Benthic Habitat Mapping: Laxey Bay Marine Nature Reserve

M.J. Garratt, C. Allison, J. Patel, I.S.M. Bloor, J.A. Emmerson & S.R. Jenkins

Bangor University Sustainable Fisheries and Aquaculture Group
School of Ocean Sciences

Report to Isle of Man Government, Department of Environment, Food and Agriculture

Contact: i.bloor@bangor.ac.uk

November 2022

To cite this report: Garratt, M. J., Allison, C., Patel, J., Bloor, I. S. M., Emmerson, J. A. and Jenkins, S. R. (2022). Benthic Habitat Mapping: Laxey Bay Marine Nature Reserve. Sustainable Fisheries and Aquaculture Report (IoM), Bangor University. pp. 1 – 18.

1. Introduction

Coastal benthic habitats provide important ecosystem services including food production, nutrient cycling, carbon sequestration and abiotic resources (Hall *et al*., 2002; Barbier *et al*., 2011). Marine Protected Areas (MPAs) offer a means of safeguarding benthic habitats and their associated functions, promoting increased biodiversity and biomass of commercially-targeted species (Halpern & Warner, 2002; Beukers-Stewart *et al*., 2005; Howarth *et al*., 2011). In the Isle of Man, 52% of the coastal territorial sea (0-3 nm) is designated within MPAs (defined as Marine Nature Reserves), with the aim of protecting priority habitats such as maerl beds, horse mussel reefs and seagrass, and supporting the fishing industry (DEFA, 2018; Howe, 2018). The most valuable fishery in Manx waters (*Pecten maximus*) is reliant on benthic habitat features such as coarse gravel, hydroids and bryozoans (Brand *et al*., 1980; Harvey *et al*., 1993; Duncan & Emmerson, 2018).

Benthic habitat and biotype mapping is therefore an important tool in marine management with regard to conservation, fisheries sustainability and marine-based resources (Harris & Baker, 2012). The general distribution of benthic habitats in the Manx territorial sea (0-12 nm) is well-established (Hinz et al., 2010; White, 2011). However there is a need for finer scale surveys in areas of conservation interest in order to account for some habitats and species that have very restricted distributions and to contribute data to management and monitoring efforts. This report forms part of an ongoing camera survey project to assess benthic habitats within the Isle of Man's Marine Nature Reserves (MNRs), and presents the results for Laxey Bay MNR.

2. Methods

2.1 Location

Laxey Bay MNR is located on the East of the Island and extends from Carrick Roayrt south to Clay Head and covers an area of around 4 km^2 (Figure 1).

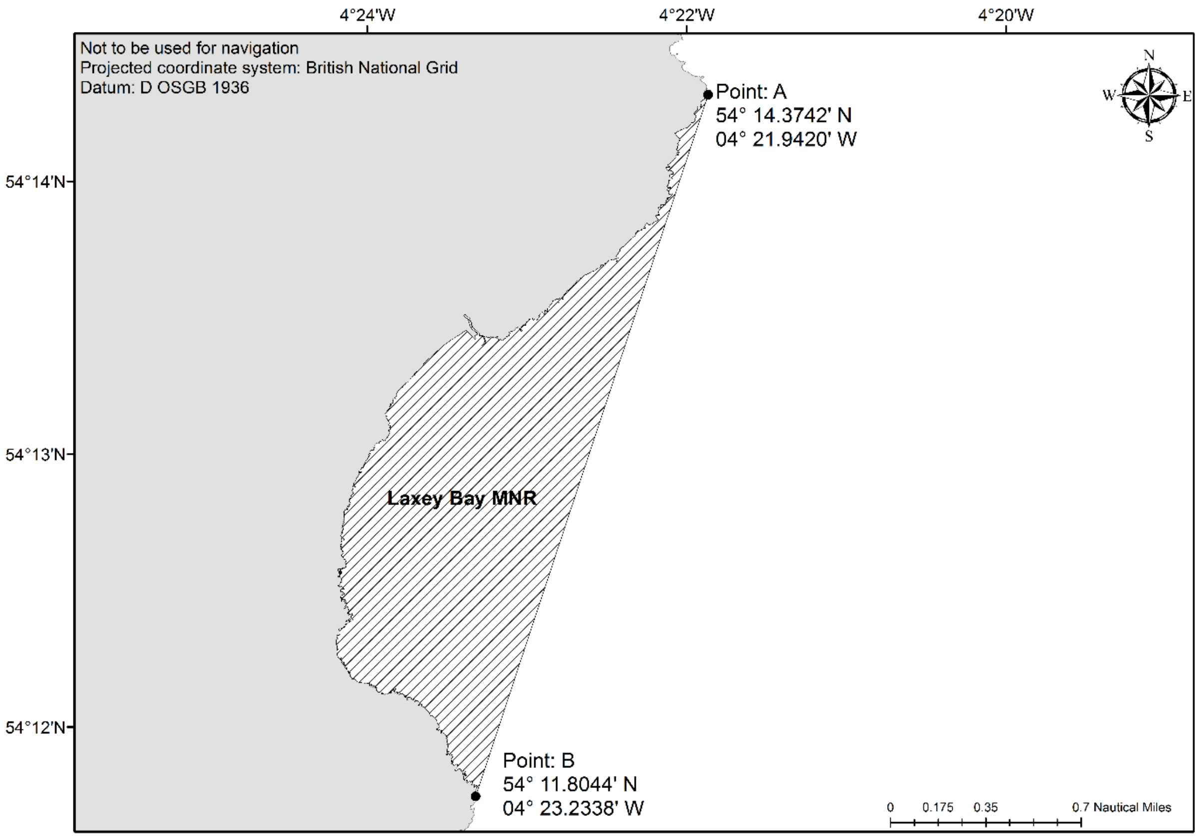

Figure 1: Map showing the location of the Laxey Bay Marine Nature Reserve.

2.2 Data collection

Benthic images were collected using a "video sledge" (Figure 2), consisting of a metal frame on skids towed along the seabed with cameras and lights attached. As surveying took place within an MNR, the sledge was designed to minimise the amount of contact with the seabed. Two cameras in waterproof housings were used throughout the survey: a Canon EOS 400D set to take a flash photograph every 10 seconds (Field of View (FOV) 44x29 cm), and a GoPro HERO3 to capture continuous video footage (FOV ~62x35 cm). These cameras were attached to a raised frame in the centre of the sledge and oriented to face the seabed, along with 2 underwater lights (RSL Ultra 1, 800 + Lux, RovTech Solutions Ltd) to illuminate the sea floor.

Figure 2: Photograph of the equipment used to collect benthic image data, designed to "ski" along the seabed with minimal damage. Cameras and lights were attached to the central raised unit.

The Laxey Bay camera survey took place on June 14th and 15th 2016 from the Fisheries Protection Vessel (F.P.V.) Barrule. Six (6) 1-hour transects (~1 knot) were completed within Laxey Bay MNR , with the aim of collecting an even distribution of data throughout the area. This resulted in a 60-minute video clip and 360 photographs from each tow. To allow photographs to be geo-referenced, GPS data (including time and vessel speed) was recorded every 30 seconds throughout the survey onboard the vessel, in addition to the start and end times of each camera tow.

2.3 Image Analysis

From each transect every 6th still photograph was selected for analysis (one per minute of tow), due to time constraints and the general consistency in biotope type along transects, which was relatively homogeneous. Prior to analysis, the photographs were assessed for clarity and quality using a standardised scoring technique adapted from Hannah & Blume (2012) (Table 1).

Table 1: Scoring system used to determine the suitability of photographs for image anlaysis (Hannah & Blume, 2012).

Table 1: Score	Visibility	Quality
0	View **completely** obscured by close-up species or suspended sediment	Photograph **completely** blurred or major problems with lighting or camera angle
1	View **largely** (>50%) obscured by close-up species or suspended sediment	Photograph **largely** (>50%) blurred or some problems with lighting or camera angle
2	View **partly** (<50%) obscured by close-up species or suspended sediment	Photograph **partly** (<50%) blurred or minor problems with lighting or camera angle
3	Clear field of view/negligible obstruction	Clear photograph/negligible quality issues

Any selected images scoring 0 or 1 in either category were omitted and replaced by that directly succeeding or preceding (randomised), assuming the alternative photograph met the given criteria. In rare cases where there were no good quality alternatives available, images scoring 1 in either category were accepted.

Images were then analysed using point sampling (Figure 3) using the software ImageJ (Schneider, Rasband and Eliceiri, 2012). To estimate percentage cover, a 5×8 grid was overlain over each image, then the substrate or organism beneath each point was counted and recorded, with each point representing 2.5% cover. Sediment cover was split into 5 main categories – sand/mud, gravel, pebble, boulder, and shell. Gravel, pebble, and boulder were distinguished by the size of stones that points fell on, though no strict parameters were set for distinguishing between gravel and pebble; distinctions between these groups were largely subjective.

The presence of any flora or fauna was recorded, with species identified to the lowest possible taxonomic level, or with a suitable physical description when necessary – e.g. for organisms too small to identify, or that could not be seen clearly in the image. Abundance data was recorded for epifaunal species whose frequencies could be feasibly counted, e.g. crustaceans or fish, otherwise only presence or absence was recorded.

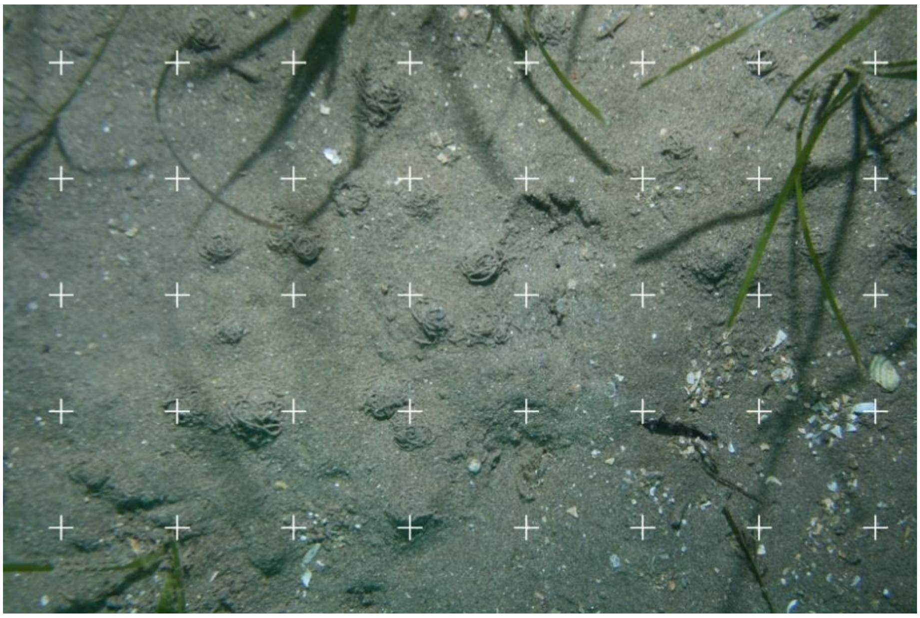

Figure 3. Image demonstrating the standardised point sampling grid used to extract percentage cover data, with each point representing 2.5% of the image.

2.4 Habitat Classification

Images were categorised into habitat types using the EUNIS habitat classification system (JNCC, 2015). The EUNIS system is a hierarchical classification procedure, which distinguishes habitats firstly into broad substrate categories before incrementally adding more detail regarding the biological community (Table 2). The expandable EUNIS habitat list on the JNCC website (https://mhc.jncc.gov.uk/) was used to qualitatively assign habitats based on a combination of video footage and still images. Each analysed image was assigned a EUNIS habitat code to the appropriate resolution (level 4, 5 or 6) based on the species present.

Table 2: Example of the EUNIS hierarchical approach to habitat classification.

Level	Category	Example	Code
Level 1	Environment	Marine	–
Level 2	Broad habitat type	Sublittoral sediment	SS
Level 3	Habitat complex	Sublittoral mixed sediment	SS.SMx
Level 4	Biotope complex	Circalittoral mixed sediment	SS.SMx.CMx
Level 5 & 6	Biotope and sub-biotope	*Cerianthus lloydii* with *Nemertesia* spp. and other hydroids in circalittoral muddy mixed sediment	SS.SMx.CMx.ClloMx.Nem

2.5 Mapping and Data Analysis

The aforementioned recordings of GPS co-ordinates taken approximately every 30 seconds were associated with their respective images. A benthic habitat map was constructed based on EUNIS habitat classification informed by sample images and tow video footage. Benthic habitat maps were constructed using the Euclidean Allocation function in ArcGIS Version 10.8.1. Euclidean allocation analysis used the positions and habitat designations to extrapolate habitat types of the surrounding, non-sampled area to construct habitat maps that encompassed the entire MNR.

Once EUNIS assignments were completed, ANOVAs were performed along with Tukey HSD post hoc tests ($\alpha = 0.05$) to determine which habitats significantly differed from one another in terms of species richness. Each habitat was also assigned a substrate category based on whether it was 'hard,' 'soft,' or 'mixed,' with any significant differences between habitats then compared with their respective substrate categories.

3. Results

3.1 Distribution of sampled images

The raw dataset was subset to every 6^{th} image, then image quality and visibility was assessed as per the methodology. A total of 377 still images constituted the dataset for further analysis (Figure 4). Areas that are far from a sampled datapoint (e.g. the northernmost extent of the Laxey MNR) are less reliable due to extrapolation.

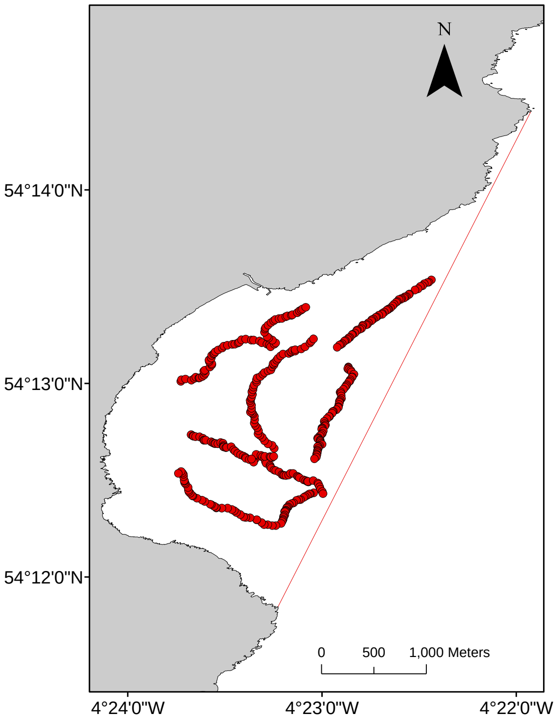

Figure 4. Distribution of sampled images from Laxey Bay (*n* = 377). Red circles represent the location of each still image, red lines indicate the extent of the MNR.

3.2 Benthic Image Analysis, Statistical Analysis & Habitat Maps

3.2.1 Image Overview

The majority of benthic images from the Laxey MNR contained sand/mud at percentage covers upwards of 80%. Those that didn't contain sand/mud were instead covered by dead maerl and/or shell fragments, indicative of damage from previous benthic trawling. In total, 62 taxa were identified from 12 different phyla (see Appendix I). Living maerl *Phymatolithon calcareum* was identified in 13 sampled images, with percentage covers between 2.5 and 15%. Worm casts were observed in numerous images containing sand/mud. These were generally similar in appearance (Figure 5), and indicative of the lugworm *Arenicola marina*.

Figure 5. Image of 3 lugworm (*Arenicola marina*) casts from a benthic image taken from the Laxey MNR.

In terms of epifauna, the main observed species were hermit crabs *Pagurus prideaux*, which was identified in 10 images. Eight of these individuals also carried the cloak anemone *Adamsia palliata* on their shells. Epifaunal species appeared to be sparsely distributed. In total, 64 species were identified/ described from the Laxey dataset.

A notable observation was the presence of the fan mussel *Atrina fragilis* within the Laxey Bay MNNR. This single observation was made whilst reviewing images and was not part of the formalised set of images processed.

3.2.2 Laxey EUNIS

Using the EUNIS classification system, 6 unique biotopes were identified in the Laxey MNR (Table 3; Appendix II). Both Maerl on Hard Substrate and Maerl and Echinoderms on Hard Substrate were very similar habitats in appearance, differing more in community composition, as some areas contained significantly more *Nemertesia* spp. and *Cerianthus lloydii*.

Table 3. Benthic habitat types determined by EUNIS classification in Laxey Bay MNR, substrate category for comparisons (soft, mixed, or hard), and the number of images comprising these biotopes. The average similarity alongside the taxa contributing >25% of the within-group similarity from SIMPER analysis are also reported.

Habitat Number, JNCC Code and EUNIS Habitat Name	**In-text Habitat Name**	**Substrate category**	**Images**	**Average similarity (%)**	**Characterising taxa**
1 – SS.SMu.CSaMu Circalittoral Sandy Mud	Circalittoral Sandy Mud	Soft	259	59.9	Worm Casts
2 – SS.SMp.SSgr.Zmar *Zostera marina/angustifolia* beds on lower shore or infralittoral clean or muddy sand	Zostera Sand	Soft	18	58.2	Worm Casts
3 – SS.SSa.IMuSa Infralittoral Muddy Sand	Infralittoral Muddy Sand	Soft	53	63.6	Brown Algae Film
4 – SS.SMp.Mrl.PCal *Phymatolithon calcareum* maerl beds in infralittoral clean gravel or coarse sand	Maerl on Hard Substrate	Hard	8	48.4	Unidentified Hydroid/Bryozoan spp.

5 – SS.SCS.ICS Infralittoral Coarse Sediment	Infralittoral Coarse Sediment	Mixed	20	34.1	Brown Algae Film, Maerl
6 – SS.SMp.Mrl.PCal.Nmix *Phymatolithon calcareum* maerl beds with *Neopentadactyla mixta* and other echinoderms in deeper infralittoral clean gravel or coarse sand	Maerl and Echinoderms on Hard Substrate	Hard	19	28.5	Maerl, Unidentified Hydroid/Bryozoan spp.

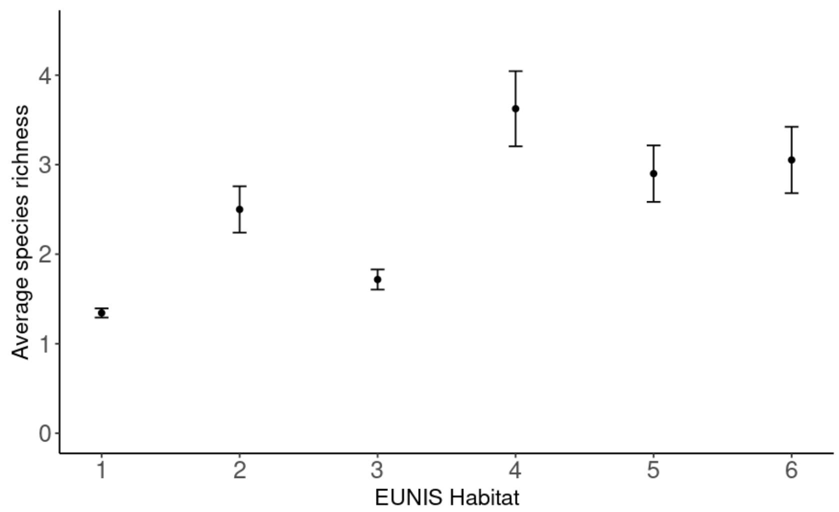

Figure 6. Mean (±SE) species richness per image (*n* = 8-259) for each Laxey EUNIS biotope.

Mean species richness significantly varied between EUNIS biotopes ($F_{(5,371)}$=31.2, $p < 0.001$) (Figure 6), with species richness apparently greatest in hard and mixed substrates (Habitats 4, 5, and 6).

Tukey HSD post hoc found that average species richness was significantly lower in Circalittoral Sandy Mud than every other habitat at a 95% confidence level – apart from Infralittoral Muddy Sand (Table 4). Infralittoral Muddy Sand, another soft substrate habitat, also featured significantly lower species richness compared to the other hard/mixed substrates identified. In summary, analysis of species richness between EUNIS habitat types supports the hypothesis of species richness being greater in habitats with harder substrates than softer substrates.

Table 4. Table showing Tukey HSD outputs at a 95% confidence level from ANOVA of species richness between Laxey EUNIS habitats. Within each pairwise comparison, the habitat with the lower mean species richness is listed on the left side, while the habitat with greater species richness is listed above. Substrate categories are also listed adjacent to each habitat label. Only results for which $p \leq 0.1$ are included. Adjusted p reported to 3 decimal places.

			Habitat with greater Species Richness				
			Soft		**Mixed**	**Hard**	
			Zostera Sand	Infralittoral Muddy Sand	Infralittoral Coarse Sediment	Maerl on Hard Substrate	Maerl and Echinoderms on Hard Substrate
Habitat with lower Species Richness	**Soft**	Circalittoral Sandy Mud	<0.001	0.090	<0.001	<0.001	<0.001
		Zostera Sand	-	0.028	-	0.056	-
		Infralittoral Muddy Sand	-	-	<0.001	<0.001	<0.001

3.2.3 Laxey Benthic Habitat Maps

Benthic habitat maps based on EUNIS habitat types were constructed using Euclidean Allocation in ArcGIS 10.8.1 (Figure 7).

The map map poses that the majority of the MNR is Circalittoral Sandy Mud, with lesser instances of Infralittoral Muddy Sand. Since some Circalittoral Sandy Mud was allocated close to the coastline, it is likely that some of this habitat blends with an infralittoral counterpart, with the transects being too far to detect this change. A blend of hard and mixed substrate habitats made up the area of the MNR around 4°23'W, between latitudes of 54°12'N and 54°13'N.

The Laxey Eelgrass Conservation Zone did not fully align with the designated Zostera Sand determined by Euclidean Allocation. This could be in part due to the patchiness of the sampling methodology leading to instances of *Zostera marina* not being recorded, as isolated clumps were what primarily determined their designations. *Z. marina* was located on circalittoral sandy mud, hence according to the produced habitat map, the species may expand into the surrounding space over a longer timeframe. The current habitat map suggests *Z. marina* may be expanding northwards, with an apparently isolated extent north of 54°13'N.

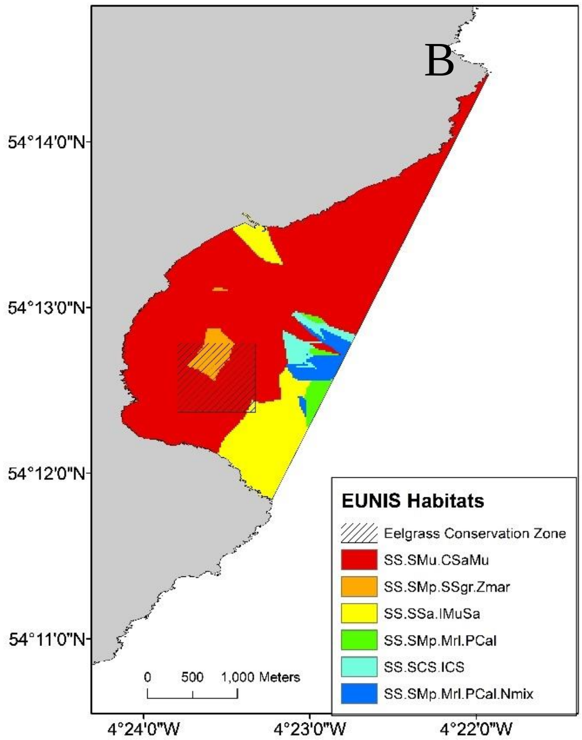

Figure 7. Benthic habitat map of Laxey produced by Euclidean allocation EUNIS habitat types.

3.3 Scallop Densities

The mean density of scallops in each of the six (1 hour) video tows ranged from 0 to 3 per 100 m^2, with four of the six tows recording no scallops per 100 m^2. The only tow with densities of scallops recorded was within maerl beds (SS.SMp.Mrl) and circalittoral fine sand (SS.SSa.CFiSa).

4. Discussion

Laxey Bay MNR was dominated by sandy/muddy substrate, containing only small patches of coarser sediment, and therefore the most common species were annelids. No rocky habitats were present in the survey area, resulting in low seaweed cover and epifaunal species richness compared to other MNRs (Port Erin, Niarbyl, Ramsey, Douglas and Baie ny Carrickey). However two important habitats of conservation priority were present, maerl beds (SS.SMp.Mrl) in deeper water at the boundary of the MNR, and seagrass beds (SS.SMp.SSgr.Zmar) in patches in shallower water. This survey (2016) showed that eelgrass had shown a limited northward extension beyond the eelgrass conservation zone. However a recent drop down camera survey by Rob Annett in November 2022 has shown a substantial northward extension of Eelgrass well beyond this point (pers comm Peter Duncan). Most maerl was dead, though 7% of images did contain small areas of live maerl. Species of commercial interest were rare in Laxey Bay, with scallop density averaging lower than other MNRs (Port Erin, Niarbyl, Ramsey, Baie ny Carrickey) due to the lack of complex habitat. Additionally a single observation of the conservation priority species *Atrina fragilis* was recorded.

5. References

Allison, C. (2016). Assessing the association between scallops, *Pecten maximus*, and the benthic ecosystem within the Isle of Man marine reserves. MSc Thesis, Bangor University.

Barbier, E. B., Hacker, S. D., Kennedy, C., Koch, E. W., Stier, A. C., & Silliman, B. R. (2011). The value of estuarine and coastal ecosystem services. *Ecological monographs*, *81*(2), 169-193.

Beukers-Stewart, B. D., Vause, B. J., Mosley, M. W., Rossetti, H. L., & Brand, A. R. (2005). Benefits of closed area protection for a population of scallops. *Marine Ecology Progress Series*, *298*, 189-204.

Brand, A. R., Paul, J. D., & Hoogesteger, J. N. (1980). Spat settlement of the scallops Chlamys opercularis (L.) and Pecten maximus (L.) on artificial collectors. *Journal of the Marine Biological Association of the United Kingdom*, *60*(2), 379-390.

DEFA. (2018). Marine Nature Reserves [Online]. [Accessed 23/07/19]. Available from: https://www.gov.im/about-the-government/departments/environment-food-and-agriculture/ecosystem-policy-and-energy/wildlife-biodiversity-and-protected-sites/protected-sites/marine-nature-reserves/

Duncan P. F., & Emmerson J. A. (2018). Commercial Fisheries & Sea Angling. In: Manx Marine Environmental Assessment (2nd Ed.). Isle of Man Government. 71 pp.

Hall, S. J. (2002). The continental shelf benthic ecosystem: current status, agents for change and future prospects. *Environmental Conservation*, *29*(3), 350-374.

Halpern, B. S., & Warner, R. R. (2002). Marine reserves have rapid and lasting effects. *Ecology letters*, *5*(3), 361-366.

Hannah, R. W., & Blume, M. T. (2012). Tests of an experimental unbaited video lander as a marine fish survey tool for high-relief deepwater rocky reefs. *Journal of Experimental Marine Biology and Ecology*, *430*, 1-9.

Harris, P. T., & Baker, E. K. (2012). Why map benthic habitats? In *Seafloor geomorphology as benthic habitat* (pp. 3-22). Elsevier.

Harvey, M., Bourget, E., & Miron, G. (1993). Settlement of Iceland scallop *Chlamys islandica* spat in response to hydroids and filamentous red algae: field observations and laboratory experiments. *Marine Ecology Progress Series*, *99*, 283-283.

Hinz, H., Murray, L.G., Gell, F., Hanley, L., Horton, N., Whiteley, H., and Kaiser, M.J. (2010). Seabed habitats around the Isle of Man. Fisheries & Conservation report No. 12, Bangor University. pp.29

Howarth, L. M., Wood, H. L., Turner, A. P., & Beukers-Stewart, B. D. (2011). Complex habitat boosts scallop recruitment in a fully protected marine reserve. *Marine Biology*, *158*(8), 1767-1780.

Howe, V. L. (2018). Subtidal Ecology. In: Manx Marine Environmental Assessment (2nd Ed). Isle of Man Government. pp 48.

JNCC. (2015). The Marine Habitat Classification for Britain and Ireland Version 15.03 [Online]. [Accessed 10/06/29]. Available from: jncc.defra.gov.uk/MarineHabitatClassification

Schneider, C. A., Rasband, W. S., & Eliceiri, K. W. (2012). NIH Image to ImageJ: 25 years of image analysis. *Nature Methods*, *9*, 671-675.

White, S. (2011). Biotope distribution and susceptibility to fishing pressure. MSc Thesis, Bangor University.

Appendices

Appendix I

List of taxa identified from benthic images taken from the Laxey MNR.

Phylum	Taxon
Porifera	Orange encrusting sponge sp.
	White encrusting sponge sp.
Bryozoa	Bugula flagellata
	Vesicularia spinosa
	Eucratea loricata
Cnidaria	Adamsia palliata
	Cerianthus lloydii
	Peachia cylindrica
	Nemertesia antennina
	Nemertesia ramosa
	Hydrallmania falcata
	Laomedea angulata
	Unidentified Hydroid sp.
Arthropoda	Pagurus bernhardus
	Pagurus prideaux
	Family Paguridae
	Corystes cassivelaunus
	Galathea intermedia
	Macropodia sp.
	Family Porcellanidae
	Pomatoceros triqueter (tubes)
	Family Spirorbidae (tubes)
	Balanus sp.
Annelida	Eupolymnia nebulosa
	Lanice conchilega
	Family Sabellidae
	Burrowing worm spp.
	Arenicola marina (casts)
Mollusca	Glycymeris glycymeris
	Spisula elliptica
	Aequipecten opercularis
	Lutraria lutraria (siphons)
	Patella sp.

Phylum	Taxon
Mollusca (cont.)	Unidentified bivalve sp.
	Euspira nitida
	Turritella communis
	Buccinum undatum
	Family Lacuninae
Echinoderms	Psammechinus miliaris
	Echinocardium cordatum
	Asterias rubens
	Ophiura ophiura
Chordata	Callionymus lyra
Rhodophyta	Phymatolithon calcareum
	Encrusting maerl sp.
	Phycodrys rubens
	Fine Rhodophyta spp.
	Branching Rhodophyta spp.
	Encrusting Rhodophyta spp.
Phaeophyta	Himanthalia elongata
	Dictyota dichotoma
	Chordraria flagelliformes
	Laminaria sp.
	Saccharina latissima
	Fine Phaeophyceae spp.
	Flat Phaeophyceae spp.
	Branching Phaeophyceae sp.
	Dark Brown encrusting algae sp.
	Brown encrusting algae sp.
Chlorophyta	Ulva spp.
	Chaetomorpha spp.
	Fine Chlorophyta spp.
Angiosperms	Zostera marina

Appendix II

Biotopes identified in Laxey Bay MNR using EUNIS habitat classification. Descriptions informed by JNCC website, accessible via the URL: https://mhc.jncc.gov.uk/

Biotope code: SS.SMu.CSaMu

Biotope description: Circalittoral Sandy Mud

Wave exposure: Exposed to Very sheltered

Tidal streams: Moderately strong (1-3 knots) to Very weak (negligible)

Substratum: Mud with significant fine to very fine sand fraction

Zone: Circalittoral

Depth range: 5-100m

Description: Generally found in deeper areas of bays and marine inlets or offshore from less wave exposed coasts. Few floral and epifaunal species. Some hermit crabs (*Pagurus prideaux* and *Pagurus bernhardus*) and sea pens (*Nemertesia* spp.) observed, but sparsely distributed. Many worm casts indicative of lugworms (*Arenicola marina*). Sparsely scattered, small shell fragments were observed throughout this habitat. This was the most widely occurring habitat, though areas may differ in detailed substrate properties or by infaunal communities.

Biotope code: SS.SMp.SSgr.Zmar

Biotope description: *Zostera marina/angustifolia* beds on lower shore or infralittoral clean or muddy sand

Wave exposure: Moderately exposed to Extremely sheltered

Tidal streams: Moderately strong to Very weak

Substratum: Clean sand to muddy fine sand or mud

Zone: Infralittoral

Depth range: 0-10m, Lower shore

Description: Expanses of clean or muddy fine sand and sandy mud in shallow waters, similar to SS.SMu.CSaMu, but with patches of eelgrass (*Zostera marina*) throughout. The hydroid *Laomedea angulata* was also observed in this habitat, sometimes attached to eelgrass blades. Other species observed less consistently include hermit crabs *Pagurus bernhardus* and *Pagurus prideaux*, and various macroalgal species – both of Rhodophyta and Phaeophyceae.

Biotope code: SS.SSa.IMuSa

Biotope description: Infralittoral Muddy Sand

Wave exposure: Moderately exposed to Sheltered

Tidal streams: Moderately strong to very weak

Substratum: Fine to very fine sand with a silt fraction

Zone: Infralittoral

Depth range: 0-20m

Description: Non-cohesive muddy sand (5-20% silt/clay), with highly infrequent worm casts, cover more dominated by brown algae film. Some detritus of *Laminaria* spp. also observed throughout the habitat. Likely richer infaunal diversity, composed of polychaetes and bivalves.

Biotope code: SS.SMp.Mrl.PCal

Biotope description: *Phymatolithon calcareum* maerl beds in infralittoral clean gravel or coarse sand

Wave exposure: Moderately exposed to Extremely sheltered

Tidal streams: Moderately strong to weak (<1 knot)

Substratum: Maerl gravel and sand

Zone: Infralittoral

Depth range: 0-20m

Description: Primarily dead maerl (*Phymatolithon calcareum*), though some living structures were observed. Substratum also consisted of larger shells alongside finer gravel. Various small bryozoan/hydrozoan turf species (e.g. bryozoan *Eucratea loricata*) alongside patches of small Rhodophyta spp. were observed throughout this habitat. Designations of this habitat were sparse, usually being closely associated with SS.SCS.ICS and SS.SMp.Mrl.PCal.Nmix, though differing from these by biological communities and substrate types.

Biotope code: SS.SCS.ICS

Biotope description: Infralittoral Coarse Sediment

Wave exposure: Exposed to Sheltered

Tidal streams: Strong (3-6 knots) to Very weak

Substratum: Sand with gravel, pebbles and/or shingle

Zone: Infralittoral

Depth range: 0-20m

Description: Sand with some shell fragments, dead maerl fragments and some covering brown algae. Some fragments of living maerl, alongside occasional crustacean (*Pagurus* spp. and *Macropodia* spp.) and anemone (*Cerianthus lloydii*) species. Some small bryozoan species observed, though otherwise lacking in consistently occurring flora and fauna. Often better characterised by polychaete, cumacean and bivalve communities.

Biotope code: SS.SMp.Mrl.PCal.Nmix

Biotope description: *Phymatolithon calcareum* maerl beds with *Neopentadactyla mixta* and other echinoderms in deeper indralittoral clean gravel or coarse sand

Wave exposure: Exposed to Sheltered

Tidal streams: Moderately strong to Very weak

Substratum: Maerl gravel, coarse sand

Zone: Circalittoral – upper, Infralittoral – lower

Depth range: 5-30m

Description: Similar to SS.SMp.Mrl.PCal but characterised by the occurrence of the anemone *Cerianthus lloydii*, alongside occasional starfish *Asterias rubens*. This habitat was the furthest from the shoreline, which was still of depths <20m.