JOINT NATURE CONSERVATION COMMITTEE

Coasts and seas of the United Kingdom

Region 17 Northern Ireland

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

Joint Nature Conservation Committee
Monkstone House, City Road
Peterborough PE1 1JY
UK

This volume has been produced by the Coastal Directories Project of the JNCC
on behalf of the project Steering Group.

JNCC Coastal Directories Project Team

Project directors	Dr J.P. Doody, Dr N.C. Davidson
Project management and co-ordination	J.H. Barne, C.F. Robson
Editing and publication	S.S. Kaznowska, A.L. Buck
Administration & editorial assistance	J. Plaza, N.M. Stevenson, R.M. Sumerling, P.A. Smith

The project receives guidance from a Steering Group which has more than 200 members. More detailed information and advice comes from the members of the Core Steering Group, which is composed as follows:

Dr J.M. Baxter	*Scottish Natural Heritage*
R.J. Bleakley	*Department of the Environment for Northern Ireland, Environment and Heritage Service*
R. Bradley	*The Association of Sea Fisheries Committees of England and Wales*
Dr J.P. Doody	*Joint Nature Conservation Committee*
B. Empson	*Environment Agency*
C. Gilbert	*Kent County Council & National Coasts and Estuaries Advisory Group*
N. Hailey	*English Nature*
Dr K. Hiscock	*Joint Nature Conservation Committee*
Prof. S.J. Lockwood	*MAFF Centre for Environment, Fisheries and Aquaculture Sciences (CEFAS) (formerly MAFF Directorate of Fisheries Research)*
C.R. Macduff-Duncan	*Esso UK (on behalf of the UK Offshore Operators Association)*
Dr D.J. Murison	*Scottish Office Agriculture, Environment & Fisheries Department*
Dr H.J. Prosser	*Welsh Office*
Dr J.S. Pullen	*WWF-UK (Worldwide Fund for Nature)*
Dr P.C. Reid	*Plymouth Marine Laboratory*
Dr M.J. Roberts	*Water Resources and Marine, Department of the Environment*
S.L. Soffe	*Countryside Council for Wales*
M.L. Tasker	*Joint Nature Conservation Committee*
R.G. Woolmore	*Countryside Commission*

Recommended citation for this volume:

Barne, J.H., Robson, C.F., Kaznowska, S.S., Doody, J.P., Davidson, N.C., & Buck, A.L., *eds*. 1997. *Coasts and seas of the United Kingdom. Region 17. Northern Ireland.* Peterborough, Joint Nature Conservation Committee. (Coastal Directories Series.)

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

Buck, A.L. 1997. Chapter 4.1 Estuaries. *In: Coasts and seas of the United Kingdom. Region 17. Northern Ireland*, ed. by J.H. Barne, C.F. Robson, S.S. Kaznowska, J.P. Doody, N.C. Davidson & A.L. Buck, 63-65. Peterborough, Joint Nature Conservation Committee. (Coastal Directories Series.)

Region 1: ISBN 1 873701 75 6
Region 2: ISBN 1 873701 76 4
Region 3: ISBN 1 873701 77 2
Region 4: ISBN 1 873701 78 0
Region 5: ISBN 1 873701 79 9
Region 6: ISBN 1 873701 80 2
Region 7: ISBN 1 873701 81 0
Region 8: ISBN 1 873701 82 9
Region 9: ISBN 1 873701 83 7
Region 10: ISBN 1 873701 84 5
Region 11: ISBN 1 873701 85 3
Region 12: ISBN 1 873701 86 1
Region 13: ISBN 1 873701 87 x
Region 14: ISBN 1 873701 88 8
Regions 15 & 16: ISBN 1 873701 89 6
Region 17: ISBN 1 873701 92 6

Set of 17 regions: ISBN 1 873701 91 8

Contents

Foreword

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

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

In addition to the value of the information itself, the way the project has been run and the data collected has made an important contribution to the quality of the product. A wide range of individuals and organisations concerned with the conservation and use of the coastal margin have collaborated in collating the information, their variety reflecting the extent of the interplay between the coastal environment and human activities. These organisations included the Ministry of Agriculture, Fisheries and Food, the Scottish Office, the Department of the Environment for Northern Ireland (DoE (NI)) Environment and Heritage Service, 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 the region and sets the region in a national context.
- **Important locations and species**: gives more detail on the region's features in relation to the topic.
- **Human activities**: describes management and other activities that can have an effect on the resource in the region.
- **Information sources used**: describes the sources of information, including surveys, on which the section is based, and notes any limitations on their use or interpretation.
- **Acknowledgements**
- **Further sources of information**: lists references cited, recommended further reading, and 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 17') is used throughout this book to refer to the coastal and nearshore zone, broadly defined, of 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 one kilometre of Mean High Water Mark, or an offshore area that may extend from the coast out to the median line between the UK and neighbouring states. Areas inland of these limits are not included unless specifically stated.

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

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

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

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

Throughout the book, the information given is a summary of the best available knowledge. The sites mentioned as important, the numbers and distributions of species, archaeological features discovered and information on all the other elements of the natural and man-made environment are as up-to-date as reasonably practicable at the time of publication (May 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 (1993; Statutory Instrument No. 3240) you may be asked to pay for information provided by organisations.

Acknowledgements

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

Arco British Ltd[1]
Ards Borough Council
Avon County Council
Banff and Buchan District Council
BHP Petroleum Ltd[1]
Ceredigion District Council
Cheshire County Council
Chevron UK Ltd[1]
Cleveland County Council
Clwyd County Council
Clyde River Purification Board
Colwyn Borough Council
Copeland Borough Council
Countryside Commission
Countryside Council for Wales
Cumbria County Council
Cunninghame District Council
Delyn Borough Council
Department of the Environment (DoE)
DoE (NI) (Environment & Heritage Service)
DoE (NI) 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
Essex County Council
Fife Regional Council
Forest of Dean District Council
Gwynedd County Council
Hampshire County Council
Highland River Purification Board
Humber Forum
Isle of Man Government, Department of Industry
Isle of Man Government, Department of Local Government & the Environment
Isle of Man Government, Department of Transport
Kyle and Carrick District Council
Lancashire County Council
Lincolnshire County Council
Marathon Oil UK Ltd[1]
Ministry of Agriculture, Fisheries and Food, Centre for Environment, Fisheries and Aquaculture Sciences (CEFAS) (formerly MAFF Directorate of Fisheries Research)
Environment Agency (formerly the National Rivers Authority)
Neath Borough Council
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 Association[2]
Vale of Glamorgan Borough Council
Water Services Association
Welsh Office
World Wide Fund For Nature - UK

Notes

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

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

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

The project has also received widespread support from the country conservation agencies: Countryside Council for Wales, English Nature, Scottish Natural Heritage and the Department of the Environment for Northern Ireland Environment and Heritage Service (DoE (NI) EHS). Special thanks are due to R.J. Bleakley and J.S. Furphy of DoE (NI) EHS, who read through the draft text to check for factual accuracy. We are grateful to the many country conservation agency regional and headquarters staff who contributed, as well as the representatives on the Core Steering Group. The editors would also like to thank the many people who have provided information for the project or given their time to comment on drafts, as well as those who gave editorial assistance:

Alastair Angus, Irish Offshore Operators Association; Dr P.J.S. Boaden, The Queen's University of Belfast Marine Station; Tricia Bradley, RSPB; Dr Nick Brannon, DoE (NI) Environment and Heritage Service; Dr R.A. Brown, RSPB; Brown McConnel Clark Ltd; Jill Butler, The Woodland Trust; J. Campbell, Newtonabbey Borough Council; D.W. Carlisle, Marine Safety Agency; Dr Sue Christie, Northern Ireland Environment Link; Dr Andrew Cooper, University of Ulster; Sonya Crawford, Northern Ireland Tourist Board; Norman Dunn, Newtonabbey Borough Council; R. Gamble, Department of Economic Development; Ronan Gorman, British Association for Shooting and Conservation; B.J. Gunn-King, Ulster Society for the Preservation of the Countryside; Dr Paul Harding, Institute of Terrestrial Ecology; Dr I.S. Heaney, Department of Agriculture Northern Ireland (DANI) Agricultural and Environmental Sciences Division; Hilary Heslip, DoE (NI) Planning Service; Arthur Jolly, Marine Conservation Society; Alan Kilgore, Newry and Mourne District Council; Jim Kitchen, WWF-UK; J.L. Lawson, Down District Council; Colin Macduff-Duncan, UKOOA; Sheila Magee, DANI Agricultural and Environmental Sciences Division; Colin McCarthy, Royal Institution of Chartered Surveyors; Dr W.I. Mitchell, Geological Survey of Northern Ireland; Brian Murphy, Environmental Policy Division, DANI; O. O'Connor, Down District Council; Philip O'Doherty, Derry City Council; Joe O'Reilly, DANI Farm Census Branch; Prof. Julian Orford, The Queen's University of Belfast; Maurice Parkinson, Belfast City Council; Pauline Simpson, Institute of Oceanographic Sciences; Dr Chris Vivian, MAFF; Dr Richard Warner, The Ulster Museum; Sarah Welton, Marine Conservation Society; Richard Weyl, DoE (NI) (EHS); Jo Whatmough, National Trust; and Mark Wilson, DANI Forest Service.

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

Portrush, Co. Antrim. The dolerite sill that forms this promontory is sandwiched between layers of 'Portrush Rock', a fossil-rich shale that has been baked by the overlying basalt. The town itself is a popular holiday resort with many attractions. Photo: Mike Hartwell, DoE (NI) EHS.

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 one kilometre of Mean High Water Mark, or (for marine topics) from the landward limit of high tides out to the median line between the UK and neighbouring states. 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 (North Sea Task Force 1993).

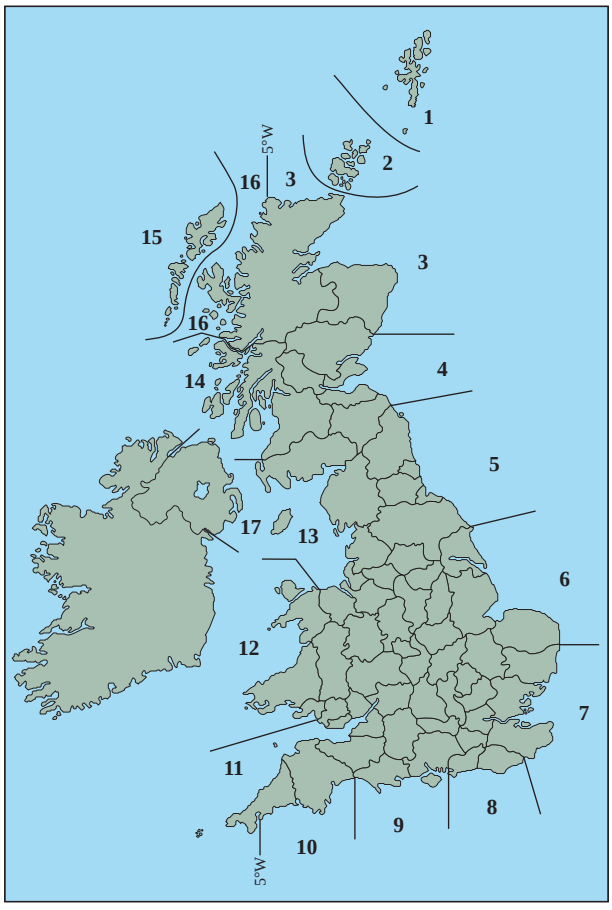
At the second meeting of the NSTF, in 1989, the UK suggested that the North Sea QSR should include consideration of terrestrial habitats and species. This was to involve the collection of information dealing with the coastal margin of the North Sea (defined as being east of longitude 5° West - i.e. from Cape Wrath in northern Scotland around the North Sea and the English Channel coasts to the Fal Estuary in Cornwall) and the collation of this information into book form. A project was set up by the Nature Conservancy Council (NCC) and, after 1991, the Joint Nature Conservation Committee (JNCC), to produce this information, with part funding from the Department of the Environment (DoE). A small group was invited to steer the project and to help identify information sources, including the DoE, the Ministry of Agriculture, Fisheries and Food (MAFF), the National Rivers Authority (NRA) (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* (Doody *et al.* 1993) - 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.

The principal aims of the *Directory* were to produce "a

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

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

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



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

1.1.3 Recent developments

These developments in coastal management fostered interest in the Coastal Directories Project and increased demand for information at a regional level, as well as at the level of whole seaboards (the approach adopted for the *Directory of the North Sea coastal margin*). In 1992, therefore, it was proposed to produce a *West Coast Directory* to cover the remainder of the coast of Great Britain, the Isle of Man and, by later agreement, Northern Ireland, as well as a series of regional volumes to cover the whole coast of the UK. Regions were defined, wherever possible, by the current local or national government coastal boundaries that most closely approximated to the limits of major coastal process cells (see section 2.4), to ensure that pragmatic management requirements were matched by an ecologically coherent information base. Volumes covering seventeen regions have been or are now being prepared: the areas that they cover are shown in Map 1.1.1. Regions 1 - 10 cover the area of the *Directory of the North Sea coastal margin*; Regions 11 - 17 deal with the west coast of Britain, Northern Ireland 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 preparation of regional plans. Discussions in the main steering group (see below) in January 1994 resulted in a decision to prioritise the completion of the regional volumes 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 received and in the commitment shown by members of the steering groups, which met regularly. The main steering group, which met annually for a seminar, 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), *The tide turns for coastal zone management: Coastal Directories users report back on their*

Table 1.1.1 Coastal Directories project management structure

Group	*Role*	*Undertaken by*
JNCC Coastal Directories Project Team	Day to day management	Head of team, project coordinators
Project management board	Liaison and executive decisions	Country conservation agencies (English Nature, Scottish Natural Heritage, Countryside Council for Wales), JNCC Coastal Directories Project Team, Department of the Environment for Northern Ireland, Environment and Heritage Service (DoE (NI) (EHS))
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

experiences (February 1996) and *Coastal zone information provision: the future* (February 1997). In addition the core steering group 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 was highlighted by the extent to which new approaches and information sources were identified. The dialogue between the Coastal Directories Project funding consortium members 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. In Northern Ireland, government policy is set out in a recent report, *Coastal Zone Management in Northern Ireland* (DoE (NI) (EHS) 1996), produced following a consultation process (DoE (NI) Environment Service 1995).

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

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

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

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.

1.1.6 Further sources of information

A. References cited

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

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

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

Department of the Environment (NI) Environment and Heritage Service. 1996. *Coastal zone management in Northern Ireland.* Belfast, DoE (NI).

Department of the Environment (NI) Environment Service. 1995. *Delivering coastal zone management in Northern Ireland. A consultation paper.* Belfast, DoE (NI).

Department of the Environment/Welsh Office. 1992. *Planning policy guidance - coastal planning.* London, HMSO. (PPG 20.)

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

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

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

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

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

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

B. Further reading

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

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Information about Coastal Directories Project	*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	NHBS Ltd, 2-3 Wills Road, Totnes, Devon TQ9 5XN, tel: 01803 865913

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

1.2 Introduction to the region

Dr J.P. Doody & R.J. Bleakley

1.2.1 Introduction

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

Region 17 covers the whole coastline of Northern Ireland from the tidal River Foyle in the north-west to Newry up-river from Carlingford Lough in the south-east. Measured at 1:50,000 scale, the coast is approximately 650 km long, some 2.7% of the United Kingdom coast length, although at a scale of 1:10,000 the much convoluted High Water Mark measures 1,050 km. The region has varied geology and landforms, which underpin three broad landscape types. The cliffed coast of the north and north-east has a rugged and open character and is a popular tourist destination. The rocky headlands and cliffs are interspersed with beaches of boulders, gravel or sand. The north coast, in particular, is exposed to the waves and swell of the Atlantic Ocean, which has a major influence on the environment. The importance of the landscape here has been reflected in the designation of three Areas of Outstanding Natural Beauty, notably the Antrim Coast and Glens, which stretches from Rathlin Island in the north to Larne in the south. The open coast to the east has a much lower relief, and where cliffs do exist they are lower and mostly glacial in origin, with a tendency to erode. The shore here is composed of sand or gravel beaches or rocks. A third type of coastline found in this eastern part centres on the major sea loughs, which are characterised by fine sand or muddy sediments and together comprise over half the region's coastline. These shallow inlets include Belfast and Strangford Loughs, which are surrounded by low-lying land.

Low-intensity agriculture is a major land use in the coastal zone, with stock farming predominating throughout most of the region. Intensive agriculture is less widespread and is associated with the sea loughs of Lough Foyle, Larne Lough, Belfast Lough and Strangford Lough. In the north-west, for example, there are large fields with intensive arable cultivation, but some of these have now reverted to grass leys or permanent pasture. Over most of the rest of the region much of the landscape is composed of a patchwork of small enclosed fields, reflecting the pastoral nature of the land use. There has been some land-claim around the main estuaries, although only in Belfast Lough has this been carried out on the scale seen in some of the estuaries in south-east England. Belfast and Londonderry are the only cities of any size in the Province, and industrial development is relatively localised. Belfast is a major port and there are significant commercial ports at Londonderry, Larne and Warrenpoint. Fishing activity is centered around the County Down ports of Portavogie, Ardglass and Kilkeel. Despite its relatively cool and moist climate there are traditional holiday centres at Portstewart, Portrush, Bangor and Newcastle. The relatively low intensity of land-use and low population density in rural areas is reflected in the fact that some 84% of the coastline is protected by some form of conservation designation - a clear indication of the overall quality of its landscape and wildlife. This figure will rise to almost 90% when the suite of national and international statutory designations is complete.

1.2.2 Structure and landscape

The solid geology of the region is extremely varied and demonstrates virtually the whole of the geological period from the pre-Cambrian to the Holocene. Notable exposures of some of the oldest, Dalradian, rocks (of Precambrian age, more than 544 million years old) and others of Silurian, Carboniferous, Permo-Triassic, Cretaceous and Tertiary ages (most notably of the volcanic period 65-53 million years ago) are present. As with most of the rest of UK, the land surface of the region shows evidence of glaciation dating from the Pleistocene period. Today's landscape is determined by the nature of the underlying rock, together with the more recent influence of glacial action, including the deposits of material left as the ice retreated. Superimposed on this is the human influence which has moulded this landscape since the first farmers arrived around 6,000 years ago.

Much of the spectacular scenery of the north coast is derived from the thick layer of virtually horizontal basalt lava flows that some 60 million years ago erupted on to the existing land surface, which consisted in many places of Cretaceous limestone. The most famous exposure of these rocks is at the Causeway Coast, where cooling of the thicker flows of lava created the polygonal columns of the Giant's Causeway itself - a World Heritage Site. To the east, the volcanic basalt overlies Cretaceous limestone, which itself lies on even older Jurassic Lias. The last of these layers is unstable and there have been numerous landslips, which have helped to create the some of the spectacular cliffs along the Antrim coast. To the south of Belfast the rocks are older and have a lower relief, with beaches and shingle shores more prevalent. There is considerable evidence of glacial activity, and the underlying geology of Strangford Lough is obscured by boulder clay deposited when the area was covered by ice sheets during the Pleistocene period between 2 and 5 million years ago. Characteristic of this area are the drumlins - relict glacial features, which occur as small, relatively low oval hills of glacial material deposited at the end of last ice age as the ice retreated. In South Down the Mourne Mountains, composed of Tertiary granite and Silurian slate, shales and greywackes, rise steeply from the coast at Newcastle and Rostrevor; these mountains have been designated as an Area of Outstanding Natural Beauty. Forty-eight geological and geomorphological sites in Northern Ireland have been identified as of national or international significance in JNCC's ongoing Earth Science Conservation Review.

After the main glacial periods, when the whole of the region was covered by ice, vertical movements of both the land and global sea level have had a major influence on the coastline. Sea level rose rapidly from about 10,000 years ago to reach approximately its present level between 6,500 and 4,500 years ago. There is some evidence in a raised beach at

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

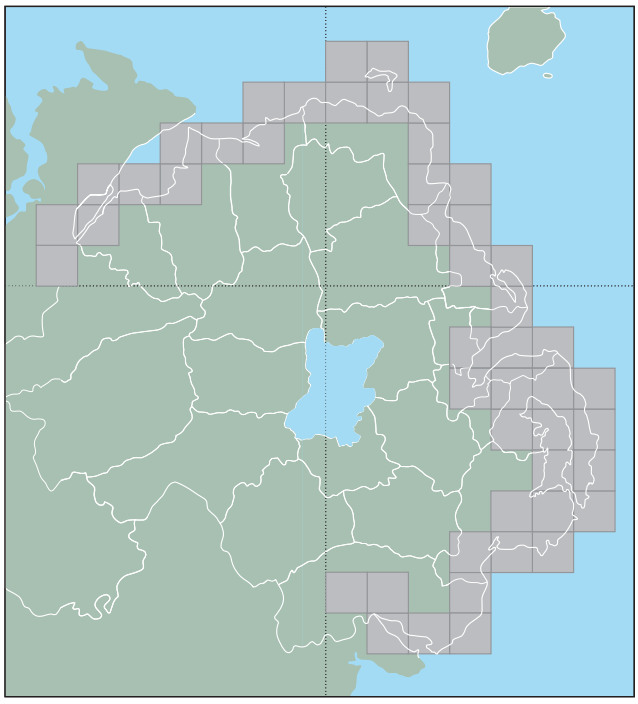
Strangford Lough that sea level may have been 5-7 m above its present level during a marine transgression 5-6,000 years ago. Relative sea level is now thought to be approximately static or possibly falling slightly, as the land continues to rise slowly, rebounding from the weight of glacial ice and so offsetting any global sea-level rise due to global warming.

Offshore the sea bed is dominated by sand and gravel deposits derived from the glacial period. There are extensive areas of exposed rocks that reflect the geology of the coast, particularly along the Antrim coast and south-east of Belfast Lough.

This is one of the windiest parts of the UK: wind speeds of between 3.5 and 4.0 m/s (Force 3) are exceeded for 75% of the time. Tidal range is relatively small, exceeding 4 m at mean spring tides only in the south-east. To the north it drops to 1.0 m at Fair Head, rising again to 2.4 m towards the west near Magilligan Point.

1.2.3 The natural environment

The coast of Region 17 has examples of all the main coastal habitat types, with particularly significant areas of sea cliffs and sand dunes. There are several sea loughs, Lough Foyle and Strangford Lough being the largest, although Larne Lough and Carlingford Lough are also important features of



Map 1.2.2 Irish Grid 10 km by 10 km squares included as 'coastal' for this region. © Crown Copyright.

the coastline. On the north coast rocky headlands and about 50 km of cliffs are interspersed with beaches made of boulders, gravel and sand. The cliffs are generally 50-100 m high, and the summit at Fair Head reaches almost 200 m above sea level. The range of cliff habitats is extensive and includes important examples of cliff vegetation, ranging from extensive exposed maritime communities, including spray zone crevice communities and grassland, to calcareous cliff communities. Much of the coastline is characterised by semi-natural habitats such as coastal cliff-top pasture and meadows; coastal woodland is scarce.

The native mammal fauna of the region is more restricted than in Great Britain because the land bridge to Ireland was severed at the end of the last glaciation before many of the species had a chance to cross. However, the varied coastal habitats support good populations of those species that do occur, including native populations of pine marten and otter, both of which have restricted distributions in the UK. Similarly, the smooth newt is probably the only native amphibian and the common lizard the only native reptile.

The region is of particular significance for its seabird numbers. Five colonies support numbers of at least one species at levels above 1% of their European Union populations. These include auks such as the razorbill *Alca torda* nesting on sea cliffs, terns *Sterna* spp. including the roseate tern *S. dougallii*, which nest on islands in some of the sea loughs, and wintering populations of a variety of divers and grebes. Other species with important coastal populations are the peregrine falcon *Falco peregrinus*, with 24 pairs (25% of the Northern Ireland breeding population), and the twite *Carduelis flavirostris*.

The sea and sea bed

The seas in this region are greatly influenced by the Atlantic Ocean: exposure to the Atlantic swell has a profound influence on the northern coastline of the region, causing erosion and flooding in extreme events. Close offshore in the north the sea bed shelves steeply to about 100 m; in the east the slope is more gentle. There is a wide range of sediment thicknesses at the sea bed: some areas, such as parts of Beaufort's Dyke between Northern Ireland and Scotland, have become partially infilled with Pleistocene and recent sediments. In other areas the presence of extensive areas of bedrock, coupled with the variation in exposure to tidal streams, provides ideal conditions for a rich marine flora and fauna, including both northern and southern species close to their geographuical limits. The sea bed around Rathlin Island supports diverse benthic communities that include half of all the species recorded in waters around Northern Ireland. This is a reflection of the range of substrata, the strong and complex tidal streams and the range of exposure experienced by different areas of the sea bed. Strangford Lough has one of the most diverse ranges of sea-bed habitats in Europe, with 20 different intertidal sea-bed communities and 22 subtidal communities. Particularly important are the cobble and boulder communities, which support many rare and scarce marine benthic species.

Sheltered inlets such as Lough Foyle, Larne Lough, Belfast Lough, Strangford Lough, Dundrum Bay (Inner and Outer) and Carlingford Lough have populations of exploited molluscs such as native oysters *Ostrea edulis*, cockles *Cerastoderma edule*, mussels *Mytilus edulis* and whelks *Buccinum undatum*. Further offshore there are areas where scallop *Pecten maximus*, queen scallop *Aequipecten opercularis* and prawns *Nephrops norvegicus* are present. The coastal waters of the region have a diverse range of fish species that include shad *Alosa alosa* and *A. fallax*, lampern *Lampetra fluviatilis*, sea lamprey *Petromyzon marinus* and sturgeon *Acipenser sturio*, all threatened species in the UK and Europe, although most are known in the region only from single records. The waters off the Mourne coast are important spawning and nursery areas for exploited species of fish such as herring *Clupea harengus*, cod *Gadus morhua*, whiting *Merlangius merlangus*, haddock *Melanogrammus aeglefinus* and plaice *Pleuronectes platessa*. Many of the river systems and inland loughs in Northern Ireland, or rivers that drain from the Province, are important for migratory fish: salmon, sea trout and eels; most significant are the river systems of the Foyle and Bann (Lower and Upper) and Loughs Neagh and Erne.

Whales, dolphins and porpoises are fairly abundant in these coastal waters. Fifteen species have been recorded, of which eight (30% of the UK species count) are resident or regularly seen each year. The common dolphin *Delphinus delphis* is the most frequently recorded species, occurring both inshore and offshore. Common seals *Phoca vitulina* and grey seals *Halichoerus grypus* both breed throughout the region. The former are most abundant in the sheltered waters of the east coast, especially Strangford Lough. The less common grey seal prefers the rugged and exposed coasts of the north and east.

Estuarine shores

There are a number of marine inlets of estuarine character in the region, some of which have clear waters and rich marine life. The most outstanding of these is Strangford Lough, which was recently included in the list of possible Special Areas of Conservation under the EC Habitats & Species Directive. It has also been designated as an Area of

Outstanding Natural Beauty (AONB) and is one of only three statutory Marine Nature Reserves in the UK.

Saltmarshes are not extensive in Northern Ireland and are generally lightly grazed. The saltmarsh areas surrounding Strangford Lough, while small in comparison with those in GB, are important in a Northern Ireland context, as are the areas in Mill Bay, Carlingford Lough. Saltmarshes show a typical succession of dominant vegetation from common saltmarsh-grass *Puccinellia maritima* to red fescue *Festuca rubra* and transitions to sea rush *Juncus maritimus* and reed *Phragmites australis* beds. There is a characteristic flora, which can be rich in areas of low intensity grazing. In Northern Ireland upper marsh communities are visually dominated by lax-flowered sea-lavender *Limonium humile* (*L. vulgaris*, the common species of ungrazed marshes in England and Wales, is absent from Northern Ireland). Common cord-grass *Spartina anglica* is a relatively recent introduction to the area and there has been considerable controversy over attempts to control its spread across sand and mud flats in Strangford Lough. Overall the areas currently colonised by *Spartina* are relatively small compared with in north-western and southern parts of England, but this invasive species has the potential to spread over a considerable area. Other elements of the saltmarsh flora are similar to those found in Scotland, and the presence of saltmarsh flat-sedge *Blysmus rufus*, a northern plant of upper saltmarsh scattered throughout the region in small beach-head saltmarshes, is of interest.

The mild climate and rich areas of tidal mud and sand flats associated with the five main inlets make this an important region in the UK for wintering waterfowl. Region 17 as a whole holds more than 4% of the January population of waders in the UK. In periods of extreme weather the region may become even more important as areas to the east become frozen and prey inaccessible to waterfowl. Strangford Lough is a particularly significant site, hosting many more than 20,000 waterfowl, the current threshold for eligibility for listing under the Ramsar Convention. Strangford Lough and Lough Foyle are important wintering grounds for the light-bellied brent goose *Branta bernicla hrota*, probably the most important of the region's wintering species. The race that visits Ireland breeds in arctic Canada and Greenland and, on the eastern side of the Atlantic, winters almost exclusively in Ireland. Strangford Lough and Lough Foyle are also staging areas for migrating birds.

Non-estuarine shores

The sand dune resource of the region includes two significant areas of dunes each with more than 700 ha of blown sand: Magilligan Strand and Ballykinler/Murlough Dunes. Both have been proposed as possible Special Areas of Conservation. At Magilligan, on the exposed northerly coastline, the prevailing winds blow sand onshore to form one of the best examples of hindshore dunes in the UK and a rare example of a dune system that is still prograding today. Succession of the vegetation at Magilligan shows a typical development, from mobile foredunes to species-rich calcareous grassland and wet dune slacks. Murlough is also very important in UK terms, containing some of the best examples of rare acid dune heaths. Several of the smaller dune sites, such as Portrush, have been highly modified by human activities. Conversion of sand dunes to golf courses has taken place at several sites, resulting at Portstewart in increased erosion and the loss of open dune habitat and its rare wildlife. Habitat loss has also been caused in places by insufficient grazing by stock or rabbits.

Within the region there are several small shingle beaches, although none is important in a national context. They show considerable variation in their structure and vegetation. The presence of yellow horned-poppy *Glaucium flavum* together with oysterplant *Mertensia maritima* is of considerable interest, the former occurring here at its northern limit, the latter at its southern limit. Sea-kale *Crambe maritima* also occurs sporadically, here at the northern end of its range.

Sea cliffs abound in the region, particularly in the north, where basalt is the dominant rock type, often overlying the Ulster White Limestone. No less than three of Northern Ireland's Areas of Outstanding Natural Beauty are associated with this coastline, and examples of the Atlantic cliff vegetation type identified in the EC Habitats & Species Directive occur in this area. These include the typical maritime rock crevice communities characterised by rock samphire *Crithmum maritimum* and rock sea-spurrey *Spergularia rupicola*, although these are restricted to the most exposed parts of Rathlin Island and the Giant's Causeway. Maritime grassland, occasionally rich in plant species, is much more widespread, with sites on the Ards Peninsula, such as Ballymacormick Point, Orlock Point and Ballyquintin Point, being especially important. These areas include a variety of winter annuals, deep-rooted or bulbous plants, such as spring squill *Scilla verna* and several species of clover, in communities similar to those of the cliffs of Cornwall (Region 11).

There are a number of seabird colonies on the cliffs. The most important is on Rathlin Island, where kittiwake *Rissa tridactyla*, razorbill *Alca torda* and guillemot *Uria aalge* occur in internationally significant numbers. A recent catastrophic decline in chough *Pyrrhocorax pyrrhocorax* populations has left Rathlin Island, a former stronghold, devoid of this species.

1.2.4 Landscape and nature conservation

The value of the region for landscape and nature conservation is shown by the number and extent of sites afforded official protection, especially under designations reflecting national or international importance. The extensive coastal Areas of Outstanding Natural Beauty, representing 12% of the total area of Northern Ireland, indicate just how rich this region is in terms of landscape. Four sites are proposed as possible Special Areas of Conservation specifically for their coastal or marine biological interest, and The Giant's Causeway is a World Heritage Site. Strangford Lough is one of only three Marine Nature Reserves in the UK and, at 16,500 ha, by far the largest. In addition to sites protected under statute, there are many sites owned and managed by the voluntary sector. Nearly 13,000 ha are owned or managed by the National Trust, and The Royal Society for the Protection of Birds manages part of Rathlin Island and several other sites. Numbers and total areas of sites protected under the main designations are given in Table 1.2.1.

Table 1.2.1 Main landscape and nature conservation designations in Region 17

Designation	*No. of sites in Region 17*	*Total area in Region 17 (ha*)*	*% of UK coast total in Region 17 (by area)*
World Heritage Sites	1	71	7.7
Special Protection Areas	2	3.6	<1.0
Environmentally Sensitive Areas	3	77,400	5.2
(National) Nature Reserves	17	3,399	3.8
Areas of Special Scientific Interest	27	21,654	3.0
Marine Nature Reserves	1	16,500	85.1
Areas of Outstanding Natural Beauty	7	181,870	16.8
Local Nature Reserves	1	28	0.2
Country Parks	5	445	9.1
National Trust sites	30	12,835	16.7
RSPB reserves	9	1,419	3.5
Ulster Wildlife Trust reserves	2	35	0.1
Ministry of Defence sites	2	1,520	2.8
The Wildfowl and Wetlands Trust	2	26	1.6

Source: DoE (NI) Environment and Heritage Service, JNCC (May 1996 SPA data). Key: *to the nearest whole hectare; RSPB = Royal Society for the Protection of Birds. 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.

1.2.5 Human activities, past and present

Exploitation of the coastal zone is evident from every cultural phase of the past, although evidence of occupation is limited. Hunter-gathers may have arrived in Ireland as early as 9,000 years ago. The remains of burial chambers including Megalithic tombs have been found, but they are relatively few. Cultivation and animal husbandry took place in small settlements, probably from around 6,000 years ago; these early Neolithic people probably sailed to Ireland from Britain, bringing with them farming stock such as cattle and sheep. Around 4,000 years ago metalworking began. Christianity is thought to have arrived in Ireland in the 5th century. The enclosed farmsteads that seem to have flourished at that time provide one of the more common types of archaeological monument in the region. Part of the eastern counties of the region were overrun by the Anglo-Normans in the late 12th/early 13th centuries. Maritime trade became important, and a significant shipbuilding industry has existed since the late 16th century. Smaller ports that were active in these early times survived the concentration of maritime trade in Belfast and Larne because of coastal trade, ferry services and the sheltered fishing waters nearby. Many castles and tower houses, a number of which survive, were built to defend maritime trade.

The scenery, wildlife, history and tourist facilities of the region have supported small-scale tourism on the coast for many years (since the 16th century), and a wide range of outdoor leisure activities take place, including golf, walking, sailing and sea angling. Rich pasture land and fertile soils have established agriculture as the major contributor to the region's economy. Livestock and arable production are within relatively small units (by the standards of much of south and east England) and the rural landscape still has an abundance of hedgerows and walled fields. Population density in the region as a whole is much lower than in the rest of UK, divided equally between the rural and urban populations. Belfast is the main centre of industrial activity and Belfast Port is one of the most important shipbuilding and repair centres in the UK. Land-claim has been more extensive here than elsewhere in the region and much of Belfast city centre and industrial complexes are built on former tidal land of Belfast Lough. Landfill takes place on a relatively small scale, though many of the licensed sites are on or near the coast. Generally, coastal water quality around the region is good, with only the two large conurbations of Belfast and Londonderry being major sources for industrial and other effluent. Licences have been issued for oil exploration in several blocks off the coast, but so far none of these has revealed significant oil or gas fields.

Only a relatively small proportion (15%) of the region's coastline has coastal defence works, although around a quarter of the coast is modified in some way. This is partly because relative to sea level the land appears to be static or barely rising, reducing the risk of flooding. However, erosion remains a problem and some coastal towns and villages are protected by revetments in bays. The traditional use of beach sand for application on fields exacerbates erosion, as beaches are depleted and their coast protection value reduced.

The fishing industry is a significant activity in Northern Ireland. It includes the exploitation of pelagic and demersal fish, but the region is most important for a wide range of shellfish species, landed for UK or Isle of Man markets or for live export abroad. Shellfish landings in the region in 1992, as a percentage of UK and Isle of Man totals, were roughly 25% for mussels (2,110 tonnes) and 21% for *Nephrops* ('scampi') (5,155 tonnes). *Nephrops* support the largest and by far the most important fishery in Northern Ireland, worth over £8 million in 1994. Mussels are dredged in Lough Foyle, Belfast Lough and Carlingford Lough, and in areas such as Dundrum Inner Bay they are hand gathered on a small scale for sale and home consumption. There is a dredge fishery for native oysters in Lough Foyle. Scallops and queen scallops are dredged from beds off the coast, and edible crabs *Cancer pagurus*, lobsters *homarus gammarus*, velvet crabs *Necora puber* and whelks are fished using pots. Periwinkles are increasingly being gathered by hand from rocky areas. Atlantic salmon *Salmo salar* and sea trout *S. trutta* are fished using rod-and-line and net methods, and the eel *Anguilla anguilla* fishery is important, especially in inland areas such as Lough Neagh. There is one marine salmon farm, at Glenarm Bay off the Antrim coast, producing approximately 300 tonnes of saleable fish per annum. Pacific oysters *Crassostrea gigas* and native oysters, mussels, Manila clams *Tapes philippinarum* and scallops are cultivated in the region.

The conservation of the coastline of Northern Ireland took a step forward with the publication in 1995 of a consultation paper on coastal zone management (DoE (NI) Environment Service 1995). A proposal for a forum for the discussion of coastal issues, similar to the approach adopted by the DoE in England, was accepted by government. The forum will advise government on the development of a coastal zone strategy, identifying objectives and priorities for

the conservation, management and sustainable development of the coastal zone. It will promote wider understanding of coastal processes and build on existing liaison arrangements, particularly local management committees such as those established for Belfast Harbour and Strangford Lough.

1.2.6 Further sources of information

A. References cited

Carter, B. 1991. *Shifting sands: a study of the coast of Northern Ireland from Magilligan to Larne*. Belfast, HMSO. (Countryside and Wildlife Research Series No. 2.)

DoE (NI) Environment Service. 1995. *Delivering coastal zone management in Northern Ireland. A consultation paper.* Belfast, DoE (NI).

Whatmough, J.A. 1995. *Grazing on sand dunes: the re-introduction of the rabbit* Oryctolagus cuniculus *L. to Murlough NNR, Co. Down.* In: The National Trust and nature conservation: 100 years on, ed. by D.J. Bullock & H.J. Harvey. *Biological Journal of the Linnean Society, 56* (Suppl.): 39-43.

B. Further reading

DoE (NI). 1993. *River and estuary quality in Northern Ireland - report of the 1991 survey*. Belfast, HMSO.

DoE (NI) (Environment and Heritage Service). 1996. *Coastal zone management in Northern Ireland*. Belfast, DoE (NI).

Meenan, J., & Webb, D.A., 1957. *A view of Ireland - twelve essays in different aspects of Irish life and the Irish countryside*. Dublin, Local Executive Committee of the British Association for the Advancement of Science.

Mills, S. 1987. *Nature in its place - the habitats of Ireland*. London, The Bodley Head.

The Antrim Coast Road, built in the mid-19th century for the then huge sum of £37,000, clings to a beautiful and dramatic shoreline. South of Cushendall, cliffs of Ulster White Limestone and basalt drop to narrow beaches made up entirely of shattered fragments of these resistant rocks. Photo: Mike Hartwell, DoE (NI) EHS.

Chapter 2 Geology and physical environment

2.1 Coastal geology

WS Atkins - Northern Ireland

2.1.1 Introduction

In Northern Ireland the variety of geology is greater than in any other area of similar size in the British Isles. Every geological system from the Precambrian to the Quaternary is represented, apart from the Cambrian period (Table 2.1.1). Many of these rock units are exposed along the coast, together with glacial and post-glacial deposits, which obscure the underlying rocks in many places. Map 2.1.1 shows the onshore coastal geology of the region; section 7.4 lists the Earth Science Conservation Review (ESCR) sites occurring in the region.

Among the oldest and structurally most complex rocks in Northern Ireland are the Dalradian metamorphic rocks of north-east Antrim and the Sperrin and Lough Foyle areas of Londonderry. The area around Lough Foyle is underlain by poorly-exposed rocks of Carboniferous and Mesozoic age, but the geomorphology of most of the rest of the coastline north of Belfast is determined by the Tertiary basalt lavas and Ulster White Limestone, which protect the underlying Mesozoic rocks from erosion. The basalt and limestone cliffs of County Antrim are unstable and huge portions of the cliff show the effects of rotational landslip due to slippage in the underlying Lias clays.

To the south of the Southern Uplands Fault, which runs south-west from Belfast, Lower Palaeozoic rocks (Ordovician and Silurian) underlie most of the area. With their complex structure and stratigraphy they are south-westerly extensions of the Southern Uplands in Scotland, although in Northern Ireland they form a much more subdued landscape, mantled by thick glacial deposits.

During the Quaternary, Northern Ireland was covered by at least two major ice sheets of distinct provenances. An ice sheet advanced south-westwards from Scotland during the Munsterian Cold Stage (300,000-130,000 years ago), and a later advance occurred during the Midlandian Cold Stage, between 120,000 and 18,000 years ago. During this last major glacial event the centre of ice accumulation was over Lough Neagh and ice moved radially outwards from there.

2.1.2 Stratigraphy

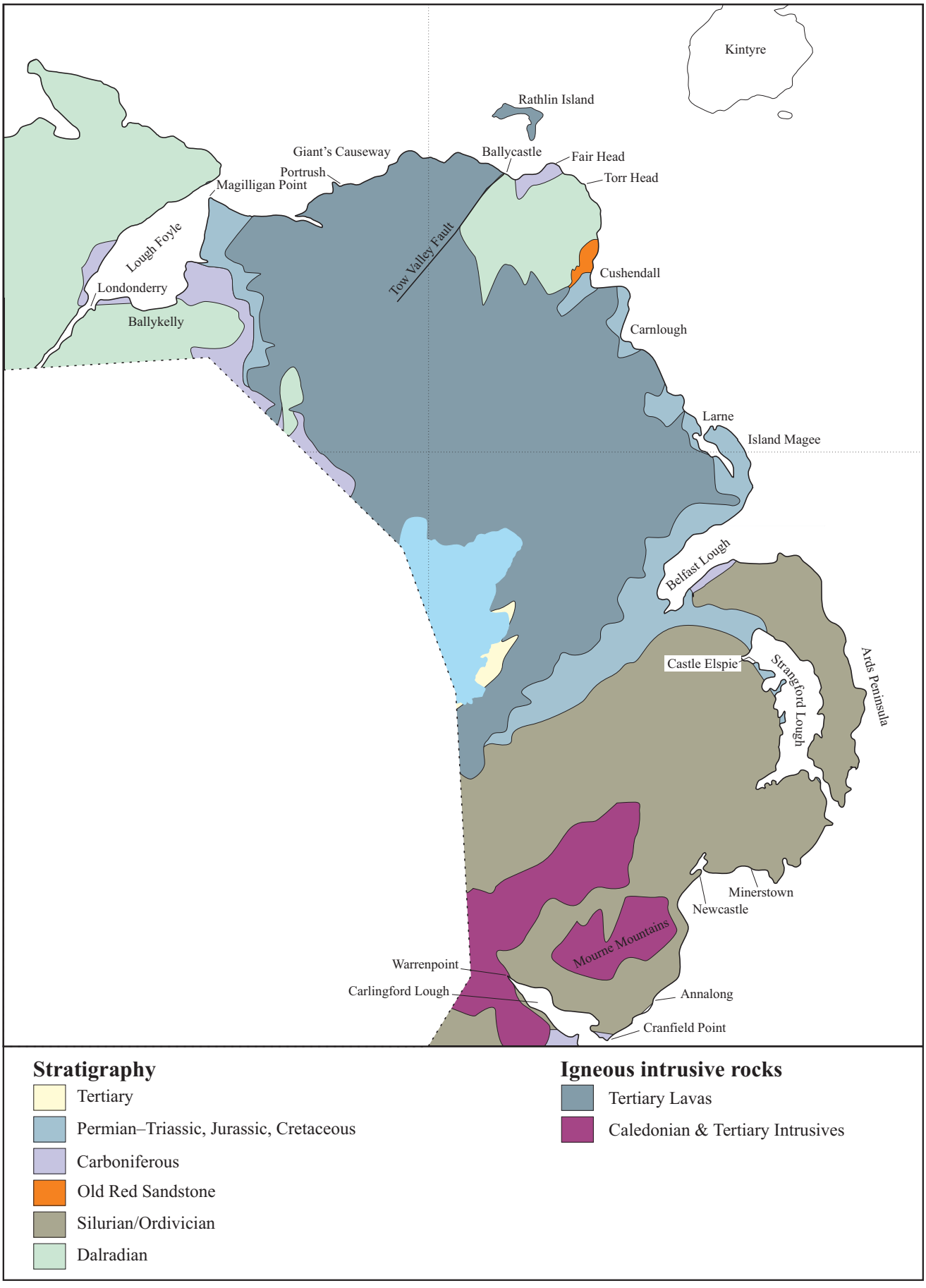
Londonderry - Magilligan

The Lough Foyle Basin represents a major depression within the Precambrian rocks of Londonderry and Donegal. The

Table 2.1.1 Geological column for Northern Ireland

Era	*Period*	*Epoch*	*Age of start (million yrs)*	*Stratigraphic units mentioned in the text*	*Significant geological events*
Cenozoic	Quaternary	Holocene	0.01		Rapid rise in sea level
		Pleistocene	1.8		Series of ice sheets cover the region
	Tertiary (Neogene)	Pliocene	5		
		Miocene	23		
		Oligocene	38		
	Tertiary (Palaeogene)	Eocene	54		
		Palaeocene	65	Antrim Plateau Basalts	Tertiary lavas and intrusions
Mesozoic	Cretaceous		146	Ulster White Limestone	Uplift of sedimentary basins
	Jurassic		208	Lias: Portrush Rock	
	Triassic		245	Mercia Mudstone Sherwood Sandstone	Deposition in Irish Sea basins
Palaeozoic (Upper)	Permian		290		
	Carboniferous		360	Carboniferous Limestone	
	Devonian		410	Old Red Sandstone	
Palaeozoic (Lower)	Silurian		440		
	Ordovician		505		Ocean floor sediments
	Cambrian		544		
Precambrian				Dalradian Moinian	Major metamorphic and structural events

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



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

southern shore of the lough is underlain by Carboniferous rocks, with Triassic and Jurassic rocks present north of the River Roe, but very few outcrops of these rocks occur. Much of the area is blanketed by thick glacial and recent deposits, with a notable glacial moraine developed near Ballykelly. Raised beach deposits of sand and gravel, together with peat and estuarine clay, are widespread. The area north of Balls Point forms part of the Magilligan complex of post-glacial gravel ridges, overlying peats and blown sand.

Magilligan - Ballycastle

At Magilligan Point on the north-east corner of Lough Foyle the coast is characterised by Holocene deposits of blown sand, which forms large areas of stable sand dunes. To the east, the basalt and the underlying Ulster White Limestone (equivalent in age to the Cretaceous chalk of Britain) create the rugged coastal scenery for which Antrim is famous. The Portrush promontory and the island chain of the Skerries are outcrops of a thick dolerite sill intruded into fossiliferous Lias shales; the latter, where metamorphosed, are known as 'Portrush Rock'. In the area between Portrush and Ballycastle the Lower Basalts are succeeded by a distinctive group of tholeiitic (a distinctive type of basalt) lava flows. These are typically 20 m or more thick and show regular columnar jointing, especially towards the base of the flow. The most famous development of these basalts is at the spectacular Giant's Causeway, where a wide depression in the Lower Basalts (possibly a river valley) was filled with the first flow of the tholeiitic series to an exceptional thickness of approximately 100 m. The process of slow cooling and the interaction with surface water in such a large pool of molten rock allowed the formation of unusually perfect columns, which have now been exposed by erosion. Spectacular cliff scenery on Rathlin Island has been formed by the basalt lavas and the Ulster White Limestone.

Ballycastle - Belfast

To the east of the Tow Valley Fault, between Ballycastle and Cushendall, is an area of Dalradian rocks very similar to the Upper Dalradian succession on Kintyre, which is located only 21 km away across the North Channel. The dominating vertical cliff of Fair Head consists of a massive Tertiary dolerite sill intruded into Carboniferous shale and sandstone with coal seams. A particular feature of the coastline is Torr Head, where black crystalline marbles and calcareous schists are intruded by epidiorite (a metamorphosed igneous rock). At Cushendall, Old Red Sandstone conglomerate and sandstone rest unconformably on Dalradian schists. To the south of Cushendall most of the east coast of Antrim is dominated by the massive flint-bearing Ulster White Limestone, which is exceptionally hard and impervious compared with the Upper Chalk of Britain; otherwise and especially on Island Magee there are low cliffs of basalt. The northern coast of Belfast Lough is formed of Triassic rocks of the Sherwood Sandstone and Mercian Mudstone groups, backed by the basalt hills of the lava plateau.

Belfast - Warrenpoint

With the exception of a restricted area of Carboniferous, Permian and Triassic rocks along the south shore of Belfast Lough, this section of coast is dominated by Ordovician and Silurian rocks that extend south-westwards into Monaghan and Cavan in the Irish Republic and north-eastwards into the Southern Uplands of Scotland. This coastline is much less dramatic than that of Antrim, particularly in the north of Down, which is mostly flat and low-lying except for the swarms of drumlins for which the Strangford Lough area is a type locality. Ordovician rocks are exposed along the northern coast of County Down, but further south the coastline is composed of Silurian rocks, with a few outliers of Carboniferous rocks, such as at Castle Espie near Comber (Strangford Lough) and at Cranfield Point (Carlingford Lough). The Tertiary granite complex of the Mourne Mountains provide an impressive backdrop to the coastline of South Down between Newcastle and Warrenpoint.
A significant feature of the geology of this area is the occurrence of numerous vertical igneous dykes. In the Ards Peninsula and east Down they are oriented east-north-east and are of Caledonian age, while to the south, the Mourne Dyke Swarm of Tertiary age includes over 120 dykes exposed along the coast south of Newcastle to beyond Annalong. There is a major Holocene series of blown sand overlying raised beach deposits between Minerstown and Newcastle, while a variety of unconsolidated glacial deposits dominates the geomorphology of other parts of the South Down coast, especially between Newcastle and Cranfield.

2.1.3 Acknowledgements

Thanks are due to Dr W.I. Mitchell, Geological Survey of Northern Ireland, and I. Enlander, DoE (NI) Environment and Heritage Service, for comprehensive comments on an early draft of the text.

2.1.4 Further sources of information

A. Maps

British Geological Survey. 1987. *Sea bed sediments around the United Kingdom (North Sheet).* 1:1,000,000 scale. Keyworth, British Geological Survey.

British Geological Survey. 1987. *Sea bed sediments around the United Kingdom (South Sheet).* 1:1,000,000 scale. Keyworth, British Geological Survey.

British Geological Survey. 1991. *Geology of the United Kingdom, Ireland and the adjacent continental shelf (North Sheet).* 1:1,000,000 scale. Keyworth, British Geological Survey.

British Geological Survey. 1991. *Geology of the United Kingdom, Ireland and the adjacent continental shelf (South Sheet).* 1:1,000,000 scale. Keyworth, British Geological Survey.

British Geological Survey. 1994. *Quaternary Geology around the United Kingdom (North Sheet).* 1:1,000,000 scale. Keyworth, British Geological Survey.

British Geological Survey. 1994. *Quaternary Geology around the United Kingdom (South Sheet).* 1:1,000,000 scale. Keyworth, British Geological Survey.

Geological Survey of Northern Ireland. 1968. *1:63,360 solid geology of Sheet 29 (Carrickfergus).* Belfast.

Geological Survey of Northern Ireland. 1968. *1:63,360 solid geology of Sheet 7 (Giants Causeway).* Belfast.

Geological Survey of Northern Ireland. 1976. *1:63,360 solid geology of Sheet 8 (Ballycastle).* Belfast.

Geological Survey of Northern Ireland. 1977. *1:250,000 geological map of Northern Ireland. Solid edition.* Belfast.

Geological Survey of Northern Ireland. 1978. *1:50,000 solid geology of parts of sheets 60, 61, 71 and 72 (Mourne Mountains).* Belfast.

Geological Survey of Northern Ireland. 1981. *1:50,000 solid geology of Sheet 12 and part of sheet 6 (Limavady).* Belfast.
Geological Survey of Northern Ireland. 1989. *1:50,000 solid geology of Sheet 37 and part of Sheet 38 (Newtownards).* Belfast.
Geological Survey of Northern Ireland. 1991. *1:250,000 geological map of Northern Ireland. Quaternary edition.* Belfast.
Geological Survey of Northern Ireland. 1994. *1:50,000 solid and drift geology of Sheet 21 (Larne).* Belfast.
Geological Survey of Northern Ireland. 1995. 1:50,000 solid and drift geology of Sheet 11 (Londonderry). Belfast.

B. Further reading

Banner, F.T., Collins, M.B., & Massie, K.S. 1980. *The north-west European shelf sea: the sea bed and the sea in motion. II. Physical and chemical oceanography and physical resources.* Cambridge, Elsevier. (Elsevier Oceanography Series.)
Bowen, D.Q. 1973. The Pleistocene succession of the Irish Sea. *Proceedings of the Geologists' Association, 84*: 249-272.
British Geological Survey. 1994. *The geology of the Malin - Hebrides Sea Area.* Keyworth, British Geological Survey. (UK Offshore Regional Report.)
Carter, R.W.G. 1982. The coast. *In: Northern Ireland environment and natural resources,* ed. by J.G. Cruickshank & D.N. Wilcock. Belfast, Queen's University of Belfast and The New University of Ulster.
Gibbons, W., & Harris, A.L., *eds.* 1994. *A revised correlation of Precambrian rocks in the British Isles*. London, Geological Society of London. (Special Report, No. 22.)
Griffith, A.E., & Wilson, H.E. 1982. *The geology of the country around Carrickfergus and Bangor*. Belfast, HMSO. (Memoir of the Geological Survey of Northern Ireland.)
Harris, A.L., & Pitcher, W.S. 1975. The Dalradian Supergroup. *In: A correlation of Precambrian rocks in the British Isles*, ed. by A.L. Harris *et al.*, 52-75. London, Geological Society. (Special Report of the Geological Society of London, No. 6.)
Jackson, A. In press. *The geology of the Irish Sea.* Keyworth, British Geological Survey. (British Geological Survey Offshore Regional Report.)
Lyle, P. 1996. *A geological excursion guide to the Causeway coast.* Belfast, DoE (NI) Environment and Heritage Service.
Mitchell, F. 1976. *The Irish landscape*. London, Collins.
Smith, R.A., Johnston, T.P., & Legg, I.C. 1991. *The geology of the country around Newtownards*. Belfast, HMSO. (Memoir of the Geological Survey of Northern Ireland.)
Wilson, H.E. 1972. *Regional geology of Northern Ireland*. Belfast, HMSO.
Wilson, H.E., & Manning, P.I. 1978. *The geology of the Causeway coast*. Belfast, HMSO. (Memoir of the Geological Survey of Northern Ireland.)
Wilson, H.E., & Robbie, J.A. 1966. *The geology of the country around Ballycastle*. Belfast, HMSO. (Memoir of the Geological Survey of Northern Ireland.)

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Geological information for Region 17; 1:50,000 scale map sheets	*DED Geological Survey of Northern Ireland, Belfast, tel: 01232 666595
Earth Science Conservation Review (ESCR) sites	*Centre for Environmental Data and Recording, The Ulster Museum, Belfast, tel: 01232 383000
Earth science conservation	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477
Coastal geomorphology and coastal processes	*The Queen's University of Belfast, School of Geosciences, Belfast, tel: 01232 245133
Coastal geomorphology and coastal processes	*The University of Ulster, School of Environmental Studies, Coleraine, tel: 01265 324401

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

2.2 Offshore geology

WS Atkins - Northern Ireland

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; named locations are shown on Map 1.2.1.

2.2.1 Holocene sea-bed sediments

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

Gravelly sediments occur extensively in the Irish Sea as a whole and are mainly relict, derived from pre-existing sediments. They occupy a broad belt in the northern Irish Sea and the North Channel (Map 2.2.1). Gravelly sediments tend to occur in places where strong tidal currents or wave action prevent the deposition of finer material (elsewhere in such places till or bedrock is exposed on the sea bed).

Areas of sand occur in narrow zones both close to shore and further offshore. There are two significant near-shore deposits, one along the northern coast and the other along the coast of Down. The north coast deposit extends eastwards from Lough Foyle along the Antrim coast and includes the Magilligan Foreland beach-ridge plain on the north-east shore of the lough. This is a classic Holocene coastal site, formed between the period of high sea level about 7,000-6,500 years ago and the return to present sea level approximately 2,000-1,500 years ago. The second area of significant sand deposits is across Dundrum Bay. From this, extensive dune systems have formed overlying shingle ridges and separating the Inner Bay from the Outer Bay. Offshore there is some evidence that the sand is extending over the present muddy sediments.

The largest area of mud deposits lies offshore from the sandy deposits of Dundrum Bay and extends across a wide expanse between the Isle of Man and the Irish coast. Although this is an area of relatively low wind and tide energy, detailed studies suggest that the muds are mainly relict. Another considerably smaller area of muddy sediments extends across Belfast Lough.

2.2.2 Pleistocene geology

The Pleistocene is the period from about 1.8 million years to about 10,000 years ago, during which the temperate zones of the Earth's surface experienced a number of glacial and inter-glacial climatic cycles (see also section 2.1.1). The retreat of the last major ice-sheet approximately 10,000 years ago left an extensive cover of drift material across Northern Ireland and on the bed of the Irish and Malin Seas. There are also drift deposits in the North Channel (Map 2.2.2).

Pleistocene deposits with four distinct lithologies have been identified in the northern Irish Sea and the North Channel. The two dominant deposits are glacial till and soft muds. Glacial tills are found throughout the North Channel (with the exception of the areas of exposed bedrock) and extend for several kilometres out to sea off the coast of Down. Soft muds occur in large areas between the Isle of Man and the coast of Down and to the south of the Mull of Kintyre. A smaller area of soft muds is found off the coast between Magilligan and Portrush.

The other two Pleistocene deposits comprise an area of sand to the south-east of Dundrum Bay and channel fill in the deep Beaufort's Dyke in the North Channel. The thickness of the Pleistocene deposits is highly variable, particularly in the North Channel, where the till is often less than 10 m thick. Further south the sediments between the Isle of Man and the Down coast are generally thicker, from 30-100 m.

2.2.3 Solid (pre-Quaternary) geology

Between the Antrim and Scottish coasts bedrock is exposed at the sea bed in many places, particularly close to the shore, but further south it is largely concealed by glacial or more recent deposits and palaeo-valley infill sediments.

Along the north coast of Londonderry and Antrim the Tertiary basalts extend for a few kilometres offshore, although a series of faults have exposed both Jurassic and Cretaceous rocks at several locations (Map 2.2.3). In north-east Antrim the Antrim Inlier of Dalradian rocks extends offshore for several kilometres before being covered once again by Permo-Triassic sedimentary deposits between Antrim and the Mull of Kintyre. Sedimentary basins containing thick sequences of Mesozoic sediments extend across large areas of the northern Irish Sea, and these deposits extend onshore across parts of southern Antrim beneath the Tertiary lava plateau.

The Ordovician and Silurian rocks of County Down extend offshore along the entire length of the coast before being covered by Carboniferous rocks in the area between the Irish coast and the Isle of Man. The bulk of the north-western Irish Sea is underlain by folded rocks of Carboniferous age, containing a few inliers of Lower Palaeozoic rocks.

2.2.4 Further sources of information

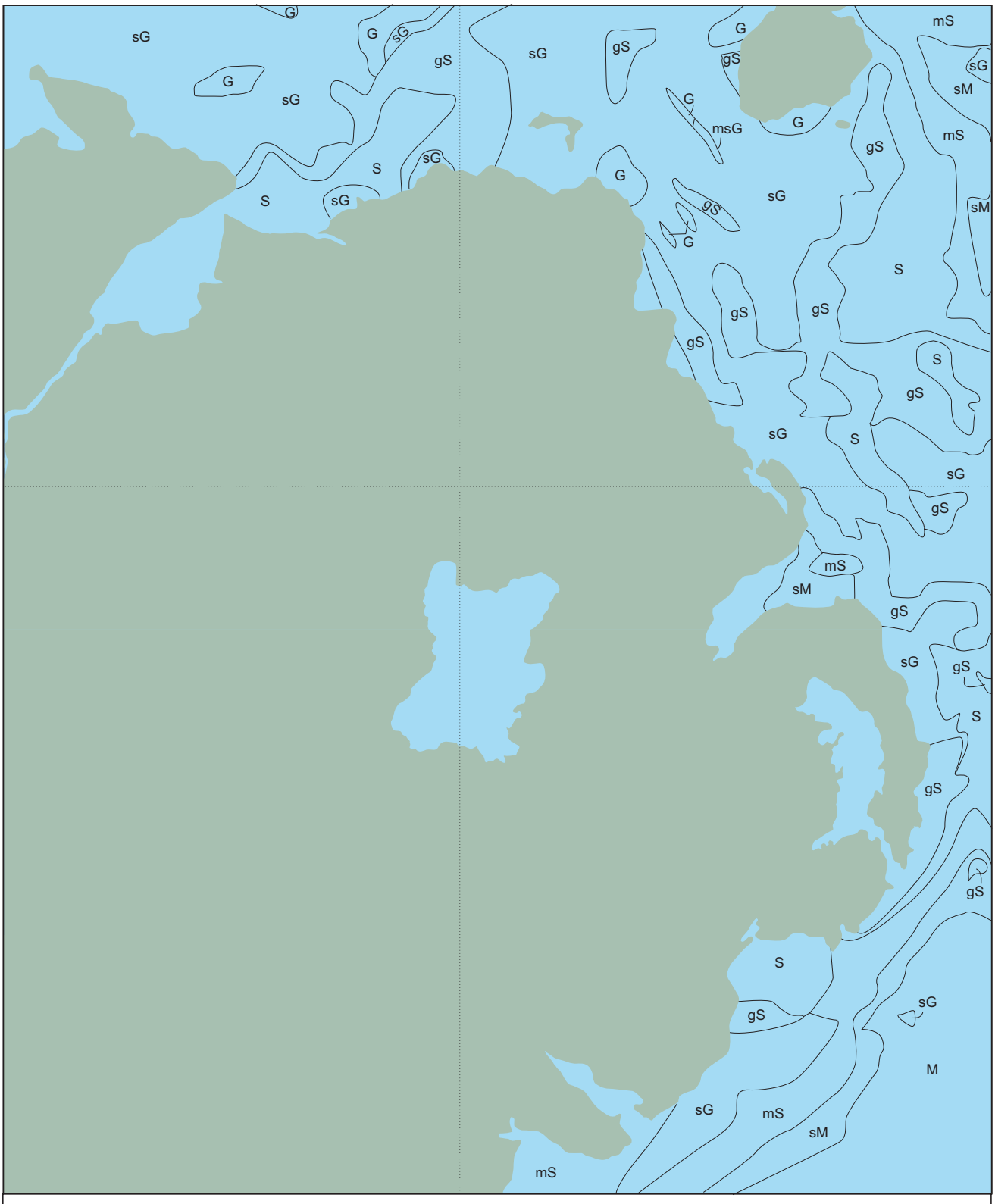
A. References cited

British Geological Survey. 1987a. *Sea bed sediments around the United Kingdom (North Sheet).* 1: 1,000,000 scale. Keyworth, British Geological Survey.

British Geological Survey. 1987b. *Sea bed sediments around the United Kingdom (South Sheet).* 1: 1,000,000 scale. Keyworth, British Geological Survey.

British Geological Survey. 1991a. *Geology of the United Kingdom, Ireland and the adjacent continental shelf (North Sheet).* 1:1,000,000 scale. Keyworth, British Geological Survey.

British Geological Survey. 1991b. *Geology of the United Kingdom, Ireland and the adjacent continental shelf (South Sheet).* 1:1,000,000 scale. Keyworth, British Geological Survey.



Key to seabed sediment symbols

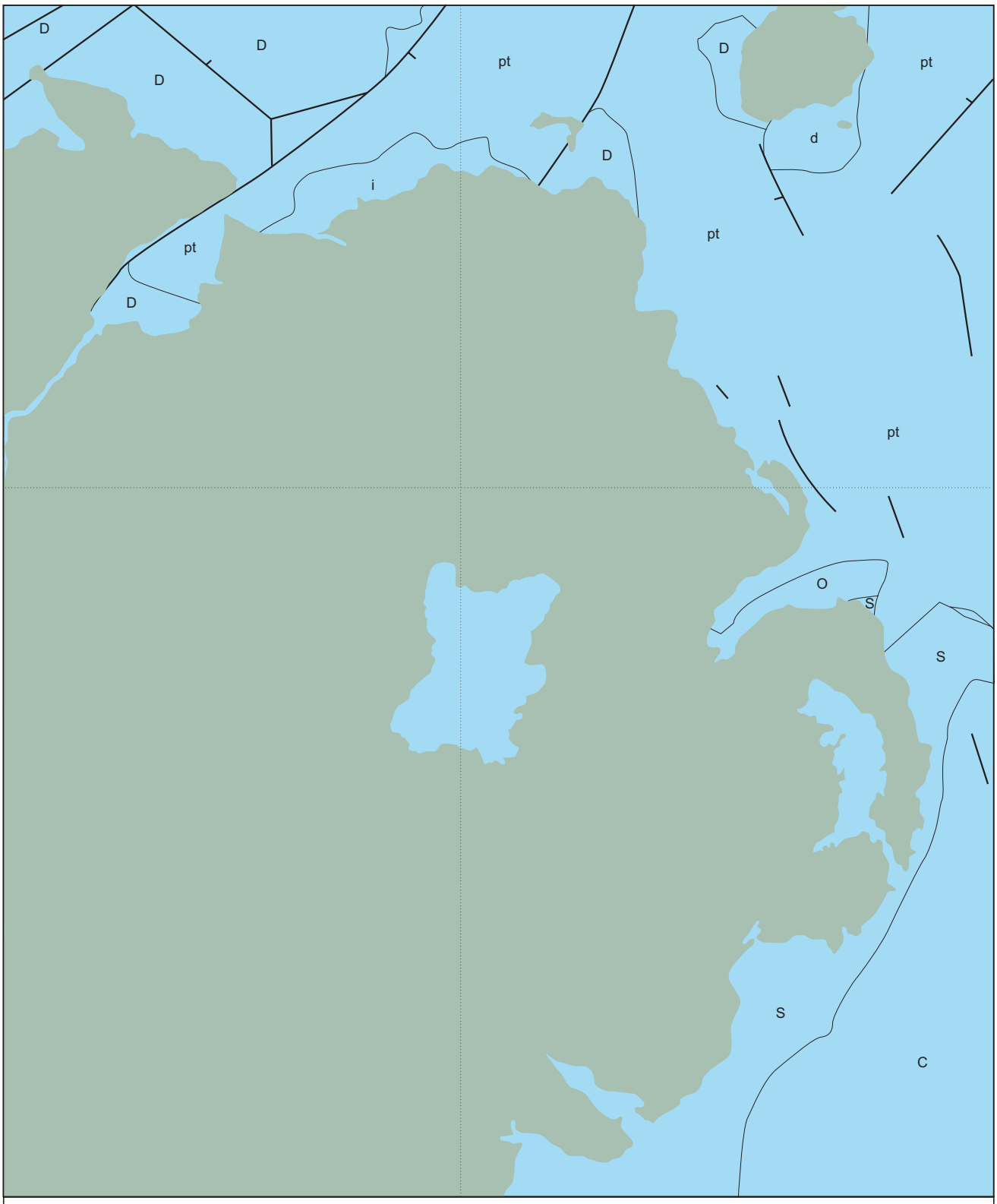
M	Mud	S	Sand	gS	Gravelly sand	msG	Muddy sandy gravel
sM	Sandy mud	mS	Muddy sand	G	Gravel	sG	Sandy gravel

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

Key to seabed sediment symbols

QLP	Late Pleistocene	1	Predominantly till
	Limit of data	2	Predominantly mud
	Mostly bedrock at sea bed	4	Predominantly sand
		6	Predominantly channel-fill

Map 2.2.2 Offshore Pleistocene deposits. Source: British Geological Survey (1994a, b). © Crown Copyright.



Stratigraphy

C	Carboniferous	S	Silurian
pt	Permian–Triassic	O	Ordovician
d	Devonian	D	Dalradian

Igneous rocks

i	Igneous

Structures

Fault, tick on downthrow side

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

British Geological Survey. 1994a. *Quaternary geology around the United Kingdom (North Sheet).* 1:1,000,000 scale. Keyworth, British Geological Survey.

British Geological Survey. 1994b. *Quaternary geology around the United Kingdom (South Sheet).* 1:1,000,000 scale. Keyworth, British Geological Survey.

Folk, R.L. 1954. The distinction between grain-size and mineral composition in sedimentary rock nomenclature. *Journal of Geology, 62:* 344-359.

B. Further reading

Banner, F.T., Collins, M.B., & Massie, K.S. 1980. *The north-west European shelf sea: the sea bed and the sea in motion. II. Physical and chemical oceanography and physical resources.* Cambridge, Elsevier. (Elsevier Oceanography Series.)

Bowen, D.Q. 1973. The Pleistocene succession of the Irish Sea. *Proceedings of the Geologists' Association, 84:* 249-272.

British Geological survey. 1994. *The geology of the Malin - Hebrides Sea area.* Keyworth, British Geological Survey. (UK Offshore Regional Report.)

Fyfe, J.A., Long, D., & Evans, D. 1993. *United Kingdom Offshore Regional Report*: *the geology of the Malin-Hebrides Sea area*. London, HMSO, for the British Geological Survey.

Jackson, A. In press. *The geology of the Irish Sea.* Keyworth, British Geological Survey. (UK Offshore Regional Report.)

Naylor, D., & Shannon, P. 1982. *Geology of offshore Ireland and west Britain*. London, Graham & Trotman.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Offshore geological information for Region 17	*DED Geological Survey of Northern Ireland, Belfast, tel: 01232 666595
Offshore geological information for Region 17	*Centre for Environmental Data and Recording, The Ulster Museum, Belfast, tel: 01232 383000
Earth science conservation	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477
Offshore geological information for Region 17	*The Queen's University of Belfast, School of Geosciences, Belfast, tel: 01232 245133
Side scan, shallow seismic records of the sea floor. Benthic stratigraphy.	*The University of Ulster, School of Environmental Studies, Coleraine, tel: 01265 324401
UKDMAP 1992. Version 2. United Kingdom digital marine atlas. Oceanographic maps.	*BODC, Birkenhead, tel: 0151 653 8633

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

2.3 Wind and water

WS Atkins - Northern Ireland

2.3.1 Wind

Parts of the coast of the region are among the windiest in the United Kingdom. Windspeeds at the coast exceed a value of between 3.5 m/s and 4.0 m/s (about Force 3 on the Beaufort Scale) for 75% of the time (Map 2.3.1), and for 0.1% of the time the wind speed along the coast to the north of Portaferry exceeds 19 m/sec (Gale Force 8) (Map 2.3.2; named locations are shown on Map 1.2.1). These values are of mean hourly speeds, but for shorter intervals the maximum speed is considerably greater. Factors such as local topography and wind direction determine local conditions and extreme speeds, but these values are representative of the windspeeds in coastal waters where they influence wave production.

On the north coast of Ireland (Malin Head) the dominant winds are from the west, south-west and south, each blowing for about 18% of the time, with winds from the north-west, east and south-east each blowing for about 10% of the time. The wind rose for Larne on the east coast shows that the dominant wind is from the south-west, blowing for about 26% of the time. The dominant winds at Killough are from the south-west, blowing for about 17% of the time, with only 6% from the east. Analysis of meteorological office wind data for Killough (Kirby 1989) showed that for the period 1977-89, 31% of the winds exceeding gale force were southerly, compared with 18% easterly, 24% south-easterly and 18% south-westerly - all onshore directions. Only 9% were westerlies. Onshore gales are the most significant in terms of erosive wave action. This information is from the Admiralty Irish Coast Pilot (Hydrographic Office 1994) (Figure 2.3.1).

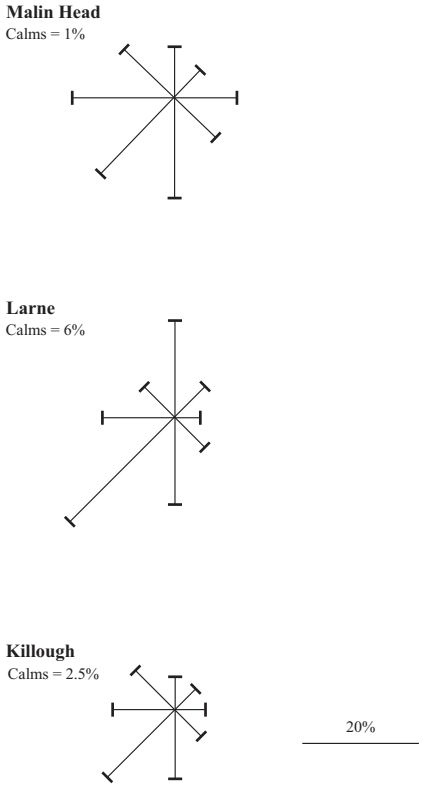
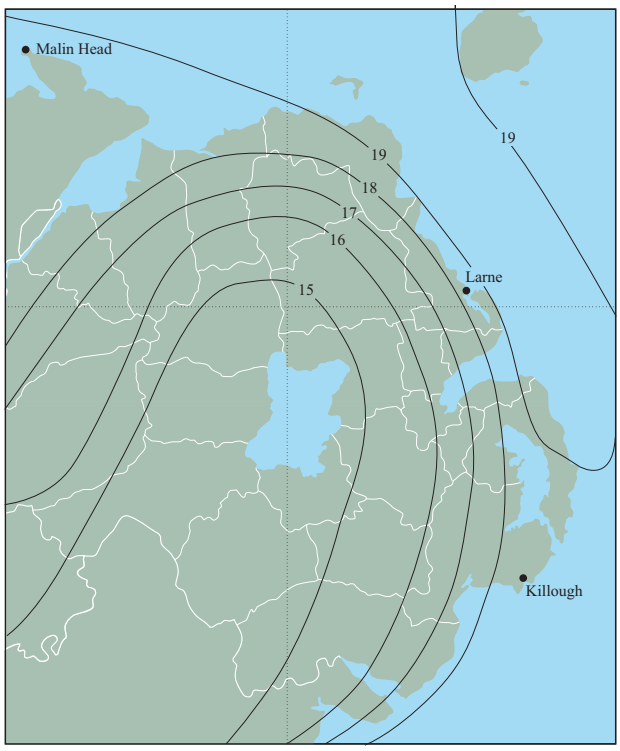


Figure 2.3.1 Wind directions at Malin Head, Larne and Killough shown as % of observations during the years 1916 - 1950. Locations are shown on Map 2.3.2. Source: Hydrographic Office (1994). © Crown Copyright.

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



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

2.3.2 Water depth

The bathymetry of the Irish coast to the south of Belfast is characterised by a shelf, generally shallower than 60 m, that continues along most of the eastern coast of the Irish Republic but extends for less than 20 km offshore (Map 2.3.3). To the east of this shelf the Celtic Trough extends to a depth generally well in excess of 60 m. The trough runs north from the Celtic Sea to the Malin Sea through the western Irish Sea and the North Channel.

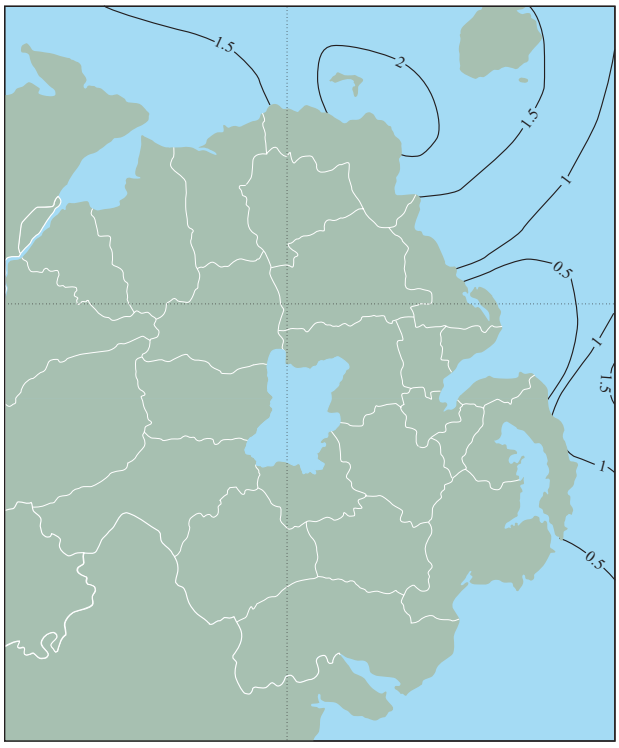
In the North Channel the sea bed is rough with many rock outcrops. Depths in this section of the trough are generally between 60-160 m, but there are upstanding areas and smaller prominences, some, such as the Maidens north of Larne, forming rocky islets. The enclosed deeps of Beaufort's Dyke attain a maximum water depth of 315 m.

Map 2.3.3 Bathymetry. Contours not shown where they lie close to the shore. Source: British Geological Survey (1987); Hydrographic Office (1994). © Crown Copyright.

2.3.3 Tidal currents

Tidal currents in the open sea during mean spring tides (Map 2.3.4) are at their maximum of over 2 m/s (4 knots) off Ballycastle and around Rathlin Island, where the North Channel reaches its narrowest point. Nearshore, particularly along the north-east coast and in most of the bays, eddies form, usually having the effect of prolonging the tidal streams in one direction (Hydrographic Office 1994). Off the headlands north of Belfast Lough and between the Ards Peninsula and the Copeland Islands the streams can be very strong at springs, running up to 2.5-3 m/s (5-6 knots) (Hydrographic Office 1994).

Tidal streams within the open water of Belfast, Strangford and Carlingford Loughs rarely exceed a rate of 0.5 m/s (1 knot), even at spring tides. The flows in constricted channels can, however, be much greater: tidal streams up to 4 m/s (8 knots) occur in the Strangford Narrows. Other instances of rapid flows in constricted channels include the mouths of Lough Foyle, Larne and Carlingford Loughs, between Magheramorne and Barney's Point within Larne Lough and at the entrances to Ardmillan Bay and the Dorn in Strangford Lough.

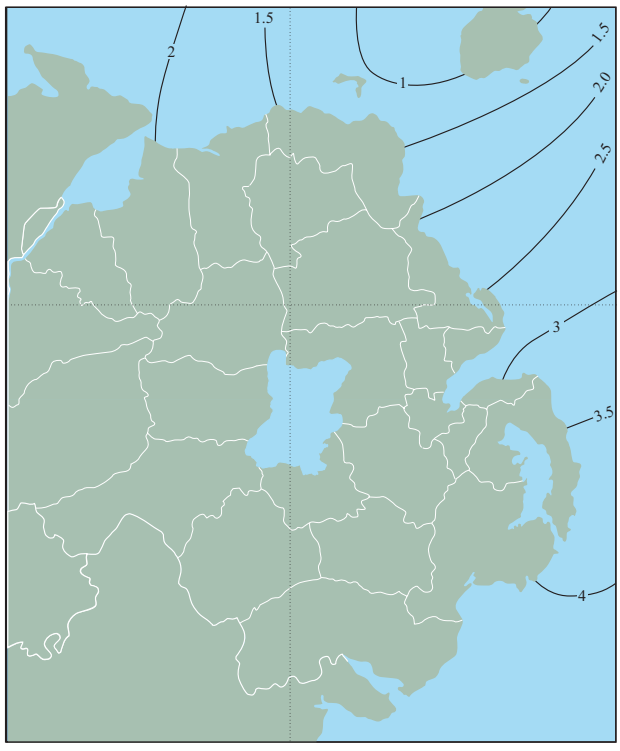


Map 2.3.4 Maximum tidal current speed (in m/s) at mean spring tides. Source: Sager & Sammler (1968). © Crown Copyright.

2.3.4 Tidal range

Around the coast of Northern Ireland the tidal range is generally low (Map 2.3.5), with a value of 2.4 m at mean spring tides at the border with County Donegal, decreasing eastwards to 1.0 m at Fair Head, one of the lowest values in the UK. The greatest tidal range (4.9 m) is found in the south-east of the province, at Dundrum Bay, which marks the meeting point of the tidal waves as they move south-eastward and north-eastward around the north and south of Ireland respectively.

Spring tides have about two to three times the range of neap tides. At Belfast the predicted spring tide range for 1996 was about 3.7 m, whilst the predicted neap tide range was about 1.4 m. In addition, tidal ranges are often modified by the weather: the effects of wind direction and barometric pressure are particularly noticeable over the gently-sloping shores of the sea loughs, where waves are small.

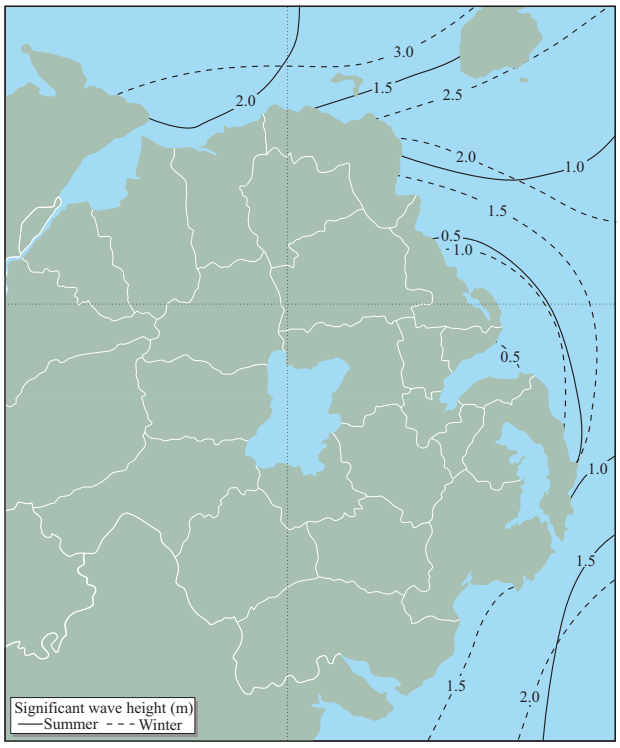


Map 2.3.5 Tidal range (m) at mean spring tides. Source: Lee & Ramster (1981). © Crown copyright.

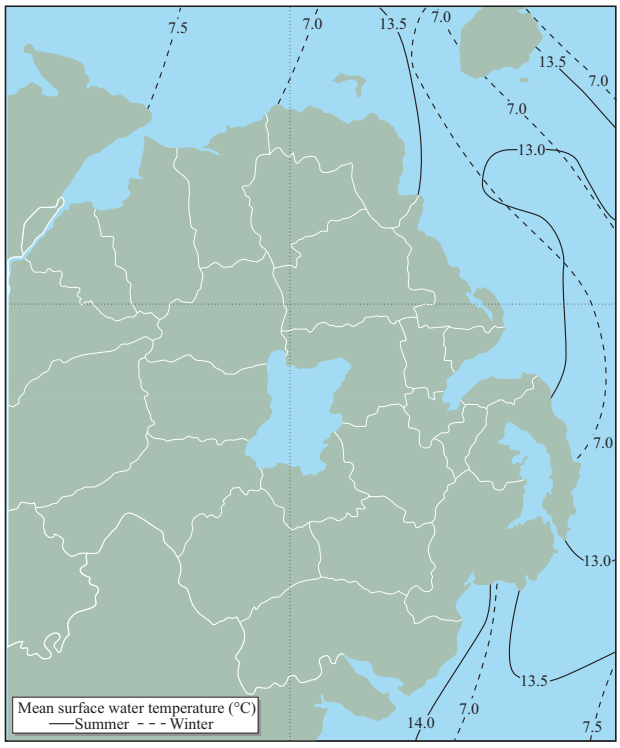
2.3.5 Wave exposure and sea state

Northern Ireland's wave climate is strongly influenced by storm waves generated by depressions moving north-eastwards across or to the north of Ireland. Long-period sea swells are also very important and help to determine the alignment of the region's beaches. Coastal wave regimes are split into two 'provinces': north coast and east coast. Map 2.3.6 shows significant wave height exceeded for 10% of the year for winter and summer respectively and demonstrates the contrast in wave energy along the north and east coasts. The north coast is the higher energy zone, as it is exposed more directly to Atlantic storms and swells, with 75% of wave power arriving from the west. The east coast is much more sheltered from the Atlantic, with its storm waves coming predominantly from the north-east and south-east. South-easterly storms appear to be more influential on beach behaviour. The predicted 50-year wave height in open water is between 16 and 25 m, being highest off Lough Foyle.

These wave heights are gross values, based on data from fully exposed sites and modified for water depth variations. Close to the shore, the varying orientation of the coast and its nearshore bathymetry modify wave heights, and waves can have a significant effect on coastal erosion and the residual drift of sediment. Whalley *et al.* (1985) analysed data from an



Map 2.3.6 Significant wave height (m) exceeded for 10% of the winter and summer. Source: Draper (1991). © Crown Copyright.



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

inshore wave pressure recorder east of Dundrum Bay and reported that the median significant wave height was 0.3 m.

2.3.6 Water characteristics

The water flow through the Irish Sea is weakly northward from St.George's Channel to the North Channel, and water typically takes a year to travel the full distance. This slow average flow is variable and strongly affected by the weather, particularly the wind. Recent research by Hill *et al*. (in press) has confirmed the existence of a seasonal anticlockwise gyre (circular motion) in the Irish Sea west of the Isle of Man. It operates in spring and summer, when stratification occurs, with warm water circulating around a dense 'dome' of cold water. This gyre provides a transport mechanism that could explain how larvae of 'southern' marine organisms, as well as contaminants from the seas off the west coast of England, reach the County Down coast.

Tidal currents dominate the movement of water in the Irish Sea. River discharge along the Northern Ireland coastline is small, but currents generated by rivers flowing out to sea are locally important in the circulation of water and sediment. Often the fresh water has a dark colour, owing to the presence of peat staining, and it can sometimes be traced several kilometres offshore as it spreads out from the river mouth.

Water temperature

Along the Northern Ireland coast there is little difference between the temperature of coastal and offshore waters. The surface temperature of the sea water (Map 2.3.7) is coldest in February/March, at about 7°C, and warmest in August/September, when it varies between 13°C and 14°C. In both seasons the waters of the region are the coolest of any part of the Irish coastline.

Warming of water at the sea surface in the summer encourages stratification, when lighter, warmer water overlies denser, colder water. Across most of the Irish Sea energetic tidal streams ensure that most of the water column is mixed throughout the year, but to the west of the Isle of Man stratification develops in summer, the surface layer being up to 5°C warmer than the bottom layer. A front up to 10 km wide may develop, separating stratified from well-mixed water. Biological activity may be high along this front during spring, when blooms of phytoplankton may occur (see section 4.3).

Salinity

The salinity of sea water around the Northern Ireland coastline varies only slightly between seasons and with distance from the shore. Map 2.3.8 shows the mean surface salinity for the summer and winter around Northern Ireland. Average surface salinity in winter and summer is 34% along the east coast. Salinity is slightly higher along the north coast, averaging 34.5% in winter and 34.25% in summer. Greater variation can occur near estuary mouths, where freshwater flows from rivers become mixed with sea water. The surface boundary between the fresh and salt water may be marked by a line of foam and a distinct colour change. Such patterns are often visible at the mouths of the Rivers Bann and Bush. The total freshwater input is small compared with the volume of the Irish Sea and is highly variable through the year and between years. Average river discharges from the east and north coast of Ireland as a whole are estimated as 180 and 70 m^3/s respectively (Irish Sea Study Group 1990). The sea loughs are essentially fully saline, although conditions of low salinity are present at the mouths of the larger rivers, such as the Foyle and Roe in Lough Foyle, the

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

Lagan in Belfast Lough, the Comber in Strangford Lough and the White Water and Narrow Water in Carlingford Lough.

2.3.7 Further sources of information

A. References cited

British Geological Survey. 1987. *Sea-bed sediments around the United Kingdom (North and South Sheets).* 1:1,000,000 scale. Keyworth, British Geological Survey.

Caton, P.G. 1976. *Maps of hourly wind speed over the UK 1965-73.* Bracknell, Meteorological Office. (Climatological Memorandum No. 79.)

Draper, L. 1991. *Wave climate atlas of the British Isles.* London, HMSO.

Hill, A.E., Brown, J., & Fernand, L. In press. *Structure and circulation of a seasonal gyre in the western Irish Sea.* (Paper presented at the 1995 annual conference of the Estuarine and Coastal Sciences Association, Trinity College, Dublin. ECSA.)

Hydrographic Office. 1994. *Irish coast pilot.* 13th ed. London, Hydrographic Office.

Irish Sea Study Group. 1990. *An environmental review.* Liverpool University Press.

Kirby, R. 1989. *Tidal flat instability and fine-grained sediment transport at Ardmillan Bay, Strangford Lough in relation to* Spartina *eradication and oyster trestle burial.* Belfast, unpublished report for DoE (NI) by Ravensrodd Consultants.

Lee, A.J., & Ramster, J.W. 1981. *Atlas of the seas around the British Isles.* Lowestoft, MAFF Directorate of Fisheries Research.

Sager, G., & Sammler, R. 1968. *Atlas der Gezeitenströme für die Nordsee, den Kanal und die Irische See.* Rostock, Seehydrographischer Dienst der DDR.

Whalley, W.B., Smith, B.J., Orford, J.D., & Carter, R.W.G. 1985. *lst International Conference on Geomorphology. Northern Ireland Field Trip 11th - 14th September 1985.* Belfast, Queen's University Belfast.

B. Further reading

Banner, F.T., Collins, M.B., & Massie, K.S., *eds*. 1980. *The north-west European shelf seas: the sea bed and the sea in motion. Vol. 2. Physical and chemical oceanography, and physical resources*. Amsterdam, Elsevier.

British Oceanographic Data Centre. 1992. *United Kingdom digital marine atlas user guide. Version 2*. Birkenhead, Natural Environment Research Council.

Carter, B. 1991. *Shifting sands - a study of the coast of Northern Ireland from Magilligan to Larne.* Belfast, HMSO/Department of the Environment for Northern Ireland.

Carter, R.W.G. 1982. The coast. *In: Northern Ireland environment and natural resources*, ed. by J.G. Cruickshank & D.N. Wilcock. The Queen's University of Belfast and The New University of Ulster.

Department of the Environment. 1992. *Digest of environmental protection and water statistics.* London, HMSO (Government Statistical Service).

Hydrographic Office. 1993. *Admiralty Tide Tables. Vol. 1. European waters*. London, Hydrographic Office.

Pantin, H.M. 1991. *The sea bed sediments around the United Kingdom: their bathymetric and physical environment, grain size, mineral composition and associated bedforms*. London, HMSO. (British Geological Survey Research Report SB/90/1.)

Shellard, H.C. 1968. *Tables of surface wind speed and direction over the United Kingdom.* London, HMSO.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
UKDMAP (United Kingdom digital marine atlas); oceanographic maps	*BODC, 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
Weather data (historical)	Belfast Weather Office, 1 College Square East, Belfast BT1 6DZ, tel: 01232 328457
Wave climate data	*DoE (NI) Construction Service, Belfast, tel: 01232 253428
Water quality data, tidal modelling	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 254736
Oceanographic data; tide gauge records; coastal process data	*The University of Ulster, School of Environmental Studies, Coleraine, tel: 01265 324401
Hydrographic data and extensive marine biological data; physical, chemical and oceanographic data	*The Queen's University of Belfast, Marine Biology Station, Portaferry, tel: 012477 28230
Hydrographic data and extensive marine biological data; physical, chemical and oceanographic data	*DANI Agricultural and Environmental Science Division, Belfast, tel: 01232 250666
Sampling and testing; physical, chemical and oceanographic data	*Department of Economic Development, Industrial Research and Technology Unit, Lisburn, tel: 01846 623000

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

2.4 Sediment transport

WS Atkins - Northern Ireland

2.4.1 Description

Coastal change in Northern Ireland is not as rapid as in parts of England (for example the south-east). The coasts of Northern Ireland are subject to a wide range of wave and tidal regimes, with the north coast being affected by Atlantic swells while the east coast is influenced by the more local wave climate generated in the Irish Sea (see section 2.3). There is little risk to human life from coastal processes; however, dune systems, saltmarshes and agricultural land are eroding in places and a few properties are threatened by cliff erosion, for example at Portballintrae. Motkya & Brampton (1993) have divided the coast of England and Wales into a series of major littoral cells and sub cells, each defining a section of the coast within which sediment erosion and accretion are inter-related and largely independent of other cells. In Northern Ireland no such comprehensive study has been undertaken, although the sediment transport of a large proportion of the Northern Ireland coast has been reviewed by Carter (1991). The following description and Map 2.4.1 are based substantially on that report. Detailed studies have been carried out on sections of the coastline, for example Bowen & Orford's (1984) examination of shore-sediment coastal cells along the Ards Peninsula.

Lough Foyle - Fair Head

Lough Foyle is supplied with sediments from the River Foyle and from Magilligan Point at the mouth of the lough. Magilligan Point is an important depositional feature, with dunes behind the beach, but further east the beach is rapidly eroding under the influence of strong north-westerly longshore drift. Around the mouth of the River Bann there are beach and dune systems at Castlerock and Portstewart, where careful management has reduced wind-driven erosion in recent times. The River Bann lies in an area of low wave energy and its mouth is protected by two large training walls, which interrupt the westerly movement of sand along the strand. Maintenance dredging is carried out at the river mouth, and the dredged material is deposited well offshore, where much of it is probably lost to the littoral system.

Portrush has two beaches, the West and East Strands on either side of Ramore Head, both of which have been affected by coastal works and sand extraction. The West Strand began to lose sand with the construction of Portrush Harbour in 1825; losses have been due to dredging, commercial extraction and wind erosion. The dune system behind the beach was lost to development in the 1960s. The East Strand (Curran Strand) is retreating slowly as a result of sand extraction, and dune 'blowouts' have resulted in loss of sand to the interior. To the east of East Strand, 5 km of stable basaltic cliffs extend as far as Portballintrae, where the beach has suffered severe local erosion. This may have been caused by the construction of Leslie's Pier in about 1895, which changed the wave regime so that beach sand was lost to deeper water.

The Giant's Causeway cliffs are suffering slow erosion, whilst from the Causeway to Ballintoy the coast is formed of raised beaches behind cliffs that are resistant to erosion. Within this stretch White Park Bay is a stable beach with a well-developed dune system that suffers relatively little erosion, but sand is removed for agricultural and commercial purposes. Towards Ballycastle the coast is characterised by cliffs subject to slow erosion, and the coast becomes more sheltered, losing the direct Atlantic influence. Longshore drift is westerly with sediments accumulating at the mouth of the river on the western side of Ballycastle Bay. The bay has suffered from loss of dunes, road construction and severe local erosion at its eastern end. The pattern of sediment transport is likely to be affected further by proposals to build additional breakwaters at Ballycastle Harbour. From Ballycastle to Fair Head the coast is formed of various igneous and sedimentary rocks, with high cliffs at Fair Head, all undergoing slow erosion.

Fair Head - Larne

From Fair Head the coastline becomes increasingly sheltered from Atlantic swells and storms. This stretch of coast is stable with little evidence of coastal erosion. There is no apparent supply of sediments and little littoral drift as far as Cushendun; coastal works and continued sand extraction have led to erosion at Cushendun and Cushendall. At Cushendun the small beach area is suffering erosion as a result of changes to the river mouth morphology. At Red Bay, where there is a slight northerly longshore drift, offshore sediments have been brought into the littoral zone. From Red Bay to Carnlough the shore is generally rocky with little sediment: longshore drift is southerly. The lack of material along this stretch of the coast is in part due to the construction of the coast road in the 1830s. At Carnlough the construction of coastal defence works has caused the gravel beach to drift to the south. South of Carnlough the shore is subject to sporadic erosion, with longshore drift to the south as far as Ballygalley Head, which acts as an effective barrier to further southerly drift.

Larne - Newry

Island Magee has cliffs with low rates of erosion and no apparent supply of sediments. The coast of Belfast Lough has been considerably modified with much infilling. There are few sediment supplies to the lough or within it. Bowen & Orford (1984) studied the cell circulation on the Ards Peninsula, which is characterised by a series of bays that are subject to slow erosion. Longshore drift can be either southerly or northerly. Strangford Lough has an eroding eastern shore with the eroded material accreting in sheltered bays to the west and south or being lost to the deeper sea bed. Some accreted material at the northern end of the lough has been resuspended and carried offshore in recent years.

Dundrum Inner Bay is virtually enclosed from the open sea by the large accreted dune systems of Ballykinler and Murlough. The position of the intervening river channel is extremely mobile, leading to alternate accretion and erosion of its sides. Currently sediment from the Murlough side is

eroding extremely rapidly, with commensurate accretion on the Ballykinler side. The dune systems are thought to be fed by northerly longshore drift from the south-west part of Dundrum Bay, but harbour and recreational developments in Newcastle appear to have altered sediment circulation, resulting in an interruption in the supply of beach sands.

The coast from Newcastle round to Carlingford Lough includes stretches of soft cliffs subject to rapid erosion (at a rate of 0.3 m/year), which feeds sediment into the system. In Carlingford Lough there is erosion on the north shore as a result of the focusing of waves through the mouth of the lough.

Map 2.4.1 Sediment transport. Sources: Adapted from Carter (1991); Orford (1985). © Crown Copyright.

2.4.2 Further sources of information

A. References cited

Bowen, R., & Orford, J.D. 1984. Residual sediment cells and the morphologically irregular coastline of the Ards Peninsula, Co. Down. *Proceedings of the Royal Irish Academy, 84B:* 13-27.

Carter, B. 1991. *Shifting sands - a study of the coast of Northern Ireland from Magilligan to Larne.* Belfast, HMSO/Department of the Environment for Northern Ireland.

Motyka, J.M., & Brampton, A.H. 1993. *Coastal management - mapping of littoral cells*. Oxford, HR Wallingford. (Report SR 328.)

Orford, J.D. 1985. Morphological units of Northern Ireland's coastline. *In: First International Conference on Geomorphology. Northern Ireland Field Trip 11th -14th September 1985,* ed. by W.B. Whalley, B.J. Smith, J.D. Orford & R.W.G. Carter. Belfast, Queen's University Belfast.

B. Further reading

British Geological Survey. 1991. *Geology of the United Kingdom, Ireland and the adjacent continental shelf (North Sheet).* 1:1,000,000 scale. Keyworth, British Geological Survey.

British Geological Survey. 1991. *Geology of the United Kingdom, Ireland and the adjacent continental shelf (South Sheet).* 1:1,000,000 scale. Keyworth, British Geological Survey.

British Geological Survey. 1987. *Sea bed sediments around the United Kingdom (North Sheet).* 1:1,000,000 scale. Keyworth, British Geological Survey.

British Geological Survey. 1987. *Sea bed sediments around the United Kingdom (South Sheet).* 1:1,000,000 scale. Keyworth, British Geological Survey.

Banner, F.T., Collins, M.B., & Massie, K.S. 1980. *The north-west European shelf sea: the sea bed and the sea in motion. II. Physical and chemical oceanography and physical resources.* Cambridge, Elsevier. (Elsevier Oceanography Series.)

Jackson, A. In press. *The geology of the Irish Sea.* Keyworth, BGS. (British Geological Survey Offshore Regional Report.)

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Marine and Earth Science database	*Centre for Environmental Data and Recording, Ulster Museum, Belfast, tel: 01232 383000
Impacts of coastal erosion; coastal process and conservation data	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477
Information relating to coastal cells	*The Queen's University of Belfast, School of Geosciences, Belfast, tel: 01232 245133
Oceanographic and coastal process data	*The University of Ulster, School of Environmental Studies, Coleraine, tel: 01265 324401

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

2.5 Sea-level rise and flooding

WS Atkins - Northern Ireland

2.5.1 Sea-level changes in the region

Apparent sea-level rise is the combined effect of vertical crustal movement (due to the removal of the weight of ice since the last glacial period, for example) and changes in global sea level, estimated as rising between 1.5 and 2 mm/year.

The best estimates of recent sea-level change across Northern Ireland are based on information from the tide gauges at Dublin, Belfast and Malin Head. At Dublin a small overall rise of 12 mm in mean tide-level over the last 40 years masks a rising trend up to 1961 followed by a falling trend since. At Belfast the data suggest that sea-level stayed constant until the 1950s but has since fallen. This may be connected with the infilling of the adjacent estuary causing a distortion of the tidal range. At Malin Head sea-level fell consistently between 1960 and 1985 at a rate of 2.4 mm/year but now appears to be rising. These trends may mark the final stages of post-glacial isostatic uplift in Ireland.

Sea-level changes may also be detected from geomorphological evidence such as shoreline erosion, beach ridge development and the evolution of coastal marshes and sand dunes such as at Magilligan, Co. Londonderry, and Dundrum Bay, Co. Down. The study of these formations provides historical information, but it is hard to interpret because of the wide contrast in wave energy, tides, sediments and geomorphology along the Northern Ireland coastline.

The data show no evidence of sea-level rise associated with global warming, the effect of which can so far only be estimated from theoretical models. It seems unlikely that there will be any noticeable increase in relative sea level in Northern Ireland before 2020 AD and substantial impact will probably not occur until the second half of the 21st century. Carter (1991) estimated a rise of 30 cm by 2035 AD.

2.5.2 Flooding in the region

Most of the coastal hinterland of Northern Ireland is above the reach of extreme high tide levels and is therefore not susceptible to flooding. The exceptions are low-lying areas in Lough Foyle and Strangford Lough, which would be subject to periodic inundation were it not for the sea defence structures.

Storm surges raise sea level for a few hours and considerably increase the risk of flooding if they coincide with high water. The predicted 50-year surge for the Northern Ireland coast is about 1.25 m. Modelling techniques allow the location and duration of surges to be predicted some hours in advance.

2.5.3 Further sources of information

A. References cited

Carter, B. 1991. *Shifting sands - a study of the coast of Northern Ireland from Magilligan to Larne.* Belfast, HMSO/Department of the Environment for Northern Ireland.

B. Further reading

Anon. 1992. *The Irish Sea Forum: global warming and climatic change - seminar report.* Liverpool, University of Liverpool Press.

Carter, R.W.G. 1982. Recent variations in sea-level on the north and east coasts of Ireland and associated shoreline response. *Proceedings of the Royal Irish Academy, 82B*: 177-187.

Department of the Environment. 1988. *Possible impacts of climate change on the natural environment in the United Kingdom.* London, HMSO.

Department of the Environment. 1992. *The UK environment: coast erosion, flooding and sea level change.* London, HMSO.

Department of the Environment & the Meteorological Office. 1990. *Global climate change.* London, HMSO.

Doornkamp, J.C., *ed.* 1990. *The greenhouse effect and rising sea levels in the UK.* Nottingham, M1 Press.

Emery, K.O., & Aubrey, D.G. 1985. Glacial rebound and relative sea levels in Europe from tide-gauge records. *Tectonophysics, 120:* 239-255.

Intergovernmental Panel on Climate Change (IPCC). 1996. *Climate change 1995. The science of climate change: summary for policy makers.* Bracknell, Meteorological Office.

UK Climate Change Impacts Review Group. 1991. *Review of the potential effects of climate change in the United Kingdom. Report 1.* London, HMSO. (Department of the Environment.)

UK Climate Change Impacts Review Group. 1996. *Review of the potential effects of climate change in the United Kingdom. Report 2.* London, HMSO. (Department of the Environment.)

Woodworth, P.L. 1987. Trends in UK mean sea level. *Marine Geodesy, 11*: 57-58.

Woodworth, P.L. 1990. A search for accelerations in records of European mean sea-level. *International Journal of Climatology, 10:* 129-143.

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

Woodworth, P.L. 1992. Sea-level changes. *In: Global warming and climatic change.* University of Liverpool. (Seminar Report, Irish Sea Forum.)

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Flood and coastal defence policy (see also section 8.4)	*DANI Rivers Agency, Belfast, tel: 01232 253355
Tide gauge data	*BODC, Birkenhead, tel: 0151 653 8633
Sea-level rise, oceanographic data, tide gauge records	*The University of Ulster, School of Environmental Studies, Coleraine, tel: 01265 324401

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

2.6 Coastal landforms

WS Atkins - Northern Ireland

2.6.1 Description

The coastal landforms of Northern Ireland are the product of a range of factors, including its geological structures and rock types, the Pleistocene glaciation of the region, Holocene sea-level changes and associated coastal processes, as well as human influences. Major coastal landforms are shown on Map 2.6.1. The region has a varied and, in places, dramatic coastline, incorporating high cliffs, extensive sand dunes, mudflats, rocky shores and, in the south, the spectacular backdrop of the Mountains of Mourne.

Lough Foyle - Portrush

The large, sheltered inlet of Lough Foyle is backed by low-lying land on its southern and eastern sides, although the mountains of Loughermore and Binevenagh form a backdrop in the hinterland, and the land is relatively steep on the west side of the lough. The River Foyle is tidal for about 53 km upstream of Culmore and Lisahally, where it enters Lough Foyle, and is still about 500 m wide more than 20 km above its entrance into the lough. To the east there are extensive areas of intertidal mud and sand, backed by land that has been claimed for agriculture, now mostly used for grazing or arable farming. The 9 km length of Magilligan Strand shelters the sedimentary shores of the lough, leaving a channel only 1 km wide at its entrance.

The Magilligan dune system is one of the largest coastal sand accumulations in the UK and consists of several lines of dunes backed by the coastal plain. The accretionary nature of the coast is seen further east at Castlerock and at Portstewart Strand, where dune systems are separated by the mouth of the River Bann, and at Portrush, where there is another significant area of dunes at Curran Strand. Between these areas of blown sand the coast is largely composed of rocky shores backed by low (<30 m) cliffs of Tertiary basalt.

Portrush - Fair Head

Low cliffs and rocky shores continue from Curran Strand to Portballintrae, north of which there is another area of dunes at Bushfoot Strand, the mouth of the River Bush. Further east the cliffs become more impressive, especially between the Giant's Causeway and Dunseverick, between Ballintoy and Ballycastle and around Fair Head, where the 100 m high cliffs are fronted by an extensive area of rock debris formed since the last Ice Age. There are intervening beaches and dune systems, for example at White Park Bay and Ballycastle Bay. At Dunseverick Harbour, and between White Park Bay and Ballintoy, there is a well-developed raised shoreline, formed when a former higher sea level cut a distinct platform into the chalk and basalt cliffs, leaving raised beaches and associated features such as caves, arches and stacks. Rathlin Island is predominantly rocky with well-developed cliffs: coastal erosion has produced notable sea-stacks towards Bull Point and a very large late-glacial raised beach in Church Bay.

Fair Head - Belfast

Moving south from Fair Head around Torr Head to Cushendun, the steep rocky coast is dominated by cliffs, against which in places lie poorly-sorted accumulations of beach material. The high Antrim plateau comes close to the coast, particularly at Greenanmore and Carnaneigh. Spectacular raised beach cliffs and caves have developed in the rocks around Cushendun. A number of rivers have cut glens down through the basalt along this stretch of coast, including the Glendun, Glenaan, Ballyemon and Glenariff Rivers, and further south, the Glencloy and Glenarm Rivers. South of Cushendall the cliffs give way to low dunes at Red Bay. Continuing southwards around Garron Point and Park Head the coast road runs between the cliffs and the sea and the coastal landscape is dominated by basalt and limestone cliffs that show large areas of rotational landslips, some of which are thought to have occurred as long ago as the end of the last Ice Age. South of Ballygalley the coastal plain widens out and there is a low raised beach, along which the coast road runs.

Larne Lough is shallow with well-developed saltmarsh at its head and extensive intertidal mudflats, while the outer coast of Island Magee has low cliffs. Black Head and White Head at the mouth of Belfast Lough are prominent headlands.

Belfast - St John's Point

Much of the low shoreline of Belfast Lough has been modified by coastal defence structures and the land claim of intertidal areas, particularly between Carrickfergus and Belfast, where the coast road follows the shoreline. At the head of the lough there is a large area of industry, port infrastructure and an airport. On the south side of the lough, between Holywood and Grey Point, sediment shores gradually give way to rock, and between Grey Point and Ballymacormick Point there are sandy beaches and stretches of low, rocky cliffs, behind which lies the town of Bangor.

The Outer Ards Peninsula from Ballymacormick Point to Ballyquintin Point is predominantly low-lying, with a series of wide, sandy bays between low, rocky headlands. Several rocky islands and reefs lie offshore, the largest being Copeland Island off Donaghadee. Intertidal rock outcrops become more extensive in the south, around Portavogie and south of Cloghy. Running from Ringboy Point to North Rocks is a 2 km gravel spit, the Ridge, the central kilometre of which is permanently submerged. There are significant stretches of raised beach deposits, particularly at Ringboy Point and Ballyquintin Point.

Sheltered by the Ards Peninsula and surrounded by low-lying land, Strangford Lough is a fine example of a drowned drumlin field in which the tops of these glacial features appear as islands and gravel ridges called 'pladdies'. There are extensive areas of intertidal mud and saltmarsh at the northern end of the lough, while the eastern shore has areas of somewhat coarser sediments. Rocky shores characterise

the narrows between Ballyquintin Point and Portaferry on the east side and Strangford to Killard Point on the west, through which a huge volume of water is forced at every rise and fall of the tide.

There are low, relatively erodible moraine cliffs at Killard and Ballyhornan, fronted by sandy beaches. Low rocky cliffs continue along the coast to St John's Point, with muddy inlets at Ardglass and Killough separated by the sandy beach at Coney Island.

St John's Point - Carlingford Lough

Rocky outcrops become less prevalent to the west, and at Dundrum Bay lie the extensive and well-developed dune systems of Ballykinler and Murlough, between which there is a tidal channel. The sand dunes shelter Dundrum Inner Bay, the estuarine mouth of three rivers, which has extensive fine sand and mudflats. On the Murlough side the sand dunes continue as far as Newcastle.

Map 2.6.1 Major coastal landforms. © Crown Copyright.

The character of the coast changes at Newcastle, where the Mountains of Mourne abut the coast, falling steeply into the sea between there and Dunmore Head, and again between Ballyneddan and Rostrevor on the shores of Carlingford Lough. Between Annalong and Cranfield Point there is a low-lying coastal plain partly edged by low cliffs of glacial sand and gravel, and now being eroded in places by the sea. Cranfield and Greencastle Points shelter the north shore of Carlingford Lough, which has extensive intertidal mudflats. The Newry River is tidal for about 10 km above its entry into the lough.

2.6.2 Acknowledgements

Thanks are due to Dr W.I. Mitchell, Geological Survey of Northern Ireland, Brian Murphy, Environmental Policy Division, DANI, and R.J. Bleakley and I. Enlander, DoE(NI) Environment and Heritage Service.

2.6.3 Further sources of information

A. Further reading

Banner, F.T., Collins, M.B., & Massie, K.S. 1980. *The north-west European shelf sea: the sea bed and the sea in motion. II. Physical and chemical oceanography and physical resources.* Cambridge, Elsevier. (Elsevier Oceanography Series.)

British Geological survey. 1994. *The geology of the Malin - Hebrides Sea area.* Keyworth, BGS. (UK Offshore Regional Report.)

Carter, B. 1991. *Shifting sands - a study of the coast of Northern Ireland from Magilligan to Larne.* Belfast, HMSO/Department of the Environment for Northern Ireland.

Jackson, A. In press. *The geology of the Irish Sea.* Keyworth, BGS. (British Geological Survey Offshore Regional Report.)

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

B. Contact names and addresses

Type of information	*Contact address and telephone no.*
Terrestrial, marine and earth science databases	*Centre for Environmental Data and Recording, The Ulster Museum, Belfast, tel: 01232 383000
Impacts of erosion and earth science conservation	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477

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

To the south-west, Dundrum Bay is dominated by the Mountains of Mourne, which 'sweep down to the sea' in one long breathtaking plunge. Slieve Donard, the highest peak visible, is also the highest point in Northern Ireland and supports some of the finest stretches of dry heath in the province. Both the Eastern Mournes and Murlough Dunes National Nature Reserve (foreground) are internationally important potential Special Areas of Conservation. Photo: Mike Hartwell, DoE (NI) EHS.

Chapter 3 Terrestrial coastal habitats

Later sections in this chapter cover terrestrial coastal habitats (habitats that are maritime influenced, i.e. are distinctive because of their association with the coast and coastal processes) in Region 17. This introduction briefly describes the other semi-natural habitats in the region that are of prime significance for nature conservation and that are adjacent to the coast but are not dependent for their character on their proximity to the sea. In this region the most important of these are bogs, heathland, montane areas and woodland. Map 3.0.1 shows locations of important areas of these semi-natural non-maritime habitats mentioned in the text. (Other non-maritime habitat types in the region include semi-natural grassland, rivers, lakes and wetlands other than peat bogs; these habitats are not discussed further.)

Actively growing blanket bog is a priority habitat for protection under the EC Habitats & Species Directive; the UK and the Republic of Ireland hold almost the entire resource in the European Union. Blanket peat covers much of the higher ground of the basalt plateaux of north Co. Londonderry and Co. Antrim, where the Garron Plateau (a candidate Special Area of Conservation - SAC) is the most extensive area of blanket bog in Northern Ireland. Here the blanket bog has numerous pool systems and extensive and well developed base-rich flushes. It supports a number of rare plant species, including few-flowered sedge *Carex pauciflora*, tall bog-sedge *C. magellanica*, for which it is the main Irish locality, and bog orchid *Hammarbya paludosa*. Less extensive blanket peat areas occur in the wetter parts of the Mourne Mountains in Co. Down, notably Kilbroney Red Bog, above Rostrevor, where few-flowered sedge also occurs.

Important areas of heathland occur in the region on both coastal dunes (see section 3.2) and the lower, drier slopes of the mountains, grading into blanket peat at higher altitudes. Lowland heathland, such as on Rathlin Island, the Copeland Islands and the outer headlands in Belfast Lough, is a scarce habitat in Northern Ireland; at these locations it is important for lower plants such as lichens and bryophytes and for a range of rare invertebrates. All recent Northern Irish breeding records for the twite *Carduelis flavirostris*, a scarce finch, come from heathland in the north of Co. Antrim. The Eastern Mournes Area of Special Scientific Interest (ASSI) - also a possible SAC - contains by far the largest area of dry heath in Northern Ireland, a result of the mild and comparatively dry 'rain shadow' local climate. Here the heathland habitat on the lower slopes is often characterised by a colourful combination of western gorse *Ulex galli*, heather *Calluna vulgaris* and bell heather *Erica cinerea* and at mid altitudes by extensive tracts of heather and bell heather.

As most of the uplands in Northern Ireland lie near the coast, alpine-type higher plant species in the Province also tend to have coastal distributions. Several montane species occur in the region, usually associated with the basalt scarps of Co. Londonderry and Co. Antrim. These scarps frequently form spectacular sea cliffs, are usually less than 5 km from the sea and can be subject to salt spray blown inland, leading to the presence of maritime species such as sea campion *Silene maritima* and thrift *Armeria maritima* at altitudes in excess of 300 m. The inland cliffs of Binevenagh,

Map 3.0.1 Locations of important areas of semi-natural non-maritime habitat mentioned in the text.

Co. Londonderry, a (National) Nature Reserve, exhibit an arctic-alpine type flora and support the only Northern Ireland populations of moss campion *Silene acaulis* and purple saxifrage *Saxifraga oppositifolia* (both Red List species), at about 300-400 m; mountain avens *Dryas octopetala* also grows at the same site at about 240-340 m, and on the basalt scarp at Sallagh Braes near Larne, Co. Antrim. Yellow saxifrage *Saxifraga aizoides* (a Red List species) occurs with smooth lady's-mantle *Alchemilla glabra* at its only Northern Ireland location, in the area of Murlough Bay and Torr Head, Co. Antrim, mostly growing at about 300 m on red sandstone below chalk cliffs but descending to sea level at Murlough Bay. Roseroot *Sedum rosea* is recorded from the steep cliffs at the north-west end of Rathlin Island and between Torr Head and Fair Head, and mossy saxifrage *Saxifraga hypnoides* is locally abundant at Binevenagh, on Rathlin on grassy scree slopes and rock faces and around the tops of waterfalls at Garron Point.

The acidic granite massif of the Mourne Mountains in south Co. Down rises steeply from the coast to Slieve Donard, only 3 km inland and, at 850 m, the highest point in Northern Ireland. The northern part and lower slopes of the range are still capped in places by Silurian shales and have basalt intrusions, both slightly base-rich in character. The mountains are rich in bryophytes, lichens and fungi, some associated with the basalt, and support a range of alpine higher plants, many associated with the Silurian rocks, and including roseroot, alpine-clubmoss *Diphasiastrum alpinum*, alpine saw-wort *Saussurea alpina* and parsley fern *Cryptogamma crispa*.

By the middle of the nineteenth century the high demand for agricultural land had led to the clearance of most of the woodland in the region. As a result the epiphytic lichen flora became generally impoverished. The lichen and fungal interest of woodland around industrial Belfast and Larne was further reduced by air pollution in the twentieth century. The region remains lightly wooded, except for a few small areas along the coasts of north Co. Londonderry, Co. Antrim and south Co. Down. Of the remaining coastal woodlands, many are old estate woods or modern conifer plantations (see also Chapter 8). A few areas in the region do contain semi-natural woodland, for example oakwoods at Umbra in Co. Londonderry, at Glenarm in Co. Antrim and at Finnebrogue and Rostrevor in Co. Down; Rostrevor may be a remnant of ancient woodland modified by coppicing and interplanting. In Co. Antrim, hazel woods with a rich understorey and spring-flowering ground flora are an important and characteristic feature of the basalt scarps, for example at Glenariff ASSI, Straidkilly (N)NR and Cave Hill Local Authority Nature Reserve (LANR). Bird cherry *Prunus padus* is a feature of the woods of the Antrim Glens.

The steep slopes of the glens that cut through the basalt scarp and run down to the coast in Co. Londonderry and the north-east of Co. Antrim are often wooded and may have streams with waterfalls, creating conditions of high humidity. This has led to the presence of oceanic lower plant species, including the liverwort *Dumortiera hirsuta* and the lichen *Sticta dufourii*. The only Irish site for the submontane liverwort *Leiocolea (Lophozia) heterocolpos* also occurs here. The basalt scarp also supports rare woodland higher plants, such as Tunbridge filmy-fern *Hymenophyllum tunbrigense*, Killarney fern *Trichomanes speciosum* and wood cranesbill *Geranium sylvaticum* (see also section 5.2). In Murlough Bay, Co. Antrim, woodland contains many rare Irish species of beetle, mollusc and two-winged fly. Woodland in Co. Down is of high significance for its fungi: 29 rare or scarce species occur in locations such as Clandeboye and Tollymore Park and other sites around the lower slopes of the Mourne Mountains.

Rathlin Island, off the north Antrim coast, is an outstanding site for nature conservation in Northern Ireland, with unspoilt examples of heathland, wetlands, sea caves and seabird cliffs, which plunge to great depths and support a rich marine fauna; its international importance has led to its selection as a possible Special Area of Conservation. Three lighthouses on the island, including the West Lighthouse (shown here), testify to the hazardous conditions shipping faces in the channel between North Antrim and the Mull of Kintyre. Photo: Mike Hartwell, DoE (NI) EHS.

3.1 Cliffs and cliff-top vegetation

Dr A. Cooper & C. Butler

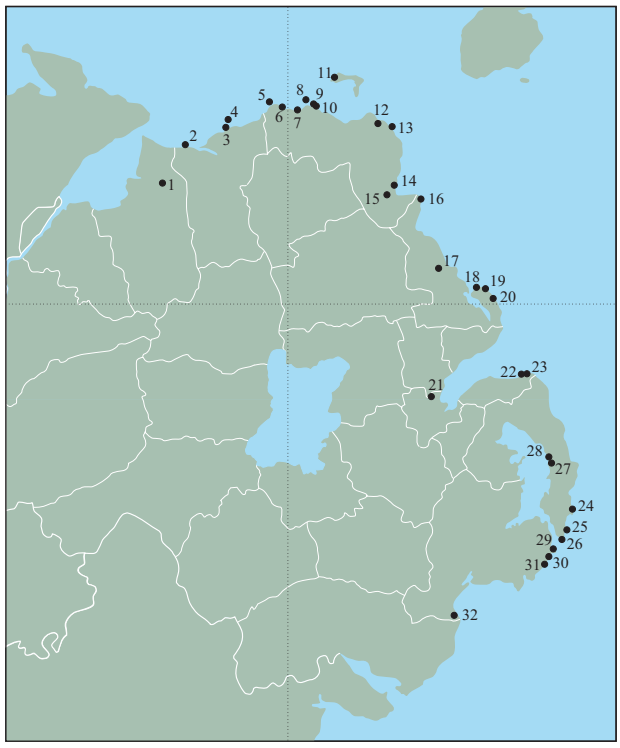
3.1.1 Introduction

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°), 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, including most of the regional resource) and unconsolidated (soft cliffs developed in easily-eroded, predominantly Quaternary - Pleistocene and Holocene - deposits).

Cliff and cliff-top vegetation varies markedly even over short distances, changing in relation to slope angle, soil type and salt spray deposition, with much local variability possible with changing exposure around headlands. The major natural and semi-natural cliff and cliff-top habitats in the UK are bare ground, spray-zone lichen-covered rock, rock crevice, cliff-ledge, seabird colony, perched saltmarsh, flushes, maritime grassland and maritime heath. Soft cliffs on sheltered coasts can develop undercliff vegetation of woodland, scrub, tall herb and rank grassland, often very close to the sea.

Cliffs and cliff-top habitats in Northern Ireland have not been fully surveyed, and so precise inter-regional and national comparisons cannot be made. However, the range of vegetation types they support illustrates the diversity of geology and landform displayed by cliffs in this region. They include the basaltic cliffs of the Giant's Causeway, basalt cliffs overlying chalk typical of much of the north and east Co. Antrim coasts, the boulder clay cliffs north of Larne, low greywacke and siltstone cliffs in eastern Co. Down and the moraine cliffs of Killard and south of Kilkeel. Cooper *et al*. (1992) surveyed nine cliff sites as part of a study of the Northern Ireland coastline. They recorded six main National Vegetation Classification (NVC) vegetation types (Rodwell in prep.) of cliff and cliff-top vegetation. These were maritime crevice vegetation (MC1); maritime therophyte (perennial) vegetation (MC5); seabird cliff vegetation (MC6); bird cliff vegetation (MC7) and two maritime grassland vegetation types (red fescue *Festuca rubra* - Yorkshire-fog *Holcus lanatus* (MC9) and red fescue - thrift *Armeria maritima* (MC8)). Two heathland vegetation types were recorded (H7, H8).

The high scenic quality of the Antrim and Mourne coasts, much of which is owned by the National Trust, is enhanced by the character of the cliffs and steep scarps of those areas. The Giant's Causeway is a World Heritage Site, cliffs on Rathlin Island are a Special Protection Area for birds (see also section 7.2); and the majority of the Antrim Coast is designated an Area of Outstanding Natural Beauty (see also section 7.3). In addition, many cliff sites are of national or international geological significance, reflected in their selection as Earth Science Conservation Review sites (see also section 7.4).



Map 3.1.1 Cliffs (Table 3.1.1). © Crown Copyright.

3.1.2 Important locations and species

The main cliff and cliff-top vegetation sites in Northern Ireland are listed in Table 3.1.1; their locations are shown on Map 3.1.1.

The coast of north-east Co. Londonderry and Co. Antrim is rugged, being dominated by basalt and chalk cliffs along much of its length. Basalt scarps are also found more inland at Binevenagh, where there is still some influence of sea-spray on the vegetation (Williamson 1984). The Giant's Causeway is especially significant for its geological formations, which represent volcanic activity of the Tertiary period. The extent of cliff exposures of columnar and massive basalt make the Causeway an area of international geological significance. The vegetation along the Causeway coast and the north Antrim coast is characterised by species-rich maritime cliff-top and cliff-slope grassland and maritime heath communities. Maritime heath is particularly well developed on cliff-tops at Kebble and Kinramer on Rathlin Island, where western gorse *Ulex gallii* occurs as wind-pruned heather *Calluna vulgaris* - western gorse heath. In the south, small areas of maritime heath are present at Horse Island to Doctor's Bay, over ridges, outcrops and low cliffs, and at Killard. Species-rich maritime grassland occurs on low-lying rocks at Templecowey and Ballyquintin Point.

The rock samphire *Crithmum maritimum* - rock sea-spurrey *Spergularia rupicola* maritime crevice community (MC1) occurs only on the exposed cliffs of the Giant's Causeway, at the western end of Rathlin Island, where it

Table 3.1.1 Cliff and cliff-top habitats in the region

Site no. on Map 3.1.1	*Name*	*Grid ref.*	*Type*	*Conservation status*
	Co. Londonderry			
1	Binevenagh*	C6830	Basalt cliff	(N)NR, AONB
2	Downhill	C758363	Basalt cliff	NT, AONB
	Co. Antrim			
3	Portrush	C858411	Low rocky cliff	(N)NR, AONB
4	The Skerries	C870426	Low rocky cliff	ASSI, AONB
5	Giant's Causeway	C952452	Columnar basalt/basalt cliff (maritime grassland, heath, ledge and crevice vegetation)	(N)NR, WHS, ASI, ESCR, NT, AONB
6	Dunseverick Castle	C987445	Basalt cliff	NT, AONB
7	White Park Bay	D023440	Chalk cliff (maritime grassland, scrub and woodland)	NT, AONB, ASSI
8	Sheep Island	D049459	Basalt sea stack	SPA, ASSI, NT, AONB
9	Larrybane/Knocksoghey	D0644	Chalk and basalt cliff	NT, AONB, ASI
10	Carrickarade	D062450	Basalt plug sea stack	ESCR, NT, AONB, ASI
11	Rathlin Island (Kebble)	D095515	Basalt cliff with breeding birds (maritime grassland, bird vegetation, fen and maritime heath)	(N)NR, ASSI, AONB
12	Fair Head/Murlough	D199419	Basalt sill/chalk and sandstone cliff	NT, AONB, ASI
13	Torr Head	D235406	Basalt cliff/chalk exposures	AONB, ASI
14	Cushendall	D245277	Basalt cliff	AONB
15	Lurigethan*	D2225	Basalt cliff	AONB
16	Garron Point	D2924	Basalt cliff	AONB
17	Sallagh Braes*	D3406	Basalt cliff	ASI, AONB
18	Skernaghan Point	D437036	Low rocky cliff	ASI, NT
19	Isle of Muck	D465025	Basalt cliff with nesting birds	UWT, ASI
20	Island Magee	D4601-J4897	Basalt cliff	ASI
21	Cave Hill*	J3279	Basalt cliff	ASI
	Co. Down			
22	Ballymacormick Point	J530838	Low rocky cliff with maritime scrub, fen, grassland and heath	ASSI, NT
23	Orlock Point	J539838	Low rocky cliff	pSPA, NT
24	Kearney/Knockinelder	J650517	Low rocky cliff	pSPA, NT
25	Templecowey	J632475	Low rocky cliff with maritime scrub and grassland	pSPA, AONB
26	Ballyquintin Point	J624456	Low rocky cliff with maritime grassland and scrub	ASSI, (N)NR, pSPA, pSAC, AONB
27	Horse Island	J598608	Low rocky cliff with maritime scrub and heath	ASSI, pSPA, pSAC, AONB
28	Horse Island to Doctor's Bay	J5960-J5961	Low rocky cliff	ASSI, pSPA, pSAC, AONB
29	Killard	J610433	Moraine cliff with maritime heath and grassland	(N)NR, ASSI, pSPA, pSAC, AONB
30	Guns Island	J600410	Shale cliff (maritime grassland, ledge, crevice and seabird vegetation)	ASSI, AONB
31	Lecale Coast	J585395	Shale cliff (maritime grassland, flush, ledge and crevice vegetation)	AONB
32	Mourne Coast	J3829-J3823	Low rocky cliff (maritime scrub)	ASI, AONB

Source: DoE (NI) Environment and Heritage Service. Note: *these cliffs lie up to 4 km inland but their flora includes maritime species. Key: pSAC = possible Special Area of Conservation; pSPA = proposed Special Protection Area; AONB = Area of Outstanding Natural Beauty; ASI = Area of Scientific Interest; ASSI = Area of Special Scientific Interest; (N)NR = (National) Nature Reserve; WHS = World Heritage Site; ESCR = Earth Science Conservation Review site; NT = National Trust Property; UWT = Ulster Wildlife Trust.

occurs on small ledges not enriched by seabirds, and St. John's Point, Co. Down. The maritime therophyte community characterised by thrift and sea mouse-ear *Cerastium diffusum* (MC5) was found on the cliff-top edge of the Giant's Causeway and occurs less commonly on Rathlin Island and on Guns Island (Cooper *et al.* 1992; Hackney 1992).

A seabird cliff community characterised by spear-leaved orache *Atriplex prostrata* and sea beet *Beta vulgaris* (MC6) occurs where there is a combination of high maritime influence, intense physical disturbance and guano enrichment by seabirds. In Northern Ireland this vegetation is found on narrow ledges on the more exposed cliffs and offshore stacks along the Causeway Coast, on Rathlin Island and on Carrickarade Island, where seabird nesting is intensive. There are also patches of the community at Killard and Guns Island at the mouth of Strangford Lough. Another seabird cliff community, MC7, characterised by common chickweed *Stellaria media*, occurs along cliff ledges below seabird nesting sites, particularly along the cliffs at the Giant's Causeway and on Rathlin Island.

A maritime grassland community strongly influenced by salt spray and characterised by thrift and red fescue (MC8) occurs sparsely but frequently over cliffs and headlands around the whole Northern Ireland coastline. The most extensive areas occur along the exposed slopes of the Giant's Causeway and Rathlin Island, with smaller areas

along the Ards and Lecale Peninsulas and the Mourne Coast. The vegetation consists of salt-tolerant, spring-flowering winter annuals such as Danish scurvy-grass *Cochlearia danica*, early and silver hair-grasses *Aira praecox* and *A. caryophyllea*, lesser trefoil *Trifolium dubium* and hop trefoil *T. campestre* and occasionally knotted clover *T. striatum*. Succulent, drought tolerant or deep-rooted perennials such as spring squill *Scilla verna*, sea and buck's-horn plantains *Plantago maritima* and *P. coronopus*, biting stonecrop *Sedum acre* and English stonecrop *S. anglica*, wild thyme *Thymus praecox* and common bird's-foot-trefoil *Lotus corniculatus* also occur in this vegetation. Maritime grassland characterised by red fescue and Yorkshire-fog (MC9) also occurs widely on the sea cliffs. It is typical of sheltered, less maritime, ungrazed places on the tops of cliffs or on grazed slopes. It is extensively developed along the cliffs of the Causeway Coast and parts of Rathlin Island, and more locally along the sheltered east coast.

Maritime heath (H7 heather - spring squill) occurs only locally in the region, most notably along the Giant's Causeway cliffs and across Rathlin Island. The distinctive H8 heather - western gorse heath occurs rarely in the region, and this community is best displayed on Rathlin Island and the north coast of Co. Down west of Bangor. It is restricted in its distribution within the British Isles and Rathlin is its most northerly known site (DoE (NI) pers. comm.).

Northern Ireland's cliff vegetation contains several regionally rare higher plant species (Hackney 1992). Rock sea-lavender *Limonium binervosum* is restricted to one short stretch of Co. Down, on cliffs at Benboy. Rock samphire is locally rare, being found only on maritime rocks in the Lecale area and the Ards Peninsula in Co. Down, and at Garron Point in Co. Antrim. Sea wormwood *Artemisia maritima* is rare in Northern Ireland. It is found growing in crevices on a steep, north-facing crag of Silurian shale at Corbet Head in Co. Down. A number of rare arctic-alpine species, listed in the Irish Red Data Book of vascular plants (Curtis & McGough 1988), occur on cliffs in the region (see also section 5.2).

Two cliff sites in Northern Ireland - Rathlin Island and Sheep Island - support important seabird colonies (see also sections 5.10 and 5.11). The sea cliffs and stacks on Rathlin Island provide nesting sites for nationally important colonies of guillemot *Uria aalge* and kittiwake *Rissa tridactyla*, and internationally important colonies of razorbill *Alca torda*. Sheep Island is nationally important as it supports one of the largest coastal colonies in the British Isles of cormorants belonging to the Northern European sub-species *Phalacrocorax carbo carbo*.

3.1.3 Human activities

Cliffs are among the least modified of terrestrial habitats, although cliff-top habitats on the landward side have often been converted to agricultural grassland or other land uses. Where there are no physical constraints, cliff-top habitats are usually grazed by sheep or cattle. Excessive sheep grazing has reduced the abundance of mossy saxifrage along the Antrim basalt scarp, so that it now occurs only on ungrazed rocky sites here. Cliff-top footpaths are becoming increasingly popular, with heavy usage causing local erosion. In much of the coastal zone from Cushendall to Larne, the coast road lies between cliffs and the sea and is popular with touring motorists. The Causeway Coast, much of which is owned by the National Trust, is one of Northern Ireland's leading tourist attractions. Public access to the bays and headlands of the coast is provided by a footpath system. A visitor centre with car park is also provided.

3.1.4 Information souces used

The full extent of cliffs and cliff-top habitats has not been surveyed, but a National Vegetation Classification (NVC) survey was carried out at several cliff sites by Cooper *et al*. (1992). NVC surveys use a reliable, consistent methodology, yielding detailed information on the distribution and species composition of vegetation (Rodwell in press). The data provide a sound baseline for future cliff vegetation studies and local management of the cliff resource. Information for this section was also contributed by staff of DoE (NI) Environment and Heritage Service (EHS).

3.1.5 Acknowledgements

Thanks are due to J.S. Furphy, R.J. Bleakley and P. Corbett, DoE (NI) EHS, for their helpful comments.

3.1.6 Further sources of information

A. References cited

Cooper, E.A., Crawford, I., Malloch, A.J.C., & Rodwell, J.S. 1992. *Coastal vegetation survey of Northern Ireland*. Lancaster, Lancaster University.

Curtis, T.G.F., & McGough, H.N. 1988. *The Irish Red Data Book: 1. Vascular plants*. Dublin, Stationery Office.

Hackney, P. 1992. *Stewart & Corry's Flora of the north-east of Ireland*. 3rd ed. Belfast, Institute of Irish Studies, The Queen's University of Belfast.

Rodwell, J.S., *ed*. In press. *British plant communities. Volume 5: maritime and open vegetation communities.* Cambridge, Cambridge University Press.

Williamson, S.D.H. 1984. *An ecological study of semi-natural vegetation of basaltic escarpments in Northern Ireland with special reference to mineral nutrition*. Jordanstown, University of Ulster. (Unpublished D.Phil. thesis.)

B. Further reading

Binggeli, P., & Rushton, B.S. 1985. A management orientated study of the birch-rowan-hazel woodland at Murlough Bay, Co. Antrim, Northern Ireland. *Irish Forestry, 42:* 16-32.

Cooper, A. 1985. Vegetation and soils of semi-natural deciduous woods in north-east Ireland. *Vegetatio, 64:* 67-74.

Department of Agriculture for Northern Ireland. 1993. *Antrim Coast, Glens and Rathlin Environmentally Sensitive Area - guidelines for farmers (ESA-2)*. Belfast, HMSO.

Department of Agriculture for Northern Ireland. 1993. *Environmentally Sensitive Areas - explanatory booklet (ESA-1)*. Belfast, HMSO.

Department of Agriculture for Northern Ireland. 1993. *Mournes and Slieve Croob Environmentally Sensitive Area - guidelines for farmers (ESA-2)*. Belfast, HMSO.

Department of the Environment for Northern Ireland. 1991. *Antrim Coast and Glens Area of Outstanding Natural Beauty - guide to designation* (also map and leaflet). Belfast, Department of the Environment for Northern Ireland.

Department of the Environment for Northern Ireland. 1991. *Causeway Coast Area of Outstanding Natural Beauty - guide to designation*. Belfast, Department of the Environment for Northern Ireland. (Includes map and leaflet.)

Department of the Environment for Northern Ireland. 1991. *Mourne Area of Outstanding Natural Beauty - Policies and Proposals*. Belfast, Department of the Environment for Northern Ireland. (Includes map and leaflet.)

Department of the Environment for Northern Ireland. Undated. *County Down Nature Reserves*. Belfast, Department of the Environment for Northern Ireland.

Department of the Environment for Northern Ireland. Undated. *North coast Nature Reserves*. Belfast, Department of the Environment for Northern Ireland.

Mitchley, J., & Malloch, A.J.C. 1991. *Sea cliff management handbook for Great Britain*. Lancaster, Lancaster University.

Praeger, R.L. 1974. *The botanist in Ireland*. Wakefield, E.P. Publishing.

Stott, A. 1992. From land use survey to policy implementation: the designation of AONBs in Northern Ireland. *In: Managing land use change,* ed. by A. Cooper & P. Wilson. Coleraine, University of Ulster. (Geographical Society of Ireland, Special Publication No. 7.)

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, location of site reports, site management. Advice on national and international policy and cliff conservation.	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477
Biological records of fauna and flora	*CEDaR, The Ulster Museum, Belfast, tel: 01232 383000

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

At the Barmouth, Portstewart, on the north coast, sand swept east along Magilligan Strand is pushed northwards by the outflow of the River Bann, which drains Lough Neagh. The river rises in the foothills of the Mourne Mountains, far to the south-east. Photo: Mike Hartwell, DoE (NI) EHS.

3.2 Sand dunes

Dr A. Cooper & C. Butler

3.2.1 Introduction

The vegetated sand dune resource in Northern Ireland has not been fully surveyed in detail, and so precise national and inter-regional comparisons cannot be made. However, Region 17 is known to contain a number of sand dune systems, the largest areas being located along the coast from Magilligan Point to Portstewart and at White Park Bay, Killard, Dundrum Bay (Ballykinler and Murlough Dunes) and Kilkeel Bay. Sandhills also occur on the Antrim and Down coasts; these are defined by Curtis (1991) as simple sand systems consisting of embryo vegetation communities with a narrow band of marram *Ammophila arrenaria* but containing no fixed dune vegetation.

Two sand dune systems, Magilligan and Murlough Dunes, are regarded as being of international importance, having been proposed as possible Special Areas of Conservation (pSACs) under the EC Habitats & Species Directive (Joint Nature Conservation Committee 1995). At Magilligan, the important habitats are grey dunes and dune slacks, while the Murlough/Dundrum Inner Bay pSAC has been selected for its dune heath (see section 7.2).

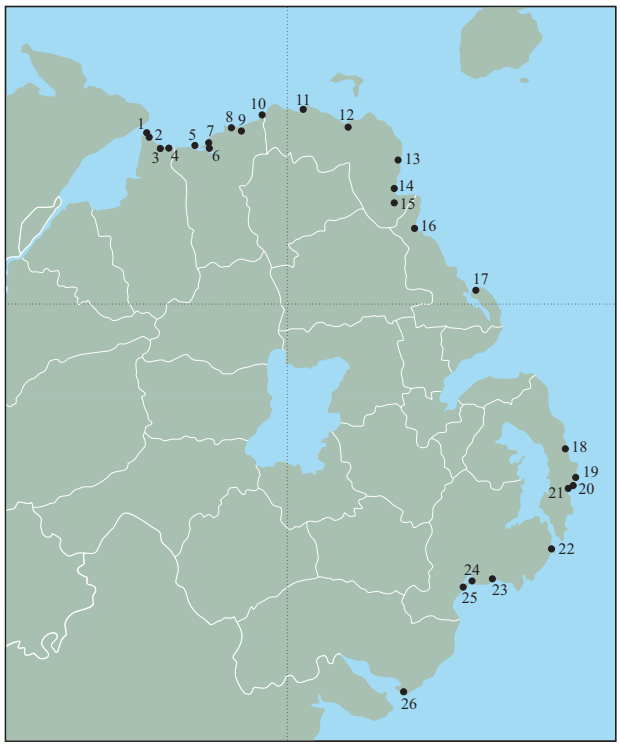
As part of a study of the coastline, Cooper *et al.* (1992) surveyed the main sand dune systems. Ten dune vegetation types were recorded, based on the National Vegetation Classification (Rodwell in press): foredune (SD4 sand couch *Elymus farctus borealis-atlanticus* community), mobile dune (SD6 marram community), semi-fixed dune (SD7 marram - red fescue *Festuca rubra* community), dune grassland (SD8 red fescue - lady's bedstraw *Galium verum* and SD9 marram - false oat-grass *Arrhenatherum elatius* communities), sand sedge dune (SD10 *Carex arenaria* community), dune slack (SD14 creeping willow *Salix repens* - moss *Campylium stellatum*, SD16 creeping willow - Yorkshire-fog *Holcus lanatus* and SD17 silverweed *Potentilla anserina* - common sedge *Carex nigra* communities) and sea-buckthorn *Hippophae rhamnoides* scrub (SD18 community). Other communities not exclusive to sand dunes were also recorded, including swamp, saltmarsh and woodland communities.

In Northern Ireland a number of rare or notable higher plant species occur within sand dune systems (see section 5.2). The 'Red List' plant smooth cat's-ear *Hypochoeris glabra* occurs on dunes at Magilligan, Castlerock, Grangemore, Portstewart and White Park Bay, and the Red List small-white orchid *Pseudorchis albida* grows at White Park Bay. Two species protected under the Wildlife Order (NI) 1985, marsh helleborine *Epipactis palustris* and bee orchid *Ophrys apifera*, occur on dunes, and a number of other rare or notable species, including shepherd's cress *Teesdalia nudicaulis*, are found on dune systems in the region.

3.2.2 Important locations and species

Sand dune systems in the region are listed in Table 3.2.1 and shown on Map 3.2.1.

The coastal foreland at Magilligan is one of the largest depositional shoreline features in the British Isles (Carter



Map 3.2.1 Sand dunes (Table 3.2.1). © Crown Copyright.

1991) and one of the most intensively studied in Ireland (DoE (NI) EHS pers. comm.). The entire dune system extends eastwards from Magilligan Point to Downhill and encompasses the dunes of Magilligan Point, the Doaghs, Ballymaclary, Benone and Umbra. The dunes have prograded in response to the supply of sand, the prevailing winds and the presence of an offshore sandbank. The site is the most calcareous dune system in Northern Ireland. At Magilligan, the dunes show a typical succession sequence, with the soil becoming more acidic as the carbonate content decreases and the organic material content increases over time (Wilson 1987). There are corresponding changes to the vegetation, with sand-binding plants such as sea couch and marram giving way to sand-stabilising plants, typically red fescue and sheep's fescue *Festuca ovina* and common bird's-foot-trefoil *Lotus corniculatus*. The dune grassland vegetation of Magilligan Point extends across the Doaghs to Ballymaclary, where there is a series of dune slacks. Scrub encroachment is a feature of the Magilligan dune system (Cooper *et al.* 1992).

In biological terms Murlough, Co. Down, is one of the best examples of a coastal system in Northern Ireland, notable for its wide variety of plant and animal communities (DoE (NI) EHS pers. comm.). The dune system displays an intact and extensive vegetation transition, grading from actively developing foredunes, through yellow and grey dunes, to species-rich dune grassland, acid dune heath and scrub, and then to saltmarsh in Dundrum Inner Bay. At Murlough Dunes, acid dune heath communities (H10 heather *Calluna vulgaris* - bell

Table 3.2.1 Dune sites in Northern Ireland

Site no. on Map 3.2.1	*Name*	*Grid ref.*	*Type*	*Conservation status*
	Co. Londonderry			
1	Magilligan Point	C663389	Dune (grassland, meadowsweet *Filipendula ulmaria* - wild angelica *Angelica sylvestris* mire M27)	(N)NR, ASSI, part military, pSAC
2	Doaghs	C670380	Dune (grassland, scrub and iris *Iris pseudacorus* fen)	Military site, ASSI, pSAC
3	Ballymaclary	C701355	Dune (grassland, slack, scrub and iris fen)	(N)NR, ASSI, pSAC
4	Benone/Umbra	C720357	Dune (grassland, slack, scrub and fen)	LNR, UWT, ASSI, pSAC
5	Castlerock	C780363	Dunes	Not protected
6	Grangemore	C806355	Dune (grassland, scrub, slack and meadowsweet - wild angelica mire M27)	NT
7	Portstewart	C805365	Dunes	NT
	Co. Antrim			
8	Portrush	C870405	Dunes	ASI
9	White Rocks	C885408	Dunes	ASI
10	Bushfoot	C937429	Dunes	ASI
11	White Park Bay	D023440	Dune (grassland, slack, fen and scrub)	NT, ASSI
12	Ballycastle	D125411	Dunes	ASI
13	Cushendun	D248327	Sandhills, dunes	NT, ASI
14	Cushendall	D247278	Sandhills	NT, ASI
15	Waterfoot	D245252	Dunes	Not protected
16	Carnlough	D288170	Sandhills	ESCR
17	Brown's Bay	D430032	Sandhills	Not protected
	Co. Down			
18	Ballywalter	J630670	Dunes	Not protected
19	Portavogie	J657593	Sandhills	Not protected
20	Kirkistown Links	J650575	Dunes	Not protected
21	Cloghy	J641575	Dune (grassland)	Not protected
22	Killard	J610433	Dune (grassland, heath and scrub)	(N)NR, ASSI, pSAC, pSPA
23	Tyrella	J475362	Dunes	Not protected
24	Ballykinler	J430360	Dune (grassland and scrub)	ASSI, pSAC, pSPA, ESCR
25	Murlough Dunes	J405343	Dune (grassland, heath, scrub and woodland)	(N)NR, ASSI, pSAC, NT
26	Cranfield	J265108	Dunes	Not protected

Sources: DoE (NI) Environment and Heritage Service; Curtis (1991). Key: (N)NR = (National) Nature Reserve; ASI = Area of Scientific Interest; ASSI = Area of Special Scientific Interest; pSAC = proposed Special Area of Conservation; pSPA = proposed Special Protection Area; UWT = Ulster Wildlife Trust; LNR = Local Authority Nature Reserve; ESCR = Earth Science Conservation Review site; NT = National Trust property.

heather *Erica cinerea* heath and H11 heather - sand sedge dune heath) dominates the parts of the dunes, including lichen heaths on dry gravel beaches exposed within the dunes, forming the most extensive and important dune heathland in Northern Ireland (DoE (NI) 1995). Murlough Dunes also support developing woodland vegetation types (W10 oak *Quercus robur* - bracken *Pteridium aquilinum* - bramble *Rubus fruticosus* and W25 bracken - bramble communities).

The invertebrate fauna of Magilligan and Murlough Dunes has been relatively well recorded. Magilligan is notable for its high diversity of Lepidoptera (butterfly and moth) species. Twenty-one butterfly species are recorded from the dune system, including the grayling *Hipparchia semele*, the dark green fritillary *Argynnis aglaja* and the marsh fritillary *Eurodryas aurinia*, a species listed for protection under the EC Habitats & Species Directive. The heath and dune vegetation at Murlough Dunes supports 55 species of bee, ant and wasp (33% of Irish fauna), 213 species of moth (48% of Northern Irish fauna) and 21 species of butterfly (71% of Northern Irish fauna), including the marsh fritillary.

3.2.3 Human activities

Many of the dune sites in Northern Ireland are designated as (National) Nature Reserves or Areas of Special Scientific Interest (Table 3.2.1; see also Chapter 7) or are under the ownership of the National Trust and consequently are managed having regard for their conservation interest.

The inner edges of many dune systems in Northern Ireland have been adversely affected by a variety of human impacts, such as military training, golf courses and agriculture, which typically lead to habitat loss or conversion of the vegetation to other, common, types (Doody 1989). Some sand hill and small dune systems along the outer Ards Peninsula have been levelled to create recreation areas and prevent sand blowing over the coast road.

The practice of taking sand from beaches reduces the sand supply to the dune system and, by lowering the beach, increases the erosive power of the waves (Carter 1991). The effects of such sand removal have been serious at White Park Bay and Cushendun. In the past, sand has been mined from the landward edge of the dunes at Tyrella and Cranfield. The removal of sediment during mechanical

beach cleaning is becoming more common, particularly on beaches used for recreation. This process affects the structure of the upper beach as well as leading to sand removal.

Most of the dune systems have a history of grazing. Where this was stopped for operational reasons, as at Ballymaclary Nature Reserve, extensive scrub encroachment has taken place. A dune grazing management policy has since been introduced. Encroachment of gorse *Ulex europaeus*, other scrub and rank grasses at Murlough Dunes has been reversed by the reintroduction of rabbits and winter grazing by sheep, rare breed cattle and ponies (Whatmough 1995). Light cattle grazing has been introduced at White Park Bay, and Killard is managed with a regime of winter grazing to favour summer-flowering herbs. At Portstewart (where a sheep-grazing regime has been introduced), Grangemore and White Park Bay, the National Trust is currently monitoring grazing levels as part of their management policy. The introduction of the prickly shrub sea-buckthorn has resulted in considerable loss of dune vegetation at Portstewart, Ballykinler and Murlough Dunes. At Portstewart and Murlough Dunes the National Trust has undertaken control measures.

Sand dune sites have a high recreational value, but intensive use can be damaging. Dunes at Portstewart, Portrush, Tyrella and, to a lesser extent, Murlough have been damaged by erosion caused by recreational use, but measures are now being taken to rehabilitate the damage. The general public drive their cars onto the beach at Benone, Portstewart, Portrush and Tyrella, which can compact the beach sands, making them less mobile and so unavailable for dune replenishment. This may have contributed to erosion at Tyrella. Dune systems at Benone, Castlerock, Portstewart, Portrush, Cloghy and Murlough have golf courses sited on them, and semi-natural habitat has been lost. Public dune protection schemes to counteract erosion are organised by local authorities at Benone, Portstewart and Tyrella. Portstewart epitomises the problems associated with dune conservation here and elsewhere in the UK. Visitor pressure and exposure led to major erosion of the sand dunes, and in an attempt to control the mobile sand, sea-buckthorn was planted. This had the desired effect in some places but has, over time, resulted in the loss of open dune habitat together with its important dune grassland communities and their rare plants and animals. Ownership by the MoD has protected dunes at Magilligan and at Ballykinler to some extent, although its needs have also resulted in some major modifications of habitat. At Magilligan, where grazing has traditionally taken place, the presence of the MoD has limited grazing by stock, threatening an increase in scrub and the loss of species-rich grassland and dune slacks. At Murlough Dunes the loss of the rabbit population and the absence of other grazing animals has led to the growth of scrub and the loss of herb-rich dune grassland. An attempt to reverse the encroachment of scrub is being made by the removal of sea-buckthorn and the introduction of myxomatosis-free rabbits (Whatmough 1995). Recently, other animals (commercial stock cattle, sheep and Dartmoor ponies) have also been used for grazing.

3.2.4 Information sources used

A major source of information for this section was the vegetation survey of selected locations around the Northern Ireland coast (Cooper *et al.* 1992). The survey was not comprehensive in terms of coverage but it did cover the largest areas of dune systems in the region. Sites were surveyed using the National Vegetation Classification (NVC) (Rodwell in press). NVC surveys use a reliable, consistent methodology yielding detailed information on the distribution and species composition of vegetation. For some sites the vegetation was mapped, and for all sites the vegetation was described and information on coastal erosion and accretion, atypical vegetation and adjoining land use was recorded. The data provide a sound baseline for future dune vegetation studies and management of the resource. Much other information was contributed by staff of Environment and Heritage Service of DoE (NI).

3.2.5 Acknowledgements

Thanks are due to J.S. Furphy, R.J. Bleakley and P. Corbett, DoE (NI) Environment and Heritage Service, for their helpful comments.

3.2.6 Further sources of information

A. References cited

Carter, B. 1991. *Shifting sands - a study of the coast of Northern Ireland from Magilligan to Larne.* Belfast, HMSO. (Department of the Environment for Northern Ireland.)

Cooper, E.A., Crawford, I., Malloch, A.J.C., & Rodwell, J.S. 1992. *Coastal vegetation survey of Northern Ireland*. Lancaster, Lancaster University.

Curtis, T.G.F. 1991. A site inventory of the sandy coasts of Ireland. Their types and distribution. *In: A guide to the sand dunes of Ireland*, ed. by M.B. Quigley. Dublin, Trinity College Dublin. (European Union for Dune Conservation and Coastal Management.)

Department of the Environment for Northern Ireland. 1995. *Murlough Area of Special Scientific Interest - citation.* Belfast, DoE (NI). (Unpublished.)

Doody, J.P. 1989. Conservation and development of the coastal dunes of Great Britain. *In: Perspectives in coastal dune management*, ed. by F. van der Meulen, P.D. Jungerius & J. Visser, 53-67. The Hague, SPB Academic Publishing.

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 (unpublished report to the Department of the Environment).

Rodwell, J.S. In press. *British plant communities. Volume 5: maritime and open vegetation communities*. Cambridge, Cambridge University Press.

Whatmough, J.A. 1995. *Grazing on sand dunes: the re-introduction of the rabbit* Oryctolagus cuniculus *L. to Murlough NNR, County Down.* In: The National Trust and nature conservation: 100 years on. *Biological Journal of the Linnean Society, 56* (Suppl.)*:* 39-43.

Wilson, P. 1987. Soil formation on coastal beach and dune sands at Magilligan Point Nature Reserve, Co. Londonderry. *Irish Geography, 20:* 43-49.

B. Further reading

Binggeli, P., Eakin, M., Macfadyen, A., Power, J., & McConnell, J. 1992. Impact of the alien sea buckthorn (*Hippophae rhamnoides* L.) on sand dune ecosystems in Ireland. *In: Coastal dunes: geomorphology, ecology and management for conservation,* ed. by R.W.G. Carter, T.G.F. Curtis & M.J. Sheehy-Skeffington, 325-337. Rotterdam, Balkema.

Brooks, A., & Agate, E. 1986. *Sand dunes: a practical conservation handbook*. Wallingford, British Trust for Conservation Volunteers.

Carter, R.W.G. 1975. The effects of human pressures on the coastlines of Counties Londonderry and Antrim. *Irish Geography, 8:* 70-85.

Carter, R.W.G. 1982. Coastal caravan sites in Northern Ireland 1960-1980. *Irish Geography, 15:* 107-111.

Carter, R.W.G. 1988. *Coast erosion and management in the Antrim Coast and Glens and the Causeway.* Belfast, Department of the Environment for Northern Ireland.

Carter, R.W.G., Curtis, T.G.F., & Sheehy-Skeffington, M.J., *eds.* 1992. *Coastal dunes: geomorphology, ecology and management for conservation*. Rotterdam, Balkema.

Doody, J.P. 1991. *Sand dunes and their management*. Peterborough, Nature Conservancy Council. (Focus on nature conservation, No. 13.)

Doody, J.P., *ed*. 1991. *Sand dune inventory of Europe*. Peterborough, Joint Nature Conservation Committee.

McManus, D. 1988. *Plant community dynamics on sand dunes at Murlough National Nature Reserve, Dundrum, County Down, Northern Ireland*. Jordanstown, University of Ulster. (Unpublished MSc. thesis.)

Nature Conservancy Council. 1990. *On course conservation: managing golf's natural heritage*. Peterborough, Nature Conservancy Council.

Praeger, R.L. 1974. *The botanist in Ireland*. Wakefield, E.P. Publishing.

Radley, G.P., & Woolven, S.C. 1990. *A sand dune bibliography*. Peterborough, Nature Conservancy Council. (Contract Surveys, No. 122.)

Ranwell, D.S. 1972. *Ecology of salt marshes and sand dunes*. London, Chapman and Hall.

Ranwell, D.S., & Boar, R. 1986. *Coast dune management guide*. Huntingdon, Institute of Terrestrial Ecology.

Riley, D.J. 1976. *Magilligan dunes - classification of the vegetation*. Coleraine, University of Ulster. (Unpublished DPhil. thesis.)

Wilcock, F.A. 1976. *Dune physiography and the impact of recreation on the north coast of Ireland*. Coleraine, University of Ulster. (Unpublished DPhil. thesis.)

Wilcock, F.A., & Carter, R.W.G. 1977. An environmental approach to the restoration of badly eroded sand dunes. *Biological Conservation, 11:* 279-291.

C. Contact names and addresses

Type of information	*Contact address and telelphone no.*
Dune and saltmarsh grazing experiment at Portstewart	Area Countryside Manager, The National Trust, North Coast Office, 42 Causeway Road, Bushmills BT57 8SU, tel: 012657 32143
Dune and saltmarsh grazing on National Trust sites: policy and monitoring	*Regional Adviser for Nature Conservation, The National Trust, Saintfield, tel: 01238 510721
Advice on national and international policy and dune conservation. Issues, coastal zone management initiatives.	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477

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

The raised cobble beach at Ballyquintin Point, on the southern tip of the Ards Peninsula, is notable for its geomorphology and shingle vegetation, including burnet rose *Rosa pimpinellifolia* (pictured). The importance of the site is recognised in its designation as an Area of Special Scientific Interest and a National Nature Reserve. Photo: Bob Bleakley, DoE (NI) EHS.

3.3 Vegetated shingle structures and shorelines

Dr A. Cooper & C. Butler

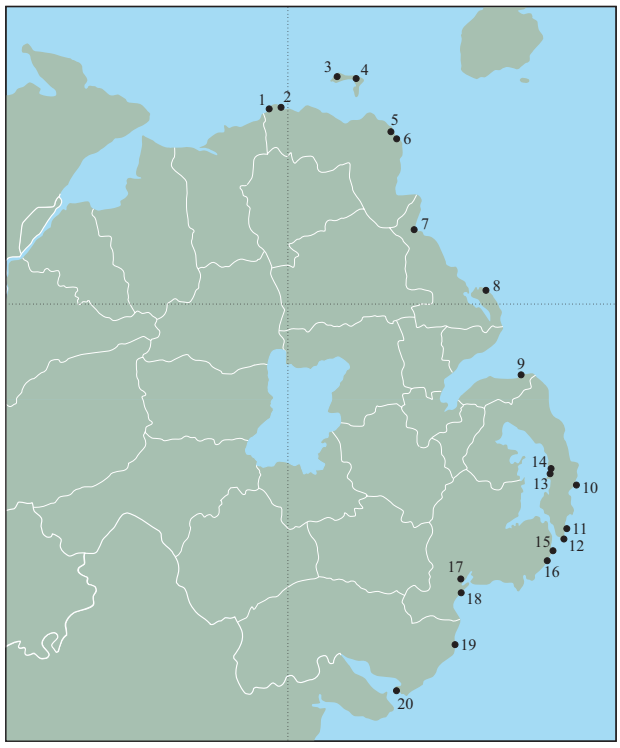
3.3.1 Introduction

Shingle is defined as sediment whose grains are larger than sand but smaller than boulders: that is, between 2 and 200 mm in diameter. Shingle sites include both simple fringing beaches and also more complex structures, such as raised beaches, where the shingle is vegetated but not buried by sand. The vegetated shingle resource in Northern Ireland has not been fully surveyed in detail, and so precise national and inter-regional comparisons cannot be made.

3.3.2 Important locations and species

Cooper *et al*. (1992) carried out a survey of coastal sites in Northern Ireland. The major shingle sites in the region are shown on Map 3.3.1 and are detailed in Table 3.3.1. Coarse shingle banks, ridges and tombolos (islands joined to the land by a sand or shingle spit) are found mainly along the low, rocky parts of the coastline of Co. Down, including in Strangford Lough. At Gransha Point there is a large shingle bank attached to the mainland by a slender shingle spit above high tide level. Shingle habitats associated with raised beaches occur along the Co. Antrim coast, in Co. Down at Ballyquintin Point, a site that is notable for its extensive vegetated shingle banks, and at Guns Island.

Of the coastal sites surveyed by Cooper *et al*. (1992), nine contained shingle or strandline National Vegetation Classification (NVC - Rodwell in press) vegetation types. These are curled dock *Rumex crispus* - yellow horned-poppy *Glaucium flavum* shingle vegetation (SD1); sea sandwort *Honkenya peploides* - sea rocket *Cakile maritima* strandline



Map 3.3.1 Coastal shingle sites (Table 3.3.1). Source: Cooper *et al.* (1992). © Crown Copyright.

Table 3.3.1 Shingle beaches and shorelines in Northern Ireland

Site no. on Map 3.3.1	*Name*	*Grid ref.*	*Site type*	*Conservation status*
	Co. Antrim			
1	Giant's Causeway	C952452	Raised shingle beach	(N)NR, WHS, ESCR, ASI
2	Dunseverick Castle	C987445	Raised shingle beach	ASI
3	Kebble, Rathlin Island	D095515	Raised shingle beach	(N)NR, pSPA, ASSI
4	Church Bay, Rathlin Island	D146510	Raised shingle beach	Part ASSI
5	Portaleen Bay	D233396	Raised shingle beach	NT, ASI
6	Loughan Bay	D246377	Raised shingle beach	NT, ASI
7	Carnlough Bay	D288170	Raised shingle beach	ASI
8	Isle of Muck	D465025	Tombolo	ASI
	Co. Down			
9	Ballymacormick Point	J525837	Shingle beach and raised beach	ASSI, pSPA, NT
10	The Ridge	J651570	Partially-submerged shingle spit	pSPA
11	Templecowey	J632475	Shingle beach and raised beach	pSPA
12	Ballyquintin Point	J624456	Raised shingle beach	(N)NR, ASSI, pSPA, pSAC
13	Gransha Point	J588594	Tombolo	ASSI, pSPA, pSAC
14	Hare Island	J594602	Tombolo	ASSI, pSPA, pSAC, NT
15	Killard	J610433	Shingle storm beach	(N)NR, ASSI, pSPA, pSAC
16	Guns Island	J597416	Shingle beach and raised beach	Not protected
17	Dundrum Inner Bay	J415380	Shingle beach and bank	ASSI, NT
18	Murlough Dunes	J405343	Shingle storm beach and raised beach	(N)NR, ASSI, pSAC, NT
19	Mourne Coast	J382297-J338152	Shingle beach and bank	ASI
20	Green Island	J240111	Shingle beach and ridge	ASSI, pSPA, NT

Source: DoE (NI) Environment and Heritage Service. Key: (N)NR = (National) Nature Reserve; WHS = World Heritage Site; ESCR = Earth Science Conservation Review site; ASI = Area of Scientific Interest; ASSI = Area of Special Scientific Interest; pSPA = proposed Special Protection Area; NT = National Trust property; pSAC = possible Special Area of Conservation.

vegetation (SD2); or sea mayweed *Matricaria maritima (Tripleurospermum maritimum)* - cleavers *Galium aparine* strandline vegetation (SD3). SD1 shingle vegetation is found at a level reached only by exceptional tides or storms and where there is organic matter derived from the strandline. Oysterplant *Mertensia maritima* (a northern species on the southern edge of its distribution) and sea-kale *Crambe maritima* (a southern species on the northern edge of its distribution) occur in this type of habitat. One site surveyed by Cooper *et al*. (1992) on the Mourne coast was the location of the rarities yellow horned-poppy and oysterplant. SD2 is a pioneer of sand and fine shingle strandlines on less exposed coasts. It has a marked southern distribution in Northern Ireland, occurring on shingle at Templecowey, Ballyquintin Point, Gransha Point, Hare Island, Killard, Murlough Dunes and the Mourne Coast in Co. Down. SD3 strandline vegetation occurs on sheltered beaches on a matrix of mixed pebble, silt and shell deposits. It was recorded on shingle at a wide range of sites, including the Giant's Causeway, Kebble on Rathlin Island, Ballymacormick Point, Templecowey, Ballyquintin Point, Gransha Point, Killard, Murlough Dunes and the Mourne Coast.

Where raised shingle beaches are occasionally inundated by sea water, free-draining beds of larger shingle or cobbles may support lichen communities, with encroachment by grasses such as squirrel-tail fescue *Vulpia bromoides*, crested hair-grass *Koeleria macrantha*, crested dog's-tail *Cynosurus cristatus* and red fescue *Festuca rubra*, as well as prostrate shrubs, notably burnet rose *Rosa pimpinellifolia*, blackthorn *Prunus spinosa* and ivy *Hedera helix*. Coarse shingle banks that are sheltered and generally stable, although subject to inundation during high spring tides, may have vegetation with affinities to saltmarsh. At the highest levels they support rank grasses such as sand couch *Elymus farctus*, while sea mayweed, common saltmarsh-grass *Puccinellia maritima* and annual sea-blite *Suaeda maritima* occur nearer the strandline. Strandlines made up of sand and fine shingle are typical on the less exposed beaches. During the summer, annual species such as sea rocket and prickly saltwort *Salsola kali* develop. In general the community is very variable and its extent may change from year to year. Sheltered shingle beaches with detritus and a mixture of sediment types including pebbles, silt and shells are found all around the coast of the Northern Ireland.

At Ballyquintin Point, along the seaward bank of the raised shingle, there are patches of low blackthorn scrub with an understorey of ivy. Along the inner bank, the community is dominated by gorse *Ulex europaeus* and bramble *Rubus fruticosus* scrub.

3.3.3 Human activities

A number of shingle sites in the region are protected as Areas of Special Scientific Interest or (National) Nature Reserves. These include the Giant's Causeway, Ballymacormick Point, Ballyquintin Point, Gransha Point, Hare Island, Killard, Murlough Dunes and Green Island (Table 3.3.1). Some have no conservation status and can be subject to high levels of disturbance from leisure and recreational use or have been damaged by exploitation as a source of gravel or grit. Stone was quarried for a time from Ballyquintin Point, from tombolos nearby and from the storm beach at Killard. Sites have also been damaged as a result of coastal development. Scrub encroachment has led to habitat loss at some sites at which agricultural grazing has been abandoned.

3.3.4 Information sources used

Shingle sites were included in the survey of Cooper *et al.* (1992) and classified using the National Vegetation Classification methodology (Rodwell in press). NVC surveys use a reliable, consistent methodology yielding detailed information on the distribution and species composition of vegetation. For some sites the vegetation was mapped, and for all sites the vegetation was described and information on coastal erosion and accretion, atypical vegetation and adjoining land use was recorded. The data provide a sound baseline for future shingle vegetation studies and management of the resource. Other information has been contributed by staff of Environment and Heritage Service of DoE (NI).

3.3.5 Acknowledgements

Thanks are due to J.S. Furphy, R.J. Bleakley and P. Corbett, DoE (NI) Environment and Heritage Service, for their helpful comments.

3.3.6 Further sources of information

A. References cited

Cooper, E.A., Crawford, I., Malloch, A.J.C., & Rodwell, J.S. 1992. *Coastal vegetation survey of Northern Ireland.* Lancaster, Lancaster University.

Rodwell, J.S., *ed*. In press. *British plant communities. Volume 5: maritime and open vegetation communities.* Cambridge, Cambridge University Press.

B. Further reading

Chapman, V.J. 1976. *Coastal vegetation*. Oxford, Pergamon Press.

Fuller, R.M. 1987. Vegetation establishment on shingle beaches. *Journal of Ecology, 75:* 1,977-1,089.

Oliver, F.W. 1912. The shingle beach as a plant habitat. *New Phytologist*, *11:* 73-99.

Praeger, R.L. 1974. *The botanist in Ireland*. Wakefield, E.P. Publishing.

Randall, R.E. 1989. Geographical variation in British shingle vegetation. *Botanical Journal of the Linnean Society, 101:* 3-18.

Scott, G.A.M. 1963. Biological flora of the British Isles: *Mertensia maritima* (L.) S.F. Gray. *Journal of Ecology, 51:* 733-742.

Scott, G.A.M. 1963. The ecology of shingle beach plants. *Journal of Ecology, 51:* 517-527.

Sneddon, P., & Randall, R.E. 1989. *Vegetated shingle structures survey of Great Britain: bibliography.* Peterborough, Nature Conservancy Council. (Research & survey in nature conservation, No. 20.)

Sneddon, P., & Randall, R.E. 1993. *Coastal vegetated shingle structures of Great Britain: main report*. Peterborough, Joint Nature Conservation Committee.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Flora, fauna and habitat information	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477

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

3.4 Coastal lagoons

Dr A. Cooper & C. Butler

3.4.1 Introduction

Lagoons are a nationally rare habitat and a 'priority habitat type' under Annex I of the EC Habitats & Species Directive. 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 partly 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). The full extent of lagoons and lagoonal habitats in Northern Ireland has not been surveyed, and so inter-regional and national comparisons cannot be made. However, Northern Ireland contains a large number of mainly small coastal lagoons, all of which are artificial, occurring either as water bodies or back drains behind coastal defence works or railway embankments.

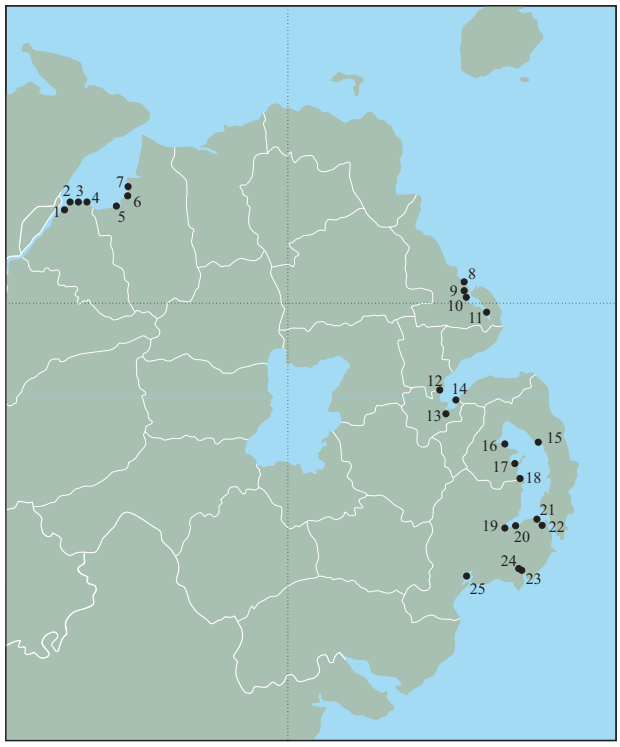
3.4.2 Important locations and species

Twenty-five lagoons have been identified in Region 17 (DoE (NI) pers. comm.) (Table 3.4.1; Map 3.4.1). Some of them, particularly those behind the railway embankments adjacent to Larne Lough, are relatively large, with much open water. Not all have been surveyed in detail.

Coastal lagoons have a marked southern distribution in Region 17, occurring mainly in and around Larne Lough, Belfast Lough and Strangford Lough. Coastal defence back drains, formed behind a sea embankment, are particularly common along Lough Foyle, where five such sites are located. At Larne Lough, Glynn Lagoon North, Glynn Lagoon South and Oldmill Bay, lagoons have been created as a result of land being enclosed from the sea by a railway embankment. The cliff and rocky topography along the north and north-east coast, from Portstewart to Larne, precludes the development of lagoons in this area.

The principal higher plant species of lagoons in the region is the common reed *Phragmites australis*, but the most common species recorded are the green algae *Chaetomorpha* spp., *Entermorpha intestinalis* and *Ulva lactuca*. The rare beaked tasselweed *Ruppia maritima* and spiral tasselweed *R. cirrhosa* have been recorded from brackish ponds in Strangford Lough and back drains around Lough Foyle (Carroll 1994; Wolfe-Murphy *et al.* 1992), and spiral tasselweed is found at the Glynn lagoons at Larne Lough. Grey club-rush *Schoenoplectus tabernaemontani* is a dominant species at the Maydown industrial site lagoon in Co. Londonderry (Cooper & Flexen 1996) and also occurs with sea club-rush *Scirpus maritimus* at Quoile Pondage in Co. Down.

Typical lagoon invertebrates recorded are the polychaete worm *Polydora ciliata*, the snail *Hydrobia ventrosa*, the brackish-water sand-shrimp *Gammarus chevreuxi* and the isopod *Idotea chelipes*, the lagoonal prawn *Palaemontes varians*



Map 3.4.1 Coastal lagoons (Table 3.4.1). © Crown Copyright.

and the bug *Sigara stagnalis* (O'Sullivan 1994). No invertebrates of particular conservation importance have been reported from the lagoons in the region.

3.4.3 Human activities

There are few serious risks of lagoon loss in the region, notwithstanding their artificial origin. A road by-pass is proposed at Glynn, with potential lagoonal habitat loss. Improvement of sluices and sea defences at Castle Espie and Strand Lough has reduced the incursion of salt water and thus reduced the salinity of the lagoons. There is little management of lagoons for conservation purposes, although the brackish Quoile Pondage basin, created in 1957 as a flood control measure, was made a (National) Nature Reserve in 1970, and the nearby Queen's Lake is the subject of a management agreement. The water levels of the Castle Espie lagoon are regulated to favour wading birds. Many of the sites fall within Areas of Special Scientific Interest (ASSIs).

3.4.4 Information sources used

A list of lagoon sites in the region was provided by the DoE (NI) Environment and Heritage Service, derived from a study of maps, staff knowledge and the Northern Ireland Lakes Survey (Wolfe-Murphy *et al.* 1992). Ecological surveys of a number of sites were undertaken as MSc. dissertations by Queen's University, Belfast (Caroll 1994; Donnan 1994;

Table 3.4.1 Lagoons in the region

Site no. on Map 3.4.1	Name	General location	Grid ref.	Description	Conservation status
	Co. Londonderry				
1	Maydown Lagoon	Lough Foyle	C485224	Artificial pool on industrial site	Not protected
2	Black Brae	Lough Foyle	C495239	Coastal defence back drain	Not protected
3	Donnybrewer	Lough Foyle	C520239	Coastal defence back drain	Not protected
4	Longfield	Lough Foyle	C540235	Coastal defence back drain	Not protected
5	Coolage Bridge	Lough Foyle	C590225	Artificial pool	Not protected
6	Ballykelly	Lough Foyle	C620245	Coastal defence back drain	Not protected
7	Ballymacran	Lough Foyle	C625270	Coastal defence back drain	Not protected
	Co. Antrim				
8	Larne Lagoon	Larne Lough	D404023	Artificial pool	Not protected
9	Glynn Lagoon North	Larne Lough	D405005	Artificial pool - enclosed by railway	ASSI
10	Glynn Lagoon South	Larne Lough	J411996	Artificial pool - enclosed by railway	Not protected
11	Oldmill Bay	Larne Lough	J455963	Artificial pool - enclosed by railway	ASSI
12	Whitehouse	Belfast Lough	J350805	Artificial pool	ASSI
	Co. Down				
13	Victoria Park	Belfast Lough	J365753	Artificial pool	ASSI
14	Belfast Harbour D2	Belfast Lough	J374783	Artificial pool	ASSI
15	Anne's Point	Strangford Lough	J557686	Bunded salt pans	ASSI
16	Castle Espie	Strangford Lough	J494673	Artificial pool - old brickworks	WWT
17	Cadew Point	Strangford Lough	J517633	Artificial pool	ASSI
18	Quarterland Bay	Strangford Lough	J524587	Artificial pool	ASSI
19	Quoile Pondage	Strangford Lough	J500478	Flood control pondage	(N)NR
20	Queen's Lake	Strangford Lough	J519486	Artificial pool	ASSI
21	Castleward Pond	Strangford Lough	J575500	Artificial pool	Not protected
22	Black Causeway	Strangford Lough	J583488	Artificial pool	ASSI
23	Strand Lough	Killough	J535374	Natural pool, artificial tidal barrage	Not protected
24	Brickworks pool	Killough	J529378	Artificial pool	Not protected
25	Dundrum Inner Bay	Dundrum	J396357	Artificial pool	ASSI

Source: DoE (NI) Environment and Heritage Service. Key: ASSI = Area of Special Scientific Interest; WWT = The Wildfowl and Wetlands Trust; (N)NR = (National) Nature Reserve.

Gorman 1994; O'Sullivan 1994). In addition, the Northern Ireland Lakes Survey (Wolfe-Murphy *et al*. 1992) examined a number of coastal lakes. The industrial site lagoon at Maydown was recorded as part of a habitat survey conducted for DuPont Limited (Cooper & Flexen 1996).

3.4.5 Acknowledgements

We are grateful for information supplied by R.J Bleakley, J.S. Furphy and P. Corbett, DoE (NI) Environment and Heritage Service.

3.4.6 Further sources of information

A. References cited

Caroll, B.A. 1994. *Brackish lagoons in Northern Ireland: a flora analysis.* Unpublished MSc. thesis, The Queen's University of Belfast.

Cooper, A., & Flexen, M. 1996. *Habitat survey: DuPont Maydown Works*. Coleraine, University of Ulster Research Report.

Donnan, H.E. 1994. *An investigation into the fauna of brackish water ponds and saline lagoons in Northern Ireland*. Unpublished MSc. thesis, The Queen's University of Belfast.

Gorman, C. 1994. *A study of the benthic fauna of brackish lagoons in Northern Ireland*. Unpublished MSc. thesis, The Queen's University of Belfast.

O'Sullivan, M. 1994. *The benthic fauna of the Quoile Pondage in relation to water quality*. Unpublished MSc. thesis, The Queen's University of Belfast.

Wolfe-Murphy, S.A., Lawrie, E.W., Smith, S.J., & Gibson, C.E. 1992. *A report by the Northern Ireland Lakes Survey*. Belfast, The Queen's University.

B. Further reading

Bamber, R.N., Batten, S.D., & Bridgwater, N.D. 1992. On the ecology of brackish water lagoons in Great Britain. *Aquatic conservation: marine and freshwater ecosystems*, 2: 65-94.

Barnes, R.S.K. 1991. A survey of the coastal lagoons of Britain: an overview and conservation appraisal. *Biological Conservation, 49:* 295-313.

Hackney, P. 1992. *Stewart and Corry's Flora of the North-east of Ireland*. Belfast, Institute of Irish Studies, The Queen's University of Belfast.

C. Contact names and addresses

Type of information	Contact address and telephone no.
Fauna, flora and habitat surveys of lagoons	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477

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

3.5 Wet grassland

Dr A. Cooper & C. Butler

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. Low-lying land next to loughs and estuaries in Northern Ireland, often the subject of land-claim, has extensive areas of improved grassland with perennial rye-grass *Lolium perenne*, or improved grassland with rough meadow-grass *Poa trivialis*, creeping bent *Agrostis stolonifera* and Yorkshire-fog *Holcus lanatus* (Cooper & McCann 1994). These grasslands are drained by either brackish or freshwater ditches. The botanical interest of the grazing areas is often located in the drainage ditches. Wet semi-natural (unimproved) grassland occurs as usually small areas or zones associated with coastal habitats such as saltmarsh, sand dunes and freshwater flushes and seepages associated with cliffs and rocky coasts.

Wet grassland habitat in Northern Ireland has not been fully surveyed in detail, and so precise inter-regional and national comparisons cannot be made.

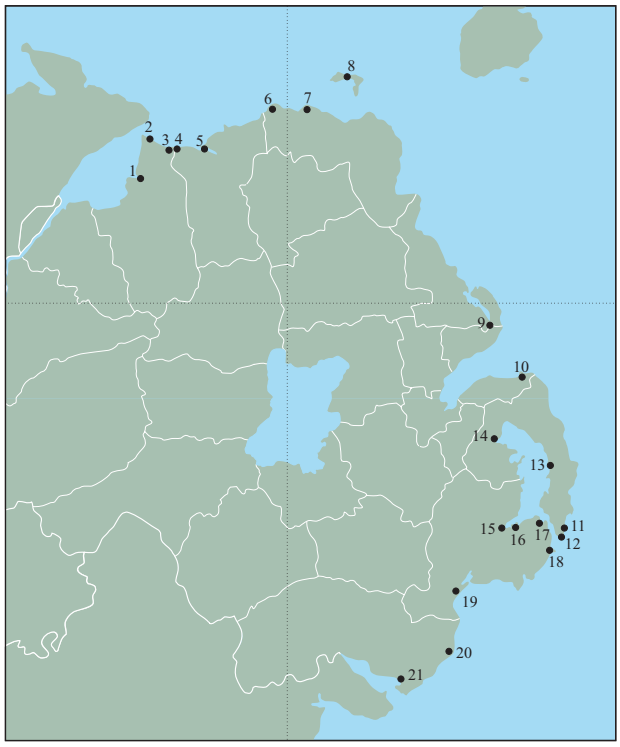
3.5.2 Important locations and species

Large areas of low-lying wet grassland occur behind the coastal defences and drained polder lands between the River Faughan and the River Roe estuaries, behind the Magilligan sand dune system on the eastern shores of Lough Foyle, and elsewhere, for example in the flat glen bottom of Glenariff. Such areas, comprising a combination of ditches and drains with a relatively short sward of wet grassland, are often used by waders and a range of other bird species.

Wet semi-natural grassland was recorded at 21 sites in a survey of selected coastal sites (Cooper *et al.* 1992), usually covering only small areas (Table 3.5.1; Map 3.5.1). Semi-natural wet grasslands in these locations represent coastal to inland vegetation transitions, which are often complex and grade into mire vegetation. Yorkshire-fog *Holcus lanatus* - soft rush *Juncus effusus* rush pasture (National Vegetation Classification (NVC) community MG10 (Rodwell 1995)), for example, occurs at the back of saltmarshes in the River Roe Estuary, Templecowey, Horse Island and Mill Bay, and on neglected, drained and reseeded grasslands at the back of the Magilligan dune system. Red fescue *Festuca rubra* - creeping bent *Agrostis stolonifera* - silverweed *Potentilla anserina* inundation grassland (MG11) is typical of narrow areas between sheltered upper saltmarsh and adjoining low-lying agricultural grassland and is widely distributed around the non-cliffed Northern Ireland coastline.

Wet grassland dominated by iris *Iris pseudacorus* occurs at the back of sand dunes at Doaghs and Ballymaclary, and along spring-lines as at Ballymacormick Point, Templecowey and a number of sites around and on islands within Strangford Lough. Its dominance in this grassland, which is grazed by farm animals, may arise because they find iris unpalatable. In places, brackish wetlands merge with mires.

Cooper *et al*. (1992) found that soft rush/sharp-flowered rush *Juncus acutiflorus* - common marsh-bedstraw *Galium palustre* rush-pasture (M23) is confined to abandoned non-tidal grassland lying inland of saltmarsh at Grangemore. Purple moor-grass *Molinia caerulea* - tormentil *Potentilla erecta* mire vegetation (M25) occurs on the flushed peaty mineral soils at the base of sheltered cliff slopes and along raised beaches that receive seepage water from overhanging cliffs, for example, at the Giant's Causeway and on Rathlin Island. Meadowsweet *Filipendula ulmaria* - wild angelica *Angelica sylvestris* mire (M27) is frequent in silted-up ditches, for example across the drained back-dune grazing marsh of the Magilligan dune system, and in vegetation grown over coastal flushes, for example, at White Park Bay and Templecowey.



Map 3.5.1 Wet grassland sites (Table 3.5.1). Source: Cooper *et al.* (1992). © Crown Copyright.

Elsewhere, saltmarsh and brackish-water sites merge with swamp communities characterised by sea club-rush *Scirpus maritimus* (S21), grey club-rush *Schoenoplectus tabernaemontani* (S20), common spike-rush *Eleocharis palustris* (S19), bottle sedge *Carex rostrata* - marsh cinquefoil *Potentilla palustris* (S27), greater pond-sedge *Carex riparia* (S16) and water-cress *Nasturtium officinale* - fool's water-cress *Apium nodiflorum* - brooklime *Veronica beccabunga* - lesser water-parsnip *Berula erecta*/water forget-me-not *Myosotis scorpioides* (S23) (Table 3.5.1).

Phragmites australis swamp and reed beds (S4) are regularly distributed around the coast of the region, typically alongside river estuaries, such as those of the Bann and Comber Rivers, in ditches, as at Magilligan, and in wet hollows, such as interdrumlin wetlands near Strangford Lough, around which they also occur as fringing habitat, as at Island Hill and Castle Espie.

Wet grasslands provide feeding habitat for wading birds

Table 3.5.1 Locations of coastal wet grassland

Site no. on Map 3.5.1	*Location*	*Grid ref.*	*National Vegetation Classification (NVC) community*	*Conservation status*
	Co. Londonderry			
1	Roe Estuary	C645293	MG10, MG11, S21	(N)NR
2	Doaghs	C670380	MG10, MG11, M27, S19, S23, S27, iris *Iris pseudacorus* beds	(N)NR, ASSI, pSAC
3	Ballymaclary	C701355	MG10, MG11, M27, S23, S27, iris beds	(N)NR, ASSI, pSAC
4	Benone/Umbra	C720357	MG11, M27,	LANR, UWT, ASSI, pSAC
5	Grangemore	C806355	MG11, S20, S21	NT
	Co. Antrim			
6	Giant's Causeway	C952452	MG11, M23, M25, M27, S19	NT, (N)NR, ASI
7	White Park Bay	D023440	MG10, MG11, M23, M27, S23, S27	NT, ASSI
8	Rathlin Island	D130520	MG11, M25, M27, S19	ASI, ASSI, (N)NR
9	Ballycarry	J466943	MG10, M27, S16	ASSI, pSPA
	Co. Down			
10	Ballymacormick Point	J530838	MG11, M23, M25, M27, S21	ASSI, NT
11	Templecowey	J632475	MG10, MG11, M25, M27, S21, S27	pSAC
12	Ballyquintin Point	J624456	MG11, S23	(N)NR, pSAC, pSPA
13	Horse Island	J598608	MG10, MG11, M23, M25	ASSI, pSAC, pSPA
14	Comber Estuary	J471685	MG11	ASSI, pSAC, pSPA
15	Quoile Pondage	J500478	MG11, S20	(N)NR, pSPA
16	Queen's Lake	J520486	MG10, MG11	ASSI, pSPA
17	Black Causeway	J583488	MG10, MG11	ASSI, MNR, pSPA
18	Killard	J610433	MG11	(N)NR, ASSI, pSAC
19	Murlough	J405343	MG11	(N)NR, pSAC
20	Mourne Coast	J382297-338152	MG11, M25, M27	ASI
21	Mill Bay	J245135	MG10, MG11, M27	ASSI

Sources: Cooper *et al*. (1992); Rodwell (1995). Key to conservation status: (N)NR = (National) Nature Reserve; ASSI = Area of Special Scientific Interest; ASI = Area of Scientific Interest; LANR = Local Authority Nature Reserve; UWT = Ulster Wildlife Trust; NT = National Trust property; pSAC = possible Special Area of Conservation; pSPA = proposed Special Protection Area; MNR = Marine Nature Reserve. Key to NVC communities: MG10 = Yorkshire-fog - soft rush; MG11 = red fescue - creeping bent - silverweed; M23 = soft rush/sharp-flowered rush - common marsh-bedstraw; M25 = purple moor-grass - tormentil; M27 = meadowsweet - wild angelica; S16 = greater pond-sedge; S19 = common spike-rush; S20 = grey club-rush; S21 = sea club-rush; S23 = water-cress - fool's water-cress - brooklime - lesser water-parsnip/water forget-me-not; S27 = bottle sedge - marsh cinquefoil.

such as curlew *Numenius arquata* and snipe *Gallinago gallinago* (which may also breed there) and are grazed by wildfowl including wigeon *Anas penelope* and greylag geese *Anser anser*. Dabbling wildfowl such as teal *Anas crecca* and shoveler *Anas clypeata* may seek cover among beds of rushes when winter floods inundate the area. Invertebrate records are lacking for most areas, but moth records exist for Quoile Pondage and include drinker *Euthrix potatoria*, ghost *Hepialus humuli*, peach blossom *Thyatira batis* and buff ermine *Spilosoma luteum*.

3.5.3 Human activities

Agricultural improvement has reduced the extent and conservation value of much of the lowland semi-natural wet grassland in the region, through drainage, intensive land use and conversion to pasture, perhaps most notably around Lough Foyle. Drainage ditches have been affected by nutrient enrichment caused by the use of fertilisers. Urban development has also caused losses of this habitat, particularly around Belfast. By contrast the construction of tidal barrages, most notably the Quoile Barrage, has led to the formation of extensive areas of new wet grassland on what was formerly foreshore.

3.5.4 Information sources used

The full extent of lowland wet grassland in the region has not been surveyed, but a National Vegetation Classification (NVC - Rodwell 1995) survey was carried out at several coastal sites by Cooper *et al*. (1992). NVC surveys use a reliable, consistent methodology yielding detailed information on the distribution and species composition of vegetation. For some sites the vegetation was mapped, and for all sites the vegetation was described and information on coastal erosion and accretion, atypical vegetation and adjoining land use was recorded. The data provide a sound baseline for future vegetation studies and management of the wet grassland resource. This information supplements a statistically-structured sample of land cover and grassland communities carried out by Murray *et al.* (1992) and Cooper & McCann (1994), known as the Northern Ireland Countryside Survey.

3.5.5 Acknowledgements

Thanks are due to J.S. Furphy, R.J. Bleakley and P. Corbett, DoE (NI) Environment and Heritage Service, for their helpful comments.

3.5.6 Further sources of information

A. References cited

Cooper, E.A., Crawford, I., Malloch A.J.C., & Rodwell, J.S. 1992. *Coastal vegetation survey of Northern Ireland.* Lancaster, Lancaster University.

Cooper, A., & McCann, T. 1994. *The botanical composition of grassland land cover types in Northern Ireland*. Coleraine, University of Ulster. (Report to Environment Service, Department of the Environment for Northern Ireland.)

Murray, R., McCann, T., & Cooper, A. 1992. *A land classification and landscape ecological study of Northern Ireland*. Report to the Department of the Environment for Northern Ireland. Coleraine, University of Ulster.

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

B. Further reading

Coleshaw, T. 1995. Rising to the water levels challenges. *Enact*, *3*(1): 7-9.

Rodwell, J.S. In press. *British plant communities*. *Volume 5: maritime and open vegetation communities*. Cambridge, Cambridge University Press.

Scholey, G. 1995. Return of the "drowners". *Enact*, *3*(1): 10-11.

Thomas, G., José, P., & Hirons, G. 1995. Wet grassland in the millenium. *Enact*, *3*(1): 4-6.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Wet grassland	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477

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

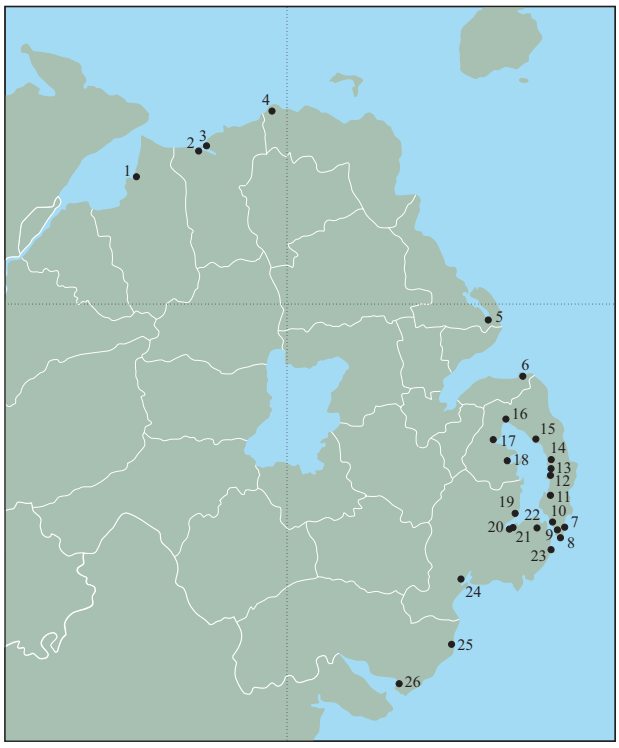
3.6 Saltmarsh

Dr A. Cooper & C. Butler

3.6.1 Introduction

Saltmarsh is a scarce habitat in Northern Ireland, often occurring as a narrow coastal marginal fringe (Baxter & Boaden 1990). The full extent of saltmarsh habitat in Northern Ireland has not been surveyed in detail, and so precise inter-regional and national comparisons cannot be made. However, there is an estimated 200 ha of saltmarsh in the region (DoE (NI) pers. comm.), of which the largest areas are found in Lough Foyle, Strangford Lough and Carlingford Lough. Small, often fragmentary beach-head saltmarshes are frequent at other sites on rocky shores and behind raised beaches around much of the coastal zone. They are generally developed over the sand and shingle deposits at the back of wave-cut platforms where the beach-head is protected to some extent by rock ridges lower down the shore. These beach-head saltmarshes are similar to the saltmarshes in Fife (Region 4), Scotland, described by Leach & Phillipson (1985). A number of geographically restricted vegetation communities and plant species are associated with them, particularly where they are flushed with freshwater. Some of the communities are transitional to non-tidal vegetation types and some are floristically rich or complex.

The most abundant NVC (National Vegetation Classification - Rodwell in press) saltmarsh vegetation types in Northern Ireland are the red fescue *Festuca rubra* - saltmarsh rush *Juncus gerardi* (SM16) and common saltmarsh-grass *Puccinellia maritima* (SM13) communities, which were present at all the sites surveyed by Cooper *et al*. (1992).



Map 3.6.1 Saltmarsh sites (Table 3.6.1). Source: Cooper *et al.* (1992).

3.6.2 Important locations and species

The most extensive areas of estuarine saltmarsh occur on the Roe Estuary in Lough Foyle, on the River Bann at Portstewart and Grangemore, at Ballycarry in Larne Lough, around Strangford Lough, and at Mill Bay, Carlingford Lough. Ballymacormick Point (on the south shore of Belfast Lough), Templecowey and Horse Island are important for their range of saltmarsh communities, developed along sheltered parts of the rocky shore. Locations mentioned in the text are listed in Table 3.6.1 and shown on Map 3.6.1.

The saltmarsh of the Roe Estuary shows the zonation from lower saltmarsh vegetation to mid-upper marsh turf of red fescue and saltmarsh rush. The seaward edge of the saltmarsh is suffering from erosion. The saltmarsh of the Bann Estuary is of a similar mid-upper marsh turf which, at Grangemore, shows an intact and extensive transition to fen and rush pasture (Cooper *et al.* 1992). Larne Lough also contains significant areas of saltmarsh. It is of botanical interest for its beds of narrow-leaved eelgrass *Zostera angustifolia* present on the intertidal mudflats. Saltmarsh vegetation occurs all around the foreshore, but is most extensive at Ballycarry (DoE (NI) pers. comm.), where it is dominated by red fescue and shows a transition to fen vegetation. Much of Strangford Lough is fringed with a narrow strip of saltmarsh, with the most extensive area being around the Comber Estuary. Here the saltmarsh ranges from lower saltmarsh vegetation to beds of common reed *Phragmites australis*. There are well-developed saltpans at Granagh Bay, Gransha Point and the Comber Estuary. Mill Bay in Carlingford Lough supports the largest intact area of saltmarsh in Northern Ireland (DoE (NI) pers. comm.); it shows a successional zonation from open mud flats to upper brackish marsh with associated saltmarsh communities. The saltmarsh is backed by extensive sea rush *Juncus maritimus* brackish marsh, and also has saltpans.

Except in very sheltered bays in Strangford Lough, a typical saltmarsh vegetation zonation in the region lacks the pioneer zone of glasswort *Salicornia* spp. that is widespread in England and Wales, instead grading from a transitional lower saltmarsh (SM10) into the low-marsh to mid-marsh of common saltmarsh-grass vegetation (SM13). The red fescue - saltmarsh rush vegetation type (SM16) is the main mid-to-upper marsh type. Sea-purslane *(Atriplex) Halimione portulacoides* saltmarsh (SM14) is not well developed and occurs predominantly in the south-east. Typically, common couch *Elymus repens* vegetation (SM28) terminates the saltmarsh at its upper limit. Where there are unbroken transitions between saltmarsh and non-tidal vegetation, or where brackish conditions develop, the upper marsh vegetation may be species-rich. Common reed *Phragmites australis* swamp and reed beds (S4) occur as an inland extension of saltmarsh at Ballycarry and Templecowey.

A number of rare species occur in the saltmarshes of Northern Ireland. Eelgrass *Zostera marina* is rare, being typical of waters from 1-4 m below low water mark to just above low water mark of spring tides. Eelgrass beds are found in only two areas, on mud flats at several sites on the eastern shore of Strangford Lough and in a small area at

Table 3.6.1 Areas of saltmarsh habitats in the region

Site no. on Map 3.6.1	*Name*	*Grid ref.*	*Saltmarsh type(s)*	*Conservation status*
	Co. Londonderry			
1	Roe Estuary	C635295	Saltmarsh, transitions to sea club-rush *Scirpus maritimus* (S21) fen	(N)NR, pSPA
2	Grangemore	C806355	Saltmarsh, transitions to sea club-rush (S21) fen and common club-rush *Schoenoplectus tabernaemontani* (S20) fen	NT
3	Portstewart	C802360	Saltmarsh	NT
	Co. Antrim			
4	Giant's Causeway	C952452	Saltmarsh (beach-head), transitions to common spike-rush *Eleocharis palustris* (S19) fen	(N)NR, WHS, ASI, ESCR
5	Larne Lough - Ballycarry	J466943	Saltmarsh, transitions to fen	ASSI, pSPA
	Co. Down			
6	Ballymacormick Point	J530838	Saltmarsh (beach-head), transitions to sea club-rush (S21) fen and (along spring lines) iris *Iris pseudacorus* fen	ASSI
7	Templecowey	J632475	Saltmarsh (beach-head, transitions to sea club-rush (S21) fen, bottle sedge *Carex rostrata* - marsh cinquefoil *Potentilla palustris* fen and (along spring lines) iris fen	pSPA
8	Ballyquintin Point	J624456	Saltmarsh (beach-head), transition to water-cress *Nasturtium officinale* - fool's water-cress *Apium nodiflorum* - brooklime *Veronica beccabunga* - lesser water-parsnip *Berula erecta*/water forget-me-not *Myosotis scorpioides* (S23) fen	ASSI, (N)NR, pSPA, pSAC
9	Bar Hall Bay	J617468	Saltmarsh (beach-head)	ASSI, pSPA, pSAC
10	Granagh Bay	J604487	Saltmarsh (beach-head)/saltpans	(N)NR, ASSI, pSPA, pSAC, MNR
11	Dorn	J595560	Accreting glasswort *Salicornia* spp. marsh	(N)NR, ASSI, pSPA, pSAC, MNR
12	Gransha	J593597	Saltmarsh/beach-head saltmarsh, saltpans	(N)NR, ASSI, pSPA, pSAC, MNR
13	Horse Island	J598608	Saltmarsh, transitions to iris fen (along spring lines)	ASSI, pSPA, pSAC, NT, MNR
14	Doctors Bay	J600624	Saltmarsh (transition to scrub)	ASSI, pSPA, pSAC, MNR
15	Anne's Point	J557686	Bunded saltmarsh	ASSI, pSPA, pSAC
16	North Strangford Lough	J495727	Saltmarsh	ASSI, pSPA, pSAC, part (N)NR, MNR
17	Comber Estuary	J475685	Saltmarsh/cord-grass *Spartina* spp. marsh/saltpans	ASSI, pSPA, pSAC, part (N)NR, NT, MNR
18	Ardmillan Bay	J510635	Saltmarsh (beach-head), saltpans	ASSI, pSPA, pSAC, MNR
19	Nickey's Point	J525515	Saltmarsh (beach-head)	ASSI, pSPA, pSAC
20	Quoile Pondage Castle Island Causeway	J517485	Bunded saltmarsh, transition to common club-rush (S20) fen	(N)NR, pSPA
21	Queen's Lake	J520486	Bunded saltmarsh grading to grazing marsh	ASSI
22	Black Causeway	J583488	Bunded saltmarsh grading to grazing marsh	ASSI, MNR
23	Killard	J610433	Saltmarsh with saltpans	(N)NR, ASSI, pSPA, pSAC
24	Dundrum Inner Bay	J397358	Saltmarsh	ASSI
25	Mourne Coast	J382297-J338152	Saltmarsh (beach-head)	ASI
26	Mill Bay, Carlingford Lough	J235135	Saltmarsh, backed by brackish marsh; saltpans	ASSI, pSPA

Source: DoE(NI) Environment and Heritage Service. Key: (N)NR = (National) Nature Reserve; pSPA = proposed Special Protection Area; WHS = World Heritage Site; ESCR = Earth Science Conservation Review site; ASSI = Area of Special Scientific Area; ASI = Area of Scientific Interest; pSAC = proposed Special Area of Conservation; NT = National Trust property; MNR = Marine Nature Reserve.

Templecowey. However, there are extensive beds of the other eelgrass species (*Z. noltii* and *Z. angustifolia*) on the intertidal flats of Lough Foyle, Larne Lough, Strangford Lough, Dundrum Inner Bay and Carlingford Lough, where they serve as a food resource for grazing wildfowl in winter. Beaked tasselweed *Ruppia maritima* occurs in saltpans on the Comber Estuary and sparsely elsewhere. Dwarf spike-rush *Eleocharis parvula*, a 'Red List' species, forms small stands in the Bann Estuary, Quoile Pondage and at Killard. Sea-purslane occurs in Strangford Lough and Mill Bay, Carlingford Lough, both as a zone and fringing creeks. Its northern limit was until recently the Gransha Point area, but it appears to be expanding its range northwards.

Although not a rare species, common cord-grass *Spartina anglica* is of note because it has been extremely invasive in parts of England and Wales, although in Northern Ireland it has been introduced less widely. It occurs for the most part in isolated clumps at the lower edge of sheltered saltmarshes in Carlingford Lough and Strangford Lough, although extensive areas have developed on the west side of Strangford Lough. Townsend's cord-grass *Spartina townsendii* occurs in Lough Foyle.

3.6.3 Human activities

Many saltmarsh sites, such as the Roe Estuary, Ballycarry, Larne Lough, Strangford Lough and Mill Bay, fall within (National) Nature Reserves and Areas of Special Scientific Interest and are consequently managed to protect their nature conservation interest. The saltmarsh sites at Grangemore, Portstewart, Horse Island and Comber Estuary are owned and managed by the National Trust.

Grazing is extensive over some saltmarshes, particularly in Lough Foyle: at Carrickhugh grazed saltmarsh is used for the production of bowling-green turf; at the Roe Estuary (N)NR sheep are grazed under licence from DoE (NI) EHS; and the National Trust monitors grazing undertaken through grazing agreements along the Bann Estuary at Grangemore and Portstewart. In other areas, such as parts of Ballycarry, grazing has been discontinued. The saltmarsh in Mill Bay, Carlingford Lough, is lightly grazed by cattle; this has helped to maintain the zonational sequence from mudflat through saltmarsh to fen vegetation.

In the nineteenth century areas of saltmarsh in Lough Foyle and Strangford Lough were claimed for agriculture; most of this land now supports productive agricultural land and crops. The only estuary where there was significant claim for port-related and industrial developments was Belfast Lough. Land-claim now occurs only infrequently. The landward boundaries of saltmarshes are generally fixed, usually where they meet agricultural grassland: this can lead to a net loss of saltmarsh in places such as the south shore of Lough Foyle, where there is erosion at the seaward edge and saltmarsh communities are prevented from migrating inland (Cooper *et al*. 1992). Erosion at the north end of Strangford Lough and in Mill Bay, Carlingford Lough, may also be reducing the extent of saltmarsh vegetation, though the location of the seaward edge of an apparently eroding marsh near Newtonards seems to be consistent with its position as shown on early Ordnance Survey maps (J. Pethick pers. comm.). Should sea levels rise through global climatic change to the levels currently predicted, there is likely to be a significant reduction in the area of saltmarsh.

The invasive common cord-grass was introduced to Strangford Lough in the 1940s. While various control measures were implemented between 1978 and 1983, particularly in the last five years of this period, the plant is again spreading rapidly, especially on the western shore. The National Trust recorded a five-fold increase in the area of *Spartina* marsh at the north end of the lough between 1992 and 1997 (Andrews 1997). Fortunately its overall distribution around the lough is patchy. Small clumps have appeared recently in Dundrum Inner Bay. The plant was introduced to Carlingford Lough in the 1950s, and although virtually eradicated by the mid-1970s, it is again spreading around Mill Bay.

Wildfowling is carried out on most, if not all, saltmarshes, except where they lie within wildfowl refuges (see section 9.7).

3.6.4 Information sources used

Saltmarshes were surveyed by Cooper *et al*. (1992) as part of a National Vegetation Classification (NVC) (Rodwell in press) survey of selected locations on the Northern Ireland coast. Beach-head saltmarsh in particular is under-represented in this survey. This survey is therefore not comprehensive in terms of coverage, but it covered the largest known and most important areas of coastal habitats. NVC surveys use a reliable, consistent methodology yielding detailed information on the distribution and species composition of vegetation. For some sites the vegetation was mapped, and for all sites the vegetation was described and information on coastal erosion and accretion, atypical vegetation and adjoining land use was recorded. The data provide a sound baseline for future saltmarsh vegetation studies and management of the resource.

3.6.5 Acknowledgements

Thanks are due to J. Pethick and to J.S. Furphy, R.J. Bleakley and P. Corbett, DoE (NI) Environment and Heritage Service, for their helpful comments. A preliminary draft was prepared by WS Atkins Ltd.

3.6.6 Further sources of information

A. References cited

Andrews, D. 1997. Spartina *survey 1997 - preliminary results.* Saintfield, unpublished internal report to the National Trust.

Baxter, J., & Boaden, P. 1990. Coastal resources of the Irish Sea. *In: The Irish Sea, an environmental review; Part 1: nature conservation.* Liverpool, Liverpool University Press. (Irish Sea Study Group.)

Cooper, E.A., Crawford, I., Malloch, A.J.C., & Rodwell, J.S. 1992. *Coastal vegetation survey of Northern Ireland.* Lancaster, Lancaster University.

Leach, S.J., & Phillipson, P.H. 1985. The saltmarsh and brackish swamp vegetation of the Fife Peninsula. *Transactions of the Botanical Society of Edinburgh, 44:* 357-373.

Rodwell, J.S. In press. *British plant communities. Volume 5: maritime and open vegetation communities.* Cambridge, Cambridge University Press.

B. Further reading

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

Cooper, A. 1982. The effect of salinity and waterlogging on the growth and cation uptake of saltmarsh plants. *New Phytologist, 90:* 263-275.

Cooper, A. 1984. A comparative study of the response of salt marsh plants to manganese. *Plant and Soil, 81:* 47-59.

Department of the Environment for Northern Ireland. 1994. *Strangford Lough proposed Marine Nature Reserve - guide to designation*. Belfast, Department of the Environment for Northern Ireland.

Hackney, P. 1992. *Stewart and Corry's flora of the North-east of Ireland*. Belfast, Institute of Irish Studies, The Queen's University of Belfast.

Praeger, R.L. 1974. *The botanist in Ireland*. Wakefield, E.P. Publishing.

C. Contact names and addresses

Type of information	Contact address and telephone no.
Dune and saltmarsh grazing experiment at Portstewart	Area Countryside Manager, The National Trust, North Coast Office, 42 Causeway Road, Bushmills BT57 8SU, tel: 012657 32143
Dune and saltmarsh grazing: policy and monitoring	*Regional Adviser for Nature Conservation, The National Trust, Saintfield, tel: 01238 510721
Saltmarsh distribution and species data	*The Ulster Museum, Belfast, tel: 01232 383000
Saltmarsh distribution and conservation management; *Spartina* control	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477
Strangford Lough Wildlife Scheme and byelaws (wildfowling, grazing, collecting)	The Head Warden, National Trust Strangford Lough Wildlife Scheme, Strangford Lough Wildlife Centre, Castleward, Strangford BT30 7LS, tel: 01396 881411
Strangford Lough: general management and policy	The Strangford Lough Officer, Strangford Lough Management Committee, 13 The Strand, Portaferry BT22 1PF, tel: 012477 28886
Wildfowling: general information on habitats, conservation and impacts	*Royal Society for the Protection of Birds, Belfast, tel: 01232 491547

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

Mahee Island is one of the dozens of small islands in Strangford Lough. Created by the passage of ice as a drumlin swarm - a group of glaciated hillocks - they have since been isolated by sea-level rise. The lough is of outstanding international importance for the diversity and richness of its marine/estuarine environments. It is the province's only Marine Nature Reserve - one of only three in the whole of the United Kingdom - and has a plethora of other conservation designations, including Area of Outstanding Natural Beauty. Photo: Mike Hartwell, DoE (NI) EHS.

Chapter 4 Marine and estuarine environments

4.1 Estuaries

A.L. Buck

4.1.1 Introduction

Estuaries are "partially enclosed tidal areas at least partly composed of soft tidal shores, open to saline water from the sea, and receiving fresh water from rivers, land run-off or seepage" (Davidson *et al*. 1991). They comprise both aquatic (marine, brackish and fresh water) and terrestrial habitats, including adjacent sand dunes, coastal grasslands and maritime heaths. All the estuaries discussed here follow the definition used in the Nature Conservancy Council's Estuaries Review (Davidson *et al*. 1991) and have at least 2 km of tidal channel or 2 km of shoreline over 0.5 km wide at low tide, either now or historically, a definition that includes the five sea loughs in the region. This section gives an overview of the main features of the estuarine resource in Region 17; for further details of habitats, species and human uses refer to relevant sections in Chapters 3, 5 and 9 respectively. Note that other definitions of an estuary may be used in different contexts; for example, that used in Northern Ireland for the Urban Waste Water Treatment Directive is based on salinity.

The eight estuaries lying wholly or partly within Region 17 (Map 4.1.1) make a substantial contribution to the UK's estuarine resource. The contribution of the region's estuaries to the wider UK resource is summarised in Table 4.1.1. Overall, they form almost 10% by area of that resource and almost 3% of the estuarine habitat of north-west Europe (Davidson *et al.* 1991).

Table 4.1.1 Contributions of Region 17 estuaries to the national resource

Resource	*Regional total*	*UK total*	*% UK*
Intertidal area (ha)	11,200	332,350	3.4
Total estuarine area (ha)	56,620	581,290	9.7
Shoreline length (km)*, +	705*	9,727*	7.2
Tidal length of main channel (km)*	185*	2,640*	7.0

Sources: Buck & Donaghy (1996); Davidson & Buck (in prep). Note: areas rounded to the nearest 10 ha; lengths rounded to the nearest 1 km. Key: *measured at 1:50,000 scale up to the tidal limits of rivers; +includes adjacent estuarine coastline in the Republic of Ireland.

The estuaries of Northern Ireland are a mixture of large and small sites, the largest being Foyle, Belfast and Strangford Loughs, where relatively small freshwater inflows open out into broad, open sea loughs; all three include more than 13,000 ha of estuarine habitats. Four of the five remaining estuaries each cover less than 1,200 ha.

Map 4.1.1 Estuaries. Source: JNCC Coastal Database. © Crown Copyright.

The estuaries are also varied in geomorphological type, including coastal plain type, bar-built (a type often associated with depositional coasts), embayment and complex. Saltmarsh occurs in all eight sites, although the vegetation covers only small (unquantified) areas in the most sheltered parts of the estuaries. The total area of saltmarsh (estimated to be 200 ha) represents less than 1% of the UK resource. However, the saltmarsh is of particular interest because a number of sites show transitions to freshwater or grassland vegetation. In many parts of the UK these transitions have been truncated by sea defences or lost to land-claim.

Although parts of some estuaries are heavily industrialised, many have substantial lengths of natural shorelines and make a significant contribution to the national resource. Several of the estuaries have considerable geomorphological, wildlife and nature conservation importance, reflected in many national and international designations. These estuaries have important sea-bed communities and rare plant and animal species, including internationally important bird populations.

4.1.2 Important locations and species

Table 4.1.2 lists the estuaries in the region (Map 4.1.1) and summarises their main physical characteristics.

The River Foyle opens out into the broad, sandy bay of Lough Foyle, whose intertidal sediments are fairly mobile. The mouth of Lough Foyle is constricted by Magilligan Point, a large sand dune system of geomorphological importance and with varied vegetation. The narrow estuary of the River Bann lies in a low-lying estuarine plain with saltmarsh vegetation that illustrates transitions to fen and rush pasture. On either side of the estuary mouth are wide, sandy beaches and sand dunes. Larne Lough is an enclosed estuarine system, modified by the deposition of quarry spoil, with areas of soft, intertidal sediments. Belfast Lough is the most modified estuary in Northern Ireland, as large areas of the former estuary have been lost to land-claim, but the intertidal flats that remain support internationally important numbers of wintering waterfowl.

Strangford Lough is of outstanding international importance for the range of marine environments present and the diversity of benthic communities that it supports (see also section 4.2). It has extensive intertidal flats, a range of saltmarsh communities and a variety of other coastal habitats. In contrast, the small bay of Killough Harbour is the smallest estuary in Northern Ireland and comprises predominantly intertidal mudflats. Dundrum Inner Bay is the estuary of three rivers that flow across muddy inner bays before opening out into a broader bay, with large sand dune systems on either side of the mouth. Of these, Murlough is of particular interest as a large, acidic dune system with a heathland vegetation. Lastly, Carlingford Lough is a very sheltered and shallow sea lough that is known to support marine communities and species of considerable interest.

The significance of the estuaries in Northern Ireland is recognised in their designation as sites of importance for nature conservation. Large parts of Larne Lough, Belfast Lough, Strangford Lough, Dundrum Inner Bay and Carlingford Lough have been designated as Areas of Special Scientific Interest (ASSIs) and there are (National) Nature Reserves, ASSIs or Areas of Scientific Interest (ASIs) covering parts of all but two estuaries (the Bann and Killough Harbour). Strangford Lough has also been designated a Marine Nature Reserve. Two estuaries in the region, Lough Foyle and Strangford Lough, regularly support more than 20,000 wintering waterfowl. Additionally, all but two (Bann Estuary and Dundrum Inner Bay) of the region's estuaries currently support internationally and nationally (in an all-Ireland context) important numbers of at least one species of waterfowl. These sites meet the criteria for designation as Special Protection Areas and listing as Ramsar sites.

4.1.3 Human activities

The largest urban development on estuaries in the region is on the upper reaches of Belfast Lough, where the shores are dominated by the city of Belfast, with the towns of Carrickfergus, Newtownabbey and Bangor nearer the mouth. The only other large towns or cities on estuaries in the region are Londonderry on the upper reaches of Lough Foyle, Coleraine on the tidal Bann, Larne at the mouth of Larne Lough and Newry on the uppermost reaches of Carlingford Lough.

Of the region's estuaries, only Belfast Lough experiences major urban and industrial pressures; here considerable areas of the former estuary have been lost to land-claim, with an extensive port and dock system and a series of industrial sites now dominating the inner parts of the estuary. Docks on some other estuaries, e.g. at Coleraine on the Bann Estuary, have declined in use as Belfast has become the main port in Northern Ireland for heavy cargo. However, docks and harbours still exist at Lisahally on Lough Foyle, where new port facilities are being developed, at Larne, where there is a roll-on/roll-off ferry and cargo port, and at Warrenpoint on Carlingford Lough.

Fishing craft are based at many harbours in the region's estuaries. Commercial fisheries in estuaries are widespread and include fishing for salmon and well as potting for lobster, prawn, whelk and crab. Dredging for molluscs occurs in some places and several estuaries support commercial shellfisheries (see also section 9.1).

Leisure and recreational pursuits are common in the region's estuaries, and sailing and other water-based sports are widespread and very popular, with marinas or dinghy parks on every estuary. Beach and other shore-based recreation activities occur on many estuaries within the region, although only a few localities are used intensively.

Table 4.1.2 Physical characteristics of Region 17 estuaries

Estuary	*Centre grid ref.*	*Geomorphological type*	*Total area (ha)**	*Intertidal area (ha)**	*Main channel length (km)*	*Spring tidal range (m)*	*Sub-tidal area (%)*
156. Lough Foyle	C5630	Coastal plain	20,692	4,097	60.5	1.8	80.2
157. Bann Estuary	C8235	Bar-built	281	128	11.4	1.8	54.4
158. Larne Lough	D4300	Coastal plain	1,189	398	11.3	2.4	66.5
159. Belfast Lough	J3982	Coastal plain	13,480	554	28.4	2.9	95.9
160. Strangford Lough	J5660	Complex	14,513	3,390	35.8	3.2	76.6
161. Killough Harbour	J5436	Embayment	213	106	2.7	4.6	50.2
162. Dundrum Inner Bay	J4137	Bar-built	1,117	1,037	7.9	4.6	7.2
163. Carlingford Lough	J2013	Complex	5,135	1,490	26.7	4.1	71.0

Sources: Buck & Donaghy (1996); JNCC Integrated Coastal Database. Key: *to the nearest whole hectare. Notes: estuary numbers are those used in Davidson *et al.* (1991). 'Geomorphological type' relates to nine estuary categories, described further in Chapter 5.7 of Davidson *et al.* (1991) and in Davidson & Buck (in prep). 'Spring tidal ranges' are for the monitoring station closest to the mouth of the estuary.

Table 4.1.3 Human influences in Region 17 estuaries

Estuary	*Grid ref.**	*Human use type*			
		urban	*indus-trial*	*rural***	*recrea-tional*
156. Lough Foyle	C5630	●	●	○	○
157. Bann Estuary	C8235	○	○	●	○
158. Larne Lough	D4300	●	●	○	○
159. Belfast Lough	J3982	●	●	○	●
160. Strangford Lough	J5660	○	○	●	●
161. Killough Harbour	J5436	○	○	●	○
162. Dundrum Inner Bay	J4137	○	○	●	●
163. Carlingford Lough	J2013	○	●	○	○

Source: Buck & Donaghy (1996). Note: estuary numbers are those used in Davidson *et al.* (1991). Key: *central point; **includes natural resource exploitation. ● = major human use; ○ = minor human use.

4.1.4 Information sources used

This section is summarised chiefly from *An inventory of UK estuaries*, being published in six regional volumes along with an introductory and methods volume. All the estuaries in Region 17 are included in *Volume 7. Northern Ireland* (Buck & Donaghy 1996). Data presented in the inventory are drawn largely from material collected during 1991-92 (updated where appropriate) under a joint project by JNCC and RSPB.

4.1.5 Acknowledgements

Thanks are due to Dr Keith Hiscock and Mark Tasker, JNCC, and Clifford Henry and R.J. Bleakley, DoE (NI) Environment and Heritage Service, for their helpful comments on draft texts.

4.1.6 Further sources of information

A. References cited

Buck, A.L., & Donaghy, A. 1996. *An inventory of UK estuaries. 7. Northern Ireland.* Peterborough, Joint Nature Conservation Committee.

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

B. Further reading

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

Erwin, D.G., Picton, B.E., Connor, D.W., Howson, C.M., Gilleece, P., & Bogues, M.J. 1990. *Inshore marine life of Northern Ireland*. Belfast, Ulster Museum.

Fuller, I. In press. *The shores of Northern Ireland.* Belfast, DoE (NI) EHS & HMSO.

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

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Integrated Coastal Database: national database of estuaries; coastal habitats; statutory & non-statutory protected sites.	*Earth Science and Coastal Advisor, Joint Nature Conservation Committee, Peterborough, tel: 01733 62626
Statutory protected sites; detailed wildlife site information; coastal geomorphology. Numerical and some digitised data.	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477
RSPB Estuaries Inventory: mapped and numerical information on land use and selected human activities for 57 major UK estuaries, including all those in Region 17.	*Estuaries Inventory Project Officer, RSPB, Sandy, tel: 01767 680551

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

4.2 The sea bed

Dr D.G. Erwin

4.2.1 Introduction

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

Sea-bed communities are particularly influenced by the nature of the substratum, by the strength of wave and tidal currents and by water turbidity (see section 2.2). The water is at its clearest on the north coast, particularly between Benbane and Torr Heads and around Rathlin Island, where algal communities can exist below 20 m depth. On coasts south of Larne turbidity is much higher and algal communities seldom exist below 10 m depth. Oceanic fronts, which often develop during the summer months (see also section 4.3), lie off the Irish coast and may have considerable effects on the existence and distribution of species and communities. The Islay Front meets the coast of the Irish Republic just east of Malin Head, while a southern front often intersects the coast between the mouth of Strangford Lough and St. John's Point (Lee & Ramster 1981): water south of it is stratified, with a warm surface layer, a cold deep layer and a marked thermocline (sharp temperature gradient).

The region includes areas of nature conservation importance for marine biology and has a number of sites of national (UK) importance. Strangford Lough and Rathlin Island are sites of international marine conservation status: in the course of the Northern Ireland Sublittoral Survey (Erwin *et al.* 1986), 90% of the species recorded were found at one or both of these two sites. Strangford Lough is a statutory Marine Nature Reserve (MNR), and it is the declared intention of DoE (NI) to designate Rathlin Island as an MNR.

Northern Ireland is close to the northern distribution limits of a number of species and to the southern limits of a few species. Many of these species are consequently rare or scarce in the region and are thus covered in section 5.4. A number of species that are not rare or scarce in any sense, for example the topshell *Monodonta lineata*, which is found from Strangford Lough to Carlingford Lough, exhibit very interesting distribution patterns in the region.

4.2.2 Important locations and communities

Map 4.2.1 shows the locations of marine biological interest described in this section.

Lough Foyle to Murlough Bay

Lough Foyle is shallow and may be subject to wide temperature fluctuations. It has extensive mussel *Mytilus edulis* beds on the lower shore and in the shallow sublittoral. The majority of the sea bed is very mobile and somewhat barren sand. Large areas of mobile sand also occur as sandy beaches between Magilligan Point and Benbane Head, often backed by dune systems. Offshore, there are very extensive

Map 4.2.1 Locations of marine biological interest described in the text. © Crown Copyright.

areas of relatively barren sand. Occasionally after a storm there are major beach strandings of the bivalve *Arctica islandica*, creating a layer of shells up to 30 cm thick along lengthy stretches of beach, which may indicate a large, as yet undiscovered, offshore population. There are very species-rich reefs of the worm *Sabellaria spinulosa* off Magilligan Point at 30 m depth. The Skerries at Portrush are a group of rocks just offshore that are characterised subtidally by sand-scoured rock and sheltered sand communities unknown elsewhere in Northern Ireland. Six percent of the species recorded in the Northern Ireland Sublittoral Survey (Erwin *et al.* 1986) were found only here. Between Benbane Head and Murlough Bay, shores are most often cliff, rock or boulders extending into the sublittoral. In bays, there are sandy shores that extend a little into the subtidal. Algal communities dominate, extending deeper into the subtidal than elsewhere on the Northern Ireland coast because of the clarity of the water. Most of the animal communities in this stretch of coast are not diverse.

Rathlin Island

Rathlin Island, lying 5 km offshore in the northern entrance to the Irish Sea, is the largest island off the coast of Northern Ireland. It is subject to strong tidal streams, with a complex pattern of tidal movements around the island. The island is very exposed to the Atlantic Ocean on its north-west coast, but is relatively sheltered on the east coast. A wide range of exposed marine habitats exist, both intertidally and subtidally. A very wide variety of species occur, including 60% of all the species recorded in the Northern Ireland

Sublittoral Survey (Erwin *et al.* 1986), several of them rare or unusual (see section 5.4).

On the western part of the north coast, a shelf 10-100 m wide extends around the base of the cliffs at a depth of 10-25 m, before plunging down again as sublittoral cliffs. To the north of the island lies a 200 m-deep channel, which, with the submerged vertical cliffs at the edge of the island 'shelf' (the deepest submerged cliffs known in the UK), constitute an environment unique in the British Isles. Unlike similar cliffs elsewhere (for example in Scottish sea lochs), these are not sheltered from wave and tidal action. On these cliffs, 'sublittoral emergence' can be detected (species which normally live in deep water occasionally 'emerge' to shallower depths). In one cave the sea pen *Virgularia mirabilis* was recorded living in fine sediment at 30 m. The sublittoral cliffs are populated by rich assemblages of sponges, tunicates and hydroids, with different species dominating in different areas. In some places limestone outcrops with arches and caves occur, providing unusual local microhabitats.

On the south-west coast of the island, steep but stable boulder slopes dominated by oatenpipes *Tubularia indivisa* (a hydroid) extend to more than 50 m depth. On the north-east coast there is a shallower slope of stable boulders and bedrock, with particularly diverse and abundant sponge assemblages. The east coast consists of bedrock, boulders and cobbles lying in coarse gravel, with rich hydroid and sponge communities. In relatively sheltered Church Bay there is a wide range of sandy sediments. The inner bay consists mostly of stable sand with dense populations of the sea cucumber *Labidoplax digitata*, the sea potato *Echinocardium cordatum* and the burrowing brittle star *Amphiura brachiata*.

Murlough Bay to Larne

Between Murlough Bay and Cushendall the most interesting feature is the presence of ephemeral populations of algae growing on mobile sublittoral cobbles. Species such as the seaweeds *Schmitzia hiscockiana, S. neopolitana, Dudresnaya verticalla* and *Scinaia turgida* grow in the summer, overwintering as crusts. Intertidally (but not sublittorally), Red Bay, which has one of the lowest tidal ranges in the British Isles, is the most species-rich of the sandy bays. There are indications of extreme stability, such as full-grown Devonshire cup corals *Caryophyllia smithii* attached to small pebbles or even apparently unattached (as also occurs off the north coast). Sublittoral boulder slopes leading onto cobbles and gravel typify the coast between Garron Point and Larne. There are well-developed maerl beds south of Garron Point and off Ballygally Head.

The Maidens

The Maidens are isolated rocks and two small islands enclosing an area of relatively shallow water (less than 50 m depth) 8 km to the north-east of Larne. The rocks are subject to very strong tidal streams and exhibit a complex pattern of variation in a small area, leading to a wide range of sublittoral habitats and communities. Many species have been recorded only here and on Rathlin Island, in particular the very rare assemblage characterised by the hydroids *Polyplumaria flabellata* and *Diphasia alata*, together with the sponge *Clathria barleii*.

Larne Lough and Island Magee

Larne Lough, which is very shallow and has a bottom of fine muddy sand, has been substantially infilled. It holds little of marine interest apart from a low-water, high-turbidity sponge community based on *Hymeniacidon perleve* on loose boulders. This is found in an area where water movement has been increased by channel restriction caused by boulder infill. The current-swept open coast of Island Magee consists of bedrock and boulders intertidally and in shallow water, grading into coarse gravel. The most diverse animal communities on this section of coast are at the Isle of Muck.

Belfast Lough to Strangford Lough

Historically, the whole of Belfast Lough was a rich and diverse marine area, but this is no longer the case. Sediments are mostly mud or heavily silted gravel. Near the mouth of the lough, beds of the brittle star *Ophiocomina nigra* occur, and recent monitoring studies by DoE (NI) have shown that the very heterogeneous sediments in this area and beyond harbour a wide range of infaunal taxa. Intertidally and close inshore, dense beds of small mussels support seabird populations. Belfast Lough was the first site in Northern Ireland to be colonised by the Australian barnacle *Elminius modestus* (Lewis 1964). It is now widespread around the Northern Ireland coast. Between Belfast Lough and Strangford Lough, sand and rock beaches give way to cobbles and coarse gravel in deeper water. On the east side of the Ards Peninsula, tidal currents are relatively strong and scour-resistant bryozoans and hydroids are common sublittorally. The Copeland Islands, at the entrance to Belfast Lough, are lacking in benthic diversity. The water is turbid, with kelp forest developed to only 10 m depth. Heavy sea urchin grazing is evident.

Strangford Lough

Strangford Lough is a fully saline sea lough (Boyd 1973) with an 8 km-long fiordic 'narrows' entrance from the Irish Sea and a fiardic main body to the lough, approximately 24 km long and 4-6 km wide. Tidal flows vary in speed from up to 4 m/s in the narrows to virtually zero in the north of the lough. Vast amounts of water flow in and out of the lough, estimated at 350,000,000 m^3 per mean tide (Boaden 1984). The lough is sheltered by land on all sides, with an available westerly wind fetch of only 5-10 km. Intertidally this has resulted in coarser sediments on the eastern shores of the lough and finer sediments on the western shores, particularly in those areas that are further protected from wind in the lee of islands (although in recent years gale events have been from the south or south-east). Wind affects only the intertidal and shallow subtidal zones and does not have a major effect at depths below 10 m. The result is a complex pattern of sublittoral bottom types and communities, related directly to the strength of tidal streams (Williams 1954; Erwin 1977).

Strangford Lough is the most intensively studied part of the Northern Ireland coastline, with considerable historical importance, and has been described as the most diverse sea lough in the British Isles (Gubbay 1988). Ulster Museum studies (Erwin *et al.* 1990) have shown that 72% of the sublittoral species recorded from Northern Ireland have

been documented here, and 28% of the species recorded from the lough have not been found elsewhere in Northern Ireland. It is the type locality for a number of species. The Northern Ireland Littoral Survey (Wilkinson *et al*. 1988) states that "Strangford Lough contains the greatest diversity of sheltered sedimentary habitats, including wide flats of muddy sand and mud and shores of mud, sand, gravel and pebbles and combinations of these found on the whole of the Northern Ireland coastline." At least 20 different intertidal sea-bed communities and 22 different subtidal communities have been identified within the lough (Baxter & Boaden 1990; Erwin *et al*. 1985, 1986, 1990; Wilkinson *et al*. 1988).

Intertidally, one of the most significant communities found in the lough is a particularly rich and diverse fauna and flora based on boulders and cobbles found on muddy gravel. Common members of the association are the alga *Fucus serratus* and the chiton *Acanthochitona crinitus* on the cobbles, the worm *Eupolymnia nebulosa* under the cobbles and the worm *Neoamphitrite figulus* in the gravel (P.J.S. Boaden pers. comm.). Subtidally, of particular note is a possibly relict and almost certainly unique community in low-energy muddy areas, based on clumps of the horse mussel *Modiolus modiolus* attached to shell. These clumps are colonised by the bivalve *Chlamys varia* and a highly diverse association of other species and are also associated with the queen scallop *Aequipecten opercularis*.

Local varieties of interest in the lough include *Calliostoma zizyphinum* var. *lyonsi*, a pure white form of topshell, which is abundant both sublittorally and on the shore. Elsewhere in the British Isles it is found only in Torsa Channel and Clachan Sound in Scotland. *Ascophyllum nodosum* f. *mackaii*, a non-attached form of the common intertidal alga, maintains a healthy population in extreme shelter in Ballyhenry Bay, within metres of the extremely fast tidal currents of the 'narrows' area.

The hybrid common cord-grass *Spartina anglica* was deliberately introduced at two sites in Strangford Lough in 1942, at one site as an ornamental, and at the other in an attempt to reinforce a causeway. The species is now widespread intertidally and in places is abundant. It has become a major problem in the conservation of the natural communities in the lough (Kirby 1989).

Strangford Lough to Carlingford Lough

At the entrance to Strangford Lough there are extensive areas of coarse shelly gravel inhabited by the sea cucumber *Neopentadactyla mixta*, a characteristic species of this habitat. Between Strangford Lough and St. John's Point there are a wide range of beach types, from cliff to sand, while boulders, coarse sand and mud predominate subtidally. On the east coast of Ireland the distribution of the topshell *Monodonta lineata*, which seems to prefer water columns that are stratified in summer, lies inside the mobile front that usually develops just south of Strangford Lough, looping back to the coast near Drogheda in the Irish Republic (Map 4.3.1). Within the loop of this front the species is common, but outside the loop it does not exist, the most northerly record in Northern Ireland being St. John's Point, although it does occur just east of Malin Head in the Republic of Ireland, beyond the Islay Front. Closely associated geographically is the northern limit of the reef-building worm *Sabellaria alveolata*, which has its most northern site at Rossglass, Co. Down. The most extensive reef built by this species occurs at Glassdrumman Port in south Down.

Dundrum Outer Bay, surveyed in 1978 by the Ulster Museum (Erwin *et al*. 1983), was found to be dominated by extremely well-sorted sands, probably relict (i.e. winnowed), characterised by the brittle star *Amphiura brachiata* and the bivalve *Echinocardium cordatum*. These sands become finer further offshore. The rocks of the Mourne Mountains give rise to granite boulder shores of low diversity, interspersed with a number of soft sediment areas. Subtidally these boulders grade with increasing depth into muddy sand. Extensive beds of the brittlestars *Ophiothrix fragilis* and *Ophiocomina nigra* are prevalent in this area. Carlingford Lough harbours a number of interesting warm-water species, both intertidally and subtidally, that occur only here in Northern Ireland (see section 5.4). The entrance is a complex of channels, with cobbles, boulders and patches of bedrock, dominated by sponge and hydroid associations. The central section has a mixed range of substrata with a wide range of species, while the inner part of the lough is mud, with the sea pen *Virgularia mirablis* and the mollusc *Philine aperta* abundant.

Offshore (defined as beyond 3 km or 50 m depth, excluding sea lochs)

No systematic information is available on benthic habitats and communities from offshore locations in the region.

4.2.3 Human activities

The human activities with the most effect on the sea bed around Northern Ireland are commercial trawling and dredging. The benthos has been modified in almost all the areas within the region that are utilised for commercial fishing (see section 9.1). The nature and extent of the effects of these commercial processes on the target species, the by-catch and the sea bed itself are the subject of dispute between the industry and conservation interests but have also led to novel compromises and accommodations between the parties: in Strangford Lough new ways to meet the needs of both sectors are currently being examined. New target species that have recently been taken commercially in large numbers include velvet crabs *Necora puber* and whelks *Buccinum undatum*. The possible effects of this exploitation on sea-bed communities are unknown.

Shellfish cultivation takes place at a number of sites around the coast (see section 9.2), normally with no major deleterious effect on the sea bed or the local flora and fauna. In a few cases it is likely that imported stock has been the source of undesirable aliens, for example 'Japweed' *Sargassum muticum*, which was discovered in 1995 associated with bags of Pacific oyster *Crassostrea gigas* imported into Strangford Lough from Guernsey (Boaden 1995; J. Parsons pers. comm.). Japweed has already established a firm hold in the immediate area of the oyster farm, but has not been found elsewhere (Davison & Davison 1995; Davison 1996); recent attempts to remove it manually appear to have been partially successful.

The city of Belfast is at the head of Belfast Lough, on which it inevitably has a major impact, both directly and indirectly. Other sea loughs also have associated urban settlements: Londonderry is at the head of Lough Foyle;

Larne, with its major port, lies at the mouth of Larne Lough; Newtownards and Comber are at the north end of Strangford Lough and Warrenpoint is at the head of Carlingford Lough. The effects of conurbations and harbours are for the most part local, except within the sea loughs. The area of Dundrum Outer Bay has no net tidal current and is therefore particularly vulnerable to any change in the physical system. Recently built structures in Newcastle, Co. Down, may have had a profound effect, leading to the loss of beach sand, presumably to the offshore area. The subtidal effects have not been determined. Sewage sludge dumping (to be discontinued in 1998) is carried out at the entrance of Belfast Lough (see also section 9.4). Sewage outfalls, of varying quality, exist all around the coastline and are the subject of controversy in some areas (e.g. Portrush on the north coast and Portaferry in Strangford Lough) (see also section 9.6).

A number of marina developments have been built in recent years and more are planned (see also section 9.7). These do not appear to have deleterious effects on the sea bed, except in their immediate vicinity. However it is possible that, in their construction phase and during maintenance dredging, disposal of spoil could have major effects on downstream filter feeders. In dogwelks *Nucella lapillus,* physiological changes affecting reproduction (imposex) have been detected, caused by the historical use of TBT anti-fouling paints around marinas, fishing ports and harbours all around the Northern Ireland coast.

Bait-digging occurs all around the coast, but is carried out semi-commercially at only two sites, on the north shore of Belfast Lough and near Island Hill in Strangford Lough, where the very sheltered sediment retains its digging 'pock marks' for many months. Shore collecting of cockles *Cerastoderma edule* and periwinkles *Littorina littorea* (locally known as 'williks'), for personal consumption is widespread but has recently increased on a semi-commercial scale in a number of areas (see also section 9.1).

Seaweed gathering is carried out commercially at a very low level, although many farms, even a long way from the coast, have historic 'wrack rights' written into their tenure documents. In some areas, particularly on the north-east coast and in Strangford Lough, a small amount of the seaweed *Palmaria palmata* is collected and dried for sale as a local Irish delicacy known as 'dulse'. Many farms in the Mourne area have the legal right to gather seaweed and a number of access lanes exist to enable farmers to collect 'wrack'. At Mill Bay, Carlingford Lough, large (160 ha) artificial boulder beds were arranged to cultivate sea wrack, which was once harvested commercially (Evans 1951).

Between the coasts of Northern Ireland and Scotland is a large area (Beaufort's Dyke) which, in the past, was used as a disposal site for armaments and explosives. A great deal of material, including poisonous gas containers and other chemical weapons, has been disposed of in this area, and in recent years corroding remnants have come ashore in Northern Ireland, Scotland and Wales. The exact nature and extent of this material and what effect it may be having on the sea bed is not known (SOAFD 1996).

Strangford Lough is designated as a Marine Nature Reserve (MNR) containing and adjoining seven (National) Nature Reserves. The MNR is within an almost complete circle of intertidal Areas of Special Scientific Interest (ASSIs) nested within a larger Area of Outstanding Natural Beauty. It has been proposed as a possible Special Area of Conservation (SAC), Special Protection Area (SPA) and Ramsar site (see also Chapter 7). In addition, the National Trust, Down District and Ards Borough Councils, DoE (NI), the Royal Society for the Protection of Birds and some commercial shellfish interests between them own or lease from the Crown Estate most of the shores and some of the sea bed of the reserve. Management of the lough is coordinated through the Strangford Lough Management Committee, composed of persons appointed by government from a wide range of user groups and interested bodies (see also Chapter 10).

4.2.4 Information sources used

Two major baseline surveys of Northern Ireland's intertidal and subtidal resources have been carried out for the Department of the Environment for Northern Ireland (DoE (NI)). Dive surveys of the Northern Ireland sublittoral were undertaken under contract to the Ulster Museum from DoE (NI) between 1982 and 1985. The methodology is described in Erwin *et al.* (1985). Results were compiled as a report to DoE (NI) (Erwin *et al.* 1986) and published in popular form as Erwin *et al.* (1990). Surveys of the marine life of the shores of Northern Ireland were undertaken under contract to The Institute of Offshore Engineering, Heriot-Watt University, from DoE (NI) between 1984 and 1988. They were compiled as a report to DoE (NI) (Wilkinson *et al.* 1988) and will be published in popular form as Fuller (in press). Both surveys identified sites of nature conservation importance and provide a basis for the selection of marine sites for statutory protection. They also inform the evaluation of proposed developments in the marine environment in terms of impacts on nature conservation. The results of all these and other Museum dive surveys are held at the Centre for Environmental Data and Recording (CEDaR).

4.2.5 Acknowledgments

We are grateful to Clifford Henry, R.J. Bleakley and A.M. Bradley, DoE (NI) Environment and Heritage Service, as well as Dr I. S. Heaney, DANI; Dr P.J.S. Boaden, The Queen's University; Dr Julia Nunn, CEDaR; and W. Reid, Strangford Lough Officer, for information and for commenting on the draft. Particular thanks are due to CEDaR for their help at all times.

4.2.6 Further sources of information

A. References cited

Baxter, J.M., & Boaden, P.J.S. 1990. Northern Ireland. *In: The Irish Sea: The Irish Sea Study Group report, nature conservation*, 83-102. Liverpool, Liverpool University Press.

Boaden, P.J.S. 1984. Strangford Lough - a conservation history. *In: Nature conservation in Ireland, progress and problems,* ed. by D.W. Jeffrey, 57-66. Dublin, Royal Irish Academy.

Boaden, P.J.S. 1995. *Sargassum muticum* (Yendo) Fensholt in Strangford Lough, Northern Ireland. *Irish Naturalists Journal, 25:* 111-113.

Boyd, R.J. 1973. The relation of the plankton to the physical, chemical and biological features of Strangford Lough, Co. Down. *Proceedings of the Royal Irish Academy, 73B:* 317-353.

Davison, D.M. 1996. Sargassum muticum *in Strangford Lough*. Edinburgh, Davison & Davison Associates. (Report to DoE (NI) Environment and Heritage Service.)

Davison, D.M., & Davison, A.J. 1995. Sargassum muticum *in Strangford Lough. A review of information, issues and implications*. Edinburgh, Davison & Davison Associates. (Report to DoE (NI) Environment Service.)

Erwin, D.G. 1977. A diving survey of Strangford Lough, the benthic communities and their relation to substrate. *In: Biology of benthic organisms*, ed. by B.F. Keegan, P.O. Ceidigh & P.J.S. Boaden, 215-224. Oxford, Pergamon Press.

Erwin, D.G., Brachi, R., Elliot, R.C.A., & Picton B.E. 1983. A diving survey of the benthic fauna and substrates of Dundrum Bay, Northern Ireland. *Progress in Underwater Science, 8* (NS): 21-48.

Erwin, D.G., Picton, B.E., Howson, C., Connor, D., & Gilleece, P. 1985. The Northern Ireland survey: methodology and early results. *Progress in Underwater Science, 10* (NS): 27-38.

Erwin, D.G., Picton, B.E., Connor, D.W., Howson, C.M., Gilleece, P., & Bogues, M.J. 1986. *The Northern Ireland sublittoral survey*. Belfast, Ulster Museum.

Erwin, D.G., Picton, B.E., Connor, D.W., Howson, C.M., Gilleece, P., & Bogues, M.J. 1990. *Inshore marine life of Northern Ireland*. Belfast, Ulster Museum/DoE(NI)/HMSO.

Evans, E.E. 1951. *Mourne Country: landscape and life in County Down*, 135-144. Dundalk, Dundalgan Press.

Fuller, I. In press. *The shores of Northern Ireland*. Belfast, DoE (NI)/HMSO.

Gubbay, S. 1988. *A coastal directory for marine nature conservation*. 2nd ed. Ross on Wye, Marine Conservation Society.

Kirby, R. 1989. *Tidal flat instability and fine-grained sediment transport at Ardmillan Bay, Strangford Lough, in relation to* Spartina *eradication and oyster trestle burial*. Belfast, DoE (NI). (Unpublished report by Ravensrodd Consultants Ltd.)

Lee, A.J., & Ramster, J.W. 1981. *Atlas of the seas around the British Isles*. Lowestoft, MAFF.

Lewis, J.R. 1964. *Ecology of rocky shores.* London, English Universities Press.

Scottish Office Agriculture and Fisheries Department. 1996. *Survey of Beaufort's Dyke explosives disposal site - November 1995: interim report.* Aberdeen, Scottish Office. (Fisheries Research Services Report, No. 1/96.)

Wilkinson, M., Fuller, I.A., Telfer, T.C., Moore, C.G., & Kingston, P.F. 1988. *Northern Ireland littoral survey*. Edinburgh, Institute of Offshore Engineering, Heriot-Watt University.

Williams, G. 1954. Fauna of Strangford Lough and neighbouring coasts. *Proceedings of the Royal Irish Academy, 56B* (3): 29-133.

B. Further reading

Boaden, P.J.S. 1966. Interstitial fauna from Northern Ireland. *Veroffentlichungen Institut Meeresforschung Bremerhaven - Sonderband, 2: 125-130.*

Brown, R.A., & Seed, R. 1977. *Modiolus modiolus* (L.) - an autecological study. *In: Biology of benthic organisms*, ed. by B.F. Keegan, P.O. Ceidigh & P.J.S. Boaden, 93-100. London, Pergamon Press.

Dickie, G. 1857. Report on the marine zoology of Strangford Lough Co. Down and corresponding part of the Irish Channel. *Report of the British Association for the Advancement of Science, 1857:* 104-112.

Earll, R., & Erwin, D.G., *eds.* 1983. *Sublittoral ecology: the ecology of the sublittoral benthos.* Oxford, Oxford University Press.

Erwin, D.G. 1984. The community concept. *In: Sublittoral ecology, the ecology of the shallow sublittoral benthos,* ed. by R. Earll & D.G. Erwin, 144-164. Oxford, Oxford University Press.

Erwin, D.G., & Picton, B.P. 1987. *The Marine Conservation Society guide to inshore marine life.* London, Immel.

Glemarec, M. 1973. The benthic communities of the European North Atlantic continental shelf. *Oceanography and Marine Biology: An Annual Review, 11:* 263-289.

Morton, O. 1994. *Marine algae of Northern Ireland*. Belfast, Ulster Museum.

Nunn, J.D. 1994. The marine mollusca of Ireland. 1: Strangford Lough, Co. Down. *Bulletin of the Irish Biogeographical Society, 17:* 23-214.

Roberts, C.D. 1975. Investigations into a *Modiolus modiolus* (L.) (Mollusca: Bivalvia) community in Strangford Lough, N. Ireland. *Progress in Underwater Science, 1* (NS): 27-49.

Savidge, G., Foster, P., & Voltolina, D. 1984. Intense localised productivity in the Irish Sea. *Estuarine, Coastal and Shelf Science, 18:* 157-164.

Wood, E., *ed.* 1988. *Sea life of Britain and Ireland.* London, Immel & Marine Conservation Society.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Intertidal and subtidal resources databases	*Centre for Environmental Data and Recording (CEDaR), The Ulster Museum, Belfast, tel: 01232 383000
Current marine research	Marine Biology Station, 12 The Strand, Portaferry, Co. Down, tel: 012477 28240
Marine conservation initiatives	*DoE (NI) Environment & Heritage Service, Belfast, tel: 01232 251477

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

4.3 Plankton

M. Edwards & A.W.G. John

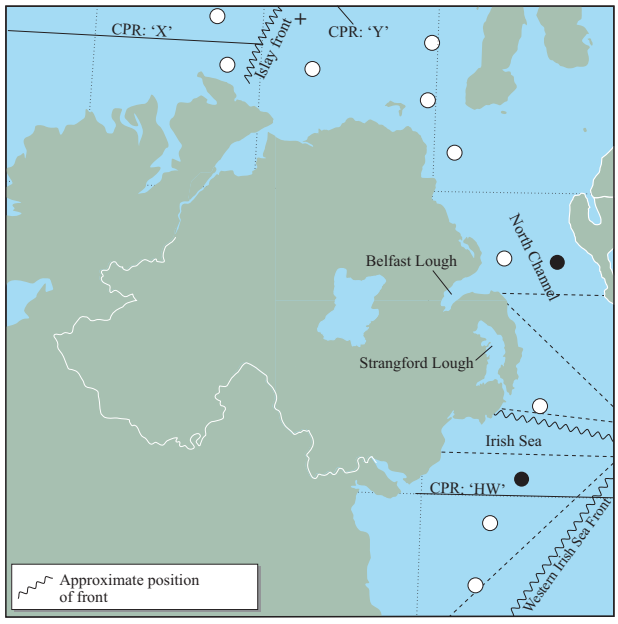
4.3.1 Introduction

Plankton include the bacteria (bacterio-), plant (phyto-) and animal (zoo-) plankton. In temperate continental shelf seas 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 (see section 2.3) and by the presence of local benthic (bottom-dwelling) and littoral (shoreline) communities (see also section 4.2). 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 likely to be of significant biological importance, since they are usually rich in plankton, which attracts other marine life. Phytoplankton blooms (transient, unsustainable growths, usually of a single species and often associated with a visible discolouration of the water) are a normal feature in the seasonal development of plankton. However, some blooms may reach exceptional proportions (>10^6 cells/l) or contain species (principally dinoflagellates) that could be toxic to humans or have an important economic impact on mariculture, fisheries and tourism.

In Region 17, as elsewhere, the plankton has a fundamental role in the food chain of both benthic (sea-bed) and pelagic (water column) wildlife. For both ecosystems, the availability of food and nutrients, the survival of larvae, the maintenance of populations and the timing of egg production are highly dependent on the amount of phyto- and zooplankton available. Any environmental stress imposed on the plankton will have consequences throughout the food chain and may affect the amount of food available to fish, birds, marine mammals etc. In coastal management, plankton can give early warnings of adverse human impacts (e.g. the effects of eutrophication) and highlight different water masses.

Region 17 includes the coastal areas of Northern Ireland, the north-western part of the Irish Sea including the North Channel, and the continental shelf seas to the north of Ireland. Mean surface temperature and offshore salinity vary (depending on season) between 7-14 °C and 34-34.75 g/kg, respectively. During most of the year the seas surrounding Northern Ireland are well mixed, except during the summer months, when some stratification may occur, forming frontal boundaries, e.g. the western Irish Sea Front (Map 4.3.1). Irish Sea water, less saline than continental shelf water, generally travels northwards through the North Channel, meeting Atlantic water flowing eastward immediately north of Ireland (Ellet 1979). Due to the contrasting densities and structure of the two water masses here, a front may be formed - the Islay Front.

Long-term records from the Continuous Plankton Recorder (CPR) survey suggest that the timing of the spring bloom in the continental shelf seas to the north of Ireland



Map 4.3.1 Locations of surveys and approximate position of frontal boundaries. Fronts are highly variable. See Table 4.3.1 for explanation of symbols. © Crown Copyright.

occurs earlier than in the northern North Sea, but overall abundance and duration of total phytoplankton numbers is quite low compared with the central and southern North Sea. Figure 4.3.1 shows the seasonal cycles of an index of phytoplankton colour (a visual estimate of chlorophyll) and numbers of copepods per sample (approximately 3 m^3 of

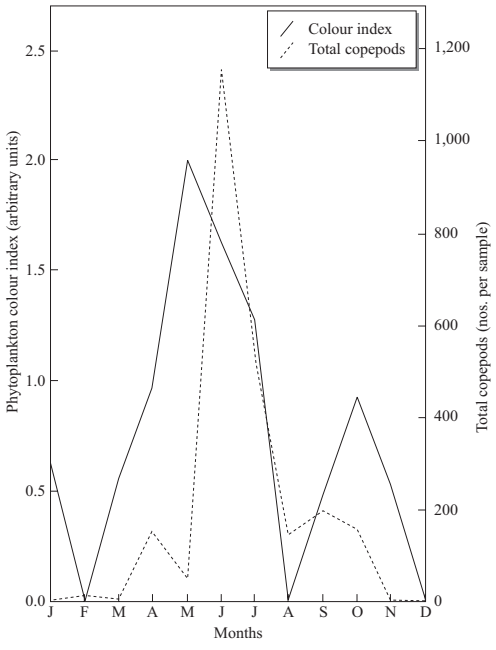


Figure 4.3.1 Average seasonal cycles of an index of phytoplankton colour (a visual estimate of chlorophyll) and the numbers of copepods per sample (approximately 3 m^3 of water filtered), derived from Continuous Plankton Recorder data for 1958-1993. Source: SAHFOS. © Crown Copyright.

water filtered), derived from CPR data for 1958-93 for Region 17. The annual cycle of phytoplankton production in the Irish Sea is similar to that in the North Sea, except that the spring bloom commences one month later (April-May). An important difference between the Irish Sea and other shelf seas is that there is considerable variability in the timing and magnitude of the spring bloom from year to year. Levels of chlorophyll *a* are typically around 1-2 mg m^{-3}, except at the Islay Front, where values of >5.6 mg m^{-3} have been recorded (Simpson *et al.* 1979). Estimates of primary production in the western Irish Sea are extremely variable, depending on where the samples were taken (for a list of estimates see Savidge & Kain 1990). The abundance of copepods to the north of Northern Ireland is quite high compared with other areas, except the Celtic Sea, and the duration of seasonal abundance is quite prolonged compared with the northern North Sea. However, the stocks of phyto- and zooplankton in the Irish Sea are much lower than those in the North Sea.

4.3.2 Important locations and species

Evidence from the CPR surveys indicates that the planktonic assemblage is mainly made up of northern intermediate (mixed water) species, with occasional oceanic species being carried into the area. The spring increase in phytoplankton begins in March, with diatoms reaching a peak in May, the dominant species being *Chaetoceros* spp. After the diatom peak in May, dinoflagellates show a steady increase during the summer until September, when abundance declines to low winter levels. All the major groups of dinoflagellates found around the British Isles (*Ceratium* spp., *Scrippsiella* spp., *Gyrodinium* spp. and *Prorocentrum* spp.) have been found in this region (Holligan *et al.* 1980). The main components of the zooplankton are small copepods, such as *Pseudocalanus elongatus, Paracalanus parvus* and *Temora longicornis*, although the larger copepods *Calanus helgolandicus* and *C. finmarchicus* can be very abundant at times. Copepod numbers start increasing by March, with highest numbers found between May and September; after October copepod numbers decrease to low winter levels. Copepods are the group with the highest diversity in the zooplankton, with overall biodiversity increasing towards the open sea. Studies by Nichols *et al.* (1993) found 21 species of fish eggs and 40 species of fish larvae in the plankton of the Irish Sea; seventeen of these species were of commercial importance, with most spawning occurring between March-May. Maximum densities of zooplankton are found in the western Irish Sea in the surface layers of the stratified waters to the north of the western Irish Sea Front (Savidge & Kain 1990) (Map 4.3.1; Table 4.3.1). Other commonly found zooplankton include euphausiids, decapod larvae, echinoderm larvae, ctenophores and the chaetognath *Sagitta elegans* (a species indicative of mixed oceanic and coastal water masses). CPR survey time-series data indicate the general decline in the abundance of phyto- and zooplankton in this region from 1960-1980, as in other shelf waters. After this initial decline, a substantial recovery to average levels occurred through the 1980s; however, the levels of abundance are decreasing again in the 1990s. These fluctuations are more likely to be linked to changes in climate (e.g. changes in the North Atlantic Oscillation index), than to human activities.

4.3.3 Human activities

Dinoflagellates are of particular importance to the coastal manager in this region because certain species may cause toxic blooms or red tides. A bloom of *Gyrodinium aureolum* was reported in the summer of 1978 at the Islay Front (Gowen 1987). Although it is not known if this bloom had any detrimental effects upon the environment, in other areas red tides caused by *G. aureolum* have been associated with severe mortalities in farmed salmon and benthic invertebrates (Jones *et al.* 1982). Red tides have also been reported locally in Irish inshore waters (Savidge & Kain 1990). There is some evidence that in other regions (e.g. the southern North Sea) the occurrence of such blooms may be linked to increasing organic pollution (Prakash 1987). Paralytic Shellfish Poisoning (PSP) toxins, produced by the phytoplankton species *Alexandrium tamarense*, have been found in shellfish in Belfast Lough (Tylor *et al.* 1995). DANI currently monitors toxin-producing algae under the EC Shellfish Directive.

4.3.4 Information sources used

The CPR surveys in this region are of particular importance because they contain long-term plankton data which can be used to assess the effects of environmental variability and

Table 4.3.1 Details of surveys

Identification on Map 4.3.1	*Frequency*	*Period*	*Reference*
CPR: 'X' route	Monthly	1948-present	
CPR: 'Y' route	Monthly	1955-1961	
CPR: 'HW' route	Monthly	1994-present	
PS (- - - - -)	Seasonal	1951-52	Williamson 1956
PS (+)	Occasional	1977	Simpson *et al.* 1979
PS (○)	Occasional	1977	Holligan *et al.* 1980
PS (●)	Seasonal	1969	Lee & Williamson 1975
Strangford Lough	Monthly	1968-69	Boyd 1973
Strangford Lough	Occasional	1976	Savidge & Hutley 1977
Strangford Lough	Winter and summer	1979 and 1981	Savidge 1988
Belfast Lough	Monthly	1974-1976	Maxwell 1978
Western Irish Sea	Occasional	1992-94	Dickey-Collas *et al.* 1996
Western Irish Sea	Monthly	1992-93	Gowen & Bloomfield 1996
Irish Sea	Spring	1982-1989	Nichols *et al.* 1993

Key: CPR: Continuous Plankton Recorder; PS: Plankton Samples

climatic change. Table 4.3.1 summarises plankton surveys in Region 17, shown on Map 4.3.1. The CPR data have been extensively used to compile this report.

For an overall picture of zooplankton in this region, the results of Williamson (1956) give some indication, while for a more detailed review of the plankton and the productivity of the Irish Sea, see Savidge & Kain (1990). MAFF's Directorate of Fisheries Research at Lowestoft (now the Centre for Environment, Fisheries & Aquaculture Sciences) undertook numerous spring plankton surveys of this region during the 1980s, investigating the relationship between hydrography and the distribution of fish eggs and larvae (Nichols *et al.* 1993).

4.3.5 Acknowledgements

Figure 4.3.1 was supplied by H.G. Hunt (Sir Alister Hardy Foundation for Ocean Science). Comments on the draft text were made by Dr D.G. Erwin; Alan Kilgore, Newry and Mourne District Council; Tim Hill, JNCC; Philip O'Doherty, EHO; Dr I.S. Heaney, DANI; Dr P.J.S. Boaden, Queen's University; and A.M. Bradley and R.J. Bleakley, DoE (NI) Environment and Heritage Service.

4.3.5 Further sources of information

A. References cited

Boyd, R.J. 1973. The relation of the plankton to the physical, chemical and biological features of Strangford Lough, Co. Down. *Proceedings of the Royal Irish Academy, 73B*(20): 317-352.

Dickey-Collas, M., Stewart, B.M., & Gowen, R.J. 1996. The role of thermal stratification in the population dynamics of *Sagitta elegans* Verrill in the Western Irish Sea. *Journal of Plankton Research, 18*(9): 1,659-1,674.

Ellett, D.J. 1979. Some oceanographic features of Hebridean waters. *Proceedings of the Royal Society of Edinburgh, 77*: 61-74.

Gowen, R.J. 1987. Toxic phytoplankton in Scottish coastal waters. *Rapports et Proces-verbaux des Reunions. Conseil Permanent International pour l'Exploration de la Mer, 187*: 89-93.

Gowen, R.J., & Bloomfield, S.P. 1996. Chlorophyll standing crop and phytoplankton production in the western Irish Sea during 1992 and 1993. *Journal of Plankton Research, 18*(9): 1,735-1,751.

Holligan, P.M., Maddock, L., & Dodge, J.D. 1980. The distribution of dinoflagellates around the British Isles in July 1977: a multivariate analysis. *Journal of the Marine Biological Association of the United Kingdom, 60*: 851-867.

Jones, K.J., Ayres, P., Bullock, A.M., Roberts, R.J., & Tett, P. 1982. A red tide of *Gyrodinium aureolum* in sea lochs of the Firth of Clyde and associated mortalities of pond-reared salmon. *Journal of the Marine Biological Association of the United Kingdom, 62*: 771-782.

Lee, J.W., & Williamson, D.I. 1975. The vertical distribution and diurnal migration of copepods at different stations in the Irish Sea. *Journal of the Oceanographical Society of Japan, 31*: 199-211.

Maxwell, T.H. 1978. *The plankton of Belfast Lough.* PhD thesis. Faculty of Science, Queens University, Belfast.

Nichols, J.H., Haynes, G.M., Fox, C.J., Milligan, S.P., Brander, K.M., & Chapman, R.J. 1993. Spring plankton surveys of the Irish Sea in 1982, 1985, 1987, 1988 and 1989: hydrography and the distribution of fish eggs and larvae. *Fisheries Research Technical Report, 95*: 1-111.

Prakash, A. 1987. Coastal organic pollution as a contributing factor to red tide development. *Rapports et Proces-verbaux des Reunions. Conseil Permanent International pour l'Exploration de la Mer, 187*: 61-65.

Savidge, G. 1988. Influence of inter- and intra-daily light-field variability on photosynthesis by coastal phytoplankton. *Marine Biology, 100*: 127-133.

Savidge, G., & Hutley, H.T. 1977. Rates of remineralization and assimilation of urea by fractionated plankton populations in coastal waters. *Journal of Experimental Marine Biology and Ecology, 28*: 1-16.

Savidge, G., & Kain, J.M. 1990. Productivity of the Irish Sea. *In*: *The Irish Sea: an environmental review. Part 3: Exploitable living resources,* ed. by T.A. Norton & A.J. Geffen, 9-43. Liverpool, Liverpool University Press.

Simpson, J.H., Edelsten, D.J., Edwards, A., Morris, N.C.G., & Tett, P.B. 1979. The Islay Front: physical structure and phytoplankton distribution. *Estuarine and Coastal Marine Science, 9*: 713-726.

Tylor, T.J.M., Lewis, J., & Heaney, I.S. 1995. A survey of *Alexandrium* spp. cysts in Belfast Lough, 1992. *In: Harmful marine algal blooms,* ed. by P. Lassus, G. Arzul, E. Erard Le Denn, P. Gentien & C. Marcaillou Le Baut, 835-840. Paris, Lavoisier.

Williamson, D.I. 1956. The plankton in the Irish Sea, 1951 and 1952. *Bulletins of marine ecology, 4*: 87-114.

B. Further reading

Aebischer, N.J., Coulson, J.C., & Colebrook, J.M. 1990. Parallel long-term trends across four marine trophic levels and weather. *Nature, 347*: 753-755.

Bruce, J.R., Colman, J.S., & Jones N.S., *eds.* 1963. *Marine fauna of the Isle of Man.* Liverpool, Liverpool University Press.

Colebrook, J.M. 1979. Continuous plankton records: seasonal cycles of phytoplankton and copepods in the North Atlantic Ocean and the North Sea. *Marine Biology, 51*: 23-32.

Dickson, R.R., *ed.* 1987. *Irish Sea status report of the Marine Pollution Monitoring Group.* Lowestoft, MAFF Directorate of Fisheries Research. (Aquatic Environment Monitoring Report, No. 17.)

Jones, K.J., & Gowen, R.J. 1990. Influence of stratification and irradiance regime on summer phytoplankton composition in coastal and shelf seas of the British Isles. *Estuarine, Coastal and Shelf Science, 30*: 557-567.

Pingree, R.D., Holligan, P.M., & Mardell, G.T. 1978. The effects of vertical stability on phytoplankton distributions in the summer on the north west European Shelf. *Deep-Sea Research, 25*: 1,011-1,028.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Continuous Plankton Recorder (CPR) survey data. Biogeographic patterns, interannual and seasonal variability, plankton identification.	Director, Sir Alister Hardy Foundation for Ocean Science, The Laboratory, Citadel Hill, Plymouth PL1 2PB, tel: 01752 633100
General plankton research	*Director, The Queens University of Belfast, Marine Biology Station, Portaferry, tel: 01247 728230
Ichthyoplankton	Director, Centre for Environment, Fisheries & Aquaculture Sciences (CEFAS), Lowestoft Laboratory, Pakefield Road, Lowestoft, Suffolk NR33 OHT, tel: 01502 562244

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

Large numbers of cormorants *Phalacrocorax carbo* breed on a few islands off the coast of Northern Ireland. Many of these birds commute to Lough Neagh to feed. Sheep Island, near Ballintoy, north Antrim, holds more than 10% of all the breeding cormorants in the United Kingdom and is a Special Protection Area on their account. Photo: Bob Bleakley, DoE (NI) EHS.

Chapter 5 Important species

5.1 Terrestrial lower plants

N.F. Stewart

5.1.1 Introduction

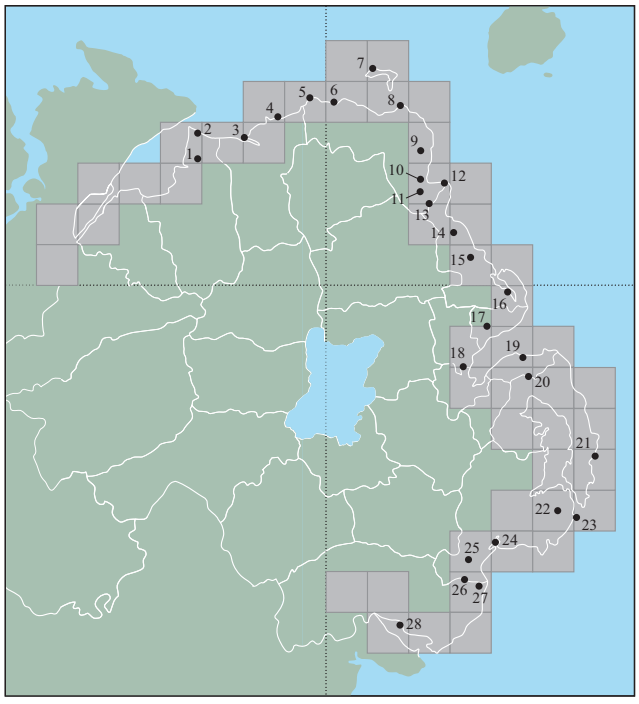
This section covers lichens, bryophytes (mosses and liverworts), fungi and freshwater stoneworts (a group of algae). Brackish water stoneworts are covered in section 5.4. The coastal strip considered here is taken from high water mark to about five km inland; it therefore includes Binevenagh Mountain in Co. Londonderry, the glens of north-east Antrim and parts of the Mourne Mountains.

Of the Irish lower plant flora, 77% of the bryophytes, 77% of the lichens and 50% of the stoneworts occur within Region 17. For the combined British and Irish lower plant flora the proportions are 56% for bryophytes, 44% for lichens and 39% for stoneworts (Seaward 1994; Corley & Hill 1981). Similar figures are not available for other groups, but taking areas of similar climate as a guide, high percentages for fungi can be expected.

At sites within Region 17 there is a wide range of habitats, from strongly to weakly oceanic in character. In international terms, the most significant coastal lower plant habitats in the region are on sand dunes, which at Magilligan in Co. Londonderry support populations of petalwort *Petalophyllum ralfsii*, a liverwort listed on the EC Habitats & Species Directive, and the moss *Rhytidium rugosum*, a scheduled species under the Wildlife (Northern Ireland) Order 1985.

5.1.2 Important locations and species

The Magilligan dune system (a possible Special Area of Conservation (SAC) - see also section 7.2.3) is particularly rich for several groups and individual species of lower plants, including petalwort and the moss *Rhytidium rugosum*. Elsewhere the coast of Co. Londonderry and Co. Antrim is dominated by rocks and cliffs, and the very varied geology results in a similarly varied lower plant flora. The Ulster White Limestone supports a flora intermediate between the hard Carboniferous limestones typical of central Ireland and the soft chalk of England. Since Ulster White Limestone is not found elsewhere in Ireland there are several Red Data Book species that are restricted to this region (e.g. the bryophytes *Apometzgeria pubescens* and several *Seligeria* spp.). In north-east Antrim, the plateau formed by the basalt lavas is cut by several deep glens leading down to the coast. The basalt cliffs are a stronghold for the internationally rare moss *Glyphomitrium daviesii*. The glens are mostly wooded, particularly with oak and ash, together with introduced beech, sycamore and conifers. Despite the easterly situation, the sheltered valleys retain high humidity and a number of oceanic species are present, including the liverwort *Dumortiera hirsuta* and the lichen *Sticta dufourii*. The only Irish site for the submontane liverwort *Leiocolea (Lophozia) heterocolpos* also occurs here.



Map 5.1.1 Sites in coastal 10 km squares known to be important for lower plants. Site numbers refer to Table 5.1.1. Sources: various. © Crown Copyright.

The lower plant flora on the Silurian slates, greywackes and glacial drift of the low-lying coast of Co. Down seems to be relatively impoverished, or at least is poorly known. However, the Murlough dune system (a possible SAC) is internationally important for lower plants. A range of upland lower plant communities is represented on the Mourne Mountains and several areas of woodland and parkland important for lower plants occur around the lower slopes.

Table 5.1.1 and Map 5.1.1 show the sites in the region that are known to be important for lower plants and have had at least some degree of survey work. Many are large, in which case the grid reference refers to a central point. Most of these sites were selected for conservation on the basis of their lower plant interest.

Northern Ireland and the Irish Republic are considered together in the compilation of Red Lists of threatened species. Irish Red Lists have been drawn up for stoneworts (Stewart & Church 1992) and bryophytes (Stewart & Church in press), and one for lichens is in preparation. Further survey work is needed before Red Lists for other algae or for fungi can be prepared, but provisional Red Lists for British fungi (Ing 1992) and European macrofungi (Ing 1993) have been drawn

Table 5.1.1 Important lower plant sites

Site no. on Map 5.1.1	*Site name*	*Grid ref.*	*Important lower plant groups*	*Habitat*	*Protected status*
	Co. Londonderry				
1	Binevenagh	C6830	Bryophytes	Grassland, rock	(N)NR
2	Magilligan/Umbra	C6837	Bryophytes, fungi, stoneworts	Sand dunes	(N)NR, ASSI, MoD, UWT, pSAC
3	Portstewart Dunes	C7936	Bryophytes^{+}	Sand dunes	NT
	Co. Antrim				
4	Portrush Dunes	C8840	Fungi, bryophytes^{+}	Sand dunes	ASI
5	Giant's Causeway	C9545	Lichens, bryophytes^{+}	Rock	NT, (N)NR, WHS
6	White Park Bay	D0143	Lichens, bryophytes^{+}	Rock, scrub	NT, ASSI
7	Rathlin Island	D1152	Lichens, bryophytes^{+}	Rock, heathland	(N)NR, ASSI
8	Fair Head/Murlough Bay	D1843	Lichens, bryophytes	Rock, scrub	NT, ASI
9	Craigagh Wood	D2232	Lichens	Woodland	NT
10	Lurigethan	D2225	Bryophytes	Rock	Not protected
11	Glenariff Forest Park	D2222	Bryophytes, lichens, fungi	Woodland, rock, stream	ASSI, (N)NR, FP
12	Garron Point	D2824	Lichens	Rock	Not protected
13	Garron Plateau	D2419	Bryophytes	Mire	ASSI, pSAC
14	Glenarm Deer Park	D3012	Lichens, bryophytes	Woodland, rock, stream	UWT
15	Sallagh Braes	D3406	Bryophytes	Rock	ASI
16	Redhall Woods	J4594	Fungi	Woodland	Not protected
17	North Woodburn Glen	J3889	Bryophytes	Woodland, stream, rock	ASSI
18	Cave Hill	J3279	Fungi, bryophytes^{+}	Woodland, rock, stream	CP
	Co. Down				
19	Crawfordsburn	J4682	Fungi	Woodland, grassland	CP
20	Clandeboye Woods	J4879	Fungi^{+}	Woodland	Not protected
21	Kirkistown Links	J6557	Bryophytes^{+}	Sand dunes	Not protected
22	Loughkeelan	J5645	Stoneworts	Freshwater, fen	ASSI
23	Killard Point	J6143	Lichens	Sand dunes, rocks	(N)NR, ASSI
24	Murlough/Ballykinler	J4136	Bryophytes, lichens	Sand dunes	(N)NR, ASSI, NT, MoD, pSAC
25	Tollymore Forest Park	J3432	Lichens, bryophytes^{+}, fungi^{+}	Woodland	FP
26	Mourne Mountains	J3327	Bryophytes, lichens, fungi^{+}	Various upland	ASSI, NT, pSAC
27	Donard Demesne	J3730	Bryophytes^{+}, fungi^{+}	Woodland	FP
28	Rostrevor Woods	J1816	Lichens, bryophytes, fungi^{+}	Woodland	(N)NR

Key: $^{+}$historically of significant lower plant interest, although recent information poor; lower plant interest probably still present; WHS = World Heritage Site; ASSI = Area of Special Scientific Interest; ASI = Area of Scientific Interest; FP = Forest Park, (N)NR = (National) Nature Reserve; CP = Country Park; UWT = Ulster Wildlife Trust; NT = National Trust; MoD = Ministry of Defence site; pSAC = proposed Special Area of Conservation under the EC Habitats & Species Directive.

up. Coastal species on the Red Lists and provisional Red Lists occurring in this region are shown in Table 5.1.2.

5.1.3 Human activities

Many of the sites with significant lower plant habitats on the Northern Irish coast are protected through statutory or non-statutory measures (Table 5.1.1).

The rocky habitats along the coast are generally little threatened, although locally there is some disturbance from trampling at popular tourist spots like the Giant's Causeway. Climbing, for instance on Fair Head, could have an influence on some of the bryophyte communities because of climbers cleaning rock crevices. The sand dune areas are rather more fragile and recreation has caused significant erosion at some sites. Holiday and leisure developments, such as caravan sites and golf courses, have encroached on some sites. A large part of the Magilligan system is an army training area. This has caused erosion in some areas, but the lack of grazing has resulted in some of the slacks drying out and becoming overgrown with coarser vegetation.

Before the Great Famine Ireland was densely populated, resulting in extensive clearance of trees, so that by the middle of the nineteenth century there were very few woodlands remaining. As a result the epiphytic lichen flora became generally impoverished. Although the amount of woodland has increased since then, the typical ancient woodland indicators, such as *Lobaria* and *Sticta* spp., remain rare. However, there are several old park woodlands associated with large houses that still support a rich lichen and fungal flora (Table 5.1.2).

Belfast is a significant industrial centre and the glens and hills around it have been affected by air pollution, which has reduced the lichen and fungal interest. The power station at Larne has also contributed some pollution to the Antrim glens, but its conversion to a gas-fired station should have environmental benefits.

Upland habitats in the Mourne Mountains and Garron Plateau have been affected by drainage and peat cutting. Significant areas of lower plant habitat have also been lost to afforestation.

5.1.4 Information sources used

The study of lower plants in Northern Ireland, and in Ireland generally, has been impeded by a lack of resident

Table 5.1.2 Irish Red Data Book lower plants

Species	*Locations*	*Habitats*
Mosses		
Antitrichia curtipendula	Binevenagh (Co. Londonderry)	Rocks
Drepanocladus lycopodioides	Magilligan (Co. Londonderry)	Calcareous dune slacks
Drepanocladus sendtneri	Magilligan (Co. Londonderry)	Calcareous dune slacks
Hedwigia integrifolia	Fair Head (Co. Antrim)	Basalt
Mnium marginatum	Sallagh Braes (Co. Antrim)	Rocks
Racomitrium canescens	Murlough Dunes (Co. Down)	Calcareous dunes
Rhytidium rugosum	Magilligan (Co. Londonderry); Binevenagh (Co. Londonderry)	Calcareous dunes; grassland
Seligeria pusilla	(Co. Antrim)	White Limestone
Thuidium abietinum	Magilligan/Umbra (Co. Londonderry)	Sand dunes
Tortella inclinata	Murlough Dunes (Co. Down)	Calcareous dunes
Weissia perssonii	Murlough Bay (Co. Antrim)	Cliff slopes
Weissia rutilans	Umbra, Lurigethan (Co. Antrim)	Clay banks
Liverworts		
Apometzgeria pubescens	(Co. Antrim)	White Limestone
Gymnomitrium concinnatum	Fair Head (Co. Antrim)	Rocky slopes
Leiocolea heterocolpos	Glenariff (Co. Antrim)	Wooded ravine
Marsupella sprucei	Fair Head (Co. Antrim)	Rocky slope
*Petalophyllum ralfsii**	Magilligan (Co. Londonderry)	Calcareous dune slacks
Lichens		
Baeomyces placophyllus	Rathlin Island (Co. Antrim); Fair Head (Co. Antrim)	Rocks/peaty soil
Catapyrenium rufescens	Cushendall (Co. Antrim)	Rocks
Cladonia cyathomorpha	Carnalea (Co. Down)	Maritime soil
Cladonia luteoalba	Carnlough (Co. Antrim)	Calcareous soi
Cladonia peziziformis	Fair Head (Co. Antrim); Mourne Coast (Co. Down)	Acid soil
Cladonia rangiferina	Fair Head (Co. Antrim)	Heathland
Collema dichotomum	Glenarm Deer Park (Co. Antrim)	River
Lecanactis homalotropa	Glenarm Deer Park (Co. Antrim)	Trees
Lecanactis subabietina	Tollymore Park (Co. Down)	Trees
Peltigera leucophlebia	Murlough Bay (Co. Antrim); Sallagh Braes (Co. Antrim)	Calcareous rocky soils
Ramalina polymorpha	Bar Hall Bay (Co. Down)	Rocks
Stereocaulon saxatile	Fair Head (Co. Antrim)	Rocky soils
Fungi		
Agaricus placomyces[1]	Dundrum Castle (Co. Down)	Woodland
Boletus impolitus[2]	Tollymore Park (Co. Down)	Woodland
Boletus satanus[2]	Donard Demesne (Co. Down)	Woodland
Chrysomyxa empetri[1]	Mourne Mountains (Co. Down)	Montane heath
Clavaria zollingeri[1, 2]	Clandeboye (Co. Down)	Woodland
Cortinarius anthracinus[2]	Clandeboye (Co. Down)	Woodland
Cortinarius caerulescens[1]	Tollymore Park (Co. Down)	Woodland
Cortinarius cyanites[1, 2]	Donard Demesne (Co. Down)	Woodland
Cortinarius cyanopus[1]	Clandeboye (Co. Down)	Beech woodland
Cortinarius subpurpurescens[1]	Clandeboye (Co. Down)	Woodland
Cortinarius varius[1]	Clandeboye (Co. Down); Tollymore Park (Co. Down)	Woodland
Entoloma prunuloides[2]	Clandeboye (Co. Down)	Woodland
Geastrum pectinatum[2]	Crawfordsburn (Co. Down)	Woodland
Geoglossum glutinosum[2]	Tollymore Park (Co. Down)	Woodland
Gomphidius maculata[2]	Mount Stewart (Co. Down); Tollymore Park (Co. Down)	Larch woodland
Grifola frondosa[2]	Crawfordsburn (Co. Down)	Trees
Hygrocybe atropuncta[1]	Glenariff (Co. Antrim)	Woodland
Hygrocybe calyptraeformis[1]	Crawfordsburn (Co. Down)	Grassland
Hygrocybe obrussea[2]	Rostrevor (Co. Down)	Grassland
Hygrocybe punicea[2]	Cave Hill, Crawfordsburn (Co. Down)	Heathland, grassland
Hygrocybe unguinosa[2]	Clandeboye (Co. Down)	Open woodland
Hygrophorus hypothejus[2]	Tollymore Park (Co. Down)	Pine woodland
Inocybe calospora[1]	Clandeboye (Co. Down); Glenariff (Co. Antrim); Tollymore Park (Co. Down)	Woodland
Inocybe godeyi[2]	Glenariff (Co. Antrim); Redhall (Co. Antrim); Tollymore Park (Co. Down)	Woodland
Lactarius controversus[2]	Tollymore Park (Co. Down)	Woodland
Microglossum viride[2]	Clandeboye (Co. Down); Redhall (Co. Antrim)	Woodland
Mutinus caninus[2]	Crawfordsburn (Co. Down); Tollymore Park (Co. Down)	Woodland
Mycena rubromarginata[1]	Donard Demesne (Co. Down)	Woodland
Phellodon meleleucus[1, 2]	Tollymore Park (Co. Down)	Woodland
Pseudocraterellus sinuosus[1]	Donard Demesne (Co. Down)	Woodland
Spathularia flava[1, 2]	Glenariff, Tollymore Park (Co. Down)	Woodland
Trichglossum hirsutum[2]	Tollymore Park (Co. Down)	Grassland

Table 5.1.2 Irish Red Data Book lower plants (continued)

Species	*Locations*	*Habitats*
Fungi (continued)		
Tricholoma acerbum[1]	Clandeboye (Co. Down)	Woodland
Tricholoma colussus[1]	Warrenpoint (Co. Down)	Woodland

Key: [1]species included in the provisional British Red List (Ing 1992); [2]species included in the provisional European Red List (Ing 1993); *protected under Annex II of the EC Habitats & Species Directive.

expertise. However, there have been periodic field excursions organised by the British Bryological Society, British Lichen Society, British Mycological Society and various visiting experts from Britain and Europe. Traditionally the three coastal counties of Northern Ireland have been well studied by bryologists, and the Floras of the north-east of Ireland have included bryophytes (Stewart & Corry 1888; Megaw 1938). In recent years survey work has been more patchy, although bryophytes remain the best studied group of lower plants in Northern Ireland. Bryophyte records are kept in a computerised database at the Biological Records Centre (BRC), Monks Wood, and a Red Data Book database has been developed by the Department of the Environment (Northern Ireland). Northern Ireland records will be entered on the database at the Centre for Environmental Data and Recording (CEDaR). Lichen survey has been rather more restricted in the region. Fenton (1969) brought together a number of lichen records for Northern Ireland, including a few that were coastal, while O'Dare (1989) covered the Fair Head area in Co. Antrim. A field meeting of the British Lichen Society in 1993 looked at a number of coastal sites in Counties Antrim and Down, but the Co. Londonderry coast remains very poorly studied. Lichen distribution data are held by the British Lichen Society and a database is being developed at CEDaR. Information on fungi is more limited and little systematic work has yet been undertaken. A database of fungal records, linked to the British Mycological Society's recording scheme, is being compiled by the Northern Ireland Fungus Group and linked to CEDaR. Stoneworts were included in a study of Northern Ireland lakes undertaken by the Department of the Environment (Northern Ireland) between 1988 and 1992. They are fairly well known, but other groups of freshwater algae have been very poorly studied.

5.1.5 Acknowledgements

Thanks are due to to R. Weyl, DoE (NI) Environment and Heritage Service, and Mark Tasker, JNCC, for comments on the draft.

5.1.6 Further sources of information

A. References cited

Corley, M.F.V., & Hill, M.O. 1981. *Distribution of bryophytes in the British Isles.* Cardiff, British Bryologial Society.

Fenton, A.F.G. 1969. The lichens of Northern Ireland. *Irish Naturalists' Journal, 16:* 110-127.

Ing, B. 1992. Provisional Red Data list of British fungi. *Mycologist, 6:* 124-128.

Ing, B. 1993. Provisional Red Data list of endangered European macrofungi. *In: Fungi of Europe: investigation, recording and conservation*, ed. by D.N. Pegler, L. Boddy, B. Ing & P.M. Kirk, 231- 237. Kew, Royal Botanic Gardens.

Megaw, W.R. 1938. Bryophytes. *In: Flora of the north-east of Ireland*, 2nd ed., ed. by R.L. Praeger. Belfast.

O'Dare, A.M. 1989. *Lichen survey of Fair Head and Murlough Bay, Co. Antrim, Northern Ireland*. Report for National Trust.

Seaward, M.R.D. 1994. Vice county distribution of Irish lichens. *Biology and environment. Proceedings of the Royal Irish Academy, 94B:* 1-18.

Stewart, N.F., & Church, J.M. 1992. *Red Data Books for Britain and Ireland: stoneworts*. Peterborough, Joint Nature Conservation Committee.

Stewart, N.F., & Church, J.M. In press. *Red Data Books for Britain and Ireland: bryophytes*. Peterborough, Joint Nature Conservation Committee.

Stewart, S.A., & Corry, T.H. 1888. *A flora of the north-east of Ireland*. Belfast, Belfast Natural History and Philosophical Society.

B. Further reading

Belcher, H., & Swale, E. 1976. *A beginner's guide to freshwater algae.* London, Institute of Terrestrial Ecology, HMSO.

Bellinger, E.G. 1980. *A key to common British algae.* London, The Institution of Water Engineers and Scientists.

Bon, M. 1987. *The mushrooms and toadstools of Britain and north-western Europe.* London, Hodder & Stoughton.

Buczacki, S. 1989. *Fungi of Britain and Europe.* London, Collins. (Collins New Generation Guide.)

Daniels, R.E., & Eddy, A. 1990. *Handbook of European Sphagna.* 2nd ed. London, Institute of Terrestrial Ecology/HMSO.

Hackney, P. 1992. *Stewart and Corry's Flora of the north-east of Ireland*. Belfast, Ulster Museum.

Hill, M.O., Preston, C.D., & Smith, A.J.E. 1991. *Atlas of the bryophytes of Britain and Ireland. Vol. 1. Liverworts*. Colchester, Harley Books.

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

Hill, M.O., Preston, C.D., & Smith, A.J.E. 1994. *Atlas of the bryophytes of Britain and Ireland. Vol. 4. Mosses (Diplolepideae)*. Colchester, Harley Books.

Hodgetts, N.G. 1995. Bryophyte site register for Europe including Macaronesia. *In: Red Data Book of European bryophytes*, ed. by The European Committee for the Conservation of Bryophytes, 195-291. Trondheim, ECCB.

Moore, J.A. 1986. *Charophytes of Britain and Ireland.* London, Botanical Society of the British Isles. (BSBI Handbook, No. 5.)

Morton, O. 1996. *Marine algae of Northern Ireland*. Belfast, Ulster Museum.

Phillips, R. 1981. *Mushrooms and other fungi of Great Britain and Europe.* London, Pan Books.

Purvis, O.W., Coppins, B.J., Hawksworth, D.L., James, P.W., & Moore, D.M. 1992. *The lichen flora of Great Britain and Ireland*. London, Natural History Museum.

Smith, A.J.E. 1978. *The moss flora of Britain and Ireland*. Cambridge, Cambridge University Press.

Smith, A.J.E. 1990. *The liverworts of Britain and Ireland.* Cambridge, Cambridge University Press.

C. Contact names and addresses

Type of information	Contact address and telephone no.
Fungi (general)	B. Ing, 24 Avon Court, Mold, Clwyd, tel: 01352-755168
Fungi (general and sand dunes)	M. Rotheroe, Fern Cottage, Falcondale, Lampeter, Dyfed SA48 7RX, tel: 01570 422041
Fungi (distribution)	P. Kirk, International Mycological Institute, Bakeham Lane, Egham, Surrey TW20 9TU, tel: 01784 470111
Fungi (Northern Ireland distribution)	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477
Lichens (general coastal)	P.W. James, c/o Department of Botany, The Natural History Museum, Cromwell Road, London SW7 5BD, tel: 0171 938 9123
Lichens (Northern Ireland)	A.M. Coppins, 35/37 High Street, East Linton, East Lothian EH40 3AA, tel: 01620 860906
Lichens (Northern Ireland)	B.J. Coppins, Royal Botanic Gardens, Inverlieth Row, Edinburgh EH3 5LR, tel: 0131 552 7171
Lichens (British Lichen Society site database)	A. Fletcher, Leicestershire Ecology Centre, Falcondale, Holly Hayes, 216 Birstall Road, Birstall, Leicester LE4 4DG, tel: 0116 267 1950
Lichens (general Ireland)	H. Fox, Coursetown, Athy, Co. Kildare, Ireland, tel: 0507 31101
Lichens (distribution)	M.R.D. Seaward, Department of Environmental Sciences, University of Bradford, West Yorkshire BD7 1DP, tel: 01274 733466
Lichens, algae (general Northern Ireland)	*O. Morton, The Ulster Museum, Belfast, tel: 01232 383000
Bryophytes (general Ireland)	D. Synnott, National Botanic Gardens, Glasnevin, Dublin, Ireland, tel: 01 837 4388
Bryophytes (Northern Ireland)	*P. Hackney, The Ulster Museum, Belfast, tel: 01232 383000
Bryophytes (BRC database)	C.D. Preston, Biological Records Centre, ITE, Monks Wood, Abbots Ripton, Huntingdon, Cambs. PE17 2LS tel: 01487 773381
Stoneworts (general)	N.F. Stewart, Withylake Cottage, Sweetham, Newton St. Cyres, Devon EX5 5AP, tel: 01392 851782
Lower plant records	Centre for Environmental Data and Recording, Ulster Museum, Belfast, tel: 01232 383000
Lower plants (species status, Red Data Book database etc)	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477

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

5.2 Flowering plants and ferns

P. Hackney

5.2.1 Introduction

This section describes the important species of flowering plants and ferns found in the region on habitats that are coastal or occur close to the coast. Particular emphasis is placed upon rare species, i.e. those noted as Red List species in the *Irish Red Data Book* (Curtis & McGough 1988). Other species that are rare or notable in Northern Ireland are also considered here. Most of the plants considered here occur in typically coastal habitats such as saltmarshes, dunes, rocky upper shores, estuaries and sea loughs, but also included are coastal species of the basalt scarp of Counties Londonderry and Antrim, which can be subject to salt spray blown inland. The scarp frequently forms spectacular sea cliffs and is usually less than 5 km from the sea, as are its associated glens, scrub and woodlands, hence the inclusion of woodland or scrub plants such as wood cranesbill *Geranium sylvaticum* and the locally extremely rare Tunbridge filmy-fern *Hymenophyllum tunbrigense*. The climate of the region may be summarised as being mild and damp, with relatively warm winters similar to the west coast of Scotland and moderate rainfall (around 100 cm per year).

A number of threatened higher plant species are recorded in the region, including eighteen Red List species. Seventeen species are protected in Northern Ireland under the Wildlife (Northern Ireland) Order 1985, of which one, Killarney fern *Trichomanes speciosum*, is also listed for protection under the EC Habitats and Species Directive.

Two species of mainly northern distribution in Europe approach their southern limits on the Northern Ireland coast: Scots lovage *Ligusticum scoticum* and oysterplant *Mertensia maritima*, both of which have declined within the past century. Conversely at least two southern species (sea purslane *(Atriplex) Halimione portulacoides* and green-winged orchid *Orchis morio*) approach their northern limits within the British Isles in the region.

5.2.2 Important locations and species

Key localities for the region's rare or notable species are shown on Map 5.2.1 and listed in Table 5.2.1. Rare and notable species grow in a range of habitats in the region, but of particular importance are sand dunes, cliffs, rocky shores, shingle and montane areas. In Ireland most of the uplands lie near the coast, and so alpine species tend to have coastal distributions. A number of montane species occur in the region associated with the basalt scarp in Counties Antrim and Londonderry. The cliffs of Binevenagh support the only populations in Northern Ireland of moss campion *Silene acaulis* and purple saxifrage *Saxifraga oppositifolia* (both Red List species) at about 300-400 m altitude; mountain avens *Dryas octopetala* also grows at the same site, and on Sallagh Braes near Larne. Yellow saxifrage *Saxifraga aizoides* (a Red List species) occurs in its only Northern Ireland station in the area of Murlough Bay/Torr Head, descending to sea-level at Murlough Bay, but mostly growing at about 300 m. Some sea-shore species ascend high up the basalt scarp at a few sites: sea campion *Silene maritima* grows on the summit of Cave Hill, Belfast, at about 300 m, and on Binevenagh and Sallagh Braes. Thrift *Armeria maritima* subsp. *maritima* and sea plantain *Plantago maritima* are also noted from Binevenagh at 300-365 m. Other species of interest include the typically upland plants mossy saxifrage *Saxifraga hypnoides*, which is common in grassy slopes below the scarp in Londonderry and Antrim and descends to nearly sea-level, and roseroot *Sedum rosea*, which occurs at about 300 m on top of Fair Head, with Welsh poppy *Meconopsis cambrica* nearby. This last species, rare in north-east Ireland, also grows at Eagle Hill above the Umbra.

Map 5.2.1 Key localities for rare and notable higher plants.

Table 5.2.2 lists species protected against picking or damage to their habitat under the Wildlife (Northern Ireland) Order 1985. The list is due for revision and will require a number of changes. All these species are listed in the Irish Red Data Book (Curtis & McGough 1988), but some are deemed not to be 'Red List' species, i.e. not threatened when judged in an all-Ireland context. These include the bee orchid *Ophrys apifera*, which is not now regarded as particularly threatened even within Northern Ireland, although it has declined at some sites. Some other Red List species, like wood cranesbill, while very local in Ireland, are abundant in a UK context.

Table 5.2.3 lists a further 38 species (including the three eelgrass *Zostera* spp.) that are worthy of attention, being rare within Northern Ireland. Some, like sea wormwood, are rare and local within the region but are presently unprotected. Others are Irish Red List species. Some coastal species are now known only from one 10 km grid square in Northern

Table 5.2.1 Key localities for rare and notable species

	Site	*Important species (examples only)*	*Habitat*	*Protected status*
	Co. Londonderry			
1	Lough Foyle, incl. Donnybrewer and Myroe levels	Eelgrasses *Zostera* spp., beaked tasselweed *Ruppia maritima*	Mudflats, brackish ditches	(N)NR, ASSI, ASI
2	Binevenagh	Red List alpine species	Basalt scarp	(N)NR
3	Magilligan/Umbra	Red List species: orchids	Dunes, dune slacks	(N)NR, ASSI
4	Bann Estuary (incl. Portstewart, Castlerock, Grangemore dunes)	Red List species: smooth cat's-ear *Hypochoeris glabra*, shepherd's cress *Teesdalia nudicaulis*, dwarf spike-rush *Eleocharis parvula*, Scots lovage *Ligusticum scoticum*, seaside centaury *Centaurium littorale*	Dunes, saltmarsh	NT
	Co. Antrim			
5	Bushfoot	Sea bindweed *Calystegia soldanella*	Dunes	ASI
6	Giant's Causeway	Red List species: Scots lovage, oysterplant *Mertensia maritima*	Basalt cliffs, shingle, rocky shore	(N)NR, WHS, ASI
7	White Park Bay/Ballintoy area	Red List species: Scots lovage, small-white orchid *Pseudorchis albida* Meadow cranesbill *Geranium pratense*, tree mallow *Lavatera arborea*	Dunes, chalk cliffs basalt rocks	ASSI, NT
8	Rathlin Island	Red List species: pyramidal bugle *Ajuga pyramidalis*, oysterplant Hairy bindweed *Calystegia sepium* subsp. *pulchrum*	Basalt cliffs, pastures	ASSI
9	Fair Head	Alpine species: roseroot *Sedum rosea*, Welsh poppy *Menocopsis cambrica*	Basalt cliff	NT, ASI
10	Murlough Bay	Red List species: yellow saxifrage *Saxifraga aizoides*	Chalk cliffs, basalt exposures	NT, ASI
11	Torr Head	Red List species: yellow saxifrage, hoary whitlowgrass *Draba incana*	Chalk exposures	ASI
12	Cushendun/Lower Glendun	Red List species: Killarney fern *Trichomanes speciosum*, Tunbridge filmy-fern *Hymenophyllum tunbrigense*	Caves, deciduous woodland	ASI
13	Glenarm area	Red List species: wood cranesbill *Geranium sylvaticum*	Scrub on basalt scarp, woodland	UWT
14	Sallagh Braes	Mountain avens *Dryas octopetala*	Basalt scarp	ASI
15	Larne Lough	Eelgrass beds, tasselweed in lagoons, hard-grass *Parapholis strigosa* on shore	Mudflats, brackish lagoons at Glynn	ASSI
16	Black Head/White Head	Bristly oxtongue *Picris echioides*, hare's-foot clover *Trifolium arvense*	Basalt cliffs, chalk cliffs and chalky soils	Not protected
	Co. Down			
17	Strangford Lough	Sea purslane *(Atriplex) Halimione portulacoides*, eelgrasses, hound's tongue *Cynoglossum officinale*, upright brome *Bromus erectus*	Mudflats, saltmarshes, coastal rough grassland	MNR, (N)NR, ASSI
18	Killard Point	Red List species: green-winged orchid *Orchis morio* Other orchids, hound's tongue, henbane *Hyoscyamus niger*, sea bindweed, common dodder *Cuscuta epithymum*	Dunes	(N)NR, ASSI
19	Ballyhornan, Guns Island, Benboy	Knotted clover *Trifolium striatum*, rock sea-lavender *Limonium binervosum*	Shingle, slaty rock exposures, low cliffs	ASSI
20	Corbet Head to St. John's Point	Red List species: oysterplant Rock samphire *Crithmum maritimum*, sea wormwood *Artemisia maritima*	Shingle, slaty rock exposures	Not protected
21	Dundrum Bay	Red List species: blue fleabane *Erigeron acer*, shepherd's cress Viper's bugloss *Echium vulgare*, hound's tongue, adder's-tongue *Ophioglossum vulgatum*	Acid dunes	(N)NR, ASSI
22	William's Harbour to Glassdrumman	Red List species: oysterplant Yellow horned-poppy *Glaucium flavum*, sea kale *Crambe maritima*	Shingle	ASI
23	Carlingford Lough	Saltmarsh and shingle species. Eelgrasses.	Saltmarsh, shingle	ASSI

Source: Hackney (1992). Key: (N)NR = (National) Nature Reserve; ASSI = Area of Special Scientific Interest; ASI = Area of Scientific Interest; MNR = Marine Nature Reserve; NT = National Trust property; UWT = Ulster Wildlife Trust reserve; WHS = World Heritage Site.

Ireland (and frequently from only a single site): these are sea wormwood, sea kale, dwarf spike-rush, Tunbridge filmy-fern, rock sea-lavender, green-winged orchid, bristly oxtongue, moss campion, purple saxifrage, green figwort and Killarney fern.

5.2.3 Human activities

There are a number of human activities that can affect the survival of coastal higher plant species. These include trampling or the use of motor vehicles on sand dunes at

Table 5.2.2 Coastal species protected in Northern Ireland under the Wildlife Order (NI) 1985

*Species**	*Principal locations*	*Habitat*
Pyramidal bugle *Ajuga pyramidalis*	West end of Rathlin Island	Slightly enriched pasture
Seaside centaury *Centaurium littorale*	Magilligan, Portstewart	Dunes
Dwarf spike-rush *Eleocharis parvula*	Bann Estuary	Estuarine mud
Marsh helleborine *Epipactis palustris*+	Magilligan, Benone, Umbra	Dune slacks
Blue fleabane *Erigeron acer*	Murlough (Co. Down)	Dunes
Wood cranesbill *Geranium sylvaticum*	Near the Co. Antrim coast, mainly around Glenarm (Glenarm Glen, Little Deer Park Glenarm)	Scrub and woodland
Smooth cat's-ear *Hypochoeris glabra*	North coast dunes: Magilligan, Castlerock, Grangemore, Portstewart, White Park Bay	Dunes
Rock sea-lavender *Limonium binervosum*+	Benboy	Rock sea cliff
Oysterplant *Mertensia maritima*	Rathlin, Giant's Causeway, St. John's Point, William's Harbour, Glassdrumman	Shingle shores
Bee orchid *Ophrys apifera*+	Magilligan, Umbra, Castlerock, Portstewart, Killard Point, Murlough (Co. Down)	Dunes
Green-winged orchid *Orchis morio*	Killard Point	Dunes
Small-white orchid *Pseudorchis albida*	Ballintoy, Whitepark Bay	Pastures
Yellow saxifrage *Saxifraga aizoides*	A little inland at Carey River; Murlough Bay (Co. Antrim); Torr Head	On damp rocks and cliffs
Purple saxifrage *Saxifraga oppositifolia*	Binevenagh	Mountain rocks and scree
Moss campion *Silene acaulis*	Binevenagh	Mountain rock ledges and scree
Shepherd's cress *Teesdalia nudicaulis*	Benone, Grangemore, Murlough (Co. Down)	Dunes
Killarney fern *Trichomanes speciosum*	Cushendun	Cave

Source: Hackney (1992). Key: *all Red List species, except those marked+.

unprotected sites, such as Tyrella, which was very much damaged but is now partially protected by the local authority. Golf courses at Castlerock and Portstewart have been extended in recent years, encroaching on areas of semi-natural dune habitat. There are plans for a landfill site at Magheramorne on the west shore of Larne Lough. Sea defences and improvements to coastal roads have been constructed along the east coast of the Ards Peninsula, resulting in reduced opportunities for the growth of species such as Scots lovage. Rocky habitats, especially cliffs and the basalt scarp, suffer fewer disturbances, although in the recent past extensive quarrying for chalk has damaged certain parts of the Antrim coast, as at Larry Bane near Ballintoy. Now chalk quarrying is carried out on only a minor scale at a very few sites, and abandoned quarries are a valuable new habitat for colonisation by wild plants. Woodland and scrub adjacent to the coast may be affected by the extension of farming activities or the entry of grazing animals, although this seems to be only a minor problem. The spraying of herbicides along coastal paths can affect a wide variety of species, as can nutrient enrichment from litter, dog fouling and grasscutting.

Of the alien, or presumed alien, species that have become established in Northern Ireland, a few are confined to the coastal habitats and some are potential threats to native vegetation. Cord-grasses *Spartina* spp. have been introduced in four sea loughs: Lough Foyle, Belfast Lough, Strangford Lough and Carlingford Lough. The plants in Belfast, Strangford and Carlingford Loughs are common cord-grass *Spartina anglica,* an aggressive colonist which threatens the eelgrass beds of the latter two loughs. The cord-grass colony introduced into Belfast Lough in the 1930s has been all but obliterated by land-claim and persists as a single clump. Townsend's cord-grass *Spartina* x *townsendii,* found between Ballykelly Bridge and Carrickhugh in Lough Foyle, is non-aggressive; it was planted in the 1930s to prevent erosion of the coastal railway line and poses no apparent threat to the extensive eelgrass beds.

Other alien, or presumed alien, species established in the region include lyme-grass *Leymus arenarius*, first recorded in the region in 1818. It has increased noticeably within the past half century, perhaps because of climatic warming of the Irish Sea basin (Allen 1984), and is now quite common on sand dunes at many sites in Counties Down and Antrim. Hottentot-fig *Carpobrotus edulis* has escaped from a garden onto a low rocky cliff at Orlock, west of Bangor, and is flourishing and expanding. This species has shown itself able to blanket out other cliff plants in some parts of England and Wales. Montbretia *Crocosmia x crocosmiiflora* is now a common species of maritime cliff ledges but appears on the whole to pose no threat to native vegetation. The umbellifer *Smyrnium olusatrum* is almost entirely a coastal species in Northern Ireland and can be prolific in marginal land and hedgerows. Corsican heath *Erica terminalis* is a curiosity of the dune slacks at the Umbra Dunes, where it has been established over a large area since the 1930s. It appears to cause few problems to the general ecology of the site, unlike sea buckthorn *Hippophae rhamnoides,* which has obliterated native vegetation where it has been planted at Umbra dunes, Portstewart dunes and at Ballykinler and Murlough (Co. Down).

5.2.4 Information sources used

Most of the information in this section is drawn from the Flora of the north-east of Ireland (Hackney 1992), which is based on records accumulated at Ulster Museum over the past 20 years. The Centre for Environmental Data & Recording (CEDaR), based at the museum, now acts as the Biological Records Centre for higher plants in Northern Ireland.

Table 5.2.3 Other rare or notable species

Species	*Principal locations*	*Habitat*
Wild celery *Apium graveolens*	Kinnegar (Belfast Harbour)	Damp ground
Hairy rock-cress *Arabis hirsuta*	Magilligan, Benone, Umbra and near Torr Head	Dunes; chalk outcrop
Sea wormwood *Artemisia maritima*	Corbet Head, Co. Down	Shingle, slate
Sea purslane *(Atriplex) Halimione portulacoides*	Strangford Lough, Carlingford Lough	Saltmarshes
Saltmarsh flat-sedge *Blysmus rufus*	Ballymacormick Point, Outer Ards, Strangford Lough, Killard Point	Beach-head saltmarsh
Moonwort *Botrychium lunaria*	Umbra, White Park Bay, Rathlin Island, Glenarm Park, Cavehill, Murlough (Co. Down)	Dunes
Upright brome *Bromus erectus*	Castle Espie, by Strangford Lough shore	Grassland
Hairy bindweed *Calystegia sepium* subsp. *roseata*	Rathlin Island and mainland opposite	Coarse damp grassland
Sea bindweed *Calystegia soldanella*	One Antrim site (Bushfoot). Mainly occurring in Co. Down.	Dunes, shingle
Carline thistle *Carlina vulgaris*	Dundrum Bay	Dunes
Sea kale *Crambe maritima*	Glassdrumman	Shingle
Rock samphire *Crithmum maritimum*	Ards and Lecale areas of Co. Down	Rocks by shore
Common dodder *Cuscuta epithymum*	Cloghy, Killard	Coastal grassland
Hound's tongue *Cynoglossum officinale*	South Island (Grey Abbey), Killard, Murlough (Co. Down)	Mainly on sand dunes disturbed by rabbit burrows
Hoary whitlowgrass *Draba incana**	Magilligan, Binevenagh, Torr Head	Dunes, basalt cliffs, chalk cliffs
Mountain avens *Dryas octopetala*	Binevenagh and Sallagh Braes	Alpine species of basalt scarp
Viper's bugloss *Echium vulgare*	Murlough (Co. Down)	Dunes
Variegated horsetail *Equisetum variegatum*	Magilligan and Umbra; near Strand Lough and Tyrella	Dune slacks
Sea holly *Eryngium maritimum*	Magilligan and Co. Down	Dunes
Meadow cranesbill *Geranium pratense*	Dunluce Castle, White Park Bay, Ballintoy	Dunes and coarse grass
Yellow horned-poppy *Glaucium flavum*	William's Harbour	Shingle shore
Tunbridge filmy-fern *Hymenophyllum tunbrigense*	Craigagh Wood in Lower Glendun	Oak/beech mature woodland
Henbane *Hyoscyamus niger*	Killard	Soft cliffs and upper part of shingle beach
Tree mallow *Lavatera arborea*	Co. Antrim north coast, Co. Down	Sea stacks (rare), sandy upper shores
Scots lovage *Ligusticum scoticum**	Magilligan, Bann Estuary, Portstewart Harbour, Bushfoot Strand, Giant's Causeway, Ballintoy, Orlock dunes	Rocks or sand dunes
Adder's tongue *Ophioglossum vulgatum*	Umbra, White Park Bay, Horse Island (Kircubbin), Killard Point	Dune slacks
Red broomrape *Orobanche alba*	Londonderry, Antrim (incl. Rathlin Island), Killard, Castlerock, Downhill	Coastal basalt scarp, dunes
Hard-grass *Parapholis strigosa*	Larne Lough, Sea Park (Craigavad), Ballymacormick Point, Castle Island (Quoile)	Saltmarsh, grassland
Bristly oxtongue *Picris echioides*	Black Head, White Head	Open and disturbed ground above shore
Ray's knotgrass *Polygonum oxyspermum*	Ballintoy, Glenarm, Co. Down coast	Sandy shores
Reflexed saltmarsh-grass *Puccinellia distans*	Myroe, Belfast Lough	Waste ground, marsh
Spiral tasselweed *Ruppia cirrhosa*	Donnybrewer and Myroe in Lough Foyle. Glynn (Larne Lough), Victoria Park Lake	Drainage ditches behind sea walls, lagoons
Beaked tasselweed *Ruppia maritima*	Strangford Lough, Strand Lough	Brackish pools
Green figwort *Scrophularia umbrosa**	Bann Estuary	Rank wet grassland
Hare's-foot clover *Trifolium arvense*	North coast dunes. Ballintoy, Black Head, Murlough (Co. Down)	Dunes, cliffs
Knotted clover *Trifolium striatum*	In the southern half of the Ards Peninsula and between Kilclief and Rossglass	Shallow peaty soil over rocks on or above the sea shore
Spring vetch *Vicia lathyroides**	Benone, Umbra, Portstewart, Portrush, Ballywalter, Slanes Bay, Murlough (Down)	Sand dunes
Eelgrasses *Zostera*(3 spp.)	Lough Foyle, Larne Lough, Belfast Lough, Strangford Lough, Carlingford Lough	Sea coasts and estuaries

Source: Hackney (1992). Key: *Red List species.

5.2.5 Further sources of information

A. References cited

Allen, D.E. 1984. *Flora of the Isle of Man.* Douglas, Manx Museum and National Trust.

Curtis, T.G.F., & McGough, H.N. 1988. *The Irish Red Data Book: 1. Vascular plants.* Dublin, Stationery Office.

Hackney, P. 1992. *Stewart & Corry's flora of the north-east of Ireland.* 3rd ed. Belfast, Institute of Irish Studies, Queen's University of Belfast.

B. Contact names and addresses

Type of information	*Contact address and telephone no.*
Higher plant records	*The Ulster Museum, Centre for Environmental Data and Recording (CEDaR), Belfast, tel: 01232 383000
Higher plants in the region	Paul Hackney, Botany Department, Sciences Division, Ulster Museum, Belfast BT9 5AB, tel: 01232 383150
Higher plants in the region	*Botanical Society of the British Isles (Irish Region), c/o Botany Dept, The Ulster Museum, Belfast, tel: 01232 383150
Higher plants in the region	*Ulster Wildlife Trust, Crossgar, tel: 01396 830282
Higher plants in the region - legal protection and conservation	*DoE (NI) (EHS), Belfast, tel 01232 251477

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

The marsh fritillary butterfly *Eurodryas aurinia* is one of a select handful of very rare species singled out for special protection in the EC Habitats & Species Directive. It is currently found at only two coastal sites in Northern Ireland, both designated nature reserves. Photo: Robert Thompson, for DoE (NI) EHS.

5.3 Land and freshwater invertebrates

B.H. Nelson & Dr R. Anderson

5.3.1 Introduction

This section deals with the land and freshwater invertebrates known from the habitats that either fringe the coast or are influenced by it. Offshore islands are covered in their entirety. At present there are no Red Data Book lists of threatened invertebrates for Ireland, but there are many sites in the region that are known to support varied invertebrate assemblages. Of the invertebrates listed on Annex II of the EC Habitats & Species Directive or protected under the Wildlife (Northern Ireland) Order 1985, only the marsh fritillary butterfly *Eurodryas aurinia* is recorded from the coast of Northern Ireland. Colonies of the marsh fritillary exist currently on the Ulster Wildlife Trust reserve at the Umbra, Co. Londonderry, and on Murlough (N)NR, Co. Down. There are historical records of the snail *Vertigo angustior*, also an Annex II species, from the Giant's Causeway, but it has not been recorded recently.

5.3.2 Important locations and species

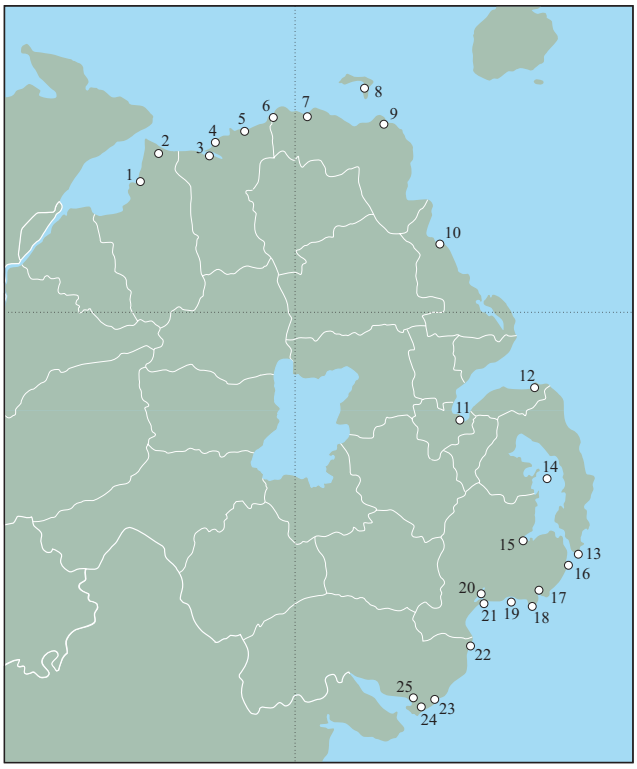
Table 5.3.1 lists some of the more notable species recorded in coastal habitats since 1970, grouped into categories according to the best available knowledge using similar methods to those employed in drawing up the British Red Data Books (see e.g. Shirt 1987).

Table 5.3.2 and Map 5.3.1 show the sites and areas in the region known to have important invertebrate assemblages.

Semi-natural coastal habitats within Lough Foyle are very limited and only the extensive saltmarsh at the Roe Estuary is of known importance. Between Magilligan and Portrush the coast consists predominately of extensive dune systems. The fauna of these differs from the Co. Down dunes in having a northern character with many southern species absent. Magilligan and Portstewart are the richest and best studied sites; the Magilligan dunes are notable for the few examples of wet dune slacks found in Northern Ireland, though the fauna is limited. The fauna of the estuarine and limited freshwater habitats on the Bann Estuary are notable.

The predominately cliffed coast east of Portrush to Ballycastle has numerous areas of freshwater seepages of interest for invertebrates, but individual sites here are small. The best examples are found at the Curran Strand/White Rocks and the Giant's Causeway. Additionally, the Giant's Causeway has the best heathland invertebrate communities along the north coast. Overall, White Park Bay is probably the single most important site along this section of coast. The diverse mix of habitats, including dune slacks with calcareous grassland and scarps, here supports a notable mollusc and insect fauna.

Habitats of importance for invertebrates on Rathlin are the areas of dry maritime heath, on which several rare ground beetles have been recorded, the numerous small freshwater ponds and the small areas of saline marsh. Murlough Bay constitutes the most extensive and best example of an undercliff invertebrate community in Northern Ireland, and together with the woodland this



Map 5.3.1 Land and freshwater invertebrates: sites of conservation importance. Numbered sites are listed in Table 5.3.2.

locality supports many rare Irish species of beetle, mollusc and two-winged fly.

Between Torr Head and Larne the coastal habitats are very limited in extent and of no more than local interest. The undercliffs, however, are of interest for their fauna of rare molluscs, especially on calcareous flushes. The best examples are found near Glenarm. The hazel scrub and small areas of chalk grassland found along this coast adds variety. The invertebrate fauna within Larne Lough and on Island Magee is largely unknown.

Within the Belfast Harbour Estate, in Victoria Park and at Kinnegar occur the best of the few examples of artificial brackish lagoons found in Northern Ireland. Grey Point has a well-studied butterfly and moth fauna. Ballymacormick Point is the richest recorded site, with a diverse saltmarsh insect fauna and old records of several rare molluscs. The Copeland Islands and the outer headlands in Belfast Lough are important sites for their interstitial rock fauna as well as their heath and grassland invertebrate communities. The limited and degraded coastal fringe on the outer Ards Peninsula is of little importance for invertebrates, with only Ballyquintin Point retaining any notable species.

The saltmarshes of Strangford Lough collectively support one of the best saltmarsh faunas in Northern Ireland. Individual areas are often small, and although none supports the whole suite of species, all are of some interest. The Quoile Pondage (N)NR provides the largest area of coastal freshwater habitat in Northern Ireland. The freshwater fauna is of only local interest, although some

Table 5.3.1 Scarce and threatened invertebrate species in Region 17 recorded since 1970

Species	*Comments*
Believed to be endangered	
Coenosia antennata	A fly; saltmarshes. Only two Irish records: Bann Estuary and Killard (N)NR.
Conostethus brevis	A plant bug, probably feeds on lavender *Limonium* spp. in saltmarshes. Ballymacormick Point is the only known Irish site.
Dolichopus latipennis	A long-headed fly; saltmarshes. Murlough (N)NR.
Gonia ornata	A parasitic fly; restricted to a very few sunny sites with well-drained soils on east coast of Ireland. Murlough (N)NR.
Haliplus apicalis	A water beetle, found in brackish pools. Only recent Irish records: Kinnegar in the Belfast Harbour Estate, Strand Lough.
Lasioglossum rufitarse	A solitary bee that breeds in sandy banks. Only Irish record: White Park Bay.
Lispe litorea	A fly; saltmarshes. Only recently confirmed in Ireland from Killard (N)NR.
Porcellionides cingendus	A woodlouse; a SW European (Lusitanian) species. St. John's Point is the only Northern Irish site and the most northerly site in Europe.
Platypalpus albocapillata	A dance fly. Gransha, Strangford Lough.
Prosena longirostris	A parasitic fly absent from Britain but which has been collected in South Down. Extremely rare. Murlough (N)NR and Bloody Bridge.
Schizoloma capitata	A parasitic wasp. Murlough (N)NR is the only site in the British Isles with a recent record.
Sphecodes pellucidus	A parasitic bee. Murlough (N)NR is the only known Irish site.
Tomosvaryella littoralis	A big-headed fly. Known from only two Irish sites: Magilligan and Murlough (N)NRs.
Villeneuvia aestuum	A fly; requires wet sand and seaweed above tide line. Very local species in the British Isles. Murlough (N)NR.
Believed to be vulnerable	
Armadillidium album	A woodlouse; a coastal species associated with driftwood on sandy shores. In Northern Ireland recorded only at Ballykinler and Murlough (N)NR.
Bembidion lunatum	A northern ground beetle of sandy estuaries. Only one extant Irish site: Roe Estuary (N)NR, Lough Foyle.
Chersodromia speculifera	A dance fly; a saltmarsh specialist found in undisturbed sites. White Park Bay and Murlough (N)NR.
Eupithecia distinctaria	A moth found on dry coastal grassland with thyme. In Northern Ireland recorded only at Giant's Causeway.
Helophorus arvernicus	A water beetle found on river banks including tidal stretches. Bann Estuary is the only recent Irish record.
Psithyrus rupestris	Cuckoo bumble-bee that takes over nests of *Bombus lapidarius*. Apparently declining. Only one recent Northern Irish site: Murlough (N)NR.
Believed to be rare	
Aleochara moerens	A rove beetle associated with carrion. Kilkeel Beach.
Bembidion saxatile	A ground beetle confined mainly to coastal seepages in Ireland. Benderg Bay and Kilkeel Beach.
Bledius erraticus	A rove beetle; northern species of sandy riverbanks and coasts. Bann Estuary.
Bledius germanicus	A rove beetle found in saltmarshes where it burrows in stiff mud. Magheramorne in Larne Lough and Dundrum Inner Bay.
Corixa iberica	A water bug of heathland pools. Restricted to extreme western Europe; only Northern Irish sites on Rathlin and Fair Head.
Cymindis vaporariorium	A ground beetle of coastal heathlands. Only recent Irish site is on Rathlin Island.
Empis digramma	A dance fly of a coastal grassland. Rare in south-west Ireland; one site in Northern Ireland, Torr Head.
Entrepia flavicinctata	A moth; feeds on yellow saxifrage *Saxifraga aizoides*. Murlough Bay, one of two Northern Irish sites.
Heliophobus albicolon	A moth of coastal sand hills. One recent Northern Irish record: Portaferry.
Helophorus fulgidicollis	A water beetle of saltmarsh pools. Horse Island (Strangford Lough) and Mill Bay (Carlingford Lough).
Hilara lundbecki	A dance fly: a predatory fly of coastal and dune grassland. Murlough (N)NR.
Neides tipularis	A plant bug that feeds on grasses. Common on Murlough/Ballykinler dunes; only one other Irish site.
Metopia campestris	A cuckoo fly that feeds on stored honey in the nests of mining bees. A coastal species in Ireland. Downhill, Killard (N)NR and Murlough (N)NR.
Nemotelus notatus	A soldier fly; saltmarshes; confined to relatively unmodified sites. Killard (N)NR and Carlingford Lough.
Neohilara subterranea	A coastal rove beetle. Murlough (N)NR.
Ochthebius auriculatus	A water beetle. Known only from saltpans at Castle Espie, Strangford Lough.
Ochthebius viridis	A water beetle of brackish pools, rare in Northern Ireland. Horse Island on east shore of Strangford Lough, and Strand Lough.
Omalium rugulipenne	A rove beetle; strandline seaweed. Known only from Killard (N)NR.
Platycheirus immarginatus	A hoverfly of brackish marshes and tidal reaches. Very local on Northern Irish coast. Larry Bane, Carrickarade and Portaferry.
Pyrausta sanguinalis	A micro-moth that feeds on thyme flowers. Rare in Ireland: only Northern Irish locality Portstewart dunes.
Rhamphomyia simplex	A dance fly; scarce saltmarsh species. Murlough Bay and Killard (N)NR.
Thereva annulata	A stiletto fly; duneland. Rare in Ireland; in Northern Ireland found only on Murlough (N)NR.
Insufficiently known	
Leptocera fuscipennis	A lesser dung fly found in the narrow strip of debris above high water mark in saltmarshes. Bann Estuary and Kinnegar.
Limonia caledonica	A cranefly associated with base-rich mossy seepages. Recently found at Murlough Bay, the only Irish site.
Metatrichoniscoides celticus	A woodlouse. A poorly-known species, recorded in Ireland only at the Giant's Causeway.
Orimargo virgo	A cranefly associated with base-rich seepages and coastal cliffs. In Ireland known only from Murlough Bay.

Source: authors' records, CEDaR, Ulster Museum.

Table 5.3.2 Sites of importance for the conservation of invertebrates

Site no. on Map 5.3.1	*Location*	*Grid ref.*	*Species group(s)*	*Habitats*	*Conservation status*
	Co. Londonderry				
1	Roe Estuary	C6429, C6529	Beetles	Saltmarsh, brackish lagoons	(N)NR
2	Magilligan to Downhill	C63, C73	Beetles, butterflies and moths, two-winged flies	Dunes, slacks, upper beach, river banks	(N)NR, ASSI, MoD, UWT, LANR
3	Bann Estuary	C73, C83	Beetles, water bugs	Saltmarsh, pools	NT
4	Portstewart	C73, C83	Moths	Grassland	NT/ASI
	Co. Antrim				
5	Curran Strand/White Rocks	C8839-C8840	Beetles	Cliff seepages	ASI
6	Giant's Causeway	C9444	Snails, beetles, two-winged flies and woodlice	Flushed grassland, heaths;	(N)NR, WHS
7	White Park Bay	D0244	Rarities in most groups	Grassland and seepages	ASSI
8	Rathlin Island	D05, D14, D15	Water bugs and beetles	Lakes, ponds, maritime heaths	(N)NR, ASSI/ASI
9	Murlough Bay	D1942	Two-winged flies, beetles and snails	Chalk grassland and flushes, woodlands	ASI
10	Park Head	D3215	Snails	Base-rich seepages, unimproved grassland	Not protected
11	Inner Belfast Lough	J3878	Water beetles, water bugs and two-winged flies	Brackish lagoons and saltmarsh	ASSI
	Co. Down				
12	Ballymacormick Point	J5283	Plant bugs, beetles, snails and two-winged flies	Heath, scrub grassland, saltmarsh	ASSI
13	Ballyquintin Point	J6245	Woodlice	Grassland, scrub	(N)NR, ASSI
14	Strangford Lough	J55, J56	Beetles and water bugs	Saltmarshes, grassland	MNR, (N)NR, ASSI
15	Quoile Pondage	J5048	Beetles and water bugs	Brackish lagoon, freshwater margins	(N)NR
16	Killard Point, Benderg Bay and Ballyhornan Bay	J6043-J5942	Butterflies, beetles, bees and wasps and two-winged flies	Soft cliff seepages, dune grassland, heathland	(N)NR, ASSI
17	Strand Lough	J5337	Beetles and water bugs	Brackish lagoon and pools	Not protected
18	St. John's Point	J5233	Woodlice, beetles and snails	Saltmarsh, freshwater seepages and rocky shore	Not protected
19	Tyrella	J4735	Beetles	Coastal stream, upper beach and saltmarsh	Not protected
20	Dundrum Inner Bay	J43	Two-winged flies, beetles	Saltmarsh, upper beach	ASSI
21	Murlough/Ballykinler	J33, J43	Many rare species in all studied groups	Dune heath and grassland, beach debris, saltmarsh, scrub and woodland	(N)NR, ASSI, MoD
22	Bloody Bridge-Glassdrumman	J3927-J3822	Two-winged flies, beetles, bees and wasps	Coastal fringe, heathland, flushes and rock pools	ASI
23	Kilkeel Beach	J3013	Beetles	Seepages and upper beach debris	Not protected
24	Cranfield	J2711	Beetles	Sandworkings with seepages	ASSI
25	Carlingford Lough	J2513	Beetles and two-winged flies	Saltmarsh in Mill Bay	ASSI

Key: (N)NR = (National) Nature Reserve; ASSI = Area of Special Scientific Interest; ASI = Area of Scientific Interest; MNR = Marine Nature Reserve; NT = National Trust property; UWT = Ulster Wildlife Trust; MoD = Ministry of Defence; LANR = Local Authority Nature Reserve; WHS = World Heritage Site.

uncommon beetles are found on the freshwater margins and some brackish species still occur here. Killard (N)NR, at the entrance to Strangford Lough, is a rather exposed headland, known for its diverse populations of butterflies and other Lepidoptera and some other sand dune insects. The soft cliffs in Benderg Bay have seepages with a good range of riparian (water's-edge) beetles.

At Killough there is some saltmarsh and brackish lagoon habitat at Strand Lough, where several uncommon brackish water insects have been recorded. The rocky shore from Ardglass to Minerstown provides habitat for the limited but highly specialised insects and molluscs that live in the rock crevices below high tide mark, and at St. John's Point there is a notable fauna associated with freshwater seepages. The expanse of Dundrum Bay from Minerstown to Newcastle is of major importance for its invertebrate communities found in the dune and heathland habitats. Murlough (N)NR, in the centre of this system, is the richest single area. Many southern species reach their northern limits in Ireland here, and it is therefore their only Northern Irish locality. This interest extends throughout the system, including the Ballykinler dunes and, to a lesser extent, Tyrella. Additionally, Dundrum Inner Bay has a notable upper beach fauna on the sandy substrates in the estuary. Small areas of saltmarsh within Dundrum Inner Bay are of local importance, especially for two-winged flies.

The coastal fringe from Newcastle to Annalong is of importance for coastal flushes and grasslands, best represented along the Bloody Bridge to Glassdrumman section. Heathland extends up some of the valleys, linking into the extensive Mourne heaths. The coast south from Annalong to Cranfield is of little interest, apart from the beach to the south of Kilkeel where freshwater seepages support a number of beetles. At Cranfield there are a number of disused sand workings that have freshwater seepages with associated uncommon beetles. Carlingford Lough has one major area of saltmarsh, in Mill Bay, an important invertebrate locality with records of a number of saltmarsh beetles.

5.3.3 Human activities and management

The management of coastal habitats for invertebrates is covered by Kirby (1992). Many of the invertebrates found in coastal habitats are dependent on the maintenance of often subtle habitat features. Examples of these include strandline debris (particularly decaying seaweed), loose sand at the top of the beach, bare sand within sand dunes and seepages on cliff faces. Their loss can have major effects on the fauna. The major threat to the invertebrate fauna of Region 17, however, continues to be habitat destruction. This has been particularly severe on the soft coasts, where dune systems have been lost completely to recreational developments, such as golf courses, and the upper beach fauna affected by sand removal and disturbance. Seaweed harvesting is an additional threat to the specialist upper beach fauna. Mechanical beach cleaning is severely damaging to strandline interests as all debris is removed. It seems to affect the structure of the upper beach, as well as leading to removal of sand. It is becoming more common and more problematic and is particularly popular on recreational or Blue Flag beaches, such as Benone, Tyrella, Cranfield and possibly other sites.

On estuaries and sea loughs, saltmarshes and upper estuarine habitats have been lost around the coast. As a result the saltmarsh fauna is confined to small, scattered remnants and the few coastal lagoon species are confined to artificial sites. These habitats are still being affected by land claim and changes to the water salinity. Undercliff and rocky shore habitats have been affected by insufficient grazing and agricultural intensification, but in general they remain in a largely natural state.

5.3.4 Information sources used

Much of the information used to compile this chapter is held by the authors on databases now being incorporated into those at the Centre for Environmental Data and Recording (CEDaR). Information on many groups is also held by Robert Nash of the Ulster Museum, who has provided all the information on the coastal Diptera. Ross (1984) contains many mollusc records from coastal sites. The National Trust Biological Survey has recorded invertebrates on its extensive holdings around the coast, and their reports have been consulted for records. Butterfly monitoring takes place on several coastal sites, and data on this and on interesting moth records are published annually in the reports produced by the Northern Ireland branch of Butterfly Conservation. Data on most invertebrate groups are patchy, with good data available for only a few groups, including the aquatic beetles, ground beetles, aquatic and semi-aquatic bugs, hoverflies, large moths and butterflies. There are, however, very few published accounts of the fauna of individual sites or accounts of groups within Northern Ireland. Most records are published in the Irish Naturalists' Journal, the Proceedings of the Royal Irish Academy or the Bulletin of the Irish Biogeographical Society.

5.3.5 Acknowledgements

Thanks are due to Jo Whatmough (National Trust) and also Robert Nash and Trevor Boyd for information on specific groups and sites and the National Trust Biological Survey for invertebrate records from their Northern Ireland survey.

5.3.6 Further sources of information

A. References cited

Kirby, P. 1992. *Habitat management for invertebrates: a practical handbook*. Sandy, Royal Society for the Protection of Birds and Joint Nature Conservation Committee.

Ross, H.C.G. 1984. *Catalogue of the land and freshwater Mollusca of the British Isles in the Ulster Museum*. Belfast, Ulster Museum.

Shirt, D.B., *ed*. 1987. *British Red Data Books: 2. Insects*. Peterborough, Nature Conservancy Council.

B. Further reading

Anderson, R. 1996. *Carabid beetles: Northern Ireland species inventory*. Belfast, DoE (NI) EHS. (Internal report.)

Day, K.R. 1987. The species and community characteristics of ground beetles (Coleoptera: Carabidae) in some Northern Ireland nature reserves. *Proceedings of the Royal Irish Academy, 87B:* 65-82.

Nash, R., Boston, M., & Nelson, B.H. 1990. The Hymenoptera Aculeata in the superfamilies Pompiloidea, Sphecoidea and Apoidea of Murlough National Nature Reserve, Co. Down. *Irish Naturalists' Journal*, *23*: 247-255.

Nelson, B.H. 1995. The distribution of the aquatic and semi-aquatic Heteroptera in Northern Ireland. *Bulletin of the Irish Biogeographical Society, 18:* 66-130.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Invertebrate records from Northern Ireland	*Centre for Environmental Data and Recording (CEDaR), The Ulster Museum, Belfast, tel: 01232 383000
Invertebrate interest of National Trust holdings	*Biological Survey Team, National Trust, Cirencester, tel: 01285 651818
Invertebrate interest of DoE (NI) Nature Reserves	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477
Butterfly and moth records	Butterfly Conservation (Northern Ireland Branch), 12 Woodland Avenue, Helen's Bay, Co. Down BT63 5PQ, tel: 01247 333927

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

5.4 Rare sea-bed species

Dr D.G. Erwin

5.4.1 Introduction

This section considers 'rare' and 'scarce' marine benthic (sea-bed) species in Northern Ireland, excluding fish. The occurrence and distribution of benthic communities are discussed in section 4.2.

The concept of rarity in the UK marine environment has recently been the subject of much discussion. Suggestions have been made for the classification of marine benthic species as 'rare' or 'scarce' on the basis of the number of 10 km squares in which they are known to exist (Sanderson 1996). This methodology and these criteria, adopted in other regional volumes in this series, are analogous to those used for other groups of organisms in British Red Data Books (e.g. Bratton 1991) and by the International Union for Conservation of Nature and Natural Resources (IUCN Species Survival Commission 1995). However, the dearth of information and recording effort on the abundance and distribution of marine species as a whole renders assessment of their rarity or scarcity more difficult than for better studied terrestrial species. The difficulty in applying this methodology is greater around the coast of Northern Ireland, as recording has taken place there at a much lower level of intensity than in the UK generally. Particularly in Northern Ireland, species may be recorded in only a few squares because these are the only squares to have been visited by an appropriate authority.

This section therefore discusses those species that have been recorded in Northern Ireland and that appear on a draft list of putative rare and scarce species for Great Britain, which has been put together using formal definitions of rarity and scarcity (Sanderson 1996); their status in Great Britain is taken as a tentative indication of their UK status. Species that are obscure and/or under-recorded around the UK are not discussed further. Some species noted here as rare or scarce may also be present in deeper waters beyond the study area. Also discussed are species thought by the author to be rare or scarce in Northern Ireland, although not included in the list of UK rare and scarce species. These include species for which Northern Ireland represents the limit of distribution (e.g. 'southern' or 'northern' species) and which may be rare within Region 17 but occur more commonly towards the centre of their biogeographic range. All species discussed here may therefore require reassessment of their status in future, whilst further species not yet investigated may subsequently be considered to be rare or scarce.

Region 17 appears to be relatively rich in rare or scarce marine benthic species, with 45 such species recorded from the region. The northern limits of a number of species and the southern limits of a few species occur close to Northern Ireland.

5.4.2 Important locations and species

Table 5.4.1 lists the rare or scarce marine benthic species that have been recorded in Region 17, together with their known areas of occurrence. Species names and order of appearance

Map 5.4.1 The most notable locations for rare or scarce marine benthic species. © Crown Copyright.

are after Howson (1987). The most important locations around Northern Ireland for rare or scarce species are considered by those working in the area to be Rathlin Island and Strangford Lough. In addition, parts of the open north east coast, the Skerries, the Maidens (off Larne) and Carlingford Lough also hold some species of interest. These locations are shown on Map 5.4.1.

Many of the rare species in Northern Ireland are restricted to a few localities where conditions suitable for their survival exist. For example, species such as *Axinella polypoides, Axinella damicornis, Gymnangium montagui, Parazoanthus axinellae, Okenia elegans, Thecacera pennigera* and *Carpomitra costata*, which have a south-western distribution in the UK, perhaps because they require exposed rocky habitats or an oceanic temperature regime, occur only around the Skerries or Rathlin Island. Deep water species that appear intolerant of temperature fluctuations (stenotherms) can emerge to depths as shallow as 25 m only at Rathlin Island and at the Maidens, where thorough vertical mixing of the water column throughout the year (see section 4.2.2) allows them to survive. Examples are *Clathria barleii, Diphasia nigra, Diphasia alata, Polyplumaria flabellata, Arachnanthus sarsi, Parazoanthus anguicomus* and *Stichastrella rosea.*

Southern species requiring high summer temperatures to reproduce but capable of withstanding low winter temperatures are limited to Strangford Lough, the south-east coast of Co. Down or Carlingford Lough. Examples are *Ocnus planci, Schmitzia neapolitiana, Atractophora hypnoides* and *Naccaria wiggii.* In contrast, some rare species in

Table 5.4.1 'Nationally rare or scarce' marine benthic species found in Region 17

Species	*Common name/type of organism*	*Area(s) of occurrence*	*Habitat/associations*	*Comments*	*Useful reference*
Axinella damicornis	A sponge	Around Rathlin Island	On vertical and horizontal faces at sites of moderate wave action. Sometimes with some silt at sites generally below 20 m.	Southern. Mediterranean species at limit of range.	Ackers *et al.* (1992)
Axinella polypoides	A sponge	Around the Skerries and Rathlin Island	Mainly on upward-facing clean or silty rock, usually in about 30 m of water.	South-western UK distribution. Past confusion with *A. dissimilis.*	Ackers *et al.* (1992)
Clathria barleii	A sponge	Rathlin Island, the Maidens	Circalittoral, on rocks, stones and sometimes on the coral *Lophelia pertusa.* Usually at more than 40 m depth.	Possibly an offshore species.	Ackers *et al.* (1992)
Spongionella pulchella	A sponge	Rathlin Island, the Maidens, Copeland Islands	Usually on rock in deeper water and moderate to strong tidal streams.	Wide North Atlantic distribution, from Greenland to Azores and in the Mediterranean.	Ackers *et al.* (1992)
Biemna variantia	A sponge	Strangford Lough	Mostly recorded in deep water.	Possibly mis-identified in species records, so only cautiously regarded as scarce.	Ackers *et al.* (1992)
Halecium plumosum	A hydroid	Rathlin Island, the Maidens	Recorded on *Sabellaria* tubes and algae, but probably colonises other structures.	From extreme lower shore to edge of the continental shelf.	Hayward & Ryland (1990)
Gymnangium montagui	A hydroid	Around Rathlin Island	On hard substrates from 10-80 m.	South-western distribution in the UK; recorded to Morocco.	Hayward & Ryland (1990)
Tamarisca tamarisca	A hydroid	Rathlin Island	10-150 m. Substrate unrecorded.	Recorded sporadically throughout the British Isles north to the Arctic Ocean.	Hayward & Ryland (1990)
Polyplumaria flabellata	A hydroid	Rathlin Island, the Maidens	30-1,378 m. Substrate apparently unrecorded.	A deep water species found from Morocco to southern Iceland.	Cornelius (1995)
Diphasia nigra	A hydroid	Rathlin Island	Recorded on mussels and other substrata.	A deep water species.	Hayward & Ryland (1990)
Diphasia alata	A hydroid	Rathlin Island, the Maidens	Unknown	Azores to mid Norway.	Hayward & Ryland (1990)
Paraerythropodium coralloides	A soft coral	Rathlin Island	In overhangs and crevices out of light and sheltered from strong wave action.	Southern. More common in SW Europe and the Mediterranean. Somewhat cryptic but still probably scarce.	Manuel (1988)
Arachnanthus sarsi	An anemone	Rathlin Island	Found in a mixture of mud and shell-sand amongst bedrock, from 15-36 m depth.	Partly nocturnal. Known from several localities in western Scotland.	Manuel (1988)
Parazoanthus axinellae	Yellow trumpet anemone	Rathlin Island	Mainly an organic substrata; shells, worm-tubes etc from 6-100 m depth.	South-western distribution in the UK; well known and common in the Mediterranean.	Manuel (1988)
Parazoanthus anguicomus	Cluster anemone	Rathlin Island, the Maidens	On organic surfaces such as sponges and corals as well as stones, from 20-400 m.	Northern species at its southern limit in the British Isles. Occurs in wide range of depths and may not be scarce in deeper water.	Manuel (1988)

Table 5.4.1 'Nationally rare or scarce' marine benthic species found in Region 17 (continued)

Species	*Common name/type of organism*	*Area(s) of occurrence*	*Habitat/associations*	*Comments*	*Useful reference*
Anemonactis mazeli	A burrowing anemone	Strangford Lough	In sand or gravel offshore in depths from 20-650 m.	From Scandinavia to the Mediterranean, may be under-recorded.	Manuel (1988)
Edwardsia timida	A burrowing anemone	Rathlin Island	Buried in sand and gravel from mid tide level to shallow sublittoral.	Small and inconspicuous	Manuel (1988)
Stiliger bellulus	A sea slug	Carlingford Lough	In shallow water, possibly associated with seagrass beds.	Norway to the Black Sea.	Thompson (1988)
Harmothoe mcintoshi	A bristle-worm	North-east coast	Subtidal in gravel.	Also known from Isle of Man and Shetland.	Tebble & Chambers (1982)
Cestopagurus timidus	A hermit crab	Rathlin Island	From low shore to 70 m.	Southern species found from the Canary Islands to south-west Scotland.	Ingle (1993)
Jordaniella nivosa	A sea snail	Strangford Lough	Unknown.	A southern species extending north from the Mediterranean.	Graham (1988)
Velutina plicatilis	A velvet shell	Copeland Islands	Associated with compound sea squirts and hydroids on hard substrata.	Extends from northern North Sea down west coast of Britain and Ireland to north coast of Spain.	Hayward & Ryland (1990)
Ovatella myosotis	A sea snail	Strangford Lough	On upper shores, especially in estuaries, among seaweed, saltmarsh vegetation and rolling debris.	South western distribution in the UK.	Hayward & Ryland (1990)
Okenia elegans	Yellow skirt slug	The Skerries	Spends much of its life concealed in burrows excavated into living sea squirts, on which it feeds.	May be under-recorded owing to its burrowing habit. Scandinavia to Devon. Most British records are from the south-west.	Picton & Morrow (1994)
Thecacera pennigera	A sea slug	Portstewart Point and the Skerries	Feeds on the sea mat *Bugula plumosa.*	South-western distribution in the UK.	Picton & Morrow (1994)
Janolus hyalinus	A sea slug	The Skerries	Found on various sea mat *Bugula* spp.	Reported from west coast of British Isles, Normandy, the Mediterranean and Morocco.	Thompson (1988)
Coryphella verrucosa	A sea slug	Widespread around the Northern Ireland coastline.	Often on the hydroid *Tubularia indivisa.*	A northern species.	Picton & Morrow (1994)
Eubranchus doriae	A sea slug	The Skerries, Rathlin Island	Feeds on the hydroid *Kirchenpaueria similis.*	A Mediterranean species also recorded from south coast of England to St. Kilda.	Picton & Morrow (1994)
Cumanotus beaumonti	A sea slug	Rathlin Island, Carlingford Lough	Found on the hydroid *Corymorpha nutans.*	Very rarely recorded; from Plymouth to Norway.	Picton & Morrow (1994)
Crenalla decusata	A bivalve	Strangford Lough	Offshore on sand and fine gravel.	A northern species. Possibly under-recorded owing to its small size (3 mm).	Hayward & Ryland (1990)
Palmicellaria skenei	A sea mat	Rathlin Island	Encrusting hard substrata, from below the kelp zone to the edge of the continental shelf.	A northern species present off most British coasts, though not particularly common.	Hayward & Ryland (1979)
Caberea ellisii	A sea mat	The Skerries, Rathlin Island, north-east coast, the Maidens	On kelp *Laminaria* spp., hydroids, shells, stones, from 10 m to 300 m.	A northern species, extending to the Arctic.	Ryland & Hayward (1977)

Table 5.4.1 'Nationally rare or scarce' marine benthic species found in Region 17 (continued)

Species	*Common name/type of organism*	*Area(s) of occurrence*	*Habitat/associations*	*Comments*	*Useful reference*
Bugula purpurotincta	A sea mat	Rathlin Island, north-east coast, the Maidens	Low water to shallow sublittoral on shells and hydroids.	A northern species. Occurs north through Norway to Spitzbergen.	Ryland & Hayward (1977)
Ocnus planci	A sea cucumber	Carlingford Lough	Apparently epifaunal on shells, worm tubes and other sessile invertebrates.	Confused with *O. lactea* in the past.	Picton (1993)
Labidoplax media	A sea cucumber	Bird Island passage and Quoile Estuary in Strangford Lough	Lives at the surface or just below the surface of flocculent mud.	Inconspicuous (2-3 cm; transparent) and possibly under-recorded.	Picton (1993)
Leptasterias mülleri	A starfish	Strangford Lough	Under boulders or in pools. Sublittoral specimens occur in moderately exposed to very exposed sites.	Northern circumpolar species reaching southern limit in south west Ireland.	Picton (1993)
Synoicum incrustatum	A sea squirt	The Skerries, north-east coast	Unknown.	Easy to overlook, but single record from the British Isles suggests it is genuinely rare.	Connor (1989)
Atractophora hypnoides	A red seaweed	Carlingford Lough	On stones, shells, pottery and maerl, sublittoral to 16 m.	Also known as *Rhododiscus pulcherrimus.*	Irvine & Chamberlain (1994)
Naccaria wiggii	A red seaweed	South-east coast of Co. Down, Carlingford Lough	Unknown.	A widely distributed but highly sporadic southern species.	Dixon & Irvine (1977)
Plagiospora gracilis	A red seaweed	Rathlin Island, Strangford Lough	In areas of cobbles in strong tidal streams.	Possibly a cold water species stretching from Baltic Sea to Western Atlantic.	Irvine (1983)
Schizymenia dubyi	A red seaweed	Rathlin Island	Epilithic, in pools exposed to some wave action. Mid to low shore.	Possibly a cold water species.	Dixon & Irvine (1977)
Schmitzia hiscockiana	A red seaweed	Rathlin Island, north-east coast, Copeland Islands and Strangford Lough narrows	Subtidal in tide-swept cobble beds and wave exposed shores.	Scattered distribution in GB. Restricted habitat. Common at few sites of occurrence. Recorded only from the British Isles and Sweden.	Maggs & Guiry (1985)
Schmitzia neapolitana	A red seaweed	South-east coast of Co. Down, Carlingford Lough	On pebbles and gravel.	A summer ephemeral.	Hiscock & Maggs (1984)
Carpomitra costata	A brown seaweed	Around Rathlin Island, Strangford Lough	Epilithic on bedrock and boulders to a depth of 37 m.	Most records for the species from the south coast of Britain.	Fletcher (1987)
Desmarestia dresnayi	A brown seaweed	North-east coast	Epilithic on small stones and shells embedded in gravel, in sublittoral in areas of moderate to strong water current.	Annual, May to September. Easily overlooked but still probably rare.	Fletcher (1987)

Note: species names and order of appearance are after Howson (1987); in the absense of a specific common name the nearest available group name has been used.

Northern Ireland are northern species approaching the southern limit of their geographical distribution. Examples are *Coryphella verrucosa, Crenella decussata, Caberea elissii* and *Bugula purpurotincta,* all of which occur south to approximately Strangford Lough.

In addition to the nationally rare or scarce species listed in Table 5.4.1 there are several species that are rare or scarce in the UK only in Region 17; these are listed in Table 5.4.2. Also, a number of distinctive sponge and ascidian entities, possibly new species, have been recorded in the region, mainly from Rathlin Island and the Maidens.

Table 5.4.2 Marine benthic species that are rare or scarce in Region 17

Species	*Common name/type of organism*	*Area(s) of occurrence*	*Habitat/associations*	*Comments*	*Useful reference*
Dercitus bucklandi	A sponge	Rathlin Island, north-east coast	Occurs only in crevices and caves. Particularly common on limestone substrata.	Possibly under-recorded due to habitat. Distribution poorly known.	Ackers *et al.* (1992)
Ciocalypta penicillus	A sponge	Carlingford Lough	On stones lightly covered with sand, in clear water.	Known from Coll and Tiree to the Mediterranean. Commonly occurs in SW of British Isles.	Ackers *et al.* (1992)
Aureliania heterocera	A burrowing anemone	Rathlin Island, north-east coast, the Maidens, Strangford Lough	Attached to rocks and shells or buried unattached in soft sediments from the lower shore.	Possibly a southern species that extends from the Mediterranean north to the Irish Sea and western Ireland.	Manuel (1988)
Leucia nivea	A bristle worm	Rathlin Island, the Maidens	Sublittoral in 8-300 m on rock, sand, shell sand.	Norway to Morocco.	Chambers (1989)
Manzonia crassa	A sea snail	Strangford Lough	Under stones or with weeds from low shore to 50 m depth.	Inconspicuous (3 mm long); found between Norway and the Mediterranean.	Graham (1988)
Erato voluta	A sea snail	Rathlin Island	Sublittoral (20-150 m) associated with ascidians on hard substrata.	Distributed from Mediterranean to Norway and widely around British Isles.	Graham (1988)
Hedylopsis brambelli	A sea slug	Strangford Lough narrows	In sublittoral shelly gravel.	Inconspicuous (2.5 mm long).	Thompson (1988)
Placida dendritica	A sea slug	Strangford Lough	Feeds on algae *Codium tomentosum* and *Bryopsias plumosa.*	Recorded from shallow waters across the globe and throughout Britain.	Thompson (1988)
Cuthona concinna	A sea slug	North-east coast and Strangford Lough	Feeds on the hydroid *Sertularia argentea.*	A northern species.	Picton & Morrow (1994)
Eubranchus vittatus	A sea slug	Strangford Lough	Feeds on the hydroid *Kirchenpaueria pinnata.*	Frequent in the north west of Britain. Much rarer in the south, but extends to north coast of Spain.	Picton & Morrow (1994)
Facelina annulicornis	A sea slug	The Skerries	Feeds on a variety of hydroids and on other sea slugs.	A southern species extending to the Meditteranean.	Picton & Morrow (1994)
Stichastrella rosea	A starfish	Rathlin Island, north-east coast, Strangford Lough	In rocky exposed or moderately exposed sites.	A deep water species.	Picton (1993)
Amphiura securigera	A brittlestar	Strangford Lough, Carlingford Lough	Buried in gravel.	Inconspicuous and rarely recorded. West and south-west of the British Isles and in the Irish Sea.	Hayward & Ryland (1990)
Archidistoma aggregatum	A sea squirt	Rathlin Island, north-east coast, the Maidens	Recorded from depths of 0-30 m.	Inconspicuous. Recorded from Anglesey southwards on west coast, and at 3 locations on east coast GB.	Millar (1970)
Diazona violacea	A sea squirt	Rathlin Island	Prefers clear offshore water.	A deep water species. Common in west Scotland and west Ireland. Range extends down to Spain.	Picton (1985)

Table 5.4.2 Marine benthic species that are rare or scarce in Region 17 (continued)

Species	*Common name/type of organism*	*Area(s) of occurrence*	*Habitat/associations*	*Comments*	*Useful reference*
Boltenia echinata	A sea squirt	Widespread around Northern Ireland coast	Usually in moderately sheltered silty sites.	A northern species. Very inconspicuous and therefore likely to be overlooked.	Picton (1985)
Pyura squamulosa	A sea squirt	Rathlin Island, north-east coast.	On stones and rocks from the lower shore to shallow water.	North, west and south coasts of British Isles. Possibly extends south to the Mediterranean.	Millar (1970)
Drachiella heterocarpa	A red seaweed	The Skerries, Rathlin Island, north-east coast	Epilithic on bedrock on vertical faces and overhangs from 2-30 m depth.	South-western UK distribution, to north Wales. Also west and north coast of Ireland.	Maggs & Hommersand (1993)
Drachiella spectabilis	A red seaweed	The Skerries, Rathlin Island	On horizontal and gently sloping rock at 2-30 m depth.	South-west GB to Islay via west and north Ireland. Inconspicuous except in early summer, when it displays a striking blue irridescence.	Maggs & Hommersand (1993)
Radicilingua thysanorhizans	A red seaweed	The Skerries, Rathlin Island, north-east coast	On unstable substrata from low shore to 30 m.	Widespread south-western UK distribution, also around Ireland except central east coast.	Maggs & Hommersand (1993)
Taonia atomaria	A brown seaweed	Carlingford Lough	Characteristic of places with intermittent sand scour.	A southern species known from the Mediterranean and south-west Britain.	Campbell (1976)

Note: species names and order of appearance are after Howson (1987); in the absence of a specific common name the nearest available group name has been used.

5.4.3 Information sources used

Two major preliminary surveys of Northern Ireland's intertidal and sub-tidal resources have been carried out for the Department of the Environment (NI); these, together with the databases deriving from them (held in the Centre for Environmental Data and Recording (CEDaR) at the Ulster Museum), are the principal sources for this section (Erwin *et al*. 1985, 1986, 1990; Wilkinson *et al*. 1988). Detailed species records are available in Erwin *et al*. (1990) and Wilkinson *et al*. (1988). In addition a number of expert authorities experienced in fieldwork on the benthic marine life of Northern Ireland were consulted on which species they consider 'rare' around the Northern Ireland coastline.

5.4.4 Acknowledgements

The author is grateful to the following for information and for commenting on the text: R.J. Bleakley (DoE (NI) Environment and Heritage Service), Dr P.J.S. Boaden (The Queen's University of Belfast), B.E. Picton (Biomar, Dublin), W. Reid (Strangford Lough Officer) and the Centre for Environmental Data and Recording (CEDaR) at the Ulster Museum (especially Dr J.D. Nunn). Particular thanks are due to Dr W.G. Sanderson and J. Plaza (JNCC).

5.4.5 Further sources of information

A. References cited

Ackers, R.G., Moss, D., & Picton, B.E. 1992. *Sponges of the British Isles ('Sponge V') - a colour guide and working document*. 5th ed. Ross-on-Wye, Marine Conservation Society.

Bratton, J.H., *ed*. 1991. *British Red Data Books: 3. Invertebrates other than insects.* Peterborough, Joint Nature Conservation Committee.

Campbell, A.C. 1976. *The Hamlyn guide to the seashore and shallow seas of Britain and Europe*. Hong Kong, Hamlyn.

Chambers, S.J. 1989. *Leucia nivea*: a polynoid (polychaeta) new to the British Isles. *Irish Naturalists' Journal*, *23*: 145-146.

Connor, D.W. 1989. *Synoicum incrustatum* (Sars, 1851), an ascidian new to the British Isles. *Irish Naturalists' Journal*, *23*: 37-80.

Cornelius, P.F.S. 1995. North-west European thecate hydroids and their medusae, part 2. Keys and notes for the identification of the species. *In: Synopses of the British Fauna (New Series), No. 50*, ed. by R.S.K. Barnes & J.H. Crothers. Shrewsbury, Field Studies Council, for Linnean Society of London/Estuarine and Coastal Sciences Association.

Dixon, P.S., & Irvine, L.M. 1977. *Seaweeds of the British Isles. Vol. 1. Rhodophyta. Part 1. Introduction,* Nemaliales, Gigartinales. London, British Museum (Natural History).

Erwin, D.G., Picton, B.E., Howson, C., Connor, D., & Gilleece, P. 1985. The Northern Ireland survey: methodology and early results. *Progress in Underwater Science*, *10 (NS):* 27-38.

Erwin, D.G., Picton, B.E., Connor, D.W., Howson, C.M., Gilleece, P., & Bogues, M.J. 1986. *The Northern Ireland sublittoral survey*. Belfast, Ulster Museum.

Erwin, D.G., Picton, B.E., Connor, D.W., Howson, C.M., Gilleece, P., & Bogues, M.J. 1990. *The inshore marine life of Northern Ireland*. London, HMSO.

Fletcher, R.L. 1987. *Seaweeds of the British Isles. Vol. 3. Fucophyceae (Phaeophyceae)*. London, British Museum (Natural History).

Graham, A. 1988. *Molluscs: prosobranch and pyramidellid gastropods. Keys and notes for the identification of the species*. 2nd ed. Leiden, E.J. Brill/Dr W. Backhuys for Linnean Society of London/Estuarine and Brackish-water Sciences Association. (Synopses of the British Fauna (New Series), No. 2.)

Hayward, P.J., & Ryland, J.S. 1979. *British ascophoran bryozoans. Keys and notes for the identification of the species*. London, Academic Press for Linnean Society of London/Estuarine and Brackish-Water Sciences Association. (Synopses of the British Fauna (New Series), No. 14.)

Hayward, P.J., & Ryland, J.S., *eds*. 1990. *The marine fauna of the British Isles and north-west Europe*. 2 vols. Oxford, Clarendon Press.

Hiscock, S., & Maggs, C.A. 1984. Notes on the distribution and ecology of some new and interesting species from south west Britain. *British Bryozoan Society Journal, 19:* 73-87.

Howson, C.M., *ed*. 1987. *Directory of the British marine fauna and flora. A coded checklist of the marine fauna and flora of the British Isles and its surrounding seas*. 1st ed. Ross-on-Wye, Marine Conservation Society.

IUCN Species Survival Commission. 1995. *IUCN Red List Categories*. Gland, Switzerland, & Cambridge, UK, IUCN.

Ingle, R. 1993. *Hermit crabs of the north-eastern Atlantic Ocean and Mediterranean Sea. An illustrated key*. London, Chapman & Hall, for Natural History Museum Publications.

Irvine, L.M. 1983. *Seaweeds of the British Isles. Vol. 1. Rhodophyta. Part 2A. Cryptonemiales (*sensu stricto*), Palmariales, Rhodymeniales*. London, British Museum (Natural History).

Irvine, L.M., & Chamberlain, Y.M. 1994. *Seaweeds of the British Isles. Vol. 1. Rhodophyta. Part 2B. Corallinales, Hildenbrandiales*. London, Natural History Museum.

Maggs, C.A., & Guiry, M.D. 1985. Life history and reproduction of *Schmitzia hiscockiana* sp. nov. (Rhodophyta, Gigartinales) from the British Isles. *Phycologia*, *24*: 297-310.

Maggs, C.A., & Hommersand, M.H. 1993. *Seaweeds of the British Isles. Vol. 1: Rhodophyta. Part 3A: Ceramiales*. London, HMSO, for Natural History Museum.

Manuel, R.L. 1988. *British Anthozoa (Coelenterata: Octocorallia and Hexacorallia); keys and notes for the identification of the species*. 2nd ed. Leiden, Linnean Society of London/Estuarine and Brackish Water Sciences Association.

Millar, R.H. 1970. *British Ascidians. Tunicata: Ascidiacea. Keys and notes for the identification of the species*. 1st ed. London, Academic Press, for Linnean Society of London. (Synopses of the British Fauna (New Series), No. 1.)

Picton, B.E. 1985. *Ascidians of the British Isles, a colour guide*. Ross-on-Wye, Marine Conservation Society.

Picton, B.E. 1993. *A field guide to the shallow-water echinoderms of the British Isles*. London, IMMEL Publishing, for Marine Conservation Society.

Picton, B.E., & Morrow, C.C. 1994. *A field guide to the nudibranchs of the British Isles*. London, Immel Publishing.

Ryland, J.S., & Hayward, P.J., *eds*. 1977. *British anascan bryozoans. Cheilostomata: Anasca. Keys and notes for the identification of the species*. 1st ed. London, Academic Press, for Linnean Society of London. (Synopses of the Brtitish Fauna (New series), No. 10.)

Sanderson, W.G. 1996. Rare marine benthic flora and fauna in Great Britain: the development of criteria for assessment. *Joint Nature Conservation Committee Report*, No. 240.

Tebble, N., & Chambers, S. 1982. *Polychaetes from Scottish waters. A guide to identification. Part 1. Family Polynoidae*. Edinburgh, Royal Scottish Museum. (Studies series.)

Thompson, T.E. 1988. *Molluscs: benthic opisthobranchs (Mollusca: Gastropoda). Keys and notes for the identification of the species*. 2nd ed. Leiden, E.J. Brill/Dr W. Backhuys, for Linnean Society of London/Estuarine and Brackish-Water Sciences Association. (Synopses of the British Fauna (New Series), No. 8.)

Wilkinson, M, Fuller, I.A., Telfer, T.C., Moore, C.G., & Kingston, P.F. 1988. *Northern Ireland littoral survey*. Edinburgh, Institute of Offshore Engineering, Heriott-Watt University.

B. Further reading

Boaden, P.J.S. 1966. Interstitial fauna from Northern Ireland. *Veroffentlichungen Institut Meeresforschung Bremerhaven - Sonderband, 2: 125-130.*

Clark, P.F. 1986. *North Atlantic crabs; an atlas of distribution*. Ross on Wye, Marine Conservation Society.

Erwin, D.G., & Picton, B.P. 1987. *The Marine Conservation Society guide to inshore marine life*. London, Immel.

Gubbay, S. 1988. *A coastal directory for marine nature conservation*. Ross on Wye, Marine Conservation Society.

Kirby, R. 1989. *Tidal flat instability and fine-grained sediment transport at Ardmillan Bay, Strangford Lough in relation to* Spartina *eradication and oyster trestle burial*. Belfast, DoE (NI). (Unpublished report by Ravensrodd Consultants Ltd.)

Lewis, J.R. 1964. *Ecology of rocky shores*. London, English Universities Press.

Morton, O. 1994. *Marine algae of Northern Ireland*. Belfast, Ulster Museum.

Nunn, J.D. 1994. The marine mollusca of Ireland. 1. Strangford Lough, Co. Down. *Bulletin of the Irish Biogeographical Society, 17:* 23-214.

Southward, A.J., & Crisp, D.J. 1954. The distribution of certain intertidal animals around the Irish coast. *Proceedings of the Royal Irish Academy, 57B:* 1-29.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Seaweeds	Osborne Morton, Curator of Algae, Botany Department, Division of Science, The Ulster Museum, Belfast BT9 5AB, tel: 01232 667769
Red seaweeds	*Dr C.A. Maggs, School of Biology and Biochemistry, Queens University of Belfast, tel: 01232 245133
Sponges, hydroids, echinoderms and opisthobranchs	*B.E. Picton, Ulster Museum, Belfast, tel: 01232 381251
Molluscs	Dr J.D. Nunn, Cherry Cottage, 11 Ballyshaft Road, Newtownards, Co. Down BT22 2AW, tel: 01247 817710
Meiofauna	*Dr P.J.S. Boaden, The Queens University of Belfast Marine Biology Station, Portaferry, tel: 01247 728230
Strangford Lough and conservation	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477
Strangford Lough	W. Reid, Strangford Lough Officer, Strangford Lough Management Committee, 13 The Strand, Portaferry, Co. Down BT22 1PF, tel: 01247 728886
General distributional information	*The Ulster Museum - Centre for Environmental Data and Recording (CEDaR), Belfast, tel: 01232 381251

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

5.5 Exploited sea-bed species

Dr R.P. Briggs

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. Many of these species also provide an essential food source for other species, such as fish and birds, for example seabirds, migrant and wintering waders and wildfowl (see also sections 5.10, 5.11 and 5.12). 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 discussed are given in Table 5.5.1.

In this region there are important inshore populations of cockles and mussels in Lough Foyle, Belfast Lough and the shores of Strangford Lough. Periwinkles occur all around the rocky coast and some native oysters are found in Lough Foyle. Lobsters, brown crab and velvet crab are common around the coast with scallop, queen scallop and in particular *Nephrops* being important species.

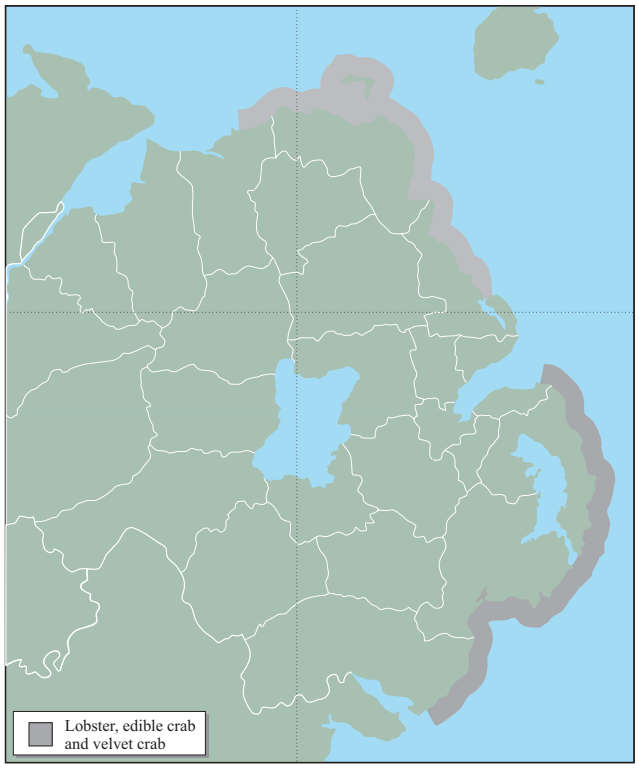
Table 5.5.1 Species names

Common name	*Scientific name*
Lobster	*Homarus gammarus*
Edible or brown crab	*Cancer pagurus*
Velvet crab	*Necora puber*
Dublin Bay prawn, scampi, Norway lobster or langoustine	*Nephrops norvegicus*
Brown shrimp	*Crangon crangon*
Pink prawn (or shrimp - referred to as both)	*Pandalus montagui*
Cockle	*Cerastoderma edule*
Mussel	*Mytilus edulis*
Native oyster	*Ostrea edulis*
Periwinkle	*Littorina littorea*
Scallop	*Pecten maximus*
Queen scallop	*Aequipecten opercularis*
Whelk	*Buccinum undatum*
Lugworm	*Arenicola marina*
Ragworm/king ragworm	*Neanthes virens* & *Hediste diversicolor*
Dulse (an alga)	*Palmaria palmata*

5.5.2 Important locations and species

Crustacea

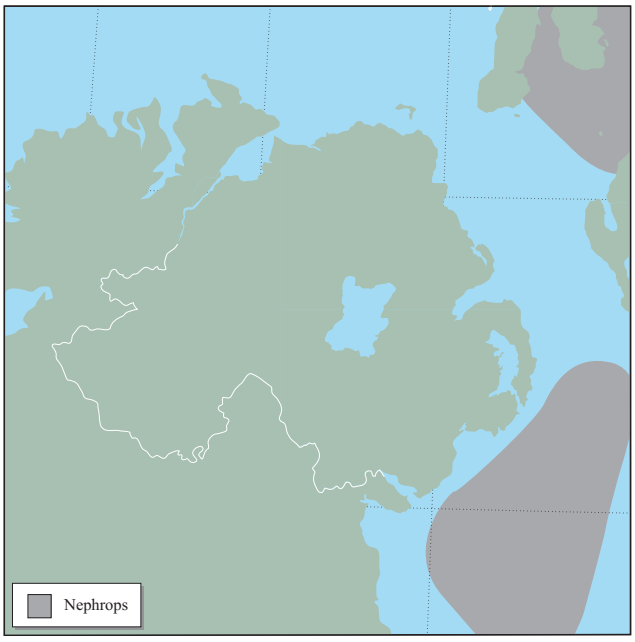
The broad-scale distributions of lobster, edible crab and velvet crab in the region are shown on Map 5.5.1. These species are present wherever there is suitable habitat, such as rocky reefs with crevices for protection. Inshore the substrate is mainly rocky, with extensive areas of sand and broken stones further offshore. Deep water inhabited by lobsters occurs close to the north and west of Rathlin Island and offshore in the North Channel. Edible crab and velvet crab also occur off the east coast, which is low-lying and considerably less exposed than the north coast and is characterised by extensive rocky reefs offshore. Beyond the 27 m depth contour on the east coast, sand and mud substrates predominate, leading into the large area of soft mud inhabited by *Nephrops* (Map 5.5.2). Whilst most of the Irish Sea is dominated by strong tides, this *Nephrops* area (stretching from Dundrum Bay to Dublin Bay) is characterised by very weak tidal currents. Pink prawns and brown shrimp also occur in this area, but not in exploitable quantities.



Map 5.5.1 Distribution of crustacea: lobster, edible crab and velvet crab. © Crown Copyright.

Molluscs

The main locations where exploitable populations of cockles, mussels, native oysters and whelks are found in the region are shown on Map 5.5.3. Cockles are found in the intertidal zones of sandy estuaries and other sheltered sites. The main locations in the region for cockles are Lough Foyle, Strangford Lough and Dundrum Bay, where they occur in relatively small quantities. Native oysters are found throughout Lough Foyle, with smaller amounts in Larne and Strangford Loughs. Mussels are found at many coastal sites in the region, from the mid shore to the subtidal



Map 5.5.2 Distribution of crustacea: *Nephrops*. Pink prawns and brown shrimp also occur in this area, but not in exploitable quantities. © Crown Copyright.

zone in water of normal or variable salinity and in areas exposed to water currents. They attach themselves using 'byssus threads' to sand, gravel or pebble substrata or other mussels and empty shells and have the effect of binding the substratum. The most important areas in the region for mussels are Lough Foyle (Briggs 1982, 1985), Belfast Lough, Dundrum Inner Bay and Carlingford Lough. Whelks are found mainly in Strangford Lough and around the southern shore of Belfast Lough. Periwinkles are present on rocky shores all around the Northern Ireland coast.

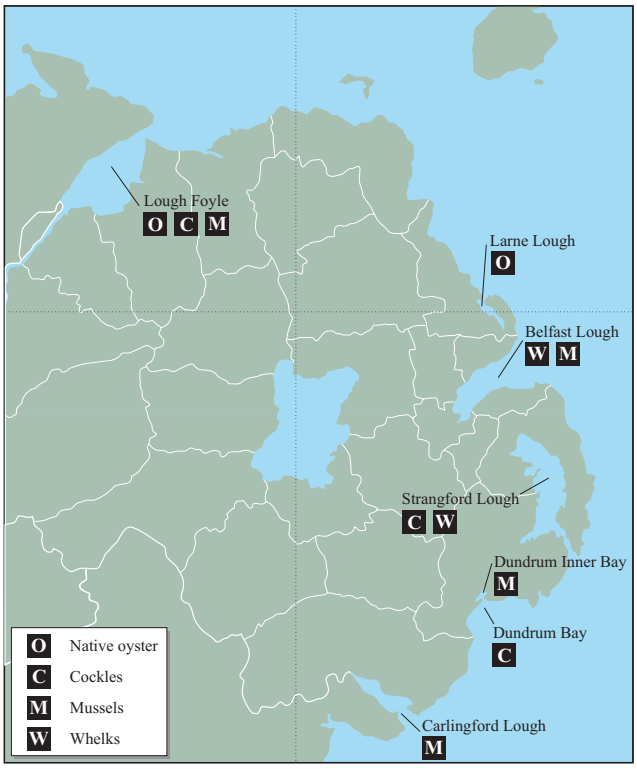
Scallops and queen scallops live on sandy/gravelly areas of sea bed. Scallops occur in water depths of 20-80 m around the coast from north of Larne to Carlingford Lough (Briggs 1980, 1992a; Stanley 1967) and within Strangford Lough. A small aggregation of scallops is also located off the north coast of the Province. Queen scallops occur off the coast east of Belfast Lough and within Strangford Lough. The broad-scale distributions of scallops and queen scallops are shown in Map 5.5.4.

Polychaetes

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

Others

The red alga known as dulse is a traditional crop, being cut from the 'stems' of kelp, on which it grows. Favoured collecting areas are the Strangford Bar Mouth and Narrows, Murlough Bay and Ballycastle. Farmers in the coastal region take some drift wrack and kelp for soil improvement, but there are currently no commercial seaweed harvesting operations in Northern Ireland.



Map 5.5.3 Main locations of cockles, mussels, native oysters and whelks. © Crown Copyright.

Map 5.5.4 Main locations of scallops and queen scallops. © Crown Copyright.

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 levels of exploitation, effects on the benthos, particularly of Strangford Lough (Service 1990; Magorrian *et al.* 1995), and competition between fisheries and other predators, such as birds.

There are no controls on fishing for either edible crabs or velvet crabs. The exploitation of *Nephrops* is regulated in ICES Area VII by the application of a catch quota management measure, with a precautionary Total Allowable Catch. *Nephrops* also has a minimum landing size of 20 mm carapace length, which underpins the minimum mesh size for trawl nets of 70 mm. Problems of excessive discarding of whiting from the *Nephrops* fishery have been reduced by the introduction of square mesh panels in trawl nets (Briggs 1992b). Scallop fishing in the Irish Sea is regulated by a minimum landing size of 110 mm shell length and a closed season from 1 June to 31 October.

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 also sections 5.11.3 and 5.12.3 and publications in section 5.5.6 B). In the substantial part of the coast under the control of the National Trust, byelaws prohibit bait digging and the collection of plants and shellfish, and these activities are also controlled under Areas of Special Scientific Interest management agreements. While much of the bait digging in Northern Ireland is on a small scale and for personal use, there are increasing concerns about the extent to which unauthorised commercial digging is taking place (National Trust pers. comm.; DoE (NI) pers. comm.) and the consequent damage to the ecology of the intertidal area. Bait collection in the region is described in section 9.1.2. In several areas the level of disturbance caused by periwinkle collecting has also become a cause for concern (DoE (NI) pers. comm.).

Collection of seaweed and other plants and animals from the foreshore and intertidal areas requires permission from the DoE (NI) Environment and Heritage Service and may be subject to regulation. Locally, traditional rights to collect seaweed are claimed and small-scale collecting for personal use is generally overlooked.

5.5.4 Information sources used

The four maps in this section show schematically the known broad-scale distributions of the main exploited species, based on current knowledge from Department of Agriculture for Northern Ireland (DANI) scientists and fishery officers on the location of the species and their fisheries. There is supporting information in the form of commercial landing statistics and biological samples of crustacea collected at local ports. These data provide some information about the location of spawning and nursery grounds, but further research is in progress on the planktonic stages, the hydrography (Hill *et al*. 1994; Gowen *et al*. 1995) and the distribution and movement of juveniles (DANI, unpublished data) to establish the links between individual spawning, nursery and recruitment areas. Barring substantial climate change or over-exploitation, these distributions and relationships are likely to remain stable over several decades. The seaward boundaries on maps are only indicative, and because only large, exploitable populations are described, the species may also be found elsewhere in the region, but in small numbers.

5.5.5 Acknowledgements

The author wishes to thank Mark McCaughan (DANI Fisheries Division) for helpful comments and additional material. Thanks also go to P.J.S. Boaden (Queens University Marine Station), Alan Kilgore (Newry and Mourne District Council), Jo Whatmough (National Trust), R.J. Bleakley (DoE (NI) Environment and Heritage Service) and Mark Tasker (JNCC) for comments on the draft. Relevant material written by G.H. Nevin (Ulster University School of Environmental Studies) was also incorporated in this section.

5.5.6 Further sources of information

A. References cited

Briggs, R.P. 1980. Shell morphology and growth in relation to minimum landing size of escallop, *Pecten maximus L.*, from Northern Ireland waters. *Record of Agricultural Research, 28*: 41-48.

Briggs, R.P. 1982. Community structure and growth of *Mytilus edulis L.* in Lough Foyle, Northern Ireland. *Proceedings of the Royal Irish Academy, 82B*: 245-259.

Briggs, R.P. 1985. Meat condition in relation to environmental factors of *Mytilus edulis L.* from Lough Foyle. *Journal of Life Sciences, 5:* 97-103.

Briggs, R.P. 1992a. A study of the Northern Ireland fishery for *Pecten maximus* (L.). *In: An international compendium of scallop biology and culture,* ed. by S.E. Shumway & P.A. Sandifer. USA, World Aquaculture Society, Louisiana State University. (World Aquaculture Workshops, No. 1.)

Briggs, R.P. 1992b. An assessment of nets with a square mesh panel as a whiting conservation tool in the Irish Sea *Nephrops* fishery. *Fisheries Research, 13*: 133-152.

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.

Gowen, R.J., Stewart, B.M., Mills, D.K., & Elliott, P. 1995. Regional differences in stratification and its effects on phytoplankton production and biomass in north-western Irish Sea. *Journal of Plankton Research, 17*(4): 753-769.

Hill, A.E., Durazo, R., & Smeed, D.A. 1994. Observations of a cyclonic gyre in the western Irish Sea. *Continental Shelf Research, 14:* 479-490.

Magorrian, B.H., Service, M., & Clarke, W. 1995. An acoustic bottom classification survey of Strangford Lough, Northern Ireland. *Journal of the Marine Biological Association of the UK, 75*: 987-992.

Service, M. 1990. *The impact of commercial trawling on the benthos of Strangford Lough*. Belfast, Department of Economic Development, T1/3160/90. (Interim Report.)

Stanley, C.A. 1967. *The commercial scallop* Pecten maximus *(L.) in Northern Ireland waters*. PhD. Thesis, Queen's University of Belfast.

B. Further reading

Briggs, R.P. 1985. Catch composition in the Northern Ireland *Nephrops* fishery. *Fisheries Research, 3:* 47-60.

Briggs, R.P. 1994. The Northern Ireland prawn fishery. *Agriculture in Northern Ireland, 8*(9): 18.

Briggs, R.P. 1995. *A review of scallop research on the Northern Ireland scallop stocks*. Cork, University College. (Proceedings of the 10th International Pectinid Workshop.)

Briggs R.P. 1995. Variability in North-west Irish Sea *Nephrops*. *Fisheries Research, 23*: 175-187.

Clark, P.F. 1986. *North-east Atlantic crabs; an atlas of distribution.* Ross-on-Wye, Marine Conservation Society.

Cryer, M., Whittle, G.N., & Williams, R. 1987. The impact of bait collection by anglers on marine intertidal invertebrates. *Biological Conservation, 42:* 83-93.

Eno, N.C., *ed.* 1991. *Marine conservation handbook.* 2nd ed. Peterborough, Joint Nature Conservation Committee.

Huggett, D. 1992. *Foreshore fishing for shellfish and bait.* Sandy, Royal Society for the Protection of Birds.

Huggett, D. Undated. *Coastal zone management and bait digging. A review of potential conflicts with nature conservation interest, legal issues and some available regulatory mechanisms*. Sandy, Royal Society for the Protection of Birds.

McLusky, D.S., Anderson, F.E., & Wolfe-Murphy, S. 1983. Distribution and population recovery of *Arenicola marina* and other benthic fauna after bait digging. *Marine Ecology (Progress Series), 11*: 173-179.

Olive, P.J.W. 1993. Management of the exploitation of the lugworm *Arenicola marina* and the ragworm *Nereis virens* (Polychaeta) in conservation areas. *Aquatic Conservation: Marine and Freshwater Ecosytems, 3*: 1-24.

Seaward, D.R. 1990. *Distribution of the marine molluscs of north-west Europe*. Peterborough, Nature Conservancy Council, for Conchological Society of Great Britain and Ireland.

Seaward, D.R. 1993. Additions and amendments to the *Distribution of the marine molluscs of north-west Europe* (1990). *Joint Nature Conservation Committee Report*, No. 165.

Watson, P.S. 1974. *The Northern Ireland lobster fishery 1954-1974*. Copenhagen, International Council for the Exploration of the Sea. (C.M. Papers and Reports, No. C.M. 1974/K:19.)

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Shellfish stocks and fisheries advice to assist with management and policy decisions for coastal zone	*DANI Fisheries Division, Belfast, tel: 01232 520100
Assessment and provision of advice on the conservation of commercial shellfish stocks; benthic surveys/databases and research	*DANI Agricultural and Environmental Science Division, Belfast, tel: 01232 250666
Marine conservation issues and fisheries	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477
Benthic surveys; Marine Nature Conservation Review database	*Marine Nature Conservation Review, JNCC, Peterborough, tel: 01733 62626
Marine conservation and issues	*Conservation Officer, RSPB, Belfast, tel: 01232 491547
Marine conservation and issues	*Fisheries Officer, Marine Section, WWF-UK, Godalming, tel: 01483 426444
Marine conservation and issues	*Conservation Officer, Marine Conservation Society, Ross-on-Wye, tel: 01989 566017

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

5.6 Amphibians and reptiles

Prof. W.I. Montgomery

5.6.1 Introduction

There are just two amphibian and one terrestrial reptile species known to occur in the coastal zone of Northern Ireland: respectively the common frog *Rana temporaria* and smooth newt *Triturus vulgaris*, and the common lizard *Lacerta vivipara*. Praeger (1969), the dominant figure in Irish natural history during the first half of the 20th century, discusses the origin of the frog in Ireland, concluding that it is of dubious origin, with a number of authors prior to the 17th century noting its absence and subsequent introduction in several localities. Other data suggest its presence in pre-history. Both smooth newt and common lizard are accepted as native to Ireland, a status they share with the natterjack toad *Bufo calamita*, which is restricted to the extreme south-west of the island. There are occasional records of turtles off the coast.

The poor amphibian and terrestrial reptile fauna of Ireland as a whole may reflect the fact that, after the last Ice Age, terrestrial links with Britain were submerged earlier than those between Britain and continental Europe. As a consequence, only species tolerant of more northerly, colder conditions, such as the smooth newt and common lizard, entered Ireland, and species requiring higher mean temperatures were unable to recolonise. The cooler, less sunny conditions prevailing in Ireland may also have prohibited successful colonisation by reptiles and amphibians. In Britain several species are found only in coastal areas enjoying higher temperatures and incidence of sunny days.

The common lizard and smooth newt are protected under Schedule 5 of The Wildlife (NI) Order 1985.

5.6.2 Important locations and species

There is a large area of habitat that could be considered ideal for reptiles and amphibians in Northern Ireland, including a number of dune systems, heathland, grassland, ponds, drains and ditches, and thinly vegetated rock. Important locations for amphibian and terrestrial reptile species and other locations mentioned in the text are shown on Map 5.6.1.

The common frog is frequently encountered in wetlands, bogs and marshes and is probably under-recorded because it is ubiquitous. In Region 17 it may be found in man-made drains, temporary ponds and ditches, but it avoids saline or brackish waters. The number of common frogs in Ireland is regarded as internationally important (Whilde 1993): this species, like so many other amphibians, is considered under threat in much of the rest of Europe.

The smooth newt and common lizard are less frequently seen, probably being recorded only where they have been sought out, and hence have very patchy known distributions. The smooth newt is widespread but not common. In a limited survey of randomly chosen sites in Northern Ireland (Marnell 1993), the smooth newt was found at Lough Foyle, Magilligan Point and Magilligan Strand, Portrush, Belfast City Airport, Crawfordsburn Country Park, Cloghy and Dundrum (Marnell 1993).

Map 5.6.1 Important locations for amphibians and reptiles in the region and other locations mentioned in the text.

It is also known from Castlerock Dunes and Articlave in Co. Londonderry and from Glastry, Portaferry, Mount Stewart and Murlough in Co. Down. The common lizard is also regarded as widespread but uncommon in the coastal zone of Northern Ireland, being recorded around Lough Foyle, Magilligan Strand, along the Antrim coast at Fair Head, at Glenstaghey in the Belfast area, around Scrabo north of Strangford Lough and at Ballykinler, Murlough (N)NR and Bloody Bridge River in south Down.

5.6.3 Human activities

All three species occurring in the region are vulnerable to habitat change associated with urbanisation and development of recreational facilities such as golf courses. Coastal engineering works associated with road construction and land improvement for agriculture also affect habitat quality for amphibians and reptiles. The under-recording of these species and their secretive and highly seasonal habits make them vulnerable to local developments simply because their presence is unknown and unsuspected. Dune habitats are generally protected in Northern Ireland, although accidental fires and deliberate misuse by, for example, off-road vehicles, puts many of these important wildlife areas at risk of further degradation. Natural and semi-natural coastal freshwater ponds used by common frogs and smooth newts are rare in Northern Ireland and any loss of this habitat may present a risk to these species in the coastal zone.

5.6.4 Information sources used

Amphibians and reptiles are not well recorded for Northern Ireland and all three species occurring are likely to be more numerous and widespread in the coastal zone than present data suggest. Data in Ni Lamhna (1979) and Whilde (1993) are based on more casual records accumulated over long periods of time and must be regarded as far from complete or recent. Marnell (1993) completed a survey of smooth newts in Northern Ireland visiting randomly selected sites. These records, however, indicate coastal locations likely to support important species of amphibians and reptiles.

5.6.5 Acknowledgements

Thanks go to S. Gibson and M. Tasker (JNCC), Dr D. McFerran (Centre for Environmental Data and Recording (CEDaR)) and Dr D.G. Erwin for comments on drafts of the text.

5.6.6 Further sources of information

A. References cited

Marnell, F. 1993. *The distribution and habitat of the smooth newt* (Triturus vulgaris L.) *in Northern Ireland.* Dublin, Trinity College. (Report to the Department of the Environment (Northern Ireland).)

Ni Lamhna, E. 1979. *Provisional distribution atlas of amphibians, reptiles and mammals in Ireland.* 2nd ed. Dublin, Irish Biological Records Centre, An Foras Forbartha.

Praeger, R.L. 1969. *The way that I went*. Dublin, Riverrun, Allen Figgis & Co. Ltd.

Whilde, A. 1993. *Threatened mammals, birds, amphibians and fish in Ireland. Irish Red Data Book 2: Vertebrates.* Belfast, HMSO.

B. Further reading

Arnold, H.R., *ed*. 1983. *Distribution maps of the amphibians and reptiles of the British Isles*. Huntingdon, Biological Records Centre, Monks Wood.

Arnold, H.R., *ed.* In prep. *Atlas of amphibians and reptiles in Britain and Ireland.* Huntingdon, Biological Records Centre, Monks Wood.

British Herpetological Society. 1990. *Garden ponds as amphibian sanctuaries.* London, British Herpetological Society. (Advice sheet.)

British Herpetological Society. 1990. *Save our reptiles.* London, British Herpetological Society. (Advice sheet.)

British Herpetological Society. 1990. *Surveying for amphibians.* London, British Herpetological Society. (Advice sheet.)

Brongersma, L.D. 1972. *European Atlantic turtles*. Leiden, Rijksmuseum van Natuurlijke Historie.

Corbett, K.S. 1990. *Conservation of European reptiles and amphibians*. London, Christopher Helm.

Mallinson, J.J. 1990. Turtle rescue. *Marine Conservation, Winter 1990/91*: 8-9.

Nature Conservancy Council. 1990. *The turtle code.* Peterborough, Nature Conservancy Council. (Advice sheet.)

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Conservation and captive breeding of amphibians and reptiles, nationally	The British Herpetological Society, c/o The Zoological Society of London, Regent's Park, London NW1 4RY, tel: 0181 452 9578
Site and species information	*Centre for Environmental Data and Recording (CEDaR), The Ulster Museum, Belfast, tel: 01232 383000
Site and species information	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477
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 Coordinator, 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, Abbots Ripton, Huntingdon, Cambridgeshire PE17 2LS, tel: 01487 773381
Turtles	Dr Colin McCarthy, Natural History Museum, Cromwell Road, London SW7 5BD, tel: 0171 938 9123

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

5.7 Fish: exploited sea fish

Dr M.J. Armstrong & Dr M. Dickey-Collas

5.7.1 Introduction

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

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; Maps 5.7.1 - 5.7.7 show the known spawning areas 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.

Map 5.7.1 Herring spawning area. Sources: Bowers (1980), Lee & Ramster (1980) and DANI. © Crown copyright.

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

5.7.2 Important locations and species

Of the pelagic species, mackerel is widely distributed around Britain and is present in the seas off the region.

Map 5.7.2 Herring nursery areas. Source: DANI. © Crown copyright.

Map 5.7.3 Cod spawning and nursery areas. Sources: Brander (1975), Nichols *et al.* (1993) and DANI. © Crown copyright.

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

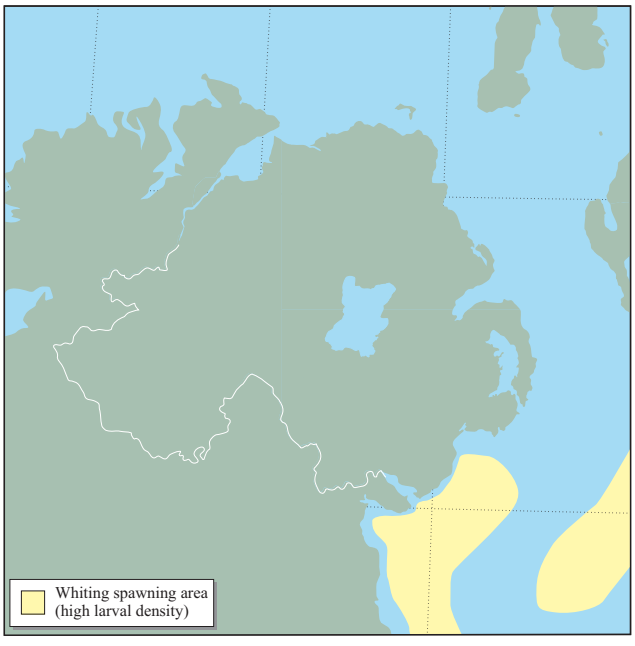
Species	*Protection measures*
Pelagic species	
Mackerel *Scomber scombrus*	MLS/QM
Horse mackerel *Trachurus trachurus*	MLS/QM
Herring *Clupea harengus*	MLS
Sprat *Sprattus sprattus*	No limitation
Demersal species	
Elasmobranchs	
Spurdog *Squalus acanthias*	No limitation
Thornback ray *Raja clavata*	No limitation
Homelyn ray *Raja brachyra*	No limitation
Cuckoo ray *Raja naevus*	No limitation
Gadoids	
Cod *Gadus morhua*	MLS/QM
Haddock *Melanogrammus aeglefinus*	MLS/QM
Whiting *Merlangius merlangus*	MLS/QM
Ling *Molva molva*	No limitation
Pollack *Pollachius pollachius*	MLS/QM
Saithe *Pollachius virens*	MLS/QM
Hake *Merluccius merluccius*	MLS/QM
Flatfish	
Plaice *Pleuronectes platessa*	MLS/QM
Dab *Limanda limanda*	MLS
Long rough dab *Hippoglossoides platessoides*	No limitation
Dover sole *Solea solea*	MLS/QM
Lemon sole *Microstomus kitt*	MLS
Turbot *Psetta maxima*	MLS
Brill *Scophthalmus rhombus*	MLS
Flounder *Platichthys flesus*	MLS
Witch *Glyptocephalus cynoglossus*	MLS
Other demersal fish	
Monkfish (angler) *Lophius piscatorius*	QM
Conger eel *Conger conger*	MLS

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

Mackerel spawn throughout the shelf waters of the British Isles, but most prolifically along the edge of the continental shelf, from February to July. Growing juveniles and adults migrate to coastal waters after spawning, where they remain until autumn. Overwintering concentrations are found west of Scotland, west of Ireland and off Cornwall, but not adjacent to this region. Herring is the most important exploited pelagic species in the region and is locally much more abundant than mackerel. The main herring spawning area is off the Mourne coast around Kilkeel (Map 5.7.1). In this area and further north the adult herring congregate in September and October. Most spawning occurs in autumn, although some can take place as late as spring (Anon 1994). Juvenile herring are found widely distributed in nursery areas off the eastern coast of Northern Ireland, particularly over muddy sea bed and off the Mourne coast (Map 5.7.2). Sprat are widely dispersed throughout the region and their egg and larval area of distribution covers the whole region. Juvenile sprat are found mixed with juvenile herring (whitebait) in the herring nursery areas.

Elasmobranch species produce relatively small numbers of live young (10-100 per year, but can be fewer in big sharks) or eggs laid on the sea bed close to their nursery areas. Several species of shark occur sporadically during their summer migrations off the west coast of Ireland, but only the spurdog is found regularly in sufficient abundance to support a directed fishery. Spurdog move in large packs following schools of pelagic fish and have been found in large concentrations in regions such as Carlingford Lough. Rays, such as the thornback ray, homelyn ray and the cuckoo ray, are more abundant in the shallow sandy and gravelly areas of the Irish Sea, particularly on the banks off the coast of Ireland and in the shallow areas between the Isle of Man and Wales (DANI unpublished survey data; Fahy 1991), but over time, like the common skate (which has now disappeared from this region), they have become less abundant.

Of the gadoids, cod are widely distributed in the region during the summer. Cod from the north and south of the Irish Sea congregate during February and March in a



Map 5.7.4 Whiting spawning areas. Sources: after Nichols *et al.* (1993) and DANI. © Crown copyright.

Map 5.7.5 Whiting nursery areas. Source: DANI. © Crown copyright.

spawning area in deep water off the Mourne coast (Map 5.7.3). Tagging studies have shown that cod may migrate to this spawning area from as far afield as the Celtic Sea off the Republic of Ireland (Brander 1975). Juvenile cod are found to the south of the spawning area and further north, east of Belfast Lough (Map 5.7.3).

Whiting spawn later in the year than cod, starting in March and continuing until June. There is a recognised spawning area in the region for whiting (Map 5.7.4), but, unlike cod, whiting do not show clear migrations to this area. A whiting nursery area is located in the coastal region off the eastern Irish coast (Map 5.7.5). Trawling surveys show that for much of the year adult whiting are most abundant in waters between the Province and the Isle of Man, although also occurring in the rest of the north-eastern Irish Sea,. The stock of haddock in the Irish Sea has grown substantially following strong recruitment of fish spawned in 1991. As yet there is no evidence of a substantial spawning by haddock in the Irish Sea since then. Juvenile, and adult, haddock are most abundant off Dundrum Bay (Map 5.7.6). Hake (not strictly a gadoid) is present mainly in the North Channel and to a lesser extent east of the Province. The Irish Sea stock is considered an offshoot of the larger northern hake stock, which occurs mainly in deeper water along the western seaboard of the British Isles. Ling, pollack and saithe (coley) are found mainly near reefs and wrecks, although they are also found over more open ground.

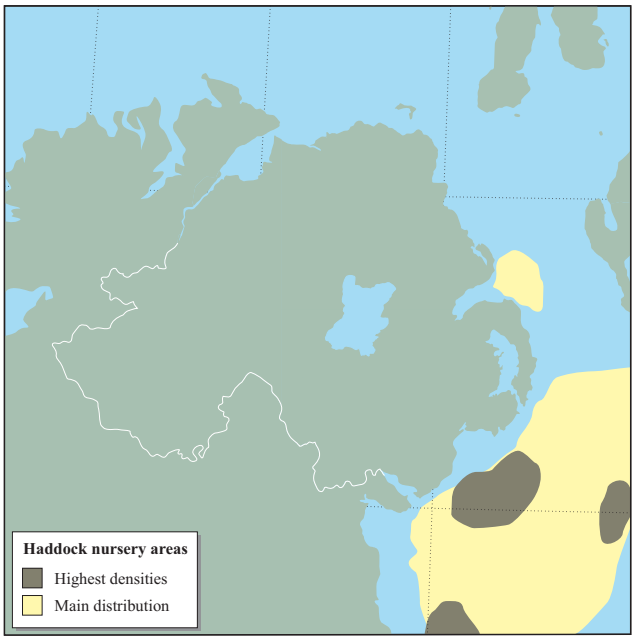
Plaice and dab are the most abundant flatfish species in the region: much more is known about the life history of the exploited plaice than the dab. These species occur on sandy areas of sea bed throughout the region but are most common in the south of the region. The distribution of plaice spawning grounds from Dundrum Bay south into the Republic of Ireland waters shows their preference for shallow, sandy areas, with important nursery areas occurring further inshore than the spawning areas (Map 5.7.7). In deeper waters the flatfish community becomes dominated by small species, such as witch and long rough dab, which favour muddy sea beds. Dover sole, which has a similar lifestyle to plaice and dab, is present in the region, although the spawning grounds are found outside the region in the eastern Irish Sea. Turbot and brill, which are much less abundant than plaice, dab and Dover sole but have a similar lifestyle, are found inshore in sandy areas such as Dundrum Bay. None of the flatfish species exhibits extensive migrations, though their larvae can drift for several weeks from offshore spawning grounds to inshore nursery areas. There may be some interchange, either way, between spawning stocks and nursery grounds in this and adjacent regions. In contrast, a more local distribution is recorded for the lemon sole, with an apparently discrete population occurring in the northern Irish Sea. In spring, flounders migrate from inshore, estuarine and even riverine nursery areas all along the coast of the region to spawn, mainly in Liverpool Bay and the Solway Firth (Region 13) but with smaller numbers recorded off the Irish coast. Flounders rarely migrate up or down the coast other than in the egg or larval phase.

Monkfish (angler) spawn in deep water along the edge of the continental shelf, but juveniles and non-spawning adults are found in the Irish Sea. Monkfish are most commonly found on the muddy sea bed between Ireland and the Isle of Man, but are also found in inshore regions including along the Ards Peninsula. Another demersal species of importance in the region is the conger eel.

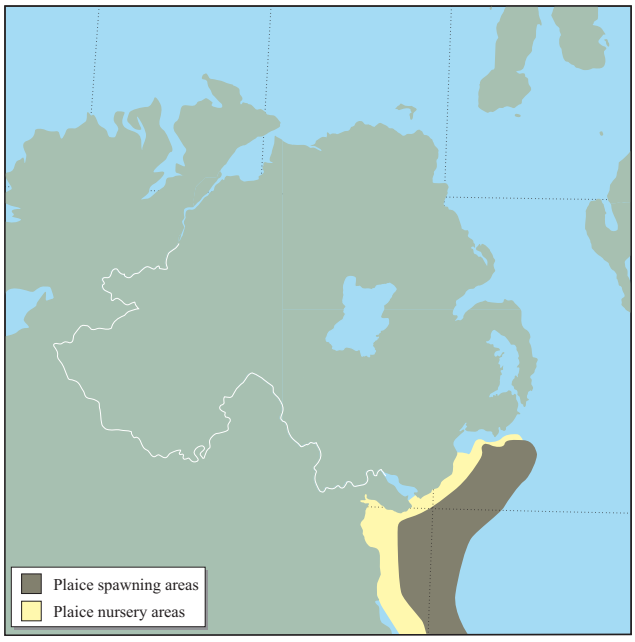
5.7.3 Human activities

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.

The Irish Sea is intensively fished and efforts are being made to conserve stocks of pelagic and demersal species by implementing a variety of management measures,



Map 5.7.6 Haddock nursery areas. Source: DANI. © Crown copyright.



Map 5.7.7 Plaice spawning and nursery areas. Sources: Norton & Geffen (1990), Nichols *et al.* (1993). © Crown copyright.

including: minimum landing sizes (MLS), minimum mesh size regulations, gear restrictions, bycatch restrictions, closed fishing areas and seasons for herring (Anon 1994) 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 9.1.3). Two such protection measures are shown in Table 5.7.1: MLS and catch quota management (QM). QM indicates that the UK has been allocated a TAC in one or more of the two ICES Divisions that cover Region 17 - Division VIa (West of Scotland) and Division VIIa (Irish Sea). TAC implementation means that fish caught below MLS or for which the quota is exhausted must be discarded at sea, and this may affect the exploited species fish stocks, as well as other fish species, birds and species that live on the sea bed. In order to reduce the bycatch of juvenile fish, square mesh panels have also been introduced; for example when fishing for *Nephrops*, a section of 80 mm square mesh panelling is now incorporated near to the cod end of nets, with a cod end mesh size of 70 mm.

The demersal fishery in the north-western Irish Sea is one of the most intensive on the European continental shelf and is likely to have caused considerable change to the structure of the fish communities. It has been estimated that some 60-70% of the adult cod and whiting alive at the beginning of each year will have been caught before the end of it (Anon 1995). Under such pressure, some species have been depleted to very low levels. Most vulnerable have been the elasmobranchs, since they have no protected status, take a relatively long time to reach reproductive maturity and produce only small numbers of young. For example, the common skate *Raja batis* was once abundant in the north-western Irish Sea and Strangford Lough but has been absent from catches there in recent years (Brander 1981). In contrast, herring are only lightly exploited at present and are protected (except as the target of the Mourne drift net fishery) by a seasonal (21 September to 31 December) prohibition in an area off the Mourne coast. The status of some ray species is currently subject to research through a European Union-sponsored project, coordinated by the Centre for Environment, Fisheries and Aquaculture Sciences (CEFAS) (formerly MAFF Directorate of Fisheries Research), Conwy, and the North Wales and North Western Sea Fisheries Committee.

Cetaceans compete with fisheries for their common food resource and are prone to accidental capture in fishing gear. The use of monofilament gill nets is prohibited in the region, as it can result in the accidental capture of seals, cetaceans and seabirds.

Spawning and nursery areas may be vulnerable to activities such as sewage sludge disposal, dredging and dredged material disposal (see also section 9.4) and the development of infrastructure such as barrages and pipelines (see also section 8.3). DANI 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. Sewage sludge disposal occurs in many parts of the Irish Sea, sometimes near important nursery and spawning areas for cod and sole. Test drilling for hydrocarbons has also occurred in recent years in the vicinity of the *Nephrops* ground and herring spawning grounds (see also section 9.5). Communication, electricity cables and gas pipelines have been laid across the Irish Sea, in places passing through gadoid and flatfish nursery grounds. Other activities, such as sea angling (see section 9.1.2) and seismic activity for oil and gas exploration (Turnpenny & Nedwell 1994) (see also section 9.5), may also have an effect on fish populations.

5.7.4 Information sources used

Whereas the life history of the exploited crustacean 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. The distribution patterns described in this section are based on published accounts (Norton & Geffen 1990; Nichols *et al*. 1993). Further information has come from research surveys into the fisheries, plankton and oceanography of the Irish Sea carried out by the Department of Agriculture for Northern Ireland (DANI) in September 1994 and 1995.

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

5.7.5 Acknowledgements

Thanks go to Mark Tasker (JNCC) for comments on the draft.

5.7.6 Further sources of information

A. References cited

Anon. 1994. *Report of the study group on herring assessment and biology in the Irish Sea and adjacent waters*. Copenhagen, International Council for the Exploration of the Sea. (Council Meeting ICES C.M. 1994/H:5.)

Anon. 1995. *Report of the Working Group on the assessment of Northern shelf demersal stocks*. Copenhagen, International Council for the Exploration of the Sea. (Council Meeting ICES C.M. 1994/Assess 1.)

Bowers, A.B. 1980. The Manx herring stock, 1948-1976. *Raports et Proces-verbaux des Reunions. Conseil Permanent International pour l'Exploration de la Mer, 177:* 166-174.

Brander, K.M. 1975. *Population dynamics and biology of cod* (Gadus morhua L.) *in the Irish Sea*. PhD thesis, University of East Anglia.

Brander, K.M. 1981. Disappearance of common skate *Raja batis* from Irish Sea. *Nature, 290:* 48-49.

European Council. 1986. EC Regulation No. 3094/86 (as amended). *Official Journal of the European Communities, L288* (29).

European Council. 1995. EC Regulation No. 3074/95. *Official Journal of the European Communities, L330* (38).

Fahy, E. 1991. The south eastern *Raja* spp. fishery, with observations on the growth of rays in Irish waters and their commercial grading. *Irish Fisheries Investigations Series B*, No. 37.

Lee, A.J., & Ramster, J.W. 1981. *Atlas of the seas around the British Isles*. Lowestoft, MAFF.

Nichols, J. H., Haynes, G.M., Fox, C.J., Milligan, S.P., Brander, K.M., & Chapman, R.J. 1993. *Spring plankton surveys of the Irish sea in 1982, 1985, 1987, 1988, and 1989: hydrography and distribution of fish eggs and larvae.* Lowestoft, MAFF Directorate of Fisheries Research. (Fisheries Research Technical Report, No. 95.)

Norton, T.A., & Geffen, A.J. 1990. *Exploitable living resources.* Liverpool, Liverpool University Press. (Irish Sea Study Group Report, Part 3.)

Pawson, M.G. 1995. *Biogeographical identification of English Channel fish and shellfish stocks.* Lowestoft, Ministry of Agriculture, Fisheries & Food, Fisheries Laboratory. (Fisheries Research Technical Report, No. 99.)

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

B. Further reading

Earll, R.C., *ed.* 1992. *Shark, skate and ray workshop.* Ross-on-Wye, Marine Conservation Society for Joint Nature Conservation Committee.

Fahy, E., & Fannon, E. 1991. The exploitation of megrim *Lepidorhombus whiffiagonis* by the Irish demersal fleet. *Irish Fisheries Investigations, Series B (Marine)*, No. 38.

Rogers, S.I. 1992. Environmental factors affecting the distribution of sole (*Solea solea* (L.)) within a nursery area. *Netherlands Journal of Sea Research, 29*(1-3)*:* 153-161.

Rogers, S.I. 1993. The dispersion of sole *Solea solea* and plaice *Pleuronectes platessa* within and away from a nursery ground in the Irish Sea. *Journal of Fish Biology, 43* (Supplement A): 275-288.

Vas, P. 1995. The status and conservation of sharks in Britain. *Aquatic Conservation: Marine and Freshwater Ecosystems, 5*: 67-79.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Fish stocks and fisheries advice to assist with management and policy decisions for coastal zone	*DANI Fisheries Division, Belfast, tel: 01232 520100
Assessment and provision of advice on the conservation of commercial fish and shellfish stocks	*DANI Agricultural and Environmental Science Division, Belfast, tel: 01232 250666
Marine conservation issues and fisheries	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477
UKDMAP software with maps showing distributions of selected sea fish species and spawning areas	*Project Manager, BODC, Birkenhead, tel: 0151 653 8633
Marine Nature Conservation Review database	*Marine Nature Conservation Review, JNCC, Peterborough, tel: 01733 62626
Marine conservation issues	*Conservation Officer, RSPB, Belfast, tel: 01232 491547
Marine conservation issues	*Fisheries Officer, Marine Section, WWF-UK, Godalming, tel: 01483 426444
Marine conservation issues	*Conservation Officer, Marine Conservation Society, Ross-on-Wye, tel: 01989 566017

*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 UK waters and have been recorded in rivers in this region. (Twaite shad *Alosa fallax* 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 the rivers and coastal seas of the UK, including Northern Ireland. 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. Sea trout generally have a westerly distribution in the UK. The rivers shown on Map 5.8.1 are the main ones in Northern Ireland (or that flow out of the Province) that are known to contain populations of salmon and sea trout. It is highly likely that smaller rivers and tributaries not shown on the map also contain populations. Eels are probably found in all river systems in the province, as elsewhere in the UK, but probably in greatest numbers in Lough Erne and Lough Neagh, where commercial fishing licences to catch eels are issued (see also section 9.1).

5.8.3 Human activities

Under the provisions of the Fisheries Act (NI) 1966, the Foyle Fisheries Commission (FFC) and the Fisheries Conservancy Board for Northern Ireland (FCB) co-operate with the Department of Agriculture for Northern Ireland (DANI) in the development and improvement of fisheries. The FCB acts as a conservator and issues fishing licences for the area of Northern Ireland not covered by the FFC. The FFC and FCB issue fishing licences, and a restrictive drift net fishery and

Map 5.8.1 Salmon and sea trout rivers. Sources: DANI (1991), Foyle Fisheries Commission (1994), Fisheries Conservancy Board (1995), Northern Regions Fisheries Board (1995), Orton (1996). © Crown Copyright.

fixed net fishery is administered by the two organisations, whose bailiffs also protect salmon and sea trout within estuarine waters. As a result, in recent years there has been a dramatic improvement in the quantity and quality of fishing. DANI's Rivers Agency is also actively engaged in the improvement of fisheries in watercourses under its control. Works include the construction of weirs, groynes and deflectors, restoration of gravel, landscaping of altered watercourses and tree-planting schemes. Salmon re-stocking takes place in the Province, mainly from stocks from the DANI fish farm at Movanagher. Salmon have recently started returning to the River Lagan following experimental stocking.

Maitland & Campbell (1992) describe the possible effects of a variety of factors on freshwater fish. Issues mentioned of relevance in the region include the possible effects of industrial and domestic pollution on the populations of diadromous fish. The movement of adult fish may be restricted by developments such as hydro-electric power stations, which can also cause death or damage to juveniles. As a requirement of the 'Non-Fossil Fuel Obligation', a significant number of these power stations are planned, with some already in place on rivers. Developments such as drainage schemes and canalisation of rivers can affect the habitat and water quality. For example, much of the Blackwater river system was subject to major drainage works in the 1980s, with consequent declines in fish stocks. Recently, extensive measures have been taken to rehabilitate the stocks and the fishery by habitat restoration and re-stocking.

The effects of exploitation, especially by different catch methods (rod-and-line or nets), is an issue for salmon and sea trout stocks. The use of drift nets to target sea fish close to the coast and in estuaries is a potential barrier to migrating salmonids, as is the use of coastal fixed nets. As well as rod-and-line, many different types of nets are licensed for use in many of the region's rivers and coastal seas (see section 9.1.2). A conflict of interest often arises between rod-and-line fishermen and net fishermen.

5.8.4 Information sources used

The *Rivers of Northern Ireland* map (DANI 1991), the list of rivers for which salmonid catch information exists (Foyle Fisheries Commission 1994; Fisheries Conservancy Board 1995), maps from the Northern Regions Fisheries Board (1995) publication and *Where to fish fishing map of Great Britain and Ireland* (Orton 1996) were used as a basis for this section and Map 5.8.1.

5.8.5 Acknowledgements

Thanks are due to R.J. Bleakley (DoE (NI) Environment and Heritage Service), Brian Murphy (DANI Environmental Policy Division), Alan Kilgore (Newry and Mourne District Council) and Mark Tasker (JNCC) for their useful comments.

5.8.6 Further sources of information

A. References cited

Department of Agriculture for Northern Ireland. 1991. *Rivers of Northern Ireland*. Belfast, Department of Agriculture for Northern Ireland. (DANI Watercourse Management Division.)

Fisheries Conservancy Board. 1995. *The Fisheries Conservancy Board Annual Report for the year ending 31st December, 1994*. Craigavon, Fisheries Conservancy Board for Northern Ireland.

Foyle Fisheries Commission. 1994. *The Foyle Fisheries Commission Annual Report for 1993*. Londonderry, Foyle Fisheries Commission.

Jones, J.W. 1959. *The salmon*. London, Collins.

Maitland, P.S., & Campbell, R.N. 1992. *Freshwater fishes of the British Isles*. London, Harper Collins. (New Naturalist series.)

Mills, D.H. 1971. *Salmon and trout: a resource, its ecology, conservation and management*. Edinburgh, Oliver and Boyd.

Mills, D.H. 1989. *Ecology and management of Atlantic salmon*. London, Chapman and Hall.

Moriarty, C. 1978. *Eels*. Newton Abbot, David and Charles.

Northern Regions Fisheries Board. 1995. *Angling over the border in Ireland*. Ballyshannon, Northern Regions Fisheries Board.

Orton, D.A., *ed.* 1996. *Where to fish fishing map of Great Britain and Ireland*. Beaminster, Thomas Harmsworth.

Shearer, W.M. 1992. *The Atlantic salmon: natural history, exploitation and future management*. Oxford, Blackwell Scientific.

Sinha, V.R.P., & Jones, J.W. 1975. *The European freshwater eel*. Liverpool, University of Liverpool Press.

Tesch, F.W. 1977. *The eel: biology and management of Anguillid eels*. London, Chapman and Hall.

B. Further reading

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 Agriculture for Northern Ireland. 1992. *Report of policy review group on provision of public angling in Northern Ireland*. Belfast, Department of Agriculture for Northern Ireland.

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

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

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Regional scientific information and advice	*Foyle Fisheries Commission, Londonderry, tel: 01504 42100
Regional scientific information and advice	*Fisheries Conservancy Board for Northern Ireland, Portadown, tel: 01762 334666
Regional scientific information and advice	*DANI Rivers Agency, Belfast, tel: 01232 253355
Regional scientific information and advice	*DANI Fisheries Division, Belfast, tel: 01232 522373
Conservation of wild salmon; salmonid research	Director, The Atlantic Salmon Trust, Moulin, Pitlochry PH16 5JQ, tel: 01796 473439
Inter-government convention regulating salmon fishing on the high seas	Secretary, North Atlantic Salmon Conservation Organisation, 11 Rutland Square, Edinburgh EH1 2AS, tel: 0131 228 2551

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

5.9 Fish: other species

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

5.9.1 Introduction

The major marine habitat types and species of fish associated with them have been identified in a series of 'ecotypes' including estuarine, littoral, sublittoral, offshore habitats and specialist habitats (symbiotic and other relationships) (Potts & Swaby 1993b). These are further divided by substrate type: mud, sand, gravel and particulate substrate, bedrock or boulders (reef), and water column. This classification provides a structure for identifying and classifying fish/habitat associations. Many fish show complex life-styles and habitat requirements, and many occupy several habitats during different phases of their life-cycles. There is no specific list of marine and estuarine fish for Northern Ireland, although inshore fishes are listed in Erwin *et al.* (1990) and others are included in the larger works on Irish fish by Thompson (1856), Ogilby (1885) and Went & Kennedy (1969). The current list of species recorded in the region is relatively diverse and stands at 142 species including three jawless fish (Agnatha), 22 sharks and rays (elasmobranchs) and 117 bony fish (teleosts).

This region has records of all seven UK marine and estuarine species protected under European and international legislation (Table 5.9.1). However, these have mostly been individual records of allis and twaite shads *Alosa alosa* and *A. fallax*, river lamprey (lampern) *Lampetra fluviatilis*, sea lamprey *Petromyzon marinus* and very occasional sturgeon *Acipenser sturio*. These species are considered threatened in UK and European waters (Potts & Swaby 1993a). The lampreys and both shads are listed in the Irish vertebrates Red Data Book (Whilde 1993).

Table 5.9.1 Scheduled species and protected status

Species	*EC Habitats & Species Directive (Annex)*	*Bern Convention (Appendix)*	*CITES (Appendix)*
River lamprey	IIa, Va	III	
Sea lamprey	IIa	III	
Sturgeon	IIa, Va	III	I
Allis shad	IIa, Va	III	
Twaite shad	IIa, Va	III	
Common goby*		III	
Sand goby*		III	

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

5.9.2 Important locations and species

The river lamprey was recorded by Thompson (1856) as "found from north to south of the island". He observed specimens at a location near Belfast and examined specimens taken in southern Ireland. Went & Kennedy (1969) do not give details of any captures of river lamprey, but they do list it as "scarce". There have been no recent records of river lamprey in the region and the current status of this species is unknown.

Thompson (1856) recorded the sea lamprey as "taken in suitable localities in all quarters of the island". He also reports the capture of four, in 1851, in a river near Newcastle, Co. Down, the largest of which was 28 cm long. Ogilby (1885) described the sea lamprey as "common" in the Foyle, and stated that specimens are "invariably thrown away". Went & Kennedy (1969) state that sea lampreys are "common", but give no further details of populations in Northern Ireland. The current status of the sea lamprey in Northern Irish waters is unknown; there are more recent records of its capture in the Republic of Ireland.

The sturgeon is recorded as "occasional" in this region by Thompson (1856), Ogilby (1885), Williams (1954) and Went & Kennedy (1956). Thompson (1856) mentions three specimens, two brought into Belfast market, caught in 1839 and 1846, and one stranded at Belfast, close to the Co. Down railway station, in 1849. He records that captures of sturgeon were made from Cushendall, Dundrum and southern Ireland, but gives no details regarding dates or specific locations. Ogilby (1885) relates that about a dozen sturgeon were caught annually in the salmon nets in the Foyle Estuary and that a specimen of 2.8 m was sent to London for consumption at the Queen's coronation dinner. Two specimens are mentioned in Williams (1954), one in 1947 from Strangford Bar and the other in 1948 56 km off Portavogie. There have been no recent records of sturgeon in Northern Ireland, but occasional records in the Republic of Ireland are reported.

Thompson (1856) recorded allis shad from the coast of Londonderry, noting them to be "by no means uncommon" there, although there may have been confusion with the twaite shad. Ogilby (1885) comments on a fish called the 'craig-herring' being caught in the Foyle during the latter part of June and July, sometimes as many as eight in a tide, and presumes this species to be the allis rather than the twaite shad. This fish is considered rare in freshwater by Went & Kennedy (1956), with sporadic records from estuaries and the sea off the north and north-west coasts of Ireland, as well as the south-west. More recently, Bracken & Kennedy (1967) give details of allis shad in the Republic of Ireland, but only relate two confirmed records of allis shad, one in 1953 from Portballintrae, Co. Antrim, and the other in 1956 from the Foyle Estuary. This species was recorded as "occasional" in herring nets by Williams (1954).

The twaite shad was reported by Thompson (1856) as annually ascending some of the southern Irish rivers and recounts a specimen in 1842 taken from Dundrum, where this species had never been recorded before. It is considered common in certain rivers in the Republic of Ireland but as only sporadic elsewhere (Went & Kennedy 1956). Bracken & Kennedy (1967) describe the twaite shad as "the common Irish species of shad", although its distribution other than in particular rivers is not well known.

5.9.3 Human activities

Human activities occurring on estuaries and adjacent coasts are summarised by Buck & Donaghy (1996); these activities

can affect the abundance and distribution of fish. Industrial development and agricultural pollution have been shown to have a detrimental effect on the estuarine environment. Urbanisation and the discharge of untreated sewage to the sea and particularly into estuaries results in a reduction in dissolved oxygen, to which fish are particularly sensitive. The result is that fish leave the area and do not return until treatment plants reduce the amount of sewage and oxygen levels increase (Potts & Swaby 1993b). The possible effects of fisheries on species is discussed in sections 5.7 and 9.1. Sea angling occurs in many places throughout the region (Orton 1996) (see section 9.1.2). Dams, weirs, barrages and abstraction intakes can impede the passage of migratory fish, which are unable to reach spawning and feeding grounds further upstream. Salmon passes can be built around dams and weirs to allow some selected species to migrate up or down the affected channels.

5.9.4 Information sources used

Information of marine and estuarine fish is included in the British Marine Fishes Database, which covers UK fish and individual records for this area. Information is being gathered from a variety of sources, including research institutes, fish biologists, anglers and fishermen. The data include published literature and unpublished reports, as well as personal communications from fish biologists.

The Fisheries Division of the Department of Agriculture for Northern Ireland (DANI) hold information on marine and estuarine fish, gathered in the course of fisheries research.

5.9.5 Further sources of information

A. References cited

Bracken, J., & Kennedy, M. 1967. Notes on some Irish estuarine and inshore fishes. *Irish Fisheries Investigations, 3(B):* 1-28.

Buck, A.L., & Donaghy, A. 1996. *An inventory of UK estuaries. 7. Northern Ireland.* Peterborough, Joint Nature Conservation Committee.

Erwin, D.G., Picton, B.E., Connor, D.W., Howson, C.M., Gilleece, P., & Bogues, M.J. 1990. *Inshore marine life of Northern Ireland.* Belfast, HMSO.

Ogilby, J.D. 1885. Notes on some Irish fishes. *Scientific Proceedings of the Royal Dublin Society, IV, (N.S.):* 510-535.

Orton, D.A., *ed.* 1996. *Where to fish 1996 - 1997.* 85th ed. Beaminster, Thomas Harmsworth.

Potts, G.W., & Swaby, S.E. 1993a. *Marine fishes on the EC Habitats and Species Directive.* Peterborough, Joint Nature Conservation Committee.

Potts, G.W., & Swaby, S.E. 1993b. *Marine and estuarine fishes of Wales. The development of the British Marine Fishes Database and monitoring programme for Wales.* Bangor, Countryside Council for Wales.

Thompson, W.M. 1856. Fishes of Ireland. *In: The natural history of Ireland. IV*. London, Henry G. Bohn.

Went, A.E.J., & Kennedy, M. 1969. *List of Irish fishes*. Dublin, National Museum of Ireland.

Whilde, A. 1993. *Threatened mammals, birds, amphibians and fish in Ireland. Irish Red Data Book 2: Vertebrates.* Belfast, HMSO.

Williams, G. 1954. Fauna of Strangford Lough and neighbouring coasts. *Proceedings of the Royal Irish Academy, 56(3B):* 125-133.

B. Further reading

Briggs, R.P., & McCurdy, W.J. 1978. Marine fishes taken in waters off the north coast of Ireland during 1977. *Irish Naturalists' Journal, 19*(8): 267-268.

Briggs, R.P., & Warren, P. 1982. Fishes trawled from the North Irish Sea by the research vessel 'Clione' during April 1980. *Irish Naturalists' Journal, 20*(10): 440-444.

Briggs, R.P. 1988. The occurrence of two rare fish species off the northern Irish coast. *Irish Naturalists' Journal, 22*(11): 480-482.

Corlett, J. 1967. Young plaice and other fish in Strangford Lough and neighbouring bays in August, 1963 and 1964. *Irish Naturalists' Journal, 15*: 249-254.

Ogilby, J.D. 1876. Notes on some fishes observed at Portrush, Co. Antrim. *The Zoologist, XI:* 4,753-4,755.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
British Marine Fishes Database	Dr G.W. Potts and S.E. Swaby, Marine Biological Association UK, Citadel Hill, Plymouth PL1 2PB, tel: 01752 633100
Fisheries	*DANI Fisheries Division, Belfast, tel: 01232 520100
Marine conservation issues and fisheries - UK	*Marine Advisory Officer, JNCC Peterborough, tel: 01733 62626
Marine conservation issues and fisheries - Northern Ireland	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477

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

5.10 Seabirds

C.W. Murphy

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 normally regarded as seabirds (listed in Table 5.10.1), but also cormorants, divers, grebes and seaducks - i.e. birds 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, especially within estuaries. Scientific names of all species are given in Table 5.10.1.

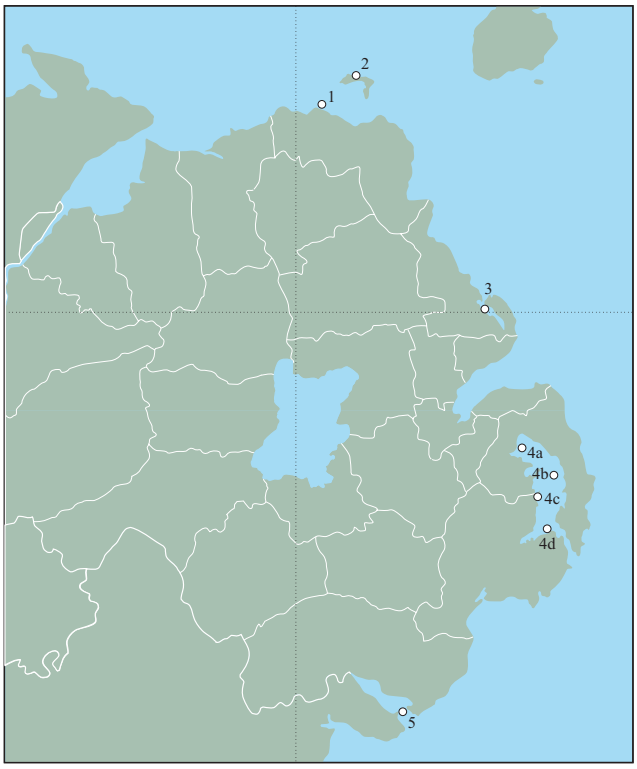
This region is important for seabirds in both national and international contexts (Table 5.10.1). The tern population is perhaps of greatest significance, with internationally important colonies on islands in Larne Lough, Strangford Lough and Carlingford Lough. In addition, there are internationally important populations of herring gull and razorbill, while several more species are of importance in both UK and British and Irish contexts.

Breeding seabirds require habitat that is free from predatory mammals, so nearly all colonies are on islands or cliffs. There are seabird colonies on many stretches of the Antrim and Down coasts, with the largest and by far the most important on Rathlin Island and on the islands of Strangford Lough. At present just two seabird colonies have been formally designated under the EC Birds Directive as Special Protection Areas (SPA): Sheep Island near Ballintoy and Swan Island in Larne Lough; Strangford Lough, which supports internationally important numbers of breeding terns, has been proposed as an SPA. Strangford Lough is the region's richest marine environment and was designated a Marine Nature Reserve in 1995 (although not primarily for the conservation of its seabirds) and is a candidate for designation as a Special Area of Conservation (again, not for the conservation of its seabirds). In addition, eleven coastal Areas of Special Scientific Interest (ASSIs) are important for seabirds.

Table 5.10.1 Overall importance of coastal breeding seabird populations in Region 17

Species	*Total* in region*	*% UK*	*% British & Irish*	*% Europe*
Fulmar *Fulmaris glacialis*	4,213	<1	<1	<1
Manx shearwater *Puffinus puffinus*	1,420	<1	<1	<1
Cormorant *Phalacrocorax carbo*	823	10.6	7.0	<1
Shag *Phalacrocorax aristotelis*	424	1.1	<1	<1
Black-headed gull *Larus ridibundus*	8,474	4.2	3.6	<1
Common gull *Larus canus*	227	<1	<1	<1
Lesser black-backed gull *Larus fuscus*	536	<1	<1	<1
Herring gull *Larus argentatus*	9,414	5.8	4.5	<1
Great black-backed gull *Larus marinus*	231	1.2	<1	<1
Kittiwake *Rissa tridactyla*	10,330	2.0	1.9	<1
Sandwich tern *Sterna sandvicensis*	1,192	7.7	6.3	2.2
Roseate tern *Sterna dougallii*	8	9.1	1.2	1.1
Common tern *Sterna hirundo*	1,170	8.3	7.3	1.3
Arctic tern *Sterna paradisaea*	550	1.2	<1	<1
Guillemot *Uria aalge*	44,141[a]	4.1	2.7	<1
Razorbill *Alca torda*	11,440[a]	7.2	4.2	1.2
Black guillemot *Cepphus grylle*	595[a]	1.6	1.5	<1
Puffin *Fratercula arctica*	2,461[a]	<1	<1	<1

Sources: figures for UK from Walsh *et al.* (1994); regional totals compiled from the most recent available good-quality counts up to 1995 (mainly JNCC's Seabird Colony Register); British and Irish totals from Lloyd *et al.* (1991) and Gibbons *et al.* (1993); Europe totals from Lloyd *et al.* (1991). Key: *pairs, except those marked [a], which are counts of individuals.



Map 5.10.1 Colonies holding at least 1% of the British and Irish population of any seabird species. Numbers are those listed in Table 5.10.2. Source: JNCC Seabird Colony Register. © Crown Copyright.

5.10.2 Important locations and species

The region's principal seabird colonies are listed in Table 5.10.2 and shown on Map 5.10.1. Five colonies hold numbers of at least one seabird species at or above 1% of the European Union (EU) total population for that species. A further three colonies are important at the British and Irish level. All these colonies have been designated as ASSIs.

At sea, important food sources for seabirds include zooplankton, shellfish, 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

Table 5.10.2 Counts of seabird colonies in the region holding more than 1% of the EU or 1% of the British and Irish total (GB/I) for particular species

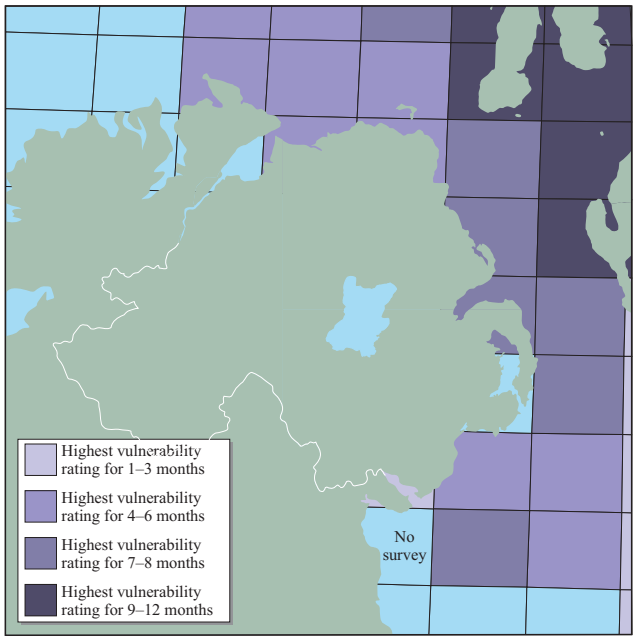
Site no. on Map 5.10.1	*Colony*	*Grid ref.*	*Species*	*Year(s)*	*Count*	*>1% EU** or GB/I*	*Protected status*
1	Sheep Island	D048459	Cormorant	1991-1995	261*	GB/I	SPA, ASSI
2	Rathlin Island	D130520	Kittiwake	1985	6,822	GB/I	pSPA, ASSI
			Razorbill	1985	8,922	EU	
			Guillemot	1985	41,887	GB/I	
3	Swan Island, Larne Lough	J424996	Roseate tern	1992-1996	6*†	EU	SPA, ASSI
			Common tern	1992-1996	199*	GB/I	
4a	Ogilby Island, Strangford Lough	J505689	Sandwich tern	1992	650	EU	ASSI, pSPA, MNR, pSAC
4b	Bird Island, Strangford Lough	J569618	Cormorant	1993	124	GB/I	ASSI, pSPA, MNR, pSAC
4c	Black Rock (Ringdufferin), Strangford Lough	J542575	Common tern	1994	221	GB/I	ASSI, pSPA, MNR, pSAC
4d	Jackdaw Island, Strangford Lough	J555515	Black-headed gull	1993	6,000	GB/I	ASSI, pSPA, MNR, pSAC
			Sandwich tern	1988	1,700	EU	
5	Green Island, Carlingford Lough	J241111	Sandwich tern	1994	449	GB/I	ASSI
			Roseate tern	1989	25	EU	
			Common tern	1994	277	GB/I	

Sources: JNCC/Seabird Group Seabird Colony Register; DoE (NI) EHS and RSPB counts. Key: SPA = Special Protection Area; pSPA = proposed SPA; ASSI = Area of Special Scientific Interest; MNR = Marine Nature Reserve; pSAC = proposed Special Area of Conservation; *average maximum figure for year range; †nineteen pairs in 1990; **GB/I (Great Britain and Ireland) = nationally important total; EU = internationally important total. Notes: all totals are of pairs of birds; for most species the most recent available good-quality count is presented; for terns, whose numbers may fluctuate markedly from year to year, reflecting inter-colony movements, the highest count from the period 1989-93 is presented.

or over some sea-bed features. Many seabirds feed on sandeels *Ammodytes* spp: offshore sandbanks are the preferred habitat for these fish, and so the waters over them are important for seabirds. Sprat and herring are also important prey species in the region's seas.

The greatest concentrations of birds at sea in this region occur near the colonies during the breeding season. Map 5.10.2 shows the importance of offshore areas for seabirds, expressed as the number of months of the year during which the seabird vulnerability rating is highest (see section 5.10.3). It appears that the area of the Irish Sea Front (see section 4.3) is of particular importance to many seabirds in autumn, especially Manx shearwaters. High densities of Manx shearwaters, kittiwakes, guillemots and razorbills feed off the coast of Northern Ireland. In addition to the waters round Rathlin Island and off south-east Co. Down, the region's two most important areas for feeding seabirds, there are also concentrations in the North Channel and between the coast of Co. Down and the Isle of Man.

Seaduck, divers and grebes tend to be found in areas with less than about 20 m water depth. The region's sea loughs are of greatest importance, especially Lough Foyle, Belfast Lough, Strangford Lough and Carlingford Lough. The first two are the principal sites in Britain and Ireland for Slavonian grebe *Podiceps auritus* and great crested grebe *P. cristatus* respectively, although in the case of the Slavonian grebe numbers are so low overall that bias may have been introduced by differences in observation intensity. Common scoter *Melanitta nigra* feed on a range of small or immature shellfish and are likely to prefer areas with high spatfalls of these species. Dundrum Bay has held between 2,000 and 4,000 common scoter in recent years, although numbers at present are much lower, possibly reflecting a temporary decline in shellfish there.



Map 5.10.2 Relative importance of region and adjacent seas for seabirds. The grid is of 15'N x 30'W rectangles; see section 5.10.1 for explanation of vulnerability ratings. Source: JNCC Seabirds at Sea Team. © Crown Copyright.

5.10.3 Human activities

The vulnerability of seabirds at sea to surface pollution such as oil is calculated from the abundance of birds in the rectangles shown on Map 5.10.2 and a factor derived from the amount of time spent on the water, the overall population size and the rate at which the species recruits new individuals to the population. For a discussion of vulnerability see Carter *et al.* (1993), Williams *et al.* (1994) or Webb *et al.* (1995).

Seabirds can be particularly affected by marine oil pollution. Spills near the main colonies during the breeding season could be particularly damaging. Divers and grebes wintering in the region, which spend most of their time on the surface of the water, are also very vulnerable to oil

pollution. Up to 1,800 great crested grebes roost in a single tight flock off Macedon Point in Belfast Lough, where even a small spill could have very serious consequences.

Introduction of rats and cats onto islands presently free of these mammals would damage their seabird populations. Several important tern colonies on islands in Strangford Lough have recently suffered from the presence of rats, although National Trust staff work hard to control numbers. The presence of ferrets on Rathlin Island in recent times has given cause for concern. Human disturbance is another factor that has led seabirds, especially terns, to abandon colonies in the region. Disturbance is greatest among the islands of Strangford Lough, where tourist pressure is growing. Ironically the increase in numbers of peregrine falcons *Falco peregrinus* is believed to have contributed to desertion of one island by large numbers of terns. Other issues with potential to affect the region's seabirds include depletion of fish stocks (especially of sandeels *Ammodytes* spp.), fish-farms, entanglement in fishing nets and habitat change in several places due to industrial, residential and leisure development.

5.10.4 Information sources used

All seabird colonies in the region were counted between 1984 and 1987. These counts, and all others made since 1969, are held on the JNCC/Seabird Group Seabird Colony Register. Numbers and breeding performance of several species, including most of the terns, are evaluated annually on islands owned or managed by the DoE (NI) EHS, the RSPB, the National Trust or the Copeland Bird Observatory. Surveys of birds at sea have been carried out by JNCC's Seabirds at Sea Team (SAST). Coverage from the land has generally been good, with several major populations discovered in recent years, for example of black-throated divers *Gavia arctica* in Strangford Lough and of Slavonian grebes in Lough Foyle.

5.10.5 Acknowledgements

Thanks are due to Kate Thompson and Mark Tasker, JNCC, and Neville McKee, Copeland Island Bird Observatory. Thanks also go to Dr R.A. Brown, RSPB, Jo Whatmough, National Trust, and R.J. Bleakley, DoE (NI) Environment and Heritage Service.

5.10.6 Further sources of information

A. References cited

Carter, I.C., Williams, J.M., Webb, A., & Tasker, M.L. 1993. *Seabird concentrations in the North Sea: an atlas of vulnerability to surface pollutants.* Aberdeen, Joint Nature Conservation Committee.

Gibbons, D.W., Reid, J.B., & Chapman, R. 1993. *The new atlas of breeding birds in Britain and Ireland 1988-1991*. London, T. & A.D. Poyser.

Lloyd, C.S., Tasker, M.L., & Partridge, K. 1991. *The status of seabirds in Britain and Ireland*. London, T. & A.D. Poyser.

Walsh, P.M., Brindley, E., & Heubeck, M. 1994. *Seabird numbers and breeding success in Britain and Ireland, 1993*. Peterborough, Joint Nature Conservation Committee. (UK Nature Conservation, No. 17.)

Webb, A., Stronach, A., Stone, C.S., & Tasker, M.L. 1995. *Vulnerable concentrations of birds to the south and west of Britain*. Peterborough, Joint Nature Conservation Committee.

Williams, J.M., Tasker, M.L., Carter, I.C., & Webb, A. 1994. A method of assessing seabird vulnerability to surface pollutants. *Ibis, 137:* S14-S152.

B. Further reading

Cranswick, P.A., Waters, R.J., Evans, J., & Pollitt, M.S. 1995. *The wetland bird survey 1993-94: Wildfowl and Wader Counts*. Slimbridge, BTO/WWT/RSPB/JNCC.

Kirby, J.S., Evans, R.J., & Fox, A.D. 1993. Wintering seaducks in Britain and Ireland: populations, threats, conservation and research priorities. *Aquatic Conservation: Marine and Freshwater Ecosystems, 3:* 105-137.

Northern Ireland Birdwatchers' Association. 1996. *Northern Ireland Bird Report 1994*. Belfast, Northern Ireland Birdwatchers' Association.

Prater, A.J. 1981. *Estuary birds of Britain and Ireland*. Calton, T. & A.D. Poyser.

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.

Rose, P.M., & Scott, D.A. 1994. *Waterfowl population estimates*. Slimbridge, International Waterfowl and Wetlands Research Bureau. (IWRB Publication No. 29.)

Sheppard, R. 1993. *Ireland's wetland wealth*. Dublin, Irish Wildbird Conservancy.

Stone, C.J., Webb, A., Barton, C., Ratcliffe, N., Reed, T.C., Tasker, M.L., & Pienkowski, M.W. 1995. *An atlas of seabird distribution in north-west European waters.* Peterborough, Joint Nature Conservation Committee.

Way, L.S., Grice, P., MacKay, A., Galbraith, C.A., Stroud, D.A., & Pienkowski, M.W. 1993. *Ireland's internationally important bird sites: a review of sites for the EC Special Protection Area network.* Peterborough, Joint Nature Conservation Committee. (Report for DoE (NI) and National Parks and Wildlife Service, Dublin.)

Walsh, P.M., Brindley, E., & Heubeck, M. 1995. *Seabird numbers and breeding success in Britain and Ireland, 1994.* Peterborough, Joint Nature Conservation Committee. (UK Nature Conservation, No. 18.)

Webb, A., Harrison, N.M., Leaper, G.M., Steele, R.D., Tasker, M.L., & Pienkowski, M.W. 1990. *Seabird distribution west of Britain*. Peterborough, Nature Conservancy Council.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Seabird colonies	*Coordinator, Seabird Colony Register, JNCC, Aberdeen, tel: 01224 655703
Seabirds at sea	*Seabirds at Sea Team, JNCC, Aberdeen, tel: 01224 655702
Wildfowl counts	*Wetland Bird Survey National Organiser (Wildfowl), The Wildfowl & Wetlands Trust, Slimbridge, tel: 01453 890333
Wader counts	*Wetland Bird Survey National Organiser (Waders), The British Trust for Ornithology, Thetford, tel: 01842 750050
Northern Ireland bird reports	Hon. Secretary, NI Birdwatchers' Association, 12 Belvoir Close, Belvoir Park, Belfast BT8 4PL, tel: 01232 693232
Ornithological records	*Ulster Museum, Centre for Environmental Data and Recording (CEDaR), Belfast, tel: 01232 383000
Bird records and conservation	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477
Nearshore waterfowl	*Wildfowl & Wetlands Trust, Comber, tel: 01247 874146

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

Northern Ireland's wild, inaccessible cliffs are home to many breeding birds besides seabirds. These well grown peregrine falcon *Falco peregrinus* chicks, their crops bulging with food, are part of a population in the region that represents 9% of that in the whole of the island of Ireland. Photo: Robert Thompson, DoE (NI) EHS.

5.11 Other breeding birds

C.W. Murphy

5.11.1 Introduction

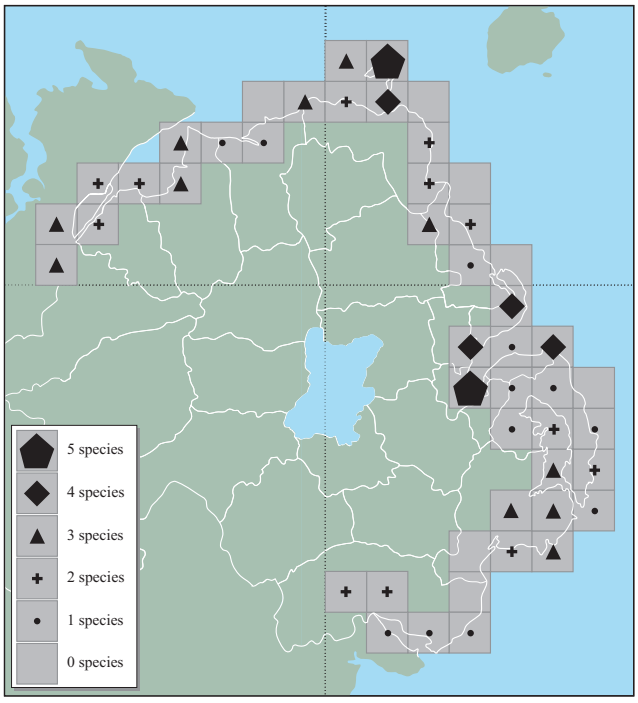
This section outlines the importance of the region to breeding birds other than seabirds. Because of their distinctive ecology and mixed-species breeding colonies, seabirds are described separately in section 5.10. Of the wide range of the region's coastal breeding bird species other than seabirds, three are of particular importance because of their vulnerability. All Irish Red Data Book species, these are chough *Pyrrhocorax pyrrhocorax*, peregrine *Falco peregrinus* and twite *Carduelis flavirostris*. For each, no one site is particularly significant, but the sum total of their populations makes them of international importance. The *New atlas of breeding birds in Britain and Ireland 1988 - 1991* (Gibbons *et al*. 1993) shows that Strangford Lough has one of the highest diversities of breeding bird species listed in the Irish Red Data Book.

5.11.2 Important locations and species

The chough is a specialised feeder restricted to areas where low-intensity livestock farming occurs close to suitable nesting sites in caves, cliffs and old buildings. Only on the wilder and more remote coasts of Britain and Ireland is this association now found (Gibbons *et al*. 1993). The chough has declined throughout Europe during the present century and is listed on Annex I to the EC Birds Directive, entitling it to special measures to ensure its conservation. Throughout this century the chough has declined as a breeding species in Northern Ireland. From the beginning of the century it was confined to the coasts of Co. Londonderry and Co. Antrim, and by 1985 the total population was estimated at 30 individuals, with the majority on Rathlin Island, its former stronghold in the region. A more recent and dramatic decline has occurred, with only three pairs recorded in 1995, all on the north Antrim coast between the Giant's Causeway and Fair Head. Occasionally birds appear on or near the south Down coast, and may be present for some time; these may be wanderers from Wales or the Isle of Man.

Twenty-five pairs of peregrine (25% of the Northern Ireland population) breed within 1 km of the high water mark, 21 of them in Co. Antrim (mostly on the mainland but also on Rathlin Island), reflecting that county's abundance of suitable nesting habitat - cliffs. Two pairs breed in Co. Londonderry and one in Co. Down. At least two more pairs, which breed inland, feed on seabirds and waders on Strangford Lough. The region's peregrines represent 9% of the total Irish population and 1.6% of the total UK population. While all currently occupied sites are on cliffs, from time to time shipyard gantries and buildings in Belfast have been used.

The twite is a rare and local breeding species in the region. One of the region's least known finches, during the breeding season it feeds on small seeds and insects; its nests are sited in heather. All recent breeding records come from north Co. Antrim, including the following coastal sites: Giant's Causeway, Carrickarade, White Park Bay and Fair Head.



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

Map 5.11.1 shows the incidence of confirmed breeding in coastal 10 km squares of selected species characteristic of wet grassland (teal *Anas crecca*, mallard *Anas platyrhynchos*, lapwing *Vanellus vanellus*, snipe *Gallinago gallinago* and redshank *Tringa totanus*). Apart from the Belfast Harbour Estate and Quoyle Pondage, the Northern Ireland coastline lacks extensive areas of wet coastal grassland or saltmarsh suitable for breeding wildfowl and waders. Map 5.11.2 shows the incidence of confirmed breeding in coastal 10 km squares of selected waterfowl species characteristic of dry coastal habitats (shelduck *Tadorna tadorna*, oystercatcher *Haematopus ostralegus* and ringed plover *Charadrius hiaticula*).

As much of the region's coastline is largely undeveloped, with a considerable are of natural habitats, many more common and widespread species occur. Table 5.11.1 lists the more important species. There are also important coastal songbird communities breeding in Northern Ireland - birds of the cliff-top, coastal heath, scrub, gorse and grassland, including skylark *Alauda arvensis*, stonechat *Saxicola torquata*, whitethroat *Sylvia communis* and linnet *Carduelis cannabina*. Also, several heronries exist close to the coastal zone and many birds feed more or less exclusively on the shore.

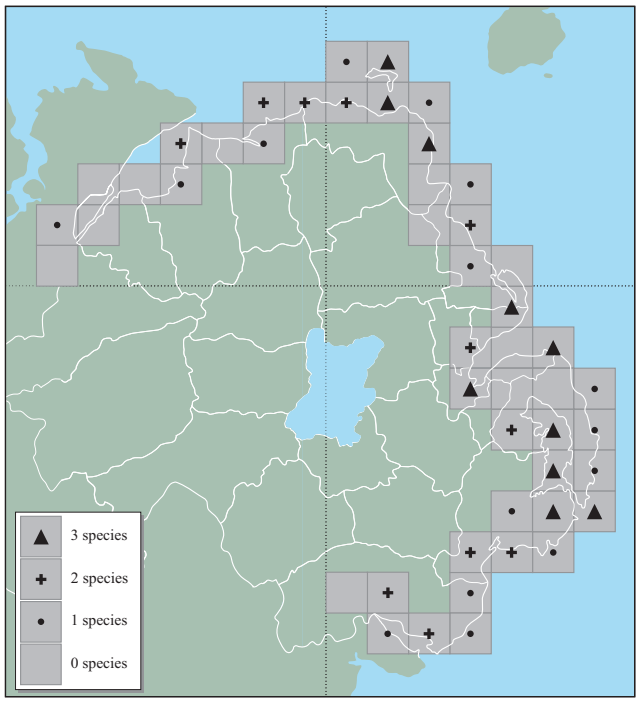
5.11.3 Human activities

Generally, changes in chough populations correlate with habitat change (Bignal & Curtis 1989), although the reasons

for the complete and sudden disappearance of choughs from Rathlin Island, their former stronghold, in the late 1980s are unclear. Among the possible causes are a move towards cattle from sheep as the main livestock; the use of anti-parasitic treatments, which may have prevented the appearance of prey species associated with dung; predation by raptors breeding in close proximity; or poor feeding opportunities during hard winter weather. On the north Antrim coast, intensification of agricultural activities may be a major factor in the chough decline, as cliff-top heath has been one of the habitats sufferring losses.

Disturbance from tourists, walkers and climbers can affect the breeding success of coastal birds, including peregrine and chough. In Northern Ireland, however, there are no known instances of either species failing to breed successfully owing to such disturbance. The only regularly climbed sea cliffs are at Fair Head, where the National Trust has agreed with the Mountaineering Federation of Ireland a series of routes that do not endanger any of the important breeding species.

In 1987 wet and dry grassland in the Belfast Harbour Estate held 50 pairs of breeding redshank, snipe, lapwing, ringed plover and mallard (Partridge 1987). By 1995, following infilling and development, this considerably reduced area held only seven breeding pairs (C.W. Murphy pers. comm.). However, a major habitat enhancement scheme undertaken in 1996 is designed to favour breeding waders at this site. Habitat management at the Quoile Pondage (National) Nature Reserve is also encouraging increased breeding numbers of lapwing and snipe.



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

5.11.4 Information sources used

The Northern Ireland Bird Reports provide a summary of the status of each of the breeding bird species in Northern Ireland (see e.g. Northern Ireland Birdwatchers' Association 1994). 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. The atlas presents the data on a 10 x 10 km square basis and also shows breeding densities derived from them. Data were collected at a tetrad (2 x 2 km) scale and are held by the British Trust for Ornithology (BTO) (see section 5.11.6). The new atlas compares distributions at the 10 x 10 km square level with the first breeding bird atlas of 1968-1972 (Sharrock 1976). Whilst the data are one of the best sources for comparisons at county, regional or national scales, care should be taken with their use to assess individual sites or 10 km squares. This is because the tetrad coverage of each 10 km square was not always the same, there may be greatly varying amounts of land within each square, and some distributions may have changed since the survey period. The Breeding Bird Survey organised by BTO on behalf of the Joint Nature Conservation Committee (JNCC) has been established to monitor commoner birds in the United Kingdom.

Extensive survey work has also been undertaken for a number of species, mostly by volunteers (e.g. for peregrines and chough). The results for Northern Ireland of wider British and/or Irish surveys are normally published in *Irish Birds*.

Table 5.11.1 Commoner breeding species on the coast of Northern Ireland

Species	*Status and distribution*
Shelduck *Tadorna tadorna*	Common and widespread
Eider *Somateria mollissima*	Common from Lough Foyle to north Down; also occurs in Strangford Lough
Red-breasted merganser *Mergus serrator*	Widespread
Buzzard *Buteo buteo*	Widespread in Londonderry and Antrim; several pairs on Rathlin Island
Oystercatcher *Haematopus ostralegus*	Common and widespread
Ringed plover *Charadrius hiaticula*	Common and widespread
Rock dove *Columba livia*	Numbers of pure-bred birds have greatly decreased as feral birds have increasingly interbred with them; it is now doubtful that any are left on the mainland but they still exist on Rathlin Island.
House martin *Delichon urbica*	Breeds near Portrush and on limestone cliffs east of Ballintoy, Co. Antrim
Sand martin *Riparia riparia*	Breeds in coastal sandbanks at Portballintrae, Antrim and Killard Point and Ballyhornan, Down
Rock pipit *Anthus petrosus*	Common and widespread
Raven *Corvus corax*	Increasing, widespread but local

Source: Northern Ireland Bird Reports 1982-1994 (e.g. Northern Ireland Birdwatchers' Association 1996).

5.11.5 Acknowledgements

Thanks are due to J. Wells (National Trust) and D.M. Craddock and D.A. Stroud (JNCC) for help in compiling this section. The following commented on drafts: Dr R.A. Brown (RSPB), M. Tasker (JNCC), J. Whatmough (National Trust) and R.J. Bleakley and J.S. Furphy (DoE (NI) Environment and Heritage Service).

5.11.6 Further sources of information

A. References cited

Bignal, E.M., & Curtis, D.J., *eds*. 1989. *Choughs and land use in Europe*. Paisley, Scottish Chough Study Group.

Gibbons, D.W., Reid, J.B., & Chapman, R. 1993. *The new atlas of breeding birds in Britain and Ireland 1988-1991*. London, T. & A.D. Poyser.

Northern Ireland Birdwatchers' Association. 1996. *Northern Ireland Bird Report 1994*. Belfast, Northern Ireland Birdwatchers' Association.

Partridge, J.K. 1987. *Northern Ireland breeding wader survey*. Belfast, RSPB. (Final report to the Department of the Environment (NI) Countryside and Wildlife Branch.)

Sharrock, J.T. 1976. *The atlas of breeding birds in Britain and Ireland*. Calton, T. & A.D. Poyser. (British Trust for Ornithology and Irish Wildbird Conservancy.)

B. Further reading

Hötker, H., *ed.* 1991. Waders breeding in wet grassland. *Wader Study Group Bulletin, 61:* Supplement.

Hutchinson, C.D. 1989. *Birds in Ireland.* London, T. & A.D. Poyser.

Prater, A.J. 1989. Ringed plover *Charadrius hiaticula* breeding population of the United Kingdom in 1984. *Bird Study, 36:* 154-159.

Ratcliffe, D.A. 1995. *The peregrine falcon.* 2nd ed. Calton, T. & A.D. Poyser.

Way, L.S., Grice, P., MacKay, A., Galbraith, C.A., Stroud, D.A., & Pienkowski, M.W. 1993. *Ireland's internationally important bird sites: a review of sites for the EC Special Protection Area network.* Peterborough, Joint Nature Conservation Committee. (Report for DoE (NI) and National Parks and Wildlife Service, Dublin.)

Whilde, A. 1993. *Threatened mammals, birds, amphibians and fish in Ireland. Irish Red Data Book 2: vertebrates*. Belfast, HMSO.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Breeding atlas data and breeding wader data	*Development Unit, The British Trust for Ornithology, Thetford, tel: 01842 750050
Breeding bird surveys; coastal habitat management	*RSPB HQ, Belfast tel: 01232 491547
Northern Ireland bird reports	Hon. Secretary, NI Birdwatchers' Association, 12 Belvoir Close, Belvoir Park, Belfast BT8 4PL, tel: 01232 693232
Coastal breeding wildfowl data	*Wildfowl and Wetlands Trust, Comber, tel: 01247 874146
Site designations	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477

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

5.12 Migrant and wintering waterfowl

C.W. Murphy

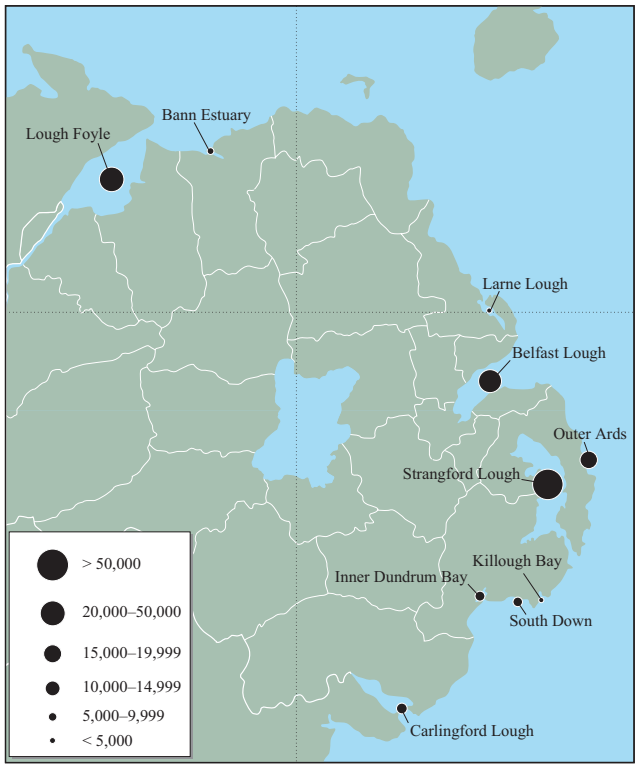
5.12.1 Introduction

Waterfowl are defined as waders and wildfowl (divers, grebes, ducks, geese and swans together with coot *Fulica atra*). This section details the importance of the region to these birds during their non-breeding period. Most species begin to arrive on the region's coast in early autumn, some using it as a refuelling station on their way to wintering grounds further south but the majority remaining until the following spring, when they are again joined by passage migrants, this time heading north. The importance of offshore areas for wintering sea duck species, divers, grebes and cormorant *Phalacrocorax carbo* is outlined in section 5.10.

Northern Ireland is one of the most important regions of the UK for wintering waterfowl. This is due in the main to its mild winter climate and abundance of a variety of wetland habitats, especially on the coast. Data from the Wildfowl and Wader Counts and Winter Shorebird Count reveal that the mid-winter wader population of the Northern Ireland coast numbers approximately 75,000 birds. Table 5.12.1 gives the total January 1994 wader counts for this coastal region as a proportion of the totals (coastal/inland) for Northern Ireland and for all counted sites in the United Kingdom and in the whole of the island of Ireland. However, such comparisons can give only a rough approximation of relative regional importance, since the data are uncorrected for coverage. It is thought that under-recording affected counts in the Republic of Ireland to a greater degree than in Northern Ireland (Cranswick *et al.* 1995). Separate coastal counts for wildfowl are not available.

According to the WeBS survey of wetland sites (see section 5.12.4), nine coastal wetlands in the region support internationally important numbers of overwintering waterfowl species. Most of these sites support nationally important numbers (in an all-Ireland context) of other species. With seven of these wetlands on its shores, the coastline of Co. Down is of especially great significance. Large sections of the Co. Antrim coast are cliff-bound, notably between the Giant's Causeway and Larne. These areas and a few, much shorter, cliff-bound sections of Counties Londonderry and Down are of generally low importance for waterfowl. Map 5.12.1 shows the distribution of the main concentrations of wintering waterfowl in the region, indicating the relative importance of the regularly-counted wetlands.

The coastal wetlands of the region are also of importance for migrant waterfowl in spring and autumn. The region lies on a major migratory flyway, and many birds moving to and from other wintering areas on the African, Mediterranean and south-west European coasts to arctic breeding grounds pass through and stage on its estuaries and coasts. In periods of severe cold weather further east in Britain or Europe, the region, being relatively mild, assumes even greater importance. Under these conditions there may be major influxes of waterfowl, such as wigeon *Anas penelope*, teal *Anas crecca*, lapwing *Vanellus vanellus* and golden plover *Pluvialis apricaria*, from other coastal regions or inland areas (Ridgill & Fox 1990; Langston 1990).



Map 5.12.1 Distribution of main concentrations of wintering waterfowl. Note: size of circle is proportional to the five-year mean of waterfowl numbers. Offshore seaduck are not shown (see section 5.10). Source: Cranswick *et al.* (1995). © Crown Copyright.

5.12.2 Important locations and species

Table 5.12.2 provides a summary of the mid-winter counts of the main species of waders on both estuarine and non-

Table 5.12.1 Overall coastal wader count of Region 17 related to the total wader count for Northern Ireland, the UK coast and Ireland in January 1994

	Total wader count in January 1994	*Number of sites counted*	*Region 17 coastal wader total as a % of the comparison area*
Coastal sites in Region 17	**69,819**	**8**	**-**
All counted sites in region (coastal and inland)	75,943	102	91.9
All counted UK coastal sites	1,591,000	161	4.4
All counted sites in Ireland (coastal and inland)	291,500	168	23.9

Source: Data from Cranswick *et al.* (1995)

Table 5.12.2 Numbers of waders counted on the estuarine and non-estuarine coasts of Northern Ireland in mid-winter, 1981-85

Species	*Estuaries*	*Non-estuaries*	*Coastal total*	*% of coastal total on estuaries*
Oystercatcher *Haematopus ostralegus*	9,081	3,529	12,610	72.0
Ringed plover *Charadrius hiaticula*	283	1,462	1,745	16.2
Golden plover *Pluvialis apricaria*	3,809	1,612	5,421	70.3*
Grey plover *Pluvialis squatarola*	115	41	156	73.7
Lapwing *Vanellus vanellus*	8,699	5,523	14,222	61.2*
Knot *Calidris canutus*	9,900	17	9,917	99.8
Sanderling *Calidris alba*	37	70	107	34.6
Purple sandpiper *Calidris maritima*	9	264	273	3.4
Dunlin *Calidris alpina*	8,671	3,388	12,059	71.9
Black-tailed godwit *Limosa limosa*	83	0	83	100.0
Bar-tailed godwit *Limosa lapponica*	2,805	188	2,993	93.7
Curlew *Numenius arquata*	4,253	2,218	6,471	65.7*
Redshank *Tringa totanus*	4,076	1,496	5,572	73.2
Greenshank *Tringa nebularia*	66	5	71	93.0
Turnstone *Arenaria interpres*	547	2,585	3,132	17.5
Total	***52,434***	***22,398***	***74,832***	-

Source: WeBS data from Cranswick *et al.* (1995). Key: *substantial additional population winters inland.

estuarine shores. As approximately 40% of the coastline of Northern Ireland is estuarine, the intertidal flats and saltmarshes of these areas are of major importance to the wintering populations of a number of wader species. Species assemblages vary greatly with the exposure of the coast and the type of substrate (Moser & Summers 1987).

In the winters between 1981 and 1985, lapwing, oystercatcher, dunlin and knot were the most numerous species present. Knot were almost exclusively estuarine, whereas oystercatcher and dunlin both had over a quarter of their populations along non-estuarine shores. Lapwing were present on both types of shore but, with golden plover and curlew, differ from the other species in also having substantial populations wintering inland (Lack 1986). In general, the densities of wader species on non-estuarine shores were much lower to the north of Belfast Lough, where there is a lower average tidal range and rockier shoreline than further south (Moser & Prys-Jones 1988).

Nine coastal wetlands (Lough Foyle, Larne Lough, Belfast Lough, Outer Ards Peninsula, Strangford Lough, Killough Bay, South Down, Dundrum Inner Bay and Carlingford Lough) are internationally important for their wintering waterfowl populations, each supporting at least 1% of the international flyway population of one or more species. Apart from Swan Island in Larne Lough, none of these sites has yet been designated as a Ramsar site and/or Special Protection Area (SPA) (see section 7.2). The Bann Estuary is of regional importance (Sheppard 1993). Table 5.12.3 summarises the wintering waterfowl interest of these wetlands.

The major coastal site in Northern Ireland for migrant and wintering waterfowl is Strangford Lough, which supports 25 waterfowl species at levels of national importance (in an all-Ireland context), three of them attaining levels of international importance. The site also qualifies as internationally important by virtue of its assemblage of

Table 5.12.3 Wintering waterfowl numbers (including seaducks, divers and grebes) on sea loughs and other coastal sites in the region

Site	*Five year mean nos. wintering waterfowl*	*1993/94 peak waterfowl numbers*	*1993/94 peak wildfowl numbers*	*1993/94 peak wader numbers*	*No. of species occurring at levels of all-Ireland importance*	*Species of international importance*[1]	*Protected status*
Lough Foyle	35,762	28,871	9,572	19,299	17	Whooper swan *Cygnus cygnus*, Bewick's swan *C. columbianus*, light-bellied brent goose *Branta bernicla hrota*, wigeon, bar-tailed godwit	ASSI, (N)NR, pSPA
Bann Estuary	4,775	2,943	1,751	1,192	4	Light-bellied brent goose	-
Larne Lough	4,010	4,660	601	4,059	0	-	pSPA, NT
Belfast Lough	20,345	21,806	5,595	16,211	12	Turnstone, knot	pSPA, ASSI
Outer Ards Peninsula	17,033	11,560	1,051	10,509	11	Ringed plover, turnstone	pSPA
Strangford Lough	58,886	51,888	23,323	28,565	25	Light-bellied brent goose, redshank, knot	ASSI, (N)NR, NT, MNR, pSPA, pSAC
Killough Bay	2,734[2]	n/a	n/a	n/a	1	Light-bellied brent goose	-
South Down	8,809[3]	n/a	n/a	n/a	1	Ringed plover	-
Dundrum Inner Bay	9,805	7,062	1,490	5,572	5	Light-bellied brent goose	ASSI, (N)NR, NT
Carlingford Lough	6,730	8,504	2,771	5,733	10	Light-bellied brent goose	ASSI, pSPA

Source: WeBS data from Cranswick *et al.* (1995). The winter season used by WeBS is November to March for waders and September to March for wildfowl; numbers include divers, grebes and cormorants. Key: ASSI: Area of Special Scientific Interest; (N)NR: National Nature Reserve; NT: National Trust property; MNR: Marine Nature Reserve; pSPA = proposed Special Protection Area; pSAC = proposed Special Area of Conservation; n/a = not available; [1]i.e. at least 1% of the total population; [2]1984-1987 mean; [3]1989-1990 figure. Notes: see Cranswick *et al.* (1995) for further detail on interpretation of counts and limitations of data.

significantly more than 20,000 waterfowl. About 95% of the region's mid-winter population of knot is on Strangford Lough, where the species has declined by more than 50%, from over 12,000 in the 1970s and 1980s to less than 6,000 in the early 1990s (Sheppard 1993). The north-west corner of the north shore of Strangford Lough is by far the most important for this species, with over 90% of the birds present during the January peak occurring there (Langston 1990).

Lough Foyle and Belfast Lough are also of international importance as sites that support more than 20,000 wintering waterfowl. Lough Foyle supports nationally important populations of seventeen species, with five of these attaining levels of international importance. Belfast Lough regularly supports internationally important populations of two species of wader and nationally important numbers of a further ten species of waterfowl.

The single most important species of waterfowl wintering on the region's coast is the light-bellied brent goose, which is split into two discrete breeding populations. That visiting Ireland breeds in arctic Canada and Greenland and, on the eastern side of the Atlantic, winters almost exclusively in Ireland, so most Northern Ireland sites are of international importance. Early arrivals at Strangford Lough soon pass on down the east coast, while other birds make their landfall at Lough Foyle, where this species has shown a dramatic increase since the mid-1980s (Sheppard 1993; Langston 1990).

5.12.3 Human activities

On Strangford Lough a persistent decline of wigeon numbers since the early 1970s has given cause for concern about the effects of human disturbance, particularly from wildfowling (see also section 9.7). However, recent analysis of count data (Mathers 1995) has suggested that a deterioration in the quality of eelgrass *Zostera* spp. beds at the north end of the lough and changes elsewhere on the flyway are more likely causes for the decline in wigeon. Earlier arrival of brent geese and alteration to the treatment of sewage effluent may account for the poorer quality of the eelgrass beds. Control of wildfowling began in 1966, with the creation by the National Trust of the Strangford Lough Wildlife Scheme. Under this scheme, wildfowling on the foreshore within the lough and on adjacent lands owned or managed by the National Trust is controlled, and shooting-free core wildlife zones have been designated. On other estuaries, such as Lough Foyle and Dundrum Inner Bay, agreements are in place between wildfowling groups, RSPB and local authorities.

Some of the problems characteristic of British estuaries are found in Northern Ireland (Prater 1981), but often on a smaller scale. Two coastal sites, Belfast Lough and Lough Foyle, are currently used for domestic refuse disposal (see also section 9.3), which has led to a steady loss of mudflats and, on the former, to subsequent industrial and road developments (see section 8.3). Port development is ongoing in Belfast Lough (see section 8.3). Bait-digging on Belfast Lough's north foreshore, a major waterfowl feeding ground, poses a potentially serious disturbance especially during hard weather, when vital feeding time can be lost (Davidson & Rothwell 1993) (see also section 9.1). Grimmett & Jones (1989) list threats from recreational pressure, such as disturbance from boating, horse-riding and walkers with dogs, and sewage pollution.

Intertidal culture of shellfish on trestles or mats takes place in areas of Larne Lough, Strangford Lough, Killough Harbour, Dundrum Inner Bay and Carlingford Lough (see also section 9.2). This attracts wader species that prefer rocky shore habitats.

5.12.4 Information sources used

The principal sources of information on wintering and migrant waterfowl in the UK are the monthly wildfowl and wader counts that are part of the UK's Wetland Bird Survey (WeBS), organised by the British Trust for Ornithology, The Wildfowl and Wetlands Trust, the Royal Society for the Protection of Birds and the Joint Nature Conservation Committee. Coastal coverage is good for Northern Irish estuaries and certain stretches of open coast that support important numbers of wintering and migratory waterfowl. Of the region's coast all but 40 km (mostly in the north-east, of which 8 km were cliffs and 32 km were non-cliffs) were surveyed for the Winter Shorebird Count of 1984/85 (Moser & Prys-Jones 1988). Sheppard (1993) reports on the all-Ireland Winter Wetlands Survey (I-WeBS) 1984/5 - 1986/87, including the seven WeBS estuarine sites (Lough Foyle, Bann Estuary, Larne Lough, Belfast Lough, Strangford Lough, Dundrum Inner Bay and Carlingford Lough) and two WeBS non-estuarine sites (Outer Ards Peninsula and Killough Harbour/Bay (now incorporated within the new site of South Down)). WeBS information is available for all these sites. The I-WeBS waterfowl count scheme is the primary sources of information on wintering and migrant waterfowl in Ireland. The annual reports for WeBS and I-WeBS summarise what are very detailed data. Detailed count data for sites can be provided by WeBS and inspection of these data is recommended for any planning-related activity.

The annual Northern Ireland Bird Reports compiled and published by the Northern Ireland Birdwatchers' Association (e.g. Northern Ireland Birdwatchers' Association 1996) summarise the region's principal migrant and wintering waterfowl assemblages. Analysis of the count data for Strangford Lough has been undertaken through the School of Biology and Biochemistry of the Queen's University, Belfast.

Way *et al.* (1993) review the available information on sites in all of Ireland proposed for designation or already designated as Special Protection Areas and provides a useful summary.

5.12.5 Acknowledgements

Thanks are due to the following people for their comments: Mark Tasker and David Stroud (JNCC), J. Whatmough (National Trust) and J.S. Furphy and R.J. Bleakley (DoE (NI) Environment and Heritage Service).

5.12.6 Further sources of information

A. References cited

Cranswick, P.A., Waters, R.J., & Pollitt, M.S. 1995. *The Wetland Birds Survey 1992-1993: wildfowl and wader counts*. Slimbridge, BTO/WWT/RSPB/ JNCC.

Davidson, N.C., & Rothwell, P.I. 1993. Disturbance to waterfowl on estuaries: the conservation and coastal management implications of current knowledge. *Wader Study Group Bulletin, 68:* 97-105.

Grimmett, R.F.A., & Jones, T.T. 1989. *Important bird areas in Europe*. Cambridge, ICBP.

Lack, P. 1986. *The atlas of wintering birds in Britain and Ireland*. Calton, Poyser.

Langston, R. 1990. *The wintering wader and wildfowl populations of Strangford Lough.* Thetford, BTO. (BTO Research Report, No. 56.)

Mathers, R.G. 1995. *The distribution and abundance of pale-bellied brent geese and wigeon on Strangford Lough; the roles of competition, food availability and human activity.* PhD thesis, Queen's University, Belfast.

Moser, M., & Prys-Jones, R.P. 1988. Population estimates, distribution patterns and site estimates for waders wintering on the coast of Northern Ireland. *Irish Birds, 3*: 551-568.

Moser, M., & Summers, R.W. 1987. Wader populations on the non-estuarine coasts of Britain and Northern Ireland: results of the 1984-85 Winter Shorebird Count. *Bird Study, 34:* 71-81.

Northern Ireland Birdwatchers' Association. 1996. *Northern Ireland Bird Report 1994*. Belfast, Northern Ireland Birdwatchers' Association.

Prater, A.J. 1981. *Estuary birds in Britain and Ireland*. Calton, Poyser.

Ridgill, S.C., & Fox, A.D. 1990. *Cold weather movements of waterfowl in western Europe*. Slimbridge, IWRB. (IWRB Special Publication, No. 13.)

Sheppard, R. 1993. *Ireland's wetland wealth*. Dublin, Irish Wildbird Conservancy.

Way, L.S., Grice, P., MacKay, A., Galbraith, C.A., Stroud, D.A., & Pienkowski, M.W. 1993. *Ireland's internationally important bird sites: a review of sites for the EC Special Protection Area network.* Peterborough, Joint Nature Conservation Committee. (Report for DoE (NI) and National Parks and Wildlife Service, Dublin.)

B. Further reading

Brown, R. 1990. *Strangford Lough. The wildlife of an Irish sea lough*. Belfast, The Institute of Irish Studies, The Queen's University.

Ellis, R.J. 1987. The wintering birds of Dundrum Inner Bay, Co. Down. *Irish Birds, 3:* 395-404.

Environment Service, DoE (NI). 1991. *Strangford Lough, a consultation paper*. Belfast, DoE (NI).

Mathers, R.G., & Montgomery, W.I. 1992. Factors affecting the distribution and abundance of wigeon and pale-bellied brent geese on Strangford Lough. *In: Current Ornithological Research in Ireland.* Cork, Second Ornithological Research Conference.

Portig, A.A., Mathers, R.G., Montgomery, W.I., & Govier, R.N. 1994. The distribution and utilisation of *Zostera* species in Strangford Lough, Northern Ireland. *Aquatic Botany, 47:* 317-328.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
High tide and low tide counts of wintering and migrant wildfowl (WeBS)	*WeBS National Organiser (Wildfowl), The Wildfowl & Wetlands Trust, Slimbridge, tel: 01453 890333
High tide counts of wintering and migrant waders (WeBS)	*WeBS National Organiser (Waders), The British Trust for Ornithology, Thetford, tel: 01842 750050
Low tide counts of wintering and migrant waders (WeBS)	*WeBS National Organiser (Low Tide Counts), The British Trust for Ornithology, Thetford, tel: 01842 750050
Northern Ireland Bird Reports	Hon. Secretary, NI Birdwatchers' Association, 12 Belvoir Close, Belvoir Park, Belfast BT8 4PL tel: 01232 693232
Analysis of Strangford Lough bird count data	*The School of Biology and Biochemistry, The Queen's University of Belfast, Belfast, tel: 01232 335786, and *National Trust, Saintfield, tel: 01238 510721
Sites designated for their ornithological interest	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477

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

5.13 Land mammals

Prof. W.I. Montgomery

5.13.1 Introduction

This section deals with land mammals occurring in Region 17 and that are of conservation interest by virtue of their rarity in the UK. Widespread, abundant species are not discussed, except to note their protected status, if any. The terrestrial mammal fauna of Ireland is more limited than that of Britain, Whilde (1993) listing only 29 species in the former compared with 52 in the latter. The relative impoverishment of the fauna may have arisen because a post-glacial land bridge between Britain and Ireland was flooded before it could be crossed by many of the species that were then expanding their range northwards from continental Europe. Of the Irish mammals, perhaps sixteen are native, including seven bat species. It is possible that the present Irish representatives of the red squirrel *Sciurus vulgaris* and the otter *Lutra lutra* are descendants of re-introductions from Britain.

Those mammals occurring along the coast of the region and that are protected under the Wildlife (Northern Ireland) Order 1985 are listed in Table 5.13.1, together with an indication of their abundance in the region; of these, all except four - whiskered bat, Natterer's bat, red squirrel and pine marten - are considered common or widespread in the region. The native mammal assemblage includes two endemic sub-species, the Irish hare *Lepus timidus hibernicus* and the Irish stoat *Mustela erminea hibernia*; there are no statutory protection measures in place for the latter. Of the fourteen species of bat that are found in the British Isles, six have been recorded in Northern Ireland. All British bats are listed under Appendix II of the Bern Convention.

5.13.2 Important locations and species

Much of the coastal zone of Northern Ireland is developed or intensively farmed, but considerable areas of good quality semi-natural habitat remain and many of the more rugged parts are havens for rare mammals. On the north and east coasts of Antrim the presence of high ground claose to the coast isolates a number of lowland areas, such as the Glens of Antrim, that are of particular importance. Significant dune areas, frequented by many mammal species, are found behind Magilligan Strand, Downhill Strand, Portstewart, Bushfoot and White Park Bay on the north coast, and Ballykinler and Murlough on the coast of Dundrum Bay in Co. Down. Important locations for mammal species mentioned in the text are shown on Map 5.13.1.

Map 5.13.1 Locations for terrestrial mammals mentioned in the text. © Crown Copyright.

Table 5.13.1 Mammal species of conservation importance in Northern Ireland

Species	*Estimate of occurrence in the region*	*Protection under the Wildlife (Northern Ireland) Order 1985*
Whiskered bat *Myotis mystacinus*	Infrequent	Schedules 5, 6 and 7
Natterer's bat *Myotis nattereri*	Infrequent	Schedules 5, 6 and 7
Daubenton's bat *Myotis daubentonii*	Common	Schedules 5, 6 and 7
Leisler's bat *Nyctalus leisleri*	Common	Schedules 5, 6 and 7
Pipistrelle *Pipistrellus pipistrellus*	Frequent, widespread	Schedules 5, 6 and 7
Brown long-eared bat *Plecotus auritus*	Common, present on offshore islands	Schedules 5, 6 and 7
Hedgehog *Erinaceus europaeus*	Widespread	Schedules 6 and 7
Irish hare *Lepus timidus hibernicus*	Widespread	Schedule 6
Red squirrel *Sciurus vulgaris*	Local	Schedule 5, 6 and 7
Red fox *Vulpes vulpes*	Common	Schedule 7
Pine marten *Martes martes*	Local, infrequent	Schedules 5, 6 and 7
Badger *Meles meles*	Common	Schedules 5, 6 and 7
Otter *Lutra lutra*	Common	Schedules 5, 6 and 7

Source: The Wildlife (NI) Order 1985. Notes: Schedule 6 lists species that may be killed only under certain circumstances and by certain methods; Schedule 7 lists species that may not be sold alive or dead without a licence.

The otter is the terrestrial mammal that uses the coast most frequently; it also makes extensive use of adjacent land and freshwater. Ireland has one of the densest populations of otters in western Europe (Chapman & Chapman 1982). Locations in the region where otters are present include Lough Foyle, Myroe Level, the River Bann Estuary, Bushfoot, Ballintoy, Island Magee, Helen's Bay, Strangford Lough, Killough Harbour and Dundrum Bay. They have also been recorded along the rugged coastline to the east of the Mourne Mountains. The population appears to have been relatively constant between 1981 and 1990 (Whilde 1993).

Little is known about the major hibernacula of bats in Northern Ireland, although a number of surveys have been carried out. Caves, disused mines, tunnels and tree hollows are all important hibernation sites, and along the Antrim coast there are a few records of sites, including sea caves, that are important to bats. In summer bats use coastal areas that are rich in unimproved grassland and mature trees, especially those around the Antrim and Down coasts. It has long been reported that long-eared bats have a strong affinity for coastal areas; there is a colony on Rathlin Island. Pipistrelles and long-eared bats can be found foraging along woodland edges on the west coast of Strangford Lough, and Natterer's and whiskered bats probably inhabit wooded areas near the coast, such as those at Glenarm, Castleward (Strangford village) and Newcastle.

The last stronghold of the red squirrel population in Northern Ireland occurs along the coastal escarpment of east Antrim, between Murlough Bay and Ballygalley. This habitat, which contains hazel scrub and oak, is commonly adjacent to upland coniferous plantations dominated by Sitka spruce. The red squirrel population extends to a point some 4 km west of Ballycastle. Other, smaller, coastal populations occur on the Ards Peninsula (primarily in estate grounds and gardens) and in the Mourne Mountains (the coniferous plantations from Newcastle to Rostrevor). Red squirrels are also found on the south shore of Lough Foyle.

The Irish stoat has been recorded from Castle Island, Strangford Lough, and from Dundrum. The Irish hare is widespread throughout Northern Ireland (Ulster Wildlife Trust 1993) but rarely reaches densities greater than two per square kilometre. The southernmost tip of Longfield Point, the Causeway Coast, Fair Head, Rathlin Island, Cushleake Mountain, Island Magee, Ards Peninsula, Ballyquintin Point, Kilclief Point, Killard Point and St. John's Point are important sites for the Irish hare. The pine marten is most frequently recorded in Northern Ireland from Co. Fermanagh (outside the coastal region), although there are a very few old records from north-east Antrim and Down. The decline in these coastal records in recent years suggests that only a very small population may remain, in the Killyleagh area of Co. Down.

5.13.3 Human activities

The coastal habitats of Northern Ireland are vulnerable to a variety of human activities. Disturbance can take the form of increased commercial, domestic and recreational use. Strangford Lough, for example, lies within one hour's drive of over half of the population of Northern Ireland, and there has been a marked increase in human activities around the lough over the last 25 years (see also section 9.7). Apparently trivial practices, for example walking dogs or horse riding, can reduce the habitat quality of some areas of the coastal zone, but it is possible to limit the effects by careful timing and zoning of activities. Activities such as aquaculture and wildfowling, and developments such as housing and marinas, are all potential sources of disturbance. Illegal hunting of otters is uncommon, and hares are coursed only infrequently and very locally.

Larger-scale changes are brought about by habitat loss and degradation. Development has had an effect, for example around Belfast Lough, where inner coastal areas are subject to urbanisation and marginal lands have been claimed for industrial development (see also section 8.3). Major habitat losses and changes have occurred through changes in agricultural practice (see also section 8.2). Agricultural intensification has an adverse effect on mammals, particularly bats: the removal of hedgerows and woodland destroys bat roosting and foraging sites as well as reducing shelter (Stebbings 1988). The Irish hare is also vulnerable to changes in agricultural practice, having markedly lower densities where agriculture is most intensive (Dingerkus 1996). Watercourse management throughout Northern Ireland has reduced the biological diversity of both aquatic and riparian habitats and has probably affected otter distributions. Contamination of rivers or the sea by industrial and agricultural effluents reduces habitat quality and biological diversity (see also section 9.6). Otters may be affected by run-off of nitrates from agricultural land and by deterioration in water quality.

Bats are vulnerable to disturbance of roost sites, whether these are in houses, caves, mines or hollow trees, especially during the hibernation period. Large numbers of mines have been capped, preventing access. These sites are very important for hibernation in the winter and nurseries in the summer; entrances should be closed by grilles to allow access by bats.

Coastal populations of red squirrels face the imminent threat of colonisation by the introduced grey squirrel *Sciurus carolinensis*, which has resulted in their decline elsewhere in Britain and Ireland. The grey squirrel is found in many areas of deciduous woodland, but although it has reached the north and east coasts, it is not yet widespread in the coastal zone, occurring in Co. Londonderry from east of Londonderry city to Ballykelly and along the north Down coast from Belfast Lough to about half-way down the Ards Peninsula. At the present rate of spread it will occupy most of coastal Co. Down, including Strangford Lough, within the next 5-10 years. Red squirrels on the south shore of Lough Foyle around Londonderry are threatened by grey squirrel colonisation at Campsie and Muff Glen, and by urban expansion at Enagh Lough and Prehen. These and other vulnerable, isolated red squirrel populations could also be adversely affected by future afforestation, which could also affect pine martens.

5.13.4 Information sources used

The most authorative accounts of the biology of land mammals in the British Isles are in Corbet & Harris (1991) and, more specifically to Ireland, in Fairley (1984). Unlike in Britain there are few published data on mammal distributions in Northern Ireland (Arnold 1993). Recent mammal surveys detailing both distribution and

habitat/land class associations, however, have been completed or are nearly complete for the Irish hare (Dingerkus 1996), red squirrel (Tangney 1996) and bats. Ni Lamhna (1979) and Whilde (1993) are based on relatively casual records accumulated over long periods of time, and must be regarded as far from complete or up-to-date. The land mammals occurring on or close to the coast of Northern Ireland are not well documented, but these records indicate coastal locations likely to be of importance to mammals.

5.13.5 Acknowledgements

Thanks go to M. Tasker (JNCC), Dr D.G. Erwin, J. Whatmough (National Trust), Dr D. McFerran (CEDaR), J. Russ, K. Dingerkus and D. Tangney (Queen's University of Belfast), and D. Hughes (Ulster Wildlife Trust) for comments on a draft of the text.

5.13.6 Further sources of information

A. References cited

Arnold, H.R. 1993. *Atlas of mammals in Britain.* Monks Wood, Institute of Terrestrial Ecology. (Research Publication No. 6.)

Chapman, P.J., & Chapman, L.L. 1982. *Otter survey of Ireland 1980-81*. London, The Vincent Wildlife Trust.

Corbet, G.B., & Harris, S.H., *eds.* 1991. *The handbook of British mammals*. 3rd ed. Oxford, Blackwell Scientific Publications.

Dingerkus, K. 1996. *The distribution of the Irish hare* Lepus timidus hibernicus *in Northern Ireland and its relationship to land classification*. Belfast, Queen's University Belfast. (Game and Wildlife Workshop Proceedings.)

Fairley, J.S. 1984. *An Irish beast book*. 2nd ed. Belfast, Blackstaff Press.

Ni Lamhna, E. 1979. *Provisional distribution atlas of amphibians, reptiles and mammals in Ireland*. 2nd ed. Dublin, Irish Biological Records Centre, An Foras Forbartha.

Stebbings, R.E. 1988. *Conservation of European bats*. London, Christopher Helm.

Tangney, D. 1996. *Distribution and habitat association of the red and grey squirrels in Northern Ireland.* Belfast, Queen's University Belfast. (Proceedings of the second NPI 'Red Alert' Forum.)

Ulster Wildlife Trust. 1993. *Mammal survey of five species*. Belfast, Ulster Wildlife Trust.

Whilde, A. 1993. *Threatened mammals, birds, amphibians and fish in Ireland. Irish Red Data Book 2: vertebrates.* Belfast, HMSO.

B. Further reading

Chanin, P.R.F. 1985. *The natural history of otters*. London, Croom Helm.

Jones, G., & van Parijs, S.M. 1993. Bimodal echolocation in pipistrelle bats: are cryptic species present? *Proceedings of the Royal Society of London, 251:* 119-125.

Kenwood, R.E., Hodder, K.H., & Rose, R.J. 1994. *Conservation of red squirrels*. *Final report.* Huntingdon, Institute of Terrestrial Ecology. (Contract report to Pedigree Pet Foods through WWF, BP Exploration, The Rutland Group of Companies.)

MacDonald, S.M. 1983. The status of the otter *Lutra lutra* in the British Isles. *Mammal Review, 13:* 11-23.

MacDonald, S.M., & Mason, C.F. 1983. Some factors influencing the distribution of otters *Lutra lutra*. *Mammal Review, 13:* 1-10.

National Rivers Authority. 1933. *Otters and river management.* Bristol, NRA. (Conservation Technical Handbook, No. 3.)

Schober, W., & Grimmberger, E. 1987. *A guide to bats of Britain and Europe*. London, Hamlyn.

Stebbings, R.E., & Griffith, F. 1986. *Distribution and status of bats in Europe*. Monks Wood, Institute of Terrestrial Ecology.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Site and species information	*Centre for Environmental Data and Recording (CEDaR), The Ulster Museum, Belfast, tel: 01232 383000
Site and species information	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477
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

R.J. Bleakley

5.14.1 Introduction

Common seals (sometimes known as harbour seals) *Phoca vitulina* are found throughout the region. They are most abundant in the sheltered waters around the Co. Down coast, where Strangford Lough is the main pupping site, with smaller numbers at Ballywalter and Minerstown. Grey seals *Halichoerus grypus* are also present throughout the region. They prefer the more rugged and exposed coasts of Co. Antrim and the open Co. Down coast from the mouth of Belfast Lough to that of Strangford Lough. Table 5.14.1 shows the estimated numbers of grey and common seals in the region in relation to estimated totals for Ireland and the UK. Counts of common seals have varied considerably from year to year since the 1950s, both in Northern Ireland as a whole and at individual sites, so estimated figures are used.

Table 5.14.1 Numbers* of common and grey seals in the region in relation to the rest of UK

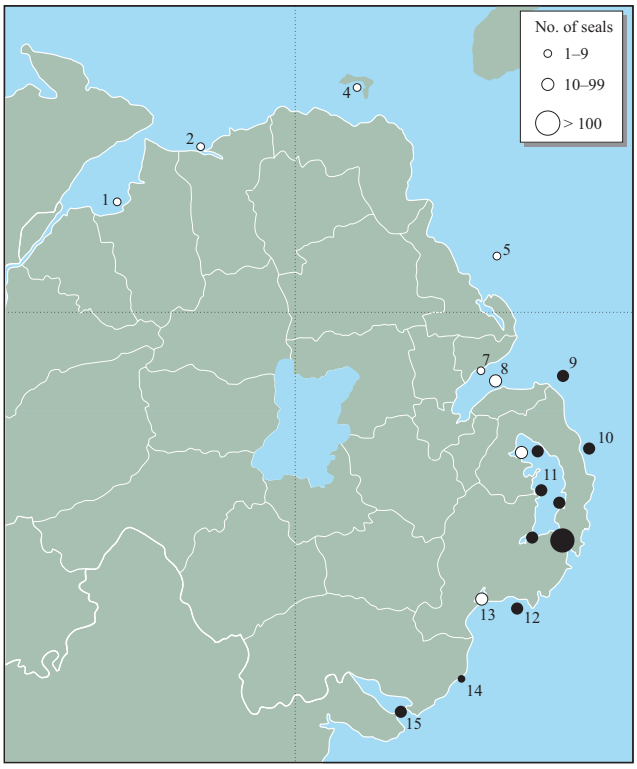
Location	*Common seals*		*Grey seals*	
	*No. of seals**	*% of UK total*	*No. of seals**	*% of UK total*
Region 17	***630***	***2.0***	***430***	***0.4***
All Ireland	1,500-2,000	5.2-7.0	2,390	2.1
UK	28,980	100	115,430	100

Source: various. Key: *approximate estimates from a number of dates.

Both the common and the grey seals of the region appear to be part of large, mobile populations that move to areas around the Irish coast and the west coast of Scotland in which food is plentiful, haul-out and pupping sites are available and levels of disturbance are low. A study of radio-tagged seal pups (Wilson & Corpe 1996) implied that even young seals are capable of moving much further afield than had been thought, but the extent to which there is movement between the region, the Republic of Ireland and Britain is unknown.

5.14.2 Important locations

The main locations of haul-out and pupping sites for common seals are shown on Map 5.14.1 and listed in Table 5.14.2. Numbers of common seals appear to have increased in the 1990s at Rockport, the Copeland Islands and Outer Ards Peninsula, where common seals are most abundant at Ballywalter. The common seal population in Strangford Lough, a stronghold for the species in the region, was estimated at 256 in 1979 (Nairn 1979), rose steadily to 666 adults and 132 pups in 1987, but fell to only 156 adults and 40 pups in 1996, although a further 251 adults and 25 pups were recorded outside the lough. As sightings of common seals off the Antrim coast have increased recently (particularly in 1995-96), this suggests that seals have moved out of Strangford Lough and are using other parts of the coastline. The sandy beaches and sandbars of Dundrum



Map 5.14.1 Common seal distribution in the region in July/August. Circles represent the number of seals at each location (see Table 5.14.2). Filled circles indicate confirmed pupping sites. Source: DoE (NI) Environment and Heritage Service. © Crown Copyright.

Inner Bay are favoured as a moulting area for common seals in the autumn, and large numbers have also been recorded recently at Selk Island near Annalong.

Common seal pups are generally born in late June and early July. Pupping sites include the foreshores of small inshore islands and sheltered rocks and boulders covered at high tide but cut off from the mainland at low tide. Within Strangford Lough islets and intertidal rocks and boulder fields in the Narrows area were the main pupping sites for common seals throughout the 1980s and early 1990s. The Minerstown/Tyrella area in Dundrum Bay proved an important pupping site in 1995, with weaned pups gathering here (Wilson & Corpe 1996).

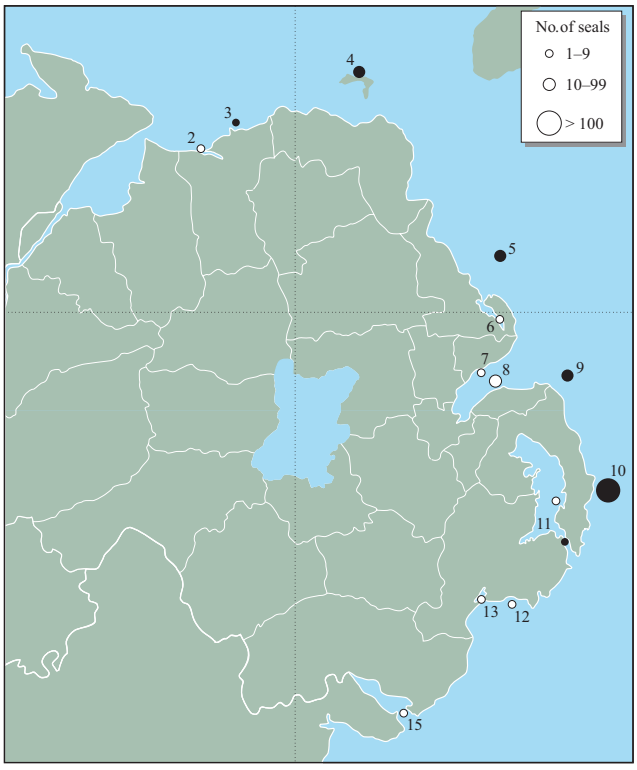
The main locations of grey seal haul-out and pupping sites are shown on Map 5.14.2 and listed in Table 5.14.2. During a 1989 census of Northern Ireland (DoE (NI) unpublished data), 95 grey seals were recorded off the Antrim coast, mostly around Rathlin Island and the Maidens, and 122 off the Co. Down coast, most from around the Copeland Islands, the Outer Ards Peninsula and in Strangford Lough. In 1996, some 250 adults were recorded around Co. Down (pers. comm. from local counters). Assuming numbers around the Antrim coast have at least remained stable, this suggests a marked increase on earlier estimates. Numbers of grey seals appear to have increased in the 1990s at Rockport, the Copeland Islands and the Outer Ards Peninsula, especially at North Rocks.

Table 5.14.2 Seal haul-out and pupping sites in Region 17

Site no. on Map 5.14.1	Location	Grid ref.	Common seals		Count date	Use of site	Grey seals		Count date	Use of site
			Adults (total 630)	Pups[1] (total 100)			Adults (total 430)	Pups[2] (total 30)		
1	Lough Foyle	C630305	<6	-	1989	H	-	-	1989	N/A
2	Bann Estuary	C798358	<6	-	1989	H	1	-	1989	H
3	Skerries to Ballycastle	C870427	-	-	1989	N/A	8	2	1989	H, P
4	Rathlin Island	D130525	<6	-	1996	H	74	8	1996	H, P
5	Maidens	D454115	<6	-	1995	H	70	2	1995	H, P
6	Larne Lough	J455985	-	-	1989	N/A	<6	-	1989	H
7	Green Island	J387853	5	-	1996	H	2	-	1996	H
8	Rockport, Belfast Lough	J433832	26	-	1996	H	24	-	1996	H
9	Copeland Islands	J590845	36	1	1996	H, P	86	3	1996	H, P
10	Outer Ards	J640705	53	5	1996	H, P	131	6	1996	H, P
11	Strangford Lough	J595478	374*	75	1995	H, P	22	9	1995	H, P
12	Minerstown/Tyrella	J498358	62	6	1996	H, P	2	-	1995	H
13	Dundrum Inner Bay	J415354	18**	-	1996	H	4	-	1996	H
14	Selk Island, Annalong	J363175	7	1	1996	H, P	-	-	1996	N/A
15	Carlingford Lough	J238119	49	12	1996	H, P	6	-	1996	H

Sources: counts carried out primarily by staff of DoE (NI) and the National Trust in June and July. Key: [1]actual numbers; [2]estimated numbers; H = haul out; P = pupping; *1995 figures; **rising to around 80 during the autumn moult; N/A = not applicable.

Grey seal pupping takes place largely in September and October but can extend into November or even later. Pupping sites are generally secluded and inaccessible. Around the Antrim coast, isolated coves and sea-caves are chosen as pupping sites, particularly on Rathlin Island and probably the Maidens. Small numbers of pups also appear regularly on islands off the Ards Peninsula and inside Strangford Lough. It is likely that total annual pup production for Northern Ireland does not exceed 30.



Map 5.14.2 Grey seal distribution in the region in July/August. Circles represent the number of seals at each location (see Table 5.14.2). Filled circles indicate confirmed pupping sites. Source: DoE (NI) Environment and Heritage Service. © Crown Copyright.

5.14.3 Human activities

Both seal species are listed in the EC Habitats & Species Directive as species whose conservation may require the designation of Special Areas of Conservation (SACs: see section 7.2). Both seal species are also fully protected under the Wildlife (Northern Ireland) Order 1985, Schedules 5-7, though they may be shot under licence if seen taking fish from 'fixed engine' salmon nets. Seals have long been suspected of competing with man for fish, but the evidence remains controversial. In Northern Ireland only the operators of 'fixed engine' salmon nets are licensed to cull seals. Over recent years returns from salmon netters indicate that around 50 seals have been shot annually under licence (J. Milburne pers. comm.). Most are grey seals, though there appears to have been a recent increase in the proportion of common seals. Numbers of both species have increased since they were given protection.

Seals suffer from disturbance caused by increased human activity at haul-outs. The intensity of salmon-netting and oyster dredging in Lough Foyle virtually excludes seals from the lough for most of the year, though fishermen do report seal damage. In Co. Down disturbance from fishermen or from those gathering dulse *Palmaria palmata* may also cause seals to take to the water. Disturbance is often associated with recreation - boating, canoeing, jetskiing, shorewalking, winkle-picking, jogging and, in some cases, wildlife watching itself. In Strangford Lough the public has been asked to observe a code of conduct. A three year study (Wilson 1995; Wilson & Corpe 1996) demonstrated that, in most instances, disturbance was only a minor factor in the fall in seal numbers in the lough, which was attributed mainly to low levels of their preferred food. It is likely that the seals that have deserted the lough have relocated to other areas, such as Dundrum Bay, where suitable food is more plentiful. At Dundrum Inner Bay disturbance has been greatly reduced by an information campaign.

In 1988 and 1989 large numbers of common seals throughout Western Europe died of phocine distemper virus (morbillivirus) (Kennedy *et al.* 1989). More than 200 corpses were discovered around the coast of Northern Ireland (DoE (NI) pers. comm.). There were fears that chemical contaminants might have rendered seals more vulnerable to the virus; however, studies showed that levels of polychlorinated biphenyls (PCBs) and DDT were relatively low compared with North Sea levels (Mitchell & Kennedy 1992; Hall *et al.* 1992). Other chlorinated hydrocarbons were present in similarly low concentrations, suggesting that organochlorine contamination is at too low a level to threaten the health of the Northern Ireland seal population. Mercury levels were thought to be high enough to affect some animals' health but there was no clear link with any susceptibility to the distemper virus.

5.14.4 Information sources used

In addition to the sources from the scientific literature (Venables & Venables 1960; Lockley 1966; Nairn 1979; Summers *et al.* 1980), the DoE (NI) Environment Service Wardens' Annual Reports (unpublished) have been accessed for the years 1985/86 - 1994/95. Also accessed was direct information from counters for 1995 and 1996, and Wilson & Corpe (1996). Wardens' Annual Reports for 1987/88 and 1988/89 chronicle the mortalities recorded during the morbillivirus epidemic.

5.14.5 Acknowledgements

Thanks are due to staff of DoE (NI) Environment and Heritage Service, in particular to Judith Montgomery, Dr Shaun D'Arcy-Burt, Stephen Foster, David Mitchel, John Greer, Ian Irvine, James McAvoy, Darrell Stanley, Dr Michael Meharg and John Milburne; to Dr Susan Wilson and Dr Heather Corpe; and to National Trust staff David Thompson, David Andrews, Eric Rainey, Hugh Thurgate and Jo Whatmough.

5.14.6 Further sources of information

A. References cited

Department of the Environment for Northern Ireland. 1985/86 - 1994/95. *Wardens' annual reports*. Belfast, DoE (NI) (unpublished).

Hall, A.J., Law, R.J., Wells, D.E., Harwood, J., Ross, H.M., Kennedy, S., Allchin, C.R., Campbell, L.A., & Pomeroy, P.P. 1992. Organochlorine levels in common seals (*Phoca vitulina*) which were victims and survivors of the 1988 phocine distemper epizootic. *The Science of the Total Environment, 115*: 145-162.

Kennedy, S., Smyth, J.A., Cush, P.F., Duignan, P., Platten, M., McCullough, S.J., & Allen, G.M. 1989. Histopathologic and immunocytochemical studies of distemper in seals. *Veterinary Pathology, 26*: 97-103.

Lockley, R.M. 1966. The distribution of grey and common seals on the coasts of Ireland. *Irish Naturalists' Journal, 15*: 136-143.

Mitchell, S.H., & Kennedy, S. 1992. Tissue concentrations of organochlorine compounds in common seals from the coast of Northern Ireland. *The Science of the Total Environment, 115*: 163-177.

Nairn, R.W.G. 1979. The status and conservation of the common seal *Phoca vitulina* (L.) in Northern Ireland. *Irish Naturalists' Journal, 19*: 360-363.

Summers, C.F., Warner, P.J., Nairn, R.W.G., Curry, M.G., & Flynn, J. 1980. An assessment of the status of the common seal *Phoca vitulina vitulina* in Ireland. *Biological Conservation, 17*: 115-123.

Venables, U.M., & Venables, L.S.V. 1960. A seal survey of Northern Ireland. *Proceedings of the Zoological Society of London, 133*: 494.

Wilson, S.C. 1995. *The effects of human disturbance of seals in Co. Down. A preliminary study - 1994.* Belfast, DoE (NI) Environment Service.

Wilson, S.C., & Corpe, H. 1996. *An investigation into the status of the harbour seals of Co. Down, Northern Ireland.* Belfast, DoE (NI) Environment and Heritage Service.

B. Further reading

Brown, R.A. 1990. *Strangford Lough. The wildlife of an Irish sea lough*. Belfast, The Institute of Irish Studies.

Harwood, J. 1989. Lessons from the seal epidemic. *New Scientist, 18.2.89*: 38-42.

Irish Sea Study Group. 1990. *The Irish Sea - an environmental review. Part 2 - waste inputs and pollution*. Liverpool, Liverpool University Press.

Kennedy, S. 1990. A review of the 1988 European seal morbillivirus epizootic. *Veterinary Record,* 127: 563-567.

Kennedy, S., Smyth, J.A., Cush, P.F., McCullough, S.J., Allan, G.M., & McQuaid, S. 1988. Viral distemper now found in porpoises. *Nature, 336*: 21.

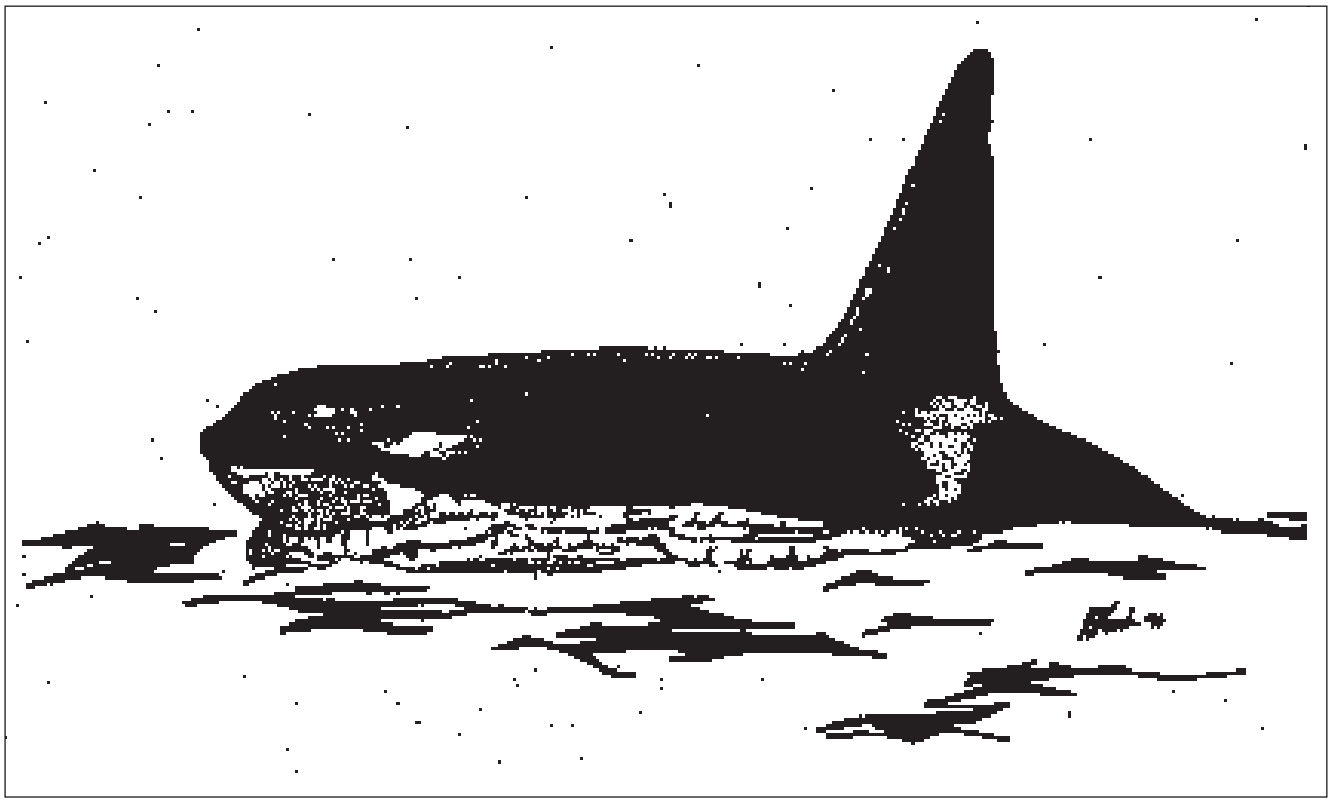
Pierce, G.J., Boyle, P.R., & Thompson, P.M. 1990. Diet selection by seals. *In: Trophic relationships in the marine environment. Proceedings of the 24th European marine biological symposium*, ed. by M. Barnes & R.M.Gibson, 222-238. Aberdeen University Press.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Seal records	*Centre for Environmental Data and Recording (CEDaR), The Ulster Museum, Belfast, tel: 01232 383000
Seal count data for Co. Down	The Warden, Quoile Countryside Centre, 5 Quay Road, Downpatrick BT30 5JB, tel: 01396 615520
Seal count data for Co. Antrim	The Warden, Portrush Countryside Centre, 8 Bath Road, Portrush, Co. Antrim BT56 8AP, tel: 01265 823600
Seal count data at National Trust sites	*Conservation Officer, The National Trust, Saintfield, tel: 01238 510721
Wardens' Annual Reports and other commissioned reports	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477

Type of information	*Contact address and telephone no.*
Seal numbers and distribution around GB	Callan Duck, Sea Mammal Research Unit, Gatty Marine Laboratory, University of St. Andrews, Fife KY16 8LB, tel: 01334 476161
Seal conservation and rehabilitation	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477
Seal ecology and behaviour	*Dr S.C. Wilson, Queen's University Belfast, School of Biology & Biochemistry, Belfast, tel: 01232 335786
Phocine organochlorine & heavy metal levels	*Dr S.H. Mitchell, DANI Agricultural and Food Science Service, Belfast, tel: 01232 250666
Phocine virology	Dr S. Kennedy, Veterinary Research Laboratories, Stormont, Belfast BT4 3 SD, tel: 01232 520011

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



The killer whale *Orcinus orca* is an occasional summer visitor to the seas off Northern Ireland, one of fifteen different cetacean species that are present here throughout the year or appear regularly. Drawing: Ian Reach, JNCC.

5.15 Whales, dolphins and porpoises

Dr P.G.H. Evans

5.15.1 Introduction

Northern Ireland is moderately rich in cetaceans (whales, dolphins and porpoises). Fifteen 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, six species (22% 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*, common dolphin *Delphinus delphis*, bottlenose dolphin *Tursiops truncatus* and minke whale *Balaenoptera acutorostrata*, with Risso's dolphin *Grampus griseus* and killer whale *Orcinus orca* recorded occasionally. Further offshore, the common dolphin is the most abundant species. For geographical comparisons of sightings rates for various cetacean species in UK waters, see Evans (1990, 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 also section 7.2).

5.15.2 Important locations and species

Table 5.15.1 summarises recorded sightings of cetacean species in the region. Other cetacean species recorded in the region include fin whale *Balaenoptera physalus*, sperm whale *Physeter macrocephalus*, Sowerby's beaked whale *Mesoplodon bidens*, Gervais beaked whale *Mesoplodon europaeus*, northern bottlenose whale *Hyperoodon ampullatus*, long-finned pilot whale *Globicephala melas*, striped dolphin *Stenella coeruleoalba*, white-beaked dolphin *Lagenorhynchus albirostris* and white-sided dolphin *Lagenorhynchus acutus*. Maps 5.15.1 to 5.15.4 show the distribution in the area of sightings records collected by the Sea Watch Foundation for the minke whale, harbour porpoise, bottlenose dolphin and common dolphin respectively.

Headlands and the sounds between islands are the most favoured localities for cetaceans in coastal waters of the region. Several cetacean species, including killer whale and Risso's dolphin, have been seen from Rathlin Island, and both harbour porpoises and bottlenose dolphins are seen regularly from the vicinity of Copeland Island and the entrance to Belfast Lough. Harbour porpoises are widespread in the region (Map 5.15.1), although usually only in small numbers. They have been recorded in most months of the year but with peak sightings between July and October. Bottlenose dolphins are present in small numbers, occurring in groups rarely exceeding 30 individuals (Map 5.15.2). They have been seen in most months of the year but with peak numbers and frequency of sightings occurring in spring (April) and early autumn (August - September), possibly reflecting a seasonal migration in and out of the Irish Sea.

Minke whales are seen in summer in the North Channel and to the north of Co. Antrim, although usually nearer the south-west Scottish coasts (Map 5.15.3). The common dolphin is the most abundant species offshore, occurring in groups of 10-100, mainly between May and September. It has been recorded particularly in the waters north-west of Co. Antrim towards the Stanton Banks (Map 5.15.4). Risso's dolphins are uncommon though regular in the region, occurring in groups of 5-20 individuals between March and September.

Since 1980 the following ten species of cetaceans have been recorded as strandings on the Northern Ireland coast: striped dolphin, white-sided dolphin, Risso's dolphin, common dolphin, bottlenose dolphin, white-beaked dolphin, harbour porpoise, pilot whale *Globicephala melas*, minke whale and sperm whale (Irish Naturalists Journals October editions 1980 - 1995).

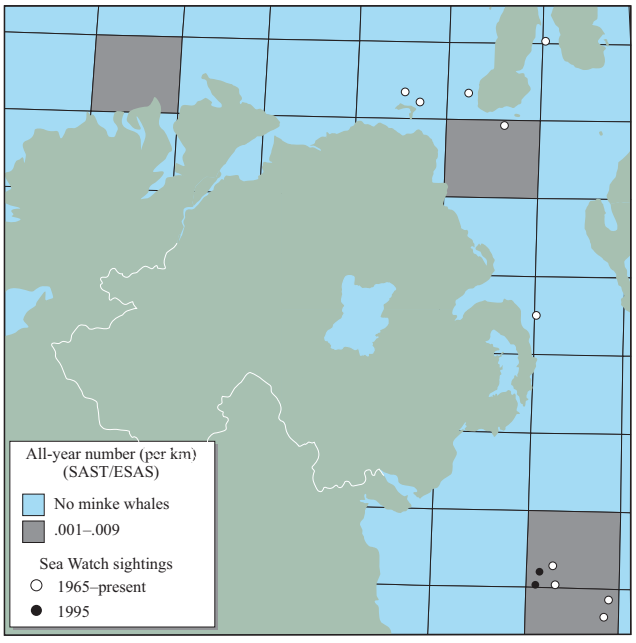
5.15.3 Human activities

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

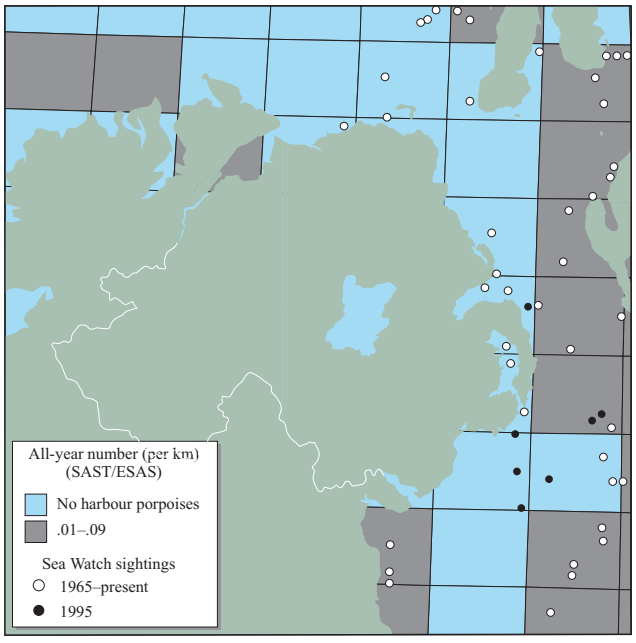
There is an active fishing industry operating out of several ports in the region (see section 9.1). There are few reports of small cetaceans in the region being killed accidentally in fishing gear, and these all involve harbour porpoise; actual figures on catch levels are not available (Northridge 1988; Evans 1993). A variety of fisheries can result in accidental capture of cetaceans, but the greatest

Table 5.15.1 Cetacean species recorded in the region since 1980

Species	*Status, distribution and seasonal occurrence*
Minke whale *Balaenoptera acutorostrata*	Uncommon in the north-west Irish Sea and North Channel, occurring mainly between July and October
Harbour porpoise *Phocoena phocoena*	Widely distributed in small numbers in the North Channel and nearshore Northern Irish waters, mainly between July and October
Bottlenose dolphin *Tursiops truncatus*	Present in small numbers in most months of the year, but with peak numbers and frequency of sightings in April and August to September
Common dolphin *Delphinus delphis*	Widely distributed and fairly common, though mainly offshore. Peak numbers and frequency of sightings between May and September.
Risso's dolphin *Grampus griseus*	Uncommon, occurring mainly between March and September
Killer whale *Orcinus orca*	Uncommon, occurring mainly between May and September



Map 5.15.1 Harbour porpoise: 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)). © Crown Copyright.



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

Map 5.15.3 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)). © Crown Copyright.

Map 5.15.4 Common 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)). © Crown Copyright.

impact in UK waters appears to come from bottom-set gill nets, including tangle nets and nets set around wrecks, most frequently affecting harbour porpoises and common dolphins. Purse seine and mid-water trawling can also lead to by-catches, and creel lines sometimes entangle minke whales.

There is no information on contaminant levels in cetaceans from the region. However, a morbillivirus infection was found in three harbour porpoises stranded on the coast of Co. Down in 1988 (Kennedy *et al.* 1988).

There are few holiday resorts in the region, the major ones being Portrush, Bangor and Newcastle (see section 9.7). Other ports with recreational activities such as the use of speedboats include Londonderry, Portstewart, Portrush, Larne, Carrickfergus, Donaghadee, Portaferry and Whiterock. Such vessels pose threats of direct physical damage from collisions as well as disturbance from the high frequency noise they generate (Evans *et al.* 1992). Codes of conduct for boat users have been produced (e.g. Sea Watch Foundation & UK Mammal Society 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 minke and other baleen whale species than with dolphins and porpoises (Richardson *et al*. 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 (as part of oil and gas exploration) involve low frequencies (20-500 Hz) and therefore are most likely to affect baleen whales, e.g. minke whale, which communicate at these frequencies. Nevertheless, recent studies indicate that other cetaceans may also be disturbed by seismic surveying, as they are sighted less frequently, either acoustically or visually, during seismic surveys (Goold 1996). It is possible that porpoises are affected (Baines 1993), perhaps indirectly by changing the distribution of their fish prey (Evans 1996).

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 (Evans 1992) and the strandings schemes organised by the Ulster Museum (T. Bruton) and the Natural History Museum in London (1913 - present) (Sheldrick *et al*. 1994). Systematic land-based watches have been carried out occasionally from Rathlin Island. Sea-based coverage is poor, but dedicated surveys of the region were conducted by Sea Watch Foundation in July and August 1995, and opportunistic sightings have been provided from the Stranraer to Larne ferry, the '*Song of the Whale*', belonging to International Fund for Animal Welfare, and the '*Marguerite Explorer*' run by Western Isles Sailing Company. Sightings effort has been highest between the months of April and September, when sea conditions are also usually best. Information on cetacean strandings can be found in each October edition of the Irish Naturalists' Journal.

5.15.5 Acknowledgements

Thanks are due to I. Grant and J. Heimlich-Boran for help in the preparation of the maps, and to all those persons who have contributed valuable sightings data, particularly the systematic observations provided by S. Hartley, E. Lewis, C. McLeod, C. Swann, M. Tasker and A. Webb, and the staff of the Stranraer to Larne ferry. The information on cetacean strandings was collated by WS Atkins - Northern Ireland. Thanks are also due to Alan Kilgore (Newry and Mourne District Council), R.J. Bleakley (DoE (NI)) and Dr D.G. Erwin for their useful comments on the draft.

5.15.6 Further sources of information

A. References cited

Baines, M.E. 1993. *Marine mammal monitoring during the seismic exploration of block 107/21 in Cardigan Bay, Autumn 1993.* Haverfordwest, Dyfed Wildlife Trust.

Evans, P.G.H. 1990. Whales, dolphins and porpoises. The order Cetacea. *In: Handbook of British mammals,* ed. by G.B. Corbet & S. Harris, 299-350. Oxford, Blackwell.

Evans, P.G.H. 1992. *Status review of cetaceans in British and Irish waters.* Oxford, Sea Watch Foundation. (Report to the Department of the Environment.)

Evans, P.G.H. 1993. *Cetacean bycatches in UK & Ireland*. Oxford, Sea Watch Foundation. (Discussion paper for MAFF Bycatch Working Group.)

Evans, P.G.H. 1996. Human disturbance of cetaceans. *In: Exploitation of mammals,* ed. by N. Dunstone & V. Taylor, 376-394. London, Chapman & Hall. .

Evans, P.G.H., Canwell, P.J., & Lewis, E.J. 1992. An experimental study of the effects of pleasure craft noise upon bottle-nosed dolphins in Cardigan Bay, West Wales. *In: European research on cetaceans - 6,* ed. by P.G.H. Evans, 43-46. Cambridge, European Cetacean Society.

Evans, P.G.H., Carson, Q., Fisher, P., Jordan, W., Limer, R., & Rees, I. 1994. A study of the reactions of harbour porpoises to various boats in the coastal waters of SE Shetland. *In: European research on cetaceans - 8,* ed. by P.G.H. Evans. Cambridge, European Cetacean Society.

Goold, J.C. 1996. Acoustic assessment of populations of common dolphins *Delphinus delphis* in conjunction with seismic surveying. *Journal of the Marine Biological Association of the UK, 16:* 811-820.

Kennedy, S., Smyth, J.A., Cush, P.F., McCullough, S.J., Allan, G.M., & McQuaid, S. 1988. Viral distemper now found in porpoises. *Nature, 336:* 21.

Natural History Museum. 1990-present. *Annual reports*. London, Natural History Museum.

Northridge, S. 1988. *Marine mammals and fisheries*. London, Wildlife Link. (Unpublished report.)

Northridge, S., Tasker, M.L., Webb, A., & Williams, J.M. 1995. Seasonal distribution and relative abundance of harbour porpoises *Phocoena phocoena* (L.), white-beaked dolphins *Lagenorhynchus albirostris* (Gray) and minke whales *Balaenoptera acutorostrata* (Lacepède) in the waters around the British Isles. *ICES Journal of Marine Science*, *52*(1): 55-56.

Richardson, W.J., Greene, C.R. Jr., Malme, C.I., & Thomson, D.H. 1995. *Marine mammals and noise.* San Diego, California, USA, Academic Press.

Sea Watch Foundation & UK Mammal Society. 1992. *Dolphin code of conduct*. Oxford, Sea Watch Foundation & UK Mammal Society.

Sheldrick, M.C., Chimonides, P.J., Muir, A.I., George, J.D., Reid, R.J., Kuiken, T., Iskjaer-Ackley, C., & Kitchener, A. 1994. Stranded cetacean records for England, Scotland and Wales, 1987-1992. *Investigations on Cetacea, 25:* 5-28.

B. Further reading

Evans, P.G.H. 1987. *The natural history of whales and dolphins*. London, Christopher Helm.

Evans, P.G.H. 1990. European cetaceans and seabirds in an oceanographic context. *Lutra*, *33*: 95-125.

Kuiken, T., Bennett, P.M., Allchin, C.R., Kirkwood, J.K., Baker, J.R., Lockyer, C.H., Walton, M.J., & Sheldrick, M.C. 1994. PCBs, cause of death and body condition in harbour porpoises *Phocoena phocoena* from British waters. *Aquatic Toxicology, 28:* 13-28.

Lee, A.J., & Ramster, J.W. 1981. *Atlas of the seas around the British Isles*. Lowestoft, MAFF.

Pingree, R.D., & Griffiths, D.K. 1978. Tidal fronts on the shelf seas around the British Isles. *Journal of Geophysical Research, 83*: 4,615-4,622.

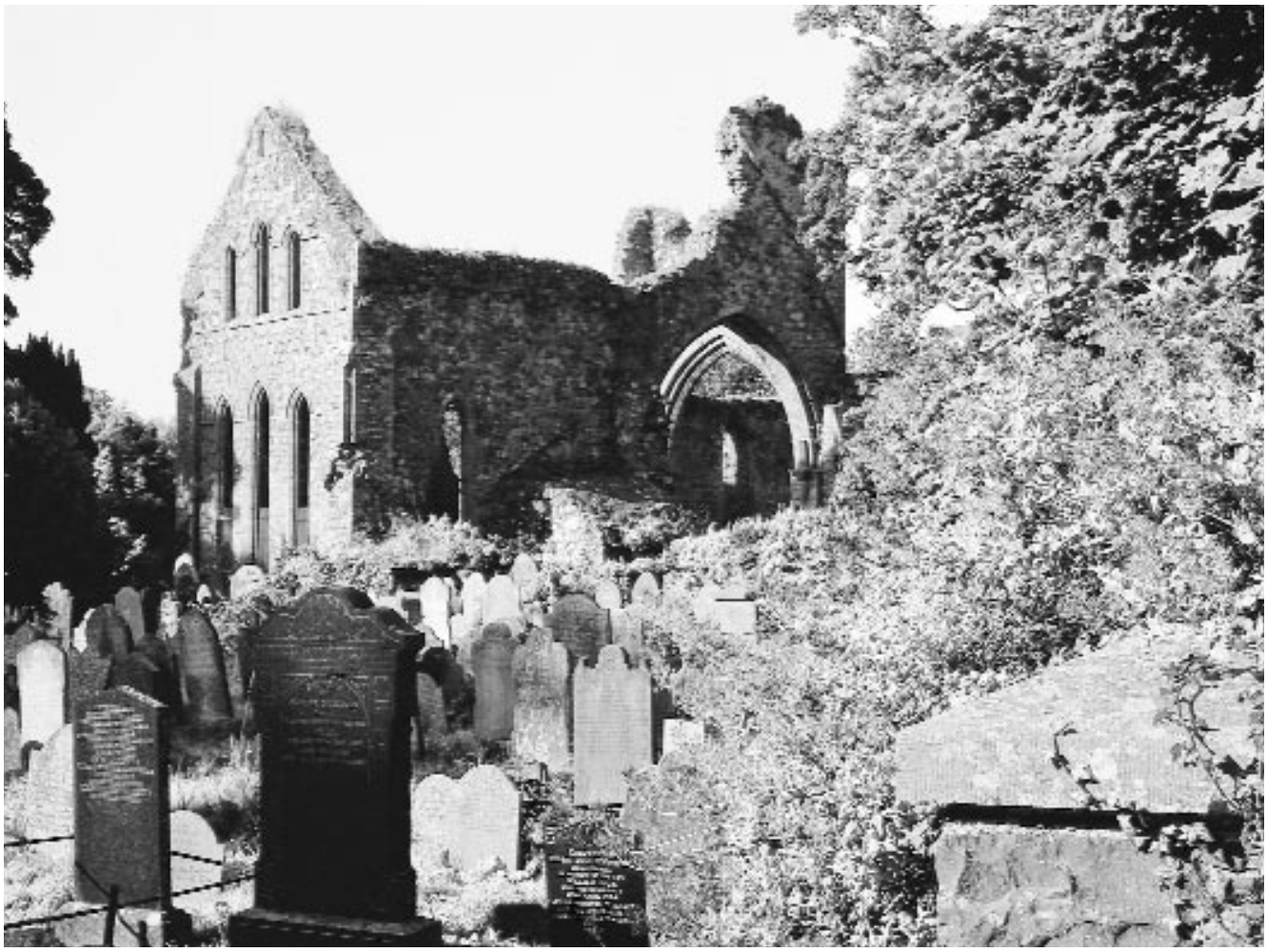
Simpson, J.H. 1981. The shelf-sea fronts: implications of their existence and behaviour. *Philosophical Transactions of the Royal Society of London, A302:* 532-546.

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

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Cetacean sightings & surveys	Dr P.G.H. Evans, Sea Watch Foundation, c/o Dept. of Zoology, University of Oxford, South Parks Road, Oxford OX1 3PS, tel: 01865 727984
Cetacean sightings and surveys	*Seabirds & Cetaceans Team, JNCC Aberdeen, tel: 01224 655702
Cetacean sightings and surveys	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477
Cetacean organochlorine & heavy metal levels	Dr R.J. Law, Centre for Environment, Fisheries & Aquaculture Sciences Burnham-on-Crouch Laboratory, Remembrance Avenue, Burnham-on-Crouch, Essex CM0 8HA, tel: 01621 787200
Cetacean virology	Dr S. Kennedy, Veterinary Research Laboratories, Stormont, Belfast, Northern Ireland, tel. 01232 760011
Cetacean strandings	Dr D. George & A. Muir, Natural History Museum, Cromwell Road, London SW7 5BD, tel: 0171 938 8861
Cetacean strandings	*T. Bruton, The Ulster Museum, Belfast, tel: 01232 383000
Cetacean strandings	R.J. Reid & H.M. Ross, SAC Veterinary Investigation Pathology Centre, Stratherrick Road, Inverness IV2 4JZ, tel: 01463 243030

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



Christianity was probably introduced into Northern Ireland around the 5th century. However, the Cistercian foundation of Greyabbey, on the eastern shore of Strangford Lough, was not built until the late 12th and early 13th centuries. It and its sister house at Inch, on the Quoile Estuary, were established by John de Courcy and his wife, after the conquest of the eastern counties of Ulster by the Normans. Photo: Mike Hartwell, DoE (NI) EHS.

Chapter 6 History and archaeology

M. McAuley

6.1 Introduction

This chapter provides an introduction to the archaeology of the region, gives information on the provisions for safeguarding known and unknown sites, and describes the extent of survey work and how to report new discoveries. For this section the terrestrial limit of the coastal region is taken as 300 m landward of the high water mark. Places named in the text are shown on Map 6.1.1; those that are scheduled monuments are numbered and listed in Table 6.3.1.

The physical remains of the human past - archaeological evidence - are an integral and irreplaceable part of the coastal resource. Archaeological sites, whether discrete or part of wider landscapes, are fragile, and those not yet located can unwittingly be destroyed. The distribution of known sites is biased by the uneven spread of survey work, and the discovery and scientific investigation of new sites is vital to developing a full picture of the past. In Northern Ireland there is growing recognition that in order to reconstruct as complete a picture as possible of the past it is not enough to concentrate on terrestrial archaeological sites: it is also necessary to investigate archaeological evidence from both intertidal and subtidal environments. To effect such a seamless approach, analysis of archaeological material, wherever it occurs, must be treated as a continuum rather than discretely according to its environmental origin. The coastal zone is a dynamic environment - constantly altering, whether shrinking through erosion, inundation and the artificial removal of material, or expanding through accretion, development and land claim. It has long been recognised that archaeology in the coastal zone has an important role to play not only in dating sea level and other environmental changes (usually in conjunction with palaeoecological evidence), but also in providing information on how human activities have affected the coastline. It is clear from the evidence so far obtained that the marine archaeological resource, although yet to be fully quantified, will have a significant bearing on a discipline previously preoccupied with land-based remains, particularly since such sites may be much better preserved than their terrestrial counterparts (Coles 1987).

Although the region's ancient monuments have been central to local tradition and folklore for centuries, it is only in the last century that physical evidence about the people who built them has been collected, studied and managed on a systematic and scientific basis. Coastal habitats are and were economically and defensively crucial to the island people of Ireland. For the inhabitants of the region's varied coastal zone, proximity to the sea in the past not only ensured a reliable food source but also meant easy access to the main communication and trade routes. For these reasons people have exploited the coastal zone from their arrival to the present day, depositing much archaeological material in the process. Sites and artefacts from every

Map 6.1.1 Archaeology: some locations mentioned in the text. Numbers refer to sites in Table 6.3.1. © Crown Copyright.

period from the Mesolithic to the medieval and beyond have been found here. Some sites have been buried under peat or sand dunes, others have been eroded by the elements, while others have subsided into the sea: sample calculations indicate that half of all located sites survive as upstanding monuments while the other half comprise located but destroyed monuments and sites which have been identified from aerial photographs. Documentary and oral sources provide information about site and monuments that can no longer be exactly located. All this evidence suggests that as agriculture and technology developed, so too did a clear preference for the lower-lying more fertile land edging the coastal region and running inland along river valleys. Lowland settlements were also less exposed than those in the mountains and hills of the Antrim Plateau or the Mournes, where travel, communication and trade were restricted by the difficult terrain. Even up until the early part of this century, travel by boat was preferable to over-land travel in many parts of north-east Antrim.

Until recently, intertidal archaeological evidence was predominantly artefactual, centring on finds from beaches at low tide or from the adjacent dunes. Given the Mesolithic peoples' reliance on the sea for food and the beach for flint,

it is not surprising that tools from this period are the most common intertidal finds. A small number of littoral occupation sites at the periphery of the intertidal zone, such as middens and dune settlements, have been identified and these sites have significantly added to our understanding of past exploitation of the area between high and low water marks. By combining data from all these sources with the results of palaeoenvironmental analysis it has proved possible to reconstruct past landscapes, outline a sea-level change chronology, and examine human effects on a particular catchment area.

Aside from cartographic evidence, there are few documentary records of subtidal archaeological remains from any period, and the only other source of information is local tradition, which tends to focus on wreck sites like that of the *L'Amité*, which sank near Ardglass in Co. Down in 1797, and that of the French Privateer the *Dei Sei*, which sank off Dunluce in Co. Antrim in 1782. Ship losses have been chronicled since the early annals, but are incomplete prior to 1660 (Woodward 1989). After this date extensive Admiralty and customs records as well as Lloyd's List, State and Parliamentary Papers and documents in the Public Record Office provide a more comprehensive picture of losses (Appleby 1989). Whilst the wreck of the *Girona* is the oldest located subtidal site, boats have been in use for over 8,000 years and earlier examples must survive awaiting discovery. Linking these early vessels with other underwater remains will shed further light on prehistoric maritime trade networks and seafaring communities.

Early Christian foundations played a very important part in life at the time in Northern Ireland. Nendrum Monastery, on Mahee Island, with its three concentric stone walls, remains of a round tower, graveyard and hut foundations, with evidence of two landing stages, a fish trap and a possible jetty close by, demonstrates that such sites were multi-functional centres for entire communities. Photo: Mike Hartwell, DoE (NI) EHS.

6.2 History and archaeology of the region

6.2.1 Colonisation (Mesolithic)

Current evidence indicates that after the end of the last Ice Age, about 9,000 years ago, the first colonists arrived in Ireland, probably coming by boat from the western shores of Britain. At this time the country was covered with dense forest and the most inviting areas of habitation were along the coastline and the edges of rivers and lakes. The Mesolithic hunters, fishers and gatherers appear to have lived in small groups comprising several families, who set up temporary camps. In order to obtain sufficient food all year round they probably had to move to different locations as the seasons changed. Their presence is usually indicated by stone tools or waste from tool manufacture, usually flint. The importance of this raw material is reflected in the number of Mesolithic sites found along the north-east coast, close to flint-bearing chalk outcrops such as at Cushendun and Glenarm. The fact that food sources were equally if not more important than tool material is demonstrated by the density of Mesolithic sites around the edges of Strangford Lough, where there is no naturally occurring flint, except as an occasional constituent of glacial till.

At that time sea level was perhaps 20-25 m below the present level, although it was rising at an average rate of some 6 mm per year (Carter 1990). As a result the coastal plain was shrinking and islands were being inundated. Clearly some Mesolithic sites that were originally on land are now either in the intertidal zone, sealed beneath alluvial layers, or on the sea bed. During a recent intertidal survey of Strangford Lough a submerged prehistoric forest was identified and Mesolithic tools were found, not only along the lough shores in the intertidal zone, but also in marine contexts around some of the many islands in the lough. These islands were created when the rising sea level flooded a drumlin field.

Around 5,500 BC the microlithic tools of the earliest Mesolithic peoples began to be replaced by much larger flaked tools, and many sites from this later period can be found in the coastal region, particularly in the raised beaches along the Antrim Coast, which are about 8 m above present sea level (Mallory & McNeill 1994). At Curran Point, in Larne, 15,000 worked flints showing wave damage were recovered from the raised beach in 1935 (Mitchell 1970). More recently a rare greywacke example of a long stone club associated with this later period was found by chance on the shore at St. John's Point in Co. Down (Mallory & McNeill 1994).

Peat outcrops in the intertidal zone, like that at Mill Strand in Portrush, which was radiocarbon dated to about 5,000 BC (Wilson & Carter 1990), could potentially have sealed deposits containing Mesolithic material, although very few such deposits have been identified to date. In the Bann Estuary geomorphological information combined with archaeological evidence has been used to reconstruct and date environmental changes. Evidently there were four main phases of sand dune accumulation in the estuary and human occupation occurred only during stable periods between the major sand movements. These findings contrast starkly with those from Murlough in Co. Down, which indicate that there was a single major sand deposition prior to 3,000 BC and that the dune system, which had remained relatively static until around 1 AD, was occupied on an almost continuous basis during this period (Wilson 1995).

6.2.2 Farmers, potters and tomb builders (Neolithic)

Around 4,500 BC the first farmers arrived, sailing across the North Channel, bringing with them seed corn and livestock. It was these Neolithic people who introduced cattle, sheep, goats and pigs, as well as pottery, and who built the megaliths - the great stone tombs. Very few of their settlements or houses have been identified; however, at Goodland in Co. Antrim an enigmatic site comprising a small ditch and over 170 pits was found underneath blanket bog (Case 1973). Additionally at White Park Bay in Co. Antrim, a Neolithic occupation layer complete with traces of round houses and associated megaliths (including one in the Bay itself) was uncovered among the dunes following a storm (Williams 1990). Neolithic pottery and tools have been found in a similar context in the sand dunes of Dundrum Bay in Co. Down (Collins 1959).

Neolithic people were reliant on stone tools and so continued to exploit the same flint reserves as their predecessors, leaving remains of production sites dotted along the Antrim Coast, notably at Cushendun, Madman's Window (near Glenarm) and Island Magee. They also manufactured polished stone axes from porcellanite extracted either at Brockley on Rathlin Island or at Tievebulliagh near Cushendall in Co. Antrim. Evidence for extensive Neolithic trade networks is suggested by finds of these polished axes in places as far away as Aberdeenshire, Dorset and Kent. The axes were probably used to clear the vast forests and open up the land for crop growing and animal husbandry. Examples of all four megalithic tomb types - court tombs, portal tombs, passage tombs and wedge tombs - can be found in or near the coastal region. Two Co. Down megaliths, a dual court tomb at Audleystown and a cairn in Millin Bay, have been excavated. The dual court tomb yielded over 30 burials, while at Millin Bay some of the stones were decorated with incised ornament reminiscent of passage tomb art. Megaliths may also have served as territorial or route markers, or perhaps even as navigation aids for those crossing the Irish Sea (Corcoran 1972).

Some indication of a late sea-level rise during the Neolithic can be gleaned from the results of an excavation at Ringneill Quay in Co. Down, where a Neolithic horizon containing charcoal was identified sealed beneath raised beach material. By radiocarbon dating it was discovered that sea level here had peaked at least 2 m above the present level (Mitchell 1970).

In 1996 the remains of a Neolithic period house were found on the top of a hill in Ballyharry on Island Magee in Co. Antrim. The house is very similar in size to a modern

bungalow, measuring 12 m x 6 m, and finds of pottery, flint tools and stone axes are prolific around the site. Evidence of coastal trade with the English Lake District is apparent, with finds of stone axes from the Great Langdale axe factory. What may be a second house nearby awaits investigation.

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

Metalworking in the region began around 2,500 BC, at the same time as new forms of ceramics were being introduced and a new funerary practice became prevalent. Collective burial in great stone tombs was replaced by individual burials in stone boxes (cists) sunk in the ground and covered with a round mound of earth or stone. Often these burials were cremations placed inside inverted urns and were accompanied by metal objects such as weapons or jewellery. Bronze Age funerary ware has been recovered from sandhill sites along the north Antrim coast and from Mount Stewart and Portaferry, both in Co. Down. Settlement evidence is rare and most Bronze Age information is derived from burial or ritual monuments like standing stones, such as the one at Ballyhalbert in Co. Down. There is, however, a Bronze Age settlement at Bay Farm near Carnlough in Co. Antrim, and some of the houses in White Park Bay could be of Bronze Age date, given that burial urns and clay moulds for casting bronze weapons were found nearby. Other Bronze Age cemeteries were uncovered in Church Bay on Rathlin Island and in the sandhills of Dundrum in Co. Down.

Archaeological evidence for the seven hundred years from about 300 BC is predominantly artefactual. Although many sagas have been written about the Iron Age, very few sites can be reliably assigned to this period. Nonetheless, there is some evidence to show that the coast was settled by Iron Age people. In Co. Antrim a magnificent wooden tankard was found at Carrickfergus, while Iron Age hearths were excavated at White Rocks and at Bay Farm near Carnlough. In Co. Londonderry an Iron Age shell midden was investigated at Ballymulholland on Magilligan foreland (Mallory & McCormick 1988). Other sites with possible Iron Age associations are promontory forts such as Doonmore on Rathlin Island and the two large earthworks near Portballintrae in Co. Antrim.

6.2.4 Conversion (the Early Christian period)

Christianity was probably brought to Ireland around the 5th century AD and was consolidated in the centuries that followed by the establishment of monasteries, particularly along the Co. Down coast, at suitable landing points like St. John's Point and Bangor (Hughes & Hamlin 1977). The remnants of a very small stone church survive at St. John's Point and excavation has revealed a cemetery of stone-built graves that pre-dated the church ruins, pointing to an early foundation date for the site. Nendrum monastery, on Mahee Island in Strangford Lough, is enclosed by three concentric stone walls, within which are a round tower stump, a ruined church, a graveyard and hut foundations. It is one of the best preserved early monasteries in Northern Ireland. Its remains clearly demonstrate that such sites were concerned with more than just disseminating Christianity: some were also centres of production, learning and sea-going trade. Two landing stages on the south-east foreshore of the island, a fish trap and a possible jetty, which were recently identified in the course of subtidal and intertidal projects in Strangford Lough, are probably associated with the medieval occupation of the monastery. Many more fish traps with possible monastic connections have been identified in nearby Greyabbey Bay.

That the settled agricultural economy established in earlier periods flourished during the Early Christian period is demonstrated by the numbers of surviving raths or enclosed farmsteads, which are the most common type of monument in Northern Ireland. Coastal raths can be seen at Dunnyneill Islands and at Ballygowan in Co. Down. Souterrains, such as at Rossglass on Dundrum Bay in Co. Down, are man-made underground places of refuge commonly associated with raths; they highlight the dangerous nature of Early Christian life, a facet exemplified by the defensive siting of the promontory forts at Larry Bane, Dunseverick and Dunluce along the north Antrim coast. Other evidence of coastal exploitation during this period comes from the sand dunes at Dundrum in Co. Down, the cave at Porbraddan and Park Cave, White Park Bay, in Co. Antrim and from shell middens like that found in a sand cliff at Oughtymore on the Magilligan Peninsula in Co. Londonderry (Mallory & Woodman 1984).

Whilst there are many documentary records of Viking activity in the region, actual archaeological evidence for them is slender. A Viking burial was uncovered on the shore near Larne in Co. Antrim in 1840 (Mallory & McNeill 1994), and in 1786 a probable Viking silver brooch was found in a grave beside a standing stone in Church Bay on Rathlin Island (Christensen 1989); but to date no Viking field monuments have been positively identified. In marked contrast to the Iron Age the archaeological evidence from the Early Christian period is vast and detailed, encompassing multiple monument types, plus superb metalwork, stone carving and manuscripts, all of which points to some form of infrastructure capable of sustaining large-scale social organisation.

6.2.5 Medieval period

John De Courcy and the Anglo-Normans conquered the eastern counties of Ulster in the late 12th/early 13th century AD, providing the impetus for major political and ecclesiastical changes as well as introducing new monument types. Mottes, such as at Ballyhalbert in Co. Down, were built by De Courcy's captains to secure lines of communication and to administer the newly conquered areas. Stone castles, because they were time consuming and expensive to build, were reserved for vital strategic locations, such as Greencastle in Co. Down, which commands the approach to Carlingford Lough, and Carrickfergus in Co. Antrim, where an entire medieval town, complete with town walls, market place, church, street plan and harbour, was gradually established. The importance of sea trade to the Anglo-Norman economy is further attested by the large numbers of tower-houses on the edges of Strangford Lough. Jordan's Castle, a conspicuous tower-house built for a merchant, is one of several tower-houses protecting the major medieval port

and town of Ardglass, while nearby Strangford Castle controlled the traffic into the lough, and across the narrows Ballyphilip tower-house stood guard over Portaferry harbour, another relatively important medieval port.

The island tower-houses at Sketrick and Mahee incorporate secure boat bays on the ground floor, facilitating both access and defence, while the remains of a jetty associated with Ringhaddy Castle were recently identified in a subtidal project. Under the jetty structural stones were found on the sea bed, probably connected with the documented rebuilding of the castle in 1600 (Breen 1995). Significantly, De Courcy and his wife also founded two major Cistercian abbeys in Co. Down: at Greyabbey, on the shores of the lough, and Inch, beside the Quoile Estuary. It was during this period that fixed dioceses and parishes were created and other new monastic orders established themselves, notably the Benedictines at Nendrum and the Augustinian Canons at Bangor, both in Co. Down, and the Franciscans at Bonamargy in Co. Antrim. Ceramics comprise the majority of the evidence for medieval sea trade, because of the durability of the material, compared with perishables such as grain, hides, wool, fish, livestock and timber products, which were in great demand, particularly during Edward I and II's campaigns against the Scots.

As the period progressed so English influence waned, particularly in north Antrim, where political instability and clan warfare led to the building of castles such as those at Dunluce, Dunseverick, Kinbane, Dunineny and Red Bay. These castles are all built on headlands or promontories, and it was from such vantage points that the floundering remains of the Spanish Armada were espied during a storm in 1588 in which the Neapolitan galleass, the *Girona*, sank close to Lacada Point on the north Antrim coast. Plantation period relics are rare in the region, although Dunluce Castle incorporates a 17th-century house, and a good example of a fortified house and bawn (enclosure) called the White House can be seen at Ballyspurge near Cloghy. A well preserved tower/customs house standing in Bangor is a reminder of another feature of this period - large-scale smuggling. The significance of coastal defence during the 17th century is underlined by an unusual artillery tower, built precariously on a rock on a small island at the mouth of Carlingford Lough.

6.2.6 Post-mediaeval and modern times

In 1584 Sir John Perrot described Belfast as "the best and most convenient place in the Province of Ulster for the establishment of shipbuilding" (Sweetnam 1989), and it was not long before craft were being built there, initially on a small scale. The subsequent rise of the shipbuilding industry in Belfast, which reached its zenith in the massive Harland & Wolff yard, was directly related to the growth of Belfast Harbour, which had established itself as the premier port in Ulster by the late 19th century. Belfast's ascendancy is but one aspect of the burgeoning of the maritime economy. Another is the numerous small harbours, such as Killough and Carnlough, which were built to cope with the increased demand for exports such as grain, fish and hides from Co. Down and limestone and coal from Co. Antrim (Appleby 1989).

The continued importance of controlling coastal waters is demonstrated by the Martello Tower at Magilligan in Co. Londonderry, which is one of a series of towers erected along the coastline in response to the threat of Napoleonic invasion. In fact, it was the rise of the railway that effectively killed off the economic viability of small ports, as export and import points were refocused on major centres such as Belfast and Larne, which were serviced by the rail network. Although some ports, such as Ardglass, declined markedly from their prime as major medieval trade centres, their proximity to sheltered fishing grounds has ensured their survival. Other ports have silted up; one such is Ballycastle in Co. Antrim, where an industrial revolution took place in the mid 18th century: the vestiges of the glassworks, which once provided bottles for a nearby brewery, are now under sand dunes. The new harbour's main function is as a terminal for the ferry to Rathlin Island.

Other remains, for example textile mills, corn mills (as in Annalong Harbour in Co. Down), windmill stumps (as at Ballybrian in Co. Down) and coal mines (like the North Star Colliery at Tornaroan in Co. Antrim), plus the numerous coastguard stations, lighthouses, quarries, mineral railways, slipways, jetties, salt works and kilns, all testify to the enduring relationship between industry and the sea. The importance of this relationship was clearly demonstrated by the building between 1832 and 1842, at a cost of £37,000, of the Antrim Coast Road, then the biggest civil engineering project ever undertaken in Ireland. More recently, this connection has been highlighted by the number of modern wreck sites identified in the course of the ongoing Strangford Lough intertidal survey.

6.3 Human activities

6.3.1 Activities and processes affecting the archaeological resource

The archaeological resource is not confined to discrete remnants from particular periods, such as megaliths or castles, but encompasses the entire landscape and way of life pertaining at any period. Historic monuments or wreck sites are but one aspect of this overall picture, about which more can be learned by combining archaeological evidence with the results of palaeoenvironmental analysis. Archaeological sites in the region occur in the terrestrial, intertidal and subtidal parts of the coastal zone, and are sensitive to both human and natural factors.

Terrestrial sites and monuments can suffer as a result of a number of human activities as well as from the effects of natural erosion through wind and wave action. A recent unpublished University of Ulster study of coastal erosion from Magilligan Point to Larne highlighted the large-scale removal of sand and shale from the beach heads by natural processes as a particular problem. Natural cliff erosion has led to castles and promontory forts subsiding into the sea (the artillery fort on an island in Carlingford Lough has been badly damaged by sea erosion), and sea level rises have inundated and destabilised prehistoric sites, such as those on the eroded drumlin islands in Strangford Lough.

The building of sea walls and embankments and the construction and repair of coast roads, ports and industrial works can have adverse effects on the archaeological resource. At Mill Strand, in Portrush, for instance, a sand cliff containing an outcrop of Neolithic peat has been covered by a sea wall and the construction of a promenade has destroyed the dune topography (Wilson & Carter 1990). As each successive redevelopment of docks and harbours such as at Belfast and Larne (and that recently proposed for Killyleagh in Co. Down) reshapes the coastline and alters the character and type of buildings fronting that coastline, so the remains of earlier waterfronts become ever more fragmentary and sealed under yet further occupation layers.

Intensive farming has also affected a number of archaeological sites, as has tree-planting, land claim, dumping and quarrying (the promontory fort at Larry Bane Head in Co. Antrim was quarried) and treasure hunting. Trampling by walkers may cause erosion on popular coastal paths. The building of tourist developments, such as the holiday home park beside Dunineny Castle in Co. Antrim, golf courses, such as those at Portrush in Co. Antrim and Newcastle in Co. Down, which occupy sand dune systems, and car parks and hotels are potential sources of damage to archaeological sites.

Because foreshore deposits are highly vulnerable to deposition and erosion by the sea, sea defence construction or the remodelling of coastal areas may damage intertidal or subtidal archaeological material. Piers, wharves and breakwaters trapping sediments can lead to an offshore shortage of the sediments required to form vital features like sandbars, thereby exposing archaeological material to deterioration. At Portballintrae, for example, the single act of extending the pier in 1895 changed the wave pattern in the bay, and the resulting strong currents flushed the bay clean of sand (Carter 1987). The extraction of large quantities of sand from the beaches at Castlerock, Portrush, Runkerry and White Park Bay may have depleted the coastal archaeological resource. Other activities in the intertidal zone that disturb archaeological deposits include shellfish gathering and commercial and small-scale bait digging, intertidal dredging, notably in the Bann Estuary, and sewage outfalls, which may upset the chemical stability of archaeological material.

Subtidally, cable and pipeline laying (such as the electricity inter-connector and the natural gas pipeline between Island Magee and Scotland) can lead to the destruction of both archaeological and palaeoenvironmental evidence. Discharges from factories, sewage outfalls and boats can increase the rate of decomposition of archaeological material by creating a chemical imbalance between the material and its environment. Marina construction, such as at Carrickfergus and Bangor, and the siting of moorings have implications for sea bed disturbance. Bottom-gear fishing and, to a lesser extent, the trawl fishing favoured at Portavogie, Ardglass and Kilkeel can damage archaeological material on or near the surface of the sea bed. Exploration for oil and gas, offshore dumping and marine aggregate extraction can all destroy or bury archaeological evidence: aggregate extraction in particular involves the large-scale removal of sea-bed deposits. Of lesser impact are small-scale fish farming, recreational diving and salvage diving (such as the removal of a cannon from the wreck of the *Dei Sei* off the north coast of Antrim). The removal of objects from wrecks by divers can seriously diminish their archaeological value, as has been the case with the wreck site of the *Taymouth Castle*, which sank with its cargo of spirits and ceramics off Cushendun in Co. Antrim in 1987. It was one of the first vessels to be built with an iron frame and is in imminent danger of being destroyed by corrosion and the activities of sports divers.

6.3.2 Protection of sites, monuments and wrecks

In Northern Ireland three primary statutory instruments are concerned with the *in situ* preservation and protection of archaeological and historical remains. The Historic Monuments and Archaeological Objects (Northern Ireland) Order 1995 (the HMAO) provides for scheduled monuments (including those in territorial waters) and for monuments in the DoE's ownership (State Care Monuments) or under its guardianship. The Planning (Northern Ireland) Order 1991 provides for listed buildings; and the Protection of Wrecks Act 1973 provides for historic wreck sites. The inventory of *State care and scheduled historic monuments* (DoE (NI) 1995) does not distinguish between monuments that are in the Department's ownership and those that are under its guardianship.

The HMAO definition of a monument includes both the remains and the sites of vessels, vehicles and aircraft, and a specific provision allows historic monuments in territorial

waters to be scheduled. The general policy is to designate wreck sites under the Protection of Wrecks Act 1973 and to schedule other types of maritime archaeological sites under the HMAO. Under the HMAO there is a presumption against the destruction of historic monuments; the HMAO provides for a protection mechanism called 'scheduled monument consent': prior consent is necessary for works that will interfere with a scheduled monument or its site. It also empowers the Department to enter into management agreements with occupiers of scheduled monuments to enhance the protection and maintenance of these monuments.

Of the 176 land-based sites identified in the region, 47 (27%) are either scheduled or are in the DoE (NI)'s ownership or under its guardianship. This percentage compares very favourably with the figure of 8% for Northern Ireland as a whole and is indicative of the archaeological value attached to terrestrial coastal remains. The majority of the scheduled monuments, particularly the castles and ecclesiastical sites, are from the medieval period; nonetheless the range of protected monuments encompasses Neolithic megaliths, Iron Age ritual earthworks, Early Christian settlements, a fortified outcrop, a Martello tower and even a windmill stump. Taken as a whole it represents a reasonable cross-section of the coastal archaeological resource. Table 6.3.1 lists monuments in the region that are either scheduled or are in the Department's ownership or under its guardianship.

It is unlikely that there will be any marked increase in the number of scheduled monuments in future, as most archaeological sites in the region have been visited, surveyed and assessed in relation to scheduling. As a result only newly-identified monuments (including intertidal features) or monuments that are threatened will be considered for scheduling in future.

The Planning (Northern Ireland) Order 1991 makes provision for buildings that are considered of special architectural or historic interest, including those on intertidal land. There is no specific overriding criterion for listing and a wide interpretation is given to the phrase 'of special historic or architectural interest'. Examples of listed buildings in the region include harbours, lighthouses, warehouses, coastguard stations, mills, piers and associated maritime structures. General practice has been to schedule historic monuments and to list historic buildings. Listing does not carry with it a general presumption against destruction (Suddards 1993), but written consent (called 'listed building consent') is required prior to executing any works altering, extending or demolishing a listed building. In addition an opportunity to record a listed building must be afforded before consent can be given to alter or demolish the building.

The Environment and Heritage Service administers the Protection of Wrecks Act 1973 on behalf of the Department of National Heritage (DNH). The 1973 Act provides for the designation of the site of what is, or may prove to be, the wreck of a vessel on the grounds that it should be protected because of its archaeological, historical or artistic importance. Within the designated area, activities such as diving, salvage and anchoring are prohibited, as well as tampering with, damaging or removing any part of the wreck, except under licence issued by the DNH. Only one historic wreck site in the region has been designated under the 1973 Act (Table 6.3.2). A licence has recently been granted to survey a specified area of the *Girona* wreck site, and a special clause in the licence provides for the lifting of any objects deemed to be at risk (Williams pers. comm.). It is clear from the research carried out as part of the Maritime Record that the sea bed is a potentially rich source of historical and archaeological information. A guidance leaflet on what to do on finding a wreck is available from the DNH or the Coastguard Agency.

6.3.3 Key organisations and their responsibilities

The DoE's Environment and Heritage Service (EHS) is the prime organisation responsible for investigating, maintaining and protecting the entire coastal archaeological resource of Northern Ireland, through its Built Heritage Directorate. It is empowered under the Historic Monuments and Archaeological Objects (Northern Ireland) Order 1995 (the HMAO) to schedule historic monuments both on land and in territorial waters, to acquire them, to control works affecting them and to manage them.

The EHS administers the Protection of Wrecks Act 1973 on behalf of the Department of National Heritage and is responsible for the collection of certain types of information: on terrestrial archaeological sites in the form of the Sites and Monuments Record (SMR); on industrial remains in the form of the Industrial Archaeology Record; and on buildings of historic or architectural interest in the form of the Buildings Record. The SMR, which is almost complete for the coastal region, is currently being integrated into an up-to-date computerised database.

The Historic Monuments Council is the statutory body that advises the DoE on the exercise of its functions under the HMAO and can itself seek to voice archaeological concerns over development proposals or planning strategy. Some District Councils own or manage a small number of coastal historic monuments (mostly graveyards) and are guided by DoE policy, which is also advocated to the National Committee for Archaeology of the Royal Irish Academy and the Ulster Archaeological Society.

6.3.4 Development control

Landward of low water mark, development and land use proposals with archaeological implications are considered within the statutory planning system based primarily on the Planning (Northern Ireland) Order 1991. The Planning Strategy for Rural Northern Ireland 1993 (DoE (NI) 1993) relates to the entire coastal region (except parts of Bangor, Belfast and Carrickfergus, which have their own specific urban area plans), and in essence there is a presumption in favour of "the physical preservation of archaeological sites, monuments and remains and their settings". Thus any development likely to alter, damage or destroy individual sites or monuments or result in an inappropriate change to the settings of such sites or monuments will not normally be permitted. The strategy recommends that developers seek to identify the existence of archaeological remains that may be affected by their proposals and consult the Environment and Heritage Service (EHS) in the first instance.

In addition to the Rural Strategy there are a number of Local Area Plans based on District Council divisions. In order to increase the protection afforded to historic

Table 6.3.1 Scheduled monuments and monuments in Region 17 in the ownership or under the guardianship of the DoE (NI)

No. on Map 6.1.1	*Location*	*Monument name*	*Grid ref.*
	Co. Londonderry		
1	Culmore	Culmore Fort stone blockhouse and earthwork	C477225
2	Doaghs Lower, Magilligan Point	*Martello Tower	C660388
	Co. Antrim		
3	Dunluce	*Dunluce Castle	C905413
4	Dunluce	Earthworks (adjacent to Dunluce Castle)	C905412
5	Bushfoot/Lissanduff	Two earthworks	C930422
6	Feigh (alias Dunseverick)	Dunseverick Castle and earthworks	C987446
7	White Park Bay	Cairn	D022440
8	Cregganboy	*Kinbane Castle	D087439
9	Ballygill North (Rathlin)	Doonmore fortified outcrop	D118525
10	Ballycarry (Rathlin)	Bruce's Castle (fortification)	D163515
11	Town Parks	Dunineny Castle	D113419
12	Bonamargy	*Franciscan Friary	D126408
13	Tornabodagh	Doon fortified outcrop	D141416
14	Bighouse	*Drumnakill Church	D195424
15	Castle Park (Cushendun)	Castle Carra	D249334
16	Red Bay	Castle: motte and baileys and tower	D243262
17	Cloney (Glenarm)	*Franciscan Friary	D310154
18	Solar	Church and graveyard (sites of)	D244122
19	Curran & Drumaliss, Larne Harbour	*Olderfleet Castle	D413016
20	Portmuck	Castle	D461023
21	White Head	Castle Chichester	J476920
22	Carrickfergus	*Town walls: Joymount to St. Bride's car park, North Gate and Irish Gate area	J414872
23	Carrickfergus	*Carrickfergus Castle	J414872
24	West Division (near Belfast)	*Castle Lug or Clogh-na-Larty	J373844
	Co. Down		
25	Bangor	Tower House	J505823
26	Ballyhalbert	Standing stone	J646635
27	Ballyhalbert	Motte	J647635
28	Ballyspurge	*The White House (fortified house)	J642550
29	Keentagh	Millin Bay Cairn (complex cairn)	J628495
30	Ballyphilip	*Portaferry Castle (tower-house)	J592509
31	Round Island (Strangford Lough)	Structural complex	J577566
32	Ardkeen (Strangford Lough)	Hillfort and castle	J593571
33	Ballybrian (Strangford Lough)	Windmill stump	J586663
34	Mahee Island (Strangford Lough)	*Mahee Castle (tower-house and bawn)	J523639
35	Mahee Island (Strangford Lough)	*Nendrum monastic site (church, round tower etc.)	J524636
36	Sketrick Island (Strangford Lough)	*Sketrick Castle (tower-house and passage to spring)	J524625
37	Ringhaddy (Strangford Lough)	*Ringhaddy Church (St. Andrew's church and enclosure)	J538589
38	Ringhaddy (Strangford Lough)	Ringhaddy Castle (tower-house)	J538588
39	Quoile (Strangford Lough)	*Quoile Castle (tower-house)	J496471
40	Audleystown (Strangford Lough)	*Dual court tomb	J561503
41	Castleward (Strangford Lough)	*Audley's Castle (tower-house and bawn)	J578505
42	Castleward (Strangford Lough)	Old Castle Ward (tower-house)	J574498
43	Strangford Lower	*Old Court (tower)	J589500
44	Strangford Lower	Strangford Castle (tower-house)	J588498
45	Kilclief	*Kilclief Castle (tower-house)	J597457
46	St. John's Point	*St. John's Point Church	J528338
47	Ballaghanery Upper	St. Mary's Church	J388267
48	Greencastle	Castle	J247118
49	Greencastle	Motte	J242118

Source: DoE (NI) Environment and Heritage Service. Key: *State Care Monument.

monuments and landscapes, Areas of Significant Archaeological Interest (ASAI) can be designated, such as that around the Navan Complex in Armagh.

The Planning (General Development) Order (Northern Ireland) 1993 stipulates certain development rights that are exempt from planning approval. It also provides for the withdrawal of these rights on the payment of compensation, a measure likely to be invoked to protect ASAIs. Other non-statutory policies affecting land-based and intertidal archaeology appear in Development Management Plans, such as those drawn up by the National Trust, which owns sections of the coast from Downhill Estate in Co. Londonderry to the Mourne Coastal Path in Co. Down.

Development to seaward of low water mark is regulated by various instruments and authorities, rather than by a single governing statute or body. Each commercial port

Table 6.3.2 Historic wreck site designated in the region

Name	*Location*	*Grid ref.*	*Designation order*	*Description*
Girona wreck site	Lacada Point, Co. Antrim	C953456	1993 No.1; 1993/976	300 m radius of the wreck of a Neapolitan galeass, part of the Spanish Armada. Wrecked October 1588. Salvage excavations in 1967 and 1968. Many artefacts recovered, all now owned by Ulster Museum.

Source: DoE (NI) Environment and Heritage Service

operates under legislation specific to it, and the Transport Division of the DoE (NI) regulates harbours through the Harbours (Northern Ireland) Act 1970. Under the Harbour Works (Assessment of Environmental Effects) Regulations (Northern Ireland) 1990, the Transport Division are required to assess the environmental effect of harbour works below low water mark, including their effect on the archaeological resource. Marine aggregate extraction is controlled by the Crown Estate. Growing awareness of marine archaeology is leading to voluntary consideration of the archaeological resource. Such practice is encouraged by the *Code of practice for seabed developers* (Joint Nautical Archaeology Policy Committee 1995).

6.3.5 Reporting archaeological information

There is no statutory requirement to report the discovery of a new terrestrial, intertidal or sea-bed monument or site, but under Article 42 of the HMAO the finder of an archaeological object is required to report the find within fourteen days to the Director of the Ulster Museum, DoE (NI) or the local police. The Director or the Department is empowered to retain the object for a maximum period of three months, to examine, record and conserve the object, and may ultimately contribute towards the cost of purchasing it. Reports of finds by members of the public have led to the identification of important new monuments. The HMAO also makes it an offence to remove an archaeological object discovered using a detecting device on the site of a scheduled monument or monument in the ownership or under guardianship of the Department, without the Department's written consent. The protection afforded to the sea-bed heritage is limited to that provided under the Merchant Shipping Act 1894, the Protection of Military Remains Act 1986 and to other provisions of the HMAO.

The fact that an archaeological object is reported does not affect legal title to the object, whether that lies with the finder, the landowner or the Crown under the law of Treasure Trove. In Northern Ireland the law of Treasure Trove is administered by DoE (NI) on behalf of the Treasury and only applies to objects found above low water mark. Its purpose is to recover for the Crown bullion (gold or silver) that was never intended to be reclaimed by the depositor; any such material must be reported to the DoE (NI), the local police or the Ulster Museum. Should a coroner's inquest declare the object Treasure Trove, it goes on loan to the Ulster Museum and an *ex gratia* payment is made to the finder. If a finding of Treasure Trove is not made, title lies with the owner of the land in which the bullion was found or with the finder of the bullion.

During the second half of 1997 it is expected that the old common law of Treasure Trove will be replaced by the Treasure Act, which sets out to a new definition of 'treasure': (a) all hoards of coins at least 300 years old (if the coins have a precious metal content of less than 5% then the hoard must consist of at least 10 coins); (b) objects at least 300 years old with a minimum precious metal content of 5%, and (c) objects found with an association with 'treasure'. Finds of potential 'treasure' must be reported to the coroner within fourteen days. A Code of Practice will be drawn up which will provide guidance to finders of 'treasure' and set out the policy on rewards. The Act will apply to England, Wales and Northern Ireland. For further information contact the Department of National Heritage or the British Museum.

Under the Merchant Shipping Act 1894 any salvaged material must be reported to the Receiver of Wreck. Wreck is now defined as any ship, aircraft, hovercraft or parts of these, their cargo or equipment, found in or on the shores of the sea or any tidal water. The Receiver advertises reported wreck in order that owners may claim their property, regardless of its age. After one year any unclaimed wreck becomes the property of the Crown and is disposed of to pay for the expenses of the Receiver and any salvage awards. During the statutory year, such items may be lodged with an appropriate museum or conservation facility with suitable storage conditions. Finders are often allowed to keep unclaimed wreck *in lieu* of a salvage award. The responsibility of the Receiver to the finder remains, regardless of the historical character of the wreck. A guidance leaflet on what to do on recovering salvage is available from the Coastguard Agency.

6.4 Information sources

6.4.1 Information gathering and collation

In establishing the Sites and Monuments Record (SMR), the DoE (NI) has conducted detailed research (including into cartographic, documentary, oral and aerial photography evidence) to identify all archaeological sites and monuments in Northern Ireland. Almost all have been visited and recorded, including the 176 terrestrial sites in the coastal region. This ongoing land-based survey, which is based on county inventories of all types of archaeological sites and monuments, is comprehensive but generalised, precluding specific thematic or coastal terrestrial survey. The results have been published in *A preliminary survey of the ancient monuments of Northern Ireland* (Chart 1940), *An archaeological survey of Co. Down* (Jope 1966) and *Historic monuments of Northern Ireland* (Hamlin 1987).

A similar approach to research, site identification and survey has been adopted in compiling the Industrial Heritage Record and the Buildings Record. These archives concentrate on remains from more recent periods. Industrial archaeology has particular significance for the coastal region, given the central role of the coast in trade and economic policy. Industrial archaeological books based on the Industrial Heritage Record, such as that for the Antrim Coast and Glens (Hamond 1991) and for Co. Down (Green 1963), and the more general work on Northern Ireland as a whole (McCutcheon 1980), provide extensive information on coastal remains such as harbours, ports and lighthouses and on coastal industries including mining and quarrying.

The Buildings Record (BR) contains descriptions of buildings considered to be of historic or architectural interest, including many maritime structures. Information on land-based coastal archaeology is also available from a range of other sources, including the Queen's University Belfast (for example the Carnlough Project), bodies such as the Irish Association for Quaternary Studies, and local archaeological and historical societies.

The majority of intertidal survey information is held by DoE (NI) as part of the Intertidal Zone Record, although some is kept on the SMR. Funds have recently become available for an intertidal zone survey of the coastal region, to be undertaken to the same standard as the terrestrial survey, to build up a complete archive of intertidal archaeology. As part of this objective an intertidal survey of Strangford Lough was commissioned in 1995. Pre-survey research on maps, aerial photographs and documents had led to the identification of over 300 potential sites, and many more remains have been identified in the course of the survey. The findings have been significant, locating Mesolithic settlement sites, multiple fish traps, piers, jetties, slipways, saltworks and artificial channels, as well as a prehistoric forest and peat sediments, amongst other finds. Some peripheral intertidal surveys have been conducted, most notably the recent sand dune survey of the north coast by the University of Ulster, which helped to establish a dune system chronology through the interpretation of archaeological and sedimentary information.

In 1993 the Maritime Record (MR) was set up by DoE in conjunction with the Institute of Irish Studies at Queens' University, Belfast, to create a database of underwater archaeological sites in territorial waters. By searching documentary and cartographic sources, the project has identified over 2,000 potential wreck sites covering the period 1700-1945. A significant by-product of this research has been the collation of extensive information on underwater non-wreck sites and on intertidal features.

The MR database is supplemented by reports submitted under the 'Dive into history' scheme and by voluntary environmental assessments of the sea bed by developers, such as that by Northern Ireland Electricity and by British Gas in relation to the interconnector and pipeline projects, respectively, as well as that by Elf of the Peel Basin, which identified a single 20th-century wreck. Other underwater surveys undertaken by the Environment and Heritage Service include the investigation of the wreck of the *Taymouth Castle* off Cushendun in Co. Antrim, projects at Ringhaddy Castle and Nendrum in Strangford Lough, multiple inspection dives of other wreck sites and the re-assessment of the wreck site of the *Girona*.

6.4.2 Acknowledgements

Special thanks go to Nick Brannon, Brian Williams and Anne Given for advice on this chapter. Particular thanks are also due to Alistair Kilpatrick for assistance with the map, Decima McAuley, Dr Richard Warner of the Ulster Museum and R.J. Bleakley, DoE (NI) EHS.

6.4.3 Further sources of information

A. References cited

Appleby, J. 1989. Merchants and mariners, pirates and privateers: an introductory survey of the records of the High Court of Admiralty as a source for regional maritime history, *c.* 1500-1800. *In: The Irish Sea, aspects of maritime history*, ed. by M. McCaughan & J. Appleby, 47-61. Belfast, The Institute of Irish Studies QUB and the Ulster Folk and Transport Museum.

Breen, C. 1995. Underwater archaeology in Northern Ireland. *Nautical Archaeology, Spring 1995:* 2.

Carter, R.W.G. 1987. The north coast. *In: The book of the Irish countryside*, ed. by F. Mitchell, 75-79. Belfast, Blackstaff.

Carter, R.W.G. 1990. Sea level and coastal evolution. *Irish Association for Quaternary Studies. Field Guide No. 13: North Antrim and Londonderry:* 10-11.

Case, H. 1973. A ritual site on north-east Ireland. *In: Megalithic graves and ritual*, ed. by G. Daniel & P. Kjaerum, 173-196. Moesgard.

Chart, D., *ed*. 1940. *A preliminary survey of the ancient monuments of Northern Ireland*. Belfast, HMSO.

Christensen, A.E. 1989. Vikings in the Irish Sea. *In: The Irish Sea, aspects of maritime history*, ed. by M. McCaughan & J. Appleby, 13-21. Belfast, The Institute of Irish Studies QUB and the Ulster Folk and Transport Museum.

Coles, J. 1987. Preservation of the past: the case for wet archaeology. *In: European wetlands in prehistory*, ed. by J. Coles & A. Lawson, 1-22. Oxford, Clarendon.

Collins, A.E. 1959. Further investigations in the Dundrum Sandhills. *Ulster Journal of Archaeology, 22:* 5-20.
Corcoran, J. 1972. Multi-period construction and the origin of chambered long cairns in western Britain and Ireland. *In: Prehistoric man in Wales and the west*, ed. by F. Lynch & C. Burgess, 31-63. Bath, Adam & Bart.
DoE (NI). 1993. *A planning strategy for rural Northern Ireland*. Belfast, HMSO.
DoE (NI). 1995. *State care and scheduled historic monuments to 31 March 1995.* Belfast, HMSO.
Green, E.R.R. 1963. *The industrial archaeology of Co. Down*. Belfast, HMSO.
Hamlin, A., *ed.* 1987. *Historic monuments of Northern Ireland*. Belfast, HMSO.
Hamond, F. 1991. *Antrim coast and glens: industrial archaeology.* Belfast, HMSO.
Hughes, K., & Hamlin, A. 1977. *The modern traveller to the early Irish Church*. London, SPCK.
Joint Nautical Archaeology Policy Committee. 1995. *Code of practice for seabed developers*. Swindon, Joint Nautical Archaeology Policy Committee.
Jope, E., *ed.* 1966. *An archaeological survey of Co. Down*. Belfast, HMSO.
Mallory, J., & McNeill, T.E. 1994. *The archaeology of Ulster*. Belfast, The Institute of Irish Studies QUB.
Mallory, J., & McCormick, F. 1988. Excavations at Ballymulholland, Magilligan Foreland, Co. Londonderry. *Ulster Journal of Archaeology, 51:* 103-114.
Mallory, J., & Woodman, P. 1984. Oughtymore: an early Christian shell midden. *Ulster Journal of Archaeology, 47:* 51-62.
McCutcheon, W.A. 1980. *The industrial archaeology of Northern Ireland*. Belfast, HMSO.
Mitchell, F. 1970. Some chronological implications of the Irish Mesolithic. *Ulster Journal of Archaeology, 33:* 3-15.
Suddards, R. 1993. Listed buildings. *In: Archaeology resource management in the UK, an introduction*, ed. by J. Hunter & I. Ralston, 77-88. Stroud, Alan Sutton.
Sweetnam, R. 1989. The development of Belfast Harbour. *In: The Irish Sea, aspects of maritime history*, ed. by M. McCaughan & J. Appleby, 101-111. Belfast, The Institute of Irish Studies QUB and the Ulster Folk and Transport Museum.
Williams, B. 1990. White Park Bay. *Irish Association for Quaternary Studies, Field Guide No. 13: North Antrim and Londonderry.*
Wilson, P. 1995. Sand dunes and archaeology. *Archaeology Ireland, 32:* 24-26.
Wilson, P., & Carter, B. 1990. Portrush to Millstrand. *Irish Association for Quarternary Studies. Field Guide No. 13: North Antrim and Londonderry.*
Woodward, D. 1989. Irish Sea trades and shipping from the later Middle Ages to *c.* 1660. *In: The Irish Sea, aspects of maritime history*, ed. by M. McCaughan & J. Appleby, 35-47. Belfast, The Institute of Irish Studies QUB and the Ulster Folk and Transport Museum.

B. Further reading

Archaeological Diving Unit. 1994. *Guide to the historic wreck sites designated under the Protection of Wrecks Act 1973.* St. Andrews, University of St. Andrews.
Breeze, D.J. 1993. Ancient monuments legislation. *In: Archaeological resource management in the UK, an introduction*, ed. by J. Hunter & I. Ralston, 44-56. Stroud, Alan Sutton.
Buchanan, R.H. 1989. The Irish Sea: the geographical framework. *In: The Irish Sea, aspects of maritime history*, ed. by M. McCaughan & J. Appleby, 1-13. Belfast, The Institute of Irish Studies and the Ulster Folk and Transport Museum.
Coffey, G., & Praeger, R. 1904. The Antrim raised beach: a contribution to the Neolithic history of the North of Ireland. *Proceedings of the Royal Irish Academy, 25C:* 143-200.
Collins, A.E. 1970. Bronze Age moulds in Ulster. *Ulster Journal of Archaeology, 33:* 23-36.
Davidson, A., & Boaden, P. 1990. *The management of Strangford Lough: a study of the marine environment, its conservation and its exploitation.* Belfast, unpublished report for School of Biology, Biochemistry, Environmental and Evolutionary Biology, QUB.
De Courcy, J. 1989. A survey of early Irish maritime trade and ships. *In: The Irish Sea, aspects of maritime history*, ed. by M. McCaughan & J. Appleby, 21-27. Belfast, The Institute of Irish Studies QUB and the Ulster Folk and Transport Museum.
De Valera, R., & Ó Ríordáin, S. 1979. *Antiquities of the Irish countryside*. London, Methuen.
DoE (NI). 1995. *Delivering coastal zone management in Northern Ireland: a consultation paper.* Belfast, DoE (NI).
DoE (NI). 1995. *The buildings and industrial heritage of Rathlin Island*. Belfast, DoE (NI). (Unpublished report.)
Firth, A. 1992. *A preliminary account of the management of underwater archaeology in the UK.* Southampton, University of Southampton, Faculty of Law.
Firth, A. 1993. The management of archaeology underwater. *In: Archaeological resource management in the UK, an introduction*, ed. by J. Hunter & I. Ralston, 65-76. Stroud, Alan Sutton.
Hamlin, A. 1976. *The archaeology of early Christianity in the North of Ireland*. Unpublished PhD thesis, Queen's University Belfast.
Hamlin, A. 1993. Legislation in Northern Ireland. *In: Archaeological resource management in the UK, an introduction,* ed. by J. Hunter & I. Ralston, 134-136. Stroud, Alan Sutton.
Killanin, L., & Duignan, M. (Revised and updated by P. Harbison.) 1989. *The Shell guide to Ireland*. London, Gill & McMillan.
Longworth, I. 1993. Portable antiquities. *In: Archaeological resource management in the UK, an introduction*, ed. by J. Hunter & I. Ralston, 56-65. Stroud, Alan Sutton.
Lynn, C., & Hamlin, A., *eds.* 1988. *Pieces of the past*. Belfast, HMSO.
McNeill, T.E. 1983. The stone castles of Northern Co. Antrim. *Ulster Journal of Archaeology, 46:* 101-128.
Mallory, J. 1990. Archaeology. *Irish Association for Quaternary Studies. Field Guide No. 13: North Antrim and Londonderry:* 14-17.
Mitchell, F. 1986. *The Shell guide to reading the Irish landscape*. Dublin, Country House.
O'Kelly, M. 1989. *Early Ireland*. Cambridge, Cambridge University Press.
O'Neill, T. 1989. Trade and shipping in the Irish Sea in the later Middle Ages. *In: The Irish Sea, aspects of maritime history*, ed. by M. McCaughan & J. Appleby, 27-35. Belfast, The Institute of Irish Studies QUB and the Ulster Folk and Transport Museum.
Oxley, I., & O'Regan, D. 1995. *The marine archaeological resource*. Unpublished draft document.
Receiver of Wreck. 1994. *Where to turn to when you've turned something up*. Southampton, The Coastguard Agency.
Wilson, I. 1979. *Shipwrecks of the Ulster coast from Carlingford Lough to Inishowen Head*. Coleraine, Impact-Amergin.
Woodman, P. 1978. The Mesolithic in Ireland. *British Archaeological Reports,* No. 58.

C. Contact names and addresses

Type of information	*Contact address and telephone number*
Reporting of finds, maintenance of Sites and Monuments Record, Buildings Record, Industrial Archaeology Record and Intertidal Zone Record	*Principal Archaeologist & Principal Architect, DoE (NI) Environment and Heritage Service, tel: 01232 235000
Reporting of finds	*Department of Archaeology and Ethnography, The Ulster Museum, Belfast, tel. 01232 383051
The *Girona* designated wreck site	*Maritime Section, Built Heritage Directorate, DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 235000
Code of practice for seabed developers	Joint Nautical Archaeology Policy Committee, Head of Recording (Maritime Section), Royal Commission on the Historical Monuments of England, National Monuments Record Centre, Kemble Drive, Swindon SN2 2GZ, tel: 01793 414713
Maintenance of Maritime Archaeological Project	*C. Breen, Institute of Irish Studies, The Queen's University of Belfast, Belfast, tel: 01232 245133
Documentary research, for example Ordnance Survey Memoirs for the 1830s. - available to view on microfiche (Catalogue number MIC6)	Public Records Office, 66 Balmoral Avenue, Belfast BT9 6NY, tel: 01232 251318
Reporting of recovered wreck in UK	Receiver of Wreck, Coastguard Agency, 105 Commercial Road, Southampton SO15 1EG, tel: 01703 329474

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

World Heritage Site is the world's top conservation designation. Only two natural sites on the UK coast have been awarded this distinction - St. Kilda, in the Western Isles (Region 15) and the Giant's Causeway (pictured). This is Northern Ireland's most popular tourist destination, attracting nearly half a million visitors a year to marvel at its perfect hexagonal basalt columns. Photo: Bob Bleakley, DoE (NI) EHS.

Chapter 7 Coastal protected sites

R.J. Bleakley, R.G. Keddie & S.M. Close

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 of Northern Ireland maps, is included as 'coastal'. Data included in this section are correct as at October 1996, unless otherwise stated.

Statutory protected sites are those notified, designated, classified or authorised under European Directives and/or implemented through Northern Ireland legislation (most notably the Nature Conservation and Amenity Lands (Northern Ireland) Order 1985) by a statutory body, thereby having recognised legal protection. Protection for European designated sites is achieved through statutory designations made using domestic legislation. 'Non-statutory sites' include a wide variety of sites that are not directly protected by legislation, but which are recognised by statutory bodies or owned, managed or both by non-statutory organisations for their nature conservation or aesthetic value. Note that the categories of conservation protection (e.g. (National) Nature Reserve, RSPB Reserve) are not mutually exclusive. In many localities several different types of protected site overlap, since they have been identified for different wildlife and landscape conservation purposes. Patterns of overlap are often complex, since site boundaries for different categories of site are not always the same.

Further explanation of many of the various site protection mechanisms can be found in Milton (1990). *A planning strategy for rural Northern Ireland* (DoE (NI) 1993) also gives useful summaries of existing site protection mechanisms. A consultation draft of a Planning Policy Statement *Planning and nature conservation* was released by DoE (NI) in 1995 (DoE (NI) 1995). It reviews both international and domestic legislation supporting statutory site protection in Northern Ireland. Although formulated for England, the Planning Policy Guidance (PPG) Note 9 - *Nature conservation* (DoE 1994) has much of relevance to the UK as a whole. 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) under the EC Birds Directive and candidate Special Areas of Conservation (SACs) under the EC Habitats & Species Directive should be treated similarly to classified SPAs and designated SACs and deals with the treatment of nature conservation issues in development plans. It also includes copies of the Ramsar Convention, the Birds Directive and the Habitats & Species Directive (including lists of important species and habitat types).

The following types of protected site have not been included in this chapter:

- archaeological designations and protected sites (covered in Chapter 6);
- the variously-named non-statutory sites identified by local authorities and wildlife trusts as having special local value for nature conservation but not currently managed for nature conservation (in Britain known by the general term 'Sites of Importance for Nature Conservation' (SINCs));
- open space sites with nature conservation potential, for example Green Belts and Countryside Policy Areas (see DoE (NI) 1993) or other sites in public ownership or management; open spaces with nature conservation potential in the City of Belfast are listed in (DoE (NI) 1992) and noted on a database at the Centre for Environmental Data and Recording, Ulster Museum, Belfast.

Non-site-based measures contained in Conventions and Directives aimed at broad species and habitat protection, such as the Bonn Convention, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), parts of the EC Birds Directive and parts of the EC Habitats & Species Directive, are also not covered. Further information on these may be obtained from sources listed in section 7.1.4A.

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. Section 7.3 discusses sites identified under national statute, whereas section 7.4 covers sites without statutory protection but which are identified, owned or managed by statutory bodies. Finally, section 7.5 describes other types of sites (i.e. those identified, owned or managed by charities, trusts etc.). For each category of protected site, a list of coastal sites is given (clockwise around the coast from the River Foyle to Newry), 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

Though much of the Northern Ireland coast is relatively unspoilt and some 77% is already subject to some form of conservation or landscape designation, survey of the conservation resource has lagged behind that in Great Britain and many important sites have yet to be designated.

Consequently, the proportion of the coast actually subject to current international designations is very small. However, Government has recently presented to the European Union a list of sites recommended for designation as Special Areas of Conservation (SACs) under the EC Habitats & Species Directive, and proposals for sites to be classified as Special Protection Areas (SPAs) under the EC Birds Directive have been published. Designation of these sites would protect about about 38% of the length of the Northern Ireland coastline as SAC and 59% as SPA. No formal proposals on the boundaries of coastal Ramsar sites have been made, but these are likely to be similar to those coastal SPAs that include wetlands. (Ramsar sites are statutory areas designated by national governments under the Ramsar Convention (the Convention on wetlands of international importance especially as waterfowl habitat).) Table 7.1.1 summarises site protection in the region, showing the numbers and areas of each type of site and comparing these with the UK (whole country coast) totals.

Table 7.1.1 Summary of site protection in Region 17

	Numbers of protected sites			*Area* covered by site protection*		
	Region	*UK coast*	*% of UK coast total in region*	*Region (ha)*	*UK coast (ha)*	*% of UK coast total in region*
World Heritage Sites	1	2	50.0	71	924	7.7
Special Protection Areas	2	101	2.0	3.6	363,106	<1.0
Possible Special Areas of Conservation	6	118	5.1	32,180	n/av	n/av
Environmentally Sensitive Areas	3	20	15.0	77,400	1,474,945	5.2
(National) Nature Reserves	17	97	17.3	3,399	90,554	3.8
Marine Nature Reserves	1	3	33.3	16,500	19,390	85.1
Areas of Special Scientific Interest	27	1,240	2.2	21,654	737,117	3.0
Areas of Scientific Interest	20	n/ap	n/ap	7,940	n/ap	n/ap
Local (Authority) Nature Reserves	1	103	1.0	28	15,458	0.2
Areas of Oustanding Natural Beauty	7	31	2.2	181,870	1,081,770	15.6
Earth Science Conservation Review/ Geological Conservation Review sites	48	1,139	4.4	n/ap	n/ap	n/ap
Country Parks	5	39	12.8	445	4,886	9.1
National Trust sites	29	482	6.0	12,835	76,962	16.7
Royal Society for the Protection of Birds reserves	9	91	9.9	1,419	40,138	3.5
The Wildfowl and Wetlands Trust	2	8	25.0	26	1,611	1.6
The Wildlife Trusts reserves	2	219	0.9	35	23,454	0.1
Ministry of Defence sites	2	112	1.8	1,520	54,930	2.8

Source: DoE (NI) Environment and Heritage Service, JNCC (May 1996 SPA data), MOD, Local Authorities and Voluntary Conservation Bodies. Key: *to the nearest whole hectare; n/ap = not applicable, n/av = not available. Notes: site types not currently found in the region: Ramsar sites, Heritage Coasts, National Scenic Areas, Biosphere Reserves, Biogenetic Reserves, Areas of Special Protection, Nature Conservation Review sites, Voluntary Marine Nature Reserves, Wildlife Refuges, National Parks, Woodland 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/Ordnance Survey Northern Ireland maps is included as coastal.

7.1.3 Acknowledgements

The authors wish to thank J. Plaza, JNCC, and all those staff of the DoE (NI) Environment and Heritage Service, JNCC, MOD, local authorities and voluntary conservation bodies who helped in the compiling of this chapter.

7.1.4 Further sources of information

A. References cited

Department of the Environment. 1994. *Planning policy guidance note (PPG) 9 - nature conservation*. London, HMSO.

Department of the Environment for Northern Ireland. 1992. *Nature in the city: a nature conservation strategy for the Belfast Urban Area*. Belfast, HMSO/Belfast Development Office.

Department of the Environment for Northern Ireland. 1993. *A planning strategy for rural Northern Ireland*. Belfast, HMSO.

Department of the Environment for Northern Ireland, Town and Country Planning Service. 1995. *Draft planning and policy statement - planning and nature conservation*. Belfast, HMSO.

Milton, K. 1990. *Our countryside, our concern*. Northern Ireland Environment Link.

B. Further reading

Department of the Environment. 1990. *This common inheritance: Britain's environmental strategy*. London, HMSO. (Cm. 1200.)

Department of the Environment. 1994. *Biodiversity: The UK action plan*. London, HMSO. (Cm. 2428.)

Department of the Environment. 1994. *Sustainable development: the UK strategy*. London, HMSO. (Cm. 2426.)

Department of the Environment for Northern Ireland. 1993. *Proposals to implement the Habitats & Species Directive in Northern Ireland - a consultation paper*. Belfast, DoE (NI) Environment Service.

Department of the Environment for Northern Ireland. 1993. *Target 2001 - a programme for the survey, declaration and monitoring of Areas of Special Scientific Interest in Northern Ireland*. Belfast, DoE (NI) Environment Service.

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

Gubbay, S. 1988. *A coastal directory for marine conservation*. Ross-on-Wye, Marine Conservation Society.

Hatton, C. 1992. *The Habitats & Species Directive: time for action.* Godalming, World Wide Fund for Nature.

Joint Nature Conservation Committee. 1995. *Council Directive on the conservation of natural habitats and wild fauna and flora (92/43/EEC) - the Habitats & Species Directive: a list of possible Special Areas of Conservation in the UK. List for consultation (31 March 1995).* Peterborough (unpublished report to the Department of the Environment).

Way, L.S., Grice, P., MacKay, A., Galbraith, C.A., Stroud, D.A., & Pienkowski, M.W. 1993. *Ireland's internationally important bird sites: a review of sites for the EC Special Protection Area network.* Peterborough, Joint Nature Conservation Committee.

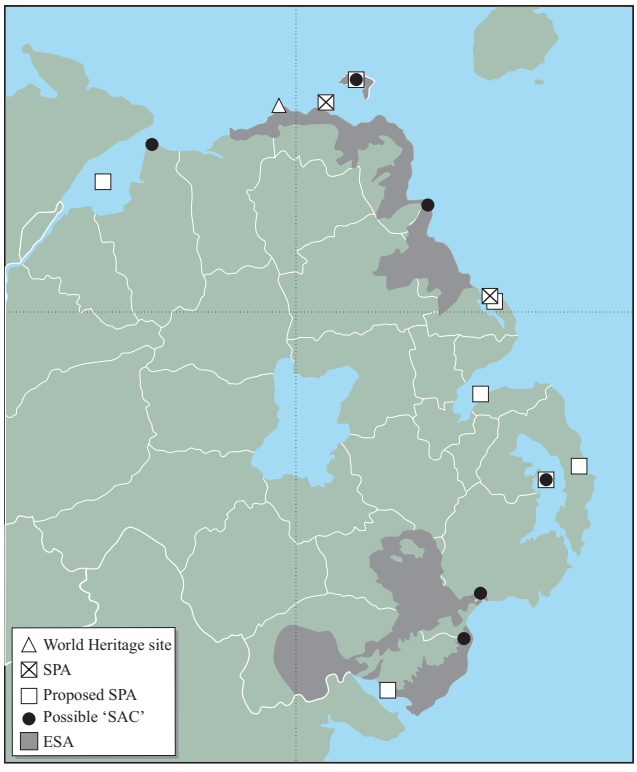
7.2 Sites designated under international conventions and directives

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 World Heritage Sites (natural)

World Heritage Sites are designated under the *Convention concerning the protection of the world cultural and natural heritage* (World Heritage Convention), adopted in 1972 by the General Conference of the United Nations Educational, Scientific and Cultural Organisation (UNESCO) and ratified by the UK Government in 1984. They are divided into two categories, 'natural' and 'cultural'. Sites selected for designation must have continuing strict legal protection. They are thus already under the protection of domestic legislation.

One site in Northern Ireland has been accorded the status of World Heritage Site (natural) - the Giant's Causeway, on the North Antrim coast (Table 7.2.1; Map 7.2.1). This outstanding geological, scenic and coastal habitat site was selected as a prime example of the earth's evolutionary history during the Tertiary era and because it contains superlative natural features (DoE (NI) 1986).



Map 7.2.1 Sites designated under International Conventions and Directives Sources: JNCC, DoE (NI) EHS. © Crown Copyright.

7.2.2 Special Protection Areas

The 1979 EC Directive on the Conservation of Wild Birds (the Birds Directive) requires member states to take conservation measures particularly for certain rare or vulnerable bird species and for regularly occurring migratory bird species. 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 in Northern Ireland through the provisions of the Nature Conservation and Amenity Lands (Northern Ireland) Order 1985. All SPAs have first to be notified as Areas of Special Scientific Interest or to be declared as (National) Nature Reserves. There are two SPAs (3.6 ha) and eight proposed SPAs in Region 17 (Table 7.2.2; Map 7.2.1). Sections 5.10, 5.11 and 5.12 describe the importance of all these sites for the region's birds.

7.2.3 Special Areas of Conservation

The Special Areas of Conservation (SAC) designation is one of the main mechanisms by which the EC Habitats & Species Directive 1992 will be implemented. SACs are areas identified as outstanding examples of selected habitat types or areas important for the continued well-being or survival of selected non-bird species. The protection measures are based around a series of six annexes: Annexes I and II list the habitats and species that may require the designation of SACs; Annex IV prohibits the taking of certain species; Annex V requires the taking of certain species to be monitored; and Annex VI prohibits some means of capture or killing of mammals and fish. In Northern Ireland the

Table 7.2.1 World Heritage Sites

Location	*No. of sites*	*Grid ref.*	*Area (ha*)*	*Date designated*	*Qualifying interest*
Antrim	**1**				
Giant's Causeway		C952452	71	1986	Spectacular coastal cliff scenery with columnar basalt formations; coastal saltmarsh, grassland and scrub habitats
Region 17	***1***		***71***		
UK coast	2		924		

Sources : DoE (NI) Environment and Heritage Service. 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 Special Protection Areas (SPAs) and proposed SPAs

Location	*No. of sites*	*Grid ref.*	*Area (ha*)*	*Date designated*	*Qualifying interest*
SPAs					
Sheep Island†		D049459	3.5	1992	Nationally important numbers of breeding cormorants *Phalacrocorax carbo*
Swan Island		J423996	0.1	1992	Internationally important numbers of breeding roseate terns *Sterna dougalii*
Region 17	***2***		***3.6***		
UK coast	101		363,106		
pSPAs					
Lough Foyle		C5630	2,000	n/ap	Internationally important numbers of wintering waterfowl
Rathlin Island Cliffs		D1352	2,300	n/ap	Internationally important numbers of breeding seabirds
Larne Lough (including Swan Island)		D4300	400	n/ap	Internationally important numbers of wintering light-bellied brent geese *Branta bernicla hrota*
Belfast Lough		J4183	7,500	n/ap	Internationally important numbers of wintering redshank and turnstone *Arenaria interpres*
Outer Ards Peninsula		J5684-J6345	1,200	n/ap	Wintering waders, including internationally important numbers of turnstones
Strangford Lough		J5660	15,000	n/ap	Internationally important numbers of wintering waterfowl
Dundrum Bay (Inner and Outer)		J4036	350	n/ap	Internationally important numbers of wintering light-bellied brent geese; regularly supports 20,000 wintering waterfowl
Carlingford Lough		J2213	1,300	n/ap	Internationally important numbers of wintering light-bellied brent geese
Region 17	***8***		***30,050***		
Total SPAs and pSPAs in Region 17	***10***		***30,054***		

Source: JNCC, DoE (NI) Environment and Heritage Service. Key: †exceptionally, designated for its importance in an all-Ireland context; *to the nearest whole hectare; n/ap = not appropriate. 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.

Directive will be implemented through the Conservation (Natural Habitats, etc.) Regulations 1994. A list of 'possible' SACs was announced by the Government on 31 March 1995. There are six possible SACs in Region 17 (Table 7.2.3; Map 7.2.1) (see JNCC (1995) for more information).

7.2.4 Environmentally Sensitive Areas

European Community authorisation for Environmentally Sensitive Areas (ESAs) is derived from Article 19 of Council Regulation (EEC) No. 797/85 - National Aid in Environmentally Sensitive Areas. ESAs are statutory areas in which the Government seeks to encourage environmentally sensitive farming practices, prevent damage that might result from certain types of agricultural intensification and restore traditional landscapes, for which member states are allowed to make payments to farmers. There are three ESAs (77,400 ha) that include land in Region 17 (Table 7.2.4; Map 7.2.1).

7.2.5 Acknowledgements

Thanks are due to Richard Weyl (DoE (NI) EHS), Alan Law and other staff of JNCC, Siâron Hooper (English Nature), the Department of Agriculture for Northern Ireland (DANI) and the Ministry of Agriculture, Fisheries and Food (MAFF).

Table 7.2.3 Possible Special Areas of Conservation (SACs)

Location	*No. of sites*	*Qualifying interest*
Londonderry	**1**	
Magilligan		Grey dunes, humid dune slacks, dunes with creeping willow *Salix arenaria*
Antrim	**2**	
Rathlin Island		Sea caves
Garron Plateau		Blanket bog (active)
Down	**3**	
Strangford Lough		Large shallow inlets and bays
Murlough		Eu-Atlantic decalcified fixed dunes
Eastern Mournes		Dry heaths
Region 17	***6***	
UK	118	

Source: JNCC, DoE (NI) Environment and Heritage Service. 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 7.2.4 Environmentally Sensitive Areas

Location	*No. of sites*	*Area (ha*)*	*Date designated*	*Interest*
Antrim	**1**			
Antrim Coast, Glens and Rathlin		34,600	1989 (extended 1993)	Species rich, semi-improved grassland and heath
Down	**1**			
Mourne Mountains and Slieve Croob		29,000	1988 (redesignated 1993)	Acid grassland and heath
Armagh	**1**			
Slieve Gullion		13,800	1994	Upland and wet heath, woodland and farmland of small fields with stone walls and hedges
Region 17	***3***	***77,400***		
Northern Ireland	5	221,800		
UK coast	20	1,474,945		

Source: DANI, 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.

7.2.6 Further sources of information

A. References cited

Department of the Environment for Northern Ireland. 1986. *UNESCO World Heritage List - Giant's Causeway - natural site nomination*. Belfast, W.J. Cairns and Partners.

Joint Nature Conservation Committee. 1995. *Council Directive on the conservation of natural habitats and wild fauna and flora (92/43/EEC) - the Habitats & Species Directive: a list of possible Special Areas of Conservation in the UK. List for consultation (31 March 1995).* Peterborough (unpublished report to the Department of the Environment).

B. Further reading

Department of Agriculture for Northern Ireland. 1994. *Environmentally Sensitive Areas - explanatory booklet (ESA-1).* Belfast, HMSO.

Gubbay, S. 1988. *A coastal directory for marine conservation.* Ross-on-Wye, Marine Conservation Society.

IUCN. 1982. *The world's greatest natural areas. An indicative inventory of natural sites of World Heritage quality.* IUCN Commission on National Parks and Protective Areas for World Heritage Committee.

Lyle, P. 1996. *A geological excursion guide to the Causeway Coast.* Belfast, DoE (NI).

Ministry of Agriculture, Fisheries and Food. 1989. *Environmentally Sensitive Areas.* London, HMSO.

Nature Conservancy Council. 1988. *Internationally important wetlands and Special Protection Areas for birds.* Peterborough, Nature Conservancy Council.

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.

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.

Von Droste, B., & Gregg, W.P. 1985. Biosphere Reserves: demonstrating the value of conservation in sustaining society. *Parks,10:* 2-5.

Watson, P.S. 1992. *The Giant's Causeway: 'a remnant of chaos.'* DoE (NI) and the National Trust. Belfast, HMSO.

Way, L.S., Grice, P., MacKay, A., Galbraith, C.A., Stroud, D.A., & Pienkowski, M.W. 1993. *Ireland's internationally important bird sites: a review of sites for the EC Special Protection Area network.* Peterborough, Joint Nature Conservation Committee.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
World Heritage Site	The Secretariat, World Heritage Committee, Division of Cultural Heritage, UNESCO, 7 Place de Fontenoy, 75700, Paris, France, tel: (00331) 456 81000
World Heritage Site, Ramsar sites, Special Protection Areas, Special Areas of Conservation	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477
World Heritage Site	*The National Trust, Saintfield, tel: 01238 510721
Ramsar sites, SPAs	*Regional Officer, RSPB, Belfast, tel: 01232 491547
Ramsar Sites, Special Areas of Conservation, Special Protection Areas	European Wildlife Division, DoE, Room 9/03B, Tollgate House, Houlton Street, Bristol BS2 9DJ, tel: 0117 987 8000
Environmentally Sensitive Areas	*DANI Countryside Management Division, Belfast, tel: 01232 520100

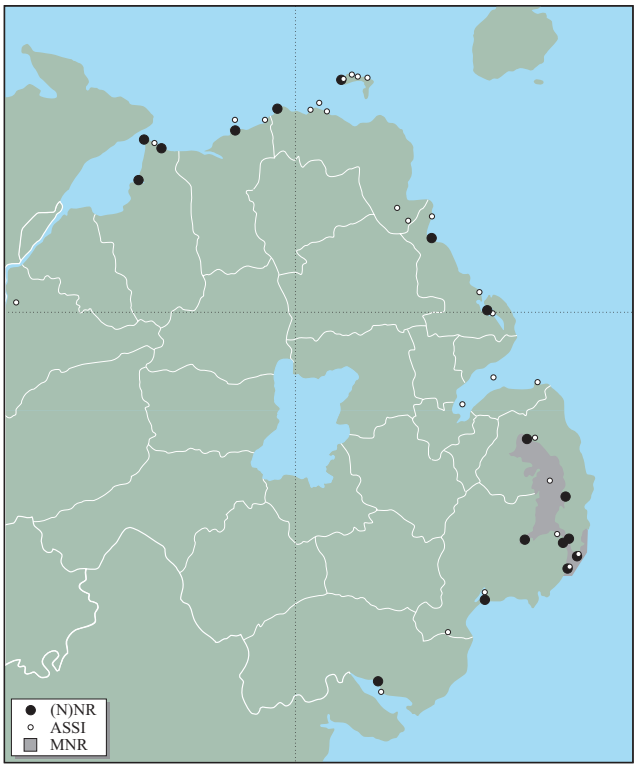
*Starred contact addresses are given in full in the Appendix.

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 by the statutory conservation agency (in this region the Environment and Heritage Service of the Department of the Environment for Northern Ireland).

7.3.1 (National) Nature Reserves

(National) Nature Reserves ((N)NRs) contain examples of some of the most important natural and semi-natural ecosystems and earth science features in Northern Ireland. They are managed to conserve their flora, fauna, features of geological, physiographical or other scientific or special interest, and to provide opportunities for the study of and research into their scientific interest. Prior to 1985 they were designated under the Amenity Lands Act (Northern Ireland) 1965 as 'Nature Reserves'. In practice these sites were generally referred to as 'National' Nature Reserves, although the legislation did not provide for 'National' in the title. From April 1985 new sites were designated as 'National Nature Reserves' under the Nature Conservation and Amenity Lands (Northern Ireland) Order 1985, as amended in 1989. If any 1965 sites are re-designated, those meeting the necessary criteria will formally become 'National Nature Reserves'. As there is essentially no difference between the status of these sites they are here referred to collectively as (N)NRs. There are seventeen coastal (N)NRs (3,399 ha) in Region 17 (Table 7.3.1; Map 7.3.1).



Map 7.3.1 Coastal (National) Nature Reserves, Marine Nature Reserve and Areas of Special Scientific Interest. Note: a single symbol may represent more than one site in close proximity. Source: DoE (NI). © Crown Copyright.

7.3.2 Marine Nature Reserves

Marine Nature Reserves (MNRs) are created by statute (under Article 20 of the Nature Conservation and Amenity Lands (Northern Ireland) Order 1985) to conserve marine flora, fauna or features of geological, physiographic or other scientific or special interest, while providing special opportunities for the study of and research into the systems involved. MNRs may be established up to 3 nautical miles seaward of the baselines from which territorial sea adjacent to Northern Ireland is measured; they can include the open sea, seashore up to highest astronomical tide and sea bed. MNRs can be protected by byelaws where no alternative protection measures under other legislation are available. There is one MNR in Region 17, Strangford Lough (16,500 ha), off the Co. Down coast (Table 7.3.2; Map 7.3.1).

7.3.3 Areas of Special Scientific Interest

Areas of Special Scientific Interest (ASSIs) are statutorily notified under the Nature Conservation and Amenity Lands (Northern Ireland) Order 1985 (as amended, 1989). They are intended to form a national network of areas, representing the parts of Northern Ireland in which the natural features, especially those of greatest value to wildlife conservation and to earth science conservation, are most highly concentrated or are of highest quality. Each ASSI represents a significant fragment of the much-depleted resource of wild nature or an important earth science site remaining in Northern Ireland. Within the area of an ASSI the provisions of the Nature Conservation and Amenity Lands (Northern Ireland) Order 1985 and its 1989 amendments aim to ensure that actions damaging to the wildlife interest of the area are not carried out. The designation is equivalent to that of Site of Special Scientific Interest (SSSI) applied in Britain under the Wildlife and Countryside Act 1981.

Whereas the Nature Conservation and Geological Conservation Reviews in Great Britain have provided a basis for the selection of SSSIs, survey of the nature conservation and geological site resource in Northern Ireland is still under way. It is intended that this will be complete by the year 2001, allowing for the completion of the designation of sites as ASSIs. 'Target 2001', a published survey and designation timetable (DoE (NI) 1993), suggests that around 110,000 ha may ultimately be designated as ASSI throughout Northern Ireland, representing about 8% of the total land mass. Currently, there are 27 coastal ASSIs (21,654 ha) in Region 17, (Table 7.3.3; Map 7.3.1). ASSIs comprise 5% of the total land mass of Northern Ireland. ASSIs in the region include many sites of interest for their rare and lower plants, terrestrial invertebrates and breeding or overwintering seabirds.

Table 7.3.1 (National) Nature Reserves

Location	*No. of sites*	*Grid ref.*	*Area (ha*)*	*Date last declared*	*Habitats*
Londonderry	**3**				
Roe Estuary		C635295	474	1976	Saltmarsh, tidal flats, mussel beds
Magilligan Point		C663389	57	1970	Yellow and grey dunes with slacks, sandy beach
Ballymaclary		C697364	227	1976	Grey dunes and slacks
Antrim	**5**				
Portrush		C858411	1	1970	Historic geological rocky shore
Giant's Causeway		C952452	71	1987	Coastal cliffs, columnar basalt, saltmarsh
Kebble		D095515	123	1976	Seabird cliffs, grassy heath, marsh
Straidkilly		D302163	8	1983	Hazel, ash/birch woods
Swan Island		J423996	<1	1972	Low, boulder clay island - nesting terns
Down	**9**				
Ballyquintin Point		J624456	16	1987	Raised cobble beach, saltmarsh
Granagh Bay		J604488	24	1974	Diverse, mixed intertidal, rocky islets
Dorn		J593575	790	1975	Mixed intertidal with tidal rapids, seals
North Strangford		J508706	1,015	1987	Tidal flats, eelgrass *Zostera* spp. and mussel beds
Quoile Pondage Basin		J500478	195	1970	Open, brackish water, marsh, woodland
Cloghy Rocks		J594478	27	1976	Mixed intertidal, seal haul-out
Killard		J610433	68	1977	Dune grassland/heath, cliff, sandy/rocky shore
Murlough		J405343	283	1977	Dune grassland/heath/scrub, shingle beach/ridges, saltmarsh, woodland
Rostrevor Forest		J187173	20	1970	Oakwood
Region 17	***17***		3,399		
Northern Ireland	45		4,434		
UK coast	97		90,554		
UK whole country	269		187,210		

Source: DoE (NI) Environment & Heritage Service. 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 Marine Nature Reserves (MNR)

Location	*No. of sites*	*Grid ref.*	*Area (ha*)*	*Date designated*	*Qualifying interest*
Down	**1**				
Strangford Lough		J560580	16,500	1995	Fjardic inlet, drowned drumlin field, highly diverse rocky, sedimentary shore and sea-bed habitats, horse mussel *Modiolus modiolus* beds, current-swept rock, tidal rapids, tidal flats, seagrass beds, wintering/breeding waterfowl and seals
Region 17	***1***				
UK coast	3		19,390		

Source: DoE (NI) Environment and Heritage Service. 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.

7.3.4 Areas of Scientific Interest

The Amenity Lands Act (Northern Ireland) 1965 made provision for the notification to the local planning authority of areas of land deemed to be of scientific interest by reason of their wildlife, natural vegetation, geological, physiographical or other special features, which were not nature reserves but were in need of special protection. The local planning authority (now the Planning Service DoE (NI)) was required by the Act to consult the Nature Reserves Committee (since replaced by the Council for Nature Conservation and the Countryside) on any development application falling within these Areas of Scientific Interest (ASIs). The Nature Conservation and Amenity Lands (Northern Ireland) Order 1985, which introduced ASSIs, did not, however, extinguish existing ASIs or the requirement for development consultation. In practice a number of ASIs have now been redesignated as ASSIs, but for the remainder the designation still provides some limited protection pending a decision on redesignation. Twenty sites (7,873 ha) in Region 17 were designated as ASIs (Table 7.3.4; Map 7.3.2). ASIs comprise 4.0% of the total land mass of Northern Ireland.

7.3.5 Local Authority Nature Reserves

Local Authority Nature Reserves (LANRs) are designated under Article 22 of the Nature Conservation and Amenity

Table 7.3.3 ASSIs in Region 17

Location	*No. of sites*	*Grid ref.*	*Area (ha*)*	*Date last notified*
Tyrone	**1**			
McKean's Moss		C368033	43	1996
Londonderry	**1**			
Magilligan		C685370	1,069	1995
Antrim	**15**			
Ramore Head and the Skerries		C857412	23	1996
Portballintrae		C923420	1	1995
White Park Bay		D024442	88	1996
Sheep Island		D049459	4	1992
Carrickarade		D055447	18	1996
Rathlin Island - coast		D130530	257	1992
Rathlin Island - Kinramer South		D103514	25	1992
Rathlin Island - Ballygill North		D118525	78	1992
Rathlin Island - Ballycarry		D156519	43	1992
Glenariff		D220220	66	1987
Garron Plateau		D2419	4,650	1994
Black Burn		D285212	20	1996
Waterloo		D409038	6	1995
Larne Lough		J450987	398	1996
Inner Belfast Lough		J370790	240	1988
Antrim & Down	**1**			
Outer Belfast Lough		J430850	147	1996
Down	**9**			
Ballymacormick Point		J530838	39	1988
Ballyquintin Point		J624456	74	1995
Strangford Lough Part 1		J530707	1,549	1988
Strangford Lough Part 2		J579497	699	1989
Strangford Lough Part 3		J552608	1,859	1989
Killard		J610433	112	1995
Murlough		J410360	1,453	1995
Eastern Mournes		J330270	7,508	1995
Carlingford Lough		J180140	1,105	1996
Region 17	***27***		***21,654***	
Northern Ireland	99		75,817	
UK coast (ASSIs & SSSIs)	1,240		737,117	
UK whole country (ASSIs & SSSIs)	6,050		1,922,093	

Source: DoE (NI) Environment and Heritage Service. 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.

Lands (Northern Ireland) Order 1985 (as amended 1989), which enables district councils to provide the Northern Ireland equivalent of the Local Nature Reserves (LNRs) designated in Great Britain. Article 22, however, refers merely to 'nature reserves', with the potential for confusion with Nature Reserves declared under the Amenity Lands Act (Northern Ireland) 1965 (see section 7.3.1). In providing lands as statutory nature reserves, district councils are required to exercise their functions in consultation with the Council for Nature Conservation and the Countryside (CNCC). These Local Authority Nature Reserves are provided for the same purposes as (N)NRs, but on account of the local (rather than national) interest of the site and its

Map 7.3.2 Areas of Scientific Interest (site and linear) and Local Authority Nature Reserves. Source: DoE (NI). © Crown Copyright.

wildlife. They generally have a strong public access and educational emphasis. District councils have the power to issue byelaws to protect the LANR. There is one statutory coastal LANR (28 ha) in Region 17 (Table 7.3.5; Map 7.3.2).

7.3.6 Wildlife Refuges

The statutory provision of an area as a 'Wildlife Refuge' (WR) is a protection mechanism under Article 16 of The Wildlife (Northern Ireland) Order 1985. The provision, made by order, is tailored to suit the particular interest of each site so protected; it can provide protection from disturbance or destruction, by means of special penalties, for plants and/or animals at any stage of their life cycle, their nests or equivalent structure. Orders providing WRs can only be made with the consent of all owners and occupiers of the area to be protected. It was intended that this provision would replace that of Bird Sanctuary, established under the Wild Birds Protection Act (Northern Ireland) 1931, extending its scope to all forms of wildlife. It is the nearest equivalent to the 'Area of Special Protection' (AoSP) in Great Britain - a statutory protection mechanism replacing Bird Sanctuary Orders under the 1954 to 1967 Protection of Birds Acts, which were repealed and amended under the Wildlife & Countryside Act 1981. There were several coastal Bird Sanctuaries in Region 17 but as yet no WRs have been established, although there are tentative plans for some. This compares with a total of 23 AoSP sites identified as coastal in Great Britain. There are 38 AoSPs in total in Great Britain (data supplied by DoE (NI) Environment and Heritage Service and DoE European Wildlife Division).

Table 7.3.4 ASIs in Region 17

Location	*No. of sites*	*Grid ref.*	*Area (ha*)*	*Date last notified*
Londonderry	**2**			
Carrickhugh		C597228	158	1970
North Derry Part 1		C705363	1,038	1971
Antrim	**7**			
Antrim North Coast		C854407-D254318	2,261	1969
The Skerries		C870426	17	1969
Sheep Island		D049459	4	1969
Rathlin Island		D130520	1,425	1969
Carnlough		D287171	7	1976
Island Magee		D474003-J454987	131	1976
Ballycarry		J466943	19	1969
Down	**11**			
Cultra		J413810	2	1969
Copeland Islands		J600860	30	1970
Coalpit Bay		J595790	15	1969
Roddan's Port		J641655	11	1973
Burial Island		J667631	10	1969
Dorn		J593575	334	1965
North Mournes		J350280	1,166	1972
Mourne Coast		J382297-J338152	344	1970
South Mourne Coast		J295117-J270099	161	1977
Green and Blockhouse Islands		J240110 & J255097	1969 73	
Mill Bay		J235135	734	1978
Region 17	***20***		***7,940***	
Northern Ireland	48		56,618	

Source: DoE (NI) Environment and Heritage Service. 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 7.3.5 Local Authority Nature Reserves in Region 17

Location	*No. of sites*	*Grid ref.*	*Area (ha*)*	*Date approved*
Londonderry	**1**			
Benone		C720357	28	1988
Region 17	***1***		***28***	
Northern Ireland	3		51	
UK coast (LANRs/LNRs)	103		15,458	

Sources: Limavady Borough Council and DoE (NI) Environment and Heritage Service, English Nature, Countryside Council for Wales, Scottish Natural Heritage. 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.

Map 7.3.3 Areas of Outstanding Natural Beauty. Source: DoE (NI) (1995). © Crown Copyright.

7.3.7 Areas of Outstanding Natural Beauty

Areas of Outstanding Natural Beauty (AONBs) are statutorily designated in Northern Ireland by the Department of the Environment on the advice of the Council for Nature Conservation and the Countryside (CNCC) and after consultation with the relevant local authorities. The first legislation providing for AONBs in Northern Ireland was the Amenity Lands Act (Northern Ireland) 1965. Under its terms, planning applications received within areas designated as AONBs were required to be submitted to the Ulster Countryside Committee (and successor bodies - currently CNCC) for comment. Under the terms of the Nature Conservation and Amenity Lands (Northern Ireland) Order 1985, as amended 1989, the AONB concept was greatly extended, allowing for the Department to formulate proposals for areas so designated. These proposals are intended to conserve and enhance the area's natural beauty, its amenities, wildlife, historic objects or natural phenomena, to promote its enjoyment by the public and to provide and maintain public access. The fact sheet entitled *Areas of Outstanding Natural Beauty in Northern Ireland* (DoE (NI) 1995) gives details of the AONBs in Region 17. Of Northern Ireland's nine AONBs, representing over 14% of its total land area, seven (181,870 ha) extend into the coast (Table 7.3.6; Map 7.3.3).

7.3.8 Acknowledgements

Thanks are due, in particular, to Joyce McCormick and Richard Weyl (DoE (NI) Environment and Heritage Service) and to Ray Woolmore and Paul Johnson (Countryside Commission), Roger Bolt (JNCC), Phillip Biss (English Nature), Site Safeguards Team (Countryside Council for Wales), Kathy Duncan and Natasha O'Connel (Scottish Natural Heritage) and Neale Oliver (DoE).

Table 7.3.6 Areas of Outstanding Natural Beauty (AONBs) in Region 17

Location	*No. of sites*	*Area (ha*)*	*Date last designated*
Londonderry	**1**		
North Derry		12,950	1966
Antrim	**2**		
Causeway Coast		4,200	1989
Antrim Coast & Glens (including Rathlin Island)		70,600	1986
Down	**3**		
Strangford Lough		18,647	1972
Lecale Coast		3,108	1967
Mourne		57,012	1986
Armagh	**1**		
Ring of Gullion		15,353	1991
Region 17	***7***	***181,870***	
UK coast	31	1,081,770	

Source: DoE (NI) Environment and Heritage Service. Key: *to the nearest whole hectare. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

7.3.9 Further sources of information

A. References cited

Department of the Environment for Northern Ireland, Environment Service. 1993. *Target 2001 -a programme for the survey declaration and monitoring of Areas of Special Scientific Interest in Northern Ireland*. Belfast, Department of the Environment for Northern Ireland.

Department of the Environment for Northern Ireland. 1995. *Areas of Outstanding Natural Beauty in Northern Ireland.* Belfast, Department of the Environment for Northern Ireland. (Environment Matters Fact Sheet, No. 29.)

B. Further reading

Cooper, E.A., Crawford, I., Malloch, A.J.C., & Rodwell, J.S. 1992. *Coastal vegetation survey of Northern Ireland.* Lancaster, Lancaster University. (Unpublished report to DoE (NI).)

Countryside Commission. 1992. *Directory of Areas of Outstanding Natural Beauty.* Cheltenham, Countryside Commission.

Countryside Commission. 1994. *Countryside planning file.* Cheltenham, Countryside Commission.

Countryside Commission. 1994. *United Kingdom protected environment map.* Southampton, Ordnance Survey.

Department of the Environment for Northern Ireland. 1991. *An introduction to Areas of Special Scientific Interest.* Belfast, Department of the Environment for Northern Ireland.

Department of the Environment for Northern Ireland. 1991. *Antrim Coast and Glens Area of Outstanding Natural Beauty - guide to designation*. Belfast, Department of the Environment for Northern Ireland. (Includes map and leaflet.)

Department of the Environment for Northern Ireland. 1991. *Causeway Coast Area of Outstanding Natural Beauty - guide to designation*. Belfast, Department of the Environment for Northern Ireland. (Includes map and leaflet.)

Department of the Environment for Northern Ireland. 1991. *Mourne Area of Outstanding Natural Beauty - policies and proposals*. Belfast, Department of the Environment for Northern Ireland. (Includes map and leaflet.)

Department of the Environment for Northern Ireland. 1994. *Strangford Lough proposed Marine Nature Reserve - guide to designation*. Belfast, Department of the Environment for Northern Ireland.

Department of the Environment for Northern Ireland. Undated. *National Nature Reserves in Northern Ireland.* Belfast, Department of the Environment for Northern Ireland.

Department of the Environment for Northern Ireland. Undated. *Lough Neagh and the north-west Nature Reserves.* Belfast, Department of the Environment for Northern Ireland.

Department of the Environment for Northern Ireland. Undated. *North coast Nature Reserves.* Belfast, Department of the Environment for Northern Ireland.

Department of the Environment for Northern Ireland. Undated. *Co. Down Nature Reserves.* Belfast, Department of the Environment for Northern Ireland.

Erwin, D.G., Picton, B.E., Connor, D.W., Howson C.M., Gilleece, P., & Bogues, M.J. 1990. *Inshore marine life of Northern Ireland.* Belfast, Ulster Museum/DOE (NI)/HMSO.

Fuller, I. In press. *The shores of Northern Ireland*. Belfast, DOE (NI)/HMSO.

Marren, P.R. 1994. *England's National Nature Reserves.* Newton Abbott, David & Charles.

Nature Conservancy Council. 1984. *Nature conservation in Great Britain.* Peterborough, Nature Conservancy Council.

Nature Conservancy Council. 1989. *Guidelines for selection of biological SSSIs.* Peterborough, Nature Conservancy Council.

Nature Conservancy Council. 1989. *Local Nature Reserves.* Peterborough, Nature Conservancy Council. (Library information sheet No. 6.)

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
(N)NRs, MNRs, ASSIs, ASIs, LANRs, Wildlife Refuges, AONBs	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477
Local Authority Nature Reserves managed by local authorities	*Limavady Borough Council, Limavady, tel: 015047 22226

*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 Sites equivalent to Nature Conservation Review sites

In Britain, the Nature Conservation Review (NCR - Ratcliffe 1977) was carried out to identify sites that might qualify for declaration as National Nature Reserves by virtue of containing the best representative examples of wildlife habitat; however, the NCR did not extend to Northern Ireland. Following the passing of the Amenity Lands Act (Northern Ireland) in 1965, sites considered for conservation designation were selected from sites identified by the Nature Reserves Committee and Department staff; often these were already well-known and no comprehensive survey took place. The passing of the Nature Conservation and Amenity Lands (Northern Ireland) Order in 1985 for the first time gave the Department the legal framework to start a systematic survey of habitats to locate all sites of potential interest for nature conservation. This exercise is still incomplete and is likely to continue until the end of the century. To date, detailed surveys of coastal areas have included the best saltmarsh and dune systems (Cooper *et al.* 1992) and some coastal heath, woodland, lowland fen, seacliff and seabird nesting sites. More extensive surveys of much of the Co. Down coast have been undertaken. The records of these surveys are held by DoE (NI) Environment and Heritage Service. Popular summaries of this survey work are being published by DoE (NI) through HMSO on an occasional basis. The final outcome will be a database of information on sites of nature conservation interest corresponding to the NCR site register.

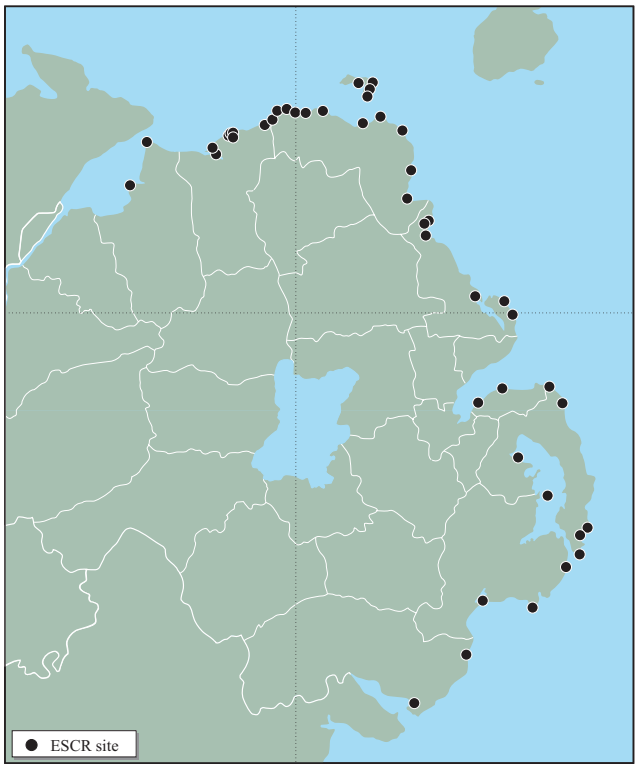
7.4.2 Earth Science Conservation Review sites

Earth Science Conservation Review (ESCR) sites are locations of national and, in some cases, international earth science importance which meet qualifying criteria determined by DoE (NI) Environment and Heritage Service and CNCC. The ESCR selection process describes and assesses key sites in the context of their geology, palaeontology, mineralogy or geomorphology. Some sites have statutory protection, for example as ASSIs or (National) Nature Reserves. Where a site has no statutory designation, its listing as an ESCR site protects it only insofar as the Environment and Heritage Service will draw attention to its earth science interest, if consulted over development proposals. The ESCR has, to date, provisionally identified some 190 individual sites as 'Single Interest Localities' (SILs). 48 provisional ESCR SILs have been identified within Region 17 (Table 7.4.1; Map 7.4.1). Detailed scientific accounts of all current and future ESCR SILs in Northern Ireland are held by Environment and Heritage Service and will be published in due course. In Great Britain, detailed scientific accounts of 519 coastal and inland Geological Conservation Review (GCR) sites have been published or are in preparation in a planned 42-volume series; this series may eventually include ESCR SILs in Northern Ireland.

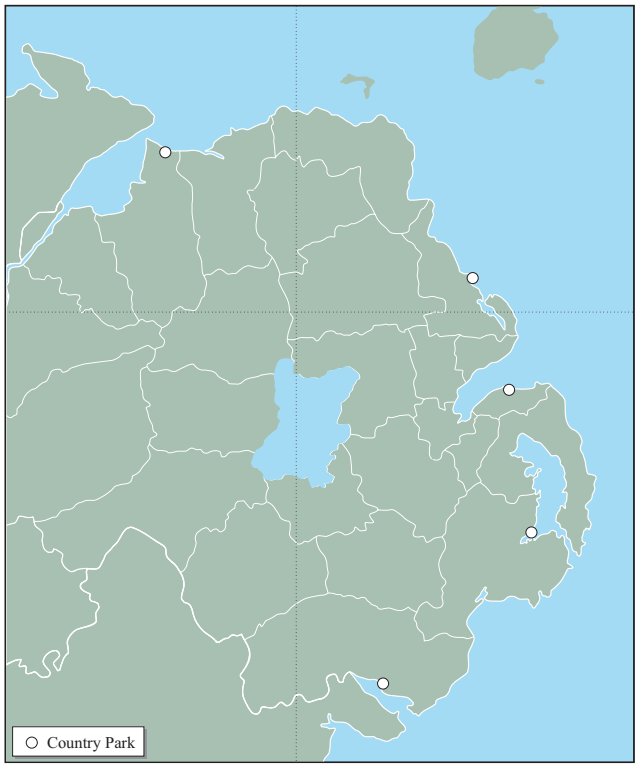
Table 7.4.1 Earth Science Conservation Review SILs†

Location	*No. of SILs*
Londonderry	**6**
Lough Foyle*	
Magilligan complex (2 SILs)+*	
Grangemore+	
Portstewart*	
Portstewart - Portrush*	
Antrim	**28**
Portrush West Strand*	
Portrush (2 SILs)+	
White Rocks (2 SILs)*	
Portballintrae	
Runkerry Strand*	
Giant's Causeway	
Port Moon	
Dunseverick	
Ballintoy+	
Larry Bane	
Carrickarade	
Church Bay, Rathlin Island*	
Maddygalla, Rathlin Island	
Doon Point, Rathlin Island	
Portadonaghy, Rathlin Island	
Ballycastle Coalfield (2 SILs)	
Carrickmore Blister	
Fair Head	
Torr Head	
Cushendun - Port Obe	
Cushendall - Red Bay	
Carnlough+	
Waterloo	
Muck Island*	
Island Magee East	
Down	**14**
Holywood - Cultra (2 SILs)	
Grey Point	
Orlock Bridge	
Coalpit Bay	
Kearney Point and Knockinelder Bay	
Ballyquintin+	
Castle Espie	
Strangford Lough*	
Killard Point	
St. John's Point	
Dundrum+*	
Mournes Coast	
Greencastle	
Region 17	***48***
UK coast	1,139

Source: DoE (NI) Environment and Heritage Service, JNCC. Key: †all sites are of geological interest, except *sites identified wholly or partly for their coastal geomorphological interest as active coastal process sites, and +sites identified as Holocene sea level history sites.



Map 7.4.1 Earth Science Conservation Review sites (Single Interest Localities). Note: a single symbol may represent more than one site in close proximity. Source: DoE (NI). © Crown Copyright.



Map 7.4.2 Country Parks. Sources: DoE (NI) & local authorities. © Crown Copyright.

7.4.3 Country Parks and Amenity Lands

Country Parks are primarily intended for recreation and leisure opportunities close to populations and do not necessarily have any nature conservation interest. Nevertheless, many are in areas of semi-natural habitat and so form a valuable network of locations at which informal recreation and the natural environment co-exist. In Northern Ireland there is no legislation providing for the statutory designation of areas as Country Parks. However the Nature Conservation and Amenity Lands (NI) Order 1985 does provide for the acquisition and management of 'Amenity Lands' by DoE (NI), with the option of passing on management to other public bodies and/or of grant-aiding their purchase of Amenity Lands. Several coastal sites acquired as Amenity Lands are managed as Country Parks. Others not so named fulfil a similar role. There are five coastal Country Parks or areas serving the same function (445 ha) in Region 17 (Table 7.4.2; Map 7.4.2).

Table 7.4.2 Country Parks

Location	*No. of sites*	*Grid ref.*	*Area (ha*)*	*Date acquired/ opened*	*Main habitats*	*Managed by*
Londonderry	**1**					
Benone tourist complex		C720357	53	1984	Dune grassland, beach	Limavady Borough Council
Antrim	**1**					
Carnfunnock		D383068	192	1957	Grassland, parkland	Larne Borough Council
Down	**3**					
Crawfordsburn		J465428	80	1971	Wooded glen, grassland, beach, rocky shore	DoE (NI) EHS
Delamont		J513506	81	1985	Parkland, woodland, shore	Down District Council
Kilbroney		J184179	39	1975	Open parkland	Newry & Mourne District Council
Region 17	***5***		***445***			
UK coast	39		4,886			

Sources: DoE (NI) Environment and Heritage Service, the Countryside Commission, the Countryside Council for Wales, district councils and Countryside Commission for Scotland (1985). 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.

7.4.4 Acknowledgements

Thanks are due to Richard Weyl, Paul Corbett and Ian Enlander (DoE (NI) Environment and Heritage Service), staff of the twelve district councils in Region 17, Ray Woolmore and Paul Johnson (Countryside Commission), Roger Bolt and Earth Sciences Branch (JNCC), Phillip Biss and Paul Gilliland (English Nature), Kathy Duncan and Natasha O'Connel (Scottish Natural Heritage), Site Safeguards Team (Countryside Council for Wales) and Maurice Parkinson (Belfast City Council).

7.4.5 Further sources of information

A. References cited

Cooper, E.A., Crawford, I., Malloch, A.J.C., & Rodwell, J.S. 1992. *Coastal vegetation survey of Northern Ireland.* Lancaster, Lancaster University. (Unpublished report to DoE(NI).)

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

B. Further reading

Carter, B. 1991. *Shifting sands - a study of the coast of Northern Ireland from Magilligan to Larne*. Belfast, DOE (NI)/HMSO.

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.)

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Habitat survey data, Earth Science Conservation Review data, Country Park data, marine survey data, Crawfordsburn Country Park	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477
Carnfunnock Country Park	*Larne Borough Council, Larne, tel: 01574 272313
Delamont Country Park	*Down District Council, Downpatrick, tel: 01396 610800
Kilbroney Country Park	*Newry and Mourne District Council, Newry, tel: 01693 65411

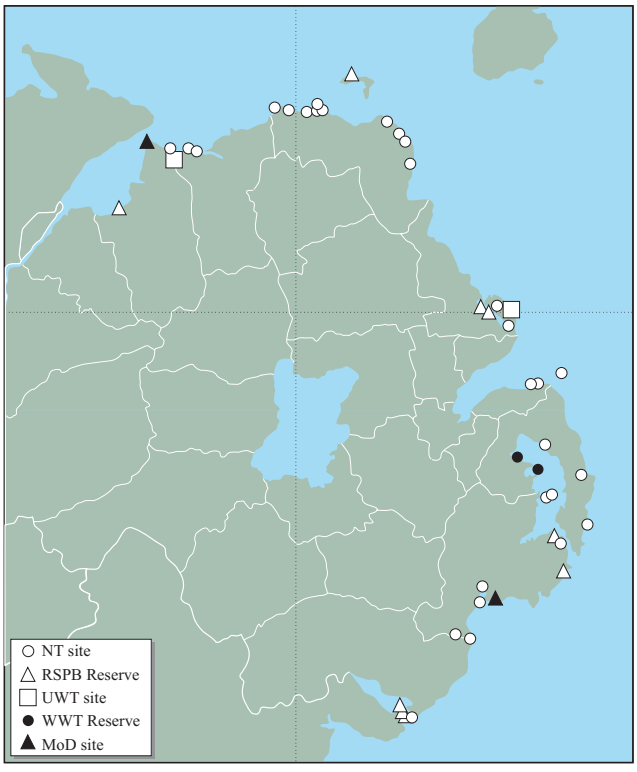
*Starred contact addresses are given in full in the Appendix

Islands and headlands in Carlingford Lough are internationally important for nesting seabirds, especially terns *Sterna* spp. Greencastle Point, pictured, is an RSPB bird reserve, and Green Island, a little way out in the lough, is a National Trust property managed by the RSPB. The lough itself is an ASSI and a proposed Special Protection Area, internationally important for wintering light-bellied brent geese *Branta bernicla hrota*. Photo: Mike Hartwell, DoE (NI) EHS.

7.5 Other types of protected site

7.5.1 The National Trust

The National Trust is an independent charity that is currently the largest private landowner in Britain. The National Trust owns about 230,000 ha of land in England, Wales and Northern Ireland and over 200 buildings of outstanding importance. It has also accepted or bought covenants that protect against development for a further 31,600 ha of land and buildings. Many of the tenanted properties have individual intrinsic value; together they protect large areas of unique landscape and countryside. The National Trust has statutory powers to protect its properties under an Act of Parliament (1907), through which it may declare its holdings of land and buildings inalienable; these properties cannot be sold or mortgaged. In addition, National Trust properties can be protected by byelaws. In 1985 the National Trust relaunched its 1965 campaign 'Enterprise Neptune' to raise funds for the purchase of coastal areas. A total of 850 km of coast in England, Wales and Northern Ireland is now owned or managed by the National Trust (National Trust 1993). There are 29 National Trust countryside sites (excluding buildings and gardens) (12,835 ha) in Region 17 (Table 7.5.1; Map 7.5.1). Several of these 'sites' comprise a number of separate, non-contiguous properties in the same area. For example within the Strangford Lough 'site' the National Trust owns around 30 islands, about 55 separate areas of foreshore and some areas of sea bed; it leases rights over extensive areas of foreshore from the Crown Estate and has management agreements over foreshore and some islands with third parties.



Map 7.5.1 National Trust, Royal Society for the Protection of Birds, Ulster Wildlife Trust, Wildfowl and Wetlands Trust and Ministry of Defence sites. Sources: respective organisations. © Crown Copyright.

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 (85,000 ha) in Great Britain (RSPB 1993). Wherever possible it purchases reserves so that the level of safeguard for the wildlife and habitats is high. Where reserves are leased, the RSPB aims to acquire long leases (>21 years) with appropriate management rights. In some cases the RSPB manages sites on behalf of other bodies. There are nine coastal RSPB sites (1,419 ha) in Region 17 (Table 7.5.2; Map 7.5.1).

7.5.3 The Wildfowl and Wetlands Trust

The Wildfowl and Wetlands Trust (WWT) has established non-statutory reserves in a number of key wintering areas for migrant wildfowl. The level of protection afforded to such sites is high, since the land is either owned or held on long leases. WWT has an interest in two sites (26 ha) in Region 17 (Table 7.5.3; Map 7.5.1). One site combines a bird collection with managed refuge areas for free-flying birds, and the other includes a ringing station.

7.5.4 The Wildlife Trusts

The Wildlife Trusts were established to promote non-statutory nature conservation at a local level. They own, lease and manage (by agreement with owners) over 1,800 nature reserves (more than 52,000 ha). The Ulster Wildlife Trust has two reserves (35 ha) in Region 17 (Table 7.5.4; Map 7.5.1).

7.5.5 The Ministry of Defence

As at August 1994, the Ministry of Defence (MOD) owned, leased or used under licence landholdings covering some 320 km of coastline around the UK, not all of it significant for its nature conservation value. The MOD gives high priority to nature conservation on the Defence Estate, subject to the overriding importance of military training. The restrictions to public access on some sites mean that they can be amongst the most pristine areas of wildlife habitat in the region. There are two MOD sites (1,520 ha) in Region 17 (Table 7.5.5; Map 7.5.1).

Table 7.5.1 National Trust sites

Location	*No. of sites*	*Grid ref.*	*Area (ha*)*	*Date acquired*	*Landform/habitat*
Londonderry	**3**				
Downhill		C758363	60	1949-80	Cliffs, lake; farmland, woodland;
Bar Mouth and Grangemore		C782365	211	1972-91	Estuary, river mouth, saltmarsh, dune grassland and heath, farmland
Portstewart Dunes and Strand		C720360	81	1981	Dune, estuary, dune grassland/scrub, sand beach, saltmarsh
Antrim	**12**				
Giant's Causeway		C952452	102	1962-95	Basalt cliffs and promontory, coastal marsh, grass, heath, scrub, farmland
Dunseverick Castle		C987445	39	1964-92	Raised beach, rocky shore, maritime grassland, farmland
White Park Bay		D023440	72	1939	'Chalk' cliffs and stacks, sand beach, dunes, calcareous grassland, scrub
Sheep Island		D048495	5	1967	Basalt sea stack with breeding cormorants and other seabirds
Larry Bane and Knocksoghey		D062450	42	1978-92	Chalk and basalt seacliffs and caves, coastal grass, heath, scrub, farmland
Carrickarade		D062450	15	1967	Dolerite sill island with basaltic tuffs and seabirds; coastal grassland, farmland
Fair Head and Murlough Bay		D199419	348	1968-86	Dolerite sill/cliffs, heath, calcareous grassland, woodland, farmland
Port-aleen Bay		D233396	3	1974	Boulder shoreline, wooded glen
Loughan Bay		D246337	11	1974	Raised beach, coastal grassland, hazel scrub
Cushendun		D248327	57	1954	River mouth and terraces, dune, beach, grassland, woodland, farmland
Skernaghan Point		J437036	35	1991	Rocky headland, coastal grassland
Ballykeel (Gobbins)		J473964	15	1990	Undercliff woodland, farmland
Down	**14**				
Ballymacormick Point		J525837	10	1952-79	Rocky foreshore, coastal marsh, grassland, heath, scrub
Orlock Point		J539838	11	1984	Rocky shore, coastal grassland, scrub
Lighthouse Island		J596858	17	1948	Coastal grassland, scrub, seabirds
Glastry		J638629	17		Clay pits, ponds and wetlands
Kearney and Knockinelder		J650517	19	1965	Rocky and sandy shore, coastal grassland
Strangford Lough		J560580	8,536	1965-95	Mixed shore and islands, saltmarsh, coastal wetland, heath, grassland, scrub, woodland, farmland
Strangford Lough (sea bed)		J560580	1,619	1965-95	Mixed sea-bed habitats
Mount Stewart		J555701	270	1952-76	Woodland, gardens
Castleward		J752494	369	1953	Parkland, woodland, farmland, shoreline
Dundrum Coastal Path		J415382	13	1981-83	Saltmarsh, grassland, scrub, island wader roost
Murlough Nature Reserve		J410350	292	1967-77	Shingle beach and ridges, saltmarsh, dune grassland, heath, scrub, woods
Mourne Coastal Path		J389269	39	1968-95	Rocky shore, bouder beach, valley; coastal grassland, flush, heath, scrub
Slieve Donard		J358277	526	1990	Granite mountain, upland heath
Green and Blockhouse Islands		J254097	1	1968	Gravelly/rocky islands, seabird colonies
Region 17	***29***		***12,835***		
UK coast	483		76,962		

Source: National Trust. 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 7.5.2 Royal Society for the Protection of Birds reserves

Location	*No. of sites*	*Grid ref.*	*Area (ha*)*	*Date acquired*	*Interest*
Londonderry	**1**				
Lough Foyle - Longfield to Myroe		C600230	1,335	1980	Intertidal mudflats with eelgrass *Zostera* spp. beds and shell ridges, wintering waterfowl
Antrim	**3**				
Rathlin North Cliffs and West Light		D127524	50	1976	Rocky sea cliff, maritime turf, nesting seabirds
Swan Island		J424977	<1	1973	Low boulder clay island, nesting terns
Blue Circle Island		J433992	<1	1995	Man-made vegetated island, nesting terns
Down	**5**				
Castleward Bay		J584493	33	1989	Intertidal mudflats, wintering waterfowl
Sandy Island		J596418	<1	1995	Sand/shingle islet, nesting terns/gulls
Blockhouse Island		J245095	<1	1968	Rocky island, nesting shags *Phalacrocorax aristotelis* and gulls
Green Island		J240111	1	1968	Unvegetated shingle, nesting terns
Greencastle Point		J240119	<1	1977	Low vegetated islands, nesting terns
Region 17	***9***		***1,419***		
UK coast	91		40,138		

Source: RSPB. 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 Wildfowl and Wetlands Trust sites

Location	*No. of sites*	*Grid ref.*	*Area (ha*)*	*Date acquired*
Down	**2**			
Castle Espie		J494672	24	1990
Mahee Point		J541646	2	1994
Region 17	***2***		***26***	
UK coast	8		1,611	

Source: Wildfowl and Wetlands Trust. 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 7.5.4 Wildlife Trusts reserves

Location	*No. of sites*	*Grid ref.*	*Area (ha*)*	*Date acquired*
Londonderry	**1**			
The Umbra		D726359	29	1980
Antrim	**1**			
Isle of Muck		D465025	6	1984
Region 17	***2***		***35***	
UK coast	219		23,455	

Source: Ulster Wildlife Trust. Key: *to the nearest whole hectare. Note: in this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

7.5.6 Acknowledgements

The authors wish to thank D.C.G. Hynds and Andrea Firth for MoD text and data, and Jo Whatmough (The National Trust), Dave Allen (RSPB), James Orr (Wildfowl & Wetlands Trust), Dermot Hughes (Ulster Wildlife Trust) and J.L. Lawson (Down District Council) for providing information.

7.5.7 Further sources of information

A. References cited

National Trust. 1993. Enterprise Neptune - saving our unspoiled coastline. *Coastline 1993,* No. 2, 1-11.

Royal Society for the Protection of Birds. 1993. *Nature reserves - information for visitors.* Sandy, Royal Society for the Protection of Birds.

Table 7.5.5 MoD sites

Location	*No. of sites*	*Area (ha)**	*Protected status*
Londonderry	**1**		
Magilligan		960	(N)NR, ASSI, pSAC, AONB, ESCR
Down	**1**		
Ballykinler		560	ASSI, pSAC, part pSPA, ESCR
Region 17	***2***	***1,520***	
UK coast	112	54,930	

Source: Ministry of Defence. Key: *all areas are approximate and include land leased or used under licence; (N)NR = (National) Nature Reserve; ASSI = Area of Special Scientific Interest; pSAC = proposed Special Area of Conservation; pSPA = proposed Special Protection Area; AONB = Area of Outstanding Natural Beauty; ESCR = Earth Science Conservation Review site. In this table any site that is wholly or partly intertidal, and any terrestrial site at least partly within 1 km of the Mean High Water Mark, or any tidal channel as depicted on 1:50,000 Ordnance Survey maps, is included as coastal.

B. Further reading

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

C. Contact names and addresses

Type of information	*Contact,address and telephone no.*
National Trust sites	*Conservation Officer, The National Trust, Saintfield, tel: 01238 510721
RSPB sites	*Regional Officer, RSPB, Belfast, tel: 01232 491547
Ulster Wildlife Trust sites	*Conservation Officer, Ulster Wildlife Trust, Crossgar, tel: 01396 830282
Wildfowl and Wetlands Trust sites	*Centre Manager, The Wildfowl and Wetlands Trust, Comber, tel: 01247 874146
MoD sites	Senior Estate Surveyor, Defence Land Agent, Harmony House, 199 Queensway, Lisburn, Co. Antrim BT27 4NH, tel: 01846 665131

*Starred contact addresses are given in full in the Appendix

The windfarm on Kilpatrick Hill, Rathlin Island, is Northern Ireland's only coastal non-fossil fuel power generation plant, although windfarms and other renewable energy power plants exist inland. The largest power stations on the coast are fuelled by coal, oil and, increasingly, gas, which is piped from Scotland to Castle Robin, Island Magee. Photo: Mike Hartwell, DoE (NI) EHS.

Chapter 8 Land use, infrastructure and coastal defence

WS Atkins - Northern Ireland

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 residential and industrial development, ports, harbours, shipping lanes, transport links and power generation; and coastal defence, including sea defence and coast protection.

Northern Ireland accounts for some 6% of the overall United Kingdom land area but has only around 2.5% (1.6 million) of the total population. More than half of the Northern Ireland population lives within the main conurbation of Belfast and its environs. Outside this area settlement is widely scattered over the countryside, reflecting the division of the land into small farms.

Northern Ireland is an Objective 1 region for EU assistance. Objective 1 promotes the structural adjustment of regions within the EU that are considered to be in need of development. Public agencies in the regions may access funds for the development of local infrastructure to allow business expansion, under four headings: the European Regional Development Fund, the European Social Fund, the European Agricultural Guidance and Guarantee Fund and the Financial Instrument for Fisheries Guidance. Region 17 has benefited from significant investment in its transport infrastructure in recent years. All four of its major ports - Londonderry, Larne, Belfast and Warrenpoint - have been upgraded. The airports have also seen major investment and growth, while the road links to these gateways have been steadily improved with the elimination of bottlenecks and the by-passing of towns.

The land use around Strangford Lough is in many ways typical of the province as a whole: a patchwork of small unimproved grasslands, bordered by ancient hedgerows. However, the gentle landscape of the Ards Peninsula and the western shore of the lough is more often used for crops than farmland is in the more rugged north and south of the region. Photo: Mike Hartwell, DoE (NI) EHS.

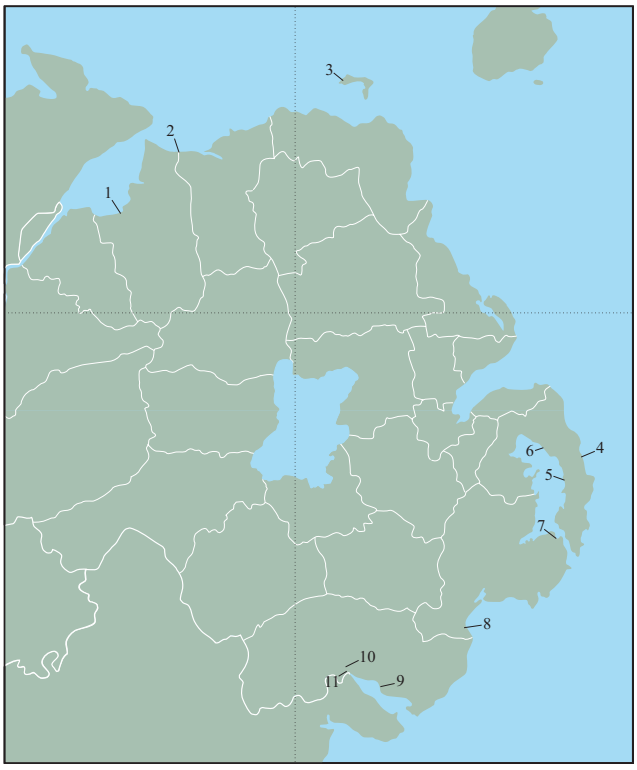
8.2 Land use

8.2.1 Introduction

Among Region 17's most valuable resources are the rich pasture lands and fertile soils which ensure that agriculture plays a major role in the economy. Farms are predominantly small and production generally concentrates on rearing livestock. There are fewer field boundaries in the coastal zone than on lowland farmed countryside inland, and a large proportion of them are earth banks (often with gorse) or post and wire fences. This reflects the constraints of exposure on tree and shrub establishment. Farmland in the north of the region is generally devoted to pasture; the grassland vegetation communities recorded in the coastal zone are largely improved eutrophic and mesotrophic grasslands, with a small area of unimproved species-rich dry grassland and species-rich wet grassland (Cooper & McCann 1994). Land claimed in the past for agriculture is a feature of the south coast of Lough Foyle, where the resulting flat expanses have been divided into unusually large fields, used almost entirely for arable crops. Following a shift in farming economics much of this land has been turned over to grassland. Crops are more common in the south-east, particularly around Strangford Lough.

The coastal region of Northern Ireland is sparsely wooded. Ancient semi-natural woodlands are few, except for a scattering of small areas, such as at Umbra in Co. Londonderry, at Glenarm in Co. Antrim and at Finnebrogue and Rostrevor in Co. Down. Of the remaining coastal woodlands, many are old estate woods or modern conifer plantations. Commercial afforestation has been carried out primarily by the Department of Agriculture for Northern Ireland (DANI). Plantations are generally of a single coniferous species planted on land regarded as too poor for agriculture, although there has been a recent policy to increase the proportion of broadleaved species where soils are suitable. The area of new planting is currently falling, largely owing to the difficulty of acquiring suitable land. Table 8.2.1 lists the larger areas of plantation woodland in Region 17 (Map 8.2.1).

The locations of sand dunes and saltmarsh with recorded stock grazing are shown on Map 8.2.2. On many of the large dune systems grazing has been largely displaced by other land uses, including golf courses and military use. Grazing takes place on certain areas of saltmarsh, some of it under management agreements, for example at Carrickhugh on Lough Foyle, where grazed saltmarsh is also used for the production of lawn turf, on the Roe Estuary under licence from the DoE (NI) EHS, along the Bann Estuary at Portstewart and Grangemore, where it is subject to monitoring by the National Trust, and at Larne Lough, Strangford Lough and Mill Bay at the mouth of Carlingford Lough.



Map 8.2.1 Coastal plantation woodland areas. Numbers refer to Table 8.2.1. Source: Department of Agriculture for Northern Ireland (1994a). © Crown Copyright.

Map 8.2.2 Saltmarshes and sand dunes with recorded grazing. See Maps 3.6.1 and 3.2.1 for distribution of saltmarsh and sand dune sites. © Crown Copyright.

Table 8.2.1 Main areas of plantation woodland

Site no. on Map 8.2.1	*Location*	*Grid ref.*	*Area (ha*)*
	Londonderry		
1	Ballykelly Forest	C610220	97
2	Downhill Forest	C757352	77
	Antrim/Rathlin Island		
3	Kinramer Wood	D103520	n/a
	Down		
4	Ballywalter Park	J625683	n/a
5	Rosemount	J582678	n/a
6	Mount Stewart	J555700	96
7	Castleward	J570495	73
8	Donard Wood	J370300	284
9	Rostrevor Forest	J194175	1,184
10	Narrow Water Forest	J116205	133
	Armagh		
11	Fathom Forest	J108205	137

Source: Department of Agriculture for Northern Ireland (Draft 1996). Key: *to the nearest whole hectare; n/a = not available.

8.2.2 Information sources used

The woodland information was extracted from Ordnance Survey of Northern Ireland 1:50,000 scale Discoverer maps and the Department of Agriculture for Northern Ireland (DANI) *Forest Service Annual Report* 1994-96 (DANI draft 1996). The agricultural information was taken from the Northern Ireland Farm Census, Rural District Data (DANI 1994b).

8.2.3 Acknowledgements

Thanks go to Sheila Magee (DANI), Prof. Julian Orford (Queens University), Mark Wilson (DANI Forest Service) and R.J. Bleakley (DoE (NI) Environment and Heritage Service) for their useful comments.

8.2.4 Further sources of information

A. References cited

Cooper, A., & McCann, T. 1994. *The botanical composition of grassland land cover types in Northern Ireland.* Report to the Environment Service. Coleraine, University of Ulster.

Department of Agriculture for Northern Ireland. 1994a. *Forest Service Annual Report 1993-1994.*

Department of Agriculture for Northern Ireland. 1994b. *Northern Ireland farm census: rural district data.* Belfast, DANI.

Department of Agriculture for Northern Ireland. Draft 1996. *Forest Service Annual Report 1994-1995/1995-1996.* Belfast, DANI.

B. Further reading

Baxter, J., & Boaden, P.J.S. 1990. Coastal resources of the Irish Sea. *In: The Irish Sea, an environmental review. Part 1: nature conservation,* ed. by Irish Sea Study Group. Liverpool, Liverpool University Press.

Cooper, A. 1985. Vegetation and soils of seminatural deciduous woods in north-east Ireland. *Vegetatio, 64:* 67-74.

Cooper, A. 1986. *A land classification of Northern Ireland.* Coleraine, University of Ulster.

Cooper, A., & Murray, R. 1987a. *A landscape ecological study of the Mourne AONB.* Coleraine, University of Ulster. (Report to the Countryside and Wildlife Branch, DoE (NI).)

Cooper, A., & Murray, R. 1987b. *A landscape ecological study of the Causeway Coast and Antrim Coast and Glens Areas of Outstanding Natural Beauty.* Coleraine, University of Ulster. (Report to the Countryside and Wildlife Branch, DoE(NI).)

Cooper, A., Murray, R., & McCann, T. 1988. *The Mourne Environmentally Sensitive Area Land Use Database.* Coleraine, University of Ulster. (Report to the Department of Agriculture for Northern Ireland.)

Cooper, A., Murray, R., & McCann, T. 1992. *The Northern Ireland Countryside Survey.* Coleraine, University of Ulster. (Report to the Department of Environment for Northern Ireland.)

Cooper, A., Taylor, D., & Murray, R. 1989. *A land use and ecological database of the Glens of Antrim Environmentally Sensitive Area.* Coleraine, University of Ulster. (Report to the Department of Agriculture for Northern Ireland.)

Cooper, E.A., Crawford, I., Malloch, A.J.C., & Rodwell, J.S. 1992. *Coastal vegetation survey of Northern Ireland.* Lancaster, Lancaster University.

Hackney, P. 1992. *Stewart & Corry's flora of the north-east of Ireland.* 3rd ed. Belfast, Institute of Irish Studies, Queen's University of Belfast.

Murray, R., McCann, T., & Cooper, A. 1992. *A land classification and landscape ecological study of Northern Ireland.* Coleraine, University of Ulster.

Stott, A. 1992. From land use survey to policy implementation: the designation of AONBs in Northern Ireland. *In: Managing land use change,* ed. by A. Cooper & P. Wilson. Coleraine, University of Ulster. (Geographical Society of Ireland, Special Publication No. 7.)

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Northern Ireland Countryside Survey land cover database	*Environment Research Group, University of Ulster, Coleraine, tel: 01265 324692
Farm census information	*Farm Census Branch, DANI Agricultural and Environmental Sciences Division, Belfast, tel: 01232 250666
Forestry information	*DANI Forest Service, Dundonald House, Belfast, tel: 01232 520100
Agricultural practice; the promotion of pollution control measures, environmentally friendly farming and conservation	*DANI Countryside Management Division, Belfast, tel: 01232 524713
Conservation and restoration of broadleaved woods	*The Woodland Trust, Grantham, tel: 01476 574297
Land-use classification	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477

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

8.3 Infrastructure

8.3.1 Introduction

Belfast, with its port, airport and major industrial and commercial development, is of pre-eminent importance in the region. The port handles some 50% of the sea traffic into and out of Northern Ireland, while its two airports account for 98% of the people travelling by air into or out of the Province. The other important ports are Larne, with around 25% of sea traffic, Warrenpoint with 7.5% and Londonderry with 5%. Belfast City (Sydenham) Airport and City of Derry (Eglinton) are adjacent to the estuaries of Belfast Lough and Lough Foyle respectively, and there is a minor civil airfield at Newtownards in Co. Down. The road network in Region 17 is generally very good for the volume of traffic. However, the coastal road, which is predominantly an 'A' class road, includes stretches that are not suitable for heavy commercial traffic. Apart from the suburban services around the shores of Belfast Lough, railway lines are confined to the major inter-city route to Dublin and that from Belfast to Londonderry.

In the north-west the Derry City Council area has a population of just over 100,000 people, including the city and its surrounding area. The port of Londonderry has now been moved downstream to the former naval base at Lisahally, providing access for larger ships than were able to navigate the dredged river channel to the former port. The City of Derry Airport is located nearby on the east bank of Lough Foyle, along with areas of industrial development.

Larne is a very busy ro-ro (roll-on, roll-off) ferry port with industrial development surrounding it. South of Larne and at the mouth of Belfast Lough lie the coastal resort of Whitehead and the ancient town of Carrickfergus with its castle. The northern shore of Belfast Lough from Carrickfergus to Belfast is heavily developed, with both heavy and light industry and large-scale residential development. The southern shore around to Bangor is less intensively developed, apart from the claimed land near the city, where the shipyard, airport and aircraft factories are to be found. Bangor has light industrial development in the area surrounding the town but remains a popular holiday resort and dormitory town for Belfast. The Co. Down coastline from here to Newcastle is largely undeveloped, apart from the fishing ports of Portavogie and Ardglass. Newcastle lies at the start of a spectacular stretch of coastline where the "Mountains of Mourne sweep down to the sea", with the fishing port of Kilkeel situated at their foot. Carlingford Lough has industrial development at the port of Warrenpoint and the large town of Newry.

8.3.2 Important locations

Residential development

The greatest concentrations of settlements in the region are in the east, particularly around the Greater Belfast area. Apart from the main population centres around Londonderry, Coleraine, Larne, Carrickfergus, Bangor and Newry there are numerous other smaller towns having permanent populations of between 5,000 and 10,000. The identity of the small towns has been preserved by green belts, with the exception of the concentrated urban areas around the major ports and harbours. Table 8.3.1 lists the coastal local authorities in Northern Ireland, the areas that they cover and their populations.

Table 8.3.1 Areas and population of coastal local authorities in Northern Ireland

Local authority	*Area (ha*)*	*Population*
Derry	38,742	95,371
Limavady	58,365	29,567
Coleraine	48,555	50,438
Moyle	49,440	14,789
Larne	33,646	29,419
Carrickfergus	8,193	32,750
Newtownabbey	15,069	74,035
Belfast	11,489	279,237
North Down (incl. Bangor)	8,158	71,832
Ards	38,067	64,764
Down	64,953	58,008
Newry and Mourne	90,937	82,943

Source: Department of Health and Social Services (1992). Key: *to the nearest whole hectare.

Industrial development

Most of the industrial development is situated around the sea loughs (Table 8.3.2; Map 8.3.1). The leading industries are the manufacture of textiles and clothing; ship and aircraft building and other forms of heavy engineering; chemical engineering (including fertiliser production); and the production of telecommunications equipment.

A major industrial centre is located in the area around Lough Foyle. There are large chemical works at Coolkeeragh. Most of the industrial activity on Larne Lough is concentrated around Larne itself, where there are oil storage facilities and a small boat repair yard. There is a paper mill located at Larne and a cement works at Magheramorne, which has left a large quarry and spoil tip on the western shore. Consideration is being given to a programme to infill the quarry with domestic and industrial waste over a 30 year period and to landscape the spoil tip. At Kilroot, Carrickfergus, there are oil storage facilities which service the power station and a large petroleum storage depot which is supplied through Belfast's deep-water port. The head of Belfast Lough is dominated by the industrial and urban shores of Belfast, where considerable land claim has taken place. Belfast Port is one of the most important shipbuilding and repairing centres of the UK. Also situated in this area is a power station, an aircraft factory and many small businesses and light engineering works. There is also a 120 m deep salt mine. Boat building and repair facilities exist at both Annalong and Kilkeel. At Kilkeel there are slipway facilities capable of handling inshore trawlers up to 30 m in length, as well as supporting

Table 8.3.2 Areas of coastal industrial infrastructure

Area no. on Map 8.3.1	*Site/area*	*Grid ref.*	*Details*
1	Culmore	C470230	Light engineering works
2	Derry	C430187 & C443150	Light industry and manufacturing
3	Coolkeeragh	C486215	Large chemical works and an oil power station
4	Coleraine	C853335	Docks for boat building and repair centres
5	Larne	D414023	Oil storage and small boat repair yard
6	Magheramorne	J437988	Large cement works and quarry (now closed)
7	Ballylumford	D421018	Oil and gas power station
8	Kilroot	J450890	Coal and oil power station
9	Carrickfergus	J400873	Two boat building and repair yards; light manufacturing industry
10	Greenisland	J387855	Engineering and chemical works and a light industrial estate
11	Belfast	J336377	Large shipbuilding industry, coal power station, many small businesses and light engineering works
12	Bangor	J350379	Small businesses and light engineering works
13	Newtownards	J349373	Small businesses and light engineering works
14	Warrenpoint	J134186	Light industrial estate
15	Newry	J095245	Light industry

Source: Buck & Donaghy (1996)

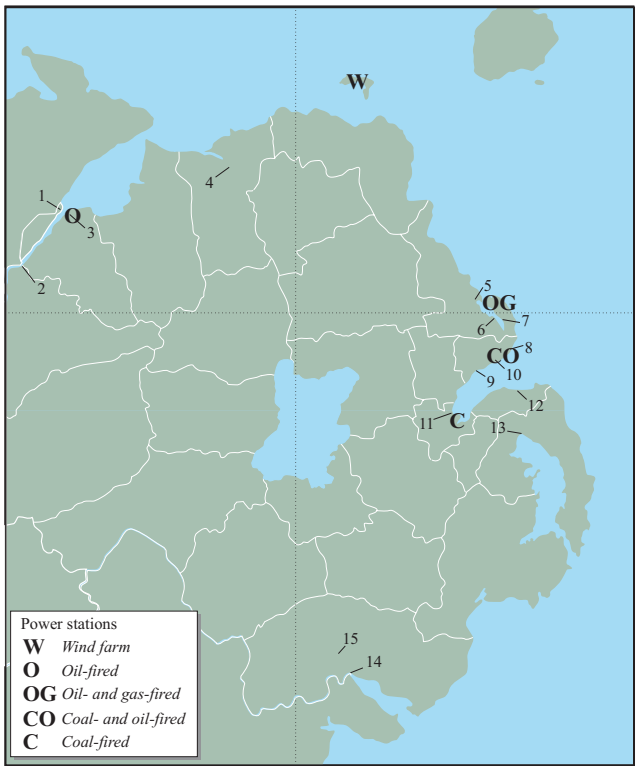
engineering services. Other areas of limited industrial importance include Bangor, Newtownards, Warrenpoint and Newry.

Ports, harbours, shipping lanes and ferries

Since 1990, the tonnage of inward freight traffic at Northern Ireland ports has increased by 20% and the outward tonnage by 29%. The principal trade ports are Belfast, Larne, Derry and Warrenpoint. Belfast is by far the largest port, offering a full range of port facilities, while Larne specialises in ro-ro (roll on, roll off) traffic. Warrenpoint has both ro-ro and lo-lo (lift on, lift off) facilities, while the old port at Derry has been closed and a new port at Lisahally with lo-lo and other facilities has been developed. There are many other small harbours and ports, but commercial traffic is very limited or has ceased as improvements have been made in road transport.

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 their Computer Assisted Ship Traffic database (COAST) which provides details of 3,500 shipping routes across the UK continental shelf giving the number of vessels and their distribution by ship, type, age and flag. An extract from this database is plotted on Map 8.3.2.

There are three primary ferry crossings which link Northern Ireland with Great Britain. Facilities for private cars and foot passengers are provided on the ferries from Larne to Cairnryan (P&O), from Belfast to Stranraer (Stena and SeaCat), and, in the summer season, from Belfast to Douglas (Isle of Man Steam Packet). Private cars are also carried on the Belfast to Liverpool service (Norse Irish) while the only other ro-ro services are the Belfast Freight Ferries service to Heysham from Belfast and the Seatruck service, also to Heysham, from Warrenpoint. Local ferries operate between Ballycastle and Rathlin Island and across the mouth of Strangford Lough between Strangford and Portaferry. A passenger ferry also operates between Larne and Ballylumford and there is a seasonal private link from



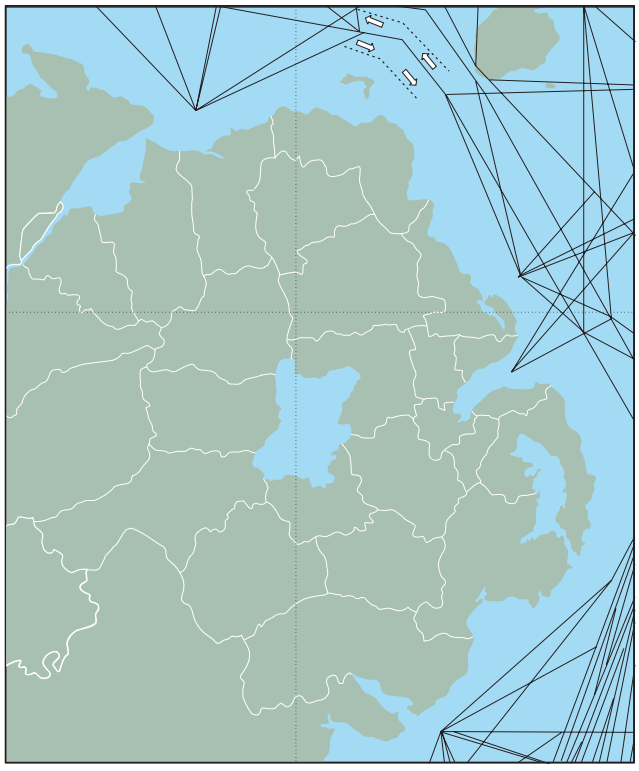
Map 8.3.1 Industrial infrastructure and coastal power stations. Numbered sites refer to those in Table 8.3.2. © Crown Copyright.

Donaghadee to the Copeland Islands. Ferries have been proposed across Lough Foyle and Carlingford Lough.

Ports and harbours in Region 17 (other than those exclusively used by fishermen) are listed in Table 8.3.3.

Power generation, pipelines and cables

The major power generation centres on the coast are at Coolkeeragh, Ballylumford, Kilroot and Belfast West (Map 8.3.1). The power station at Coolkeeragh is oil-fired and outputs thermal discharges into Lough Foyle. The station at Ballylumford is primarily oil-fired but is in the process of



Map 8.3.2 Shipping routes and Traffic Separation Scheme. Sources: Marine Safety Agency and COAST database held by Dovre Safetec Ltd. © Crown Copyright.

Table 8.3.3 Harbours and ports

Location	Main uses
Port of Londonderry (Lisahally)	Commercial shipping
Coleraine	Minor trade port (occasional), River Bann
Ballycastle	Ferry service to Church Bay, Rathlin Island
Carnlough	Minor boat harbour
Glenarm	Awaiting restoration of minor leisure harbour
Larne	Major ferry and commercial shipping port (to Scotland)
Ballylumford	Import of oil for power station; passenger ferry from Larne Town
Kilroot	Import of coal and oil for power station
Belfast	Major commercial shipping and expanding ferry port - oil/coal for the power station and grain
Donaghadee	Yachting base, passenger summer ferry to Copeland Islands
Killyleagh	Minor commercial (old)
Dundrum	Minor old commercial port (no longer used)
Warrenpoint	Busy commercial and ferry port at mouth of Newry River

being transferred to natural gas. A natural gas transmission pipeline has recently been constructed between Scotland and Northern Ireland. It makes landfall at Castle Robin, Island Magee, and transports gas to Ballylumford Power Station. The Kilroot power station is coal- and oil-fired whereas the Belfast West power station is coal-fired only. It is planned to provide an electricity interconnector cable from Scotland that will come ashore on Island Magee just south of the Isle of Muck.

Northern Ireland uses hydro-electric, wind and sewage gas as non-fossil fuel sources of power, but the only coastal site is a windfarm on Rathlin Island. There are no offshore wave power energy operations at present. A tidal power barrage across the mouth of Strangford Lough was considered by government but discounted on both economic and ecological grounds.

8.3.3 Information sources used

Industrial development information was extracted from various sources: transport and communication statistics were obtained from DoE (NI) and the Ordnance Survey of Northern Ireland Discoverer Series 1:50,000 maps. The information on population statistics comes from the 1992 summary report of the Department of Health and Social Services, which gives the results of the most recent census in 1991. A survey of the quality of UK port reception facilities for the disposal of ship's wastes was carried out by WRC (1995). The Marine Safety Agency also carry out a regular quantification of port reception facilities for the International Maritime Organisation.

8.3.4 Acknowledgements

Thanks are due to Hilary Heslip (Planning Service, DoE (NI)), Prof. Julian Orford (Queen's University Belfast), Dr Andrew Cooper (University of Ulster), Norman Taylor (Transport Policy and Legislation Division, DoE (NI)), Alan Kilgore (Newry and Mourne District Council) and R.J. Bleakley (DoE (NI) Environment and Heritage Service) for their useful comments. Shipping routes on Map 8.3.2 are reproduced from the COAST Database, developed and held by Dovre Safetec Ltd.

8.3.5 Further sources of information

A. References cited

Buck, A.L., & Donaghy, A. 1996. *An inventory of UK estuaries. 7. Northern Ireland.* Peterborough, Joint Nature Conservation Committee.

Department of Health and Social Services. 1992. *The Northern Ireland Census 1991.* Belfast, DHSS.

Donaldson, J.F., Lord. 1994. *Safer seas, cleaner ships. Report of Lord Donaldson's inquiry into the prevention of pollution from merchant shipping.* London, HMSO. (CM2560.)

Waste Regulation Council. 1995. *The survey of UK reception facilities for oil and garbage.* Southampton, Marine Safety Agency. (Report No. 352.)

B. Further reading

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 Trade and Industry. 1994. *Digest of UK energy statistics 1994.* London, HMSO.

Department of Trade and Industry. 1994. The non-fossil fuel obligation. London, Department of Trade and Industry. *REview: the magazine of renewable energy, 22* (supplement).

ENDS. 1994. Cleaner combustion technology - a revolution waiting to happen. *ENDS Report, No. 230, March 1994*. Environmental Data Services Ltd.

Technica. 1985. *Shipping routes in the area of the United Kingdom continental shelf*. Prepared by Technica for the Department of Energy. London, HMSO.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Planning developments - Northern Ireland local government districts	*The Planning Service, DoE (NI), Belfast, tel: 01232 540715
European Regional Development Funds	Department of Trade and Industry, Regional Policy Division, Room 317, Kingsgate House, 66-74 Victoria Street, London SW1E 6SW, tel: 0171 215 8594
International Maritime Organisation	4 Albert Embankment, London SE1 7SR, tel: 0171 735 7611
The UK Major Ports Group Ltd	150 Holborn, London EC1N 2LR, tel: 0171 404 2008
Port and harbour authorities	*see Appendix A2

Type of information	*Contact address and telephone no.*
Transport information for Northern Ireland	*DoE (NI) Statistics Branch, Belfast, tel: 01232 540540
Ballylumford power station (oil - in the process of being converted to gas)	Premier Power Ltd, Ballylumford, Island Magee, Larne, Co. Antrim BT40 3RS, tel: 019603 81100
Coolkeeragh power station (oil)	MGT Buy Out, Coolkeeragh Power Ltd, Electra Road, Maydown, Londonderry BT47 1UL, tel: 01504 860351
Kilroot power station (coal and oil)	Nigen, Kilroot Power Station, Larne Road, Carrickfergus, Co. Antrim BT38 7LX, tel: 019603 51644
Belfast west power station (coal)	Nigen, McCaughey Road, Belfast BT3 9AE, tel: 01232 747331

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

8.4 Coastal defence

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 by the sea. Sea defences protect against the flooding of low-lying land, especially to preserve human life and property in coastal settlements and industrial areas. Many sea defences were built in the past to protect low-lying agricultural land from flooding and to enable agricultural improvement and drainage. It is sometimes difficult to differentiate between the two different categories of coastal works, particularly where they protect against both erosion and flooding, or where they are owned and maintained by bodies not usually responsible for coastal defences, such as the Ministry of Defence. For this reason this section describes coastal defence works in general, irrespective of the purpose for which they were constructed. The works can range from simple wooden groynes installed on beaches to control sediment movement, to major concrete engineering works. Some of these forms of coastal defence can provide vital 'toe' support to the base of coastal cliffs.

Compared with other shorelines in Ireland, erosion is not a serious problem along this coast; however a number of site-specific problems can be identified. These fall into three categories: erosion associated with natural processes; erosion related to losses from the coastal sediment budget, and erosion due to disruption of natural drift or equilibrium patterns. Indirect losses of sediment are also occurring where beaches and dunes are being damaged by recreation so that material is becoming more mobile and washing or blowing away. A widespread problem in the region is the removal of sand from beaches for agricultural purposes, which can have a serious effect in areas where sediment supply is limited.

8.4.2 Important locations

Map 8.4.1 shows the locations of coastal defence works in the region. Little of the coastline of the region is at risk from flooding but there have been sea defence works in some areas such as the Quoile Barrage in Strangford Lough. Significant flood defences on estuarine rivers have been constructed at Belfast (the Blackstaff), Newtownards, Newcastle (the Burren) and Newry. Other sea defence works protect coastal roads.

On the south shore of Lough Foyle 19 km of embankment are maintained, from the mouth of the River Faughan to Longfield Bridge and from Ballykelly Bridge to the Roe Estuary. These are backed by drains from which water is pumped to the shore. The embankments are being upgraded following production of an environmental impact assessment: the Myroe Sea Embankment has been reinforced over its entire length of 4.5 km, with further works programmed to the remaining embankments by the turn of the century. They protect two airfields, the railway line, low-lying settlements and cottage industries and around 10 sq km of Grade 2 agricultural land. Rock

Map 8.4.1 Locations of coastal defence works. © Crown Copyright.

armouring has recently been used to defend the road to Magilligan Point.

Along the north coast artificial structures have disrupted the natural stability of various shorelines. The construction of training walls at the mouth of the River Bann and the dredging of the sand bar across the entrance interrupts the drift within the system, which may lead to problems for the adjacent shoreline. The building of the harbour and seawall at Portrush and Leslie's Pier at Portballintrae have led to irreversible changes in the shoreline, probably due to the loss of sand from the beach system to offshore as a result of alterations in the sediment transport regime. Carter (1991) reports the case of the loss of sand from the bay of Portballintrae as a salutary lesson in coastal geomorphology. A stone pier was built in the north-west of the bay around 1895 and appears to have changed the wave pattern within the bay, resulting eventually in the extensive sandy beach being washed offshore and lost to the system. Today the beach is mostly gravel and the cliffs once protected by the beach are eroding. Most other bays along the north-east coast have sea walls or revetments where coastal settlements are located near the shoreline, for example at Portbraddan, Ballycastle, Cushendall, Waterfoot, Carnlough and Glenarm. New breakwaters have been built to provide greater protection from storm waves at the harbour in Church Bay on Rathlin Island.

The most extensive coast defence works in this part of the region are to be found alongside the Antrim Coast Road, which is protected by a retaining wall for almost its full length. In places the wall is a massive concrete structure, up to 3-4 m high. The impact of the wall has been to cut off the

beaches from their natural sediment supplies. The coast road, as it continues around Belfast Lough, and the railway line that runs along the shores of parts of Larne and Belfast Loughs are generally defended by rock armouring. A new weir across the River Lagan at Belfast, with gates which allow the escape of bottom water on a falling tide, serves at a defence against a tidal surge.

Along the Ards Peninsula the coast road has an associated retaining wall. Over the years, a variety of structures including stone walls and concrete revetments have been constructed at various points. Rock armouring is now generally used where these require reinforcement. There are now significant lengths of coastal defences along the eastern shore of Strangford Lough and around Dundrum Bay. Within the lough, short defences to the north of Greyabbey protect farmland and a few houses which adjoin Strangford Lough. The National Trust has recently reinforced defences around a plantation woodland at Mount Stewart. About 3 km of embankments between Newtownards and Comber, partly-upgraded in the mid-1980s, are currently the subject of an impact assessment. The upper estuary of the Quoile River at Downpatrick was turned into a freshwater marsh and grazing land by the construction of a tidal barrage in 1745. A further barrage was built at the mouth of the estuary in 1957 and sluice gates allow river water out at low tide.

From Killard to St. John's Point the coast is characterised by low cliffs interrupted by occasional bays with little or no formal protection. Recently, part of the soft cliff north of Ballyhornan has been rock armoured to protect the coast road. Much sea defence work has been undertaken in Dundrum Bay and more is planned, since there is coastal erosion in several parts of the bay, particularly to the south of the tidal inlet. The MoD has attempted to curtail erosion at its Ballykinler property by means of land-claim and gabions. The Royal Down Golf Club has constructed rock armour defences to protect its golf course. At Newcastle the promontory and a small number of groynes interrupt longshore drift to the north, resulting in the loss of sand from parts of the beach. Towards Warrenpoint at the head of Carlingford Lough the coast road runs alongside the shore, with a retaining wall.

8.4.3 Management

In Northern Ireland, there is a statutory regime of sea defences for the protection of land against flooding under the Drainage (Northern Ireland) Order 1973. Existing sea defences are designated by the Drainage Council for Northern Ireland, and drainage schemes for the construction of sea defence works are prepared and carried out by the Department of Agriculture, which is also responsible for their maintenance. Coast protection works that prevent or slow the erosion of land and encroachment by the sea are not covered by the order. Some coastal defences are owned and maintained privately or by other bodies such as the National Trust. The various harbour and port authorities also possess statutory powers within their area of jurisdiction.

Northern Ireland does not have any legislation specifically dedicated to coastal erosion. Essential works within the spheres of interest of various Northern Ireland government departments continue to be dealt with under existing legislation, according to an inter-departmental agreement known as the Bateman Formula. The Department of Economic Development (DED) is responsible for schemes related to tourism in harbours; the Department of the Environment for Northern Ireland (DoE (NI)) deals with schemes where there is a road or promenade interest for which DED has no responsibility. All projects are subject to scrutiny by DoE (NI)'s Construction Service.

8.4.4 Information sources used

The main information sources for this section were Carter (1991) and Orford (1985), along with contributions from those listed in section 8.4.5.

8.4.5 Acknowledgements

Thanks are due for information or comments on early drafts of the text to Sonya Crawford (Northern Ireland Tourist Board), D.W. Carlisle (Marine Safety Agency), Alan Kilgore (Newry and Mourne District Council), Mark Wilson (DANI Forest Service), B.J. Gunn-King (Ulster Society for the Protection of the Countryside), Philip O'Doherty (Derry City Council), Brian Murphy (Environmental Policy Division, DANI), J.L. Lawson (Down District Council), Prof. Julian Orford (Queen's University, Belfast), Dr Andrew Cooper (University of Ulster) and R.J. Bleakley (DoE (NI) Environment and Heritage Service).

8.4.6 Further sources of information

A. References cited

Carter, B. 1991. *Shifting sands. A study of the coast of Northern Ireland from Magillligan to Larne*. Belfast, HMSO.

Orford, J.D. 1985. Morphological units of Northern Ireland's coastline. *In: Proceedings of the 1st international conference on geomorphology. Northern Ireland Field Trip 11th - 14th September 1985*, ed. by W.B. Whalley, B.J. Smith, J.D. Orford & R.W.G. Carter. Belfast, Queen's University Belfast.

B. Further reading

Boorman, L., & Hazelden, J. 1995. Saltmarsh creation and management for coastal defence. *In: Directions in European coastal management*, ed. by M.G. Healy & J.P. Doody, 175-183. Cardigan, Samara Publishing Ltd.

Carter, R.W.G. 1982. Recent variations in sea-level on the north and east coasts of Ireland and associated shoreline response. *Proceedings of the Royal Irish Academy, 82B*: 177-187.

Irish Sea Forum. 1992. *Global warming and climatic change*. Liverpool, University Press. (Seminar Report, University of Liverpool, April 1992.)

Ministry of Agriculture, Fisheries and Food. 1995. *The EC Habitats Directive: implications for flood and coastal defence*. London, MAFF.

Swash, A.R.H., Leafe, R.N., & Radley, G.P. 1995. Shoreline management plans and environmental considerations. *In: Directions in European coastal management*, ed. by M.G. Healy & J.P. Doody, 161-167. Cardigan, Samara Publishing Ltd.

University of Hull, Institute of Estuarine and Coastal Studies. 1992. *Coastal erosion, habitat change, saltmarshes, sea defences*. Hull, University of Hull.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Coastal engineering and data on storm effects	*DoE (NI) Construction Service, Belfast, tel 01232 253428
Flood defence policy, grants towards capital expenditure	*DANI Rivers Agency, Belfast, tel: 01232 253355
Coastal Engineering Research Advisory Committee	International Council for the Exploration of the Sea, Palægade 2-4, DK-1261, Copenhagen K, Denmark
National Landslide Databank	Rendel Geotechnics, Norfolk House, Smallbrook Queensway, Birmingham B5 4LJ, tel: 0121 627 1777
Coastal Engineering Advisory Panel	Anne-Marie Ferguson, Institution of Civil Engineers, Great George Street, London SW1P 3AA, tel: 0171 222 7722

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

Belfast, with its port, airport and major industrial and commercial development, is of pre-eminent importance in the region. Belfast Port is one of the most important shipbuilding and repairing centres in the UK; the city's other industries include a power station, an aircraft factory and many light engineering works. In the foreground is the recently completed Lagan Weir, a flood defence barrier, and behind it the cross-harbour road and rail bridges. Photo: Mike Hartwell, DoE (NI) EHS.

Chapter 9 Human activities

9.1 Fisheries

H.M.C. McCaughan & C.F. Robson

9.1.1 Introduction

This section gives an overview of the main fishing activities in the coastal waters and rivers of the region. There are fisheries for pelagic and demersal fish and several marine shellfish species (demersal fish live on or near the sea bed; pelagic fish tend to be found in mid water) and diadromous fish (in this section salmon, sea trout and eels), which spend part of their lives in fresh water and part at sea. The section also covers sea angling and bait collection. For more information about the species concerned, including their scientific names, see sections 5.5, 5.7 and 5.8.

The main fishing ports in Northern Ireland are Londonderry, Belfast, Portavogie, Ardglass and Kilkeel. The locations of these and smaller ports and harbours in the region where landings are recorded by the Department of Agriculture for Northern Ireland (DANI) are shown in Map 9.1.1.

In 1992, 3.5% of all recorded landings of fish and shellfish species in the UK and the Isle of Man were made in this region, which is below the regional average of 5.9%. The total tonnages of pelagic, demersal and shellfish species landed in the region represent 1.7%, 3.7% and a more significant 7.2% respectively of the UK and Isle of Man totals. The region is most important for a wide range of shellfish species, which are landed for UK or Isle of Man markets or for live export abroad. Shellfish landings in the region, compared with UK and the Isle of Man totals, are 24.4% for mussels and 20.8% for *Nephrops*. A summary of the totals for pelagic, demersal and shellfish species is given in Table 9.1.1.

Table 9.1.2 summarises total landings to Northern Ireland ports in the five 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 is based.

Salmon, sea trout and eels support fisheries in the

Map 9.1.1 Fishing ports. © Crown copyright.

Table 9.1.2 Landings[a] of all fish species (tonnes) to Northern Ireland ports 1991-1995

	1991	*1992*	*1993*	*1994*	*1995*
Tonnes	24,443	22,861	21,603	20,880	20,081

Source: Department of Agriculture for Northern Ireland (1995, 1996; pers. comm.) Key: [a]landings totals relate to 'nominal live weight', i.e. weight of the whole fish.

Table 9.1.1 Species group landings in 1992 (tonnes)

Species group	*Region 17*	*West Coast, Isle of Man and Region 17*	*UK and Isle of Man*	*% of 'West Coast', Isle of Man and Region 17 total landed in region*	*% of combined UK and Isle of Man total landed in region*
Pelagic	4,281	72,307	256,616	5.9	1.7
Demersal	10,441	57,845	285,901	18.0	3.7
Shellfish	8,139	51,124	113,056	15.9	7.2
All species	***22,861***	***181,276***	***655,573***	***12.6***	***3.5***

Source: Department of Agriculture for Northern Ireland (1993), Ministry of Agriculture, Fisheries and Food (1994); Scottish Office Agriculture and Fisheries Department (1993); Isle of Man Department of Agriculture, Fisheries & Forestry (pers. comm.). Note: amounts landed are rounded up to the next whole tonne. Figures are given in 'nominal live weight' i.e. weight of the whole fish. Calculating the figures in this table was a complex process: refer to section 9.1.4.

region, the most important of which are for salmon (and grilse, which are young salmon that have spent not more than one winter at sea before maturing). The main areas of interest for salmon and grilse are the Foyle Fisheries Commission (FFC) waters (River and Lough Foyle and associated sea area), the north coast net fishery and the Lower River Bann. The main river of interest for sea trout is the River Faughan. As shown in Table 9.1.3 a very large percentage of the five-year annual average for salmon and grilse recorded as caught from the West Coast and the UK is from this region, although the percentage is much lower for sea trout.

Table 9.1.3 Average annual catch (numbers of fish) of salmon and grilse and sea trout 1989-1993

Totals	*Salmon and grilse*	*Sea trout*
Region 17*	62,748	1,239
West Coast, Isle of Man and Region 17	109,553	38,263
UK	***305,800***	***143,052***
% of West Coast, Isle of Man and Region 17 total in region	57.3	3.2
% of UK and Isle of Man total in region	20.6	0.9

Source: Foyle Fisheries Commission (1994) & Fisheries Conservancy Board (1990, 1991, 1992, 1993, 1994), Scottish Office Department of Agriculture and Fisheries (1990); National Rivers Authority (1991, 1992, 1993, 1994a, b) and Scottish Office (1991, 1992, 1993, 1994). Note: *FFC area includes part of catchment in Republic of Ireland as well as Northern Ireland. 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. Herring is caught by trawl and pair trawl in the Irish Sea during the summer and autumn months. Most of the herring are landed in the Port of Ardglass where they are processed for kippers and frozen fillet blocks. Mature herring also supply the roe market. A drift net fishery takes place in the Kilkeel/Annalong area each autumn for spawning herring which supplies a local kipper trade. Mackerel, although present, are not of commercial importance in the region.

Demersal species

Table 9.1.5 gives the quantities of various demersal species landed in 1992 in the region, compared with landings nationally. The Northern Ireland fishing fleet use trawls and fixed nets to catch demersal fish. Cod and hake are caught by single vessel semi-pelagic trawl (which does not touch the sea bed) and are targeted specifically by the larger vessels during spring and autumn. Whiting, cod, monkfish (angler) and flatfish species such as megrim and plaice are principally caught as a by-catch of the *Nephrops* trawl. In this method, tickler chains ensure constant contact is made between the bottom of the net and the sea bed. A large proportion of the UK landings of dogfish (mostly spurdog) are made in the region. Dogfish, along with saithe and pollack, are caught on hard ground using rock-hopper trawl gear, where the bottom of the net is protected by steel and rubber bobbins.

Shellfish species

Table 9.1.6 gives the quantities of various shellfish species landed in 1992 in the region, compared with landings nationally.

The *Nephrops* grounds fished are principally in the area between the Province and the Isle of Man. Landings are made daily at three of the main ports in Northern Ireland - Kilkeel, Ardglass, Portavogie - from where larger *Nephrops* are exported whole to markets in France and Spain and where processing facilities produce products such as scampi. *Nephrops* form the largest and by far the most important fishery to Northern Ireland (Briggs 1994), worth over £8 million in 1994. Incidental catches of pink prawns and brown shrimp are used as bait by sea anglers.

Mussels are fished by dredge in Lough Foyle (Briggs 1985), Belfast Lough and Carlingford Lough and landed locally for shipment to France, Holland and Belgium. However, the fishery has declined since these mussels have a low market value in comparison to the high quality cultivated rope-grown mussels. Mussels are also collected on a small scale in areas such as Dundrum Inner Bay for home consumption.

Table 9.1.4 Pelagic species landings in 1992 (tonnes)

Species	*Region 17*	*West Coast, Isle of Man and Region 17*	*UK and Isle of Man*	*% of 'West Coast', Isle of Man and Region 17 total landed in region*	*% of combined UK and Isle of Man total landed in region*
Herring	4,038	14,982	89,688	27.0	4.5
Horse mackerel	224	349	1,723	64.2	13.0
Mackerel	19	55,379	150,745	<0.1	<0.1
Pilchard	0	0	4,244	0	0
Sprat	0	1,554	10,032	0	0
Whitebait	0	0	1	0	0
Others	0	43	183	0	0
Total	***4,281***	***72,307***	***256,616***	***5.9***	***1.7***

Source: Department of Agriculture for Northern Ireland (1993), Ministry of Agriculture, Fisheries and Food (1994); Scottish Office Agriculture and Fisheries Department (1993); Isle of Man Department of Agriculture, Fisheries & Forestry (pers. comm.). Note: amounts landed are rounded up to the next whole tonne. Figures are given in 'nominal live weight', i.e. weight of 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 17*	*West Coast, Isle of Man and Region 17*	*UK and Isle of Man*	*% of 'West Coast', Isle of Man and Region 17 total landed in region*	*% of combined UK and Isle of Man total landed in region*
Elasmobranchs					
Dogfish	803	6,702	14,151	12.0	5.7
Skates and rays	109	4,120	7,936	2.7	1.4
Gadoids					
Cod	2,809	8,893	62,333	31.6	4.5
Haddock	285	4,650	53,871	6.1	0.5
Hake	1,013	4,044	4,633	25.0	21.9
Ling	111	1,544	6,138	7.2	1.8
Pollack (lythe)	100	1,202	3,123	8.3	3.2
Saithe	439	2,009	13,041	21.9	3.4
Whiting	3,196	7,518	44,251	42.5	7.2
Whiting, blue	0	0	6,531	0	0
Flatfish					
Brill	30	156	473	19.2	6.3
Dab	1	199	1,216	0.3	<0.1
Dover sole	55	910	2,931	6.1	1.9
Flounder	0	106	273	0	0
Halibut	P	28	194	-	-
Halibut, Greenland	0	18	137	0	0
Lemon sole	9	578	5,582	1.6	0.2
Megrim	59	2,717	4,096	2.2	1.4
Plaice	183	3,321	24,070	5.5	0.8
Turbot	22	203	764	10.8	2.9
Other species					
Catfish	1	40	1,936	1.9	<0.1
Conger eel	220	631	730	34.9	30.2
Gurnard	10	269	637	3.6	1.5
Monkfish (angler)	397	5,262	15,075	7.6	2.6
Redfish	1	57	775	1.7	0.1
Sand eels	0	0	4,152	0	0
Torsk (tusk)	5	47	212	10.1	2.2
Witch	86	662	2,067	13.0	4.2
Others	432	1,846	4,265	23.4	10.1
Fish roes	65	113	308	57.4	21.0
Total	***10,441***	***57,845***	***285,901***	***18.0***	***3.7***

Source: Department of Agriculture for Northern Ireland (1993), Ministry of Agriculture, Fisheries and Food (1994); Scottish Office Agriculture and Fisheries Department (1993); Isle of Man Department of Agriculture, Fisheries & Forestry (pers. comm.). Key: P = species landed in the region in small quantities (here <0.5 tonnes); - = % not calculated. Note: amounts landed are rounded up to the next whole tonne. Figures are given in 'nominal live weight' i.e. weight of the whole fish. Calculating the figures in this table was a complex process: refer to section 9.1.4.

There is a dredge fishery for native oysters in Lough Foyle, with a minimum landing size of three inches (7.5 cm), which is open from the beginning of September to the end of April. Landings (approximately 400 tonnes p.a.) are made to the Republic of Ireland, so these figures are not included in Table 9.1.6. There are proposals to boost the existing small numbers of native oysters in Larne and Strangford Loughs and to re-establish fisheries by seeding with juvenile native oysters.

Scallops are dredged from beds off the Ards Peninsula and the north coast and there is also a small fishery in Strangford Lough. Appreciable numbers of scallops are taken from Strangford Lough by SCUBA divers for home consumption and on a semi-commercial basis (DoE (NI) 1994). Scallops are generally landed locally or where a market for them can be found. Queen scallops are fished from Strangford Lough and beds in the Irish Sea and are processed at Portavogie.

Edible crabs are mostly fished using pots and some are caught as a by-catch in tangle nets. Landings peak in late summer/early autumn and most of the edible crabs are sold outside Northern Ireland. Potting vessels tend to be small and operate mostly from small ports along the coast. A number of modern small/pocket trawlers based at Kilkeel and Annalong specialise in the trade to service a market for crab meat used in reconstituted 'crab sticks'. Velvet crabs are caught mostly during the winter months by small potting vessels close inshore. Specialist dealers market velvet crab catches on the continent.

Lobsters are caught in pots set in rocky areas mainly during the summer months. Although some vessels specialise in this fishery, most catches are made by small boats working part-time from small ports. Lobsters are exported to the continent in vivier (water tank) lorries.

Whelks are caught in inshore waters by specialist pots

Table 9.1.6 Shellfish landings* in 1992 (tonnes)

Species	*Region 17*	*West Coast, Isle of Man and Region 17*	*UK and Isle of Man*	*% of 'West Coast', Isle of Man and Region 17 total landed in region*	*% of combined UK and Isle of Man total landed in region*
Cockles	0	5,848	32,047	0.0	0
Crabs	221	8,074	17,191	2.7	1.3
Lobsters	24	471	1,093	5.1	2.2
Mussels	2,110	3,800	8,665	55.5	24.4
Nephrops	5,155	16,426	24,794	31.4	20.8
Periwinkles	113	1,705	2,020	6.6	5.6
Queen scallops	98	9,164	11,371	1.1	0.9
Scallops	246	4,017	8,536	6.1	2.9
Shrimps	0	128	743	0	0
Squids	90	713	2,095	12.6	4.3
Whelks	82	570	2,475	14.4	3.3
Others	0	207	2,026	0	0
Total	***8,139***	***51,124***	***113,056***	***15.9***	***7.2***

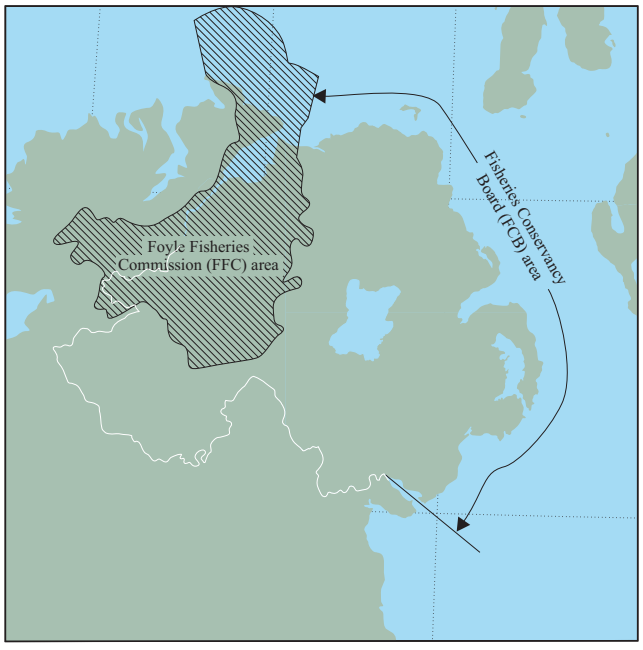
Source: Department of Agriculture for Northern Ireland (1993), Ministry of Agriculture, Fisheries and Food (1994); Scottish Office Agriculture and Fisheries Department (1993); Isle of Man Department of Agriculture, Fisheries and Forestry (pers. comm.). Key: *excluding landings of farmed shellfish - see section 9.2. Note: amounts landed are rounded up to the next whole tonne. Calculating the figures in this table was a complex process: refer to section 9.1.4.

(Buckie pots) and are sold mainly on the continent. Periwinkles are gathered extensively by hand from rocky areas of coast, both for personal use and for specialist markets. Squid appear as a by-catch in bottom trawls and are sold at commercial fish markets. There is no commercial cockle fishing in Northern Ireland. Cockle beds in the region tend to be small and attract only casual collectors.

Diadromous species

The distribution of diadromous fish species in rivers in the region is discussed in section 5.8 and shown on Map 5.8.1. Salmon and grilse are caught in the region both by rod-and-line and by drift net and fixed net methods. There are two distinct coastal net fisheries licensed to catch salmon in the region, administered by the Foyle Fisheries Commission (FFC) and by the Fisheries Conservancy Board (FCB) (Map 9.1.2). They operate in adjacent sea areas close to the Foyle/Bann Estuaries on the north coast. A restrictive licensing scheme is in operation; monofilament net is prohibited and other restrictions such as closed seasons and prohibited areas are in place. Details of sites/net length are recorded in the licences and not all licensed nets are operated. As well as rod-and-line, a total of 213 commercial net licences were issued to catch salmon and grilse in Northern Ireland 1993, with drift nets the main method used. Rod-and-line fishing for salmonids also remains popular in the region. Table 9.1.7 shows the average annual numbers of salmon and grilse and sea trout caught in the region's rivers and fisheries between 1989 and 1993, the methods used to catch them, and the numbers of net licences issued for catching salmon and grilse in 1993.

Between 1989 and 1993, an average annual total of 785 tonnes of eels were caught under licence and an annual average of 409 commercial eel fishing licences were issued (Department of Agriculture for Northern Ireland 1994; Fisheries Conservancy Board 1990, 1991, 1992, 1993, 1994). Commercial fishing licences to catch eels are administered by the Fisheries Conservancy Board mainly for Lough Neagh but also for River and Lough Erne. The methods



Map 9.1.2 Area of Foyle Fisheries Commission and Fisheries Conservancy Board for Northern Ireland. Source: Foyle Fisheries Commission (1994) © Crown copyright.

used to catch eels are weirs, fixed nets, draft nets, long lines and fyke nets (which make up the majority of licences).

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. Orton (1996) lists contact addresses for fishing clubs in the region and national organisations.

Table 9.1.7 Salmon and grilse and sea trout five-year (1989-1993) average annual catch (as numbers of fish reported), catch methods used and number of net licences for salmon and grilse issued in 1993

Location	*Salmon & grilse*	*Sea trout*	*Method used & no. of commercial net licences issued in 1993*
Rivers in FFC area			
River Foyle	10	37	Rod
River Foyle	12,521	n/av	Draft nets (62)
Foyle sea area	6,182	n/av	Drift nets (20)
Lough Foyle & sea area	19,038	n/av	Drift nets (80)
Lough Foyle only	8,790	n/av	Drift nets (12)
Camowen/Drumragh River	14	2	Rod
Culdaff River	0	1	Rod
Dennet River	5	71	Rod
River Derg	39	10	Rod
Deele River	0	4	Rod
River Faughan	286	801	Rod
River Finn and Reelan	161	59	Rod
River Glenelly & Owenkillew River	21	17	Rod
Mourne River & River Strule	204	55	Rod
River Roe	72	111	Rod
River Roe	879	n/av	Draft net (1) & fixed engine (1)
Miscellaneous	12	71	Rod
Rivers in FCB area			
Lower River Bann	1,386	n/av	Rod
Bush River	419	n/av	Rod
Remainder of FCB area (except Lough Erne & River Lagan)	932	n/av	Rod
North coast salmon fishery	11,777	n/av	Bag nets (14), fixed tidal draft nets (6), drift nets (9), draft nets (4) and salmon boxes (4)
Region 17*	***62,748***	***1,239***	***213 commercial net licences issued***

Source: Foyle Fisheries Commission (1994) & Fisheries Conservancy Board (1990, 1991, 1992, 1993, 1994). Key: n/av = not available. Notes: 'sea trout' here includes all migratory trout. 'Nets' are defined as instruments other than rod-and-line. *FFC area includes part of catchment in Republic of Ireland as well as Northern Ireland.

Sea angling occurs in many places in the region from rocks and beaches and in sheltered inlets such as Belfast and Strangford Loughs, which protect boat anglers from adverse weather. The bank off the Giant's Causeway is a favoured place for cod, saithe, plaice and turbot. Wrasse, pollack, saithe and mackerel are caught over rocks off Ballycastle and wreck fishing occurs off Rathlin Island. Rock and wreck fishing occur at Larne, Whitehead, Carrickfergus and Murlough Bay. Bangor, Donaghadee and Kilkeel in Co. Down provide sea angling from beaches, piers, rocks and harbour walls. Strangford Lough has a deep-water entrance, with the best fishing occurring at slack water (Orton 1996). Other notable places where sea fishing occurs include Magilligan Point, Barmouth Pier, Dunseverick, Ballycastle and Carlingford Lough. Shore fishing takes place from rocky outcrops, especially on the north coast, for species such as mackerel, pollack, saithe and wrasse. There is also some beach casting for flatfish and occasionally bass at Benone, Portrush and Portstewart during summer months. Mackerel fishing is popular from boats sailing from small harbours such as Portballintrae, Ballintoy and Bangor. Deep sea anglers catch cod, ling and conger eel on favoured wrecks throughout the year. Orton (1996) also lists further details on the sea fishing stations such as the facilities available and likely catch species.

Bait collection

Bait collection for sea angling has traditionally taken place in many intertidal areas of the region, although some areas are more prolific than others and may attract commercial collectors. Anglers often collect their own bait locally, while commercial collectors travel in teams to suitable shores. Many species are collected in the region, including ragworm, lugworm, peeler crabs (moulting shore crabs), mussels, cockles, limpets and razor shells (see section 5.5). Different bait species are targeted according to the species of fish being caught as well as the location and time of year. The main collecting techniques on the shore are digging and boulder turning. Bait digging, especially for lugworm and ragworm, is carried out over the lower part of muddy and sandy shores around the time of low water. Bait digging for lugworm and ragworm occurs mainly in Lough Foyle, Larne Lough, Inner Belfast Lough, Strangford Lough and Carlingford Lough. Island Hill, on the north shore of Strangford Lough near Comber, has recreational and recently some commercial bait digging occurring.

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 byelaws must conform with 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; within Region 17, these rights apply to France, the Republic of Ireland and Belgium. Norway is permitted under the London Convention into south-west Scottish waters. Beyond 12 nautical miles (the limit of the UK Territorial Seas) access to vessels from the other member states is limited based on historic fishing rights and to vessels from non-member countries by reciprocal agreements within the European Union. Specifically within Region 17, other member states including France, the Republic of Ireland, Belgium and Holland have access for species in ICES Division VIIa (Irish Sea), and Germany and Spain have access to Division VIa (West of Scotland) for some species.

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 two 'divisions': Division VIa (West of Scotland) and Division VIIa (Irish Sea). ICES provides scientific advice on the management of all the important commercial species of fin fish and some shellfish stocks in all areas of the north-east Atlantic. This work is summarised in the annual report of the Advisory Committee for Fisheries Management, which is responsible for providing scientific advice on TACs and other conservation measures to the international fisheries commissions, including the EU. The TAC is a fishery management tool which, amongst other management needs, takes account of the maximum level of exploitation that a given stock can sustain. Precautionary TACs are applied to important stocks where there are not enough scientific data to make an analytical assessment. Once the TACs are set for each stock they are divided between member states in the form of catch quotas. European Council Regulation No. 3074/95 (European Council 1995) fixes, for 1996, details of the catch quotas for fish and shellfish species for all European countries and certain conditions under which the species may be fished. The annual TACs, UK quotas and 'uptake' for 1995 for each species in the two ICES statistical divisions in the region are given in SOAFD (1996), 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.

In Northern Ireland the administration and management of sea fisheries is carried out by the Department of Agriculture for Northern Ireland (DANI), who are responsible for fisheries protection including enforcement of EU, national and local (Northern Ireland Statutory Instruments) legislation. DANI Fisheries Officers deal with quota management and also mariculture (see section 9.2). DANI fisheries protection vessels enforce legislation in the Province, which is reinforced by naval patrol vessels and patrols of the Scottish Fisheries Protection Agency. DANI are also responsible for the development and improvement of facilities for angling and angling facilities. DANI currently provides angling on many stretches of rivers; the rest are owned by angling clubs. Movanagher fish farm supplies DANI public fishing waters and also sells fish to stock privately owned waters and replacement stock for locations where fish kills occur as a result of pollution.

The Fisheries Conservancy Board (FCB) is responsible for the conservation and protection of the salmon and inland fisheries of Northern Ireland, except for those within the Foyle Fisheries Commission (FFC) area. The FFC is jointly funded by the Governments of Northern Ireland and the Republic of Ireland to act as a conservator; it issues fishing licences in the Foyle area (see Map 9.1.2 for boundaries). Salmon and sea trout are protected within estuarine waters by bailiffs appointed by the FFC and the FCB. The FCB also acts as a conservator and issues fishing licences for the remainder of the Province not covered by the FCC. A restrictive drift net fishery and a fixed net fishery are administered by the two organisations.

The Ulster Angling Federation is the governing body of game angling in Northern Ireland, representing 64 clubs and nearly 10,000 anglers. Problems with bait digging have been encountered at locations such as around the Mill Bay area of Larne Lough, where bait digging has damaged habitats and the structure of the lower shore. The northern foreshore of Inner Belfast Lough experiences intensive bait digging by hand, which is a potential problem as part of the area is an ASSI; however, there is no evidence of declining bird numbers. The National Trust owns the foreshore at Island Hill and is trying to curb the bait collection due to resulting bird disturbance, damage to eelgrass *Zostera* spp. beds and problems with other users such as bathers and horse-riders, who are endangered by holes created by digging for the bait.

Issues relating to the fisheries for pelagic, demersal, shellfish and diadromous species and sea angling and bait collection are closely linked to wildlife conservation in several ways. For instance, factors such as over-fishing, pollution and development are thought to have been responsible for seriously reducing the eel fishery in the region. Issues include the effects on target species as major components in marine ecosystems, the changed availability of food for predators, the effects on non-target species, and effects on species and habitats of nature conservation interest. Further information on issues concerning fisheries can be found in references such as Commission of the European Communities (1995), and concerning the species targeted in references given in sections 5.5.3, 5.7.3 and 5.8.3.

9.1.4 Information sources used

Brady (1995) lists details of all fishing vessels, their base ports and main fishing methods. The key GB statutes

relating to fisheries are described in Eno & Hiscock (1995). Figures given in Tables 9.1.1-9.1.7 come from various sources: DANI, Ministry of Agriculture, Fisheries and Food (MAFF), FCC, FCB, National Rivers Authority (NRA, now the Environment Agency), Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD) and Isle of Man Department of Agriculture, Fisheries and Forestry (IoM DAFF); their interpretation is described below.

Pelagic, demersal and shellfish species

Statistics given in this section are for landings recorded for fish and shellfish species 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 and vice-versa. Some fish caught may have been discarded before landing. The data presented from DANI (1993) 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 UK and the Isle of Man. Data for 1993 to 1995 have been collated in DANI (1994, 1995, 1996). The tonnages of various pelagic, demersal and shellfish species (fresh and frozen) landed by UK vessels in Northern Ireland are taken from DANI (1993). These data have been combined to give the figures in the 'Region 17' column for Tables 9.1.1 and 9.1.4-9.1.6.

The figures in the 'West Coast' column in Tables 9.1.1 and 9.1.4-9.1.6 were calculated by adding together all the landings data for the six 'West Coast' regions, including the Isle of Man (see section 1.1), and the landings made into Northern Ireland.

The figures in the 'UK and the Isle of Man' column were obtained by combining all DANI, 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 DANI, MAFF and IoM DAFF provide them as 'nominal live weight' (whole fish). These two are the same for pelagic and shellfish species, but converted data from SOAEFD were used for all demersal species, apart from sandeels (which are not gutted), so that all the data presented are in 'nominal live weight'.

Diadromous species

For Table 9.1.7 data from the Foyle Fisheries Commission (FFC) and the Fisheries Conservancy Board for Northern Ireland (FCB) annual reports have been used to compile a five-year annual average (1989-1993) catch of salmon and sea trout from the region's rivers and coastal net fisheries. It must be noted that the FFC area includes part of the catchment area of the Foyle that lies in Republic of Ireland as well as that part lying in Northern Ireland; hence the 'Region 17' total includes some catches made in the Republic. Rod catch return rates are not published for FCB but between 1989 and 1993 average 5% of the annual average catch for the FFC. Table 9.1.3 compares this 'regional' total with that for the 'West Coast' and the UK. The figures in the 'West Coast' column in Table 9.1.3 were calculated by adding together all the catch data for the six 'West Coast' regions, the Isle of Man and Northern Ireland. The figures in the total UK column were obtained by combining all data for all the 17 regions in the UK. For regions in England and Wales NRA reported catches for salmon, grilse and sea trout are used (National Rivers Authority 1991, 1992, 1993, 1994a, b). Reported catches vary in accuracy from year to year, as they represent only declared catches by individuals with a net or rod-and-line licence. For regions in Scotland data from the Scottish Salmon Fishery Statistical Districts are used, based on returns made in response to an annual questionnaire sent to proprietors and occupiers of salmon fishings (SODAF 1990; SO 1991-1995). Over 95% of the forms sent in the region in 1992 were returned.

Northern Regions Fisheries Board (1995) and Northern Ireland Tourist Board (1996) also contain information on angling for diadromous species in Northern Ireland.

Sea angling

In the 85th edition of *Where to fish*, Orton (1996) lists much useful information relating to angling, including the locations from which various species of fish can be caught.

9.1.5 Acknowledgements

Thanks go to staff at the Foyle Fisheries Commission and the Fisheries Conservancy Board for providing copies of their annual reports. Thanks are also due to R.J. Bleakley and Clifford Henry (DoE (NI) Environment and Heritage Service), Mark Tasker (JNCC) and Alan Kilgore (Newry and Mourne District Council) for comments on the draft.

9.1.6 Further sources of information

A. References cited

Brady, P. 1995. *Fishing vessels of Britain & Ireland 1995*. 3rd ed. London, Emap Business Communications.

Briggs, R.P. 1985. Meat condition in relation to environmental factors of *Mytilus edulis l.* from Lough Foyle. *Journal of Life Sciences, 5:* 97-103.

Coffey, C. 1995. *Introduction to the Common Fisheries Policy: an environmental perspective*. London, Institute for European Environmental Policy. (IEEP London Background Briefing, No. 2.)

Commission of the European Communities. 1995. *Evaluation of the biological impact of fisheries*. Brussels, Commission of the European Communities. (5.5.95, COM (95) 40.)

Department of Agriculture for Northern Ireland. 1993. *Report on the sea and inland fisheries of Northern Ireland, 1992*. Belfast, HMSO.

Department of Agriculture for Northern Ireland. 1994. *Report on the sea and inland fisheries of Northern Ireland, 1993*. Belfast, HMSO.

Department of Agriculture for Northern Ireland. 1995. *Report on the sea and inland fisheries of Northern Ireland, 1994*. Belfast, HMSO.

Department of Agriculture for Northern Ireland. 1996. *Report on the sea and inland fisheries of Northern Ireland, 1995*. Belfast, HMSO.

DoE (NI). 1994. *Strangford Lough proposed Marine Nature Reserve. Guide to designation*. Belfast, Department of the Environment for Northern Ireland, Environment Service.

Eno, N.C., & Hiscock, K. 1995. *Key statutes, Directives and Conventions for marine wildlife conservation in Great Britain*. Peterborough, Joint Nature Conservation Committee. (Marine Information Notes, No. 3 (edition 1, June 1995).)

European Council. 1992. EC Regulation No. 3760/92. *Official Journal of the European Communities, L 389* (35).
European Council. 1995. EC Regulation No. 3074/95. *Official Journal of the European Communities, L 330* (38).
Fisheries Conservancy Board. 1990. *The Fisheries Conservancy Board Annual Report for the year ending 31st December, 1989*. Craigavon, Fisheries Conservancy Board for Northern Ireland.
Fisheries Conservancy Board. 1991. *The Fisheries Conservancy Board Annual Report for the year ending 31st December, 1990*. Craigavon, Fisheries Conservancy Board for Northern Ireland.
Fisheries Conservancy Board. 1992. *The Fisheries Conservancy Board Annual Report for the year ending 31st December, 1991*. Craigavon, Fisheries Conservancy Board for Northern Ireland.
Fisheries Conservancy Board. 1993. *The Fisheries Conservancy Board Annual Report for the year ending 31st December, 1992*. Craigavon, Fisheries Conservancy Board for Northern Ireland.
Fisheries Conservancy Board. 1994. *The Fisheries Conservancy Board Annual Report for the year ending 31st December, 1993*. Craigavon, Fisheries Conservancy Board for Northern Ireland.
Foyle Fisheries Commission. 1994. *The Foyle Fisheries Commission Annual Report for 1993*. Londonderry, Foyle Fisheries Commission.
Ministry of Agriculture, Fisheries and Food. 1994. *UK sea fisheries statistics 1991 and 1992*. London, HMSO.
National Rivers Authority. 1991. *Salmonid and freshwater fisheries statistics for England and Wales, 1989*. Almondsbury, NRA.
National Rivers Authority. 1992. *Salmonid and freshwater fisheries statistics for England and Wales, 1990*. Almondsbury, NRA.
National Rivers Authority. 1993. *Salmonid and freshwater fisheries statistics for England and Wales, 1991*. Almondsbury, NRA.
National Rivers Authority. 1994a. *Salmonid and freshwater fisheries statistics for England and Wales, 1992*. London, HMSO & NRA.
National Rivers Authority. 1994b. *Salmonid and freshwater fisheries statistics for England and Wales, 1993*. London, HMSO & NRA.
Northern Ireland Tourist Board. 1996. *Game angling in Northern Ireland - an opportunity for tourism development*. Belfast, Northern Ireland Tourist Board.
Northern Regions Fisheries Board. 1995. *Angling over the border in Ireland*. Ballyshannon, Northern Regions Fisheries Board.
Orton, D.A., *ed.* 1996. *Where to fish 1996 - 1997*. 85th ed. Beaminster, Thomas Harmsworth.
Scottish Office. 1991. *Scottish salmon and sea trout catches: 1990*. Edinburgh, Scottish Office. (Scottish Office Statistical Bulletin, Fisheries Series.)
Scottish Office. 1992. *Scottish salmon and sea trout catches: 1991*. Edinburgh, Scottish Office. (Scottish Office Statistical Bulletin, Fisheries Series No. Fis/1992/1.)
Scottish Office. 1993. *Scottish salmon and sea trout catches: 1992*. Edinburgh, Scottish Office. (Scottish Office Statistical Bulletin, Fisheries Series No. Fis/1993/1.)
Scottish Office. 1994. *Scottish salmon and sea trout catches: 1993*. Edinburgh, Scottish Office. (Scottish Office Statistical Bulletin, Fisheries Series No. Fis/1994/1.)
Scottish Office. 1995. *Scottish salmon and sea trout catches: 1994*. Edinburgh, Scottish Office. (Scottish Office Statistical Bulletin, Fisheries Series No. Fis/1995/1.)
Scottish Office Agriculture, Environment and Fisheries Department. 1996. *Scottish sea fisheries statistical tables 1995*. Edinburgh, Scottish Office.
Scottish Office Department of Agriculture and Fisheries. 1990. *Scottish salmon and sea trout catches: 1989*. Edinburgh, Scottish Office. (DAFS Statistical Bulletin 1/90.)
Scottish Office Agriculture and Fisheries Department. 1993. *Scottish sea fisheries statistical tables 1992*. Edinburgh, Scottish Office.

B. Further reading

Bergman, M.J.N., Fonds, M., Hup, W., & Uyl, D. den. 1990. Direct effects of beam trawling fishing on benthic fauna. *In: Effects of beam trawl fishery on the bottom fauna in the North Sea. Beleidgericht Ecologisch Onderzoek Norddzee - Wadenzee. Rapport, 8:* 33 - 57.
Bonfil, R. 1994. *Overview of world elasmobranch fisheries*. Rome, Food and Agriculture Organization of the United Nations. (FAO Fisheries Technical Paper, No. 341.)
Department of Agriculture for Northern Ireland. 1992. *Report of policy review group on provision of public angling in Northern Ireland*. Belfast, Department of Agriculture for Northern Ireland.
Dunn, E., & Harrison, N. 1995. *RSPB's vision for sustainable fisheries*. Sandy, Royal Society for the Protection of Birds.
Elson, P.F., & Tuomi, A.L.W. 1975. *The Foyle fisheries - new basis for rational management*. Londonderry, Foyle Fisheries Commission.
Fisheries Conservancy Board. 1995. *The Fisheries Conservancy Board Annual Report for the year ending 31st December, 1994*. Craigavon, Fisheries Conservancy Board for Northern Ireland.
Foyle Fisheries Commission. 1993. *The Foyle Fisheries Commission Annual Report for 1992*. Londonderry, Foyle Fisheries Commission.
Foyle Fisheries Commission. 1995. *The Foyle Fisheries Commission Annual Report for 1994*. Londonderry, Foyle Fisheries Commission.
Fowler, S.L. 1989. *Nature conservation implications of damage to the seabed by commercial fishing operations*. Peterborough, Nature Conservancy Council (unpublished report).
Hall, S.G. In press. *The effects of fishing on marine ecosystems and communities*. Oxford, Fishing News Books.
Holden, M. 1994. *The Common Fisheries Policy: origin, evaluation and future*. Oxford, Fishing News Books.
Huggett, D. 1992. *Foreshore fishing for shellfish and bait*. Sandy, Royal Society for the Protection of Birds.
Kaiser, M.J., & Spencer, B.E. 1993. *A preliminary assessment of the immediate effects of beam trawling on a benthic community in the Irish Sea*. Copenhagen, Denmark, International Council for the Exploration of the Sea (ICES).
Lucas, M.C., Diack, I., & Laird, L. 1991. *Interactions between fisheries and the environment. Proceedings of the Institute of Fisheries Management 22nd annual study course, 10-12th September 1991*. Aberdeen, University of Aberdeen.
Lutchman, I. 1992. *A general overview of European and UK fisheries*. Godalming, WWF International.
Mason, J. 1987. *Scallop and queen fisheries in the British Isles*. Farnham, Fishing News Books for Buckland Foundation.
Ministry of Agriculture, Fisheries and Food. 1995. *UK sea fisheries statistics 1993*. London, HMSO.
Ministry of Agriculture, Fisheries and Food. 1995. *UK sea fisheries statistics 1994*. London, HMSO.
Ministry of Agriculture, Fisheries and Food. 1996. *UK sea fisheries statistics 1995*. London, HMSO.
Northern Ireland Tourist Board. 1991. *Sea fishing from boats*. Belfast, Northern Ireland Tourist Board. (Information Bulletin No. 9.)
Northern Ireland Tourist Board. 1991. *Fishing from the seashore*. Belfast, Northern Ireland Tourist Board. (Information Bulletin No. 10.)
Sea Fish Industry Authority. 1992. *Regional, socio-economic study in the fisheries sector. United Kingdom: Scotland and Northern Ireland*. Edinburgh, Sea Fish Industry Authority. (A report for the Commission of the European Communities, Directorate-General for Fisheries.)
Watson, P.S. 1974. *The Northern Ireland lobster fishery 1954-1974*. Copenhagen, International Council for the Exploration of the Sea. (C.M. Papers and Reports, No. C.M. 1974/K:19.)

C. Contact names and addresses

Type of information	Contact address and telephone no.
Local inshore fisheries information; quota management, advice on byelaws; licensing of fishing vessels; enforcement of national and EC legislation; additional statistics other than those in publications	*DANI Fisheries Division, Belfast, tel: 01232 520100
Scientific aspects of managing important fish and shellfish stocks	General Secretary, International Council for the Exploration of the Sea, Palaegade 2 - 4, DK-1261 Copenhagen K, Denmark, tel: 00 45 33157092
Assessment and advice on the conservation of fish stocks exploited by UK vessels	*DANI Agricultural and Environmental Science Division, Belfast, tel: 01232 250666
Diadromous fisheries for Foyle area; salmonid and freshwater statistics	*Foyle Fisheries Commission, Londonderry, tel: 01504 42100
Diadromous fisheries for remainder of Province not covered by FFC; salmonid and freshwater statistics	*Fisheries Conservancy Board for Northern Ireland, Portadown, tel: 01762 334666
Fishing gear technology	Technical Director, Sea Fish Industry Authority, Seafish Technology Division, Sea Fish House, St. Andrew's Dock, Hull HU3 4QE, tel: 01482 27837
UKDMAP software; mapped fishing areas of selected species, ICES Statistical Division boundaries etc.	*Project Manager, BODC, Birkenhead, tel: 0151 653 8633
Shellfish production (commercial)	Director, Shellfish Association of the UK, Fishmongers' Hall, London Bridge, London EC4R 9EL, tel: 0171 626 3531
Affiliated game angling clubs	Assistant Secretary, Ulster Angling Federation, 6 Beech Green, Doagh, Ballyclare, Co. Antrim BT39 0QB, tel: 01960 340884
Game fishing	Director, Salmon and Trout Association, Fishmongers' Hall, London Bridge, London EC4R 9EL, tel: 0171 2835838
Interaction between fisheries and non-fisheries conservation issues	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477
Marine Fisheries Task Group paper; interaction between fisheries and non-fisheries conservation issues	*Fisheries Officer, JNCC Peterborough, tel: 01733 62626
Interaction between fisheries and non-fisheries conservation issues	*RSPB Regional Headquarters, Belfast, tel: 01232 491547
Interaction between fisheries and non-fisheries conservation issues	*Conservation Officer, Marine Conservation Society, Ross-on-Wye, tel: 01989 566017
Information and advice on marine conservation issues	*Ulster Wildlife Trust, Crossgar, tel: 01396 830282
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

H.M.C. McCaughan & C.F. Robson

9.2.1 Introduction

Mariculture is the cultivation of marine species. In this region mariculture occurs in Lough Foyle, off the Antrim coast, and in Larne Lough, Belfast Lough, Strangford Lough, Dundrum Inner Bay and Carlingford Lough.

9.2.2 Locations and species

Map 9.2.1 shows the locations of commercial mariculture areas and the species that are cultivated in the region. Table 9.2.1 lists the main species that are under commercial cultivation in the region and in the UK and the Isle of Man. There is currently no cultivation of non-salmonid fish or polychaetes in the region.

Table 9.2.1 Main species that are cultivated in the region and in the UK

Species	*Species status*	*Cultivated in region?*
Salmonids		
Atlantic salmon *Salmo salar*	Native	✓
Sea trout *Salmo trutta*	Native	
Non-salmonids		
Turbot *Psetta maxima*	Native	
Halibut *Hippoglossus hippoglossus*	Native	
Shellfish: bivalve molluscs		
Common mussel *Mytilus edulis*	Native	✓
Native oyster *Ostrea edulis*	Native	✓
Pacific oyster *Crassostrea gigas*	Un-established introduction	✓
Hard shelled clam *Mercenaria mercenaria*	Non-native	
Manila clam *Tapes philippinarum*	Un-established introduction	✓
Palourde *Tapes decussatus*	Native	
Scallop *Pecten maximus*	Native	✓
Queen scallop *Aequipecten opercularis*	Native	
Polychaetes		
King ragworm *Neanthes virens*	Native	

Sources: Department of Agriculture for Northern Ireland (1993, 1994, 1995), 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

Salmon cultivation started in Northern Ireland in 1987 from one farm at Glenarm in Co. Antrim. Salmon smolts are reared at the local hatchery and transferred to sea cages at three sites (Largy, Glenarm and Red Bay) approximately 1 mile off the Antrim coast. Strong sea currents ensure that salmon flesh is firm, and marketable fish are produced after 18 months, with approximately 300 tonnes per annum

Map 9.2.1 General location of mariculture areas and species in culture. Sources: DANI, and La Tene Maps (1995). © Crown copyright.

produced. A trial in Strangford Lough during the 1960's demonstrated that rainbow trout could be cultivated in sea cages. However, this has not been developed on a commercial scale.

Shellfish

The cultivation of shellfish species takes place in sheltered areas around the Northern Ireland coastline, in Lough Foyle, Larne Lough, Belfast Lough, Strangford Lough, Killough Harbour, Dundrum Inner Bay and Carlingford Lough. Table 9.2.2 shows the tonnage of different species landed in the five years between 1990 and 1995. This does not include production taking place in Lough Foyle that is landed in the Republic of Ireland. The estimated value of the shellfish totals shown in Table 9.2.2 has grown from £433,914 in 1991 to £1,039,448 in 1995 (Department of Agriculture for Northern Ireland 1993, 1994, 1995, 1996).

Pacific oysters are grown, mainly in bags on trestles placed in the intertidal zone, from hatchery-reared seed in accessible bays in Lough Foyle, Larne Lough, Strangford Lough (Parsons 1974; Briggs 1978), Dundrum Inner Bay and Carlingford Lough. Pacific oysters are also being grown on an experimental basis in Killough Harbour. After purification most oysters are sold to retail outlets and some are used for value-added products (e.g. smoked oysters). Native oysters are also farmed in these areas but take longer to grow to a marketable size, so Pacific oysters tend to be cultivated preferentially.

Table 9.2.2 Weight (tonnes) of shellfish sold for human consumption in tonnes (1990-1994) by commercial shellfish farms in Region 17

Year	*Oysters (native and Pacific)*	*Mussels*	*Others (scallops and clams)*	*Total*
1990	181	387	4	572
1991	192	35	3	230
1992	251	38	3	292
1993	337	50	4	391
1994	299	63	4	366
1995	358	75	12	445
5 year annual average	***324***	***130***	***6***	***459***

Source: Department of Agriculture for Northern Ireland (1993, 1994, 1995, 1996).

Table 9.2.3 Provisional classification of shellfish production areas

Production area	*Species*	*Classification*
Lough Foyle	Mussels and cockles	B
Belfast Lough	Mussels	B
Strangford Lough	Oysters and clams	A
Strangford Lough	Scallops and cockles	A & B
Dundrum Bay	Mussels	B
Carlingford Lough	Mussels, oysters and clams	A & B

Source: La Tene Maps (1995b). Key: A - live bivalve molluscs from such areas can be collected for direct human consumption; B - live bivalve molluscs from these areas must be treated in an approved purification station or re-layed in clean sea water prior to sale for human consumption. Notes: provisional classification indicates that additional information is required to define these areas more accurately and the classification is updated on a regular basis.

Mussels are cultivated at sites in Larne Lough, Belfast Lough, Dundrum Inner Bay and Carlingford Lough by the re-laying of bottom-dredged seed. Some production also takes place using long-lines in Larne Lough and Strangford Lough. Some of the mussels are sold at local markets but the majority are exported to specialist producers in the Republic of Ireland and France.

Manila clams are grown experimentally in Lough Foyle, Strangford and Carlingford Loughs and there has not yet been any commercial production. However, there is a firm market on the continent for this species. Scallop production is licensed in Strangford Lough but there is currently no commercial production. The licence holder is conducting research and development into establishing a system for commercial production.

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 DANI and DoE (NI), following sampling carried out by the Port Health Authority or Local Authority. Samples of live shellfish are submitted to the Public Health Laboratory Service for bacteriological examination and, depending on the resulting category (A, B, C or D), restrictions and further treatment may apply before human consumption is permitted. Table 9.2.3 shows the provisional classification of shellfish production areas in the region.

The Environment and Heritage Service of the Department of the Environment for Northern Ireland (DoE (NI)) is responsible for policy and legislation on waste management and issues consents to discharge effluent under the Water Act (Northern Ireland) 1972. Water consents have been issued under the Water Act (Northern Ireland) 1972 for the salmon farm cages at the three sites around Glenarm in Co. Antrim. Consents are required for shellfish depuration ('purification') plants that discharge effluent into the aqautic environment.

The consent of the owners or managers of the sea bed is required and a lease may be needed before structures for mariculture can be erected on the sea bed. In many areas consent must be sought from the Crown Estate, since it owns or manages the majority of the foreshore, including areas of tidal rivers between mean high and low water mark, together with virtually the entire territorial sea bed. If the structures are potentially hazardous to navigation the Department of Transport must also authorise their construction, and if they are to be above mean low water mark planning permission must be sought from the DoE (NI) Planning Service. In this region much of the coast is protected by national and international designations, including Area of Special Scientific Interest (ASSI) and Area of Outstanding Natural Beauty (AONB), as well as local and voluntary conservation measures, so nature conservation and landscape considerations also apply.

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. There is also the risk that the introduction from overseas of shellfish may be accompanied by accidental releases of associated non-native predators, pests, parasites and diseases. In order to prevent this, DANI administer a shellfish deposit order licensing system, whereby a licence is needed to bring any shellfish into Northern Ireland. In effect, this means that only hatchery-reared spat is admitted. In addition, the importation and release of lobsters is prohibited in Northern Ireland by statute.

The DoE/DANI Committee on aquaculture has assessed the existing pattern and future development of aquaculture in Northern Ireland and examined controls that may be necessary to ensure that its future development is sensitive to its impact on the environment (DoE/DANI 1991). The report examines the following areas: the potential environmental impact of aquaculture, the future development of fin fish culture in Northern Ireland, environmental quality objectives and standards and proposed environmental recommendations and research requirements. Mariculture and its effects are limited in this region, compared with in some other parts of the UK, and are likely to be localised. However, issues relating to the cultivation of marine species are closely linked to marine nature conservation interests, particularly the possible effects on species and habitats of nature conservation interest.

9.2.4 Acknowledgements

Thanks are due to Anne Blacker (DoE (NI) Environment and Heritage Service) for providing information on Water Act

consents. Thanks also go to Mark Tasker (JNCC) and R.J. Bleakley and Clifford Henry (DoE (NI) Environment and Heritage Service) for comments on the draft.

9.2.5 Further sources of information

A. References cited

Briggs, R.P. 1978. Aspects of oyster culture in Strangford Lough, Northern Ireland. *Aquaculture, 15*: 307-318.

Department of Agriculture for Northern Ireland. 1993. *Report on the sea and inland fisheries of Northern Ireland, 1992*. Belfast, HMSO.

Department of Agriculture for Northern Ireland. 1994. *Report on the sea and inland fisheries of Northern Ireland, 1993*. Belfast, HMSO.

Department of Agriculture for Northern Ireland. 1995. *Report on the sea and inland fisheries of Northern Ireland, 1994*. Belfast, HMSO.

Department of Agriculture for Northern Ireland. 1996. *Report on the sea and inland fisheries of Northern Ireland, 1995*. Belfast, HMSO.

DoE/DANI. 1991. *A scientific assessment of aquaculure in Northern Ireland waters: future development and environmental consequences*. Belfast, DoE (Northern Ireland).

La Tene Maps. 1995a. *Major Scottish finfish farms*. Dublin, La Tene Maps.

La Tene Maps. 1995b. *Scottish shellfish farming*. Dublin, La Tene Maps.

Parsons, J. 1974. Advantages in tray cultivation of Pacific oysters (*Crassostrea gigas*) in Strangford Lough, N. Ireland. *Aquaculture, 3:* 221-229.

B. Further reading

Brown, J.R., Gowen, R.J., & McLusky, D.S. 1987. The effect of salmon farming on the benthos of a Scottish sealoch. *Journal of Experimental Biology and Ecology, 109*: 39-51.

Cobham Resource Consultants. 1987. *An environmental assessment of fish farms.* Final report to Countryside Commission for Scotland, Crown Estate Commissioners, Highlands and Islands Development Board and Scottish Salmon Growers Association.

Dixon, F. 1986. *Development of the bottom culture mussel industry in the UK.* Hull, Sea Fish Industry Authority. (Industrial Development Unit Internal Report, No. 1271.)

Frid, C.L.J., & Mercer, T.S. 1989. Environmental monitoring of caged fish farming in macrotidal environments. *Marine Pollution Bulletin, 20:* 379-383.

Galbraith, C. 1992. *Mussel farms; their management alongside eider ducks*. Edinburgh, Nature Conservancy Council.

Institute of Offshore Engineering. 1991. *A review of nature conservation implications of molluscan shellfish farming*. Report to the Joint Nature Conservation Committee and the Nature Conservancy Council for Scotland. (IOE 90/1073.)

Lumb, C.M., & Fowler, S.L. 1987. Assessing the benthic impact of fish farming. *In: Developments in estuarine and coastal study techniques*, ed. by J. McManus & M. Elliot, 75-78. Dundee, ESCA.

Nature Conservancy Council. 1989. *Fish farming in the UK.* Peterborough, Nature Conservancy Council. (Memorandum to the House of Commons Agriculture Committee.)

Ross, A. 1988. Fish farms and wildlife: are they really compatible? *Marine Conservation*, summer 1988.

Spencer, B.E. 1990. *Cultivation of Pacific oysters*. Lowestoft, MAFF. (Directorate of Fisheries Research Laboratory Leaflet, No. 63.)

Scottish Salmon Growers Association. 1990. *Salmon farming and predatory wildlife: a code of practice.* Perth, Scottish Salmon Growers Association.

Torrissen, O.J. 1994. Symposium on cultivation of Atlantic salmon. *Aquaculture & Fisheries Management, 25*(1).

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Mariculture activities	*DANI Fisheries Division, Belfast, tel: 01232 520100
Bivalve mollusc production areas; classification of shellfish waters	Chief Environmental Health Officer, Department of Health and Social Security, Room 118a, Dundonald House, Stormont Estate, Upper Newtownards Road, Belfast BT4 3SF, tel: 01232 525065
Water Act consents	*DoE (NI) Environment and Heritage Service, Environmental Protection, Water Quality Unit, Belfast, tel: 01232 254736
Shellfish diseases	DANI Fish Diseases Unit, Veterinary Sciences Division, Stoney Road, Dundonald, Belfast BT4 3FD, tel: 01232 520011
Leases	*The Crown Estate, c/o Brown McConnel Clark, Belfast, tel: 01232 320634
Marketing advice on shellfish and technical advice on shellfish depuration	Sea Fish Industry Authority, Sea Fish House, St. Andrews Dock, Hull HU3 4QE, tel: 01482 27837
Shellfish production (commercial)	Director, Shellfish Association of the UK, Clerk, Fishmongers' Hall, London Bridge, London EC4R 9EL, tel: 0171 626 3531
Technical advice and research on mariculture	Centre for Marine Resources and Mariculture, 12 The Strand, Portaferry, Co. Down BT22 1PF, tel: 012477 29648
Interaction between mariculture activities and marine nature conservation issues	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477
Marine Fisheries Task Group paper; interaction between mariculture activities and marine nature conservation issues	*Fisheries Officer, JNCC Peterborough, tel: 01733 62626
Interaction between mariculture activities and marine nature conservation issues	*RSPB Regional Headquarters, Belfast, tel: 01232 491547
Interaction between mariculture activities and marine nature conservation issues	*Fisheries Officer, WWF-UK, Godalming, tel: 01483 426444
Seals and mariculture	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.

9.3 Quarrying and landfilling

Dr G.H. Nevin

9.3.1 Introduction

In this section, quarries are classified as coastal if they are less than 2 km inland and landfill sites if they are in a coastal 10 km square. The main resources quarried in the region are basalt, limestone, gritstone (sandstone), granite and sand and gravel. These resources are readily available at inland sites closer to the main centres of demand, where road access is better and planning restrictions fewer, and as a result although the coastal region has numerous small abandoned quarries, only three hard rock quarries located within 2 km of the coast continue to operate today. Of these, one produces ground lime. A second produces granite dimension stone, accounting for most of the Northern Ireland production total for this material; almost all the production of igneous rock in Northern Ireland is used for aggregate. The area south of Kilkeel is extensively worked for sand and gravel; most of the pits are small, some are worked only intermittently and several are approaching exhaustion. Table 9.3.1 gives production levels for sites in Region 17, compared with totals for the whole of Northern Ireland.

Table 9.3.1 Northern Ireland quarry and mine production (tonnes)

	Lime-stone	*Sand-stone*	*Igneous rock*	*Sand & gravel*	*Rock salt*
Region 17 (1994/95)[1]	100,000	120,000	40,000	125,000-150,000	250,000
Northern Ireland (1994)[2]	3,782,000	5,480,000	6,480,000	5,109,000	*c.*250,000

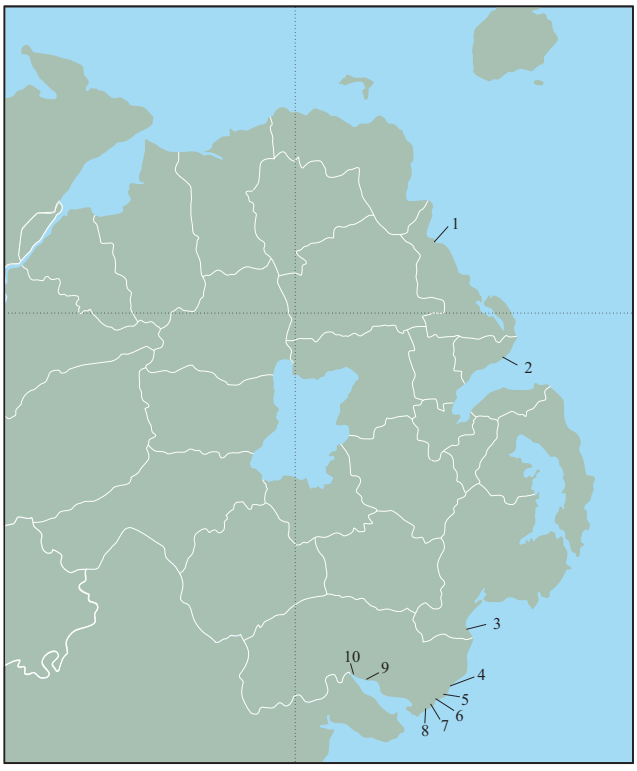
Sources: [1]estimated figures for average production based on information supplied by operators; [2]data from the Minerals and Petroleum Unit of the Department of Economic Development.

Landfill in the region is used almost exclusively for the disposal of all controlled, industrial (non-special), construction and demolition wastes produced in Northern Ireland. There are 80 licensed landfill sites in Northern Ireland (Aspinwall & Co. 1990), of which 31 lie within coastal 10 km grid squares.

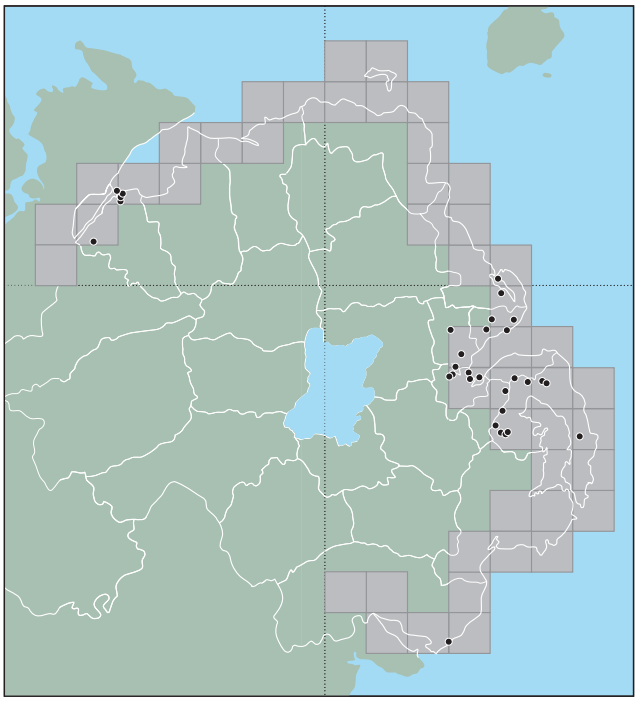
9.3.2 Important locations

The ten operating mines and quarries within 2 km of the coast are listed in Table 9.3.2 and shown on Map 9.3.1. At Kilroot, Irish Salt Mining and Exploration Ltd. produce about 0.25 million tonnes p.a. of rock salt, used mainly for road salting, from underground workings that extend for up to 3 km inland; there are no undersea workings.

Map 9.3.2 shows the locations of public and privately operated landfill sites within Region 17. As in the rest of the UK (Davidson *et al.* 1991), waste tipping, including municipal solid wastes, spoil and power station ash, is one of the most common activities leading to land-claim in



Map 9.3.1 Operating mines and quarries within 2 km of the coast. Numbers refer to those in Table 9.3.2. Sources: BGS (1994). © Crown copyright.



Map 9.3.2 Landfill sites within coastal 10 km squares. Note: a single symbol may represent more than one site in close proximity. Source: Aspinwall & Co. (1990). © Crown Copyright.

Table 9.3.2 Coastal mines and quarries in use (August 1995)

Site no. on Map 9.3.1	*Location*	*Operator*	*Mineral*
	Co. Antrim		
1	Glenarm	Eglinton Limestone	Limestone (chalk)
2	Kilroot	Irish Salt Mining & Exploration Ltd	Rock salt
	Co. Down		
3	Newcastle	S. McConnell & Sons	Granite: dimension and ornamental stone
4	Kilkeel	Blackford Sands	Sand & gravel
5	Kilkeel	W. Annett	Sand & gravel
6	Kilkeel	F. Baird & Son	Sand & gravel
7	Cranfield	T. & C. Patterson	Sand & gravel
8	Cranfield	E. Carville	Sand & gravel
9	Narrow Water	Big Wood Quarry	Gritstone (temporarily closed)
	Co. Armagh		
10	Drumalane, Newry	Rooney & McParland	Gritstone; granite (small quantity, all for aggregate)

Source: based on BGS 1994 (updated).

Region 17. Most of the landfill sites in Northern Ireland are classified as small (Aspinwall & Co. 1990). Of the larger sites, two - Culmore, Derry City, and Dargan Road, Belfast - are landfill over estuarine mudflats. Large amounts of spoil from the former Blue Circle cement works limestone quarry have been deposited over estuarine mudflats at Magheramorne, Larne Lough, and the quarry is currently (1996) being considered for a large-scale engineered landfill to replace the Belfast site at Dargan Road. Power station ash is disposed of into artificial coastal lagoons at Kilroot, Co. Antrim. Small areas of intertidal land are still being claimed, for example at Carrickfergus and at Cloghan, where there is now a landfill site for fly-ash from Kilroot Power Station.

9.3.3 Management and issues

The Department of Economic Development holds the onshore mineral rights and rights to coal offshore in Northern Ireland's territorial waters. Protocols have been established whereby the Planning Service and the Environment and Heritage Service (EHS) of DoE (NI) are consulted over the licensing of mineral exploration and production. Although a number of companies are involved in the export of construction aggregates, produced from inland sites and shipped through the ports of Belfast and Coleraine, the development of coastal superquarries in Northern Ireland seems unlikely, on account of the exposed nature of much of the hard coastline and the difficulty of finding undeveloped and technically suitable sites outside protected areas.

The DoE (NI) EHS is responsible for policy and legislation on waste management. The DoE (NI) Planning Service is responsible for the issue of planning permission for waste disposal facilities. The 26 district councils in Northern Ireland, twelve of which are coastal, are responsible for waste disposal planning, the licensing of waste disposal sites and the collection and disposal of wastes.

Small-scale removal of sand and gravel from beaches and dunes has been recognised as a problem in Northern Ireland (Carter *et al.* 1992). In some areas, the traditional rights of farmers to remove sand, gravel and shell grit still exist. Within most Areas of Special Scientific Interest (ASSIs) it is a notifiable operation, while in several other areas voluntary restrictions have been negotiated. Refuse disposal by tipping on estuarine mudflats has been identified a cause of serious loss of wildlife habitat (Milton 1990).

9.3.4 Information sources used

The figures for mineral production for the coastal sites were provided by local managers; figures for the whole of Northern Ireland were provided by the Minerals and Petroleum Unit of the Department of Economic Development (DED). UK statistics can be obtained from the British Geological Survey's 1994 *Directory of mines and quarries* (British Geological Survey 1994); however, the information for Northern Ireland is not up-to-date in this edition. While the Geological Survey of Northern Ireland do not have a specific responsibility for quarrying, aggregates or resources below high water mark, their records do show the occurrence of some of these resources. The *Review of waste disposal in Northern Ireland* (Aspinwall & Co. 1990), prepared for the DoE (NI), is a comprehensive review of waste disposal in Northern Ireland, including a list of all licensed landfills.

9.3.5 Acknowledgements

Thanks are due to staff at the Geological Survey of Northern Ireland and the Minerals and Petroleum Unit, DED, for assistance in obtaining records; to quarry managers for supplying production figures; to Suzanne McLaughlin for drawing the maps; and to Clifford Henry and R.J. Bleakley, DoE (NI) EHS, for their comments.

9.3.6 Further sources of information

A. References cited

Aspinwall & Co. 1990. *A review of waste disposal in Northern Ireland.* Shrewsbury, Aspinwall & Co. (Report prepared on behalf of the Environment Protection Division, DoE (NI).)

British Geological Survey. 1994. *Directory of mines and quarries 1994.* 4th ed. Keyworth, Nottingham, British Geological Survey.

Carter, R.W.G., Eastwood, D.A., & Bradshaw, P. 1992. Small scale sand removal from beaches in north-east Ireland. *Aquatic Conservation, Marine and Freshwater Ecosystems,* 2(1): 95-113.

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

Milton, K. 1990. *Our countryside, our concern. The policy and practice of conservation in Northern Ireland.* Belfast, Northern Ireland Environment Link.

B. Further reading

British Geological Survey. 1995. *United Kingdom minerals yearbook 1994.* Keyworth, Nottingham, British Geological Survey.

Carter, B. 1991. *Shifting sands. A study of the coast of Northern Ireland from Magilligan to Larne.* Belfast, HMSO. (Countryside and Wildlife Research series, No. 2.)

Central Statistical Office. 1994. *Business monitor - minerals*. London, HMSO. (PA1007.)

Department of the Environment. 1991. *Environmental effects of surface mineral workings.* London, HMSO. (Report to the DoE prepared by Roy Waller Associates Ltd.)

Department of the Environment. 1994. *Minerals Planning Guidance (MPG) Note 6: guidelines for aggregate provision in England.* London, HMSO.

Wells, J. 1988. *Waste disposal and conservation in Northern Ireland.* Belfast, RSPB.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Mines and quarries (British Directory of Mines and Quarries)	Director, British Geological Survey, Keyworth, Nottingham NG12 5GG, tel: 0115 936 3393
Mineral statistics	*DED Minerals and Petroleum Unit, Belfast, tel: 01232 529900
Minerals (general information) and FEPA Consents	*DED Geological Survey of Northern Ireland, Belfast, tel: 01232 666595
Planning permissions - quarries and landfills	*Special Studies Section, DoE (NI) Planning Service, Belfast, tel: 01232 540715
Waste management - Derry	*City Engineer, Derry City Council, tel: 01504 365151
Waste management - Limavady	*Chief Technical Services Officer, Limavady Borough Council, tel: 015047 22226
Waste management - Coleraine	*Director of Technical Services, Coleraine Borough Council, tel: 01265 52181
Waste management - Moyle	*Chief Technical Officer, Moyle District Council, tel: 012657 62225
Waste management - Larne	*Director of Amenity Services, Larne Borough Council, tel: 01574 272313
Waste management - Carrickfergus	*Chief Technical Officer, Carrickfergus Borough Council, tel: 01960 351604
Waste management - Newtownabbey	*Director of Leisure & Technical Services, Newtownabbey Borough Council, tel: 01960 352681
Waste management - Belfast	Director of Health & Environmental Services, Belfast City Council, The Cecil Ward Building, 4-10 Linenhall Street, Belfast BT2 8BP, tel: 01232 320202
Waste management - North Down	*Director of Technical Services, North Down Borough Council, tel: 01247 270371
Waste management -Ards	*Chief Technical Officer, Ards Borough Council, tel: 01247 812215
Waste management - Down	*Chief Technical Officer, Down District Council, tel: 01396 610800
Waste management - Newry & Mourne	Management Services Officer, Newry & Mourne District Council, Unit 19, Rampart Road, Greenbank Industrial Estate, Newry BT34 2QU, tel: 01693 65411

*Starred contact addresses are given in full in the Appendix

9.4 Marine aggregate extraction, dredging and solid waste disposal at sea

Dr G.H. Nevin

9.4.1 Introduction

Since the 1960s, marine dredged sand and gravel has made an increasing contribution to the supply of aggregates in the United Kingdom and Northern Europe. Sand and gravel on the sea bed are important sources of industrial aggregate for concrete production, road construction, building and, increasingly, for beach replenishment and soft coastal defences. Approximately 16% of the total UK market demand is currently met from marine sources, with the highest demand in the south-east of England (Smith & Collis 1993). In mainland Britain, it has been government policy to encourage marine extraction of sand and gravel; however, in Northern Ireland there is generally considered to be an oversupply of both sand and gravel and crushed rock and there has been little pressure to look beyond existing onshore sources. There are currently no licences for the extraction of aggregates in the Northern Ireland offshore area. A small number of licence areas in which interest had been expressed were offered for tender at the end of 1995, but no licences were issued.

Capital dredging is principally associated with the deepening of shipping channels and the construction of new harbour facilities and involves the one-off removal of sediment, usually in large quantities over a short period of time. Maintenance dredging is the regular dredging of ports and their approaches to maintain safe navigation, in response to external inputs of silt, natural sediment redistribution within the channel and the movement of sediments by propeller wash. It may involve either removal of sediment to licensed offshore disposal sites or plough dredging, which evens out the high and low spots within the channel.

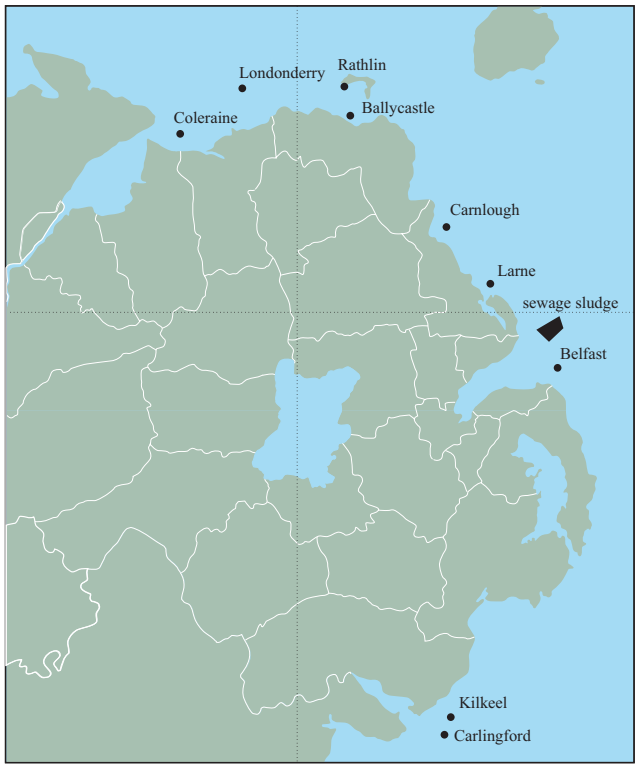
Sewage sludge is disposed of at sea at one site in the region, in the North Channel.

9.4.2 Important locations

Table 9.4.1 and Map 9.4.1 give the locations of sites licensed in 1994 under the Food and Environmental Protection Act, 1985, for the disposal of materials at sea, together with the amounts licensed for disposal. The Londonderry site shown on the map was not used during this period.

In 1994 a total of 91,314 wet tonnes of dredged material was deposited in Northern Irish sites, representing only 0.2% of the UK total of 35,962,835 wet tonnes; only five out of the eight sites under licence in Northern Ireland were used.

Capital dredging was carried out in the ports of Larne and Warrenpoint during 1993. Regular maintenance dredging takes place at Redcastle in the Port of Londonderry approach channel, the mouth of the River Bann and Warrenpoint. Since 1977, between 30,000 and 60,000 tonnes of sand have been removed every year from the mouth of the River Bann to maintain access to the port of Coleraine and is disposed of in a designated site 4 km to the north-west. Less frequent maintenance dredging takes place in Larne Harbour (every 2-3 years), Carrickfergus, Belfast (every 4-5 years) and Kilkeel. The establishment of new ferry services in Belfast in 1996 prompted the deepening of the Belfast approach channel.



Map 9.4.1 Licensed marine disposal sites for dredge spoil (see Table 9.4.1) and sewage sludge. Source: DoE (NI). © Crown copyright.

In terms of sewage disposal, the UK produces some 1.1 million tonnes of dry solids (tds) annually and disposes of approximately 300,000 tonnes (equivalent to about 10 million wet tonnes) to the sea. In Northern Ireland wet sewage sludge equivalent to approximately 14,500 tonnes of dry solids is deposited annually at a licensed disposal site in

Table 9.4.1 Licensed marine disposal sites in the region in 1994

Site name	*Location*	*Amount licensed for disposal (tonnes)*
Coleraine	55° 11.2′N, 6° 47.5′W	70,000
Rathlin	55° 16.8′N, 6° 15.5′W	4,800
Ballycastle	55° 13.2′N, 6° 14.2′W	8,800
Carnlough	54° 59.7′N, 5° 55.4′W	3,200
Larne (2 licences)	54° 52.9′N, 5° 46.9′W	146,300
Belfast (3 licences)	54° 42.1′N, 5° 29.1′W	152,600
Kilkeel (2 licences)	54° 01.5′N, 5° 55.5′W	54,000
Carlingford	53° 59.5′N, 5° 56.5′W	800,000
Region 17		***1,239,700***

Source: DoE (NI) Environment and Heritage Service.

the North Channel (Map 9.4.1), the most highly dispersive such site in the UK. This disposal site is monitored annually according to guidelines provided by the National Group Co-ordinating Sea Disposal Monitoring, a sub-group of the Marine Pollution Monitoring Management Group. The disposal of sewage sludge will end in 1998 in compliance with the EC Urban Waste Water Treatment Directive.

9.4.3 Management and issues

The primary legislation in force to control the disposal of dredged material at sea in the UK is the Food and Environmental Protection Act, 1985 (Deposition at Sea and in Intertidal Areas). In Northern Ireland licensing is handled by the Department of the Environment for Northern Ireland (DoE (NI)) Environment and Heritage Service (EHS). As part of the licensing procedure applicants may be required to provide results of chemical analysis for the material to be disposed of, in accordance with the Oslo and Paris Conventions for the Prevention of Marine Pollution *Guidelines for the management of dredged materials* (Oslo Commission 1993). DoE (NI) EHS is planning to set up a structure to bring together into a single unit its responsibilities for the consideration of water quality, marine conservation and other environmental issues connected with offshore aggregate production and onshore facilities.

The EHS initiated physical surveys of three of the licensed disposal sites in Region 17 at the end of 1995, to involve running a hydrodynamic model for each area and a survey of bottom sediment types. From this baseline, a temporal trend monitoring programme will be developed, in line with guidelines written by the National Group Co-ordinating Sea Disposal and Monitoring.

All dredging activities have short-term, localised effects, such as the removal of material and organisms, but long-term effects on, say, fish stocks or morphology are much more difficult to assess, owing to the difficulty of determining which effects are the result of dredging and which the result of the many other factors operating (Doody *et al*. 1993). In general, the principal biological impact of marine aggregate extraction is the disturbance and removal of benthic infauna and epifanuna and alteration of the substrate upon which colonisation depends. The loss from the immediate coastal zone of the sand dredged from the River Bann at Coleraine may lead to problems for the adjacent shoreline: already there is some evidence of erosion around the river mouth breakwaters and on the beach nearby (Carter 1991).

9.4.4 Information sources used

Information used in this section was mainly provided by the Environment and Heritage Service, DoE (NI) and the Crown Estate.

9.4.5 Acknowledgements

Thanks are due to staff of the Environment and Heritage Service (DoE (NI)), the Crown Estate, and the ports of Belfast, Larne, Londonderry and Warrenpoint, for information and helpful discussions. Thanks also go to Mark Tasker (JNCC), and Clifford Henry and R.J. Bleakley (DoE (NI) Environment and Heritage Service) for comments on drafts.

9.4.6 Further sources of information

A. References cited

Carter, B. 1991. *Shifting sands. A study of the coast of Northern Ireland from Magilligan to Larne.* Belfast, HMSO. (Countryside and Wildlife Research series, No. 2.)

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

Oslo Commission. 1993. *Guidelines for the management of dredged materials.* Berlin, Oslo and Paris Conventions for the Prevention of Marine Pollution. (Fifteenth Meeting of the Oslo and Paris Commissions.)

Smith, M.R., & Collis, L. 1993. *Aggregates. Sand, gravel and crushed rock for construction purposes.* 2nd ed. London, Geological Society.

B. Further reading

BMAPA. 1994. *Aggregates from the sea: why dredge?* London, British Marine Aggregate Producers Association.

Irish Sea Study Group. 1990. *The Irish Sea, an environmental review. Part 1. Nature conservation.* Liverpool, Liverpool University Press.

Irish Sea Study Group. 1990. *The Irish Sea, an environmental review. Part 2. Waste inputs and pollution.* Liverpool, Liverpool University Press.

Warren, W.P., & Keary, R. 1989. The sand and gravel resources of the Irish Sea Basin. *In: The Irish Sea: a resource at risk,* ed. by J.C. Sweeny. Maynooth, Geographical Society of Ireland. (Geographical Society of Ireland Special Publications, No. 3.)

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Marine sand and gravel: licences	*The Crown Estate, c/o Brown McConnel Clark, Belfast tel: 01232 320634
Marine sand and gravel: policy and regulation	*DoE (NI) Environment and Heritage Service, Belfast, tel: 01232 251477
Dredged material disposal	*Water Quality Unit, DoE (NI), Belfast, tel: 01232 254736
Dredging operations: Londonderry	*Londonderry Port Commissioners, Lisahally, tel: 01504 860555
Dredging operations: Belfast	*Belfast Harbour Commissioners, Dredging Department, Belfast, tel: 01232 554422
Dredging operations: Warrenpoint	*Warrenpoint Harbour Authority, Warrenpoint, tel: 01693 773381

9.5 Oil and gas development

Dr G.H. Nevin

9.5.1 Introduction

This section describes oil and gas exploration and related development in the region. There has been sporadic interest in offshore oil and gas exploration in Northern Ireland coastal waters for two decades, but so far there have been no announcements of any oil or gas finds.

9.5.2 Important locations

An important sedimentary basin, the Clyde Basin, runs south-westwards across the North Channel into the Magee and North Channel Basins, extending some distance inland into Co. Antrim and north-westwards into the Rathlin Trough (Map 9.5.1) (Naylor & Shannon 1982). Early interest concentrated on the Rathlin Trough, where seismic exploration was carried out in 1981. More recently petroleum licences were issued in the 14th Offshore Licensing Round (June 1993) for five blocks between Belfast Lough and the Mull of Galloway totalling 1,142 sq km, and three blocks between the Co. Down coast and the Isle of Man totalling 434 sq km. Exploratory drilling took place in the latter area during 1994. Onshore petroleum licences issued in 1995 by the Department of Economic Development include two areas in Co. Antrim, one stretching inland from behind Ballycastle Bay and the other extending along the coast between Carnlough and Whitehead.

The Scotland - Northern Ireland undersea gas pipeline (SNIP) from Portnaughan, north-west of Stranraer, to Castle Robin Bay was completed in October 1996.

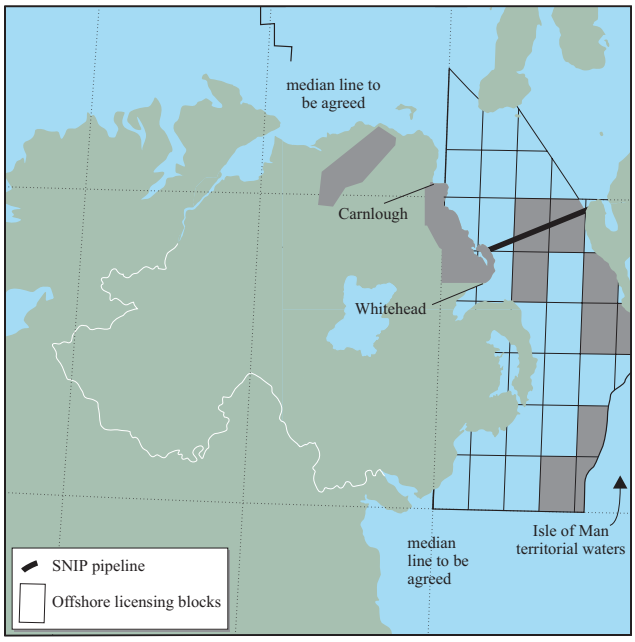
Map 9.5.2 shows offshore blocks under licence in the region as at 1 August 1995, onshore petroleum licensed areas as at 31 March 1996 and the SNIP pipeline.

9.5.3 Management and issues

The Department of Economic Development (DED) (Northern Ireland) is responsible for licences for onshore exploration and production of minerals (other than precious metals) and petroleum, issued under the Mineral Development Act (Northern Ireland) 1969 and the Petroleum Production Act (Northern Ireland) 1964. Offshore petroleum activities are licensed through the Department of Trade and Industry (DTI) in consultation with a wide range of organisations, including government departments (such as the DoE (NI) Environment and Heritage Service and the Department of Agriculture for Northern Ireland), environmental agencies, local groups, local authorities, fishermen's federations and other non-governmental organisations. A range of conditions may be applied, linked to the environmental sensitivity of the block. At present neither the DED nor the DTI has power to grant petroleum licences over the foreshore or areas within bay closing lines.

While general concern has been expressed about the possible environmental effects of oil and gas exploration and production, a more specific issue in the region arises from the proximity to the Northern Ireland coast of the routes of large tankers. Detailed plans have been made by the DoE (NI) Emergency Pollution Unit for dealing with oil pollution threats, and there are site-specific coastal assessments, covering topics such as access, priorities for protection, use of dispersants and local support available to emergency response teams.

Map 9.5.1 Sedimentary basins in the Northern Ireland offshore area. Sources: DTI (1995); Naylor & Shannon (1982). © Crown copyright.



Map 9.5.2 Oil and gas onshore and offshore licensing blocks; the SNIP pipeline. Note: shaded blocks are those under licence as at March 1996 (onshore) and August 1995 (offshore). Sources: DTI (1995); DED (1995). © Crown copyright.

9.5.4 Information sources used

Information used in compiling this section came from DED (1994, 1995), the DTI list of Offshore Production Licences and the United Kingdom Oil and Gas Activity Map (Department of Trade and Industry 1995).

9.5.5 Acknowledgements

Thanks go to Reg Peachey, DTI, and Angus McRobert, DoE (NI) Environment and Heritage Service, for up-to-date information and useful discussion on issues, and to Mark Tasker, JNCC, for his comments on the draft.

9.5.6 Further sources of information

A. References cited

Department of Economic Development. 1994. *Minerals and petroleum exploration and development in Northern Ireland, 1991-94.* Belfast, HMSO.

Department of Economic Development. 1995. *Minerals and petroleum exploration and development in Northern Ireland, 1994-1995 (Supplement).* Belfast, HMSO.

Department of Economic Development. 1996. *Minerals and petroleum exploration and development in Northern Ireland, 1995-1996 (supplement).* Belfast, HMSO.

Department of Trade and Industry. 1995. *United Kingdom oil and gas activity map*. London, Lynx Information Systems Ltd.

Naylor, D., & Shannon, P. 1982. *Geology of offshore Ireland and West Britain.* London, Graham & Trotman.

B. Further reading

Clark, R.B. 1992. *Marine pollution.* 3rd ed. Oxford, Clarendon Press.

Davies, G.J., & Wilson, J.L.J. 1995. Wildlife sensitivity criteria for oil and gas developments in Great Britain. *Joint Nature Conservation Committee Report, No. 206.*

Department of Trade and Industry. 1996. *The energy report. Vol. 2: oil and gas resources of the United Kingdom.* London, HMSO.

Pickering, H.J. 1990. Energy. *In: The Irish Sea, an environmental review. Part 4: planning, development and management,* ed. by H.D. Smith & A.J. Geffen. Liverpool, The Irish Sea Study Group/Liverpool University Press.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Oil and gas developments	Public Relations Officer, Department of Trade and Industry, 1 Palace Street, London SW1E 5HE, tel: 0171 215 5000
Petroleum licences, offshore	Head of Exploration & Licensing, Department of Trade and Industry, 1 Victoria Street, London SW1H 0ET, tel: 0171 215 5061
Petroleum licences, onshore	*Minerals and Petroleum Unit, Department of Economic Development, Belfast, tel: 01232 529900
Petroleum licensing - Republic of Ireland	Petroleum and Minerals Division, Department of Energy, Beggars Bush, Dublin 4, tel: 00 353 1 671 5233
Oil and gas industry issues - UK	Public Relations Officer, UK Offshore Operators Association, 3 Hans Crescent, London SW1X 0LN, tel: 0171 589 5255
Oil and gas industry issues - Republic of Ireland	Irish Offshore Operators Association, Tramway House, Dartry Road, Dublin 6, tel: 00 353 1 497 5716
Oil pollution: policy, planning and emergency action	*DoE (NI) Emergency Pollution Unit, Belfast, tel: 01232 254868
Scotland - Northern Ireland Pipeline project (SNIP)	The Chief Executive Officer, Premier Transco Ltd., Stamford House, 1b Hill Street, Hinckley, Leicestershire LE10 1DS, tel: 01455 636381

Type of information	*Contact address and telephone no.*
Oil transportation and terminals	Technical Adviser, Oil Companies International Marine Forum (OCIMF), 15th Floor, 96 Victoria Street, London SW1E 5JW, tel: 0171 828 7966
General information on the oil industry	Librarian, Institute of Petroleum Library and Information Service, 61 New Cavendish Street, London W1M 8AR, tel: 0171 467 7100
Oil spillages: government body carrying out pollution control at sea	Marine Pollution Control Unit, Spring Place, 105 Commercial Road, Southampton SO15 1EG, tel: 01703 329484
Response (privately-funded) to oil spills: worldwide	Oil Spill Response, Oil Spill Service Centre, Lower William Street, Northam, Southampton SO14 5QE, tel: 01703 331551
Research into oil pollution	Oil Pollution Research Unit, Fort Popton, Angle, Pembroke, Dyfed SA71 5AD, tel: 01646 641404
Advice on oil pollution strategies worldwide	International Tanker Owner's Pollution Federation Ltd, Staple Hall, Stonehouse Court, 87-90 Houndsditch, London EC3A 7AX, tel: 0171 621 1255
Advice on oil spill control equipment	British Oil Spill Control Association (BOSCA), 4th Floor, 30 Great Guildford Street, London SE1 0HS, tel: 0171 928 9199
Local information on the environmental effects of exploration and production	*Ulster Wildlife Trust, Downpatrick, tel: 01396 830282
Information on the environmental effects of exploration and production	*WWF - UK, Belfast, tel: 01960 353005

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

9.6 Water quality and effluent discharges

Dr G.H. Nevin & S. McLaughlin

9.6.1 Introduction

This section provides a general introduction to the coastal water quality of Northern Ireland, including an overview of effluent discharges along the coast. Contamination of coastal waters can come from a variety of sources, for example domestic sewage, industrial effluents and river discharges or from material disposed of directly into the sea, such as sewage sludge and dredged sediments (see section 9.4). In general, coastal waters of Northern Ireland are not affected by major industrial pollution, as there are only two large industrial centres on its coastline (Londonderry and Belfast) where there are significant discharges of industrial effluent into the marine environment. Cooling water discharges from power stations are also significant. Discharges occurring outside the region may also have a detrimental effect on coastal water quality. Radioactivity in the form of caesium-137 is widely dispersed in the Irish Sea, with Sellafield discharges probably being the main source. Caesium-137 discharges into the Irish Sea have now decreased from 325 TBq in 1985 to below 20 TBq per annum (O'Grady & Currivan 1990). In the report *River and estuary quality* (DoE (NI) 1991), water in 88% of estuaries surveyed in the region was of good quality. Beach quality in the region is generally good.

9.6.2 Important locations

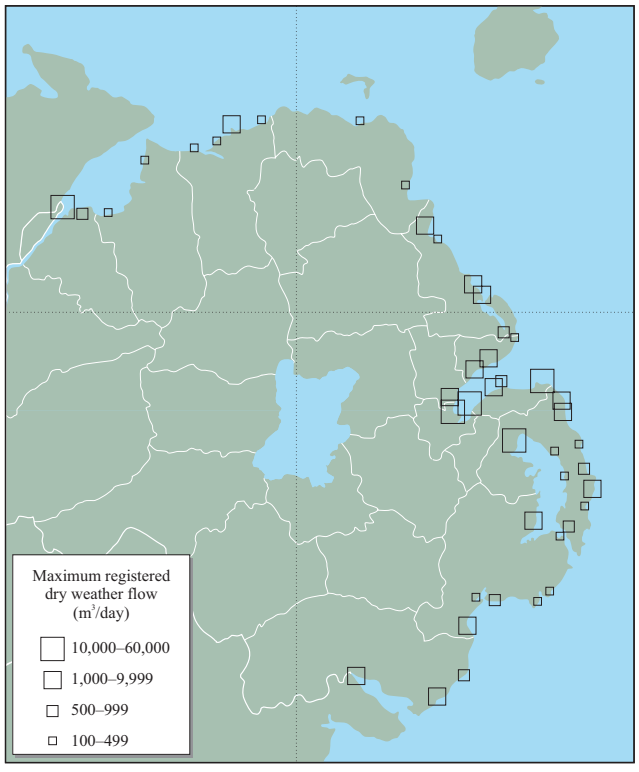
Map 9.6.1 shows the locations of sewage outfalls with registered 'dry weather flows' (i.e. undiluted by rain) in excess of 100 m^3 per day. Many of the sewage outfalls in the first category (<500 m^3) are relatively small discharges of 150-250 m^3 per day. There are a further 26 minor discharges of 10-100 m^3 per day that are not included, but the DoE (NI) Water Service has plans to transfer these smaller outfalls to larger sewage works over the next few years. Table 9.6.1 lists the outfalls with registered 'dry weather flows' in excess of 6,000 m^3 per day: these are all in the vicinity of the larger population centres, particularly the Greater Belfast Area.

Map 9.6.2 and Table 9.6.2 show the locations of

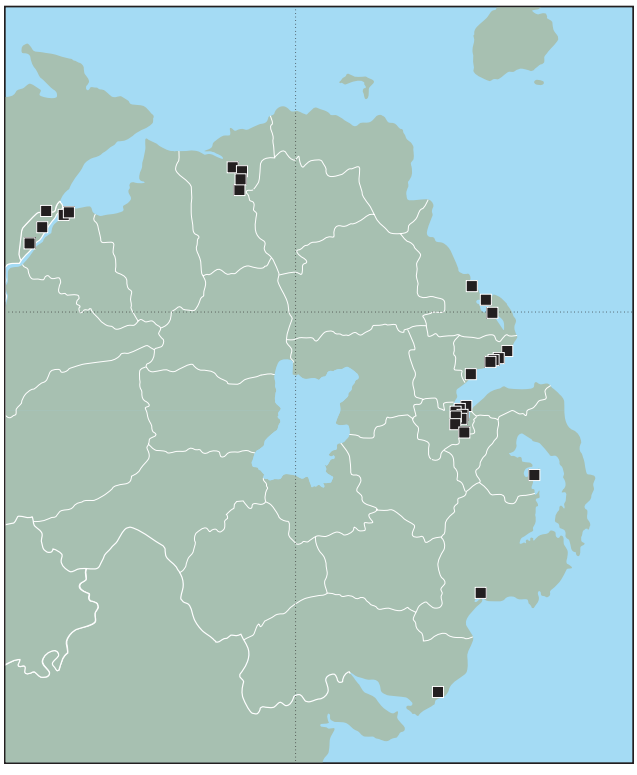
Table 9.6.1 Sewage outfalls in the region with registered 'dry weather flows' >6,000m^3 per day

Sewage treatment works	*Location*	*Grid ref.*	*Treatment*	*Max. registered daily dry weather flow (m^3)*
Culmore	River Foyle	C475230	Primary	32,900
Carrickfergus	Belfast Lough	J431886	Primary	8,000
Whitehouse	Belfast Lough	J344801	Secondary	9,200
Belfast	Belfast Lough	J351768	Primary	57,500
Kinnegar	Belfast Lough	J391790	Primary	32,000
Briggs Rock, Bangor	Belfast Lough	J552837	Preliminary	19,000
Ballyrickard	Strangford Lough	J488705	Secondary	13,800

Source: DoE (NI) Environment and Heritage Service.



Map 9.6.1 Locations of sewage outfalls with registered 'dry weather flows' in excess of 100 m^3 per day. Source: DoE (NI). © Crown Copyright.



Map 9.6.2 Locations of industrial discharges that are consented under the Water Act (1972) Northern Ireland, by DoE (NI). © Crown Copyright.

Table 9.6.2 Industrial discharges consented under the Water Act (1972) N Ireland

Location	*Grid ref.*	*Company name*	*Industry/effluent type*	*Maximum registered flow*
Derry	C470217	Londonderry PHC	Surface water	Not specified
Derry	C473219	Londonderry PHC	Surface water	Not specified
Derry	C447221	Londonderry PHC	Surface water	Not specified
Derry	C440187	Lanes	Surface water	Not specified
Derry	C429153	Ready Mix Concrete	Concrete/quarrying	Not specified
Coolkeeragh	C482223	Du Point	Textiles	125 m^3/day
Coolkeeragh	C482221	Coolkeragh	Power station	2,000 m^3/day
Coleraine	C854304	ABC Laboratories	Laboratory	30 m^3/day
Coleraine	C859331	R.J. Maxwell & Sons	Quarry	Not specified
Coleraine	C847334	Dairy Produce Packers	Food	400 m^3/day
Coleraine	C865315	Cawoods	Surface water	Not specified
Larne	D407042	F.G. Wilson	Engineering	150 m^3/day
Larne	D421018	Ballylumford Power Station	Cooling water A	710 m^3/day
Larne	D421018	Ballylumford Power Station	Cooling water B	2,500 m^3/day
Larne	D421018	Ballylumford Power Station	Oil/water separator	7,900 m^3/day
Larne	D421018	Ballylumford Power Station	Rot air pump	14,000 m^3/day
Larne	D421018	Ballylumford Power Station	Oil/water separator	7,900 m^3/day
Larne	D421018	Ballylumford Power Station	Demineralisation and polishing plant (microcontaminant removal)	1,800 m^3/day
Magheramorne	J436988	Blue Circle	Cooling water	570 m^3/day
Whitehead	J465903	NIES Cloughan Pt	Storm water	1,926 m^3/day
Kilroot	J446888	Kilroot Power Station	Coal store	Not specified
Kilroot	J440886	Kilroot Power Station	Wheelwash	Not specified
Kilroot	J439885	Kilroot Power Station	Cooling water	3,350 m^3/day
Kilroot	J441885	Kilroot Power Station	Oil/water interceptor	Not specified
Kilroot	J439886	Kilroot Power Station	Ash disposal area	Not specified
Kilroot	J440887	Kilroot Power Station	Boiler blow down	Not specified
Kilroot	J435885	Kilroot Power Station	Central oil/water separator	Not specified
Kilroot	J446888	Ulster Industrial	Chemical works	45 m^3/week
Carrickfergus	J397864	Flaxall Products	Textiles	720 m^3/day
Belfast	J357778	Cawoods	Surface water	Not specified
Belfast	J350738	Tenants Textiles	Chemical works	3,000 m^3/day
Belfast	J364765	Clearway	Industrial	Not specified
Belfast	J364764	Cohen	Surface water	Not specified
Belfast	J363763	Belfast Harbour Commissioners	Surface water	Not specified
Belfast	J359773	Richardson's	Fertiliser manufacture	1,400 m^3/day
Belfast	J352765	Belfast West Power Station	Generator service water	Not specified
Belfast	J353766	Belfast West Power Station	Generator service water	Not specified
Belfast	J354763	Belfast West Power Station	Cooling water	1,010 m^3/day
Belfast	J354763	Belfast West Power Station	Air heater wash	Not specified
Belfast	J362768	Harland & Wolff	Oil/water/separator	25 litres/second
Belfast	J364751	Esso	Surface water	Not specified
Belfast	J365761	Shorts Bombardier	Plating	Not specified
Belfast	J370722	Shell UK	Oil/water separator	Not specified
Belfast	J373780	BP	Oil/water separator	11,400 m^3/day
Whiterock	J527626	Cuan Sea Fishery	Depuration ('purification')	Not specified
Dundrum	J408364	Dundrum Oyster Fishery	Depuration ('purification')	15 m^3/day
Kilkeel	J313144	Aquaculture Ltd	Food processing	25 m^3/day

Source: DoE (NI) Environment and Heritage Service

industrial discharges that are registered by the DoE (NI) under the Water Act (1972) Northern Ireland. The majority of these discharges are related to the four main power stations in Northern Ireland: Coolkeeragh, Ballylumford, Kilroot and Belfast West, which each have consent to discharge up to 3,350 m^3 of cooling water per day. Some of the other industrial discharges are minimal, with registered flows as low as 25 m^3/day. Further impacts on water quality may arise from port and harbour operations, both industrial and recreational.

Map 9.6.3 and Table 9.6.3 show the quality of the region's bathing waters in recent years. The quality of bathing water along the coast is very high, with 94% of the 16 EC-identified bathing waters passing the 'mandatory' standards every year from 1990-1995; in 1996 the pass rate was 100%. A further ten non-identified bathing waters are monitored under the bathing waters programme, all of which complied with the mandatory standard of the EC Bathing Water Directive in 1995. The Directive contains higher 'guideline' standards as well as the mandatory standards; 75% of the EC-identified bathing areas in Northern Ireland met these higher standards in 1995, along with eight of the ten non-identified beaches.

In 1996 the Tidy Northern Ireland Group awarded Blue Flag and Seaside Awards to seven beaches: Benone, Portstewart Strand, Portrush West Strand, Portrush East

Table 9.6.3 EC identified bathing waters - compliance with mandatory standards, 1994-96 seasons

Bathing water	*1994*	*1995*	*1996*
Benone	Pass	Pass	Pass
Castlerock	Pass	Fail	Pass
Portstewart	Pass	Pass	Pass
Portrush (West)	Pass	Pass	Pass
Portrush (East)	Pass	Pass	Pass
Ballycastle	Pass	Pass	Pass
Brown's Bay	Pass	Pass	Pass
Helen's Bay	Pass	Pass	Pass
Crawfordsburn	Pass	Pass	Pass
Ballyholme	Pass	Pass	Pass
Groomsport	Pass	Pass	Pass
Millisle	Pass	Pass	Pass
Tyrella	Pass	Pass	Pass
Newcastle	Pass	Pass	Pass
Cranfield (Nicholson's Point)	Pass	Pass	Pass
Cranfield Bay	Fail	Pass	Pass

Source: DoE (NI) EHS, Water Quality Unit.

Strand, Ballycastle, Crawfordsburn and Cranfield West. To qualify for a Blue Flag Beach Award, a bathing water must meet the guideline standard of the EC Bathing Water Directive as well as demonstrating good beach management practice.

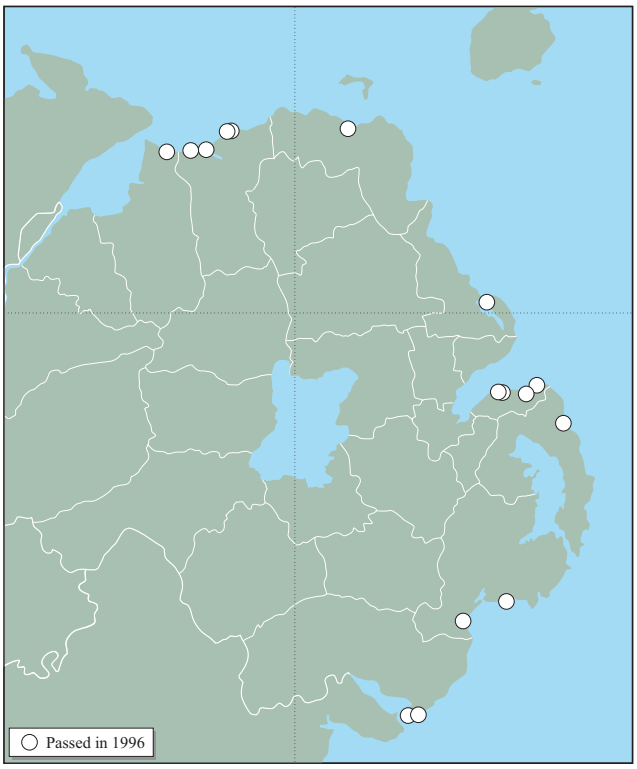
In general, according to the Beachwatch 94 survey carried out by the Marine Conservation Society (Morton 1994) the most common litter items found on the participating beaches were plastic, metal, polystyrene, paper and glass.

9.6.3 Management and issues

The main legislation that controls discharges into the aquatic environment in Northern Ireland is the Water Act (1972) NI (which is under review); it is the responsibility of the DoE (NI) to register sewage discharges and issue trade effluent licences for the release of substances into the marine environment. Conditions relating to trade effluent consents are set to protect the quality of the receiving waters. A discharge that would cause a fall in water quality would not be permitted.

Water quality is monitored by the Department of the Environment for Northern Ireland (DoE (NI)) on at least four occasions throughout the year at a total of 40 monitoring stations within Lough Foyle, River Bann, Larne Lough, Belfast Lough, Strangford Lough, Dundrum Inner Bay and Carlingford Lough, as part of the Estuarine and Coastal Waters Monitoring Programme. In addition to this monitoring of estuarine water quality, a detailed analysis of the nutrient budgets of both Belfast and Strangford Lough is being undertaken by the DoE (NI) to enable their classification under the EC Urban Waste Water Treatment and Nitrates Directives. Bathing water quality is monitored by the DoE (NI) at sixteen EC-identified bathing waters, which are regularly sampled for levels of coliforms (bacteria that indicate the presence of sewage) in accordance with the EC Bathing Waters Directive.

An important management issue relates to the combined effect of discharging sewage, trade and agricultural effluents into tidal rivers. Even though they are not directly



Map 9.6.3 EC-identified bathing waters: compliance with the mandatory coliform standards in 1996 (all 16 beaches passed). Source: DoE (NI). © Crown Copyright.

discharged into coastal waters, this is where effluents ultimately emerge. This is an issue in sensitive areas such as Strangford Lough, as the rivers are entering what is, in places, a relatively low-energy estuarine environment as opposed to the open sea. In setting consents to discharge water under the Water Act (1972) NI, the sensitivity of the receiving waters is a prime consideration; it is a policy of the DoE (NI) that the quality of Northern Ireland receiving waters should not deteriorate.

Under the Urban Waste Water Treatment Directive (91/271/EEC), by the year 2005 all significant sewage discharges, i.e. from outfalls serving populations >10,000 (roughly equivalent to 1,800 m^3 per day), and discharges to estuaries, where they serve populations >2,000 (roughly 360 m^3 per day), will have to have a minimum of secondary treatment, except for those discharges in High Natural Dispersion Areas (HNDAs). In Northern Ireland, the Briggs Rock outfall at Bangor and the proposed combined outfall at Portrush would discharge into possible HNDAs, each encompassing coastal water within a 10 km radius. Mandatory comprehensive studies are ongoing at Portrush and Bangor to show that there would be no adverse effects on the environment if discharges were premitted without secondary treatment. None of the other outfalls in Table 9.6.1 is considered to discharge into an HNDA. The management of sewage outfalls is the responsibility of the Water Service, DoE (NI). Monitoring of discharges and the maintenance of records is carried out jointly by the Environment and Heritage Service (EHS), DoE (NI) and the Water Service, DoE (NI), which has a programme of regular monitoring of all discharges of over 1,000 population equivalent.

Tributyltin (TBT) is an organic compound of tin used in antifouling paints on ships; it is on the UK Red List of the

'most dangerous' chemicals entering the marine environment (Irish Sea Study Group 1990). TBT has been detected in Irish coastal waters and is known to affect the growth of benthic organisms (Langston *et al.* 1990; Waite *et al.* 1991). In 1986 legislation was introduced to control its use.

In the event of coastal pollution the DoE (NI) EHS coordinates the onshore response in liaison with the Marine Pollution Control Unit. The EHS holds equipment and materials at strategic locations throughout Northern Ireland to deal with both coastal and inland pollution incidents.

9.6.4 Information sources used

Information about the quality of coastal waters and marine bathing waters around Northern Ireland comes from the Environment and Heritage Service, DoE (NI) Water Quality Unit. Schemes such as the Tidy Northern Ireland Group Seaside Award and the European Blue Flag are monitored during the year previous to the publication of their results. Monitoring of the EC Bathing Waters and other beaches under schemes such as Coastwatch UK and Beachwatch (Morton 1994) take place over one or two days. The results may therefore be skewed by heavy rain or localised effects at the time of survey. Coastwatch UK and Beachwatch do not sample the whole coastline in the region, owing to a shortage of volunteers. The results may therefore sometimes be unrepresentative because of the small sample size.

9.6.5 Acknowledgements

Thanks go to staff of the DoE (NI) Environment and Heritage Service and Water Service, for information and helpful discussions, and in particular to Clifford Henry and R.J. Bleakley.

9.6.6 Further sources of information

A. References cited

DoE (NI). 1991. *River and estuary quality in Northern Ireland: report of the 1991 survey.* Belfast, HMSO/Department of the Environment for Northern Ireland.

Irish Sea Study Group. 1990. *The Irish Sea: an environmental review*. Liverpool, Liverpool University Press/Irish Sea Study Group.

Langston, W.J., Bryan, G.W., Burt, G.R., & Gibbs, P.E. 1990. Assessing the impact of tin and TBT in estuaries and coastal regions. *Functional Ecology, 4:* 433-443.

Morton, M. 1994. *Beachwatch '94: nationwide beach clean and survey report.* Ross-on-Wye, Marine Conservation Society Ltd.

O'Grady, J., & Currivan, L. 1990. *Radioactivity in the Irish marine environment. Technology Ireland, 22*(2): 49-53.

Waite, M.E., Waldock, M.J., Thain, J.E., Smith, D.J., & Milton, S.M. 1991. Reductions in TBT concentrations in UK estuaries following legislation in 1986 and 1987. *Marine Environmental Research, 32:* 89-111.

B. Further reading

Allen, J. 1994. Persistent marine debris and shoreline litter: a local authority's response. *Seas at risk, North Sea Monitor*, 11-12.

Bates, J.H. 1985. *United Kingdom marine pollution law.* London, Lloyd's of London Press Ltd.

European Community. 1988. *Quality of bathing waters.* Luxembourg, Office for Official Publications for the EC.

GESAMP. 1990. *The state of the marine environment.* Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP). (Reports and Studies, No. 39.)

Hunt, G.L. 1989. *Radioactivity in surface and coastal waters of the British Isles*. Lowestoft, Ministry for Agriculture, Fisheries and Food, Directorate of Fisheries Research. (Aquatic Environment Monitoring Report, No. 21.)

Institution of Civil Engineers. 1980. *Coastal discharges, engineering aspects and experience.* London, Institution of Civil Engineers. (Coastal Discharges, Conference Proceedings 7-9th October 1980.)

Levenson, H., & Barnard, W.D. 1988. *Wastes in marine environments*. Hemisphere Publishing Corporation.

Sweeney, J.C., *ed.* 1987. *The Irish sea: a resource at risk.* Maynooth, Geographical Society of Ireland. (Geographical Society of Ireland Special Publications No. 3.)

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Sewage outfalls/effluent discharges: information on trade discharge consents; aquatic environment research and data relating to water quality and waste disposal to coastal waters; bathing waters, as outlined by EC Directive (76/160/EEC); pollution from industrial sites; general issues relating to pollution	*DoE (NI) Environment and Heritage Service, Water Quality Unit, Belfast, tel: 01232 254754
Pollution from industrial sites; general issues relating to pollution	*DoE (NI) Environment and Heritage Service, Emergency Pollution Unit, Belfast, tel: 01232 254868
Management of sewage outfalls	*DoE (NI) Water Service, Belfast, tel: 01232 244711
Water quality, Strangford Lough	The Strangford Lough Officer, Strangford Lough Management Committee, 13 The Strand, Portaferry BT22 1PF, tel: 012477 28886
Waste regulation authorities (local authority offices)	*District and Borough Councils, see Appendix A2
Beachwatch	*Marine Conservation Society, Ross-on-Wye, tel: 01989 566017
Beach litter; Blue Flag and Seaside Award beaches	Tidy Northern Ireland Group, Philip House, 123 York Street, Belfast BT15 1AB, tel: 01232 328105
Industrial waste disposal - international issues	The Oslo and Paris Commission, New Court, 48 Carey Street, London WC2A 2JE, tel: 0171 242 9927
Coastwatch UK	Project Officer, Coastwatch UK, Farnborough College of Technology, Boundary Road, Farnborough, Hampshire GU14 6SB, tel: 01252 377503

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

9.7 Leisure and tourism

D. Noë-Murphy

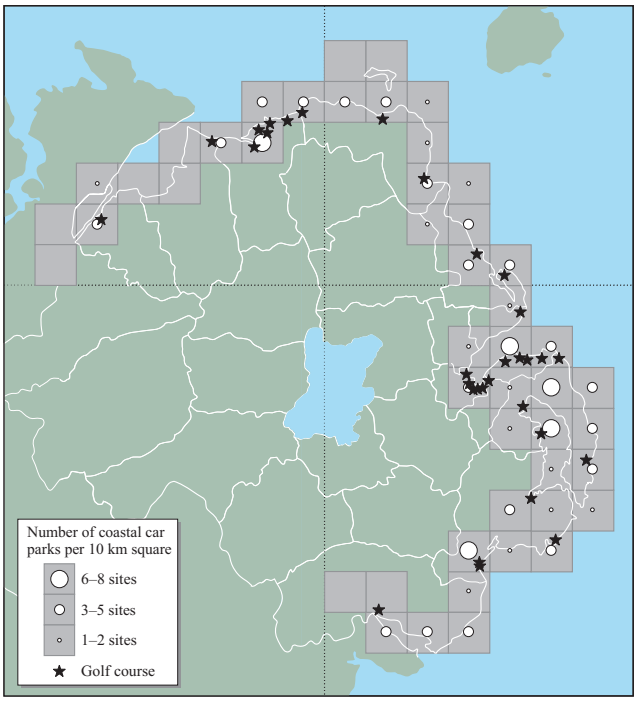
9.7.1 Introduction

An unpolluted environment gives much appeal to Northern Ireland as a visitor destination, and coastal landscapes and protected areas provide a strong basis for the development of tourism. From the mouth of Lough Foyle around to Belfast the largely unspoilt coastline is one of the most beautiful stretches of coast in the British Isles. Seven Areas of Outstanding Natural Beauty (AONBs) (section 7.3) encompass more than 30% of the highest quality scenic coast in Northern Ireland. The Giant's Causeway, a World Heritage Site, attracted over 400,000 visitors in 1995. Good bathing water quality (section 9.6), a Marine Nature Reserve and 30 coastal National Trust properties (section 7.5) give an indication of the high recreational quality of Northern Ireland's coast. The Northern Ireland Tourist Board (NITB), in its publication *A sustainable approach* (1993), acknowledges the advantages of working in sympathy with the environment.

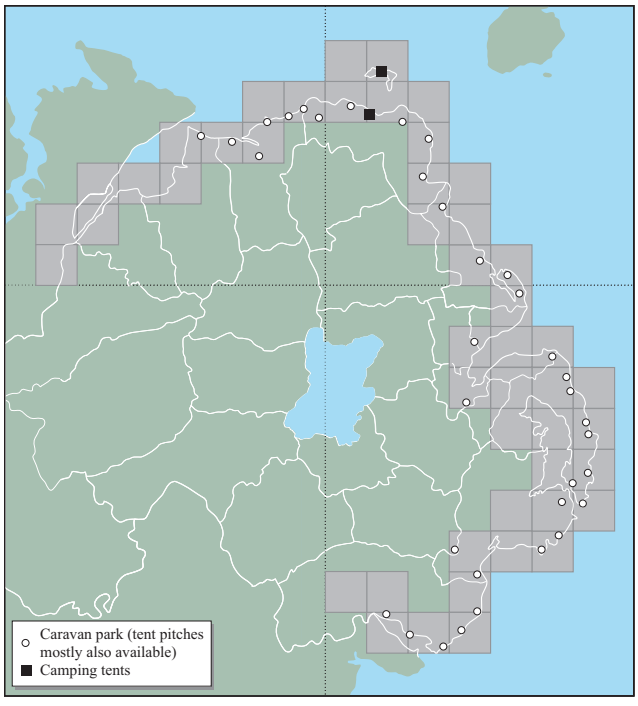
Tourism and the leisure industry have historically played only a minor part in Northern Ireland's economy. Overall employment in tourism now accounts for 12,500 jobs, or 2.2% of the workforce. The number of visitors from outside Northern Ireland who spend at least one night here has more than doubled since 1988, and this sector now accounts for 30% of visitors (Northern Ireland Tourist Board 1995b). 1995 was the seventh consecutive record year for tourism in Northern Ireland, with 1.6 million visitors. Many European and overseas tour operators included Northern Ireland as a destination in their 1996 catalogues and a strong increase in tourism, particularly along the North Coast, is anticipated for the future. In addition, the region is a well-established holiday destination for the Irish market, although tourism has suffered from the impact of 'the troubles'. In 1991, 5.7 million day trips were made to beach/seaside resorts in Region 17 (Coast of Down Consortium 1994). Group travel and coach tours are in their infancy in Northern Ireland, but a large increase in Republic of Ireland visitors was noticeable in 1995, most travelling by car.

Access to the coast is relatively easy, with a good infrastructure in place, although car parking facilities are in short supply in some areas. Map 9.7.1 shows the distribution of car parks in coastal 10 km squares. Long distance footpaths, notably the 16 km long North Antrim Cliff Path, allow exploration of less accessible sites. A ferry service from Ballycastle to Campbeltown, Scotland, is planned. Several seaside resorts, such as Newcastle, Bangor, Portrush and Portstewart, have a strong traditional accommodation base due to the popularity they enjoyed during the last century. Portstewart, with car-parking on the beach, attracts over 5,000 visitors on a fine summer's day and has one of the most popular beaches. Camping and caravan sites are located all around the coast (Map 9.7.2). There are four links golf courses in Northern Ireland: Castlerock (27 holes), Portstewart (45 holes), Portrush (36 holes) and Royal Co. Down (36 holes). The locations of these and other coastal golf courses are shown on Map 9.7.1.

Many kinds of outdoor leisure activities take place around the coast, including walking, golf, horse-riding, general beach use, birdwatching, flying and gliding. The water-based activities include sailing, sea-angling, fishing from the seashore, scuba diving, wind surfing, canoeing,



Map 9.7.1 Numbers of coastal car parks and locations of coastal golf courses in the region's coastal 10 km squares. © Crown Copyright.



Map 9.7.2 Locations of coastal camping and caravan sites in coastal 10 km squares in the region's coastal 10 km squares. Source: Northern Ireland Tourist Board (1996). © Crown Copyright.

surfing and bathing (Coast of Down Consortium 1994; Northern Ireland Tourist Board 1995c). There is a very long tradition of wildfowling in Northern Ireland. Commercial wildfowling was banned in 1931, but sporting wildfowling has continued in most coastal locations where wildfowl and waders are found. In most of these areas there was little regulation of activities until the 1960s, and even today there are areas where individuals operate rather than clubs.

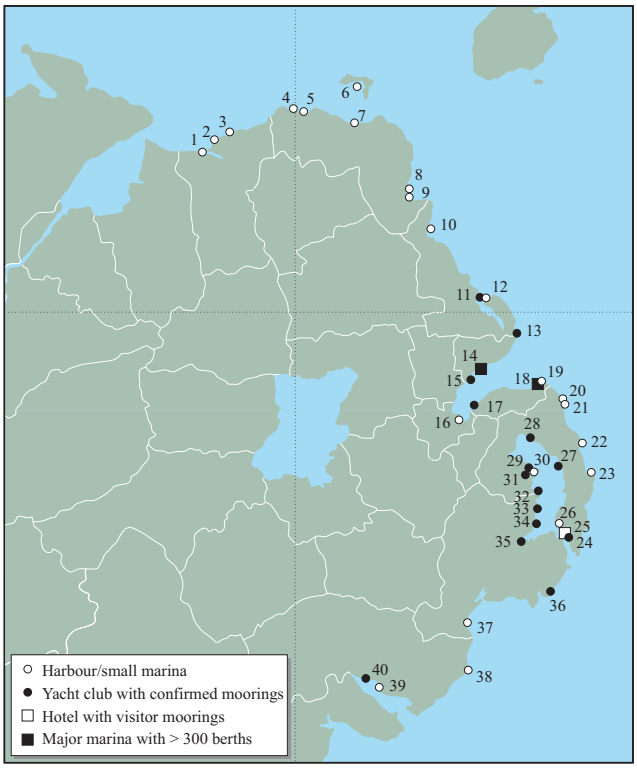
European funding opportunities are available for tourism initiatives in the private and voluntary sectors, and past decline in the long-stay market in the region and the inherent seasonality of the tourist industry are being counteracted with the development of marinas, interpretation centres, golf courses and many other leisure-based activities.

9.7.2 Important locations

Table 9.7.1 shows the locations of indoor and outdoor coastal attractions and the numbers of visits made to them (including domestic day trips) in 1994.

Carrickfergus and Bangor are the only two large marinas in the region, each having more than 300 berths. Their locations, and those of the 38 additional visitor berthing facilities used for water-based activities, are shown on Map 9.7.3; sites are listed in Table 9.7.2.

On the north coast there are fine beaches, such as those at Portstewart and White Park Bay. Portrush and Portstewart are popular seaside resorts, connected by railway to Belfast. The largest caravan site, licensed for 810 caravans, is on the outskirts of Portrush. Benone has a caravan holiday village and a Blue Flag beach. The coast from Portstewart to Ballycastle has coastal and cliff-top walks, beaches, golf and sightseeing (Dunluce Castle,



Map 9.7.3 Boat berthing facilities. Source: Northern Ireland Tourist Board (1995c). © Crown Copyright.

Table 9.7.1 Coastal attractions (1994)

Location	*Type of attraction*	*Owner*	*Nos. of visitors*
Co. Londonderry			
Portstewart Strand	Beach	NT	173,766
Co. Antrim			
Waterworld, Portrush	Fun park	LA	84,100
Fantasy Island, Portrush	Fun park	P	75,429
Dunluce Centre, Portrush	Visitor centre	LA	93,274
Portrush Countryside Centre	Visitor centre	G	44,000
Dunluce Castle	Historic property	G	19,793
Giant's Causeway	World Heritage Site with visitor centre	NT	408,790
Carrickarade Rope Bridge, Larry Bane	Coastal walk	NT	99,453
Rathlin Island West Light Platform	Nature reserve	G	8,470
Carrickfergus Castle	Historic property	G	63,430
Lagan Lookout Centre	Visitor centre	P	12,124
Co. Down			
Crawfordsburn Country Park	Country Park	G	750,000
Pickie Family Fun Park, Bangor	Fun park	LA	283,000
Bangor Marina	Marina	LA	6,000
Exploris, Portaferry	Aquarium	LA	148,893
Mount Stewart House	Historic property and gardens	NT	43,402
Castle Espie Wildfowl Centre	Wildfowl centre	P	40,001
Delamont Country Park	Country park	LA	45,000
Quoile Countryside Centre and National Nature Reserve	Nature reserve	G	64,351
Castleward	Historic house and gardens	NT	43,927
Tyrella Beach and dune system	Beach	LA	77,000
Dundrum Castle	Historic property	G	8,254
Murlough Nature Reserve, Dundrum	Nature reserve	NT	245,000
Tropicana, Newcastle	Fun park	LA	60,000

Source: Northern Ireland Tourist Board 1995a. Key: NT = National Trust, G = Government, LA = Local Authority, P = Private.

Table 9.7.2 Berthing facilities in Region 17

Site no. on Map 9.7.3	*Name*
1	Coleraine Marina
2	Portstewart Harbour
3	Portrush Harbour
4	Dunseverick Harbour
5	Ballintoy Harbour
6	Rathlin Harbour
7	Ballycastle Harbour
8	Cushendall
9	Waterfoot
10	Carnlough Harbour
11	East Antrim Boat Club
12	Ballylumford
13	Country Antrim Yacht Club
14	Carrickfergus Marina
15	Newtownabbey Boat Club
16	Lagan Weir, Laganside
17	Royal North of Ireland Yacht Club
18	Bangor Marina
19	Groomsport Harbour
20	Donaghadee Harbour
21	Copelands Marina
22	Ballywalter Harbour
23	Ballyhalbert Harbour
24	Portaferry Sailing Club
25	Portaferry Hotel
26	Portaferry Regeneration
27	Kircubbin Sailing Club
28	Newtownards Sailing Club
29	Down Cruising Club
30	Sketrick Marine
31	Strangford Lough Yacht Club
32	Ringhaddy Cruising Club
33	East Down Yacht Club
34	Killyleagh Yacht Club
35	Quoile Yacht Club
36	Ardglass Marina (under construction)
37	Newcastle Harbour
38	Annalong Harbour
39	Killowen Yacht Club
40	Warrenpoint Boat Club

Source: Sail Northern Ireland (1995).

Giant's Causeway and Carrickarade Rope Bridge). Giant's Causeway is the most popular outdoor attraction of the area and almost all out-of-state visitors visit it. Visitor numbers for Dunluce Castle rose from almost 20,000 in 1994 to 35,000 in 1995. The world's oldest licensed whiskey distillery, at Bushmills, is a popular tourist destination.

The north-east coast leading down to the port of Larne features spectacular cliffs and headlands and the glens of Antrim. The Antrim Coast Road, from Ballycastle to Larne, was built in the last century on a raised beach and for much of its length runs very close to the water's edge; some sea-fishing and diving takes place from it. The road passes through a series of picturesque villages - Cushendun, Cushendall, Carnlough and Glenarm - and caravans and beach-based activities feature in such villages. Rathlin Island, off Ballycastle, is a popular summer day trip destination and in May/June the West Lighthouse offers close views of a breeding colony of thousands of auks. Major investment has poured into Ballycastle recently and a new hotel and sea front now attract many visitors; there are several holiday villages and caravan parks on the outskirts of the town.

Belfast Lough is popular for sailing and is the location for Northern Ireland's two biggest marinas, at Carrickfergus and Bangor. The Laganside Development is currently regenerating parts of Belfast Harbour for leisure activities: the Hilton Hotel is currently under construction and Belfast Concert Hall, the Belfast Weir and the Lagan Lookout Interpretative Centre are now operational. Leisure activities also include boat-trips, although beach-based activities are no longer available in the Greater Belfast area; a formerly popular stretch along the north foreshore has been used as a municipal tip for the past fifteen years. The coastal walk that stretches from Holywood to Groomsport, passing through Crawfordsburn Country Park, is one of Northern Ireland's most popular outdoor coastal attractions.

The Outer Ards Peninsula is popular for caravanning (Map 9.7.1). Most pitches are static, with an average number of around 250 pitches and fewer touring caravan pitches available at each site. The coastline between Ballywalter and Ballyhalbert is dotted with caravan parks and, just south of Ballywalter, contains the biggest site in the area, licensed for 650 caravans on 16.7 hectares.

Strangford Lough has long attracted people who enjoy outdoor recreation, in particular water sports and more recently wildlife watching. The Lough is a Marine Nature Reserve and also contains a number of (National) Nature Reserve and ASSI sites; it is internationally important for birdlife and is a candidate for Ramsar and SPA designation. The importance of this site means that potential tourism/leisure development on land or water must be considered in an environmentally friendly and sustainable manner.

Around 5,000 people are believed to sail regularly on Strangford Lough, using around 2,000 craft (DoE (NI) 1994). Eleven yachting clubs have been established (Table 9.7.2; Map 9.7.3), collectively represented by the Association of Strangford Lough Yacht Clubs (ASLYC). Most cruisers are moored on permanent swing moorings close to club premises. Elsewhere there are a few public moorings and scattered private moorings. A few craft are mud-berthed and a few are berthed at marina-type jetties. Some motor cruisers are moored at most anchorages around Strangford Lough, with concentrations at Down and Ringhaddy Cruising Clubs, Portaferry and Comber. There are also some speedboats at moorings. Club races and regattas take place throughout the summer, with frequent all-Ireland and international events for single classes. The annual Portaferry gathering of Galway Hookers, the traditional working boats of the West of Ireland, attracts most public interest. There is currently little provision for visiting craft, despite the restoration of navigation lights in the Narrows, a treacherous area for the inexperienced sailor. Windsurfing has become increasingly popular over recent years, particularly at Cunningburn, Kircubbin and Whiterock; typically, 50 craft are involved over a summer weekend. Several motor cruisers are available for hire for fishing parties, wildlife watchers etc., though the potential for this is largely underdeveloped. Jet-skiing has recently appeared as a water-based recreational pursuit on the lough. Whiterock appears to be the main centre for this activity, though as yet is has taken place only on a small scale. Whiterock in particular is also popular for water-skiing. Killyleagh Harbour has been identified in the relevant Area Plan as a suitable location for a marina in the lough, and a new berthing facility at Portaferry is planned for the

beginning of 1997. Leisure boat trips are offered from Strangford village during the summer, including a ferry to Portaferry, the location of the Exploris Aquarium, Northern Ireland's top indoor coastal attraction.

The coastline between Strangford and St. John's Point has virtually no modern leisure infrastructure, although tourist attractions include coastal walks and historic monuments. Dundrum Bay includes the popular beaches of Tyrella, Murlough and Newcastle. Murlough (National) Nature Reserve is popular with day trippers. Large caravan and camping sites and a championship golf course are found between here and Newcastle.

Carlingford Lough has a high concentration of caravans at Cranfield Point. Canoeing and watersports are popular in the sheltered waters of the Lough, as is sailing at the nearby towns of Warrenpoint and Rostrevor.

The chief areas for coastal wildfowling are Lough Foyle and Strangford Lough, with areas of lesser significance at Larne Lough, Belfast Lough, Dundrum Inner Bay and Carlingford Lough. The principal target species for wildfowlers in the reigon are mallard *Anas platyrhynchos,* wigeon *A. penelope* and teal *A. crecca*, with some greylag geese *Anser anser* and Canada geese *Branta canadensis* shot subject to locally agreed restrictions.

9.7.3 Management and issues

The Northern Ireland Tourist Board (NITB) is a statutory body set up as part of the Department of Economic Development to encourage tourism in Northern Ireland. NITB liaises with many other agencies, including government departments and voluntary bodies. All local authorities are concerned with tourism developments. They employ tourism officers and consider tourism in their local plans.

During the 1960s the number of visitors to Northern Ireland fell, but pre-'troubles' visitor figures were regained in the early 1990s. The Northern Ireland Tourist Board recognises that it is important to develop Northern Ireland's tourism industry in a sensitive and co-ordinated manner that does not harm the main attraction of the Province as a tourist destination: the natural beauty and historic landscapes of Northern Ireland. NITB has adopted a sustainable approach to tourism (Northern Ireland Tourist Board 1993). The self-catering sector is encouraged and grants are available to convert derelict farm buildings and cottages. The Rural Cottage Company, which renovates cottages with character in a lease arrangement with the owners, has also been developed. Special-interest marketing groups, such as Sail Northern Ireland and Birdwatch Northern Ireland, have been established in an effort to expand the tourist season outside the June-August season. The popularity of the north coast coupled with the effects of the elements has led to some path erosion, and much of the lower section of the Giant's Causeway cliff walk remains closed following a serious landslip.

The open season for coastal wildfowling is 1 September to 31 January. As well as the statutory restrictions on wildfowling, there are local regulations and agreements. The National Trust holds the sporting rights to most of the intertidal area of Strangford Lough; wildfowling there is controlled by agreement with the British Association for Shooting and Conservation (BASC) under the Strangford Lough Wildlife scheme. Wildfowling by members of participating clubs is permitted over most of the intertidal shore, except for designated Core Wildlife Zones, in which no shooting is permitted, and local refuges, where shooting is regulated. In Lough Foyle, wildfowling is controlled through an agreement between the Lough Foyle Wildfowlers' Association, DoE (NI) Environment and Heritage Service and the RSPB.

9.7.4 Information sources used

Maps used for this section included the Ordnance Survey of Northern Ireland Discoverer Series (1:50,000) and Michelin's Golf Ireland (1:400,000). Most of the data came from publications and staff of the Northern Ireland Tourist Board, DoE (NI), National Trust and local councils. The county with the most detailed breakdown of leisure activities is Down, for which several consultation papers are available. No complete coastal survey of watersports has been undertaken to date; the Sports Council figures used in this section include inland areas. The Environmental Health Officer of each local council is the licensing body for caravan sites and the capacity of each site can be obtained from them. Much of the wildfowling information used in this section came from discussions with headquarters and regional staff of DoE (NI) Environment and Heritage Service and the National Trust; together, these organisations are responsible for the management of the greater part of the Northern Ireland coastline. The *Guide to designation* for the Strangford Lough Marine Nature Reserve (DoE (NI) 1994) provided a wide range of information for the lough.

9.7.5 Acknowledgements

Thanks are due to Olga Murtagh (Causeway Coast Consortium), Steven Reid (Coast of Down), Rachel Graham (Northern Ireland Tourist Board), Stephen Wilson (Northern Ireland Sports Council), and headquarters and regional staff of the Environment and Heritage Service, DoE (NI), especially R.J. Bleakley. Help from Jo Whatmough, David Thompson and Philip Watson (National Trust), James Orr (The Wildfowl & Wetlands Trust), Billy Reid (Strangford Lough Officer) and staff of the Coastal Research Unit of the University of Ulster has also been invaluable. For comments on the draft, thanks go to Dr I.S. Heaney, Department of Agriculture for Northern Ireland; Alan Kilgore, Newry and Mourne District Council; R. Gamble, Department of Economic Development; Sonya Crawford, Northern Ireland Tourist Board; J.L. Lawson, Down District Council; and Mark Tasker, JNCC.

9.7.6 Further sources of information

A. References cited

Coast of Down Consortium. 1994. *Tourism opportunity review & marketing plan 1994/95.* Newtownards, Coast of Down.

DoE (NI). 1994. *Strangford Lough proposed Marine Nature Reserve. Guide to designation.* Belfast, Department of the Environment for Northern Ireland, Environment Service.

Northern Ireland Tourist Board. 1993. *Tourism in Northern Ireland - a sustainable approach.* Belfast, Northern Ireland Tourist Board.

Northern Ireland Tourist Board. 1996. *An information guide to camping and caravanning*. Belfast, Northern Ireland Tourist Board.
Northern Ireland Tourist Board. 1995a. *Survey of visitor attractions. 1994 report.* Belfast, Northern Ireland Tourist Board.
Northern Ireland Tourist Board. 1995b. *Tourism in Northern Ireland: a development strategy 1995-2000*. Belfast, Northern Ireland Tourist Board.
Northern Ireland Tourist Board. 1995c. *Northern Ireland travel trade manual 1995-1996*. Belfast, Northern Ireland Tourist Board.
Sail Northern Ireland. 1995. *Information sheet*. Bangor, Sail Northern Ireland.

B. Further reading

Begbie, E., *ed*. 1992. *The new wildfowler.* Wrexham, British Association for Shooting and Conservation.
British Marine Industries Federation. 1992. *A guide to boating and the environment: important information for boat owners and boating or watersport enthusiasts.* Egham, British Marine Industries Federation.
Buck, A.L., & Donaghy, A. 1996. *An inventory of UK estuaries. 7. Northern Ireland.* Peterborough, Joint Nature Conservation Committee.
DoE (NI). 1990. *Antrim coast & glens - Area of Outstanding Natural Beauty. Guide to designation*. Belfast, HMSO
DoE (NI). 1989. *Mourne - Area of Outstanding Natural Beauty. Policies and proposals*. Belfast, HMSO.
Glen, M., & Quinion, M. 1988. *Wild water country - the Ards tourism study.* Bristol, Touchstone Associates.
Jepsen, P.U. 1990. *A review of the Strangford Lough Wildlife Scheme.* Slimbridge, International Waterfowl and Wetlands Research Bureau.
McMeekin, M. 1990. *Wildfowling methods and activities in Strangford Lough: a report commissioned by the Strangford Lough Wildlife Scheme Review*. Wrexham, British Association for Shooting and Conservation.
Milton, K. 1990. *Our countryside: our concern*. Belfast, Northern Ireland Environment Link.
Northern Ireland Tourist Board. 1993. *Annual Report*. Belfast, Northern Ireland Tourist Board.
Northern Ireland Tourist Board. 1994. *Tourism in Northern Ireland - an indicative plan.* Belfast, Northern Ireland Tourist Board.
Northern Ireland Tourist Board. 1996. *The best of Northern Ireland.* Belfast, Northern Ireland Tourist Board.
Northern Ireland Tourist Board, Department of the Environment (NI) & Sports Council. 1994. *Access to the Northern Ireland countryside - summary report*. Belfast, HMSO.
Queen's University of Belfast. 1970. *Conservation in the development of Northern Ireland.* Conference report. Belfast, Queens University.
Quigley, M.B., *ed*. 1991. *A guide to the sand dunes of Ireland*. Galway, European Union for Dune Conservation and Coastal Management.
Rogers, R.S., & Gallagher, L. 1992. *Castle, coast and cottage*. Dundonald, Blackstaff Press.

C. Contact names and addresses

Type of information	*Contact address and telephone no.*
Tourist facilities	*Derry City Council, Derry, tel: 01504 365151 *Limavady District Council, Limavady, tel: 01504 722226 *Coleraine Borough Council, tel: 01265 52181 *Moyle District Council, Ballycastle, tel: 01265 762225 *Larne Borough Council, Larne, tel: 01574 272313 *Carrickfergus Borough Council, Carrickfergus, tel: 01960 351604 *Newtownabbey Borough Council, Ballyclare, tel: 01960 352681 *Belfast City Council, Belfast, tel: 01232 320202 *North Down Borough Council, Bangor, tel: 01247 270371 *Ards Borough Council, Newtownards, tel: 01247 812215 Down Tourist Information Centre, 74 Market Street, Downpatrick BT36 6LZ, tel: 01396 612233 *Newry & Mourne District Council, Newry, tel: 01693 65411
General tourism and funding for tourism-related developments	*Northern Ireland Tourist Board, Belfast, tel: 01232 231221 or *Department of Economic Development, Belfast, tel: 01232 529900
Sports - natural facilities database	*Sports Council for Northern Ireland, Belfast, tel: 01232 381222
Wildfowling; general policy; designations; ASSI management agreements	*Environment and Heritage Service, DoE (NI), Belfast, tel: 01232 251477
Provision of water-based and waterside recreational facilities	*DANI Rivers Agency, Belfast, tel: 01232 253355
Strangford Lough Wildlife Scheme (wildfowling, interpretation, collecting)	The Head Warden, The National Trust, Strangford Lough Wildlife Scheme, Strangford Lough Wildlife Centre, Castleward, Strangford BT30 7LS, tel: 01396 881411
Strangford Lough: general management and policy	The Strangford Lough Officer, Strangford Lough Management Committee, 13 The Strand, Portaferry BT22 1PF, tel: 012477 28886
Wildfowl and wetlands: conservation; education	*The Wildfowl and Wetlands Trust, Comber, tel: 01247 874146
Wildfowling: activities and clubs	*British Association for Shooting and Conservation, Ballymena, tel: 01266 652349
Wildfowling: general information on habitats, conservation and impacts	*Royal Society for the Protection of Birds, Belfast, tel: 01232 491547

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

Chapter 10 Coastal management

R.J. Bleakley & I. Basu

10.1 Introduction

This chapter describes UK-wide (section 10.1.1), Northern Ireland-wide (section 10.2) and local (section 10.3) coastal zone management initiatives taking place wholly or partly within Region 17. UK initiatives that are not currently being implemented in the region are outside the scope of this chapter. However, as the chapter concludes with a list of contacts with wider involvement in coastal zone management (section 10.3.5), contact points for some of these organisations are included there. In addition, names and addresses of many contacts are given within the relevant section.

10.1.1 Coastal zone management in the UK

This section outlines the direction of national policy-making, within which many of the regional initiatives operate. Numerous issues and activities affect the coastal environment and inshore waters, and the coastline is subject to many demands and uses. Competition may arise between the various interests, making the task of coastal zone planning and management a very complex one. This complexity is compounded by the large number of authorities responsible for particular statutory duties, which are summarised in Eastwood & Erwin (1992). In Northern Ireland the responsible authorities often differ from those in Great Britain, with more functions being carried out by government departments. The resulting system of coastal zone management seeks, through the co-ordination of coastal activities and controls, to minimise conflict and ensure that the development and use of coastal resources is sustainable.

Integrated coastal zone management promotes an inter-disciplinary approach to multiple use and conflict resolution between interest groups "to ensure the long-term future of the resources of the coastal zone through environmentally sensitive programmes, based on the principle of balanced, sustainable use" (Gubbay 1990). Coastal zone management ensures that all land and sea use issues are co-ordinated, including development, conservation, waste disposal, fisheries, transport, coast protection and flood defence. The advantages of this have been recognised by coastal planners in many areas, and several local authorities and other bodies now promote coastal 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 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. These included :

- the endorsement of an integrated approach to coastal zone management, incorporating maritime land, sea and intertidal areas;
- a review of existing legislation;
- the need for international (EU) policy initiatives;
- clearer responsibilities for planning and action in the coastal zone, based on a national strategic framework;
- appropriate funding for accountable bodies with responsibilities;
- research into the physical functioning of the coastal zone and associated protection and conservation measures;
- a review of planning mechanisms to allow effective safeguard of the coastal resource;
- monitoring and environmental assessment of coastal activities to assess their impacts;
- the involvement of local communities in coastal zone management planning;
- the integration of responsibility for coast protection and sea defence under one body;
- better statutory protection for sites of nature conservation importance;
- better provisions for control of marine pollution;
- the need for fisheries activities to take account of marine conservation issues.

Later in 1992, the Department of the Environment and Welsh Office issued *Planning Policy Guidance: Coastal Planning (PPG20),* which emphasised the need for planning decisions to take account of environmental and conservation issues.

In response to the recommendations listed above, the Department of the Environment and Welsh Office produced two other publications in 1993: *Development below low water mark: a review of regulation in England and Wales* (Department of the Environment/Welsh Office 1993a) and *Managing the coast: a review of coastal management plans in England and Wales and the powers supporting them* (Department of the Environment/Welsh Office 1993b). These papers explored ways of achieving good practice in the regulation of development and in the planning and management of recreation at the coast.

In 1995 DoE published national policy guidelines for the coast (DoE 1995). These guidelines, which are applicable throughout the UK, do not replace existing documents but provide a concise digest, pointing out common themes and principles. Public and private bodies are asked to have close regard to them in taking forward their coastal zone management functions. The UK government published a Rural White Paper (DoE/MAFF 1995), which was to have included a statement on coastal policy, although in the event only sea fishing was addressed. *Coastal zone management, towards best practice* has recently been published by DoE (1996). This guide sets out the basic principles and objectives relating to coastal zone management plans, helping to define the respective roles of key players, taking account of the diverse uses of the coastal zone and giving examples of best practice in helping to resolve competing pressures on the coast. It helps to clarify how the different elements of coastal zone management interact, including relationships with other strategies. The *Review of byelaw making powers for the coast* now being prepared by DoE is

examining the byelaw powers available to bodies with responsibilities for the coast and aims to assess whether they meet modern needs. It is also considering the broader relationship between the voluntary principle and other regulatory mechanisms.

The European Commission was asked by the Council of the EU to propose a strategy for the whole EU coast by the end of 1994. The initial response was to adopt the *Communication on integrated management of coastal zones* (COM/95/511), which sets out proposals for EU funding for demonstration programmes of coastal management. The strategy is to be based on principles of sustainability and sound ecological and environmental practice, but will have no legal standing (see European Commission Services 1996).

The Conservation (Natural Habitats, etc.) Regulations (Northern Ireland) 1995 (DoE (NI) 1995a) make provision for the implementation of the EC Birds and Habitats & Species Directives in this region. As they relate to the coast, these regulations allow 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.

The Department of the Environment for Northern Ireland has produced a consultation paper *Delivering coastal zone management in Northern Ireland* (DoE (NI) 1995b). This sets out the existing mechanisms for regulating coastal activities and made suggestions for improving the management and conservation of the coast in Northern Ireland. Its main recommendations were for:

- ensuring the sustainability of developments in the coastal zone;
- the establishment of an advisory coastal zone forum for Northern Ireland;
- the provision of local management structures for special interest areas of the coast; and
- the establishment of a comprehensive database of information about Northern Ireland's coastal zone.

The government has accepted these recommendations and has undertaken to establish a Northern Ireland Coastal Forum (DoE (NI) 1996) (see section 10.2.4).

10.2 National coastal initiatives as applied to Northern Ireland

10.2.1 Introduction

Involvement by both statutory and non-statutory bodies in the promotion of coastal zone management initiatives is increasing throughout the UK. Government agencies, in particular the Environment and Heritage Service (EHS) of DoE (NI), undertake in Northern Ireland many of the coastal initiatives carried out by the statutory nature and heritage conservation agencies and environmental protection agencies in Great Britain. Other government departments involved in planning and management of the coast include the Department of Agriculture for Northern Ireland, the Department of Economic Development and the Department of Trade and Industry.

Several national non-governmental organisations (NGOs) with a particular interest in the conservation of the coastal zone, including the National Trust, the Royal Society for the Protection of Birds (RSPB), the Wildfowl and Wetlands Trust (WWT) and the World Wide Fund for Nature (UK), are active in the region and undertake, or contribute to, coastal zone management initiatives in Northern Ireland. Other bodies, such as the Ulster Wildlife Trust (UWT) and the Marine Conservation Society, are involved in coastal zone management.

The Irish Sea Forum, to which the Irish Sea Study Group reported (Irish Sea Study Group 1990), was set up in 1990. It draws its membership from interested organisations and individuals from all the countries bordering the Irish Sea, including Northern Ireland, and considers integrated management towards the enhancement of the environmental health of the Irish Sea and its coasts and the sustainable use of its resources.

There are many other interest groups and organisations that now have national policies with regard to the coastal zone. These include the Royal Yachting Association (RYA) and the British Association for Shooting and Conservation (BASC), whose representatives are involved in regional or local groups or fora. The Sports Council, which has links with the Sports Council for Northern Ireland, has generic policies relating to countryside and water recreation, and the Royal Institute of Chartered Surveyors is producing a coastal report focusing on management of the coastal zone.

10.2.2 DoE (NI) Environment and Heritage Service

The Environment and Heritage Service (EHS) was established as a DoE (NI) 'Next Steps Agency' in April 1996. EHS performs much the same functions as those carried out in Great Britain by the agencies responsible for the conservation of nature and landscape (English Nature, the Countryside Commission, Scottish Natural Heritage and the Countryside Council for Wales), the conservation of the built heritage (English Heritage, Historic Scotland and Cadw), and environmental protection (the Environment Agency and the Scottish Environmental Protection Agency). Predecessor bodies to the EHS have played a leading role in initiatives to further coastal zone conservation in Northern Ireland, mainly through a programme of designations.

EHS is advised by the Council for Nature Conservation and the Countryside (CNCC), a statutory advisory body composed of scientists, amateur naturalists, business people, farmers and others, which produces regular reports

on its deliberations. In 1994 CNCC published recommendations for coastal zone planning and management, which included the establishment of a Coastal Zone Management Committee and additional management initiatives based on those already in existence at Strangford Lough and Belfast Harbour (CNCC 1994) (see section 10.3.4).

10.2.3 DoE (NI) Planning Service

A significant difference between coastal zone management in Northern Ireland and that in Great Britain is that in Northern Ireland there is only one planning authority: the former Town and Country Planning Service was restructured as a DoE (NI) 'Next Steps Agency' in April 1996 and renamed the Planning Service. The main control on human activity at the coast is exercised by the Planning Service, using development plans and development control.

In 1993 the Town and Country Planning Service issued *A planning strategy for rural Northern Ireland* (DoE (NI) 1993a). This non-statutory policy statement introduced the new concept of Countryside Policy Areas (CPAs), in which restrictions may be placed on development to protect areas of countryside under pressure from development, to protect the visual amenity of areas of landscape quality and to maintain the rural character of the countryside. Contained within it is Strategic Policy 13 "to protect the coast from inappropriate development", which is amplified by seven policies, as follows:

- to conserve the natural character and landscape of the undeveloped coast;
- to encourage and support proposals for the enhancement and regeneration of urban waterfronts;
- to protect from development those parts of the coast, within urban areas, that are important in terms of their amenity or nature conservation value;
- to encourage schemes which provide or extend public access to the coastline;
- exceptionally, proposals for the provision of tourist or recreational schemes in undeveloped coastal areas may be granted permission in situations where a coastal location is essential, provided the development would not lead to unacceptable impairment of the amenity of the area;
- to resist proposals for new static caravan sites, or chalet development for holiday purposes, or the enlargement of existing facilities within the undeveloped coast;
- proposals for the creation of new marinas or the extension of existing marinas within existing settlements will be given favourable consideration provided they are of a scale appropriate to the settlement.

These policies will allow the Planning Service to play an important part in the maintenance and improvement of the quality of the coastal zone.

10.2.4 The Northern Ireland Coastal Forum

Ministerial approval for the establishment of the Northern Ireland Coastal Forum was received in 1996 (DoE (NI) 1996). It will comprise a wide range of interested bodies and will provide for an exchange of views on issues related to the region's coastal zone.

The forum will include representatives of conservation, commercial (fishing, farming, industry and tourism) and recreational organisations, relevant statutory organisations, harbour authorities, local and central government. A membership of around 25 is planned under the chairmanship of a senior official of DoE (NI).

The Northern Ireland Coastal Forum will seek to:

- promote understanding of the natural and man-made processes that influence the coastal zone;
- build on existing liaison arrangements at regional and local level, in particular with local management committees;
- advise on the development of a coastal zone strategy as the basis for integrated management, and
- liaise with other relevant initiatives elsewhere in the UK and Republic of Ireland.

Its main task will be to advise government on the development of a coastal zone strategy in order to identify objectives and promote priorities for the conservation, management and sustainable development of the coastal zone. Its remit will not include matters of an operational nature. The forum will be assisted in its work by the establishment of a Coastal Officers Liaison Group, comprising representatives of Northern Ireland government departments, including those responsible for environment and heritage conservation, planning, transport, defence, fisheries, minerals and petroleum exploitation, water, drainage and coastal defence.

10.2.5 The National Trust

The National Trust was one of the first conservation organisations specifically to target the coast, with its 'Enterprise Neptune' campaign, first launched in 1965 and relaunched in 1985. This campaign sought to attract funds for the purchase and management of important undeveloped coastal sites in England, Wales and Northern Ireland. To date around 850 km have been acquired, including important stretches of coast in Region 17 (see section 7.5). The National Trust has prepared detailed management plans for its individual properties and is also finalising its strategic plan for the coasts and estuaries of the region, which will provide guidance to its staff on the acquisition of coastal sites under Enterprise Neptune and on responses to coastal issues. By virtue of its large Northern Ireland holdings on the Antrim Coast and in Strangford Lough, it is a major player in regional and local coastal zone management fora.

10.2.6 Royal Society for the Protection of Birds

The Royal Society for the Protection of Birds (RSPB) has established an important role for itself in coastal zone conservation, both on a national and local scale, through participation in coastal fora and by virtue of its coastal properties (see section 7.5). In 1990, it launched a three-year campaign to promote the importance of estuaries in the United Kingdom and the need for coordinated management (Rothwell & Housden 1990). The RSPB Estuaries Inventory project compiled both mapped and numerical information on land use and selected human activities for 57 major UK estuaries, including the estuarine inlets of Region 17 (see

section 4.1). In 1994 the RSPB launched its 'Marine Life' campaign to increase awareness of the problems facing the marine environment and its wildlife, including pollution, fisheries and shipping safety. It has also published *A review of coastal zone management powers* (RSPB 1995).

10.2.7 Aquatic environment management

Responsibility for the management of the aquatic environment rests among several government departments and appointed bodies, each of which may have 'management plans' covering its particular remit. Their responsibilities are summarised in Table 10.2.1.

The Water Act (Northern Ireland) 1972 made provision for the preparation by relevant government bodies, now DoE (NI) and DANI, of statutory Water Management Programmes for areas such as river catchments. Work towards these began in the mid 1980s. Water Quality Management Strategies (WQMSs) are now being prepared for the Erne, Foyle and Lagan catchments and for Lough Neagh and the Lower Bann, with the aim of creating a framework to achieve the water quality needs of all water users, while meeting the requirements of local, national and European legislation. The Lough Foyle Water Quality Management Strategy is outlined in Table 10.2.2.

10.2.8 Statutory site designation

Statutory and non-statutory designations (see Chapter 7) provide a degree of coastal zone management through their management plans. These plans tend to focus on the conservation of landscapes, buildings and/or habitats and species, rather than on wider and more integrated coastal issues, although at some sites a focus on visitor use or community involvement is important. Designated sites include nature reserves managed by EHS, local authorities, RSPB, the Ulster Wildlife Trust or other approved bodies for nature conservation objectives, Areas of Outstanding Natural Beauty (AONBs) (see below) and possible Special Areas of Conservation (SACs). Management objectives for Strangford Lough Marine Nature Reserve seek to balance the needs of the local people with the conservation interests (DoE (NI) 1994). A draft management plan for the MNR has been prepared (see also Table 10.3.1). A list of designated site-based coastal management initiatives is given in Table 10.2.3.

European marine sites

For marine SACs and SPAs, the regulations (DoE (NI) 1995a) require that, under the direction of the Secretary of State for Northern Ireland, DoE (NI), DANI and other 'relevant authorities' with jurisdiction in the marine environment shall exercise their powers in drawing up and implementing a unified management scheme for each site. A range of bodies and individuals will be involved, including all 'relevant and competent authorities', e.g. the Departments of the Environment, Agriculture and Economic Development, district councils, the Commissioners of Irish Lights, harbour authorities, the Fisheries Conservancy Board for Northern Ireland, the Foyle Fisheries Commission, pilotage authorities, the Crown Estate and others. For SPAs proposed in Lough Foyle and Carlingford Lough, the management schemes will be drawn up jointly with the government of the Republic of Ireland.

Under the EC Habitats and Species Directive, a list of marine Special Areas of Conservation (SACs) to be designated in the UK must be agreed by the UK Government and the European Commission by 1998 (see section 7.2.3). A list of 280 'possible' sites was published in March 1995; of these 112 were coastal and 37 were selected, in whole or in part, for their marine habitats and/or species. Under the directive, marine and terrestrial SACs will have to be managed in a way that secures their 'favourable conservation status'. All 'possible' sites should be managed,

Table 10.2.1 Responsibilities for aquatic environment management

*Organisation**	*Responsibility*	*Procedures*
DANI Rivers Agency	Land drainage via designated watercourses such as rivers, canals and streams; flood defence and sea defence; provision of water-based and waterside recreational facilities such as riverside paths and boating facilities.	Conduct environmental screening including environmental assessment and river corridor surveys.
DANI Fisheries Division	Supervision and protection of fisheries and fostering their establishment and development in Northern Ireland	License fish farms. Issue angling permits for DANI waters.
Fisheries Conservancy Board	Conservation and protection of salmon and inland fisheries of Northern Ireland other than in the Foyle system.	Issue angling licences. Enforce regulations through water bailiffs.
Foyle Fisheries Commission	Conservation, protection, and development of all fisheries within the Foyle system	License fishing and shellfish farming. Enforce regulations.
DoE (NI) Environment and Heritage Service (EHS), Environmental Protection Directorate	Promotion of the conservation of water resources and cleanliness of water in waterways and underground strata (see section 9.6)	Prepare Water Quality Management Plans. Set/monitor/enforce water quality standards.
DoE (NI) Water Service	Supply of drinking water and treatment of sewage	Devise Water Resources Management Strategies
Local authorities	Public health monitoring; recreation and tourism	Prepare recreation and tourism strategies. License waste disposal.

* Contact addresses are given in Appendix A.1.

Table 10.2.2 Water Quality Management Strategy - Lough Foyle

Initiative name	*Activities*	*Organisations involved*	*Contact address*
Lough Foyle Water Quality Management Strategy	Preparation of an integrated and sustainable development approach to the Lough Foyle catchment	DoE (NI), DANI and local authorities in the Republic of Ireland with input from other interested organisations	*DoE (NI), Environment and Heritage Service, Belfast, tel: 01232 254754

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

Table 10.2.3 Designated site-based coastal management initiatives

Initiative name	*Activities*	*Organisations involved*	*Contact address*
Strangford Lough Marine Nature Reserve	Management of the lough waters, sea bed and shores plus an area offshore out to half a nautical mile for marine nature conservation; outline management plan and voluntary codes of conduct drawn up.	Environment and Heritage Service, DANI Fisheries Division, SLMC, CNCC; National Trust, Ards Borough Council, Down District Council, RSPB, other owners/lessees of foreshore or seabed; other 'relevant bodies' with a management role.	*DoE (NI), Environment and Heritage Service, Belfast, tel: 01232 251477 or Strangford Lough Marine Nature Reserve, 13 The Strand, Portaferry, Co. Down BG22 1PF, tel: 01247 728886
SPAs/proposed SPAs/ proposed SACs (see section 7.2) at Lough Foyle, Carlingford Lough, Magilligan, Sheep Island, Rathlin Island, Larne Lough (including Swan Island), Belfast Lough, Strangford Lough and Murlough	Drafting of 'conservation plans' to ensure that the features of interest of the sites are maintained and enhanced. These will form a basis for statutory management schemes and will have a cross-frontier element where necessary.	EHS, DANI, MOD, RSPB, National Trust, private land owners, relevant harbour and local authorities, user groups and relevant bodies with a management role.	*DoE (NI), Environment and Heritage Service, Belfast, tel: 01232 251477
Giant's Causeway World Heritage Site	Site-specific conservation measures undertaken to maintain and enhance the coastal landscape, facilitate public access and interpret the site	The National Trust with interpretive centre run by Moyle District Council; EHS has a monitoring role and agrees the management plan.	*The National Trust, Saintfield, tel: 01238 510721

Note: management plans also exist for statutory Nature Reserves (see section 7.3), some other protected sites such as Country Parks (see section 7.4) and sites managed by voluntary conservation organisations (see section 7.5). Key: *starred contact addresses are given in full in the Appendix.

on a voluntary basis, as though they were already designated. Management will be coordinated through an agreed management scheme, backed by existing statutory measures, as appropriate.

Areas of Outstanding Natural Beauty (AONBs)

For AONBs (see section 7.3), management is achieved by means of partnerships between the EHS and district councils, the National Trust and others. AONB designation under 1985 legislation provides for the formulation of environmental policies, and liaison groups and management committees have been set up to formulate and further these. Management actions are greatly influenced by local views and depend on the individual circumstances of each area. The management of some AONBs in the region is guided by local fora (Table 10.3.1).

10.3 Local coastal management groups and initiatives

10.3.1 Introduction

A number of coastal management initiatives in Northern Ireland are currently being furthered by bodies that have a local remit within the region. These include district councils, harbour and port authorities, and local coastal fora which seek to coordinate coastal zone management. This section reviews these locally-based initiatives.

There are currently no coastal engineering groups established within the region. In Northern Ireland DANI is the authority with statutory powers to undertake works on designated sea defences (see section 8.4 on coastal defence). However, unlike the role of MAFF in the rest of the UK, DANI does not have a legislative responsibility for coastal protection against erosion. Thus DANI, DoE (NI) (where infrastructure such as coast roads is involved), the Department of Economic Development (DED) (where industrial development may be affected) and local authorities with coastal recreational developments may each have an input into measures to control coastal erosion and flooding. Coastal defence has been identified as a topic for consideration by the proposed Coastal Forum (see section 10.2.4).

10.3.2 Local authority and ports/harbours initiatives

Coastal zone planning is primarily the responsibility of the Planning Service of DoE (NI). Consequently local authorities in Northern Ireland have relatively little jurisdiction over the coast and do not have coastal/shoreline management plans or strategies, or structure plans for coastal zone policies. Commercial ports in Northern Ireland are largely independent of both central and local government and have statutory remits under their own individual legislation to control activities within an area reserved to the port. Harbour authorities are the responsibility of the Transport Division of DoE (NI). Proposed works below low water are exempt from planning regulations and therefore require assessment on their environmental impact through the Harbour Works (Assessment of Environmental Effects) Regulations (NI) 1990.

10.3.3 Local coastal fora

Management advice from broadly-based committees made up of all the main interest and user groups in an area is particularly valuable to those with management responsibilities where the coastal zone is of high conservation or recreation importance, or where there may be substantial conflicting uses. There are two major coastal fora operating in the region, the Belfast Harbour Forum, set up in 1991, and the Strangford Lough Management Committee, set up in 1992. The work and composition of these and other local coastal fora is summarised in Table 10.3.1.

The local plan for Belfast Harbour attempted to resolve the conflicts between port development and nature conservation interests. To facilitate negotiations during the local plan process, DoE (NI) established a steering committee which led to the formation of the Belfast Harbour Forum (BHF). Following approval of the subject plan, a pilot programme of projects, aimed at implementing aspects of the plan, was developed. Initiatives of the BHF include the development of an artificial lagoon, originally destined for infill, as a waterfowl refuge with bird watching hides and habitat enhancement, plans for a nature park, and habitat and open space creation on claimed land and infilled areas. These schemes are to be integrated within major commercial developments.

Membership of the Strangford Lough Management Committee is drawn from nominees of the main interest groups, including the independent local residents' group the Strangford Lough Nature Conservation Association (SLNCA).

The Mourne Committee covers issues in the Mourne AONB and has a partial coastal remit. It is paralled by the Mourne Liaison Group, comprising bodies with executive and management powers in the area, and includes representatives of the Mournes Advisory Council (MAC), an independent group. In sensitive areas like these, coastal plans or strategies can provide a structured means at a local level to bring together the different interests, to order priorities and to ensure resources are deployed effectively. It is notable that all three fora were preceded by the formation of local pressure groups which are now represented on the fora.

10.3.4 Acknowledgements

Thanks are due to all coastal managers and consultees for responding to our questionnaire and in particular J.L. Lawson (Down District Council), Dr R.A. Brown (RSPB), Dr S. Christie (Northern Ireland Environment Link (NIEL)), Mark Tasker (JNCC), Jim Kitchen (WWF-UK), Hilary Heslip (DoE (NI) Planning Service), Jo Whatmough (National Trust) and Clifford Henry (DoE (NI) Environment and Heritage Service).

Table 10.3.1 Local coastal fora (including AONBs)

Initiative name	*Activities*	*Organisations involved*	*Contact address*
Antrim Coast and Glens Liaison Group	Formulation of environmental policies. Manages the work of the Liaison Officer.	DoE (NI) EHS, Moyle District, Larne Borough and two inland councils, Northern Ireland Tourist Board	Antrim Coast and Glens Liaison Group, Glenmona Resource Centre, Cushendun, Co. Antrim BT44 0PZ, tel: 01266 761242
Belfast Harbour Forum (BHF)	Development of areas in the harbour estate under the Belfast Harbour Initiative for nature conservation and recreation.	DoE (NI) EHS, Belfast Development Office, Planning, Water, Works and Landscape Services; Belfast Harbour Commissioners, Belfast City Council, Belfast City Airport Authority, tenants, land users, CNCC, Belfast Lough Nature Conservation Committee, RSPB and UWT. Funding from European Regional Development Funds.	*Belfast Harbour Forum, DoE (NI) Belfast Development Office, Belfast, tel: 01232 540540
Strangford Lough Management Committee (SLMC)	An advisory forum for all groups with an interest in Strangford Lough. Advises on MNR, AONB and management schemes for these. Considers local issues.	DoE (NI), DANI, Ards Borough Council, Down District Council, CNCC, National Trust, RSPB, WWT, Northern Ireland Environment Link (NIEL), Strangford Lough Nature Conservation Association, Sports Council for Northern Ireland, and commercial fishing, farming, business, tourism, yachting, wildfowling and diving interests	The Strangford Lough Office, 13 The Strand, Portaferry, Co. Down BT22 1PF, tel: 012477 28886
Strangford Lough Nature Conservation Association (SLNCA)	A forum to choose nominees to SLMC; also meets on an *ad hoc* basis in response to issues of local concern.	Local landowners, businessmen, fishermen, sportsmen etc., and representatives of Ards Borough Council and Down District Council	The Honorary Secretary, SLNCA, 23 Barhall Road, Portaferry, Co. Down BT22 1RQ, tel: 01247 728708
Ballykinler Conservation Group	Chaired by the MoD and covers matters relating to the Ballykinler MoD camp. Management Plan exists for the site.	MoD, DoE (NI) EHS, National Trust, RSPB liaison group and CNCC	Chairperson, Ballykinler Training Centre, Depot, The Royal Irish Regiment, British Forces Post Office 805, tel: 01232 251477
Dundrum Bay Advisory Committee	Local discussion group, meeting on an *ad hoc* basis in response to issues	Down District Council, National Trust, RSPB, Dundrum Village Committee, wildfowlers, Dundrum Oyster Fisheries	*Dundrum Bay Advisory Committee, c/o Down District Council, Downpatrick, tel: 01396 610800
Mourne Committee	Advises Mourne Liaison Group on the management of the Mourne AONB and considers local issues	EHS (chair); Mournes Advisory Council, Down District and Newry and Mourne District Councils, National Trust, CNCC, farming, recreational and educational bodies.	*Mourne Committee, c/o DoE(NI) EHS, Belfast, tel: 01232 251477
Mourne Liaison Group	Coordinates management activities in Mourne AONB in light of advice from Mourne Committee	EHS (chair); DoE (NI) Water, Roads and Planning Services; DANI Forest Service, Countryside Management, Watercourse Management and Fisheries Divisions; officers of Down District and Newry and Mourne District Councils	Mourne Liaison Group, 5-33 Hill Street, Belfast BT1 2LA, tel: 01232 251477
Mournes Advisory Council (MAC)	Local discussion group which feeds its views to the Mourne Committee and which may comment on coastal issues	Down District and Newry and Mourne District Councils, RSPB, National Trust, Mourne Ramblers, local residents and user groups	Mournes Advisory Council, 115a Central Promenade, Newcastle, Co. Down BT33 0EU, tel: 01693 762061

Key: *starred contact addresses are given in full in the Appendix.

10.3.5 Further sources of information

A. References cited

Council for Nature Conservation and the Countryside. 1994. *Coastal zone management policy for Northern Ireland*. Belfast, CNCC.

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

Department of Environment. 1996. *Coastal zone management, towards best management*. A report prepared by Nicholas Pearson Associates for the Department of Environment, DoE, Bristol.

Department of the Environment for Northern Ireland. 1993. *A planning strategy for rural Northern Ireland.* Belfast, HMSO.

Department of the Environment for Northern Ireland. 1994. *Strangford Lough proposed Marine Nature Reserve - guide to designation.* Belfast, HMSO.

Department of the Environment for Northern Ireland. 1995a. *The Conservation (Natural Habitats, etc.) Regulations (Northern Ireland) 1995.* Belfast, HMSO.

Department of the Environment for Northern Ireland. 1995b. *Delivering coastal zone management in Northern Ireland.* Belfast, Environment Service.

Department of the Environment for Northern Ireland. 1996. *Coastal zone management in Northern Ireland.* Belfast. DoE (NI).

Department of the Environment/Ministry of Agriculture, Fisheries and Food. 1995. *Rural England. A nation committed to a living countryside. A white paper laid before Parliament.* London, HMSO.

Department of the Environment/Welsh Office. 1992. *Planning policy guidance - coastal planning.* London, HMSO. (PPG 20.)

Department of the Environment/Welsh Office. 1993a. *Development below Low Water Mark: a review of regulation in England and Wales.* London, HMSO.

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

Earll, R.C., *ed.* 1994. *Statutory and non-statutory plans in the estuarine and coastal environment. Overlapping plans - is this an issue?* Unpublished report of a meeting in July 1994.

Eastwood, S.M., & Erwin, D. 1992. *Managing the coast of Northern Ireland. A synopsis of the existing situation in coastal zone management.* Belfast, Ulster Museum for CNCC.

European Commission Services. 1996. *Demonstration programme on integrated management of coastal zones.* Brussels, European Commission Sevices, DG Environment, Nuclear Safety and Civil Protection, DG Fisheries, DG Regional Policy and Cohesion (XI/79/96).

Gubbay, S. 1990. *A future for the coast? Proposals for a UK coastal zone management plan.* Ross-on-Wye, a report to the WWF UK from the Marine Conservation Society (unpublished).

House of Commons. 1992. *Coastal zone protection and planning.* HMSO, London. (Environment Committee Second Report, HC17.)

Irish Sea Study Group. 1990. *The Irish Sea: an environmental review. Introduction and overview*. Liverpool, Irish Sea Study Group.

King, G., & Bridge, L. 1994. *Directory of coastal planning and management initiatives in England.* Maidstone, National Coasts and Estuaries Advisory Group.

Rothwell, P.I.Y., & Housden, S.D. 1990. *Turning the tide - a future for estuaries.* Sandy, RSPB.

Royal Society for the Protection of Birds. 1995. *Review of coastal zone management powers.* Sandy, RSPB.

B. Further reading

Baxter, J., & Boaden, P.J.S. 1990. Northern Ireland. *In: The Irish Sea, an environmental review. Irish Sea Study Group Report, Part 1: nature conservation*, 83-102. Liverpool, Liverpool University Press.

Carroll, M., & Dubsky, K., *eds.* 1994. *Coastal zone management from needs to action. Proceedings of a conference 3-6 September 1994, Dublin Castle.* Dublin, Coastwatch Europe Network.

Costello, M.J., Wilson, J., O'Sullivan, G., Duffy, L,. Emblow, C., Kelly, K., & Kurtz, I. 1995. *Strategies and methods in coastal and estuarine management. Programme and Abstracts of the 25th annual symposium of the Estuarine and Coastal Sciences Association.* Dublin, Trinity College Environmental Sciences Unit.

Department of Agriculture for Northern Ireland. Annually since 1967. *Report on the sea and inland fisheries of Northern Ireland.* Belfast, HMSO.

Department of Agriculture for Northern Ireland. 1989. *Countryside management - the DANI strategy.* Belfast, HMSO.

Department of the Environment. 1992. *Coastal zone protection and planning. The Government's response to the Second Report from the House of Commons Select Committee on the Environment.* London, HMSO. (CM2011.)

Department of the Environment/Welsh Office. 1994. *The Conservation (Natural Habitats etc.) Regulations.* London, HMSO (SI 2716).

Department of the Environment for Northern Ireland. 1990. *Belfast Harbour Local Plan 1990-2005.* Belfast, HMSO.

Department of the Environment for Northern Ireland. 1993. *Proposals to implement the Habitats Directive in Northern Ireland. A consultation paper.* Belfast, Environment Service.

Department of the Environment for Northern Ireland. 1995. *The Habitats Directive. How it will apply in Northern Ireland.* Belfast, Environment Service.

Earll, R.C., *ed*. 1995. *Marine environmental management review. Review of events in 1994 and future trends. The proceedings of a meeting held on the 17-18th January 1995*. Kempley, Gloucestershire.

European Sea Ports Organisation. 1995. *Code of Practice on the Environment.* London, British Ports Association.

Gubbay, S. 1994a. *Seas: the opportunity. Working together to protect our marine life*. Sandy, RSPB.

Gubbay, S. 1994b. *Recommendations for a European Union coastal strategy.* Cambridge, Birdlife International.

Healy, M.G., & Doody J.P., *eds.* 1995. *Directions in European coastal management.* Cardigan, Samara Publishing Ltd.

Irish Sea Forum/Marine Forum. 1993. *Managing marine fisheries: a case study of the Irish Sea. Report of Joint Seminar held at University of Liverpool, 16/17 September 1993.* Liverpool, Liverpool University Press.

Irish Sea Study Group. 1990. *The Irish Sea, an environmental review. Irish Sea Study Group Report, Part 2: waste inputs and pollution*. Liverpool, Liverpool University Press.

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.

National Coasts and Estuaries Advisory Group. 1993. *Coastal planning and management: a good practice guide.* Maidstone, National Coasts and Estuaries Advisory Group.

Organisation for Economic and Cultural Development. 1993. *Coastal zone management. Integrated policies*. Paris, OECD.

Pernetta, J., & Elder, D. 1993. *Cross-sectoral integrated coastal area planning. Guidelines and principles for coastal area development*. Switzerland, IUCN.

Royal Society for the Protection of Birds. 1992. *A shore future. RSPB vision for the coast*. Sandy, RSPB.

Scottish Natural Heritage. 1997. *Natura 2000: managing European marine sites - an introduction.* Edinburgh, Scottish Natural Heritage.

Smith, H.D., & Geffen, A.J., *eds.* 1990. *The Irish Sea, an environmental review. Irish Sea Study Group Report, Part 4: planning, development and management*. Liverpool, Liverpool University Press.

Ulster Wildlife Trust. 1990. *The conservation of sea loughs. A conference organised by the Ulster Wildlife Trust and the British Association of Nature Conservationists.* Belfast, UWT.

UNCED. 1992. *The global partnership for environment and development. A guide to Agenda 21.* Geneva, UNCED.

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 zone management. These either provide information on particular local or national initiatives (such as the statutory or non-governmental organisations' estuaries (England) and firths (Scotland) 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.

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.

Coastline UK. Quarterly journal of the National Coasts and Estuaries Advisory Group (NCEAG). Aimed at maritime local authority planners. Published by NCEAG.

CZM News. Occasional Newsletter of Eurocoast UK, reporting on projects and developments in the field of coastal zone management. Published by Eurocoast UK.

Intercoast Network. International newsletter of coastal management. International and European notes on CZM related projects. Contains information on conferences, seminars, publications, networks, periodicals and resources. Published by Coastal Resources Centre (see 10.3.6C).

Journal of Coastal Conservation. Twice yearly journal of the European Union for Coastal Conservation (EUCC). New scientific journal for integrated research and management of the coastal zone. The emphasis will be on natural resources and their sustainable use in the context of past and future social and economic developments.

Marine Scene. Occasional marine newsletter of the statutory conservation agencies in the UK. Aimed at marine scientists, and users and regulators of the sea. Published by JNCC.

Marine Update. A briefing to highlight WWF-UK's work in marine conservation. Published by WWF-UK.

Strangford Lough Update. Occasional newsletter of Strangford Lough Management Committee.

Wavelength. Newsletter of the Coastal Forum for England. Provides updates on coastal initiatives, Forum reports and features of general interest. Published by the Department of the Environment.

National and local planning/management publications

Department of the Environment for Northern Ireland. 1993. *A planning strategy for rural Northern Ireland.* Belfast, HMSO. (Framework for DoE (NI) Planning Service; introduces concept of Countryside Policy Areas.)

Department of the Environment for Northern Ireland. 1995. *Delivering coastal zone management in Northern Ireland.* Belfast, Environment Service. (Described existing mechanisms for regulating coastal activities and suggested ways of improving coordination of the management and conservation of the coast.)

Department of the Environment. 1995. *Policy guidelines for the coast.* London, HMSO. (Highlights government coastal policy and summarises essential guidance.)

DoE/Welsh Office. 1992. *Planning Policy Guidance (PPG) Note No. 20 on coastal planning*. London, HMSO. (Recognises the need to define a coastal zone incorporating areas affected by natural near-shore processes. Advises local authorities to consider the impacts of off-shore and on-shore developments within the full coastal zone. Endorses the precautionary approach.)

DoE/Welsh Office. 1993. *Development below low water mark - a review of regulation in England and Wales.* London, HMSO. (Rejects the 1992 Environment Committee's recommendations for the extension of development controls off-shore. Seeks to strengthen existing arrangements to overcome limitations and draw-backs in the present land-use planning system.)

DoE/Welsh Office. 1993. *Managing the coast: a review of coastal management plans in England and Wales and the powers supporting them.* London, HMSO. (Includes proposals for coastal management plans to be based on a voluntary, multi-agency approach, generally led by local authorities.)

House of Commons Environment Committee. 1992. *Second report - coastal zone protection and planning*. London, HMSO. (Recommended that coastal zone management be adopted as the framework for all coastal zone planning and management practice in the United Kingdom. Called for a national coastal strategy, a review of the many organisations responsible for the coast, the extension of planning controls offshore, and the establishment of a Coastal Zone Unit in Department of the Environment.)

MAFF. 1994. *Shoreline management plans.* (A procedural guide for operating authorities. Final version, June 1995.)

C. Contact names and addresses

Organisation/group	Activities	Contact address and telephone no.
British Association for Shooting and Conservation (BASC)	Has developed national policies on the coastal zone. Represented on local coastal fora.	*The BASC, Ballymena, tel: 01266 652349
Coastal Forum (for Northern Ireland)	Will provide for an exchange of views on issues related to the coastal zone in Northern Ireland by a wide range of interested bodies, including conservation, commercial and recreational organisations, relevant statutory organisations and central and local government.	*Department of the Environment for Northern Ireland, Environment and Planning Division, Belfast, tel: 01232 250250
Coastal Forum (for England)	Provides for an exchange of views on issues related to the coastal zone in England by a wide range of interested bodies, including central and local government, conservation, commercial and recreation organisations. Proceedings are reported to government ministers.	Coastal Forum Secretariat, Department of the Environment, Room 912, Tollgate House, Houlton Street, Bristol BS2 9DJ, tel: 0117 9878003
Coastal Resources Centre	Publishes Intercoast Network (see above)	Coastal Resources Centre, UR1 Bay Campus, Narragansett, RI 02882, USA
Coastal Technical Officers Group	The coastal group of the statutory conservation agencies (English Nature, Scottish Natural Heritage, Countryside Council for Wales, Department of the Environment for Northern Ireland, Joint Nature Conservation Committee and the Countryside Commission)	*Coastal Technical Officers Group: English Nature, Maritime Team, Peterborough, tel: 01733 340345 (secretariat)
Coastal Zone Institute	Provides a one-stop institute for industries, local authorities, government agencies etc. to access expertise on coastal studies. Aims to facilitate the rational development of the coastal zone, ensuring the avoidance of conflict between competing users.	Munster Institute Buildings, University College, Cork, Ireland, tel: +353 21 276871
Council for Nature Conservation and the Countryside (CNCC)	Appointed statutory committee that advises government on matters relating to nature and landscape conservation and countryside access	*CNCC Secretariat, Belfast, tel: 01232 235000
The Crown Estate	Owns approximately 76% of the Northern Ireland foreshore and most of the sea bed out to the territorial limit	*The Crown Estate, c/o Brown McConnel Clark, Belfast, tel: 01232 320634
Eurocoast UK	Aims to improve the basis for protection, development and management of the coastal zone. Primarily a communication network.	Eurocoast UK Secretariat, Department of Maritime Studies & International Transport, UWCC, PO Box 907, Cardiff CF1 3YP, tel: 01222 874271
European Union for Coastal Conservation (EUCC)	International grouping of organisations and individuals with an interest in coastal nature conservation matters, including coastal zone management	European Union for Coastal Conservation (EUCC) Secretariat, PO 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
Irish Sea Forum	Seminars, publications and research towards the integrated management and the enhancement of the environmental health of the Irish Sea and its coasts, and the sustainable use of its resources	Centre for Marine and Coastal Studies, Faculty of Science, The University of Liverpool, PO Box 147, Liverpool L69 3BX, tel: 0151 794 4089
Marine Conservation Society	Provides advice and supports 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 for Environmental Issues	National network provides forum for discussion of marine issues relating to the seas around UK. Members include governmental and non-governmental organisations and individuals. Occasional seminars are held, covering a range of topics including coastal management.	Honorary Secretary, The Marine Forum for Environmental Issues, c/o University College Scarborough, Filey Road, Scarborough YO11 3AZ, tel: 01723 362392

C. Contact names and addresses (continued)

Organisation/group	*Activities*	*Contact address and telephone no.*
National Coasts and Estuaries Advisory Group	Represents maritime local authorities in the UK. Advises on the sustainable development of coastal and estuarine environments, furthers the development of partnerships in coastal management, and promotes best practice in coastal management	Alan Inder, Secretary, National Coasts and Estuaries Advisory Group (NCEAG), Hampshire County Council, The Castle, Winchester SO23 8UJ, tel: 01962 846749
National Trust	Has extensive coastal land holdings in the region (see section 7.5.1); protects coastal land, especially through Enterprise Neptune. Has byelaw making powers and regularly reviews management plans for its properties.	*The National Trust, Saintfield, tel: 01238 510721
Northern Ireland Environment Link (NIEL)	A networking organisation for voluntary groups involved with wildlife, countryside and nature conservation: Black Mountain Environmental Group, the BASC, Conservation Volunteers Northern Ireland, Friends of the Bog Meadows, Friends of the Earth (FoE), Groundwork, International Tree Foundation, Lenadoon Environmental Forum, Mountaineering Council for Ireland, Mournes Advisory Council, National Trust, RSPB, Tidy Northern Ireland, Ulster Archaeological Society, Ulster Architectural Heritage Society, Ulster Society for the Preservation of the Countryside, Ulster Society for the Prevention of Cruelty to Animals, Ulster Wildlife Trust, Upper Faughan River Trust, Wildfowl and Wetlands Trust (WWT), WWF-UK.	*Northern Ireland Environment Link, Belfast, tel: 01232 314944
Royal Institution of Chartered Surveyors	Producing a coastal report focusing on fully integrated development and management of the coastal zone	Alpha House, 3 Rosemary Street, Belfast BT12 1QA, tel: 01232 322877
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.	*RSPB, Belfast, tel: 01232 491547
Royal Yachting Association (RYA), Northern Ireland	Has developed national policies on the coastal zone. Represented on local coastal fora.	Council of the RYA, SCNI, House of Sport, Upper Malone Road, Belfast BT9 5LA, tel: 01232 381222
Ulster Wildlife Trust	Manages two coastal nature reserves, promotes conservation through member participation, themed conferences and representation on local fora. The region's equivalent of the County Wildlife Trusts in Britain, affiliated to RSNC.	*Ulster Wildlife Trust, Crossgar, tel: 01396 830282
World Wide Fund for Nature - UK	Provides funding for research, local voluntary policy development and local initiatives, and publications on integrated coastal management. Draws on considerable international experience with coastal management initiatives.	*World Wide Fund for Nature - UK, Godalming, tel: 01483 426444

Key: *starred contact addresses are given in full in the Appendix.

Ballintoy Port, on the beautiful Causeway Coast Area of Outstanding Natural Beauty - is a popular centre for canoeing and also has berths for visiting boats. Care is needed to ensure that tourism and other developments on the coast do not detract from the wonderful scenery or the integrity of the natural environment. Such issues will be addressed by the Northern Ireland Coastal Forum. Photo: Mike Hartwell, DoE (NI) EHS.

Appendix

A.1 Frequently cited contact names and addresses

Name	*Contact address and telephone no.*
Statutory bodies	
The Crown Estate (Managing Agents)	The Crown Estate, c/o Brown McConnel Clark, 11 Rosemary Street, Belfast BT1 1QF, tel: 01232 320634
British Oceanographic Data Centre - NERC (BODC), Proudman Oceanographic Laboratory	Bidston Observatory, Birkenhead, Merseyside L43 7RA, tel: 0151 653 8633
Council for Nature Conservation and the Countryside (CNCC)	CNCC Secretariat, 5-33 Hill Street, Belfast BT1 2LA, tel: 01232 235000
Department of Agriculture for Northern Ireland (DANI)	Dundonald House, Upper Newtownards Road, Belfast BT4 3SB, tel: 01232 520100
DANI Agricultural and Environmental Sciences Division	Newforge Lane, Belfast BT9 5PX, tel: 01232 250666
DANI Countryside Management Division	Dundonald House, Upper Newtownards Road, Belfast BT4 3SB, tel: 01232 520100
DANI Fisheries Division	Annexe 5, Castle Grounds, Stormont Estate, Belfast BT4 3PW, tel: 01232 520100
DANI Forest Service	Dundonald House, Upper Newtownards Road, Belfast BT4 3SB, tel: 01232 520100
DANI Rivers Agency	Hydebank, 4 Hospital Road, Belfast BT8 8JP, tel: 01232 253355
Department of Economic Development (DED) (including Minerals and Petroleum Unit)	Netherleigh, Massey Avenue, Belfast BT4 2JP, tel: 01232 529900
DED Geological Survey of Northern Ireland	20 College Gardens, Belfast BT9 6BS, tel: 01232 666595
DED Industrial Development Board	IDB House, 64 Chichester Street, Belfast BT1 6JX, tel: 01232 233233
DED Industrial Research and Technology Unit	Industrial Science Centre, 17 Antrim Road, Lisburn, Co. Antrim BT28 3AL, tel: 01846 623000
DED Northern Ireland Tourist Board (NITB)	NITB Headquarters, St Anne's Court, 59 North Street, Belfast BT1 1NB, tel: 01232 231221
Department of the Environment for Northern Ireland (DoE (NI))	Clarence Court, 10-18 Adelaide Street, Belfast BT2 8GB, tel: 01232 540540
DoE (NI) Belfast Development Office	Clarence Court, 10-18 Adelaide Street, Belfast BT2 8GB, tel: 01232 540540

Name	*Contact address and telephone no.*
Statutory bodies (continued)	
DoE (NI) Construction Service	Hydebank, 4 Hospital Road, Belfast BT8 8JP, tel: 01232 253428
DoE (NI) Environment and Heritage Service (EHS), Natural Heritage	Commonwealth House, 35 Castle Street, Belfast BT1 1GH, tel: 01232 251477
DoE (NI) (EHS) Water Quality Unit, Environmental Protection	Calvert House, 23 Castle Place, Belfast BT1 1FY, tel: 01232 254754
DoE (NI) (EHS), Emergency Pollution Unit	Calvert House, 23 Castle Place, Belfast BT1 1FY, tel: 01232 254868
DoE (NI) (EHS) Built Heritage	5-33 Hill Street, Belfast BT1 2LA, tel: 01232 235000
DoE (NI) Ordnance Survey of Northern Ireland	Colby House, Stranmillis Court, Belfast BT9 5BJ, tel: 01232 255755
DoE (NI) Planning Service	Clarence Court, 10-18 Adelaide Street, Belfast BT2 8GB, tel: 01232 540715
DoE (NI) Roads Service	Clarence Court, 10-18 Adelaide Street, Belfast BT2 8GB, tel: 01232 540540
DoE (NI) Water Service	Northland House, Frederick Street, Belfast BT1 2NR, tel: 01232 244711
Department of Transport, Marine Safety Agency	Marine Office, Custom House, Queen Square, Belfast BT1 8ET, tel: 01232 234466
Fisheries Conservancy Board for Northern Ireland	1 Mahon Road, Portadown, Co. Armagh BT62 3EE, tel: 01762 334666
Foyle Fisheries Commission	8 Victoria Road, Londonderry, Co. Londonderry BT47 2AB, tel: 01504 42100
HM Coastguard	Bregenz House, Quay Street, Bangor, Co. Down BT20 5ED, tel: 01247 463933
Joint Nature Conservation Committee (JNCC)	Monkstone House, City Road, Peterborough PE1 1JY, tel: 01733 62626
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
Marine Pollution Control Unit	Spring Place, 105 Commercial Road, Southampton SO15 1EG, tel: 01703 329484
Northern Ireland Office	Dundonald House, Upper Newtownards Road, Belfast BT4 3SB, tel: 01232 520700

Name	*Contact address and telephone no.*
Statutory bodies (continued)	
The Sports Council for Northern Ireland (SCNI)	House of Sport, Upper Malone Road, Belfast BT9 5LA, tel: 01232 381222
Voluntary bodies	
Marine Conservation Society	9 Gloucester Road, Ross-on-Wye, Herefordshire HR9 5BU, tel: 01989 566017
The British Association for Shooting and Conservation (BASC)	Courtyard Cottage, Galgorm Castle, Ballymena, Co. Antrim BT42 1HL, tel: 01266 652349
The British Trust for Ornithology	The Nunnery, Nunnery Place, Thetford, Norfolk IP24 1PU, tel: 01842 750050
The National Trust	Rowallane House, Saintfield, Ballynahinch, Co. Down BT24 7LH, tel: 01238 510721
National Trust National Biological Survey Team	33 Sheep Street, Cirencester, Gloucestershire GL7 1QW, tel: 01285 651818
The Royal Society for the Protection of Birds (RSPB)	Regional Headquarters, Belvoir Park Forest, Belfast BT8 4QT, tel: 01232 491547
RSPB Headquarters	The Lodge, Sandy, Bedfordshire SG19 2DL, tel: 01767 680551
Ulster Society for the Preservation of the Countryside (USPC)	Peskett Centre, 2A Windsor Road, Belfast BT9 7FQ, tel: 01232 381304
Ulster Wildlife Trust (UWT)	Crossgar Nature Centre, 3 New Line, Crossgar, Downpatrick, Co. Down BT30 9EP, tel: 01396 830282
The Wildfowl & Wetlands Trust (WWT)	Castle Espie, 78 Ballydrain Road, Comber, Co. Down BT23 6EA, tel: 01247 874146

Name	*Contact address and telephone no.*
Voluntary bodies (continued)	
WWT Headquarters	Slimbridge, Gloucestershire GL2 7BX, tel: 01453 890333
Northern Ireland Environment Link	47a Botanic Avenue, Belfast BT7 1LJ, tel: 01232 314944
The Woodland Trust	Autumn Park, Dysart Road, Grantham, Lincolnshire NG31 6LL, tel: 01476 574297
World Wide Fund for Nature - UK (WWF-UK)	59 Cable Road, Whitehead BT38 9PZ, tel: 01960 353005
WWF-UK Headquarters	Panda House, Weyside Park, Cattershall Lane, Godalming, Surrey GU7 1XR, tel: 01483 426444
Others	
The Ulster Museum - Centre for Environmental Data and Recording (CEDaR)	Botanic Gardens, Belfast BT9 5AB, tel: 01232 383000
The Ulster Museum - Biological Records Centre and general administration	Malone Buildings, 12 Malone Road, Belfast BT9 5BM, tel: 01232 383000
The Queen's University of Belfast	University Road, Belfast BT7 1NN, tel: 01232 245133
The Queen's University of Belfast, School of Biology and Biochemistry	Medical Biology Centre, Lisburn Road, Belfast BT9 7BL, tel: 01232 335786
The Queen's University of Belfast, Marine Biology Station	13 The Strand, Portaferry, Co. Down BT22 1PF, tel: 012477 28230
University of Ulster (at Coleraine)	Cromore Road, Coleraine, Co. Londonderry BT52 1SA, tel: 01265 324401

A.2 Planning Service divisional offices; local authorities; port and harbour authorities

Name	*Address and telephone no.*
Divisional planning offices	
Divisional Planning Office (council areas of Derry, Limavady, Coleraine and Moyle)	40 Foyle Street, Londonderry BT48 6AT, tel: 01504 319900
Divisional Planning Office (council areas of Larne and Carrickfergus)	County Hall, 182 Galgorm Road, Ballymena, Co. Antrim BT42 1QF, tel: 01266 653333
Belfast Divisional Planning Office (council areas of Newtownabbey and Belfast)	Bedford House, 16-22 Bedford Street, Belfast BT2 7FD, tel: 01232 252800
Divisional Planning Office (council areas of North Down, Ards and Down)	Rathkeltair House, Market Street, Downpatrick, Co. Down BT30 6EJ, tel: 01396 612211
Divisional Planning Office (council areas of Newry and Mourne)	Marlborough House, Central Way, Craigavon, Co. Armagh BT64 1AD, tel: 01762 341144
Coastal local authorities	
Derry City Council	98 Strand Road, Londonderry BT48 7NN, tel: 01504 365151
Limavady Borough Council	7 Connell Street, Limavady, Co. Londonderry BT49 0HA, tel: 01015047 22226
Coleraine Borough Council	Cloonavin, 41 Portstewart Road, Coleraine, Co. Londonderry BT52 1EY, tel: 01265 52181
Moyle District Council	Sheskburn House, 7 Mary Street, Ballycastle, Co. Antrim BT54 6EY, tel: 012657 62225
Larne Borough Council	Smiley Buildings, Victoria Road, Larne, Co. Antrim BT40 1RU, tel: 01574 272313
Carrickfergus Borough Council	Town Hall, Joymount, Carrickfergus, Co. Antrim BT38 7DL, tel: 01960 351604
Newtownabbey Borough Council	1 The Square, Ballyclare, Co. Antrim BT39 9BA, tel: 01960 352681
Belfast City Council	PO Box 234, City Hall, Belfast BT1 5GS, tel: 01232 320202
North Down Borough Council	Town Hall, The Castle, Bangor, Co. Down BT20 4BT, tel: 01247 270371
Ards Borough Council	2 Church Street, Newtownards, Co. Down BT23 4AP, tel: 01247 812215

Name	*Address and telephone no.*
Coastal local authorities (continued)	
Down District Council	24 Strangford Road, Downpatrick, Co. Down BT30 6SR tel: 01396 610800
Newry and Mourne District Council	Monaghan Row, Newry, Co. Down BT35 8DL, tel: 01693 65411
Port and harbour authorities	
Londonderry Port and Harbour Commissioners	Harbour Office, Port Road, Lisahally, Co. Londonderry BT47 1FL, tel: 01504 860555
Portrush Harbour Company	Harbour Road, Portrush, Co. Antrim BT56 8DF, tel: 01265 822307
Coleraine Harbour Commissioners	Harbour Office, The Quay, Coleraine, Co. Londonderry BT52 1BJ, tel: 01265 42012
Larne Harbour Ltd	9 Olderfleet Road, Larne, Co. Antrim BT40 1AS, tel: 01574 279221
Carrickfergus Harbourmaster's Office	West Pier, The Harbour, Carrickfergus, Co. Antrim BT38 7BQ, tel: 01960 351292
Belfast Harbour Commissioners	Harbour Office, Corporation Square, Belfast BT1 3AL, tel: 01232 554422
Donaghadee Harbour Office	Harbour House, Parade, Donaghadee, Co. Down BT21 0HE, tel: 01247 882377
Northern Ireland Fishery Harbour Authority	3 St. Patrick's Avenue, Downpatrick, Co. Down BT30 6DW, tel: 01396 613844
Carlingford Lough Commission	126 Greencastle Road, Greencastle, Kilkeel, Co. Down BT34 4JP, tel: 01693 765267
Warrenpoint Harbour Authority	The Docks, Warrenpoint, Co. Down BT34 3JR, tel: 01693 773381
Others	
Bangor Marina	Bregenz House, Quay Street, Bangor, Co. Down BT20 5ED, tel: 01247 453297
Association of Local Authorities of Northern Ireland	123 York Street, Belfast BT15 4AB, tel: 01232 249286

A.3 Core reading list

There are several publications that either provide information on a variety of topics covered in these regional reports (and so are frequently referred to) or give a good overview of regional and national information on coasts and seas. They are listed below.

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

British Oceanographic Data Centre. 1992. *UKDMAP (United Kingdom digital marine atlas).* Birkenhead, BODC (Computer software.).

Brown, A. 1992. *The UK environment*. London, HMSO

Buck, A.L., & Donaghy, A. 1996. *An inventory of UK estuaries. 7. Northern Ireland.* Peterborough, Joint Nature Conservation Committee.

Cruickshank, J.G., & Wilcock, D.N. 1982. *Northern Ireland environment and natural resources.* Belfast, The Queen's University of Belfast and The New University of Ulster.

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.

Donn, S., & Wade, M. 1994. *UK directory of ecological information.* Chichester, Packard.

Eno, N.C., *ed*. 1991. *Marine conservation handbook.* 2nd ed. Peterborough, English Nature.

Erwin, D.G., Picton, B.E., Connor, D.W., Howson C.M., Gilleece, P., & Bogues, M.J. 1990. *Inshore marine life of Northern Ireland.* Belfast, Ulster Museum/DoE (NI)/HMSO.

Gubbay, S. 1988. *A coastal directory for marine conservation.* Ross-on-Wye,Marine Conservation Society.

Lee, A.J., & Ramster, J.W. 1981. *Atlas of the seas around the British Isles.* Lowestoft, MAFF.

A.4 Contributing authors

Author	*Address*
Dr R. Anderson	1, Belvoir View Park, Newtownbreda, Belfast BT8 4BL
Dr M.J. Armstrong	DANI Agricultural and Environmental Science Division, Newforge Lane, Belfast BT9 5PX
J.H. Barne	JNCC, Monkstone House, City Road, Peterborough PE1 1JY
I. Basu	Hyder Consulting, Beacon House, William Brown Close, Llantarnum Park, Cwmbran, Gwent NP44 3AB
R.J. Bleakley	DoE (NI), Environment and Heritage Service, Commonwealth House, 35 Castle Street, Belfast BT1 1GU
Dr R.P. Briggs	DANI Agricultural and Environmental Science Division, Newforge Lane, Belfast BT9 5PX
A.L. Buck	JNCC, Monkstone House, City Road, Peterborough PE1 1JY
C. Butler	School of Environmental Studies, University of Ulster, Cromore Road, Coleraine, Co. Londonderry BT52 1SA
S.M. Close	DoE (NI), Environment and Heritage Service, Commonwealth House, 35 Castle Street, Belfast BT1 1GU
Dr Alan Cooper	School of Environmental Studies, University of Ulster, Cromore Road, Coleraine, Co. Londonderry BT52 1SA
Dr N.C. Davidson	JNCC, Monkstone House, City Road, Peterborough PE1 1JY
Dr M. Dickey-Collas	DANI Agricultural and Environmental Science Division, Newforge Lane, Belfast BT9 5PX
Dr J.P. Doody	JNCC, Monkstone House, City Road, Peterborough PE1 1JY
M. Edwards	Sir Alister Hardy Foundation for Ocean Science, c/o Plymouth Marine Laboratory, Citadel Hill, Plymouth, Devon PL1 2PB
Dr. D.G. Erwin	Quoile Quay House, 25 Quoile Quay Road, Downpatrick BT30 6SF
Dr P.G.H. Evans	Seawatch Foundation, Department of Zoology, University of Oxford, South Parks Road, Oxford OX1 3PS
P. Hackney	Botany Department, Sciences Division, Ulster Museum, Belfast BT9 5AB
A.W.G. John	Sir Alister Hardy Foundation for Ocean Science, c/o Plymouth Marine Laboratory, Citadel Hill, Plymouth, Devon PL1 2PB
S.S. Kaznowska	JNCC, Monkstone House, City Road, Peterborough PE1 1JY
R.G. Keddie	JNCC, Monkstone House, City Road, Peterborough PE1 1JY
M. McAuley	90 North Road, Belfast BT4 3DJ
H.M.C. McCaughan	DANI Fisheries Inspectorate, Annex 5, Castle Grounds, Stormont Estate, Belfast BT4 3PW
S. McLaughlin	Ulster University School of Environmental Studies, Cromore Road, Coleraine, Co. Londonderry BT52 1SA
Prof W.I. Montgomery	School of Biology and Biochemistry, Medical and Biological Centre, Queens University Belfast BT9 5AB
C.W. Murphy	Larches, 12 Belvoir Close, Belvoir Park, Belfast BT8 4PL
B.H. Nelson	Department of Zoology, Ulster Museum, Botanic Gardens, Belfast BT8 4BL
Dr G.H. Nevin	Ulster University School of Environmental Studies, Cromore Road, Coleraine, Co. Londonderry BT52 1SA
D. Noë-Murphy	Larches, 12 Belvoir Close, Belvoir Park, Belfast BT8 4PL
Dr G.W. Potts	The Marine Biological Association of the UK, The Laboratory, Citadel Hill, Plymouth PL1 2PB
C.F. Robson	JNCC, Monkstone House, City Road, Peterborough PE1 1JY
N.F. Stewart	Withylake Cottage, Sweetham, Newton St. Cyres, Devon EX5 5AP
S.E. Swaby	The Marine Biological Association of the UK, The Laboratory, Citadel Hill, Plymouth PL1 2PB
WS Atkins Ltd	Woodcote Grove, Ashley Road, Epsom, Surrey KT18 5BW