

Marine Nature Conservation Review

Sector 1

Shetland

Area summaries

Christine Howson



1999

Series editor: David Connor

10

Dury Voe

Location

Position (centre)	HU 480 620	60°20.3'N 01°07.8'W
Administrative area	Shetland Islands	
Conservation agency/area	Scottish Natural Heritage	North Areas (Northern Isles)

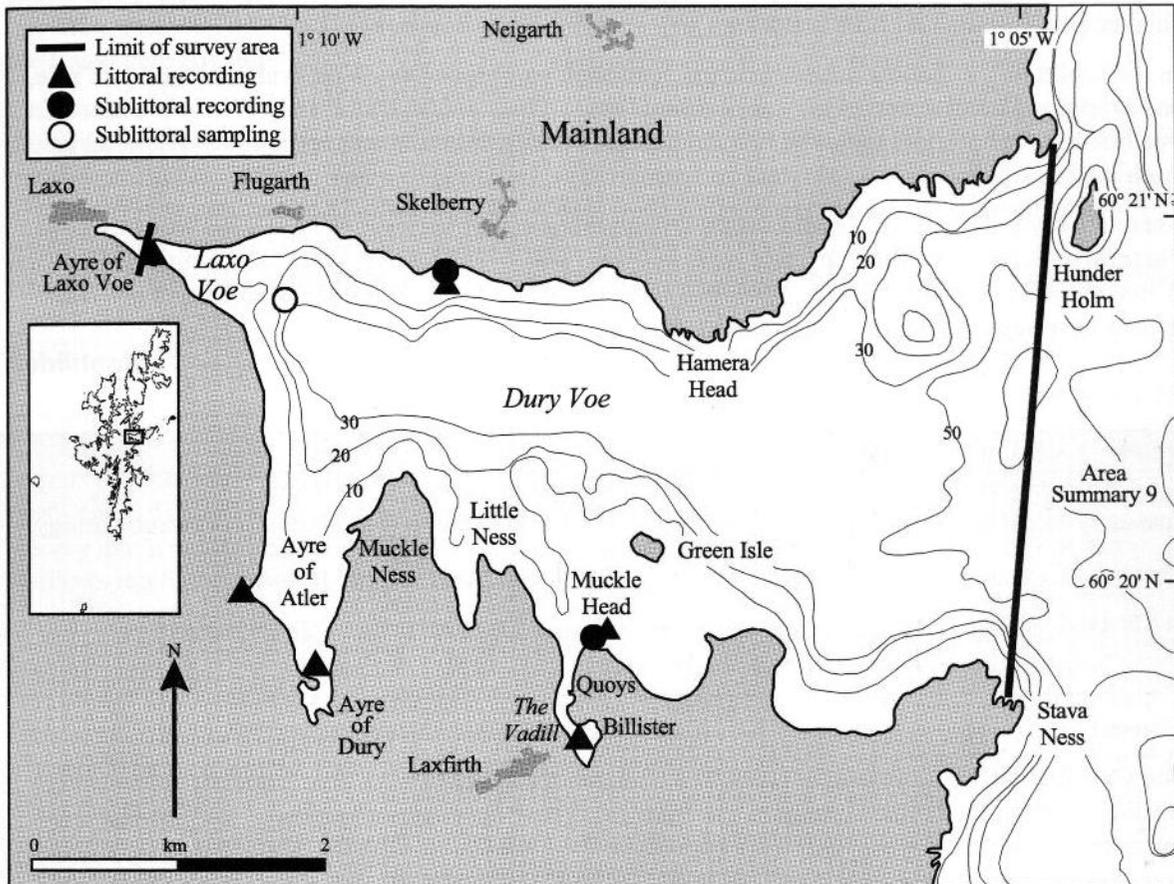


Figure 10.1 Main features of the area, showing sites surveyed.

© Crown copyright. All rights reserved. JNCC GD27254X/1999.

Physical features

Physiographic type	Voe
Length of coast	25.9 km
Area of inlet	14.6 km ²
Bathymetry	Maximum depth 59 m at entrance; 30 m near head of voe
Wave exposure	Moderately exposed at entrance to extremely sheltered; mostly sheltered
Tidal streams	Negligible
Tidal range	1.8 m (mean springs); 0.9 m (mean neaps)
Salinity	Fully marine; probably variable in houbes and vadills

Introduction

Dury Voe, on the east coast of Mainland Shetland, is one of the largest and deepest of the Shetland voes, with a maximum depth of 59 m at its entrance. The voe is relatively broad and has three small arms or side inlets into which sizeable streams enter, forming small muddy houbes. The entrance to Dury Voe is partly sheltered by the islands of Whalsay and West Linga (*Area summary 9*) but because

of its width, moderately exposed conditions are found at the entrance and some distance into the voe along the north shore. There is then a gradation to extremely sheltered conditions in the inner arms. Moderate tidal streams flow past the entrance to the voe but there is little if any tidal flow within the voe itself. The area is fully marine, with localised areas of variable or low salinity where streams enter.

Bedrock fringes the entrance to Dury Voe, the north coast and headlands whilst the small bays and the sides of the inner arms have shingle and mixed sediment beaches. There are shingle spits across the entrances to the houbts at Laxo Voe (Thorpe 1998) and Ayre of Dury with muddy sand basins behind these. There is one of the largest areas of saltmarsh in Shetland at the head of Ayre of Dury with smaller patches at the Ayre of Laxo Voe.

In the sublittoral, a shallow mixed rock and sand shelf surrounds Dury Voe, wider on the south side, and dropping steeply into a muddy sand central basin. There are depths of over 30 m at the head of the voe but it shallows rapidly into the two inner arms. There is little information for the sublittoral in Area 10.

There are several roads and small villages around the voe, and ferries to Whalsay run from a pier at Flugarth on Laxo Voe. There are also piers at Quoys and Ayre of Atler. Much of the surrounding land is steep hillside supporting rough grazing. There are salmon *Salmo salar* cages on Dury Voe. The houses have septic tanks and water quality is good.

Marine biology

Marine biological surveys				
	Survey methods	No. of sites	Date(s) of survey	Source
Littoral	Recording	4	July-August 1974	Institute of Terrestrial Ecology (1975a)
	Recording	2	August 1987	Howson (1988)
Sublittoral	Recording	2	July-August 1974	Institute of Terrestrial Ecology (1975b); Earll (1982)
	Infaunal sampling (grab)	1	1963	Pearson, Coates & Duncan (1994)

Littoral

The shoreline on the south side of Dury Voe consists of a series of bays or small inlets separated by headlands whilst the northern shore is less indented. These headlands and most of the northern shore and entrance area have steep, unbroken bedrock in the littoral zone with the embayments having more gradually sloping shingle and mixed sediment beaches. The houbts at Laxo Voe (Thorpe 1998) and Ayre of Dury and the Vadill at Billister have extremely sheltered basins fringed by bedrock and boulder with sediment flats of peaty gravel and muddy sand. Freshwater streams entering the voe via these inlets have cut stream beds with steep banks in places and create conditions of locally reduced or variable salinity. There are shingle spits across the entrances to the two houbts; salt water may percolate through the shingle.

The data for the shores are limited to six sites around Dury Voe but these illustrate the range of habitat types and the transition from moderately exposed to extremely sheltered conditions. Moderately exposed bedrock in the middle regions of the voe supports yellow and grey lichens in the supralittoral whilst the littoral fringe has a band of the black lichen *Verrucaria maura* (YG; Ver.Ver). Below this is a band of the furoid alga *Pelvetia canaliculata* (Pel) with the addition of *Fucus spiralis* on the more sheltered south coast of the voe (Fspi). Barnacles *Semibalanus balanoides* and limpets *Patella vulgata* form a distinct mid-eulittoral band (BPat.Sem) with a mosaic of the furoid *Fucus vesiculosus* and barnacles lower on the shore (FvesB). On the more exposed north coast of the voe, this biotope gives way to thongweed *Himanthalia elongata* and red algae in the lower eulittoral (Him) and then a zone of kelps *Alaria esculenta* and *Laminaria digitata* in the sublittoral fringe (Ala.Ldig). On the south coast, *F. vesiculosus* is more abundant in the eulittoral zone and whilst there are patches of barnacles and limpets and a furoid-barnacle mosaic, there is also an area blanketed by

F. vesiculosus (Fves). The lower eulittoral and sublittoral fringe biotopes here are similar to the north coast of the voe. In contrast, bedrock on the upper shore in extremely sheltered conditions around the Vadill supports dense *P. canaliculata* followed by a blanket of the fucoid *Ascophyllum nodosum* (Asc).

Shingle, gravel and coarse sediment in sheltered conditions at Ayre of Adler supports a suite of biotopes characteristic of the unstable substrata. *S. balanoides* covers many of the cobbles across the width of the shore with scattered fucoids according to the height on the shore: *F. spiralis* in the upper eulittoral and *F. vesiculosus* and *A. nodosum* in the mid-eulittoral (FvesX, AscX). The mussel *Mytilus edulis* is found amongst the *F. vesiculosus*. Fucoids are sparse where the coarse sediment increases, and more mussels, littorinids *Littorina littorea* and *Littorina saxatilis* and cockles *Cerastoderma edule* are found here (BLlit).

Plains of peaty gravel and muddy sand in the sheltered basins at the Vadill and Ayre of Dury have scattered boulders on the surface which support *F. vesiculosus* and *F. serratus*, *L. littorea* and the barnacle *Balanus crenatus*. The sediment itself is dominated by lugworm *Arenicola marina* with the bivalves *Mya arenaria* and *C. edule* (LMX). Where fresh water enters these basins, the brackish-water fucoid *Fucus ceranoides* occurs attached to stones and boulders (FcerX). This species is particularly abundant in the stream bed at Ayre of Laxo Voe along with the green alga *Enteromorpha* sp.

Sublittoral

A shallow shelf of coarse sand, which is particularly broad along the south shore, is extensive in the sublittoral around Dury Voe. There is a bedrock slope inshore reaching depths of a few metres, and islands of rock and boulders on the sand to depths of at least 7 m on the south coast and 13 m on the north coast. The coarse sand slope is fairly gradual to about 20 m, beyond which depth it drops steeply into a muddy sand central basin. There are depths of over 30 m at the head of the voe but it shallows rapidly into the two inner arms.

There is very little biological information for the sublittoral zone in Area 10. The bedrock and boulders support a sparse kelp forest of small *Laminaria hyperborea* with scattered *Laminaria saccharina* in the understory (XKScrR). The brittlestar *Ophiocomina nigra* is common on the kelp fronds and small numbers of juvenile queen scallops *Aequipecten opercularis* occur on the sea bed. The sand supports foliose algae with the grazing molluscs *Rissoa parva* and *Gibbula cineraria* whilst the burrowing urchin *Spatangus purpureus* is found in the sediment at 13 m. Muddy sand and shell debris at 28 m depth at the head of Dury Voe contains polychaetes *Scoloplos armiger* and *Nephtys* spp., the bivalve *Abra alba* and the amphipod *Dexamine* sp. (SpMeg).

Nature conservation

Conservation sites		
Site name	Status	Main features
Laxo Burn	SSSI	Botanical
Shetland Islands	ESA	Agri-environmental scheme

Human influences

Coastal developments and uses

There are several small villages around Dury Voe and piers at Flugarth (for the ferry to Whalsay), Ayre of Adler and Quoys. The houses have septic tanks and water quality is good. The majority of the hinterland is rough grazing with a small amount of improved grassland.

Marine developments and uses

There is a fin-fish farm on Dury Voe. Potting for crustaceans is carried out around the inshore rocky coast. Small fishing boats use the piers and moor at times in the embayments.

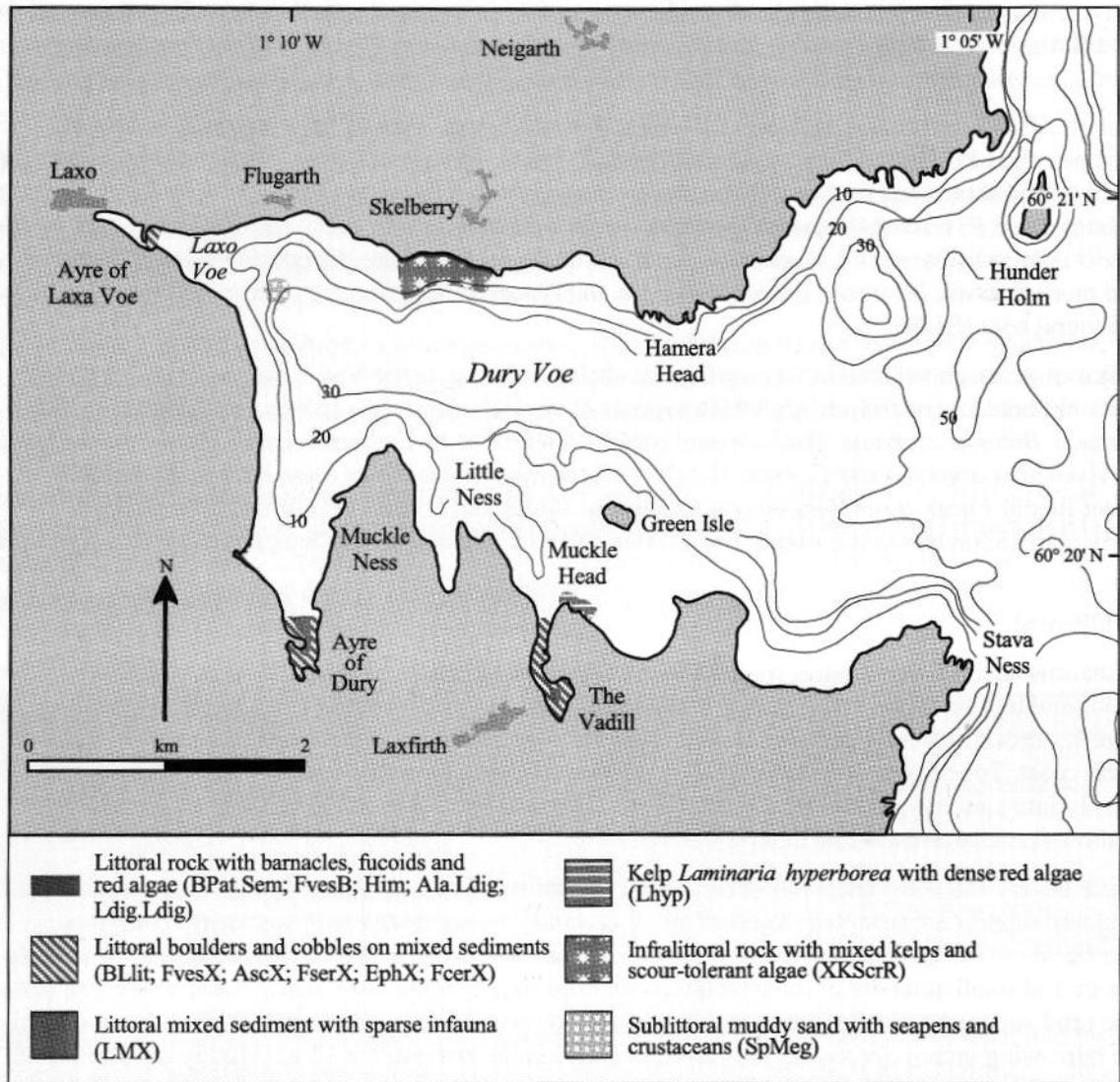


Figure 10.2 Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 10.1, cited literature and additional field observations).

© Crown copyright. All rights reserved. JNCC GD27254X/1999.

References and further reading

- Earll, R.C. 1982. Report on a sublittoral survey of Shetland. (Contractor: Underwater Conservation Society, Ross-on-Wye.) *Nature Conservancy Council, CSD Report*, No. 466.
- Howson, C.M. 1988. Marine Nature Conservation Review: survey of Shetland, Foula and Fair Isle, 1987. (Contractor: Field Studies Council, Oil Pollution Research Unit, Pembroke.) *Nature Conservancy Council, CSD Report*, No. 816.
- Institute of Terrestrial Ecology. 1975a. Report to the Nature Conservancy Council on some aspects of the ecology of Shetland. Part 6.2. Littoral biota of rocky shores. *Nature Conservancy Council, CSD Report*, No. 27.
- Institute of Terrestrial Ecology. 1975b. Report to the Nature Conservancy Council on some aspects of the ecology of Shetland. 6.4: Sublittoral biota. *Nature Conservancy Council, CSD Report*, No. 30.

Pearson, T.H., Coates, A., & Duncan, J.A.R. 1994. Shetland subtidal sediment community analysis. Report on analysis of subtidal sediment data from Shetland to identify community types present. (Contractor: SEAS Ltd, Oban.) *JNCC Report*, No. 191. (Marine Nature Conservation Review Report, No. MNCR/OR/20.) (SEAS Report, No. SR64.).

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 30: 1974 ITE report on sublittoral biota of Shetland (Institute of Terrestrial Ecology 1975b; Earll 1982)

Survey 261: 1986/87 OPRU/MNCR survey of Shetland, Foula and Fair Isle (Howson 1988).

Survey 377: 1963 DAFS sublittoral survey at Shetland (Pearson, Coates & Duncan 1994).

Survey 434: 1974 ITE report on rocky shore ecology of Shetland (Institute of Terrestrial Ecology 1975a).

Littoral sites					
Survey	Site	Site name	Grid reference	Latitude/longitude	Biotopes recorded
261	104	The Vadill, North Nesting, Dury Voe.	HU 479 600	60°19.3'N 01°07.9'W	Pel; Asc; FvesX; FcerX; FserX; LMX
261	105	Ayre of Dury, North Nesting, Dury Voe.	HU 461 605	60°19.5'N 01°09.9'W	LMX
434	1	Laxo Voe, Dury Voe.	HU 450 633	60°21.1'N 01°11.0'W	YG; Ver.Ver; FcerX
434	18	Ayre of Adler, Dury Voe.	HU 456 610	60°19.8'N 01°10.4'W	Fspi; Fves; AscX; EphX; BLlit
434	21	Muckle Head, Dury Voe.	HU 480 607	60°19.6'N 01°07.8'W	Ver.Ver; Pel; Fspi; BPat; FvesB; Fves; Him; Ala.Ldig
434	38	Skeo Taing, Dury Voe.	HU 470 633	60°21.0'N 01°08.8'W	YG; Ver.Ver; PelB; Pel; BPat.Sem; FvesB; Him; Ala.Ldig; Ldig.Ldig

Sublittoral sites					
Survey	Site	Site name	Grid reference	Latitude/longitude	Biotopes recorded
377	12	S of Flugarth pier, Dury Voe.	HU 459 630	60°20.9'N 01°10.0'W	SpMeg
230	20	Muckle Head, Dury Voe.	HU 480 607	60°19.6'N 01°07.8'W	Lhyp
230	22	Skeo Taing, Dury Voe.	HU 470 633	60°21.0'N 01°08.8'W	XKScrR

Compiled by: Christine Howson

Location

<i>Position (centre)</i>	HU 500 555	60°16.8'N 01°05.7'W
<i>Administrative area</i>	Shetland Islands	
<i>Conservation agency/area</i>	Scottish Natural Heritage	North Areas (Northern Isles)

Physical features

<i>Physiographic type</i>	Open coast and embayments
<i>Length of coast</i>	Mainland: 35.7 km; South Isle of Gletness: 2.4 km
<i>Area of inlet</i>	South Nesting Bay: 10.1 km ²
<i>Bathymetry</i>	50 m contour within 300 m of mainland coast in northern part of area and offshore islands; within 3 km elsewhere
<i>Wave exposure</i>	Exposed - sheltered; mostly moderately exposed
<i>Tidal streams</i>	Moderately strong around islands and headlands; weak or negligible elsewhere
<i>Tidal range</i>	1.8 m (mean springs); 0.9 m (mean neaps)
<i>Salinity</i>	Fully marine

Introduction

This stretch of open coast on the east of Mainland Shetland includes South Nesting Bay and the headlands and peninsulas to the north and south. Area 11 is fairly well-populated with several villages including Garth, Skellister, Gletness and Kirkabister and roads follow most of the coastline. There are low cliffs along the headlands but otherwise the area is low-lying, particularly around Skellister and Garth at the head of South Nesting Bay where there is a sizeable lagoon, Vadill of Garth (Thorpe 1998). Most of Area 11 is exposed or moderately exposed to wave action with some sheltered areas in South Nesting Bay behind the headlands of Eswick. Moderate tidal streams flow around the headlands and islands but tidal flow elsewhere is negligible. The area is fully marine, with variable salinity conditions in the silled inlet at Vadill of Garth (Thorpe 1998).

The littoral zone consists predominantly of bedrock with gullies and pools but there are some areas of boulders and blocks of rock and occasional barren shingle beaches. There are several sandy beaches around South Nesting Bay, with sand dunes at Dock of Lingness and Eswick. Rock continues into the sublittoral as a gradual slope with terraces, gullies, small caves and boulders to depths of 20-25 m. In South Nesting Bay, there are plains of coarse shell-sand beyond this depth whilst south of Eswick, there are plains of cobble and pebble.

Most of the land in Area 11 is rough grazing, with sand dunes at the back of some bays and small patches of saltmarsh. There are salmon *Salmo salar* cages and a hatchery and smolt farm at South Nesting. Common seals *Phoca vitulina* frequent the area. The houses have septic tanks and water quality is good.

Marine biology**Marine biological surveys**

	<i>Survey methods</i>	<i>No. of sites</i>	<i>Date(s) of survey</i>	<i>Source</i>
<i>Littoral</i>	Recording	8	July-August 1974	Institute of Terrestrial Ecology (1975a)
<i>Sublittoral</i>	Recording	3	July-August 1974	Institute of Terrestrial Ecology (1975b); Earl (1982)
	Recording	3	July-August 1987	Moss & Ackers (1987)
	Recording	5	August 1987	Howson (1988)
	Infaunal sampling (grab)	1	1963	Pearson, Coates & Duncan (1994)

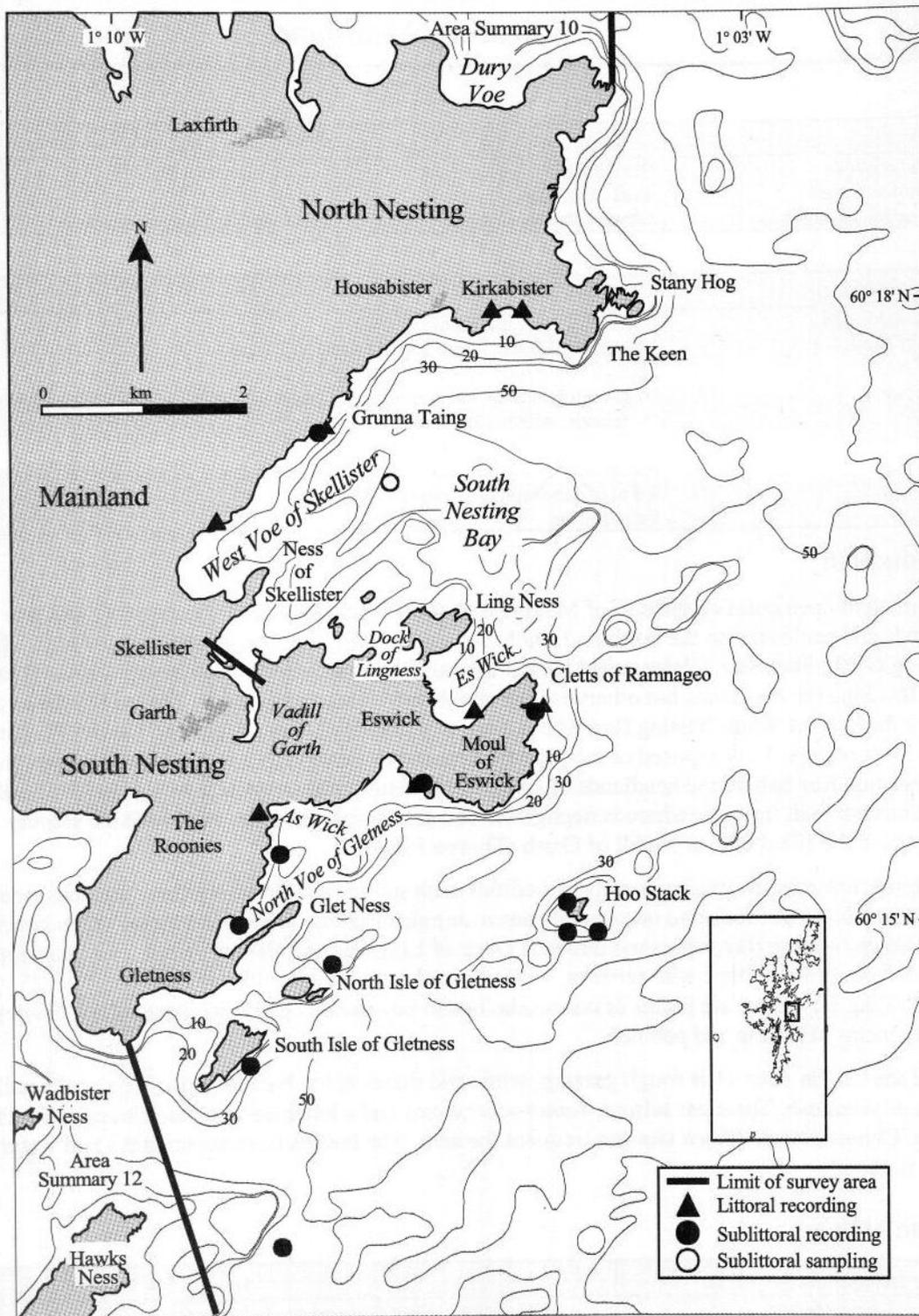


Figure 11.1 Main features of the area, showing sites surveyed.
 © Crown copyright. All rights reserved. JNCC GD27254X/1999.

Littoral

The littoral zone on the open coast consists of fairly gradual slopes of bedrock, large blocks of rock and boulders, with gullies and pools. There is an apparently barren shingle beach at Kirkabister with

bedrock and a large pool on the lower shore and a shingle spit at the entrance to Vadill of Garth. Several of the small bays around South Nesting Bay have sand beaches backed by dunes.

The majority of shores for which there are data are exposed or moderately exposed to wave action and these have sparse furoid algae in the mid-eulittoral. There are yellow and grey lichens in the supralittoral zone whilst the littoral fringe is dominated by the black lichen *Verrucaria maura* with the addition of scattered barnacles *Semibalanus balanoides* in the lower part of the zone (YG; Ver.Ver). On the most exposed, east-facing shores, the mid-eulittoral has a broad band of limpets *Patella vulgata* and barnacles with the addition at some sites of a narrow band of small mussels *Mytilus edulis* and barnacles in the lower part of the zone (MytB). In slightly more sheltered conditions, a mosaic of barnacles, limpets, *M. edulis* and the furoid *Fucus vesiculosus* develops (FvesB). The lower eulittoral is dominated by thongweed *Himanthalia elongata* and foliose red algae including *Mastocarpus stellatus* (Him). This biotope gives way to a sublittoral fringe with the kelps *Alaria esculenta* and *Laminaria digitata* on the exposed shores (Ala.Ldig) or *L. digitata* alone in moderately exposed conditions (Ldig.Ldig).

With an increase in shelter, furoid algae are able to grow and in Es Wick the upper eulittoral has bands of *Pelvetia canaliculata* (Pel) followed by *Fucus spiralis* (Fspi). This biotope gives way to mosaics of *F. vesiculosus* with barnacles and mussels in the mid-eulittoral, bands of *H. elongata* and *Fucus serratus* in the lower eulittoral (Fser.R), and kelps *A. esculenta* and *L. digitata* in the sublittoral fringe. Foliose algae are frequent in the lower eulittoral with species such as the green alga *Cladophora rupestris* and the red algae *Porphyra umbilicalis* and *M. stellatus* (R). In localised shelter on the north side of South Nesting Bay, the entire shore is furoid-covered, with *P. canaliculata* and *F. spiralis* in the upper eulittoral, *F. vesiculosus* in the mid-eulittoral (Fves), *F. serratus* in the lower eulittoral and kelps *L. digitata* and *Laminaria saccharina* in the sublittoral fringe (Lsac.Ldig). Littorinids and algae such as *Chondrus crispus*, *Corallina officinalis* and *C. rupestris* are common amongst the mid- and lower eulittoral furoids. A nearby shore has dense stands of the furoid *Ascophyllum nodosum* on rock outcrops (Asc.Asc), indicative of very sheltered conditions.

Large rockpools are a feature of this area and there is a series of interconnected pools at the foot of a shingle beach on the north side of South Nesting Bay which support *L. digitata*, *F. serratus*, *C. rupestris* and *M. stellatus* and the littorinids *Littorina littorea* and *Littorina obtusata* (FK). Gullies in Es Wick have similar pools with kelp in the lower eulittoral and support *A. esculenta* and *L. saccharina* in addition to *L. digitata* whilst a pool at As Wick has a boulder floor but a similar species composition.

Well-drained white sand beaches at Dock of Lingness and West Voe of Skellister contain a sparse fauna which includes the polychaetes *Arenicola marina* and *Nephtys hombergii*, the bivalves *Chamelea gallina* and *Angulus tenuis* and the holothurian *Leptosynapta inhaerens* (Institute of Terrestrial Ecology 1975b).

Sublittoral

In the sublittoral, gradual slopes of bedrock with terraces, gullies, small caves and boulders extend to depths of 20-25 m. South of Eswick, there are plains of cobble and pebble from about 17 m depth from the base of the bedrock slope. Biotopes on the rock are widely distributed, and fairly uniform throughout the area. The upper infralittoral is dominated by *Laminaria hyperborea* kelp forest to a depth of 9-10 m (LhypGz.Ft), and the lower infralittoral by kelp park of either a combination of *L. hyperborea* and *Laminaria saccharina* or by *L. saccharina* alone (LhypGz.Pk). Kelp reaches a maximum depth of about 24 m where the substratum permits. Intense grazing by the urchin *Echinus esculentus* results in foliose algae being largely confined to the kelp stipes; rock surfaces are dominated by encrusting algal species and grazing-resistant animals such as the keel worm *Pomatoceros triqueter*, the featherstar *Antedon bifida* and the cup coral *Caryophyllia smithii*. Grazing is particularly marked in the lower part of the kelp park, below about 15 m. Small vertical rock faces in the shallow infralittoral kelp forest have a dense covering of surge-tolerant ascidian and sponge species.

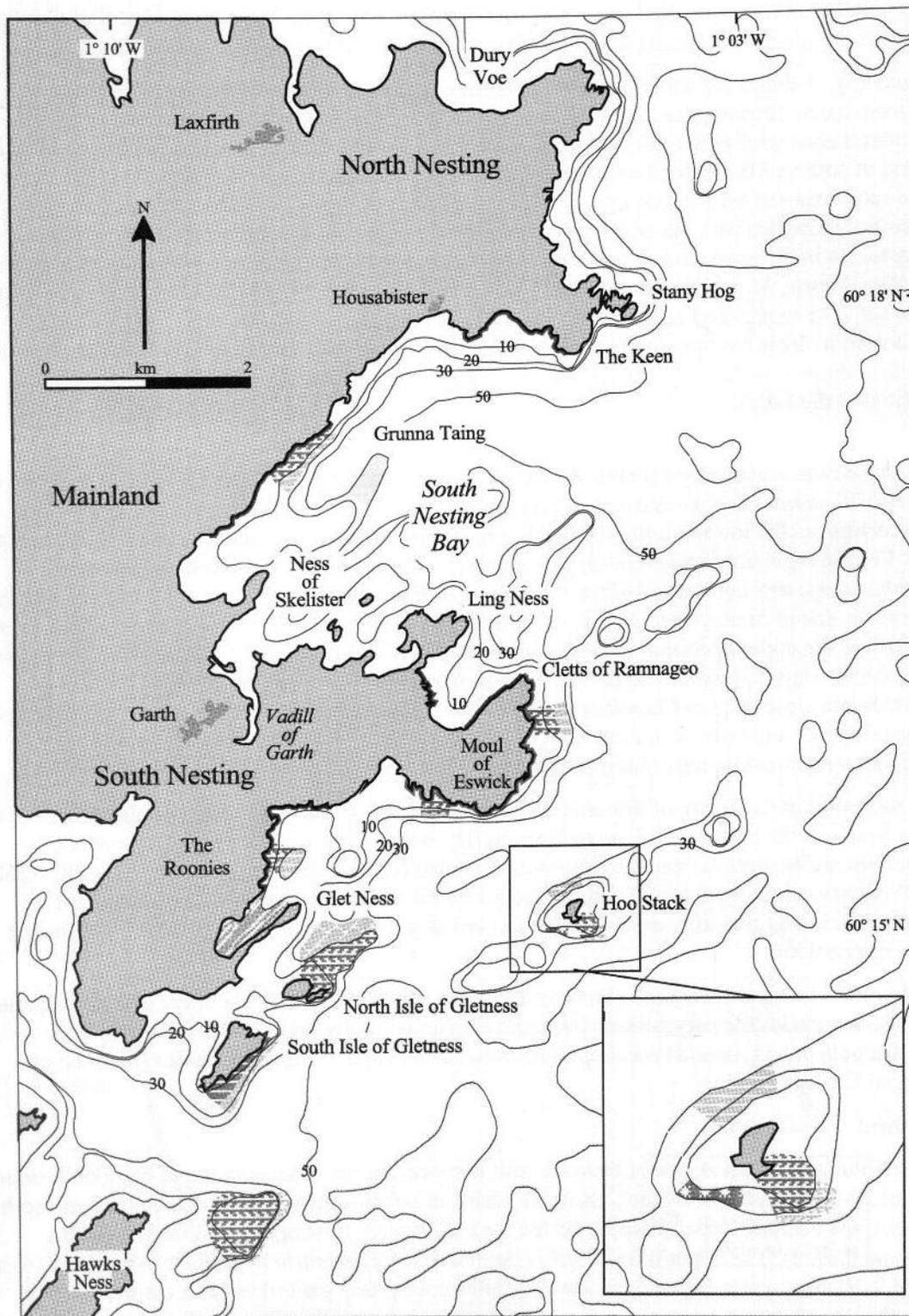


Figure 11.2 Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 11.1, cited literature and additional field observations). (Key to biotopes symbols on next page.)
 © Crown copyright. All rights reserved. JNCC GD27254X/1999.

 Littoral rock with mussels and barnacles (Ver.Por; MytB)	 Circalittoral rock with sparse fauna (FaAIC; FaAIC.Abi)
 Littoral rock with barnacles, fucoids and red algae (BPat.Sem; FvesB; Fser.R; Ala.Ldig)	 Circalittoral rock or mixed substrata with dense brittlestars (Oph)
 Littoral rock with dense fucoid algae (Fves; Asc.Asc; Fser.Fser; Ldig.Ldig; Lsac.Ldig)	 <i>Modiolus</i> beds with hydroids and ascidians (ModHAs)
 Kelp <i>Laminaria hyperborea</i> with dense red algae (Lhyp.Pk)	 Circalittoral gravels and sands (CGS)
 Grazed kelp <i>Laminaria hyperborea</i> (LhypGz.Ft; LhypGz.Pk)	 Sublittoral muddy sand with polychaetes (SpiSpi)
 Infralittoral rock with mixed kelps and scour-tolerant algae (XKScrR)	 Sublittoral mixed sediment with <i>Laminaria saccharina</i> (LsacX)

The horse mussel *Modiolus modiolus* is conspicuous on rock and cobble, rather than sediment, in the circalittoral zone throughout this area, forming a band between about 17-20 m and sometimes as deep as 27 m (ModHAs). There are often large numbers of the brittlestars *Ophiothrix fragilis* and *Ophiocomina nigra* associated with the mussels, and these may form a separate zone in deeper water, particularly on areas of cobble (Oph). The presence of these species has a similar effect on the surrounding fauna and flora to the grazing activities of *E. esculentus*. There are few foliose algae in the upper circalittoral, and dead-man's fingers *Alcyonium digitatum*, encrusting coralline algae and animals such as *P. triqueter* and the encrusting bryozoan *Parasmittina trispinosa* are common on bedrock (FaAIC). Vertical rock faces and projecting edges of rock, such as are found in gullies in this area, has dense *A. bifida* between depths of 16 and 22 m (Ant).

Of note on the boulders and cobbles in this area are large numbers of the northern sea urchin *Strongylocentrotus droebachiensis*, a voracious grazer. This species often occurs in clumps, grazing on both attached algae and algal debris, and is responsible together with *E. esculentus* and brittlestars for the superficially barren appearance of much of Area 11. The epifaunal holothurian *Cucumaria frondosa*, another northern species, is present, although recorded in only small numbers.

In South Nesting Bay, bedrock and boulders inshore give way at 20-24 m to plains of coarse shell-sand and gravel which continue into deeper water. South of Eswick, the rock-sediment boundary is deeper and records are restricted to the cobble plains. There is no biological information available for these coarse circalittoral sediments. Infralittoral clean sand is found in the small inlet of the North Voe of Gletness and this supports the brown algae *L. saccharina* and *Chorda filum* and numerous casts of lugworm *Arenicola marina*.

Nature conservation

Conservation sites

Site name	Status	Main features
Shetland Islands	ESA	Agri-environmental scheme

Human influences

Coastal developments and uses

Area 11, particularly South Nesting, is fairly well-populated, with several villages and roads fringing most of the coast. The houses have septic tanks and water quality is good. Land is cultivated around the villages but most of the hinterland is rough grazing.

Marine developments and uses

There are no piers in Area 11 but many of the small inlets and bays are used for occasional mooring of small fishing boats. Potting for crustaceans takes place around the inshore rocky coast. Queen scallops *Aequipecten opercularis* are fished in the north of the area and scallops *Pecten maximus* throughout.

There are salmon *Salmo salar* farms at South Nesting and South Isle of Gletness, with a hatchery and smolt unit at South Nesting.

References and further reading

- Earll, R.C. 1982. Report on a sublittoral survey of Shetland. (Contractor: Underwater Conservation Society, Ross-on-Wye.) *Nature Conservancy Council, CSD Report*, No. 466.
- Howson, C.M. 1988. Marine Nature Conservation Review: survey of Shetland, Foula and Fair Isle, 1987. (Contractor: Field Studies Council, Oil Pollution Research Unit, Pembroke.) *Nature Conservancy Council, CSD Report*, No. 816.
- Institute of Terrestrial Ecology. 1975a. Report to the Nature Conservancy Council on some aspects of the ecology of Shetland. Part 6.2. Littoral biota of rocky shores. *Nature Conservancy Council, CSD Report*, No. 27.
- Institute of Terrestrial Ecology. 1975b. Report to the Nature Conservancy Council on some aspects of the ecology of Shetland. 6.3. Littoral biota of soft shores. (Contractor: Institute of Terrestrial Ecology.) *Nature Conservancy Council, CSD Report*, No. 28.
- Institute of Terrestrial Ecology. 1975c. Report to the Nature Conservancy Council on some aspects of the ecology of Shetland. 6.4: Sublittoral biota. *Nature Conservancy Council, CSD Report*, No. 30.
- Moss, D., & Ackers, G. 1987. *A sublittoral survey of Shetland, 1987*. Unpublished, Marine Conservation Society.
- Pearson, T.H., Coates, A., & Duncan, J.A.R. 1994. Shetland subtidal sediment community analysis. Report on analysis of subtidal sediment data from Shetland to identify community types present. (Contractor: SEAS Ltd, Oban.) *JNCC Report*, No. 191. (Marine Nature Conservation Review Report, No. MNCR/OR/20.) (SEAS Report, No. SR64.)
- 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 227: 1987 MCS sublittoral survey of Shetland (Moss & Ackers 1987).
- Survey 230: 1974 ITE report on sublittoral biota of Shetland (Institute of Terrestrial Ecology 1975c; Earll 1982).
- Survey 261: 1987 OPRU/MNCR survey of Shetland, Foula and Fair Isle (Howson 1988).
- Survey 377: 1963 DAFS sublittoral survey at Shetland, 1963 (Pearson, Coates & Duncan 1994).
- Survey 434: 1974 ITE report on rocky shore ecology of Shetland (Institute of Terrestrial Ecology 1975a).

Littoral sites					
<i>Survey</i>	<i>Site</i>	<i>Site name</i>	<i>Grid reference</i>	<i>Latitude/longitude</i>	<i>Biotores recorded</i>
434	9	Kirkabister, South Nesting Bay.	HU 500 580	60°18.2'N 01°05.7'W	Ver.Ver; Pel; Fspi; Fves; Fser.Fser; Ldig.Ldig; Lsac.Ldig
434	22	Eswick, South Nesting Bay.	HU 495 540	60°16.0'N 01°06.3'W	YG; Ver.Ver; PelB; Pel; Fspi; BPat.Sem; FvesB; MytFves; Fser.R; Him; FK; Ala.Ldig
434	26	West Voe of Skellister, South Nesting Bay.	HU 470 559	60°17.1'N 01°08.9'W	YG; Ver.Ver; Pel; BPat.Sem; FvesB; Him; R; Ala.Ldig
434	52	Kirkabister, South Nesting Bay.	HU 497 580	60°18.2'N 01°06.0'W	Asc.Asc; Fser.Fser; FK
434	53	Grunna Taing, South Nesting Bay.	HU 480 568	60°17.5'N 01°07.9'W	Ver.Ver; BPat; BPat.Sem; Him; Ala.Ldig
434	62	Cletts of Ramnageo, Eswick, South Nesting Bay.	HU 501 540	60°16.0'N 01°05.6'W	YG; Ver.Ver; Ver.Por; BPat.Sem; MytB; FvesB; Coff; FK; Ldig.Ldig
434	73	Pund of Eswick, Gletness.	HU 490 533	60°15.6'N 01°06.8'W	YG; Ver.Ver; Ver.B; BPat; BPat.Sem; MytB; Fves; Him; Ldig.Ldig
434	77	As Wick, Gletness.	HU 474 530	60°15.5'N 01°08.6'W	YG; Ver.Ver; FvesB; Fves; R; Him; FK; Ldig.Ldig

Sublittoral sites					
<i>Survey</i>	<i>Site</i>	<i>Site name</i>	<i>Grid reference</i>	<i>Latitude/longitude</i>	<i>Biotores recorded</i>
61	136	Hoo Stack, Gletness.	HU 504 518	60°14.8'N 01°05.3'W	XKScrR
261	137	South Isle of Gletness.	HU 473 505	60°14.1'N 01°08.7'W	Lhyp.Pk; Oph.Oacu; ModHAs; Ant
261	138	Colsie, North Isle of Gletness.	HU 481 515	60°14.7'N 01°07.8'W	LhypGz.Ft; LhypGz.Pk; ModHAs
261	139	E of Aswick Skerries, Gletness.	HU 476 526	60°15.3'N 01°08.3'W	LhypGz.Pk; Oph
261	140	N Voe of Gletness.	HU 472 519	60°14.9'N 01°08.8'W	SpiSpi
377	13	E of Seudills Wick, South Nesting Bay.	HU 487 563	60°17.3'N 01°07.1'W	CGS
227	20	SE Hoo Stack, Gletness.	HU 507 518	60°14.8'N 01°05.0'W	FaAIC
227	21	N Hoo Stack, Gletness.	HU 504 521	60°15.0'N 01°05.3'W	Oph
227	22	SE of South Isle of Gletness.	HU 476 487	60°13.2'N 01°08.4'W	FaAIC; FaAIC.Abi
230	11	Eswick, South Nesting Bay.	HU 501 540	60°16.0'N 01°05.6'W	EIR
230	25	Grunna Taing, South Nesting Bay.	HU 480 568	60°17.5'N 01°07.9'W	MIR
230	36	Pund of Eswick, Gletness.	HU 490 533	60°15.6'N 01°06.8'W	EIR

Compiled by: Christine Howson

12

Cat Firth, Wadbister Voe, Lax Firth and Dales Voe

Location

Position (centre)	HU 455 500	60°13.9'N 01°10.7'W
Administrative area	Shetland Islands	
Conservation agency/area	Scottish Natural Heritage	North Areas (Northern Isles)

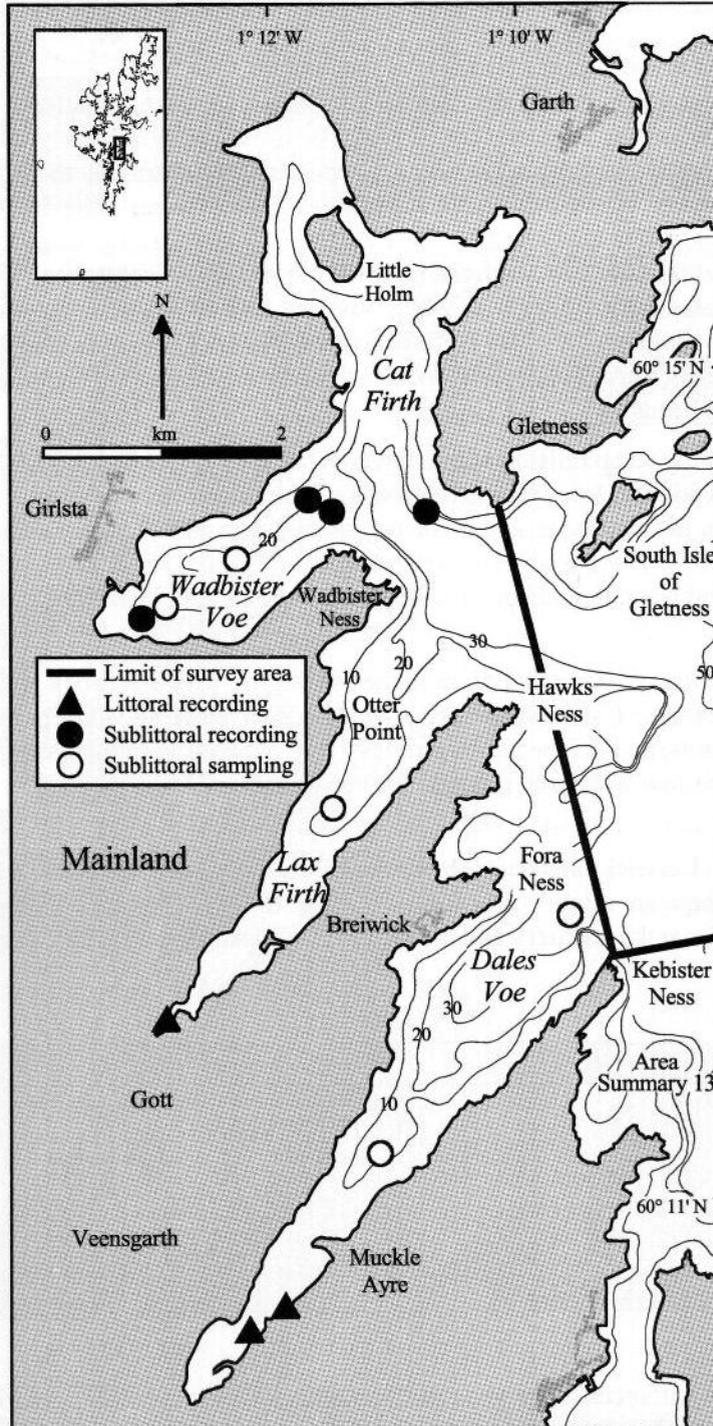


Figure 12.1 Main features of the area, showing sites surveyed.

© Crown copyright. All rights reserved. JNCC GD27254X/1999.

Physical features

<i>Physiographic type</i>	Voers
<i>Length of coast</i>	47.2 km
<i>Area of inlet</i>	Cat Firth: 2.8 km ² Dales Voe: 7.3 km ² Lax Firth: 7.0 km ² Wadbister Voe: 1.7 km ²
<i>Bathymetry</i>	Cat Firth: 29 m; Dales Voe: 39 m; Lax Firth: 27 m; Wadbister Voe: 29 m; depth of 38 m south of Gletness
<i>Wave exposure</i>	Moderately exposed to extremely sheltered; mostly sheltered
<i>Tidal streams</i>	Negligible
<i>Tidal range</i>	1.7 m (mean springs); 0.7 m (mean neaps)
<i>Salinity</i>	Fully marine; perhaps variable or low at voe heads

Introduction

Area 12, which lies just north of Lerwick on the east coast of Mainland Shetland, includes the voes of Cat Firth, Wadbister Voe, Lax Firth and Dales Voe. The area is predominantly sheltered from wave action although conditions range from moderately exposed at the entrances to the voes to extremely sheltered in the voe heads. Wadbister Voe is unusual in Shetland terms in having an entrance sill. The depth of this is less than 20 m and behind it lies a basin of 29 m depth; the other three voes all shallow gradually towards their heads from depths of up to 40 m outside their entrances. There are extensive areas of shallow water at the heads of both Dales Voe and Lax Firth where streams enter, and several shingle spits or ayres, although there are no fully-formed houbes. Tidal streams within the voes are negligible and the area is fully marine, with localised areas of variable or low salinity where streams enter, notably the voe heads.

Dales Voe is bordered by steep hillside with a lower-lying area at its head whilst there is more gradually-sloping hillside and low-lying ground around the remainder of Area 12. Shores are a mixture of bedrock on the headlands at the voe entrances and boulders, shingle and mixed muddy sediment within the voes. There is an extensive sediment flat and a small saltmarsh (0.58 ha) at the head of Dales Voe, and a smaller sediment flat behind a spit on Lax Firth. There is a shingle beach at the head of Cat Firth.

There is a limited amount of hard substratum in the sublittoral, with a bedrock and boulder slope reaching 15 m depth outside Cat Firth and occasional bedrock outcrops in deeper water. However, sandy mud predominates, and this becomes progressively muddier with increasing depth but is coarser with shell debris in shallow water and towards the voe entrances.

Despite the proximity to Lerwick, there are only scattered villages and houses in Area 12. The main A970 road north from Lerwick runs past the heads of Dales Voe, where there is a golf course, and Wadbister Voe, and there are minor roads around most of the rest of the area. There are salmon *Salmo salar* farms on the voes and a hatchery and smolt unit at Girlsta. Water quality is good.

Marine biology**Marine biological surveys**

	<i>Survey methods</i>	<i>No. of sites</i>	<i>Date(s) of survey</i>	<i>Source</i>
<i>Littoral</i>	Recording	2	August 1974	Institute of Terrestrial Ecology (1975)
	Recording	1	August 1987	Howson (1988)
<i>Sublittoral</i>	Recording	1	July 1987	Moss & Ackers (1987)
	Recording	3	August 1986	Hiscock (1986)
	Infaunal sampling (grab)	5	1963	Pearson, Coates & Duncan (1994)

Littoral

The littoral zone at the entrances to the voes and around headlands consists primarily of gradually-sloping or terraced bedrock and boulders. Within the voes, boulder, shingle and mixed muddy sediment shores predominate. A shallow bay at the head of Lax Firth, where the freshwater Strand Loch connects with the sea, has a muddy sand stream bed with cobbles, pebbles and some boulders.

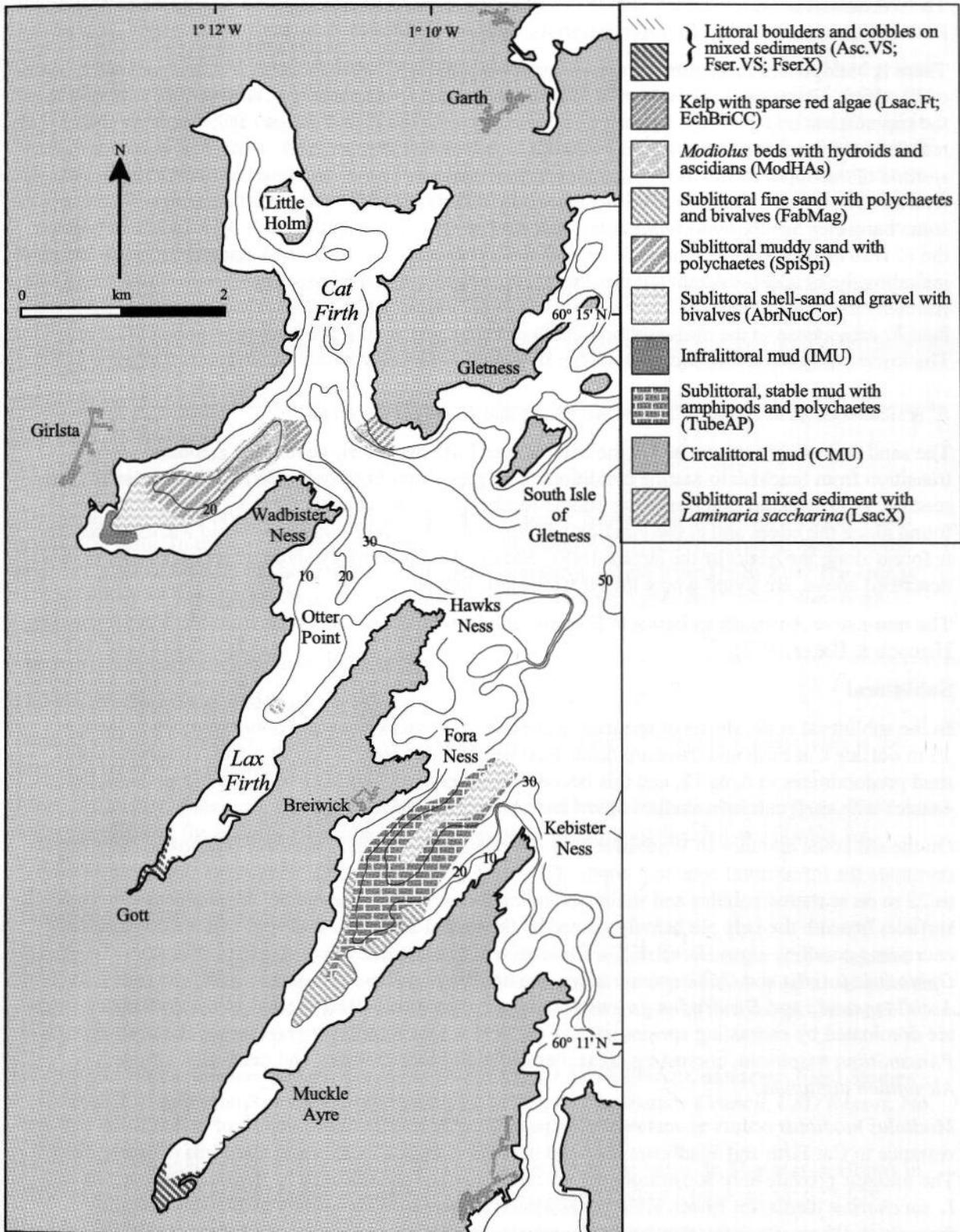


Figure 12.2 Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 12.1, cited literature and additional field observations).

© Crown copyright. All rights reserved. JNCC GD27254X/1999.

There is an extensive sediment flat at the head of Dales Voe and a smaller one behind a spit on Lax Firth but there is no biological information for these.

There is biological information for two adjacent very sheltered sites in Dales Voe and one at the head of Lax Firth. Flat terraces of bedrock and boulders in Dales Voe support yellow and grey lichens in the supralittoral and the black lichen *Verrucaria maura* in the littoral fringe (YG; Ver.Ver). The remainder of the shore is dominated by furoid algae, with *Pelvetia canaliculata* (Pel) and then *Fucus spiralis* in the upper eulittoral (Fspi), *Ascophyllum nodosum* in the upper part of the mid-eulittoral (Asc.Asc) and dense *Fucus vesiculosus* across the remainder of the mid-eulittoral (Fves). There are some barnacles *Semibalanus balanoides*, limpets *Patella vulgata* and mussels *Mytilus edulis* beneath the *F. vesiculosus*. *Fucus serratus* dominates the lower eulittoral with small amounts of other furoids including the brackish-tolerant species *Fucus ceranoides* and the brown alga *Chorda filum* (Fserr.VS). A nearby shingle and boulder shore supports similar biotopes although *A. nodosum* is more abundant than *F. vesiculosus* in the mid-eulittoral and there are larger numbers of mussels beneath the algae. The lower eulittoral at this site has a higher proportion of muddy gravel but suggests a similar community to the adjacent rocky shore, with *F. serratus* dominant and smaller quantities of *F. vesiculosus*, *A. nodosum*, *C. filum*, *M. edulis* and *P. vulgata* (FserX).

The sand and shingle stream bed at the head of Lax Firth has a well-developed gradation along a transition from brackish to marine conditions. The green alga *Enteromorpha* sp. dominates the upper reaches, *F. ceranoides* dominates the middle reaches and main channel (FcerX), and *A. nodosum* is found along the edges and at the junction with the voe. The small saltmarsh furoid *Fucus muscoides* is found along the banks of the stream (NVC SM13). Sheltered rocky shore biotopes, similar to those described above, are found where the stream enters the voe.

The non-native Australasian barnacle *Elminius modestus* has been recorded from Cat Firth (Hiscock, Hiscock & Baker 1978).

Sublittoral

In the sublittoral zone, slopes of terraced bedrock with vertical faces and boulders reach a depth of 15 m outside Cat Firth and there are occasional bedrock outcrops in deeper water. However, sandy mud predominates in Area 12, and this becomes progressively muddier with increasing depth but is coarser with shell debris in shallow water and towards the voe entrances.

On the sill at the entrance to Wadbister Voe and outside Cat Firth, *Laminaria saccharina* kelp forests dominate the infralittoral zone to a depth of 11-15 m (Lsac.Ft; LsacX), with plants occurring as deep as 22 m on scattered cobbles and shells, including those of the horse mussel *Modiolus modiolus*. Rock surfaces beneath the kelp are heavily grazed by the urchin *Echinus esculentus* and are covered with encrusting coralline algae (EchBriCC). Crevices and boulder interstices support brittlestars *Ophiothrix fragilis* and *Ophiocomina nigra*, the holothurian *Pawsonia saxicola* and the ascidians *Ascidia mentula* and *Dendrodoa grossularia*. Vertical rock faces and overhangs within the kelp forest are dominated by encrusting species such as the keel worm *Pomatoceros triqueter*, the bryozoan *Parasmittina trispinosa*, encrusting algae, barnacles *Balanus crenatus* and dead-man's fingers *Alcyonium digitatum*.

Modiolus modiolus occurs as scattered clumps on muddy sand between depths of about 20-25 m at the entrance to Cat Firth and Wadbister Voe and at other scattered locations in Cat Firth (Comely 1981). The mussels provide hard substratum for the attachment of species such as hydroids, brittlestars and *L. saccharina* plants; the queen scallop *Aequipecten opercularis* is usually associated with the mussels and there is scattered maerl on the adjacent sediment surface (ModHAs). In shallower water in the outer parts of the area, clean shell-gravel with pebbles in 12 m has *L. saccharina*, the bivalve *Mya* sp., the brittlestar *Ophiura ophiura* and sand gobies *Pomatoschistus minutus* (LsacX). Clean shelly sand at 18-20 m contains the anemone *Cerianthus lloydii* and the sand mason worm *Lanice conchilega* (SpiSpi). In contrast, sediment in 13-14 m in extremely sheltered conditions at the head of Wadbister Voe consists of soft mud. This is burrowed by the snake blenny *Lumpenus*

lumprætaeformis and the anemone *Sagartiogeton laceratus*, and supports queen scallops *Aequipecten opercularis*, hermit crabs *Pagurus bernhardus* and sand gobies (IMU).

Much of the remainder of Area 12, from depths deeper than 12 m, consists of muddy sand and gravel, one of the most widespread habitats in Shetland voes, containing the bivalve *Clausinella fasciata*, the polychaete *Myriochele* sp. and the amphipod *Urothoe elegans* (FabMag). The basin behind the sill in Wadbister Voe at a depth of 26 m has somewhat coarser and poorly-sorted shell-sand and gravel with numerous large stones and broken shells. This contains the bivalve *Chamelea gallina*, the polychaete *Magelona mirabilis* and the amphipod *Perioculodes longimanus* (AbrNucCor).

Nature conservation

Conservation sites		
Site name	Status	Main features
Catfirth	SSSI	Botanical
Loch of Girlsta	SSSI	Freshwater fish
Shetland Islands	ESA	Agri-environmental scheme

Human influences

Coastal developments and uses

The population in the northern part of Area 12 is fairly sparse, concentrated in small villages to the east of Cat Firth. In the south of the area, which is on the main A970 road to Lerwick, there are the larger villages of Gott, at the head of Lax Firth and Veensgarth, inland from Dales Voe. The area is well provided with roads. Much of the surrounding land is improved grassland with some rough grazing.

There is a golf course at the head of Dales Voe.

Marine developments and uses

There is a pier at Girlsta on Wadbister Voe close to a disused quarry. There is a major quay at the mouth of Dales Voe, but this is little used.

There are salmon *Salmo salar* farms on all the voes in Area 12 with a salmon hatchery and smolt unit at Girlsta. Fishing for scallops *Pecten maximus* takes place throughout the area and potting for crustaceans is carried out around the inshore rocky coastline.

References and further reading

- Comely, C.A. 1981. The physical and biochemical condition of *Modiolus modiolus* (L.) in selected Shetland voes. In: *The marine environment of Sullom Voe and the implication of oil developments*, ed. by T.H. Pearson & S.O. Stanley, *Proceedings of the Royal Society of Edinburgh. Series B: Biological Sciences*, 80 (1/4): 299-322.
- Hiscock, K. 1986a. Marine biological surveys in Shetland. August 1986. (Contractor: Field Studies Council, Oil Pollution Research Unit, Pembroke.) *Nature Conservancy Council, CSD Report*, No. 678.
- Hiscock, K., Hiscock, S., & Baker, J.M. 1978. The occurrence of the barnacle *Elminius modestus* in Shetland. *Journal of the Marine Biological Association of the United Kingdom*, 58: 627-629.
- Howson, C.M. 1988. Marine Nature Conservation Review: survey of Shetland, Foula and Fair Isle, 1987. (Contractor: Field Studies Council, Oil Pollution Research Unit, Pembroke.) *Nature Conservancy Council, CSD Report*, No. 816.
- Institute of Terrestrial Ecology. 1975. Report to the Nature Conservancy Council on some aspects of the ecology of Shetland. Part 6.2. Littoral biota of rocky shores. *Nature Conservancy Council, CSD Report*, No. 27.

Moss, D., & Ackers, G. 1987. *A sublittoral survey of Shetland, 1987*. Unpublished, Marine Conservation Society.

Pearson, T.H., Coates, A., & Duncan, J.A.R. 1994. Shetland subtidal sediment community analysis. Report on analysis of subtidal sediment data from Shetland to identify community types present. (Contractor: SEAS Ltd, Oban.) *JNCC Report*, No. 191. (Marine Nature Conservation Review Report, No. MNCR/OR/20.) (SEAS Report, No. SR64.).

Sites surveyed

Survey 227: 1987 MCS sublittoral survey of Shetland (Moss & Ackers 1987).

Survey 261: 1986/87 OPRU/MNCR survey of Shetland, Foula and Fair Isle (Hiscock 1986, Howson 1988).

Survey 377: 1963 DAFS sublittoral survey at Shetland, 1963 (Pearson, Coates & Duncan 1994).

Survey 434: 1974 ITE report on rocky shore ecology of Shetland (Institute of Terrestrial Ecology 1975).

Littoral sites					
Survey	Site	Site name	Grid reference	Latitude/longitude	Biotopes recorded
261	200	Head of Lax Firth.	HU 433 464	60°12.0'N 01°13.1'W	Pel; Fspi; FcerX; Fserr.VS
434	2	Dales Voe.	HU 443 440	60°10.7'N 01°12.0'W	Ver.Ver; Pel; Fspi; Fves; Asc.VS; Fserr.VS
434	23	Dales Voe.	HU 440 438	60°10.6'N 01°12.4'W	YG; Pel; Fves; Asc.Asc; Fser.Fser; FserX

Sublittoral sites					
Survey	Site	Site name	Grid reference	Latitude/longitude	Biotopes recorded
261	61	NW Wadbister Ness, Wadbister Voe.	HU 445 508	60°14.3'N 01°11.7'W	ModHAs; Phy.HEc; SpiSpi; CMU
261	63	Sill, Wadbister Voe.	HU 447 507	60°14.3'N 01°11.5'W	Lsac.Ft; EchBriCC; LsacX
261	65	W Wadbister Voe.	HU 431 498	60°13.8'N 01°13.3'W	IMU
377	1	SE of Fora Ness, Dales Voe.	HU 467 473	60°12.4'N 01°09.4'W	AbrNucCor; TubeAP
377	2	E of South Califf, Dales Voe.	HU 451 453	60°11.4'N 01°11.2'W	FabMag; TubeAP
377	3	SE of Chalder Ness, Wadbister Voe.	HU 433 499	60°13.9'N 01°13.0'W	AbrNucCor
377	4	SW of Ritta Taing, Wadbister Voe.	HU 439 503	60°14.1'N 01°12.4'W	SpiSpi
377	5	E of North Hamarsland, Lax Firth.	HU 447 482	60°12.9'N 01°11.5'W	AbrNucCor; FabMag
227	23	SW Ling Ness, Gletness.	HU 455 507	60°14.3'N 01°10.6'W	ModHAs; LsacX

Compiled by:

Christine Howson

13

Bressay and Isle of Noss

Location

Position (centre)	HU 520 405	60°08.7'N 01°03.8'W
Administrative area	Shetland Islands	
Conservation agency/area	Scottish Natural Heritage	North Areas (Northern Isles)

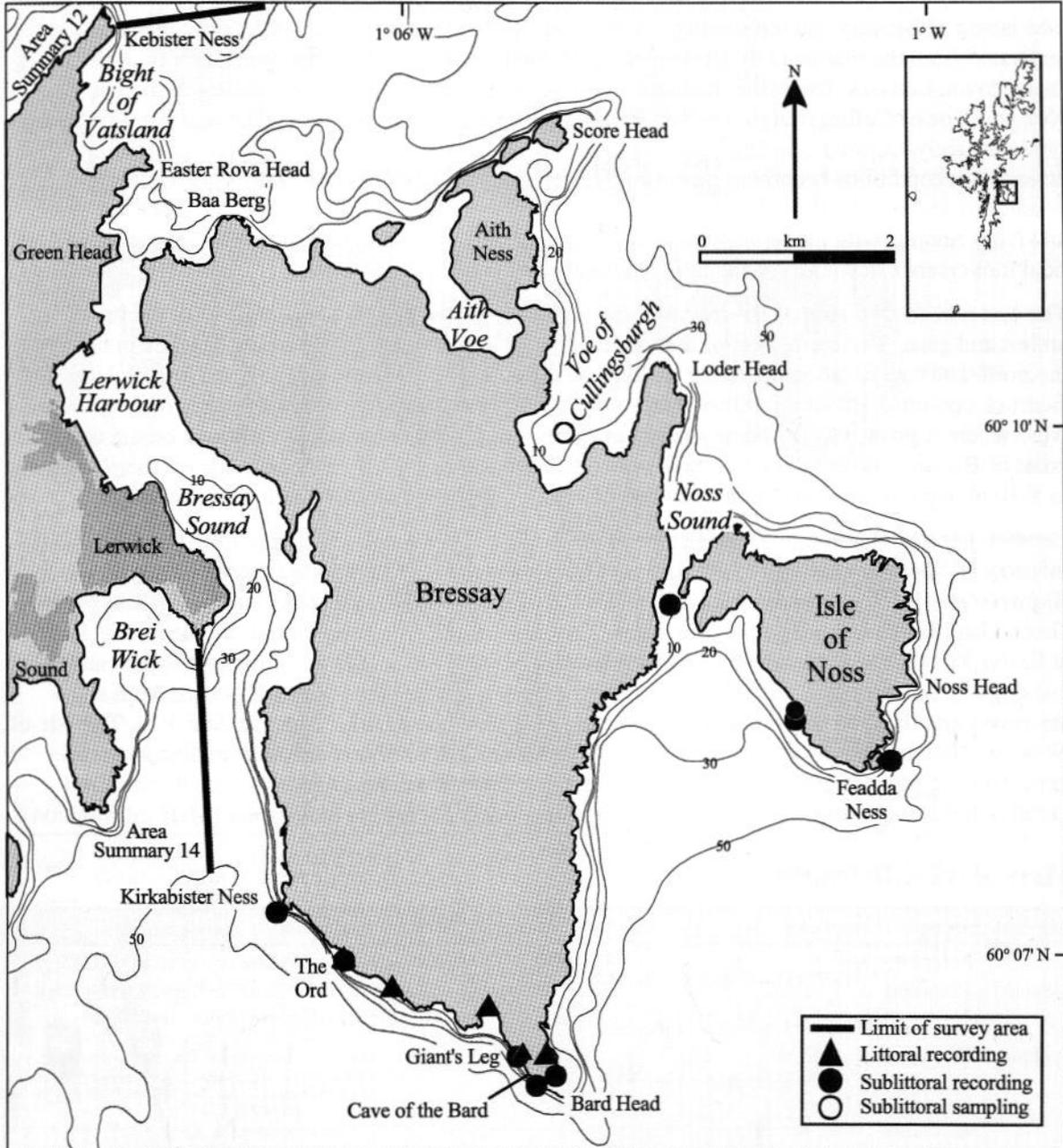


Figure 13.1 Main features of the area, showing sites surveyed.

© Crown copyright. All rights reserved. JNCC GD27254X/1999.

Physical features	
<i>Physiographic type</i>	Islands
<i>Length of coast</i>	69 km
<i>Bathymetry</i>	50 m contour within 500 m around most of coast except Bressay and Noss Sounds
<i>Wave exposure</i>	Very exposed on open coasts to extremely sheltered in parts of Bressay Sound; most of coastline exposed
<i>Tidal streams</i>	Moderate around open coast headlands; weak or negligible elsewhere
<i>Tidal range</i>	1.7 m (mean springs); 0.7 m (mean neaps)
<i>Salinity</i>	Fully marine

Introduction

The island of Bressay and the smaller Isle of Noss lie off the east coast of Mainland Shetland, separated from the mainland by Bressay Sound which creates a sheltered natural harbour. Shetland's major town, Lerwick, fronts the mainland coast of the Sound. Area 13 also includes two voes, Aith Voe and Voe of Cullingsburgh, both on Bressay, and the small Noss Sound. The area has a rocky and predominantly exposed coastline; most of the south and east-facing coastline is very exposed to wave action with conditions becoming increasingly sheltered in the sounds and voes. Very sheltered conditions are found within Aith Voe and Bressay Sound. Strong tidal streams flow through Bressay and Noss Sounds with moderate tidal streams around the outer headlands but with weak or negligible tidal movement elsewhere. The area is fully marine.

The east and south coasts of Bressay and most of Noss are fringed by steep cliffs with stacks, caves, arches and geos. The north-west of the island is lower-lying, and there are sandy beaches in bays on the north and east coasts and shingle beaches on the east side of Bressay Sound and in Aith Voe. Bedrock continues into the sublittoral to about 25-35 m depth around the south coasts of Bressay and Noss where it gives way to coarse shelly sand and gravel. This boundary is shallower on the north coast of Bressay and in Bressay Sound, which shallows from a depth of 31 m at the southern entrance to 8-10 m depth in the north with a sea bed of muddy mixed sediments.

Lerwick has a population of 7,280 (Barne *et al.* 1997) and is a major port supporting the offshore oil industry and handling fish. In 1994, 31.3% of the total Scottish fish landings were made in Lerwick (Barne *et al.* 1997). The harbour has over 3,000 m of quay side and there is a large industrial site at Green Head which includes a power station. The only consented sewage outfall in Shetland is located at Easter Rova Head to the north of Bressay Sound. Bressay has a number of minor roads, scattered housing and piers for the Lerwick and Noss ferries. Most of the island is rough grazing with some improved grassland on the west coast and there are salmon *Salmo salar* cages in Aith Voe. The Isle of Noss is a National Nature Reserve for its seabird colonies. Noss Sound and surrounding seas are important for common porpoise *Phocoena phocoena*, and the sea north and south of Bressay and Lerwick holds important concentrations of moulting eiders *Somateria mollissima* (SNH information).

Marine wildlife features

Marine biological surveys				
	<i>Survey methods</i>	<i>No. of sites</i>	<i>Date(s) of survey</i>	<i>Source</i>
<i>Littoral</i>	Recording	5	July-August 1974	Institute of Terrestrial Ecology (1975a)
<i>Sublittoral</i>	Recording	2	July-August 1974	Institute of Terrestrial Ecology (1975b); Earll (1982)
	Recording	1	August 1986	Hiscock (1986)
	Recording	1	August 1987	Moss & Ackers (1987)
	Recording	6	August 1987	Howson (1988)
	Infaunal sampling (grab)	1	1963	Pearson, Coates & Duncan (1994)

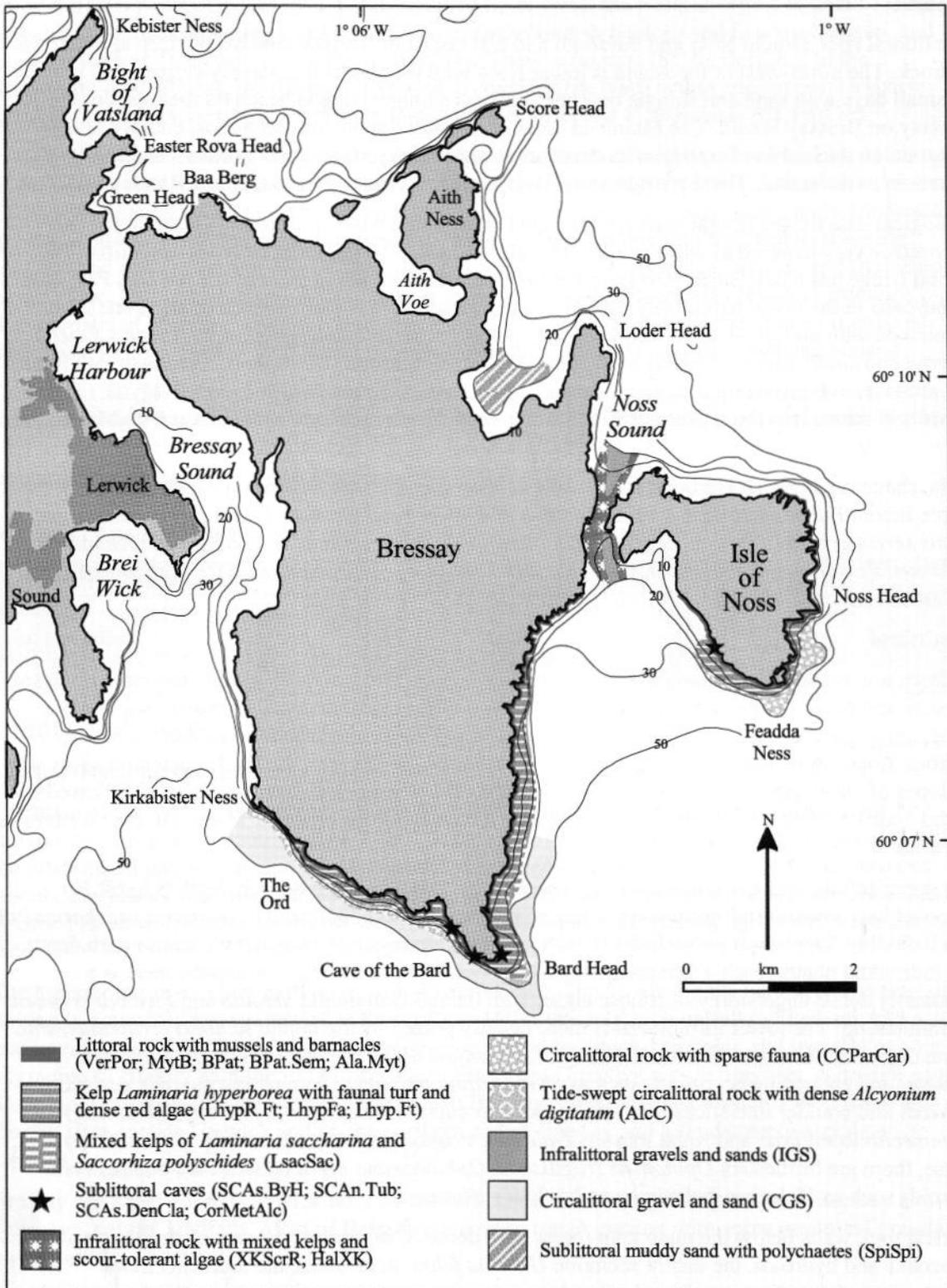


Figure 13.2 Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 13.1, cited literature and additional field observations).

© Crown copyright. All rights reserved. JNCC GD27254X/1999.

Littoral

The littoral zone around Noss and the south and east coasts of Bressay consists of steep and vertical bedrock. The north-west of the island is lower lying with the shores less steeply-sloping and broken by small bays with sand and shingle beaches. There is a longer shingle beach on the west coast of Bressay on Bressay Sound. The Mainland coast of Bressay Sound consists almost entirely of artificial substrata on the harbour frontage with small stretches of rocky shore at the northern and southern entrances to the sound. There are numerous stacks, arches, caves and geos around Bressay and Noss.

Biological data for the littoral zone are restricted to the south coast of Bressay. These shores are exposed or very exposed to wave action and consist of steep bedrock slopes or vertical cliffs. The littoral fringe has black lichen *Verrucaria maura* with the addition of mats of the red alga *Porphyra umbilicalis* in the lower part of this zone (Ver.Por). However, the entire stretch of shoreline is animal-dominated with no furoid algae recorded, with barnacles *Semibalanus balanoides*, limpets *Patella vulgata* and small mussels *Mytilus edulis* across the mid-eulittoral (BPat.Sem). The lower eulittoral has mussels, overgrown by a distinct band of foliose red algae present at some sites (MytB). The mussels continue into the sublittoral fringe where kelp *Alaria esculenta* is dominant (Ala.Myt), occasionally mixed with *Laminaria digitata* (Ala.Ldig), extending to a depth of about 2 m.

In the shelter of Lerwick Harbour, stone walls support furoids with a zonation pattern including the scarce furoid *Fucus evanescens*, which forms a mid-shore band between *Fucus spiralis* above and *Fucus serratus* below (Powell 1957). In this situation it replaces *Fucus vesiculosus* and *Ascophyllum nodosum*. Powell suggested that *F. evanescens* is more tolerant of pollution in the harbour than either *F. vesiculosus* or *A. nodosum*.

Sublittoral

Bedrock and boulders continue into the sublittoral to about 25-35 m depth around the south coasts of Bressay and Noss. On the south of Bressay, there is a cliff to 8-10 m depth followed by a boulder slope, although at Giant's Leg, vertical rock continues to 20 m, and around Noss there is a steep bedrock slope on the east and a boulder slope on the west. In all cases, the hard substratum gives way to slopes of clean, coarse shell-sand. Noss Sound has steep bedrock sides to about 10 m followed by mixed bedrock, boulder, cobble and clean sand in the centre of the channel. There are several caves in this area.

The upper infralittoral has *Laminaria hyperborea* kelp forest to about 8-10 m depth (LhypR.Ft) followed by a lower infralittoral zone of mixed kelp species, predominantly *Laminaria saccharina* but also including *Saccorhiza polyschides* (LsacSac). The kelp becomes increasingly sparse with depth, and individual plants reach a maximum depth of about 25 m. In the shallow depths, there is a reasonably dense understory of foliose algae, with the red *Odonthalia dentata* and *Phycodryis rubens* predominating. The lower infralittoral is more heavily grazed by the urchin *Echinus esculentus*, with encrusting coralline algae, dead-man's fingers *Alcyonium digitatum*, keel worms *Pomatoceros triqueter* and encrusting bryozoans such as *Parasmittina trispinosa* dominating the rock surfaces. Crevices and boulder interstices hold species such as cuckoo wrasse *Labrus mixtus*, the urchin *Psammechinus miliaris* and squat lobsters *Galathea strigosa*. In areas where kelp is particularly sparse, there are brittlestars *Ophiothrix fragilis* and *Ophiocomina nigra* between the boulders and hydroids such as *Halecium halecinum* on boulder surfaces.

Vertical rock walls below the main kelp forest have dense *A. digitatum*, patches of short turfs of bryozoans and hydroids, the dahlia anemone *Urticina felina* in crevices, the ascidians *Ciona intestinalis* and *Ascidia mentula* and extensive areas of encrusting species such as *P. triqueter* and *P. trispinosa* (AlcC). Overhangs on these cliffs and in shallower water within the kelp forest have communities similar to those found in the outer parts of caves in the area and beneath the arch of Giant's Leg. These have turfs of surge-tolerant species such as dwarf plumose anemones *Metridium senile*, daisy anemones *Sagartia elegans* and jewel anemones *Corynactis viridis* (CorMetAlc). Beneath the arch where there is scour in addition to surge, there are also dense barnacles *Balanus crenatus*, bryozoan turf and clumps of the hydroid *Tubularia indivisa* (SCAn.Tub). In the Cave of the

Bard on Bressay and a similar cave on the southern tip of Noss, the walls at depths of about 1-5 m have dense sponges including *Clathrina coriacea*, *Halichondria panicea* and *Leucosolenia* sp. and ascidians such as *Dendrodoa grossularia* and *Polyclinum aurantium* (SCAs.DenCla). In the circalittoral around Noss, the habitat is exposed to considerable wave action and supports a sparse fauna with a few encrusting species including coralline crusts and *P. trispinosa* (CCParCar).

In the tide-swept conditions of Noss Sound, upward-facing bedrock at the sides of the channel at up to 10 m depth is sand-scoured and supports a mixed kelp forest of *L. hyperborea*, *L. saccharina* and *Alaria esculenta* (XKScrR). Vertical bedrock supports encrusting bryozoans, particularly *Umbonula* sp., the ascidian *C. intestinalis* and scattered foliose red algae. Further into the channel there are boulders and cobbles surrounded by sand with *L. saccharina*, the green alga *Ulva* sp. and filamentous brown algae. Bedrock outcrops at 12 m have a dense forest of the brown alga *Halidrys siliquosa*, characteristic of shallow, scoured conditions (HalXK). Most of the floor of the channel is covered with clean, mobile, rippled sand with sand-eels *Ammodytes* sp. and lugworm *Arenicola marina*.

Clean sand and gravel beyond the base of the boulder and bedrock slopes has little visible epifauna. Sand, maerl and fine silt at 16-18 m depth in the Voe of Cullingsburgh contains polychaetes *Nephtys cirrosa* and *Eumida sanguinea*, bivalves *Angulus tenuis*, *Ensis* sp. and *Abra prismatica*, and the amphipod *Ampelisca brevicornis* (SpiSpi).

Nature conservation

Conservation sites		
Site name	Status	Main features
Easter Rova Head	SSSI: GCR	Geological
Noss	NNR, SSSI, SPA	Ornithological
Shetland Islands	ESA	Agri-environmental scheme

Human influences

Coastal developments and uses

The town of Lerwick, a natural harbour and Shetland's major town, fronts the mainland coast of Bressay Sound. It has a population of 7,280 (Barne *et al.* 1997) and is a major port for fisheries and the offshore oil industry. It also handles freight, passengers (ferries and cruise liners) and research vessels, has leisure moorings and ship repair facilities. There is a large industrial site on claimed land at Green Head which includes the oil supply base, a diesel-powered generating station, waste disposal facilities, a helipad and a number of small industrial sites.

The harbour has over 3,000 m of quay with 40 berths including 16 oil-service berths. At the time of writing, a consented sewage outfall at Easter Rova Head, the only such outfall in Shetland, had a maximum output of 1,650 m³/day with the sewage treated by coarse screening and maceration, but upgrading to comply with the EU Waste Water Treatment Directive was in progress. A dredge-spoil dumping-ground outside the northern entrance to Bressay Sound was last used in 1990. There are landfill sites outside Lerwick and on the northern end of Bressay and a sandstone quarry near Lerwick.

Bressay has a pier for the Lerwick ferry on the west coast; the summer ferry between Bressay and Noss uses natural landfalls. Most of Bressay consists of rough grazing with some improved grassland on the west coast.

Marine developments and uses

Lerwick is a major fishing port and, in 1994, 31.3% of the total Scottish landings were made here. Herring *Clupea harengus*, mackerel *Scomber scombrus* and scad *Trachurus trachurus* are particularly important (Barne *et al.* 1997). There is a major sand-eel *Ammodytes* spp. fishing-ground south of Noss. In 1995, 501 fish factory ships and related vessels used the harbour. At the height of the herring and mackerel fishing season, a fleet of about 40 'Klondykers' formerly moored north of Lerwick in Bressay Sound, but the number of factory ships is now much reduced. However, there is a major fish-

meal factory on Bressay; since the Shetland sand-eel fishery reopened in 1995, all catches must be landed here (Goodlad & Napier 1997).

There are salmon *Salmo salar* cages in Aith Voe on Bressay.

Lerwick has yacht berths in the harbour, and the Lerwick Boating Club is based here.

References and further reading

- Barne, J.H., Robson, C.F., Kaznowska, S.S., Doody, J.P., & Davidson, N.C., eds. 1997. *Coasts and seas of the United Kingdom. Region 1 Shetland*. Peterborough, Joint Nature Conservation Committee. (Coastal Directories Series).
- Earll, R.C. 1982. Report on a sublittoral survey of Shetland. (Contractor: Underwater Conservation Society, Ross-on-Wye.) *Nature Conservancy Council, CSD Report*, No. 466.
- Goodlad, D. & Napier, I. 1997. *Assessment of the Shetland sandeel fishery – 1996*. Scalloway, North Atlantic Fisheries College (Fisheries Development Note, No. 6).
<http://www.nafc.ac.uk/publish/note6/note6.htm>
- Hiscock, K. 1986. Marine biological surveys in Shetland. August 1986. (Contractor: Field Studies Council, Oil Pollution Research Unit, Pembroke.) *Nature Conservancy Council, CSD Report*, No. 678.
- Howson, C.M. 1988. Marine Nature Conservation Review: survey of Shetland, Foula and Fair Isle, 1987. (Contractor: Field Studies Council, Oil Pollution Research Unit, Pembroke.) *Nature Conservancy Council, CSD Report*, No. 816.
- Institute of Terrestrial Ecology. 1975a. Report to the Nature Conservancy Council on some aspects of the ecology of Shetland. Part 6.2. Littoral biota of rocky shores. *Nature Conservancy Council, CSD Report*, No. 27.
- Institute of Terrestrial Ecology. 1975b. Report to the Nature Conservancy Council on some aspects of the ecology of Shetland. 6.4: Sublittoral biota. *Nature Conservancy Council, CSD Report*, No. 30.
- Moss, D., & Ackers, G. 1987. *A sublittoral survey of Shetland, 1987*. Unpublished, Marine Conservation Society.
- Pearson, T.H., Coates, A., & Duncan, J.A.R. 1994. Shetland subtidal sediment community analysis. Report on analysis of subtidal sediment data from Shetland to identify community types present. (Contractor: SEAS Ltd, Oban.) *JNCC Report*, No. 191. (Marine Nature Conservation Review Report, No. MNCR/OR/20.) (SEAS Report, No. SR64.).
- Powell, H.T. 1957. Studies in the genus *Fucus* L. II. Distribution and ecology of forms of *Fucus distichus* L. emend Powell in Britain and Ireland. *Journal of the Marine Biological Association of the United Kingdom*, 36: 663-693.

Sites surveyed

- Survey 227: 1987 MCS sublittoral survey of Shetland (Moss & Ackers 1987).
- Survey 230: 1974 ITE report on sublittoral biota of Shetland (Institute of Terrestrial Ecology 1975b; Earll 1982).
- Survey 261: 1986/87 OPRU/MNCR survey of Shetland, Foula and Fair Isle (Hiscock 1986; Howson 1988).
- Survey 377: 1963 DAFS sublittoral survey at Shetland (Pearson, Coates & Duncan 1994).
- Survey 434: 1974 ITE report on rocky shore ecology of Shetland (Institute of Terrestrial Ecology 1975a).

Littoral sites

<i>Survey</i>	<i>Site</i>	<i>Site name</i>	<i>Grid reference</i>	<i>Latitude/longitude</i>	<i>Biotores recorded</i>
434	45	Geo of Vaing, Bressay Sound.	HU 510 365	60°06.6'N 01°04.9'W	Ver.Ver; Ver.Por; MytB; BPat.Sem; R; Ala.Ldig
434	47	Mid Dublin, Bressay Sound.	HU 516 360	60°06.3'N 01°04.3'W	BPat.Sem; Ala.Myt
434	48	Cave of the Bard, Bressay Sound.	HU 513 360	60°06.3'N 01°04.6'W	MytB; BPat; BPat.Sem; Ala.Myt
434	49	Ayre of Baggie, Bressay Sound.	HU 500 367	60°06.7'N 01°06.0'W	Ver.Por; BPat; BPat.Sem; Ala.Ldig
434	50	The Ord, Bressay Sound.	HU 495 370	60°06.9'N 01°06.5'W	Ver.Por; MytB; BPat.Sem; Ala.Myt

Sublittoral sites

<i>Survey</i>	<i>Site</i>	<i>Site name</i>	<i>Grid reference</i>	<i>Latitude/longitude</i>	<i>Biotores recorded</i>
261	124	Giant's Leg, Bressay.	HU 515 357	60°06.1'N 01°04.4'W	Ala.Myt; LhypR.Ft; LhypFa; LsacSac; SCAs.ByH; CorMetAlc; AlcC
261	126	S Noss Sound, Bressay.	HU 529 407	60°08.8'N 01°02.8'W	XKScrR; HalXK; IGS
261	127	Barn Stane, Noss, Bressay.	HU 542 395	60°08.2'N 01°01.4'W	LsacSac; AlcC; CCParCar
261	128	Holm of Noss, Bressay.	HU 557 389	60°07.8'N 00°59.8'W	LhypR.Ft; LsacSac; CCParCar
261	129	Cave near Barn Stane, Bressay.	HU 542 396	60°08.2'N 01°01.4'W	SCAs.DenCla; Lhyp.Ft
261	130	Bard Head, Bressay.	HU 517 358	60°06.2'N 01°04.2'W	LhypR.Ft; LsacSac; AlcC
261	46	S Kirkabister Ness, Bressay Sound.	HU 488 375	60°07.1'N 01°07.3'W	LsacSac; CCParCar; CGS
377	6	W of Bay of Cuppa, Voe of Cullingsburgh, Bressay.	HU 518 425	60°09.8'N 01°03.9'W	SpiSpi
227	35	Giant's Leg, Bressay Sound.	HU 515 357	60°06.1'N 01°04.4'W	CCParCar; Ala.Myt; LsacSac; SCAn.Tub; SCAs.ByH; AlcByH; CorMetAlc
230	21	Cave of the Bard, Bressay Sound.	HU 513 360	60°06.3'N 01°04.6'W	EIR
230	26	The Ord, Bressay Sound.	HU 495 370	60°06.9'N 01°06.5'W	EIR

14

Lerwick to Wick of Sandsayre

Location

Position (centre)	HU 450 315	60°03.9'N 01°11.4'W
Administrative area	Shetland Islands	
Conservation agency/area	Scottish Natural Heritage	North Areas (Northern Isles)

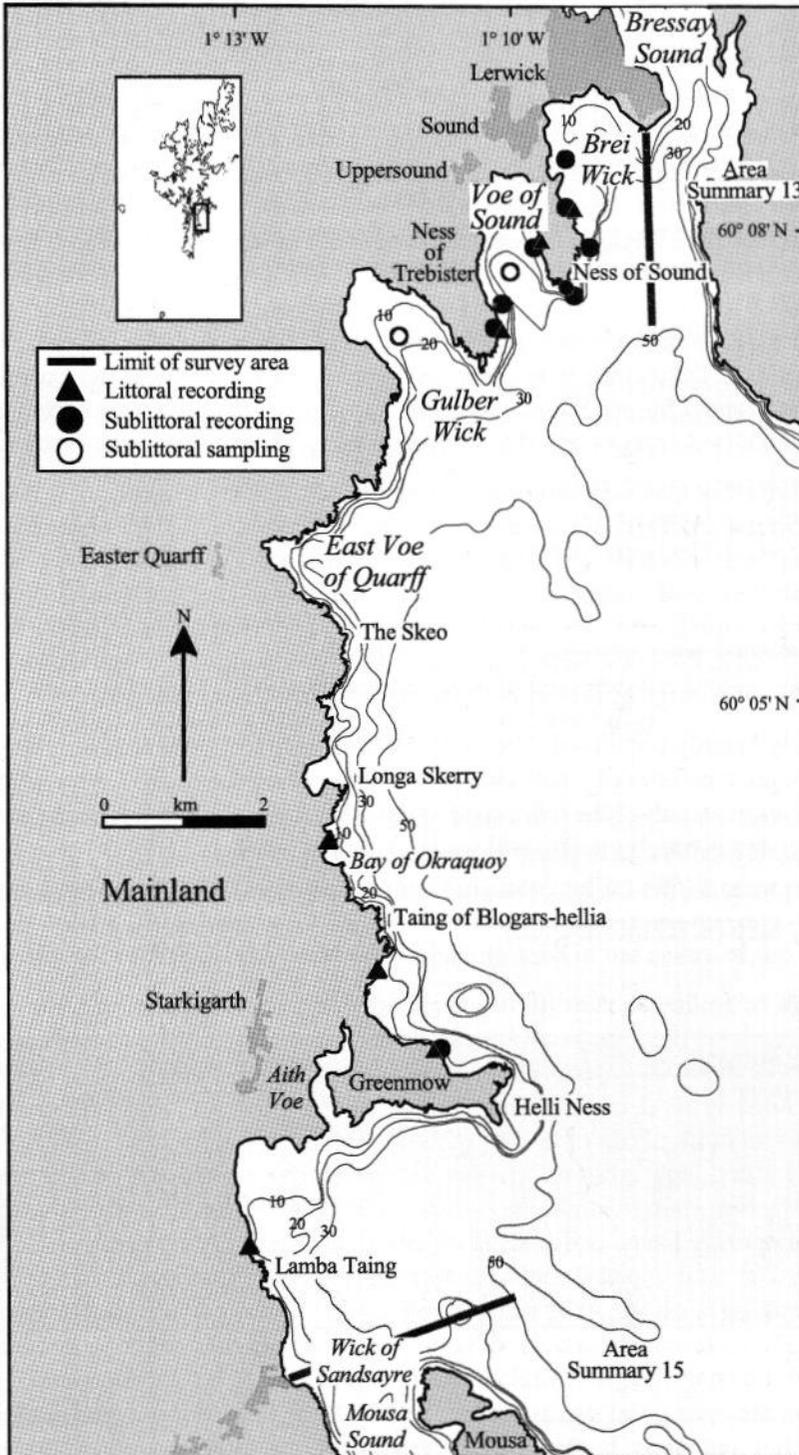


Figure 14.1 Main features of the area, showing sites surveyed.

© Crown copyright. All rights reserved. JNCC GD27254X/1999.

Physical features	
<i>Physiographic type</i>	Open coast with embayments
<i>Length of coast</i>	46.2 km
<i>Area of inlet</i>	Brei Wick: 3.2 km ² ; Voe of Sound: 2.7 km ² ; Gulber Wick: 3.1 km ²
<i>Bathymetry</i>	50 m contour within 1 km of coast in most of area; shallower in approaches to Lerwick
<i>Wave exposure</i>	Very exposed - sheltered; mostly exposed
<i>Tidal streams</i>	Moderate through Bressay Sound and Mousa Sound, outside northern and southern edges of area; otherwise negligible
<i>Tidal range</i>	1.7 m (mean springs); 0.7 m (mean neaps)
<i>Salinity</i>	Fully marine

Introduction

This stretch of east Mainland coast between Lerwick and Mousa includes the three moderately large, south-facing bays of Brei Wick, Voe of Sound and Gulber Wick, a number of smaller bays and inlets and the headland of Helli Ness. Lerwick, Shetland's major town, and the suburbs of Sound and Uppersound lie around Brei Wick on the northern boundary of Area 14, although Lerwick's port and industrial facilities are concentrated along Bressay Sound (*Area summary* 13). This is an open rocky coastline which faces south and east, with a small amount of shelter provided by the islands of Bressay to the north and Mousa to the south, and so the majority of the area is exposed or very exposed to wave action. Tidal streams are generally weak or negligible with the exception of Helli Ness and the approaches to Mousa Sound where the speed of water movement increases. The area is fully marine with localised areas of variable salinity in the more sheltered inlets such as Aith Voe.

The coastline is formed of Old Red Sandstone occurring as cliffs along most of the outer coast between Ness of Sound and Helli Ness and north of Wick of Sandsayre, and hence most of the shores consist of steep bedrock or boulders. The inlets and embayments are generally lower-lying with sand beaches at the head of Voe of Sound and Gulber Wick and shingle in East Voe of Quarff and Aith Voe. Steep bedrock continues into the sublittoral, reaching depths of 25-30 m on the headlands and open coast and 8-10 m in the voes. Below this, clean sand predominates. There are numerous large geos creating steep-sided surge gullies in both the littoral and sublittoral zones.

Area 14 is relatively heavily populated. The main A970 road from Lerwick to Sumburgh follows the coastline and there are a number of small villages scattered along the coast. Lerwick has a population of 7,280 and the villages south of the town have several hundred inhabitants (Barne *et al.* 1997). Most of the surrounding land is rough grazing and water quality is good.

The sea south of Helli Ness is very important for common porpoise *Phocoena phocoena*, probably acting as a nursery area (SNH information).

Marine biology

Marine biological surveys				
	<i>Survey methods</i>	<i>No. of sites</i>	<i>Date(s) of survey</i>	<i>Source</i>
<i>Littoral</i>	Recording	7	July-August 1974	Institute of Terrestrial Ecology (1975a)
<i>Sublittoral</i>	Recording	4	July-August 1974	Institute of Terrestrial Ecology (1975b); Earll (1982)
	Recording	3	August 1986	Hiscock (1986)
	Recording	2	July-August 1987	Moss & Ackers (1987)
	Infaunal sampling (grab)	2	1963	Pearson, Coates & Duncan (1994)

Littoral

The littoral zone on the open coast consists of vertical cliffs or steep slopes of bedrock and boulders with numerous gullies and pools. In the more sheltered sites, the shores are generally less steeply-sloping, with sand between boulders and with muddy gravel and stones in the most sheltered locations. There is a shingle beach at East Voe of Quarff and a boulder bank at the back of the shore in the sheltered Bay of Okraquoy. Both Gulber Wick and Voe of Sound, which are exposed to winds

from the south, have sand beaches with dunes at the heads of the bays whilst Aith Voe, which is sheltered from wave action, has a muddy sediment flat at its head and mixed shingle and sediment shores along most of its length.

On shores exposed to wave action, there are few if any furoid algae in the mid-eulittoral. The littoral fringe is dominated by the black lichen *Verrucaria maura* with additional species including the littorinid *Littorina saxatilis* var. *rudis* (Ver.Ver). The most exposed shores surveyed in this area, on Ness of Trebister and Turri Ness, have in addition mats of the red alga *Porphyra umbilicalis* in the lower part of the zone (Ver.Por) and scattered barnacles, both *Chthamalus stellatus* and *Semibalanus balanoides*. The mid-eulittoral has a broad band of limpets *Patella vulgata* and barnacles *Semibalanus balanoides* (BPat.Sem) with, on the most exposed shores, a band of small mussels *Mytilus edulis* and barnacles across the lower part of the zone (MytB). There may be scattered tufts of red algae in this zone, with species such as *Mastocarpus stellatus* and *Corallina officinalis* present. On the more exposed shores, this band of mussels extends across the lower eulittoral with an increase in abundance of red algae, particularly *M. stellatus* and *C. officinalis*, at the bottom of the zone. On moderately exposed shores, the lower eulittoral is dominated by the furoid *Fucus serratus* often mixed with thongweed *Himantalia elongata* and foliose red algae (Fser.R). This biotope gives way to a sublittoral fringe with kelps *Alaria esculenta* and *Laminaria digitata*, and mussels on the exposed shores (Ala.Ldig; Ala.Myt) or *L. digitata* alone in moderately exposed conditions (Ldig.Ldig).

More sheltered shores are dominated by furoids although they have similar supralittoral and littoral fringe biotopes to those of more exposed conditions with zones of yellow and grey lichens (YG) and *V. maura*. In the upper eulittoral, the furoid algae *Pelvetia canaliculata* (Pel) and *Fucus spiralis* (Fspi) are common and the mid-eulittoral is dominated by the furoid *Fucus vesiculosus* with *Ascophyllum nodosum* in the lower part of the zone in slightly more sheltered conditions (Fves; Asc.Asc). Mosaics of *F. vesiculosus* and barnacles, mussels and limpets are found in the mid-eulittoral on a shore in Brei Wick where rocky ridges create localised conditions of both shelter and moderate exposure (FvesB). Lower eulittoral boulders and sand on the most sheltered shore for which there are records, Bay of Okraquoy, are dominated by *F. serratus*, with algae such as *C. officinalis* and *Cladophora rupestris* beneath the canopy (Fser.Fser). In this case, the kelps *Laminaria saccharina* and *L. digitata* characterise the sublittoral fringe (Lsac.Ldig).

Sublittoral

Steep bedrock continues into the sublittoral, reaching depths of 25-30 m on the headlands and open coast and 8-10 m in the voes. In Brei Wick, a boulder slope changes to a cobble and pebble plain at about 8 m and sand at 10 m depth. There are a number of surge gullies on the open coast in Area 14, with vertical walls and boulder floors at 22-25 m. Clean sand predominates beyond the rock-sediment boundary with both Gulber Wick and Voe of Sound having sand in the centre of the bay.

Laminaria hyperborea is the dominant kelp in the upper infralittoral, extending to a depth of 7-10 m (LhypFa) beyond which a lower infralittoral park of mixed kelp species is found, with *Laminaria saccharina* often dominant, extending to depths of 15-17 m (LsacSac). At more sheltered sites, the upper and lower infralittoral comprise a mixture of *L. hyperborea* and *L. saccharina* to a maximum depth of 11 m. The infralittoral zone is generally heavily grazed by the urchin *Echinus esculentus* and rock surfaces beneath the kelp are dominated by dark red and coralline algal crusts with foliose algae sparse. In the shallow kelp forest on the open coast, however, there are more animals found, including the jewel anemone *Corynactis viridis* and dead-man's fingers *Alcyonium digitatum* on the rock surface and brittlestars and terebellid worms *Eupolymnia nebulosa* in crevices. In Brei Wick, a shallow slope of small boulders supporting dense kelp gives way to a plain of cobbles, pebbles and shell-gravel at about 8 m depth with the cobbles covered in the crustose coralline alga *Lithothamnion glaciale*, which forms knobably 'hedgheg stones'. There is little else recorded here other than the hermit crab *Pagurus bernhardus*.

At sites around the entrance to Gulber Wick, the lower infralittoral kelp is replaced by very intensely grazed bedrock and boulders at about 15-25 m depth. These are dominated by *E. esculentus*, encrusting coralline algae, the keel worm *Pomatoceros triqueter* and brittlestars *Ophiothrix fragilis*,

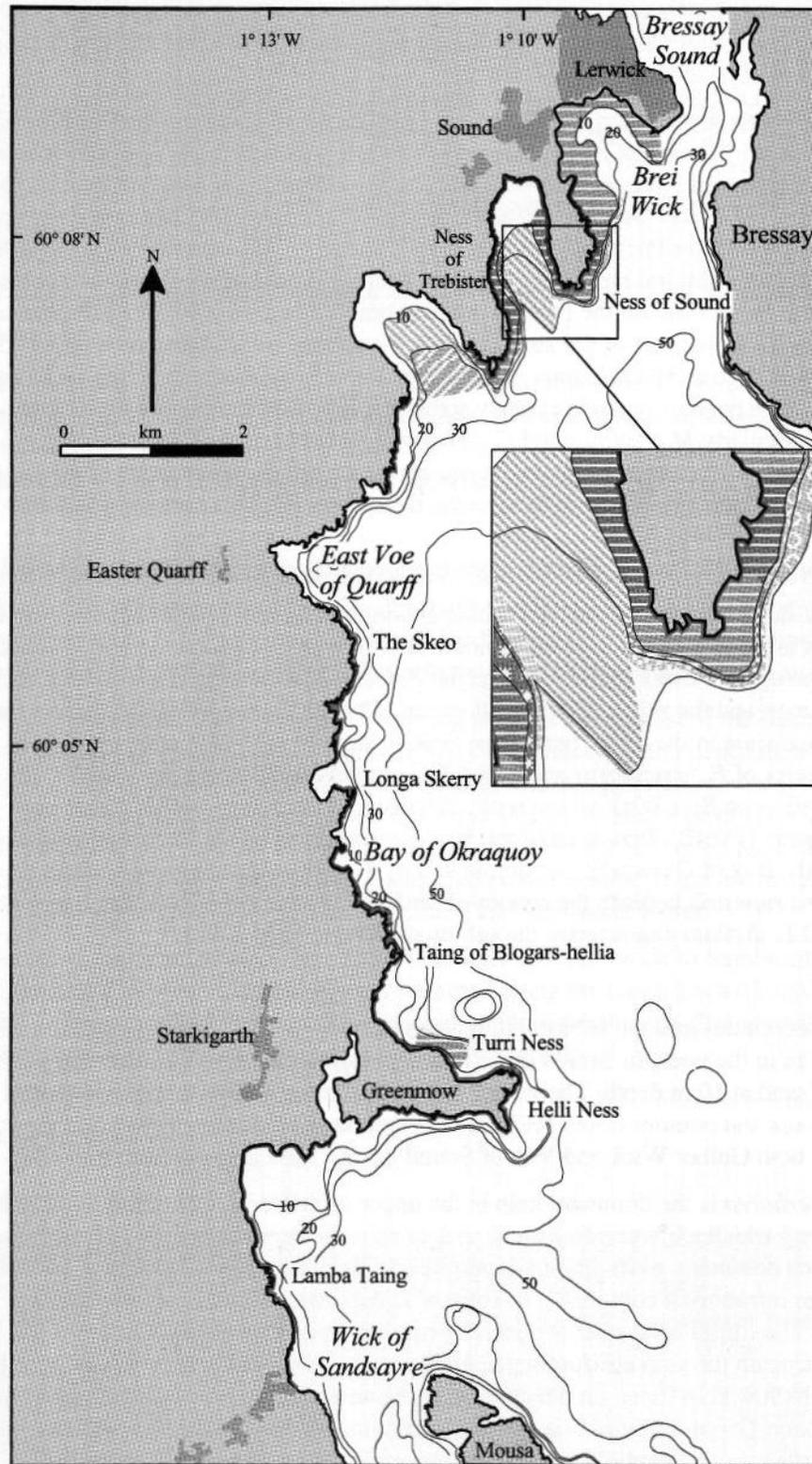


Figure 14.2 Indicative distribution of the main biotopes in the area (based on data from survey sites shown in 14.1, cited literature and additional field observations). (Key to biotopes symbols on next page.)

© Crown copyright. All rights reserved. JNCC GD27254X/1999.

 Littoral rock with mussels and barnacles (VerPor; MytB; BPat; BPat.Sem; Ala.Myt)	 Mixed kelps <i>Laminaria hyperborea</i> and <i>Laminaria saccharina</i> (LhypLsac)
 Littoral rock with barnacles, fucoids and red algae (BPat; BPat.Sem; FvesB; Him; FserR; Ala.Ldig; Ldig.Ldig)	 Circalittoral rock with sparse fauna (CCParCar)
 Littoral rock with dense fucoid algae (Pel; Fspi; Fves; Asc.Asc; Fser.Fser; Lsac.Ldig)	 Tide-swept circalittoral rock with dense <i>Alcyonium digitatum</i> (AlcC)
 Kelp <i>Laminaria hyperborea</i> with faunal turf and dense red algae (LhypR.Ft; AlcByH; CorMetAlc)	 Circalittoral rock or mixed substrata with dense brittlestars (Oph)
 Mixed kelps of <i>Laminaria saccharina</i> and <i>Saccorhiza polyschides</i> (LsacSac)	 Sublittoral fine sand with polychaetes and bivalves (FabMag)
 Kelp <i>Laminaria hyperborea</i> with dense red algae (Lhyp)	 Sublittoral muddy sand with polychaetes (SpiSpi)
 Infralittoral rock with mixed kelps and scour-tolerant algae (XKScrR)	

Ophiopholis aculeata and *Ophiocolina nigra*, with grazing-tolerant species such as *A. digitatum*, the ascidian *Ascidia mentula*, and the cup-coral *Caryophyllia smithii* (FaAIC). At other sites in the area, the horse mussel *Modiolus modiolus* and blankets of brittlestars are abundant on upward-facing rock in the lower infralittoral and circalittoral, where the brittlestars have a similar effect to the grazing activities of urchins (Oph). The urchin *Psammechinus miliaris* is found occasionally under the boulders, but of particular interest in this area are large numbers of the northern urchin *Strongylocentrotus droebachiensis*, found primarily on the circalittoral boulders and cobbles in a population separate from the *E. esculentus*.

Cliffs and steep-sided gullies with boulder and sand floors on the exposed headlands in this area have rich, surge-tolerant biotopes on the vertical walls. In the shallow infralittoral, in depths of 2-7 m, there are dense jewel anemones *Corynactis viridis*, daisy anemones *Sagartia elegans*, ascidians including *Diplosoma listerianum*, *Sidnyum* sp., *Botrylloides leachii* and small *Ascidiella* sp., and bryozoans such as *Scrupocellaria* sp. (CorMetAlc). Below 7 m, the walls are dominated by *A. digitatum* with scattered plumose anemones *Metridium senile*, featherstars *Antedon bifida*, the ascidian *Clavelina lepadiformis*, *C. smithii*, *P. triqueter* and encrusting algae (AlcByH). On the lower parts of the cliffs, in depths beyond about 18 m, hydroids become more numerous.

The clean sand at 20 m depth in Gulber Wick and Voe of Sound contains some larger stones and broken shells. Species characteristic of this sediment include the polychaete *Magelona mirabilis*, bivalves *Chamelea gallina* and *Moerella pygmaea* and the amphipod *Perioculodes longimanus*. (FabMag). Coarser duned sediment in about 27 m at the entrance to these voes is composed largely of empty *P. triqueter* tubes and there are a number of epifaunal species at the rock-sand boundary, including the starfish *Luidia ciliaris* and *Solaster endeca*, the brittlestar *Ophiura albida*, the hermit crab *Pagurus bernhardus* and sand-eels *Ammodytes* sp.

Nature conservation

Conservation sites		
Site name	Status	Main features
Burn of Aith	SSSI; GCR	Geological
Aith Meadows	SSSI	Botanical
Shetland Islands	ESA	Agri-environmental scheme

Human influences

Coastal developments and uses

Area 14 is relatively heavily populated. The main A970 road from Lerwick to Sumburgh follows the coastline with several side roads leading down to a number of small villages scattered along the coast. Lerwick has a population of 7,280 (Barne *et al.* 1997) and the villages south of the town have several hundred inhabitants. The harbour facilities, industrial developments and waste disposal at Lerwick are

concentrated along Bressay Sound (see *Area summary* 13) rather than in Area 14. There is some improved grassland but most of the surrounding land is rough grazing. Most of the houses outside Lerwick have septic tanks but there is a mains sewerage system for Lerwick itself, the outfall for which lies in Area 13. Water quality is good.

Marine developments and uses

The sea south of Helli Ness is part of a major sand-eel *Ammodytes* spp. fishing-ground. Factory ships anchor south of Bressay Sound. Potting for crustaceans takes place in inshore rocky areas.

References and further reading

- Barne, J.H., Robson, C.F., Kaznowska, S.S., Doody, J.P., & Davidson, N.C., eds. 1997. *Coasts and seas of the United Kingdom. Region 1 Shetland*. Peterborough, Joint Nature Conservation Committee. (Coastal Directories Series).
- Earll, R.C. 1982. Report on a sublittoral survey of Shetland. (Contractor: Underwater Conservation Society, Ross-on-Wye.) *Nature Conservancy Council, CSD Report*, No. 466.
- Hiscock, K. 1986. Marine biological surveys in Shetland. August 1986. (Contractor: Field Studies Council, Oil Pollution Research Unit, Pembroke.) *Nature Conservancy Council, CSD Report*, No. 678.
- Institute of Terrestrial Ecology. 1975a. Report to the Nature Conservancy Council on some aspects of the ecology of Shetland. Part 6.2. Littoral biota of rocky shores. *Nature Conservancy Council, CSD Report*, No. 27.
- Institute of Terrestrial Ecology. 1975b. Report to the Nature Conservancy Council on some aspects of the ecology of Shetland. 6.4: Sublittoral biota. *Nature Conservancy Council, CSD Report*, No. 30.
- Moss, D., & Ackers, G. 1987. *A sublittoral survey of Shetland, 1987*. Unpublished, Marine Conservation Society.
- Pearson, T.H., Coates, A., & Duncan, J.A.R. 1994. Shetland subtidal sediment community analysis. Report on analysis of subtidal sediment data from Shetland to identify community types present. (Contractor: SEAS Ltd, Oban.) *JNCC Report*, No. 191. (Marine Nature Conservation Review Report, No. MNCR/OR/20.) (SEAS Report, No. SR64.).

Sites surveyed

- Survey 227: 1987 MCS sublittoral survey of Shetland (Moss & Ackers 1987).
- Survey 230: 1974 ITE report on sublittoral biota of Shetland (Institute of Terrestrial Ecology 1975b; Earll 1982).
- Survey 261: 1986 OPRU/MNCR survey of Shetland, Foula and Fair Isle (Hiscock 1986).
- Survey 377: 1963 DAFS sublittoral survey at Shetland (Pearson, Coates & Duncan 1994).
- Survey 434: 1974 ITE report on rocky shore ecology of Shetland (Institute of Terrestrial Ecology 1975a).

Littoral sites					
<i>Survey</i>	<i>Site</i>	<i>Site name</i>	<i>Grid reference</i>	<i>Latitude/longitude</i>	<i>Biotores recorded</i>
434	19	Ness of Sound, Bressay Sound.	HU 466 390	60°08.0'N 01°09.6'W	Ver.Ver; Pel; BPat; BPat.Sem; Him; Fser.Fser; Ldig.Ldig
434	33	Torvald's Geo, Brei Wick, Bressay Sound.	HU 470 395	60°08.2'N 01°09.2'W	Ver.Ver; Ver.Por; Pel; FvesB; Fspi; Him; Fser.R; Ala.Ldig; Ldig.Ldig
434	54	Oxen Punds, Ness of Trebister, Bressay Sound.	HU 461 380	60°07.4'N 01°10.2'W	Ver.Ver; Ver.Por; MytB; BPat; BPat.Sem; Ala.Myt
434	55	Longi Geo, Aith Wick.	HU 446 300	60°03.1'N 01°11.9'W	YG; Ver.Ver; MytB; BPat; BPat.Sem; Him; Fser.R; Fser.Fser; Ala.Ldig; Ala.Myt
434	63	Buggie, Mousa Sound.	HU 430 266	60°01.3'N 01°13.7'W	Ver.Ver; Ver.Por; MytB; BPat; BPat.Sem; Ala.Myt
434	66	Bay of Okraquoy.	HU 440 316	60°04.0'N 01°12.5'W	YG; Ver.Ver; Pel; Fspi; Fves; Asc.Asc; Fser.Fser; Lsac.Ldig
434	67	Turri Ness, Aith Wick.	HU 453 290	60°02.6'N 01°11.2'W	YG; Ver.Ver; Ver.Por; MytB; BPat.Sem; Him; Coff; Ala.Myt; Ala.Ldig

Sublittoral sites					
<i>Survey</i>	<i>Site</i>	<i>Site name</i>	<i>Grid reference</i>	<i>Latitude/longitude</i>	<i>Biotores recorded</i>
261	47	S of Ness of Sound, Bressay.	HU 471 384	60°07.6'N 01°09.1'W	LhypR.Ft; XKScrR; CorMetAlc; AlcByH; CCParCar
261	48	South Taing, Brei Wick, Bressay.	HU 470 401	60°08.5'N 01°09.2'W	LhypLsac.Ft; LhypLsac.Pk
261	52	N of Skersund Skerry, Voe of Sound, Bressay.	HU 462 383	60°07.6'N 01°10.1'W	XKScrR; Oph; IGS
227	36	S Ness of Sound, Bressay Sound.	HU 470 385	60°07.7'N 01°09.2'W	LhypFa; LsacSac; AlcByH; CCParCar
227	37	Munga Skerries, Bressay Sound.	HU 473 390	60°08.0'N 01°08.9'W	LhypLsac.Ft; AlcC
230	9	Turri Ness, Aith Wick.	HU 453 290	60°02.6'N 01°11.2'W	Ala.Myt; LhypR.Ft
230	12	Ness of Trebister, Bressay Sound.	HU 461 380	60°07.4'N 01°10.2'W	EIR
230	28	Torvald's Geo, Brei Wick, Bressay Sound.	HU 470 395	60°08.2'N 01°09.2'W	MIR
230	30	Ness of Sound, Bressay Sound.	HU 466 390	60°08.0'N 01°09.6'W	SIR
377	7	N Ness of Setter, Gulber Wick.	HU 449 379	60°07.4'N 01°11.5'W	SpiSpi; FabMag
377	21	Voe of Sound.	HU 463 387	60°07.8'N 01°09.9'W	FabMag

Compiled by: Christine Howson

Location

<i>Position (centre)</i>	HU 460 240	59°59.9'N 01°10.5'W
<i>Administrative area</i>	Shetland Islands	
<i>Conservation agency/area</i>	Scottish Natural Heritage	North Areas (Northern Isles)

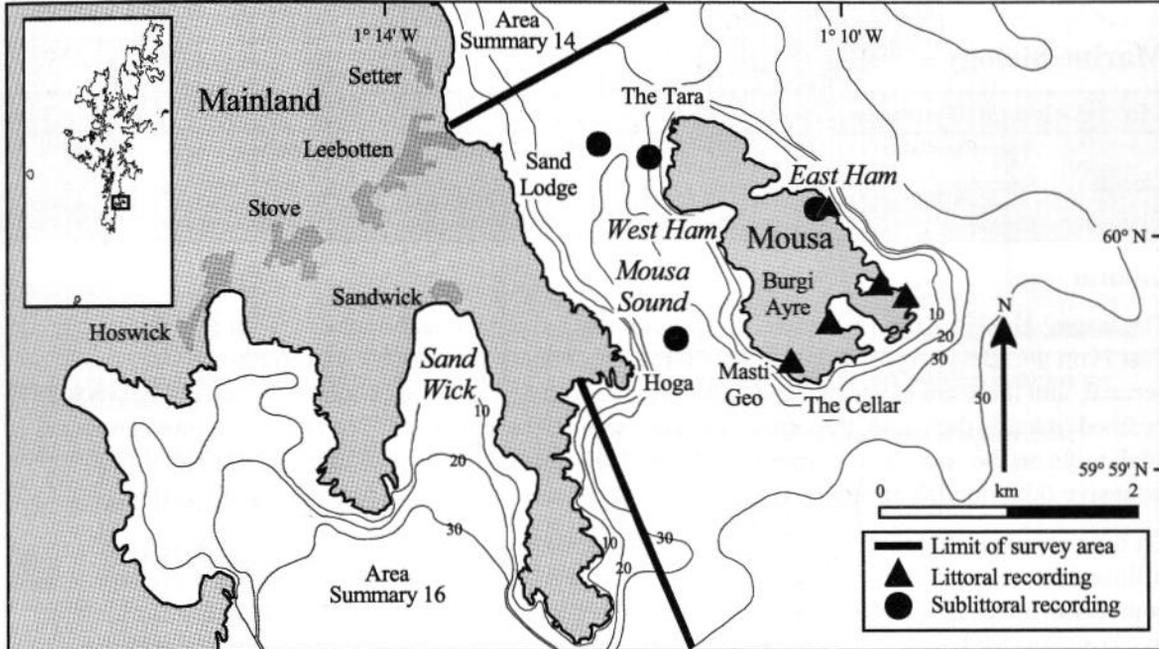


Figure 15.1 Main features of the area, showing sites surveyed.

© Crown copyright. All rights reserved. JNCC GD27254X/1999.

Physical features

<i>Physiographic type</i>	Island
<i>Length of coast</i>	14.2 km
<i>Bathymetry</i>	50 m contour within 1 km of south and west coasts; Mousa Sound reaches maximum depth of 48 m at southern entrance, 38 m in centre
<i>Wave exposure</i>	Very exposed on open coasts to very sheltered in parts of Mousa Sound; most of coastline exposed
<i>Tidal streams</i>	Moderate around open coast headlands and through sound; weak or negligible elsewhere
<i>Tidal range</i>	1.7 m (mean springs); 0.7 m (mean neaps)
<i>Salinity</i>	Fully marine

Introduction

The island of Mousa lies off the south-east coast of Mainland Shetland. It has a rocky coastline with low cliffs and bedrock platforms and it is separated from the Mainland by the tide-swept Mousa Sound. It has a predominantly exposed coastline and the south and east facing coasts are very exposed to wave action with sheltered conditions in Mousa Sound. Very sheltered conditions are found in the small inlet of West Ham. Tidal streams of moderate strength flow through Mousa Sound and around the headlands. The area is fully marine.

Mousa is fringed by low cliffs and bedrock platforms with numerous pools and some caves. There are two large, interconnected tidal pools on the south-east corner of the island which are used by seals. There are two small embayments, West Ham and East Ham, the latter having a shingle beach at its

head, with a second shingle beach at Burgi Ayre on Mousa Sound. Steep and vertical bedrock continues into the sublittoral, reaching a level floor of bedrock and boulders at 30 m. Mousa Sound has bedrock to a depth of 13 m where it is replaced by a mixture of cobbles, coarse sand and shell-gravel with clean, shelly sand at 36 m in the centre of the channel.

A summer ferry runs between Wick of Sandsayre and West Ham but there are few houses in the area. Most of Mousa is semi-improved grassland and crops are grown on the adjacent Mainland. Mousa is an important site for both common seals *Phoca vitulina* and grey seals *Halichoerus grypus* and for its populations of breeding seabirds, and the surrounding waters are important for common porpoise *Phocoena phocoena* (SNH information). Water quality around the island is excellent.

Marine biology

Marine biological surveys

	Survey methods	No. of sites	Date(s) of survey	Source
Littoral	Recording	5	August 1987	Howson (1988)
Sublittoral	Recording	4	August 1987	Howson (1988)

Littoral

The littoral zone in Area 15 consists almost entirely of bedrock and boulders, with shingle beaches in East Ham and Burgi Ayre. Some of the shores, particularly in the north and south-west of Mousa, are vertical, and there are caves in these cliffs. In the south and east they consist of shelving bedrock inclined towards the shore, thus creating a series of ridges and pools. The two large, interconnected tidal pools on the south-east corner of the island are floored by large slate boulders. There is an extensive tidal rapids connecting the western pool to the sea, and this too has a boulder floor.

On the very exposed east coast of Mousa, the rocky shores are animal-dominated with the mid-eulittoral covered by barnacles *Semibalanus balanoides* and limpets *Patella vulgata* with large numbers of small mussels *Mytilus edulis* and the red algae *Porphyra umbilicalis* and *Callithamnion* sp. abundant (MytB). The upper eulittoral zone has the black lichen *Verrucaria maura* with the littorinids *Littorina saxatilis* and *Melarhapha neritoides* and scattered barnacles including *Chthamalus stellatus*. Mussels dominate the lower eulittoral and are covered by a mat of *P. umbilicalis* (MytB). Kelp *Alaria esculenta* is found with mussels in the sublittoral fringe (Ala.Myt). Ridges on the shores provide localised shelter, and the furoid *Fucus vesiculosus* is found in scattered patches with the red alga *Mastocarpus stellatus* whilst kelp *Laminaria digitata* occurs in small quantities in the sublittoral fringe. Small rock pools behind the ridges in the splash zone are dominated by *Enteromorpha* spp. and contain three-spined sticklebacks *Gasterosteus aculeatus* (G). Mid-shore pools are lined with encrusting coralline algae and have turfs of the red alga *Corallina officinalis* (Cor). A variety of anemones including *Metridium senile*, *Sagartia elegans*, *Urticina felina* and *Actinia equina* are found in these pools; several of these species are more characteristic of the sublittoral. Deeper pools contain furoid algae and kelp (FK).

A cave at Masti Geo, about 150 m long and 10 m high, has sloping walls covered by encrusting coralline algae, *S. balanoides* and *M. edulis* and with a few *P. vulgata* and some *Clava* sp., a surge-tolerant hydroid, at the entrance. The encrusting algae, some barnacles and spirorbid worms continue to the back of the cave, and in the middle reaches there are encrusting bryozoans, dead-man's fingers *Alcyonium digitatum*, urchins *Echinus esculentus* and anemones *S. elegans* and *A. equina* (SByAs). Boulders on the cave floor are rounded and smooth.

Eulittoral rock and boulders around the west tidal pool support the algae *Codium fragile*, *Fucus serratus* and *Cladophora rupestris* whilst submerged boulders have thongweed *Himantalia elongata* and kelp *Laminaria saccharina* (FK). Rock surfaces beneath the algal canopy are encrusted with coralline algae and dense *C. officinalis* with *P. vulgata* and *S. balanoides*, and there is a wide variety of other species present. Boulders in the western rapids are covered by *F. serratus*, *H. elongata* and *C. rupestris* (Fserr.T). The sponge *Halichondria panicea*, spirorbid worms and a variety of other sponge and ascidian species are found beneath the boulders in these rapids.

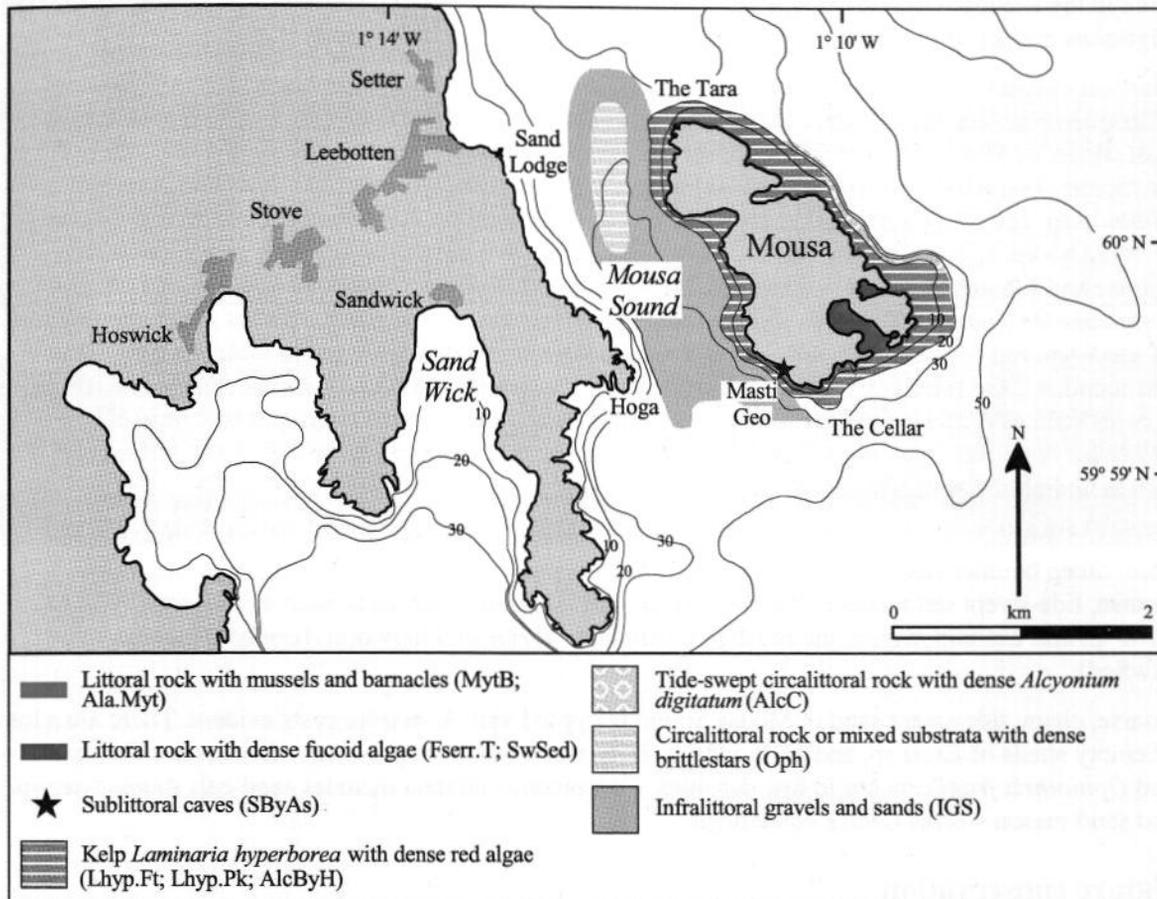


Figure 15.2 Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 15.1, cited literature and additional field observations).

© Crown copyright. All rights reserved. JNCC GD27254X/1999.

Sublittoral

Bedrock continues into the sublittoral zone with vertical rock reaching a level floor of bedrock and boulders at 30 m depth on the east coast of Mousa and sloping rock giving way to sand-covered bedrock, cobble and coarse shell-sand at 13 m on the west coast. There are also large boulders and bedrock outcrops on the sand in Mousa Sound at 19 m. At a depth of 36 m in the centre of the channel there is very barren, clean, shelly sand. The eastern tidal pool has boulder sides and a muddy sand floor and an entrance channel floored with cobbles and shell-gravel.

The upper infralittoral zone is dominated by *Laminaria hyperborea* kelp forests which support a reasonably dense epiflora on the stipes and species such as the red alga *Bonnemaisonia asparagoides* and the brown algae *Desmarestia* sp. and *Laminaria saccharina* on the rock surface (Lhyp.Ft). The lower limit of the kelp appears to be determined by substratum availability at the sites for which there are records. On the east coast, a shelf at 12-14 m depth on an otherwise vertical and overhanging wall is the deepest extent of the kelp. On the north-west coast, the rock-sand boundary occurs at 14 m, the lower limit of the main forest, although there is kelp park on boulders in the sand at 19 m (Lhyp.Pk). The kelp park appears grazed, with large numbers of the urchin *Echinus esculentus*, abundant encrusting algae and the keelworm *Pomatoceros triqueter* on the upward-facing surfaces with brittlestars, terebellid worms and the featherstar *Antedon bifida* under and between boulders. Vertical

rock in the shallow infralittoral and sublittoral fringe is covered with dead-man's fingers *Alcyonium digitatum* and a turf of the bryozoan *Scrupocellaria* sp. and hydroids (AlcByH).

Vertical circalittoral rock is also dominated by *A. digitatum*, but encrusting algae, *E. esculentus* and *P. triqueter* replace the bryozoan and hydroid turf of the shallow infralittoral (AlcC). On the north-east corner of Mousa, the vertical wall reaches a plain of rock and boulders at 30 m depth where the brittlestar *Ophiocoma nigra* is abundant with *A. digitatum* and grazers such as chitons, topshells *Gibbula* sp. and *E. esculentus*. The rock slope is more gradual on the west of the island and the sand-covered bedrock, boulders and cobbles between 13 and 19 m have little kelp but a wide range of foliose and filamentous red algal species. These include *Porphyra miniata*, *Antithamnion cruciatum*, *Antithamnion plumula*, *Polysiphonia elongata* and *Nitophyllum punctatum*, species which are tolerant of sand-scoured conditions (EphR). *O. nigra* dominates scoured bedrock and cobbles in the centre of the sound at 27 m (Oph). The substrata support a fairly diverse community with a variety of hydroid species such as *Hydrallmania falcata*, *Sertularia argentea* and *Nemertesia* spp., horse mussels *Modiolus modiolus*, anemones *Urticina* sp., starfish *Crossaster papposus* and *Solaster endeca* and fish including the wolf fish *Anarhichas lupus*.

Sheltered infralittoral communities are found in permanently submerged conditions in the east tidal pool. Steep boulder sides here are covered with *L. saccharina* and the brown alga *Chorda filum*. Coarse, tide-swept sediments in the entrance channel support green algae such as *Enteromorpha* sp., *Ulva* sp. and *Codium fragile*, the red alga *Ceramium rubrum* and lugworm *Arenicola marina* (SwSed).

Coarse, clean, tide-swept sand in Mousa Sound is rippled with *A. marina* casts evident. There are a lot of empty shells of *Ensis* sp. and *M. modiolus* shells and a few live specimens. Brittlestars *O. nigra* and *Ophiothrix fragilis* occur in low densities. Conspicuous infauna includes sand-eels *Ammodytes* sp. and sand mason worms *Lanice conchilega*.

Nature conservation

Conservation sites

Site name	Status	Main features
Mousa	SSSI; SPA	Ornithological
Mousa	cSAC	Marine interest for common seals <i>Phoca vitulina</i>
Shetland Islands	ESA	Agri-environmental scheme

Human influences

Coastal developments and uses

There is very little development of any sort and few houses in Area 15. Most of Mousa is semi-improved grassland, and crops are grown on the adjacent Mainland. A seasonal ferry runs between Wick of Sandsayre and West Ham on Mousa. There are numerous pleasure and wildlife-watching tours to the island, with the Broch of Mousa being a major archaeological attraction.

Marine developments and uses

There are major sand-eel *Ammodytes* spp. fishing-grounds in Mousa Sound and to the east of Mousa. Some potting for crustaceans and scallop-dredging takes place in the area.

References and further reading

Howson, C.M. 1988. Marine Nature Conservation Review: survey of Shetland, Foula and Fair Isle, 1987. (Contractor: Field Studies Council, Oil Pollution Research Unit, Pembroke.) *Nature Conservancy Council, CSD Report, No. 816.*

Sites surveyed

Survey 261: 1987 OPRU/MNCR survey of Shetland, Foula and Fair Isle (Howson 1988).

Littoral sites

Survey	Site	Site name	Grid reference	Latitude/longitude	Biotopes recorded
261	73	S Holes of Burro, Mousa.	HU 464 244	60°00.1'N 01°10.0'W	Cor
261	74	East Pool, Mousa.	HU 468 238	59°59.8'N 01°09.6'W	SwSed
261	75	West Pool, Mousa.	HU 464 235	59°59.6'N 01°10.0'W	G; FK; Fserr.T
261	76	Muckle Bard, Mousa.	HU 470 237	59°59.7'N 01°09.4'W	MytB; FK; Ala.Myt
261	77	Masti Geo (cave), Mousa.	HU 461 232	59°59.4'N 01°10.4'W	SByAs

Sublittoral sites

Survey	Site	Site name	Grid reference	Latitude/longitude	Biotopes recorded
261	72	N Holes of Burro, Mousa.	HU 463 244	60°00.1'N 01°10.1'W	Lhyp.Ft; AlcByH; AlcC
261	133	N Mousa Sound.	HU 446 249	60°00.4'N 01°12.0'W	Oph; IGS
261	134	S Mousa Sound.	HU 452 234	59°59.6'N 01°11.3'W	IGS
261	135	W of North Isle, Mousa Sound.	HU 450 248	60°00.3'N 01°11.5'W	Lhyp.Ft; Lhyp.Pk; EphR

16

No Ness to Sumburgh Head

Location

Position (centre)	HU 415 170	59°56.1'N 01°15.4'W
Administrative area	Shetland Islands	
Conservation agency/area	Scottish Natural Heritage	North Areas (Northern Isles)

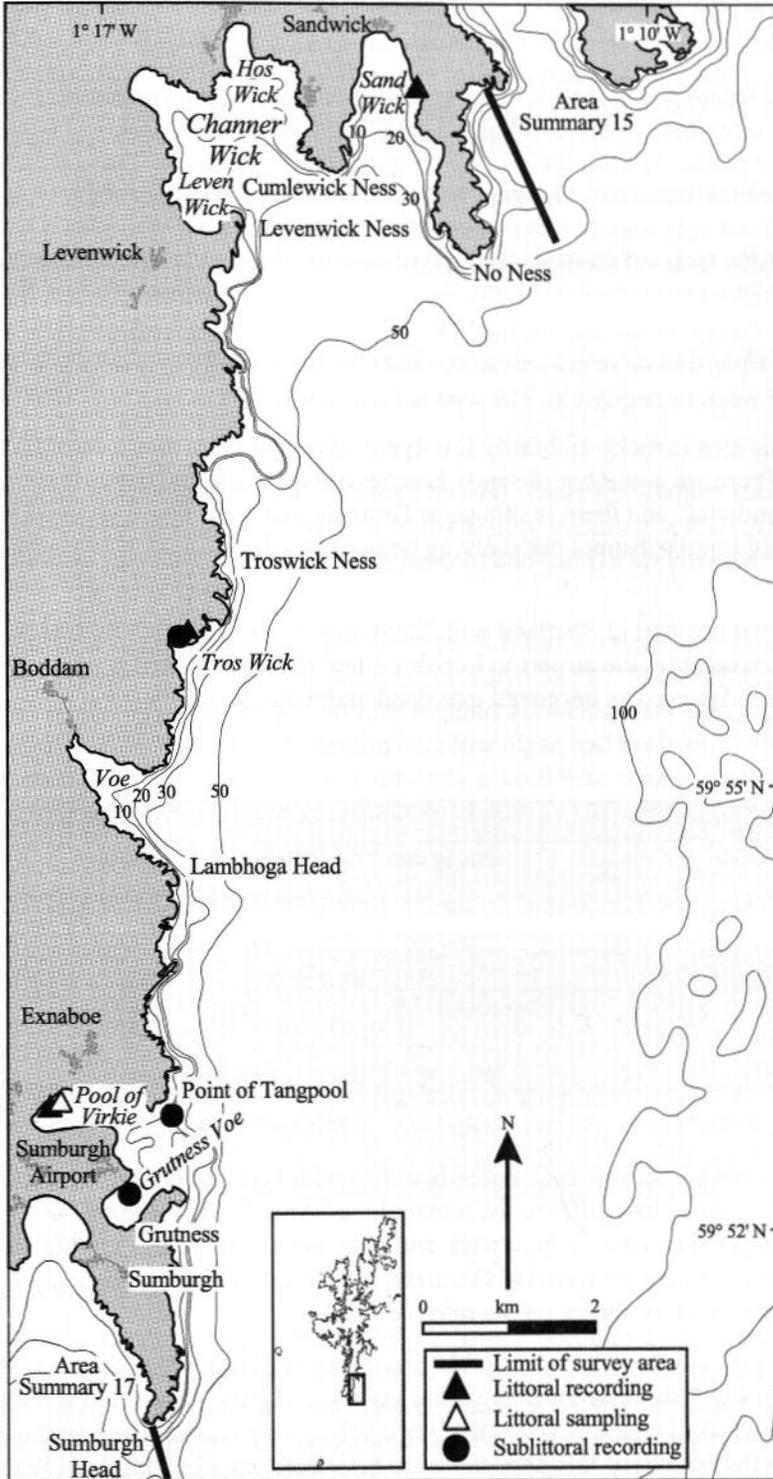


Figure 16.1 Main features of the area, showing sites surveyed.

© Crown copyright. All rights reserved. JNCC GD27254X/1999.

Physical features

<i>Physiographic type</i>	Open coast with embayments
<i>Length of coast</i>	51 km
<i>Bathymetry</i>	50 m contour within 500 m along most of coastline; 2 km offshore at Cumlewick Ness
<i>Wave exposure</i>	Very exposed - sheltered; mostly very exposed
<i>Tidal streams</i>	Very strong (up to 7 knots) off Sumburgh Head; weak or negligible elsewhere
<i>Tidal range</i>	1.5 m (mean springs); 0.7 m (mean neaps)
<i>Salinity</i>	Fully marine

Introduction

Area 16 covers the south-east corner of Mainland Shetland. It is a predominantly linear, east-facing coastline although three bays in the north of the area, Sand Wick, Hos Wick and Channer Wick, open to the south and are protected from the east by the peninsula of No Ness. There are also three small inlets in the south of the area, Voe, Grutness Voe and the Pool of Virkie, a shallow, enclosed, sand-floored basin. This is a very exposed coastline where the 50 m contour comes close inshore and with no protection afforded from offshore islands apart from the north of the area where there is some shelter from the north-east. Sheltered conditions are found in localised areas in the inlets, such as the Pool of Virkie and Leven Wick. Very strong tidal streams, reaching speeds of up to 7 knots, run around Sumburgh Head and there are moderate tidal streams around the headland of No Ness, but elsewhere they are weak or negligible. The area is fully marine.

The coastline in this area is rocky and fairly low-lying, although there are steep cliffs around Sumburgh Head. There are a number of sandy beaches at bay heads and in the Pool of Virkie with dune systems at Sandwick, and there is shingle at Grutness and Voe. There is very little information available on the sublittoral substrata but shelving bedrock reaches at least 30 m depth in the south of the area.

This a relatively populous part of Shetland with Sumburgh Airport situated in the south of the area and the main A970 road from the airport to Lerwick running a short distance inland from the east coast. Most of the land is used as improved grassland and water quality is good.

Marine biology

Marine biological surveys

	<i>Survey methods</i>	<i>No. of sites</i>	<i>Date(s) of survey</i>	<i>Source</i>
<i>Littoral</i>	Recording	2	July-August 1974	Institute of Terrestrial Ecology (1975a)
	Recording	1	August 1987	Howson (1988)
	Core sampling	1	August 1987	Howson (1988)
<i>Sublittoral</i>	Recording	1	July-August 1974	Earl (1982); Institute of Terrestrial Ecology (1975b)
	Recording	2	February-March 1993	Covey & Hill (1993)

Littoral

Most of the littoral zone consists of bedrock or boulders with high cliffs around Sumburgh Head and gradually shelving shores or low cliffs in the remainder of Area 16. There are a number of sediment shores, notably clean sand beaches at Sandwick and other embayments and sandflats in the sheltered Pool of Virkie. Shingle shores are found at Grutness, in Voe and along stretches of other inlets whilst gravel occurs on some boulder shores on the open coast.

There is limited biological information available from three well-separated locations. A wave-exposed, shelving bedrock shore in Sand Wick has yellow and grey lichens and thrift *Armeria maritima* in the supralittoral zone (YG) and the black lichen *Verrucaria maura* in the littoral fringe (Ver.Ver). Towards the bottom of this zone there are littorinids, small numbers of limpets *Patella vulgata* and the barnacle *Semibalanus balanoides* and small mussels *Mytilus edulis*. The mid-eulittoral is animal-dominated with *S. balanoides*, *P. vulgata* and *M. edulis* in the upper part of the

zone (BPat.Sem) whilst in the lower part, mussels become dominant and barnacles less conspicuous (MytB). The lower eulittoral is algal-dominated with thongweed *Himanthalia elongata*, the coralline alga *Corallina officinalis* and the red alga *Ceramium* sp. (Him). Kelps *Laminaria digitata* and *Alaria esculenta* dominate the sublittoral fringe with mussels and limpets continuing from higher on the shore and the furoid *Fucus serratus* present (Ala.Ldig).

A boulder and gravel shore at Tros Wick is slightly more sheltered. There is a band of yellow and grey lichens at the top of the shore (YG) with the furoid *Pelvetia canaliculata* in the upper eulittoral (Pel), indicating more sheltered conditions than on the previous shore. The upper part of the mid-eulittoral is dominated by *S. balanoides* with *P. vulgata* and some plants of the furoid *Fucus vesiculosus* (BPat.Sem). This furoid becomes abundant lower on the shore, grading into a zone of mixed furoid algae with *F. vesiculosus* (Fves) and *F. serratus*, *H. elongata*, the red algae *Mastocarpus stellatus* and *C. officinalis*, limpets and barnacles (Fser.R).

The littoral zone in the Pool of Virkie consists of a large medium to fine sandflat with scattered boulders and cobbles on the mid and upper shore. A harbour wall also provides hard substrata. The sand is extensively worked by lugworm *Arenicola marina* and contains bivalves including *Cerastoderma edule* and *Chamelea gallina*, oligochaetes, and polychaetes such as *Scoloplos armiger* and *Ampelisca brevicornis* (AP.P). Boulders and the harbour wall support fucoids with *Fucus spiralis* on the upper shore (Fspi), *Ascophyllum nodosum* on the mid-shore (Asc.Asc) and *F. serratus* on the lower shore (Fser.Fser).

Sublittoral

Information for the sublittoral zone in Area 16 is very limited. There are shallow rock platforms at 4-5 m depth with gullies 1 m deep at Tros Wick, a bedrock slope reaching at least 30 m outside the Pool of Virkie and mixed angular boulders, cobble, pebbles and sand in approximately 10 m depth in Grutness Voe.

Kelp forests of *Laminaria hyperborea* dominate the upper infralittoral with kelp park in the lower infralittoral reaching a depth of at least 21 m (LhypGz.Ft; LhypGz.Pk). Rock surfaces in the lower infralittoral zone are intensely grazed by sea urchins *Echinus esculentus* and chitons, although kelp stipes have a reasonably dense epiflora. Encrusting coralline algae and keelworms *Pomatoceros triqueter* cover the rock. The circalittoral zone is similarly grazed with rock encrusted by algae; crevices here contain the bivalve *Chlamys* sp., brittlestars and squat lobsters *Galathea strigosa* (FaAIC).

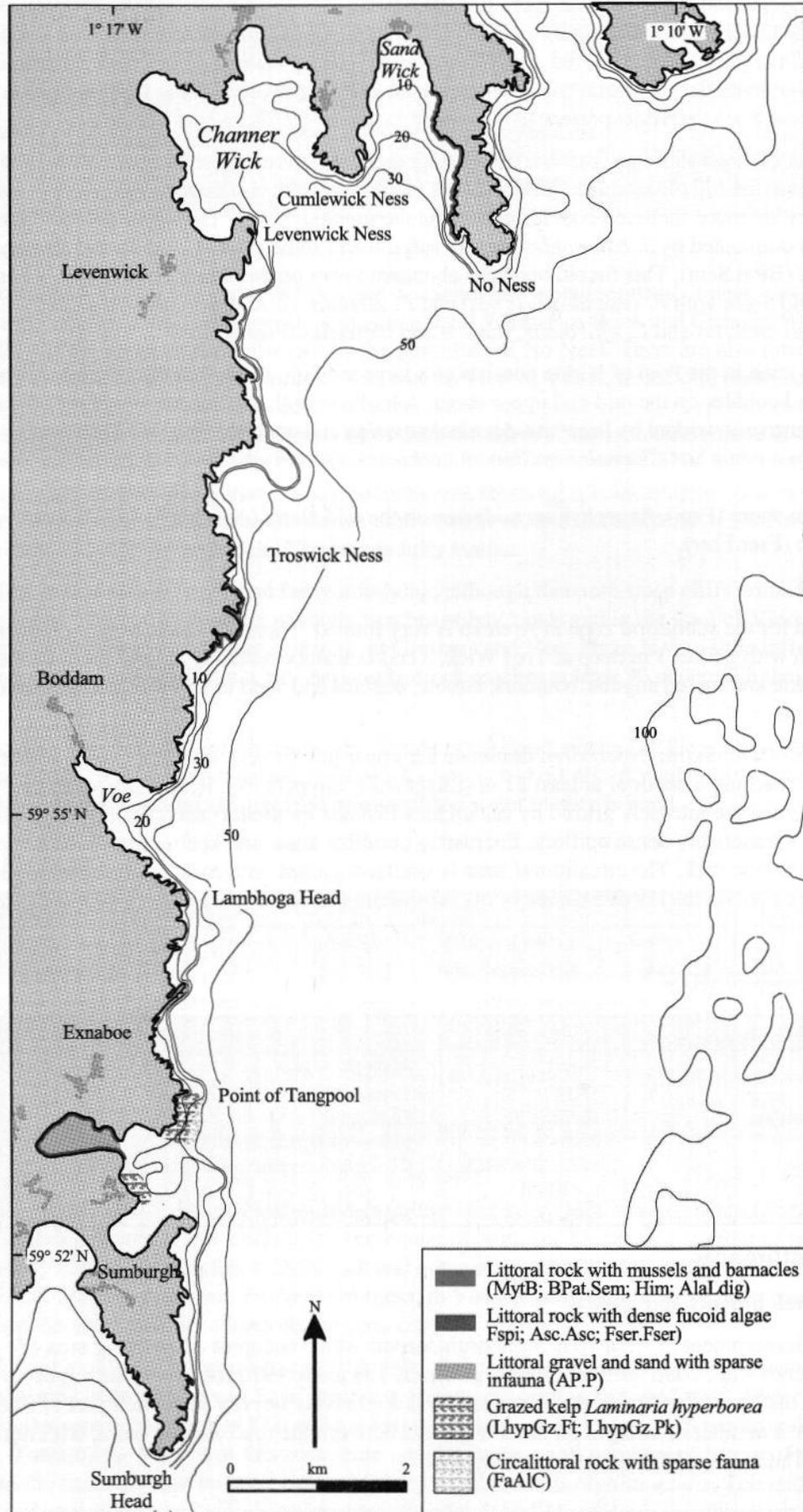
Nature conservation

Conservation sites		
Site name	Status	Main features
Dalsetter	SSSI	Botanical
The Cletts, Exnaboe	SSSI; GCR	Geological
Pool of Virkie	SSSI	Marine biological; ornithological
Sumburgh Head	SSSI; SPA; GCR; RSPB	Geological; ornithological (seabirds)
Shetland Islands	ESA	Agri-environmental scheme

Human influences

Coastal developments and uses

The major development in Area 16 is Sumburgh Airport which occupies a low-lying area of approximately 1 km², 2 km north of Sumburgh Head. The main A970 road from the airport to Lerwick runs a short distance inland from the east coast. This a relatively heavily populated part of Shetland and there are a number of villages on the low ground between the road and the coast, with numerous side roads. There is a sandstone quarry at Exnaboe.



< **Figure 16.2** Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 16.1, cited literature and additional field observations).

© Crown copyright. All rights reserved. JNCC GD27254X/1999.

Some crops are grown on the land around Sandwick in the north of the area but most of the land is improved grassland with some rough grazing.

Marine developments and uses

The ferry to Fair Isle runs from a pier at Grutness and there are piers or jetties at Exnaboe and Cumlewick. There is a marina at Pool of Virkie.

There are several sand-eel *Ammodytes* spp. fishing-grounds between Troswick and Sumburgh. Potting for crustaceans takes place along the inshore rocky coastline. There is no mariculture in Area 16.

References and further reading

Covey, R., & Hill, T.O. 1993. *Shetland oil spill marine benthos survey 25 February - 2 March 1993. Field survey report.* (Contractor: Joint Nature Conservation Committee, Peterborough.) Unpublished report to Scottish Natural Heritage.

Earl, R.C. 1982. Report on a sublittoral survey of Shetland. (Contractor: Underwater Conservation Society, Ross-on-Wye.) *Nature Conservancy Council, CSD Report*, No. 466.

Howson, C.M. 1988. Marine Nature Conservation Review: survey of Shetland, Foula and Fair Isle, 1987. (Contractor: Field Studies Council, Oil Pollution Research Unit, Pembroke.) *Nature Conservancy Council, CSD Report*, No. 816.

Institute of Terrestrial Ecology. 1975a. Report to the Nature Conservancy Council on some aspects of the ecology of Shetland. Part 6.2. Littoral biota of rocky shores. *Nature Conservancy Council, CSD Report*, No. 27.

Institute of Terrestrial Ecology. 1975b. Report to the Nature Conservancy Council on some aspects of the ecology of Shetland. 6.4: Sublittoral biota. *Nature Conservancy Council, CSD Report*, No. 30.

Sites surveyed

Survey 230: 1974 ITE report on sublittoral biota of Shetland (Institute of Terrestrial Ecology 1975b).

Survey 261: 1987 OPRU/MNCR survey of Shetland, Foula and Fair Isle (Howson 1987).

Survey 387: 1993 MNCR Shetland *Braer* oil spill marine benthos survey (Covey & Hill 1993).

Survey 434: 1974 ITE report on rocky shore ecology of Shetland (Institute of Terrestrial Ecology 1975a).

Littoral sites					
Survey	Site	Site name	Grid reference	Latitude/longitude	Biotopes recorded
261	81	Pool of Virkie, Sumburgh.	HU 395 113	59°53.1'N 01°17.6'W	Fspi; Asc.Asc; Fser.Fser; AP.P
434	68	Tros Wick.	HU 410 167	59°56.0'N 01°15.9'W	YG; Ver; Pel; BPat.Sem; Fves; Fser.R; Fser.Fser; Him; Mas
434	74	E Sand Wick.	HU 438 230	59°59.4'N 01°12.8'W	YG; Ver.Ver; MytB; BPat.Sem; Him; Ala.Ldig
Sublittoral sites					
Survey	Site	Site name	Grid reference	Latitude/longitude	Biotopes recorded
230	10	Tros Wick.	HU 410 167	59°56.0'N 01°15.9'W	EIR
387	6	Point of Tangpool, Shetland.	HU 409 112	59°53.0'N 01°16.1'W	LhypGz.Pk; FaAIC
387	7	Grutness Voe, Shetland.	HU 404 103	59°52.6'N 01°16.6'W	LhypGz.Ft

Compiled by: Christine Howson

17

Sumburgh Head to South Havra

Location

Position (centre)	HU 355 170	59°56.2'N 01°21.8'W
Administrative area	Shetland Islands	
Conservation agency/area	Scottish Natural Heritage	North Areas (Northern Isles)

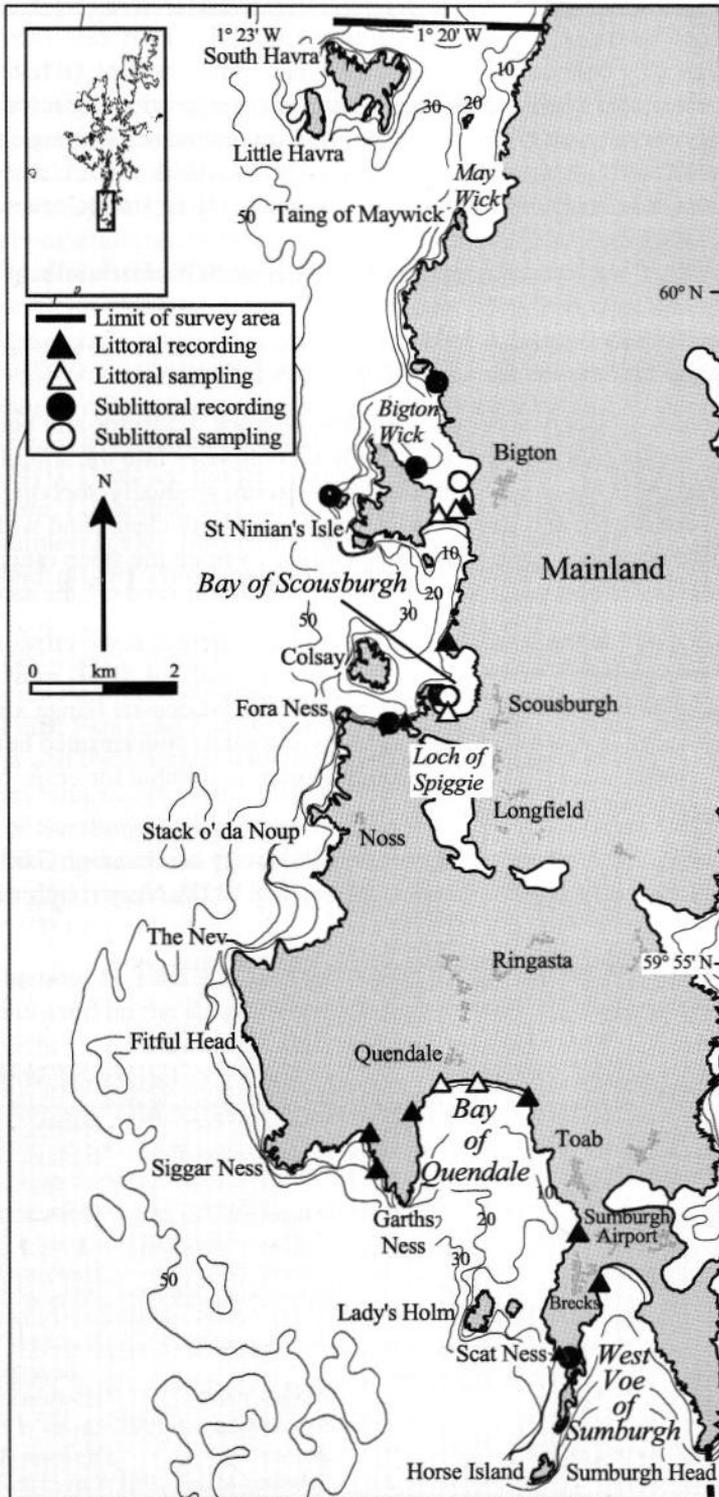


Figure 17.1 Main features of the area, showing sites surveyed.

© Crown copyright. All rights reserved. JNCC GD27254X/1999.

Physical features	
<i>Physiographic type</i>	Open coast with embayments and islands
<i>Length of coast</i>	65 km
<i>Bathymetry</i>	30 m contour closely follows coastline; 50 m contour from 500 m to 2 km from coast
<i>Wave exposure</i>	Extremely exposed to sheltered; mostly very exposed
<i>Tidal streams</i>	Very strong (up to 7 knots) off Sumburgh Head; moderate around Fitful Head; weak or negligible elsewhere
<i>Tidal range</i>	1.5 m (mean springs); 0.7 m (mean neaps)
<i>Salinity</i>	Fully marine

Introduction

Area 17, the south-west corner of Mainland Shetland, is very exposed along most of its length and although essentially an open, linear coast, it has a variety of landforms. There are spectacular cliffs at Fitful Head which, at 270 m high, are the second highest in Shetland, and are amongst the highest sea cliffs in the British Isles. The rocky coastline has numerous skerries, stacks, caves and geos. There are a number of bays including Bay of Quendale, which is exposed to the south and has a large, clean sand beach backed by Shetland's most extensive dune system. St Ninian's Isle on the west coast is connected to the mainland by a shell-sand tombolo, which is of national importance as the largest example of such a structure in Britain. A sand-bar separates the Bay of Scousburgh from Loch of Spiggie, which no longer has any marine input. The area is fully marine.

Many of the shores consist of steep or vertical bedrock, bedrock platforms and boulders. There are also a large number of sandy shores in this area. Bedrock continues into the sublittoral to depths of at least 25 m, with vertical cliffs off exposed headlands and more gradually-shelving rock elsewhere. Bays such as Bay of Scousburgh and Bigton Wick are floored with clean sand with patches of boulders. The rock-sand boundary varies from deeper than 25 m on the steep outer coast of St Ninian's Isle to 10 m on its east coast with shallower sublittoral sand off the sandy beaches.

Sumburgh Airport is situated in the south-east of the area and there is some erosion of the sand beaches in West Voe of Sumburgh to the south of the airport, with the dunes moving northward. Options for coastal defence here are being considered. Whilst the coastal fringe around Bigton and from Quendale to Sumburgh is low-lying, with villages and roads concentrated here, much of the rest of the area consists of steep hillside. The land around Bigton is suitable for crops but the majority of the area is improved grassland or rough grazing.

In January 1993, the oil tanker *Braer* went aground on the rocky headland of Garths Ness west of Bay of Quendale (Ritchie & O'Sullivan 1994; Davies & Topping 1997). Very rough weather at the time helped disperse the resulting oil spill and there has been little residual impact (Environment and Resource Technology Ltd. 1996). Water quality in the area remains good.

Marine biology

Marine biological surveys				
	<i>Survey methods</i>	<i>No. of sites</i>	<i>Date(s) of survey</i>	<i>Source</i>
<i>Littoral</i>	Recording	4	July-August 1974	Institute of Terrestrial Ecology (1975a)
	Recording	1	August 1987	Howson (1988)
	Recording	6	February-March 1993	Covey & Hill (1993)
	Infaunal sampling (cores)	1	August 1987	Howson (1988)
	Infaunal sampling (cores)	4	February-March 1993	Fuller & Donnan (1993)
<i>Sublittoral</i>	Recording	2	July-August 1974	Earl (1982); Institute of Terrestrial Ecology (1975b)
	Recording	2	August 1987	Howson (1988)
	Recording	1	February-March 1993	Covey & Hill (1993)
	Infaunal sampling (suction sample)	1	August 1987	Howson (1988)
	Infaunal sampling (cores)	2	February-March 1993	Covey & Hill (1993)

Littoral

The littoral zone consists primarily of steep or vertical bedrock, bedrock platforms and boulders which are extremely or very exposed to wave action. Cliffs, such as some of those around Garths Ness, may have a cobble foreshore. There are mobile, clean sand shores at several locations including Bay of Quendale, Bay of Scousburgh, May Wick and St Ninian's tombolo. At the junction between the sandy and rocky shores, there are generally areas of rock and boulder which are heavily scoured by sand.

The majority of the rocky shores have biotopes characteristic of very exposed conditions with the mid-eulittoral dominated by animals rather than fucoid algae. Yellow and grey lichens dominate the supralittoral (YG) whilst the littoral fringe has a wide band of the black lichen *Verrucaria maura* (Ver.Ver). In the lower part of this zone, the *V. maura* is covered with a blanket of the red algae *Porphyra umbilicalis* and *Porphyra linearis* (Ver.Por). Crevices contain littorinids and small pools have green algae *Enteromorpha* spp. Below this zone, the mid-eulittoral has a zone of barnacles *Chthamalus stellatus* and *Semibalanus balanoides* and the limpet *Patella vulgata* (BPat.Sem) followed by mats of small mussels *Mytilus edulis* with fewer barnacles and limpets (MytB). This mussel-dominated band may cover the entire mid-eulittoral and extend over the lower eulittoral as well. At some sites, algae characterise the lower eulittoral, with thongweed *Himanthalia elongata*, red algae *Mastocarpus stellatus*, *Callithamnion* sp., *Porphyra umbilicalis* and *Corallina officinalis* and the green alga *Cladophora rupestris* common and mussels, barnacles and *P. vulgata* beneath these (Him). Kelp *Alaria esculenta* dominates the sublittoral fringe with *M. edulis*, *C. officinalis* and coralline crusts (Ala.Myt). Pools are numerous on these exposed shores; deep rocky pools contain kelps *Laminaria digitata*, *Laminaria saccharina* and *A. esculenta* and red and green algal species similar to the lower eulittoral (FK). Mid-eulittoral pools are lined with coralline crusts and have large quantities of *C. officinalis* (Cor) whilst those in the upper eulittoral are dominated by green algae such as *Enteromorpha* sp.

On slightly less exposed shores, some fucoid algae are present, forming open mosaics with barnacles and limpets. The fucoids *Pelvetia canaliculata* and *Fucus spiralis* are present in small quantities in the upper eulittoral (PelB; Fspi) and *Fucus vesiculosus* in the mid-eulittoral. Mussels are still present in significant numbers and form a zone with barnacles in the lower eulittoral. In the sublittoral fringe, *A. esculenta* dominates with *C. officinalis* and *M. edulis*. On the most sheltered of this group of shores, in West Voe of Sumburgh, the mid-eulittoral has a *F. vesiculosus* mosaic (FvesB) followed by bands of barnacles and limpets, dense *F. vesiculosus* and, in the lower eulittoral, *Fucus serratus* (Fser.Fser). The sublittoral fringe here has *L. saccharina* and *L. digitata* rather than *A. esculenta* (Lsac.Ldig).

Biotopes on rock influenced by sand are variable and depend on the relative proportions and the distribution of rock and sand on the shore. Where there is rock on the upper shore, as at the east side of Bay of Quendale, lichens, *Porphyra* spp. and coralline rockpools are found with *M. stellatus* on the lower shore although the lowest, most scoured, rocks are devoid of species. On the opposite side of the bay, boulder and shingle in the mid-shore has a patchy cover of *S. balanoides* and *M. edulis*, lower shore rock supports foliose red algae and the sublittoral fringe is dominated by *L. digitata* (Ldig.Ldig). Boulders on the sand have some *F. vesiculosus* and are covered with *Enteromorpha* sp. and *M. stellatus*. At the eastern end of St Ninian's tombolo, lower shore scoured boulders are covered with encrusting algae whilst nearby sand-covered bedrock has a turf of the filamentous red alga *Audouinella* spp. and the green *C. rupestris* (Rho). There are a variety of rock pools here, including coralline pools in the mid-eulittoral and deeper pools with sand-covered floors supporting the green alga *Codium fragile*, filamentous brown algae, *Audouinella* spp., limpets, barnacles and shore crabs (SwSed). Pools with rock floors contain *C. rupestris*, *Enteromorpha* sp., and red algae *Polysiphonia brodiei* and *Ceramium* sp.

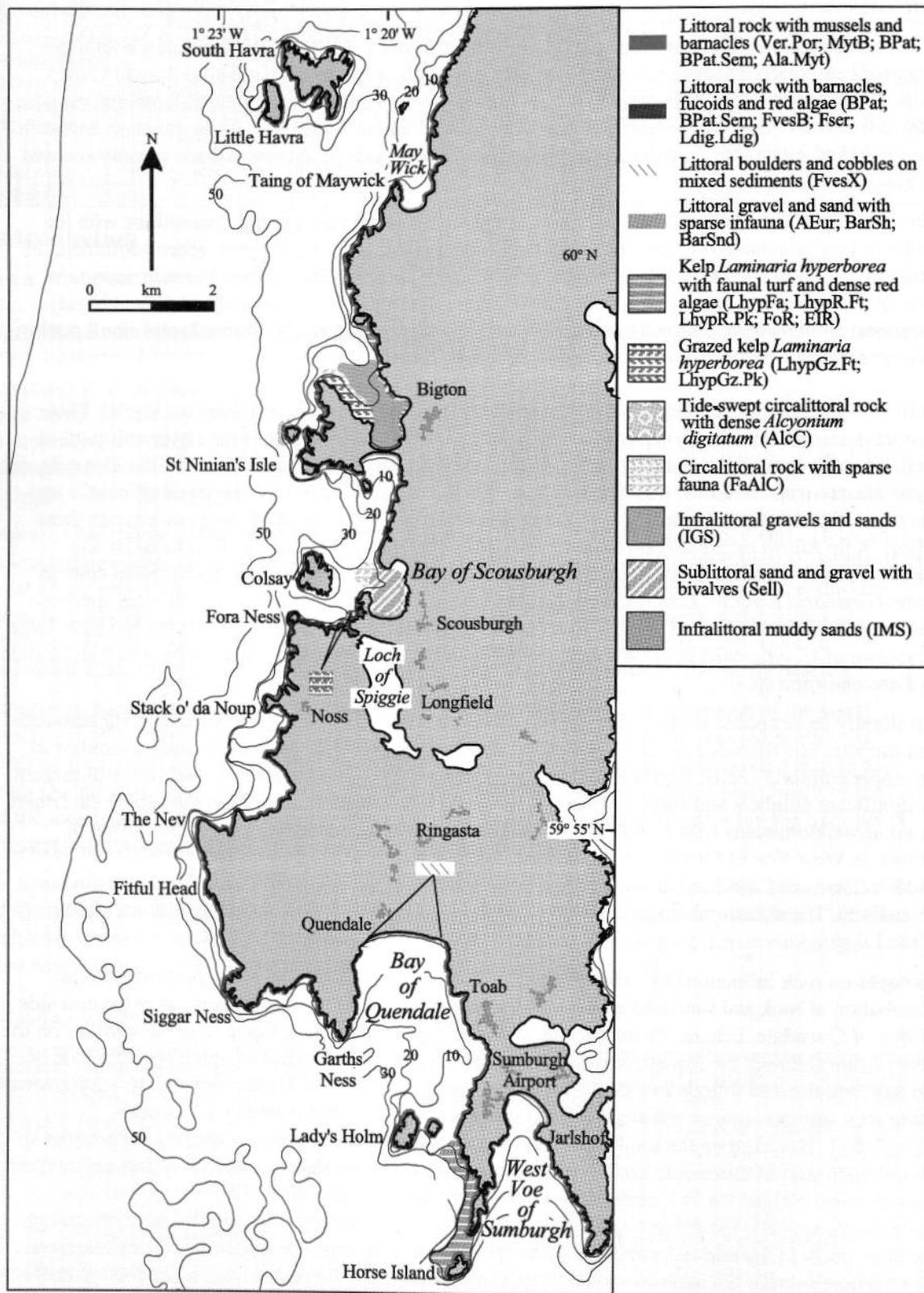


Figure 17.2 Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 17.1, cited literature and additional field observations).

© Crown copyright. All rights reserved. JNCC GD27254X/1999.

The majority of the sand shores investigated are highly mobile with no obvious macro-infauna (BarSnd). Shingle on St Ninian's tombolo is similarly barren (BarSh). The exception is the western end of the beach in Bay of Quendale, adjacent to boulders, where medium-grained sand contains the polychaete *Eurydice pulchra* and amphipods *Talitrus saltator* and *Echinogammarus pirloti* (AEur).

Surveys to assess the impact of the *Braer* oil spill (Covey & Hill 1993) showed that rocky shores close to the site of the spill had few littorinid molluscs or limpets, with many unoccupied limpet scars. Rockpools were particularly badly affected, with bleached coralline algae and few if any limpets, littorinids, anemones or dogwhelks *Nucella lapillus*.

Sublittoral

Much of the sublittoral on the open headlands has steep or vertical bedrock, occasionally with boulders at the cliff base, with more gradually shelving rock and boulders elsewhere. This hard substratum drops to at least 25 m depth off St Ninian's Isle, 18 m south-west of Scat Ness and 12 m in Bigton Wick. The rock gives way to coarse, clean sand which is often formed into waves or dunes and there may be scattered boulder outcrops on the sand.

Dense *Laminaria hyperborea* kelp forests dominate the infralittoral to a depth of 15-18 m at the most exposed sites and 10-12 m at more sheltered sites. Kelp park continues to about 22 m. Foliose algae such as *Odonthalia dentata* and *Delesseria sanguinea* are dense on both the rock surface and kelp stipes indicating low levels of grazing in the extremely exposed conditions (LhypR.Ft). In the shallow infralittoral, there is a rich surge-tolerant fauna on the rock with sponges such as *Halichondria panicea*, *Oscarella lobularis* and *Clathrina coriacea*, ascidians including *Lissoclinum perforatum*, *Polyclinum aurantium*, *Dendrodia grossularia* and *Sidnyum* spp., barnacles *Balanus crenatus* and encrusting bryozoans (LhypFa).

More sheltered sites, which include the east of St Ninian's Isle and Bay of Scousburgh, are more heavily grazed with no dense faunal or algal turfs present and rock surfaces are instead dominated by encrusting algae (LhypGz.Ft; LhypGz.Pk). At these sites, encrusting algae also dominate the lower infralittoral and upper circalittoral zones, with large numbers of sea urchins *Echinus esculentus*, brittlestars *Ophiocoma nigra* and *Ophiothrix fragilis*, chitons and keel worms *Pomatoceros triqueter*. Crevices shelter squat lobsters *Galathea strigosa* and *Munida rugosa* and the swimming crab *Liocarcinus puber* (FaAIC). On the exposed sites, in contrast, foliose algae continue beyond the kelp park to depths of at least 25 m (FoR). Vertical faces support dense dead-man's fingers *Alcyonium digitatum*, colonies of the tubeworm *Salmacina dysteri* and turfs of bryozoans and sponges (AlcC).

Shell-gravel east of St Ninian's Isle, adjacent to rock, contains the dahlia anemone *Urticina felina* but there is little other information available for the sediment communities (IGS). In Bigton Wick the sediment comprises fine sand and mud, a survey showed no visible epi- or infauna (IMS). However, surveys to assess the impact of the *Braer* oil spill revealed that sand in Bay of Scousburgh contained a large number of dead razor clams *Ensis* sp. and heart urchins *Echinocardium* sp. (Covey & Hill 1993).

Nature conservation

Conservation sites		
Site name	Status	Main features
Shetland: South West Mainland	NSA	Landscape
Lochs of Spiggie & Brow	SSSI; pSPA	Biological; ornithological
Quendale	SSSI	Botanical
Sumburgh Head	SSSI; SPA; GCR; RSPB	Geological; ornithological (seabirds)
St Ninian's Tombolo	SSSI; GCR	Geological
Shetland Islands	ESA	Agri-environmental scheme

Human influences

Coastal developments and uses

The major development in this area is Sumburgh Airport, which occupies a low-lying area of approximately 1 km², 2 km north of Sumburgh Head. There is some erosion of the sand beaches in West Voe of Sumburgh to the south of the airport, with the dunes moving northward. Options for coastal defence here are being considered.

There are a number of villages and roads on the low-lying ground around Bigton and Sumburgh, and crops are grown here, but much of the rest of the area consists of steep hillside with improved grassland or rough grazing. There are sandstone and sand and gravel quarries at Quendale.

The Norse settlement at Jarlshof is a major archaeological site and a tourist attraction with an associated museum. It is situated on sandy ground on the east shore of West Voe of Sumburgh.

Marine developments and uses

Potting for crustaceans takes place along the rocky coastline. There is no mariculture in Area 17.

In January 1993, the oil tanker *Braer* went aground on the rocky headland of Garths Ness to the west of Bay of Quendale. Very rough weather at the time helped disperse the resulting oil spill and there has been little residual impact to the natural heritage of the area; however, at the time of writing, mussels *Mytilus edulis* were still tainted and unharvestable and the fishery for Norway lobster *Nephrops norvegicus* was still closed (J. Uttley, pers. comm.). Water quality in the area remains good.

References and further reading

- Covey, R., & Hill, T.O. 1993. *Shetland oil spill marine benthos survey 25 February - 2 March 1993. Field survey report.* (Contractor: Joint Nature Conservation Committee, Peterborough.) Unpublished report to Scottish Natural Heritage.
- Dargie, T. 1992. Sand dune survey of Great Britain. Site report No. 134. Quendale, Shetland, Scotland. 1991. *JNCC Report*, No. 41.
- Dargie, T. 1994. Quendale Bay dune vegetation following the *Braer* oil spill incident. *Scottish Natural Heritage Research, Survey and Monitoring Report*, No. 22.
- Dargie, T. 1998. Sand dune vegetation survey of Scotland: Shetland. *Scottish Natural Heritage Research, Survey and Monitoring Report*, No. 122.
- Davies, J.M., & Topping, G., eds. 1997. *The impact of an oil spill in turbulent waters: the Braer: Proceedings of a symposium held at the Royal Society of Edinburgh, September 1995.* Edinburgh, HMSO.
- Earll, R.C. 1982. Report on a sublittoral survey of Shetland. (Contractor: Underwater Conservation Society, Ross-on-Wye.) *Nature Conservancy Council, CSD Report*, No. 466.
- Environment and Resource Technology Ltd. 1996. Diving and littoral survey of south Shetland relating to '*Braer*'. (Contractor: Environment and Resource Technology Ltd, South Queensferry.) *Scottish Natural Heritage Research, Survey and Monitoring Report*, No. 9.
- Fisheries Research Services. 1997. *The REAL story: the environmental impact of the Braer.* Aberdeen, Fisheries Research Services.
- Fuller, I., & Donnan, D. 1993. *Braer oil spill rocky shore survey; 26 February to 3 March 1993.* Unpublished, Scottish Natural Heritage. (Internal report.)
- Howson, C.M. 1988. Marine Nature Conservation Review: survey of Shetland, Foula and Fair Isle, 1987. (Contractor: Field Studies Council, Oil Pollution Research Unit, Pembroke.) *Nature Conservancy Council, CSD Report*, No. 816.

- Institute of Terrestrial Ecology. 1975a. Report to the Nature Conservancy Council on some aspects of the ecology of Shetland. Part 6.2. Littoral biota of rocky shores. *Nature Conservancy Council, CSD Report, No. 27.*
- Institute of Terrestrial Ecology. 1975b. Report to the Nature Conservancy Council on some aspects of the ecology of Shetland. 6.4: Sublittoral biota. *Nature Conservancy Council, CSD Report, No. 30.*
- Kingston, P.F., Dixon, I.M.T., Hamilton, S., Moore, C.G., & Moore, D.C. 1997. Studies on the response of intertidal and subtidal marine benthic communities to the *Braer* oil spill. In: *The impact of an oil spill in turbulent waters: the Braer. Proceedings of a symposium held at the Royal Society of Edinburgh, September 1995*, ed. by J.M. Davies & G. Topping, 209-233. Edinburgh, HMSO.
- Lees, G. 1994. Effects of the *Braer* oil spill on Sites of Special Scientific Interest in the Shetland Isles. *Scottish Natural Heritage Research, Survey and Monitoring Report, No. 12.*
- Ritchie, W. & O'Sullivan, M. 1994. *The environmental impact of the wreck of the Braer. Report of the Ecological Steering Group on the Oil Spill in Shetland.* Edinburgh, Scottish Office Environment Department.
- Wills, J. & Warner, K. 1993. *Innocent passage: the wreck of the tanker Braer.* Edinburgh, Mainstream Publishing.

Sites surveyed

- Survey 230: 1974 ITE report on sublittoral biota of Shetland (Institute of Terrestrial Ecology 1975b).
- Survey 261: 1987 OPRU/MNCR survey of Shetland, Foula and Fair Isle (Howson 1987).
- Survey 387: 1993 MNCR Shetland *Braer* oil spill marine benthos survey (Covey & Hill 1993; Fuller & Donnan 1993).
- Survey 434: 1974 ITE report on rocky shore ecology of Shetland (Institute of Terrestrial Ecology 1975a).

Littoral sites					
<i>Survey</i>	<i>Site</i>	<i>Site name</i>	<i>Grid reference</i>	<i>Latitude/longitude</i>	<i>Biotopes recorded</i>
261	82	Bay of Quendale, Sumburgh.	HU 370 128	59°53.9'N 01°20.3'W	FvesX; AEur
261	83	Skeo Clett, St Ninian's Isle.	HU 374 209	59°58.3'N 01°19.8'W	Cor; FK; SwSed; XR; Rho
387	3	Bay of Scousburgh littoral, Shetland.	HU 371 180	59°56.7'N 01°20.1'W	BarSnd
387	4	W end of tombolo, St Ninian's Isle.	HU 370 208	59°58.2'N 01°20.2'W	BarSh; BarSnd
387	5	E end of tombolo, St Ninian's Isle.	HU 373 209	59°58.3'N 01°19.9'W	BarSnd
387	8	NW of Hestingsgot, Bay of Quendale, Shetland.	HU 382 126	59°53.8'N 01°19.0'W	YG; Ver.Ver; Ver.Por; Cor; Mas
387	9	Bay of Quendale Beach, Shetland.	HU 375 128	59°53.9'N 01°19.7'W	BarSnd
387	11	Garthbanks (Quendale Bay), Shetland.	HU 366 124	59°53.7'N 01°20.7'W	BPat; XR; Ldig.Ldig
387	17	S of W end of Sumburgh Airport, Shetland.	HU 389 107	59°52.8'N 01°18.3'W	Ver.B; PelB; MytB; FvesB; Coff; Ala.Myt
387	18	Longi Geo shore, Shetland.	HU 365 179	59°56.7'N 01°20.8'W	Ver.Por; MytB; BPat; Ala.Myt
387	19	E of 'Braer' wreck, Garths Ness, Shetland.	HU 361 116	59°53.3'N 01°21.2'W	Ver.Por; BPat.Sem; MytB; FK
387	20	'Caves', NW corner, Garths Ness, Shetland.	HU 360 121	59°53.5'N 01°21.3'W	Ver.Por; BPat.Sem; FK; Mas; Ldig.Ldig
434	27	Brecks, West Voe of Sumburgh.	HU 392 100	59°52.4'N 01°17.9'W	Fspi; BPat.Sem; FvesB; XR; Fser; Fser.Fser; Lsac.Ldig
434	43	Hog of Breigeo, Scatness, Bay of Quendale.	HU 388 090	59°51.8'N 01°18.4'W	YG; Ver.Por; Ent; MytB; BPat.Sem; Him; Ala.Myt
434	69	Ness of Rerwick, St Ninian's Isle.	HU 371 190	59°57.2'N 01°20.1'W	Ver.Ver; Ver.Por; BPat; MytB; Ala.Myt
434	78	Cork Hole, Tromba of Griskerry, St Ninian's Isle.	HU 370 227	59°59.2'N 01°20.2'W	YG; Ver.Ver; Ver.Por; MytB; BPat.Sem; Him; Ala.Myt

Sublittoral sites					
<i>Survey</i>	<i>Site</i>	<i>Site name</i>	<i>Grid reference</i>	<i>Latitude/longitude</i>	<i>Biotopes recorded</i>
230	13	Scatness, Hog of Breigeo, Bay of Quendale.	HU 388 090	59°51.8'N 01°18.4'W	LhypFa
230	14	Tromba of Griskerry.	HU 370 227	59°59.2'N 01°20.2'W	EIR
261	78	Bigton Wick, St Ninian's Isle.	HU 373 213	59°58.5'N 01°19.9'W	IMS
261	79	Hich Holm, St Ninian's Isle.	HU 355 211	59°58.4'N 01°21.8'W	Ala.Myt; LhypR.Ft; LhypR.Pk; FoR; AlcC
261	80	Fauchin House, St Ninian's Isle.	HU 367 215	59°58.6'N 01°20.5'W	LhypGz.Ft; FaAIC; IGS
387	1	East of Longi Geo, Shetland.	HU 363 179	59°56.7'N 01°21.0'W	LhypGz.Pk
387	2	Bay of Scousburgh, Shetland.	HU 370 183	59°56.9'N 01°20.1'W	FaAIC; Sell

Compiled by: Christine Howson

Location

<i>Position (centre)</i>	HU 360 360	60°06.4'N 01°21.1'W
<i>Administrative area</i>	Shetland Islands	
<i>Conservation agency/area</i>	Scottish Natural Heritage	North Areas (Northern Isles)

Physical features

<i>Physiographic type</i>	Islands, Sounds, Voe.
<i>Length of coast</i>	114.41 km
<i>Area of inlet</i>	Lang Sound: 0.5 km ² ; Clift Sound: 9.3 km ² ; West Burra Firth: 0.8 km ² ; South & West Voes: 2.3 km ² ;
<i>Bathymetry</i>	>70 m S of Oxna; Lang Sound: 9 m; Clift Sound: 38 m; West Burra Firth: 27 m; South and West Voes: 24 m.
<i>Wave exposure</i>	Very exposed to ultra-sheltered
<i>Tidal streams</i>	Moderately strong to negligible
<i>Tidal range</i>	1.1 m (mean springs); 0.7 m (mean neaps)
<i>Salinity</i>	Fully marine

Introduction

This part of the south-west mainland of Shetland, which includes the fishing port of Scalloway, is a complex of islands, sounds and channels. The trend of the land is from NNE to SSW and the sounds follow this line between chains of elongate islands. The outer coasts are west-facing and so are very exposed to wave action. However, conditions become increasingly sheltered in the inlets and thus environmental conditions range from the exposure of the open coasts to ultra-sheltered conditions at the head of South Voe. There are several narrow channels connecting the sounds and these have tidal streams of moderate strength flowing through them.

The entire area is fringed by bedrock and boulders with a number of arches, stacks and geos on the west-facing coasts. On the open coast, coarse, clean shell-gravel replaces rock in depths of approximately 40 m, whilst in the shelter of the islands slopes of poorly-mixed and predominantly muddy sediments begin in depths of 10-20 m. The depth of this transition becomes gradually shallower with increasing shelter until, at the head of Clift Sound, there is very little hard substratum in the sublittoral.

The fishing port of Scalloway, the second largest town in Shetland, is situated on a small inlet at the northern end of Area 18. There is a small harbour development, and Scalloway is one of the main ports used by fishing boats in Shetland. Much of the remainder of the area is rural, with roads and villages along the island chains of West and East Burra but none on the steep hillside to the east of Clift Sound. There are several salmon *Salmo salar* farms in the area.

Marine biology**Marine biological surveys**

	<i>Survey methods</i>	<i>No. of sites</i>	<i>Date(s) of survey</i>	<i>Source</i>
<i>Littoral</i>	Recording	4	July-August 1974	Institute of Terrestrial Ecology (1975a)
	Recording	1	February-March 1993	Covey & Hill (1993)
<i>Sublittoral</i>	Recording	2	July-August 1974	Institute of Terrestrial Ecology (1975b), Earl (1982)
	Recording	5	July-August 1987	Moss & Ackers (1987)
	Recording	9	August 1986 & 1987	Hiscock (1986); Howson (1988)
	Recording	1	May 1988	Hiscock (1988)
	Recording	4	February-March 1993	Covey & Hill (1993)
	Infaunal sampling (suction sample)	2	August 1986 & 1987	Hiscock (1986); Howson (1988)
	Infaunal sampling (anchor dredge)	1	May 1988	Hiscock (1988)
Infaunal sampling (grab)	5	June 1993	Kingston <i>et al.</i> (1997)	

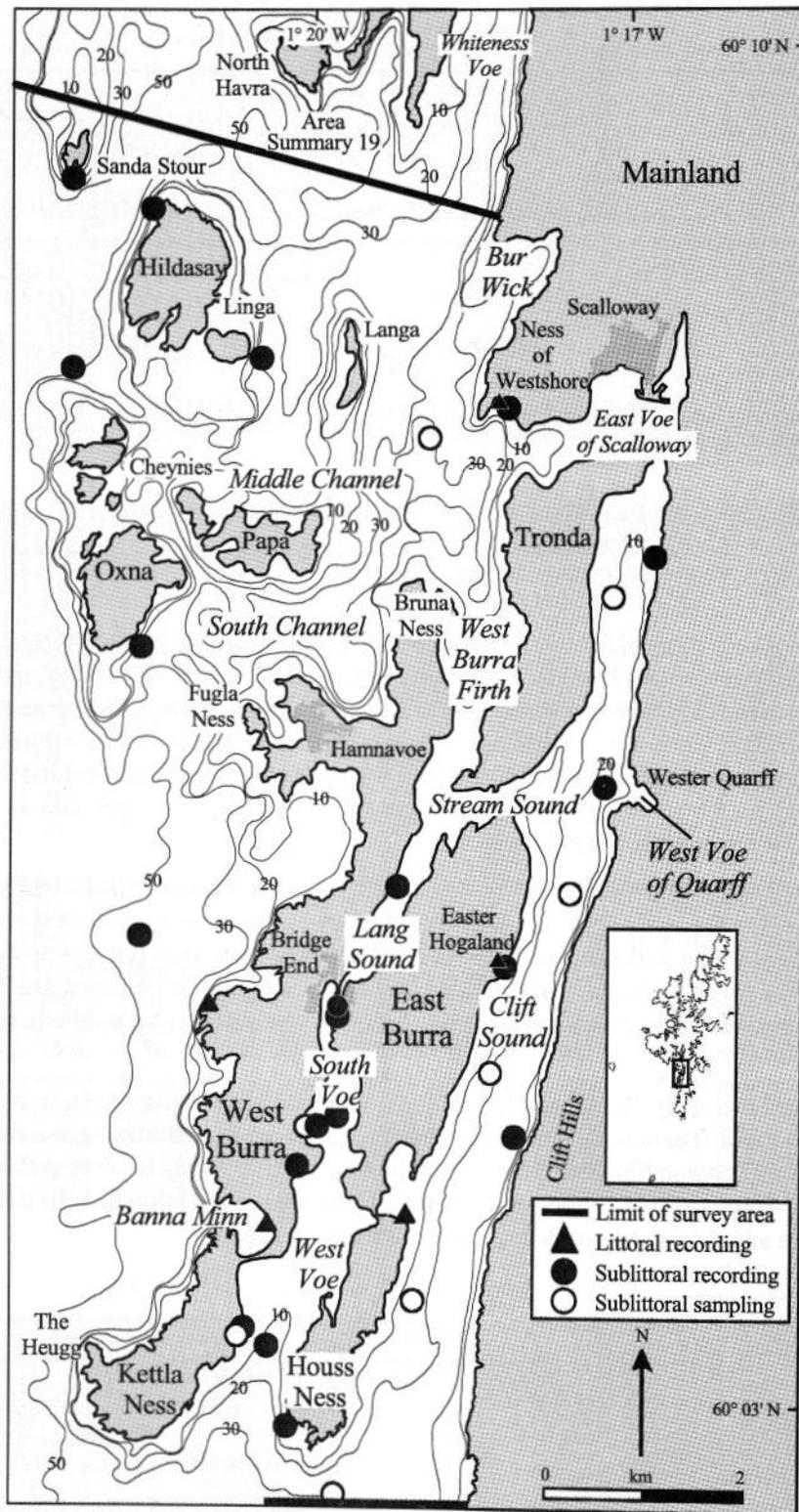


Figure 18.1 Main features of the area, showing sites surveyed.

© Crown copyright. All rights reserved. JNCC GD27254X/1999.

Littoral

Most of the littoral zone consists of steeply-sloping bedrock and boulders with particularly steep shores along the east side of Clift Sound. There are occasional small sandy beaches in embayments on the outer coasts whilst in the inner, sheltered areas, particularly at the heads of inlets, there are gradually-sloping shores of muddy sediment overlain with stones. In West Voe of Quarff, there is a wider shore where a stream enters the sea, and harbour walls at Scalloway provide artificial hard substrata.

Biological data for the littoral zone in this area are sparse, with survey records for only five rocky sites and one mixed substrata site. These do however cover a range of wave exposures. Where there is adequate rock on the high shore, there are yellow and grey lichens in the supralittoral (YG) followed lower by a zone of the black lichen *Verrucaria maura* (Ver.Ver). The mid-eulittoral is dominated by barnacles and limpets on the exposed shores (BPat.Sem), by a mosaic of barnacles and the furoid *Fucus vesiculosus* on shores of moderate exposure (FvesB) and by dense *F. vesiculosus* on the single sheltered site surveyed (Fves). The furoid *Ascophyllum nodosum* is common in areas of localised shelter on otherwise exposed shores and would be expected to dominate the most sheltered shores in this area (Asc.Asc). The furoid *Fucus serratus* and red algae such as *Chondrus crispus*, *Mastocarpus stellatus* and *Laurencia pinnatifida* are common in the lower eulittoral throughout the area (Fser.R). The red algae are particularly abundant on the more exposed shores where kelp *Alaria esculenta* and mussels *Mytilus edulis* dominate the sublittoral fringe (Ala.Myt). At moderately exposed and sheltered sites, *Laminaria digitata* is the dominant kelp in this zone (Ldig.Ldig).

The exposed steep rocky shore on the west coast of West Burra has a considerable amount of fresh-water seepage which influences the communities present. Here, the supralittoral fringe and upper eulittoral are dominated by the filamentous green algae *Enteromorpha* spp. with barnacles and the red alga *Porphyra umbilicalis* rather than by the lichens which characterise these zones on the other barnacle-dominated shore surveyed (EntPor). The more sheltered furoid-dominated shores have *Pelvetia canaliculata* and *Fucus spiralis* in the upper eulittoral (Pel; Fspi) with the rough periwinkle *Littorina saxatilis* var. *rudis*.

The nationally scarce furoid alga *Fucus distichus*, a species characteristic of wave-exposed northern shores, has been recorded over a 1 km stretch of exposed shore at West Burra in coralline pools with the algae *M. stellatus*, *Ceramium rubrum* and *Enteromorpha* spp. (Russell 1974). There are also coralline rockpools in the upper eulittoral in Banna Minn; these are likely to be widespread throughout Area 18 (Cor).

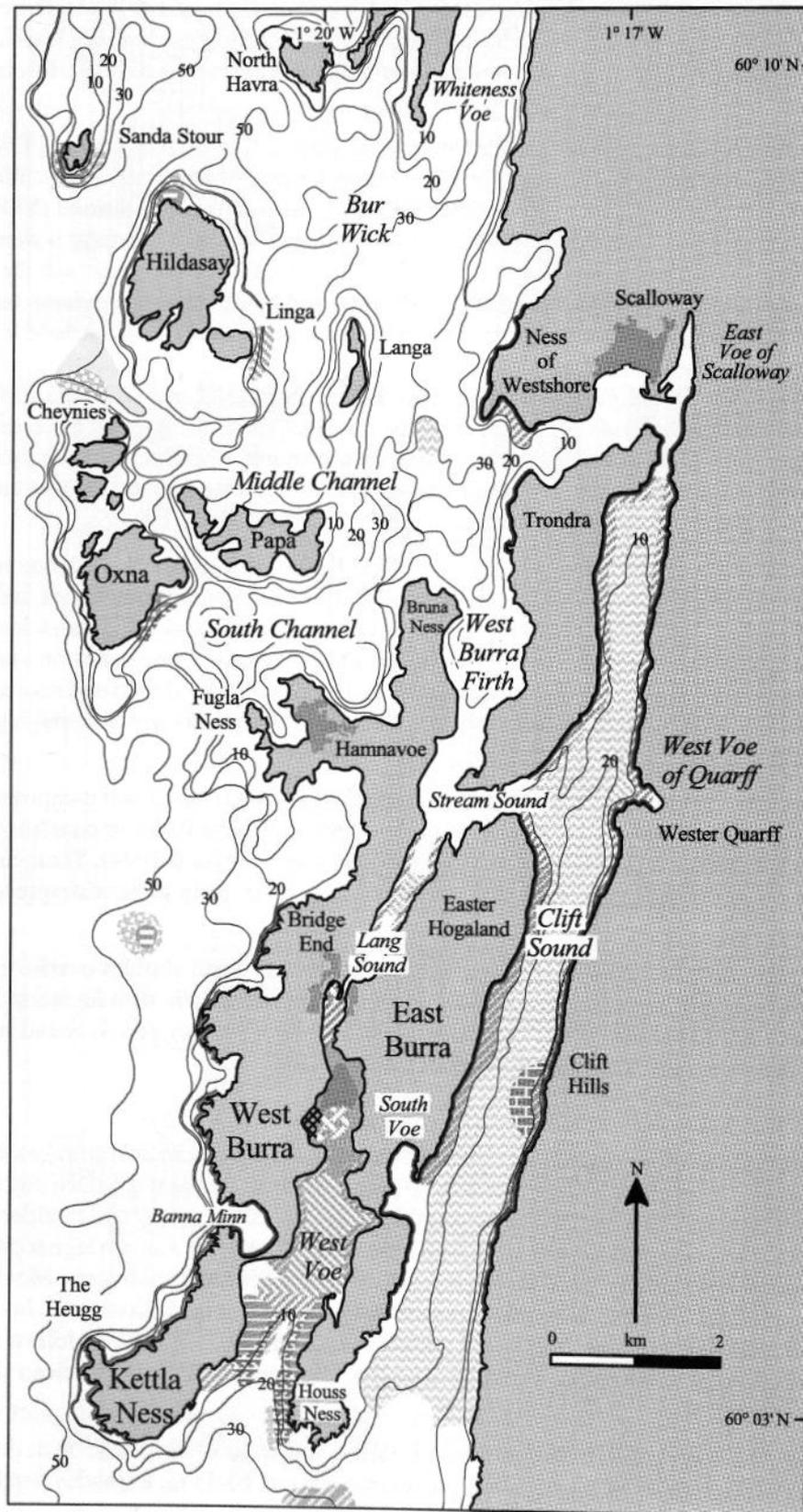
A sheltered shingle shore in East Voe of Scalloway, where boulders and cobbles overlie muddy sediment, supports furoids including *A. nodosum* and the mussel *M. edulis* with lugworm *Arenicola marina* in areas of open sediment. The brackish-water furoid *Fucus ceranoides* is found in streams running across the shore (Institute of Terrestrial Ecology 1975c).

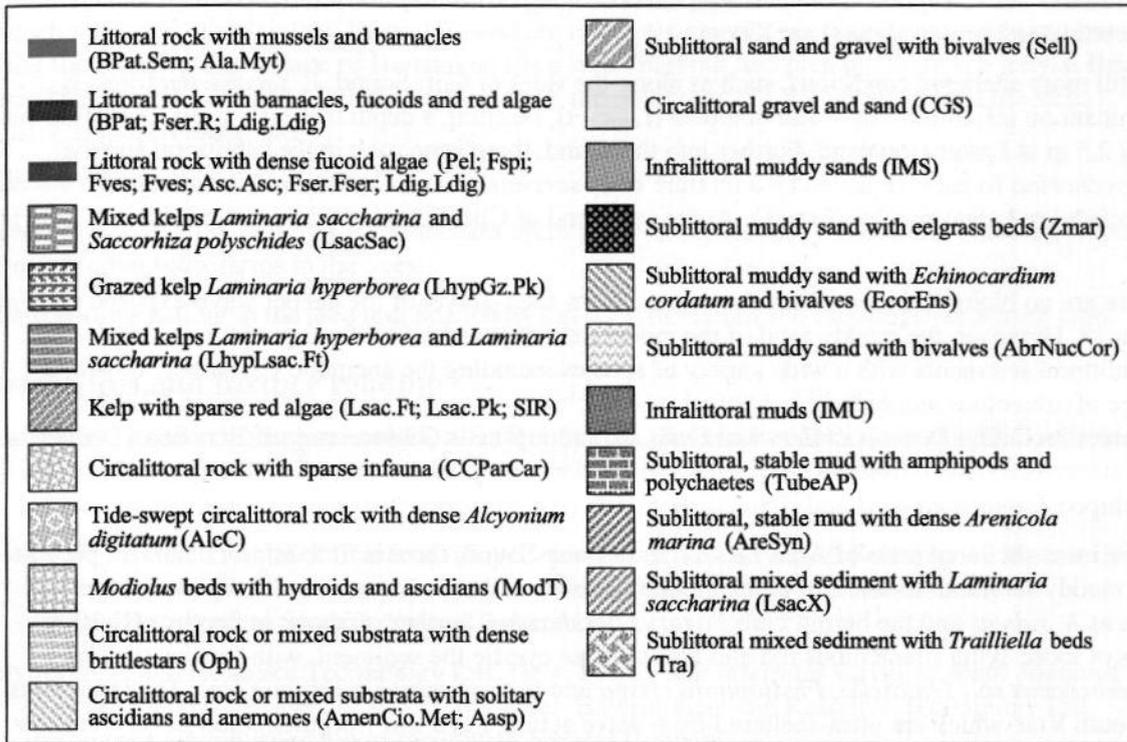
Sublittoral

On the outer coasts, steep or vertical bedrock and boulders in the nearshore sublittoral extend to depths of at least 40 m, where the rock gives way to plains of clean shell-sand, which can be duned, even at this depth. In more sheltered situations on the lee side of islands, rock and boulder changes to sediment at much shallower depths of 6-10 m, and here the sediment has a much higher proportion of mud; this mixed muddy shell-gravel is very characteristic of the Shetland sublittoral. Moving into the shelter of the sounds, the rock-sediment boundary becomes increasingly shallow until, in the inner sounds, no sublittoral rock remains. Sublittoral gullies at the entrance to West Voe follow the trend of the land, running parallel to the shore. These have vertical rock walls and floors of clean shell-gravel at depths of up to 20 m.

Sediments within the inlets grade from shell-gravel starting in depths of around 25 m at the outermost sites, through extensive slopes of muddy shell-gravel in depths of 10-25 m, to muddy sand in the sheltered sites found from the sublittoral fringe downwards. At the very heads of the sounds and in the

most sheltered embayments, soft flocculent mud occurs at depths as shallow as 1-2 m, and at all the sheltered sites, the sediment becomes increasingly muddy with depth.





< **Figure 18.2** Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 18.1, cited literature and additional field observations). (Key to biotopes symbols above.)

© Crown copyright. All rights reserved. JNCC GD27254X/1999.

The few records from the upper infralittoral zone of the most wave-exposed sites in Area 18 indicate that *Laminaria hyperborea* is the dominant kelp forest species (LhypGz.Ft; LhypGz.Pk). The kelp stipes support dense foliose algae such as *Plocamium cartilagineum*, *Phycodrys rubens* and *Membranoptera alata* but rock surfaces are generally fairly bare and dominated by encrusting coralline algae, characteristic of heavy grazing by the urchin *Echinus esculentus*. Kelp forest extends to depths of 9-10 m on the open coast, with kelp park in the lower infralittoral as deep as 20 m. This wave-exposed lower infralittoral, which is often heavily grazed, varies in its biotope composition, with either *L. hyperborea* continuing as the dominant kelp, or a park of mixed kelp species with *L. hyperborea*, *Laminaria saccharina* and *Saccorhiza polyschides* present in varying abundances (LsacSac).

The influence of grazing is also significant in the structure of the rocky circalittoral biotopes which are dominated by encrusting fauna, particularly the keel worm *Pomatoceros triqueter* and the bryozoan *Parasmittina trispinosa*, and coralline algae (CCParCar). Species are similar on both upward-facing and steep circalittoral rock. Dead-man's fingers *Alcyonium digitatum* is often abundant with featherstars *Antedon bifida*, the urchin *Echinus esculentus*, small starfish *Asterias rubens* and robust hydroids such as *Abietinaria abietina* and the northern species *Thuiaria thuja* (AlcC; FaAlC). Upward-facing rock and cobble occasionally has dense beds of brittlestars *Ophiothrix fragilis* and *Ophiocomina nigra* (Oph).

In the moderately exposed and sheltered conditions on the lee side of the outer islands and just inside the entrances to the inlets, the maximum depth of kelp is shallower at 10-12 m and the structure of the upper infralittoral kelp forest changes. Here, the main kelp forest is generally a mixture of *L. hyperborea* and *L. saccharina* (LhypLsac.Ft) occasionally with a band of grazed *L. hyperborea* in the lower infralittoral where the substratum extends deep enough (LhypGz.Pk). In most cases, the lower limit of the rock is shallower, at 6-10 m, and here it is replaced by muddy sand and shell-gravel

with stones which support *L. saccharina*, the brown alga *Chorda filum* and species of filamentous and foliose red and brown algae (LsacX).

In still more sheltered conditions, such as along the sides of Clift Sound, *L. saccharina* forest is dominant on infralittoral rock and boulders (Lsac.Ft), reaching a depth of 12-15 m off Clift Hills but only 2.5 m at Easter Hogaland. Further into the sound, there is no rock in the sublittoral and the *L. saccharina* forest is replaced by a mixture of *L. saccharina* and *C. filum* with a variety of associated red algal species (LsacX). At the inner end of Clift Sound, the lower depth limit of kelp is 7 m.

There are no biological records for the coarse, clean shell-gravel of the deeper wave-exposed parts of Area 18. However, the muddy sand of the moderately exposed infralittoral grades into rich circalittoral sediments with a wide variety of species including the anemone *Cerianthus lloydii*, a range of tubicolous amphipods and polychaetes including large numbers of the worm *Chone* sp., bivalves including *Dosinia exoleta* and *Ensis* sp. and topshells *Gibbula magus* (EcorEns). Deeper sediments are characterised by the polychaete *Myriochele* sp., the bivalve *Clausinella fasciata*, the amphipod *Urothoe elegans* and sipunculan worms (AbrNucCor).

In the most sheltered parts of Area 18 such as in Lang Sound, there is little or no *Laminaria* present and muddy sediment in shallow water supports lugworm *Arenicola marina* with epifaunal species such as *A. rubens* and the hermit crab *Pagurus bernhardus*. Further offshore, at depths of 2-10 m, mats of loose-lying filamentous red and brown algae overlie the sediment, with species such as *Asperococcus* sp., *Trailliella*, *Phyllophora crispa* and Ectocarpaceae common (Tra). The inner parts of South Voe, which are ultra-sheltered from wave action, have soft flocculent mud in very shallow water with conspicuous casts of *A. marina* (AreSyn).

Of particular note are two small beds of eelgrass *Zostera marina* mixed with *C. filum* in the shelter of South Voe, on soft flocculent mud in the northern end of the voe and on firmer sandy mud behind the island of Papil (Zmar). The opisthobranch *Akera bullata* is common on the mud amongst the *Zostera* whilst rissoids and the bivalves *Parvicardium ovale* and *Musculus marmoratus* are found on the leaves.

A further feature of the area are the gullies at the entrance to West Voe which support rich surge-tolerant communities on the vertical walls with species such as the sponge *Oscarella lobularis* on the open rock and the holothurian *Pawsonia saxicola* and squat lobster *Galathea strigosa* in crevices (AlcByH). The horse mussel *Modiolus modiolus* is common on more upward-facing rock in the lower infralittoral at this site, providing a refuge from grazing for species such as the algae *Callophyllis laciniata* and *Phycodrys rubens* and the ascidian *Ciona intestinalis* (ModT).

Nature conservation

Conservation sites		
Site name	Status	Main features
Shetland: South West Mainland	NSA	Landscape
Shetland Islands	ESA	Agri-environmental scheme

Human influences

Coastal developments and uses

The fishing port of Scalloway is the second-largest town in Shetland, with a population of 1,053. It is a natural harbour, used mainly by fishing vessels, and the area has a local fishing fleet of about 32 vessels although a larger number of other boats use the facilities (365 in 1995) (Barne *et al.* 1997). The North Atlantic Fisheries College is based at Scalloway and is dedicated to supporting the fisheries industry through training, research and development. There is a fish-processing factory, and a deep-water mooring was constructed in 1991. A quarry just outside the town lies a few hundred metres from the head of East Voe of Scalloway.

Much of the remainder of Area 18 is rural. The islands of Trondra and West and East Burra are joined to each other and the Mainland by bridges and are relatively heavily populated with roads and housing along their length. The village of Hamnavoe has a small harbour and pier and there is a jetty at Bridge End. There are no roads and little habitation down the east coast of Clift Sound, where the steep hillside is grazed moorland.

Marine developments and uses

In addition to fishing, potting for crustaceans takes place along the rocky shoreline. There are several salmon *Salmo salar* farms in the voes.

There is some sailing in the area and Scalloway has a yacht marina and moorings for leisure craft.

References and further reading

- Barne, J.H., Robson, C.F., Kaznowska, S.S., Doody, J.P., & Davidson, N.C., eds. 1997. *Coasts and seas of the United Kingdom. Region 1 Shetland*. Peterborough, Joint Nature Conservation Committee. (Coastal Directories Series).
- Covey, R., & Hill, T.O. 1993. *Shetland oil spill marine benthos survey 25 February - 2 March 1993. Field survey report*. (Contractor: Joint Nature Conservation Committee, Peterborough.) Unpublished report to Scottish Natural Heritage.
- Environment and Resource Technology Ltd. 1994. *Diving and intertidal survey of south Shetland relating to Braer. November 1993*. (Contractor: Environment and Resource Technology Ltd, Stromness.) Unpublished report to Scottish Natural Heritage.
- Environment and Resource Technology Ltd. 1996. *Diving and littoral survey of south Shetland relating to 'Braer'*. (Contractor: Environment and Resource Technology Ltd, South Queensferry.) *Scottish Natural Heritage Research, Survey and Monitoring Report*, No. 9.
- Hiscock, K. 1986. *Marine biological surveys in Shetland. August 1986*. (Contractor: Field Studies Council, Oil Pollution Research Unit, Pembroke.) *Nature Conservancy Council, CSD Report*, No. 678.
- Hiscock, K. 1988. *Marine Nature Conservation Review: Marine biological surveys in Shetland, 28th May-5th June 1988. Field Report*. Unpublished, Nature Conservancy Council, Peterborough.
- Howson, C.M. 1988. *Marine Nature Conservation Review: survey of Shetland, Foula and Fair Isle, 1987*. (Contractor: Field Studies Council, Oil Pollution Research Unit, Pembroke.) *Nature Conservancy Council, CSD Report*, No. 816.
- Institute of Terrestrial Ecology. 1975a. *Report to the Nature Conservancy Council on some aspects of the ecology of Shetland. Part 6.2. Littoral biota of rocky shores*. *Nature Conservancy Council, CSD Report*, No. 27.
- Institute of Terrestrial Ecology. 1975b. *Report to the Nature Conservancy Council on some aspects of the ecology of Shetland. 6.4: Sublittoral biota*. *Nature Conservancy Council, CSD Report*, No. 30.
- Institute of Terrestrial Ecology. 1975c. *Report to the Nature Conservancy Council on some aspects of the ecology of Shetland. 6.3. Littoral biota of soft shores*. (Contractor: Institute of Terrestrial Ecology.) *Nature Conservancy Council, CSD Report*, No. 28.
- Kingston, P.F., Dixon, I.M.T., Hamilton, S., Moore, C.G., & Moore, D.C. 1997. *Studies on the response of intertidal and subtidal marine benthic communities to the Braer oil spill. In: The impact of an oil spill in turbulent waters: the Braer. Proceedings of a symposium held at the Royal Society of Edinburgh, September 1995*, ed. by J.M. Davies & G. Topping, 209-233. Edinburgh, HMSO.
- Moss, D., & Ackers, G. 1987. *A sublittoral survey of Shetland, 1987*. Unpublished, Marine Conservation Society.

North Atlantic Fisheries College. 1999. <http://www.nafc.ac.uk/>

Ritchie, W. & O'Sullivan, M. 1994. *The environmental impact of the wreck of the Braer. Report of the Ecological Steering Group on the Oil Spill in Shetland*. Edinburgh, Scottish Office Environment Department.

Russell, G. 1974. *Fucus distichus* communities in Shetland. *Journal of Applied Ecology*, 11: 679-684.

Sites surveyed

Survey 1: 1988 MNCR survey of Shetland (Hiscock 1988).

Survey 227: 1987 MCS sublittoral survey of Shetland (Moss & Ackers 1987).

Survey 230: 1974 ITE report on sublittoral biota of Shetland (Institute of Terrestrial Ecology 1975b, Earll 1982).

Survey 261: 1986 & 1987 OPRU/MNCR survey of Shetland, Foula and Fair Isle (Hiscock 1986; Howson 1987).

Survey 387: 1993 MNCR Shetland *Braer* oil spill marine benthos survey (Covey & Hill 1993).

Survey 434: 1974 ITE report on rocky shore ecology of Shetland (Institute of Terrestrial Ecology 1975a).

Survey 723: 1993 SOAFD sublittoral grab survey of Clift Sound (Kingston *et al.* 1997).

Littoral sites					
Survey	Site	Site name	Grid reference	Latitude/longitude	Biotores recorded
387	12	Banna Minn (NE rocky shore)	HU 366 308	60°03.6'N 01°20.5'W	Ver.Ver; Fspi; Asc.Asc; Cor; Fser.Fser
434	24	Clettna Taing, West and East Burra.	HU 380 309	60°03.6'N 01°19.0'W	YG; Ver; Pel; FvesB; Fves: Asc.Asc; Fser.Fser; Ldig.Ldig
434	34	Easter Hegoland, West and East Burra.	HU 390 334	60°05.0'N 01°17.9'W	Ver.Ver; Pel; Fves; Fser; Fser.Fser; Ldig.Ldig
434	64	Sandwick, West and East Burra.	HU 360 330	60°04.8'N 01°21.1'W	Ent; EntPor; BPat.Sem; Ala.Myt
434	70	Ness of Westshore, Scalloway, West and East Burra.	HU 390 390	60°08.0'N 01°17.8'W	YG; Ver.Ver; BPat; Fser.R; XR; Ldig.Ldig

Sublittoral sites

Survey	Site	Site name	Grid reference	Latitude/longitude	Biomes recorded
1	210	N Cheynies, middle channel, Scalloway.	HU 346 394	60°08.2'N 01°22.6'W	CCParCar; CGS
1	D31	E of Langa, Scalloway.	HU 382 387	60°07.8'N 01°18.7'W	AbrNucCor
261	5	NE Holm of Papil, West and East Burra.	HU 373 319	60°04.2'N 01°19.7'W	IMU; Tra
261	6	Lang Sound, West and East Burra.	HU 379 342	60°05.4'N 01°19.1'W	LsacX; AmenCio.Met
261	7	Off Clift Hills, West and East Burra.	HU 391 317	60°04.1'N 01°17.8'W	Lsac.Pk; TubeAP
261	148	S of Point of Guide, West Voe, West and East Burra.	HU 363 297	60°03.0'N 01°20.8'W	LhypGz.Ft; LhypGz.Pk; IGS; EcorEns; LsacX
261	149	S of the Holms, South Voe, West and East Burra.	HU 373 329	60°04.7'N 01°19.7'W	Zmar; Tra
261	152	Holm of Papil, South Voe.	HU 371 318	60°04.1'N 01°20.0'W	Zmar
261	62	Point of Guide, West Voe, West and East Burra.	HU 366 296	60°03.0'N 01°20.5'W	LhypLsac.Ft; LhypGz.Ft; EcorEns; LsacX
261	64	Off Papil, South Voe, West and East Burra.	HU 371 318	60°04.1'N 01°20.0'W	IMS; Zmar
261	66	Scaalie Point, West Voe, West and East Burra.	HU 368 288	60°02.5'N 01°20.3'W	LhypGz.Ft; LhypGz.Pk; CC.Mob; AlcByH; CCParCar; ModT
227	4	Sanda Stour, Weisdale Voe, Hildasay and West Burra.	HU 346 413	60°09.3'N 01°22.6'W	LsacSac; Oph
227	5	SE Oxna, Weisdale Voe, Hildasay and West Burra.	HU 353 366	60°06.7'N 01°21.8'W	LhypLsac.Ft; LhypGz.Pk
227	6	E Linga, Weisdale Voe, Hildasay and West Burra.	HU 365 395	60°08.3'N 01°20.5'W	LhypLsac.Ft; EcorEns
227	7	NW Hildasay, Weisdale Voe, Hildasay and West Burra.	HU 354 410	60°09.1'N 01°21.7'W	AlcC
227	8	W Skerry East, Weisdale Voe, Hildasay and West Burra.	HU 353 337	60°05.2'N 01°21.9'W	LsacSac; AlcC
230	8	Ness of Westshore, Scalloway, West and East Burra.	HU 390 390	60°08.0'N 01°17.8'W	VsenMtru; LsacX
230	23	Easter Hogoland, West and East Burra.	HU 390 334	60°05.0'N 01°17.9'W	SIR
387	13	NW of West Voe, Shetland.	HU 369 314	60°03.9'N 01°20.2'W	Lsac.Ft; EcorEns
387	14	N end of South Voe, Shetland.	HU 373 330	60°04.8'N 01°19.7'W	AreSyn
387	15	N of West Voe of Quarff, Shetland.	HU 400 352	60°06.0'N 01°16.7'W	Aasp; IMS; LsacX
387	16	Clift Sound North, Shetland.	HU 405 375	60°07.2'N 01°16.2'W	IGS; LsacX
723	1	Station 1, Clift Sound.	HU 375 278	60°02.0'N 01°19.5'W	Sell
723	2	Station 2, Clift Sound.	HU 383 303	60°03.4'N 01°18.6'W	AbrNucCor
723	3	Station 3, Clift Sound.	HU 389 324	60°04.5'N 01°18.0'W	AbrNucCor
723	4	Station 4, Clift Sound.	HU 395 343	60°05.5'N 01°17.3'W	AbrNucCor
723	5	Station 5, Clift Sound.	HU 401 370	60°06.9'N 01°16.6'W	AbrNucCor

Compiled by: Christine Howson

19

Whiteness, Stromness, Weisdale and Sandsound Voes

Location		
<i>Position (centre)</i>	HU 350 470	60°12.3'N 01°22.1'W
<i>Administrative area</i>	Shetland Islands	
<i>Conservation agency/area</i>	Scottish Natural Heritage	North Areas (Northern Isles)
Physical features		
<i>Physiographic type</i>	Open coast; voes	
<i>Length of coast</i>	98.6 km	
<i>Area of inlet</i>	Whiteness Voe: 3.3 km ² ; Stromness Voe: 1 km ² ; Weisdale Voe: 5.3 km ² ; Sandsound Voe: 1.5 km ²	
<i>Bathymetry</i>	Depths of up to 90 m to west of Lunga Skerries, 60 m to east; remainder of area shallows gradually towards heads of voes.	
<i>Wave exposure</i>	Moderately exposed to ultra-sheltered; most of the area is sheltered	
<i>Tidal streams</i>	Negligible in most of area; moderately strong through the narrows in Sandsound Voe and Stromness Voe	
<i>Tidal range</i>	1.1 m (mean springs); 0.7 m (mean neaps)	
<i>Salinity</i>	Fully marine; possibly variable in Stromness Voe and heads of Whiteness Voe and the Firth	

Introduction

This group of voes on the west coast of Mainland Shetland lies to the east of the Walls peninsula which protects the area from the force of the prevailing westerly winds. Area 19 comprises the four major voes of Whiteness, Stromness, Weisdale and Sandsound and the two smaller inlets of Sand Voe and Seli Voe. The trend of the land is from north to south and the voes follow this line, with the exception of the inner basin of Sandsound Voe, called the Firth, which lies west to east. The entrances to the voes face south and are protected to some extent by the islands of East and West Burra (*Area summary* 18) and thus the entrances and outer parts of the voes are moderately exposed to wave action. Conditions become increasingly sheltered in the inlets and environmental conditions range from moderately exposed in the southern part of the area to ultra-sheltered conditions at the head of Stromness and Whiteness Voes. There are narrow channels towards the entrances to both Sandsound and Stromness Voes and another at the junction of Stromness Voe with Loch of Strom, a large lagoon (Thorpe 1998), and these have moderate or strong tidal streams flowing through them.

The majority of Area 19 is fringed by bedrock and boulders with shingle and sediment shores in many of the more sheltered parts, such as the Firth. Rock extends into the sublittoral to a depth of about 15-20 m at the voe entrances where it gives way to muddy shell-gravel. Moving into the shelter of the voes, this boundary becomes gradually shallower, the sediment increasingly muddy and rock surfaces have a layer of silt. In the most sheltered heads of the voes, there is little or no sublittoral rock and the shallow basins are floored with muddy sand and soft mud.

There are several lagoons which adjoin this area. These include Loch of Strom, the Vadill at the head of Whiteness Voe and Loch of Hellister on Weisdale Voe (Thorpe 1998). There are small patches of saltmarsh where streams enter and there is heathland and rough grazing on the surrounding hillsides.

Roads fringe most of the coastline in this area with linear settlements along many of these. There has been concern that sewage entering the head of Whiteness Voe from surrounding houses has created eutrophic conditions and adversely affected the beds of eelgrass *Zostera marina* and other biotopes in the voe's northern basin (Bunker, Rostron & Perrins 1995). At the time of writing, a centralised sewage treatment facility was under construction to replace both septic tanks and raw sewage outfalls. There are several small piers in the area and many salmon *Salmo salar* farms.

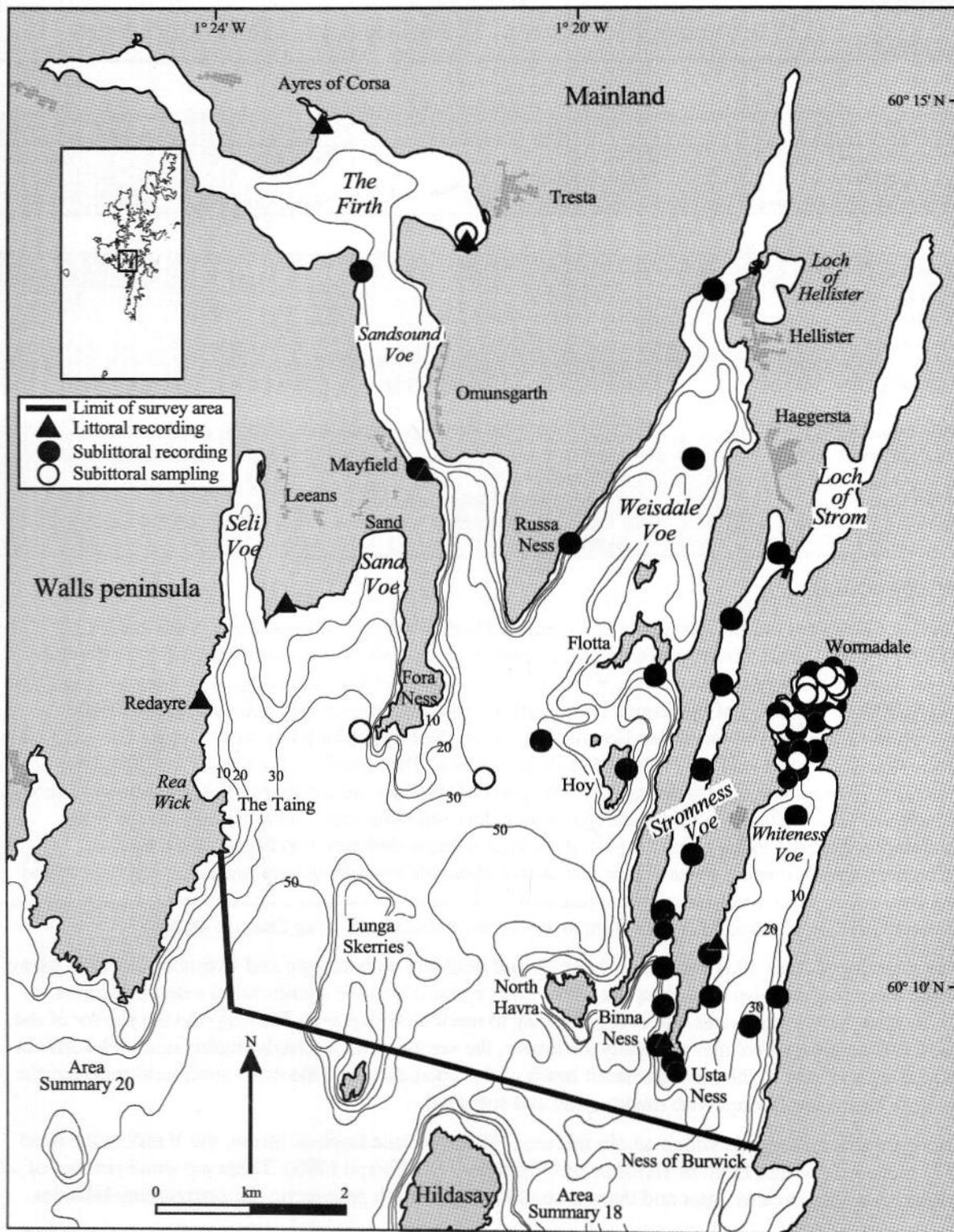


Figure 19.1 Main features of the area, showing sites surveyed.

© Crown copyright. All rights reserved. JNCC GD27254X/1999.

Marine biology

Marine biological surveys

	Survey methods	No. of sites	Date(s) of survey	Source
<i>Littoral</i>	Recording	5	July-August 1974	Institute of Terrestrial Ecology (1975a)
	Recording	2	August 1987	Howson (1988)
<i>Sublittoral</i>	Recording	2	July-August 1974	Institute of Terrestrial Ecology (1975b)
	Recording	15	August 1986	Hiscock (1986)
	Recording	7	August 1987	Howson (1988)
	Recording	2	July-August 1987	Moss & Ackers (1987)
	Recording	7	June 1989	Hiscock (1989)
	Recording	8	August 1994	Bunker, Rostron & Perrins (1994)
	Infaunal sampling (anchor dredge)	2	August 1988	Hiscock (1988)
	Infaunal sampling (suction sample)	1	August 1987	Howson (1988)
	Infaunal sampling (suction sample)	4	June 1989	Rostron (1989)
	Infaunal sampling (suction sample)	12	August 1994	Bunker, Rostron & Perrins (1994)
	Infaunal sampling (grab)	3	March 1994	Kingston <i>et al.</i> (1997)

Littoral

There is a variety of shore types in this area, with steep bedrock and boulder shores on headlands such as Usta Ness and Fora Ness, around islands and in the outer parts of the voes. These are broken on the open coast by sandy beaches such as those at Rea Wick and Redayre. Moving in to the shelter of the voes, the shores become more gradually sloping with cobble and pebble on the mid- and upper shore and sand and gravel on the lower shore. Large stretches of shore in the Firth and the inner parts of Weisdale and Whiteness Voes are of this type.

Biological data for the littoral zone in this area are sparse with survey records for only seven sites. These do however represent a range of wave exposures and substrata. Where there is adequate rock on the high shore, yellow and grey lichens in the littoral fringe are followed lower down by a zone of the black lichen *Verrucaria maura* (YG; Ver.Ver). The upper eulittoral on Usta Ness, the most exposed shore surveyed, has a band of the furoid alga *Pelvetia canaliculata* (Pel) with the addition of the furoid *Fucus spiralis* (Fspi) in more sheltered conditions in Whiteness Voe and Sandsound Voe. The mid-eulittoral is dominated by barnacles and limpets on the more exposed shores (BPat.Sem), by mosaics of barnacles, the furoid *Fucus vesiculosus* and mussels *Mytilus edulis* on shores of intermediate exposure (FvesB) and by *F. vesiculosus* on sheltered shores (Fves). The furoid *Ascophyllum nodosum* is common on rock outcrops on the most sheltered site at Ayres of Corsa (Asc.VS). The furoid *Fucus serratus* dominates the lower eulittoral at all the sites surveyed with red algae such as *Chondrus crispus*, *Mastocarpus stellatus* and *Osmundea pinnatifida* common in this zone on the open coast as well as in the narrows of Sandsound Voe where there are moderate tidal streams (Fser.R). *Laminaria digitata* is the dominant kelp in the sublittoral fringe (Ldig.Ldig) with the kelp *Alaria esculenta* present only at Usta Ness (Ala.Ldig).

Shingle shores in the Firth have cobbles in the upper eulittoral which are too unstable for extensive furoid growth and instead support barnacles *Semibalanus balanoides* with the littorinids *Littorina littorea* and *Littorina saxatilis* amongst them (BLlit). Muddy sand and gravel in the mid- and lower eulittoral have lugworm *Arenicola marina* and bivalves such as the cockle *Cerastoderma edule* (PCer); scattered stable boulders on this part of the shore have *F. serratus*, *F. vesiculosus* and *A. nodosum* (Fser; Fves; Asc). At Ayres of Corsa, the shore is crossed by a large stream which is brackish in its lower reaches. The lower eulittoral furoids and *A. marina* extend along the banks of this stream for some distance up the shore. The stream bed is dominated by the green alga *Enteromorpha* spp. and the brackish-water furoid *Fucus ceranoides* with *M. stellatus* and *A. marina* common (FcerX).

There are few data for the open coast sandy shores in this area but a wide clean beach in Sand Voe has a sparse fauna with *A. marina*, the tellin *Angulus tenuis* and the polychaete *Scolecopsis squamata*.

Rocky outcrops on sand nearby, where the rock surfaces are scoured by the sand, have *F. serratus* in the lower eulittoral and ephemeral green and red algae elsewhere (EntPor).

Sublittoral

Rock extends into the sublittoral to a depth of about 15-20 m at the voe entrances where it gives way to the muddy shell-gravel which is very characteristic of the Shetland sublittoral. Moving into the shelter of the voes, this boundary becomes gradually shallower, the sediment increasingly muddy and rock surfaces have a layer of silt. This gradation is illustrated by sites along Stromness Voe where the rock-sediment boundary shallows from a depth of 12 m inside the entrance, to 10 m about one-third of the distance into the inlet, to 1-3 m at its head. The head of Whiteness Voe, which has been extensively studied in comparison with the rest of Area 19, has very little littoral or sublittoral rock and is fringed by coarse sediments of cobbles, pebbles and shells. The centre of this basin is floored with muddy sand and soft mud.

The upper infralittoral zone on rock and boulders around the headlands and islands of the outer parts of Area 19 supports *Laminaria hyperborea* kelp forest to a depth of about 6 m (Lhyp.Ft). This is followed by a mixed kelp forest with various combinations of *L. hyperborea*, *Laminaria saccharina* and *Saccorhiza polyschides* or a kelp park of *L. saccharina* to a depth of about 15 m (LsacSac). These kelp forests are often heavily grazed by the urchin *Echinus esculentus* and have grazing-tolerant animal species such as the featherstar *Antedon bifida* and the ascidian *Clavelina lepadiformis* but few foliose algae (LhypGz.Ft). In the kelp park, boulders and cobbles may be mixed with sediment, and this habitat supports a wider variety of animal species such as the squat lobster *Munida rugosa*, the burrowing sea cucumber *Thyone fusus* and brittlestars *Ophiothrix fragilis* and *Ophiocoma nigra* (XKScrR). Moving into increased shelter, *L. saccharina* becomes the dominant kelp species and this is the most widely distributed type of kelp forest on rock in this area (Lsac.Ft). It reaches a maximum depth of about 8 m in the inner parts of the voes where there is adequate hard substratum available; in these sheltered situations, it grows as cape-form plants.

There are few records of circolittoral biotopes on rock in this area, a factor of the relatively shallow rock-sediment interface. Where rock does extend beyond the lower limit of the kelp, such as at Usta Ness, it supports a biotope characteristic of heavy grazing by the urchin *E. esculentus*. Coralline algal crusts dominate the rock surface with the keel worm *Pomatoceros triqueter*, *A. bifida* and hydroids such as *Plumularia setacea*, whilst crevices hold brittlestars *Ophiopholis aculeata* and ascidians such as *Ascidia mentula* (CCParCar).

Sediments in the area are predominantly muddy and whilst the sediment slope begins at a depth of about 15-20 m in the outermost sites, cobbles, pebbles and shell debris on muddy sand are found as shallow as 5 m just inside the voes. These shallow sheltered sediments support *L. saccharina* mixed with the brown alga *Chorda filum* and a variety of other species of algae such as *Asperococcus fistulosus*, *Ulva* sp. and *Ceramium* spp. (LsacX). The associated sediments have burrowers such as lugworm *Arenicola marina* and razor clams *Ensis* sp. In slightly tide-swept conditions in the entrance narrows to Sandsound Voe, a cobble and shell slope in shallow water has *L. saccharina* with occasional horse mussels *Modiolus modiolus*.

These shallow sediments become increasingly muddy with depth and slowly grade into muddy shell-gravel and sand which is the most widely distributed sediment type in the Shetland voes. This supports beds of *M. modiolus* which in turn provide hard substrata for the attachment of other species such as brittlestars, ascidians and hydroids; these mussel beds are found in depths from 10 m to over 30 m throughout the moderately exposed and sheltered parts of this area (ModHAs). Slightly cleaner sand and shell-gravel is found at the moderately exposed entrance to Whiteness Voe with bivalves including the scallop *Pecten maximus*, the anemone *Cerianthus lloydii*, the starfish *Astropecten irregularis* and holothurians *Thyone fusus* and *Thyone roscovita* (SpiSpi). Gravel in 20 m depth at the entrance to Sand Voe has rhodoliths of maerl, the northern brittlestar *Ophiura affinis* and the chiton *Leptochiton asellus* on the surface and an infaunal community characterised by the polychaete *Platynereis dumerilii* (IMX).

In still more sheltered conditions, as are found in the Firth, Stromness Voe and the head of Whiteness Voe, sediments in shallow water are muddier but support a similar *L. saccharina* and *C. filum* biotope to that described above. This is replaced by muddy shell-gravel overlain by a mat of filamentous algae, predominantly *Trailliella* (Tra), and in the Firth, sparse *M. modiolus* occurs beyond this to a depth of 17 m with the sea-pen *Virgularia mirabilis*, *P. maximus* and the northern epibenthic sea cucumber *Cucumaria frondosa* (ModHo).

Stromness Voe

Stromness Voe is an elongate, narrow voe with tide-swept channels at both ends; the northern of these connects with Loch of Strom, a large lagoon (Thorpe 1998). Limestone rock around the edges of the voe reaches a depth of about 10 m outside the entrance, with outcrops in deeper water, and about 12 m just north of the southern narrows. Further in, there are small cliffs to about 10 m depth. In the northern, shallower part of the voe there are outcrops at up to 3 m depth but shelly mud and stones is the predominant substratum in the sublittoral fringe. The rock gives way to sandy mud in the southern part of the voe and soft flocculent mud further north.

A mixed kelp forest and park of *Laminaria saccharina* and *Laminaria hyperborea* dominates the silty rock surfaces to 11-15 m in the southern parts of Stromness Voe (LhypLsac.Ft). This gradually changes to a forest of cape form *L. saccharina* mixed with *Chorda filum* on the shelly substrata at the voe head (LsacX). Lower infralittoral rock is heavily grazed and has a low diversity of species, with the solitary ascidians *Ascidia mentula* and *Ascidiella aspersa*, the brittlestar *Ophiothrix fragilis* and coralline algal crusts (EchBriCC).

Mixed sediments south of the outer narrows are fairly sandy with species such as the scallop *Pecten maximus*, the starfish *Astropecten irregularis* and sand gobies *Pomatoschistus* sp. The floor of the narrows itself has coarse shelly gravel. The horse mussel *Modiolus modiolus* occurs in sparse beds throughout this area, supporting *A. aspersa*, the featherstar *Antedon bifida* and crabs such as *Hyas araneus* and *Inachus* spp. (ModHAs). Inside Stromness Voe, away from the influence of the tides through the narrows, the soft mud in depths of 8-15 m is burrowed, and snake blennies *Lumpenus lumpretaeformis*, gobies, the anemone *Cerianthus lloydii*, the queen scallop *Aequipecten opercularis* and *A. aspersa* are found (IMU). Shallow mud, particularly in the northern half of the voe, is covered with mats of filamentous algae, and the bivalve *Mya arenaria*, the holothurian *Leptopentacta elongata* and brittlestars *Amphiura* spp. are common (IMU). The rapids joining the voe to Loch of Strom are dominated by the mussel *Mytilus edulis*, the barnacle *Balanus crenatus*, dwarf plumose anemones *Metridium senile*, and *L. saccharina* (Lsac.T).

Upper Whiteness Voe

Upper Whiteness Voe, which has been surveyed and mapped in some detail, is mostly shallower than 10 m. There are outcrops of sublittoral rock to the west of these and at the entrance to the basin; otherwise, the sublittoral substrata grade from cobble and pebble around the edges of the basin to finer sand and then soft mud.

Silty rock has cape form *Laminaria saccharina* (Lsac.Ft). Pebbles and cobbles around the fringe are also algal-dominated with *L. saccharina*, *Chorda filum*, the red alga *Cystoclonium purpureum* and lugworm *Arenicola marina* (LsacX). Mud in the centre of the basin is covered with a mat of filamentous red algae, predominantly *Trailliella*, and populations of the opisthobranch *Akera bullata*, snake blenny *Lumpenus lumpretaeformis* and the holothurian *Leptosynapta inhaerens* (Tra). It contains a moderately diverse infaunal community dominated by the polychaete *Mediomastus fragilis*, the bivalve *Mysella bidentata* and nematodes. There are mats of filamentous green algae in places (FiG). A band of mud between the zone of cobbles and the zone of algal mats is dominated by *A. marina*.

Eelgrass *Zostera marina* occurs in several small beds around this upper basin, often mixed with *C. filum*, and the plants supports large numbers of the gastropod *Rissoa membranacea* and the mussel *Musculus costulatus* (Zmar). Coarse sand in the *Zostera* beds contains bivalves *M. costulatus*, *M. bidentata* and *Venerupis senegalensis*, the polychaete *Protodorvillea kefersteini* and the amphipod

Phtisica marina. Slightly deeper sediments at 10 m depth at the entrance to this basin contain more silt in the sediment and the polychaete *Scalibregma inflatum* and the bivalves *Fabulina fabula* and *Corbula gibba* are present (FabMag).

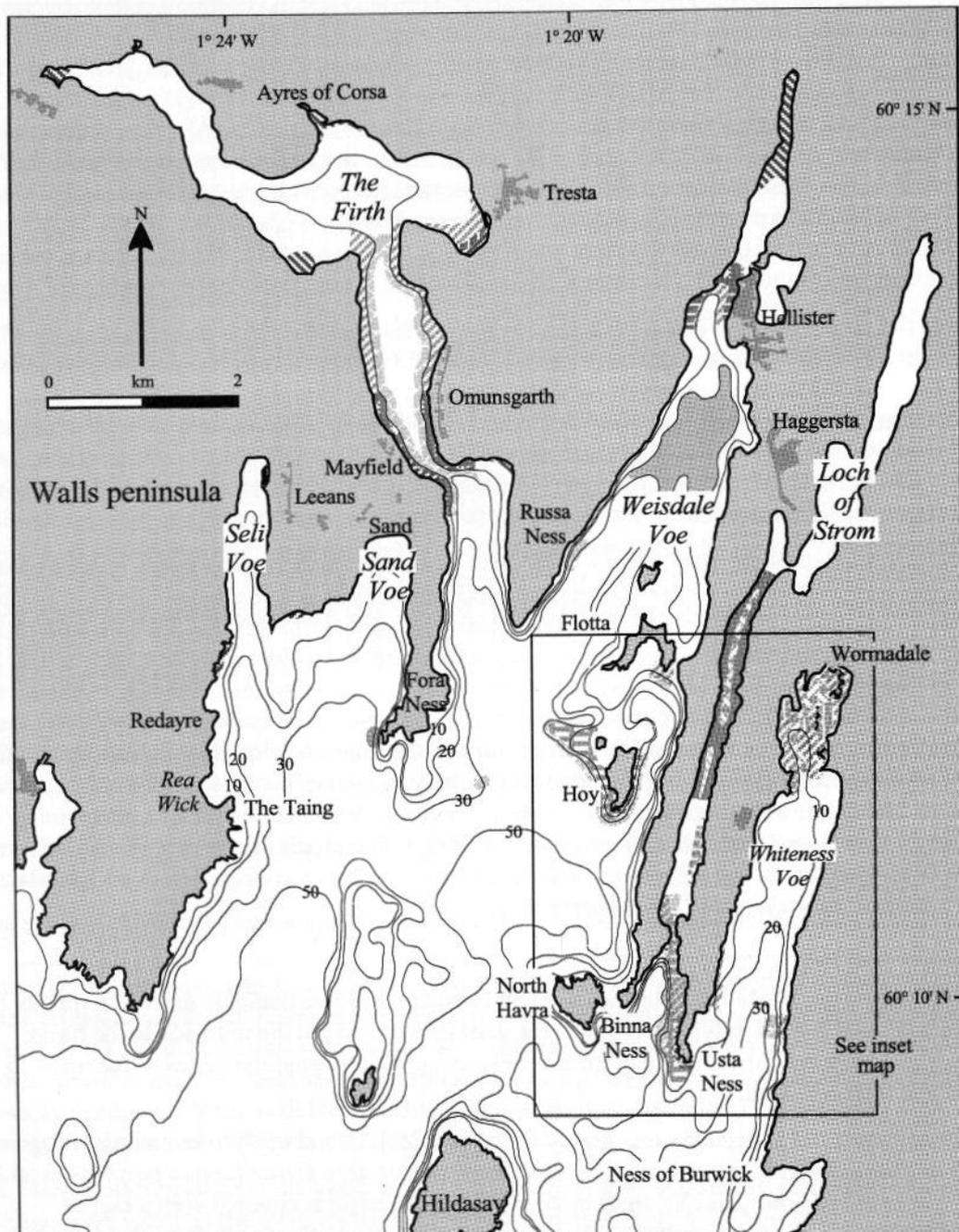


Figure 19.2 Indicative distribution of the main biotopes in the area (based on data from survey sites shown in Figure 19.1, cited literature and additional field observations). (Key to biotopes symbols on next page.) See Figure 19.3 for enlargement of Stromness and Whiteness Voes.

© Crown copyright. All rights reserved. JNCC GD27254X/1999.

	Littoral rock with barnacles, fucoids and red algae (BPat.Sem; Myt.Fves; FvesB; Fser.R; Ala.Ldig)		<i>Modiolus</i> beds with hydroids and ascidians (ModHAs)
	Littoral rock with dense fucoid algae (Pel; Fspi; Fves; Fser.Fser; Ldig.Ldig)		Circalittoral rock or mixed substrata with solitary ascidians and anemones (AmenCio; Aasp)
	Littoral boulders and cobbles on mixed sediments (BLlit; FvesX; AscX; FserX; FcerX)		Sublittoral muddy sand with eelgrass beds (Zmar)
	Littoral muddy sand with bivalves (PCer)		Sublittoral, disturbed, muddy sand with polychaetes and oligochaetes (Cap)
	Mixed kelps of <i>Laminaria saccharina</i> and <i>Saccorhiza polyschides</i> (LsacSac)		Infralittoral muds (IMU)
	Kelp <i>Laminaria hyperborea</i> with dense red algae (Lhyp.Ft)		Sublittoral, stable mud with dense <i>Arenicola marina</i> (AreSyn)
	Grazed kelp <i>Laminaria hyperborea</i> (LhypGz.Ft)		Circalittoral mud (CMU)
	Infralittoral rock with mixed kelps and scour-tolerant algae (XKScrR)		Sublittoral mixed sediment with <i>Laminaria saccharina</i> (LsacX)
	Mixed kelps <i>Laminaria hyperborea</i> and <i>Laminaria saccharina</i> (LhypLsac.Ft; LhypLsac.Pk)		Sublittoral mixed sediment with <i>Trilliella</i> beds (Tra)
	Kelp with sparse red algae (Lsac.Ft; Lsac.Pk)		Sublittoral mixed sediment with green algal mats (FiG)
	Tide-swept kelp <i>Laminaria saccharina</i> (Lsac.T)		Sublittoral mixed sediment with <i>Modiolus</i> beds (ModHo)

Nature conservation

Conservation sites

Site name	Status	Main features
Shetland: South West Mainland	NSA	Landscape
Whiteness Voe	MCA	Marine biological
South Whiteness	SSSI	Botanical
Shetland Islands	ESA	Agri-environmental scheme

Human influences

Coastal developments and uses

Roads fringe most of the coastline in Area 19 with linear settlements along many of these. There has been concern that sewage entering the head of Whiteness Voe from surrounding houses has created eutrophic conditions and adversely affected the beds of eelgrass *Zostera marina* and other biotopes in the voe's northern basin (Bunker, Rostron & Perrins 1995). At the time of writing, a centralised sewage treatment facility was under construction to replace both septic tanks and raw sewage outfalls. There are several small piers in the area.

Marine developments and uses

There are salmon *Salmo salar* farms in most of the voes in Area 19 with the exception of Whiteness Voe, sea trout *Salmo trutta* farms in the Firth and Loch of Strom, and mussel *Mytilus edulis* farms in Stromness Voe and the Firth. Potting for crustaceans takes place in the inshore rocky areas. Some sailing takes place and the sheltered voes are occasionally used as anchorages.

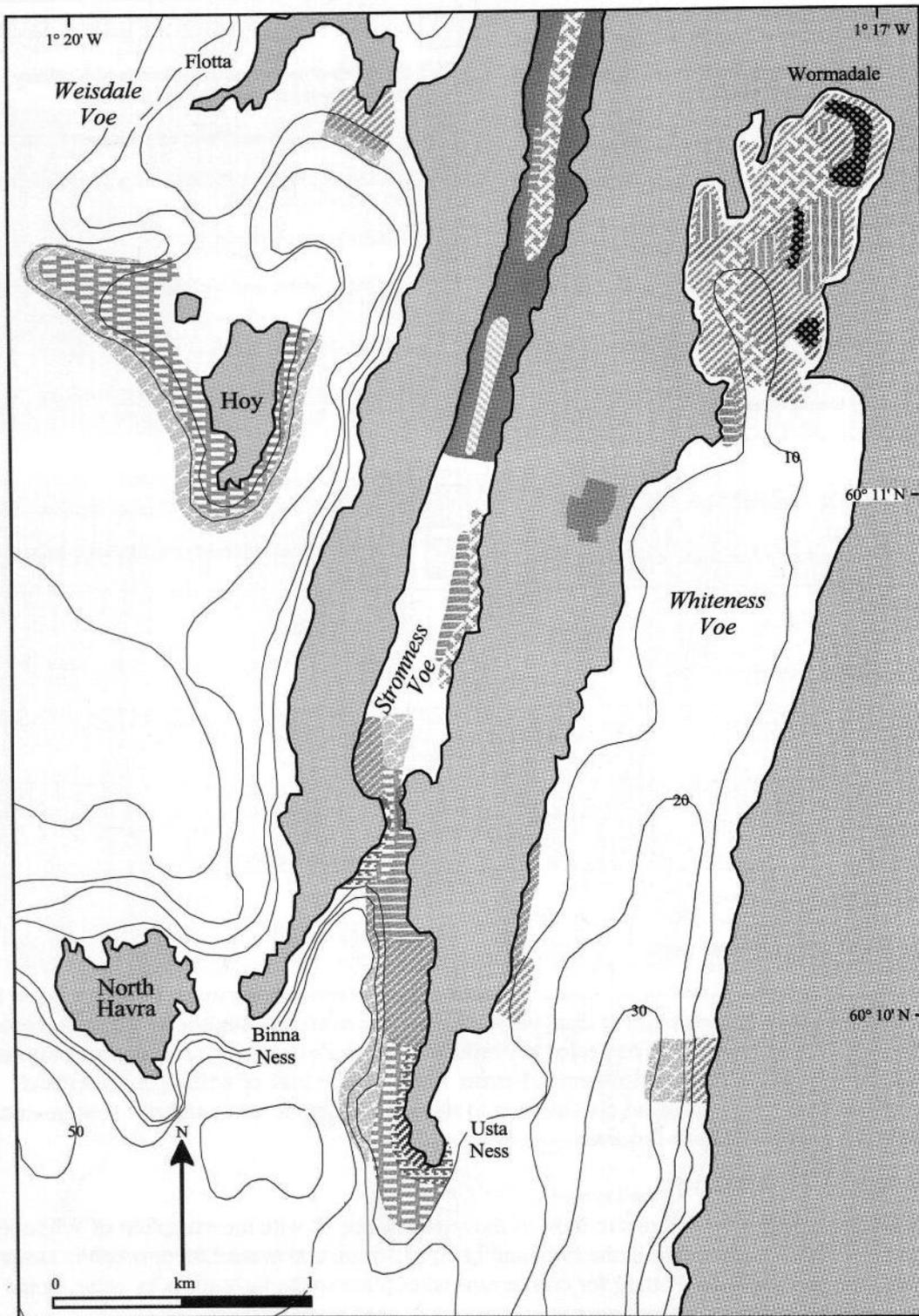


Figure 19.3 Indicative distribution of the main biotopes in Stromness and Whiteness Voes (based on data from survey sites shown in Figure 19.1, cited literature and additional field observations). (Key to biotopes symbols on previous page.)

© Crown copyright. All rights reserved. JNCC GD27254X/1999.

References and further reading

- Bunker, F.St.P.D., Rostron, D. & Perrins, J.M. 1995. An assessment of the impact of eutrophication by domestic sewage effluent in Whiteness Voe Marine Consultation Area (9th to 13th August 1994). (Contractor: Marine Seen, Hundleton, Dyfed.) *SNH Research, Survey and Monitoring Report*, No. NE94/006.
- Hiscock, K. 1986. Marine biological surveys in Shetland. August 1986. (Contractor: Field Studies Council, Oil Pollution Research Unit, Pembroke.) *Nature Conservancy Council, CSD Report*, No. 678.
- Hiscock, K. 1988. *Marine Nature Conservation Review: Marine biological surveys in Shetland, 28th May-5th June 1988. Field Report*. Unpublished, Nature Conservancy Council, Peterborough.
- Hiscock, K. 1989. Marine biological survey of upper Whiteness Voe, Shetland Islands. 13 & 14 June 1989. *Nature Conservancy Council, CSD Report*, No. 973. (Marine Nature Conservation Review Report, No. MNCR/SR/9.).
- Howson, C.M. 1988. Marine Nature Conservation Review: survey of Shetland, Foula and Fair Isle, 1987. (Contractor: Field Studies Council, Oil Pollution Research Unit, Pembroke.) *Nature Conservancy Council, CSD Report*, No. 816.
- Institute of Terrestrial Ecology. 1975a. Report to the Nature Conservancy Council on some aspects of the ecology of Shetland. Part 6.2. Littoral biota of rocky shores. *Nature Conservancy Council, CSD Report*, No. 27.
- Institute of Terrestrial Ecology. 1975b. Report to the Nature Conservancy Council on some aspects of the ecology of Shetland. 6.4: Sublittoral biota. *Nature Conservancy Council, CSD Report*, No. 30.
- Kingston, P.F., Dixon, I.M.T., Hamilton, S., Moore, C.G., & Moore, D.C. 1997. Studies on the response of intertidal and subtidal marine benthic communities to the Braer oil spill. In: *The impact of an oil spill in turbulent waters: the Braer. Proceedings of a symposium held at the Royal Society of Edinburgh, September 1995*, ed. by J.M. Davies & G. Topping, 209-233. Edinburgh, HMSO.
- Moss, D., & Ackers, G. 1987. *A sublittoral survey of Shetland, 1987*. Unpublished, Marine Conservation Society.
- Nature Conservancy Council. 1990. *Marine Consultation Areas: Scotland*. Unpublished, Nature Conservancy Council (Scotland), Edinburgh.
- Rostron, D. 1989. Sediment communities in upper Whiteness Voe, Shetland. June 1989. *Nature Conservancy Council, CSD Report*, No. 971.
- 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 1: 1988 MNCR survey of Shetland (Hiscock 1988).
- Survey 13: 1989 MNCR survey of Whiteness Voe (Hiscock 1989; Rostron 1989).
- Survey 227: 1987 MCS sublittoral survey of Shetland (Moss & Ackers 1987).
- Survey 230: 1974 ITE report on sublittoral biota of Shetland (Institute of Terrestrial Ecology 1975b).
- Survey 261: 1986/87 OPRU/MNCR survey of Shetland, Foula and Fair Isle (Hiscock 1986; Howson 1988).
- Survey 434: 1974 ITE report on rocky shore ecology of Shetland (Institute of Terrestrial Ecology 1975a).
- Survey 499: 1994 sublittoral survey of Whiteness Voe (Bunker, Rostron & Perrins 1995).
- Survey 724: 1994 SOAFD sublittoral grab survey of Whiteness Voe (Kingston *et al.* 1997).

Littoral sites					
<i>Survey</i>	<i>Site</i>	<i>Site name</i>	<i>Grid reference</i>	<i>Latitude/longitude</i>	<i>Biotores recorded</i>
261	119	Ayres of Corsa, the Firth.	HU 343 517	60°14.9'N 01°22.8'W	AscX; FvesX; FserX; BLlit; FcerX; MytX
261	120	Tresta Voe, the Firth.	HU 358 505	60°14.2'N 01°21.2'W	Fser; Fves; BLlit; PCer
434	28	Housigarth, Whiteness Voe.	HU 384 430	60°10.2'N 01°18.4'W	Ver.Ver; Pel; Fspi; Fves; Fser.Fser
434	39	Sandsound Voe.	HU 354 480	60°12.9'N 01°21.6'W	Ver.Ver; Fspi; Fves; FvesB; Fser; Fser.Fser; Ldig.Ldig
434	59	Usta Ness, Whiteness Voe.	HU 379 420	60°09.6'N 01°19.0'W	YG; Ver; Ver.Ver; Pel; BPat.Sem; Him; Osm; Fser.R; Fser.Fser; Ala.Ldig; Ldig.Ldig
434	60	Seli Voe, Sand Voe.	HU 331 460	60°11.8'N 01°24.1'W	YG; Ver.Ver; BPat.Sem; FvesB; Fser.R; MytFves; Ldig.Ldig
434	75	Kirka Ness, Sand Voe.	HU 340 466	60°12.1'N 01°23.1'W	EntPor

Sublittoral sites					
<i>Survey</i>	<i>Site</i>	<i>Site name</i>	<i>Grid reference</i>	<i>Latitude/longitude</i>	<i>Biotores recorded</i>
1	D34	E of Kirk Holm, Sand Voe, Loch Leven.	HU 347 453	60°11.4'N 01°22.4'W	IMX
1	D35	NE of Billy Baa, Weisdale Voe.	HU 360 448	60°11.1'N 01°21.0'W	ModHAs
13	237	Wormadale to North Rock, Whiteness Voe.	HU 396 457	60°11.6'N 01°17.1'W	HalXK; PolAhn; VsenMtru; FabMag; AreSyn; LsacX; Tra
13	238	Mailland to Otter Holm, Whiteness Voe.	HU 392 451	60°11.3'N 01°17.5'W	Lsac.Ft; Zmar; AreSyn; LsacX; Tra; IMU
13	239	Breck to Centre Rocks, Whiteness Voe.	HU 392 453	60°11.4'N 01°17.5'W	Lsac.Ft; IGS; Zmar; IMU; AreSyn; Tra
13	240	W of Mousa Ness, Whiteness Voe.	HU 391 455	60°11.5'N 01°17.6'W	IMS; AreSyn; Tra
13	241	Between Nesbister & Wormadale, Whiteness Voe.	HU 396 457	60°11.6'N 01°17.1'W	Zmar; AreSyn
13	242	Nesbister to Centre Rocks, Whiteness Voe.	HU 396 455	60°11.5'N 01°17.1'W	Zmar; Tra
13	243	Northern Rock to Vadill entrance, Whiteness Voe.	HU 394 456	60°11.6'N 01°17.3'W	PolAhn; LsacX; Tra
227	38	Flotta, Weisdale Voe, Hildasay and West Burra.	HU 378 459	60°11.7'N 01°19.0'W	Lsac.Ft; ModHo; IGS; EcorEns; LsacX
227	39	Russa Ness, Weisdale Voe, Hildasay and West Burra.	HU 369 473	60°12.5'N 01°20.0'W	ModHAs; IMS
230	7	Usta Ness, Whiteness Voe.	HU 379 420	60°09.6'N 01°19.0'W	LsacSac; LhypGz.Ft; ModHAs; CCParCar
230	24	Housigarth, Whiteness Voe.	HU 384 430	60°10.2'N 01°18.4'W	SIR
261	16	Harpa Skerry, Whiteness Voe.	HU 384 425	60°09.9'N 01°18.4'W	LsacX
261	17	Otter Holm, Whiteness Voe.	HU 393 449	60°11.2'N 01°17.4'W	Lsac.Ft; LsacX; Tra
261	18	Brei Geo, Whiteness Voe.	HU 391 423	60°09.8'N 01°17.7'W	ModHAs; ModHo; LsacX
261	20	W of Haggersta, Weisdale Voe.	HU 382 482	60°13.0'N 01°18.6'W	CMU
261	21	SW Junk, Hoy, Weisdale Voe.	HU 366 452	60°11.4'N 01°20.4'W	Lsac.Sac; ModHAs; IGS
261	25	Sound of Hoy, Weisdale Voe.	HU 375 449	60°11.2'N 01°19.4'W	Ala.Myt; LsacSac; ModHAs
261	26	Grave Yard, Weisdale Voe.	HU 384 500	60°13.9'N 01°18.3'W	Lhyp.Ft; XKScrR; LsacX
261	27	NW of North Ustaness, Stromness Voe.	HU 382 440	60°10.7'N 01°18.6'W	Lsac.Pk; IMS
261	28	NW of Pund, Stromness Voe.	HU 379 434	60°10.4'N 01°19.0'W	Lsac.Pk; ModHAs
261	29	Opposite Jackville, Stromness Voe.	HU 379 428	60°10.1'N 01°19.0'W	LhypLsac.Ft; EchBriCC; IMX
261	30	Opposite South Stromness, Stromness Voe.	HU 383 449	60°11.2'N 01°18.5'W	AmenCio; Aasp; IMU
261	31	Narrows of Pund, Stromness Voe.	HU 379 432	60°10.3'N 01°19.0'W	XKScrR; Lsac.T
261	41	Oligarth, Stromness Voe.	HU 391 472	60°12.4'N 01°17.6'W	Lsac.Ldig; IMS

Sublittoral sites continued					
Survey	Site	Site name	Grid reference	Latitude/longitude	Biotopes recorded
261	42	Stromness Broch, Stromness Voe.	HU 385 458	60°11.7'N 01°18.3'W	LhypLsac.Ft; IMU; Tra
261	43	SW of Brugarth, Stromness Voe.	HU 386 465	60°12.0'N 01°18.2'W	IMS
261	116	Salt Ness, Sandsound Voe, the Firth.	HU 347 502	60°14.1'N 01°22.4'W	Lsac.Ft; IMU; ModHo; LsacX
261	117	The Narrows, Sandsound Voe, the Firth.	HU 353 481	60°12.9'N 01°21.7'W	XKScrR; ModHo
261	118	E Tresta Voe, the Firth.	HU 358 506	60°14.3'N 01°21.2'W	LsacX
261	141	Usta Ness, Whiteness Voe.	HU 380 418	60°09.5'N 01°18.9'W	LhypLsac.Ft; LhypLsac.Pk; SpiSpi
261	142	N of Point of Nesbister, Whiteness Voe.	HU 395 451	60°11.3'N 01°17.2'W	Zmar
261	150	SW of Wornadale, Whiteness Voe.	HU 397 459	60°11.7'N 01°17.0'W	Zmar; AreSyn
261	151	N of Silver Skerry, White Ness, Whiteness Voe.	HU 379 424	60°09.8'N 01°19.0'W	Lsac.Ft; Oph; ModHAs; IMS; IMU; EcorEns; LsacX
499	1	W of Otter Holm to W of Cure Holm, Whiteness Voe.	HU 392 448	60°11.1'N 01°17.5'W	LhypLsac.Ft; LsacX
499	2	E side of mid Whiteness Rocks, S end, Whiteness Voe.	HU 393 453	60°11.4'N 01°17.3'W	LhypLsac.Ft
499	3	N mid Whiteness Rocks to Burn of Wornadale, Whiteness Voe.	HU 395 457	60°11.6'N 01°17.2'W	Beg; FiG; LsacX; Tra
499	4	Zostera bed at Burn of Wornadale, Whiteness Voe.	HU 397 459	60°11.7'N 01°16.9'W	Zmar; MytX
499	5	N Otter Holm to Mailland, Whiteness Voe.	HU 393 451	60°11.3'N 01°17.4'W	AreSyn; LsacX; Tra
499	7	E of Breck to W Mousa Ness beach, Whiteness Voe.	HU 391 455	60°11.5'N 01°17.6'W	Beg; FiG
499	8	NW of Nesbister, Whiteness Voe.	HU 395 454	60°11.5'N 01°17.2'W	Lsac.Ft; LsacX
499	9	NW mid Whiteness Rocks to jetty on E Mousa Ness, Whiteness Voe.	HU 394 456	60°11.6'N 01°17.3'W	Beg; LsacX; Tra
499	10	Burn of Wornadale, Whiteness Voe.	HU 397 459	60°11.7'N 01°17.0'W	LsacX
499	11	Burn of Wornadale, Whiteness Voe.	HU 396 458	60°11.7'N 01°17.0'W	AreSyn
499	12	NW of mid Whiteness Rocks, Whiteness Voe.	HU 395 457	60°11.6'N 01°17.1'W	Tra
499	13	Burn of Wornadale, Whiteness Voe.	HU 397 458	60°11.7'N 01°16.9'W	IMS
499	15	W of Nesbister, Whiteness Voe.	HU 396 455	60°11.5'N 01°17.1'W	FiG
499	16	W of Burn of Wornadale, Whiteness Voe.	HU 396 459	60°11.7'N 01°17.1'W	Cap
499	17	SE of Vadill Bridge, Whiteness Voe.	HU 394 458	60°11.7'N 01°17.2'W	Tra
499	18	E of jetty on E Mousa Ness, Whiteness Voe.	HU 394 457	60°11.6'N 01°17.3'W	Tra
499	19	Just W of mid Whiteness rocks, Whiteness Voe.	HU 393 454	60°11.5'N 01°17.3'W	Cap
499	20	SW of Mousa Ness, Whiteness Voe.	HU 391 454	60°11.5'N 01°17.6'W	AreSyn
499	21	WNW of Otter Holm, Whiteness Voe.	HU 393 450	60°11.3'N 01°17.4'W	Tra
499	14	N of Nesbister and SSW of Wornadale, Whiteness Voe.	HU 396 457	60°11.6'N 01°17.0'W	Zmar
724	1	Head, Whiteness Voe.	HU 393 444	60°10.9'N 01°17.4'W	SpiSpi
724	2	Mid Whiteness Voe.	HU 388 428	60°10.1'N 01°17.9'W	CMX
724	3	Mouth, Whiteness Voe.	HU 381 418	60°09.6'N 01°18.7'W	SpiSpi