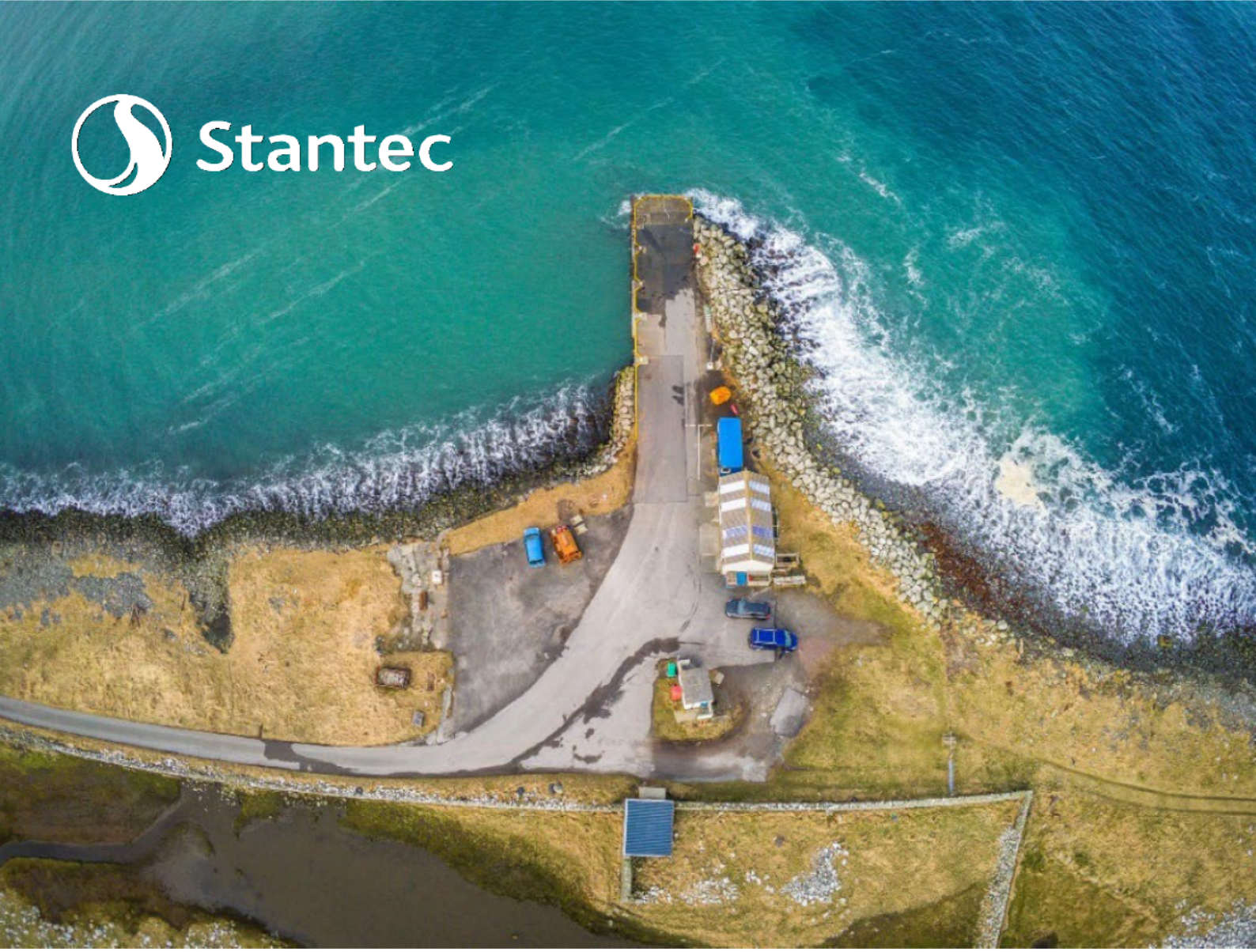


Appendix G

Benthic Report

On behalf of

Shetland Islands Council

Project Ref:332511168| Rev: A | Date: March 2023

Front Cover Photograph provided by Brian Gray

Registered Office: Buckingham Court Kingsmead Business Park, London Road, High Wycombe, Buckinghamshire, HP11 1JU
Office Address: 3rd Floor, Capital Square, 58 Morrison Street, Edinburgh EH3 8BP
T: +44 (0)141 352 2360 E: info.Glasgow@stantec.com

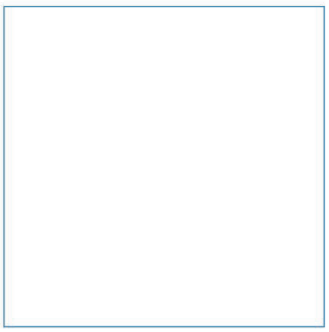
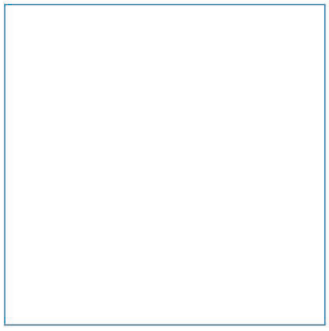
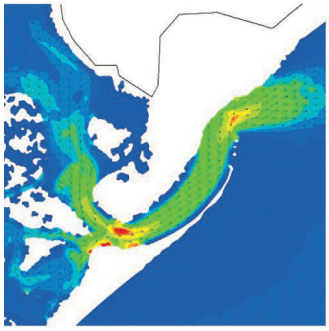
Stantec

Fair Isle Ferry Upgrade

Benthic Survey Report

February 2023




Innovative Thinking - Sustainable Solutions

ABP mer

Page intentionally left blank

Fair Isle Ferry Upgrade

Benthic Survey Report

February 2023

Document Information

Document History and Authorisation		
Title	Fair Isle Ferry Upgrade	
	Benthic Survey Report	
Commissioned by	Stantec	
Issue date	February 2023	
Document ref	R.4064	
Project no	R/5177	
Date	**Version**	**Revision Details**
15/11/2022	1	Issued for client review
11/01/2023	2	Issued for client use
06/02/2023	3	Issued for client use

Prepared (PM)	Approved (QM)	Authorised (PD)
Vicky West	Colin Trigg	Stephen Hull
[redacted]	[redacted]	[redacted]

Suggested Citation

ABPmer, (2023). Fair Isle Ferry Upgrade, Benthic Survey Report, ABPmer Report No. R.4064.
A report produced by ABPmer for Stantec, February 2023.

Notice

ABPmer
Quayside Suite, Medina Chambers, Town Quay, Southampton, Hampshire SO14 2AQ
T: +44 (0) 2380 711844 W: http://www.abpmer.co.uk/

Summary

Fair Isle is the United Kingdom's most remote community, lying 24 miles off the southern tip of the Shetland Islands. The island is connected to mainland Shetland by two lifeline transport links. The main passenger link is through an air service, but the existing ferry service provides the critically important supply chain and freight link as well as capacity for 12 passengers.

Shetland Island Council is progressing the Fair Isle Ferry Upgrade Project to replace the existing vessel, which is approaching the end of its life, together with ferry infrastructure at each of the berthing sites; North Haven Bay, on Fair Isle and at Grutness, near Sumburgh Head on the Shetland Isles. As such ecological surveys were required at these berthing sites to determine the baseline benthic habitats and species present.

ABPmer was commissioned to undertake benthic ecological surveys to characterise the habitats and species present at North Haven and Grutness. Intertidal and subtidal surveys were completed at both sites. Intertidal walkover surveys mapped the biotopes surrounding the piers/ quays and at the nearby beaches of both sites. Subtidal surveys, consisting of grab and underwater video operations, were similarly carried out in the marine environment within and around the footprint of the proposals for each site.

At North Haven the rocky intertidal areas consisted of a zonation of *Fucus vesiculosus*, *Fucus serratus* and *Laminaria digitata,* alongside a variety of red seaweeds and a rich faunal community. The majority of the nearby beach was formed of fine, clean, sand with *Arenicola* spp.. No Priority Marine Feature (PMF) habitats or species were identified within the intertidal areas at North Haven.

In the subtidal areas the site consisted of a mosaic of muddy sand and rocky kelp outcrops. These kelp outcrops were identified as *Laminaria hyperborea* forest and foliose red seaweeds on tide-swept upper infralittoral mixed substrata (IR.MIR.KR.LhypTX), a component of the kelp bed PMF habitat. This PMF was patchy in extent, forming a mosaic with non-PMF biotopes.

No PMFs were identified within the intertidal environment at Grutness. The rocky areas of the shore followed a typical zonation from upper shore barnacle dominated littoral rock to *F. vesiculosus*, *F. serratus* and lower shore *L. digitata* and *Saccharina latissima* kelp communities. While the beach to the west of the study area was identified as barren littoral coarse sand.

In the subtidal, *Laminaria hyperborea* forest and foliose red seaweeds on tide-swept upper infralittoral mixed substrata was similarly found but was also considered to be a relatively poor example of the PMF due to the patchy/ mosaic nature of the feature across the subtidal area.

There were also a variety of other non-PMF biotopes recorded at subtidal stations at Grutness including 'Mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock', '*Alaria esculenta* on exposed sublittoral fringe bedrock' and 'Mixed *Laminaria hyperborea* and *Saccharina latissima* forest on sheltered upper infralittoral rock.'

No Invasive Non-Native Species (INNS) were recorded at either site.

Contents

Appendices

Tables

Figures

1 Introduction

1.1 Overview

Fair Isle is the United Kingdom's most remote community, lying 24 miles off the southern tip of the Shetland Islands. The island is separated from Shetland mainland by a body of water known as the 'Roost', which has a reputation of being one of the most demanding stretches of water in the UK, and indeed Europe. This means that the island is not just geographically remote but is also remote from a connectivity perspective – indeed, the island had no transport connections on 221 days in 2017.

The island is within the Shetland Islands Council (SIC) administrative area and is connected to mainland Shetland by two lifeline transport links. The main passenger link is through an air service by means of an eight seat Britten-Norman BN-2 Islander aircraft. The existing ferry service provides the critically important supply chain and freight link as well as capacity for 12 passengers per sailing.

SIC is progressing the Fair Isle Ferry Upgrade Project ('the Project') to replace the existing vessel, together with upgrading ferry infrastructure at each of the berthing sites; North Haven Bay, on Fair Isle and at Grutness, near Sumburgh Head on the Shetland Isles.

1.2 Objectives

The Fair Isle and Grutness sites are both located within environmental designations including Special Protection Areas (SPA) and a Special Area of Conservation (SAC) (North Haven, Fair Isle). As such ecological surveys are required at both of the berthing sites to determine the baseline benthic habitats and species present.

ABPmer was commissioned to undertake benthic ecological surveys to characterise the habitats and species present at North Haven and Grutness.

This report describes the survey methods used to monitor the intertidal and subtidal habitats and benthic invertebrate assemblage(s) present within the vicinity of the project and provides a summary of the survey results.

2 Methods

In order to characterise the habitats and species present within and adjacent to the proposed works, at North Haven and Grutness, intertidal and subtidal surveys were carried out. The methods for each are described in more detail below.

2.1 Sampling

2.1.1 Intertidal

Phase 1 intertidal habitat surveys were undertaken at both North Haven, Fair Isle and at Grutness, on the 11 and 16 July, respectively.

The surveys were undertaken at low water and coincided with a spring tidal phase. The survey approach was based on the standardised Phase 1 mapping methodology as detailed in the Marine Monitoring Handbook, Procedural Guidance No 3-1 (Wyn and Brazier, 2001) and Countryside Council for Wales (CCW) Handbook for Marine Intertidal Phase 1 Survey and Mapping (Wyn *et al.,* 2000). Habitats in the area were mapped using a hand-held Global Positioning System (GPS) and described in accordance with the Marine Habitat Classification for Britain & Ireland (MHCBI) v22.04) to biotope class levels 4 or 5 (JNCC, 2022). Any characterising or rare/ scarce species were also noted as well as any evidence of anthropogenic disturbance

The habitats recorded in the surveys are described in more detail in Section 3 below. The spatial distribution of intertidal habitats that have been mapped and the distribution of biotopes identified from the subtidal samples are shown in the figures in Section 3.

In addition, an unmanned aerial vehicle (UAV) or drone, the '*DJI Mavic 3*', was flown at North Haven, Fair Isle to obtain aerial imagery of the site. The drone could not be used at Grutness due to flight restrictions as a result of the sites proximity to Sumburgh airport.

2.1.2 Subtidal

Subtidal benthic surveys were conducted on board the '*Ruby May*' at Grutness on the 14 July and Fair Isle on the 16 July. The subtidal surveys utilised a combination of grab sampling and underwater video to characterise the benthic habitats and species. Sampling was conducted at 10 stations, four grab and six video, at both Fair Isle and Grutness, the locations of which are shown in Figure 1 and Figure 2, respectively, and coordinates provided in Appendix A.

Due to the presence of nesting Fulmar on the stack (nestled between the breakwater) at the Fair Isle site, operations maintained a minimum distance of 20 m from the breakwater to prevent disturbance to the nesting sites. The 20 m buffer zone is shown Figure 1 and all survey locations were situated outwith the buffer area.

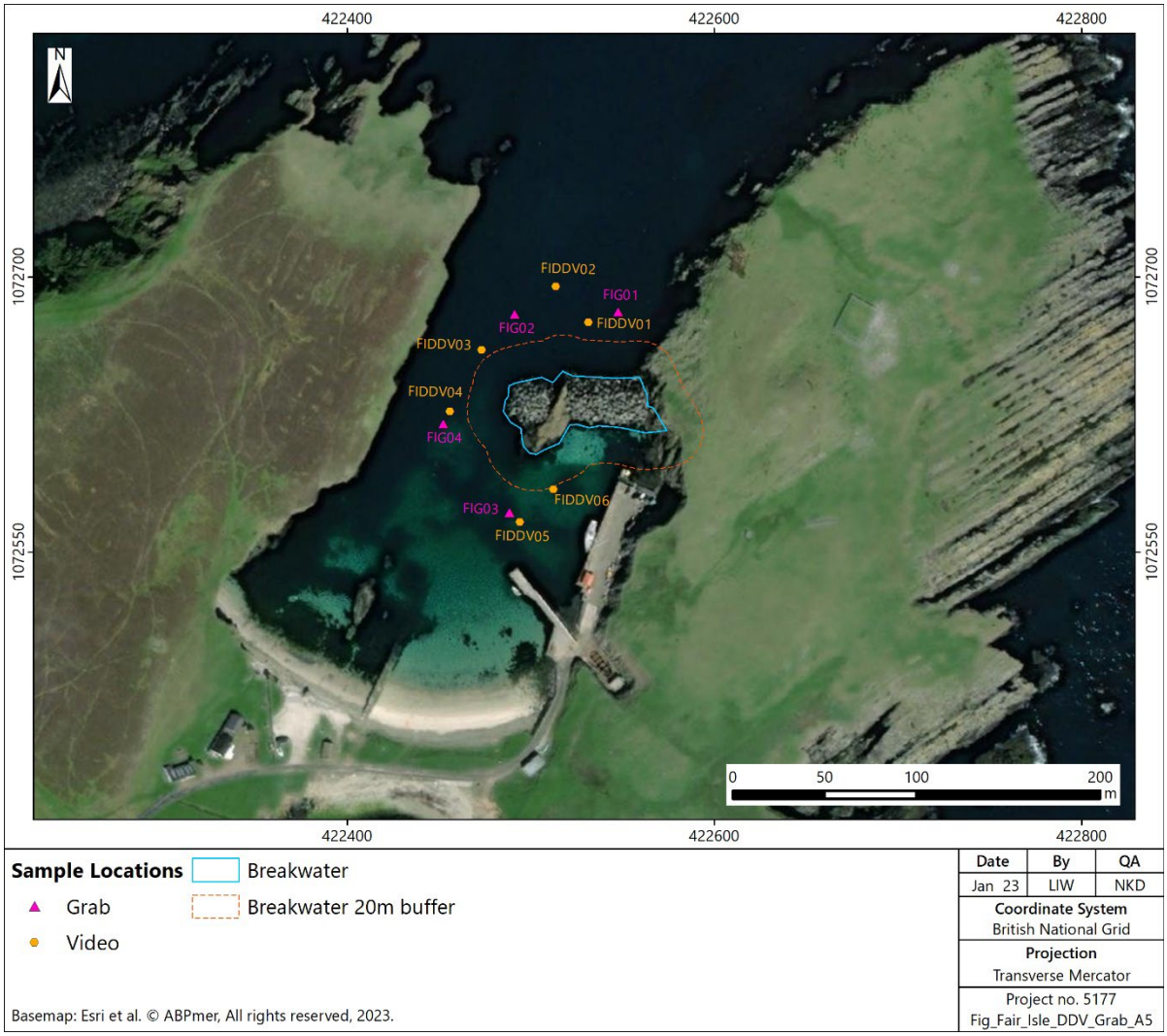


Figure 1. Survey locations at North Haven, Fair Isle

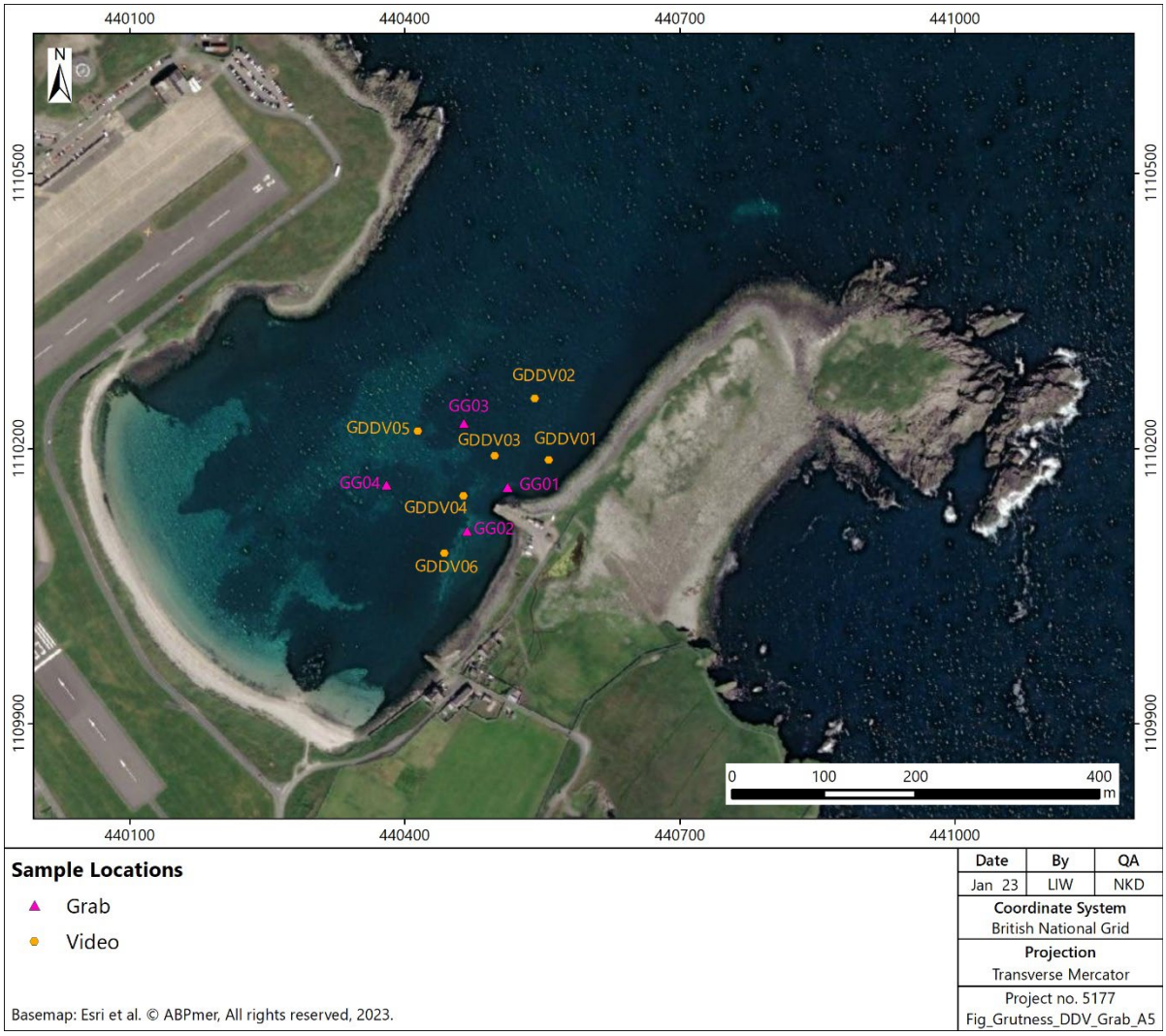


Figure 2. Survey locations at Grutness, Shetland Isles

Grab sampling

Sampling at Fair Isle and Grutness was carried out using a 0.1 m^2 Van Veen grab deployed from the stern of the survey vessel (Figure 3A). Single grab samples were collected at each of the 4 stations at each site for macrofauna analysis (faunal composition, abundance and biomass).

Following successful deployment, the grab sample was decanted into a suitable container and photographed. If the sample volume was >5 L a representative sub-sample of sediment, approximately 500 ml was taken for Particle Size Analysis (PSA) and Total Organic Carbon (TOC) determination. A note was made of the volume of sample obtained prior to sieving along with supplementary information about the sediment composition. The sample was then discharged onto a sieving table and then gently washed over a 1 mm sieve using seawater to remove excess substrate.

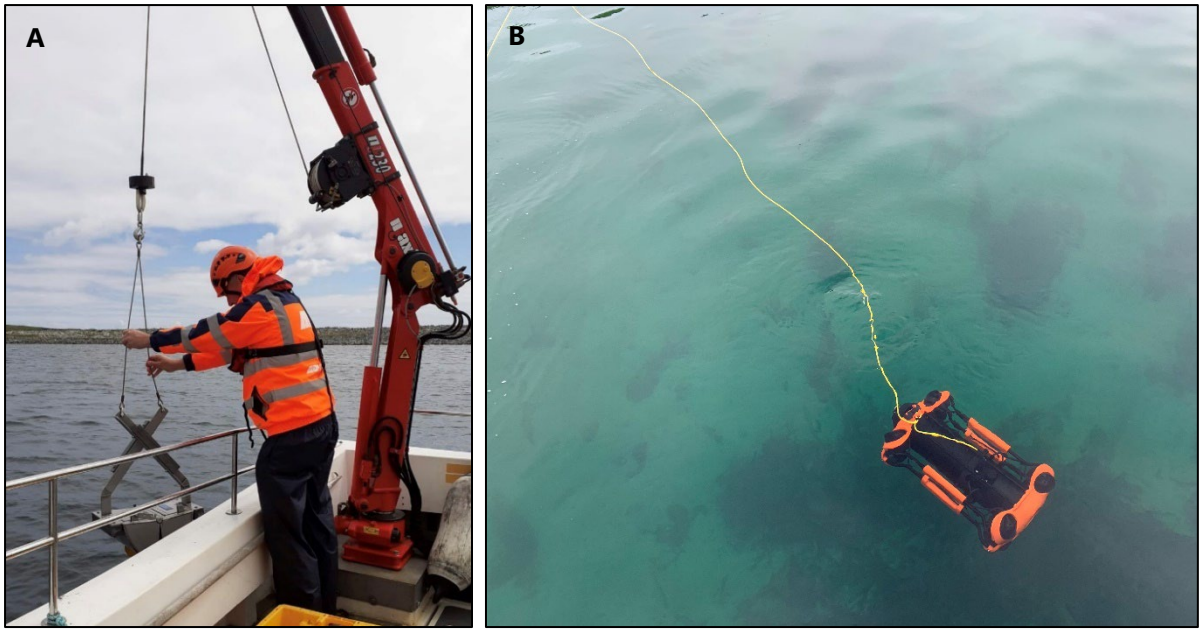


Figure 3. A) Van Veen grab sampling, B) Chasing M2 Pro' Remotely Operated Underwater Vehicle (ROV)

The residue was photographed before being transferred into a labelled sample container and preserved in 4% buffered formalin solution before being sent to a National Marine Biological Analytical Quality Control (NMBAQC) accredited laboratory for processing. The PSA and TOC sediment samples were placed into a labelled sample bag.

If the sediment volume was <5 L, the material was discarded. At each station, up to 3 attempts were made to retrieve a sample containing sufficient volume for analysis. If a suitable sample could not be attained the ROV was deployed to obtain imagery of the seabed.

Underwater video

Six video stations were surveyed at each site using a '*Chasing M2 Pro*' Remotely Operated Underwater Vehicle (ROV) deployed from the stern of the vessel (Figure 3B). The vessel was manoeuvred to location and the ROV deployed to just above the seabed to prevent damage or interaction with the seabed. The ROV was then flown within a 10 m radius to obtain representative images of the seabed. A live feed from the ROV to a mobile device allowed real time viewing of footage. All footage was geo-refenced to allow suitable habitat mapping.

2.2 Analysis

2.2.1 Faunal analysis

Infaunal samples were analysed by Marinescope Taxonomy, an accredited NMBAQC laboratory.

Faunal samples were sieved over a 1 mm mesh to remove fauna and residue less than 1 mm. Samples were then sorted from the sieve residue using low power binocular microscopes. All of the macroinfaunal specimens were identified to species level (where practicable), enumerated and biomassed. This work was undertaken in adherence with International Organization for Standardization (ISO) 16665 standards and the NMBAQC Scheme Guidelines (Worsfold *et al.,* 2010).

QA of the faunal analysis was undertaken internally by Marine Scope Taxonomy. Following the NMBAQC guidelines, 10 % of samples were re-analysed for extraction, identification and enumeration. All samples passed QA checks and no remedial action was required.

Infauna samples were subsequently assigned biotopes to a minimum Level 3 (Connor *et al.* 2004). Raw data from the faunal analysis are shown in Appendix B.

2.2.2 PSA analysis

The PSA sample analysis was undertaken by ABPmer using the NMBAQC standardised methodology. The analysis was carried out using a Mastersizer laser diffractor which produces detailed sedimentary profiles for fine sediments (clay, sand and silts).

PSA data were standardised to Wentworth (1922) size classes for each station. Sediment classifications for mean particle size data at each station were calculated using GRADISTAT (Blott and Pye, 2001). Results of the PSA are shown in Appendix C.

2.2.3 Data processing

Following the completion of the survey, the extent of biotopes recorded in the area were mapped into Geographical Information System (GIS) layers using ArcGIS and the positional information derived from the GPS readings. All maps used a WGS84 datum.

Post processing of the imagery also included mapping of sampling locations with an indication of biotope/habitat present at each station. The biotopes assigned to the imagery at each drop-down video station are shown in Appendix D. Records were made of notable fauna, Priority Marine Features (PMF's) such as kelp beds and the presence of any invasive non-native species (INNS).

A habitat map for the site was then produced by analysing and interpreting the available habitat data (as detailed above). The results of the analysis are presented in Section 3 below.

3 Results

3.1 North Haven, Fair Isle

3.1.1 Intertidal habitats

Rock armour

The species on the upper-mid section of the rock armour surrounding the pier/ quay at North Haven consisted of a mosaic of bladder wrack *Fucus vesiculosus* (LR.LLR.F.Fves.FS: *Fucus vesiculosus* on full salinity moderately exposed to sheltered mid eulittoral rock) and serrated wrack *F. serratus* (LR.LLR.F.Fserr.FS: *Fucus serratus* on full salinity sheltered lower eulittoral rock).

The lower part of the rock armour in this area was characterised by a zone of kelp/ oarweed *Laminaria digitata* (IR.MIR.KR.Ldig.Bo *Laminaria digitata* and under-boulder fauna on sublittoral fringe boulders; Figure 5). Beneath the canopy a variety of red seaweeds such as false Irish moss *Mastocarpus stellatus*, *Palmaria palmata* and *Ceramium spp*. were present alongside a rich faunal community including the presence of juvenile edible crab *Cancer pagurus* (Figure 4).

Figure 4. Under canopy flora and fauna: juvenile Cancer pagurus and red seaweeds Mastocarpus stellatus and Ceramium spp.

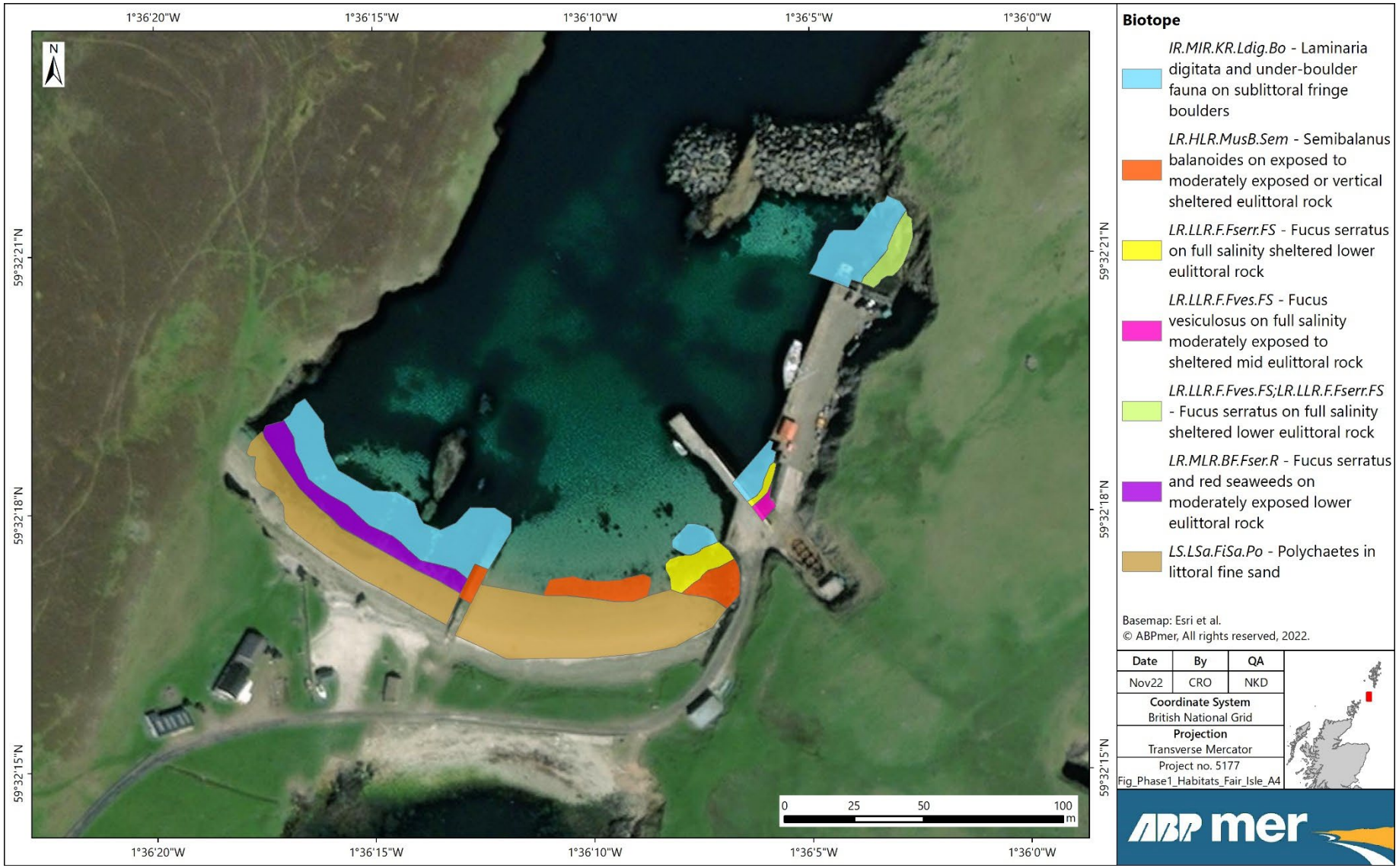


Figure 5. Distribution of intertidal habitats identified on the Phase 1 survey at North Haven, Fair Isle

Beach

The majority of the nearby beach at Fair Isle was formed of fine, clean, sand across the extent of the beach with the presence of *Arenicola sp*. worm casts at approximately 10-15 per m^2 within the mid shore. As such this area was classified as polychaetes in littoral fine sand (LS.LSa.FiSa.Po). Above this zone, barren littoral rock was present which formed part of the strandline. No fauna were visible within this zone (Figure 6A).

Within the centre of the beach a concrete slipway was present. On the mid-zone of the slipway barnacles dominated with the limpet *Patella vulgata* and occasional *Fucus spiralis*, *Ulva sp*. and *Nemalion helminthoides* (Figure 6B), classified as LR.HLR.MusB.Sem *Semibalanus balanoides* on exposed to moderately exposed or vertical sheltered eulittoral rock.

To the western extent of the beach, boulders and rock within the lower shore were covered in a range of algae species including *F. serratus* and red seaweeds such as *M. stellatus* and *Ceramium spp*.. The green seaweeds *U. intestinalis* and *U. lactuca* were also present. This habitat was most appropriately assigned to LR.MLR.BF.Fser.R *Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock (Figure 6C). Extending below this zone *L. digitata* predominated with a diversity of red seaweeds and epifaunal species, most appropriately classified as IR.MIR.KR.Ldig.Bo *Laminaria digitata* and under-boulder fauna on sublittoral fringe boulders (Figure 6D).

Figure 6. **Biotopes identifed at North Haven, Fair Isle: A) polychaetes in littoral fine sand; B) Semibalanus balanoides on exposed to moderately exposed or vertical sheltered eulittoral rock; C) Fucus serratus and red seaweeds on moderately exposed lower eulittoral rock; D) Laminaria digitata and under-boulder fauna on sublittoral fringe boulders**

Within the wider area at North Haven a number of sea caves were also identified (Figure 7.)

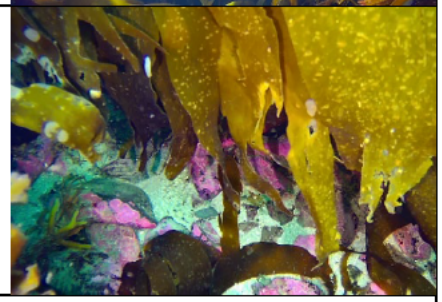
Figure 7. Caves identifed at North Haven, Fair Isle

3.1.2 Subtidal habitats

The sediments from grab samples collected within North Haven consisted of predominantly muddy sand. However, only two of the four samples (FIG03 and FIG04) could be obtained due to the presence of cobble substrate. Where grabs could not be obtained, underwater imagery was collected to classify the habitats at the site.

In total, 40 taxa were recorded from samples FIG03 and FIG04, ranging from 26 at FIG03 and 27 at FIG04. The faunal assemblage at FIG03 were predominantly characterised by polychaetes (*Malacoceros vulgaris*, *Capitella spp*. and *Spio martinensis*), the crustacea *Dexamine thea* and *Nototropis guttatus* and Nematoda (Table 1).

Table 1. North Haven subtidal benthic grab survey results

Station	Sediment Type	Depth (mBCD)	No. of Taxa (0.1 m^2)	No. of Individuals (0.1 m^2)	Total Biomass (g per m^2)	Key Characterising Species (Number per sample shown in brackets)	Identified Biotope	Site Image
FIG01	Cobbles	6.3	No successful grab samples			*Laminaria hyperborea* *Laminaria digitata* *Saccharina latissima* *Lithothamnion sp.*	IR.MIR.KR.LhypTX.Ft	
FIG02	Cobbles	11.5	No successful grab samples			*Laminaria hyperborea* *Laminaria digitata* *Saccharina latissima* *Lithothamnion sp.*	IR.MIR.KR.LhypTX.Ft	
FIG03	Sand	5.7	26	959	79.1	Polychaeta *Malacoceros vulgaris* (319) Polychaeta *Capitella* spp. (270) Crustacea *Dexamine thea* (85) NEMATODA (73) Polychaeta *Spio martinensis* (56)	SS.SSa.IMuSa	No image
FIG04	Sand	6.4	27	407	23.1	NEMATODA (170) Polychaeta *Capitella* spp. (53) Crustacea *Bathyporeia pelagica* (33) Crustacea *Perioculodes longimanus* (26) Crustacea *Nototropis guttatus* (23)	SS.SSa.IMuSa	No image

The fauna at FIG04 were predominantly characterised by Nematoda, crustacean species (*Bathyporeia pelagica, Perioculodes longimanus* and *Nototropis guttatus*) and the polychaete *Capitella* spp.. No INNS were recorded within either sample. Biomass at both stations was dominated by Annelida.

At FIG01 and FIG02 where no successful grab samples could be obtained underwater imagery was utilised. The imagery identified dense kelp of *Laminaria hyperborea* with *Laminaria digitata* and *Saccharina latissima* on mixed cobble, pebble substrate (Figure 8). Foliose red seaweeds were also present on kelp stipes.

This habitat was identified as *Laminaria hyperborea* forest and foliose red seaweeds on tide-swept upper infralittoral mixed substrata (IR.MIR.KR.LhypTX) which is a component biotope of the kelp bed PMF. This PMF was patchy in extent and presence, recorded primarily as a mosaic with non-PMF biotopes.

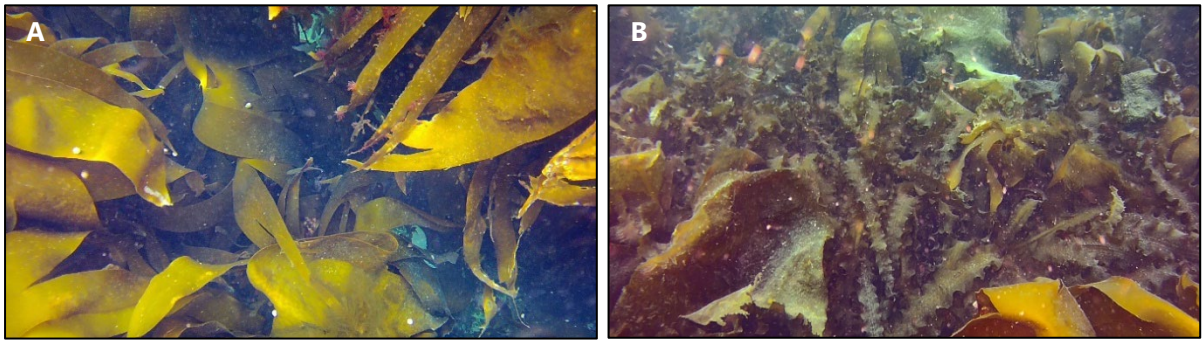


Figure 8. Laminaria hyperborea forest and foliose red seaweeds on tide-swept upper infralittoral mixed substrata present at stations FIG01 and FIG02.

At the underwater video stations two dominant biotopes were identified; *Laminaria hyperborea* forest and foliose red seaweeds on tide-swept upper infralittoral mixed substrata (IR.MIR.KR.LhypTX) and *Arenicola marina* in infralittoral fine sand or muddy sand (SS.SSa.IMuSa.AreISa), Figure 9A and Figure 9B respectively.

In addition, at station FIDDV02 a mosaic of Mixed *Laminaria hyperborea* and *Saccharina latissima* on sheltered infralittoral rock (IR.LIR.K.LhypSlat) and Infralittoral muddy sand (SS.SSa.IMuSa) were observed.

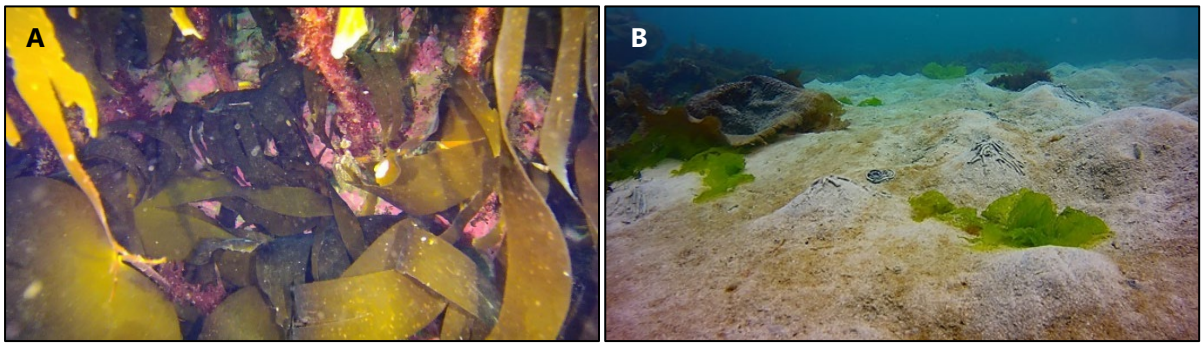


Figure 9. A) Laminaria hyperborea forest and foliose red seaweeds on tide-swept upper infralittoral mixed substrata (IR.MIR.KR.LhypTX) and B) Arenicola marina in infralittoral fine sand or muddy sand (SS.SSa.IMuSa.AreISa).

The distribution of biotopes identified during the subtidal survey are shown in Figure 10.

Figure 10. Distribution of subtidal biotopes at North Haven, Fair Isle

3.2 Grutness, Shetland Isles

3.2.1 Intertidal habitats

Rocky shore

The upper shore on the rocky shore to the east of Grutness terminal was dominated by spiral wrack *Fucus spirali*s and the ephemeral green seaweed *Ulva intestinalis* (LR.MLR.BF.FspiB *Fucus spiralis* on exposed to moderately exposed upper eulittoral rock). Above this zone, green algae with occasional lichens were present on predominantly barren supralittoral rock (LR.FLR.Lic: Lichens or small green algae on supralittoral and littoral fringe rock; Figure 11).

To the mid shore *Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock (LR.MLR.BF.FvesB) and *F. serratus* on moderately exposed lower eulittoral rock (LR.MLR.BF.Fser) formed a mosaic across a very thin band along the shore. Below this *Laminaria digitata* on moderately exposed sublittoral fringe bedrock (IR.MIR.KR.Ldig.Ldig) was present (Figure 12).

Figure 11. Rocky shore to the east of Grutness ferry terminal

Figure 12. Distribution of intertidal habitats identified on the Phase 1 survey at Grutness, Shetland Isles

To the west of the Grutness ferry terminal the upper shore was dominated by barnacles and limpets LR.HLR.MusB.Sem.Sem *Semibalanus balanoides, Patella vulgata and Littorina spp.* on exposed to moderately exposed or vertical sheltered eulittoral rock (Figure 13).

As with the biotopes observed to the east, the characterising species observed on the mid-section of the shore were *Fucus vesiculosus* and *F. serratus*, however on the western side these formed two distinct bands as opposed to a mosaic. With *Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock (LR.MLR.BF.FvesB) above *F. serratus* on moderately exposed lower eulittoral rock (LR.MLR.BF.Fser) (Figure 12).

In the lower shore kelp predominated with both *Laminaria digitata* and *Saccharina latissima* equally abundance. Red seaweeds were present below the algal canopy. This habitat was most appropriately assigned to IR.LIR.K.Slat.Ldig *Saccharina latissima* and *Laminaria digitata* on sheltered sublittoral fringe rock.

Figure 13. Rocky shore to the west of Grutness ferry terminal

Beach

To the far west of the Grutness ferry terminal the beach was formed predominantly of Barren littoral coarse sand (LS.LSa.MoSa.BarSa) with little evidence of any infauna. A small rocky outcrop was present to the southern end of the beach were *L. digitata* and *F. serratus* were present with abundant red seaweeds such as *M. stellatus* and *Membranoptera alata*. This habitat was most appropriately assigned to IR.MIR.KR.Ldig.Ldig *Laminaria digitata* on moderately exposed sublittoral fringe bedrock

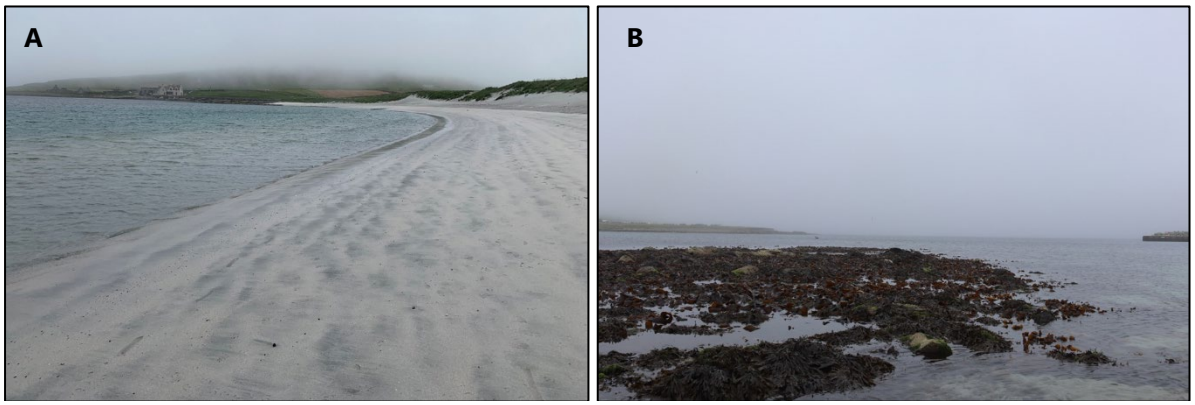


Figure 14. A) Barren littoral coarse sand beach to the west of Grutness ferry terminal; B) rocky outcrop to the south of the beach

3.2.2 Subtidal habitats

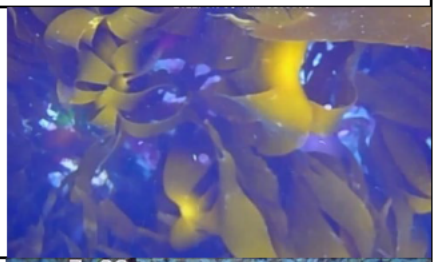
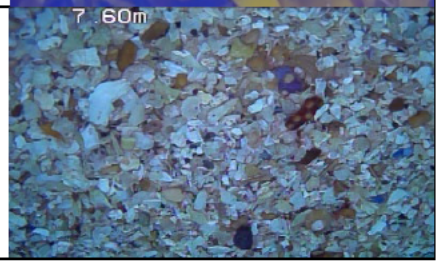
The sediments from grab samples collected at Grutness predominantly consisted of sand. However, only two of the four samples (GG02 and GG04) could be obtained due to the presence of cobbles. Where grabs could not be obtained, underwater imagery was collected to classify the habitats at the site.

In total, 62 taxa were recorded from samples GG02 and GG04, ranging from 28 at GG02 to 46 at GG04. The faunal assemblage at GG02 were predominantly characterised by Nematoda and oligochaete species (*Tubificoides benedii* and *T. pseudogaster*), the polychaetes *Cirriformia* spp. and *Cirriformia tentaculata* (Table 2). The fauna at GG04 were predominantly characterised by Nematoda, Copepoda, *T. pseudogaster, C. tentaculata* and *Gammaridae*. No INNS were recorded for either sample, however, the small sea cucumber *Rhabdomolgus ruber* was recorded at GG04. This species is thought to be rare, although it is potentially under recorded due to its small size. Biomass at both stations was dominated by Annelida.

At GG01 and GG03, where no successful grab samples could be obtained, underwater imagery was utilised. The imagery identified high density of the kelp *Alaria esculenta*; with encrusting coralline algae and a red seaweed understorey including species such as *Membranoptera alata* at GG01. This was best categorised as *Alaria esculenta* on exposed sublittoral fringe bedrock (IR.HIR.KFaR.Al).

Dense *Laminaria hyperborea* with *Saccharina latissima* were present on a mixed cobble and pebble substrata. The stipes of these kelps were covered with foliose red seaweeds at GG03 (Figure 15). This biotope was identified as '*Laminaria hyperborea* forest and foliose red seaweeds on tide-swept upper infralittoral mixed substrata (IR.MIR.KR.LhypTX)', which is a component biotope of the kelp bed PMF. This PMF was patchy in extent and presence, recorded primarily as a mosaic with non-PMF biotopes.

Table 2. Grutness subtidal benthic grab survey results

Station	Sediment Type	Depth (mBCD)	No. of Taxa (0.1 m^2)	No. of Individuals (0.1 m^2)	Total Biomass (g per m^2)	Key Characterising Species (Number per sample shown in brackets)	Identified Biotope	Site Image
GG01	Cobbles and gravel	5.3	No successful grab samples			*Alaria esculenta* *Laminaria digitata* *Saccharina latissima* *Lithothamnion sp.*	IR.HIR.KFaR.Al	
GG02	Gravelly Sand	5.0	28	510	54.5	Nematoda (349) Oligochaete *Tubificoides benedii* (45) Oligochaete *Tubificoides pseudogaster* (27) Polychaeta *Cirriformia* (23) Polychaeta *Cirriformia tentaculate* (16) Nemertea (13)	SS.SSa.IFiSa.IMoSa	No image
GG03	Cobbles and gravel	6.0	No successful grab samples			*Laminaria hyperborea* *Saccharina latissima*	IR.MIR.KR.LhypTX.Ft	
GG04	Gravelly Sand	6.2	46	847	104.8	Nematoda (367) Copepoda (63) Oligochaete *Tubificoides pseudogaster* (61) Polychaeta *Cirriformia tentaculate* (51) Gammaridae (51) Amphipoda *Jassa falcata* (43)	SS.SSa.IFiSa.IMoSa	

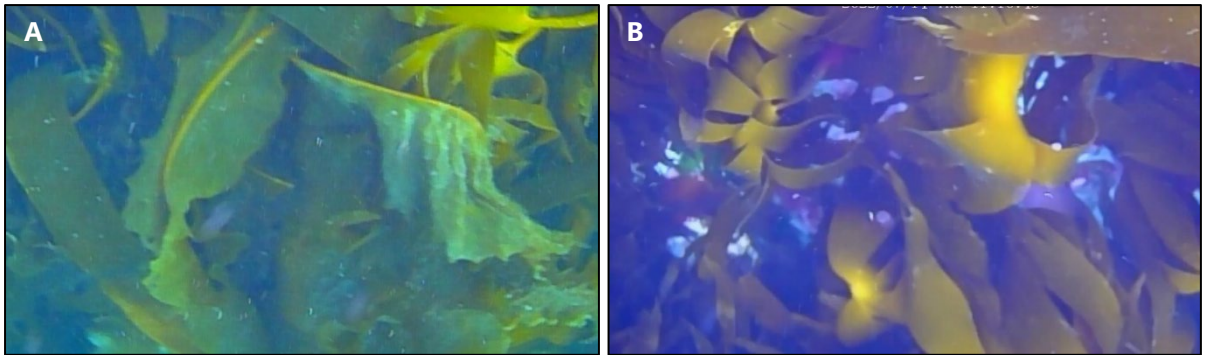


Figure 15. **A) Alaria esculenta on exposed sublittoral fringe bedrock present at stations GG01; B) Laminaria hyperborea forest and foliose red seaweeds on tide-swept upper infralittoral mixed substrata present at stations GG03.**

At the underwater video stations a number of biotopes were identified. These included 'mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock (IR.HIR.KSed.XKScrR) at GDDV01 and GDDV02 where it formed a matrix with *Alaria esculenta* on exposed sublittoral fringe bedrock (IR.HIR.KFaR.Al). The biotope 'mixed *Laminaria hyperborea* and *Saccharina latissima* forest on sheltered upper infralittoral rock (IR.LIR.K.LhypSlat.Ft)' was recorded at GDDV03 and the biotope 'infralittoral mobile clean sand with sparse fauna (SS.SSa.IFiSa.IMoSa)', at GDDV05.

The PMF habitat *Laminaria hyperborea* forest and foliose red seaweeds on tide-swept upper infralittoral mixed substrata (IR.MIR.KR.LhypTX.Ft) was recorded at GDDV04 and GDDV06, but as with GG03 this was considered a poor example of the feature (Figure 16).

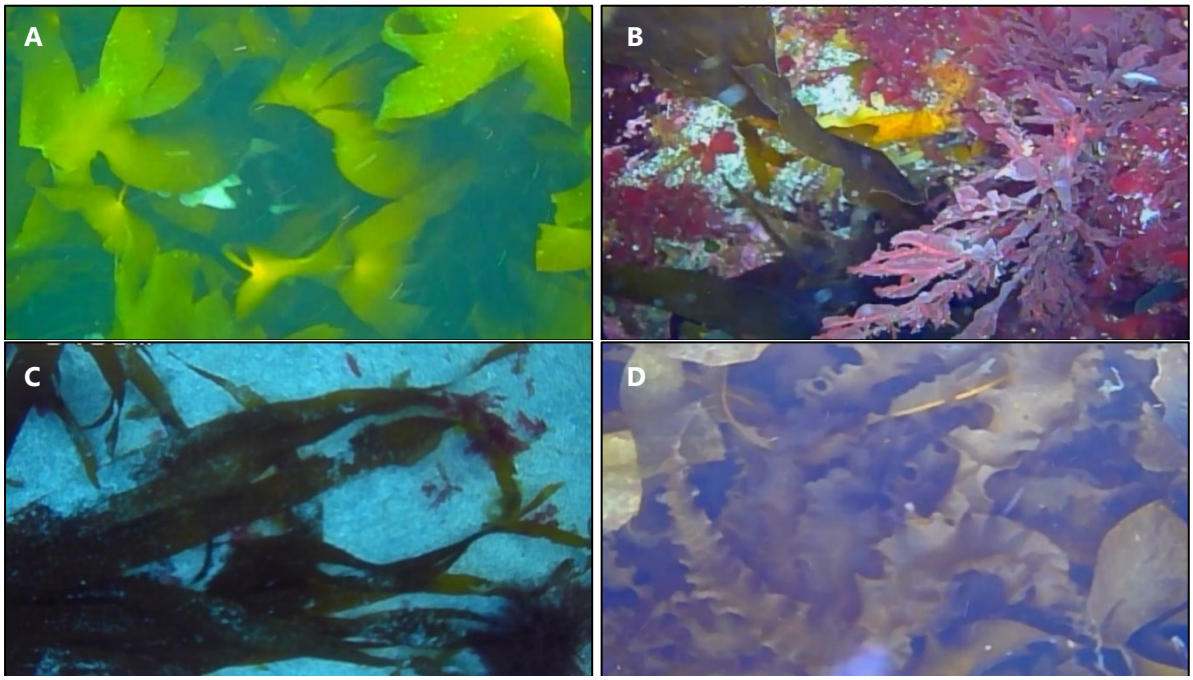


Figure 16. **A and B) Laminaria hyperborea forest and foliose red seaweeds on tide-swept upper infralittoral mixed substrata (IR.MIR.KR.LhypTX); C) Infralittoral mobile clean sand with sparse fauna (SS.SSa.IFiSa.IMoSa) and D) Mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock (IR.HIR.KSed.XKScrR)**

The distribution of biotopes identified during the subtidal survey are shown in Figure 17.

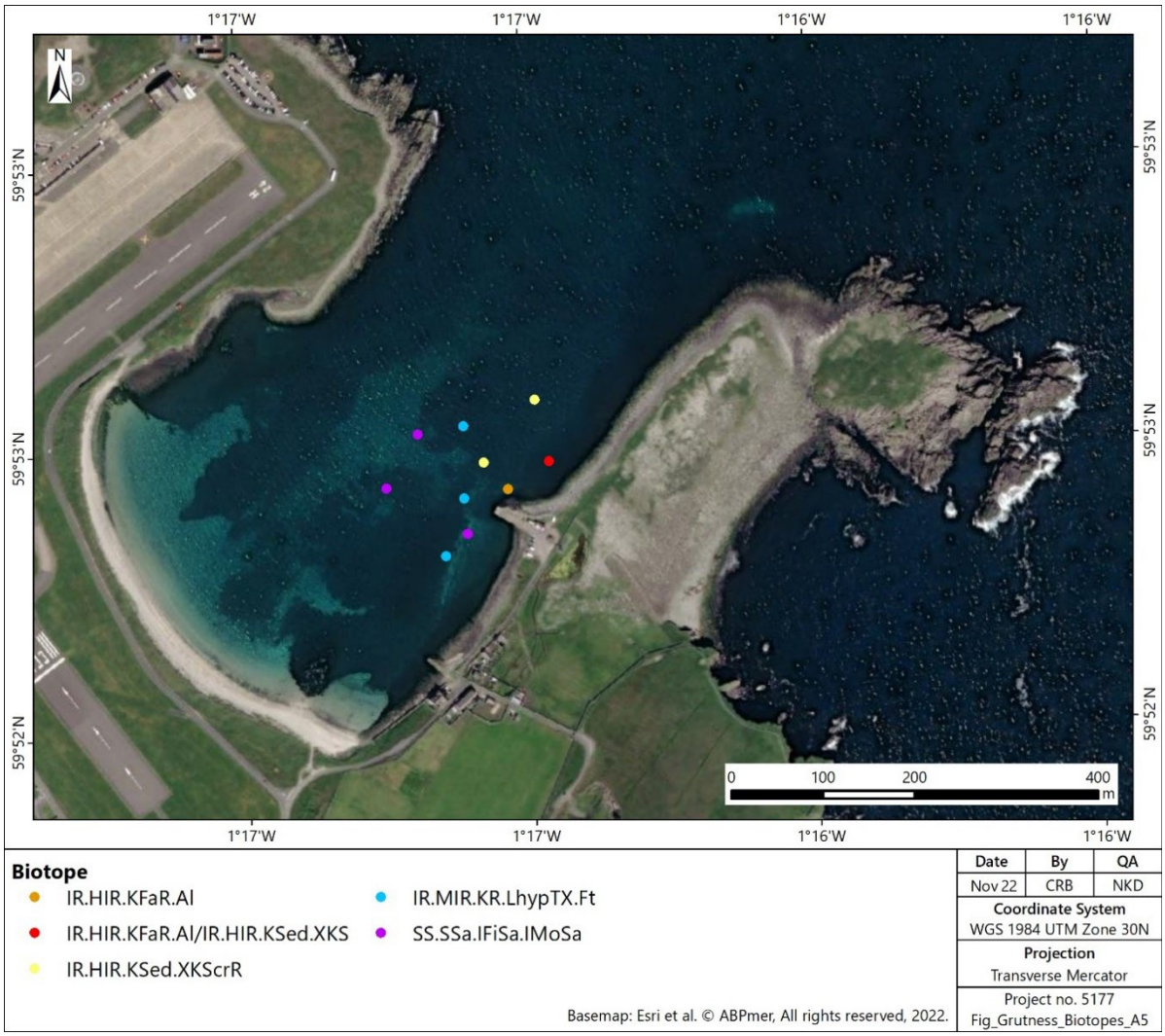


Figure 17. Distribution of subtidal biotopes at Grutness, Shetland Isles

4 Conclusions

Intertidal and subtidal surveys were successfully completed at Grutness, Shetland and North Haven, Fair Isle. Intertidal walk over surveys mapped the biotopes present on rocky areas surrounding the piers/ quays and the nearby beaches at both sites. Subtidal surveys consisted of grab and underwater video operations. The results provide a greater insight into the current ecological status of North Haven and Grutness.

At Fair Isle the rocky intertidal areas consisted of a zonation of *F. vesiculosus*, *F. serratus* and *L. digitata,* beneath the canopy of which was a variety of red seaweeds alongside a rich faunal community. The majority of the nearby beach was formed of fine, clean, sand across the extent of which were *Arenicola* spp. worm casts. Boulders and rock within the lower shore were covered in a range of algae species including *F. serratus*, red seaweeds, *Ulva spp*. and *L. digitata.* No PMF habitats or species were identified within the intertidal areas at Fair Isle.

In the subtidal areas the site consisted of a mosaic of muddy sand and rocky kelp outcrops. These kelp outcrops were identified as *Laminaria hyperborea* forest and foliose red seaweeds on tide-swept upper infralittoral mixed substrata (IR.MIR.KR.LhypTX) a component of the kelp bed PMF habitat. However, due to the very patchy extent and presence of this feature, it being found primarily as a mosaic with non-PMF biotopes at the site, this is considered a relatively poor example of this PMF.

As with Fair Isle, no PMFs were identified within the intertidal zone at Grutness. The rocky areas of the shore followed a typical zonation from upper shore barnacle dominated littoral rock to *F. vesiculosis*, *F. serratus* and lower shore *L. digitata* and *S. latissima* kelp communities. The beach to the far west of the area was identified as barren littoral coarse sand.

In the subtidal, *Laminaria hyperborea* forest and foliose red seaweeds on tide-swept upper infralittoral mixed substrata was recorded. This was identified at stations GG03, GDDV04 and GDDV06 but was also considered to be a relatively poor example of the PMF due to its patchy extent and presence within the subtidal area.

There were also a variety of other non-PMF biotopes recoded at subtidal stations at Grutness including Mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock, *Alaria esculenta* on exposed sublittoral fringe bedrock and Mixed *Laminaria hyperborea* and *Saccharina latissima* forest on sheltered upper infralittoral rock.

Within the inner bay at North Haven, the habitats are dominated by sandy substrata a likely result of the breakwater. While beyond the breakwater cobble substrate and kelp dominated biotopes predominate. Other than the effects from the breakwater at North Haven there was no evidence of anthropogenic activities impacting habitat distribution at either site. No INNS were recorded at either site (Grutness/North Haven).

5 References

Blott, S.J. and Pye, K. (2001) GRADISTAT: a grain size distribution and statistics package for the analysis of unconsolidated sediments. Earth Surface Processes and Landforms 26, 1237-1248.

Connor, D.W., J.H. Allen, N. Golding, K.L. Howell, L.M. Lieberknecht, K.O. Northen and J.B. Reker (2004) The Marine Habitat Classification for Britain and Ireland Version 04.05 ISBN 1 861 07561 8. Available from: https://mhc.jncc.gov.uk/resources#version0405

ISO 16665: Water quality - Guidelines for quantitative sampling and sample processing of marine soft-bottom macrofauna. International Organization for Standardization.

JNCC (2022) The Marine Habitat Classification for Britain and Ireland Version 22.04. Available from: https://mhc.jncc.gov.uk/

Wentworth, C.K., (1922) A scale of grade and class terms for clastic sediments. The Journal of Geology, 30(5), pp.377-392.

Worsfold, T.M., Hall, D.J. and O'Reilly, M. (Ed.) (2010) Guidelines for processing marine macrobenthic invertebrate samples: a Processing Requirements Protocol: Version 1.0, June 2010. Report to the NMBAQC Committee. June 2010.

Wyn G., Brazier P. (2001). Procedural Guideline No. 3-1. In situ biotope recording. Marine Monitoring Handbook.

Wyn, G., Brazier, P., Birch, K., Bunker, A., Cooke, A., Jones, M., Lough, N., McMath, A. and Roberts, S. (2000) Handbook for Marine Intertidal Phase 1 Biotope Mapping Survey. CCW, Bangor.

6 Abbreviations/Acronyms

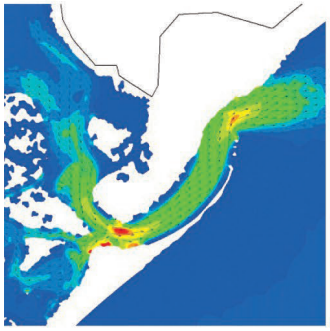
BN	Britten-Norman
CCW	Countryside Council for Wales
DDV	Drop Down Video
GIS	Geographic Information System
GPS	Global Positioning System
GRADISTAT	Particle Size Analysis Software (Kenneth Pye Associates Ltd)
ID	Identity
INNS	Invasive Non-Native Species
ISO	International Organization for Standardization
JNCC	Joint Nature Conservation Committee
mBCD	metres Below Chart Datum
MHCBI	Marine Habitat Classification for Britain & Ireland
NMBAQC	National Marine Biological Analytical Quality Control
PMF	Priority Marine Feature
PSA	Particle Size Analysis
QA	Quality Assessment
ROV	Remotely Operated Vehicle
SAC	Special Area of Conservation
SIC	Shetland Islands Council
SPA	Special Protection Area
TOC	Total Organic Carbon
UAV	Unmanned Aerial Vehicle
UK	United Kingdom

Cardinal points/directions are used unless otherwise stated.

SI units are used unless otherwise stated.

Appendices




Innovative Thinking - Sustainable Solutions

ABP mer

A Subtidal Sample Locations

Table A1. Coordinates (WGS84) of sample locations at Fair Isle and Grutness

Sample Name	Sample Type	Location	Latitude	Longitude
G01	Grab	Fair Isle	59.53937	-1.60308
G02	Grab	Fair Isle	59.53936	-1.60414
G03	Grab	Fair Isle	59.53844	-1.60392
G04	Grab	Fair Isle	59.53876	-1.60455
DDV01	DDV	Fair Isle	59.53932	-1.60341
DDV02	DDV	Fair Isle	59.53946	-1.60363
DDV03	DDV	Fair Isle	59.53918	-1.60444
DDV04	DDV	Fair Isle	59.53898	-1.60471
DDV05	DDV	Fair Isle	59.5385	-1.60431
DDV06	DDV	Fair Isle	59.53861	-1.6035
G01	Grab	Grutness	59.87465	-1.27833
G02	Grab	Grutness	59.87423	-1.27891
G03	Grab	Grutness	59.87538	-1.27894
G04	Grab	Grutness	59.8746	-1.28029
DDV01	DDV	Grutness	59.87467	-1.27748
DDV02	DDV	Grutness	59.87539	-1.27786
DDV03	DDV	Grutness	59.87478	-1.27876
DDV04	DDV	Grutness	59.87449	-1.27915
DDV05	DDV	Grutness	59.87508	-1.27992
DDV06	DDV	Grutness	59.87401	-1.27958

B Subtidal Species List

Table B1. Species identified from grab samples at Fair Isle and Grutness

Taxa ID	Qualifiers	Phylum	FIG03	FIG04	GG02	GG04
Animalia	eggs					P
Porifera		Porifera				P
Sycon ciliatum		Porifera				1
Haliclystus salpinx		Cnidaria				1
Campanulariidae		Cnidaria				P
Nemertea		Nemertea			13	2
Nematoda		Nematoda	73	170	349	367
Pisione remota		Annelida			2	1
Pholoe baltica		Annelida	2			
Phyllodoce mucosa		Annelida				1
Glycera	juvenile	Annelida			1	
Eusyllis blomstrandi		Annelida			1	
Streptosyllis websteri		Annelida	5	2	1	1
Syllides benedicti		Annelida				1
Nephtys cirrosa		Annelida			2	1
Nephtys longosetosa		Annelida			1	
Ophryotrocha		Annelida			1	2
Protodorvillea kefersteini		Annelida			8	1
Scoloplos armiger		Annelida		22		
Malacoceros tetracerus		Annelida		5		
Malacoceros vulgaris		Annelida	319			2
Spio filicornis		Annelida	11			
Spio martinensis		Annelida	56	3		1
Spiophanes bombyx		Annelida		3		
Spiophanes kroyeri		Annelida		1		
Chaetozone	juvenile	Annelida		10		
Chaetozone christiei		Annelida	3	10	1	
Cirriformia	juvenile	Annelida			23	12
Cirriformia tentaculata		Annelida	1		16	51
Baldia johnstoni		Annelida		1		
Capitella		Annelida	270	53		38
Arenicola marina		Annelida		2		
Spirorbinae		Annelida				2
Tubificoides benedii		Annelida	8	2	45	25
Tubificoides pseudogaster	agg.	Annelida	14	8	27	61
Grania		Annelida	11	12		40
Copepoda		Arthropoda	4	1	2	63
Apherusa bispinosa		Arthropoda				5
Perioculodes longimanus		Arthropoda	21	26		
Pontocrates arenarius		Arthropoda				1
Harpinia laevis		Arthropoda		2		
Atylidae	juvenile	Arthropoda				24
Nototropis falcatus		Arthropoda				2
Nototropis guttatus		Arthropoda	28	23		3

Taxa ID	Qualifiers	Phylum	FIG03	FIG04	GG02	GG04
Dexamine spinosa		Arthropoda				4
Dexamine thea		Arthropoda	85			18
Ampelisca brevicornis		Arthropoda	13	5		
Bathyporeia pelagica		Arthropoda		33		
Gammaridae	indet.	Arthropoda	1			51
Gammarus locusta		Arthropoda				4
Ampithoe ramondi		Arthropoda	3			
Jassa falcata		Arthropoda				43
Aoridae	female	Arthropoda	1			2
Aora gracilis		Arthropoda				1
Corophiidae	indet.	Arthropoda			1	
Caprellidae	indet.	Arthropoda				1
Munnidae		Arthropoda				1
Idotea pelagica		Arthropoda				6
Bodotria scorpioides		Arthropoda	3	7	2	2
Monopseudocuma gilsoni		Arthropoda			1	
Crangon crangon		Arthropoda				1
Patella pellucida		Mollusca				1
Lacuna	juvenile	Mollusca	3	1		
Rissoidae		Mollusca	1			
Euspira nitida		Mollusca			1	
Mytilidae	juvenile	Mollusca	6			2
Lucinoma borealis	juvenile	Mollusca	7			
Kurtiella bidentata		Mollusca	10			
Mactra stultorum	juvenile	Mollusca			3	
Ensis	juvenile	Mollusca		1	1	
Ensis ensis		Mollusca			1	
Abra prismatica		Mollusca		3		
Veneroidea	juvenile	Mollusca			3	
Chamelea striatula	juvenile	Mollusca			1	
Dosinia lupinus		Mollusca			1	
Membranipora membranacea		Bryozoa				P
Electra pilosa		Bryozoa		P		P
Celleporella hyalina		Bryozoa				P
Amphiuridae	juvenile	Echinodermata		1		
Rhabdomolgus ruber		Echinodermata			1	
Ammodytidae		Chordata			1	
Chironomidae	larvae	Arthropoda				1

C Particle Size Analysis Results

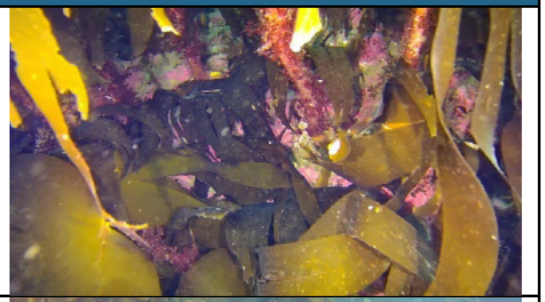
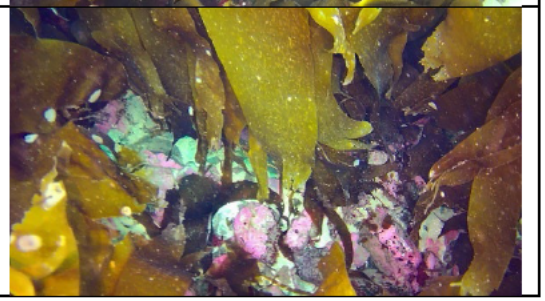
Table C1. Sediment classifications for mean particle size data from grab samples at Fair Isle and Grutness

Station	GG04	GG02	FIG03	FIG04
Textural group:	**Gravelly Sand**	**Gravelly Sand**	**Sand**	**Sand**
% GRAVEL:	12.1%	14.3%	0.0%	0.0%
% SAND:	87.9%	84.9%	94.0%	96.7%
% MUD:	0.0%	0.7%	6.0%	3.3%
% V. coarse gravel	0.0%	0.0%	0.0%	0.0%
% Coarse gravel	0.0%	3.8%	0.0%	0.0%
% Medium gravel	4.9%	5.0%	0.0%	0.0%
% Fine gravel	4.0%	2.7%	0.0%	0.0%
% V. fine gravel	3.1%	2.9%	0.0%	0.0%
% V. coarse sand	38.8%	43.4%	0.0%	0.0%
% Coarse sand	35.0%	31.0%	9.8%	8.9%
% Medium sand	13.1%	9.4%	37.6%	60.7%
% Fine sand	1.0%	0.3%	35.0%	26.6%
% V. fine sand	0.1%	0.8%	11.6%	0.6%
% V. coarse silt	0.0%	0.3%	1.5%	1.0%
% Coarse silt	0.0%	0.1%	1.7%	0.9%
% Medium silt	0.0%	0.1%	1.4%	0.7%
% Fine silt	0.0%	0.1%	0.9%	0.6%
% V. fine silt	0.0%	0.1%	0.4%	0.1%
% Clay	0.0%	0.0%	0.0%	0.0%

D Subtidal Underwater Imagery

D.1 North Haven, Fair Isle

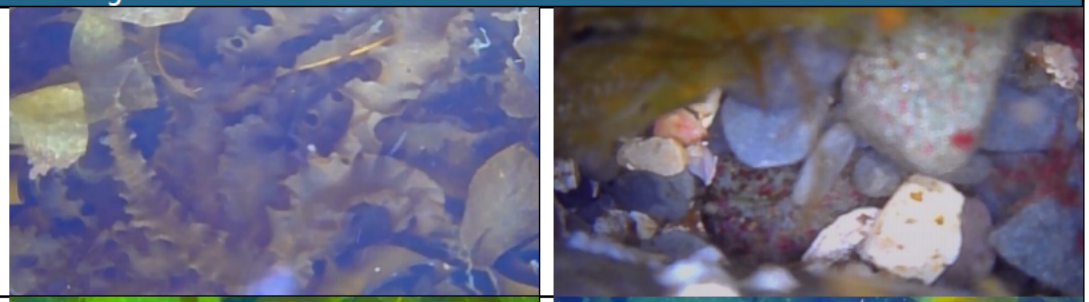
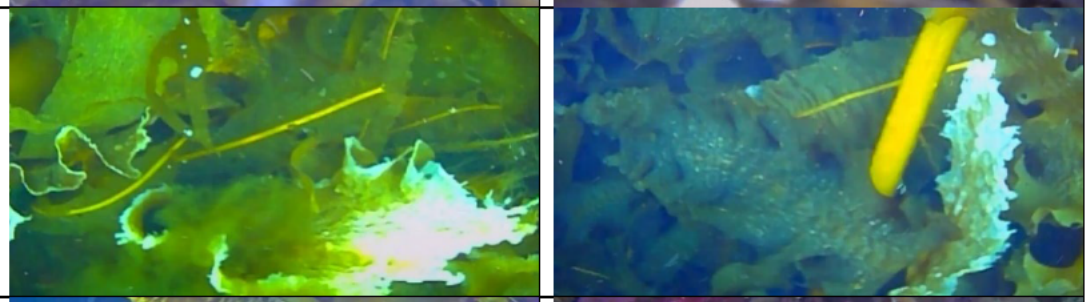
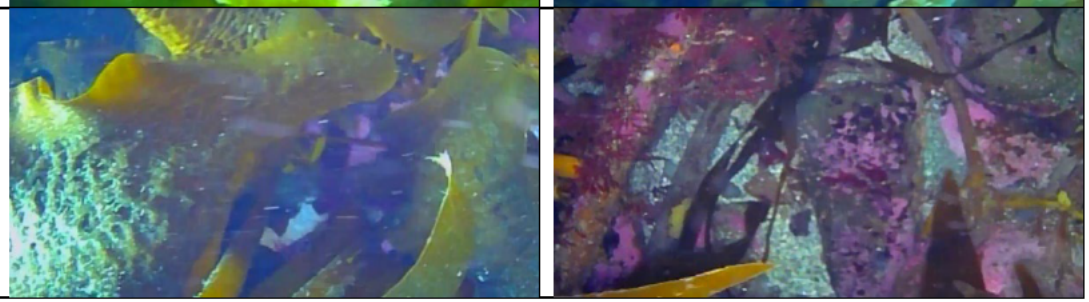
Table D1. Underwater imagery Fair Isle

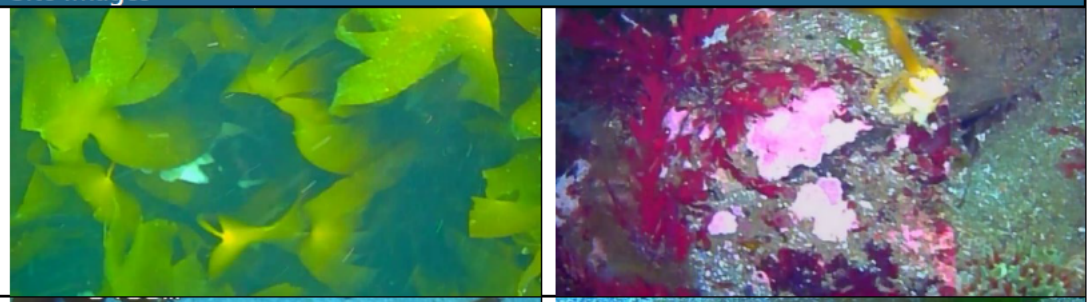
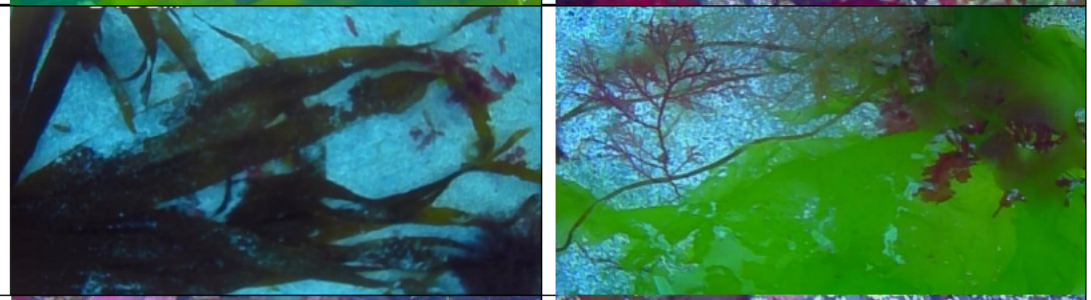
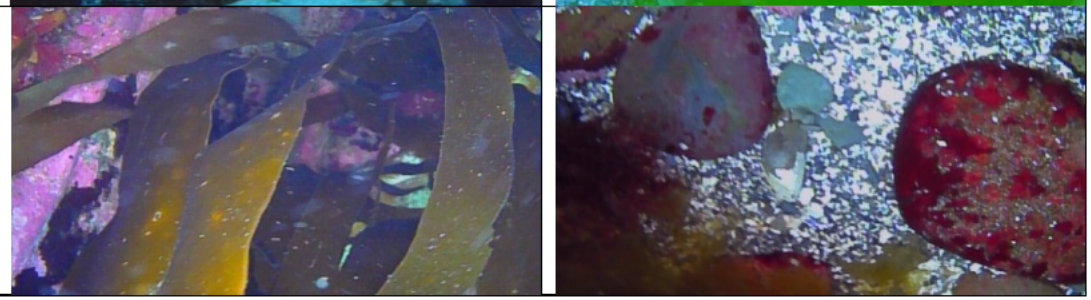
Station	Biotope	Site Images
FIDDV01	*Laminaria hyperborea* forest and foliose red seaweeds on tide-swept upper infralittoral mixed substrata (IR.MIR.KR.LhypTX)	 
FIDDV02	Mixed *Laminaria hyperborea* and *Saccharina latissima* on sheltered infralittoral rock (IR.LIR.K.LhypSlat)/ Infralittoral muddy sand (SS.SSa.IMuSa)	 
FIDDV03	*Laminaria hyperborea* forest and foliose red seaweeds on tide-swept upper infralittoral mixed substrata (IR.MIR.KR.LhypTX)	 

Station	Biotope	Site Images
FIDDV04	*Arenicola marina* in infralittoral fine sand or muddy sand (SS.SSa.IMuSa.ArelSa)	 
FIDDV05	*Arenicola marina* in infralittoral fine sand or muddy sand (SS.SSa.IMuSa.ArelSa)	 
FIDDV06	*Arenicola marina* in infralittoral fine sand or muddy sand (SS.SSa.IMuSa.ArelSa)	 

D.2 Grutness, Shetland Isles

Table D2. Underwater imagery Grutness

Station	Biotope	Site Images
GDDV01	Mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock (IR.HIR.KSed.XKScrR)	
GDDV02	*Alaria esculenta* on exposed sublittoral fringe bedrock (IR.HIR.KFaR.Al) / Mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock (IR.HIR.KSed.XKScrR)	
GDDV03	Mixed *Laminaria hyperborea* and *Saccharina latissima* forest on sheltered upper infralittoral rock (IR.LIR.K.LhypSlat.Ft)	

Station	Biotope	Site Images
GDDV04	*Laminaria hyperborea* forest and foliose red seaweeds on tide-swept upper infralittoral mixed substrata (IR.MIR.KR.LhypTX.Ft)	
GDDV05	Infralittoral mobile clean sand with sparse fauna (SS.SSa.IFiSa.IMoSa)	
GDDV06	*Laminaria hyperborea forest and foliose red seaweeds on tide-swept upper infralittoral mixed substrata (IR.MIR.KR.LhypTX.Ft)*	

Contact Us

ABPmer

Quayside Suite,
Medina Chambers
Town Quay, Southampton
SO14 2AQ

T +44 (0) 23 8071 1840
F +44 (0) 23 8071 1841
E enquiries@abpmer.co.uk

www.abpmer.co.uk