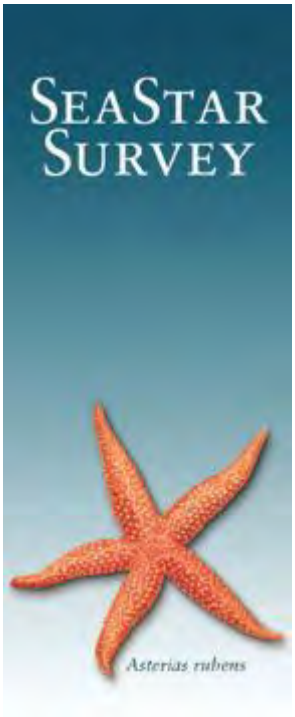
TECHNICAL APPENDIX 5.4

2022 Hatston Pier and Harbour Habitat Mapping Survey

Survey Report

27th April 2023



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1 INTRODUCTION

1.1 Background

In 2020, the Orkney Island Council Harbour Authority (OICHA) unveiled the Orkney Harbour Masterplan Phase I. The Masterplan proposed a £230 million investment in a range of harbour infrastructure enhancements to be completed over a 20-year period. Phase I of the Masterplan considers five locations on the Orkney mainland, namely:

- Scapa Deep Water Quay;
- Hatston Pier and Harbour;
- Scapa Pier;
- Kirkwall Pier and Harbour; and
- Stromness.

Phase II of the Masterplan will include the development and expansion of smaller harbours and piers across the wider Orkney Islands.

Seastar Survey Ltd. (hereafter Seastar) and Physalia Associates Ltd. (hereafter Physalia) were commissioned by Envirocentre to undertake a broadscale habitat assessment of the intertidal and subtidal habitats at and in the vicinity of the proposed Hatston Pier expansion project. The data obtained will inform the Environmental Impact Assessment (EIA) that will be submitted with the project planning permission application by the Orkney Island Council Harbour Authority (OICHA). If planning permission is granted, a full baseline survey of the area will be conducted, which, when combined with a suitable monitoring scheme, will enable potential future changes to the local habitats and biological communities to be detected and quantified.

1.2 The existing site

Currently, Hatston Pier comprises a 200 m causeway edged with rock armour that accesses a ‘T’-shaped pier formed from piles topped by a concrete slab. Landward of the causeway is an area that is used for vehicle parking, freight marshalling and storage. The pier and harbour provides significant deep-water commercial berth facilities and currently accommodates a wide range of commercial activities including cruise ships, renewable energy operations, ferries, oil and gas and cargo/livestock transportation.

The shoreline at and in the vicinity of Hatston Pier comprises a rocky foreshore leading to sand-dominated subtidal substrate. The landward edge of the intertidal zone is bounded by a steep rocky embankment and cliff. Between 1974 and 1990, annual surveys of rocky shores in Orkney were conducted (e.g. Baxter, Jones and Simpson, 1985), which included a transect located within the current survey area. However, as the associated data were not made available during the planning process, the transect was not incorporated into the current survey. Furthermore, as the associated data are not recent (predating the current survey by more than 30 years), and because the annual surveys were started and completed prior to any pier development at Hatston, their use in informing the current survey has been deemed to be limited.

1.3 Proposed development summary

As part of the Orkney Harbour Masterplan Phase I it is proposed that the existing Hatston Pier be extended by 300 m and that the area between the pier and the shore be in-filled to provide additional laydown area. A total of 7.77 ha of land reclamation is proposed. This will result in the direct loss of both intertidal and subtidal habitats and the associated biotic communities. The quay extension will require additional capital dredging alongside the new berths and the approach channel. These activities have the potential to cause indirect impacts due to dissemination of disturbed particulate substrate, including modification of habitat conditions and habitat smothering.

Details of the proposed Hatston Pier and Harbour development and design drawings are presented in the project's EIA Scoping Report (see EnviroCentre, 2022).

1.4 Survey aims and objectives

The aim of the survey was to conduct a broadscale habitat mapping survey, i.e. to identify and map the extent and distribution of the range of habitats present at and in the vicinity of the proposed Hatston Pier and Harbour development. The objectives of the survey were to;

- conduct a Phase I survey of the intertidal habitats at a series of belt transects within the survey area;
- identify and map the extent and distribution of intertidal habitats within the transects;
- identify and map the extent and distribution of the littoral biotopes present;
- characterise the habitats observed by providing semi-quantitative data on species composition of representative intertidal rock habitat biotopes;
- conduct a drop-down camera and benthic grab sampling survey of the subtidal benthic habitats within the survey area;
- identify and map the extent and distribution of subtidal habitats within the survey area;
- identify and map the extent and distribution of the sublittoral biotopes present;
- identify any protected species and/or communities including habitats of conservation or ecological importance such as Priority Marine Features (PMFs) or Annex I habitats.

2 METHODS

2.1 Intertidal survey

The aim of the Phase I intertidal survey was to determine the range, distribution and extent of the habitats present by assigning biotopes *in situ* on vertical (i.e. running from high to low shore) transects, in accordance with best practice guidance. The collection and analysis of the data was completed in accordance with Common Standards Monitoring guidance (JNCC, 2004) and procedural guidelines outlined in the Marine Monitoring Handbook (Davies *et al*., 2001) and the CCW Handbook for Marine Intertidal Phase I Survey and Mapping (Wyn, *et al*., 2006).

2.1.1 Transect locations

Prior to the survey, target locations for four intertidal 'belt' transects were selected. No aerial photography data for the survey area were available in which the intertidal zone was visible, and no previous habitat mapping data were made available. Therefore, in order to achieve good geographical spread, and in an attempt to sample a range of habitat types, two transects were placed either side of the existing pier within the proposed development area, with two additional transects placed outside of the proposed development area, one approximately 450 m to the west of the pier and one approximately 450 m along the coast to the southeast.

Start of line (SOL) and end of line (EOL) positions for each transect were input into a Garmin GPSMAP 276Cx portable chartplotter. These included a central transect line and two parallel 'boundary' lines, one 30 m either side of the central transect line. The appropriateness of these target transect sites was re-assessed in the field and, where necessary, locations changed in order to accommodate features or conditions that hampered survey operations (e.g. impediments to access, accumulations of phytodetritus).

The transect locations used for the Hatston intertidal survey are presented in Table 2.1 and illustrated in Figure 2.1.

Table 2.1: Start of line (SOL) and end of line (EOL) positions of the centre line of each of the four belt transects surveyed during the 2022 Hatston Pier Phase I intertidal survey. Positions are WGS84 (DD MM.MMMM) negative longitudes are west).

Transect Name	Transect Number	SOL Position WGS84		EOL Position WGS84		Bearing to EOL
		Latitude	Longitude	Latitude	Longitude	
Hatston	**H_1**	59 00.0173	-002 58.9469	59 00.0328	-002 58.9385	030°
Hatston	**H_2**	59 00.0327	-002 59.2791	59 00.0588	-002 59.2638	020°
Hatston	**H_3**	58 59.9381	-002 58.8073	58 59.9444	-002 58.7542	085°
Hatston	**H_4**	58 59.8081	-002 58.5757	58 59.8331	-002 58.5634	015°

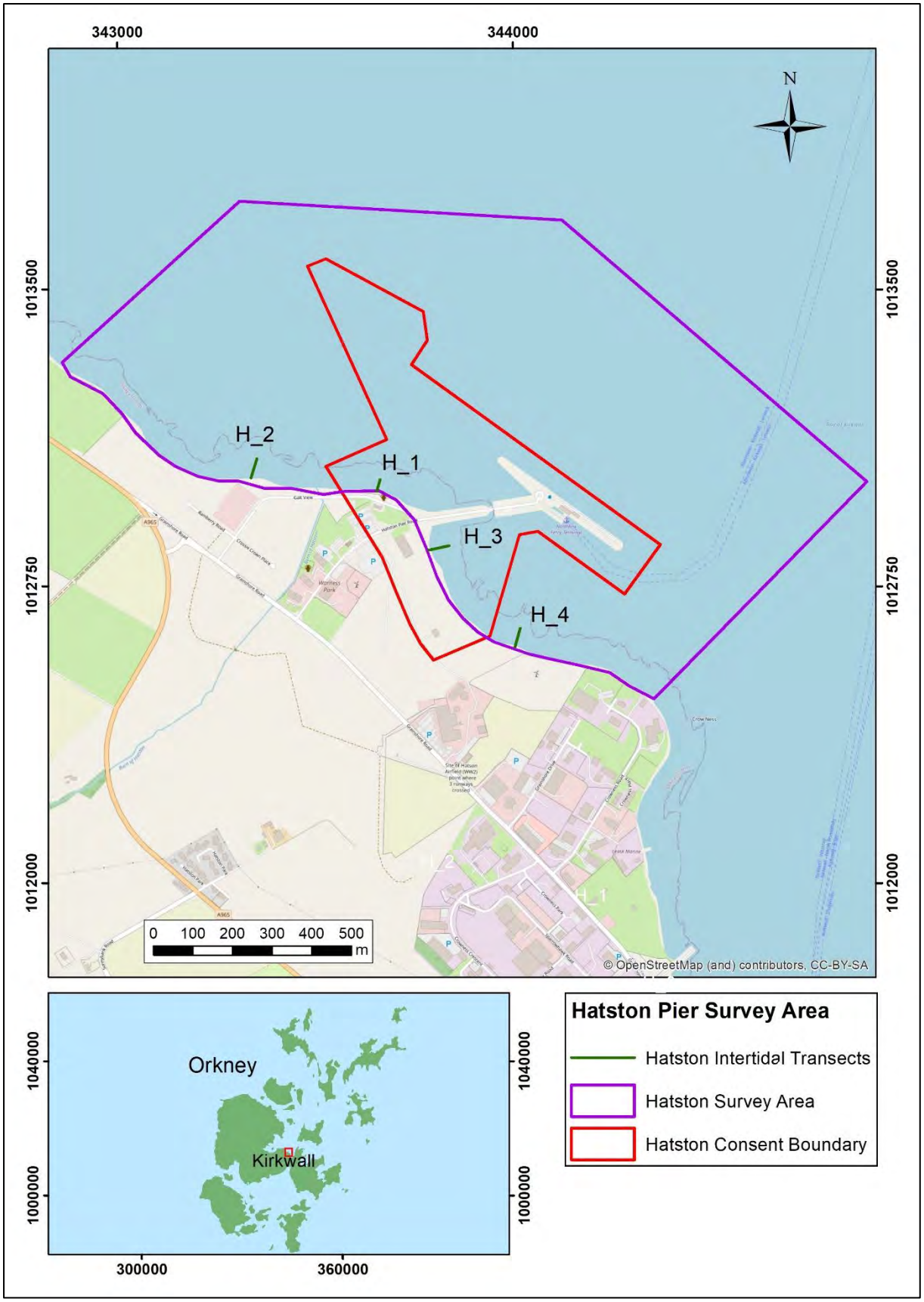

Figure 2.1: Locations of the four intertidal belt transects (centre lines only) surveyed during the 2022 Hatston Pier Phase I intertidal survey.

2.1.2 Survey dates and tide times

Due to the requirement to undertake the survey in early winter 2022, it was not possible to undertake the survey at low tide on a spring tide as these coincided with hours of darkness. Instead, the best available low tides were utilised, maximising the tidal range (i.e. the amount of beach exposed) whilst ensuring work could be undertaken in daylight hours. The intertidal survey work at the Hatston Pier site was completed on 2nd and 5th December 2022. Details of the tide times are provided in Table 2.2. The surveys were undertaken during the period two hours before and after low water.

Table 2.2: Tide times (UTC) and heights relative to Chart Datum during the Hatston Pier Phase I intertidal survey.

Survey Day	High Water 1		Low Water		High Water 2	
	Time	Height (m)	Time	Height (m)	Time	Height (m)
Friday 02/12/2022	05:56	2.57	11:39	1.51	17:39	2.78
Monday 05/12/2022	08:32	2.82	14:19	1.14	20:27	2.96

2.1.3 Access

Access to the foreshore at Hatston was arranged by EnviroCentre. The foreshore was approached on foot from the un-named access road running adjacent to the shore from the pier causeway.

2.1.4 Transect assessment

At each transect, all habitat types present within the 60 m wide 'belt' were recorded and assigned a biotope as per the latest iteration of the MNCR Marine Habitat Classification for Britain and Ireland (JNCC, 2022), incorporating information regarding species composition and abundance, shore height, exposure of the shore and substrate type. The vertical width (high-low shore) of each habitat was recorded and GPS positions were taken at the habitat boundaries along the central transect line using the GPSMAP portable chartplotter (which used both GPS and GLONASS sensors for improved positional accuracy). The distribution of biotopes 30 m either side of the central line were recorded using wireframe map annotations. In addition, the track function in the GPS was used to map each biotope boundary.

For each identified biotope, a detailed habitat description was recorded using modified MNCR field forms (see Appendix I), including information regarding shore position, substrate type and percentage cover, rock type, surface relief, texture and stability, modifiers such as scour, silt and macroalgal mats, and any anthropogenic influences present. In addition, for each identified habitat a list of the dominant/conspicuous biota present was produced with taxa enumerated using the semi-quantitative SACFOR[1] scale. Any additional relevant metadata, including time, state of tide, weather etc., were also recorded.

[1] **S**uper-abundant, **A**bundant, **C**ommon, **F**requent, **O**ccasional, **R**are.

Photographs documenting the zonation patterns present were taken at three locations (high, mid and low shore) along the central transect line. Where images could not be taken in the low shore due to tidal timings (see section 2.1.2), 'low shore' images were taken as far down the shore as possible. At each location, the GPS position was recorded and photographs were taken up-shore, down-shore, and along-shore in both directions.

2.1.5 Additional observations

When transiting on foot to, from and between transects, any non-indigenous species (NIS), freshwater outflows, litter or other anthropogenic influences were documented. In each instance, the position was recorded from the GPS and a photograph was taken. Where anthropogenic influences were clearly impacting the surrounding environment, details of this were recorded. Where NIS were encountered, abundance was recorded using the semi-quantitative SACFOR scale.

2.1.6 Analysis

All field notes, including field sketches, were digitised post-survey and photographic records were reviewed by a senior marine ecologist to confirm the assigned biotopes and taxon identifications. Species lists were created for each Phase I habitat ensuring that all taxa were recorded in accordance with the World Register of Marine Species (WoRMS Editorial Board, 2023) and assigned an MCS alphanumeric bio-code according to Howson and Picton (1997), where applicable, to avoid problems in species nomenclature. Biotopes were ascribed according to the Marine Habitat Classification for Britain and Ireland (JNCC, 2022) following the guidance provided in Parry (2019).

2.1.7 GIS

Data obtained during the Phase I survey, included all GPS trackplots and relevant point data, were imported into ArcGIS. Utilising these data together with the wireframe map field sketches created during the Phase I surveys, polygons were created within the GIS in order to map the location of the different biotopes identified within each of the four belt transects.

2.2 Subtidal survey

The subtidal survey work comprised a drop-down camera survey for the acquisition of high-definition video and high-resolution still images and a grab sampling survey to acquire samples for macrobenthic invertebrate assessment and particle size analysis (PSA). The survey work was undertaken from *MV Uskmoor*, a local survey vessel suited to the work and equipped with a winch, A-frame, and crane. For the Hatston Pier subtidal survey, the vessel was mobilised from Kirkwall harbour.

The Hatston Pier drop-down camera survey was undertaken on 10th December 2022, with grab sampling taking place on the 11th December 2022.

2.2.1 Drop-down camera survey

The underwater imagery survey work was conducted in accordance with operational guidelines issued by the NMBAQC scheme for drop-down camera systems (Hitchin *et al*., 2015).

Prior to the survey, a total of 15 target drop-down targets were selected for investigation, aiming to achieve good geographical spread at a range of depths. The plan was to run a 10-minute transect across each of the targets against the direction of the tide at the time of survey. However, in order to save time and reduce the number of deployments, multiple targets were surveyed on a single camera deployment resulting in camera deployments of approximately 20 – 30 minutes in duration.

The following equipment was used during the camera survey:

- Leica GX1230 RTK GPS
- Hypack survey management software
- SubC Rayfin camera system
- SubC Aquorea LED Flash
- Four CT4011 LED lights
- NETMC digital video recorder with video overlay

Survey navigation was achieved using a Leica GX1230 RTK GPS. The GPS antenna was mounted inboard and offsets between the antenna and vessel's A-frame measured and entered into Hypack prior to the survey.

The GPS was used in full RTK mode; within the GPS, satellite derived positions (WGS84 latitude and longitude) were updated in real-time with pseudo-range corrections from Leica Smartnet, via a GSM receiver. Used in full RTK mode, GPS positions were accurate to ± 0.03 m in three dimensions. During the survey, positional data were recorded using Hypack survey management software and converted to OSGB36 National Grid coordinates in real time using the OSTN15 model within Hypack. Navigation checks of the Leica GX1230 RTK GPS system were carried out against a known location at the start and end of the survey day.

Positioning of the camera frame was achieved by calculating a layback within the survey management software, and was based on the vessel's known position, vessel heading, vessel speed, water depth, height of the A-frame, and the amount of winch wire out.

A SubC Rayfin camera system was used which included a full colour HD video camera and a high-resolution stills camera with manual focus. The camera was mounted at an oblique angle on the camera frame (facing the direction of travel), with the external flash gun and LED video lights mounted on the frame so as to minimise backscatter, deliver bright and even illumination, and maximise image quality. The camera, flash, video lights, and lasers were connected to the surface using a 200 m multifunction soft umbilical, which allowed the LED lights, flash, and camera settings to be adjusted from the topside unit.

The HD video feed was viewed in real time and recorded to a hard drive using the digital video recorder with video overlay. The video overlay included date, time, sample number and height of camera above seabed. The still photographs were recorded sub-sea and uploaded at the

end of each survey day. Before each deployment a new folder was created with a unique sample number and the video and stills data were saved to this folder using unique filenames.

The clocks associated with all equipment were synchronised with the GPS time at the start of each survey day, and all survey log entries were made with a record of the GPS time. The times (to the second) of the start and end of each deployment were recorded as were the times that each photograph was taken in order to enable the position of each video transect and photograph to be extracted from the navigation data following the survey.

Prior to camera deployment the skipper steered the vessel into the prevailing conditions (current and wind) and set up on a bearing toward the selected target. The camera was lowered to the seabed whilst the vessel moved toward the initial selected target. When the camera frame reached approximately 1 m above the seabed (as observed using the topside unit) the camera operator started logging navigation data and then started recording the HD video.

During each deployment the height of the camera system above the seabed was controlled by a winch operator on deck, who was in constant communication with the camera operator. The camera was flown just above the seabed to reduce impact on the environment and then landed to take still images at regular intervals (approximately every one minute). Vessel speeds over the ground were maintained at approximately 0.5 knots throughout each deployment.

At the end of each survey day, all survey navigation data, still photographs, and HD video recordings were backed-up onto an external hard drive, which was removed from the vessel.

2.2.2 Benthic grab sampling

Grab sampling locations were selected following completion of the drop-down camera survey and were based on an initial review of the video footage. A total of eight sampling locations were selected, spread geographically throughout the survey area and at a range of depths with the aim of sampling areas of different types of soft sediment.

At each sampling location the vessel set up on the proposed position and a 0.1 m^2 Day grab sampler was deployed over the side of the vessel. A ‘fix’ of GPS position and time was recorded in Hypack and manually logged in the logbook when the grab was determined to be on the seabed. The grab was recovered to deck and the sample inspected for quality.

Samples were to be rejected on the grounds of poor quality for the following reasons:

- Uneven surface indicative of striking the seabed at an angle;
- Washed out sample;
- Disturbed surface sediment;
- Contamination of the sediment (e.g. hagfish, paint chips, oil etc.);
- Sample touching the top of the grab;
- Sample <40 % of the grab’s capacity.

If the sample was not acceptable the vessel was repositioned on the sample location and the grab was redeployed. If after three attempts at a location a successful grab was not collected

a new location was chosen close to the original station. If the sample was acceptable a brief description of the sediment was recorded (including appearance, texture, odour, etc.) and a labelled photograph taken.

A sub-sample for PSA was collected from each acceptable grab sample following the NMBAQC's Best Practice Guidance for PSA to support biological analysis (Mason, 2016). The PSA sub-sample was collected using a metal scoop to remove a 5 cm deep core from the grab sample, ensuring that at least 100 ml of sediment was collected. Any conspicuous biota was noted in the logbook and removed from the sub-sample before storing the sediment in labelled plastic bags.

Following sub-sampling for PSA the rest of the grab sample was processed for macrobenthic invertebrate analysis. The sediment in the grab was transferred to a dump tray and washed gently over a 0.5 mm field sieve. The sediment retained in the sieve was photographed before being transferred to a labelled plastic bucket and fixed using a 4 % buffered formaldehyde-seawater solution for subsequent laboratory analysis.

2.2.3 Laboratory methods

2.2.3.1 Particle size analysis

Particle size analysis (PSA) was carried out using wet and dry sieving at one phi intervals. Samples were visually assessed and all marine biota (>1 mm) that was alive at the time of sampling were removed. A brief sediment description was noted in the PSA log, together with details of any biota removed, and any other pertinent sediment characteristics (e.g. presence worm tubes, shell fragments).

The results were analysed to determine the proportions of gravel, sand, and mud within the samples and sediment names were assigned as per the modified Folk classification (1954).

2.2.3.2 Macrobenthic invertebrate analysis

In the laboratory, the macrobenthic invertebrate samples were washed through a 0.5 mm sieve in order to remove the fixative and any mud remaining in the sample. The sample retained on the sieve was then transferred to petri dishes and was sorted by experienced personnel using low magnification microscopes. The picked taxa were split by phyla and stored in glass vials in 80 % industrial methylated spirit (IMS) ready for identification.

Taxa were identified to the lowest practical taxonomic level with reference to WoRMS (WoRMS Editorial Board, 2023) for species nomenclature. Epifauna were identified and recorded when clearly attached to substrate.

Identified taxa were separated by major taxonomic group and preserved in 80 % IMS before being analysed for biomass by major taxonomic group. Taxa were removed from their sample vials and blotted dry to remove excess IMS before being weighed using a calibrated balance accurate to 5 decimal places. A reference collection, consisting of examples of each identified taxon, was also created.

2.2.4 Data analyses

2.2.4.1 Video analysis

The video analysis was conducted using software that enabled slow-motion, freeze frame and standard play analysis. During the first review, video footage was viewed at 2x - 4x normal speed in order to divide the footage into segments of different habitat types; any segments of video showing camera deployment and recovery was discounted from further review. Brief changes in habitat type, considered to be less than 5 m distance, were treated as incidental patches and not recorded as separate segments, however the presence of these habitats was recorded as part of the habitat description. The distance travelled by the camera was estimated based on the navigation data.

The start and end time and position of each segment was recorded, and each segment was then analysed in more detail. For each segment, all observations were recorded in a pro forma spreadsheet. Each video segment was assessed for quality, according to NMBAQC scheme guidelines (Turner *et al*., 2016). A description of the observed habitat and a broadscale habitat (BSH) type was assigned to each video segment, and the presence of any visible impacts or modifiers (e.g., trawl marks, litter, evidence of strong currents etc.) was also recorded.

A list of the encountered taxa was produced for each video segment, using species reference numbers as cited in the Marine Conservation Society Species Directory (Howson and Picton, 1997) with additional reference to the World Register of Marine Species (WoRMS Editorial Board, 2023) to avoid problems in species nomenclature. Taxa were identified to the lowest (i.e. most detailed) practical taxonomic level. Identification of taxa was only attempted where biota was considered to be large and conspicuous enough to be confidently and reliably identified. Where lifeforms could not be identified to a specific taxonomic group a brief description was used (e.g. mixed faunal turf). Sponge morphologies were divided into appropriate pre-defined categories after Berman *et al*. (2013). Where sponge species showed plasticity, separate records were made for each morphology type.

Assignment of biotopes

Following analysis of the video segments, the information recorded was reviewed and used to determine the most appropriate MNCR biotope according to JNCC (2022), following guidance outlined in Turner *et al*. (2016) and Parry (2019). Wherever possible biotopes were assigned at the biotope (level 5) or sub-biotope (level 6) level. However, where biological information was lacking (e.g., barren soft sediments with very little epifauna), biotopes were recorded at the biotope complex level (level 4). Where the seabed comprised a mosaic of more than one substrate type (e.g., <5 m alternating bands of exposed bedrock and coarse sediment) it was considered appropriate to assign more than one biotope to the same video segment. In these cases, the most dominant biotope was assigned as the ‘primary’ biotope and the other assigned as secondary.

Assignment of priority marine features

Following identification of biota and assignment of biotope(s) to each video segment, priority marine features (PMFs), as per Tyler-Walters *et al*. (2016), were assigned. If PMF components were found to be present within a video segment (i.e. if a relevant biotope had been assigned, or if a component species had been identified) the PMF was assigned. If two

component biotopes had been assigned to one video segment (see above), two PMFs were assigned.

Where seapens and/or burrowed mud was present, both the biotope **SS.SMu.CFiMu.SpnMeg** and the associated PMF 'seapens and burrowing megafauna in circalittoral fine mud' were assigned based on the OSPAR definition of the habitat (OSPAR, 2010) and the subsequent JNCC interpretation of this definition (Robson, 2014). The interpretation states that whilst seapens do not need to be present (which is particularly relevant in areas of seabed where seapens may have previously existed but have been removed by anthropogenic activity), the habitat does need to include multiple burrows or mounds from associated megafauna. Furthermore, while the habitat occurs predominately in fine mud sediments, examples of this habitat have also been identified in areas of sandy muds. Therefore, the primary defining characteristic used to assign the PMF 'seapens and burrowing megafauna in circalittoral fine mud' was burrow density (irrespective of the presence or absence of seapens), with burrows needing to be at least frequent on the SACFOR scale.

Where maerl was present, the NatureScot evolving definition was used as a guide to assignment of the PMF 'maerl beds.' A substrate consisting of a minimum of 20 % maerl that was clearly identifiable as either twiglets, medallions, or hedgehog stones (>1 cm in size) qualified as a maerl bed, irrespective of whether the rhodoliths were alive or dead. An exception to this is where the substrate underlying the fully formed maerl rhodoliths was comminuted maerl gravel; in this case a 5 % cover of maerl (dead or alive, fully formed rhodoliths > 1 cm) was sufficient to qualify a habitat as maerl bed. It should be noted, however, that areas conforming to this exception are considered to reflect degradation of previously healthy maerl bed habitat, as it can be assumed that fully formed maerl rhodoliths were once much more prolific to have created the maerl gravel substrate.

Assignment of Annex I habitats

The presence of any Annex I habitats and associated sub-features, including reef sub-features, was also recorded for each video segment. Reef features were determined using criteria outlined in Irving (2009), with a minimum of 10 % hard substrate (i.e. bedrock, boulders or cobbles) required for assignment of Annex I habitat. Due to difficulties inherent in estimating elevation from video footage, assessment of 'reefiness' (Table 2.3) was primarily based on seabed composition, i.e. percentage coverage of hard substrate.

Table 2.3: The main characterising features of a stony reef, after Irving (2009).

Characteristic	Not a reef	Resemblance to being a stony reef		
		Low	Medium	High
Composition	< 10 %	10 - 40 %	40 - 95 %	> 95 %
Elevation	Flat seabed	< 64 mm	64 mm - 5 m	> 5 m
Extent	< 25 m^2	> 25 m^2		
Biota	Dominated by infaunal species			> 80 % of species epifauna

2.2.4.2 Still image analysis

The still image analysis was undertaken following analysis of the video. Each still image was assessed for quality, according to NMBAQC scheme guidelines (Turner *et al*., 2016), and a brief description of the habitat and characterising biota present in each image recorded. All observations were recorded in a pro forma spreadsheet. A BSH was recorded based on the substrate type present.

Epibiota were identified, with taxa recorded to the best practical taxonomic level. A list of the encountered taxa was produced for each image, using species reference numbers as cited in the Marine Conservation Society Species Directory (Howson and Picton, 1997) with additional reference to the World Register of Marine Species (WoRMS Editorial Board, 2023) to avoid problems in species nomenclature. For each image, all biota was identified and enumerated. Taxon abundance data was recorded using the semi-quantitative SACFOR scale, with counts or percentage cover recorded where appropriate. The most appropriate MNCR biotope (JNCC, 2022) was assigned to each still image with reference to the parent video segment, following guidance outlined in Turner *et al*. (2016) and Parry (2019).

2.2.4.3 GIS

Data obtained during the drop-down camera and grab survey were imported into ArcGIS. These included all GPS video trackplots and relevant target (‘fix’) locations. These data were presented as annotated maps identifying the locations of the biotopes and benthic community types identified during the study.

3 RESULTS

3.1 Intertidal survey

Representative images documenting the zonation at each of the transects are provided in Appendix II and the logs detailing the results of the Phase I survey are provided in Appendix III. Full species lists for each habitat zone at each transect are provided in Appendix IV, and a glossary of the biotopes assigned is provided in Appendix V. Note that in the descriptive text below, the abundance (according to SACFOR), is provided in parentheses following the taxon name and refers to the abundance within the respective habitat zone.

3.1.1 Hatston Transect 1 (H_1; Plates 1a – 1d)

Transect 1 was located approximately 130 m WNW of the Hatston Pier causeway (see Figure 2.1 and Table 2.1). The central line of the 60 m wide belt transect extended 27 m from the upper shore cliff to the low water mark on the day of the survey (low water was 1.51 m above CD).

The cliff was north facing and represented the upper littoral and supralittoral (splash) zone. The cliff was approximately 3 m high and comprised heavily fissured sandstone bedrock. The upper section of the cliff was characterised by terrestrial grasses (unidentified) associated with the residual topsoil layer. Grasses occurred sporadically throughout the mid and lower sections of the cliff along with other macrophytes including common scurvygrass (*Cochlearia officinalis*) and moss saxifrage (*Saxifraga bryoides*). A variety of lichen species occurred occasionally on the cliff, including the foliose sea ivory (*Ramalina siliquosa*) and the encrusting lichens *Ochrolechia parella*, *Verrucaria maura* and *Caloplaca* sp.. These, however, were not present in sufficient abundance to justify the allocation of the biotope complex **LR.FLR.Lic** ('Lichens or small green algae on supralittoral and littoral fringe rock') or any related biotope.

The distribution of the habitat zones identified during the survey are shown in Figure 3.1. Below the cliff, the shore comprised four distinct habitat zones.

H_1 Zone 1. This zone comprised the majority of the upper half of Transect 1 and was characterised by boulders, cobbles and pebbles overlying bedrock. Within Zone 1, at the base of the cliff, an accumulation of algal detritus, primarily fucoid species, was present. Where the bedrock was exposed or large stable boulders were present, green biofilm layer was present on the rock surface which was not present on smaller, unstable cobble and pebbles. Attached to the occasional cobbles were sparse macroalgae, primarily fucoids, including spiral wrack (*Fucus spiralis;* rare), bladder wrack (*Fucus vesiculosus*; rare) and egg wrack (*Ascophyllum nodosum*; rare) with associated epiphytic *Vertebrata lanosa* (rare). It is probable that these seaweeds, together with their cobble substrate, had been transported into the upper shore from the lower shore algal zone (Zone 4; see below) during periods of rough weather. Fauna was sparse within Zone 1 with only the barnacle *Semibalanus balanoides* (rare), the common limpet (*Patella vulgata*; rare) and spirorbinae tube worms being observed. Given the predominance of uncolonised cobbles and pebbles overlying bedrock within Zone 1, the zone was assigned as a mosaic habitat with the broad habitat **LR** ('Littoral rock') with and the biotope **LS.LCS.Sh.BarSh** ('Barren littoral shingle') both recorded.

H_1 Zone 2. Zone 2 consisted of an outcrop of exposed bedrock which extended from the cliff for approximately 10 m at the eastern edge of the transect and a bedrock area of

approximately 10 m x 4 m located on the transect mid-line from 7 m from the cliff base (see Figure 3.1). The rock was characterised by sparse patches of channelled wrack (*Pelvetia canaliculata*; frequent) and patches of the lichens *V. maura* (occasional), *O. parella* (rare) and *Caloplaca* sp. (rare). A biofilm was present on the exposed rock surface. The fauna was not diverse, however both *P. vulgata* (common) and *Littorina saxatilis* (frequent) were recorded. No barnacles were observed.

Given the occurrence of *P. canaliculata*, the biotope **LR.LLR.F.Pel** ('*Pelvetia canaliculata* on sheltered littoral fringe rock') was assigned to this zone, however the unvegetated areas of rock within this zone were dominated by *V. maura*; the biotope **LR.FLR.Lic.Ver.B** ('*Verrucaria maura* and sparse barnacles on exposed littoral fringe rock') may also therefore be considered an appropriate biotope assignment.

H_1 Zone 3. At the mid-tide level of the shore, between 11 m and 15 m from the cliff base, an area of cobbles and pebbles was present. This area was characterised by a relatively diverse invertebrate fauna including the periwinkles *Littorina obtusata* (common), *L. saxatilis* (common) and *Melarhaphe neritoides* (frequent), the anemone *Actinia equina* (frequent), *P. vulgata* (rare) and epilithic worms (Spirorbinae; rare). In addition, numerous gammarid shrimps (Gammaridae; frequent) were observed underneath the cobbles. Seaweeds were sparse in Zone 3, being limited to red encrusting calcareous alga (Corallinaceae; rare) and juvenile fucoids (Fucales; rare).

Given the general lack of abundant taxa, the habitat complex **LS.LCS** ('Littoral coarse sediment') was assigned to this zone.

H_1 Zone 4. From 15 m from the cliff base to the low water mark on the day of survey the shore comprised cobbles and pebbles with a range of taxa recorded. The most abundant seaweed present was *F. vesiculosus* (abundant), with several other seaweeds, including *A. nodosum* (common), *F. spiralis* (occasional), *Lomentaria articulata* (occasional), *Fucus serratus* (rare), *Chondus crispus* (rare) and *Laminaria digitata* (rare) also recorded. Encrusting red algae (Corallinaceae, common), was present on the more stable cobbles. The fauna was dominated by periwinkles and limpets, with *P. vulgata*, *Littorina littorea*, *L. saxatilis*, *L. obtusata*, and *M. neritoides* all recorded as abundant. The barnacle *S. balanoides* (common) was found to occur on the rock surfaces and the shore crab *Carcinus maenas* (common) was found beneath and between the cobbles. Other taxa present included *A. equina* (occasional) and the dog whelk (*Nucella lapillus*, occasional). Due to the substrate type present and the dominance of *F. vesiculosus*, the habitat was assigned the biotope **LR.LLR.F.Fves.X** ('*Fucus vesiculosus* on mid eulittoral mixed substrata').

Figure 3.1: Distribution of MNCR biotopes (JNCC, 2022) at Transect 1 (H_1), surveyed as part of the 2022 Hatston Pier Phase I intertidal survey.

3.1.2 Hatston Transect 2 (H_2; Plates 2a – 2d)

Transect 2 was located ~450 m WNW of the pier causeway. The foreshore was bounded on the landward side by a grassy bank, approximately 1 m high. The shore was divided into four distinct habitats. The distribution of these habitats is illustrated in Figure 3.2.

H_2 Zone 1. In the upper shore, the substrate consisted of a band of barren cobbles and pebbles, although occasional amphipods were observed under the cobbles. This zone extended to 8 m from the bank and was assigned the biotope **LS.LCS.Sh.BarSh**. Immediately adjacent to the grassy bank was a strandline accumulation of algal debris (**LS.LSa.St**; 'Strandline') primarily comprising detached kelp and fucoid fronds. There was not a detectable sandhopper community present amongst the algae and, therefore, the biotope **LS.LSa.St.Tal** ('Talitrids on the upper shore and strandline') did not apply.

H_2 Zone 2. Below the barren shingle was a 3 m band of sand with occasional cobbles overlying. No fauna was recorded in this zone. The algal taxa present were restricted to *Cladophora* sp. (occasional), *F. spiralis* (rare) and *A. nodosum* (rare), with the epiphytic alga *V. lanosa* (rare) also recorded. Due to the lack of biota, the habitat complex **LS.LCS** was assigned to this zone.

H_2 Zone 3. In the mid shore (Zone 3), the substrate comprised bedrock with overlying sand and cobbles, which extended for 15 m down the central transect line. The seaweed community was dominated by *F. vesiculosus* (abundant) and *A. nodosum* (abundant). Other species present included *Cladophora* sp. (occasional), *Ulva lactuca* (rare), *Ulva intestinalis* (rare), *F. spiralis* (rare) and corallinaceae (rare). Faunal taxa recorded included the periwinkle *L. obtusata* (common) and the shore crab *C. maenas* (occasional), and gammarid amphipods (occasional) were recorded under and amongst the cobbles. The biotope **LR.LLR.F.Fves.X** was assigned to this zone.

H_2 Zone 4. Zone 4 extended from the mid shore to the low water mark (a distance of 33 m on the day of the survey). The substrate comprised bedrock with dense coverage by brown seaweeds dominated by *A. nodosum* (super-abundant). Amongst the *A. nodosum* were clumps of *F. vesiculosus* (occasional) and a variety of red seaweeds, including *C. crispus*, *L. articulata* and *Osmundea pinnatifida*, all present in very low (rare) abundance. The fauna was dominated by *P. vulgata* (abundant) and *L. obtusata* (frequent). Lower quantities of *L. littorea* (occasional) and *Patella aspera* (occasional) were also present along with very low densities of other invertebrates including *N. lapillus* (rare), the sponge *Hymeniacidon perlevis* (rare) and Spirorbinae sp. (rare), which occurred on the fronds of *F. serratus* (rare).

The biotope assigned to Zone 4 was **LR.LLR.F.Asc.FS** ('*Ascophyllum nodosum* on full salinity mid eulittoral rock'). It was apparent at the time of the survey that this biotope extended further beyond the low water mark by approximately 20 m. Given that it was not possible to undertake the survey on a spring tide (see Section 2.1) it is likely that this area represented an extension of Zone 4 rather than being an infralittoral biotope (e.g. IR.MIR, 'Moderate energy infralittoral rock,' or similar).

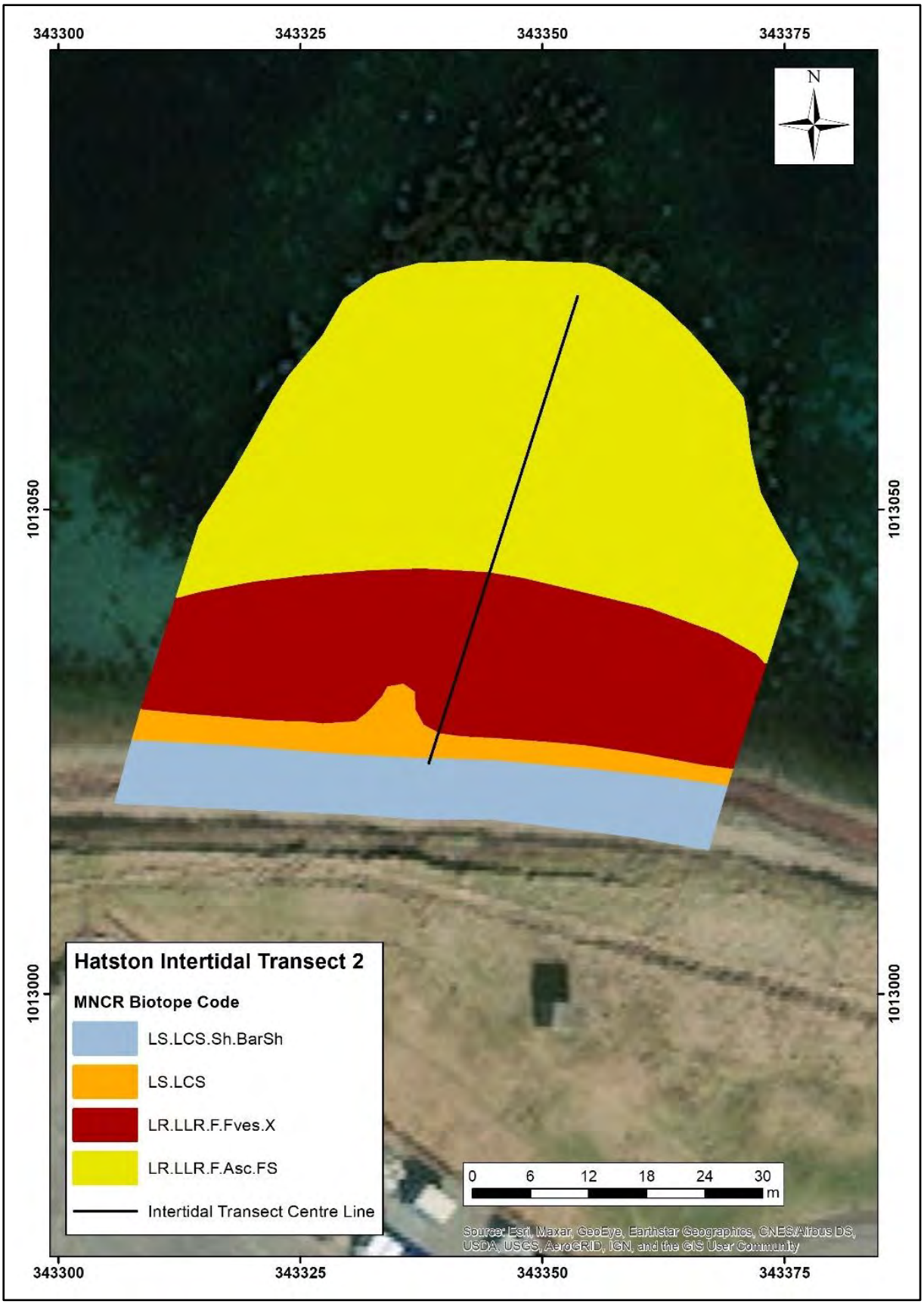

Figure 3.2: Distribution of MNCR biotopes (JNCC, 2022) at Transect 2 (H_2), surveyed as part of the 2022 Hatston Pier Phase I intertidal survey.

3.1.3 Hatston Transect 3 (H_3; Plates 3a – 3d)

Transect 3 was located approximately 65 m to the south of the Hatston Pier causeway (see Figure 2.1). The upper shore was bounded to the west by a grassy bank, approximately 2 m in height. The foreshore at this site was divided into two distinct biotope zones. The distribution of biotopes at this transect is shown in Figure 3.3.

H_3 Zone 1. The substrate in the upper shore comprised cobbles and pebbles with shell debris. This habitat extended approximately 13 m from the grassy bank. The majority of the substrate in this zone was overlaid with a thick layer (c. 20 cm) of algal detritus, comprising primarily detached kelp and fucoids. A few specimens of algae were noted attached to pebbles and cobbles amongst the debris, including *A. nodosum*, *F. vesiculosus*, *Cladophora* sp. and indeterminate red seaweeds. However, it was assumed that these had been transported to the upper shore from elsewhere and, consequently, were noted as 'present' (P) rather than being ascribed a SACFOR abundance category.

The faunal community was also very depauperate within Zone 1. Individual specimens of gammarid shrimps, *C. maenas* and *L. littorea* were observed although, again, it appeared that these had been imported to the upper shore along with the phyto-detritus.

Given the coverage of detached seaweed debris, this zone was assigned at the biotope complex level; **LS.LSa.St**. The lack of an associated invertebrate community suggests that the detritus was either recently deposited and/or transient; stable strandline biotopes are expected to develop a characteristic talitrid-dominated fauna, which was not the case at this location.

H_3 Zone 2. Below Zone 1, extending 45 m to the low water mark, was an area of cobbles and boulders interspersed with occasional patches of sand and muddy sand. The seaweed community was dominated by *A. nodosum* (super-abundant) and *F. vesiculosus* (frequent), and was therefore assigned the biotope **LR.LLR.F.Asc.X** ('*Ascophyllum nodosum* on full salinity mid eulittoral mixed substrata'). A range of other green, brown, and red algae were also recorded but at much lower abundances (occasional or rare), with a total of 15 seaweed taxa observed. The most abundant invertebrate species were *P. vulgata* (common), *L. littorea* (frequent) and *L. obtusata* (frequent). Other faunal species recorded included *H. perlevis* (rare), spirorbinae worms (rare, primarily on *F. vesiculosus* fronds), *S. balanoides* (rare), *C. maenas* (rare) and *N. lapillus* (rare).

Within the Zone 2 habitat, a small area of elevated exposed bedrock was present. The biotope here deviated slightly from the remaining Zone 2 habitat in that it supported a high abundance of the barnacle *S. balanoides* on the vertical surfaces while the upper section of the rock was characterised by *F. spiralis*, resembling the biotope **LR.LLR.F.Fspi.FS** ('*Fucus spiralis* on full salinity sheltered upper eulittoral rock'). However, due to the small size of this habitat a separate habitat zone/biotope was not assigned.

Below the low water mark on the day of the survey, an area characterised by *F. serratus* and the kelp *L. digitata* was visible extending approximately 10 m offshore. Due to the survey being undertaken on foot, closer inspection of the habitat could not be conducted. However, if subtidal, the area could likely be described by the biotope **IR.MIR.KR.Ldig** ('*Laminaria digitata* on moderately exposed sublittoral fringe rock').

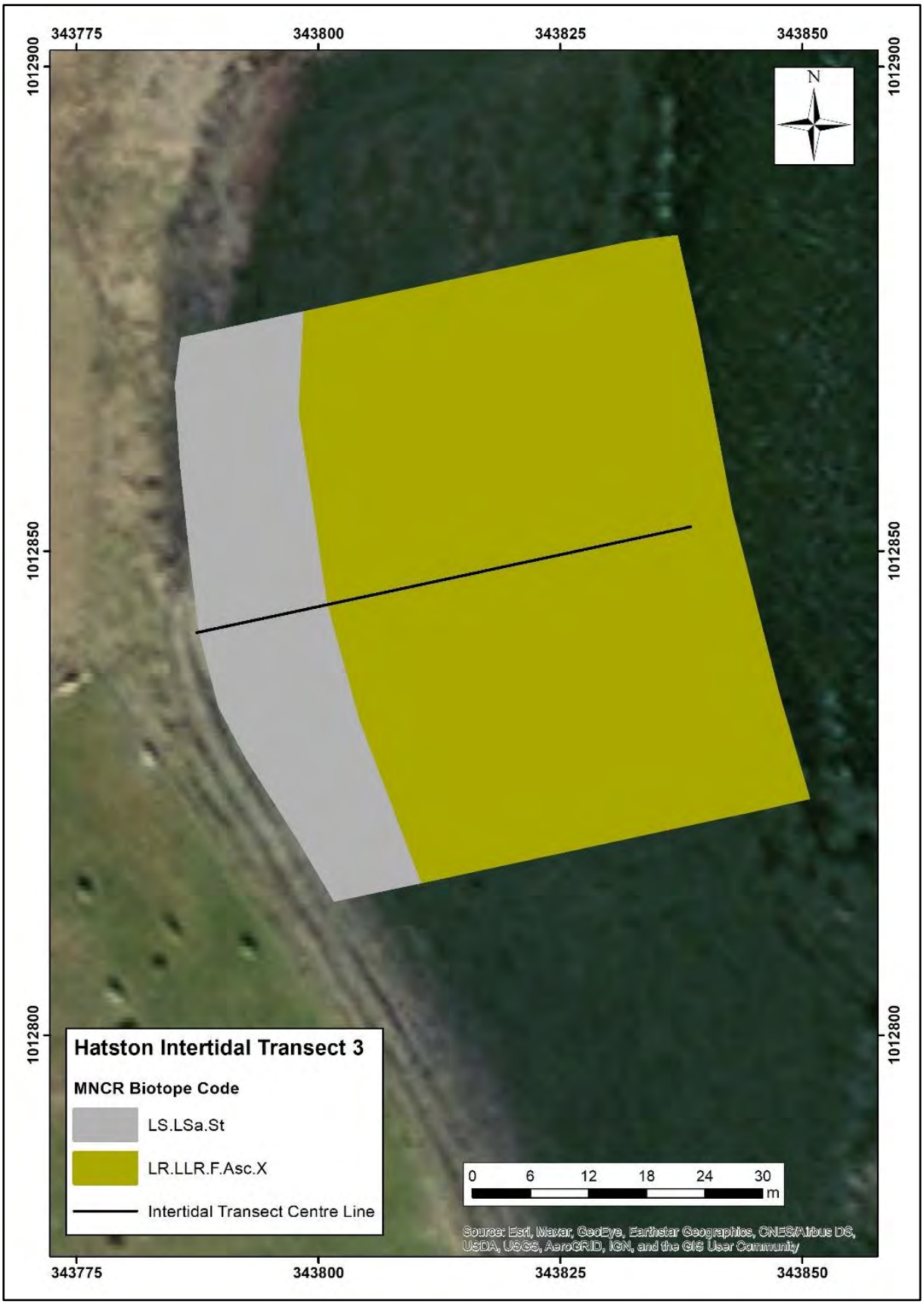

Figure 3.3: Distribution of MNCR biotopes (JNCC, 2022) at Transect 3 (H_3), surveyed as part of the 2022 Hatston Pier Phase I intertidal survey.

3.1.4 Hatston Transect 4 (H_4; Plates 4a – 4d)

Transect 4 was the most southerly of the Hatston transects and was located approximately 340 m southeast of the pier causeway. The section of shore encompassing Transect 4 consisted of a triangular outcrop of foreshore with a narrower intertidal zone on either side. A grassy bank with exposed soil and clay at the lower level formed the landward boundary of the shore. The intertidal habitat within the transect boundary was divided into five distinct zones, which are shown in Figure 3.4.

H_4 Zone 1. In the upper shore, adjacent to the grassy bank, the substate comprised cobbles and pebbles. At the transect centre line, this formed a narrow (~1 m) band parallel with the bank but widened to approximately 6 m width at the western and eastern boundaries of the transect. Sparse clumps of detached algal detritus (primarily fucoid fronds) were present but not sufficient to form a deep coverage as seen at Transect 3 or a contiguous strandline. On the larger, more stable cobbles the lichen *V. maura* (occasional) was present. The only other taxon recorded in this zone was talitridae (occasional), which were observed under cobbles. Given the paucity of biota, the biotope assigned to this zone was **LS.LCS.Sh.BarSh**.

H_4 Zone 2. Below Zone 1 was a zone of sand with occasional cobbles and boulders, extending down to approximately 8 m from the grassy bank. The sand itself was devoid of visible biota and conformed to the biotope **LS.LSa.MoSa.BarSa** ('Barren coarse littoral sand'). The occasional large cobbles and boulders within this zone were colonised with *F. spiralis* (rare) and *P. canaliculata* (rare), however these were not present in sufficient abundance to constitute separate biotopes or a biotope mosaic.

H_4 Zone 3. Zone 3 was a discrete patch approximately 4 m x 30 m in size, oriented parallel to the shoreline, but did not form a continuous band along the foreshore. The substrate consisted of cobbles and boulders characterised by dense *F. spiralis* (super-abundant); the biotope **LR.LLR.F.Fspi.X** ('*Fucus spiralis* on full salinity upper eulittoral mixed substrata') was therefore assigned. Other seaweeds present included *P. canaliculata* (occasional) and *Cladophora* sp. (rare), and fauna recorded included *P. vulgata* (common), *L. obtusata* (frequent) and *L. saxatilis* (frequent), *L. littorea* (occasional) and *S. balanoides* (rare).

H_4 Zone 4. Zone 4 appeared to be an area of community transition between Zone 3 and Zone 5. The substrate within Zone 4 was very similar to that of Zone 3, however the biota were characterised by a mosaic of *A. nodosum* and *F. spiralis* (both abundant). For the purposes of this report, the biotope in Zone 4 has therefore been ascribed as a mosaic of **LR.LLR.F.Fspi.X** and **LR.LLR.F.Asc.X**.

H_4 Zone 5. Zone 5 comprised the lower section of the exposed foreshore extending from approximately 19 m below the grassy bank to the low water mark. The substrate comprised cobbles and boulders and was dominated by *A. nodosum* (super-abundant), with *F. spiralis* now absent; the biotope **LR.LLR.F.Asc.X** was therefore assigned to this zone. Other seaweeds, including *F. vesiculosus*, *F. serratus*, *Cladostephus spongiosus*, *O. pinnatifida* and *C. crispus* (all rare), were recorded in low abundances. Fauna recorded in this zone included *P. vulgata* (common) and *L. littorea* (frequent).

Below the low water mark on the day of the survey, an area of rocks and boulders supporting a canopy of *F. serratus* and *A. nodosum* was visible, however further information would be required to ascribe a biotope to this area.

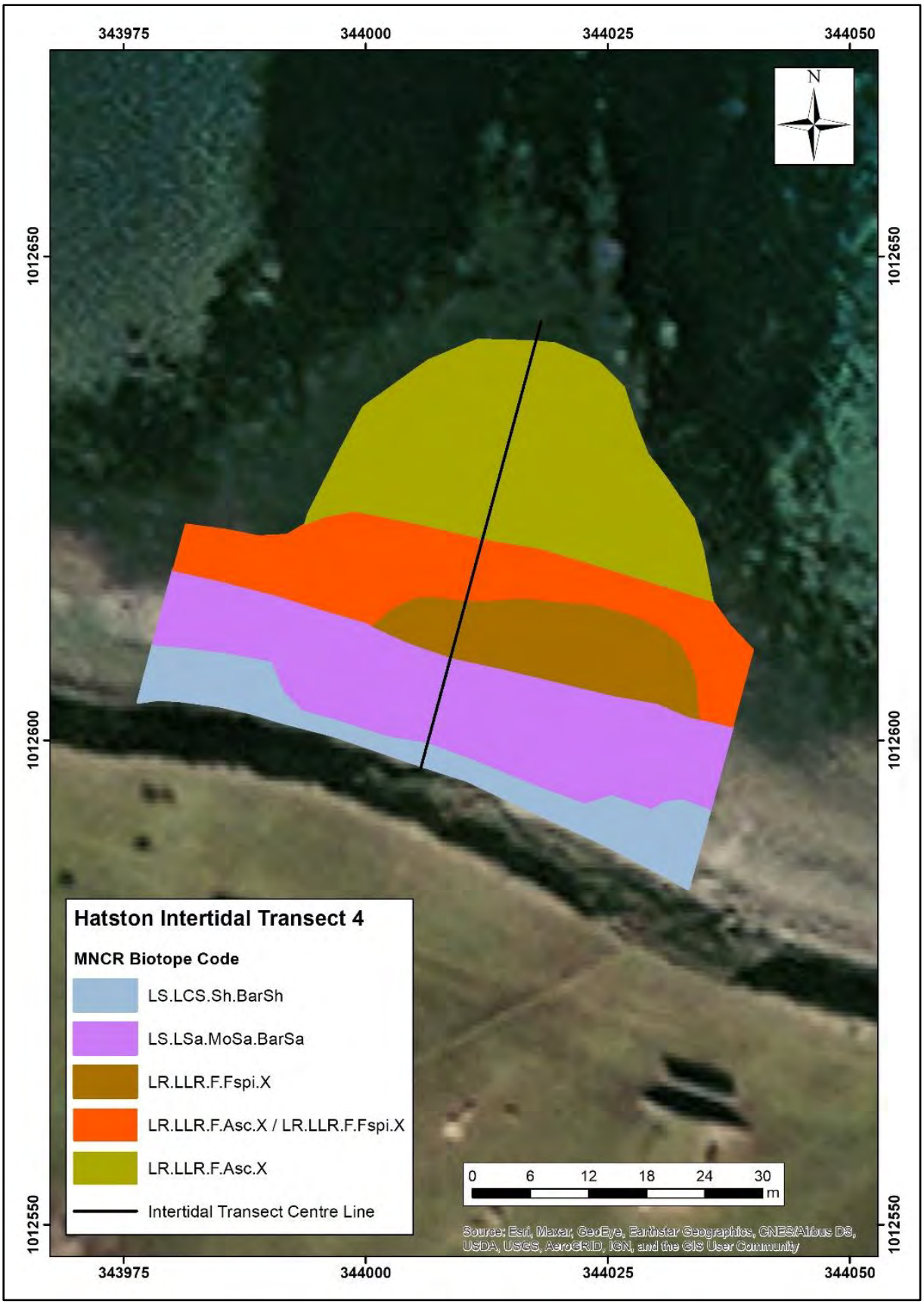

Figure 3.4: Distribution of MNCR biotopes (JNCC, 2022) at Transect 4 (H_4), surveyed as part of the 2022 Hatston Pier Phase I intertidal survey.

3.1.5 Additional observations

The intertidal habitats and biological communities recorded at the four transects were largely representative of the foreshore within the general Hatston Pier survey area. The only site at which there was a notable local variation to the patterns described in the transects was to the southeast of the pier causeway, between Transects 3 and 4, at position 58° 59.8521 N, 002° 58.7125 W (WGS84 latitude and longitude, DD MM.MMMM). At this location, the bank between the adjacent fields and the foreshore was reduced in height and a small freshwater stream emerged onto the upper shore. This presumably comprised primarily surface run-off but may have had a groundwater component. On the foreshore, the stream was constrained at the upper and mid-tide level by a low, man-made training wall constructed from cobbles and boulders. The freshwater input did not appear to have a widespread effect on the intertidal communities. The only visible effect was an increase in the abundance and density of green epilithic algae, comprising *Ulva* spp. and filamentous algae, in the immediate vicinity of the stream path at the mid and upper foreshore. This conformed to the littoral rock feature **LR.FLR.Eph.Ulv** ('*Ulva* spp. on freshwater-influenced and/or unstable upper eulittoral rock').

3.2 Underwater imagery analysis

The 15 target sites selected for investigation were surveyed using a total of 8 camera deployments. A total of 180 still images were taken, with 179 of these deemed suitable for analysis. A summary of the logs for each camera deployment are provided in Appendix VI.

The survey area was found to be characterised primarily by soft sediment habitats, although areas of hard substrate, consisting variously of bedrock, boulders and cobbles, were also recorded. A total of 13 different biotopes and biotope complexes were identified. A summary of the habitats observed is given in Appendix VII and the distribution of biotopes assigned to the video records is shown in Figure 3.5 (see Appendix V for the biotope glossary).

The most common soft sediments observed were muds and sandy muds, although some areas of muddy sand (**SS.SSa.IMuSa**, 'Infralittoral muddy sand') were also recorded in the southeast of the survey area, between the existing ferry terminal and the shore. The muddy soft sediment habitats were primarily located in the north and west of the survey area. While small mounds, worm casts and other lebensspuren were frequently observed, visible biota was generally sparse. The most common fauna present included sabellid worms including *Chone infundibuliformis* and *Acromegalomma vesiculosum* (both *incerta*), the king scallop *Pecten maximus* and the seapen *Virgularia mirabilis*. In some cases, both simple and complex burrows were evident; where these were frequent or greater the biotope **SS.SMu.CFiMu.SpnMeg** ('Seapens and burrowing megafauna in circalittoral fine mud') was assigned (regardless of whether seapens were present). This biotope, and the associated PMF 'seapens and burrowing megafauna in circalittoral fine mud' was assigned to a total of three video segments across two videos (HC3 and HC8), although analysis of the still images suggested that small patches of this biotope may have also been present on three further transects (HC4, HC6 and HC7). Where burrows were either less than frequent or entirely absent and biota was sparse, the biotope complex **SS.SMu.ISaMu** ('Infralittoral sandy mud') was assigned.

Where a higher fraction of coarse sediment was present, patches of the kelp *Saccharina latissima* were frequently observed on sediment together with sparse foliose and filamentous

red seaweeds. These areas were assigned the biotope **SS.SMp.KSwSS.SlatR** ('*Saccharina latissima* and red seaweeds on infralittoral sediments'), although due to the generally low abundances of seaweeds present the communities observed likely represent an impoverished version of this biotope. This biotope and the associated PMF 'kelp and seaweed communities on sublittoral sediment' were assigned to a total of 13 video segments across 5 transects, only being absent from the east of the survey area.

On two of the transects (HC6 and HC7), both located in the east of the survey area, muddy mixed sediment was associated not only with macroalgae but also with high abundances (common) of the tubeworm *Sabella pavonina*, sponges including *Suberites* sp., and *P. maximus*. These areas were assigned the biotope **SS.SMx.IMx.SpavSpAn** ('*Sabella pavonina* with sponges and anemones on infralittoral mixed sediment').

Areas of hard substrate comprising a mixture of bedrock, boulders and cobbles were observed on a total of five transects. These areas were generally distributed inshore of the existing pier and were characterised by patchy *S. latissima*, although *Laminaria hyperborea* was also recorded in very low abundance. Below the kelp, the observed rock was heavily sediment-influenced, either being covered with a thin layer of silt, or being present adjacent to sandy sediment and exhibiting signs of scour and/or heavy grazing, with the most conspicuous biota present being calcareous red algal crusts (corallinaceae). The most common biotope assigned to these areas was **IR.LIR.K.Slat.Gz** ('Grazed *Saccharina latissima* with *Echinus*, brittlestars and coralline crusts on sheltered infralittoral rock'), although where *L. hyperborea* was recorded as present the biotope **IR.LIR.K.LhypSlat.Gz** ('Grazed, mixed *Laminaria hyperborea* and *Saccharina latissima* on sheltered infralittoral rock') was recorded instead. A variety of faunal taxa were recorded in these habitats, the most common being echinoderms, including the common urchin *Echinus esculentus* and the seastars *Asterias rubens*, *Luidia ciliaris*, *Henricia* sp. and *Marthasterias glacialis*.

Maerl was recorded on a total of five transects. The vast majority of occurrences were so-called 'hedgehog stones,' maerl growing as a series of 'spikes' over hard substrate such as pebbles and cobbles. Both living and dead 'hedgehog stones' were recorded, and were generally associated with low-energy rock habitats adjacent to sandy soft sediments. In addition, large, apparently free-living rhodoliths were also recorded in two images from transects HC3 and HC4, although these were isolated nodules, and no maerl gravel was observed. In all cases, the quantity of maerl present was very low, ranging from <1 % cover to a maximum of 5 % cover. The PMF 'maerl beds' was therefore not assigned to any video segment.

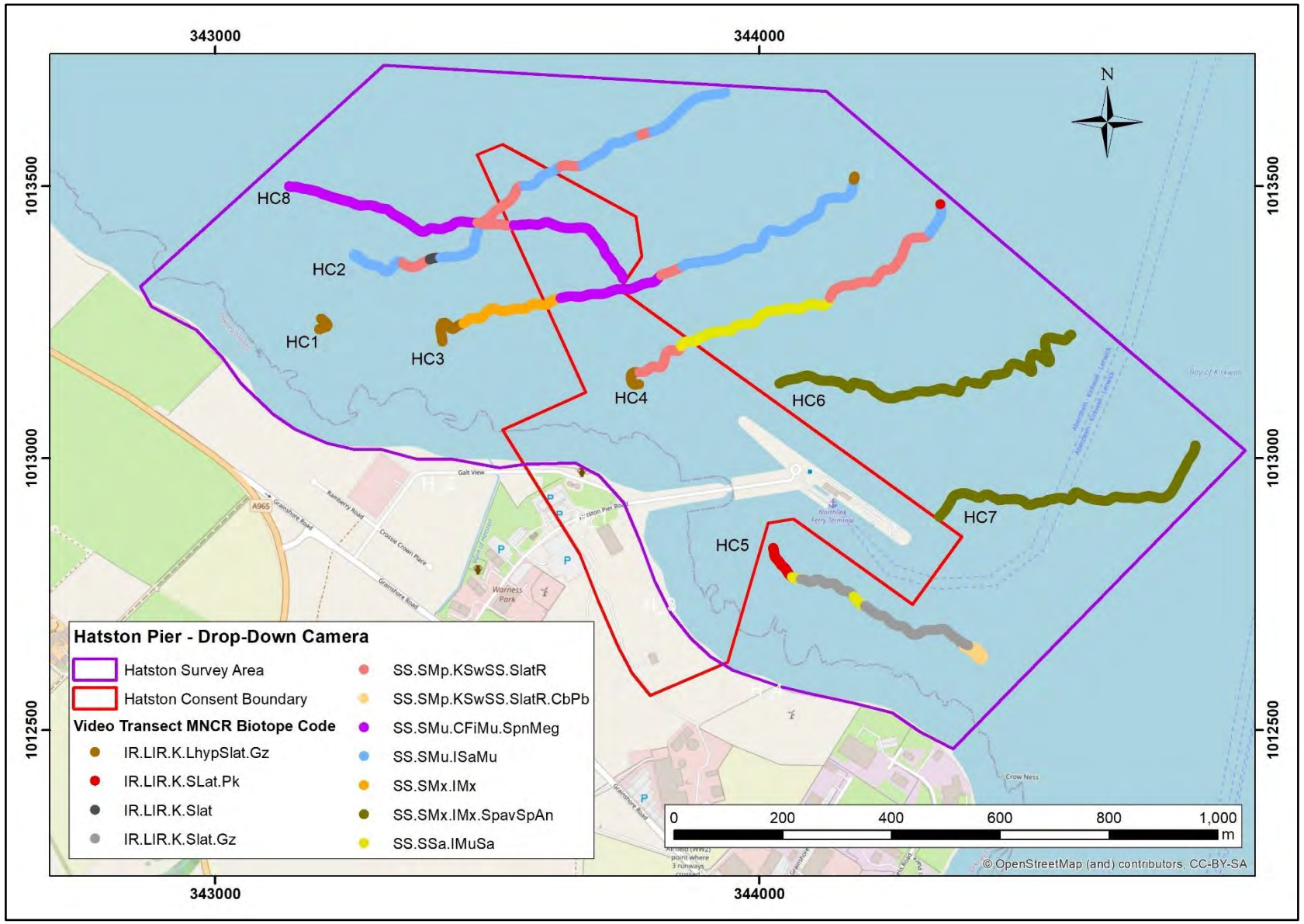

Figure 3.5: MNCR biotopes (JNCC, 2022) assigned to video segments following analysis of underwater imagery collected as part of the 2022 Hatston Pier broadscale mapping survey.

3.3 Benthic grab sample analyses

Eight grab samples were successfully collected from the survey area. The survey logs are provided in Appendix VIII.

3.3.1 Sediment particle size analysis

A summary of the results of the PSA is given in Table 3.1. Full results are provided in Appendix IX. The distribution of sediment types identified is shown in Figure 3.6.

Table 3.1: Summary of the particle size analysis results of grab samples collected as part of the 2022 Hatston Pier broadscale habitat mapping survey.

Sample no.	Grab no.	Gravel	Sand	Mud	Classification	Abbreviation
568#25	HG1	0.42	80.69	18.89	Muddy sand	mS
568#26	HG2	0.19	85.84	14.00	Muddy sand	mS
568#27	HG3	1.31	84.63	14.04	Slightly gravelly muddy sand	(g)mS
568#28	HG4	0.15	88.55	11.25	Muddy sand	mS
568#29	HG5	0.10	88.62	11.24	Muddy sand	mS
568#30	HG6	0.91	84.23	14.82	Muddy sand	mS
568#31	HG7	1.41	83.72	14.90	Slightly gravelly muddy sand	(g)mS
568#32	HG8	34.95	53.97	11.13	Muddy sandy gravel	msG

The soft sediments across the survey area was found to be fairly homogeneous, with seven of the eight samples found to be composed of muddy sand with a minor (< 2 %) gravel fraction. The final sample (HG8), located in the southeast section of the survey area (northeast of the existing pier), was more coarse, however, with a gravel fraction of ~35 %. Despite this, the fraction of mud present in the samples was fairly consistent throughout the survey area (11 – 19 %).

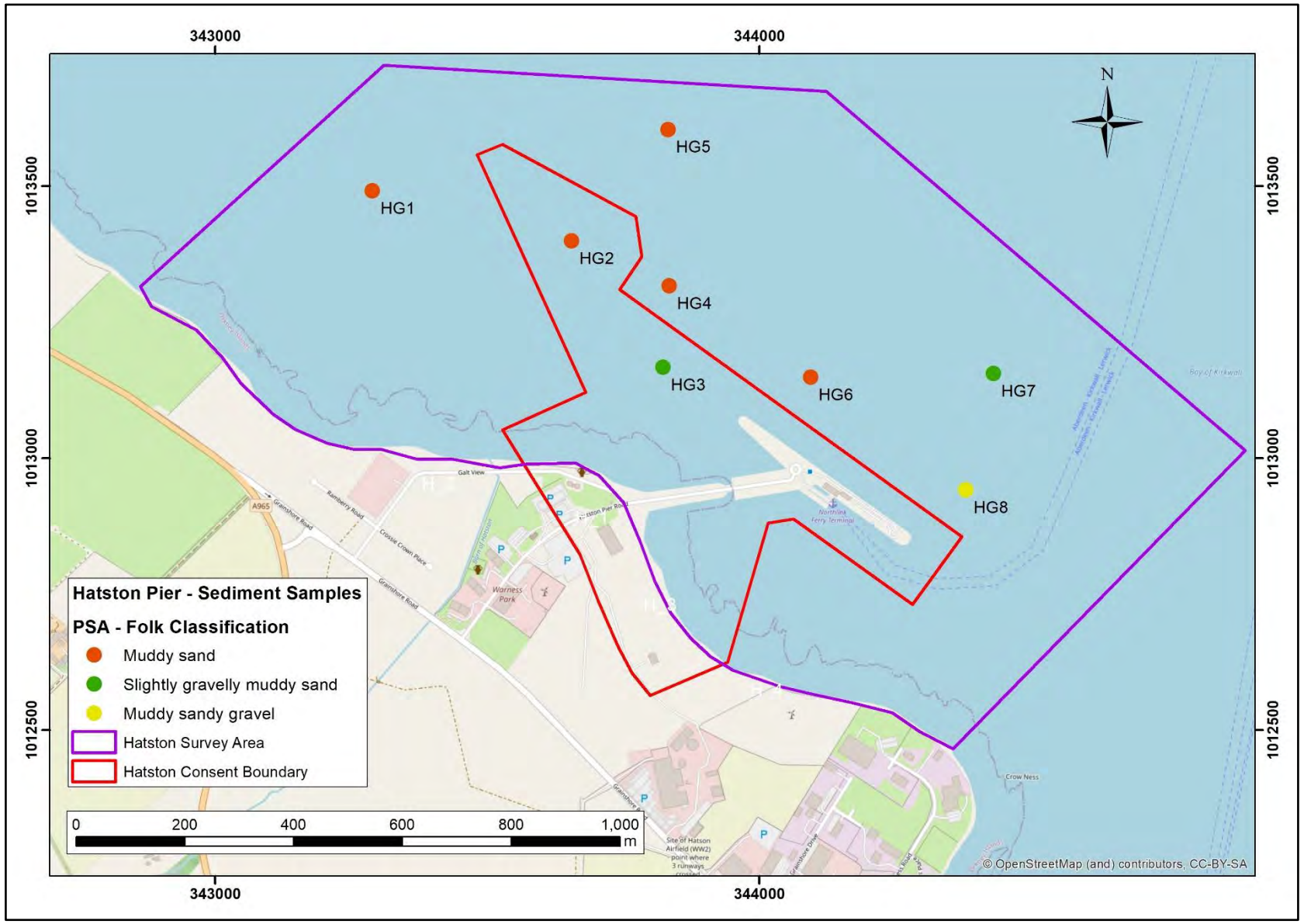

Figure 3.6: Sediment types assigned following particle size analysis of grab samples collected as part of the 2022 Hatston Pier broadscale habitat mapping survey.

3.3.2 Macrobenthic invertebrate analysis

The macrofaunal analysis identified a total of 7169 individuals and 215 taxa (excluding unquantifiable meiofauna and epifauna). The full results of the macrobenthic invertebrate analysis are provided in Appendix X. The total numbers of individuals (N) and taxa (S) for each sample are given in Table 3.2. The total numbers of individuals at each station ranged from 455 to 1677 individuals per sample. The total number of taxa (S) was however more consistent throughout the survey area, ranging from 75 to 120 per sample.

Table 3.2: Summary of the total numbers of individuals (N) and taxa (S) identified in grab samples collected as part of the 2022 Hatston Pier broadscale habitat mapping survey.

Grab no.	Target no.	N	S
HG1	HP_C17	1246	102
HG2	HP_C18	455	75
HG3	HP_C06	876	108
HG4	HP_C08	1677	94
HG5	HP_C11	1036	83
HG6	HP_C09	794	120
HG7	HP_C13	594	98
HG8	HP_C10	491	87

Overall, the macrofauna was dominated by Annelida (45.6 %) followed by Crustacea (41.4%) and Mollusca (8.7 %). The remaining 4.3 % of individuals comprised Nematoda (2.5 %), Echinodermata, Nemertea, Cnidaria, Phoronida, Sipuncula, Pycnogonida and Chordata (all <1 %). A summary of the most abundant taxa present in the samples given in Table 3.3.

Table 3.3: Total abundance of the macrofaunal taxa identified in grab samples collected as part of the 2022 Hatston Pier broadscale habitat mapping survey. Taxa shown comprise 75 % of total individuals identified.

Taxon	Qualifier	Abundance (total no. in all samples)
Galathowenia oculata		502
Ampelisca provincialis		454
Tanaissus danica		364
Euclymene oerstedii		342
Ampelisca sp.	juvenile	335
Thyasira flexuosa		315
Leiochone leiopygos		292
Parexogone hebes		289
Prionospio fallax		252
Harpinia antennaria		241
Nephtys sp.	juvenile	228

Taxon	Qualifier	Abundance (total no. in all samples)
Myodocopida		218
Phtisica marina		189
Nematoda		179
Harpinia crenulata		167
Kurtiella bidentata		150
Eudorella truncatula		116
Diplocirrus glaucus		103
Photis longicaudata		98
Chaetozone setosa		90
Aoridae	female	88
Mediomastus fragilis		86
Nephtys hombergii		84
Ampharete lindstroemi		76
Terebellides sp.	indet.	73

The most abundant taxa included a number of amphipods, including *Ampelisca* spp., *Harpinia* spp., *Phtisica marina* and *Photis longicaudata* and several polychaete worms, including *Galathowenia oculata*, *Euclymene oerstedii*, *Parexogone hebes*, *Prionospio fallax*, *Nephtys* spp., *Mediomastus fragilis* and a variety of terebellids, such as *Diplocirrus glaucus*, *Chaetozone setosa* and *Ampharete lindstroemi*. In addition, the bivalves *Thyasira flexuosa* and *Kurtiella bidentata* were also among the most abundant fauna.

Of the 25 most common taxa identified, 24 were present in 7-8 of the samples, with only the polychaete *Leiochone leiopygos* (5) present in fewer than 7 samples. This suggests that the infaunal communities in the survey area are fairly consistent.

Due to the sediment types present in the survey area, and to the consistent presence of the bivalves *T. flexuosa* and *K. bidentata* and the polychaete *P. fallax*, all samples were assigned the biotope **SS.SMx.CMx.KurThyMx** (‘*Kurtiella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment’). The presence of a range of infaunal polychaetes, amphipods such as *Ampelisca* spp., and high numbers of the cumacean *Eudorella truncatula* indicate that this biotope is an excellent fit for the community recorded.

4 SUMMARY

4.1 Intertidal survey

The habitats and associated biological communities recorded in the Hatston Pier intertidal survey area were typical of low energy, sheltered, rocky and mixed substrate coastlines in the north of Scotland. The zonation of patterns observed on the four representative transects reflected the exposure tolerances of the seaweed and animal communities, ranging from the barren or lichen-dominated upper shore (supra-littoral zone) to the lower littoral fringe and infralittoral habitats.

Table 4.1 provides a summary of the biotopes recorded at each transect. None of the biotopes identified are considered of national or international importance or of special interest (see Annex I, Brazier *et al.* (2019)) and no PMF habitats or species (Tyler-Walters *et al.*, 2016) were observed.

Table 4.1: A summary of the biotopes identified at each transect surveyed as part of 2022 Hatston Pier intertidal survey.

Biotope Code	H_1	H_2	H_3	H_4	Add Bio*
LR	●				
LR.LLR.F.Pel	●				
LR.LLR.F.Fspi.FS					
LR.LLR.F.Fspi.X				●	
LR.LLR.F.Fves.X	●	●			
LR.LLR.F.Asc.FS		●			
LR.LLR.F.Asc.X			●	●	
LR.FLR.Eph.Ulv					●
LS.LCS	●	●			
LS.LCS.Sh.BarSh	●	●		●	
LS.LSa.St		●	●		
LS.LSa.MoSa.BarSa				●	
IR.MIR.KR.Ldig			●		

* Additional biotopes observed in the survey area but not represented on the transects.

The dog whelk, *N. lapillus*, occurred at varying abundances on transects H_1, H_2 and H_3. This species was included on the OSPAR List of threatened and/or declining species and habitats in 2003 (OSPAR, 2009). The decline in the *N. lapillus* populations has been linked with contamination effects of tributyltin (TBT) compounds used in boat and ship antifouling paints. Even at low concentrations, these cause a condition known as imposex, where female *N. lapillus* develop male characteristics (the formation of a vas deferens and growth of a penis) and become sterile. Whilst recovery of *N. lapillus* populations has been demonstrated at some locations that were previously denuded of this species, *N. lapillus* still remains on the OSPAR list (OSPAR, 2018).

4.2 Subtidal survey

While the results of the grab survey indicate that the soft-sediment infaunal communities in the survey area are fairly consistent, the results of the underwater imagery analysis indicate that the epibiotic communities present are more diverse, with a total of 13 biotopes and biotope complexes assigned to the imagery records. A summary of the biotopes identified on each video transect is given in Table 4.2.

Table 4.2: A summary of the biotopes identified at each transect surveyed as part of 2022 Hatston Pier subtidal drop-down camera survey.

Biotope code	HC1	HC2	HC3	HC4	HC5	HC6	HC7	HC8
IR.MIR.KR.XFoR								○
IR.LIR.K.LhypSlat.Gz	●		●	●				
IR.LIR.K.Slat		●						
IR.LIR.K.Slat.Gz					●			
IR.LIR.K.SLat.Pk					●			
SS.SSa.IMuSa			○	●	●			
SS.SMu.ISaMu		●	●	●				○
SS.SMu.CFiMu.SpnMeg*			●	○		○	○	●
SS.SMx.IMx			●			○	○	
SS.SMx.IMx.SpavSpAn						●	●	
SS.SMx.CMx.ClloMx						○		
SS.SMp.KSwSS.SlatR*		●	●	●	○	○	○	●
SS.SMp.KSwSS.SlatR.CbPb*					●			

● = Identified from video footage

○ = Identified from still images only (and therefore unlikely to represent an actual biotope)

* associated with PMF habitats

Two PMF habitats were identified in the subtidal survey area. The PMF habitat 'kelp and seaweed communities on sublittoral sediment' was identified on a total of five transects (HC2, HC3, HC4, HC5 and HC8), and was recorded within the proposed development consent boundary. It was noted, however, that, due to the low abundance of characterising taxa, the habitats observed likely represent an impoverished version of the PMF. The PMF habitat 'seapens and burrowing megafauna in circalittoral fine mud' was recorded on two transects (HC3 and HC8), which included areas within the proposed development consent boundary. While in all cases burrows met the minimum threshold for assignment of the habitat (see section 2.2.4.1), the vast majority of burrows present were small (<3 cm), simple dwelling traces with larger, more complex burrows being far less common. In addition, only one species of seapen was identified (*V. mirabilis*), and, due to both the shallow depths and the sandy sediments present within the survey area, it is thought that the tall seapen (*Funiculina quadrangularis*), a component species of the PMF habitat, is unlikely to occur in this area.

Maerl, whilst present in the survey area, was primarily observed as scattered/isolated 'hedgehog stones' in very low abundances (up to 5 % but generally < 2 % coverage in any given still image in which it occurred, and < 1% in any of the video records). The PMF 'maerl beds' was therefore not assigned to any of the imagery records.

While kelp communities were observed, these were typical of low-energy, highly sediment-influenced environments. The PMF 'kelp beds' has several biotope components (Tyler-Walters *et al*., 2016), however these are all high- and moderate-energy biotopes not recorded in the present survey. The PMF 'kelp beds' was therefore not assigned to any of the imagery records.

4.3 Limitations

Due to the timings associated with the submission of the planning permission, there was a requirement to undertake the surveys in early winter 2022. In addition to the issues with the intertidal survey, caused due to spring low tide times coinciding with hours of darkness, this is likely to have impacted the biological communities observed. This particularly pertains to the macroalgal-dominated habitats in the intertidal and the kelp communities observed in the shallow subtidal, as a significant amount of autumn/winter 'die-back' is likely to have occurred prior to the survey being conducted. It is possible that the communities and biotopes recorded would change significantly if the survey was conducted in the summer. It is strongly recommended that any baseline and monitoring surveys are conducted in late summer (ideally August) when macroalgal growth is at maximum and spring low tides can be utilised for intertidal survey.

There were some discrepancies in the assignment of BSHs between the underwater imagery analysis and the grab sample analysis. While muds and sandy muds were frequently recorded in the imagery analysis, the results of the PSA indicate that the majority of the sediments in the survey area were in fact sand-dominated. In the underwater imagery analysis the assignment of sediment types was based solely on the visual assessment of the analyst, and there is therefore a degree of uncertainty in the assessment of the proportions of mud, sand and gravel present (particularly below the sediment surface). For example, there were several video segments and still images where it was very difficult to distinguish between fine sand and mud. The presence of burrows (particularly complex burrows) was generally taken as indication that the sediment included a significant mud component, and the BSH and biotopes assigned to the imagery records were based on this assumption. However, while the PSA results indicate these assessments may have been incorrect, the epibiotic communities present were highly indicative of mud-dominated sediments and the biotopes assigned reflect this. It is therefore considered that changes to the biotopes assigned to video segments are not necessary.

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6 APPENDICES

Appendix I: Modified MNCR field form used as part of the Phase I intertidal surveys conducted as part of the 2022 Hatston Pier habitat mapping survey.

Intertidal Ecological Surveys - Phase I recording form (one per habitat per transect)

1) Site information

Date:				
Time/weather/state of tide/other data				
Transect no.:				
Habitat no.				
Shore position (circle appropriate):	**Strandline**	**High**	**Mid**	**Low**
Position (centre point of habitat):		**N**		**W**

2) Photo Taken (tick as appropriate):	Up-shore ☐ Down-shore ☐ Right ☐ Left ☐

3) Site Description (tick appropriate score):		**1**	**2**	**3**	**4**	**5**
Surface relief (even-rugged)						
Texture (smooth-pitted)						
Stability (stable-mobile)						
Scour (none-scoured)						
Silt (none-silted)						
Fissures > 10mm (none-many)						
Crevices < 10mm (none-many)						
Boulder/cobble/pebble shape (rounded-angular)						
Rockpools (none-all)						

4) Note if the following are present:	**Tick as appropriate**
Burrows / holes	
Tubes	
Algal mat	
Drainage channels / creeks / freshwater runoff	
Standing water	
Sediment veneer	
Sabellaria alveolata (detail below)	
Macroalgae (detail below)	
Anthropgenic feature (detail below)	
Other (please specify)	

Substrate Type	**% cover (approx.)**
Bedrock	
Boulders (S/L/XL)	
Cobbles	
Pebbles	
Gravel (stone/shell)	
Sand	
Mud	
Biogenic (specify below)	
Artificial (specify below)	
Peat	

5) MNCR Biotope code / notes (e.g. variant)

6) Major taxa present (Please note species below with SACFOR abundance)

7) Additional notes (rock type, anthropogenic features etc.)

Appendix II: Transect and habitat photographs taken during the Phase I intertidal survey conducted as part of the 2022 Hatston Pier habitat mapping survey.

Field photographs captured on the centre line at each intertidal belt transect in the mid shore. Photographs were taken up-shore, down-shore and along-shore in both directions and have been displayed in this order. Note that, due to the timing of the survey relative to the spring tide, the low shore was not always visible, however the label 'low shore' has been retained for simplicity.

Plate 1a. Hatston Pier and Harbour intertidal survey Transect 1 - upper shore.

Plate 1b. Hatston Pier and Harbour intertidal survey Transect 1 - mid and lower shore.

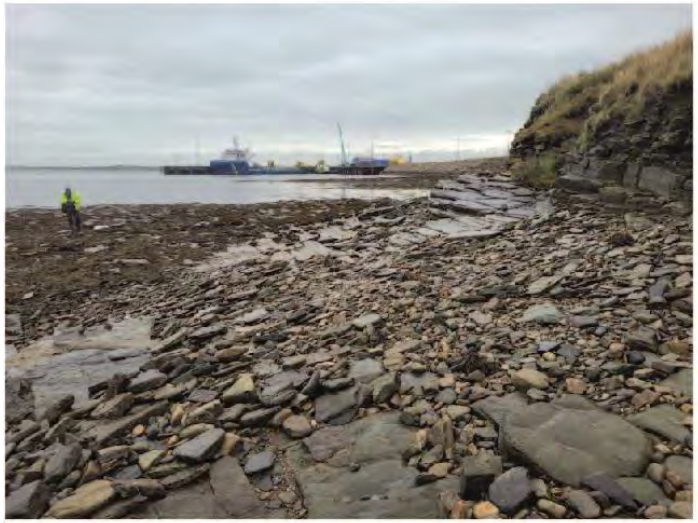

Plate 1c. Hatston Pier and Harbour intertidal survey Transect 1 - upper shore, view east towards Hatston Pier.

Plate 1d. Hatston Pier and Harbour intertidal survey Transect 1 - upper shore, view west.

Plate 2a. Hatston Pier and Harbour intertidal survey Transect 2 - mid and upper shore.

Plate 2b. Hatston Pier and Harbour intertidal survey Transect 2 - lower shore.

Plate 2c. Hatston Pier and Harbour intertidal survey Transect 2 - lower shore, view east towards Hatston Pier.

Plate 2d. Hatston Pier and Harbour intertidal survey Transect 2 - lower shore, view west.

Plate 3a. Hatston Pier and Harbour intertidal survey Transect 3 - upper shore.

Plate 3b. Hatston Pier and Harbour intertidal survey Transect 3 - mid and lower shore.

Plate 3c. Hatston Pier and Harbour intertidal survey Transect 3 - upper shore, view south-east.

Plate 3d. Hatston Pier and Harbour intertidal survey Transect 3 - upper shore, view north-west towards Hatston Pier causeway.

Plate 4a. Hatston Pier and Harbour intertidal survey Transect 4 - upper shore.

Plate 4b. Hatston Pier and Harbour intertidal survey Transect 4 - mid and lower shore.

Plate 4c. Hatston Pier and Harbour intertidal survey Transect 4 - upper shore, view south-east.

Plate 4d. Hatston Pier and Harbour intertidal survey Transect 4 - upper shore, view north-west towards Hatston Pier.

Appendix III: Phase I intertidal survey logs for work conducted as part of the 2022 Hatston Pier habitat mapping survey.

All positions represent the lower boundary of the habitat as recorded on the central transect line and are given in WGS84 latitude and longitude (DD MM.MMMM; negative longitudes are west).

Transect No.	Habitat No.	Shore Position	Date	Time (BST)	Latitude	Longitude	Habitat width (m)	Habitat Description	MNCR Biotope Code
H_1	1	High	2nd Dec 2022	10:06	59 00.0212	-002 58.9464	7	Barren bedrock with overlying shingle.	LR / LS.LCS.Sh.BarSh
H_1	2	High	2nd Dec 2022	10:19	59 00.0242	-002 58.9435	4	Stepped exposed bedrock with *Verrucaria maura* and *Pelvetia canaliculata.*	LR.LLR.F.Pel
H_1	3	Mid	2nd Dec 2022	10:32	59 00.0264	-002 58.9426	4	Pebbles and cobbles with *Littorina* spp. and *Actinia equina.*	LS.LCS
H_1	4	Low	2nd Dec 2022	10:44	59 00.0328	-002 58.9385	12	*Fucus vesiculosus* and *Ascophyllum nodosum* on cobbles with *Patella vulgata* and *Littorina* spp..	LR.LLR.F.Fves.X
H_2	1	High	2nd Dec 2022	12:06	59 00.0509	-002 59.2675	8	Barren shingle at the strandline	LS.LCS.Sh.BarSh
H_2	2	Mid	2nd Dec 2022	12:01	59 00.0372	-002 59.2757	3	Sand with occasional cobbles with sparse *Cladophora* sp..	LS.LCS
H_2	3	Mid	2nd Dec 2022	11:55	59 00.0459	-002 59.2711	15	*Fucus vesiculosus* and *Ascophyllum nodosum* on cobbles overlying bedrock with sand veneer.	LR.LLR.F.Fves.X
H_2	4	Low	2nd Dec 2022	11:28	59 00.0588	-002 59.2638	33	Dense *Ascophyllum nodosum* on rock.	LR.LLR.F.Asc.FS
H_3	1	High	5th Dec 2022	14:06	58 59.9401	-002 58.7941	13	Thick layer of phytodetritus at the strandline overlying shingle.	LS.LSa.St

Transect No.	Habitat No.	Shore Position	Date	Time (BST)	Latitude	Longitude	Habitat width (m)	Habitat Description	MNCR Biotope Code
H_3	2	Mid	5th Dec 2022	14:15	58 59.9444	-002 58.7542	45	*Ascophyllum nodosum* on cobbles and boulders overlying mixed sediment.	LR.LLR.F.Asc.X
H_4	1	Strandline	5th Dec 2022	12:48	58 59.8088	-002 58.5786	1	Barren shingle with small patches of *Verrucaria maura* on larger cobbles.	LS.LCS.Sh.BarSh
H_4	2	High	5th Dec 2022	12:58	58 59.8123	-002 58.5772	7	Medium well sorted sand with occasional cobbles.	LS.LSa.MoSa.BarSa
H_4	3	Mid	5th Dec 2022	13:06	58 59.8154	-002 58.5723	4	*Fucus spiralis* on cobbles and boulders overlying sand and gravel.	LR.LLR.F.Fspi.X
H_4	4	Mid	5th Dec 2022	13:20	58 59.8159	-002 58.5702	4	*Ascophyllum nodosum* and *Fucus spiralis* on cobbles and boulders with sand and gravel infill.	LR.LLR.F.Asc.X / LR.LLR.F.Fspi.X
H_4	5	Low	5th Dec 2022	13:30	58 59.8331	-002 58.5634	10	*Ascophyllum nodosum* on boulders and cobbles with sand and gravel infill.	LR.LLR.F.Asc.X

Appendix IV: Species lists for each habitat at each intertidal transect surveyed as part of the 2022 Hatston Pier habitat mapping survey.

Site Name	Hatston	Hatston	Hatston	Hatston
Transect no.	H_1	H_1	H_1	H_1
Habitat no.	1	2	3	4
Shore position	High	High	Mid	Low

Taxon	Qualifier	SACFOR class				
Biofilm		crust/meadow	F			
Verrucaria maura		crust/meadow		C	R	F
Ochrolechia parella		crust/meadow				
Caloplaca	sp.	crust/meadow				
Hymeniacidon perlevis		crust/meadow				
Actinia equina		1 - 3 cm			F	O
Spirorbinae		crust/meadow	R		R	R
Semibalanus balanoides		crust/meadow	R			C
Talitridae		<1 cm				
Gammaridae		<1 cm			F	
Paguridae		3 - 15 cm				
Carcinus maenas		3 - 15 cm				C
Steromphala cineraria		1 - 3 cm				
Patella aspera		3 - 15 cm				
Patella vulgata		3 - 15 cm	R	C	R	A
Littorina littorea		1 - 3 cm				A
Littorina obtusata		1 - 3 cm			C	A
Littorina saxatilis		1 - 3 cm		F	C	A
Melarhaphe neritoides		<1 cm			F	
Nucella lapillus		1 - 3 cm				O
Rhodophyta	dark red crusts	crust/meadow				
Rhodophyta	filamentous red	massive/turf				
Corallinaceae		crust/meadow			R	C
Chondrus crispus		massive/turf				R
Mastocarpus stellatus		massive/turf				
Lomentaria articulata		crust/meadow				
Osmundea pinnatifida		massive/turf				O
Vertebrata (= Polysiphonaria) lanosa		crust/meadow	R			F
Cladostephus spongiosus		crust/meadow				
Laminaria digitata		crust/meadow				R
Fucales	sporelings	crust/meadow		R	R	
Ascophyllum nodosum		crust/meadow	R			C
Fucus spiralis		crust/meadow	R			O
Fucus vesiculosus		crust/meadow	R			A
Pelvetia canaliculata		crust/meadow		F		
Fucus serratus		crust/meadow				R
Ulva intestinalis		massive/turf				
Blidingia	sp.	massive/turf				
Ulva lactuca		massive/turf				
Cladophora	sp.	massive/turf				

Site Name	Hatston	Hatston	Hatston	Hatston
Transect no.	H_2	H_2	H_2	H_2
Habitat no.	1	2	3	4
Shore position	High	Mid	Mid	Low

Taxon	Qualifier	SACFOR class				
Biofilm		crust/meadow	R			
Verrucaria maura		crust/meadow				
Ochrolechia parella		crust/meadow				
Caloplaca	sp.	crust/meadow				
Hymeniacidon perlevis		crust/meadow			R	R
Actinia equina		1 - 3 cm			R	
Spirorbinae		crust/meadow				R
Semibalanus balanoides		crust/meadow			R	R
Talitridae		<1 cm				
Gammaridae		<1 cm	O		O	
Paguridae		3 - 15 cm				
Carcinus maenas		3 - 15 cm			O	
Steromphala cineraria		1 - 3 cm				R
Patella aspera		3 - 15 cm				O
Patella vulgata		3 - 15 cm				A
Littorina littorea		1 - 3 cm				O
Littorina obtusata		1 - 3 cm			C	F
Littorina saxatilis		1 - 3 cm			R	
Melarhaphe neritoides		<1 cm				
Nucella lapillus		1 - 3 cm				R
Rhodophyta	dark red crusts	crust/meadow				
Rhodophyta	filamentous red	massive/turf				O
Corallinaceae		crust/meadow			R	R
Chondrus crispus		massive/turf				R
Mastocarpus stellatus		massive/turf				
Lomentaria articulata		crust/meadow				R
Osmundea pinnatifida		massive/turf				R
Vertebrata (= Polysiphonaria) lanosa		crust/meadow		R	R	R
Cladostephus spongiosus		crust/meadow				
Laminaria digitata		crust/meadow				
Fucales	sporelings	crust/meadow				R
Ascophyllum nodosum		crust/meadow		R	A	S
Fucus spiralis		crust/meadow		R	R	
Fucus vesiculosus		crust/meadow			A	O
Pelvetia canaliculata		crust/meadow				
Fucus serratus		crust/meadow				R
Ulva intestinalis		massive/turf			R	
Blidingia	sp.	massive/turf				
Ulva lactuca		massive/turf			R	R
Cladophora	sp.	massive/turf		O	O	

Site Name	Hatston	Hatston	Hatston	Hatston
Transect no.	H_3	H_3	H_4	H_4
Habitat no.	1	2	1	2
Shore position	High	Mid	Strandline	High

Taxon	Qualifier	SACFOR class				
Biofilm		crust/meadow	P		R	R
Verrucaria maura		crust/meadow		R	O	O
Ochrolechia parella		crust/meadow			R	R
Caloplaca	sp.	crust/meadow				R
Hymeniacidon perlevis		crust/meadow		R		
Actinia equina		1 - 3 cm				
Spirorbinae		crust/meadow		R		
Semibalanus balanoides		crust/meadow		R		
Talitridae		<1 cm			O	
Gammaridae		<1 cm	P			
Paguridae		3 - 15 cm				
Carcinus maenas		3 - 15 cm	P	R		
Steromphala cineraria		1 - 3 cm				
Patella aspera		3 - 15 cm				
Patella vulgata		3 - 15 cm		C		
Littorina littorea		1 - 3 cm	P	F		
Littorina obtusata		1 - 3 cm		F		
Littorina saxatilis		1 - 3 cm				
Melarhaphe neritoides		<1 cm				
Nucella lapillus		1 - 3 cm		R		
Rhodophyta	dark red crusts	crust/meadow	P	R		
Rhodophyta	filamentous red	massive/turf		O		
Corallinaceae		crust/meadow		R		
Chondrus crispus		massive/turf		R		
Mastocarpus stellatus		massive/turf		R		
Lomentaria articulata		crust/meadow				
Osmundea pinnatifida		massive/turf				
Vertebrata (= Polysiphonaria) lanosa		crust/meadow		R		
Cladostephus spongiosus		crust/meadow		R		
Laminaria digitata		crust/meadow				
Fucales	sporelings	crust/meadow		R		
Ascophyllum nodosum		crust/meadow	P	S		
Fucus spiralis		crust/meadow		R		R
Fucus vesiculosus		crust/meadow	P	F		
Pelvetia canaliculata		crust/meadow				R
Fucus serratus		crust/meadow		R		
Ulva intestinalis		massive/turf				
Blidingia	sp.	massive/turf		R		
Ulva lactuca		massive/turf		R		
Cladophora	sp.	massive/turf	P	R		

Site Name	Hatston	Hatston	Hatston
Transect no.	H_4	H_4	H_4
Habitat no.	3	4	5
Shore position	Mid	Mid	Low

Taxon	Qualifier	SACFOR class			
Biofilm		crust/meadow	R		
Verrucaria maura		crust/meadow			R
Ochrolechia parella		crust/meadow			
Caloplaca	sp.	crust/meadow			R
Hymeniacidon perlevis		crust/meadow			
Actinia equina		1 - 3 cm			
Spirorbinae		crust/meadow			R
Semibalanus balanoides		crust/meadow	R	R	O
Talitridae		<1 cm			
Gammaridae		<1 cm	O	O	
Paguridae		3 - 15 cm			R
Carcinus maenas		3 - 15 cm			R
Steromphala cineraria		1 - 3 cm			
Patella aspera		3 - 15 cm			
Patella vulgata		3 - 15 cm	C	C	C
Littorina littorea		1 - 3 cm	O	O	F
Littorina obtusata		1 - 3 cm	F	F	O
Littorina saxatilis		1 - 3 cm	F	F	
Melarhaphe neritoides		<1 cm			
Nucella lapillus		1 - 3 cm			
Rhodophyta	dark red crusts	crust/meadow	R		R
Rhodophyta	filamentous red	massive/turf			O
Corallinaceae		crust/meadow	R	R	O
Chondrus crispus		massive/turf			R
Mastocarpus stellatus		massive/turf			
Lomentaria articulata		crust/meadow			
Osmundea pinnatifida		massive/turf			R
Vertebrata (= Polysiphonaria) lanosa		crust/meadow		R	O
Cladostephus spongiosus		crust/meadow			R
Laminaria digitata		crust/meadow			
Fucales	sporelings	crust/meadow	R		
Ascophyllum nodosum		crust/meadow		A	S
Fucus spiralis		crust/meadow	S	A	
Fucus vesiculosus		crust/meadow		O	R
Pelvetia canaliculata		crust/meadow	O	R	
Fucus serratus		crust/meadow			R
Ulva intestinalis		massive/turf			
Blidingia	sp.	massive/turf			
Ulva lactuca		massive/turf			
Cladophora	sp.	massive/turf	R		

Appendix V: Glossary of biotopes assigned to habitats and samples assessed as part of the 2022 Hatston Pier habitat mapping survey.

Biotope code	Biotope name
LR	Littoral rock (and other hard substrata)
LR.LLR.F.Pel	*Pelvetia canaliculata* on sheltered littoral fringe rock
LR.LLR.F.Fspi.X	*Fucus spiralis* on full salinity upper eulittoral mixed substrata
LR.LLR.F.Fves.X	*Fucus vesiculosus* on mid eulittoral mixed substrata
LR.LLR.F.Asc.FS	*Ascophyllum nodosum* on full salinity mid eulittoral rock
LR.LLR.F.Asc.X	*Ascophyllum nodosum* on full salinity mid eulittoral mixed substrata
LS.LCS	Littoral coarse sediment
LS.LCS.Sh.BarSh	Barren littoral shingle
LS.LSa.St	Strandline
LS.LSa.MoSa.BarSa	Barren littoral coarse sand
IR.MIR.KR.XFoR	Dense foliose red seaweeds on silty moderately exposed infralittoral rock
IR.LIR.K.LhypSlat.Gz	Grazed, mixed *Laminaria hyperborea* and *Saccharina latissima* on sheltered infralittoral rock
IR.LIR.K.Slat	*Saccharina latissima* on very sheltered infralittoral rock
IR.LIR.K.Slat.Gz	Grazed *Saccharina latissima* with *Echinus*, brittlestars and coralline crusts on sheltered infralittoral rock
IR.LIR.K.SLat.Pk	*Saccharina latissima* park on very sheltered lower infralittoral rock
SS.SSa.IMuSa	Infralittoral muddy sand
SS.SMu.ISaMu	Infralittoral sandy mud
SS.SMu.CFiMu.SpnMeg	Seapens and burrowing megafauna in circalittoral fine mud
SS.SMx.IMx	Infralittoral mixed sediment
SS.SMx.IMx.SpavSpAn	*Sabella pavonina* with sponges and anemones on infralittoral mixed sediment
SS.SMx.CMx.ClloMx	*Cerianthus lloydii* and other burrowing anemones in circalittoral muddy mixed sediment
SS.SMx.CMx.KurThyMx	*Kurtiella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment
SS.SMp.KSwSS.SlatR	*Saccharina latissima* and red seaweeds on infralittoral sediments
SS.SMp.KSwSS.SlatR.CbPb	Red seaweeds and kelps on tide-swept mobile infralittoral cobbles and pebbles

Appendix VI: Underwater imagery logs for the drop-down camera survey conducted as part of the 2022 Hatston Pier habitat mapping survey.

Positions are given in OSGB36 Easting and Northing (m).

Sample no.	Transect No.	Date	Start time (UTC)	Start of line position		End time (UTC)	End of line position		Video duration	No. stills
				Easting	Northing		Easting	Northing		
568#17	HC1	10th Dec 2022	09:24:01	343159.41	1013222.24	09:26:01	343192.59	1013256.89	00:02:00	5
568#18	HC2	10th Dec 2022	09:34:50	343266.70	1013357.16	09:57:19	343945.97	1013676.13	00:22:29	20
568#19	HC3	10th Dec 2022	10:09:02	343417.24	1013217.88	10:38:44	344176.27	1013519.87	00:29:42	30
568#20	HC4	10th Dec 2022	10:51:10	343774.26	1013134.95	11:21:09	344334.24	1013485.99	00:29:59	30
568#21	HC5	10th Dec 2022	11:38:55	344026.76	1012831.52	11:59:43	344354.86	1012674.58	00:20:48	20
568#22	HC6	10th Dec 2022	12:14:42	344042.27	1013139.04	12:40:38	344576.38	1013226.65	00:25:56	25
568#23	HC7	10th Dec 2022	12:51:03	344334.09	1012894.56	13:15:50	344802.66	1013025.45	00:24:47	25
568#24	HC8	10th Dec 2022	13:38:11	343138.91	1013498.57	14:03:35	343751.19	1013323.58	00:25:24	25

Appendix VII: Summary of the results of the analysis of underwater imagery captured during the drop-down camera survey conducted as part of the 2022 Hatston Pier habitat mapping survey.

Transect no.	Section no.	Habitat description	MNCR biotope code(s) assigned	PMF(s) present	Annex I habitats present
HC1	S1	Sparse kelp on cobbles, boulders and bedrock with coarse sediment infill	IR.LIR.K.LhypSlat.Gz		Reefs
HC2	S1	Slightly shelly sandy mud with burrows	SS.SMu.ISaMu		
HC2	S2	*Saccharina latissima* and red seaweeds on mixed sediment	SS.SMp.KSwSS.SlatR	Kelp and seaweed communities on sublittoral sediment	
HC2	S3	Sparse *Saccharina latissima* and red seaweeds on silty bedrock slabs with mixed sediment infill	IR.LIR.K.Slat		Reefs
HC2	S4	Burrowed slightly shelly sandy mud and patchy pebbles with *Pecten maximus*	SS.SMu.ISaMu		
HC2	S5	*Saccharina latissima* and red seaweeds on mixed sediment with *Pecten maximus*	SS.SMp.KSwSS.SlatR	Kelp and seaweed communities on sublittoral sediment	
HC2	S6	Shelly sandy mud with *Pecten maximus*	SS.SMu.ISaMu		
HC2	S7	*Saccharina latissima* and red seaweeds on mixed sediment with *Pecten maximus*	SS.SMp.KSwSS.SlatR	Kelp and seaweed communities on sublittoral sediment	
HC2	S8	Slightly shelly muddy sand with *Virgularia mirabilis* and *Pecten maximus*	SS.SMu.ISaMu		
HC2	S9	*Saccharina latissima* and red seaweeds on mixed sediment	SS.SMp.KSwSS.SlatR	Kelp and seaweed communities on sublittoral sediment	
HC2	S10	Slightly shelly muddy sand with *Virgularia mirabilis* and *Pecten maximus*	SS.SMu.ISaMu		
HC3	S1	Sparse kelps on silty cobbles and boulders overlying mixed sediment	IR.LIR.K.LhypSlat.Gz		Reefs
HC3	S2	Slightly shelly muddy sand, pebbles and cobbles with sparse/patchy seaweeds	SS.SMx.IMx		

Transect no.	Section no.	Habitat description	MNCR biotope code(s) assigned	PMF(s) present	Annex I habitats present
HC3	S3	*Virgularia mirabilis* in slightly shelly sandy mud with simple and complex burrows	SS.SMu.CFiMu.SpnMeg	Seapens and burrowing megafauna in circalittoral fine mud	
HC3	S4	*Saccharina latissima* and red seaweeds on mixed sediment	SS.SMp.KSwSS.SlatR	Kelp and seaweed communities on sublittoral sediment	
HC3	S5	*Virgularia mirabilis* in burrowed slightly shelly sandy mud with *Pecten maximus* and patchy kelp	SS.SMu.ISaMu		
HC4	S1	Heavily-grazed silty cobbles and boulders with sparse kelps, *Echinus esculentus* and red seaweeds	IR.LIR.K.LhypSlat.Gz		Reefs
HC4	S2	Red seaweeds and sparse kelp on gravelly muddy sand with pebbles and patchy cobbles	SS.SMp.KSwSS.SlatR	Kelp and seaweed communities on sublittoral sediment	
HC4	S3	*Saccharina latissima* and red seaweeds on slightly shelly muddy sand	SS.SMp.KSwSS.SlatR	Kelp and seaweed communities on sublittoral sediment	
HC4	S4	Slightly gravelly muddy sand with patches of *Saccharina latissima* and seaweeds	SS.SSa.IMuSaSS.SMp.KSwSS.SlatR	Kelp and seaweed communities on sublittoral sediment	
HC4	S5	*Saccharina latissima* and red seaweeds on slightly shelly muddy sand	SS.SMp.KSwSS.SlatR	Kelp and seaweed communities on sublittoral sediment	
HC4	S6	Slightly shelly sandy mud	SS.SMu.ISaMu		
HC5	S1	*Saccharina latissima*, coralline crusts and sparse red seaweeds on cobbles and boulders with gravelly sand infill	IR.LIR.K.SLat.Pk SS.SSa.IMuSa		Reefs
HC5	S2	Slightly gravelly muddy sand with patchy *Saccharina latissima*	SS.SSa.IMuSa		
HC5	S3	*Saccharina latissima*, coralline crusts and sparse red seaweeds on grazed cobbles and boulders overlying sand	IR.LIR.K.Slat.Gz		Reefs
HC5	S4	Slightly gravelly muddy sand with patchy organic matter	SS.SSa.IMuSa		

Transect no.	Section no.	Habitat description	MNCR biotope code(s) assigned	PMF(s) present	Annex I habitats present
HC5	S5	Alternating bands of patchy *Saccharina latissima* on grazed cobbles and boulders and muddy sand	IR.LIR.K.Slat.Gz SS.SSa.IMuSa		Reefs
HC5	S6	*Saccharina latissima* and red seaweeds on pebbles and cobbles	SS.SMp.KSwSS.SlatR.CbPb	Kelp and seaweed communities on sublittoral sediment	
HC5	S7	Sparse *Saccharina latissima* and patchy red seaweeds on grazed cobbles and boulders with sand infill	IR.LIR.K.Slat.Gz SS.SSa.IMuSa		Reefs
HC6	S1	*Sabella pavonina* on shelly mixed sediment with patchy *Saccharina latissima* and sparse red seaweeds	SS.SMx.IMx.SpavSpAn		
HC6	S2	*Sabella pavonina* and sponges on muddy mixed sediment with red seaweeds and sparse kelp	SS.SMx.IMx.SpavSpAn		
HC7	S1	*Sabella pavonina*, sponges and scallops on shelly mixed sediment with red seaweeds and sparse kelp	SS.SMx.IMx.SpavSpAn		
HC7	S2	*Sabella pavonina*, sponges and scallops on muddy mixed sediment with red seaweeds and sparse kelp	SS.SMx.IMx.SpavSpAn		
HC8	S1	Burrowed sandy mud with *Virgularia mirabilis* and sparse patches of cobbles	SS.SMu.CFiMu.SpnMeg	Seapens and burrowing megafauna in circalittoral fine mud	
HC8	S2	Sparse kelp and red seaweeds on mixed muddy sediment	SS.SMp.KSwSS.SlatR	Kelp and seaweed communities on sublittoral sediment	
HC8	S3	Burrowed sandy mud with *Virgularia mirabilis*, *Pecten maximus* and sparse patches of seaweed	SS.SMu.CFiMu.SpnMeg	Seapens and burrowing megafauna in circalittoral fine mud	

Appendix VIII: Benthic grab logs for samples collected as part of the 2022 Hatston Pier habitat mapping survey.

Positions are given in OSGB36 Easting and Northing (m).

Sample no.	Grab no.	Date	Time (UTC)	Easting	Northing
568#25	HG1	11th Dec 2022	09:21	343288.71	1013502.53
568#26	HG2	11th Dec 2022	09:43	343683.85	1013393.47
568#27	HG3	11th Dec 2022	10:11	343889.94	1013161.52
568#28	HG4	11th Dec 2022	10:31	343896.44	1013391.13
568#29	HG5	11th Dec 2022	10:51	343827.92	1013604.47
568#30	HG6	11th Dec 2022	11:35	344176.17	1013241.25
568#31	HG7	11th Dec 2022	12:02	344470.14	1013141.55
568#32	HG8	11th Dec 2022	12:25	344449.44	1012927.09

Appendix IX: Results of the particle size analysis of grab samples collected as part of the 2022 Hatston Pier habitat mapping survey.

Percentage of sediment retained at each phi interval for each grab sample collected as part of the 2022 Hatston Pier habitat mapping survey.

Sieve mesh size	HG1	HG2	HG3	HG4	HG5	HG6	HG7	HG8
16 mm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.86
8 mm	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.38
4 mm	0.13	0.07	0.19	0.02	0.00	0.10	0.78	1.12
2 mm	0.29	0.12	1.12	0.13	0.10	0.60	0.64	0.57
1 mm	1.73	0.63	3.98	0.69	0.62	2.09	0.94	1.45
500 µm	0.98	2.59	5.98	2.24	2.16	3.06	1.87	1.94
250 µm	2.04	4.62	8.73	4.31	4.53	5.09	4.88	4.16
125 µm	16.30	22.10	24.15	28.68	39.02	21.70	18.68	13.11
63 µm	59.64	55.88	41.81	52.68	42.33	52.32	57.33	33.28
< 63 µm	18.89	14.00	14.04	11.26	11.25	14.82	14.89	11.12

Appendix X: Results of the macrobenthic invertebrate analysis of grab samples collected as part of the 2022 Hatston Pier habitat mapping survey.

Taxon	Qualifier	HG1	HG2	HG3	HG4	HG5	HG6	HG7	HG8
Lagotia viridis		P		P			P	P	
Animalia	eggs					P	P		
Astrorhiza							1		
Porifera								P	
Cliona									P
Bougainvilliidae			P			P			
Actiniaria								2	
Edwardsiidae		3	1	1	2	1		1	
Virgularia mirabilis		2	13						
Nemertea		1	2	7	4	2	5	3	6
Nematoda		54	4	67	27	16	6	4	1
Sipuncula	juvenile							7	1
Annelida	bits	FRAG		FRAG	FRAG			FRAG	
Harmothoe		1					2	4	4
Harmothoe aspera							1	1	
Harmothoe extenuata				1				1	1
Harmothoe impar				2					
Gattyana cirrhosa							1		
Malmgrenia arenicolae						1			
Pholoe baltica		2			1	1			
Pholoe inornata		3			1	1	1	1	
Sthenelais boa							1		2
Sthenelais limicola						4			
Phyllodocidae	sp. indet				1				
Eteone longa	agg.		1	2			1		
Phyllodoce mucosa		3	2	2	3		6	2	4
Pseudomystides limbata		4		1	4	2		1	
Eumida	indet.	5		1					1
Eumida bahusiensis		1							
Eumida sanguinea					1	1	2	1	2

Taxon	Qualifier	HG1	HG2	HG3	HG4	HG5	HG6	HG7	HG8
Tomopteris nisseni						1			
Oxydromus flexuosus		5	1			2	4		1
Oxydromus				1	4				
Syllidia armata		4		4			3	5	
Autolytinae							1		
Odontosyllis fulgurans								1	
Odontosyllis gibba							4	4	1
Syllides benedicti									1
Eurysyllis tuberculata		1							
Syllis armillaris							1	4	
Exogoninae	epitoke				2				
Brania pusilla								1	
Parexogone hebes		65	6	33	120	34	6	10	15
Exogone naidina		16	2	4	44	2		1	
Prosphaerosyllis tetralix		7		2					
Sphaerosyllis taylori		3	1		2				
Scoloplos armiger			1	3			1		1
Platynereis				2			1	2	
Nephtys	juvenile	61	32	38	41	29	7	13	7
Nephtys hombergii		21	10	13	12	10	7	5	6
Magelona filiformis			2		5			1	
Lysidice unicornis									1
Ophryotrocha		4	2	2	10	16	1		1
Lumbrineris	nr. cingulata	7	2	3	3	5	3	1	3
Aricidea (Aricidea) wassi				1	1				
Pygospio elegans		7	3	5	35				
Aurospio banyulensis		19			6	1	1	1	
Spio decorata					3				
Spio symphyta		4	2	2	1				1
Prionospio cirrifera		1		2					

Taxon	Qualifier	HG1	HG2	HG3	HG4	HG5	HG6	HG7	HG8
Prionospio fallax		36	26	8	119	44	6	11	2
Prionospio multibranchiata		1			1				
Spiophanes bombyx					1	3			
Spiophanes kroyeri		1	3	1	5	4		4	
Dipolydora flava		2	8	14	4	15	1	4	6
Pseudopolydora pulchra		7	1	6	5	5	1	9	2
Chaetozone setosa		11	7	20	18	11	8	6	9
Cirratulus	juvenile								2
Cirratulus cirratus							2	4	1
Macrochaeta				1	1				
Ophelina acuminata				1					
Pherusa plumosa			1				3	2	
Diplocirrus glaucus		46	3	10	22	13	6	1	2
Capitella		2		2	6			1	1
Notomastus		6	5	19	12	9	10	4	4
Mediomastus fragilis		2	4	56		4	8	2	10
Rhodine	indet.			1					16
Leiochone	indet.		6	1			5	4	2
Leiochone leiopygos		110	26		113	42	1		
Praxillella affinis		1	3	1		6			
Praxillella praetermissa		3	1		2	2			
Praxillura longissima								2	
Euclymene oerstedii		48	26	9	68	71	44	24	52
Euclymene lombricoides									1
Proclymene muelleri								1	
Galathowenia oculata		108	19	5	243	88	25	7	7
Myriochele						1			
Owenia		2	3	5	5	9	13	8	4
Amphictene auricoma					1				
Ampharete lindstroemi		19	6	15	16	16	1	3	

Taxon	Qualifier	HG1	HG2	HG3	HG4	HG5	HG6	HG7	HG8
Terebellidae	indet.			1					
Pista mediterranea								1	
Lanice conchilega							1		8
Neoamphitrite edwardsii		1							
Amphitritides gracilis									1
Eupolymnia nesidensis							1		
Terebellides	indet.	22	4	12	11	9	7	6	2
Sabellidae	indet.			2	1	2		1	2
Branchiomma bombyx							8	11	8
Chone fauveli		1	5				3		
Jasmineira	indet.						1		1
Jasmineira caudata				1			1		1
Parasabella cambrensis			3		1	1	14	8	3
Sabella pavonina							6	3	
Tubificoides amplivasatus									1
Tubificoides benedii				1					
Tubificoides insularis				1					
Tubificoides pseudogaster	agg.			2	1			1	1
Limnodriloides		2			3			1	
Anoplodactylus petiolatus							3		
Phoxichilidium femoratum							1		
Crustacea		FRAG			FRAG		FRAG		
Copepoda		8		1	18	13	2		
Myodocopida		19	2	23	13	60	39	25	37
Podocopida		1		2					
Erythrops elegans			1	1					
Nebalia kocatasi							1		
Nebalia strausi							1	1	1
Sarsinebalia urgorrii		1							
Caprella mutica	female			1					

Taxon	Qualifier	HG1	HG2	HG3	HG4	HG5	HG6	HG7	HG8
Pariambus typicus				4	29	14	1		
Phtisica marina		2	17	20	2	12	109	19	8
Pseudoprotella phasma							2		
Lysianassidae	juvenile			1					
Perrierella audouiniana							2		
Lysianassa ceratina				1			3	4	
Tryphosa nana		1	1						
Tryphosites longipes					1	1			
Lepidepecreum longicorne							5		
Iphimedia obesa							4		1
Peltocoxa brevirostris							1		
Metaphoxus fultoni		1				1			
Harpinia antennaria		14	13		60	93	23	15	23
Harpinia crenulata		29	13	21	53	3	25	18	5
Harpinia laevis		3		3	7	7			1
Harpinia pectinata			1	3			33	20	10
Deflexilodes subnudus								1	1
Perioculodes longimanus		15	5	8	5	5	8	4	2
Synchelidium maculatum		1	3	6	4		5	3	
Westwoodilla caecula		10	3	5	1	2	6	10	
Urothoe elegans			2	9	13	14	2	3	1
Argissa hamatipes		1		2	5	9			
Leucothoe lilljeborgi		2	5	10	5	8	4	1	1
Ampelisca	juvenile	21	6	81	103	1	56	45	22
Ampelisca brevicornis				1					
Ampelisca diadema								3	
Ampelisca provincialis		5	9	118	33	8	64	114	103
Aoridae	female	14	5	31	3	5	12	10	8
Leptocheirus pectinatus		19		3	33	7	2		1
Microdeutopus anomalus				1			1	3	2

Taxon	Qualifier	HG1	HG2	HG3	HG4	HG5	HG6	HG7	HG8
Cheirocratus	female	2		11	15		12	3	2
Cheirocratus intermedius				1			4	7	3
Microprotopus maculatus			1			2			
Gammaropsis maculata		3		8	2	1	5	4	
Photis longicaudata		3	7	5	10	39	10	19	5
Megamphopus cornutus		1	1	1	2	3	1	1	1
Ericthonius	female			4			4		
Ericthonius punctatus				2			4	1	
Centraloecetes kroyeranus						9			
Corophiidae	sp. indet					2	5		
Monocorophium sextonae				1	1		2	2	
Dexamine spinosa							1		1
Tritaeta gibbosa				2					
Nototropis vedlomensis				1		1	1		1
Astacilla dilatata		3			1	5			
Eurydice pulchra					1	1			
Pseudoparatanais batei							1		
Tanaissus danica		87	13	28	136	62	20	11	7
Diastylidae	juvenile	3		2					
Diastylis rugosa		11	3	4	3	5	3	3	
Cumella (Cumella) pygmaea					1				
Eudorella truncatula		51	3	9	31	13	3	4	2
Pseudocuma (Pseudocuma) longicorne		3							
Decapoda	bits			FRAG					
Liocarcinus	sp. Juv								1
Cylichna cylindracea							1		
Diaphana minuta							1		
Laona quadrata		12	9		2	1	1		
Turritellinella tricarinata			2						
Odostomia unidentata		4	6	2			2	3	

Taxon	Qualifier	HG1	HG2	HG3	HG4	HG5	HG6	HG7	HG8
Pyrgiscus crenatus							1		1
Onoba semicostata									1
Rissoa parva				6				2	
Vitreolina philippi		1							
Buccinum undatum	juvenile	1							
Bivalvia	siphon				FRAG				
Nucula nucleus				1	2		1	1	
Anomiidae	juvenile			3			1	1	
Mytilidae	juvenile	1							
Musculus discors				1					
Parvicardium exiguum		1							
Parvicardium pinnulatum				2			1		
Parvicardium scabrum					1		1		
Acanthocardia echinata	juvenile	1							
Thyasira flexuosa		81	54	8	42	72	24	17	17
Kurtiella bidentata		44	11	1	27	59	4		4
Abra	juvenile	13		7					
Abra alba		3	1	2	4	3	7	1	2
Abra nitida		3	1	1	2		2		1
Mysia undata		1				1			
Myrtea spinifera			1						
Lucinoma borealis								1	1
Lucinoma borealis	juvenile				2		1	1	1
Chamelea striatula					1		1	1	
Chamelea striatula	juvenile	3							
Gari fervensis	juvenile		1						
Myidae	juvenile	1		1					
Mya arenaria							1	2	1
Phaxas pellucidus					1	2			
Mactridae	juvenile	1	1						

Taxon	Qualifier	HG1	HG2	HG3	HG4	HG5	HG6	HG7	HG8
Thracia phaseolina			1						
Phoronis		1	2	1	1	2	1		3
Ophiuroidea		FRAG			FRAG	FRAG	FRAG		
Ophiura albida							1	1	
Ophiura ophiura			1						
Amphiuridae	juvenile	1							
Acrocnida brachiata			1			1			
Amphiura filiformis		3			5	5	1		
Amphipholis squamata			2		2		4	2	
Ophiothrix fragilis	juvenile			11					
Cucumariidae	juvenile	1				FRAG			
Leptosynapta bergensis					2				
Paraleptopentacta elongata							1		
Ascidiacea	juvenile						1	1	
Ascidiella aspersa							1		
Didemnidae								P	
Chlorophyta	Filamentous greens			P					
Corallinaceae		P		P		P	P	P	P
Rhodophyta									P
Rhodophyta	Encrusting red						P		P
Plocamium cartilagineum				P					
Ochrophyta	Encrusting brown	P		P		P	P	P	P

Plastics		P	P	P	P	P	P	P	P
Plastic fibres		P	P	P	P	P	P		
Plastic film			P					P	
Paint chips				P	P	P	P	P	P
Metal								P	