JOINT NATURE CONSERVATION COMMITTEE

Marine Nature Conservation Review

Sector 2

Orkney

Area summaries

Eleanor Murray, Matt Dalkin, Frank Fortune & Karen Begg

1999

Series editor: David Connor

Coasts and seas of the United Kingdom - MNCR series

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

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Preface

The *Marine Nature Conservation Review* (MNCR) was initiated by the Nature Conservancy Council in 1987 as the third major resource survey, following the *Nature Conservation Review* and the *Geological Conservation Review*. Since April 1991, the MNCR has been undertaken within the Support Unit of the Joint Nature Conservation Committee. The JNCC is a forum through which the three country agencies, the Countryside Council for Wales, English Nature and Scottish Natural Heritage, deliver their special statutory responsibilities for Great Britain as a whole and internationally. These special responsibilities, known as special functions, contribute to sustaining and enriching biological diversity, enhancing geological features and sustaining natural systems.

The MNCR has drawn together information on marine ecosystems around Great Britain with the objectives of:

- extending our knowledge of benthic marine habitats, communities and species in Great Britain, particularly through description of their characteristics, distribution and extent; and
- identifying sites of nature conservation importance.

The data collected also provide information to support more general measures to minimise adverse effects of development and pollution, particularly on sites and species of nature conservation importance.

The area included in the MNCR is the coastline of England, Scotland and Wales (excluding the Isle of Man and the Channel Isles), extending on the shore from the lower limit of terrestrial flowering plants and within marine inlets from the limit of marine influence out to the limit of British territorial seas. Saline lagoons are also included. The MNCR included a major field survey programme of the shores and near-shore sublittoral zone, undertaken to standard methodology.

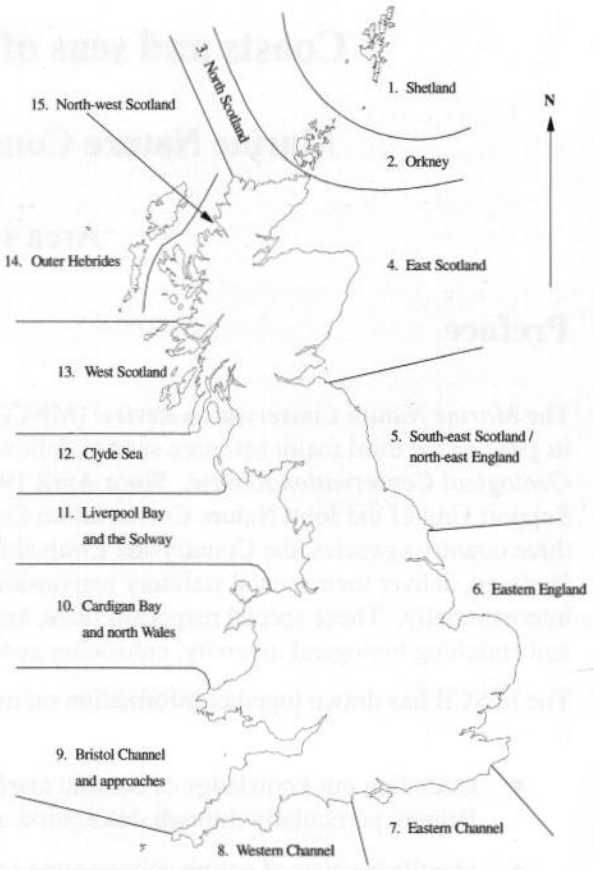
MNCR studies have been undertaken within particular coastal sectors around Britain (see map overleaf) or of major physiographic types, such as lagoons and sealochs. These studies are being presented, in the *Coasts and seas of the United Kingdom - MNCR series*, as *area summaries*, each of which provides an account of a discrete stretch of open coast, a marine inlet or a lagoon within the area of study. A list of *area summary* volumes and other major publications from the MNCR is given overleaf.

A full list of MNCR and other JNCC marine reports is available from the Marine Information Officer, JNCC, or at JNCC's website www.jncc.gov.uk//marine. JNCC publications can be purchased from NHBS Ltd, 2-3 Wills Road, Totnes, Devon, TQ9 5XN (tel. 01803-865 913; fax. 01803-865 280; e-mail nhbs@nhbs.co.uk). JNCC reports are available directly from JNCC (tel. 01733-562 626; fax. 01733-555 948).

David Connor

Joint Nature Conservation Committee

Publications in the MNCR series



MNCR coastal sectors, as used in the *Coasts and seas of the United Kingdom - MNCR series.*

Volumes published or near publication:

Sector	Title	Authors	Date
	Foundation volumes		
1-15	Rationale and methods	Hiscock, *ed.*	1996
1-15	Benthic marine ecosystems of Great Britain and the north-east Atlantic	Hiscock, *ed.*	1998
	Biotope classification		
1-15	Marine biotope classification for Britain and Ireland. Volume 1. Littoral biotopes (*JNCC Report*, No. 229)	Connor, Brazier, Hill & Northen	1997
1-15	Marine biotope classification for Britain and Ireland. Volume 2. Sublittoral biotopes (*JNCC Report*, No. 230)	Connor, Dalkin, Hill, Holt & Sanderson	1997
	Area summaries		
1	Shetland	Howson	1999
1-2	Lagoons in Shetland and Orkney	Thorpe	1998
2	Orkney	Murray, Dalkin, Fortune & Begg	1999
3, 4, 12, 13, 15	Lagoons in mainland Scotland and the Inner Hebrides	Covey, Fortune, Nichols & Thorpe	1998
5	South-east Scotland and north-east England	Brazier, Davies, Holt & Murray	1998
6	Inlets in eastern England	Hill, Emblow & Northen	1996
8	Inlets in the western English Channel	Moore, Smith & Northen	1999
9	Inlets in the Bristol Channel and approaches	Moore, Smith, Northen & Little	1998
10	Cardigan Bay and north Wales	Brazier, Holt, Murray & Nichols	1999
11	Liverpool Bay and the Solway Firth	Covey	1998
12	Sealochs in the Clyde Sea	Dipper & Beaver	1999
13	Sealochs in west Scotland		Due 2000
14	Lagoons in the Outer Hebrides	Thorpe, Dalkin, Fortune & Nichols	1998
14	Sealochs in the Outer Hebrides		Due 2000
15	Sealochs in north-west Scotland		Due 2000

Marine Nature Conservation Review

Sector 2

Orkney

Area summaries

Synopsis

The marine environment of Orkney (MNCR Sector 2) has been studied as part of the Marine Nature Conservation Review programme. The studies included field surveys of shores and the nearshore subtidal zone to describe the marine habitats and communities (together referred to as biotopes) and to assess their marine natural heritage importance. Comparable data from other organisations have been added to provide information on over 460 sites within the Sector and analysed to classify the biotopes present. Information on the designated conservation sites and main human activities in each area has also been compiled.

The information available for Orkney is presented as ten *area summaries*:

1	South Sanday	6	Eynhallow, Wyre and Rousay Sounds
2	Deer Sound	7	Wide Firth and Shapinsay Sound
3	Scapa Flow	8	Papa Westray
4	South-west Mainland	9	Eday Sound
5	Hoy Sound and Bring Deeps	10	North Sanday

Each area is described in a standard format, giving details of its physical and biological character, the marine biotopes present and their distribution, the sites surveyed, current nature conservation designations, the main human influences and relevant literature. The sites surveyed and the marine biotope information is also presented in a series of maps. These *area summaries* are supported by a summary of the biotopes defined for the Sector (from Connor *et al.* 1997a, b) and by a list of species recorded from the surveys.

References

Connor, D.W., Brazier, D.P., Hill, T.O., & Northen, K.O. 1997a. Marine Nature Conservation Review: marine biotope classification for Britain and Ireland. Volume 1. Littoral biotopes. Version 97.06. *JNCC Report*, No. 229.

Connor, D.W., Dalkin, M.J., Hill, T.O., Holt, R.H.F., & Sanderson, W.G. 1997b. Marine Nature Conservation Review: marine biotope classification for Britain and Ireland. Volume 2. Sublittoral biotopes. Version 97.06. *JNCC Report*, No. 230.

Introduction

Background

MNCR Sector 2 includes the whole of Orkney, including Sule Skerry and Stack Skerry which lie over 60 km off the west coast of Orkney Mainland, and the Pentland Firth islands of Swona and Muckle Skerry. Orkney is an archipelago surrounded by clear, relatively shallow water. The islands have a complex coastline, varying from high cliffs on Hoy and west mainland to extensive sand beaches and dune systems on Sanday. The channels between the islands are relatively shallow and consequently cause an increase in tidal streams, with some areas such as Hoy Sound having tidal races exceeding 7 knots. Orkney is subject to severe winds, and some of the coastline is thus very exposed to wave action. The complexity of the coastline affords shelter for some areas such as Scapa Flow where shelter and limited tidal movement provide calmer conditions and a marine environment different from many other parts of Orkney. Orkney has no major rivers, so true estuarine habitats are few and small.

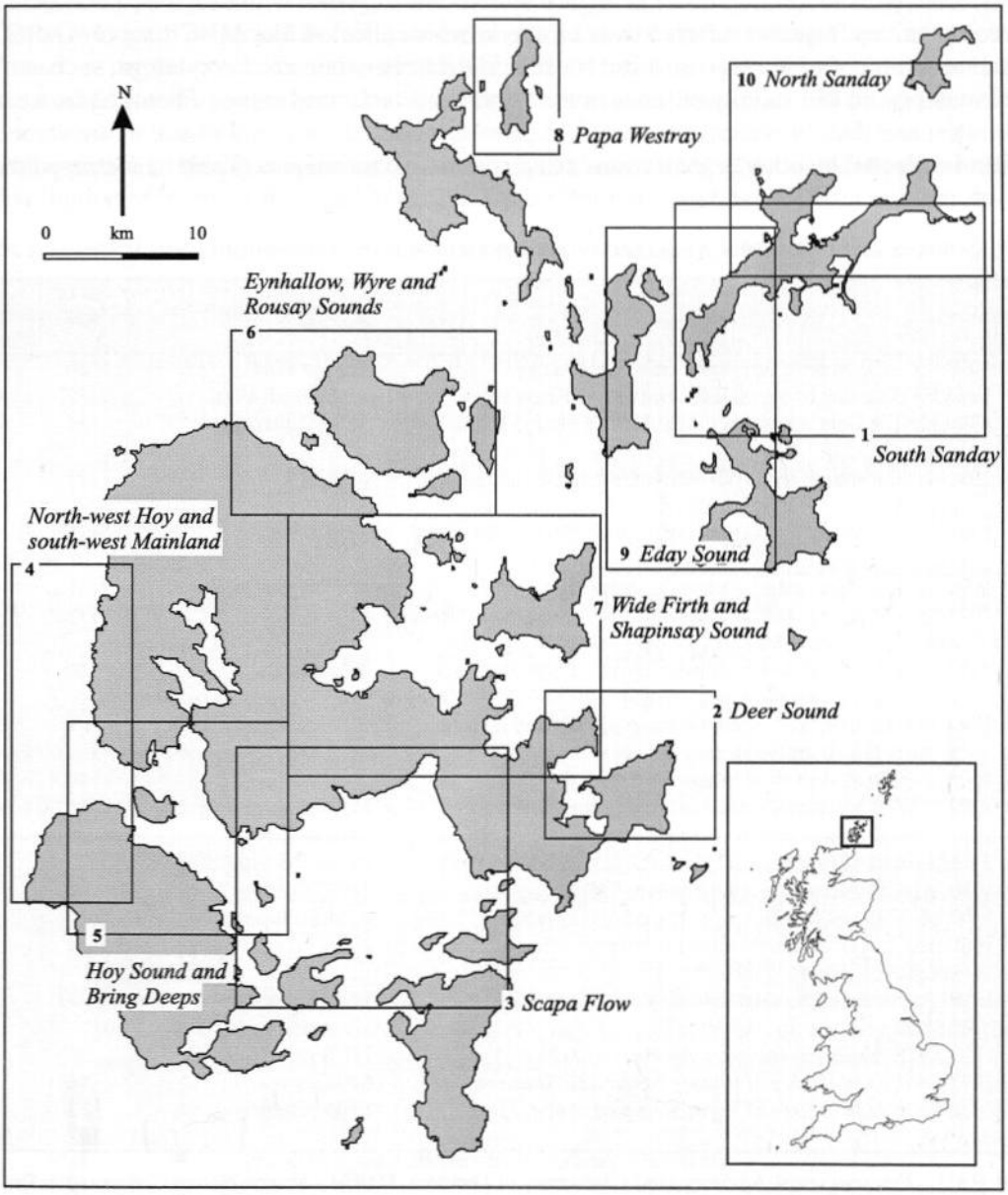


Figure 1 Location of the ten reporting areas (*area summaries*) in MNCR Sector 2.

Previous studies of Orkney's marine environment are described in Jones (1985) and summarised in Bennett & Covey (1998). These have mainly taken place since the 1970s, with the development of the North Sea oil industry, and have focused principally on Scapa Flow, which has an oil-handling terminal on the island of Flotta. The present volume does not include lagoons; these are described by Thorpe (1998).

Data collection and the classification of biotopes

Field surveys were undertaken in 1995, 1996 and 1997, as part of the Marine Nature Conservation Review programme, to describe the marine biology of shores and the nearshore subtidal zone and to assess their marine natural heritage importance. These surveys complemented surveys carried out by other organisations, including the University of Dundee and University of Newcastle-upon-Tyne who made data available to the MNCR. Together, the data from these surveys provide an extensive and geographically detailed dataset to describe the marine biology of Sector 2. A summary of these surveys is given in Table 1.

During the MNCR field surveys, data on the nature of each site, together with its habitats and their associated communities (together referred to as biotopes) were collected. For MNCR surveys, sites were selected to sample a wide range of substrata and different environmental conditions, such as differing wave exposure and salinity regimes in the littoral and sublittoral zones. Photographs were taken of the sites, and their biotopes and species, to provide a permanent visual record of the areas surveyed. Data collected by other organisations using compatible techniques (Table 1) increased the volume of information available and its geographical coverage.

Table 1 Sources of MNCR and MNCR-compatible field survey information

MNCR database survey no.	Survey	Source	No. of sites	No. of habitats surveyed
119	1978-79 UCS/NorFed sublittoral survey in Orkney.	Dipper 1984	26	0
130	1986 EAU survey of the infaunal benthos of Scapa Flow.	Jones *et al.* 1988	17	17
442	1996 MNCR Deer Sound and Wide Firth (Orkney) littoral survey	MNCR survey	15	89
444	1995 MNCR littoral survey of Wyre, Eynhallow and Rousay Sounds	MNCR survey	15	83
445	1996 MNCR Wyre, Eynhallow and Rousay Sounds (Orkney) sublittoral survey	MNCR survey	25	41
446	1996 MNCR Deer Sound (Orkney) sublittoral survey	MNCR survey	21	44
448	1995 MNCR littoral and sublittoral survey of Shapinsay Sound and Wide Firth, (Orkney)	MNCR survey	31	58
449	1995 MNCR littoral and sublittoral survey of west coast Mainland and Hoy (Orkney)	MNCR survey	36	67
483	1993 BioMar RoxAnn™ acoustic mapping of maerl beds of Rousay Sound and environs (Orkney)	Foster-Smith & Davies 1993	1	0
649	1995 SNH ROV survey of Scapa Flow and Hoy Sound	SNH survey	24	27
678	1997 MNCR sublittoral survey of Scapa Flow (Orkney)	MNCR survey	21	49
679	1997 MNCR littoral survey of Scapa Flow, Hoy Sound & west Mainland (Orkney)	MNCR survey	26	134
680	1997 MNCR littoral survey of Sanday (Orkney)	MNCR survey	26	128
681	1997 MNCR sublittoral survey of Sanday (Orkney).	MNCR survey	45	67
682	1987 EAU sublittoral grab survey of Inganess Bay and the lower reaches of Wideford Burn	Jones *et al.* 1987	20	20
683	1997 Unicomarine infaunal survey of Hoy Sound and Shapinsay Sound.	MNCR survey	29	29
691	1997 MCS Seasearch survey, Papa Westray (Orkney)	MCS survey	56	76
692	1993 SNH ROV survey of Rousay Sound and Shapinsay	SNH survey	14	16
725	1996 SNH ROV survey of Wyre Sound (Orkney)	SNH survey	17	21
		Total	**465**	**966**

Abbreviations: EAU – Environmental Advisory Unit (University of Dundee); MNCR - Marine Nature Conservation Review (JNCC); SNH – Scottish Natural Heritage; UCS – Underwater Conservation Society (now Marine Conservation Society)

The sites were surveyed following standard MNCR recording and infaunal-sampling techniques (Connor & Hiscock 1996). The location and physiographic characteristics of each site were recorded

on a standard MNCR Site Form. The physical details of each habitat and the species present were recorded on standard MNCR Habitat Forms (Littoral or Sublittoral as appropriate). The conspicuous species present were recorded using the MNCR semi-quantitative abundance scales. Species which could not be identified *in situ* were collected for later identification in the laboratory.

Core samples of littoral sediment habitats were taken for infaunal species identification. Four 0.01 m^2 core samples were taken and sieved over a 0.5 mm mesh sieve. Material retained on the sieve from all four cores was combined and preserved in seawater-formalin for subsequent identification and enumeration of the species present. Abundances of large infaunal species were estimated after digging over areas of sediment with a spade. A separate sediment sample was taken for granulometric analysis. In the sublittoral most MNCR samples were obtained using an anchor dredge and subsequently washed out, sieved and preserved. Samples from external sources were obtained using a variety of grabs, such as the Day or van Veen.

The species data from the surveys were analysed, in conjunction with their associated habitat data, to identify which biotopes, as defined in the MNCR national biotope classification (Connor *et al.* 1997a, b), were present in the dataset. Multivariate analytical techniques, including TWINSPAN and DECORANA, were employed to facilitate the identification of distinct assemblages of species within the dataset, using the procedures given in Mills (1994). Data from 465 sites (966 different habitat or station records) were used in the analyses, resulting in the identification of 137 biotopes or sub-biotopes from the national classification (Appendix A). Full descriptions of each biotope and the general approach to biotope classification are given in Connor *et al.* (1997a, b). Appendix B shows the distribution of biotopes recorded in each area.

Species recorded from the surveys listed in Table 1 are given in Appendix C.

Area summaries and their format

Survey data is available for ten discrete areas of Orkney (Figure 1); each area is described in a standard format.

1	South Sanday	6	Eynhallow, Wyre and Rousay Sounds
2	Deer Sound	7	Wide Firth and Shapinsay Sound
3	Scapa Flow	8	Papa Westray
4	South-west Mainland	9	Eday Sound
5	Hoy Sound and Bring Deeps	10	North Sanday

Each *area summary* contains the following sections:

Location

The geographic location is given as the central latitude/longitude position and Ordnance Survey grid reference, together with the local government administrative area (Orkney Islands Council) and nature conservation agency and area (Scottish Natural Heritage, North Areas: Orkney Isles). A location map shows the main features and bathymetry of the area, key place names and the limit of the area considered by the *area summary*. Place names are taken from the Ordnance Survey 1:50,000 scale second series Landranger maps. The sites surveyed are shown according to four main types of survey:

- ▲ recording on littoral rock/hard substrata
- ● recording on sublittoral rock/hard substrata
- Δ sampling by cores in littoral sediment
- ❍ sampling by cores or grab in sublittoral sediment.

Physical features

A summary of the main physical features includes:

Physiographic type	As defined in Connor & Hiscock (1996)
Maximum length of coast	Measured from the relevant 1:50,000 Ordnance Survey (Landranger series) map. Inlets are measured from the mouth of the inlet to the limit of tidal influence.
Area of inlet, where applicable	Measured from the relevant 1:50,000 Ordnance Survey (Landranger series) map.
Bathymetry	The maximum depth below chart datum, as indicated from Admiralty charts.
Wave exposure	Taken from field observations, as defined in Connor & Hiscock (1996) and from Admiralty charts.
Tidal streams	Taken from field observations and tidal streams atlas, as defined in Connor & Hiscock (1996) (1 knot ≅ 0.5 m/s).
Tidal range	Figures for mean spring and mean neap tidal range, quoted for the nearest secondary port, and based on Admiralty tide tables and charts, or as estimated during the survey (the latter applies to semi-enclosed sections of coast such as lagoons which have a restricted tidal range).
Salinity	The salinity range, as categorised in Connor & Hiscock (1996), as estimated at the time of survey (based on the species present and their known salinity tolerances and the presence of freshwater sources) or as given in available literature.

All heights and depths given are corrected to chart datum.

Introduction

The overall physical characteristics of the area and significant human influences and activities are described.

Marine biology

A table lists marine biological surveys of the shores and sublittoral which have been used in compiling the *area summary*, including the survey type (littoral/sublittoral), survey method, date(s) of survey and reference source (MNCR database survey number in the case of recent MNCR surveys). The distribution of survey sites is shown on the location map, and sites are listed at the end of each *area summary*.

The marine biological nature of the area is described with reference to the biotopes present and their distribution within the area, based primarily on the findings of the most recent MNCR survey but with reference to previous studies where appropriate. The heights and depths noted in the text are corrected to lowest tide level (chart datum). The biotope codes given in parentheses are from the MNCR national classification, as listed in Appendix A; a summary of biotopes recorded within each area is presented in Appendix B. Marine species nomenclature follows Howson & Picton (1997); that for lichens follows Purvis *et al.* (1992), and that for higher plants follows Stace (1991).

A map assembled with aid of interpretation on a Geographical Information System, illustrates the distribution of the main biotopes and biotope complexes within the area; some mapped areas represent more than one biotope.

NOTE: The biotopes maps give an indication of the *likely* distribution and extent of biotopes and biotope complexes, based on the data available, including sketch maps of biotope

distribution made at the time of survey, cited literature and information on Admiralty charts. In some areas data are sparse, and additional data or more comprehensive survey would enable more accurate maps to be drawn.

Nature conservation

A summary of statutory and non-statutory wildlife and landscape conservation designations for the marine and coastal parts of the area is given (from Barne *et al.* 1997, where further information on the types of designation can be found, and Scottish Natural Heritage information).

Key to abbreviations used: (c = candidate; p = proposed):

ASV	Area of Scenic Value (Regional Landscape Designation)
GCR	Geological Conservation Review site
LNR	Local Nature Reserve
MoD	Ministry of Defence
NCR	Nature Conservation Review site
NSA	National Scenic Area
Ramsar	Ramsar site
RSPB	Royal Society for the Protection of Birds nature reserve
SAC	Special Area of Conservation
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest

Human influences

This section describes the main uses of and activities in the area, including urbanisation, industrial or commercial activities that have (or potentially have) an impact on the area. These can include sewage discharges, industrial effluent, development, dredging, spoil-dumping, fishing, aquaculture, recreation and shipping. Although as accurate as possible at the time of writing, readers should be aware that further developments, particularly improvements to sewage treatment and disposal, and changes in the number and location of mariculture installations, are likely to have occurred since then. Further details of human influences are given in Barne *et al.* (1997) and, for aquaculture, La Tene Maps (1999).

References and further reading

A list of cited references and other relevant literature and information sources.

Sites surveyed

This lists the sites surveyed within the area from the surveys shown in Table 1, with additional information on the location of each site (OS grid reference and latitude/longitude), and an inventory of biotopes known to be present at the time of survey.

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Field surveyors for MNCR and Seasearch surveys (JNCC unless otherwise stated):

Colin Adams (Scottish Natural Heritage)
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David Connor
Victoria Copley (*Seasearch* surveyor)
Roger Covey
Matt Dalkin
Jon Davies (University of Newcastle-upon-Tyne)
David Donnan (Scottish Natural Heritage)
Frank Fortune
Terry Goldie (*Seasearch* surveyor)
Jason Hall-Spencer (University Marine Biological Station, Millport)
Melanie Harding (*Seasearch* surveyor)
Tim Hill
Keith Hiscock
Christine Howson (Independent)
Lucy Kay (*Seasearch* surveyor)
Paul Kay (*Seasearch* surveyor)
Jenny Mallinson (*Seasearch* surveyor)
Scot Mathieson (Scottish Natural Heritage)
Charlie Morgan (*Seasearch* surveyor)
Jim Munford (Scottish Natural Heritage)
Eleanor Murray
Dora Nichols
Kate Northen
Ian Reach
Dale Rostron (SubSea Services)
Bill Sanderson
Graham Saunders (*Seasearch* surveyor)
Sue Scott (Independent)
Alison Skene (Scottish Natural Heritage)
Simon Teague (*Seasearch* surveyor)
Peter Tinsley (*Seasearch* surveyor)
Dave Trimble (*Seasearch* surveyor)
Darren Williams (*Seasearch* surveyor)
Sarah Williamson (*Seasearch* surveyor)
Mark Woombs (*Seasearch* surveyor)
Angel Williams (*Seasearch* surveyor)

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1 South Sanday

Location		
Position (centre)	HY 71 38	59°14'N 02°30'W
Administrative area	Orkney Islands	
Conservation agency/area	Scottish Natural Heritage	North Areas (Northern Isles)

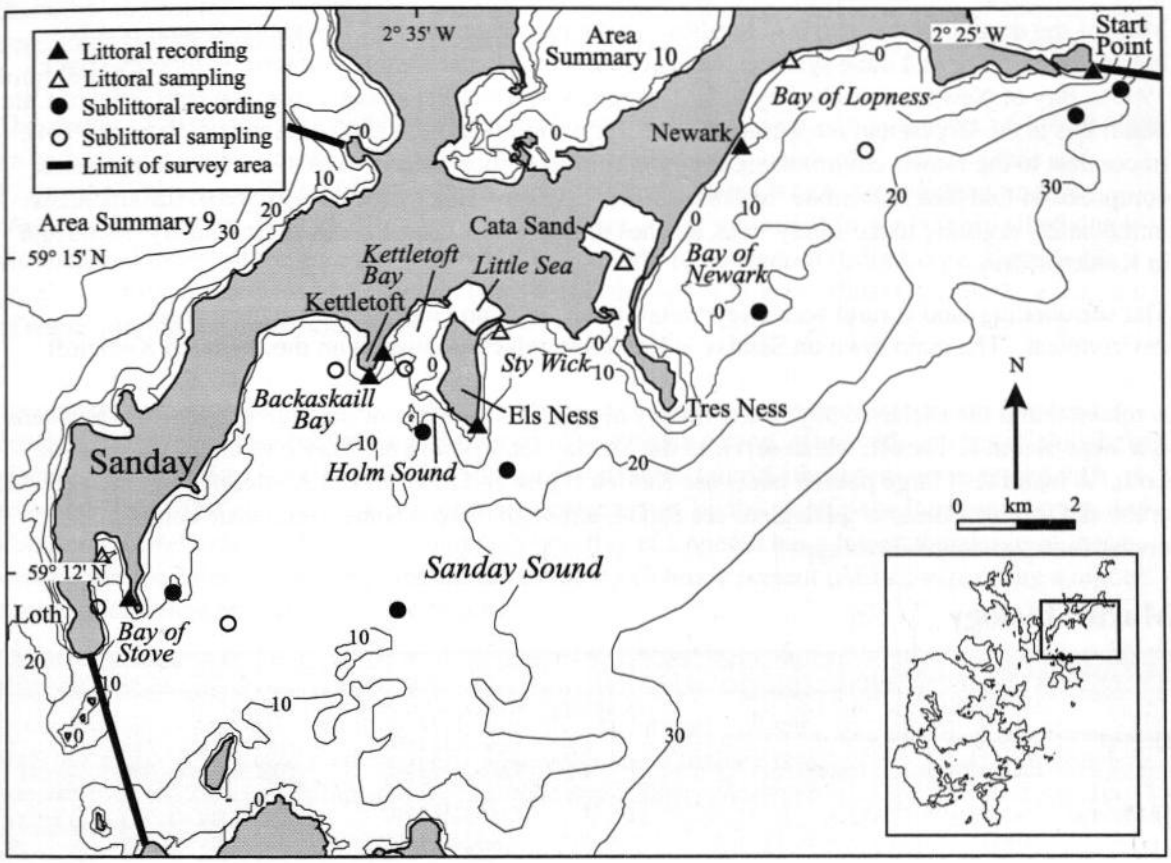

Figure 1.1 Main features of the area, showing sites surveyed.

Physical features	
Physiographic type	Linear coast with embayments.
Length of coast	53 km
Bathymetry	South Sanday comprises large shallow embayments of less then 10 m depth and most of Sanday Sound has depths of less than 20 m. The 30 m contour comes within 1 km of the coast at Start Point, although it is generally 5 km offshore for the majority of the area. There are two large intertidal embayments of Cata Sand and the Little Sea.
Wave exposure	The coast is open to the south-east, but is afforded some shelter by the offshore shallows and the complicated coastline; consequently, the open coast is generally exposed or moderately exposed to wave action. The embayments of Cata Sand and the Little Sea are almost completely enclosed and are therefore very sheltered from wave action.
Tidal streams	Strong to moderately strong in Sanday Sound; negligible on the open coast.
Tidal range	3.5 m (mean springs); 1.6 m (mean neaps)
Salinity	Fully marine

Introduction

Sanday is a large island in the north-east of the Orkney archipelago. It is a low-lying island with the highest point being 65 m above sea level. The south of the island comprises large, sweeping sandy bays interspersed with rocky headlands. There are two large inlets sheltered behind the headlands of Tres Ness and Els Ness, which comprise large extents of intertidal sediment very sheltered from wave action. With the exception of these embayments, wave exposure is generally exposed to moderately exposed. The western end of Sanday Sound and waters around Start Point experience strong tidal streams; the open coast between these areas has negligible tidal movement. Water quality is excellent and sea temperatures average 7°C in winter and 14°C in summer (Lee & Ramster 1981).

Most of the south of the island is of sand-blown deposits characterised by extensive sand beaches backed by machair and dune systems, which contain the largest area of saltmarsh in Orkney (Buck 1993). Bay of Newark is backed by a dune-capped spit which separates it from the large inlet of Cata Sand; this is the largest and most complex beach system in Orkney (Mather, Smith & Ritchie 1974). In contrast to the littoral environment, the sublittoral is predominantly extensive bedrock platforms, composed of Old Red Sandstone (Mykura 1975). Sublittoral sediment is restricted to inshore areas immediately adjacent to the sandy bays, patches of tide-swept coarse sediment in Sanday Sound and in Kettletoft Bay.

The surrounding land is rural with a few minor roads, with no large impact on the marine environment. The main town on Sanday is Kettletoft, which is situated on the sheltered Kettletoft Bay, opposite to the entrance of the Little Sea. The population is less than 100, and although sewage is released into the sheltered bay, water quality appears to be excellent (E. Murray, pers. obs.). There is a large pier at Kettletoft, which serviced the Sanday ferry before the Ro-Ro terminal was built at Loth. A handful of large potting boats use Kettletoft pier and moorings in Kettletoft Bay; mainly crabs and lobster *Homarus gammarus* are fished, although there is some small-scale commercial diving for razor clams *Ensis* spp.

Marine biology

Marine biological surveys

	Survey methods	*No. of sites*	*Date(s) of survey*	*Source*
Littoral	Recording (epibiota)	6	June-July 1997	MNCR survey 680
	Infaunal sampling (cores)	4	June-July 1997	MNCR survey 680
Sublittoral	Recording (epibiota)	7	June-July 1997	MNCR survey 681
	Infaunal sampling (cores)	5	June-July 1997	MNCR survey 681

Littoral

Littoral habitats on the south side of Sanday comprise moderately exposed, rugged rocky headlands, interspersed with long bays of coarse sand. There are large sheltered inlets of the Little Sea and Cata Sand, which are predominantly intertidal, comprising stable fine sand. There are some areas of cobble and shingle shores at the entrance to the Little Sea, and in Kettletoft Bay. The Bay of Stove at the south-west end of the island comprises two very long, protruding headlands which act as a wave trap for the shore of fine sediment which is over 1 km^2 in littoral extent.

South and east-facing rocky headlands are essentially similar in community composition throughout the area. Ridged bedrock platforms form the eulittoral, with broken shingle on the upper shore, backed by low-lying grazing land. The mobile upper shore substrata restricts the development of lichen communities; yellow, grey and black lichens occur patchily throughout the area (YG; Ver.Ver). The expanse of bedrock on the shore provides localised shelter for the upper shore which consequently supports sparse fucoids *Pelvetia canaliculata* (Pel) and *Fucus spiralis* (Fspi). The mid-shore is moderately exposed to wave action and is characterised by barnacles *Semibalanus balanoides* and limpets *Patella vulgata* (BPat.Sem), or often as a mosaic of limpets, barnacles and bladder wrack *Fucus vesiculosus* (FvesB). Start Point, the easternmost point of Sanday, is exposed to wave action and the mid-shore is characterised by a mosaic of limpets, barnacles and *F. vesiculosus* var. *linearis*

(BPat.Fvesl), a morph of the fucoid characteristic of increased wave exposure (Fletcher 1987). The lower eulittoral is exposed to wave action and comprises mosaics of red algae (XR), often with serrated wrack *Fucus serratus* (Fser.R) or dense swathes of thongweed *Himanthalia elongata* (Him). Sublittoral fringe biotopes are generally characteristic of moderately exposed conditions with kelp *Laminaria digitata*, red algae and encrusting coralline algae (Ldig.Ldig). Sublittoral fringe biotopes at Start Point are dominated by *L. digitata* and dabberlocks *Alaria esculenta*, the latter being characteristic of the more wave-exposed conditions (Ala.Ldig).

The rugosity of the shores provide conditions for large numbers of rockpools to occur. Most mid-shores have deep rockpools rich in algal species, including fucoids and kelps (FK). Some pools are floored with cobbles and sand, which are still rich in algae, although a different suite of species occur, dominated by more scour-tolerant algae such as *Laminaria saccharina*, *Chorda filum* and *Halidrys siliquosa* (SwSed).

The shelter of Kettletoft Bay and Bay of Stove allows the development of a lush cover of fucoid algae on bedrock and cobble shores. The upper shore comprises narrow bands of *P. canaliculata* and *F. spiralis* (Pel; Fspi). The mid-shore has a dense cover of knotted wrack *Ascophyllum nodosum* (Asc.Asc) and the lower shore of *F. serratus* (Fser.Fser). The sublittoral fringe is fairly silted due to the sheltered nature of the area and supports the cape form of *L. digitata* (Ldig.Ldig). Despite the proximity of the settlement of Kettletoft, there was little sign of human influence, with the exception of some litter on the upper shores.

Littoral sediments on south Sanday comprise contrasting wave-exposed coarse sand beaches on the open coast, and very stable, wave-sheltered sediments of the Little Sea and Cata Sand. Exposed beaches in Sty Wick and Bay of Lopness are of coarse, rippled sand, often with patches of shingle in places. The strandline is of cobbles and soft sand with some talitrid amphipods amongst the drift seaweed (Tal). The mid- and lower shores are characterised by the amphipods *Bathyporeia* spp. and *Pontocrates arenarius* (AP.Pon); the mid-shore on Bay of Lopness has a lesser abundance of these species and the robust burrowing amphipod *Eurydice pulchra* is present (AEur), suggesting a higher degree of drainage on that part of the beach.

Sheltered sediment in the upper parts of the Bay of Stove and throughout the large littoral extent of Cata Sand is of fine, stable sand covered with an algal mat. The sediment has a good deal of standing water (probably freshwater from the high rainfall experienced), reducing the salinity in the area. This shift in salinity is reflected by the infauna which comprises high densities of the polychaete *Fabricia sabella* and oligochaetes, dominated by *Capitella* spp., *Heterochaeta costata* and *Tubificoides* spp. (HedMac; HedMac.Are).

Sublittoral

Inshore sublittoral habitats to the south of Sanday comprise bedrock reefs adjacent to the rocky headlands and extents of fine sediment adjacent to the large sand beaches. At Start Point, the rock is much more folded, and deep gullies are fashioned into the shallow sublittoral. Offshore, the sea bed is level bedrock platforms at ca. 20 m depth.

Kelp forests in the shallow sublittoral are rich in red algae. The kelp *Laminaria hyperborea* is very dense, with stipes heavily epiphytised by red algae, including *Ptilota gunneri*, *Callophyllis laciniata*, *Heterosiphonia plumosa* and the ascidians *Aplidium punctum* and *Botryllus schlosseri* (LhypR.Ft). The rock surfaces are generally free of silt and covered with encrusting red and brown algae, over which grows a turf of red algae dominated by *Plocamium cartilagineum* and *Odonthalia dentata*. Vertical faces are covered with the breadcrumb sponge *Halichondria panicea* and the ascidian *Dendrodoa grossularia*, and crevices in the vertical faces provide refugia for crabs and brittlestars. At Start Point there are large gullies throughout the kelp forest, with vertical walls dominated by encrusting sponges including *Clathrina coriacea*, and *D. grossularia* (SCAs.DenCla).

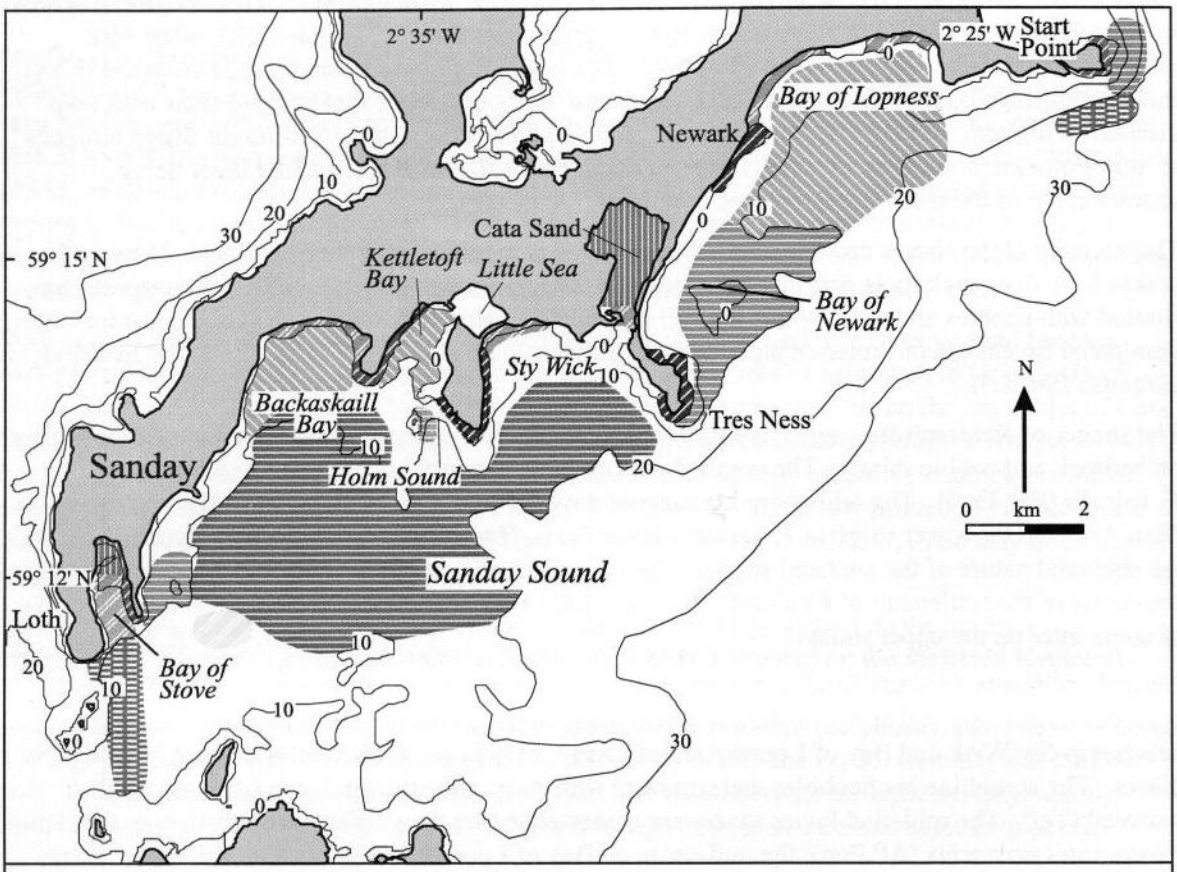

Figure 1.2 Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 1.1, cited literature and additional field observations).

In the relative shelter of Holm Sound the kelp forest is a mixture of *L. hyperborea* and *Laminaria saccharina,* with some *Chorda filum* between (LhypLsac.Ft). Cobble and pebble areas amongst the kelp forest are interspersed with pockets of sand and covered with a thick layer of silt, supporting scour-tolerant algae such as *Ahnfeltia plicata* and *Dilsea carnosa.*

Offshore bedrock platforms are also heavily-silted and support a sparse kelp forest of *L. hyperborea* with small amounts of *L. saccharina* (Lhyp.Ft). Although the kelp is abundant, the plants are fairly small and gave an impression of a more 'open' forest. Similarly to the inshore sites, kelp stipes are heavily epiphytised by red algae and ascidians. The silted bedrock supports robust red foliose algae such as *O. dentata*, *Delesseria sanguinea* and *Kallymenia reniformis*. An area just south of Start Point is subject to increased tidal streams, and resembles kelp forest more typical of North Ronaldsay Sound, with a dense carpet of mussels *Musculus discors* covering the rock (Lhyp.TFt). Other filter-feeding organisms such as the featherstar *Antedon bifida* and erect hydroids and bryozoans are conspicuous.

Tide-swept sediment at 16 m at the western entrance to Sanday Sound consists of dead maerl, empty shells and coarse sediment. Infauna comprises sparse polychaetes and large burrowing bivalves, including *Ensis arcuatus*, *Clausinella fasciata* and *Paphia rhomboides* (Ven). Although adjacent to exposed sand shores, shallow sediment is fine and fairly stable; fine sand in Backaskaill Bay supports sparse *Zostera marina*. Infaunal communities on the open coast are similar to those found in the shallow sheltered sediment in the middle of Kettletoft Bay and comprise sparse polychaetes and amphipods and *Ensis* spp. (EcorEns).

Nature conservation

Conservation sites

Site name	*Status*	*Main features*
Sanday	cSAC	Common seals *Phoca vitulina*
East Sanday Coast	SPA; Ramsar; SSSI	Ornithological; botanical; common seals *Phoca vitulina*
Central Sanday	SSSI; GCR	Geological/geomorphological; botanical; ornithological

Human influences

Coastal developments and uses

The coast of south Sanday is relatively undeveloped, with the village of Kettletoft being the main settlement. There is a small pier, and moorings for a small-scale fishing fleet with no other coastal development. There are small sewage outfalls but in general, water quality is excellent, and except for some litter on the upper shore, there is little sign of human influence.

The wreck of a German destroyer which ran aground in 1919 can be seen at low water mark in the Bay of Lopness.

Marine developments and uses

There is a small-scale fishing fleet based in Kettletoft, mainly potting for lobster *Homarus gammarus* and crab on the rocky skerries throughout the area. There is a small-scale diving operation for razor clams *Ensis* spp.

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Sites surveyed

Survey 680: 1997 MNCR littoral survey of Sanday (MNCR, unpublished data).
Survey 681: 1997 MNCR sublittoral survey of Sanday (MNCR, unpublished data).

Littoral sites

Survey	*Site*	*Place*	*Grid reference*	*Latitude/longitude*	*Biotopes recorded*
680	8	Kettletoft Hotel, South Sanday.	HY 659 386	59°13.9'N 02°35.8'W	Fspi; Asc.Asc; Fser.Fser; Lsac.Ldig
680	9	Bea Ness, Kettletoft, South Sanday.	HY 657 382	59°13.7'N 02°36.0'W	YG; Ver.Ver; Pel; Fspi; Asc.Asc; Fser.Fser; Ldig.Ldig
680	10	Cata Sand, South Sanday.	HY 702 402	59°14.8'N 02°31.3'W	AP.P; HedMac; HedMac.Are
680	11	Long Taing of Newark, South Sanday.	HY 723 423	59°16.0'N 02°29.1'W	Pel; Fspi; BPat.Sem; XR; Fser.Fser; SwSed; Ldig.Ldig; Lsac.Ft
680	13	Start Point, South Sanday.	HY 788 434	59°16.6'N 02°22.3'W	YG; Ver.Por; Pra; Pel; Fspi; BPat.Fvesl; Him; Cor; FK; Ala.Ldig
680	17	W Hacks Ness, Bay of Stove, South Sanday.	HY 615 344	59°11.7'N 02°40.4'W	Fspi; Asc.Asc; Fser.Fser; SwSed
680	18	Bay of Stove, South Sanday.	HY 610 350	59°12.0'N 02°40.9'W	AP.P; Ol
680	21	SE Els Ness, South Sanday.	HY 676 373	59°13.2'N 02°34.0'W	Pel; Ver.Ver; Fspi; FvesB; Fser.R; Cor; SwSed; Ldig.Ldig
680	22	Sty Wick, South Sanday.	HY 680 390	59°14.2'N 02°33.6'W	Tal; AP.Pon
680	23	Bay of Lopness, South Sanday.	HY 745 422	59°15.9'N 02°26.8'W	AEur; AP.Pon

Sublittoral sites

Survey	*Site*	*Place*	*Grid reference*	*Latitude/longitude*	*Biotopes recorded*
681	4	Bay of Stove, South Sanday.	HY 609 341	59°11.5'N 02°41.0'W	FaS
681	15	Dennis Skerry, South Sanday.	HY 623 345	59°11.7'N 02°39.5'W	LhypR.Ft
681	16	Holm Sound, South Sanday.	HY 666 372	59°13.2'N 02°35.1'W	LhypLsac.Ft
681	17	Start Point, South Sanday.	HY 789 433	59°16.5'N 02°22.1'W	Ala.Myt; LhypR.Ft; SCAs.DenCla
681	19	Backaskaill Bay, South Sanday.	HY 650 382	59°13.8'N 02°36.7'W	EcorEns
681	20	Kettletoft Bay, South Sanday.	HY 663 383	59°13.8'N 02°35.4'W	EcorEns
681	21	West Sanday Sound, South Sanday.	HY 631 339	59°11.4'N 02°38.7'W	Ven
681	22	Mid Sanday Sound, South Sanday.	HY 661 340	59°11.5'N 02°35.5'W	Lhyp.Ft
681	23	Bay of Lopness, South Sanday.	HY 738 441	59°17.0'N 02°27.4'W	EcorEns
681	24	Baa Gruna, South Sanday.	HY 725 393	59°14.4'N 02°28.8'W	LhypR.Ft
681	41	S of Start Point, South Sanday.	HY 780 428	59°16.2'N 02°23.1'W	Lhyp.TFt
681	43	E of Fosky Reef, South Sanday.	HY 680 366	59°12.9'N 02°33.5'W	Lhyp.Ft

Compiled by: Eleanor Murray

2 Deer Sound

Location		
Position (centre)	HY 54 08	59°57'N 02°48'W
Administrative area	Orkney Islands	
Conservation agency area	Scottish Natural Heritage	North Areas (Northern Isles)

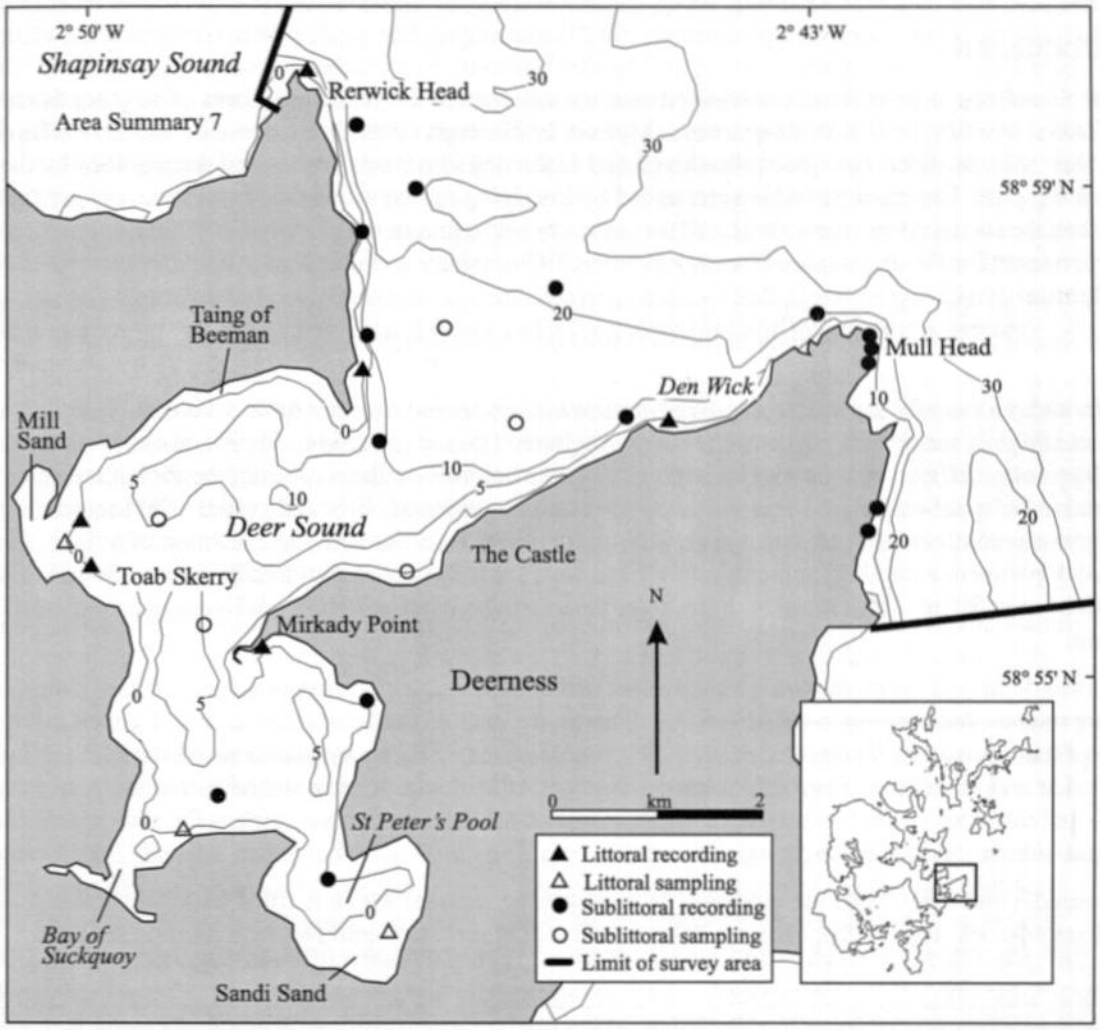


Figure 2.1 Main features of the area, showing sites surveyed.

Physical features	
Physiographic type	Embayment
Length of coast	36 km
Area of inlet	23 km^2
Bathymetry	The outer part of the embayment ranges from 10 to 30 m with the 10 m contour running close to the coastline. The inner part of the embayment is less than 10 m in depth with the exception of a few small areas in the centre of the embayment. There are extensive intertidal areas at St Peter's Pool and Bay of Suckquoy.
Wave exposure	Exposed on the outer headlands to very sheltered in St Peter's Pool
Tidal streams	Moderately strong in the outer basin to negligible in the inner basin.
Tidal range	2.6 m (mean springs); 1.2 m (mean neaps)
Salinity	Fully marine

Introduction

Deer Sound is a large embayment situated near the eastern tip of Orkney Mainland. The outer Sound is flanked by cliffs of Old Red Sandstone (Mykura 1975): high cliffs on the east side and low cliffs on the west side; the latter have been weathered and fashioned into stacks, caves and deep gullies by the pounding seas. The inner Sound is surrounded by low-lying agricultural land. Tidal streams vary from moderately strong across the entrance to the sound to negligible in the inner basin of the sound. Sea temperatures for the east coast of Orkney average 7°C in winter and reach up to 14°C in summer (Lee & Ramster 1981).

Deer Sound comprises three main basins: a deep, outer basin which has a northerly aspect and is exposed to strong wave action, due to deep water inshore with no offshore obstructions; a middle basin with an easterly aspect and sheltered from wave action and an inner basin with a northerly aspect which is restricted by narrows and very sheltered from wave action. Shores of outer basin are of steep rock cliffs on the east and low-lying stepped platforms on the west side; the rock platforms extend into the sublittoral and shelve steeply to 10 m as a series of cliffs and gullies. Sublittoral habitats are dominated by sediment at depths ranging from 10-30 m with the exception of a flat bedrock platform extending approximately 1 km west from Rerwick Head into Shapinsay Sound to a depth of over 30 m. Tidal streams in the outer basin around Mull and Rerwick Heads are moderately strong.

The middle basin is very shallow and sediment dominated, with depths ranging from 10 m in the centre to less than 1 m depth off Mill Sand. There is an area of sand-scoured rocky reef on the north side of the basin at the Taing of Beeman. Shores are of low-lying rocky platforms on the north and west side and of steep, stepped platforms on the east. At Mirkady Point, a spit of barren shingle has mid- and lower shores subject to weak tidal streams. Mill Sand on the west side is the only extent of littoral sediment in this basin.

The middle and inner basin are separated by a deepening channel which is filled with very stable mud; tidal streams are weak in this channel. The inner basin is separated into two by a narrow, shallower channel, although tidal streams through both these channels are negligible. The inner basin is very shallow, with a maximum depth of 4 m and is predominantly stable mud with a large rocky outcrop in the middle of the basin. Shores are dominated by banks of stable cobbles; the southern shore is sediment-dominated with a small muddy inlet experiencing freshwater input in the Bay of Suckquoy and a large expanse of fine sand at Sandi Sand.

The area surrounding Deer Sound is sparsely populated and the land is mainly used for grazing. There appear to be few anthropogenic impacts on marine communities in the Sound.

Marine biology

Marine biological surveys				
	Survey methods	*No. of sites*	*Date(s) of survey*	*Source*
Littoral	Recording (epibiota)	6	August 1996	MNCR survey no. 442
	Infaunal sampling (cores)	3	August 1996	MNCR survey no. 442
Sublittoral	Recording (epibiota)	16	July 1996	MNCR survey no. 446
	Infaunal sampling (cores)	5	July 1996	MNCR survey no. 446

Littoral

Shores in the outer basin comprise steep, stepped bedrock exposed to wave action. Supralittoral habitats are characterised by yellow and grey lichens (YG); littoral fringe habitats have a dense cover of the black lichen *Verrucaria maura* with littorinid molluscs in crevices, particularly *Melarhaphe neritoides*, a species characteristic of wave-exposed conditions (Ver.Ver). Mid-shore biotopes comprise a mosaic of barnacles, limpets and bladder wrack *Fucus vesiculosus* (FvesB) with *F. vesiculosus* var. *linearis* present on the headlands at either side of the entrance to the sound (BPat.Fvesl). Lower shore biotopes comprise dense swathes of thongweed *Himanthalia elongata* with a dense turf of red algae and *Leathesia difformis* beneath (Him). At Rerwick Head, where the rugged bedrock platforms are more wave-exposed, a turf of red algae dominated by *Mastocarpus stellatus* and *Corallina officinalis* occurs beneath the *Himanthalia*. Sublittoral fringe communities have a mixture of the kelps *Laminaria digitata* and *Alaria esculenta*, the latter being a species characteristic of strong wave action (Ala.Ldig).

The complex coastline on the west side of the embayment provides some areas of shelter from wave action. These areas of stepped bedrock have a dense growth of fucoid algae throughout the eulittoral with channelled wrack *Pelvetia canaliculata* and spiral wrack *Fucus spiralis* characterising the upper shore biotopes (Pel, Fspi). Horizontal surfaces in the mid-eulittoral have a dense covering of knotted wrack *Ascophyllum nodosum* (Asc.Asc) and lower eulittoral biotopes are characterised by serrated wrack *Fucus serratus* (Fser.Fser).

Rocky habitats in the middle and inner basins comprise level shores of broken bedrock and stable boulders and cobbles. The substrata as a whole are fairly silted due to the sheltered nature of the inlet, and species richness is generally poor. The shores are backed by low-lying grazing land and the supralittoral zone is of mobile shingle with lichen communities absent due to the mobility of the substrata. Upper shore biotopes comprise sparse clumps of *P. canaliculata* and *F. spiralis* (Pel, Fspi) with some *V. maura* encrusting the rock beneath. Mid-shore biotopes have a dense cover of *A. nodosum* or *F. vesiculosus* or a mixture of the two algae. The understorey is fairly silted and impoverished, the rock encrusted with *Verrucaria* spp. and the red alga *Rhodothamniella* sp. binding sediment to the rock in places (Asc.Asc, Fves). There are large numbers of the flat periwinkles *Littorina obtusata/mariae* amongst the algae. Lower shore habitats here are subject to scour and silting and are species-poor with a dense cover of *F. serratus* (Fser.Fser). At Toab Skerry and Mill Sand sheltered lower shore areas with silted boulders and some standing water have a dense canopy of ephemeral algae and scour-tolerant algae. The main cover species are kelps *Laminaria digitata* and *Laminaria saccharina*, *Trailliella intricata* and *L. difformis*, with *Chorda filum* and *Codium* sp. scattered throughout (Lsac.Ldig). Mixed shores are stable enough to support similar communities of dense fucoid algae (AscX, FserX).

Littoral sediment in the middle and inner basin is of muddy fine sand with dense lugworms *Arenicola marina* (MacAre). The lower shore at Mill Sand and Sandi Sand has a dense population of cockles *Cerastoderma edule* (PCer). The extreme low shore sand at Sandi Sand has a turf of *Zostera marina* and *C. filum* (Zmar); this biotope extends offshore and occurs in most of the sublittoral in St Peter's Pool.

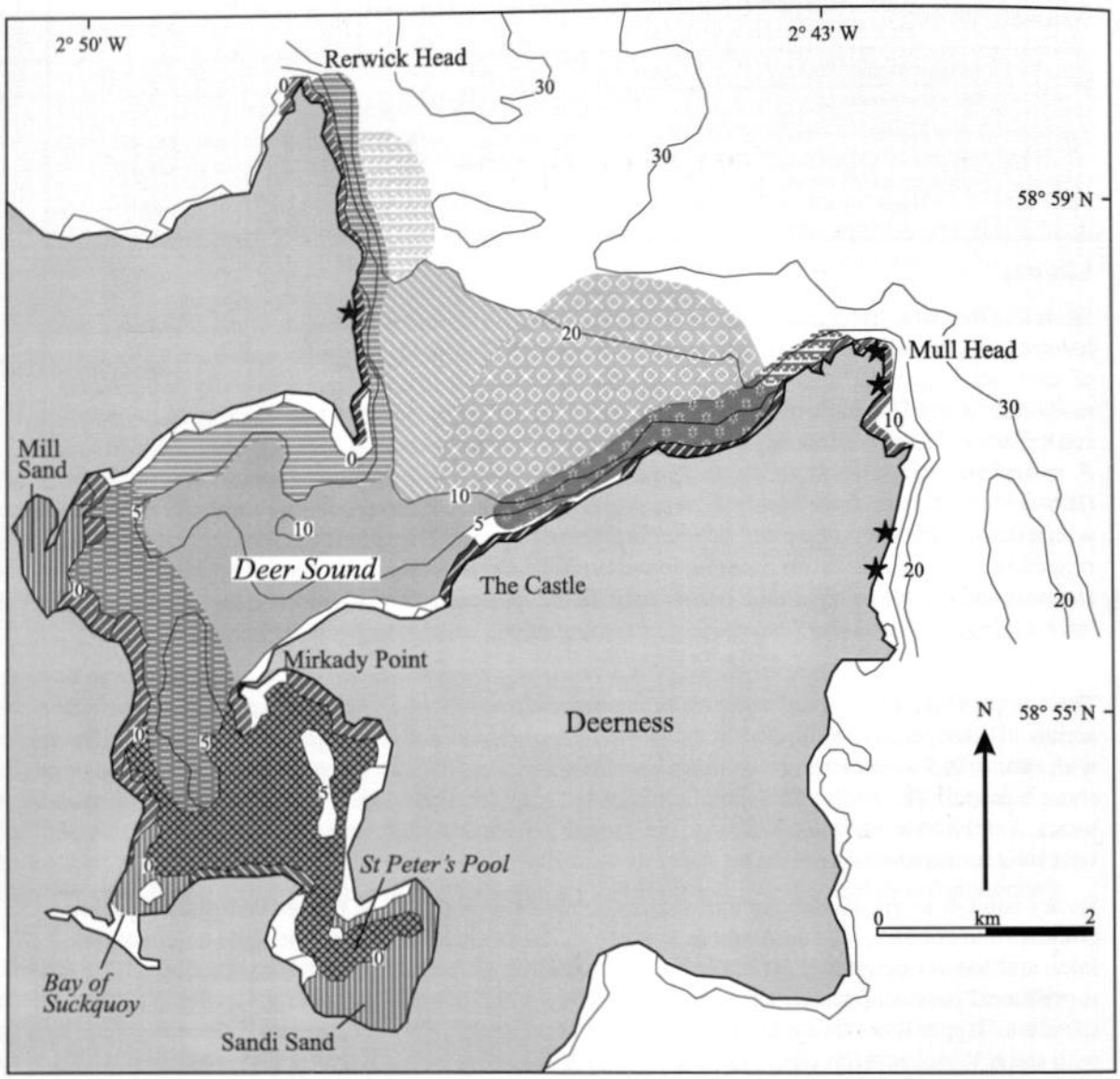
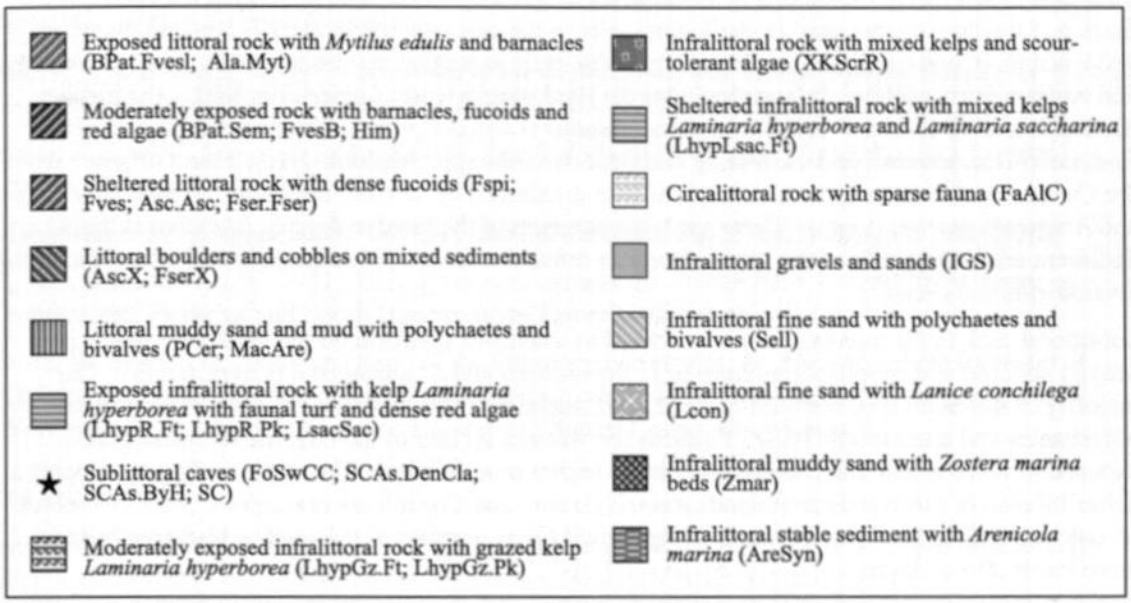


Figure 2.2 Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 2.1, cited literature and additional field observations). (Key to biotopes symbols on next page.)

Sublittoral

Most sublittoral rock communities in Deer Sound are subject to some sediment influence. Kelp forests contain a mixture of ephemeral and scour-tolerant algae, particularly *Laminaria saccharina* and *Saccorhiza polyschides*, and robust red and brown algae in the understorey.

The coastline of the outer basin comprises steeply-shelving bedrock and boulders from the sublittoral fringe to 10 m depth. The west side of the basin is exposed to wave action and kelp forests are rich in red algae, and in places have large amounts of *S. polyschides*, which is often characteristic of wave-exposed conditions (LhypR.Ft, LsacSac). The eastern side of the basin has coarse sediment fairly close inshore, which, combined with strong wave action during storms provides scoured conditions on the infralittoral rock. These areas have mixed kelp forests of *Laminaria hyperborea*, *L. saccharina* and *S. polyschides* (XKScrR) with an understorey of red algae, particularly *Trailliella intricata* and the brown algae *Desmarestia* spp. covering the rock, all fast-growing opportunistic species (Dixon & Irvine 1977; Fletcher 1987). Areas adjacent to the sediment have red algal crusts and the barnacle



Balanus crenatus encrusting the rock; small vertical faces have a cover of polyclinid ascidians and the ascidian *Clavelina lepadiformis*. Dahlia anemones *Urticina felina* occur in crevices, and sponges, especially *Leucosolenia complicata* and breadcrumb sponge *Halichondria panicea*, encrust kelp stipes. Large vertical faces in the upper infralittoral have a dense turf of ascidians, sponges and bryozoans. The faunal turf is dominated by *C. lepadiformis* with a variety of sponges and bryozoans, particularly *Scrupocellaria scruposa*, beneath. The rock is encrusted with *B. crenatus* and coralline algal crusts.

Stepped bedrock platforms extending offshore from Rerwick Head are subject to moderate tidal streams and sand-scour. Vertical faces have a dense cover of dead-man's fingers *Alcyonium digitatum* with the keel worm *Pomatoceros triqueter* and *B. crenatus* encrusting the rock beneath (AlcByH). The horizontal surfaces are largely devoid of any fauna and are covered with red algal crusts; *U. felina*, featherstars *Antedon bifida* and brittlestars *Ophiothrix fragilis* are restricted to the crevices (FaAlC).

Caves have formed in the cliffs on the west coast of Deer Sound, and just outside the embayment on the east side of Deerness. Some of these caves are extensive and up to 15 m in depth, the cave ceilings all being exposed to the air. The vertical faces in the sublittoral fringe are subjected to some wave action and their biotopes resemble those of surge gullies, characterised by anemones and ascidians. The main community on vertical faces is a dense cover of the ascidian *Dendrodoa grossularia*. This was often associated with the sponge *Clathrina coriacea*, although in some areas *Dendrodoa* has an almost exclusive association with the sponge *Leucosolenia complicata* (SCAs.DenCla). Areas of rock not covered by *Dendrodoa* have a dense cover of sponges, particularly the encrusting sponges *Halisarca dujardini*, *H. panicea* and the cave-dwelling white form of elephant's hide sponge *Pachymatisma johnstonia*. There are occasional large specimens of the sponges *Scypha ciliata* and *Leuconia nivea*, both species characteristic of vertical cave surfaces (SC).

Areas of rock at the entrance to the caves have a reduced cover of *Dendrodoa* and an increased number of colonial ascidians, particularly *Diplosoma spongiforme* (SCAs.ByH). This biotope has a similar assemblage of sponges but experiences a higher degree of siltation (E. Murray, pers. obs.). Cave walls near the cave bottom and towards the back of the cave are subject to scour from cobbles and wave action. These walls support a very sparse encrusting fauna of *B. crenatus* and spirorbid worms (CC.BalPom) and are scoured clean in places.

Sublittoral sediment in the outer basin comprises coarse tide-swept sand at 30 m in the centre of the basin and medium coarse sand in shallower water to the east side where there is some shelter from wave action. Coarse sediment in the centre of the basin is heaped up into waves by tidal movement, and appears fairly mobile. Infauna includes the sand mason worm *Lanice conchilega*, the bivalve *Arctica islandica* and sand-eels *Ammodytes tobianus* (Lcon). Epifauna comprises sand gobies *Pomatoschistus minutus* and swimming crabs *Liocarcinus* spp. Medium-grained sand offshore from the Castle is stable and supports a richer infauna dominated by sabellid fanworms, *Lanice conchilega* and *Arenicola marina* (Lcon). There are large numbers of the bivalve *Arctica islandica* at this site. Sediment on the east side of the bay supports an infauna of errant polychaetes and bivalves, including *Spisula elliptica* (Sell).

Sublittoral rock in the middle basin is restricted to a bedrock platform on the north side which is heavily scoured and supports a mixture of *L. hyperborea* and *L. saccharina* (LhypLsac.Ft). The majority of the basin is of medium-grained sand, sheltered from wave action, with a fairly sparse polychaetes and amphipods (IGS). Towards the western section of the bay, the sediment is less exposed to wave action and consequently has a higher mud fraction. The stable sediments support a richer infauna of tubicolous amphipods *Ampelisca* spp. and *Corophium crassicorne*, and less robust bivalves including *Mysella bidentata*. Deeper mud in the narrows to the west of Mirkady Point is more stable and is covered in places by an algal mat. The sediment surface is very uneven, heaped up into very large mounds and casts by *Arenicola marina* and disturbed by the opisthobranch mollusc *Philine aperta* (AreSyn).

The inner basin and St Peter's Pool have muddy mixed sediment in the sublittoral. The sediment is very stable and there are large amounts of drift algae throughout the basin, blown in from the outer basins. The sediment has a very dense bed of eelgrass *Zostera marina* with sparse brown algae between (Zmar). The blades of the *Zostera* support ascidians *Ascidia mentula* and *Ascidiella aspersa*, and *Ciona intestinalis* is free-living on the mud between the plants.

Nature conservation

Conservation sites

Site name	*Status*	*Main features*
Den Wick	SSSI; GCR	Geomorphological.
Mull Head	LNR	Botanical; ornithological; geological

Human influences

Coastal development and uses

The coast surrounding the area is sparsely populated, the main land-use being livestock grazing. The middle and inner bays are used as anchorages for potting boats and there is a small jetty at the Hall of Tankerness. Domestic sewage is mainly deposited in septic tanks which may seep onto the shore, although few signs of enrichment or sewage were observed in the area, with the exception of the Bay of Suckquoy where some raw sewage is discharged.

Marine developments and uses

There is a small fishery in the area for cockles *Cerastoderma edule*, and potting for edible crabs *Cancer pagurus*, velvet swimming crabs *Necora puber*, and lobsters *Homarus gammarus*. There are licences for a mussel farm in the inner part of Deer Sound, and a scallop farm and a halibut *Hippoglossus hippoglossus* hatchery in its outer reaches (La Tene Maps 1999).

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Sites surveyed

Survey 442: 1996 MNCR littoral survey of Deer Sound and Wide Firth (MNCR, unpublished data).
Survey 446: 1996 MNCR sublittoral survey of Deer Sound (MNCR, unpublished data).

Littoral sites

Survey	*Site*	*Place*	*Grid reference*	*Latitude/longitude*	*Biotopes recorded*
442	3	Rerwick Point, Deer Sound.	HY 539 122	58°59.6'N 02°48.1'W	YG; Ver.Ver; BPat.Fvesl; Him; Cor; Ala.Myt; Ldig.Ldig
442	4	The Ness, Deer Sound.	HY 545 093	58°58.1'N 02°47.4'W	YG; Ver.Ver; Pel; Fspi; FvesB; Asc.Asc; Him; Fser.Fser; Ala.Ldig
442	7	Mirkady Point, Deer Sound.	HY 535 066	58°56.6'N 02°48.4'W	Fspi; Fves; Asc.Asc; FserX
442	8	Scarva Taing, Deer Sound.	HY 574 088	58°57.8'N 02°44.4'W	YG; Ver.Ver; Pel; BPat.Fvesl; Cor; Him; Ldig.Ldig
442	11	Toab Skerry, Deer Sound.	HY 520 074	58°57.0'N 02°50.0'W	Fspi; Asc.Asc; Ent; Fser.Fser; Ldig.Ldig; Lsac.Ldig
442	12	Mill Sand, Deer Sound.	HY 516 076	58°57.1'N 02°50.4'W	MacAre; PCer
442	13	Bay of Suckquoy, Deer Sound.	HY 527 048	58°55.6'N 02°49.3'W	AscX; MacAre; PCer; Ol
442	14	Mill Sand Bar, Deer Sound.	HY 518 077	58°57.2'N 02°50.2'W	Ver.Ver; Fspi; AscX; FserX; Lsac.Ldig
442	15	Sandi Sand, Deer Sound.	HY 547 038	58°55.1'N 02°47.2'W	MacAre; PCer

Sublittoral sites

Survey	*Site*	*Place*	*Grid reference*	*Latitude/longitude*	*Biotopes recorded*
446	1	Lea Taing, Deer Sound.	HY 546 105	58°58.8'N 02°47.3'W	LhypR.Pk; LsacSac; SCAs.ByH
446	2	The Ness, Deer Sound.	HY 546 087	58°57.8'N 02°47.3'W	LhypLsac.Ft; LsacChoR
446	3	E of Rerwick Head, Deer Sound.	HY 549 110	58°59.0'N 02°47.0'W	AlcByH; FaAlC
446	4	S of Rerwick Head, Deer Sound.	HY 544 116	58°59.4'N 02°47.6'W	LhypR.Ft; XKScrR; Bug
446	5	SW Taing of Barn, Deer Sound.	HY 549 072	58°57.0'N 02°47.0'W	IGS
446	6	Off Mill Sand, Deer Sound.	HY 525 077	58°57.3'N 02°49.5'W	AreSyn
446	7	The Gloup, Deer Sound.	HY 592 077	58°57.3'N 02°42.5'W	FoSwCC; SCAs.DenCla;
446	8	Cave S of the Gloup, Deer Sound.	HY 592 078	58°57.3'N 02°42.5'W	FoSwCC; SCAs.DenCla; CC.BalPom
446	9	NW of Braebuster, Deer Sound.	HY 544 060	58°56.3'N 02°47.4'W	Zmar
446	10	Peter's Pool, Deer Sound.	HY 541 043	58°55.4'N 02°47.8'W	Zmar
446	11	Cave S of Mull Head, Deer Sound.	HY 593 095	58°58.3'N 02°42.3'W	SCAs.DenCla; SCAs.ByH
446	12	Cave S of Chip of the Mull, Deer Sound.	HY 593 095	58°58.3'N 02°42.3'W	CC.BalPom; SCAs.DenCla; SC
446	13	Gully N of Howan Lickan, Deer Sound.	HY 592 093	58°58.2'N 02°42.4'W	FoSwCC; SCAs.DenCla; SCAs.ByH; SC
446	14	N of the Castle, Deer Sound.	HY 558 087	58°57.8'N 02°46.0'W	Lcon
446	15	2 km W of Den Wick, Deer Sound.	HY 552 096	58°58.3'N 02°46.6'W	Sell
446	16	N of Denwick Head, Deer Sound.	HY 570 087	58°57.8'N 02°44.8'W	XKScrR;
446	17	Mull Head, Deer Sound.	HY 588 098	58°58.4'N 02°42.9'W	LhypGz.Ft; LhypGz.Pk
446	18	Middle of the entrance to Deer Sound.	HY 563 101	58°58.5'N 02°45.5'W	Lcon
446	19	S of Lea Taing, Deer Sound.	HY 545 096	58°58.2'N 02°47.4'W	SCAs.DenCla; SCAs.ByH; Bug
446	20	W of Mirkady Point, Deer Sound.	HY 529 067	58°56.7'N 02°49.1'W	AreSyn
446	21	NW of the Point of Od, Deer Sound.	HY 530 050	58°55.8'N 02°48.9'W	Zmar

Compiled by: Eleanor Murray

3 Scapa Flow

Location		
Position (centre)	HY 40 00	58°53'N 03°03'W
Administrative area	Orkney Islands	
Conservation agency/area	Scottish Natural Heritage	North Areas (Northern Isles)

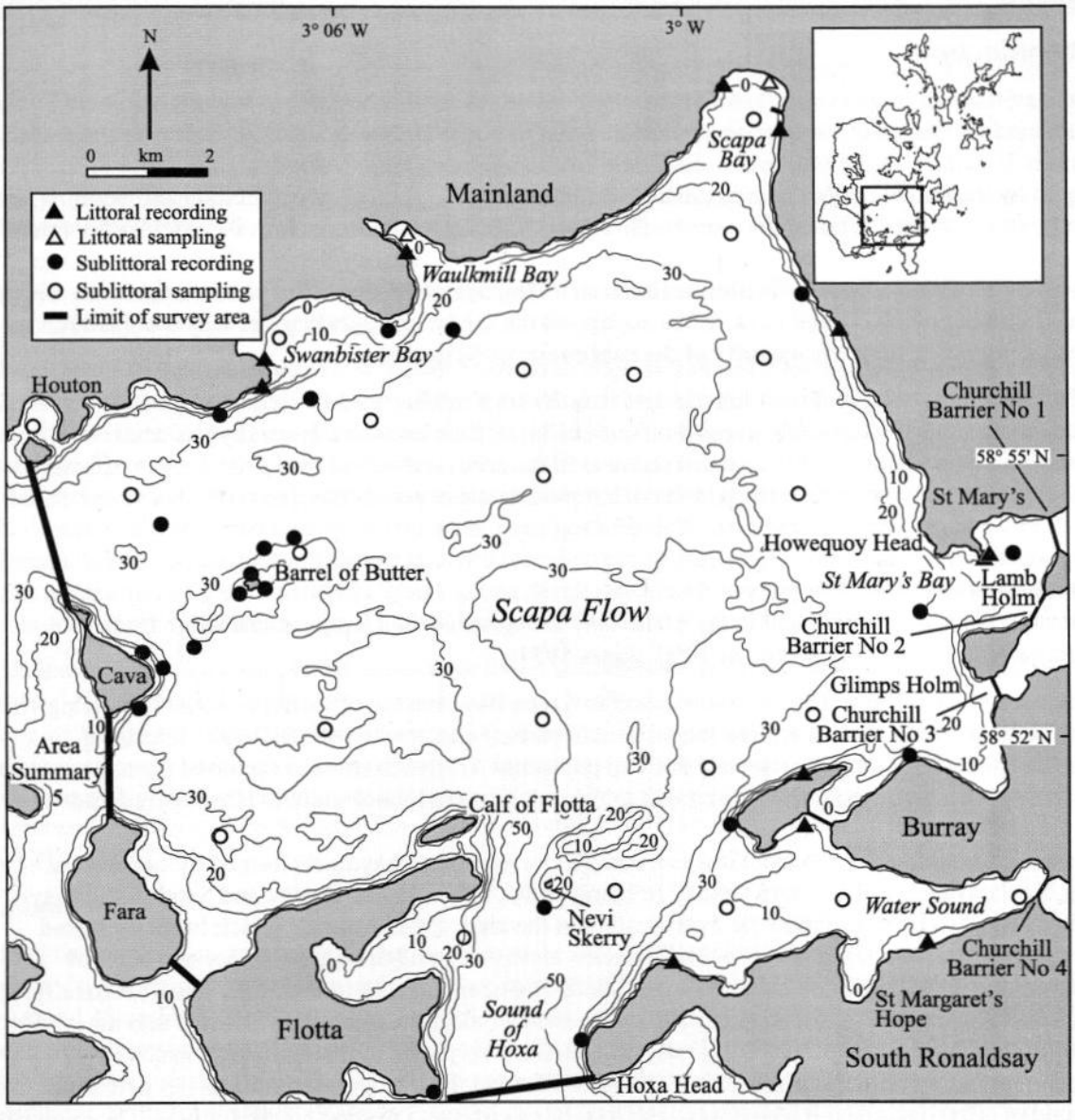


Figure 3.1 Main features of the area, showing sites surveyed.

Physical features	
Physiographic type	Embayment
Length of coast	92 km
Area of inlet	156 km^2
Bathymetry	The coastline shelves steeply to 20 m, then more gently to over 30 m in the majority of the Flow. The centre of the Flow is fairly level, punctuated by the steep-sided islets of the Barrel of Butter and Nevi Skerry. There are numerous embayments on the north and east sides of the Flow, which are less than 10 m deep.
Wave exposure	Moderately exposed to very sheltered
Tidal streams	Moderately strong in entrance and exit channels, negligible within basin
Tidal range	3.2 m (mean springs) 1.2 (mean neaps)
Salinity	Fully marine

Introduction

Scapa Flow is a large marine basin located in the south of the Orkney archipelago. It is formed by the surrounding islands of Hoy to the west, Mainland Orkney to the north and east, Burray to the east and South Ronaldsay and Flotta to the south. It is connected to the open water of the Pentland Firth to the south by the Sound of Hoxa, and smaller sounds between Hoy and Flotta and Flotta and South Walls, and to the Atlantic Ocean to the west by Hoy Sound. The original channels to the north and south of Burray are blocked by the Churchill Barriers, causeways which carry the A961 road. The coastline consists of Middle Old Red Sandstone (Mykura 1976), heavily contorted in places and broken with a small number of sand-filled bays. In the sublittoral the sandstone quickly gives way to mixed sandy sediments which form the majority of the substratum of Scapa Flow.

The fetch over the basin is restricted to less than 20 km in all but a small section of the northern shore which is exposed to the south across the Pentland Firth. This leads to a generally sheltered environment with moderately exposed sections in the north and east of the basin. However, severe winds cause a severe surface chop, reflected in more wave-exposed biotopes on the shore compared with those in the shallow sublittoral. The tidal regime was modified by the closing of the eastern passages during World War II, restricting the water flow within the north-east section. Water enters and exits Scapa Flow through Hoy Sound and the Sound of Hoxa with moderately strong surface tidal streams. Water movement within the basin itself is negligible. Sea temperatures range from a minimum of 5°C to a maximum of 13°C (Jones 1975).

The north shore of Scapa Flow from Houton to Scapa Bay consists of scalloped bays. Low-lying cliffs and boulder slopes lead down into the sublittoral on the open coasts with the bays comprising gradually-sloping sandy beaches and boulder platforms. The north shore is sheltered from wave action in the west becoming moderately exposed to the east. The east shore south to Howequoy Head consists of steep cliffs with broken slopes. It is linear in nature and moderately exposed to wave action. The south-east of Scapa Flow is a complex system of embayments formed by causeways linking the islands of Mainland Orkney to Lamb Holm, Glims Holm, Burray and South Ronaldsay. The causeways have modified the hydrography of the area, closing sounds which formerly linked Scapa Flow and the North Sea. The embayments consist of gradual boulder slopes and bedrock platforms with wide sand beaches. The headlands and open sections of coastline, south to Hoxa Head on South Ronaldsay, consist of small cliffs with boulder slopes leading steeply down into the sublittoral. The wave exposure of this area ranges from very sheltered in the embayments to moderately exposed at Hoxa Head. The island of Flotta to the south of Scapa Flow lies across the Sound of Hoxa from South Ronaldsay with low-lying cliffs and sloping boulder shores. The east coast of Flotta is moderately exposed to wave action, the north shore sheltered to very sheltered behind the Calf of Flotta. The islands of Cava and Fara form the western limits of the survey area, their coastline consisting of small cliffs and boulder slopes down into the sublittoral; their coastline is sheltered from wave action.

The sublittoral bedrock and boulder slopes of Scapa Flow give way to mixed sandy sediment which forms the majority of the substratum of the area. The circalittoral sediments are mixed with a greater percentage of fines than well-sorted sands of the infralittoral and sublittoral fringe. There is little terrestrial input of silt into the system.

Marine biology

Marine biological surveys				
	Survey methods	*No. of sites*	*Date(s) of survey*	*Source*
Littoral	Recording (epibiota)	12	May 1996	MNCR survey no. 679
	Infaunal sampling (cores)	2	May 1996	MNCR survey no. 679
Sublittoral	Recording (epibiota)	16	May 1996	MNCR survey no. 678
	Remote survey (ROV)	6	July 1995	SNH survey no. 649
	Infaunal sampling (grab)	17	1986	Jones *et al.* 1987
	Infaunal sampling (cores)	4	May 1996	MNCR survey no. 678

Littoral

Throughout Scapa Flow, the more open expanses of coastline, comprising craggy sandstone bedrock and boulders, are very similar in nature with the biotopes present being determined by the topography of the shore rather than differences in exposure and tidal streams. The upper shore supports relatively sparse populations of the fucoids *Pelvetia canaliculata* (Pel) and *Fucus spiralis* (Fspi) with only a small extent of supralittoral lichens. Vertical and steep rock faces consist of barnacle and fucoid mosaics, with the fucoids *Fucus vesiculosus* (FvesB) and *Fucus serratus* (Fser.R) dominant in the sloping shore areas and knotted wrack *Ascophyllum nodosum* (Asc.Asc) on the lee side of craggy bedrock and larger boulders. The sublittoral fringe is characterised by dense kelp *Laminaria digitata* and encrusting coralline algae (Ldig.Ldig).

Along the north coast of Scapa Flow within Swanbister Bay, Waulkmill Bay and Scapa Bay there are extensive bedrock platforms and gently-sloping boulder and cobble shores. These sheltered areas are fucoid-dominated with lower shore under-boulder surfaces supporting a wide range of sponges and ascidians. There are very sparse populations of supralittoral lichens due to lack of suitable substrata. Much of the rock is affected by sand deposition and is overlain with sediment bound by the algae *Rhodothamniella* spp. (Rho). Bedrock and boulders in the sublittoral fringe are dominated by a mixture of the algae *L. digitata*, *Asperococcus fistulosus* and *Halidrys siliquosa* (Lsac.Ldig). Similar sheltered shores are found in the artificially created embayments of St Mary's Bay and Water Sound in the south-east of the basin.

Sediment beaches are found in the majority of the inlets and bays of Scapa Flow, mainly formed of relatively clean sand. The lugworm *Arenicola marina* is characteristic in the mid- to upper shore along with high densities of spionid polychaetes including *Pygospio elegans* and *Spio martinensis* (AP.Pon). Upper shore areas with increased freshwater run-off are dominated by the opportunistic polychaete *Capitella* sp. Amphipods *Bathyporeia* spp. occur throughout the sandy shores in varying abundance. The more mobile lower shore sands are characterised by the bivalve *Angulus tenuis* (AP.P).

Sublittoral

Along the north coast, between Houton and Swanbister Bay, and the east coasts from Scapa Bay to St Mary's, the infralittoral zone consists almost entirely of boulder slopes, and small bedrock outcrops to around 15 m depth. Below this the rock becomes overlain by mixed sandy sediment which slopes down into the main basin. The biology of the infralittoral rock is very similar, with a dense *Laminaria hyperborea* kelp forest (Lhyp.Ft), which becomes grazed with depth (LhypGz.Ft; LhypGz.Pk), until eventually, at the lower limits of the kelp forest, the rock is heavily grazed by the urchin *Echinus esculentus* with only a few red algae and a limited range of fauna occurring (EchBriCC). The kelp forest thins out in the rock/sediment transition zone to a sparse kelp park with the rock dominated by encrusting red and brown algae. At Hoxa Head, in the south of Area 3, the sublittoral fringe and shallow infralittoral is dominated by the kelps *Alaria esculenta* and *Laminaria digitata* (Ala.Ldig), with the lower infralittoral having a similar zonation to the areas described formerly. In sheltered water on the north side of Burray, a mixed kelp forest of *Laminaria saccharina* and *L. hyperborea* replaces the *L. hyperborea* forest (LhypLsac.Ft). A small rock pinnacle, the Barrel of Butter, which

lies in the north-west of the main basin, is surrounded by broken bedrock and boulders characterised by mixed kelp biotopes indicating a disturbed environment (XKScrR).

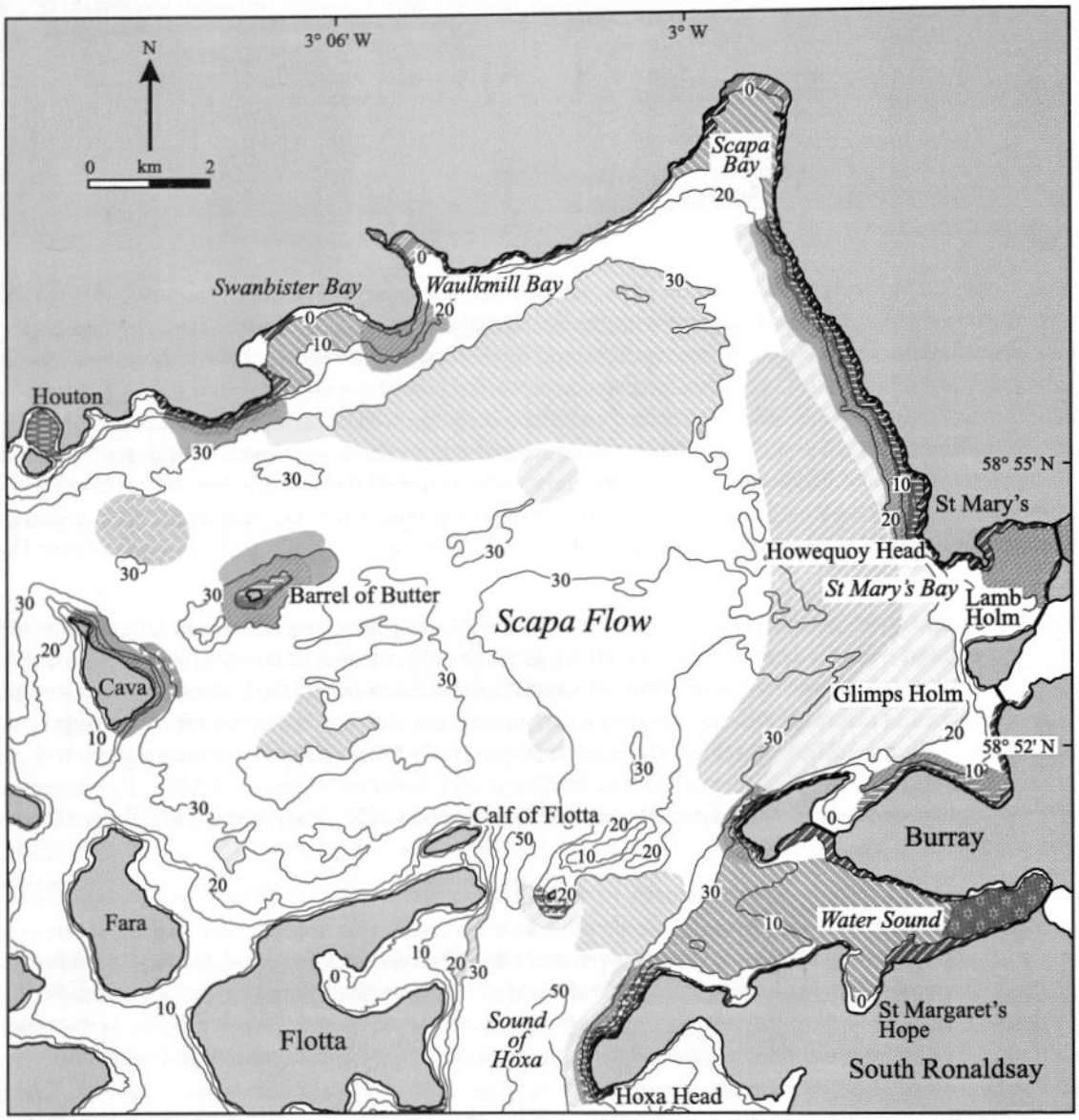
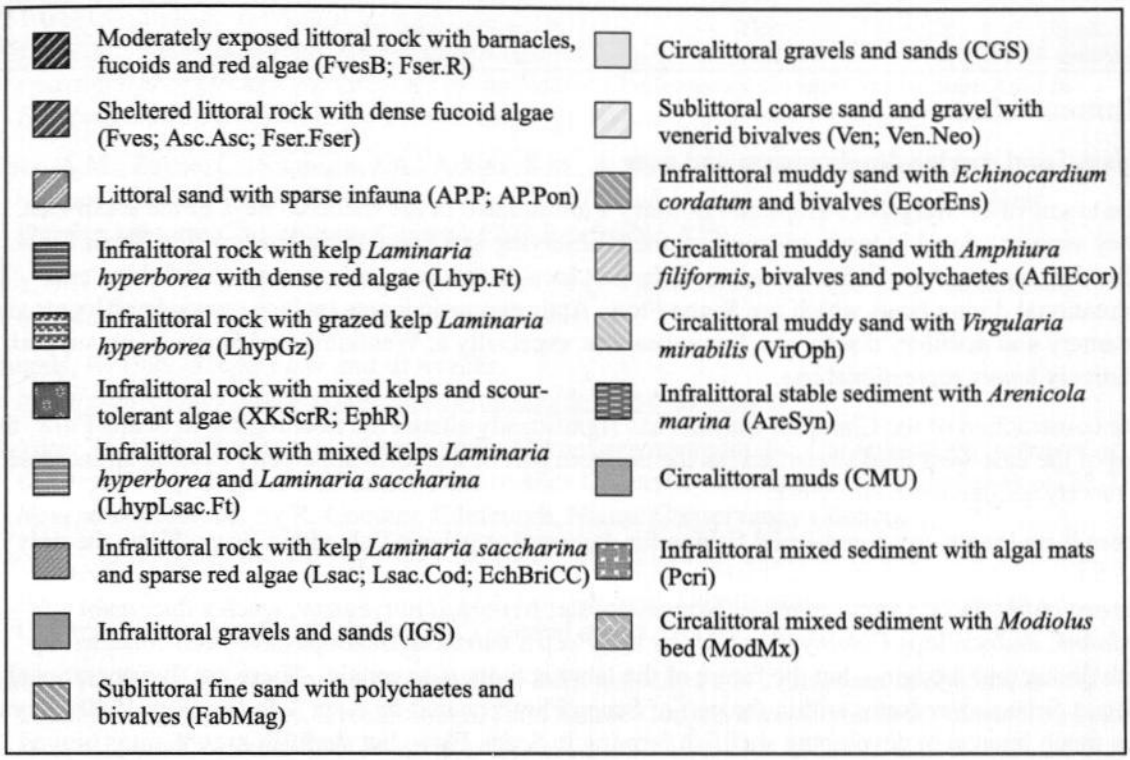


Figure 3.2 Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 3.1, cited literature and additional field observations). (Key to biotopes symbols on next page.)

Scapa Flow has very few examples of circalittoral rock biotopes, although the wrecks of scuttled warships support a mixed faunal turf dominated by the sponges *Myxilla incrustans* and *Suberites ficus* (AlcByH).

Around the Churchill Barriers in Water Sound and St Mary's Bay the shallow infralittoral consists of mixed substrata of boulders and cobbles on fine sediment with occasional bedrock outcrops. The rock supports a range ephemeral algal species and large areas are covered with ectocarpoid algae

(XKScrR; Lsac.Cod). These areas are a sink for drift algae, with the detached kelp supporting large solitary ascidians.



To the east of Cava the infralittoral rock gives way to mixed sandy sediment with small pebbles and stones supporting red algae, predominantly *Phyllophora crispa* (Pcri), encrusting coralline algae and the keel worm *Pomatoceros triqueter* (PomByC).

Very sheltered shallow sediment in Bay of Houton is very stable and is covered in places by an algal mat. The sediment surface is very uneven, heaped up into very large mounds and casts by lugworm *Arenicola marina* (AreSyn).

In the main basin, the infralittoral sediment infauna is dominated by razor clams *Ensis* sp., the sand mason worm *Lanice conchilega* and many large bivalves including *Dosinia exoleta* (FabMag). In the shallow infralittoral of Scapa Bay and Water Sound the sediment consists of well-sorted sands characterised by the common heart urchin *Echinocardium cordatum* and *Ensis* sp. (EcorEns).

Circalittoral sediments are sandy in the central basin, with a larger percentage of stone and gravel material present at the east and west sides, and a higher proportion of fine sediment towards Scapa Bay in the north-east. To the south the Sound of Hoxa is characterised by clean gravel and sand thrown into waves by tidal streams. The main basin supports communities more typical of muddy mixed sediments characterised by the slender sea pen *Virgularia mirabilis*, the brittlestar *Amphiura filiformis*, a number of bivalves including *Thyasira flexuosa*, *Pecten maximus* and *D. exoleta*, the polychaete *Prionospio fallax* and the burrowing anemone *Cerianthus lloydii* (VirOph; AfilEcor). The waved gravel and sand of the Sound of Hoxa supports a community characterised by the sea cucumber *Neopentadactyla mixta* and *L. conchilega* (Ven.Neo).

To the north of Cava mixed sediment supports a population of the horse mussel *Modiolus modiolus*, which in turn supports a community more commonly associated with stable hard substrata, including the brittlestars *Ophiothrix fragilis* and *Ophiopholis aculeata* (ModMx). The extent of the mussel bed is uncertain.

Nature conservation

Conservation sites		
Site name	*Status*	*Main features*
Waulkmill	SSSI	Saltmarsh; shingle spit
Hobbister	RSPB	Ornithological

Human influences

Coastal and marine developments and uses

The towns of St Margaret's Hope and St Mary's are situated in the sheltered bays of the south-east. They support a local industry of creeling, shellfish-diving and line-fishing boats within Scapa Flow. Although outside Area 3, Stromness is the largest local community, a ferry port with fishing and recreational diving boats which use Scapa Flow. Anthropogenic inputs include quayside effluents and creamery and distillery discharges. Some beaches, especially at Waulkmill and Scapa Bays, support relatively heavy recreational use.

The construction of the Churchill Barriers has significantly altered the tidal regime in Scapa Flow, the loss of the east-west tidal stream across the northern part of the basin apparently causing an increase in muddy sediments (Kerr 1999).

There is no longer any commercial fishing for demersal or pelagic fish within Scapa Flow; the only catch of commercial value is shellfish, including lobster *Homarus gammarus*, crabs *Cancer pagurus*, *Necora puber* and *Carcinus maenas*, Norway lobster *Nephrops norvegicus*, whelks *Buccinum undatum*, and scallops *Chlamys opercularis* and *Pecten maximus*. Scallops have been collected by both diving and dredging, but the future of the latter activity is uncertain. There are five operational salmon *Salmo salar* farms within the part of Scapa Flow covered by Area 3. In the early 1980s, there was much interest in developing shellfish farming in Scapa Flow, but shellfish growth rates proved too slow for these schemes to be commercially viable; there is now only one current shellfish farm licence (for the growing-on of wild-collected scallops) at Longhope, to the south-west of Area 3 (Kerr 1999).

The oil-handling terminal on Flotta creates both gas and oil tanker traffic from the south through the Sound of Hoxa with loading and unloading taking place at two mooring points and at a jetty in the western section of Scapa Flow. In addition, tankers use an anchorage in the north-east corner, off Scapa Bay. The area is listed as one of the world's best diving locations and is heavily used by recreational divers, who visit the remains of German fleet scuttled in the north-west of Scapa Flow after World War I. Little recreational diving occurs away from the wrecks. Oil pollution dating from both World Wars still occurs, with visible seepage from the wreck of HMS *Royal Oak*, torpedoed during World War I.

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Survey 130: 1986 EAU survey of the infaunal benthos of Scapa Flow (Jones *et al.* 1988).
Survey 649: 1995 SNH ROV survey of Scapa Flow and Hoy Sound (MNCR, unpublished data).
Survey 678: 1997 MNCR sublittoral survey of Scapa Flow, Orkney (MNCR, unpublished data).
Survey 679: 1997 MNCR littoral survey of Scapa Flow, Hoy Sound & west Mainland (MNCR, unpublished data).

Littoral sites

Survey	*Site*	*Place*	*Grid reference*	*Latitude/longitude*	*Biotopes recorded*
679	4	W of Hunda Reef, Scapa Flow.	ND 439 965	58°51.1'N 02°58.3'W	Pel; Fspi; Fves; Asc.Asc; Fser.R; FserX.T; Lsac.Ldig
679	5	Sunless Geo, Scapa Flow.	ND 438 973	58°51.5'N 02°58.4'W	Ver.Ver; Pel; Fspi; FvesB; Fser.R; Ldig.Ldig
679	6	Croo Taing, Scapa Flow.	ND 416 944	58°50.0'N 03°00.7'W	YG; Ver.Ver; Pel; Fspi; Fves; Fser.R; Ldig.Ldig
679	7	Knockhall Point, Scapa Flow.	ND 458 945	58°50.0'N 02°56.3'W	Pel; Asc.Asc; Fser.R; Lsac.Ldig; MacAre
679	8	N of Bay of Deepdale, Scapa Flow.	HY 452 046	58°55.5'N 02°57.1'W	Ver.Ver; Pel; Fspi; FvesB; Fser.R; Ldig.Ldig
679	9	S of Scapa Pier, Scapa Flow.	HY 443 077	58°57.2'N 02°58.1'W	Fves; Fser.Fser.Bo; Ldig.Ldig.Bo
679	10	W of Skaildaquoy Point, Scapa Flow.	HY 471 006	58°53.3'N 02°55.0'W	YG; Pel; Fspi; Asc.Asc; Fser.R; SwSed; Ldig.Ldig
679	11	E of Skaildaquoy Point, Scapa Flow.	HY 473 007	58°53.4'N 02°54.8'W	Fspi; Asc.Asc; Fser.Fser.Bo; Lsac.Ldig; MacAre
679	14	Waulkmill Bay, Scapa Flow.	HY 380 064	58°56.4'N 03°04.6'W	AP.P; AP.Pon
679	15	W Waulkmill Bay, Scapa Flow.	HY 380 060	58°56.2'N 03°04.6'W	YG; Ver.Ver; Pel; Fspi; Asc.Asc; Fser.Fser; Ldig.Ldig
679	16	Point of the Baits, Scapa Bay, Scapa Flow.	HY 433 085	58°57.6'N 02°59.1'W	Ver.Ver; Pel; Fves; Fser.Fser; G
679	17	N Scapa Bay, Scapa Flow.	HY 440 086	58°57.6'N 02°58.4'W	AP.Pon; HedOl
679	22	S of Toy Ness, Scapa Flow.	HY 355 041	58°55.1'N 03°07.2'W	Ver.Ver; Fspi; FvesB; Fser.Fser; Ldig.Ldig
679	23	NE of Toy Ness, Scapa Flow.	HY 356 045	58°55.4'N 03°07.1'W	Pel; Fspi; Asc.Asc; Fser.Fser; Ldig.Ldig

Sublittoral sites

Survey	*Site*	*Place*	*Grid reference*	*Latitude/longitude*	*Biotopes recorded*
130	1	Station 6, Scapa Flow.	ND 383 950	58°50.3'N 03°04.1'W	AfilEcor
130	2	Station 7, Scapa Flow.	ND 407 954	58°50.5'N 03°01.6'W	VirOph
130	3	Station 8, Scapa Flow.	ND 426 952	58°50.4'N 02°59.6'W	FabMag
130	4	Station 9, Scapa Flow.	ND 424 975	58°51.7'N 02°59.8'W	AfilEcor
130	5	Station 9a, Scapa Flow.	ND 440 982	58°52.1'N 02°58.1'W	Ven
130	6	Station 10, Scapa Flow.	ND 398 983	58°52.1'N 03°02.5'W	Ven
130	7	Station 11, Scapa Flow.	ND 362 984	58°52.1'N 03°06.3'W	VirOph
130	8	Station 12, Scapa Flow.	ND 344 968	58°51.2'N 03°08.1'W	Ven
130	9	Station 14, Scapa Flow.	HY 334 023	58°54.2'N 03°09.3'W	ModMx
130	10	Station 15, Scapa Flow.	HY 359 013	58°53.7'N 03°06.6'W	Ven
130	11	Station 19, Scapa Flow.	HY 441 018	58°54.0'N 02°58.2'W	AfilEcor
130	12	Station 20, Scapa Flow.	HY 400 023	58°54.3'N 03°02.4'W	Ven
130	13	Station 21, Scapa Flow.	HY 373 034	58°54.8'N 03°05.3'W	VirOph
130	14	Station 21e, Scapa Flow.	HY 400 041	58°55.2'N 03°02.5'W	VirOph
130	15	Station 22, Scapa Flow.	HY 415 041	58°55.2'N 03°00.9'W	VirOph
130	16	Station 22e, Scapa Flow.	HY 436 041	58°55.2'N 02°58.7'W	AfilEcor
130	17	Station 23, Scapa Flow.	HY 432 060	58°56.3'N 02°59.1'W	Ven
649	17	N of Barrel of Butter, Scapa Flow.	HY 338 018	58°53.9'N 03°08.9'W	ModMx
649	18	E of Barrel of Butter, Scapa Flow.	HY 354 014	58°53.7'N 03°07.2'W	CMU
649	19	E of Barrel of Butter 2, Scapa Flow.	HY 358 015	58°53.8'N 03°06.7'W	CMU
649	20	Barrel of Butter, Scapa Flow.	HY 352 008	58°53.4'N 03°07.3'W	Lsac.Pk; IGS
649	22	East side of Cava, Scapa Flow.	ND 332 990	58°52.4'N 03°09.4'W	Lsac.Ft; IMS
649	24	Stranger Head, Flotta, Scapa Flow.	ND 372 922	58°48.8'N 03°05.1'W	Lhyp.Ft; AlcByH
678	1	W Nevi Skerry, Sound of Hoxa, Scapa Flow.	ND 396 954	58°50.5'N 03°02.8'W	IR; LhypGz.Ft; Ven.Neo
678	2	NW of Hoxa Head, Scapa Flow.	ND 403 932	58°49.4'N 03°01.9'W	Ala.Ldig; Lhyp.Ft; LhypGz.Pk; EchBriCC; Ven
678	3	W Water Sound, Scapa Flow.	ND 472 951	58°50.4'N 02°54.8'W	XKScrR; Cap
678	4	S of Wha Taing, Scapa Flow.	ND 445 952	58°50.5'N 02°57.7'W	EcorEns
678	5	Swannies Point, Scapa Flow.	ND 456 974	58°51.6'N 02°56.5'W	LhypLsac.Ft; Lsac.Cod; EchBriCC; Ven
678	6	Bor Taing, Scapa Flow.	ND 428 965	58°51.1'N 02°59.4'W	LhypGz.Ft; EphR; XKScrR; EchBriCC; IGS
678	7	NW Barrel of Butter, Scapa Flow.	HY 351 010	58°53.5'N 03°07.5'W	IGS; LhypLsac.Ft; EchBriCC
678	8	S of the Barrel of Butter, Scapa Flow.	HY 350 007	58°53.3'N 03°07.6'W	IGS; XKScrR; EchBriCC
678	9	S of Waulkmill Bay, Scapa Flow.	HY 386 048	58°55.6'N 03°03.9'W	VirOph
678	10	Offshore Swanbister Bay, Scapa Flow.	HY 362 037	58°55.0'N 03°06.4'W	CGS
678	11	Centre of Swanbister Bay, Scapa Flow.	HY 358 047	58°55.5'N 03°06.8'W	FabMag
678	12	Bay of Houton, Scapa Flow.	HY 315 035	58°54.8'N 03°11.3'W	AreSyn
678	13	West of St Mary's Bay, Scapa Flow.	ND 459 998	58°52.9'N 02°56.2'W	Ven
678	14	Off Gaitnip Hill, Scapa Flow.	HY 444 050	58°55.7'N 02°57.9'W	Lhyp.Ft; XKScrR; EchBriCC; IGS
678	15	Scapa Bay, Scapa Flow.	HY 438 078	58°57.2'N 02°58.5'W	EcorEns
678	16	Kirk Sound, Scapa Flow.	HY 476 006	58°53.4'N 02°54.5'W	Lsac.Cod
678	17	East Cava, Scapa Flow.	ND 336 995	58°52.7'N 03°09.0'W	PomByC; Pcri
678	18	N of Tuberry Point, Cava, Scapa Flow.	ND 334 997	58°52.8'N 03°09.3'W	Ala.Myt; Lsac.Ft; EchBriCC; IGS
678	19	S of the Lash, Scapa Flow.	HY 376 048	58°55.6'N 03°04.9'W	Lsac.Ft; EchBriCC; IGS
678	20	S of Hangaback, Scapa Flow.	HY 347 037	58°55.0'N 03°08.0'W	XKScrR; EchBriCC; IGS
678	21	Wreck of the *Dresden*, Scapa Flow.	ND 342 998	58°52.9'N 03°08.4'W	AlcByH

Compiled by: Matt Dalkin

4 North-west Hoy and south-west Mainland

Location		
Position (centre)	HY 16 19	59°03'N 03°28'W
Administrative area	Orkney Islands	
Conservation agency/area	Scottish Natural Heritage	North Areas (Northern Isles)

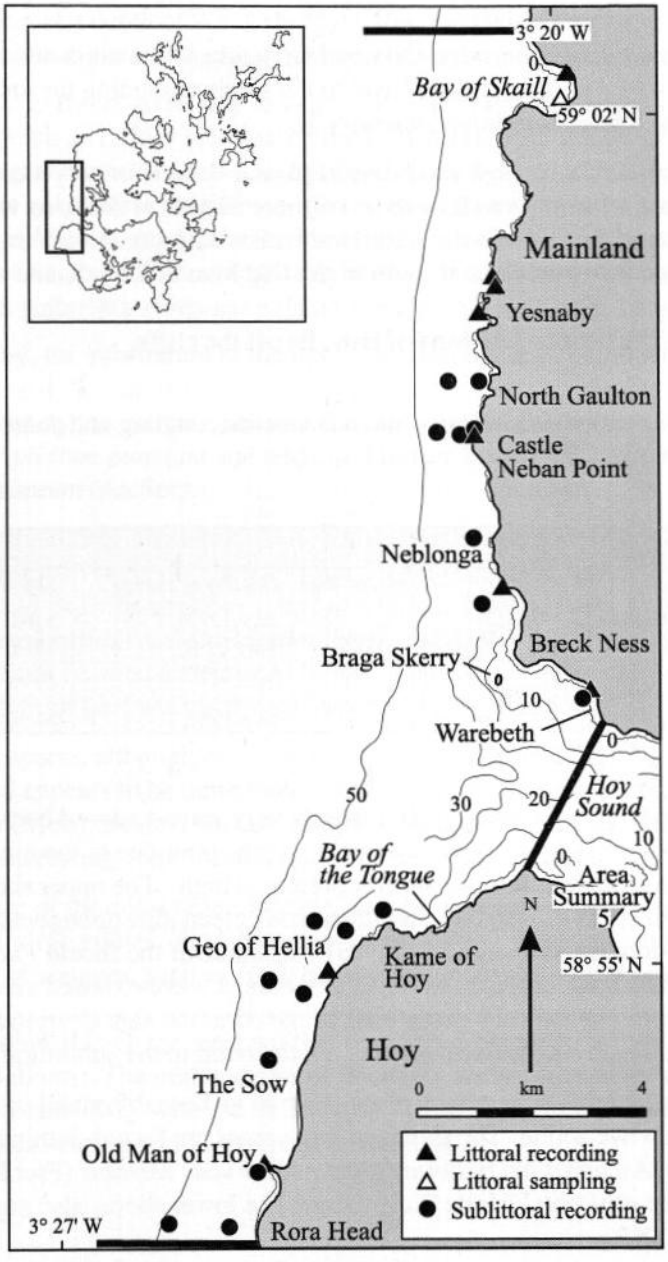


Figure 4.1 Main features of the area, showing sites surveyed.

Physical features	
Physiographic type	Open coast
Length of coast	35 km
Bathymetry	Maximum depth 75 m, 4 km west of Braga Skerry; 50 m depth within 1 km of coast.
Wave exposure	Very exposed
Tidal streams	Variable, from 2 knots near to Hoy Sound to negligible along most of the coast. The tide is accelerated around headlands such as Rora Head, Kame of Hoy and the Old Man of Hoy.
Tidal range	2.9 m (mean springs), 1.3 m (mean neaps)
Salinity	Fully marine

Introduction

Area 4 covers the open coast of south-west Orkney Mainland and the north-west coast of Hoy, between Bay of Skaill to the north and Rora Head to the south, excluding the area of Hoy Sound east of Bay of the Tongue and Warebeth (*area summary* 5).

The coastline is very exposed with high sandstone cliffs and vertical or very steep rocky shores, facing into the prevailing wind and swell, with no offshore islands or shallows to provide shelter. The rocky substrata extend steeply into the sublittoral where tidal streams are in general very weak, though there is increased water movement south of the Old Man of Hoy, Kame of Hoy and towards the entrance of Hoy Sound. There are a number of notable sea-caves extending deep into the cliffs, while stacks, including the famous Old Man of Hoy, lie off the cliffs.

The shore backing is a mixture of moorland and arable land with no major areas of habitation. The few uses of the sea along this stretch of coast include creeling, angling and some recreational diving.

Marine biology

Marine biological surveys				
	Survey methods	***No. of sites***	***Date(s) of survey***	***Source***
Littoral	Recording (epibiota)	2	July 1995	MNCR survey no. 449
	Recording (epibiota)	7	May 1997	MNCR survey no. 679
	Infaunal sampling (cores)	1	May 1997	MNCR survey no. 679
Sublittoral	Recording (epibiota)	17	July 1995	MNCR survey no. 449

Littoral

The shores along this coastline comprise predominantly very wave-exposed bedrock, with some areas of extremely large boulders. The shores are relatively species-poor due to the high energy nature of the coastline, although abundance of those species present is high. The upper shore is characterised by the red alga *Porphyra* sp. (Ver.Por) and the filamentous green alga *Spongomorpha arcta*, grading into a mussel-barnacle-dominated mid-shore (MytB) with some of the fucoid *Fucus distichus* occurring in places (Fdis). This fucoid is restricted to the most wave-exposed areas of Orkney. The lower shore is characterised by the very dense turfs of the coralline alga *Corallina officinalis* (Coff), with the kelp *Alaria esculenta* and mussels *Mytilus edulis* found in the sublittoral fringe (Ala.Myt).

In places where substantial erosion has taken place, such as at Yesnaby, small inlets are formed which offer some shelter from wave action. The shores in these areas are fucoid-dominated with a zonation of *Fucus spiralis* (Fspi), *Ascophyllum nodosum* (Asc.Asc), *Fucus serratus* (Fser.Fser) and the kelp *Laminaria digitata* in the sublittoral fringe (Ldig.Ldig). The lower shores also support a high abundance of red algae (XR).

Between Neban Point and Yesnaby are numerous sea caves and large gullies which support a variety of encrusting algae and lichens. The supralittoral, and most of the higher sections of the caves, support the lichen *Verrucaria* spp. with littorinid snails in crevices (Ver.B). Mid-shore rock sections are covered in the barnacle *Semibalanus balanoides* and *M. edulis*, which in turn are covered by encrusting coralline algae (MytB). Rockpools in the caves support numerous sponge species, a sparse cover of red foliose algae and the anemone *Actinia equina* (Cor). Bedrock in the sublittoral fringe is

subject to a large amount of wave surge and is encrusted with *M. edulis*. Large boulders in the bottom of the caves are covered with a patchwork of the sponges *Halichondria panicea* and *Esperiopsis fucorum* (SC).

Sublittoral

The shallow sublittoral is predominantly bedrock and large, stable boulders, the upper surfaces of which support *Laminaria hyperborea* kelp forest (LhypFa; LhypR) with small patches of the kelp *Saccorhiza polyschides* and an understorey of red algae (LsacSac). The kelp *Alaria esculenta* is found at locations within the shallow sublittoral subject to disturbance; these are areas of smaller, more mobile boulders, such as north-east of Geo of Hellia, where very dense *A. esculenta* occurs on barnacle-covered boulders at a depth of 9 m (Ala.Myt). Vertical bedrock surfaces support rich communities of polyclinid ascidians and sponges, such as *Pachymatisma johnstonia* (AlcByH).

With increasing depth, kelp forest gives way to kelp park, again on bedrock and small boulders. The park supports red algae such as *Ptilota plumosa* on the kelp stipes, with the bryozoan *Flustra foliacea* growing extensively on grazed rock surfaces, in cavities formed below stacked boulders (LhypGz.Pk). The anemone *Actinothoe sphyrodeta* extensively covers vertical rock surfaces, along with some crustose sponges, such as *Myxilla incrustans*, hydroids and the soft coral *Alcyonium digitatum* (AlcByH). Kelp park has an upper limit at approximately 17 m depth over much of the coast and extends as deep as 27 m at the Sow, Hoy.

Near the Old Man of Hoy, the substratum in the upper circalittoral, at 27-32 m depth, comprises bedrock steps, approximately 0.5 m in height, with a greater proportion of surface area upward-facing. The area is heavily grazed by the urchin *Echinus esculentus* and is fairly impoverished, with foliose red algae, the ascidian *Aplidium punctum* and a hydroid turf on horizontal surfaces. Vertical surfaces are dominated by *A. digitatum* (AlcSec).

In areas of increased current flow, such as Rora Head, species richness increases, with thick coverings of *F. foliacea* and *A. digitatum* occurring in the lower circalittoral to depths of 39 m (AlcSec). To the west of Neblonga, scoured bedrock steps are found at a depth of 36 m. These support patchy *F. foliacea*, with common brittlestars *Ophiocomina nigra* and dahlia anemone *Urticina felina* on upper faces. The vertical faces are fissured and support brittlestars *Ophiopholis aculeata*, encrusting bryozoans and dense cover of keel worms *Pomatoceros triqueter* (Flu.Flu).

Sediment in this area is sparse, although clean, coarse to medium-grained sand occurs at 25 m depth west of Castle. The sand appears to be quite mobile and supports only sparse epibiota such as the starfish *Asterias rubens* (Mob); infauna was not sampled. Adjacent to the sediment are outcrops of scoured bedrock, with encrusting coralline algae and sparse foliose red algae (XKScrR).

Caves are a major feature of the coast around Castle, supporting some communities similar to those found in wave-exposed surge gullies. The outer parts of the caves, between 1 and 5 m depth, are characterised by sheets of sponges, such as *Halichondria panicea*, *Esperiopsis fucorum* and *Myxilla incrustans*, and polyclinid ascidians, with the ascidian *Molgula citrina* also present in high densities (SCAs.ByH). A zone below this on the cave walls is dominated by crustose coralline algae and barnacles to 6 m (CC.BalPom). The mid-sections of the caves are dominated by sponges such as *H. panicea* and *M. incrustans* (SC), with the inner, darker areas of the caves dominated by the barnacles *Balanus crenatus* and spirorbid worms (CC.BalPom).

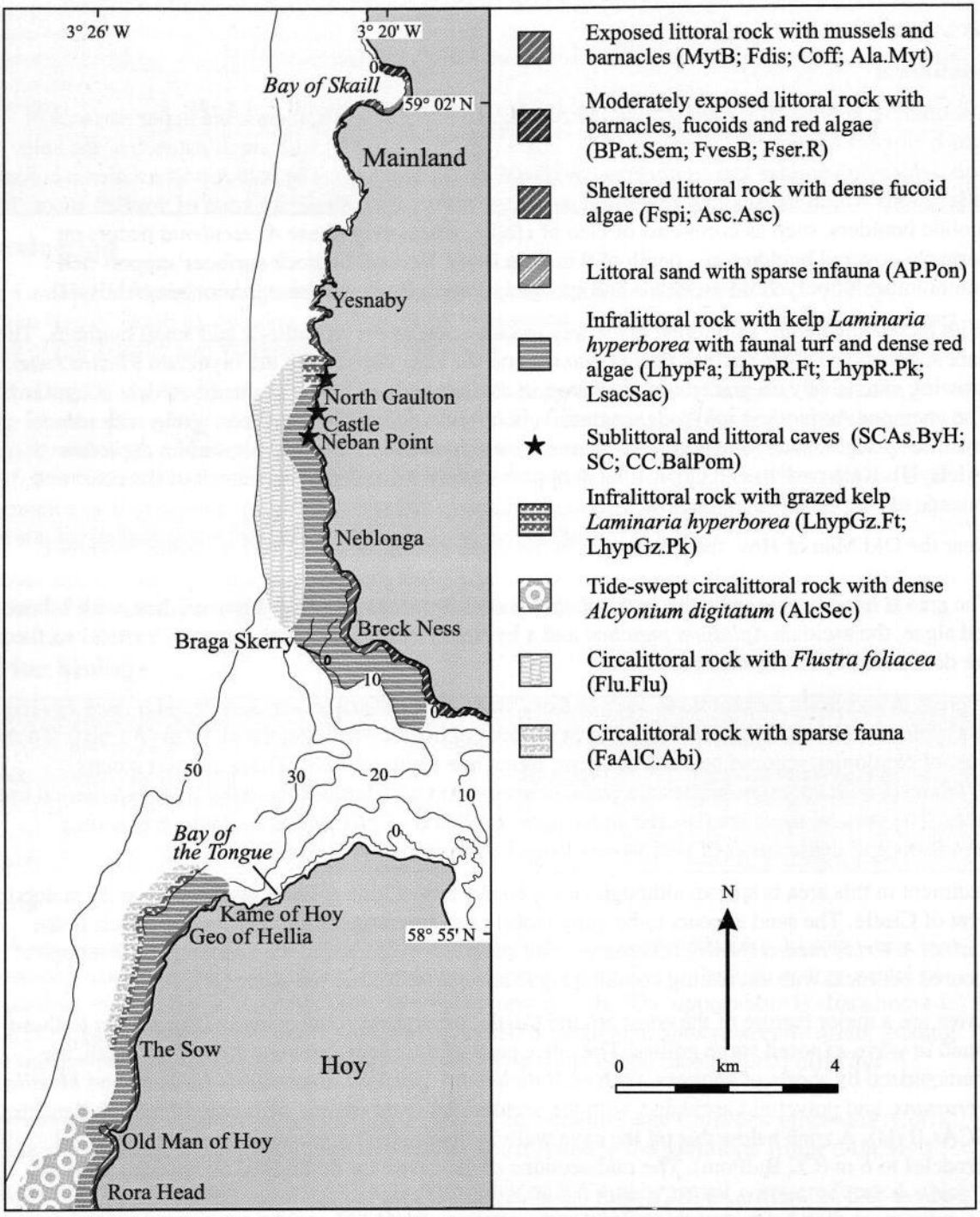


Figure 4.2 Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 4.1, cited literature and additional field observations).

Nature conservation

Conservation sites

Site name	*Status*	*Main features*
Hoy and West Mainland	NSA; ASV	Landscape
Hoy	cSAC; pSPA; SSSI; NCR; GCR	Ornithological; botanical; geological; geomorphological
Muckle Head and Selwick	SSSI; GCR	Geomorphological
Stromness Heaths and Coast	cSAC; SSSI; NCR; GCR	Botanical; geological; geomorphological
Bay of Skaill	SSSI; GCR	Geological
North Hoy	RSPB	Ornithological

Human influences

Marine developments and uses

Creeling for crustaceans and some recreational angling and diving takes place from boats along this coast. Pilot study-scale kelp harvesting has been carried out. Dumping of dredge-spoil and shellfish processing waste takes place just outside the entrance to Hoy Sound.

References and further reading

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 2: Orkney.* Peterborough, Joint Nature Conservation Committee.

Sites surveyed

Survey 449: 1995 MNCR survey of west coast mainland and Hoy, Orkney (MNCR, unpublished data).

Survey 679: 1997 MNCR littoral survey of Scapa Flow, Hoy Sound & west Mainland, Orkney (MNCR, unpublished data).

Littoral sites

Survey	*Site*	*Place*	*Grid reference*	*Latitude/longitude*	*Biotopes recorded*
449	21	Old Man of Hoy Shore, NW Hoy.	HY 174 009	58°53.3'N 03°25.9'W	Ver.Por; Fdis; MytB; XR; Coff; Ala.Myt
449	27	Geo of Hellia, NW Hoy.	HY 188 042	58°55.1'N 03°24.6'W	Fdis
679	1	Bay of Skaill, west Mainland.	HY 233 188	59°02.9'N 03°20.2'W	BarSnd; AP.Pon
679	2	N Bay of Skaill, west Mainland.	HY 233 197	59°03.4'N 03°20.2'W	YG; Pra; Fspi; FvesB; Fser.R; SwSed; Ldig.Ldig
679	3	S of Yesnaby Fort, west Mainland.	HY 218 155	59°01.1'N 03°21.7'W	Ver.Por; Ver.Ver; Fdis; MytB; BPat.Cht; Mas; FK; Ala.Myt
679	19	N of Warebeth beach, west Mainland.	HY 233 089	58°57.6'N 03°20.0'W	Pel; Fspi; FvesB; Fser.R; Ldig.Ldig; LsacSac
679	21	E Brough of Bigging Cairn, west Mainland.	HY 221 158	59°01.3'N 03°21.4'W	YG; Ver.Ver; Fspi; Asc.Asc; Fser.R; Ldig.Ldig
679	24	W of Yesnaby, west Mainland.	HY 222 157	59°01.3'N 03°21.3'W	Ver.Por; Pel; Fspi; FvesB; Fser.R; Ldig.Ldig
679	25	Cave, N of Neban Point, west Mainland.	HY 216 133	59°00.0'N 03°21.8'W	Chr; Ver.B; MytB; Cor; SC
679	26	Skrowa Skerry and cave, west Mainland.	HY 219 109	58°58.7'N 03°21.5'W	Ver.Por; Fdis; MytB; BPat.Sem; Ala.Myt

Sublittoral sites

Survey	*Site*	*Place*	*Grid reference*	*Latitude/longitude*	*Biotopes recorded*
449	17	Offshore Rora Head, NW Hoy.	ND 164 993	58°52.4'N 03°27.0'W	AlcSec
449	18	Inshore Rora Head, NW Hoy.	ND 170 992	58°52.4'N 03°26.3'W	LhypR.Ft; AlcByH
449	19	Old Man of Hoy, NW Hoy.	HY 173 007	58°53.2'N 03°26.0'W	LhypFa; AlcSec
449	22	The Sow, NW Hoy.	HY 177 028	58°54.3'N 03°25.6'W	LhypGz.Pk
449	23	Between St John's Head and Geo of Hellia, NW Hoy.	HY 183 038	58°54.8'N 03°25.0'W	LhypFa
449	24	Offshore St John's Head and Geo of Hellia, NW Hoy.	HY 179 040	58°54.9'N 03°25.4'W	FaAlC.Abi
449	25	NE of Geo of Hellia, NW Hoy.	HY 190 046	58°55.3'N 03°24.3'W	Ala.Myt; LhypR.Ft; SCAs.ByH
449	26	W of Geo of Hellia, NW Hoy.	HY 185 048	58°55.4'N 03°24.8'W	FaAlC.Abi
449	28	Kame of Hoy, NW Hoy.	HY 195 051	58°55.6'N 03°23.8'W	LhypR.Ft; LhypGz.Pk
449	29	NW of Kirk Rocks, SW Mainland.	HY 231 088	58°57.6'N 03°20.2'W	LhypR.Ft
449	30	S of Skrowa Skerry, SW Mainland.	HY 216 105	58°58.5'N 03°21.8'W	LhypFa
449	31	W of Neblonga, SW Mainland.	HY 201 129	58°59.8'N 03°23.3'W	Flu.Flu
449	32	SW of Castle, SW Mainland.	HY 215 133	59°00.0'N 03°21.9'W	AlcByH
449	33	Offshore Castle, SW Mainland.	HY 212 134	59°00.0'N 03°22.3'W	LhypR.Pk; XKScrR; AlcByH; Mob
449	34	Castle (cave), SW Mainland.	HY 217 134	59°00.0'N 03°21.7'W	Ala.Myt; LsacSac; SC; CC.BalPom
449	35	Point of Lyre Geo, SW Mainland.	HY 216 142	59°00.4'N 03°21.9'W	LhypGz.Ft; AlcByH
449	36	Cave at Point of Lyre Geo, SW Mainland.	HY 219 142	59°00.4'N 03°21.5'W	SC; SCAs.ByH; CC.BalPom

Compiled by: Frank Fortune, Karen Begg & Matt Dalkin

5 Hoy Sound and Bring Deeps

Location		
Position/(limits)	HY 40 09 – ND 33 96	58° 58'N 03°02'W - 58°51'N 03°10'W
Region/district	Orkney Islands	
Conservation agency/area	Scottish Natural Heritage	North Areas (Northern Isles)

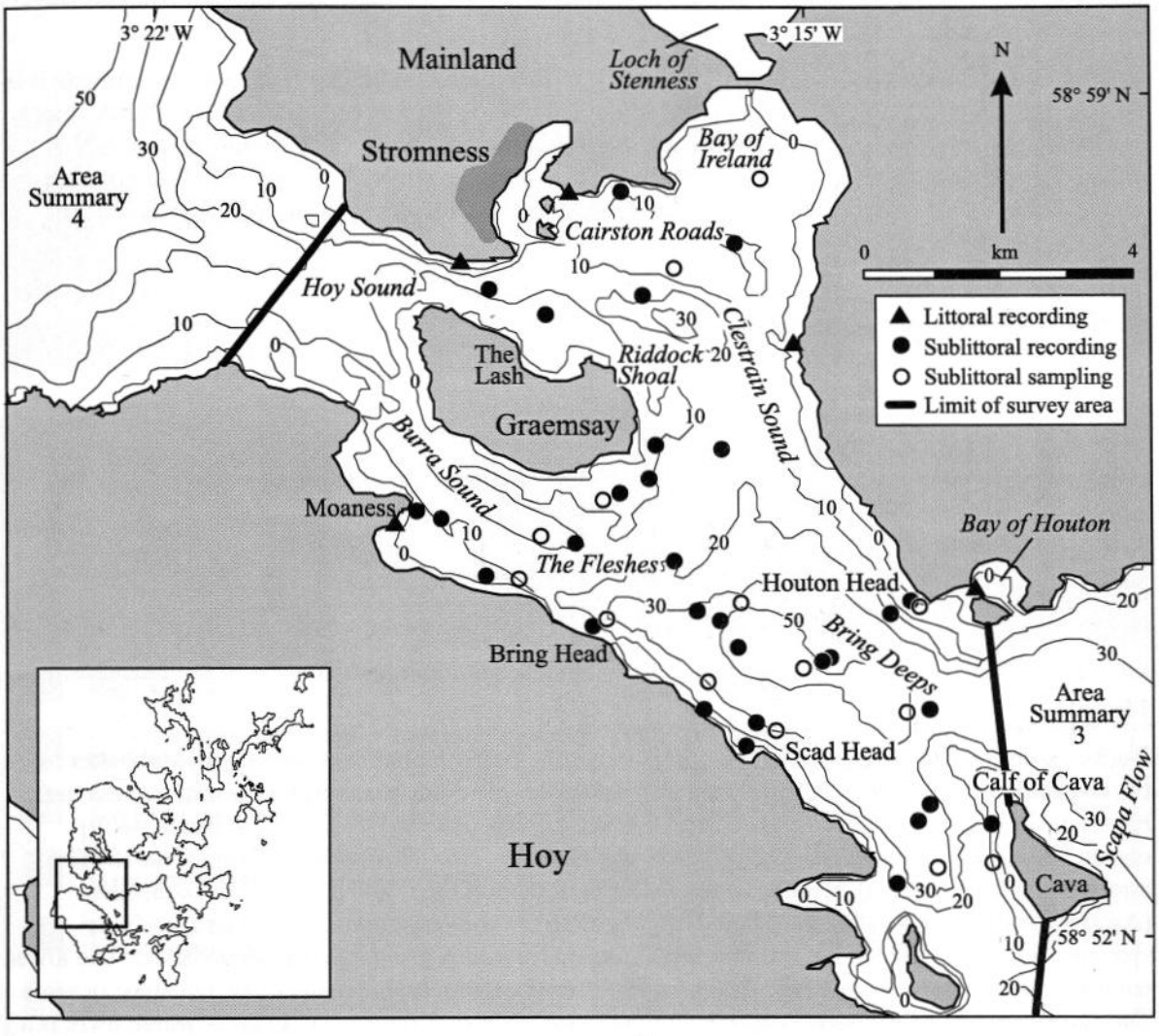


Figure 5.1 Main features of the area, showing sites surveyed.

Physical features	
Physiographic type	Sounds with embayments
Length of coast	58 km
Area of inlet	44 km^2
Bathymetry	Maximum depth 62 m in Bring Deeps
Wave exposure range	Moderately exposed to very sheltered
Tidal stream range	8 knots north of Graemsay to negligible in sheltered areas such as Bay of Ireland
Tidal range	2.9 m (mean springs), 1.3 m (mean neaps)
Salinity range	Fully marine but with locally reduced salinity near entrance to Loch of Stenness

Introduction

Hoy Sound and Bring Deeps lie between Hoy and Mainland, extending around the island of Graemsay and southwards to Cava, leading into the main basin of Scapa Flow. This area is characterised by strong tides and water exchange in the west, around Burra and Clestrain Sounds, with decreasing tidal streams in the Bay of Ireland and through Bring Deeps. Frequent high winds can cause considerable disturbance of surface waters but, due to the short fetch, wind-generated waves fail to affect deeper water.

The coastline is generally low-lying and sheltered, with cliffs (approximately 60 m high) occurring in the Bring Head area of Hoy. The shore backing is predominantly agricultural with a mixture of sheep and cattle grazing.

Stromness is the only major settlement, supporting fishing, areas of industry, and a ferry terminal; it is also the main sport-diving centre for Scapa Flow. There are a number of wrecked ships (block ships) and other underwater obstructions within the channels of Burra Sound and Clestrain Sound, which were deliberately placed as an anti-submarine defence measure during World War II. The northern end of Burra Sound, to the west of Graemsay, is blocked underwater by a series of wrecks, one of which breaks the water surface.

The area is fully marine, though the Bay of Ireland is influenced by the flow of reduced salinity water from the lagoonal Loch of Stenness (Thorpe 1998).

Marine biology

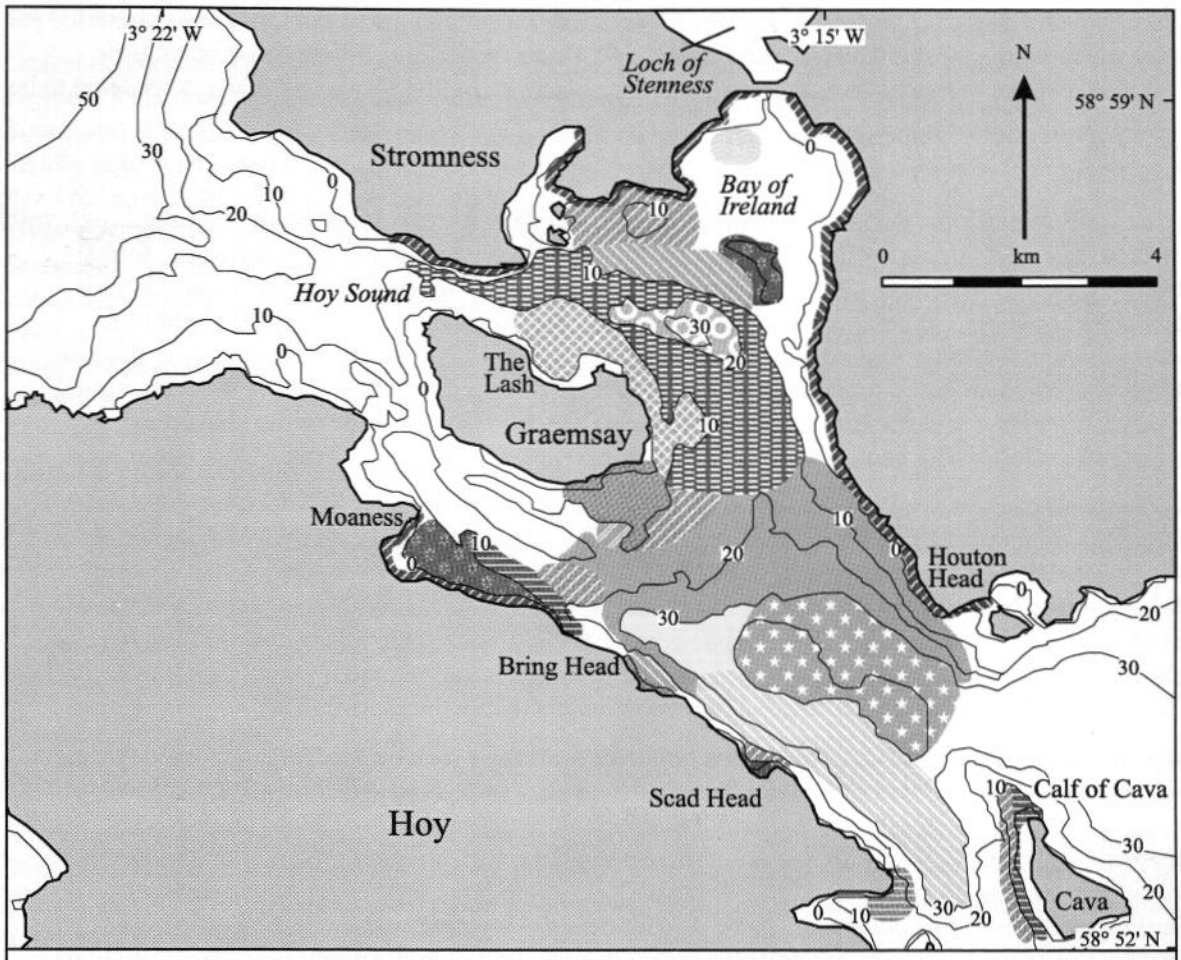
Marine biological surveys

	Survey method	*No. of sites*	*Date of survey*	*Source*
Littoral	Recording (epibiota)	1	July 1995	MNCR survey 449
	Recording (epibiota)	4	May 1997	MNCR survey 679
Sublittoral	Recording (epibiota)	13	July 1995	MNCR survey 449
	Remote survey (ROV)	17	July 1995	SNH survey 649
	Infaunal sampling (cores)	1	May 1997	MNCR survey 678
	Infaunal sampling (grab)	14	May 1997	Unicomarine survey 683

Littoral

Rocky shores in Hoy Sound are of low-lying, extensive bedrock platforms which provide shelter for the communities found there. The shores are backed by low cliffs of sandstone, beneath which are barren, mobile cobbles on the upper shore. The eulittoral is essentially fucoid-dominated, with channelled wrack *Pelvetia canaliculata* (Pel) and *Fucus spiralis* (Fspi) in the upper eulittoral. The mid-shore is dominated by bladder wrack *Fucus vesiculosus* (Fves) and *Ascophyllum nodosum* (Asc.Asc), or a mixture of both. These biotopes often cover a large littoral extent and are fairly species-poor, with only the fucoids and some grazing littorinids present in high abundance. The lower eulittoral has a dense turf of serrated wrack *Fucus serratus* with sparse filamentous red algae beneath. The sublittoral fringe comprises dense kelp *Laminaria digitata* (Ldig.Ldig). In areas where there is a higher degree of exposure such as on headlands and the western part of the area, the lower shore biotopes are more characteristic of exposed conditions with thongweed *Himanthalia elongata* and short turfs of red algae such as *Chondrus crispus*, *Mastocarpus stellatus* and *Osmundea pinnatifida* (Him). This biotope may reflect disturbed water due to wave 'chop' or tidal streams on the lower shore, as the sublittoral fringe biotopes are often more sheltered in character (Ldig.Ldig).

On the east side of Bay of Ireland, and the entrance to Bay of Houton, the shores comprise stable cobbles and pebbles, often with pockets of sand between. These shores are similar in biological composition to bedrock shores, due to the stability of the substrata, but with a slight reduction in numbers of species of fauna and flora present. The sublittoral fringe is generally dominated by a mixture of kelps *L. digitata* and *Laminaria saccharina*, the latter indicating a greater degree of mobility in the substrata in this zone than the more consolidated mid- and upper shores (Lsac.Ldig).



Sheltered littoral rock with dense fucoids (Pel; Fspi; Fves; Asc.Asc)

Littoral boulders and cobbles on mixed sediments with fucoids (AscX; EphX)

Moderately exposed infralittoral rock with kelp *Laminaria hyperborea* with dense red algae (Lhyp.Ft)

Tide-swept infralittoral rock with kelp *Laminaria hyperborea* and faunal turf (Lhyp.TFt; Lhyp.TPk)

Infralittoral rock with mixed kelps and scour-tolerant algae (XKScrR; EphR)

Sheltered infralittoral rock with mixed kelps *Laminaria hyperborea* and *Laminaria saccharina* (LhypLsac.Ft)

Sheltered infralittoral rock with *Laminaria saccharina* and sparse red algae (Lsac.Ft; EchBriCC)

Tide-swept circalittoral rock with dense *Alcyonium digitatum* (AlcSec)

Infralittoral gravels and sands (IGS)

Infralittoral gravel/sand with maerl beds (Phy.R; Phy.HEc)

Infralittoral fine sand with polychaetes and bivalves (FabMag)

Sublittoral sand and gravels with *Sertularia cupressina* (ScupHyd)

Cicalittoral gravels and sands (CGS)

Infralittoral muddy sand with *Echinocardium cordatum* and bivalves (EcorEns)

Infralittoral muddy sand with spionid polychaetes (SpiSpi)

Circalittoral muddy sand with *Abra alba*, bivalves and polychaetes (AbrNucCor)

Circalittoral muddy sand with *Virgularia mirabilis* (VirOph)

Infralittoral mixed sediment with *Laminaria saccharina* (LsacX)

Figure 5.2 Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 5.1, cited literature and additional field observations).

Littoral sediments in Area 5 were not sampled during the MNCR surveys; however the Bay of Creekland and Bay of Quoys were described by Atkins, Jones & Simpson (1985). They considered the latter site to be the most interesting sandy beach in Orkney, supporting a very dense polychaete assemblage and a uniquely diverse amphipod assemblage, including species normally considered to be sublittoral.

Sublittoral

In the sublittoral fringe, the kelp *Laminaria digitata* dominates bedrock and boulders (Ldig.Ldig), with the kelp *Alaria esculenta* forming a narrow band on the upper parts of the *Laminaria* spp. forest, to a depth of 2 m. Although the area is moderately exposed to sheltered, the presence of *Alaria* is indicative of higher wave exposure. It is thought that the short fetch and high wind speed often experienced in this area create disturbance in shallow water which leads to biotopes in the shallow sublittoral which are more exposed in character than those found at greater depth. With increasing depth, *A. esculenta* gives way to the kelp *Laminaria saccharina* with some of the kelp *Saccorhiza polyschides* additionally being found on the north-east coast of Hoy, to a depth of 9 m (Lsac.Ft).

West of Calf of Cava, on Cava's north-west coast, *Laminaria hyperborea* kelp forest on bedrock (Lhyp.Ft) gives way with depth to *L. saccharina* forest on boulders (Lsac.Ft). At 7 m depth, boulders give way to muddy sand and gravel, burrowed by the razor clam *Ensis arcuatus*, with a covering layer of filamentous brown algae and occasional *L. saccharina* plants (LsacX). At approximately 10 m depth the covering of filamentous red algae is replaced by a dense covering of the red alga *Trailliella* with some of the red alga *Phyllophora crispa,* the sediment being burrowed by the tube worm *Chaetopterus variopedatus*, the bivalve *Mya truncata* and terebellid worms (Tra).

At Scad Head, north-east Hoy, *Saccorhiza polyschides* forms a park on boulders, with muddy sand between, to a depth of 10 m (XKScrR), which then gives way to sand and mixed sediment with a dense covering of *Trailliella* and *Arenicola marina* within the sand (Tra). Below 16 m, muddy sand is burrowed by the echiuran worm *Amalosoma eddystonense,* with a patchy covering of *Trailliella.* At depths greater than 20 m, surveyed to a depth of 35 m, there is no algal cover on the sediment. The sea pen *Virgularia mirabilis* occurs alongside *A. eddystonense* together with some *C. variopedatus* (VirOph). In more wave-exposed areas on the north-east coast of Hoy around Bring Head, all algal communities end with the boulder slope at 8 m. Below this, a steep sediment slope is characterised by the bivalves *E. arcuatus* and *Arctica islandica* and, in deeper water to a depth of 33 m, the sea pen *V. mirabilis* (VirOph).

In areas of increased water movement, such as Clestrain Sound, Burra Sound and Hoy Sound, hard substrata are dominated by *L. hyperborea* (Lhyp.Ft). Where hard substrata are absent, such as to the west of Riddock Shoal and the Lash (both adjacent to Clestrain Sound), kelp is replaced by maerl at around 12 m depth (Phy.R).

In the central area of Clestrain Sound, scoured bedrock, dominated by the bryozoan *Flustra foliacea* and dead-man's fingers *Alcyonium digitatum*, occurs at about 30 m depth (AlcSec). Dense maerl beds also occur at the western edge of Clestrain Sound (Phy.R; Phy.HEc) and north-west of Clestrain Sound at Cairston Roads, where the maerl is mixed with maerl-sand and gravel and has a covering of attached cape form *L. saccharina* at 7 m depth (LsacX). In the deeper waters south-east of Clestrain Sound, off Houton Head, the maerl grades into coarse sand and dead maerl, burrowed by *E. arcuatus* and *Mya truncata*, with barnacles on occasional pebbles (IGS). The shallow sediment in the shelter of the Bay of Ireland comprises a rich infauna of amphipods and the bivalve *Abra alba* (AbrNucCor). This biotope is more characteristic of deeper areas, but occurs in the shallows at 7 m due to the sheltered nature of the site.

In the Moaness area of Burra Sound, *L. saccharina* kelp forest on bedrock and boulders grades into sand-covered bedrock, with species-rich sand-tolerant algal communities, including the red algae *Polyides rotundus*, *Cystoclonium purpureum*, *Dilsea carnosa* and *Cordylecladia erecta* at a depth of 9 m (XKScrR). In the Fleshes at the southern end of Burra Sound, shallow tide-swept sand, burrowed extensively by *E. arcuatus* and the heart urchin *Echinocardium cordatum*, is found at 11 m depth

(EcorEns), with sparse plants of eelgrass *Zostera marina* amongst the *L. saccharina* in shallower water from 4-11 m (LsacX).

Gravel and coarse sand dominates the area between Bring Head and Houton Head and most of the Fleshes. This sediment is subjected to considerable tidal streams where Clestrain Sound meets Burra Sound and is probably very disturbed. This is reflected in the infaunal community which comprises mainly polychaetes and oligochaetes, dominated by the polychaetes *Streptosyllis websteri* and *Aricidea minuta* (IGS). This biotope also occurs in the shallower parts of Bring Deeps, but gradually gives way to more stable gravel below 30 m which supports a hydroid community dominated by *Sertularia cupressina* (ScupHyd). Infaunal communities in Bring Deeps are very species-rich, comprising large numbers of polychaetes adapted for living in gravel, such as glycerids, syllids and *Pholoe* spp. There are also large numbers of robust amphipods and robust bivalve species, capable of living in the coarse gravel and sands, and the brittlestar *Amphipholis squamata* which lives in the interstices.

Nature conservation

Conservation sites

Site name	*Status*	*Main features*
Hoy and West Mainland	NSA; ASV	Landscape
Hoy	cSAC; pSPA; SSSI; NCR; GCR	Ornithological; botanical; geological; geomorphological
Muckle Head and Selwick	SSSI; GCR	Geomorphological
Stromness	MOD	Rock

Human influences

Coastal developments and uses

Stromness, the only major settlement within the area, discharges sewage into the Bay of Ireland and Stromness Harbour. Stromness has a mixed economy of fishing, sport diving, some light industry and is the location for a ferry terminal, providing services to mainland Scotland, Shetland and local ferries to the southern Orkney Islands.

Marine developments and uses

There is no longer any commercial fishing for demersal or pelagic fish within Area 5; the only catch of commercial value is shellfish, including lobster *Homarus gammarus*, crabs *Cancer pagurus*, *Necora puber* and *Carcinus maenas*, whelks *Buccinum undatum*, and scallops *Chlamys opercularis* and *Pecten maximus*. Scallops have been collected by both diving and dredging, but the future of the latter activity is uncertain. Recreational angling for sea trout *Salmo trutta* takes place.

There are no longer any shellfish farms within Area 5. An application for a salmon *Salmo salar* farm was submitted in 1999.

In Bring Deep, there is an emergency bad weather dump site for dredge-spoil and shellfish processing waste, which is normally dumped outside the entrance to Hoy Sound (*Area summary* 4).

References and further reading

Atkins, S.M., Jones, A.M., & Simpson, J.A. 1985. The fauna of sandy beaches in Orkney: a review. *In*: *The marine biology of the Orkney Islands*, ed. by A.M. Jones. *Proceedings of the Royal Society of Edinburgh, Section B (Biological Sciences) 87* (1/2): 27-45.

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Kerr, S.A. 1999. *Scapa Flow management strategy – final report*. Stromness, International Centre for Island Technology for Orkney Islands Council.

Nature Conservancy Council. 1981. *The shoreline of Scapa Flow. Shoreline description and treatment recommendations for oil pollution contingency planning.* Unpublished, Nature Conservancy Council, North-east (Scotland) Region. (Internal report, No. NC 182 L).

Thorpe, K. 1998. *Marine Nature Conservation Review Sectors 1 & 2. Lagoons in Shetland and Orkney: area summaries.* Peterborough, Joint Nature Conservation Committee. (Coasts and seas of the United Kingdom. MNCR series.)

Sites surveyed

Survey 449: 1995 MNCR survey of west coast Mainland and Hoy, Orkney (MNCR, unpublished data).
Survey 649: 1995 SNH ROV survey of Scapa Flow and Hoy Sound
Survey 678: 1997 MNCR sublittoral survey of Scapa Flow, Orkney (MNCR, unpublished data).
Survey 679: 1997 MNCR littoral survey of Scapa Flow, Hoy Sound & west Mainland, Orkney (MNCR, unpublished data).
Survey 683: 1997 Unicomarine infaunal survey of Hoy Sound and Shapinsay Sound.

Littoral sites

Survey	*Site*	*Place*	*Grid reference*	*Latitude/longitude*	*Biotopes recorded*
449	2	Bay of Quoys, Hoy Sound.	HY 244 036	58°54.8'N 03°18.7'W	Ver.Ver; Pel; Fspi; Asc.Asc; Fser.Fser
679	12	E of Noust of Netherton, Hoy Sound.	HY 248 077	58°57.0'N 03°18.4'W	YG; Pel; Fspi; Asc; Fser.Fser; Him; EphX; Ldig.Ldig
679	13	E of Stromness, Hoy Sound.	HY 263 088	58°57.6'N 03°16.8'W	Fspi; Fves; Asc.Asc; Fser.Fser; Ldig.Ldig
679	18	NW Holm of Houton, Scapa Flow.	HY 314 035	58°54.8'N 03°11.4'W	Pel; Fspi; AscX; Fser.Fser; Lsac.Ldig
679	20	Clestrain Skerries, Hoy Sound.	HY 290 070	58°56.6'N 03°14.0'W	Pel; Fspi; Asc.Asc; Fser.Fser; Him; Lsac.Ldig

Sublittoral sites

Survey	*Site*	*Place*	*Grid reference*	*Latitude/longitude*	*Biotopes recorded*
449	1	Moaness, Hoy, Hoy Sound.	HY 246 039	58°55.0'N 03°18.5'W	XKScrR
449	3	The Fleshes, Hoy Sound.	HY 264 034	58°54.7'N 03°16.6'W	LsacX
449	5	Scad Head, Hoy Sound.	HY 287 008	58°53.3'N 03°14.1'W	EphR; XKScrR; VirOph; Tra
449	7	Green Head, Hoy, Hoy Sound.	ND 307 992	58°52.5'N 03°12.1'W	LhypLsac.Ft; EchBriCC
449	8	W of Calf of Cava, Hoy Sound.	HY 320 003	58°53.1'N 03°10.7'W	Lhyp.Ft; Lsac.Ft; LsacX; Tra
449	9	Houton Head, Hoy Sound.	HY 304 033	58°54.7'N 03°12.5'W	FaS
449	10	Bring Head, Hoy Sound.	HY 268 021	58°54.0'N 03°16.1'W	Lsac.Ft; EcorEns; VirOph
449	11	Croo Taing, Graemsay, Hoy Sound.	HY 269 042	58°55.2'N 03°16.1'W	Lsac.Ft
449	12	SSE of Riddock Shoal, Hoy Sound.	HY 285 048	58°55.5'N 03°14.5'W	Lhyp.TPk
449	13	W of Riddock Shoal, Hoy Sound.	HY 274 052	58°55.7'N 03°15.6'W	Phy.HEc
449	14	W of Sandside Point, Hoy Sound.	HY 263 066	58°56.4'N 03°16.7'W	Phy.R
449	15	W of Moo Taing, Hoy Sound.	HY 285 079	58°57.1'N 03°14.4'W	XKScrR
449	16	Bay of Navershaw, Hoy Sound.	HY 269 089	58°57.7'N 03°16.2'W	Phy.R; LsacX
649	1	Channel north of Graemsay, Scapa Flow.	HY 253 071	58°56.7'N 03°17.8'W	Lhyp.TFt
649	2	Inner Hoy Sound, Scapa Flow.	HY 271 070	58°56.6'N 03°16.0'W	AlcSec
649	3	East Graemsay, Scapa Flow.	HY 274 043	58°55.2'N 03°15.5'W	XKScrR; Phy.R; LsacX
649	4	The Fleshes, Scapa Flow.	HY 251 038	58°54.9'N 03°18.0'W	Lhyp.Ft
649	5	N of Whaness, Scapa Flow.	HY 250 031	58°54.5'N 03°18.0'W	IMS
649	6	Bring Head, Scapa Flow.	HY 279 014	58°53.7'N 03°14.9'W	VirOph
649	7	Graemsay to Scad Head, (Bring Deeps) 1, Scapa Flow.	HY 277 033	58°54.7'N 03°15.2'W	IGS
649	8	Graemsay to Scad Head (transect) 2, Scapa Flow.	HY 280 031	58°54.5'N 03°14.9'W	IGS; LsacX
649	9	Graemsay to Scad Head (transect) 3, Scapa Flow.	HY 282 026	58°54.3'N 03°14.7'W	CGS
649	10	Graemsay to Scad Head 4, Scapa Flow.	HY 285 023	58°54.1'N 03°14.4'W	IGS
649	11	Graemsay to Scad Head 5, Scapa Flow.	HY 288 011	58°53.5'N 03°14.0'W	VirOph
649	12	Graemsay to Scad Head 6, Scapa Flow.	HY 297 022	58°54.1'N 03°13.1'W	IGS
649	13	Graemsay to Scad Head 7, Scapa Flow.	HY 302 032	58°54.6'N 03°12.6'W	IGS
649	14	Bring Deeps 1, Scapa Flow.	HY 311 005	58°53.2'N 03°11.6'W	VirOph
649	15	Bring Deeps 2, Scapa Flow.	HY 311 015	58°53.7'N 03°11.7'W	ModMx
649	16	Bring Deeps 3, Scapa Flow.	HY 298 023	58°54.1'N 03°13.0'W	Ven.Neo
649	21	Between Green Head and Cava, Scapa Flow.	HY 309 001	58°53.0'N 03°11.9'W	VirOph
683	16	Station 16.	HY 282 093	58°57.9'N 03°14.8'W	AbrNucCor
683	17	Station 17.	HY 276 077	58°57.0'N 03°15.4'W	FabMag
683	18	Station 18.	HY 267 041	58°55.1'N 03°16.3'W	SpiSpi
683	19	Station 19.	HY 260 035	58°54.7'N 03°17.0'W	IGS
683	20	Station 20.	HY 256 030	58°54.5'N 03°17.4'W	IGS
683	21	Station 21.	HY 269 024	58°54.1'N 03°16.0'W	FabMag
683	22	Station 22.	HY 285 027	58°54.3'N 03°14.3'W	ScupHyd
683	23	Station 23.	HY 280 017	58°53.8'N 03°14.9'W	CGS
683	24	Station 24.	HY 295 021	58°54.0'N 03°13.4'W	ScupHyd
683	25	Station 25.	HY 292 010	58°53.4'N 03°13.7'W	VirOph
683	26	Station 26.	HY 306 032	58°54.6'N 03°12.2'W	ScupHyd
683	27	Station 27.	HY 308 015	58°53.7'N 03°11.9'W	ScupHyd
683	28	Station 28.	ND 312 997	58°52.7'N 03°11.5'W	CMX
683	29	Station 29.	ND 320 997	58°52.7'N 03°10.7'W	IMX

Compiled by: Frank Fortune, Karen Begg & Eleanor Murray

6 Eynhallow, Wyre and Rousay Sounds

Location		
Position (centre)	HY 430 310	59°10'N 03°00'W
Administrative area	Orkney Islands	
Conservation agency area	Scottish Natural Heritage	North Areas (Northern Isles)

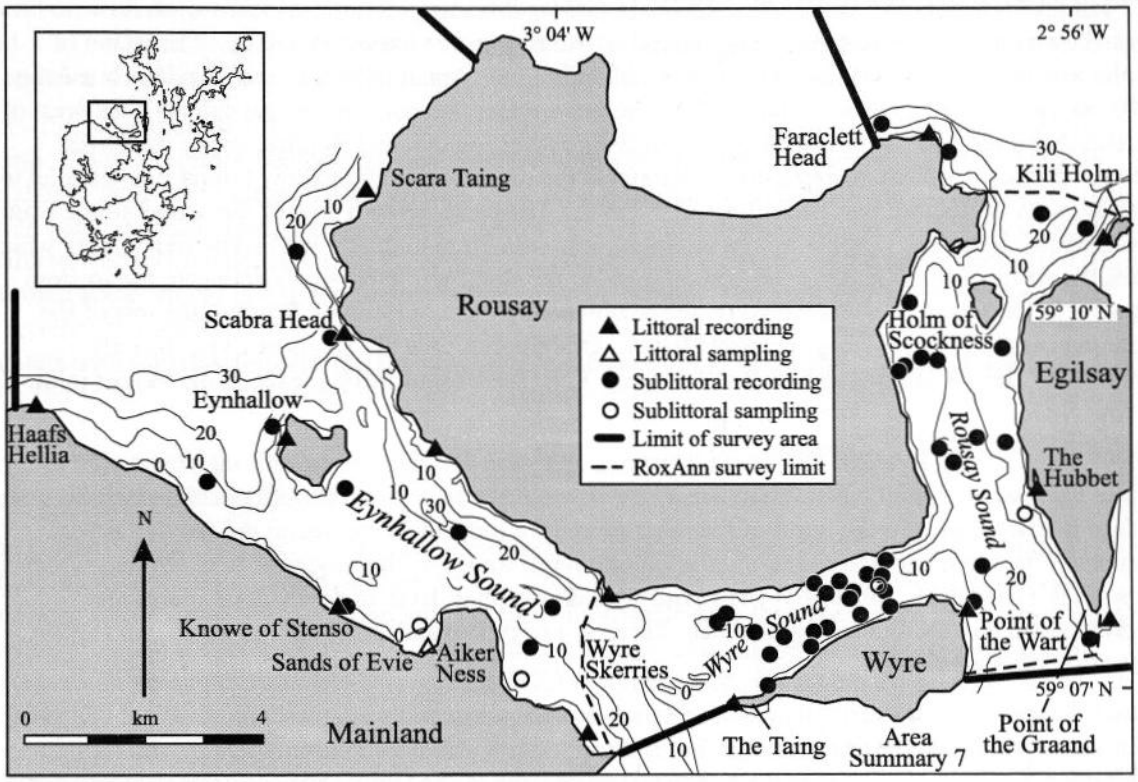

Figure 6.1 Main features of the area, showing sites surveyed.

Physical features	
Physiographic type	Sounds
Length of coast	66 km
Bathymetry	Most of the area is shallower than 30 m; the 30 m contour is found at the northern entrance of Rousay Sound and the western entrance to Eynhallow Sound. There is a deeper basin in the centre of Eynhallow Sound to a depth of 38 m. Rousay and Eynhallow Sounds have a channel in the centre exceeding 10 m depth, with large areas shallower than 10 m depth to the south of the island of Eynhallow and south-east of Holm of Scockness. Wyre Sound is predominantly less than 10 m deep.
Wave exposure	Very exposed on the west side of Rousay to sheltered in the sounds
Tidal streams	Moderately strong in Wyre and Rousay Sounds (up to 2.9 knots), strong in Eynhallow Sound (up to 3.3 knots).
Tidal range	3.3 m (mean springs); 2.3 m (mean neaps)
Salinity	Fully marine

Introduction

Eynhallow, Wyre and Rousay Sounds are situated to the south and east of the island of Rousay, which lies north-west of Orkney Mainland. They are three open-ended channels flanked by islands, through

which tidal movement is funnelled, resulting in an increase in tidal stream strength. All of the islands bordering the sounds are rural and sparsely populated, with livestock farming being the main land-use adjacent to the coast. Bedrock in the area is of hard Old Red Sandstone (Mykura 1975), which is relatively resistant to weathering, although gullies and caves have formed in the high cliffs on the north and west coasts of Rousay.

Wave exposure is very variable throughout the area due to the complexity of islands and shallows. The cliffs on western Mainland and the west side of Rousay are very exposed to wave action, whereas some areas of the sounds and shallow bays are sheltered. Sea temperatures average 7°C in winter and reach up to 14°C in summer (Lee & Ramster 1981).

Eynhallow is the largest of the sounds, separating Rousay from Orkney Mainland. The island of Eynhallow in the middle of the sound is uninhabited; it has large numbers of seabirds which use the cliffs on the west side, and seals haul-out on the low rocky platforms on the east side. To the west of the island the sea bed shelves steeply to 30 m before levelling out, and stepped, rocky platforms extend offshore. A deep, bedrock-lined channel at the north end of Eynhallow Sound runs parallel to Rousay, with the central part exceeding 30 m depth. The south-eastern area of the sound, to the south of the island, is of very shallow mixed sediment, less than 10 m in depth, with some rocky reefs which break the surface at low water, scattered throughout the shallows. High cliffs delineate the western entrance to the sound at Haafs Hellia on the Mainland and Scabra Head on Rousay; the rest of the shoreline consists of low-lying rocky platforms. On Mainland are the Sands of Evie, the only significant extent of littoral sediment in the area. Tidal streams are strong, exceeding 3 knots in the narrow channel between Eynhallow and Rousay; the shallower area on the southern side of the sound is subject to moderate tidal streams.

Where Eynhallow Sound meets Wyre Sound lie Wyre Skerries, a group of rocky reefs which break the surface at low water. To the north of the skerries and for most of Wyre Sound the sea bed is dominated by maerl and maerl-gravel, heaped into large waves by the moderate tidal streams which the sounds experience. Most of Wyre Sound is shallower than 10 m in depth. The shores are predominantly low-lying rocky platforms. There is a ferry slip and small pier on Wyre and Rousay, either side of Wyre Sound.

Rousay Sound separates the east coast of Rousay from Egilsay, with the small, uninhabited island of Holm of Scockness at the northern entrance to the sound. Tidal streams are moderate, although accelerated locally through the narrow channels either side of the Holm. The substrata throughout are generally of mixed sediment and patchy maerl. High cliffs mark the north-west entrance to the sound at Faraclett Head; here the sea bed is steep, with large gullies. The 30 m contour running from Faraclett Head to Kili Holm on the northern tip of Egilsay marks the limit of Rousay Sound.

Marine biology

Marine biological surveys

	Survey methods	*No. of sites*	*Date(s) of survey*	*Source*
Littoral	Recording (epibiota)	14	June 1996	MNCR survey no. 444
	Infaunal sampling (cores)	1	June 1996	MNCR survey no. 444
Sublittoral	Recording (epibiota)	21	June 1996	MNCR survey no. 445
	Remote survey and mapping (RoxAnn™ & ROV)	9	October 1993	Foster-Smith & Davies (1993)
	Remote survey (ROV)	17	August 1996	SNH survey no. 725
	Infaunal sampling (cores)	4	June 1996	MNCR survey no. 445

Littoral

The base of the cliffs at the western entrance to Eynhallow Sound and on the west coast of the island of Eynhallow comprise bedrock steps which are very exposed to wave action. These shores are relatively species-poor due to the high energy nature of the site, although abundance of those species present is high. Supralittoral and littoral fringe habitats are very extensive due to the high amount of wave splash from winter storms (YG, Ver.Ver). Vertical faces in the eulittoral have a dense cover of

mussels *Mytilus edulis* and barnacles (MytB), whilst horizontal faces support a mosaic of mussels, barnacles and fucoid algae characteristic of wave-exposed conditions, including *Fucus vesiculosus* var. *linearis* (BPat.Fvesl), and *Fucus distichus* on Eynhallow (Fdis). Lower eulittoral habitats are characterised by dense turfs of red algae, predominantly *Mastocarpus stellatus*, and the brown thongweed *Himanthalia elongata* (Him). At Scara Taing on the west coast of Rousay the lower eulittoral has a very dense turf of the red alga *Corallina officinalis* (Coff). Sublittoral fringe communities are dominated by dabberlocks *Alaria esculenta* with mussels and coralline crusts beneath (Ala.Myt). Cliffs on the north coast of Rousay, at the entrance to Rousay Sound, have a similar topography although they are not subject to the Atlantic swells experienced on the west coast; however, with deep water inshore, they are still subject to strong wave action. On these shores the mid- and lower eulittoral are essentially similar in character, although the upper eulittoral has a cover of spiral wrack *Fucus spiralis* (Fspi), and the supralittoral zones are not so extensive.

Very steep bedrock shores occur on the north side of Eynhallow Sound and the east side of Wyre island. These comprise bedrock dipping seaward with vertical steps throughout the shore running parallel to the water's edge. These vertical steps provide localised shelter for fucoid algae and small pools with coralline algae. The very steep bedrock is subjected to moderate wave action and is characterised by channelled wrack *Pelvetia canaliculata* and *F. spiralis* on the upper shore (Pel, Fspi), afforded some shelter due to the rugged nature of the substrata. The mid- and lower eulittoral experience more wave action and are similar in biological character to the more exposed rocky habitats with mussels amongst the fucoid-barnacle mosaics in the mid-eulittoral and *H. elongata* with red algae in the lower eulittoral (Him). Sublittoral fringe communities have a very dense cover of kelp species, particularly *Laminaria digitata* and *Alaria esculenta*, and coralline crusts on the rock beneath (Ala.Ldig); the absence of mussels from this habitat suggests less wave surge compared to the west and north coasts of Rousay.

The majority of rocky shores in the area are of gently-sloping broken bedrock and stable boulders which are moderately exposed to wave action. The backing for these shores are low-lying grazing land with upper shores of broken, mobile cobbles and shingle with the lichen zone generally absent. Littoral zonation is fucoid-dominated, with dense *P. canaliculata* in the littoral fringe (Pel), and *F. spiralis* in the upper eulittoral (Fspi). Mid-eulittoral habitats are characterised by a mosaic of bladder wrack *Fucus vesiculosus* and barnacles *Semibalanus balanoides* (FvesB). Lower shore communities have a dense cover of serrated wrack *Fucus serratus* (Fser.Fser); in areas of stronger tidal movement, such as at the Knowe of Stenso and the north side of Wyre, there is a dense turf of 0red algae beneath the *F. serratus* (Fser.R). Sublittoral fringe communities are generally dominated by *L. digitata* (Ldig.Ldig).

An extensive area of rocky shore between the islands of Kili Holm and Egilsay comprises medium-sized boulders across which significant tidal streams flow. Lower shore communities are dominated by *F. serratus* (Fser.Fser.Bo). Under-boulder communities on the lower shore are very rich, with sponges and ascidians encrusting under-boulder surfaces and brittlestars lying beneath the boulders.

The Hubbet, a small muddy inlet on the west side of Egilsay has a bedrock sill restricting water exchange from Rousay Sound. The bedrock sill is very sheltered from wave action with a dense growth of fucoid algae throughout the zones. On the seaward side of the inlet there are a series of sand-filled drainage pools, with some cobbles and a dense canopy of algae, particularly bootlace weed *Chorda filum*, sea oak *Halidrys siliquosa*, cape form *L. digitata* and large plants of the green alga *Codium* sp. All of the algae are heavily epiphytised by sponges, ascidians, bryozoans and the hydroid *Clava multicornis* (SwSed).

Littoral sediment is limited to shingle at the top of some rocky shores and the sandy bay at the Sands of Evie. The latter shore comprises gravel and medium to coarse sand, moderately exposed to wave action and dominated by lugworm *Arenicola marina* with some areas burrowed by cockles *Cerastoderma edule* (LMX).

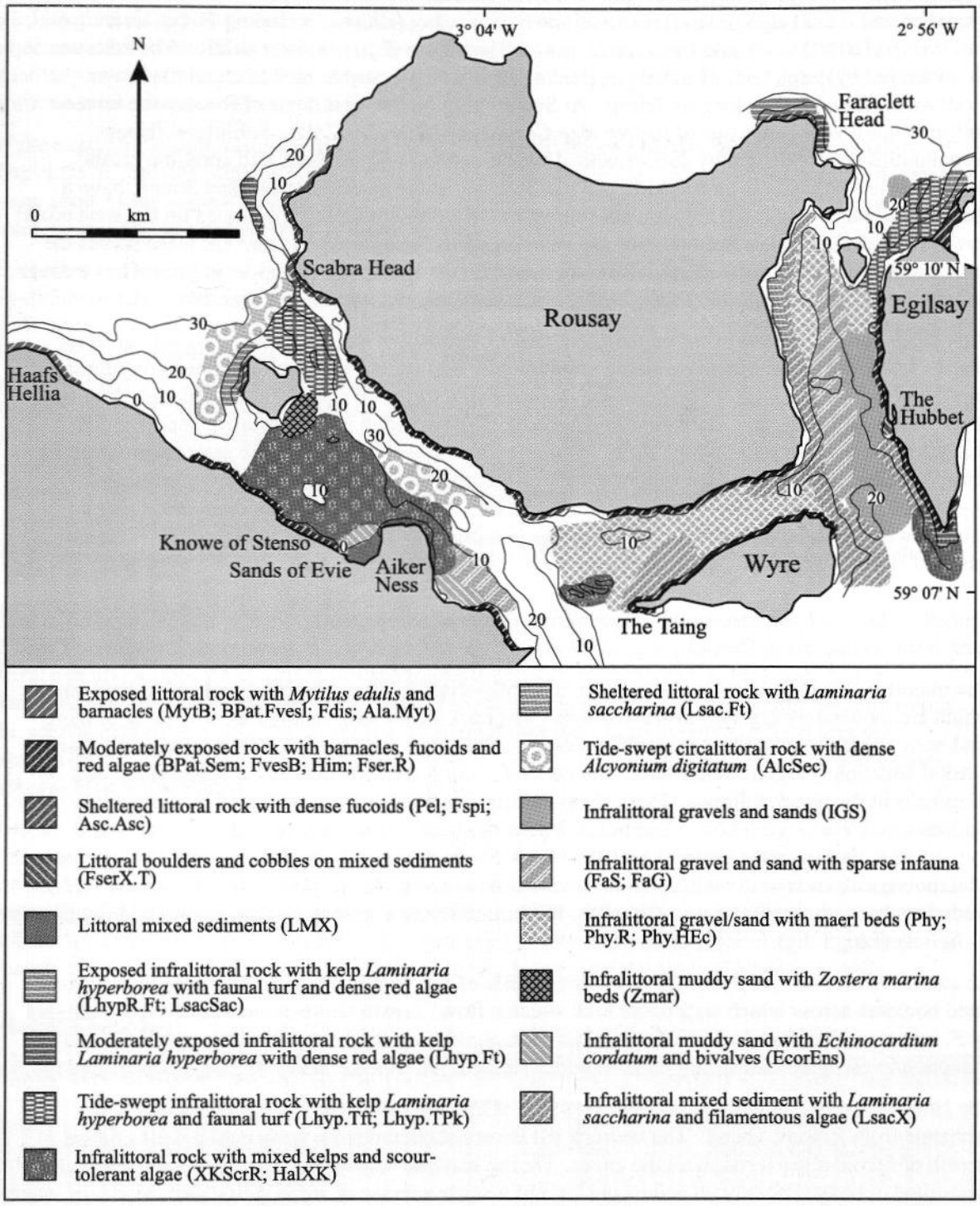

Figure 6.2 Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 6.1, cited literature and additional field observations).

Sublittoral

Although having a similar physiographic character, the sublittoral habitats of Eynhallow, Rousay and Wyre Sounds are very different from each other. Eynhallow Sound is characterised by tide-swept

bedrock platforms, with the exception of the shallows south of Eynhallow, which are of kelp-dominated mixed rock and sediment. Wyre Sound comprises dense maerl and maerl-gravel, whilst Rousay Sound is essentially sediment-dominated, with patches of boulders, cobbles, maerl-gravel and sand.

The deeper, stepped bedrock at the western entrance to Eynhallow Sound and the northern entrance to Rousay Sound are similar to each other in character, with dense tide-swept kelp forest in the infralittoral and rugged bedrock with a faunal turf in the circalittoral. Kelp forests are dominated by dense *Laminaria hyperborea* with red algae, particularly *Phycodrys rubens*, *Cryptopleura ramosa* and *Ptilota gunneri* encrusting the stipes (Lhyp.TFt). They are subject to moderate tidal streams and have hydroids and anemones, particularly *Sertularia argentea* and *Sagartia elegans*, in the understorey with red algae *Odonthalia dentata*, *Delesseria sanguinea* and *Trailliella intricata* covering the rock surfaces. The sponges *Haliclona viscosa* and *Myxilla incrustans* encrust the rock; breadcrumb sponge *Halichondria panicea* generally encrusts the kelp stipes. In shallower areas the dominant sponge is *Esperiopsis fucorum*, which encrusts both the rock and stipes. Vertical faces in the kelp forest are devoid of algae, with a dense cover of *Alcyonium digitatum* (AlcByH). Between the *A. digitatum* is a faunal turf dominated by hydroids, bryozoans and ascidians. Hydroid species comprise mainly *Abietinaria abietina* and *Sertularia argentea*, with some *Tubularia indivisa* on rock edges where water movement is stronger. Colonial ascidians, particularly *Polyclinum aurantium*, *Aplidium punctum* and *Morchellium argus*, encrust vertical faces.

Open tide-swept bedrock in the circalittoral below the kelp forests and in the centre of Eynhallow Sound has a dense faunal turf (AlcSec). The turf is dominated by *A. digitatum* and the bryozoans *Securiflustra securifrons* and *Flustra foliacea*. Hydroid communities are characterised by *A. abietina*, *Nemertesia antennina* and the bottle-brush hydroid *Thuiaria thuja*, an Arctic species with a northern distribution. There are numerous sponges associated with the faunal turf, particularly massive growths of *M. incrustans*, *Cliona celata* and *Pachymatisma johnstonia* and the smaller *Suberites ficus* in the centre of Eynhallow Sound.

Shallow areas on the southern side of Eynhallow Sound comprise mixed substrata with ephemeral algal species attached to pebbles and gravel, with pockets of sediment in the small embayments. Cobbles and boulders in the infralittoral, subject to scour, have a dense canopy of the kelps *Laminaria saccharina* and *Saccorhiza polyschides* with *Chorda filum* attached to smaller pebbles and shells (XKScrR). Rock surfaces adjacent to the coarse sand support scour-tolerant algae, such as *Halidrys siliquosa* and *Polyides rotundus* attached. Boulder holes and crevices provide haven for crabs, especially *Necora puber*, and the ascidian *Ascidia mentula*. Mixed sediment to the west of Wyre Skerries has dense patches of live maerl, between kelp-dominated cobbles supporting assemblages similar to those in Rousay and Wyre Sounds (XKScrR).

Sediment in Eynhallow Sound is restricted to the bays either side of Aiker Ness and to the east of Eynhallow. Medium and fine sand to the east and west of Aiker Ness is characterised by razor clams *Ensis* sp. and the urchin *Echinocardium cordatum* (EcorEns) with tide-swept coarse sand with no apparent infauna offshore east of Aiker Ness (FaS). A large expanse of medium and fine sand to the east of Eynhallow has similar infaunal assemblages to the other sediments, but with a greater diversity of bivalve species. The habitat has a dense epifloral assemblage of eelgrass *Zostera marina* with the kelps *L. saccharina* and, unusually for this habitat, *Alaria esculenta* between (Zmar).

Wyre Sound consists predominantly of shallow, tide-swept maerl and maerl-gravel heaped into waves which run perpendicular to the tidal streams. The crests of the waves are predominantly of live maerl *Phymatolithon calcareum* (approx. 50% cover), with maerl-gravel and empty shells in the troughs (Phy.R). Epiflora comprises brown algae, predominantly *L. saccharina*, *C. filum*, *Desmarestia* spp. and ectocarpoids. Infauna are sparse, but include some bivalve species including *Paphia rhomboides*, *Dosinia exoleta* and *Circomphalus casina*. There are occasional burrowing sea cucumbers *Neopentadactyla mixta* on the wave crests. At the eastern end of the sound, between the ferry slipways, there is a very large bank of patchy live maerl and maerl-gravel at 3 m depth, sloping steeply to the east, where the percentage of live maerl increases.

The northernmost entrance to Rousay Sound is exposed to wave action, and sublittoral rock supports dense kelp forest with an understorey rich in red algae (LhypR.Ft). The majority of the Sound is characterised by mixed sediment with patches of maerl and ephemeral algae attached. The northern reaches of the sound comprised dense patches of maerl with a similar infauna of bivalves to that of Eynhallow Sound (Phy.HEc; Phy.R). Towards the south of Rousay Sound, the sediment comprises pebbles and coarse sand with a conspicuous infauna of sabellid fanworms, the sand mason worm *Lanice conchilega*, and *Ensis* spp. (FaG; IGS) Algal communities are dominated by *L. saccharina*, *C. filum*, *Desmarestia* spp. and some foliose red algae attached to cobbles and pebbles (LsacX).

Nature conservation

Conservation sites

Site name	*Status*	*Main features*
Eynhallow	SSSI	Common seals *Phoca vitulina*; ornithological
Rousay	pSPA; SSSI	Ornithological; botanical

Human influences

Coastal developments and uses

The coast surrounding the area is sparsely populated, the main land-use being livestock grazing. Domestic sewage is mainly deposited in septic tanks which may seep onto the shore, although no signs of enrichment or sewage were observed in the area. A small car ferry links the islands of Rousay, Wyre and Egilsay to Orkney Mainland; there are ferry slips on each of the islands.

Marine developments and uses

The area supports one of the larger Orkney creel fisheries, potting for velvet crabs, edible crabs *Cancer pagurus* and lobsters *Homarus gammarus*. 'Spooting', the collecting of razor clams *Ensis* sp. low on the shore, is a popular activity at low spring tides. There are licences for a salmon *Salmo salar* hatchery and a salmon farm in Rousay Sound, and a halibut *Hippoglossus hippoglossus* farm in Wyre Sound (La Tene Maps 1999).

In 1995, a licence was granted for suction-dredging of maerl in Wyre Sound, to take 4000 m^3 per year over a five-year period. The maerl is intended for use as a filtration medium in the aquarium business.

References and further reading

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Sites surveyed

Survey 444: 1995 MNCR littoral survey of Wyre, Eynhallow and Rousay Sounds (MNCR, unpublished data).
Survey 445: 1996 MNCR sublittoral survey of Wyre, Eynhallow and Rousay Sounds (MNCR, unpublished data).
Survey 692: 1993 SNH ROV survey of Rousay Sound and Shapinsay (Foster-Smith & Davies 1993)
Survey 725: 1996 SNH ROV survey of Wyre Sound, Orkney.

Littoral sites

Survey	*Site*	*Place*	*Grid reference*	*Latitude/longitude*	*Biotopes recorded*
444	1	Evie Sands, Eynhallow Sound.	HY 377 264	59°07.2'N 03°05.3'W	LMX
444	2	N of Ness of Woodwick, Eynhallow Sound.	HY 400 251	59°06.5'N 03°02.8'W	Ver.Ver; Pel; Fspi; FvesB; Fser.Fser; Ldig.Ldig
444	3	Ayre of Skersie, Rousay Sound.	HY 455 270	59°07.6'N 02°57.1'W	Pel; Ent; BPat.Sem; FK; Fser.R; Lhyp.Ft
444	4	The Taing, Wyre Sound.	HY 421 256	59°06.8'N 03°00.6'W	YG; Ver.B; Fspi; FvesB; Fser.Fser; Ldig.Ldig
444	5	Sole Geo, Eynhallow Sound.	HY 320 298	59°09.0'N 03°11.3'W	Ver.Ver; Fspi; FK; MytB; Him
444	6	Knowe of Stenso, Eynhallow Sound.	HY 363 267	59°07.3'N 03°06.7'W	Fspi; FvesB; Fser.R; Ldig.Ldig
444	7	S of Marlow, Rousay Sound.	HY 474 323	59°10.4'N 02°55.2'W	Pel; Fspi; Asc.Asc; FK; Fser.Fser.Bo; Him; LsacSac; Lhyp.Ft
444	8	Quear of Eastafea, Rousay Sound.	HY 449 337	59°11.2'N 02°57.8'W	Pra; Fspi; MytB; FK; Him; Ala.Myt
444	9	Taing of Tratland, Eynhallow Sound.	HY 403 272	59°07.6'N 03°02.5'W	Pel; Fspi; Asc.Asc; Fser.Fser; Lhyp.Ft
444	10	Moa Ness, Eynhallow Sound.	HY 378 293	59°08.7'N 03°05.2'W	Ver.Ver; Pel; Fspi; FvesB; Him; LsacSac
444	11	The Hubbet, Rousay Sound.	HY 465 286	59°08.4'N 02°56.1'W	Pel; Asc.Asc; SwSed; FserX.T
444	12	Point of the Graand, Rousay Sound.	HY 475 268	59°07.5'N 02°55.0'W	YG; Pel; Fspi; FvesB; Fser.R; Lhyp.Ft
444	13	S of Scabra Head, Eynhallow Sound.	HY 364 309	59°09.6'N 03°06.7'W	YG; Ver.Ver; Ver.B; MytB; BPat.Fvesl; FK; Cor; Ala.Ldig; SC
444	14	Scara Taing, Eynhallow Sound.	HY 368 332	59°10.8'N 03°06.3'W	YG; Ver.Por; MytB; BPat.Fvesl; XR; Ala.Ldig
444	15	Eynhallow Island, Eynhallow Sound.	HY 356 294	59°08.8'N 03°07.5'W	Fdis; Him; Ala.Myt

Sublittoral sites

Survey	*Site*	*Place*	*Grid reference*	*Latitude/longitude*	*Biotopes recorded*
445	1	Point of the Wart, Rousay Sound.	HY 454 270	59°07.6'N 02°57.1'W	LhypLsac.Ft; LsacX
445	2	Wyre Sound.	HY 433 273	59°07.7'N 02°59.3'W	Phy
445	3	W of Wyre Skerries, Wyre Sound.	HY 416 255	59°06.7'N 03°01.1'W	XKScrR; Phy.R
445	4	Between the jetties, Wyre Sound.	HY 442 272	59°07.7'N 02°58.5'W	Phy.R
445	5	E of Point of Avelshay, Rousay Sound.	HY 453 290	59°08.6'N 02°57.3'W	LsacX; Phy.HEc
445	6	Point of the Graand, Rousay Sound.	HY 471 264	59°07.3'N 02°55.3'W	XKScrR
445	7	S of Muckle Brig, Rousay Sound.	HY 444 303	59°09.4'N 02°58.2'W	Lsac.Ft; LsacX
445	8	S of the Hubbet, Rousay Sound.	HY 462 282	59°08.2'N 02°56.3'W	LsacX
445	9	Off Point of Hisber, Eynhallow Sound.	HY 364 269	59°07.4'N 03°06.5'W	XKScrR
445	10	N of Point of Vastray, Eynhallow Sound.	HY 389 258	59°06.9'N 03°03.9'W	EcorEns
445	11	Off Quear of Eastafea, Rousay Sound.	HY 450 334	59°11.0'N 02°57.6'W	Lhyp.Ft
445	12	Off Sands of Evie, Eynhallow Sound.	HY 375 266	59°07.3'N 03°05.4'W	EcorEns
445	13	N of Taing of Tratland, Eynhallow Sound.	HY 381 279	59°08.0'N 03°04.8'W	AlcSec
445	14	Mid Rousay Sound.	HY 450 292	59°08.8'N 02°57.6'W	LsacX

Sublittoral sites continued

Survey	*Site*	*Place*	*Grid reference*	*Latitude/longitude*	*Biotopes recorded*
445	15	S of Howie Sound, Rousay Sound.	HY 458 306	59°09.5'N 02°56.7'W	FaG; HalXK
445	16	E of Aiker Ness, Eynhallow Sound.	HY 394 269	59°07.5'N 03°03.5'W	XKScrR
445	17	Egilsay's Revenge, Rousay Sound.	HY 471 323	59°10.5'N 02°55.5'W	Lhyp.TFt
445	18	N tip of Faraclett Head, Rousay Sound.	HY 441 339	59°11.3'N 02°58.6'W	LhypR.Ft; Lhyp.Ft; Lhyp.TPk; CorMetAlc; SCAs.ByH
445	19	N of Ayre Skersi, Wyre Sound.	HY 442 272	59°07.7'N 02°58.4'W	LsacX
445	20	E of Eynhallow Island, Eynhallow Sound.	HY 365 287	59°08.4'N 03°06.5'W	Zmar
445	21	E of Braga Reef, Eynhallow Sound.	HY 344 288	59°08.4'N 03°08.7'W	AlcSec
445	22	S of Scabra Head, Eynhallow Sound.	HY 362 309	59°09.6'N 03°06.9'W	FoR; AlcByH; Lhyp.TFt
445	23	N of Aiker Ness, Eynhallow Sound.	HY 391 263	59°07.1'N 03°03.7'W	FaS
445	24	W of Eynhallow, Eynhallow Sound.	HY 354 295	59°08.9'N 03°07.7'W	LhypR.Ft; AlcByH
445	25	W of Quoynalonga Ness, Eynhallow Sound.	HY 357 321	59°10.2'N 03°07.4'W	Lhyp.Ft; AlcByH
692	1	NE of Holm of Scockness, N of Rousay Sound.	HY 464 325	59°10.6'N 02°56.2'W	IGS
692	2	E of Holm of Scockness, Rousay Sound.	HY 445 312	59°09.8'N 02°58.1'W	Lsac.Ft; LsacX
692	3	Gord of Banks (inshore), Rousay Sound.	HY 445 304	59°09.4'N 02°58.1'W	Lsac.Ft
692	4	Gord of Banks (offshore), Rousay Sound.	HY 447 305	59°09.4'N 02°57.9'W	LsacX; Phy.R
692	5	NE of Kirk Noust 2, Rousay Sound.	HY 450 305	59°09.4'N 02°57.7'W	LhypLsac.Ft; Phy.R
692	6	NE of Kirk Noust 1, Rousay Sound.	HY 456 294	59°08.9'N 02°57.0'W	LsacX; IGS
692	7	W of Bay of Skaill, Rousay Sound.	HY 459 293	59°08.8'N 02°56.6'W	IGS
692	8	NE of Wyre, south Rousay Sound.	HY 456 275	59°07.8'N 02°57.0'W	LsacX; Phy.R
692	9	Wyre Sound.	HY 438 271	59°07.6'N 02°58.8'W	LsacX; Phy.R
725	1	N of Wyre Ferry Pier, Wyre Sound.	HY 443 270	59°07.6'N 02°58.3'W	Phy.R
725	2	SW of Rousay Ferry Pier 2, Wyre Sound.	HY 441 274	59°07.8'N 02°58.5'W	IGS; Phy.R
725	3	Near shore to SW of Brinian Ho, Wyre Sound.	HY 442 276	59°07.9'N 02°58.5'W	LsacX
725	4	SW of Rousay Ferry Pier 1, Wyre Sound.	HY 440 274	59°07.8'N 02°58.7'W	LsacX
725	5	From W of extraction site to E of extraction site, Wyre Sound.	HY 437 273	59°07.7'N 02°58.9'W	Phy.R
725	6	Transect to NW of the Bu, Wyre, Wyre Sound.	HY 439 268	59°07.5'N 02°58.7'W	Phy.R
725	7	Centre of extraction site, Wyre Sound.	HY 438 271	59°07.6'N 02°58.8'W	Phy.R
725	8	SW of Rousay Ferry Pier, Wyre Sound.	HY 435 271	59°07.6'N 02°59.1'W	Phy.R
725	9	Point of Hallbreck east, Wyre Sound.	HY 434 266	59°07.4'N 02°59.2'W	Phy.R
725	10	Point of Hallbreck, west, Wyre Sound.	HY 432 266	59°07.3'N 02°59.5'W	Phy.R
725	11	Point of Hallbreck, Wyre Sound.	HY 432 264	59°07.2'N 02°59.5'W	Phy.R
725	12	SE of the Taing of Trumland, Wyre Sound.	HY 428 265	59°07.3'N 02°59.9'W	LsacX
725	13	N of the Taing, Wyre, mid-channel, Wyre Sound.	HY 426 263	59°07.2'N 03°00.1'W	LsacX
725	14	Bay of Whelkmulli, Wyre Sound.	HY 425 258	59°06.9'N 03°00.2'W	LsacX
725	15	SW of Taing of Trumland, Wyre Sound.	HY 424 266	59°07.3'N 03°00.3'W	Phy.R
725	16	S of Nearhouse 1, Wyre Sound.	HY 418 267	59°07.4'N 03°00.9'W	Phy.R
725	17	S of Nearhouse 2, Wyre Sound.	HY 418 266	59°07.4'N 03°00.9'W	FaS

Compiled by: Eleanor Murray