Braer* tanker incident. Efforts to protect the coast from spilled oil brought the urgent need to dig holding pits. This posed an immediate, and previously unrecognised, threat to archaeological remains. Detailed maps of remains are in preparation to assist in any future incident planning (V. Turner pers. comm.).

6.3.2 Activities and processes affecting the archaeological resource

The archaeological resource does not consist entirely of discrete sites and it is not confined to particular environmental zones. Extensive palaeoenvironmental deposits, for example, can extend from dry land across the intertidal area and on to the sea bed. The need to consider the archaeological resource during the planning stage of land developments is recognised (see [section 6.3.5](#)). Developments such as coast defences, sewage outfalls and pipe and cable-laying can also affect archaeology in the intertidal and subtidal zone.

Erosion, resulting from ongoing post-glacial sea-level rise, has been identified by Historic Scotland as a long-term serious threat to Scottish archaeological sites. In a recent overview, at least 92 Shetland sites, many multi-period with numerous features, were classed as eroding (Ashmore 1994). Sites are vulnerable to tidal, wave and storm attack. Dune systems are important as they entomb and preserve sites: their loss is a serious concern. Human or animal activity can accelerate soil erosion by denuding sites of vegetation. Control of farm animals is also important. Ploughing and peat cutting have cut into archaeological sites, causing damage but also leading to discoveries. Agricultural improvements can have an adverse effect; for example, drainage can lead to desiccation of buried waterlogged deposits. Where peat has been cut in earlier periods it seems likely that the prehistoric monuments that were revealed were subsequently reduced by people taking the stone for later constructions. In their decayed state, many of Shetland's stone monuments may appear to the untrained eye as unremarkable mounds of stone. Such sites are as vulnerable to stone removal for construction now as in preceding centuries (Fojut 1994). Commercial operations can also remove surface features; for example some

prehistoric buildings at Mavis Grind were destroyed by quarrying, while others were buried by overburden from the works (Cracknell & Smith 1983).

6.3.3 Protection of sites, monuments and wrecks

The White Paper *This common inheritance* (DoE *et al.* 1990) expressed the government's commitment to preserving and enhancing the archaeological heritage. Remains are non-renewable and "the primary policy objectives are that they should be preserved wherever feasible and that, where this proves not to be possible, procedures should be in place to ensure proper recording before destruction, and subsequent analysis and publication" (Scottish Office 1994a). The development planning system provides the main policy framework for achieving this objective (see [section 6.3.5](#)).

In Scotland, three statutes provide for protection of *in situ* remains of archaeological or historic importance. The Ancient Monuments & Archaeological Areas Act 1979 (AMAA) provides for Scheduled Ancient Monuments (SAMs), the Town & Country Planning (Scotland) Act 1972 provides for Listed Buildings and Conservation Areas, and the Protection of Wrecks Act 1973 allows designation of shipwrecks of archaeological, historic or artistic importance.

The legislative arrangements, controls on works and criminal offences related to SAMs and the criteria for determining the national importance of sites are described in Planning Advice Note 42 (Scottish Office 1994b). The AMAA definition of monument includes sites both on land and in UK territorial waters, including remains of vehicles, vessels and aircraft. There are over 280 SAMs in Shetland (Historic Scotland 1995), compared with 5,300 in Scotland as a whole and 21,000 in the whole of Great Britain. The majority of those in Shetland are prehistoric, but the more recent monuments include castles and modern gun emplacements. The permission of the Secretary of State for Scotland is required prior to any works that will alter, restore, damage or destroy a SAM. Current review programmes are increasing the number of SAMs in Britain; in Scotland the increase is around 300 monuments a year. SAMs may also be taken into direct state care: there are eight such monuments in Shetland, including Fort Charlotte (17-18th century), which was built to command Bressay Sound. SAMs represent only a small number of the total known archaeological sites.

The Town & Country Planning (Scotland) Act 1972 (as amended) provides for buildings considered of special architectural or historic importance to be designated as Listed Buildings. The prior consent of the Secretary of State for Scotland is required for any works which will alter, damage or destroy a Listed Building. Historic environments, particularly in urban settings, can be designated as Conservation Areas. Historic Scotland (1993) details guidance on the treatment of Listed Buildings, for which controls are generally exercised by the local authority.

Shipwrecks of archaeological, historical or artistic

importance may be designated under the Protection of Wrecks Act 1973. There are no standard criteria for designation, but Historic Scotland receives guidance from the Advisory Committee on Historic Wreck. Except under licence from Historic Scotland 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). Sites may be visited on behalf of Historic Scotland by the Archaeological Diving Unit, which is contracted by the Department of National Heritage to provide field inspection throughout the UK.

There are two designated wrecks in this region (Table 6.3.1) (Archaeological Diving Unit 1994). Fewer than 45 wrecks have been designated for the whole of Britain, and their distribution cannot be accepted as a reasonable guide to the total sea-bed resource. Information on shipwrecks in the region is contained in the Shetland Sites and Monument Record (SMR) and in the National Monuments Record Scotland - Maritime Section (NMRS-MS), maintained by the RCAHMS. Shetland's shipwrecks are recognised as an underwater heritage, attracting visitors from around the world. Good visibility down to depths of 50 m aids discovery and enjoyment. To prevent looting, the Shetland Islands Council has leased from the Crown Estate the sea bed rights in more than fifteen areas that contain historic wrecks. Diving is permitted but objects must not be removed from wrecks or the surrounding sea bed.

6.3.4 Key organisations and their responsibilities

Historic Scotland (HS) executes the responsibility of the Secretary of State for Scotland in respect of the protection, management and interpretation of the built heritage (i.e. ancient monuments, archaeological sites and landscapes, historic buildings, parks and gardens, and designed landscapes). HS compiles and amends the Schedule of Ancient Monuments and the statutory lists of buildings of special architectural or historic interest. HS also has responsibility for administration of the Protection of Wrecks Act 1973.

The Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS) has responsibility for survey and inventory of archaeological sites. It maintains a database of archaeological sites known as the National Monuments Record Scotland (NMRS). In 1992 a new Royal Warrant extended its remit to the territorial seas. The Commission has begun to compile a maritime section of the NMRS. RCAHMS is also the lead agency for local Sites and Monuments Records (SMRs) - an inventory of all known archaeological features in the area and the main source of information at a local level. The Shetland Archaeologist is responsible for the compilation and maintenance of the Sites

and Monuments Record for Shetland. Employed by Shetland Amenity Trust, the service is funded by Shetland Islands Council Charitable Trust. Site protection is achieved primarily through the planning system but the Shetland Archaeologist is also involved in other aspects of management and interpretation.

The Scottish Institute for Maritime Studies at St Andrews University is the only formally constituted academic department in Scotland concentrating on maritime heritage. It undertakes and supervises research and is involved in fieldwork.

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. National Planning Policy Guidance Note 5 (Scottish Office 1994a) explains the regard that should be accorded to archaeological remains. In essence there is a presumption in favour of preservation *in situ* because "the primary policy objectives are that they should be preserved wherever possible". Stress is laid on early consultation between planning authorities and developers, with information and advice from the SMR, in order to reconcile the needs of archaeology and development. Where preservation *in situ* is not justified, planning "procedures should be in place to ensure proper recording before destruction, and subsequent analysis and publication". Account must be taken of sites with regional or local significance and of other sites and finds recorded in the SMR. Specific guidance is also available on the treatment of SAMs within the planning system (Scottish Office 1994b).

Planning decisions should take into account the more detailed policies that appear in Development Plans. Archaeological policies are being prepared for the Shetland Structure Plan and are also found in the Local Plans. The Zetland County Council Act (1974) gives control of development within the three mile limit to Shetland Island Council.

To seaward of low water mark there is a sectoral approach to development control. Regulation, including the need for Environmental Assessment, is divided between a range of government departments and agencies. Until recently consideration of archaeology was precluded by lack of information on the extent of the resource and the absence of a management structure in the subtidal zone. However, growing awareness of marine archaeology and the development of the NMRS Maritime Section should encourage closer consideration of the marine resource. Sea bed developers can now obtain guidance from a *Code of practice for seabed developers* (Joint Nautical Archaeology Policy Committee 1995).

Table 6.3.1 Wreck sites designated under the Protection of Wrecks Act 1973

Name	Location	Grid ref.	Description	Designation order
<i>Kennemerland</i>	Stoura Stack, Out Skerries	HU688713	Dutch East Indiaman; lost 1664	1978 No. 3: 1978/664
<i>Wrangels Palais</i>	Out Skerries	HU704719	Danish Warship; lost 1687	1990 No. 3: 1990/2573

Sources: Archaeological Diving Unit (1994); conversions from latitude and longitude by RCAHMS

6.3.6 Reporting archaeological information

The Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS) and the Shetland Sites and Monuments Record (SMR) are the accepted reporting points for new archaeological information. Objects should be reported to the Shetland Museum. Information and enquiries concerning Scheduled Ancient Monuments (SAMs) and Historic Wrecks should be directed to Historic Scotland. Those concerning Listed Buildings should be directed to the planning department of Shetland Islands Council.

In Scotland the law of *bona vacantia* (encompassing Treasure Trove) means that, in effect, all antiquities found on land can be claimed by the Crown. This extends to low water mark and harbour waters and applies to all objects. Finders are legally obliged to report all finds, ultimately to the Queen's and Lord Treasurer's Remembrancer at the Crown Office; this can be done *via* the Treasure Trove Advisory Panel Secretariat (at the National Museums of Scotland) or the local museum, local authority archaeologist, the police or the Procurator Fiscal. Finds from excavations funded by Historic Scotland, made casually on monuments in care or from excavations undertaken with SAM Consent, if not claimed by the Crown, go before the Finds Disposal

Panel, which determines to which museum they should go (Historic Scotland 1994).

The Merchant Shipping Act 1894, as amended, requires any recovered wreck to be reported to the Receiver of Wreck; reports may be made via the local coastguard. Wreck is now defined as any ship, aircraft, hovercraft or parts of these, their cargo, or equipment, found in or on the shores of the sea or any tidal water. Reporting forms are available from the Receiver of Wreck. These include a form which finders may use to volunteer to RCAHMS information on the identity and condition of wreck sites. The Receiver advertises reported wreck, regardless of age, in order that owners may claim their property. After one year, unclaimed wreck becomes the property of the Crown and is disposed of in order to pay the expenses of the Receiver and any salvage awards. During the statutory year, 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. Finders are often allowed to keep unclaimed wreck *in lieu* of a salvage award.

6.4 Information sources

6.4.1 Information gathering and collation

Historic Scotland's examination of archaeology in the coastal erosion zone (Ashmore 1994) states that, prior to 1993, there had been no systematic survey targeted to the coast of Shetland. The content of the SMR had been updated as a result of walking many stretches of coast, and Historic Scotland had funded excavation in advance of erosion, between 1977 and 1992, at Burland, Eastshore, Fair Isle South Harbour, Ness of Burgi, Sands of Breckon and Scatness.

RCAHMS has compiled an initial Maritime Section of the NMRS. This has drawn on entries within the Wreck Index of the Hydrographic Department. The index lists mainly metal wrecks that stand proud of the sea bed and which have been identified by remote sensing, as well as the last position reports of 20th century shipping casualties. RCAHMS will develop their record using documentary accounts of ships losses and reports from field observations. RCAHMS record is linked to a Geographic Information System (GIS), and incorporation of environmental data on sea-bed deposits should help to indicate areas of likely preservation.

A register of some 1,500 shipwrecks has been compiled in Shetland. These are known either from documentary sources, from oral tradition or from being located on the sea bed. It is planned to incorporate these records within the computerised SMR. There has been little general archaeological survey of the sea bed. In 1972, however, Gulber Wick and an area off Jarlishof were searched for Viking material (Milne 1973). Starting in 1996 a five-year programme will examine specific areas of the coast, to inform future management strategies. The work will include preparation of maps, for use by emergency response teams, which show areas of known and archaeological potential.

6.4.2 Acknowledgements

Thanks are due to P. Ashmore and N. Fojut (Historic Scotland), A. Taylor (Shetland Islands Council), V. Turner (Shetland Archaeologist) and staff from all the organisations mentioned in the text who provided information and advice.

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C. Contact names and addresses

<i>Type of information</i>	<i>Contact address and telephone no.</i>
Scheduled Ancient Monuments; Listed Buildings; designated wreck sites; rescue archaeology; management of monuments in care	Principal Inspector of Monuments, Historic Scotland, Longmore House, Salisbury Place, Edinburgh EH9 1SH, tel: 0131 668 8650
Scheduled Ancient Monuments and Listed Buildings - Shetland	Shetland Islands Council, Planning Department, Lerwick, tel: 01595 693535
Reporting of recovered wrecks in Britain	Receiver of Wreck, Coastguard Agency, Spring Place, 105 Commercial Road, Southampton SO15 1EG, tel: 01703 329474
Research and education	The Secretary, Scottish Institute for Maritime Studies, University of St Andrews, St Andrews, Fife KY16 9AL, tel: 01334 462916
<i>Code of practice for seabed developers</i>	Joint Nautical Archaeology Policy Committee, Head of Recording (Maritime), National Monuments Record, Royal Commission on the Historical Monuments of England, National Monuments Record Centre, Kemble Drive, Swindon SN2 2GZ, tel: 01793 414600
National Monuments Record - information and location of sites	Royal Commission on the Ancient and Historical Monuments of Scotland, National Monuments Record of Scotland, John Sinclair House, 16 Bernard Terrace, Edinburgh EH8 9NX, tel: 0131 662 1456
Regional Sites and Monuments Records	Shetland Archaeologist, Shetland Amenity Trust, 22-24 North Road, Lerwick, Shetland ZE1 0NQ, tel: 01595 694688
Information on, and reporting of, Treasure Trove	Archaeology Department, National Museums of Scotland, Queen Street, Edinburgh EH2 1JD, tel: 0131 225 7534
Reporting objects and Treasure Trove in Shetland	The Curator, Shetland Museum, Hillhead, Lerwick, Shetland ZE1 0EL, tel: 01595 695057



The international importance of Shetland for breeding seabirds is hard to overstate. 23 colonies hold numbers of seabirds that equal or exceed 1% of the individual species' total populations in the European Union. Keen of Hamar National Nature Reserve (NNR), on north-east Unst, supports internationally important numbers of breeding fulmar *Fulmarus glacialis* (pictured), arctic skua *Stercorarius parasiticus* and great skua *Catharacta skua*. However, like the majority of such sites in Shetland, it has no international conservation designation on account of its birds. Photo: Pat Doody, JNCC.

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'. Data included in this section are correct as at February 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), although dealing specifically with planning policy in England, also gives useful summaries of some of the existing site protection mechanisms also found in Scotland. 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 statutory framework for site protection in Scotland is set out in

Scottish Office Circular 6/90/95 (Scottish Office 1995). The Scottish Office is currently preparing two National Planning Policy Guidance (NPPG) notes, one on natural heritage and one on coastal matters.

Archaeological designations and protected sites (covered in Chapter 6) and 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) are omitted from this chapter. Non-site based measures contained in conventions and directives aimed at broad species and habitat protection, such as in 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.

This chapter is divided into five sections. A regional summary of all categories of site is given in Table 7.1.1. Section 7.2 covers those site-based protection measures falling under international conventions or European directives. Sites identified under national statute are discussed in section 7.3, whereas section 7.4 covers sites without statutory protection but which are identified, owned or managed by statutory bodies; and finally, other types of 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, island by island), 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

Shetland is small, encompassing only 0.7% of the area of Great Britain, but approximately 7.4% of the length of its coastline. Consequently, in absolute terms, only a small proportion by area of the Great Britain totals of many British coastal protected site categories are found here. Despite this, much of Shetland has been designated for the protection of its coastal habitats, indicating its importance at a national scale. All of Shetland is an Environmentally Sensitive Area, whilst approximately one tenth of the coastline falls within Sites of Special Scientific Interest (SSSIs). Shetland also contains 14% of Great Britain's Marine Consultation Areas. The region also contains 7% by area of Great Britain's RSPB reserves, and 3.9% of its Geological Conservation Review sites. Shetland is one of the few regions in Britain that currently lack Ramsar sites and Wildlife Trust sites. Table 7.1.1 summarises site protection in the region, showing the numbers and areas of each type of site and comparing these with North Sea Coast and British (whole country coast) totals.

Table 7.1.1 Summary of site protection in Shetland

	Number of protected sites					Area covered by site protection				
	Region 1	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
Special Protection Areas	8	61.5	13.0	100	8.0	6,113	199,736	3.1	363,112	1.7
Possible Special Areas of Conservation	7	49	14.3	112	6.3	n/av	n/av	n/av	n/av	n/av
Environmentally Sensitive Areas	1	7	14.3	17	5.9	146,478	279,478	52.4	1,397,545	10.5
National Nature Reserves	3	45	6.7	82	3.7	1,307	36,615	3.6	88,701	1.5
Sites of Special Scientific Interest	72	561	13.0	1,212	6.0	15,582	336,345	4.6	717,286	2.2
National Scenic Areas	1	4	25.0	27	3.7	11,600	52,400	22.1	745,800	1.6
Geological Conservation Review sites	40	551	7.3	1,096	3.6	n/ap	n/ap	n/ap	n/ap	n/ap
Marine Consultation Areas	4	6	66.7	29	13.8	531	8,609	6.2	111,896	0.5
Preferred Conservation Zones	1	17	5.9	22	3.7	n/av	n/av	n/av	n/av	n/av
The National Trust & The National Trust for Scotland sites ^a	1	191	0.5	453	0.2	1,089	18,610	5.9	64,127	1.7
Royal Society for the Protection of Birds reserves	5	56	8.9	87	5.7	2,720	24,836	11.0	39,888	6.8
Ministry of Defence sites	2	64	1.6	109	0.9	72	34,496	0.2	53,456	0.1

Source: JNCC (November 1996 Ramsar/SPA data). Key: *to the nearest whole hectare; n/ap = not applicable, n/av = not available; ^aincludes National Trust sites for England and Wales. Notes: site types not currently found in the region: World Heritage (Natural) Sites, Biogenetic Reserves, Biosphere Reserves, Ramsar sites, Marine Nature Reserves, Local Nature Reserves, Country Parks, Regional Landscape Designations, Wildlife Trust sites, Woodland Trust sites and 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.

7.1.3 Further sources of information

A. References cited

- Davidson, N.C., Laffoley, D.d'A., Doody, J.P., Way, L.S., Gordon, J., Key, R., Drake, C.M., Pienkowski, M.W., Mitchell, R., & Duff, K.L. 1991. *Nature conservation and estuaries in Great Britain*. Peterborough, Nature Conservancy Council.
- Department of the Environment. 1994. *Planning Policy Guidance Note 9 - nature conservation*. London, HMSO.
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B. Further reading

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- Gubbay, S. 1988. *A coastal directory for marine conservation*. Ross-on-Wye, Marine Conservation Society.
- Hatton, C. 1992. *The Habitats Directive: time for action*. Godalming, WWF-UK (World Wide Fund for Nature).
- Hywell-Davies, J., & Thom, V. 1984. *Macmillan's guide to Britain's Nature Reserves*. London, Macmillan.
- Scottish Natural Heritage. 1995. *Natura 2000: a guide to the 1992 EC Habitats Directive in Scotland's marine environment*. Perth, Scottish Natural Heritage.

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 Special Protection Areas

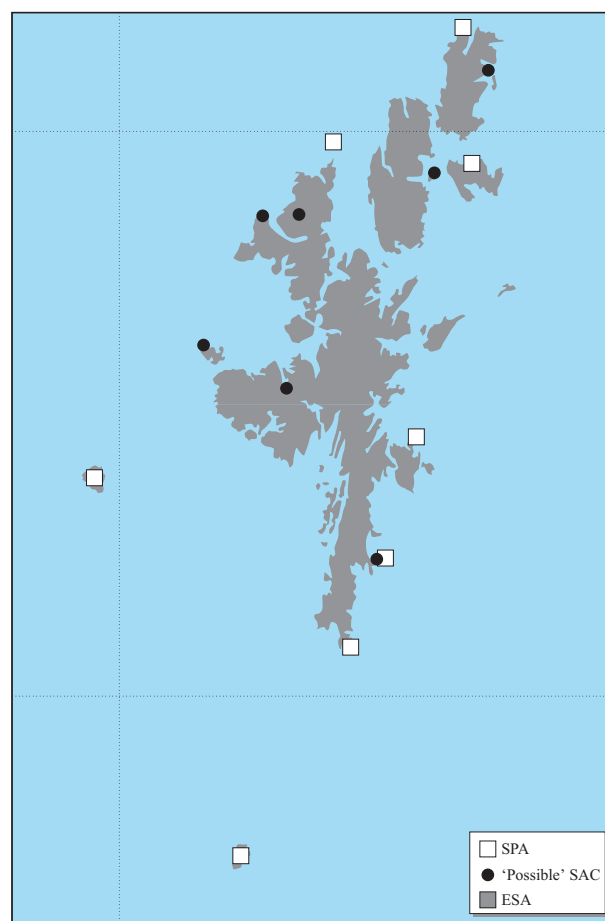
The 1979 EC Directive on the Conservation of Wild Birds (the Birds Directive) requires member states to take conservation measures particularly for certain rare or vulnerable species and for regularly occurring migratory species of birds. In part this is achieved through the designation of statutory 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 eight coastal SPAs (6,113 ha) in Shetland ([Table 7.2.1](#); [Map 7.2.1](#)). [Table 7.2.1](#) summarises the interest of these sites, and sections [5.10](#), [5.11](#) and [5.12](#) describe the importance of these sites for the region's birds. Designation of SPAs is an ongoing process and further sites may be announced in the future.

7.2.2 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. They are areas considered to be important for certain habitats and non-avian species of interest in a European context. The protection measures are based around a series of six annexes: Annexes I and II require the designation of SACs for certain habitats and species; Annex IV prohibits the taking of certain species; Annex V requires the taking of certain species to be monitored; and Annex VI prohibits some means of capture or killing of mammals and fish. In the UK the Directive is implemented through the Habitats etc. Regulations 1994 (DoE 1994; Scottish Office 1995). A list of possible SACs was announced by the Government on 31 March 1995. There are seven possible SACs in Shetland ([Table 7.2.2](#); [Map 7.2.1](#)), out of a total of 112 coastal possible SACs in GB (JNCC 1995).

7.2.3 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



Map 7.2.1 Special Protection Areas (SPAs), Environmentally Sensitive Area (ESA) and 'possible' Special Areas of Conservation (SACs). Sources: JNCC, SNH.

intensification, and restore traditional landscapes, for which member states are allowed to make payments to farmers.

All of Shetland (146,478 ha) has been designated an ESA ([Table 7.2.3](#); [Map 7.2.1](#)). Ten ESAs have been designated in Scotland (Parliamentary News 1994), seven in Wales and 22 in England. Of the Scottish sites, four are coastal.

7.2.4 Acknowledgements

Thanks are due to John Gibson (JNCC) and staff at SOAEFD and MAFF.

Table 7.2.1 Special Protection Areas (SPAs)

Site name	No. of sites	Grid ref.	Area (ha*)	Date designated	Selection criteria used
Hermaness & Saxa Vord		HP605165	980	1994	Internationally important numbers of breeding gannet <i>Sula bassana</i> , shag <i>Phalacrocorax aristotelis</i> and great skua <i>Stercorarius skua</i> ; nationally important numbers of fulmar <i>Fulmarus glacialis</i> , guillemot <i>Uria aalge</i> and puffin <i>Fratercula arctica</i>
Fetlar		HU625935	2,639	1994	Internationally important numbers of breeding great skua; nationally important numbers of breeding seabirds and waders, including 70% of the British red-necked phalarope <i>Phalaropus lobatus</i> population
Noss		HU545405	313	1996	Internationally important numbers of breeding gannet, guillemot and great skua, nationally important numbers of breeding fulmar and kittiwake <i>Larus tridactyla</i> ; presence of the arctic tern <i>Sterna paradisaea</i> (Annex 1 species)
Mousa		HU460240	210	1995	Nationally important numbers of breeding storm petrels <i>Hydrobates pelagicus</i> and black guillemot <i>Cepphus grylle</i>
Sumburgh Head		HU408091	41	1996	Nationally important numbers of breeding shag
Ramna Stacks and Gruney		HU380970	11	1996	One of only seven known breeding stations of Leach's petrel <i>Oceanodroma leucorhoa</i> in the EU
Foula		HT960390	1,327	1995	Internationally important numbers of breeding great skua, guillemot and puffin, and nationally important numbers of breeding fulmar, shag, arctic skua <i>Stercorarius parasiticus</i> and razorbill <i>Alca torda</i>
Fair Isle		HZ210720	592	1994	Supports entire world population of endemic Fair Isle subspecies of wren <i>Troglodytes troglodytes fridariensis</i> and internationally important numbers of breeding arctic tern. Regularly supports internationally important numbers of eight migratory seabird species.
Shetland	8		6,113		
North Sea Coast	61.5		199,736		
GB coast	100		363,112		
GB whole country	136		495,843		

Sources: JNCC November 1996 data; Scottish Natural Heritage; Pritchard *et al.* (1992). 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 7.2.2 Possible Special Areas of Conservation (SACs)

Site name	Grid ref.	No. of sites	Qualifying interest
Keen of Hamar	HP645097		Calaminarian grasslands. Eutric scree.
Hascosay	HU553923		Blanket bog (active only)
Mousa	HU465245		Common seal <i>Phoca vitulina</i>
The Vadills	HU295555		Lagoons
Papa Stour	HU147615		Reefs. Submerged or partly submerged sea caves.
Ronas Hill -North Roe	HU323855		Alpine and subalpine heaths. Blanket bog (active only).
Tingon	HU255840		Blanket bog (active only)
Shetland		7	
North Sea Coast		49	
GB		112	

Sources: JNCC 1995; SNH (1995 data). 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 7.2.3 Environmentally Sensitive Areas

Site name	No. of sites	Area (ha*)	Date designated	Interest
Shetland Islands		146,478	1987	Natural heritage, crofting and farming. Serpentine heath, rushy and improved pasture, hay meadows, stone dykes. Peat and heather moorland important for breeding birds; marshy grassland for breeding waders. Relict field patterns of Neolithic and Bronze Age.
<i>Shetland</i>	1	146,478		
North Sea Coast	7	279,478		
GB coast	17	1,397,545		

Sources: SOAEFD, SNH, MAFF. 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.

7.2.5 Further sources of information

A. References cited

- Department of the Environment. 1994. *The Conservation (Natural Habitats, &c.) Regulations*. London, HMSO. (Statutory Instrument, No. 2716.)
- Joint Nature Conservation Committee. 1995. *Council Directive on the conservation of natural habitats and wild fauna and flora (92/43/EEC) - the Habitats Directive: a list of possible Special Areas of Conservation in the UK. List for consultation (31 March 1995)*. Peterborough, Joint Nature Conservation Committee (unpublished report to the Department of the Environment).
- Parliamentary News. 15/03/94. *Environmentally Sensitive Areas (in a report on the House of Lords debate on the proposed merger of English Nature and the Countryside Commission)*.
- 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.
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B. Further reading

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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.
SPAs, Special Areas of Conservation	*Conservation Officer, SNH, Northern Isles Area, Shetland Office, Lerwick, tel: 01595 693345
SPAs	*Regional Officer, RSPB Shetland Office, Lerwick, tel: 01950 460800
ESAs	*Scottish Office Agriculture, Environment and Fisheries Department, Edinburgh, tel: 0131 556 8400
Special Areas of Conservation	*Department of the Environment (DoE), European Wildlife Division, Bristol, tel: 0117 987 8000

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

7.3 Sites established under national statute

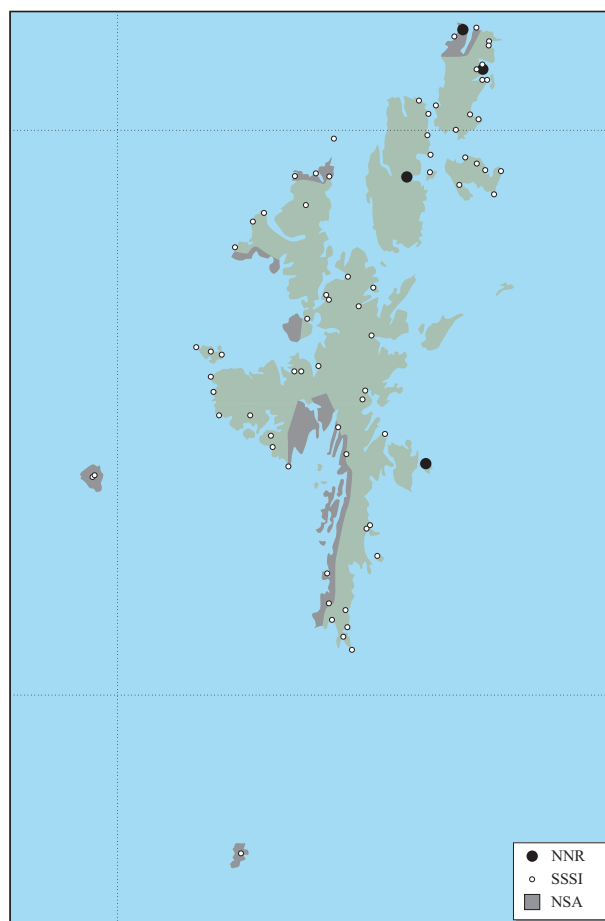
Included in this section are the types of site identification made under national legislation relating to wildlife, landscape and amenity value. Identifications are made in Shetland by the statutory nature conservation agencies (in this region Scottish Natural Heritage), Shetland Island Council or the 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 three coastal NNRs (1,307 ha) in Shetland (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 73 coastal SSSIs



Map 7.3.1 Coastal National Nature Reserves (NNRs), Sites of Special Scientific Interest (SSSIs) and National Scenic Area (NSA). Note: a single symbol may represent more than one site in close proximity. Sources: SNH, JNCC.

Table 7.3.1 National Nature Reserves

Site name	No. of sites	Grid ref.	Area (ha*)	Date last declared	Habitats
Hermaness		HP605160	964	1955	Skerries, cliffs, grassland and rough moorland
Keen of Hamar		HP645099	30	1975	Stony hillside of serpentinite rock, fellfield, periglacial features, montane and maritime flora
Noss		HU545404	313	1955	Island with sandstone cliffs
<i>Shetland</i>	3		1,307		
North Sea Coast	45		36,615		
GB coast	82		88,701		
GB whole country	288		195,531		

Source: SNH. 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 7.3.2 SSSIs in Region

Site name	No. of sites	Grid ref.	Area (ha*)	Date last notified	Site name	No. of sites	Grid ref.	Area (ha*)	Date last notified
Unst	14				Mainland (cont.)				
Saxa Vord		HP628173	59	1988	Mousa		HU461242	210	1983
Norwick		HP650148	6	1991	Dalsetter		HU405163	34	1989
Norwick Meadows		HP646138	23	1984	The Cletts, Exnaboe		HU407130	13	1987
Punds to Wick of Hagdale		HP645107	5	1994	Sumburgh Head		HU408091	41	1984
Crussa Field and the Heogs		HP625105	474	1986	Pool of Virkie		HU398112	32	1983
Keen of Hamar		HP645097	51	1983	Quendale		HU380134	143	1986
Balta		HP660077	16	1988	Lochs of Spiggie & Brow		HU374160	154	1983
Skeo Taing to Clugan		HP647075	15	1990	St Ninian's Tombolo		HU372208	13	1987
Qui Ness to Pund Stacks		HP622033	2	1989	Lochs of Tingwall & Asta		HU417429,	72	1985
Ham Ness		HP636017	32	1990			HU413415		
Easter Loch		HP598013	7	1982	South Whiteness		HU388458	82	1986
Lunda Wick		HP566044	1	1987	Burn of Valayre		HU369693	6	1984
Tonga Greff		HP585140	20	1988	Skelda Ness		HU302405	3	1989
Hermaness		HP605160	980	1986	Culswick Marsh		HU273445	8	1983
Fetlar	7				Ward of Culswick		HU268463	152	1988
Tressa Ness-Colbinstoff		HU615944	14	1989	Lochs of Kirkigarth & Bardister		HU238497,	18	1983
North Fetlar		HU625930	1,676	1986			HU238502		
Virva		HU645920	1	1989	Fidlar Geo to Watsness		HU190493	19	1987
Trona Mires		HU670915	153	1986	Sel Ayre		HU177540	1	1990
Funzie		HU656884	7	1991	Melby		HU168565	6	1987
Lamb Hoga		HU602897	810	1986	Papa Stour Fish Bed		HU186604	<1	1990
Hascosay		HU553923	165	1987	Papa Stour		HU165610	593	1987
Yell	5				Ness of Clousta to The Brigs		HU304582	70	1989
Breckon		HP529052	58	1983	Papa Stour Coast		HU147615	112	1990
Ness of Cullivoe		HP550025	11	1988	Loch of Clousta		HU315582	50	1983
Gutcher		HU551997	2	1989	Burn of Lunklet		HU370573	1	1994
North Sandwick		HU550965	6	1988	Muckle Roe Meadows		HU338659,	3	1992
East Mires		HU495955	604	1996			HU341659		
Mainland	47				Eshaness Coast		HU210790	52	1989
Ramna Stacks & Gruney		HU380970	11	1984	Villians of Hamnavoe		HU240824	56	1987
Voxter Voe & Valayre Quarry		HU365697	24	1988	Tingon		HU255840	584	1988
Quoys of Garth		HU408741	<1	1989	North Roe Meadow		HU371897	1	1994
The Ayres of Swinister		HU449723	27	1987	Ronas Hill-North Roe		HU323855	4,907	1986
Dales Voe		HU408687	5	1989	Fugla Ness-North Roe		HU313914	5	1986
Laxo Burn		HU445634	<1	1994	Uyea-North Roe Coast		HU344916	264	1991
Catfirth		HU437538	<1	1984	Foula Coast		HT961391	236	1990
Loch of Girlsta		HU433522	102	1983	Foula		HT960390	1,327	1987
Easter Rova Head		HU474453	4	1987	Fair Isle		HZ213720	593	1984
Burn of Aith		HU442295	14	1989	Shetland	73			15,582
Noss		HU545404	313	1983	North Sea coast	561			336,345
Aith Meadows		HU440293	24	1986	GB coast	1,212			717,286
					GB whole country	6,150			2,069,628

Source: SNH. 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.

(15,582 ha) in Shetland (Table 7.3.2; Map 7.3.1). Around 8% of the total land mass of Britain is SSSI.

Approximately four fifths of the coastal SSSIs in the region (78%) have some intertidal land, while only 22% are purely terrestrial. Over half of the SSSIs (56%) were selected at least partly for their biological interest and 61% at least partly for their earth science (geological or geomorphological) interest. Of the total, 17% have both biological and earth science interest. The most frequently

occurring habitats and species within the SSSIs in this region are open water, sea cliffs and peatland/bog. Each of these occurs in between 12% and 18% of sites. SSSIs in the region include several sites of interest for their breeding waders (17%) and/or breeding seabirds (27%). Further details of SSSIs may be found in the *Coastal and marine UKDMAP datasets* module disseminated by JNCC (BODC 1992; Barne *et al.* 1994).

Table 7.3.3 National Scenic Areas

Site name	No. of sites	Area (ha*)	Date designated
Shetland			1980
Shetland	1	11,600	
North Sea Coast	4	52,400	
GB coast	27	745,800	

Sources: Countryside Commission for Scotland (1978), SNH.
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.

7.3.3 National Scenic Areas

National Scenic Areas (NSAs) are identified by Scottish Natural Heritage as the best of Scotland's landscapes, deserving special protection in the nation's interest. They are designated under section 262c of the Town & Country Planning Act (Scotland) 1972. This designation replaces two earlier categories of importance for scenic interest, which served to fulfil some of the approaches embodied in the National Park and Area of Outstanding Natural Beauty designations in England and Wales. The seaward boundary of NSAs is the same as that for planning purposes in Scotland, i.e. mean low water of spring tides. Special development control measures for the 40 NSAs in Scotland were introduced by the Scottish Development Department in 1980. There is one NSA (11,600 ha), comprising several parts, in Shetland (Table 7.3.3; Map 7.3.1).

7.3.4 Acknowledgements

Thanks are due to Roger Bolt (JNCC), Kathy Duncan and Natasha O'Connell (Scottish Natural Heritage) and Neale Oliver (DoE).

7.3.5 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.
- British Oceanographic Data Centre. 1992. *UKDMAP (United Kingdom digital marine atlas)*. Birkenhead, BODC. (Computer software.)
- Countryside Commission for Scotland. 1978. *Scotland's scenic heritage*. Perth, Countryside Commission for Scotland.

B. Further information

- Hodgetts, N.G. 1992. *Guidelines for selection of biological SSSIs: non-vascular plants*. Peterborough, Joint Nature Conservation Committee.
- JNCC. 1996. *Guidelines for selection of biological SSSIs: intertidal marine habitats and saline lagoons*. Peterborough, JNCC.
- Nature Conservancy Council. 1984. *Nature conservation in Great Britain*. Peterborough, NCC.
- Nature Conservancy Council. 1989. *Guidelines for selection of biological SSSIs*. Peterborough, NCC.

C. Contact names and addresses

Type of information	Contact address and telephone no.
Site designations, Scotland	*Maritime Unit, Advisory Services, SNH, Edinburgh, tel: 0131 554 9797
NNRs, SSSIs and NSAs	*Conservation Officer, SNH, Northern Isles Area, Shetland Office, Lerwick, tel: 01595 693345
National Scenic Areas	*Shetland Islands Council Planning Department, Lerwick, tel: 01595 744800
Coastal and marine UKDMAP datasets	*Coastal Data Custodian, JNCC, Peterborough, tel: 01733 62626

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

7.4 Sites identified by statutory agencies

This section covers sites which, although not protected by statute, have been identified by statutory agencies as being of nature conservation or landscape importance.

7.4.1 Nature Conservation Review sites

Nature Conservation Review (NCR) sites are non-statutory sites that are the best representative examples of wildlife habitat; for some coastal sites, for example estuaries, all sites that were above a critical standard of nature conservation importance were selected. 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

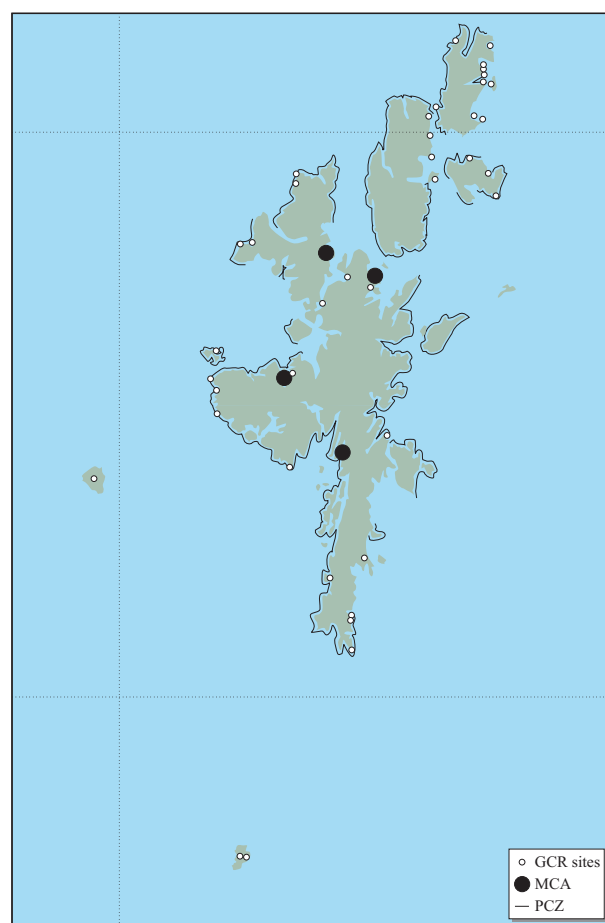
Geological Conservation Review (GCR) sites are non-statutory sites identified as having national or international importance for earth science. As such, it is intended that all GCR sites will eventually be notified as SSSIs. The GCR selection process describes and assesses key sites in the context of their geology, palaeontology, mineralogy or geomorphology; GCR sites are the earth science equivalent of NCRs. There are 40 coastal GCR sites in Shetland (Table 7.4.1; Map 7.4.1). Detailed scientific accounts of coastal and inland GCR sites are contained in volumes of a planned 42-volume *Geological Conservation Review* series (see e.g. Ellis *et al.* 1996). Twelve of these volumes have been published to date.

7.4.3 Marine Consultation Areas

The non-statutory Marine Consultation Area designation identifies areas considered by Scottish Natural Heritage to deserve particular distinction in respect of the quality and sensitivity of the marine environment within them. Their selection encourages coastal communities and management bodies to be aware of marine conservation issues in the area. There are four Marine Consultation Areas (531 ha) in Shetland (Table 7.4.2; Map 7.4.1).

7.4.4 Preferred Conservation Zones (PCZ)

Created in the 1970s, Preferred Conservation Zones (PCZs) are non-statutory coastal areas in Scotland, of particular national scenic, environmental or ecological importance, in



Map 7.4.1 Coastal Geological Conservation Review (GCR) sites, Marine Consultation Areas (MCAs) and Preferred Conservation Zone (PCZ). Note: a single symbol may represent more than one site in close proximity. Sources: JNCC, SNH, NCC (1990).

which major new oil- and gas-related developments would in general be inappropriate or would have a socio-economic impact on a small community, and would only be justified in exceptional circumstances (see also section 9.5). They are areas with a distinctive aesthetic appeal, heritage and character, where tourism and recreation take priority over major industrial processes. PCZs are the opposite of Preferred Development Zones. In Shetland there is one PCZ comprising several parts (Map 7.4.1). This compares with 22 PCZs on the Scottish mainland and larger islands and numerous potential PCZs around the smaller islands (only the larger islands have defined Preferred Conservation Zones) (Scottish Development Department 1974).

7.4.5 Acknowledgements

Thanks are due to Roger Bolt (JNCC), Marcus Polley (English Nature) and Donald Balsillie, Kathy Duncan, Natasha O'Connell and Stuart Gardner (Scottish Natural Heritage).

Table 7.4.1 GCR Single Interest Locations

Location	No. of sites
Unst	10
Norwick	
The Punds to Wick of Hagdale	
Wick of Hagdale	
Hagdale Chromite Quarry	
Balta Island	
Qui Ness to Pund Stacks	
Skeo Taing to Clugan	
Ham Ness	
Lunda Wick	
Tonga-Greff Coast	
Fetlar	3
Tressa Ness to Colbinsoft	
Virva	
Funzie	
Yell	4
Cullivoe	
Hascosay	
Gutcher	
North Sandwich	
Mainland	23
Voxter Voe & Valayre Quarry	
Garths Voe	
The Ayres of Swinister	
Easter Rova Head	
Burn of Aith	
The Cletts, Exnaboe	
The Cletts	
Sumburgh Head	
St Ninian's Tombolo	
Skelda Ness	
Fidlar Geo to Watsness	
Sel Ayre	
Melby	
Papa Stour (2 sites)	
Ness of Clousta to The Brigs	
Eshanness Coast	
Villians of Hamnavoe	
Fugla Ness	
Uyea to North Roe Coast	
Foula	
Fair Isle	
Sloagar	
Shetland	40
North Sea Coast	551
GB coast	1,096
GB whole country	3,025

Sources: SNH, JNCC. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

7.4.6 Further sources of information

A. References cited

Ellis, N.V. (ed.), Bowen, D.Q., Campbell, S., Knill, J.L., McKirdy, A.P., Prosser, C.D., Vincent, M.A., & Wilson, R.C.L. 1995. *An introduction to the Geological Conservation Review*. Peterborough, Joint Nature Conservation Committee. (Geological Conservation Review series, No. 1.)

Table 7.4.2 Marine Consultation Areas

Site name	No. of sites	Area (ha*)	Date established
Brindister Voe and the Vadills		131	1990
Swinister Voe and the Houb of Fora Ness		32	1990
The Houb, Fugla Ness		30	1990
Whiteness Voe		338	1990
Shetland	4	531	
North Sea Coast	6	8,609	
Scotland	29	111,896	

Source: NCC (1990). Key: *to the nearest whole hectare.

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Countryside Commission. 1994. *United Kingdom protected environment map*. Southampton, Ordnance Survey.
Gordon, J.E., & Sutherland, D.G., eds. 1993. *Quaternary of Scotland*. London, Chapman and Hall. (Geological Conservation Review series.)
Gregory, K.J., ed. In prep. *Fluvial geomorphology of Great Britain*. London, Chapman and Hall. (Geological Conservation Review series.)
Scottish Development Department. 1981. *National planning guidelines - priorities for development planning*. Edinburgh.

C. Contact names and addresses

Type of information	Contact address and telephone no.
NCR sites, GCR sites, MCA	*Conservation Officer, SNH Northern Isles Area, Shetland Office, Lerwick tel: 01595 693345
PCZs	*Planning Department, Shetland Islands Council Planning Department, Lerwick, tel: 01595 744800

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

7.5 Other types of protected site

7.5.1 The National Trust for Scotland

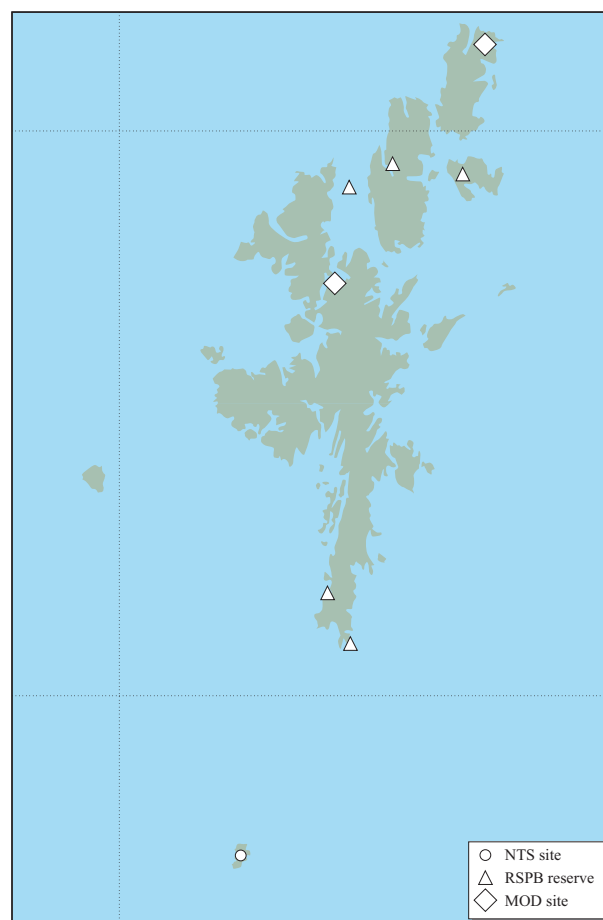
The National Trust for Scotland (NTS) is a charitable organisation, established in 1931 (National Trust for Scotland Order Confirmation Act 1935) for the purposes of promoting the permanent preservation of Scotland's heritage of fine buildings, beautiful landscape and historic places, and to encourage public enjoyment of them. The Trust now has over 100 properties in its care, including over 40,500 ha of countryside, from forest, mountains and moorland to the coast (National Trust for Scotland 1996). Land that is not owned by the Trust can be protected by a Conservation Agreement under power given to the National Trust for Scotland by a 1938 Act of Parliament. Conservation agreements are entered into voluntarily by landowners who wish their land to come under a form of protection short of full Trust ownership. The National Trust for Scotland practices active conservation and management of its land. There is one NTS site in Shetland (Table 7.5.1; Map 7.5.1).

7.5.2 The Royal Society for the Protection of Birds

The Royal Society for the Protection of Birds (RSPB) has substantial non-statutory reserve holdings and currently manages over 140 reserves (97,100 ha) in Britain (S. Gilbert pers. comm.). 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 five RSPB reserves (2,720 ha) in Shetland (Table 7.5.2; Map 7.5.1).

7.5.3 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



Map 7.5.1 Other types of coastal protected site. Sources: National Trust for Scotland (NTS), Royal Society for the Protection of Birds (RSPB) and Ministry of Defence (MoD).

they can be amongst the most pristine areas of wildlife habitat in the region. There are two coastal MoD sites (71.5 ha) in Shetland (Table 7.5.3; Map 7.5.1).

7.5.4 Acknowledgements

The author wishes to thank Bob Scott and Steve Gilbert (RSPB), Andrea Firth (MoD) and Dr J. Fenton (National Trust for Scotland) for providing information.

Table 7.5.1 National Trust for Scotland sites

Site name	No. of sites	Grid ref.	Area (ha*)	Date acquired	Landform
Fair Isle		HZ210720	1,089	1954	Island
<i>Shetland</i>	<i>1</i>		<i>1,089</i>		
North Sea Coast**	191		18,610		
GB whole coast**	453		64,127		

Source: National Trust (1992), National Trust for Scotland (1996) Key: *to the nearest whole hectare; **includes National Trust sites in England (and Wales). Notes: in this table only sites of natural heritage interest have been included; any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

Table 7.5.2 Royal Society for the Protection of Birds reserves

Site name	No. of sites	Grid ref.	Area (ha*)	Date acquired	Interest
Fetlar		HU604916	731	1968	Grassy heathland with summits, high sea cliffs, boulder shores - majority of Britain's breeding red-necked phalaropes <i>Phalaropus lobatus</i> , breeding seabirds, breeding waders, breeding wildfowl, breeding passerines, passing migrants, otters <i>Lutra lutra</i> , common seals <i>Phoca vitulina</i> and grey seals <i>Halichoerus grypus</i>
Lumbister & Black Park		HU490940	1,843	1982	Heather moorland, bog, gorge, grass-topped cliffs, rocky shore-nesting seabirds, breeding raptors, breeding waders, otters, grey and common seals offshore
Ramna Stacks and Gruney		HU405890	11	1970	Rocky shores, stacks, low cliffs, peat and maritime grassland, nesting seabirds including storm petrel <i>Hydrobates pelagicus</i> , Leach's petrel <i>Oceanodroma leucorhoa</i> and breeding grey seals
Sumburgh Head		HU407079	16	1995	Nationally important numbers of breeding shag <i>Phalacrocorax aristotelis</i>
Loch of Spiggie		HU373166	119	1979	Shallow brackish loch, sand dunes, marsh-nesting, displaying and wintering wildfowl, nesting waders, breeding terns <i>Sterna</i> spp., otters
Shetland	5		2,720		
North Sea coast	56		24,836		
GB coast	87		39,888		

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 MoD sites

Site name	No. of sites	Area (ha)*	Habitats	Protected status
Saxa Vord		58.5	Cliff, moorland	None
Scatsta		13.0	Shingle	None
Shetland	1	71.5		
North Sea Coast	64	34,496		
GB coast	109	53,456		

Source: Ministry of Defence. Key: *approximate areas, including land leased or used under licence. 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 Further sources of information

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C. Contact names and addresses

Type of information	Contact address and telephone no.
National Trust for Scotland sites	*The National Trust for Scotland, Edinburgh, tel: 0131 226 5922
RSPB sites	*Regional Officer, RSPB Shetland Office, Lerwick, tel: 01950 460800
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.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.

Shetland comprises over 100 islands, of which sixteen are inhabited, only six having populations of more than 100 people. The coastline is highly indented and all of the population centres are close to the coast. The population has traditionally been heavily dependent on agriculture and fisheries for sustaining its rural and coastal communities, but the economy has diversified since the opening of the Sullom Voe oil terminal. Fish farming is also important (see [section 9.2](#)).

Shetland forms part of the Highlands and Islands Enterprise Area, an Objective 1 (least favoured) region designated by the European Union (Objective 1 areas aim to promote the development and structural adjustment of regions whose development is lagging behind in relation to 'average' economic performance indicators within the EU). This provides for financial support under the EU's Structural Fund and Regional Aid programmes, available for economic development, tourism, improvement of the physical and social environment, investment in the development of people, transport, energy, development of agriculture and the rural economy, fisheries and protection of the natural and built environment. A series of proposed programmes were produced for the Objective 1 area (which also includes Orkney (Region 2), the Western Isles (Region 15) and most of north and west Scotland (Regions 14 and 16)) in 1993 (Highland Regional Council 1993). The programmes cover agricultural consolidation, fisheries development, tourism investment and enterprise growth.



The landscape of Shetland is predominately one of moorland and rough grassland, with little arable and even less residential or industrial development. This view of Fair Isle is typical of the islands. Photo: David Stroud, JNCC.

8.2 Land use

S.L. Fowler & S.J. Everett

8.2.1 Introduction

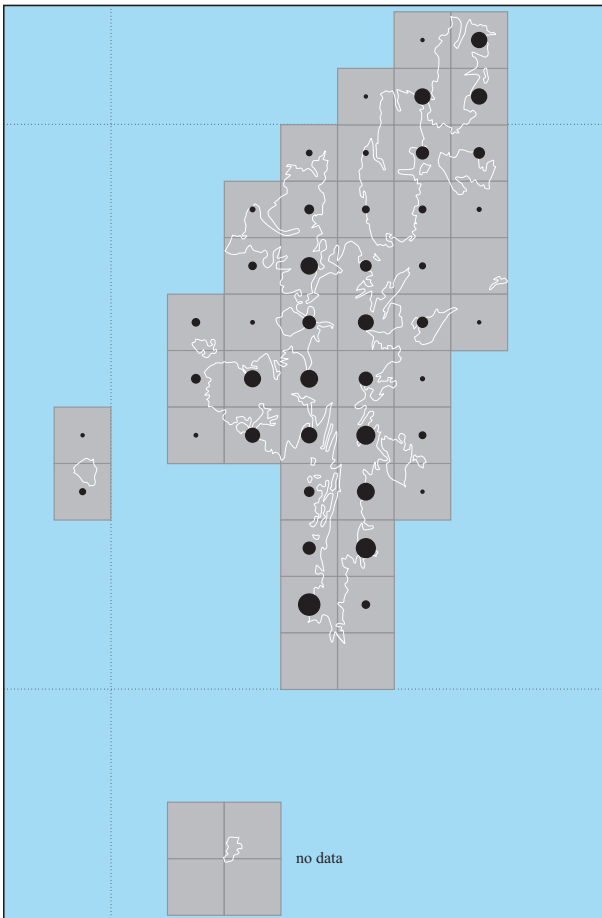
Only 440,900 ha (5.7%) of Scotland’s land surface is covered by prime quality land (Classes 1, 2 and 3.1). The agricultural capability of land in Shetland is low and the majority lies in agricultural land Classes 6 and 7, with small pockets in Class 5 (Macaulay Institute for Soil Research 1982). Agricultural development on Shetland has been funded through the European Community’s Agricultural Development Programme for the Scottish Islands; for example, in 1991, it provided funds for the improvement of about 900 ha of permanent pasture and nearly 25,000 m of land drains.

Overall, 10% of the land area in Scotland is devoted to forestry, with about 60% of this managed by Forest Enterprise. There is very little semi-natural woodland on Shetland.

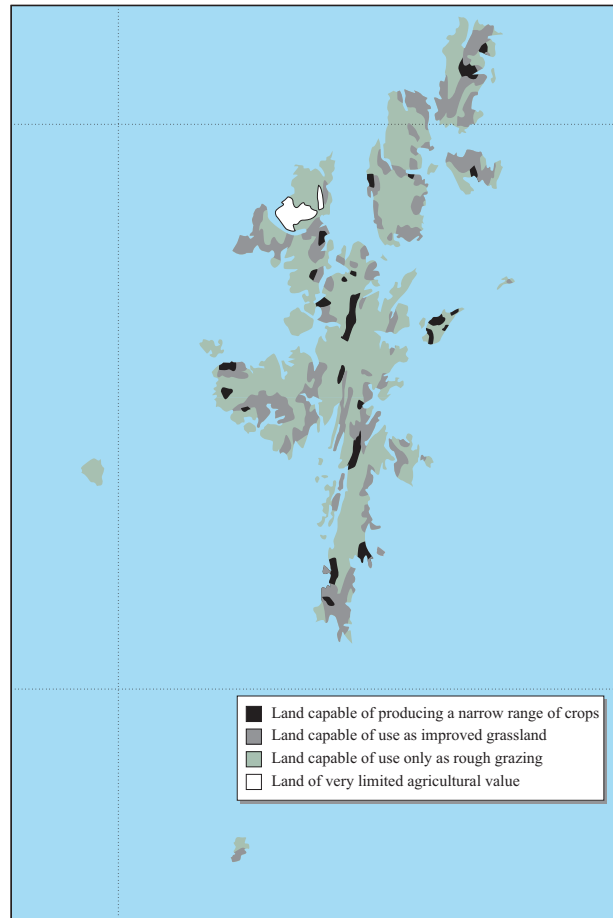
8.2.2 Locations and land uses

The distribution of managed grasslands and moorland grass is shown in **Map 8.2.1**. **Map 8.2.2** shows the distribution of land capability for agriculture in Shetland. **Map 8.2.3** shows the distribution of heath, bog and moor and **Map 8.2.4** shows the distribution of saltmarshes with recorded grazing.

The predominant land use, occupying around 90% of the land area, is rough grazing for sheep and cattle. In addition, crofting is widely practised. There were 2,333 agricultural holdings and 100 common grazings in 1995 (Shetland Islands Council 1996). The area under tillage in 1995 was 493 ha (compared with 1,410 ha in 1971 and 749 ha in 1991). This was mainly under barley, oats, potatoes, root crops and cabbage. Grassland and crops occupy a little less than 19,000 ha and an additional 126,000 ha were under rough grazing in 1995. About 5,900 head of cattle and 401,700 sheep were recorded in 1995 and about 300,000 kg of wool are produced annually.



Map 8.2.1 Area of managed grassland and moorland grass. Note: area of circle indicates the area of this land cover type in the 10 km square. Source: Countryside Survey (1990), ITE Monks Wood.



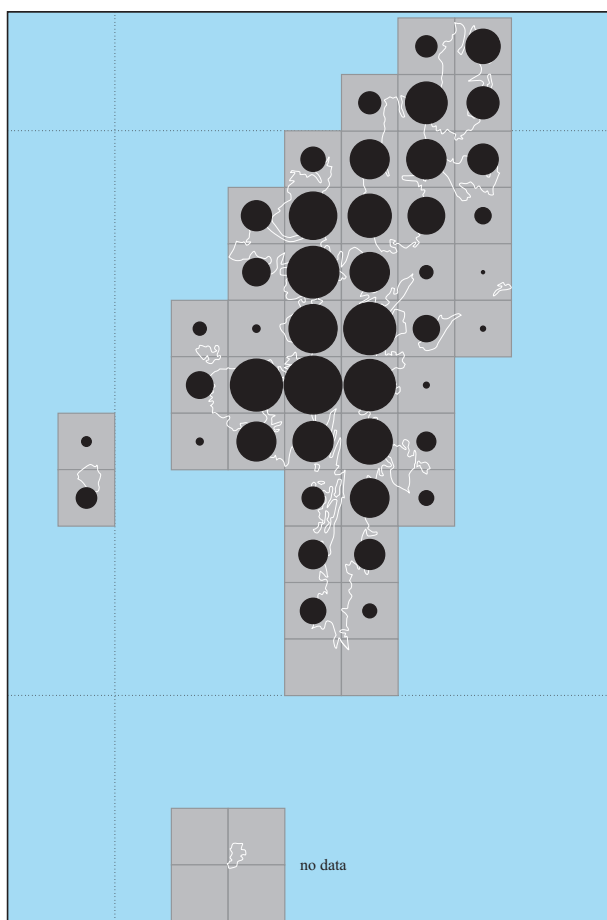
Map 8.2.2 Land capability for agriculture in Shetland. Source: Macaulay Land Use Research Institute (1982).

The native woodland that existed on Shetland thousands of years ago has been reduced to a few isolated pockets by climatic change, grazing pressure and exploitation by man. These relict wooded sites are restricted to cliffs and islets in remote hill lochs. Species include aspen, willow, birch, rowan and hazel, and the trees are stunted as a result of the harsh climate and poor soil. Shetland Amenity Trust, with assistance from the Objective 1 Programme, is bringing native species into cultivation in order that they may be used more widely in tree planting initiatives in Shetland.

There are a number of non-native woodlands in Shetland, one of the best documented being at Kergord, which has some of the largest trees in Shetland. Sitka spruce, Japanese larch and sycamore are the predominant species. Kergord has been designated a Site of Special Scientific Interest (SSSI) because of its importance to migrating birds. Other sizeable plantations exist at Voxter, Nesting and Sullom.

8.2.3 Information sources used

The main source of information for this section was the Countryside Survey 1990 (Institute of Terrestrial Ecology 1993) and Shetland Islands Council (1985, 1996). The

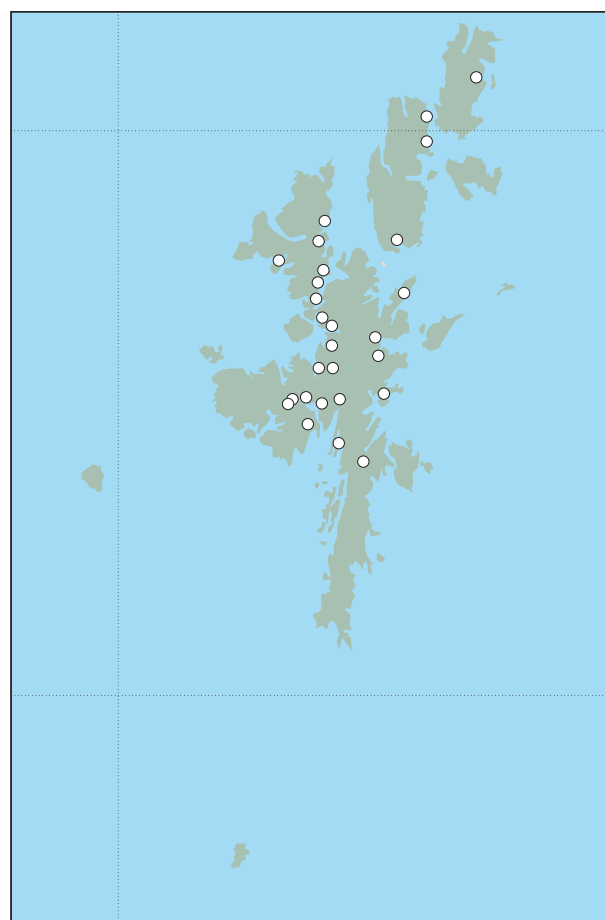


Map 8.2.3 Heath, bog and moor. Note: area of circle indicates the area of this land cover type in the 10 km square. Source: Countryside Survey (1990), ITE Monks Wood.

Countryside Survey is based primarily on high resolution satellite images. These images show the dominant land cover for each 25 m x 25 m area (pixel) of Great Britain. These are classified into seventeen key types (including tilled land and managed grassland), and field surveys of randomly selected areas were used to check the results. [Maps 8.2.1, 8.2.3, 8.2.4](#) are derived from these data, which are held in the Department of the Environment Countryside Information System. The main limitations of these data derive 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.

8.2.4 Acknowledgements

Thanks are due to Alan Blain (Shetland Amenity Trust) for information on woodlands.



Map 8.2.4 Location of saltmarshes with recorded grazing. See [Map 3.6.1](#) for distribution of saltmarsh sites. Source: JNCC Coastal Database.

8.2.5 Further sources of information

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- Shetland Islands Council. 1986. *Fetlar Integrated Development Plan*. Lerwick, Shetland Islands Council.

C. Contact names and addresses

Type of information	Contact address and telephone no.
Agricultural policy in Scotland	*SOAEFD, Edinburgh, Scotland tel: 0131 556 8400
Land use (agricultural and forestry land capability information) in Scotland	Macaulay Land Use Research Institute, Craigiebuckler, Aberdeen AB15 8QH, tel: 01224 318611
ITE Countryside Survey 1990	*Department of Rural Affairs, DoE, Bristol, tel: 0117 987 8000
Crofting	Crofters Commission, 4/6 Castle Wynd, Inverness IV2 3EQ, tel: 01463 663450
Woodlands in Shetland	Shetland Amenity Trust, 22-24 North Road, Lerwick ZE1 0QD, tel: 01595 694688
Crown agricultural and forestry estates	The Crown Estate, 10 Charlotte Square, Edinburgh EH2 4DR, tel: 0131 226 7241

*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, ports, harbours, ferries and power generation, and land claim for these developments. Oil and gas exploration and development are covered in [section 9.5](#). Fisheries and mariculture are covered in [sections 9.1](#) and [9.2](#) respectively.

8.3.2 Important locations

Residential development

Shetland is relatively undeveloped and supports a small population, with an estimated 9,300 houses occupied in 1992. Some two-thirds of the population lives on Mainland (around one third in Lerwick alone), with most of the remainder distributed on the islands of Unst, Yell, Whalsay, Bressay and West Burra. There are less than 100 inhabitants on the islands of Foula, Papa Stour, Fetlar, Fair Isle, Vaila, Bruray, Housay, Trondra, East Burra and Muckle Roe.

[Map 8.3.1](#) shows the areas of urban and industrial development land cover types in 10 km squares, with main towns and islands named.

The population of Shetland from the censuses was 22,522 in 1991, compared with 23,542 in 1981 and 17,567 in 1971. Populations of the major towns and villages and districts in the region are shown in [Table 8.3.1](#).

Industry

Industry in Shetland is primarily situated in coastal locations, particularly around Lerwick, Scalloway and the oil terminal in Sullom Voe ([Table 8.3.2](#)), although there are also eighteen serviced industrial sites and estates throughout the islands, most of them small (2 ha or less). [Map 8.3.2](#) shows major industrial infrastructure and industrial sites in Shetland.

Sullom Voe Oil Terminal covers an area of about 400 ha on the coast at Calback Ness, where there is deep water close to the shore and a sheltered anchorage. It is Europe's largest oil and liquefied gas terminal and has a capacity to handle over half the UK's potential offshore oil production. BP operates the terminal on behalf of about 30 companies participating in the Brent and Ninian pipeline groups. Construction began in 1975 and it was completed in 1982. Its throughput design capacity is 1.41 million barrels of crude oil per day (70 million tonnes per year), but it has never operated at full capacity. Peak throughput was reached in 1984 (58 million tonnes) and has since declined. The terminal had a throughput of over 37 million tonnes of oil and 600,000 tonnes of gas (propane and butane) in 1995, when 360 oil tankers and 34 gas tankers used the port. This represents around 1% of total world oil production.

The main industries in the region include marine engineering, fisheries, fish farming and fish processing



Map 8.3.1 Distribution of areas of industrial and residential development. Note: area of circle indicates the combined area of these land cover types in the 10 km square. Towns and islands are also shown. Source: Countryside Survey (1990); ITE Monks Wood.

(17 processing factories in 1995). Fish processing factories are located at Hamnavoe, Scalloway and Skeld. The fish farming industry (mainly salmon) in Shetland has grown rapidly over the past ten years (see [section 9.2](#)). The land-based infrastructure associated with fish and shellfish farms include jetties, sheds, hatcheries, processing plants and other supporting facilities. Some of these occupy existing buildings onshore, including former crofting, fisheries or

Table 8.3.1 Main centres of population from the 1991 population census

Location	Population
Lerwick	7,280
Scalloway	1,053
Whiteness/Weisdale/Gott/Tingwall	1,183
Sandwick/Cunningsburgh	1,352
Delting & Nesting	2,491
Dunrossness	1,519
Shetland total	22,522

Source: Shetland Islands Council (1996a)

Table 8.3.2 Major areas of coastal industrial development

Site/area	Grid ref.	Details
Calback Ness, Sullom Voe	HU3975	Largest oil terminal in Europe; c. 400 ha; sixteen crude oil storage tanks each with a capacity of 600,000 barrels
Sella Ness, Sullom Voe	HU4073	Berthing for oil terminal service vessels and tug jetty; industrial site of c. 9 ha
Lerwick	HU4643	Green Head/Gremista: oil supply base (marine engineering); helipad, waste disposal, storage, chandlery etc.; Lerwick Generating Station and small industrial sites

Source: Shetland Islands Council (1990, 1996b) and Ordnance Survey 1:50,000 Landranger maps.

ports infrastructure. Others have been purpose-built for fish farm operations.

The main employers in Shetland are the service industries. In addition, the Shetland knitwear industry has about 30 businesses employing 80-90 employees, over 20 self-employed, and 1,000 home knitters. The crafts industry also employs a small number of people.

Power generation

The region's power installations are shown on **Map 8.3.2** and listed in **Table 8.3.3**. The installation at Lerwick is operated by Scottish Hydro-Electric and consists of two diesel-fired stations (Station A was commissioned in 1953 and Station B in 1984), which together produce just over 0.1% of the UK's conventionally produced power. The maximum winter power demand for Shetland is approximately 40 MW, which

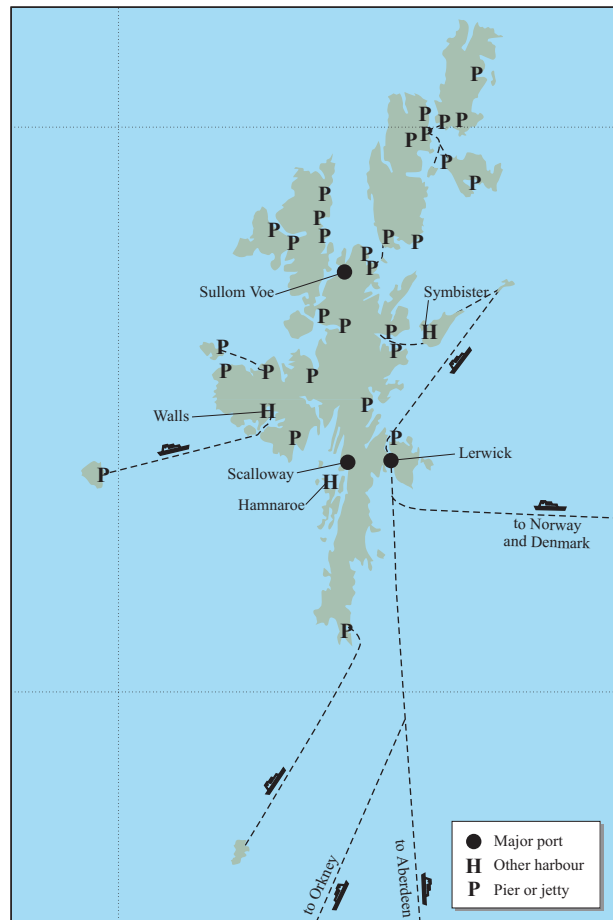
can normally be met by the Lerwick diesel powered station. Approximately 10-12 MW enters the grid from Sullom Voe (Scottish Hydro-Electric pers. comm.). In addition to these conventional installations, there is a privately-operated combined wind/diesel plant on Fair Isle and a similar combined wind/diesel/hydro plant on Foula.

An assessment of the potential for renewable energy in Scotland has been produced by a group of bodies including Scottish Hydro-Electric, Scottish Power, the Scottish Office, Scottish Enterprise and the Department of Trade and Industry (DTI). The DTI carried out a *Review of wave energy* in 1992 (DTI 1992) and established that there was potential to generate electricity from wave power along the north and west coast of the British Isles (from the South West Approaches to Shetland) corresponding to 11-15% of current UK electricity capacity.

Diversification in the electricity generating industry has been encouraged by guidelines such as the government's



Map 8.3.2 Major and minor industrial sites and coastal power stations. Source: Ordnance Survey Landranger maps. © Crown copyright.



Map 8.3.3 Major ports, other harbours, pier/jetties and ferry routes. Sources: Walker (1996) and others.

Table 8.3.3 Coastal power installations in the region

Site location (see Map 8.3.2)	Type	Power producing capacity (MW)
Sullom Voe	Gas	100
Lerwick	Diesel	66.75
Total		166.75

Source: Scottish Hydro-electric (pers. comm.)

Scottish Renewables Order (SRO), introduced under the 1989 Electricity Act, and the EC's 1988 Directive on Large Combustion Plant. There are currently no renewable energy installations in the Shetland under the SRO. However, a proposal for a wind turbine generator has been submitted for consideration in the second round of the SRO (Scottish Hydro-Electric pers. comm.).

Ports, harbours and ferry transport

There are three major ports in Shetland, at Sullom Voe, Scalloway and Lerwick. In 1994 Sullom Voe was the fifth most important UK port in relation to the total tonnage of traffic handled and the second most important port in terms of tonnes of oil-related cargo handled (14.3% of UK total traffic). Sullom Voe Terminal has large jetties alongside the

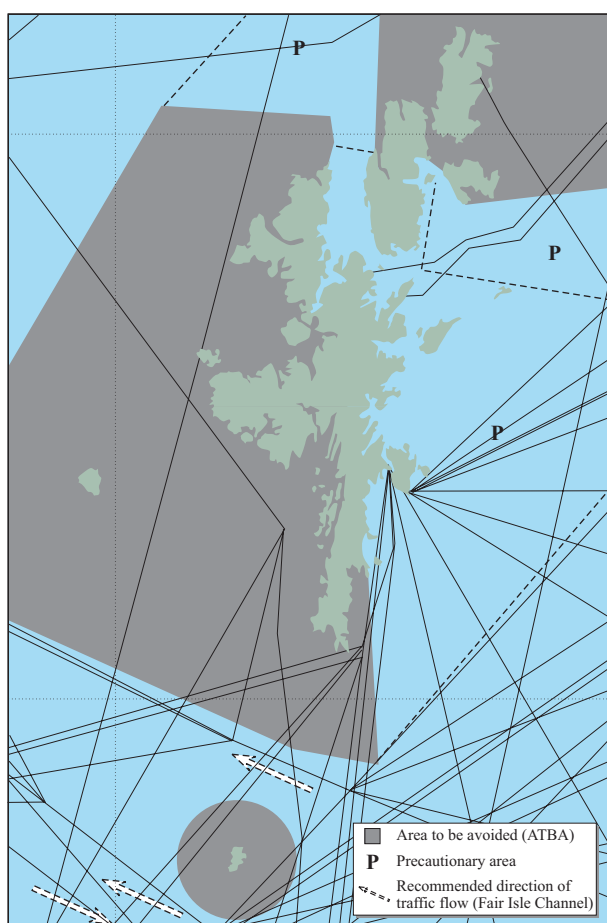
main terminal, where tankers may berth, and a number of smaller jetties and breakwaters at Sella Ness for the servicing vessels and tugs. In 1995, 360 oil tankers and 34 gas tankers used the port. In addition to the main ports and harbours there are numerous other landing jetties and piers ([Table 8.3.4](#); [Map 8.3.3](#)).

Construction of the terminal site at Sullom Voe required a large amount of land fill and the conversion of intertidal and subtidal areas, including the most of Orca Voe. The coastline in this area has been substantially altered by the development.

Scalloway and Lerwick are natural harbours which were the original locations for port developments in the islands, with Lerwick and Bressay forming an important fishing centre. There are sixteen oil-service berths in Lerwick, one in Scalloway and two at Broonies Taing, Sandwick. The main base for large fishing vessels in Shetland is the island of Whalsay, and there are also fishing centres at Out Skerries and the northern islands of Yell and Unst. There are numerous other smaller harbours throughout the islands, many of them having facilities for the inter-island ferries. Scalloway was originally the capital of the islands but has a relatively small harbour, which is now used mainly by fishing vessels. It is run by Shetland Islands Council. Scalloway and the adjacent islands of Burra and Trondra have a local fishing fleet of about 32 vessels (1991 figures). The main focus of shipping is now the much larger harbour of Lerwick, the present capital, sheltered by the island of Bressay. It is a Trust Port and member of the British Ports Federation and handles general cargo, ro-ro facilities, ferries, cruise liners, North Sea oil supply, research and support vessels and facilities for yachts.

The isolated nature of the Shetland Islands makes them very dependent upon ferry transport. [Map 8.3.3](#) shows there are inter-island ferry links from Lerwick to Bressay and Out Skerries (with a seasonal passenger link from Bressay to Noss); from Sumburgh to Fair Isle; from Walls to Foula; from West Burrafirth to Papa Stour, from Laxo to Whalsay (and thence to Out Skerries); from Toft to Ulsta (Yell); and from Gutcher on Yell to Unst and Fetlar. The main external ferry routes to Shetland run to Lerwick. The P&O line from Aberdeen calls at Orkney on some services and also runs a weekly service to Bergen during the summer months. All services carry vehicles and passengers.

Lord Donaldson (1994) recorded that there was virtually no clear information available on where ships go within UK waters. 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. Information from this database, showing shipping routes, Areas To Be Avoided (ATBAs), Precautionary Areas and traffic separation schemes in the region, is given on [Map 8.3.4](#). Vessels of 5,000 GRT (Gross Registered Tonnage) or more carrying oil or other hazardous cargoes are advised to avoid ATBAs. Precautionary areas may contain large, deep-draught vessels with limited manoeuvrability. In this region shipping is advised to avoid passages between the Mainland and Foula or the Skerries because of large numbers of fishing vessels and use recommended directions of traffic flow through the Fair Isle Channel. Laden vessels using the Fair Isle Channel are



Map 8.3.4 Shipping routes, areas to be avoided (ATBA), precautionary areas and Traffic Separation Schemes. Shipping routes reproduced from the COAST database, held by Dvovre Safetec Ltd. Other information from the Marine Safety Agency.

Table 8.3.4 Ports, harbours, piers and jetties

<i>Port</i>	<i>Notes</i>
Unst	
Baltasound	Jetty and pier
Uyeasound	Two jetties
Belmont	Landing pier (ferry to Yell and Fetlar)
Yell	
Cullivoe	Pier
Gutcher	Landing pier (ro-ro (roll on, roll off) ferry to Unst and Fetlar)
Burravoe	Piers
Ulsta, Whale Firth	Landing pier (ro-ro ferry to Mainland)
Fetlar	
Oddsta	Landing pier (ro-ro ferry to Unst and Yell)
Houbie	Pier
Mainland	
Collafirth Pier	Used by fishing and commercial vessels; licensed to handle explosives; 55 m berths (main berthing face) plus berths for smaller vessels on north side of pier; under the jurisdiction of Sullom Voe Harbour Authority
Ollaberry	Pier - small craft only
Sullom Voe	Major deep water harbour serving BP-operated Sullom Voe Oil and Gas Complex; oil is delivered via the Brent and Ninian Pipelines from offshore installations; three out of the original four loading jetties are in operation, No. 1 jetty takes vessels up to 120,000 tonnes, Nos. 2 & 4 can accommodate tankers up to 250,000 tonnes but larger tankers may be accepted. Gaza Jetty: constructed for exporting aggregates from nearby quarries. Sella Ness: berthing for oil terminal service vessels and tug jetty.
Toft	Pier (ro-ro ferry to Yell)
Mossbank	Jetty
Laxo Voe, Dury Voe	Pier (ro-ro ferry to Whalsay)
Ayre of Atler, Dury Voe	Pier
Vidlin	Pier (ferry to Out Skerries and Whalsay)
Quoys, Dury Voe	Pier
Wadbister Voe	Pier (next to disused quarry)
Dales Voe	Pier
Lerwick (includes marine service base at Gremista/ Green Head)	More than 3,000 m of quay and 40 berths; one of the major ports supporting the offshore oil industry and an important port for handling fish (501 fish factory ships and related vessels visited in 1995); 1,100,000 tonnes p.a. (handled 500,000 tonnes of oil-related cargo in 1992); multi-user port visited by cruise liners, research ships, fishing boats, yachts and oil-related vessels; the major point of import for all consumer goods to Shetland and for animal and farmed salmon feed products; exports of fresh and processed fish, frozen salmon and animal produce; c. 10,000 tonnes of transships of fish a year; ro-ro ferry terminal: passenger/freight service to/from Aberdeen, Bergen, Torshaven and Hantsholm; lifeboat station; moorings for leisure craft; ship repair/graving; 5,349 vessels visited in 1995, of which 2,040 were British fishing (excludes local fleet), 170 were foreign fishing vessels, 920 were oil rig tenders, 166 were other oil-related shipping). The OIL Shetland supply base has a jetty with nine berths, 1.8 ha of warehousing and 10 ha of open storage.
West coast of Bressay	Piers and landing point for Lerwick ro-ro ferry
Grutness Voe	Jetty (ferry to Fair Isle)
Hamnavoe, Lunna Ness	Harbour with pier
Scalloway	Four berths (total length 370 m) plus a general cargo berth; fishing harbour inside berths 3 and 4; 30,000 tonnes p.a.; open storage: 3.3 ha; dry bulks, oil/petroleum, general cargo, fish (the principal export); ferry to Foula; ship repair/graving; visited by 365 vessels in 1995; vessels visiting in 1992 included 278 British fishing vessels (excluding local fishing fleet), nine foreign fishing vessels, 49 general cargo vessels, 26 yachts and 81 other vessels; a deepwater berth (Blacksness Pier) was constructed in 1991 to enhance the economic and cargo-handling potential of the harbour.
Easter Skeld	Pier
Walls	Harbour/piers (ferry to Foula)
Ness of Melby	Pier
West Burrarfirth	Jetty (ferry to Papa Stour)
Aith	Pier and lifeboat station
Voe	Jetty
Brae	Jetty
Ronas Voe	Two piers
Other islands	
Symbister, Whalsay	Harbour (fishing and ro-ro ferry)
Out Skerries	Pier (ferry to Mainland)
Hamnavoe, West Burra	Harbour with pier
Ham Voe, Foula	Landing pier (ferry to Mainland)
Papa Stour	Landing pier (ferry to Mainland)
North Haven, Fair Isle	Landing pier (ferry to Mainland)

Source: Walker (1996), Shetland Islands Council (1996a, b), Ordnance Survey 1:50,000 Landranger Series 3 maps. Note: section 9.7.2 details recreational harbours and associated facilities.

requested to make position reports to Shetland Coastguard.

Lord Donaldson also noted that no records are kept of how many ships use UK port facilities. Under MARPOL (the United Nations' International Convention on the Prevention of Pollution from Ships), the UK must provide port facilities that are "adequate to meet the needs of ships using them and do not cause undue delay to ships". These facilities should prevent ships from discharging oil and other wastes into the sea. However, Lord Donaldson (1994) describes UK facilities as "inadequate". A survey of the quality of UK port reception facilities for the disposal of ship's wastes was carried out by the Waste Regulation Council (WRC 1995). The Marine Safety Agency also carry out a regular assessment of port reception facilities for the International Maritime Organisation.

Airfields

The main airport is at Sumburgh, on the southern tip of Mainland. Other airfields include Tingwall (Lerwick), which is mainly used for inter-island services, and Scatsta (Sullom Voe), which is mainly used for oil industry charters. There are also airstrips on Unst, Fetlar, Out Skerries, Whalsay, Fair Isle, Papa Stour and Foula. Foula, Fair Isle, Papa Stour and Out Skerries are serviced by scheduled flights from Tingwall, and Unst from Sumburgh.

8.3.3 Information sources used

The main sources of information for this section were Shetland Islands Council (1985, 1990, 1996a, b), Walker (1996) and Ordnance Survey Landranger 1:50,000 maps.

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 power generation was provided the Scottish Hydro-Electric District Office in Lerwick. The list of projects for inclusion in the second round of the Scottish Renewables Order will not be finalised until April 1997. The Office for Electricity Regulation is responsible for dissemination of this information following publication of the list. Shipping routes on Map 8.3.4 are reproduced from the COAST Database.

Summary statistics on the main Shetland ports have been published by Shetland Islands Council (1996a). Further information is available in the Shetland Islands Ports Handbook (Shetland Islands Council 1996b) and in the Compass UK Ports Directory (Walker 1996).

8.3.4 Acknowledgements

Thanks are due to Austin Taylor and Alasdair Hamilton (Shetland Islands Council), John Uttley and Kathy Duncan (SNH), Mark Tasker (JNCC), Dovre Safetec Ltd (information from the COAST Database) and Scottish Hydro-Electric.

8.3.5 Further sources of information

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- Technica. 1985. *Shipping routes in the area of the United Kingdom continental shelf*. London, HMSO for the Department of Energy.

C. Contact names and addresses

Type of information	Contact address and telephone no.	Type of information	Contact address and telephone no.
Planning developments	*Shetland Islands Council, Planning Department, Lerwick, tel: 01595 744800	Renewable energy general	*Scottish Office Development Department, Energy Efficiency Office, Edinburgh, tel: 0131 556 8400
Economic and urban development policy including European Funds	*Scottish Office Development Department, Edinburgh, tel: 0131 556 8400	Renewable energy (SRO-2 list)	Office for Electricity Regulation, Regent Court, 70 West Regent Street, Glasgow G2 2QZ, tel: 0141 331 2678
Economic development: Highlands and Islands Objective 1 area	Highlands and Islands Partnership Programme, Bridge House, 20 Bridge Street, Inverness IV1 1QY, tel: 01463 244292	Ports and shipping	
Economic development: Highlands and Islands Objective 1 area	Highlands and Islands Enterprise, Bridge House, 20 Bridge Street, Inverness IV1 1QY, tel: 01463 234171	British Ports Association	Africa House, 64-78 Kingsway, London WC2B 6AH, tel: 0171 242 1200
Energy production		The UK Major Ports Group Ltd	150 Holborn, London EC1N 2LR, tel: 0171 404 2008
Energy production general	Department of Energy, 1 Palace Street, London SW1E 5HE, tel: 0171 238 3000	Port reception facilities	Marine Safety Agency, Spring Place, 105 Commercial Road, Southampton SO15 1EG, tel: 01703 329100
Energy production general	Secretary, Institute of Energy, 18 Devonshire Street, London W1N 2AU, tel: 0171 580 7124	Dovre Safetec Ltd (COAST Database)	36 Upperkirkgate, Aberdeen AB10 1BA, tel: 01224 648651
Conventional and renewable energy	Scottish Hydro-Electric, District Office, Market Street, Lerwick ZE1 0JA, tel: Freephone 0800 300 000	Lerwick Harbour Trust	*Lerwick, Shetland, tel: 01595 692991
Conventional power production, further details of power stations	Scottish Hydro-Electric, Lerwick Power Station, Gremista, Lerwick ZE1 0PS, tel: 01595 695030	Sullom Voe	*Sullom Voe Harbour Authority; Shetland, tel: 01806 242551
		Sullom Voe Harbour Operator	BP Exploration Operating Co. Ltd, Sullom Voe Terminal, Moss Bank, Shetland ZE2 9TU, tel: 01806 243000
		Scalloway Port Authority	*Shetland Islands Council, Development Department, tel: 01595 693535
		Baltasound	*Baltasound, Unst, Shetland Islands, tel: 01957 81444

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

8.4 Coastal defence

S.L. Fowler & S.J. Everett

8.4.1 Introduction

Coastal defence covers two types of works: coast protection and sea (or flood) defence. Coast protection works prevent or slow the erosion of land and encroachment by the sea. Sea defences protect low-lying land from flooding by the sea or rivers, especially to protect human life and property in coastal settlements and industrial areas; in the past some were built to protect agricultural land from flooding by the sea and to allow agricultural improvement and drainage. Some forms of coastal defence may protect against both erosion and flooding. It may be difficult to differentiate between the two different forms of coastal works, particularly where they are owned and maintained privately or by bodies not usually responsible for coastal defences.

There is only localised risk of coastal erosion or flooding in the region. Rising net sea levels from climate change and increasing frequency of storm conditions and wave heights in the Atlantic and North Sea are increasing the future potential for erosion and flooding on the east coast of Scotland and decreasing the expected useful life of coastal works.

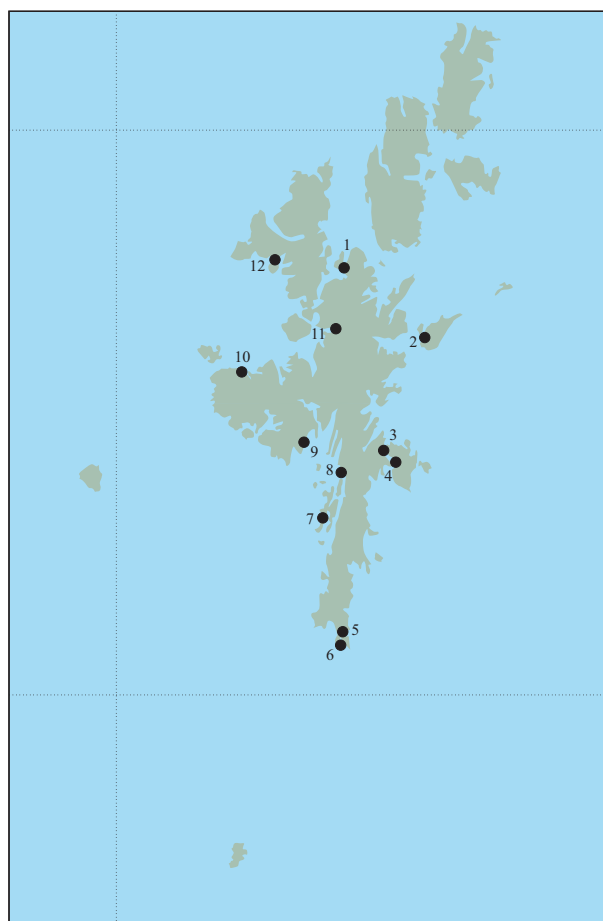
8.4.2 Important locations

On east Shetland between Sumburgh Head and Hermaness, and on parts of West Shetland, soft beach frontages are subject to drawdown of beach material and coastal edge undercutting. There are also varying degrees of cliff erosion, depending on the rock type. There is concern about the rate of coastal erosion caused by storms, which threaten archaeological sites such as Jarlshof at Sumburgh, which was about 20 m further from the sea when built 2,000 years ago. However, coastal erosion is not, overall, a major problem on Shetland.

The main areas of land claim and coastal works in the region are associated with ports, industrial developments, harbours and settlements. For example, at Sullom Voe the inlet of Orca Voe was almost completely infilled when the oil terminal was constructed. There are also coastal works at Sella Ness and along the low-lying roads to the terminal, which are exposed to onshore wave action during storms from the south-west, albeit with only a short fetch in Sullom Voe.

There has been land claim along the harbour frontage at Lerwick and in neighbouring areas of Mainland, where new industrial estates and marine engineering facilities have been built, for example at Greenhead. The older areas of the Lerwick waterfront have been protected by coastal works and jetties. The same pattern may be seen at Scalloway and, to a lesser extent, at other smaller harbours and coastal settlements. Coastal defence options are currently being considered to the south of Sumburgh Airport to contain the sandblow (caused by eroding dunes) over the airport runways and helicopter maintenance hangars.

Other, small, coastal defence schemes have been carried out, mainly to protect residential land holdings from



Map 8.4.1 Principal locations of coastal defence works (Table 8.4.1). Sources: HR Wallingford (1995); Shetland Islands Council (pers. comm.) and Ordnance Survey 1:50,000 Landranger maps.

erosion. Problem areas are put forward by local people for consideration by Shetland Islands Council. Principal locations of coastal defence works are listed in [Table 8.4.1](#) and shown on [Map 8.4.1](#).

8.4.3 Management

Shetland Islands Council has power as the coast protection authority in Shetland under the Coast Protection Act (1949) to protect land from erosion and encroachment. The principal legislation governing flood control is the Flood Prevention (Scotland) Act 1961, which gives local authorities permission to prevent flooding of non-agricultural land. Flood prevention of agricultural land is covered under the Land Drainage (Scotland) Act 1958. Departmental responsibility for flood defence and coast protection lies with the Scottish Office Agriculture, Environment and Fisheries Department. Repair and maintenance of existing coast protection works is the responsibility of the landowner, except where a government grant was made available for their construction.

Table 8.4.1 Coastal erosion and principal locations of coastal defence works

No. on Map 8.4.1	Location	Grid ref.	Details
1	Sullom Voe and Sella Ness	HU3875, HU3975, HU4077, HU4073 etc.	Land claim and coastal defence works (oil terminal and marine service base)
2	Symbister, Whalsay	HU5361	Harbour protection works
3	Lerwick	HU4744, HU4644, HU4642, HU4741 etc.	Harbour protection works; land claim and artificial frontage at Green Head industrial area and for power station construction
4	Gardie House, Bressay	HU4842	Rebuilt sea wall protecting boundary wall and garden of listed building
5	Sumburgh	HU3910, HU3911, HU3912	Movement and wave (winter) erosion of dunes to the south side of the airport; threatened breach of dunes (currently unprotected); rock armour, dune stabilisation, managed retreat options under consideration in 1996; some rock armour elsewhere on Sumburgh coast by airport
6	Jarlshof	HU3909	Rock armour sea wall protecting Scheduled Ancient Monument
7	Bana Minn, West Burra	HU3630	Stabilisation/protection of ayre using gabion baskets/matting
8	Scalloway	HU3939, HU4039	Harbour protection works
9	Reawick	HU3344	40 m of rock armour protecting minor settlement; significant erosion
10	Creek of Sandness	HU1957	Rock armour stabilisation of beach head to prevent breach to low lying land/loch to rear
11	Voe	HU4063	Rebuilt sea wall protecting road and part of settlement
12	Hillswick	HU2876	Rock armour stabilisation protecting parts of settlement

Source: HR Wallingford (1995); Shetland Islands Council (pers. comm.); A.M. Taylor (pers. comm.) and Ordnance Survey 1:50,000 Landranger maps. Note: the numerous harbours, piers, docks, urban and industrial frontages are not listed in this table unless specific sea defence/coast protection data were presented in the HR Wallingford report. They are listed in Tables 8.3.2 and 8.3.4.

HR Wallingford is conducting a study on coastal process cells in Scotland, co-sponsored by Scottish Natural Heritage, the Scottish Office and Historic Scotland. This study sets out for the first time a basis for the coastal process management of the coast in Scotland.

8.4.4 Information sources used

The principal sources of information were HR Wallingford (1995) (for Table 8.4.1 and Map 8.4.1) and the Planning Department of Shetland Islands Council.

8.4.5 Acknowledgements

Thanks go to J. Barratt and A.M. Taylor (Shetland Islands Council) and George Lees (SNH).

8.4.6 Further sources of information

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C. Contact names and addresses

<i>Type of information</i>	<i>Contact address and telephone no.</i>
Flood defence and coast protection policy, grants towards capital expenditure	*Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD), Edinburgh, tel: 0131 556 8400
Coast protection and flood defence	*Shetland Islands Council, Planning Department, tel: 01595 744800
Storm Tide Warning Service	Meteorological Office, Johnstone House, London Road, Bracknell, Berkshire RG12 2SZ, tel: 01344 420242
National Landslide Databank	Rendel Geotechnics, Norfolk House, Smallbrook Queensway, Birmingham B5 4LJ, tel: 0121 627 1777
Coastal Engineering Advisory Panel	Secretary, Institute of Civil Engineers, Great George Street, London SW1P 3AA, tel: 0171 222 7722

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



Some aspects of land use and human activities in Shetland have remained little changed over the centuries since Viking times. Horizontal water mills used to grind barley, housed in small stone buildings and placed in sequence on burns, are still a feature of Shetland's agricultural landscape, although they have not been used since World War II. One such sequence, on Fair Isle (pictured), is located in a gully once used to trap migrating songbirds for food. Photo: David Stroud, JNCC.

Chapter 9 Human activities

9.1 Fisheries

D. Murison & C.F. Robson

9.1.1 Introduction

This section gives an overview of the main fishing activities in the coastal waters and burns of the region. There are fisheries for pelagic and demersal fish (demersal fish live on or near the sea bed; pelagic fish do not), several marine shellfish species, and diadromous fish (which spend part of their lives in fresh water and part at sea - in this section salmon, sea trout and eels). The section also covers sea angling and bait collection. For more information about the species concerned, including their scientific names, see sections 5.5, 5.7 and 5.8.

The locations of the main fishing ports and islands in the region where landings are recorded by SOAEFD are shown in [Map 9.1.1](#). The islands of Shetland, including Fair Isle, make up the Shetland Sea Fisheries District. Mainland (the largest island) supports two principal fishing ports, Lerwick and Scalloway, plus additional smaller ports and recognised landing places. Other islands supporting commercial fishing boats include Whalsay, Out Skerries, Yell and Unst. Fishing has traditionally been one of the main industries in Shetland, with 19% of the population of Shetland involved (Green 1993). In 1994 fishing, fish processing, salmon farming and associated industries were worth £102 million to the Shetland economy, 22.3% of Shetland's total income (Shetland Islands Council 1995). The inshore fleet comprises vessels that tow or set various types of gear, including demersal trawls, scallop dredges, seine nets, creels and fixed nets. During the 1980s most of the pelagic landings were to 'Klondykers' (east European factory fishing boats) moored close to shore, but these are now much reduced in number owing to an increase in costs and the introduction of more stringent regulations.

In 1992, 18.8% of all recorded landings of fish and shellfish species in Britain and the Isle of Man were made in this region, which is significantly above the average of all regions of 5.9%. The total tonnages of demersal and shellfish species landed in the region represent 7.3% and 1.1% respectively of the British and Isle of Man totals. The shellfish sector has become increasingly important, the value of landings rising from £0.2 million in 1971 to £1.6 million in 1992 (Ritchie & O' Sullivan 1994). Total landings of pelagic species in the region, at 97,649 tonnes, account for 38.7% of the British and Isle of Man and 53% of the North Sea totals. The 59,777 tonnes of mackerel landed in the region represents 39.7% of the British and Isle of Man total and there are also significant landings of herring (43.8%). The 374 tonnes of horse mackerel landed in the region is not significant locally, compared with the large landings of mackerel and herring, but is still a significant proportion (24.9%) of the British and Isle of Man landings. A summary of the totals for pelagic, demersal and shellfish species is given in [Table 9.1.1](#).



Map 9.1.1 Fishing ports, areas and islands in the Shetland Sea Fisheries District.

Approximately 84% of all fish registered as landed in the region in 1992 was landed to Lerwick. [Table 9.1.2](#) summarises landings to the ports of Lerwick and Scalloway and the islands of Yell, Fetlar and Unst 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.

In the Shetland Salmon Fishery Statistical District, salmon and sea trout support a very small rod-and-line fishery from sea lochs in the region ([Table 9.1.3](#)).

Table 9.1.1 Species group landings in 1992 (tonnes)

Species group	Region 1	North Sea Coast*	Scotland	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	97,649	184,309	227,669	252,335	53.0	38.7
Demersal	20,075	228,056	193,914	275,460	8.8	7.3
Shellfish	1,163	61,933	46,112	104,917	1.9	1.1
All species	118,887	474,298	467,695	632,712	25.1	18.8

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.). Key: *of Britain (see section 9.1.4). 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^a of all fish species to selected Region 1 ports 1991 - 1994 (thousands of tonnes)

Port	1991	1992	1993	1994
Lerwick	99.3	111.9	101.6	147.1
Scalloway	5.5	4.4	4.4	4.2
Yell, Fetlar and Unst	0.8	1.1	1.5	1.4
Region 1 selected ports	105.6	117.4	107.5	152.7
Scotland	458.4	467.7	491.8	487.8
% of Scottish total landed in above ports	23.0	25.1	21.9	31.3

Sources: Ministry of Agriculture, Fisheries and Food (1995b). Key: ^alandings totals relate to 'nominal live weight', i.e. weight of the whole fish.

Table 9.1.3 Average catch (numbers of fish) of salmon and grilse and sea trout 1989 - 1993

Totals	Salmon and grilse	Sea trout
Region 1	22	333
North Sea Coast*	196,247	104,789
Scotland	187,481	65,468
GB	254,829	141,813
% of North Sea Coast* total in region	<0.1	0.3
% of GB total in region	<0.1	0.2

Source: Scottish Office Department of Agriculture and Fisheries (1990); National Rivers Authority (1991, 1992, 1993, 1994a, b) and Scottish Office (1991, 1992, 1993, 1994). Key: *of Britain (see section 9.1.4). Note: calculating the figures in this table was a complex process: refer to section 9.1.4.

9.1.2 The fisheries

Pelagic species

Table 9.1.4 gives the quantities of various pelagic species landed in 1992 in the region, compared with landings nationally. Pelagic species such as herring and mackerel are exploited by the purse seiners and pelagic trawlers. Main

fishing effort for herring is between July and September. Some of the herring are caught within 12 miles of the coast as the shoals migrate southward. In October the pelagic fleet switch to the mackerel fishery, which carries on until February. Quota constraints on North Sea herring and the resurgence of Atlanto-Scandinavian herring means Shetland's pelagic vessels are actively seeking increased opportunities in waters further north than the region.

Table 9.1.4 Pelagic species landings in 1992 (tonnes)

Species	Region 1	North Sea Coast*	Scotland	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	37,497	74,706	83,879	85,650	50.2	43.8
Horse mackerel	374	1,374	473	1,499	27.2	24.9
Mackerel	59,777	95,366	141,583	150,726	62.7	39.7
Pilchard	0	4,244	0	4,244	0	0
Sprat	0	8,478	1,554	10,032	0	0
Whitebait	0	1	0	1	0	0
Others	1	140	180	183	0.7	0.5
Total	97,649	184,309	227,669	252,335	53.0	38.7

Source: Ministry of Agriculture, Fisheries and Food (1994); Scottish Office Agriculture and Fisheries Department (1993); Isle of Man Department of Agriculture, Fisheries & Forestry (pers. comm.). Key: *of Britain (see section 9.1.4). 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 9.1.5 Demersal species landings in 1992 (tonnes)

Species	Region 1	North Sea Coast*	Scotland	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	310	7,449	9,657	13,348	4.2	2.3
Skates and rays	220	3,816	3,670	7,827	5.8	2.8
Gadoids						
Cod	2,266	53,440	35,898	59,524	4.2	3.8
Haddock	2,695	49,221	49,867	53,586	5.5	5.0
Hake	42	589	1,993	3,620	7.1	1.2
Ling	527	4,594	4,318	6,027	11.5	8.7
Pollack (lythe)	89	1,921	1,285	3,023	4.6	2.9
Saithe	811	11,032	10,310	12,602	7.4	6.4
Whiting	2,835	36,733	35,923	41,055	7.7	6.9
Whiting, blue	3,570	6,531	6,531	6,531	54.7	54.7
Flatfish						
Brill	0	317	50	443	0	0
Dab	3	1,017	759	1,215	0.3	0.2
Dover sole	0	2,021	57	2,876	0	0
Flounders	0	167	4	273	0	0
Halibut	3	166	114	194	1.8	1.5
Halibut, Greenland	P	119	20	137	-	-
Lemon sole	79	5,004	2,566	5,573	1.6	1.4
Megrim	228	1,379	2,566	4,037	16.5	5.6
Plaice	227	20,749	7,902	23,887	1.1	1.0
Turbot	6	561	196	742	1.1	0.8
Other species						
Catfish	31	1,896	1,378	1,935	1.6	1.6
Conger eel	2	99	107	510	2.0	0.4
Gurnard	0	368	32	627	0	0
Monkfish/angler	1,800	9,813	11,557	14,678	18.3	12.3
Redfish	13	718	193	774	1.8	1.7
Sand eel	4,152	4,152	4,152	4,152	100	100
Torsk (tusk)	16	165	194	207	9.7	7.7
Witch	41	1,405	1,789	1,981	2.9	2.1
Others	104	2,419	682	3,833	4.3	2.7
Fish roes	5	195	144	243	2.6	2.1
Total	118,887	228,056	193,914	275,460	8.8	7.3

Source: Ministry of Agriculture, Fisheries and Food (1994); Scottish Office Agriculture and Fisheries Department (1993); Isle of Man Department of Agriculture, Fisheries & Forestry (pers. comm.). Key: *of Britain (see section 9.1.4); P = species landed in the region in small quantities (here <0.5 tonnes). Notes: amounts landed are rounded up to the next whole tonne. Calculating the figures in this table was a complex process: refer to section 9.1.4.

Demersal species

Table 9.1.5 gives the quantities of various demersal species landed in 1992 in the region, compared with landings nationally. The Shetland demersal trawler fleet predominantly fish offshore, as demersal fish have become increasingly scarce inshore during the last 10-15 years. The local trawler fleet have become increasingly efficient and able to exploit rough ground using rock hopper gear. The inshore fleet consists of modern boats 10-12 m in length and older wooden boats of up to 16 m in length that use both trawl and seine nets. Traditional inshore fishing grounds include Burra Firth and St Magnus Bay, which is sheltered from north-easterly winds and is often fished during the winter. Demersal species, mainly haddock and whiting, with smaller amounts of cod, saithe, plaice, lemon sole and other flatfish species, are landed from around the

islands. Demersal species are also landed as a by-catch in the *Nephrops* fishery. With the introduction of restrictive quotas on demersal gadoids in the early 1990s, Shetland's demersal vessels have increasingly targeted monkfish/angler and megrim on the shelf edge to the west of Shetland.

During the late 1970s and throughout the 1980s there was a summer inshore trawl fishery for sandeels around Shetland. This fishery peaked in 1982 when 52,000 tonnes were landed; however, in 1989 landings had fallen to 3,500 and in 1990 to 2,300 tonnes. Studies have indicated that the decline was due to reduced recruitment to the Shetland area of sandeels that spawned on unfished grounds north of Orkney. Faced with this and growing concerns about the possible impact of continued fishing on breeding seabirds, the sandeel fishery was closed in June 1990. After further research the fishery was re-opened at the start of 1995, under more restrictive management measures (see section

Table 9.1.6 Shellfish landings* in 1992 (tonnes)

Species	Region 1	North Sea Coast**	Scotland	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	0	26,199	2,546	32,047	0	0
Crabs	274	9,117	7,501	16,970	3.0	1.6
Lobsters	16	622	564	1,069	2.6	1.5
Mussels	0	4,865	3,067	6,555	0	0
<i>Nephrops</i>	29	8,368	17,707	19,639	0.3	0.1
Periwinkles	4	315	1,837	1,907	1.3	0.2
Queen scallops	54	2,207	5,518	11,273	2.4	0.5
Scallops	535	4,519	5,068	8,290	11.8	6.5
Shrimps	0	615	180	743	0	0
Squids	66	1,382	1,071	2,005	4.8	3.3
Whelks	185	1,905	858	2,393	9.7	7.7
Others	0	1,819	195	2,026	0	0
Total*	1,163	61,933	46,112	104,917	1.9	1.1

Source: Ministry of Agriculture, Fisheries and Food (1994); Scottish Office Agriculture and Fisheries Department (1993); Isle of Man Department of Agriculture, Fisheries & Forestry (pers. comm.). Key: *excluding landings of farmed shellfish (see section 9.2); **of Britain (see section 9.1.4). Notes: amounts landed are rounded up to the next whole tonne. Calculating the figures in this table was a complex process: refer to section 9.1.4.

5.7.3). The 4,152 tonnes of sandeels landed in the region in 1992 (Table 9.1.5) were caught outside the region (North Sea or the Minch) but landed at Lerwick. Approximately 1,000 tonnes were caught in each of the years 1995 and 1996 (P. Ellis (RSPB) pers. comm.).

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 of the registered creel boats set pots on a seasonal basis, with edible crab, lobster and velvet crabs being the most targeted species. The main season for edible crabs is from April to September and for lobster from April to the end of the year. As most coastal waters are very exposed, pots are set close inshore for lobster, which limits effort. More effort is expended on the edible crab fishery, where pots are set further offshore. Smaller creel boats fishing on a part-time basis may use around 100 pots, whereas a full-time creel boat will set over 500 pots at any one time. An increasing amount of effort is also directed towards potting for whelks.

Scallops and queen scallops are exploited by the inshore fleet around the islands of Shetland. For scallops dredges are used: the smaller boats use four or five dredges attached to a single beam, whereas the larger boats work twin beams, with a total of up to fourteen dredges attached. Scallops are also exploited by SCUBA diving, including areas inaccessible to boats. Queen scallops are exploited close inshore by smaller vessels, with some only using a single dredge.

Diadromous species

The distribution of diadromous fish species in sea lochs and coastal sea of the region is discussed in section 5.8. In this region, two diadromous species - salmon (including grilse) and sea trout - support a small rod-and-line fishery from sea lochs (Table 9.1.3).

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. Sea angling is a popular sport practised by over two million people in Great Britain (Fowler 1992). The governing body in Scotland is the Scottish Federation of Sea Anglers, which has approximately 64 affiliated clubs and approximately 200 additional personal members, who are not always members of affiliated clubs. Lerwick is renowned for its skate angling (Orton 1996). A wide range of species, such as ling, cod, torsk (tusk), haddock and pollack, are also caught. The main angling areas are on Whalsay, Unst and Burra.

Bait collection

Fowler (1992) identified that at the time of the bait collection survey (1985) the exploitation of bait species was virtually unknown in Shetland, apart from the collection of razor shells. Anglers may collect their own bait locally, including species such as ragworm, lugworm, peeler crabs (moulting shore crabs), mussels, cockles, limpets and razor shells. Different bait species are targeted according to the species of fish being caught as well as the location and time of year.

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, 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.

The CFP seeks to manage stocks of fish in EU waters on a biological basis, 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. Between 6 and 12 nautical miles from baseline (low water mark) other member states with historic rights also have access, and beyond 12 nautical miles (the limit of the British Territorial Seas) access by vessels from the other member states is limited based on historic fishing rights and by vessels from non-member countries by reciprocal agreements with the European Union.

For the purpose of stock assessment, the UK coastal waters have been designated by the International Council for the Exploration of the Sea (ICES) into statistical areas. The coastal seas around this region are part of Division IVa (Northern North Sea). ICES provides scientific advice on the management of all the important commercial species of fin fish and some shellfish stocks in all areas of the north-east Atlantic. This work is summarised in the annual report of the Advisory Committee for Fisheries Management, which is responsible for providing scientific advice on TACs and other conservation measures to the international fisheries commissions, including the EU. The TAC is a fishery management tool which may, amongst other management needs, take account of the maximum level of exploitation which 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, details of the catch quotas for fish and shellfish species for all European countries and certain conditions under which the species could be fished. The TACs, UK quotas and 'uptake' for 1995 for each species in the ICES statistical division in the region are given in SOAEFD (1996a), which is published annually. European Council Regulation No. 3760/92 (European Council 1992) summarises the CFP, including the proportions by which TACs are allocated as national quotas. Information on minimum landing sizes and whether an annual quota applies in the region for the important pelagic and demersal species is given in [Table 5.7.1](#).

The economy of Shetland is largely dependent on the fishing industry and the surrounding seas have important spawning areas for many species. Fishing effort is restricted by the European Union in an area known as the 'Shetland Box'. The number of visiting boats allowed to fish within this area is limited through the 'Shetland Box licensing

scheme', which limits the activity of vessels >26 m long fishing for demersal species. It is designed to help Shetland as a fisheries-dependent area by restricting access by non-UK vessels to a greater degree than anywhere else in UK waters. 128 licences are allocated - 62 to UK, 52 to France, twelve to Germany and two to Belgium. The 'Norway Pout Box' includes the waters to the south and east of Shetland. Here the use of small mesh net (16 mm minimum) for Norway pout is prohibited, thus protecting juvenile stock of other demersal species.

In Scotland the administration and management of sea fisheries is carried out by the Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD) in accordance with the CFP of the European Union. Research relating to the CFP and other fisheries management requirements is carried out by the SOAEFD Marine Laboratory, Aberdeen. The Shetland Sea Fisheries District Office collects data on landings throughout the region. Administration and enforcement of sea fisheries legislation within the Sea Fisheries District is the responsibility of the Sea Fisheries Inspectorate branch of the Scottish Fisheries Protection Agency, which operates the Fisheries Protection Fleet and aircraft. In Scottish inshore waters (to 6 nautical miles from baselines), the principal instrument of fisheries management is the Inshore Fishing (Scotland) Act 1984. This gives the Secretary of State powers to regulate fishing in specified inshore waters and to prohibit the carriage of specified types of net.

The Sea Fisheries (Wildlife Conservation) Act 1992 gives SOAEFD limited scope to have due regard for wider environmental interests when managing fisheries and permits the restriction of time that a fishing vessel can spend at sea. Fisheries managers have also been given environmental responsibilities under the Environment Act 1995 and the Conservation (Natural Habitats etc.) Regulations 1994. There are a total of nine Regulating Orders in Britain covering approximately 215,889 ha (as at July 1995) (MAFF 1995a). While Regulating Orders do not presently apply in Scotland, the Scottish Office issued a consultation paper in December 1994 reviewing its policy on Several and Regulating Orders. Regulating Orders can be granted under the Sea Fisheries (Shellfish) Act 1967 by SOAEFD to a responsible body to enable it to regulate the natural fishery via regulations and restrictions and to levy tolls or royalties. Several Orders are discussed in more detail in [section 9.2.3](#). A committee has been formed with the aim of setting up a Regulating Order for the Shetland Islands, allowing the committee to impose restrictions, if necessary, on commercial fishing for shellfish. The Shetland Islands Council also has a role in providing infrastructure support to the fishing industry, for example in the form of piers, harbours and fishmarkets. Commercial loans to purchase new vessels are made available from the Shetland Development Trust.

Fishermen's Organisations, such as the national Scottish Fishermen's Federation and, in this region, the Shetland Fishermen's Association, represent fishermen's and boat owners' interests in the fishing industry and are consulted on fisheries management and other fisheries-related issues. The Shetland Salmon Fishery Statistical District covers the whole region. In Scotland there is no public right to fish for salmon, and exclusive rights for each stretch of river are privately owned. Coastal and estuarine fisheries are similarly governed by heritable titles. Within District

Salmon Fishery Board areas there may be associations of those concerned with a fishery, such as the proprietors, tenants, gillies and anglers.

The *MV Braer* was grounded at Garths Ness at the southern end of Shetland on 5 January 1993. The resulting oil spill of 85,000 tonnes of oil meant that a temporary exclusion zone for fish and shellfisheries was introduced. The moratorium on catching wild finfish was lifted in April 1993, with the shellfish ban progressively lifted thereafter; firstly crabs and lobsters were given the all clear, then scallops, queen scallops and *Nephrops*. However the ban on taking whelks and mussels in the worst affected area - west Shetland - had not been lifted in January 1997. Further information on the environmental impact of the *Braer* can be found in Ritchie & O' Sullivan (1994).

Issues relating to the fisheries for pelagic, demersal and shellfish species and sea angling 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. 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, 5.7 and 5.8.

9.1.4 Information sources used

Inshore fisheries review of England, Scotland and Wales, 1992/1993 (Gray 1994) has been used in compiling this section. Gray (1994) describes the different types of fishing gear used inshore and any related restrictions. It also gives details of the numbers of boats operating from ports in the region, the amount of fishing effort involved by various methods and which species or species groups are targeted during the different seasons. Brady (1995) lists details of all fishing vessels, their base ports and main fishing methods. The key GB statutes relating to fisheries are described in Eno & Hiscock (1995) and specifically for Scotland in Cleator & Irvine (1994). Figures given in Tables 9.1.1 - 9.1.6 come from various sources: MAFF, NRA (now the Environment Agency), SOAEFD and Isle of Man Department of Agriculture, Fisheries and Forestry (IoM DAFF); their interpretation is described below.

Information on the number and size of fishing vessels based in the region may be obtained from the *The Scottish fishing fleet at December 1995* (SOAEFD 1996b). Numbers of full-time and part-time fishermen resident in the Shetland Sea Fisheries District are also given in this annual publication. Trends in fish landings (tonnage and value) at Scottish ports are described in detail in MacKay & Adam (1995).

Pelagic, demersal and shellfish species

Statistics given in this section are for landings recorded in the region, as distinct from fish catches taken. Choice of landing port reflects a combination of operational factors such as market prices, distance from the fishing grounds and the location of fishermen's weekend bases.

Consequently, locally based vessels may land at ports in other regions. Some fish caught may have been discarded before the catch is landed. 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 Scotland are published annually for the Shetland Sea Fisheries District in the *Scottish sea fisheries statistical tables*; data for 1992, 1993 and 1994 are available in SOAFD (1993, 1994, 1995) and for 1995 in SOAEFD (1996a).

The landings for the Sea Fisheries Districts have been combined to give the figures in the 'Region 1' column for Tables 9.1.1 and 9.1.4 - 9.1.6. The figures in the 'North Sea Coast' column were calculated by adding together all the landings data for the ten Coastal Directorates regions on the 'North Sea Coast' of Great Britain, as defined in section 1.1. The figures in the 'Scotland' column of these tables were calculated by adding together all of the SOAEFD data for Scotland, and those in the 'Britain and Isle of Man' column by combining MAFF, SOAEFD and IoM DAFF data. Because these organisations do not use the same categories, landings in some of their categories have been added to the 'others' rows in the tables in this section. Also, SOAEFD publish the weight of fish as 'standard landed weight' (gutted fish with head on), whereas MAFF and IoM DAFF publish them as 'nominal live weight' (whole fish). These two are the same for pelagic and shellfish species, but converted data from SOAEFD were used for all demersal species, apart from sandeels (which are not gutted), so that all the data presented are as 'nominal live weight'.

Diadromous species

The data for the Shetland Salmon Fishery Statistical District are based on returns made in response to an annual questionnaire sent to proprietors and occupiers of salmon fishings under the provisions of section 15 of the Salmon and Freshwater Fisheries (Protection) (Scotland) Act 1951, as amended by the Salmon Act 1986. Over 95% of the forms sent out in 1992 were returned. The figures presented are the reported catch and no allowance is made for inaccuracies, non-returns or gaps in the roll of proprietors and occupiers. Therefore the figures given in Table 9.1.3 should be used only as an indication of the pattern of the catch in the region. In order to protect commercial confidentiality, the reported catches for each district are published without an indication of catch method. A *Statistical Bulletin* of Scottish salmon and sea trout lists catch returns for each individual Salmon Fishery Statistical District and is published annually (SODAF 1990; SO 1991-1996).

Sea angling

In the 85th edition of *Where to fish*, Orton (1996) lists much useful information relating to sea angling.

Bait collection

Bait collection is discussed by Fowler (1992), who presents results from a survey around the coast of Britain in 1985.

9.1.5 Acknowledgements

The author thanks the following for their contributions and comments: Phil Kunzlik (SOAEFD), Austin Taylor (Shetland Islands Council), John H. Goodlad (Shetland Fishermen's Association), David Donnan (Scottish Natural Heritage), Mark Tasker (JNCC), Peter Ellis (RSPB Shetland Officer) and Daniel Owen and Euan Dunn (RSPB).

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Salmon are not naturally abundant in Shetland's rivers, which are mostly too small to allow spawning, but they are reared in fish farms in virtually every sheltered voe and firth in the islands. Salmon farming is very important to the economy of Shetland, and in 1995 Shetland supplied about 22% of the farmed salmon produced in Scotland. Photo: Lorne Gill, Scottish Natural Heritage.

C. Contact names and addresses

Type of information	Contact address and telephone no.	Type of information	Contact address and telephone no.
Scientific aspects of managing important fish stocks	General Secretary, International Council for the Exploration of the Sea, Palaegade 2 -4, DK-1261 Copenhagen K, Denmark, tel: 00 45 331 57092	UKDMAP software; mapped fishing areas of selected species, ICES Statistical Division boundaries etc.	*Project Manager, BODC, Birkenhead, tel: 0151 653 8633
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	Shellfish production (commercial)	Director, Shellfish Association of the UK, Clerk, Fishmongers Hall, London Bridge, London EC4R 9EL, tel: 0171 6263531
Statistics on sea fish landings in Scotland. Analysis and dissemination of data and statistics on vessels in the Scottish fishing fleet.	*SOAEFD Division J4, Pentland House, Edinburgh, tel: 0131 244 6230	Affiliated sea angling clubs	Secretary, Scottish Federation of Sea Anglers, Administrator, Caledonia House, South Gyle, Edinburgh EH12 9DQ, tel: 0131 317 7192
International fisheries policy for Scotland. Fisheries conservation including quota policy.	*SOAEFD Division J1, Pentland House, Edinburgh, tel: 0131 244 6230	Game fishing	Director, Salmon and Trout Association (Scottish Branch), Administrator, 10 Great Stuart Street, Edinburgh EH3 7TN, tel: 0131 225 2417
Domestic fisheries policy for Scotland. Inshore and shellfisheries management - including Regulating Orders, enforcement and environmental aspects.	*SOAEFD Division J2, Pentland House, Edinburgh, tel: 0131 244 6230	Interaction between fisheries and non-fisheries conservation issues	*Fisheries Officer, JNCC, Peterborough, tel: 01733 62626
Marine and estuarine fisheries research in Scottish waters; interaction between fisheries and non-fisheries conservation issues in Scotland; seals and fisheries	*SOAEFD Fisheries Research Services, Marine Laboratory, Aberdeen, tel: 01224 876544	Interaction between fisheries and non-fisheries conservation issues	*Maritime Unit, Advisory Services, SNH, Edinburgh, tel: 0131 554 9797
Diadromous fish and fisheries information	SOAEFD Freshwater Fisheries Laboratory, Montrose Field Station, 16 River Street, Montrose, Angus DD10 8DL, tel: 01674 677070	Interaction between fisheries and non-fisheries conservation issues	*Marine Policy Officer, RSPB HQ, Sandy, tel: 01767 680551 and RSPB Shetland Office, East House, Sumburgh Head Lighthouse, Virkie, Shetland ZE3 9JN, tel: 01950 460800
Wild salmon and freshwater fisheries policy; contact details of the Clerks of the District Salmon Fishery Boards	*SOAEFD Division K2, Pentland House, Edinburgh, tel: 0131 556 8400 or 0131 244 6231	Interaction between fisheries and non-fisheries conservation issues	*Conservation Officer, WWF Scotland, Aberfeldy, tel: 01887 820449 and *Fisheries Officer, WWF-UK, Godalming, tel: 01483 426444
Scottish Office publications sales	HMSO, 21 South Gyle Crescent, Edinburgh EH12 9EB, tel: 0131 479 3141	Interaction between fisheries and non-fisheries conservation issues	*Conservation Officer, Marine Conservation Society, Ross-on-Wye, tel: 01989 566017
Research and development, marketing and training for the fishing industry	Sea Fish Industry Authority, 18 Logie Mill, Logie Green Road, Edinburgh EH7 4HG, tel: 0131 558 3331	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
Representation of fishermen's and boat owners' interests in the Scottish fishing industry	Scottish Fishermen's Federation, 14 Regent Quay, Aberdeen AB11 5AE, tel: 01224 582583	Seals and fisheries	Co-ordinator, Wildlife & Countryside Link Seals Group, 15 Park Road, East Grinstead, West Sussex RH19 1DW, tel: 01342 315400
Representation of fishermen's and boat owners' interests in Shetland	Shetland Fishermen's Association, Shetland Seafood Centre, Stewart Building, Lerwick, Shetland ZE1 0LL, tel: 01595 693197	Seals and fisheries	Sea Mammal Research Unit, Gatty Marine Laboratory, University of St Andrews, Fife KY16 8LB, tel: 01334 476161

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

9.2 Mariculture

C.F. Robson

9.2.1 Introduction

Mariculture is the cultivation of marine species. In this region the coastline provides good shelter and adequate water exchange for mariculture, mainly salmon farms, which have become an important feature of the local economy. Shellfish are also cultivated around the region's coast and voes; mussels are grown at several locations. Other shellfish species such as Pacific oyster, native oyster, scallop and queen scallop are also being grown at the North Atlantic Fisheries College in Scalloway for training purposes.

9.2.2 Locations and species

Table 9.2.1 lists the main species that are currently under commercial cultivation in the region and in Great Britain and the Isle of Man.

Species	Species status	Cultivated in region?
Salmonids		
Atlantic salmon <i>Salmo salar</i>	Native	✓
Sea trout <i>Salmo trutta</i>	Native	✓
Non-salmonids		
Turbot <i>Psetta maxima</i>	Native	
Halibut <i>Hippoglossus hippoglossus</i>	Native	
Shellfish: bivalve molluscs		
Common mussel <i>Mytilus edulis</i>	Native	✓
Native oyster <i>Ostrea edulis</i>	Native	✓
Pacific oyster <i>Crassostrea gigas</i>	Un-established introduction	✓
Hard shelled clams <i>Mercenaria mercenaria</i>	Non-native	
Manila clams <i>Tapes philippinarum</i>	Un-established introduction	
Palourde <i>Tapes decussatus</i>	Native	
Scallop <i>Pecten maximus</i>	Native	✓
Queen scallop <i>Aequipecten opercularis</i>	Native	✓
Polychaetes		
King ragworm <i>Neanthes virens</i>	Native	

Sources: The Crown Estate & Scottish Office Agriculture, Environment and Fisheries Department (pers. comms.), La Tene Maps (1995a, b). 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.

Salmonids and non-salmonids

Salmon are cultivated in most of the sheltered voes, sounds and firths in Shetland, and there is also a sea trout farm in The Firth at Tresta. There are also some land-based salmon hatchery and smolt units. There may also be other sites that are leased for fish farming but not currently used for

cultivation. Table 9.2.2 shows the levels of production of salmon in Region 1, compared with levels in the whole of Scotland for 1995. Both Region 1 and Scotland as a whole have shown large increases in production since 1992. Salmon farming is very important to the economy of Shetland, and, as Table 9.2.2 shows, in 1995 Shetland supplied about 22% of the farmed salmon produced in Scotland.

Table 9.2.2 Employees and annual production (tonnes) in 1995 of salmon at sea sites

	No. of staff*	Annual production
Region 1	310	15,523
Scotland	1,355	70,060

Source: Scottish Office Agriculture, Environment and Fisheries Department (1996a). Key: *full and part time.

Shellfish

Shellfish farming in Scotland has developed significantly in the last ten years, but the number of active shellfish companies has now decreased slightly since its peak in 1990. Shellfish, mostly mussels, are now widely farmed in Shetland, especially on moderately exposed west coasts of Mainland, and there may also be other sites that are leased for shellfish farming but not currently used for cultivation. Mussels are mainly cultivated on rafts. Scallops and queen scallops are grown from natural spat suspended in bag nets. Pacific and native oysters are grown to marketable size from hatchery-reared 'spat' in bags made from net, located on the lower shore on trestles or in cages on the sea bed. Table 9.2.3 shows the 1995 SOAEFD survey results, the latest for which figures were available at the time of writing, of shellfish companies in Region 1, compared with those in the whole of Scotland.

9.2.3 Management and issues

The Food Safety (Live Bivalve Molluscs) Regulations (which implement European Council Directives) require that all waters from which bivalve molluscs are taken for human consumption are classified by the Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD) following sampling carried out by the Port Health Authority or Local Authority. Samples of live shellfish are submitted to SOAEFD Marine Laboratory 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 human consumption must comply.

The consent of the owners or managers of the sea bed is required and a lease may be needed, applications for which

Table 9.2.3 Scottish shellfish companies 1995 production* (weight of shellfish in tonnes)

Area	No. of companies	No. of staff**	Pacific oysters	Native oysters	Mussels	Queen scallops	Scallops
Region 1	10	17	0.2	0	21	0	0
Scotland	190	327	273	15	882	46	36

Source: Scottish Office Agriculture, Environment and Fisheries Department (1996b). Key: *'production' is that for sale for the table only; **full time, part time and casual. Note: except for mussels, which are recorded in tonnes, the following average weights of individuals have been used to convert numbers of individuals to (next whole) tonnes: Pacific and native oyster - 80 g, queen scallop - 40 g, scallop - 120 g.

must go through an extensive consultation process, before leases can be granted. In many areas a lease must be sought from the Crown Estate, since it owns or manages 55% of the foreshore and the same proportion of the beds of tidal rivers between mean high and low water in Great Britain, together with virtually the entire territorial sea bed. In Shetland all maritime structures are controlled by a system of works licences issued under the Zetland County Council Act 1974. Thus in Shetland a Crown Estate lease is issued for mariculture purposes following the grant of an appropriate works licence by the Shetland Islands Council. Details of all land-based and marine salmonid and shellfish cultivation licences in this region are held by the Shetland Islands Council. If the intended structures are potentially hazardous to navigation the Department of Transport must also issue a consent. If they are to be above mean low water mark planning permission must be sought from the local authority, who will take nature conservation and landscape considerations into account. SEPA and the Shetland Islands Council are responsible for processing consents to discharge from fish and shellfish farms; they hold details of the consents issued to operational sites and site monitoring records.

Several Orders are granted under section 1 of the Sea Fisheries (Shellfish Act) 1967 and are administered in Scotland by SOAEFD. Several Orders take precedence over the public right to fish and are granted to an individual, a co-operative or a responsible body to cultivate the sea bed within a designated area of water and to establish, protect, conserve and enhance a fishery for named molluscan shellfish species. There are no Several Orders in this region, out of 22 in Britain covering a total of approximately 3,299 ha (as at July 1995) (MAFF 1995). There are consultations proceeding to extend the Act to cover crustacea as well as molluscs.

In Shetland, salmon farming is represented by the Shetland Salmon Farmers Association and shellfish growing by the Association of Shetland Shellfish Growers. The Scottish Salmon Growers Association and the Association of Scottish Shellfish Growers are also trade associations, acting as information sources for the mariculture industry in Scotland, encouraging research and acting as consultees on relevant issues.

Phytoplankton blooms are a normal feature in the seasonal development of plankton (see section 4.3). However some blooms may reach exceptional proportions or contain species, principally dinoflagellates, that are potentially toxic. In the summer of 1988 there were a number of mortalities attributed to phytoplankton blooms among farmed Atlantic salmon in the Shetland Islands (Bruno *et al.* 1989).

The *MV Braer* was grounded at Garths Ness at the southern end of Shetland on 5 January 1993. The resulting oil spill of 85,000 tonnes of oil meant local salmon farmers

were required to slaughter all fish which were in the water at the time of the spill. By 1995, half of the £40 million compensation to various sectors had gone to fish-farming. Further information on the environmental impact of the *Braer* can be found in Ritchie & O' Sullivan (1994).

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 importation and 'deposit' of molluscan shellfish and lobsters, under the EC Fish Health Directive (Directive 91/67). The regulations list 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 only be made from areas of equal or better health status, and imports of Pacific oysters are subject to screening for species contamination. Imports from non-EU countries can only be made under licence, and enter through designated border inspection posts. Fish farming and shellfish farming businesses in Scotland should register with SOAEFD within two months of starting operations. This is a requirement under the Registration of Fish Farming and Shellfish Farming Businesses Order 1985, with a view to preventing the spread of disease. Diagnosis, collation of information and research on fish- and shellfish-related diseases in Scotland is carried out by SOAEFD Marine Laboratory.

Issues relating to the cultivation of marine species are closely linked to marine nature conservation interests, particularly the possible effects on species and habitats of nature conservation interest. For instance, the intensification of mussel farming can enhance the potential for eider ducks, which feed on mussels, increasingly to predate the farmed shellfish, causing a conflict between interests. Advice on precautions against eider duck predation of mussel farms is outlined in Galbraith (1992). Bird-scaring devices and human presence on the farms may also be effective deterrents.

As in agriculture, efficient mariculture operations depend on intensive production methods (i.e. at greater than natural population densities), requiring high water quality. The maintenance of the coastal marine environment in an uncontaminated and fully functional state is recognised as an important objective shared by mariculturists and other users of the coastal zone. The presence of fish farming operations in the sea may lead to

some interactions between husbandry procedures and the environment. This subject is an active research and monitoring area in Scotland and other northern European countries where salmon farming has developed as the primary form of mariculture. Interactions that give rise to expressions of concern are associated with: the siting and appearance of fish farms, effects on water quality, the sea bed, benthic communities and wildlife (fish predators), opportunities for exchange of pathogens and parasites between wild and farmed fish, the use of veterinary medicines to treat sea lice, the use of antibiotics and their persistence in sediments and the potential for genetic interactions between wild fish and escaped farmed fish. Since January 1997 all treatments used in fish farms have had to be licensed veterinary medicines. All shellfish species cultivated in Scotland depend on natural food supplies and receive no therapeutic (chemical) treatments for disease or parasites.

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C. Contact names and addresses

Type of information	Contact address and telephone no.	Type of information	Contact address and telephone no.
Locations of marine shellfish farms in Shetland	The Crown Estate, 10 Charlotte Square, Edinburgh EH2 4DR, tel: 0131 226 7241, and *Maritime Unit, Advisory Services, SNH, Edinburgh, tel: 0131 554 9797	Commercial advice on shellfish	Director, Shellfish Association of the UK, Fishmongers Hall, London Bridge, London EC4R 9EL, tel: 0171 626 3531
Fish and shellfish farming policy, disease control, Several Orders in Scotland.	*SOAEFD, Pentland House, Edinburgh, tel: 0131 244 6203	Interaction between mariculture activities and marine nature conservation issues	*Maritime Unit, Advisory Services, SNH, Edinburgh, tel: 0131 554 9797
Research into fish and shellfish cultivation in Scotland, interaction between mariculture activities and marine nature conservation issues	*SOAEFD Fisheries Research Services, Marine Laboratory, Aberdeen, tel: 01224 876544	Interaction between mariculture activities and marine nature conservation issues	*Fisheries Officer, JNCC, Peterborough, tel: 01733 62626
Works licences	*Shetland Islands Council, Lerwick, tel: 01595 693535	Mariculture and marine nature conservation issues	*Marine Policy Officer, RSPB HQ, Sandy, tel: 01767 680551, and RSPB Shetland Office, East House, Sumburgh Head Lighthouse, Virkie, Shetland ZE3 9JN, tel: 01950 460800
Leases	The Crown Estate, 10 Charlotte Square, Edinburgh EH2 4DR, tel: 0131 226 7241	Mariculture and marine nature conservation issues	*Conservation Officer, WWF Scotland, Aberfeldy, tel: 01887 820449, and *Fisheries Officer, WWF-UK, Godalming, tel: 01483 426444
Discharge consents and water quality	*Scottish Environment Protection Agency (SEPA), Northern Region HQ, Dingwall, tel: 01349 862021	Mariculture and marine nature conservation issues	*Conservation Officer, Marine Conservation Society, Ross-on-Wye, tel: 01989 566017
Market research and technical advice on shellfish purification	Sea Fish Industry Authority, 18 Logie Mill, Logie Green Road, Edinburgh EH7 4HG, tel: 0131 558 3331	Seals and the cultivation of salmon	Shetland Salmon Farmers Association, Shetland Seafood Centre, Stewart Building, Alexandra Wharf, Lerwick, Shetland ZE1 0LL, tel: 01595 695579
Salmon farming in Shetland	Chief Executive, Shetland Salmon Growers Association, Shetland Seafood Centre, Stewart Building, Lerwick ZE1 0LL, tel: 01595 695579	Seals and mariculture	Co-ordinator, Wildlife & Countryside Link Seals Group, 15 Park Road, East Grinstead, West Sussex RH19 1DW, tel: 01342 315400
Shellfish farming in Shetland	Association of Shetland Shellfish Growers, c/o North Atlantic Fisheries College, Port Arthur, Scalloway ZE1 0UN, tel: 01595 880328	Seals and mariculture	Sea Mammal Research Unit, Gatty Marine Laboratory, University of St Andrews, Fife KY16 8LB, tel: 01334 476161
Salmon farming in Scotland	Chief Executive, Scottish Salmon Growers Association, Drummond House, Scott Street, Perth PH1 5EJ, tel: 01738 635420		
Shellfish farming in Scotland	Association of Scottish Shellfish Growers, Overton, 2a Manse Road, Roslin, Midlothian EH25 9LS, tel: 0131 440 2116		

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

9.3 Quarrying and landfilling

Scott Wilson Resource Consultants

9.3.1 Introduction

In this section, quarries are included as coastal if they are less than 2 km inland; all landfill sites are included as the whole of the region is in coastal 10 km squares. The minerals quarried in the region are igneous rock, sandstone, sand and gravel and talc. These are put to a variety of uses, including for roadstone and construction (igneous rock), concrete aggregate (igneous rock and sand and gravel), coating and fill (sand and gravel) and railway ballast (igneous rock).

In 1993 Shetland produced 5,000 tonnes of talc, the region's most important mineral product, representing the entire UK production total for that year. Production levels for igneous rock, sandstone and sand and gravel are not available, as this information is commercially sensitive because of the small number of operators in Shetland. **Table 9.3.1** presents production levels for Scotland for the main minerals quarried in the region, compared with British levels.

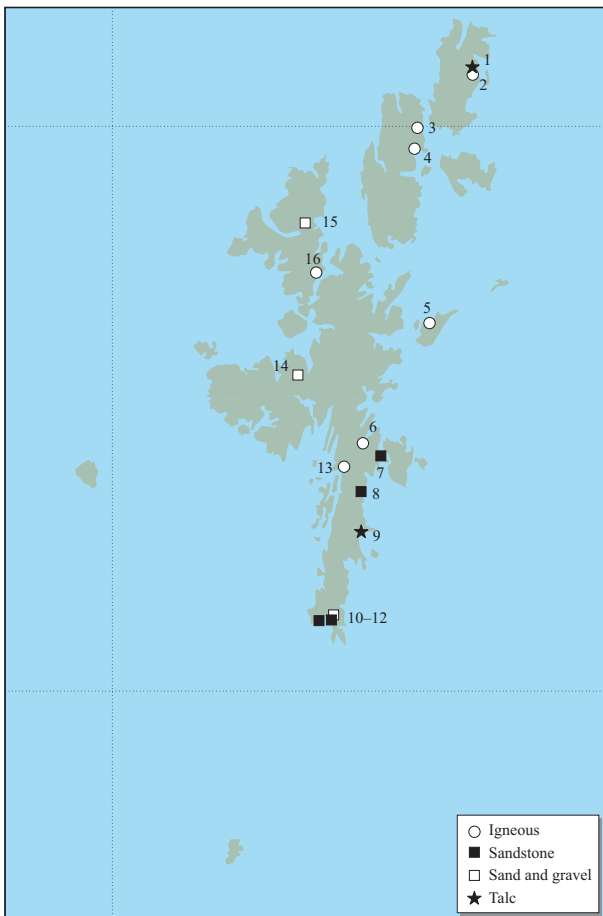
Table 9.3.2 shows the numbers of mineral workings in Shetland by type of mineral, compared with British totals (which include inland sites).

9.3.2 Important locations

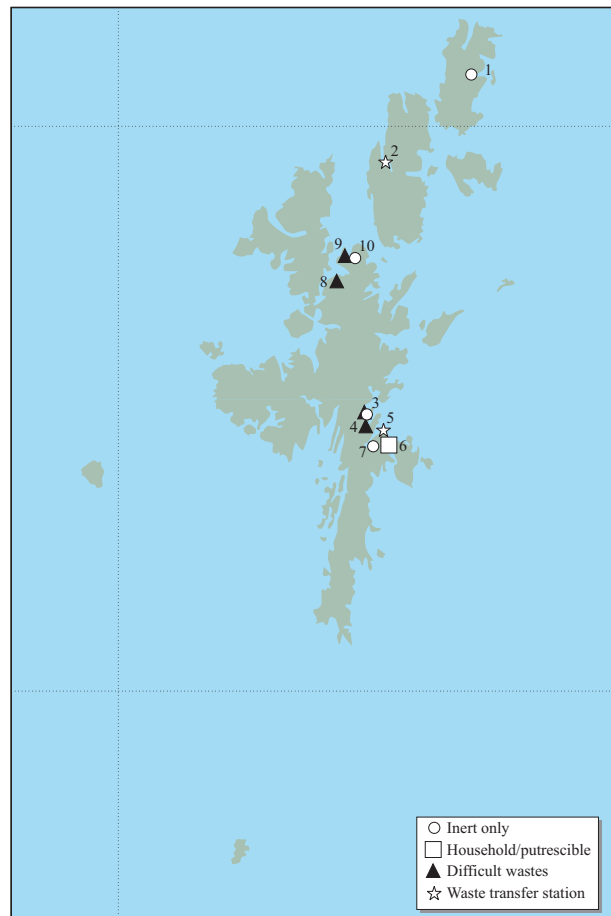
Coastal quarries in the region are listed in **Table 9.3.3** and shown on **Map 9.3.1**.

The region's currently-used landfill sites are shown on **Map 9.3.2** and listed in **Table 9.3.4**. All household and putrescible waste is shipped to Lerwick for incineration. Shetland and other island communities use different categories to describe waste in waste management licences from those used elsewhere in the UK, because of the difficulties of disposal. Oily waste found on beaches is disposed of either by incineration or by 'oil farming', when the oil is spread on the earth to be broken down by soil organisms.

Waste transfer stations (where waste is collected for disposal elsewhere) are located on Mid Yell, handling scrap cars, and at Rova Head, handling scrap metal and waste from offshore operators.



Map 9.3.1 Coastal quarries (**Table 9.3.3**). Sources: British Geological Survey (1994). © Crown copyright.



Map 9.3.2 Coastal landfill sites (**Table 9.3.4**). Source: Aspinwall & Co. (1994).

Table 9.3.1 Minerals production in Scotland (1993) in thousands of tonnes*

Area	Igneous rocks		Sand & gravel		Sandstone		Talc	
	Tonnes	% of GB total	Tonnes	% of GB total	Tonnes	% of GB total	Tonnes	% of GB total
Scotland	20,806	42.3	11,359	12.7	1,716	14.2	5	100
Great Britain	49,209	100	89,470	100	12,100	100	5	100

Source: Central Statistical Office (1994). Key: *amounts rounded up to the next whole thousand tonnes.

Table 9.3.2 Numbers of coastal workings in Shetland, compared with British (whole country) totals, by mineral type

Type of working	No. in Shetland	No. in Britain (including inland)
Igneous	7	236
Sandstone	4	No data
Sand and gravel	3	896
Talc	2	2
Totals	16	2,012

Source: British Geological Survey (1994).

9.3.3 Management

In April 1996 the Scottish Environment Protection Agency (SEPA) came into force, under the terms of the 1995 Environment Act. The region falls entirely within SEPA North Region. The new agency integrates the functions of several pre-existing authorities: Her Majesty's Industrial Pollution Inspectorate (HMIPI), the local Waste Regulation Authorities (WRAs) and the River Purification Authorities. Landfill site licensing is now the responsibility of SEPA, which is required to maintain public registers of waste management licences and resolutions. Waste management

licences were introduced by the Environmental Protection Act 1990 to replace the disposal site licences previously required by the 1974 Control of Pollution Act. Also within the Environment Act 1995 is the requirement for mine operators to give SEPA at least six months' notice of their intention to abandon a mine, in order that steps can be taken to avoid pollution from minewater. Also relevant to quarrying and landfilling are the provisions relating to producer responsibility for waste. These will provide a mechanism to ensure that business initiatives on re-using, recovering and recycling waste are not undermined by those seeking to avoid their obligations.

Planning for mineral extraction in Scotland is guided by *Land for mineral working* (National Planning Policy Guideline (NPPG) 4) (Scottish Office 1994). This notes that land-based sources are the main supply for aggregates in Scotland. Planning authorities are requested to maintain a minimum of a ten-year 'landbank' for minerals, i.e. a stock of planning permissions for the winning and working of minerals. Demand for aggregates in the UK is anticipated to rise to around 370-440 million tonnes in twenty years' time (Scottish Office 1996). The potential role of coastal superquarries (producing in excess of 5 million tonnes per year) in meeting this demand has been identified. In a 1992 report (Whitbread & Marsay 1992) the Department of the

Table 9.3.3 Coastal quarries in Region 1

Site no. on Map 9.3.1	Location	Grid ref.	Operator	Mineral
Unst				
1	Harold's Wick	HP6312	Alexander Sandison and Sons	Talc
2	Harold's Wick	HP6312	Alexander Sandison and Sons	Igneous
Yell				
3	Gutcher	HU5499	Hubert Dickie	Igneous
4	Sellafirth	HU5297	Shetland Islands Council	Igneous
Whalsay				
5	Brough	HU5565	H & H Plant	Igneous
Mainland				
6	Girlsta	HU4350	Garrick Quarries Ltd.	Igneous
7	Lerwick	HU4741	Keith Leslie	Sandstone
8	Lerwick	HU4741	Sullom Quarries	Sandstone
9	Cunningsburgh	HU4230	Rio Tinto - Shetland Talc Ltd	Talc
10	Quendale	HU3713	Garrick Quarries Ltd.	Sand and gravel
11	Quendale	HU3713	Garrick Quarries Ltd.	Sandstone
12	Exnaboe	HU4012	Martin Thompson	Sandstone
13	Scalloway	HU4140	Shetland Islands Council	Igneous
14	Bixter	HU3352	G.M. Johnston	Sand and gravel
15	Queyfirth	HU3482	Shetland Islands Council	Sand and gravel
16	Sullom	HU3472	Jeniva Landfill	Igneous

Source: British Geological Survey (1994).

Table 9.3.4 Status of the region's waste disposal sites

Site no. on Map 9.3.2	Location	Grid ref.	Type of waste disposal facility	Type of waste handled
	Unst			
1	Hagdale, Baltasound	HP638101	Landfill	Inert only
	Yell			
2	Mid Yell	HU509977	Waste transfer station	Scrap cars
	Mainland			
3	Girlsta Quarry	HU430504	Landfill/oil incinerator	Inert and oily wastes
4	North Tinwall	HU432483	Landfill	Oily wastes
5	Rova Head	HU470446	Waste transfer station	Scrap metal and offshore operators waste
6	Rova Head	HU475455	Landfill	Household/putrescible
7	Staney Hill Quarry	HU448422	Landfill	Inert only
8	Scatsta	HU402728	Oil incinerator	Oily wastes
9	Sullom Voe Terminal	HU402765	Landfill	Difficult wastes
10	Sullom Voe Terminal	HU404766	Landfill	Inert only

Source: Aspinwall & Co. (1994).

Environment speculated that there may be scope for five superquarries in Scotland, with the greatest potential being found on the north and west coasts. Regions considered suitable for the development of superquarries are listed in Scottish Office (1994) and include Shetland. However, Scottish Office (1994) notes that no more than four sites should be identified by 2009. The main environmental objection to development is likely to be the potential release of contaminated ballast water from transport ships, as has been the case with the proposed superquarry on the Isle of Harris (Region 15). It is thought that this could result in damage to the aquatic environment, including impacts on local fish farms. Landscape issues are also potentially important. A number of criteria have been devised to guide the selection of sites for superquarry development; these include minimising impacts to local interest and the natural heritage and assessing the potential benefits to the community (Scottish Office 1994).

Shetland Islands Council are currently reviewing their structure and local plans and are producing a series of working papers that are being released for public consultation. The revised structure and local plans incorporate plans for mineral and aggregate extraction (e.g. Shetland Islands Council 1993, 1994).

9.3.4 Information sources used

Data on quarrying were obtained from the *Directory of mines and quarries* (British Geological Survey 1994) and from *Business monitor (minerals)* (Central Statistical Office 1994), which are the most up to date and comprehensive information sources available. Additional information can also be gained from *NPPG4 Land for mineral working* (Scottish Office 1994). Data for quarrying in BGS (1994) may predate that publication date by up to three years and may therefore include information on some operations that have now ceased.

The data for landfilling were provided by Aspinwall & Co., from their *Sitefile Digest* on waste treatment and disposal (Aspinwall & Co. 1994), and Shetland Islands Council. The *Sitefile Digest* provided information from the

152 former Waste Regulation Authorities (WRAs) and represents the most up to date collection of public information on British waste management available at the time of writing (waste regulation is now the responsibility of SEPA). The Hazardous Waste Inspectorate produced summary statistics of waste disposal in Scotland between 1991 and 1992.

9.3.5 Acknowledgements

Thanks go to Dr Ron Moore and Susan Morley (Aspinwall & Co.) for providing information from the *Sitefile Digest*. Thanks are also due to Austin Taylor and Gwenan Hughes (Shetland Islands Council) and Clare Scanlan (SEPA) for comments on the draft text.

9.3.6 Further sources of information

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- Scottish Office. 1989. *Survey of aggregate working in Scotland. Collated results and commentary*. Edinburgh, Scottish Office Environment Department.

C. Contact names and addresses

<i>Type of information</i>	<i>Contact address and telephone no.</i>
General information on Scottish mining	British Geological Survey - Scottish Office, Murchison House, West Mains Road, Edinburgh EH9 3LA, tel: 0131 667 1000
British Directory of Mines and Quarries	Director, British Geological Survey, Keyworth, Nottingham NG12 5GG, tel: 0115 936 3100
Landfill sites (Sitefile Digest)	Senior Consultants, Aspinwall & Co., Walford Manor, Baschurch, Shrewsbury SY4 2HH, tel: 01939 262200
Waste regulation	*SEPA North Region HQ, Dingwall, tel: 01349 862021
Waste regulation	SEPA, c/o OIL Building, Grimister, Lerwick, Shetland ZE1 ONP, tel: 01595 696926
Local plans (including minerals planning)	*Shetland Islands Council, Lerwick, tel: 01595 744800182

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

9.4 Marine aggregate extraction, dredging and solid waste disposal at sea

Scott Wilson Resource Consultants

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, beach replenishment and soft coastal defences. The national demand for aggregate from all sources increased steadily during the 1980s, and marine aggregates satisfy an increasing proportion of the British requirement - 8.2% in 1992 (British Marine Aggregate Producers Association pers. comm.). A total of 26.1 million tonnes were dredged in Britain in 1995 under licence from the Crown Estate (Crown Estate 1996). Approximately 6.8 million tonnes of aggregate were exported to landing ports abroad, although the main market is in the south-east of England.

There is currently no commercial extraction of aggregate in this region and no aggregate was extracted under licence from the Crown Estate in Scottish waters or landed in Scottish ports in 1993 (Crown Estate 1995). Generally, prospecting for sand and gravel deposits in Scotland's waters has been unpromising, with only limited exploitable reserves being located, although some good quality gravels in shallow waters have been reported from reconnaissance surveys. Also, there is a lack of local demand for marine-based resources, local requirements being adequately met from land-based supplies (see also [section 9.3](#)). British Geological Survey sea-bed sediment sheets give an overview of potential resources (see also [section 2.2](#)), but in the absence of detailed company prospecting, these have not been verified.

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. Navigational dredging is the responsibility of individual harbour authorities and is carried out as required. Shetland's rivers are very small and there is consequently no significant down-river transport of silt. As a result, dredging is carried out only very occasionally and is undertaken only to deepen shipping berths etc. (Shetland Islands Council pers. comm.).

Between 1988 and 1993, there was a downward trend in the wet tonnage of dredged material deposited in the seas around the UK, from 44,305,995 tonnes in 1989 to 29,866,256 tonnes in 1993. However, this trend was reversed in 1994, when 35,962,835 tonnes were deposited around the UK. No dredged material was deposited at offshore sites in the region in 1994. However, there was some activity prior to 1994.

No sites are licensed for the disposal of solid industrial waste in Scottish waters. Other material deposited at sea under licence from the Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD) includes sewage sludge. The UK produces some 1.1 million tonnes



Map 9.4.1 Coastal disposal sites for dredged material. Source: SOAEFD (pers. comm.).

dry solids (tds) of sewage sludge annually and disposes of approximately 300,000 tds in the sea. However, no sewage sludge is deposited in this region.

9.4.2 Important locations

[Table 9.4.1](#) lists the main sites used for the disposal of dredged material in Shetland between 1990 and 1994, and the quantities of material disposed of at each site ([Map 9.4.1](#)).

9.4.3 Management and issues

Marine aggregates dredging

Marine sand and gravel are extracted by commercial mineral companies under licence from the Crown Estate.

Table 9.4.1 Amounts of dredged material disposed of at licensed sites in the region between 1990 and 1994

Location	MAFF code	Wet tonnages disposed of in:				1994	Water depth (m)	Distance from coast (km)
		1990	1991	1992	1993			
Symbister	FI060	0	0	0	0	0	35	1.6
Lerwick	FI080	19,075	0	0	0	0	35	0.5
Foula	FI100	0	6,574	0	0	0	20	0.6
North Haven	FI110	0	0	15,470	0	0	43	0.9

Source: SOAEFD (pers. comm.).

Aggregates from terrestrial sources are insufficient to meet UK demand (Doody *et al.* 1993), and dredging for marine aggregates tends to arouse less controversy than terrestrial extraction. So Government policy for the provision of aggregates, formulated in 1982 and 1989, has encouraged marine extraction of sand and gravel. 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).

The Scottish Office is currently considering changing 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 Scottish Office (Crown Estate 1994). As part of this process the Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD) undertakes an assessment of the potential effects of the proposed new aggregate extraction areas on the marine environment and on commercial fishery operations.

Solid waste (including dredged material) disposal

The primary legislation in force to control the disposal of solid waste, including dredged material, at sea in the UK is the Food and Environment Protection Act (1985) (Deposition at Sea and in Intertidal Areas). In this region, licences to deposit solid wastes, including sewage sludge and dredged material, at sea are issued by SOAEFD under that Act. Each licence is subject to certain conditions, which have become more stringent in the last few years. 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 also include within their scope disposal of solid wastes and dredged material at sea.

The main effect of the disposal of dredged material is blanketing of the sea bed, burying benthic flora and fauna and preventing respiration and feeding. Other impacts may include the elevation of metal concentrations originating from the deposited sediment. Localised increases in the turbidity of the water column may temporarily interfere with fish migration. Changes in sediment particle size can result in changes in benthic flora and fauna which, while not damaging in themselves, may affect the distribution of higher animals by altering the food chain. Shallows over banks of sediment can also be created, which could be a navigation hazard (Irish Sea Study Group 1990).

9.4.4 Information sources used

The statistics on marine aggregate extraction relate to

royalty returns to the Crown Estate (as owners of the sea bed). Data on the disposal of dredged material were provided by SOAEFD. MAFF publishes two annual Aquatic Environment Monitoring Reports. One reports on radioactivity in the marine environment, the other deals with non-radioactive pollution and waste disposal operations at sea (e.g. MAFF 1995). The latter gives details of the effects of the disposal of dredged material and other kinds of waste on the sea bed.

9.4.5 Acknowledgements

Thanks are due to M. Cox (Crown Estate) and R.J. Pearson (British Marine Aggregate Producers Association) for information on marine aggregate extraction. Dr C. Vivian (MAFF Fisheries Laboratory, Burnham-on-Crouch) provided information on waste disposal at sea.

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- Scottish Office. 1994. *Land for mineral working.* Edinburgh, Scottish Office. (National Planning Policy Guideline (NPPG) 4.)

C. Contact names and addresses

Type of information	Contact address and telephone no.
Navigational operations	Shetland Islands Council, Marine Operations, Port Administration Buildings, Sella Ness, Sullom Voe, Shetland ZE2 9QR, tel: 01806 242551
Waste regulation	*SEPA, Northern Region HQ, Dingwall, tel: 01349 862021
Waste regulation - Shetland	SEPA, c/o OIL Building, Grimister, Lerwick, Shetland ZE1 ONP, tel: 01595 696926
Offshore geoscience data including 1:250,000 maps of geology of coastline	*Director, British Geological Survey, Nottingham, tel: 01602 363100
Marine aggregate extraction	The Crown Estate, 10 Charlotte Square, Edinburgh EH2 4DR, tel: 0131 226 7241
Licensing of disposal at sea	*SOAEFD, Edinburgh, tel: 0131 556 8400
Marine dredging and disposal of sewage and dredged materials; scientific assessments of dredging and waste disposal	*SOAEFD Marine Laboratory, Aberdeen, tel: 01224 876544
Marine aggregate extraction: conservation issues	*SNH, Maritime Unit of Advisory Services, Edinburgh, tel: 0131 554 9797
Marine aggregate extraction	Secretary, British Marine Aggregate Producers Association (BMAPA), 156 Buckingham Palace Road, London SW1 9TR, tel: 0171 730 8194
Marine resource management (Managing Agents Offshore for The Crown Estate)	Technical Manager, Posford Duvivier, Eastchester House, Harlands Road, Haywards Heath, West Sussex RH16 1PG, tel: 01444 458551
Database of licensed disposal operations at sea	Head of Laboratory, Centre for Environment, Fisheries and Aquaculture Sciences, Remembrance Avenue, Burnham-on-Crouch, Essex CM0 8HA, tel: 01621 782658
Sand and gravel extraction	Director, Sand and Gravel Association (SAGA), 1 Bramber Court, 2 Bramber Road, London W14 9PB, tel: 0171 381 8778
Disposal of dredged material at sea - international	The Oslo and Paris Commissions, New Court, 48 Carey Street, London WC2A 2JE, tel: 0171 242 9927
Disposal of dredged material at sea - international	London Convention Secretariat, International Maritime Organisation (IMO), 4 Albert Embankment, London SE1 7SR, tel: 0171 735 7611

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

9.5 Oil and gas developments

Scott Wilson Resource Consultants

9.5.1 Introduction

Shetland is a major UK centre for oil and gas transhipment. Offshore fields exporting their production through Shetland were responsible for over 30% of the UK's oil production in 1995, when total UK continental shelf production reached a record of 220 million tonnes of oil equivalent and contributed about 2% of UK Gross Domestic Product (Department of Trade and Industry (DTI) 1996).

Map 9.5.1 shows oil and gas licensing blocks and oil and gas pipelines in inshore waters around Shetland. There are no blocks under licence on land or in the coastal waters of this region, but extensive areas are under licence further offshore, both east and west of Shetland (outside the area covered by Map 9.5.1). The 17th Offshore Oil and Gas Licensing Round is currently under way, and a total of 275 blocks were offered for licence on 21 November 1995, including 33 blocks north of Shetland. The closing date for the round was in March 1997.

9.5.2 Important locations

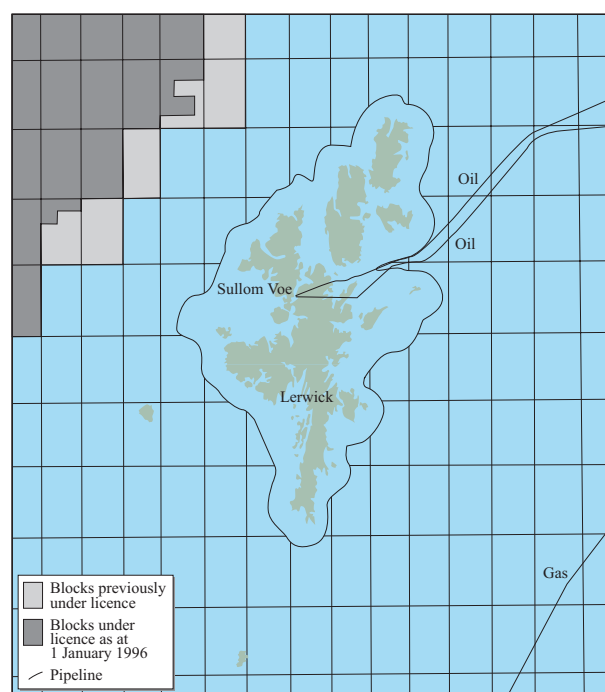
During 1995, fourteen exploration wells and nine appraisal wells were drilled in the west of Shetland area; no significant discoveries were announced. Four exploration wells east of Shetland produced three significant discoveries in the same year. In total, 98 exploration and appraisal wells were drilled in the UK continental shelf (UKCS) in 1995 and seven significant discoveries were announced (DTI pers. comm.).

Many fields that are in production east of Shetland, including the Brent Field, the first to be discovered (in 1971), and the Beryl Field, the first into production (in 1976), are linked by pipeline to Shetland. To the west of the region the Foinaven and Schiehallion fields are now under development, and production from them is scheduled to come onstream during 1997 and 1998 respectively (DTI pers. comm.). It is believed that production from the Schiehallion field will be routed through Shetland (D. Irvine pers. comm.).

All oil production presently reaching Shetland by pipeline arrives at the major oil terminal situated at Calback Ness, on the shores of Sullom Voe, approximately 30 miles north of Lerwick. Sullom Voe oil terminal is Europe's largest oil and liquefied gas exporting terminal, with a throughput of 40,569,604 tonnes of oil in 1992 and 350,497 and 248,164 tonnes of propane and butane respectively in 1991 (Shetland Islands Council 1993).

9.5.3 Management and issues

Licences for oil and gas exploration and production 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



Map 9.5.1 Oil and gas licensing blocks and infrastructure. Source: DTI (1994). © Crown copyright.

non-governmental organisations. A range of conditions may be applied, linked to the environmental sensitivity of the block, and a specific oil-spill contingency plan is required for every well as part of each consent application.

The range of potential issues for nature conservation is wide. The potential for oil spills to harm birds and marine and coastal wildlife is well known, especially in sheltered embayments. Spills may result from exploration and production procedures or from oil transportation. Fields east of Shetland have been developed using traditional platform and pipeline systems; west of Shetland developments will use floating production systems with offshore loading to tankers, and there is some concern about the pollution hazard that this may present. An Oil Spill Contingency Plan is produced by Shetland Islands Council (the operators of Sullom Voe Oil Terminal) and is reviewed and updated annually. Contingency plans are also produced by a number of other organisations, including Lerwick Harbour Trust and the operators of every exploration rig and production platform.

The most notable spillage of oil in this area occurred in Sullom Voe in late December 1978, when the oil tanker *Esso Bernicia* collided with a jetty, causing a large fuel oil spill, which damaged many bird species in Yell Sound (Heubeck & Richardson 1980). Some, but not all, species in Yell Sound have recovered (Heubeck 1989), and enhanced anti-pollution surveillance and tanker-handling procedures have meant that there have been no major incidents subsequently (Richardson *et al.* 1982). In January 1993 the *MV Braer* was wrecked on the southern tip of Mainland, releasing 80,000 tonnes of light crude oil into the sea. Luckily the type of oil

and weather conditions meant that the oil did not linger long on the water surface or the shores. Spills can also occur from non-tanker shipping movements, and the majority of samples of oil collected from Shetland beaches appear to come from wastes from the bilges or fuel tanks of ships.

Concern has also been expressed about the potential risk to seals and dolphins of oil-related developments in the region. There is a small risk of injury to marine mammals in the immediate vicinity of a vessel conducting seismic surveys (see also sections 5.14 and 5.15). The air-gun arrays used in seismic surveys generate high levels of low frequency sound, most of which is outside the known hearing range of seals and is unlikely to disturb them. In the case of cetaceans, results obtained during seismic surveys by Marathon Oil UK Ltd and BHP Petroleum Ltd in the Irish Sea were inconclusive (Evans *et al.* 1993). Nevertheless recent studies indicate that cetaceans may be disturbed by seismic surveying, as they are sighted less frequently, either acoustically or visually, during seismic surveys (Goold 1996). Best practice environmental management guidance for carrying out seismic surveys in areas where marine mammals occur, without compromising safety or operational viability, is among environmental issues considered in UKOOA's *Environmental guidelines for exploration operations in near-shore and sensitive areas* (UKOOA 1994). Licensees and their contractors are required by the DTI to conduct seismic exploration in accordance with Department of the Environment's *Guidelines for the minimisation of acoustic disturbance to small cetaceans* (DOE undated).

9.5.4 Information sources used

Data included in this section come from the DTI's 'Brown Book' (DTI 1996), which should be referred to for further explanation. It is updated annually.

9.5.5 Acknowledgements

Thanks are due to C. Harding and K. Walford (DTI) and to D. Irvine (Shetland Islands Council) for comments on the draft.

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C. Contact names and addresses

<i>Type of information</i>	<i>Contact address and telephone no.</i>	<i>Type of information</i>	<i>Contact address and telephone no.</i>
Oil and gas developments	Public Relations Officer, Department of Trade and Industry, 1 Palace Street, London SW1E 5HE, tel: 0171 215 5000	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
Oil and gas licensing	Oil and Gas Division - Exploration and Licensing Branch, Department of Trade and Industry, 1 Victoria Street, London SW1H 0ET, tel: 0171 215 5000	Response (privately-funded) to oil spills worldwide	Oil Spill Response, Oil Spill Service Centre, Lower William St, Northam, Southampton SO14 5QE, tel: 01703 331551
Oil and gas production	Oil and Gas Division - Development and Production Branch, Department of Trade and Industry, Atholl House, 86-88 Guild Street, Aberdeen AB11 6AR, tel: 01224 254000	Research into oil pollution	Oil Pollution Research Unit, Fort Popton, Angle, Pembroke, Dyfed SA71 5AD, tel: 01646 641404
Oil and gas industry issues	Public Relations Officer, UK Offshore Operators Association, 3 Hans Crescent, London SW1X 0LN, tel: 0171 589 5255	Advice on oil pollution strategies worldwide	International Tanker Owner's Pollution Federation Ltd, Staple Hall, Stonehouse Court, 87-90 Houndsditch, London EC3A 7AX, tel: 0171 621 1255
Oil transportation and terminals	Technical Adviser, Oil Companies International Marine Forum (OCIMF), 15th Floor, 96 Victoria Street, London SW1E 5JW, tel: 0171 828 7966	Effects of gas and oil exploitation on the marine environment	*SOAEFD, Development Department, Edinburgh, tel: 0131 244 0213
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	Guidelines on the environmental protection of offshore waters	*SOAEFD Marine Laboratory, Aberdeen, tel: 01224 876544
Gas industry	Director and Secretary, Society of British Gas Industries, 36 Holly Walk, Leamington Spa, Warwickshire CV32 4LY, tel: 01926 334357	Licensing the use of oil spill dispersants	Marine Environment and Wildlife Branch, SOAEFD, Pentland House, 46 Robbs Loan, Edinburgh EH14 1TW, tel: 0131 244 6232
Shetland Oil Terminal Environmental Advisory Group (SOTEAG)	Executive Secretary, SOTEAG, AURIS Ltd., Aberdeen University, 23 St Machar Drive, Aberdeen AB24 3RY, tel: 01224 272884	Effects of gas and oil exploitation on the marine environment	Head of Laboratory, Centre for Environment, Fisheries and Aquaculture Sciences, Remembrance Road, Burnham-on-Crouch, Essex CM0 8HA, tel: 01621 782658
Shetland Oil Spill Contingency Plan	Shetland Islands Council, Marine Operations, Port Administration Buildings, Sella Ness, Sullom Voe, Shetland ZE2 9QR, tel: 01806 242551	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
Oil spills in Lerwick Harbour - contingency plans	Lerwick Harbour Trust, Albert Building, The Esplanade, Lerwick, Shetland ZE1 0LL, tel: 01595 692991	Acoustic disturbance guidelines	*Department of the Environment, European Wildlife Division, tel: 0117 987 8291
Reporting of oil pollution - Shetland	SEPA, c/o OIL Building, Grimister, Lerwick, Shetland ZE1 ONP, tel: 01345 737271	Information on the environmental effects of exploration and production	*SNH, Maritime Unit of Advisory Services, Edinburgh, tel: 0131 554 9797
		Information on the environmental effects of exploration and production	*Marine Advisor, JNCC HQ, Peterborough, tel: 01733 62626
		Oil spills and birds - Shetland	RSPB, East House, Sumburgh Head Lighthouse, Virkie, Shetland ZE3 9JN, tel: 01950 460800

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

9.6 Water quality and effluent discharges

Scott Wilson Resource Consultants

9.6.1 Introduction

This section summarises information about water quality and effluent discharge from a number of sources. Solid waste 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.

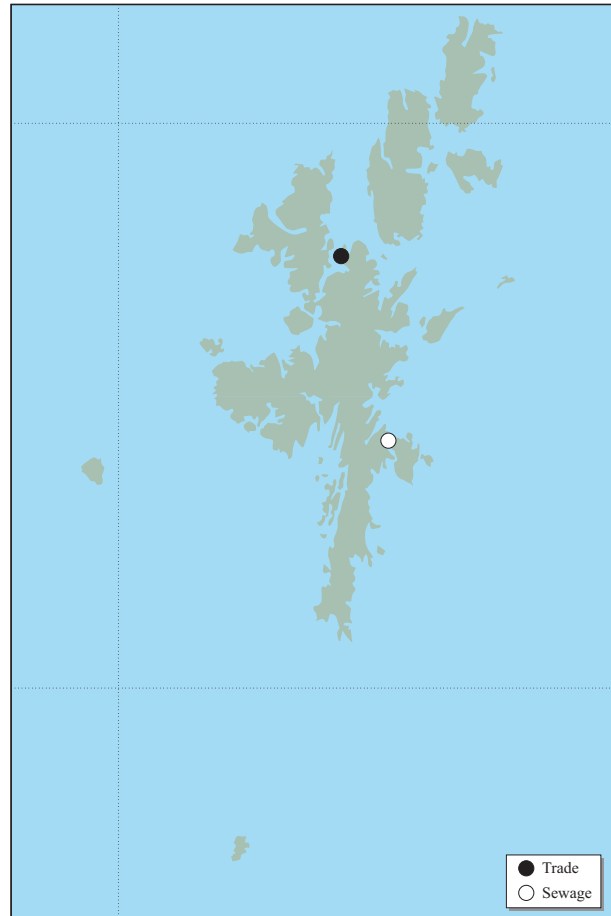
Waste products and effluents containing contaminants reach the marine environment in this region in a number of ways: sewage, agricultural run-off and trade effluents are discharged from outfalls into watercourses or directly into the sea, and contaminants can reach the sea by airborne means, for example aerosols and rain. Industrial pollutants can enter the marine environment under licensed discharge or by accidental release. There are two effluent outfalls in the region with maximum consented daily flows in excess of 1,000 m³ per day, one trade and one sewage (Scottish Environment Protection Agency (SEPA) pers. comm.).

There are 472 EU-identified Bathing Waters (those that are tested for certain standards of quality under the Bathing Water Directive (76/160/EEC)) around the UK coast but none in this region. One of the criteria used to identify EU Bathing Waters relates to the number of people using each beach per day, and because of the small population of Region 1 and its isolated location, the numbers of bathers do not reach the required levels for monitoring. However, random sampling of bacteria levels in the waters around Shetland have shown all samples to meet the mandatory standards required by the Directive. The 1995 data for the UK as a whole, assessed by DOE in accordance with the Bathing Water Directive, show a slight increase in compliance (89%) with the mandatory standards, compared with 1994 (82%). There are also no Blue Flag Beaches or Tidy Britain Group Seaside Award Beaches.

No beach quality monitoring is undertaken in the region, but beach litter is a major problem (J. Uttley pers. comm.). In May each year, Shetland Amenity Trust organises a beach litter clean-up, known as 'Da Voar Redd Up', which uses volunteer labour.

9.6.2 Important locations

The single major sewage outfall in the region with a consented daily flow greater than 1,000 m³ is shown on [Map 9.6.1](#). It discharges at Rova Head, Lerwick, and has a maximum dry weather flow of 1,650 m³ per day. Sewage treatment at present is limited to coarse screening and maceration of the effluent; under the Urban Waste Water Treatment (UWWT) Plan, the level of treatment will need to be upgraded by 2002 (SEPA pers. comm.). The only major trade effluent outfall in the region, at Calback Ness, with a maximum consented daily effluent flow of 60,000 m³, discharges treated ballast water from Sullom Voe oil terminal ([Map 9.6.1](#)).



Map 9.6.1 Consented sewage and trade effluent outfalls. Map shows all outfalls with consented flows greater than 1,000 m³/day. Source: SEPA (pers. comm).

9.6.3 Management and issues

A range of legislation is in force to control discharges to the aquatic environment. The primary statute in Scotland is the Control of Pollution Act 1974 as amended by the Water Act 1990. Consents to discharge from 'prescribed processes', including trade effluent, must be authorised by SEPA under the Environmental Protection Act 1990. Environmental Quality Standards (EQSs) for many of the substances are specified in the Environmental Protection (Prescribed Processes etc.) Regulation 1991. The EQSs may be set by the EU (under the Dangerous Substances Directive 76/464/EEC and Framework Directive 86/280/EEC) or nationally (Department of the Environment Circular 7/89, March 1989). Discharges from nuclear installations are licensed by SEPA under the Radioactive Substances Act 1993. Their effect on the aquatic environment is monitored by SOAEFD.

Under the Urban Waste Water Treatment Directive (91/271/EEC) all significant sewage discharges 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 authorities, show that there will be no adverse effects on the environment. The majority of outfalls in this region are extremely small, being septic tank outputs from domestic premises.

9.6.4 Information sources used

Monitoring of water quality in the region is carried out by SEPA and SOAEFD, with SEPA concerned mainly with point sources of contamination from outfalls in the nearshore environment. The interests of SOAEFD lie in the disposal of sewage sludge and dredge spoil further offshore and their possible effects on fisheries; they carry out a wide range of associated sampling work. SEPA and SOAEFD 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.

SEPA also has coastal and estuarine classification schemes based on a range of parameters, results of which are published in SEPA (formerly River Purification Board) annual reports. Every five years a national classification is published by the Scottish Office (e.g. Scottish Office 1992). Further information on discharges can be obtained from the local offices of SEPA, who issue discharge consents and authorisations.

The Department of the Environment (DoE) Environmental Protection Statistics Division publishes an annual *Digest of environmental statistics* (e.g. Department of the Environment 1996), which provides detailed national statistics on aspects of environmental protection, including coastal and marine waters, radioactivity, waste and recycling, and wildlife. MAFF publishes two annual Aquatic Environment Monitoring Reports (e.g. MAFF 1994, 1995). One reports on radioactivity in the marine environment, the other deals with non-radioactive pollution and waste disposal operations at sea.

9.6.5 Acknowledgements

Thanks are due to Dave Okill (SEPA Shetland Area Office) for providing information on trade and sewage effluent outfalls in the region, and to John Uttley (SNH), Clare Scanlan (SEPA) and Mark Tasker (JNCC) for comments on the text.

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- Schultz-Bull, D.E., Petrick, G., & Duinker, J.C. 1991. Polychlorinated biphenyls in North Sea water. *Marine Chemistry*, 36: 365-384.

C. Contact names and addresses

Type of information	Contact address and telephone no.
Discharge consents and database, coastal water quality and sewage treatment	*SEPA, Northern Region HQ, Dingwall, tel: 01349 862021
Discharge consents and database, coastal water quality and sewage treatment - Shetland	SEPA, c/o OIL Building, Grimister, Lerwick, Shetland ZE1 ONP, tel: 01595 696926
Da voar redd up (The spring clean)	Shetland Amenity Trust, 22-24 North Road, Lerwick ZE1 0QD, tel: 01595 694688
Environmental research and scientific assessment of water quality in Scotland	*SOAEFD Marine Laboratory, Aberdeen, tel: 01224 876544
Aquatic environmental research and monitoring related to water quality and waste disposal at sea: national issues	Head of Laboratory, Centre for Environment, Fisheries and Aquaculture Sciences, Remembrance Avenue, Burnham-on-Crouch, Essex CM0 8HA, tel: 01621 782658

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



There are at least fifteen marinas in Shetland, and more than 20 harbours, anchorages and other moorings. Although the weather in winter makes sailing inadvisable, in the summer months increasing numbers of yachts visit the islands: around 500 visiting yachts used Lerwick and Scalloway harbours in 1995, compared with just over 100 in 1981. Photo: Lorne Gill, Scottish Natural Heritage.

9.7 Leisure and tourism

S.J. Everett

9.7.1 Introduction

Land-based leisure infrastructure on the British coast commonly includes golf courses, caravan parks and campsites, rural car parks (which provide necessary access points for land and water-based leisure activities) and leisure parks. However, many of these types of infrastructure and activity are absent in Shetland, which has a small population and an isolated location. Access by tourists is relatively difficult and expensive and there are relatively few tourists in comparison with other parts of the UK. In 1994 the total number of visitors (including business visitors) to Shetland was estimated as 54,000 (Shetland Islands Council 1996) and there are about 1,700 bed spaces in total.

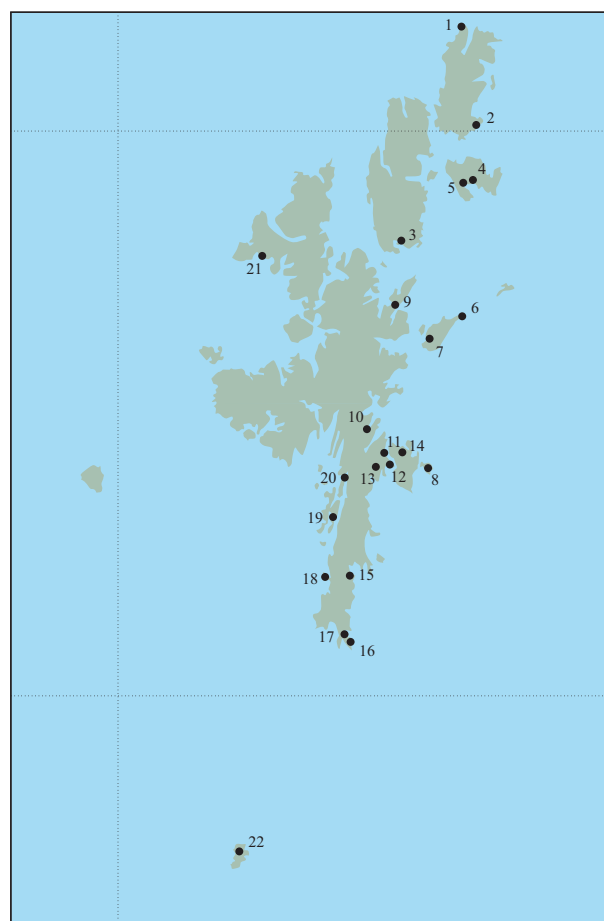
Land-based tourism in this region relies on the islands' reputation for wild landscapes, historical and archaeological sites and spectacular seabird colonies. The most widespread visitor activity is walking on beaches and cliffs (A. Taylor pers. comm.), often combined with another interest such as ornithology, botany or cetacean-watching. Water-based activities undertaken along the coast include sailing, sub-aqua and angling.

9.7.2 Important locations

The main land-based leisure sites are listed in [Table 9.7.1](#) and numbered sites are shown on [Map 9.7.1](#). There are three small caravan parks/camping sites adjacent to the coast of the region, and at least four nine-hole golf courses, as well as a number of museums and visitor centres at sites of natural or historical interest.

Bird watching and natural history are major Shetland tourist attractions, with most visits being informal. The Fair Isle Bird Observatory has hostel-type accommodation for visiting birdwatchers and the National Nature Reserve on the Isle of Noss has a visitor room with an exhibition. A hide for viewing red-necked phalaropes *Phalaropus lobatus* is sited on the RSPB Fetlar Nature Reserve. The Sumburgh Head RSPB Nature Reserve has a car park and interpretative signs and offers opportunities to view seabirds and cetaceans. Sites of archaeological and historical interest and museums are distributed around Shetland (see [Chapter 6](#)). One of the main archaeological attractions is the ancient settlement of Jarlshof (located at the southern tip of Mainland), where there is a visitor centre.

Important water-based leisure locations, such as marinas, harbours and anchorages, are listed in [Table 9.7.2](#). Marinas are becoming increasingly popular; in September 1996 there were fifteen operating, and a further five with outstanding planning permission (at Burravoe, East Voe, Gruting, Trondra and Skeld). At least one berth is retained in each marina for visiting yachts. Visitors also use anchorages in over a dozen locations on the sheltered channels through the islands. Around 500 visiting yachts were counted in Lerwick and Scalloway Harbours in 1995,



Map 9.7.1 Locations of land-based leisure and tourism. Source: Ordnance Survey Landranger maps and Shetland Islands Tourism pers. comm. © Crown copyright.

compared with just over 100 in 1981. Due to the harsh winter weather conditions, yachts are advised not to visit Shetland between October and March. Local boat clubs are located at Sandwick, Walls, Scalloway, Aith, Tresta, Skeld (Reawick and District), Whiteness and Weisdale on West Mainland; Ness (South Mainland); Scalloway, Burra (Hamnavoe), South Nesting (Central Mainland); and at Lerwick. As well as sailing, canoeing is a popular activity, and there is a windsurfing club based in Brae.

9.7.3 Management and issues

Shetland Islands Tourism markets Shetland as a tourist destination and produces an annual tourist guide, a list of holiday accommodation and a general tourist brochure. The work of the Shetland Islands Council and the Area Tourist Board is supported by national agencies and other specific-purpose bodies. The Scottish Tourist Board is the agency responsible for the marketing of tourism in Scotland, with Scottish Enterprise responsible for tourism development. The Scottish Sports Council is the national body responsible for the promotion of sport and physical

Table 9.7.1 Land-based leisure and tourist facilities

No. on Map 9.7.1	Site	Grid ref.	Notes
	Unst		
1		HP6018	Hermaness National Nature Reserve and visitor centre
2		HP6201	Muness Castle Two museums (heritage centre, boat haven), golf course
	Yell		
3		HU5279	Museum
	Fetlar		
4		HU6290	RSPB nature reserve with permanent warden
5		HU6190	Museum Caravan and campsite
	Whalsay		
6		HU6066	Golf course
7		HU5362	Museum
	Isle of Noss		
8		HU5440	National Nature Reserve with visitor room and exhibition
	Mainland		
9	Lunna Kirk	HU4869	Ancient church
10	Veensgarth	HU4244	Museum
11	Gremista	HU4643	Museum
12	Lerwick	HU4741	Museum
13	Lerwick	HU4641	Camp site, caravan site
14	Bressay	HU4942	Golf course
15	Levenwick	HU4021	Caravan site, campsite
16	Sumburgh Head	HU4008	RSPB nature reserve
17	Sumburgh	HU4009	Jarlshof settlement and visitor centre
18	St Ninian's Isle	HU3620	Ancient church
19	South Voe	HU3732	Croft house museum
20	Scalloway	HU4039	Museum, castle, golf course
21	Tangwick Haa	HU2377	Museum
22	Fair Isle	HZ2172	Fair Isle Bird Observatory

Source: Ordnance Survey & Hamlyn (1995), Pemberton (1994).

recreation in Scotland. Scottish Natural Heritage has a statutory duty to facilitate the enjoyment of the countryside and to promote recreation with regard to the conservation of Scotland's natural heritage.

Shetland Islands Council prepared a Tourism Development Plan in 1984, with the main objective of increasing the income generated by tourism. The Council intends to continue the development of Shetland as a tourist destination. The West, South and Central Local Plan (Shetland Islands Council 1992) undertakes to consider tourist development proposals favourably, provided that they do not seriously detract from the amenities, nature conservation interests or character of the area concerned.

Whilst public access to the coast is not generally intensive, visitor pressure is a potential problem at some sensitive sites. At present, visitor pressure requires management only at Hermaness, but a watching brief is maintained at other sites.

9.7.4 Information sources used

Information on land-based leisure is derived from tourist brochures (e.g. Shetland Islands Tourism 1996) and Ordnance Survey & Hamlyn (1995). Information on water-based leisure was derived from Admiralty Charts and from a nautical almanac (D'Oliveira & Featherstone 1993).

Although still under development, the Scottish Sports Council database holds information about the geographical distribution of activities throughout Scotland. Coverage of sports and geographical areas is not yet uniform.

9.7.5 Acknowledgements

The author wishes to thank Peter Ellis (RSPB), Austin Taylor (Shetland Islands Council) and Alison Leith (Shetland Islands Tourism) for comments on the draft.

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Table 9.7.2 Important locations for water-based leisure activities

<i>Site</i>	<i>Grid ref.</i>	<i>Facilities</i>
Baltasound, Unst	HP6209	Harbour; marina; anchorage off wharf
Basta Voe, Yell	HP5197	Anchorage above shingle bank
Mid Yell Voe, Yell	HP5191	Anchorage; pier on south side
Cullivoe, Yell	HP5402	Marina
Mid Yell	HU5191	Marina
Dales Voe, Mainland	HU4370	Anchorage
Colla Firth, Mainland	HU4469	Anchorage; pier at Colla Firth, marina
Vidlin	HU4865	Marina
Out Skerries	HU6871	Marina
Symbister, Whalsay	HU5362	Marina
Cat Firth, Mainland	HU4552	Anchorage
Lerwick, Mainland	HU4643	Yacht berths without facilities in harbour; Lerwick Boating Club, marina
Bressay	HU4941	Marina
Aith Voe	HU4428	Marina
Pool of Virkie	HU4011	Marina
Hamnavoe, West Burra	HU3635	Pier; anchorage
Scalloway, Mainland	HU4039	Anchorage; harbour; two piers; slipway; jetty; Scalloway Boating Club; yacht marina; 19 yachts visited in 1995.
Gruting Voe, Mainland	HU2547	Anchorage in main voe, Browland, Seli & Scutta Voes
Vaila Sound, Mainland	HU2347	Anchorage north of Salt Ness
Walls	HU2449	Marina
Aith Voe	HU3458	Marina
Roe Sound	HU3366	Marina
Swarbacks Minn, Mainland	HU3557	Anchorage in voes and islands including Uyea Sound
Olna Firth, Mainland	HU3765	Anchorage
Sullom Voe, Mainland	HU3773	Anchorage in voe above 'The Narrows'
Urafirth, Mainland	HU2978	Anchorage in Firth and Hamar Voe
North Haven, Fair Isle	HZ2272	Mooring alongside pier; anchorage offshore

Source: D'Oliveira & Featherstone (1993).

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- Royal Yachting Association. 1992. *Annual directory of RYA affiliated organisations*. Romsey, RYA.

C. Contact names and addresses

Type of information	Contact address and telephone no.	Type of information	Contact address and telephone no.
Tourist information - Scotland	Scottish Tourist Board, 23 Ravelston Terrace, Edinburgh EH4 3EU, tel: 0131 332 2433	Golf	Secretary, Scottish Golf Union, The Cottage, 181a Whitehouse Road, Edinburgh EH4 6BY, tel: 0131 339 7546
Tourist information centre - Shetland	Shetland Islands Tourism, Market Cross, Lerwick, Shetland ZE1 0LU, tel: 01595 693434	Horse riding	Secretary, The Trekking and Riding Society of Scotland, Boreland Riding Centre, Fearnan, Aberfeldy PH15 2PG, tel: 01887 830274
Fair Isle Bird Observatory	Fair Isle, Shetland ZE2 9JU, tel: 01595 760258	Sailing, yachting and windsurfing	Royal Yachting Association, Scottish Region, Caledonia House, South Gyle, Edinburgh EH12 9DQ, tel: 0131 317 7388
Sumburgh Head RSPB reserve	RSPB, East House, Sumburgh Head Lighthouse, Virkie, Shetland ZE3 9JN, tel: 01950 460800	Sub-aqua	Scottish Sub-Aqua Club, Administrative Secretary, Cockburn Centre, 40 Bogmoor Place, Glasgow G51 4TQ, tel: 0141 425 1021
Recreation pressures on nature conservation interests	*SNH, Edinburgh, tel: 0131 554 9797	Surfing	Secretary, Scottish Surfing Federation, c/o Royal Yachting Association, Scottish Region, Caledonia House, South Gyle, Edinburgh EH12 9DQ, tel: 0131 317 7388
Sports facilities including computerised maps of sea- and land-based leisure activities	Scottish Sports Council, Caledonia House, South Gyle, Edinburgh EH12 9DQ, tel: 0131 317 7200	Water skiing	Scottish Water Ski Association, Development Officer, Scottish Water Ski Centre, Town Loch, Town Hill, Dunfermline KY12 0HT, tel: 01383 620123
Marine leisure industries; small craft marine industries	British Marine Industries Federation, Meadlake Place, Thorpe Lea Road, Egham, Surrey TW20 8HE, tel: 01784 473377	Wildfowling (general, including details of affiliated clubs)	Director, The British Association for Shooting and Conservation, Scottish Centre, Trochry, Dunkeld PH8 0DY, tel: 01350 723226
Leisure activities		Wildfowling (the sport)	Press and Information Officer, British Field Sports Society, 59 Kennington Road, London SE1 7PZ, tel: 0171 928 4742
Angling	Scottish Anglers National Association, Caledonia House, South Gyle, Edinburgh EH12 9DQ, tel: 0131 339 8808	Yacht harbours	The Yacht Harbour Association, Hardy House, Somerset Road, Ashford, Kent TN24 8EW, tel: 01303 814434
Board sailing	UK Board Sailing Association, PO Box 28, Fareham, Hants PO14 3XD, tel: 01329 664779	Forum for organisations interested in countrysideaccess	Scottish Countryside Activities Council, c/o Harold Wilkinson, 23 Lochardil Place, Inverness IV2 4LN, tel: 01463 235720
Camping	Secretary, The Camping and Caravanning Club (Scottish Region), 70 Douglas Road, Longniddry, East Lothian EH32 0LJ, tel: 01875 853292		
Canoeing	Administrator, Scottish Canoe Association, Caledonia House, South Gyle, Edinburgh EH12 9DQ, tel: 0131 317 7314		
Field Sports	Secretary, British Field Sports Society (Scottish Branch), Green Burns, Coupar, Angus PH13 9HA, tel: 01828 27015		

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

Chapter 10 Coastal management

S.J. Everett & S.L. Fowler

10.1 Introduction

This chapter describes national (section 10.2) and regional (section 10.3) coastal management initiatives taking place wholly or partly within Region 1. International, GB and UK national initiatives without a specific regional focus, notably those led by non-governmental agencies and user groups, are outside the scope of this chapter. However, as the whole chapter concludes with a list of contacts with a wider involvement or interest in coastal management (section 10.3.6C), contact points for some of these organisations are included there. In addition, names and addresses of regional contacts are given in Table 10.3.1.

10.1.1 Coastal zone management in the UK

This section outlines the direction of UK 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). Integrated coastal management is designed to ensure that all land and sea use issues are co-ordinated, including development, conservation, waste disposal, fisheries, transport, 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 zone management. However, approaches differ from area to area, with overlap in some places and patchy coverage elsewhere (Earll 1994; King & Bridge 1994).

The House of Commons Environment Committee Second Report (House of Commons 1992), although limited in scope to England and the estuaries it shares with Wales and Scotland, made recommendations for the planning and implementation of coastal management that have had policy and practical implications throughout the UK. Amongst the Environment Committee’s recommendations were:

- the endorsement of an integrated approach to coastal management, incorporating maritime land, sea and intertidal areas;
- a review of existing legislation;
- the need for international (EU-wide) policy initiatives;
- clearer responsibilities for planning and action in the coastal zone, based on a national strategic framework;

- appropriate funding for accountable bodies with responsibilities;
- research into the physical functioning of the coastal zone and associated protection and conservation measures;
- a review of planning mechanisms to allow effective safeguard of the coastal resource;
- monitoring and environmental assessment of coastal activities to assess their impacts;
- the involvement of local communities in coastal 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.

Strategic planning guidelines for the Scottish coast were first set out in Scottish Development Department (1974), based on a series of maps published in Skinner (1974). These guidelines were updated by Scottish Development Department (1981) to cover most of the major developments for port, industrial and power generation purposes. More recently, the Scottish Office has commissioned a review of Scottish coastal issues (Burbridge & Burbridge 1994). This review urges the development of new coastal planning policies and guidelines to deal with the integration of coastal resource-based activities at the local and regional level. The report suggests that these should support planning authorities in dealing with planning applications and advise on the production of local and regional coastal management plans and strategies. It also suggests the promotion of a national strategy for the sustainable development and management of coastal land and water resources.

The Burbridge report of 1994 was followed up with the publication of a discussion paper *Scotland’s coasts* (Scottish Office Agriculture, Environment and Fisheries Department 1996). This provides a summary of Scottish coastal issues and identifies a range of actions that should be taken or investigated for the purposes of achieving sustainable management of the coast and its resources. The government proposed the establishment of a Scottish Coastal Forum, similar to those that have already been established in England and Wales (Scottish Office Agriculture, Environment and Fisheries Department 1996). The Scottish Coastal Forum was announced in November 1996 and comprises representative bodies with a major interest or responsibility in coastal zone issues; it will provide a national context for coastal zone management planning.

In 1994, the UK Government published its Regulations to implement the EC Habitats & Species Directive

(Department of the Environment 1994). Guidance on implementation of the regulations in Scotland is given in the Scottish Office Environment Department Circular 6/95 (Scottish Office 1995). As they relate to the coast, these regulations provide for single management groups to be set up for whole sites, making the production of unified management plans a practical proposition. Where these sites are of European importance for their nature conservation interest, the conservation of that interest must be the primary consideration of the management plan. For this, the regulations require all relevant authorities to exercise a general duty of care for their long-term conservation. At the time of writing, discussions are continuing on how these requirements will work in practice (see also [section 10.2.7](#)).

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 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.

In 1995 the Local Government Management Board issued 'Roundtable Guidance' on the implementation of Local Agenda 21 on the coast (Local Government Management Board 1995).

10.2 National coastal initiatives with regional elements

10.2.1 Introduction

Partly as a result of developments at UK and international level, many 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 zone 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 10.2.6](#)). The National Trust for Scotland has recently been carrying out a complete review of its Coastal Strategy Plans and has an ongoing review of coastal site management plans. Only national initiatives that have distinct local elements in the region are described here. Many other diverse interest groups and organisations now have national policies with regard to coastal management and estuaries management, for example the British Association for Shooting and Conservation and the Royal Yachting Association. Regionally-led coastal management initiatives are dealt with in [section 10.3](#).

10.2.2 The Scottish Coastal Forum

The Scottish Coastal Forum, which was put forward in the discussion paper *Scotland's coasts* (Scottish Office Agriculture, Environment and Fisheries Department 1996), was announced in November 1996. A wide range of organisations with interests in coastal matters will be invited to participate in the Scottish Coastal Forum, including representatives from the Association of Shellfish Growers, Confederation of British Industry Scotland, CoastNET, Convention of Scottish Local Authorities, Crown Estate, Highlands and Islands Enterprise, Scottish Enterprise, Scottish Environment Protection Agency, Scottish Fishermen's Federation, Scottish Natural Heritage,

Scottish Salmon Growers' Association, Scottish Sports Council, Scottish Tourist Board, Scottish Wildlife and Countryside Link and the Scottish Office. The Forum will provide a focus for coastal issues as well as a national context for the work of local coastal forums.

10.2.3 Scottish Environment Protection Agency (SEPA)

The Scottish Environment Protection Agency was established under the Environment Act 1995. It carries out the functions of the former River Purification Boards with respect to water resources, water pollution, enforcement of legislation in relation to releases of substances into the environment and flood warning systems. It has also been assigned the waste regulation and disposal functions formerly the responsibility of the local authorities and other functions with respect to pollution control, and must be consulted over land drainage proposals to controlled waters. It does not, however, have responsibilities for flood and coastal defence, unlike the Environment Agency (England and Wales). Unlike in England and Wales, there is currently no system of Integrated Catchment Management planning (see Macaulay Land Use Research Institute 1995) in Scotland, although there is widespread support that this approach should be pursued.

10.2.4 Scottish Natural Heritage

Focus on Firths

The major national coastal management initiative currently under way in Scotland is 'Focus on Firths', instigated by Scottish Natural Heritage (SNH). It aims to promote the protection and better management of the natural resources of the major Scottish estuaries and firths by stimulating

understanding and voluntary co-operation among the various users and statutory authorities. A local management forum will be set up for each site, made up of statutory, industrial, voluntary agencies and community representatives as appropriate, to develop proposals for its sustainable management. In Scotland there are currently five coastal zone management initiatives, three of which, covering the Solway Firth, the Firth of Forth and the Moray Firth, are included in the Focus on Firths Initiative; the other two, for the Cromarty Firth and the Firth of Clyde, are partly funded by SNH under that initiative. A proposal for a Tay project is under development. There are no Focus on Firths projects in this region..

10.2.5 CoastNET: the Coastal Heritage Network

CoastNET was established in 1995 to link individuals and organisations working for the sustainable management of the coastal and marine environment, building on the achievements of its predecessor, the Heritage Coast Forum. CoastNET aims to provide a network for coastal managers and field staff on the UK coast, to improve the ways in which the coastal heritage of the UK is managed, and to ensure that the practical experience of coastal managers and field staff contributes to the formulation of policy for the coastal zone. CoastNET is a membership body open to all those with an interest in the practical management of the UK coastline. In November 1996 it held a national workshop for coastal managers in Scotland (CoastNET 1997).

10.2.6 Royal Society for the Protection of Birds

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* (Royal Society for the Protection of Birds 1995). The Royal Society for the Protection of Birds (1993) reviews strategic planning and management initiatives in the region.

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 zone 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 for nature conservation objectives by Scottish Natural Heritage, the National Trust for Scotland, the RSPB and other bodies, and National Scenic Areas (see [section](#)

[7.3.3](#)) managed for a broader range of conservation and recreational objectives. The Natural Heritage (Scotland) Act 1991 makes provision for the designation of Natural Heritage Areas (NHAs), which will cover extensive areas of land within which nature conservation, landscapes and cultural interests will be managed under a single integrated management plan to be approved by the Secretary of State. No NHAs have been designated yet. Of particular interest because of their specific requirement for wide consultation are Marine Special Areas of Conservation (SACs) and Marine Consultation Areas (see also [sections 7.2.3](#) and [7.4.3](#)).

Special Areas of Conservation (SACs)

Under the EC Habitats & Species Directive 1992, a list of 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 7.2.2](#)). A list of seven candidate sites in Shetland has been put forward for consideration by the European Commission. Marine SACs may include intertidal areas and/or subtidal areas; terrestrial SACs may include important coastal maritime habitats such as lagoons, saltmarshes or sand dunes. Under Scottish Office Environment Division Circular 6/90/95 (Scottish Office 1995), 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 Scottish Environment Protection Agency (SEPA), port and harbour authorities, Scottish Natural Heritage, Scottish Office Agriculture Environment and Fisheries Department, 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. Shetland Islands Council Planning Department, under the auspices of the Planning Committee, has established a management forum for the candidate Special Areas of Conservation ([Table 10.3.1](#)). The Department of the Environment has drafted guidance (DoE/WO 1996) on the preparation and application of management schemes for SACs and the Scottish Office will be producing similar guidance in due course. At the time of writing the UK nature conservation agencies are preparing a generic management model for marine SACs, giving an overview of how schemes of management should develop (Laffoley in prep.).

Marine Consultation Areas

This non-statutory designation is used by Scottish Natural Heritage to indicate important marine sites and stimulate consultation over developments within them (Nature Conservancy Council 1990). There are four Marine Consultation Areas in Shetland. These are: The Houb, Fugla Ness; Swinister Voe & the Houb of Fora Ness; Brindister Voe and the Vadills; and Whiteness Voe.

10.3 Regional coastal management groups and initiatives

10.3.1 Introduction

The Government has stated its support for the encouragement of more local coastal fora along the lines of the Focus on Firths initiative (Scottish Office 1996), although integrated coastal management initiatives are largely absent from Shetland. Initiatives that do exist tend to be issue-related; for example, the Shetland Islands Council has policies on coast protection, coastal aggregates and marine fish farming, and has a coastal strategy insofar as development control is concerned. There are also pollution-response initiatives based at Sullom Voe and advisory

shipping routes, which aim to prevent tanker disasters. Table 10.3.1 lists the coastal management initiatives in the region.

10.3.2 Local planning authorities and port/harbour authorities

The Shetland Islands Council has far-reaching powers over developments in both land and sea areas, under the Zetland County Council Act 1974. The council is the Local Planning

Table 10.3.1 Regional coastal management initiatives

Initiative name	Activities	Organisations involved	Contact details
The Shetland Oil Terminal Environmental Advisory Group (SOTEAG)	Advice on, and monitoring of, the environmental implications of the Sullom Voe Terminal and the tankers that use it.	University of Aberdeen, Shetland Islands Council, oil industry, SNH, SEPA, Scottish Office, Shetland Fishermen's Association, Shetland Salmon Farmers' Association and Shetland Bird Club	SOTEAG, Auris Business Centre, 23 St Machar Drive, Old Aberdeen AB2 1RY, tel: 01224 272884
Wildlife Response Co-ordinating Committee and the Wildlife Response Centre	A sub-committee of SOTEAG created in 1990 to define a policy for dealing with wildlife affected by a major oil incident in Shetland. The Wildlife Response Centre was established after the <i>Braer</i> incident specifically to deal with oiled seabirds/mammals.	Sullom Voe Terminal, Shetland Islands Council, SEPA, Scottish Society for the Prevention of Cruelty to Animals, SNH, RSPB, Hillswick Wildlife Sanctuary, Shetland Bird Club	SOTEAG, Auris Business Centre, 23 St Machar Drive, Old Aberdeen AB2 1RY, tel: 01224 27288
Sullom Voe Oil Spill Advisory Committee	Reviews policies, strategies and procedures relating to oil spill prevention and response measures, to make recommendations for their enhancement.	Shetland Islands Council, oil industry, Department of Transport, HM Coastguard and Shetland Towage	*Shetland Islands Council, Lerwick, tel: 01595 744509
Sella Ness pollution response base	Responsible for the deployment of oil spill containment and clean-up resources within Sullom Voe only (Shetland Islands Council is the lead organisation for other areas).	Sullom Voe Terminal	Sullom Voe Terminal, Mossbank, Shetland, ZE2 9QR tel: 01806 242551
Marine Consultation Areas	Stimulates consultation over important marine sites for nature conservation	Scottish Natural Heritage	*SNH Northern Isles Area, Shetland Office, Lerwick, tel: 01595 693345
Management forum for marine Special Areas of Conservation	Establish management plans for marine SACs in Shetland	Includes all "relevant and competent authorities", including Shetland Islands Council Planning Dept., SEPA, SNH, SOAEFD, owners and occupiers of foreshore etc.	Austin Taylor, Shetland Islands Council Planning Department, Cranfield, Lerwick, Shetland ZE1 0NT, tel: 01595 744800
Coast protection and flood defence	Coast protection strategy	Shetland Islands Council	*Shetland Islands Council, Planning Department, Lerwick, tel: 01595 7448001

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

Authority for the islands, the Port and Harbour Authority for all ports and harbours except Lerwick, the Coast Protection Authority, and the authority for issuing works licences for structures in the sea (such as salmon cages). Shetland Islands Council is therefore able to undertake integrated coastal zone management on a statutory basis. As a Port and Harbour Authority, Shetland Islands Council also has a statutory remit to control activities within its areas of authority, which may include coastal waters. Developments in Lerwick Harbour are controlled by Lerwick Harbour Trust.

The Council has published a series of 'reports of survey' and local plans. A structure plan for Shetland was approved in 1981 and a structure plan 'report of survey' was published in 1985. A comprehensive review of the plan is currently under way. The Council has policies for controlling a variety of coastal developments, including aggregate extraction/export, coast protection and marine fish farming, and these provide the statutory planning framework for development control purposes. The Council is strongly involved in initiatives that aim to minimise the risk of oil pollution and provide a rapid response should such an incident occur.

10.3.3 Coastal (engineering) groups

At present there are no formal coastal (engineering) groups and no shoreline management plans in Shetland. HR Wallingford have carried out a study on coastal process cells in Scotland (HR Wallingford 1995), co-sponsored by Scottish Natural Heritage, the Scottish Office Environment Department and Historic Scotland. This study aims to set out, for the first time, a framework for management of coastal areas in Scotland and could be used as the basis for new coastal management initiatives, similar to the coastal groups established in England and Wales. HR Wallingford are also producing a series of eleven regional reports, summarising coastal processes for each of the coastal cells in Scotland.

10.3.4 Other local initiatives

Public and political concern at oil pollution in Shetland, following the opening of the Sullom Voe Oil Terminal in 1978, stimulated the introduction of a number of non-statutory measures designed to eliminate or reduce chronic pollution off-shore. One of the main concerns was the illegal discharge of ballast water or tank slops from tankers trading to Sullom Voe. As a result, the local authority and oil industry introduced a system of tanker routing, 'areas to be avoided' (see [Map 8.3.4](#)), unscheduled aerial surveillance of all tankers, rigorous inspection of ballast quality and quantity, and the requirement for vessels to carry at least 35% ballast on arrival at the port (so providing a disincentive to deballast at sea). Pollution, as indicated by the quantity of oil and numbers of oiled birds coming ashore, subsequently decreased dramatically. Action is coordinated through the Shetland Oil Terminal Environmental Advisory Group and the Sullom Voe Oil Spill Advisory Committee.

10.3.5 Acknowledgements

Thanks are due to A.W. Taylor and R. Nickerson (Shetland Islands Council), K. Hiscock (JNCC) and J. Uttley (SNH).

10.3.6 Further sources of information

A. References cited

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- Skinner, D. 1974. *The coast of Scotland: some recently collected survey material prepared for the Scottish Development Department*. Edinburgh, Scottish Development Department.

B. Further reading

Included in the following list of references are items relating to England and Wales that may be of interest to individuals and organisations involved in coastal management in Scotland.

- Bown, D. 1988. *Coastal development: a planner's view*. Paper presented to the Council for the Protection of Rural Wales (CPRW) Annual Study Conference (unpublished).
- Coastal Heritage Forum. 1995. *Heritage Coasts: a guide for councillors and officers*. Manchester, Coastal Heritage Forum.
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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 10.3.6C](#).

- 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. A quarterly publication on all matters concerned with coastal management in the UK. Published by the Coastal Heritage Network.
- 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-UK.
- Wavelength*. The (English) Coastal Forum newsletter. Reports the work of the Forum to a wider audience. Published by the Department of the Environment.

National planning/management publications

- 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.)
- Scottish Office. 1995. *Nature conservation: implementation in Scotland of the EC Directives on the conservation of natural habitats and of wild flora and fauna, and the conservation of wild birds: the conservation (natural habitats, etc.) regulations 1994*. Edinburgh, Scottish Office Environment Division, Rural Affairs Department. (Circular 6/90/95.)
- Scottish Office. 1995. *Scottish Office National Planning Policy Guidelines - planning and flooding*. Edinburgh, Scottish Office. (NPPG7.)

C. Contact names and addresses

(See also Table 10.3.1.)

Organisation/group	Activities	Contact address and telephone no.
CoastNET 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. While the network builds on the previous work of the Heritage Coast Forum and still links the 45 Heritage Coasts, it has a much wider UK and coastal management remit.	CoastNET (Coastal Heritage Network), Centre for Environmental Interpretation, Manchester Metropolitan University, St. Augustine's, Lower Chatham Street, Manchester M15 6BY, tel: 0161 247 1067
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, Maritime Team, English Nature, Northminster House, Peterborough PE1 1UA, tel: 01733 455000 (secretariat)
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, P.O. 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 zone management.	European Union for Coastal Conservation (EUCC) Secretariat, P.O. Box 11059, 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
Joint Nature Conservation Committee	Information and advice on coastal management.	*Earth Science/Coastal Advisor, JNCC, Peterborough, tel: 01733 62626
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 (<i>Coasts and seas of the United Kingdom. MNCR series</i>) on a coastal sector basis, as well as more detailed area summaries.	*JNCC, Peterborough, tel: 01733 62626
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, University College Scarborough, Scarborough, tel: 01723 362392
National Coasts and Estuaries Advisory Group (NCEAG)	On behalf of local authorities, provides advice on sustainable management of coastal and estuarine environments; published guide to good practice (NCEAG 1993).	Alan Inder, Secretary, National Coasts and Estuaries Advisory Group (NCEAG). Hampshire County Council, The Castle, Winchester SO23 8UJ, tel: 01962 846749
National Trust for Scotland	Has coastal land holdings in the region (see section 7.5.1) and plans to extend its Enterprise Neptune project to Scotland (purchase and management of coastal land for nature conservation landscape and public enjoyment).	*National Trust for Scotland, Edinburgh, tel: 0131 226 5922

C. Contact names and addresses (continued)

(See also Table 10.3.1.)

<i>Organisation/group</i>	<i>Activities</i>	<i>Contact address and telephone no.</i>
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.	*D. Huggett, Coastal Policy Officer, RSPB HQ, Sandy, tel: 01767 680551
Scottish Environment Protection Agency (SEPA)	Water resources planning, pollution control and enforcement, flood warning, waste regulation and disposal, regulation of land drainage to controlled waters.	*Scottish Environment Protection Agency (SEPA), Head Office, Stirling, tel: 01786 457700, and *Scottish Environment Protection Agency (SEPA), Northern Region HQ, Dingwall, tel: 01349 862021
Scottish Office Development Department	Coastal policy and planning. Preparation of Rural White Paper.	*Scottish Office Development Department, Edinburgh, tel: 0131 554 9797
Scottish Natural Heritage	Marine Consultation Areas, coastal cells in Scotland	*Coastal Ecologist, SNH, Edinburgh, tel: 0131 554 9797
Scottish Office Agriculture, Environment and Fisheries Department	Departmental responsibility for flood defence and coast protection. May establish group to co-ordinate the work of local authorities.	*A.S. Burdekin, SOAEFD European Environment and Engineering Unit, Victoria Quay, Edinburgh, tel: 0131 556 8400
World Wide Fund for Nature - UK	Provides funding for research, local voluntary policy development and local initiatives, and publications on integrated coastal management.	*World Wide Fund for Nature - UK, Godalming, tel: 01483 426444, and *WWF Scotland, Aberfeldy, tel: 01887 820449

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

Appendix

A.1 Frequently cited contact names and addresses

<i>Name</i>	<i>Contact address and telephone no.</i>	<i>Name</i>	<i>Contact address and telephone no.</i>
Statutory bodies		Statutory bodies (continued)	
British Oceanographic Data Centre (BODC)	Proudman Oceanographic Laboratory, Bidston Observatory, Birkenhead, Merseyside L43 7RA, tel: 0151 653 8633	SOAEFD Marine Laboratory	Fisheries Research Services, PO Box 101, Victoria Road, Torry, Aberdeen AB11 9DB, tel: 01224 876544
Department of the Environment (DoE), European Wildlife Division/Dept. of Rural Affairs	DoE, Room 9/03B, Tollgate House, Houlton Street, Bristol BS2 9DJ, tel: 0117 987 8000	Wildlife Trusts	
Institute of Terrestrial Ecology (ITE), Monks Wood	Abbots Ripton, Huntingdon, Cambs. PE17 2LS, tel: 01487 773381	Scottish Wildlife Trust (SWT) HQ	Cramond House, Kirk Cramond, Cramond Glebe Road, Edinburgh EH4 6NS, tel: 0131 312 7765
Joint Nature Conservation Committee (JNCC), Headquarters	Monkstone House, City Road, Peterborough, Cambs. PE1 1JY, tel: 01733 62626	National voluntary bodies	
JNCC, Seabirds and Cetaceans Team	Seabirds and Cetaceans Team, Joint Nature Conservation Committee, 11 Dunnet House, 7 Thistle Place, Aberdeen AB10 1UZ, tel: 01224 655702	The British Trust for Ornithology	The Nunnery, Thetford, Norfolk IP24 2PU, tel: 01842 750050
Scottish Environment Protection Agency (SEPA), Head Office	Erskine Court, The Castle Business Park, Stirling FK9 4TR, tel: 01786 457700	Marine Conservation Society	9 Gloucester Road, Ross-on-Wye, Herefordshire HR9 5BU, tel: 01989 566017
SEPA Northern Region HQ	Graesser House, Fodderty Way, Dingwall IV14 9XB, tel: 01349 862021	The National Trust for Scotland	5 Charlotte Square, Edinburgh EH2 4DU, tel: 0131 226 5922
Scottish Natural Heritage (SNH) HQ	12 Hope Terrace, Edinburgh EH9 2AS, tel: 0131 447 4784	Royal Society for the Protection of Birds (RSPB) HQ	The Lodge, Sandy, Bedfordshire SG19 2DL, tel: 01767 680551
SNH Advisory Services	2 Anderson Place, Edinburgh EH6 5NP, tel: 0131 554 9797	The Wildfowl & Wetlands Trust (WWT), HQ	Slimbridge, Gloucestershire GL2 7BT, tel: 01453 890333
SNH Northern Isles Area, Shetland Office	Ground Floor, Stewart Building, Alexandra Wharf, Lerwick, Shetland ZE1 0LL, tel: 01595 693345	Worldwide Fund For Nature - UK (WWF-UK)	Panda House, Weyside Park, Cattershall Lane, Godalming, Surrey GU7 1XR, tel: 01483 426444
Scottish Office Development Department	Victoria Quay, Edinburgh EH6 6QQ, tel: 0131 556 8400	WWF Scotland	1 Crieff Road, Aberfeldy, Perthshire PH15 2BJ, tel: 01887 820449
Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD)	Pentland House, 47 Robb's Loan, Edinburgh EH14 1TY, tel: 0131 244 6015 and Victoria Quay, Edinburgh EH6 6QQ, tel: 0131 556 8400	Others	
		British Geological Survey	Keyworth, Nottingham NG12 5GG, tel: 0115 936 3100
		Marine Forum for Environmental Issues	c/o University College of Scarborough, Filey Road, Scarborough, Yorkshire YO11 3AZ, tel: 01723 362392

A.2 Local planning authorities; port and harbour authorities

Name	Address and telephone no.	Name	Address and telephone no.
Shetland Islands Council	Town Hall, Lerwick ZE1 0HB, tel: 01595 693535	<i>Ports and harbours (continued)</i>	
<i>Ports and harbours</i>		Baltasound	Alex Sandison & Sons Ltd. Northside, Baltasound, Unst, Shetland Islands ZE2 9DS, tel: 01957 711444
Sullom Voe	Marine Operations Department, Port Administration Building, Sella Ness, Mossbank, Shetland ZE2 9QR, tel: 01806 242551	Scalloway Harbour	Marine Operations Department, Port Administration Building, Sella Ness, Mossbank ZE2 9QR, tel: 01806 242551
Lerwick Harbour	Lerwick Harbour Trust, Albert Building, Lerwick, Shetland ZE1 0LL, tel: 01595 692991		

A.3 Core reading list

There are a number of publications that either provide information on a variety of topics covered in these regional reports (and so are frequently referred to) or give a good overview of regional and national information on coasts and seas. They are listed below.

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

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

Steers, J.A. 1964. *The coastline of Scotland*. Cambridge, Cambridge University Press.

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