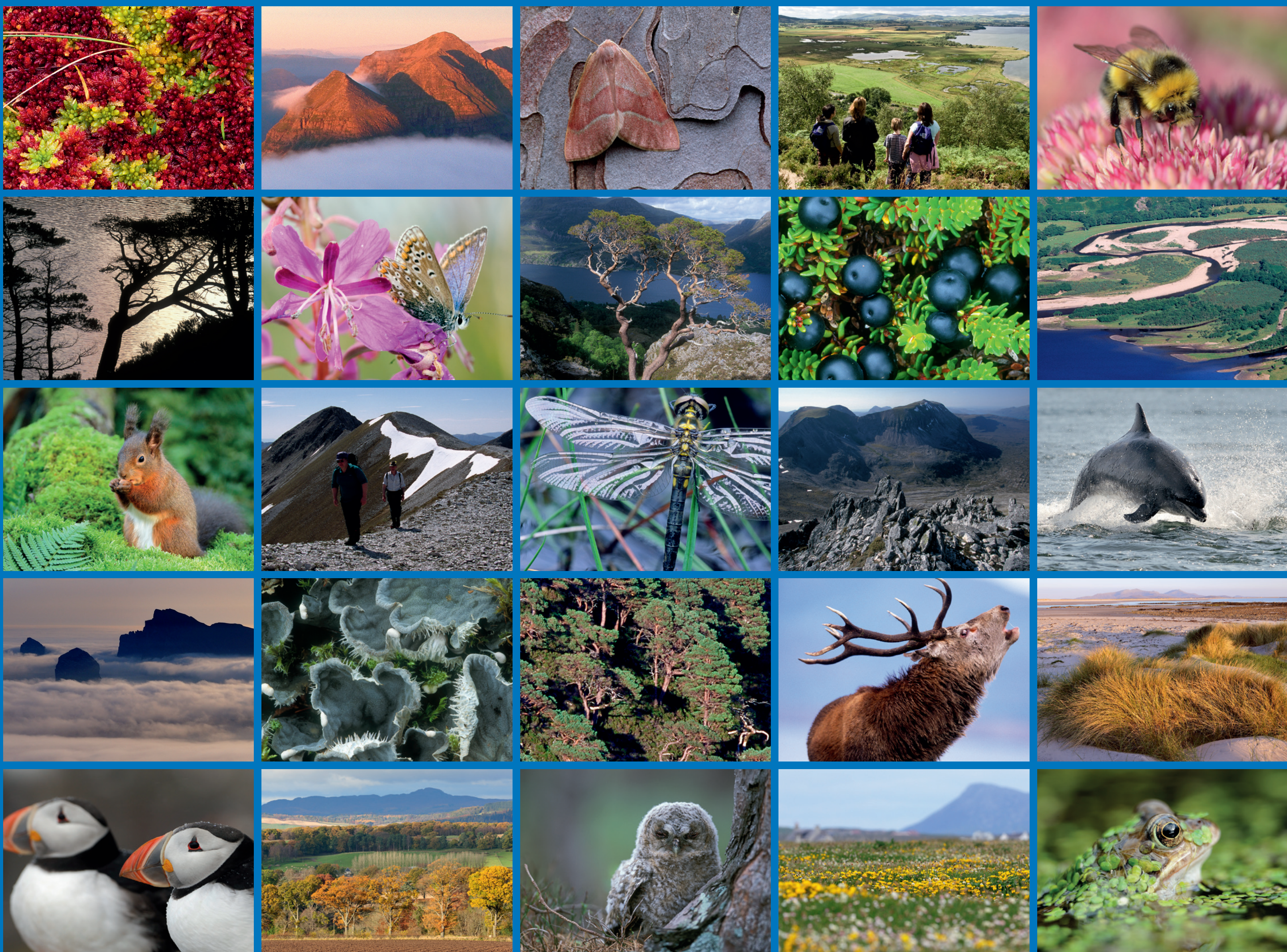
Scottish Natural Heritage
Research Report No. 882

South Arran MPA diver survey of maerl beds, kelp and seaweed communities on sublittoral sediment, and seagrass beds 2014



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RESEARCH REPORT

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South Arran MPA diver survey of maerl beds, kelp and seaweed communities on sublittoral sediment, and seagrass beds 2014

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RESEARCH REPORT

Summary

South Arran MPA diver survey of maerl beds, kelp and seaweed communities on sublittoral sediment, and seagrass beds 2014

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Keywords

MPA; South Arran; maerl beds; kelp and seaweed communities on sublittoral sediment, seagrass beds; survey; diving

Background

The South Arran Marine Protected Area was designated by the Scottish Government as one of 33 new Nature Conservation Marine Protected Areas (MPAs) in 2014.

A series of surveys were conducted around that time to collate the evidence base for the MPA and to establish a baseline against which to assess the effectiveness of any new management measures. The results of one of these surveys are presented here - a diving survey which collected detailed biological information on three of the MPA's protected features: 'maerl beds', 'kelp and seaweed communities on sublittoral sediment', and 'seagrass beds'. The results formed part of the documentation underpinning the MPA designation process.

The 'maerl beds' and 'kelp and seaweed communities on sublittoral sediment' features encompassed within the South Arran MPA have been exposed to demersal fishing activity for many years. Maerl (the collective term for several species of calcified red seaweed which in their free-living form and under favourable conditions can create extensive beds) is particularly sensitive to pressures arising from bottom-contacting fishing activity. Maerl habitats studied to date within the MPA have generally been considered to be in poor condition with a very low proportion of live maerl cover. The maerl beds feature within the South Arran MPA has therefore been assigned a 'recover' conservation objective.

A threshold of 5% cover of live maerl has been adopted for maerl biotope recognition within the MPA to align with previous studies (Moore, 2014). On this basis, beds of living maerl are currently believed to be confined to Lamlash Bay and to small pockets off the south coast (around Pladda and the Iron Rock Ledges), in areas of formerly low levels of fishing pressure. More extensive areas that incorporate clusters of records of sparse living maerl and relatively unbroken dead maerl have also been identified (including off the south of Holy Isle). These 'maerl recovery areas', which are believed to represent areas of historically richer maerl, appear to offer the most suitable targets for management action for this feature and were included within broader management proposals consulted upon at the end of 2014 (Marine Scotland, 2014).

The dive survey presented here was designed to sample different maerl beds (areas known to support living maerl exceeding 5% cover) and maerl gravel habitats (where the proportion of live maerl material was less than 5% cover) in comparable shallow infralittoral settings across the MPA. The three maerl gravel sites studied were part of the ‘kelp and seaweed communities on sublittoral sediment’ protected feature. The aims of the work were to determine the respective levels of biological diversity in these habitats and to investigate the differences in associated communities with differing proportions of live maerl. Sampling locations were established inside and outside the Lamlash Bay No Take Zone and within maerl recovery areas off Pladda and to the south of Holy Isle. Together with the other work conducted to establish a baseline of condition in the South Arran MPA, these data will aid the assessment of the effectiveness of the recently introduced management measures, and chart recovery of relevant degraded maerl habitats.

Main findings

- Two maerl beds in the South Arran MPA were surveyed in detail by divers for the first time. With 29% and 76% live maerl coverage; these beds contained by far the highest proportions of live maerl of any extant maerl beds in the Clyde. These records show that Clyde maerl beds can comprise a continuous layer of well-developed live fragments. Both beds had a relatively rich infaunal community and rich epibiota.
- One of the two newly recorded maerl beds, located in Lamlash Bay, was of the biotope **SS.SMp.Mrl.Lgla** - Lithothamnion glaciale *maerl beds in tide-swept variable salinity infralittoral gravel.* The bed was dominated by fine twigs of *L. glaciale.* This is the first instance of a record of this biotope in the Clyde. All other maerl bed records so far were of biotopes based on a different maerl species (*Phymatolithon calcareum* - **SS.SMp.Mrl.Pcal**). A detailed record of species associated with this new biotope was created.
- The other rich maerl bed recorded during this survey, west of the Isle of Pladda, was of the biotope **SS.SMp.Mrl.Pcal.R** - Phymatolithon calcareum *maerl beds with red seaweeds in shallow infralittoral clean gravel or coarse sand.* The *Phymatolithon calcareum* on this much more exposed bed formed large medallions.
- A third biotope containing maerl gravel was recorded at the south end of Holy Isle and on the Isle’s north-east coast (**SS.SMp.KSwSS.LsacR.Gv** - *Laminaria saccharina* and robust red algae on infralittoral gravel and pebbles). In these semi-exposed areas the maerl gravels possessed significant over-growths of the invasive algal species *Heterosiphonia japonica* and *Trailliella intricata.*
- Relatively rich infaunal communities, dominated by large bivalves were found to be present within the underlying sediments at all dive sites.
- A seagrass bed in Whiting Bay was surveyed opportunistically as an alternative to the remoter and exposed maerl gravel areas around the Iron Rock Ledges. Survey logistics and weather prevented access to these. A healthy, rich epifaunal and floral community was found to be associated with the *Zostera marina* bed in Whiting Bay.

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1. INTRODUCTION

The South Arran Marine Protected Area (MPA) (Figure 1) is one of three MPAs within the Clyde Sea, together with the Clyde Sea Sill MPA to the south and Upper Loch Fyne and Loch Goil MPA to the north.

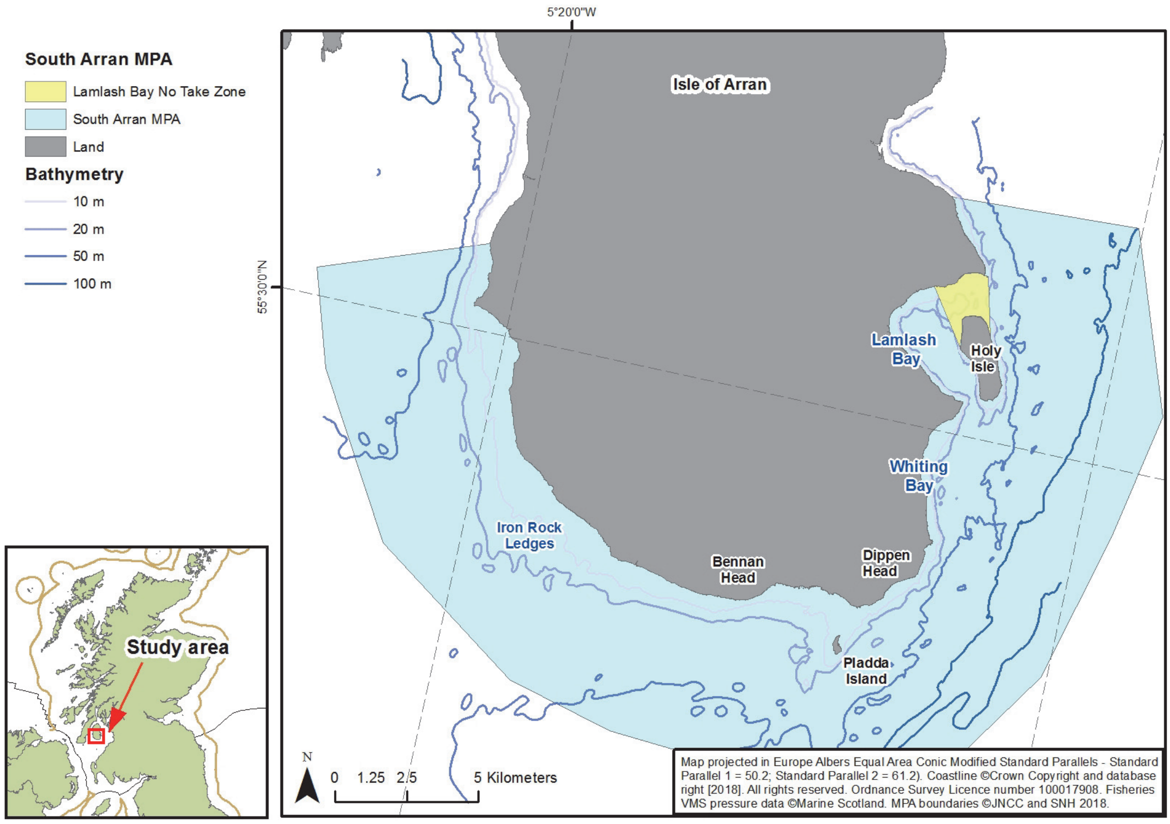

Figure 1. The South Arran MPA.

The 'maerl beds' within the MPA are largely considered to be in poor condition and a 'recover' conservation objective has been assigned to this feature by SNH. Site management proposals consulted upon at the end of 2014 (Marine Scotland, 2014), included known maerl beds and larger 'recovery areas' located around clusters of records of sparse living maerl and relatively unbroken dead maerl which are deemed to have the highest potential to aid recovery. These maerl habitats were initially afforded protection through an urgent Marine Conservation Order[1] which took effect on 1 October, 2014 after a voluntary fisheries management agreement was breached. The habitats are now protected under the fisheries management measures which came into force in December 2015 (Scottish Statutory Instruments, 2015).

Survey work undertaken in connection with the Scottish MPA Project since 2012 greatly improved understanding of the distribution of all seabed habitat features within the MPA, but records were still concentrated on the existing Lamlash Bay *No Take Zone* (NTZ). To better define the full distribution and extent of relevant seabed habitats throughout the MPA and to inform future site management decisions, a broad coverage drop-down video survey was conducted in 2014 (reported separately as Morris-Webb, 2015). That study, which was undertaken just prior to the more detailed diving studies reported upon here, helped to target suitable locations for diver sampling.

[1] See http://www.gov.scot/Topics/marine/marine-environment/mpanetwork/southarranmco

The principal aim of the presented study was to assess the levels of biodiversity associated with maerl and maerl gravel biotopes around Arran in order to create a baseline against which the effectiveness of future management measures can be assessed. The collection of detailed diver observations from the subtidal *Zostera marina* seagrass beds within Whiting Bay, the largest known example of this feature in the Clyde Sea, was a contingency objective for adverse weather conditions, to provide context to extent mapping of this habitat undertaken earlier (Morris-Webb, 2015). Aquatic Survey and Monitoring Limited were commissioned to conduct detailed assessments of various sites representative of the respective protected features, using *in situ* diving observations and collection of core samples for infaunal analyses.

In the field season of 2015 SNH collected additional drop video, grab and diving data to establish a pre-management baseline of maerl bed, maerl gravel, and burrowed mud feature condition in the South Arran MPA. Results of these surveys will be reported on separately once analysis is concluded, and all pre-management data will then be combined to establish a baseline.

2. METHODS

Between September 21 - 26, 2014 MNCR phase II style dive surveys were conducted at six locations within the South Arran MPA (Table 1 and Table 2, Figure 2). Survey stations were selected to provide representation of a range of environmental conditions and pressure regimes, inside and outside areas where existing and potential future protection measures were expected to be in place, while making concessions to accessibility in the prevailing weather. The final management measures will now afford protection from bottom contacting mobile fishing to all maerl bed and maerl gravel areas in the MPA, but drop video and grab work in 2015 also contains stations outside the MPA that act as un-managed comparison sites. Precise locations of stations in this survey were based on data collected prior to the dive survey by an SNH drop-down video survey (Morris-Webb, 2015). That work identified new high quality examples of maerl beds in the MPA which had not been surveyed in detail previously and hence were visited during this dive survey.

Table 1. Location of dive sites targeted during the 2014 Arran survey.

Dive site name	Date	Site code	Latitude	Longitude	Depth BCD (m)
Pladda	21/09/2014	PL34	55° 26.181'	-5° 7.496'	7.5
Holy Isle South	22/09/2014	HI22	55° 30.646'	-5° 3.727'	7.8
Holy Isle North (inside the NTZ*)	23/09/2014	HIN04	55° 32.320'	-5° 4.655'	6.2
Lamlash Bay North maerl bed	24/09/2014	LBN	55° 32.760'	-5° 5.314'	9.8
Holy Isle North (outside the NTZ*)	25/09/2014	HIN02	55° 32.138'	-5° 4.339'	6.0
Whiting Bay *Zostera* bed	26/09/2014	WBZ	55° 29.852'	-5° 5.273'	4.4

* No Take Zone

A further two reconnaissance dives were undertaken to determine the eastern and western extent of the Lamlash Bay North (LBN) maerl bed. Positional information for these two diving stations is provided below (Table 2). A pair of divers swam along the maerl bed following the 8 and 12 m contours respectively until live maerl coverage dropped below 5%. At that point they moved to the middle of the maerl band at about 10 m depth, signalled the end of the bed with tugs on their SMB, and the position was recorded by a snorkeler carrying a GPS.

Table 2. 2014 dive sites marking the eastern and western margins of the Lamlash Bay North maerl bed (LBN).

Dive site name	Date	Site code	Latitude	Longitude	**Depth BCD (m)** (at middle of maerl band)
Lamlash Bay North maerl bed	23/09/2014	Eastern edge	55° 32.750'	-5° 5.192'	9.8
Lamlash Bay North maerl bed	25/09/2014	Western Edge	55° 32.768'	-5° 5.428'	9.8

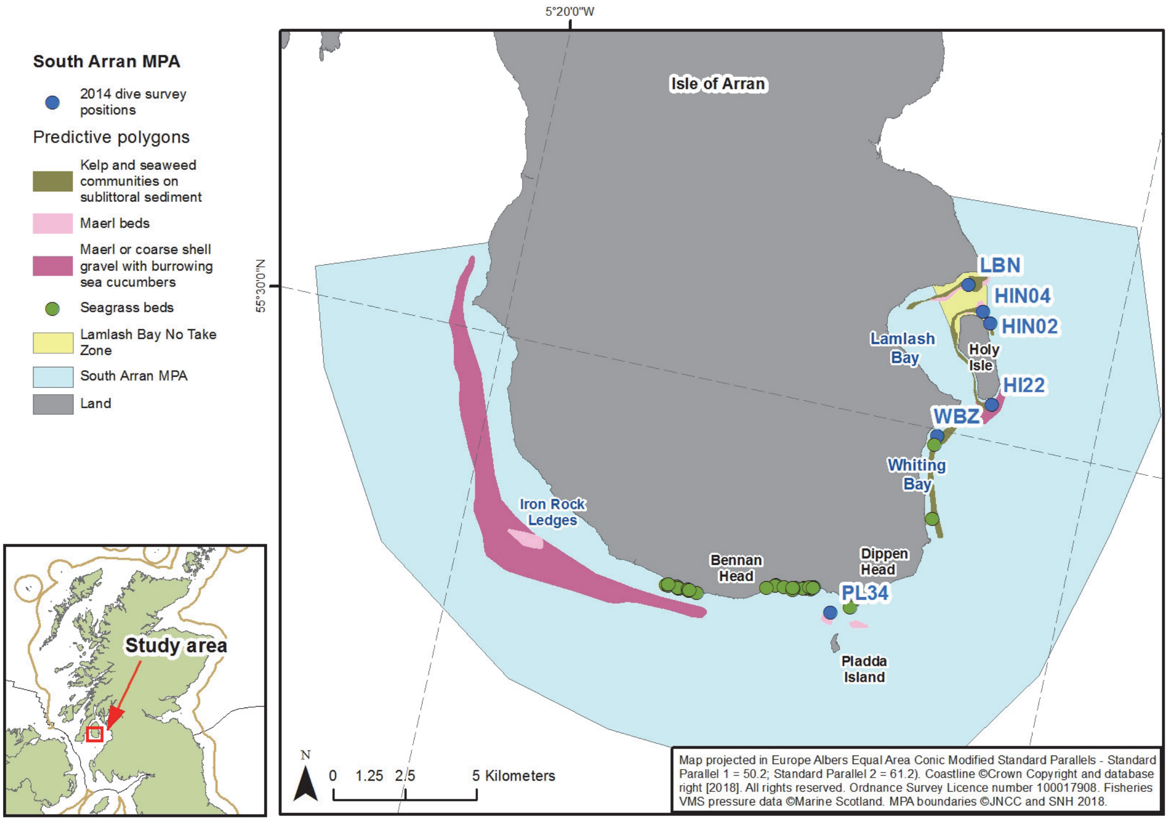

Figure 2. Dive survey positions presented with relevant biodiversity data.

2.1 MNCR phase II – style diver transect surveys

The survey was conducted from the 5.8 m rib, *North Shore.* Survey sites were identified with the boat's chart plotter (Standard Horizon CP180i GPS), and marked with a buoyed shot to which a 25 m tape measure and leaded safety line were attached. Surveys were conducted along fixed 25 m transects. A pair of divers descended the shot line and selected a bearing for the 25 m transect which was most representative of the target survey feature. This depended on the topography of the seabed and features such as mats or clumps of algae such as *Saccharina latissima* which were avoided. The tape and leaded safety line were then laid out along the selected bearing. A small weight was attached to the end of the tape and line to keep them in place. The divers then returned to the origin of the transect and began the Phase II survey. During the survey, divers clipped themselves to the leaded line with buddy lines to be in contact with the surface via the shot line if necessary.

The 25 m transect was surveyed for a width of 2 m either side of the tape. The abundance of all taxa observed was recorded according to the MNCR Abundance Scale (SACFOR). The divers, an algologist and a zoologist, surveyed the seabed for flora and fauna on one side of the tape each, and upon reaching the end of the tape swapped sides and continued the survey along the opposite side of the transect. The pair of divers was equipped with a digital camera and flash, with which they took a photographic record of much of the faunal and floral component of the biotope.

2.2 Diver transect quantitative maerl assessments

When the first pair of divers returned to the boat, a second wave of three divers entered the water. Two of the divers took with them a 0.25 m^2 quadrat and camera each. They recorded percentage cover of live and dead maerl in 20 quadrats placed at pre-selected random distances along the transect, and took a picture of each quadrat. The pictures were reviewed at a later time as a quality control measure of the maerl abundance assessments made in the field.

2.3 Maerl biotope infaunal diver coring and epifloral sampling and video records

The third diver of the second wave collected infaunal sediment cores, a sediment sample for particle size distribution (PSD) analysis, and algal samples.

The 10 cm diameter corers were driven into the sediment to a depth of 20 cm (minimum) before they were securely capped, extracted from the sediment and retained. The PSD sample consisted of a sediment sample taken from the top 5 cm of the undisturbed seabed. The sediment core samples and PSD samples were all collected from random locations within 5 m of the shot weight.

Some of the small and finely branched seaweeds associated with maerl can only be identified with a microscope. To study these, samples of maerl and sediment were collected from five randomly selected decimetre squares in the vicinity of the transect. The surface 30 mm of maerl within these decimetre squares were sampled carefully by hand and placed in mesh bags with a 1 mm mesh size.

The core samples, PSD sample and maerl algae bags were carefully returned to the surface with the aid of a diver lifting bag.

On finishing the infaunal macrobenthic and maerl sampling, a video record was made of both sides of the transect with a handheld HD video camera.

2.4 Whiting Bay *Zostera* bed - method variations

To select a location for a survey of the *Zostera* bed location in Whiting Bay, the presence of a suitable dense *Zostera marina* sward was confirmed using both a bathyscope over the side of the RIB, and with snorkelers in the water. Once on location, a buoyed shot was dropped in the sand between patches of seagrass to mark the dive site.

Because of the small-scale patchiness of the seagrass, a fixed 25 m transect was not suitable to record details of the seagrass bed. Therefore the Phase II information was collected by the first pair of divers from within a 50 m radius of the shot marker, but only within the seagrass bed patches.

A second pair of divers collected *Zostera marina* shoot density records within 46 0.25 m^2 quadrats. The quadrats were haphazardly thrown into seagrass patches within the survey area. A video record was also made of the *Zostera* biotope.

2.5 Field laboratory methods

Following the daily fieldwork, samples were returned to the field laboratory and variously processed:

- **Specimens** collected during the dives for taxonomic verification were identified using both high and low powered microscopes and the latest taxonomic keys. Field data sheets and notes were updated and data were entered into Excel spreadsheets.

- **Photographs** were downloaded, renamed and catalogued in an Excel spreadsheet. The photos were processed using a set protocol. Jpg photograph files were renamed with the following convention: **20140925_FDB_HIN02_0074.jpg** = 8 digit date (YYYYMMDD), 3 letter initials of photographer (Francis Daly Bunker), Site code (Holy

Isle North 02) and a 3 or 4 digit consecutive photo ID number derived from the camera (0074) followed by the file extension(.jpg). No spaces were allowed in the file name. The photographs were catalogued in the relevant Excel spreadsheet that included a hyperlink that allowed the photographs to be opened directly from the Excel file when stored in the appropriate sub-directory.

- **Maerl algae samples**. The maerl algae bags had a 1 mm mesh and so the fine particles of sediment were removed by gentle agitation in seawater. The remaining larger particles (mainly fragments of shell, gravel and maerl) were examined under a stereomicroscope and species lists of the seaweeds present were compiled. Any macrofauna present were also noted for completeness.

- **Macrobenthic infaunal cores** were extracted and sieved over a 1 mm mesh. The sieved residue was placed in a container labelled inside and out with the site name, replicate number, date taken and sieve mesh size. The samples were then fixed in a 10% formaldehyde solution and labelled with both toxic and hazardous labels.

2.6 Laboratory methods

- **Macrobenthic taxonomic analysis**. The analysis of marine macrobenthic samples adhered to the mandatory sections of the NMBAQC Processing Requirement Protocol (Version 1.0) which conforms to EN ISO 16665:2005 and BS EN 14996:2006. All five replicate cores taken at each location were processed and analysed. Each of the fixed and preserved sediment samples was carefully washed in freshwater to remove the formalin, transferred into labelled buckets and Rose Bengal was added to stain the biological material in order to facilitate the sorting process. Samples were then placed in gridded white trays, systematically examined by eye and all fauna picked out, sorted into phyletic groups and placed in vials in 70% industrial methylated spirit.

  The extracted biota were identified to the lowest possible taxonomic group using a combination of binocular stereo microscopes and high magnification binocular compound microscopes and counted. Where possible all organisms were identified to species level according to the nomenclature of the World Register of Marine Species (WoRMS) with species codes (where available) consistent with Howson & Picton (1997). Taxonomic literature used was consistent with the NMBQAC Taxonomic Literature database (version 107), including use of relevant journal papers, unpublished workshop keys (primarily from NMBAQC workshops), internet keys and internal documents compiled from these sources.

  All whole organisms were identified and counted. Damaged or incomplete specimens were identified and counted only if the head was present; otherwise parts of organisms were recorded but not enumerated. Juveniles were recorded as such when identification to species level was not possible due to the under-development of key features, or if the specimen was less than 10% of the average adult body size.

- **Particle size distribution** analysis was carried out by Hebog Environmental Ltd. using a dry sieving technique and sieves conforming to the Wentworth scale. Approximately 80 g of sediment was oven dried at 100 °C until constant weight was reached. The dried sediment was weighed and washed through a 63 µm sieve. The effluent, which contained the mud/silt fraction (< 63 µm) was not retained. The remaining sediment was again oven dried at 100 °C until constant weight was reached. This weight was recorded and the percentage of the mud/silt fraction (< 63 µm) was calculated as the difference between these two weights. The fractions > 63 µm were transferred to the coarsest of a series of stacked sieves, placed on an automatic shaker for 15 minutes and the contents of each sieve weighed. Fractions are > 8 mm, 4 - 8 mm, 2 - 4 mm, 1000 - 2000 µm, 500 - 1000 µm, 250 - 500 µm, 125 - 250 µm, 63 - 125 µm and < 63 µm. All fractions were weighed to an accuracy of ± 1 mg.

- **Loss on ignition analysis** was also carried out in order to determine the amount of organic matter found in the sediment and available to the macrobenthic infauna. Approximately 10 g of sediment was placed into a ceramic crucible and dried at 100°C in an oven. The sample was weighed to an accuracy of ± 1 mg and heated to 550°C for four hours. The crucible was placed over a desiccant to cool and then re-weighed (methodology is based on Holme and McIntyre (1984) Methods for the Study of Marine Benthos, Chapter 3: Sediment Analysis. IBP Handbook 16, Blackwell Scientific Publications, p. 41-65).

3. RESULTS

All raw data are presented in tabular form in Annex 1.

3.1 Physical characteristics of maerl habitats

Table A in Annex 1 presents the site characteristics data for all five of the 'maerl' and 'maerl or coarse shell gravel with burrowing sea cucumbers' sites. The groups fall into three distinct sediment categories:

1. Pladda (PL34): this site was a tide swept, exposed and level seabed consisting mostly of maerl gravel and live medallions of *Phymatolithon calcareum* maerl (quadrats determined 29 % live maerl, and 92 % combined live maerl and maerl gravel), with some pebbles and a substantial amount of lose empty shells covering the maerl gravel (30 %).
2. Holy Isle (HI22, HIN04 and HIN02): these sites all had less whole shell on the surface (~ 20 %) and were made up of close to 100 % maerl gravel, but contained very little live *Phymatolithon calcareum* maerl (< 1 – 2 %). Fragments of *Lithothamnion glaciale* were also seen at HIN04. All three sites were determined to be part of the 'kelp and seaweed communities on sublittoral sediment' protected feature.
3. Lamlash Bay (LBN): this site had a very high live *Lithothamnion glaciale*[2] maerl content (55 – 75 %) and lower maerl gravel content (~25 %), a slightly lower whole shell component and slightly higher mud component than the other maerl sites, a fact borne out by the silt/clay fraction result for this site (see Annex 1 Table E - diver core PSD). The increased softness at this site was highly noticeable during the dive. The bed sloped from north to south into the channel between Arran and Holy Isle.

3.2 Phase II dive survey epifaunal and floral abundance data

The Phase II survey produced records of 186 taxa within the five maerl and maerl gravel sites dived. Taxa abundance was collected as SACFOR values (JNCC, 1990), hence multivariate statistics are not appropriate for analysis. The full set of results is shown in Annex 1 Table C.

Table 3 below contains the abundance values of the dominant flora and fauna at each site. Only those recorded at Super abundant (S) to Frequent (F) are presented. The following sections describe the flora and fauna at each station in further detail.

[2] Confirmed by 'thin section analysis' after acid digestion by F. Bunker, J Hall-Spencer and Dr Viviana Peña.

Table 3. SACFOR abundances of dominant flora and fauna recorded by Phase II style dive surveys at each of the South Arran dive sites in 2014. Maerl entries are pink, other algae green, and animals white. S = super abundant, A = abundant, C = common, F = frequent, O = occasional, R = rare.

PL34

Phymatolithon calcareum	C
Marthasterias glacialis	C
Pomatoschistus sp.	C
Heterosiphonia japonica	F
Saccharina latissima	F
Scinaia interrupta	F
Cerianthus lloydii	F
Chaetopterus variopedatus	F
Necora puber	F
Spirobranchus sp.	F
Testudinalia testudinalis	F

LBN

Lithothamnion glaciale	S
Bonnemaisonia hamifera (Trailiella intricata)	S
Chaetopterus variopedatus	C
Galathea intermedia	C
Hydroides norvegicus	C
Inachus dorsettensis	C
Necora puber	C
Spirobranchus sp.	C
Spirorbinae	C
Saccharina latissima	F
Pomatoschistus sp.	F
Tectura virginea	F

HI22

Phymatolithon calcareum	R
Cerianthus lloydii	A
Saccharina latissima	C
Desmarestia aculeata	F
Heterosiphonia japonica	F
Ascidiella aspersa	F
Chaetopterus variopedatus	F
Dosinia exoleta	F
Gibbula magus	F
Necora puber	F
Polititapes rhomboides	F
Pomatoschistus sp.	F

HIN04

Lithothamnion glaciale	R
Phymatolithon calcareum	R
Heterosiphonia japonica	S
Saccharina latissima	C
Asterias rubens	C
Cancer pagurus	F
Cerianthus lloydii	F
Luidia ciliaris	F
Marthasterias glacialis	F
Necora puber	F
Pomatoschistus sp.	F
Porania pulvillus	F
Spirobranchus sp.	F

HIN02

Phymatolithon calcareum	O
Heterosiphonia japonica	C
Saccharina latissima	C
Ascidiella aspersa	C
Chaetopterus variopedatus	C
Tectura virginea	C
Cancer pagurus	F
Marthasterias glacialis	F
Necora puber	F
Pecten maximus	F
Pecten maximus (juv)	F
Pomatoschistus sp.	F
Spirobranchus sp.	F

WBZ

Zostera marina	A
Echinocardium cordatum	C
Echiurus echiurus	C
Ensis arcuatus	C
Liocarcinus depurator	C
Macropodia rostrata	C
Pagurus bernhardus	C
Pomatoschistus sp.	C
Rissoa lilacina	C
Rissoa parva	C
Heterosiphonia japonica	F
Saccharina latissima	F
Necora puber	F
Ophiura ophiura	F
Pholis gunnellus	F

3.2.1 Pladda (station PL34)

SS.SMp.Mrl.Pcal.R This station was a shallow (*circa* 8 m BCD) tide-swept maerl bed, with substantial growths of the kelps *Saccharina latissima* and *Saccorhiza polyschides,* as well as the brown alga *Desmarestia aculeata* on cobbles and boulders, along with encrusting corallines. The combined live maerl and maerl gravel component of the substrate made up 92 %, and live maerl coverage was 29 %, i.e. SACFOR Common (avg. of 20 quadrats – see Annex 1 Table B), in the form of *Phymatolithon calcareum* medallions on the sediment surface, along with both *Ulva* sp. and *Scinaia interrupta* which were frequent on the pebbles and amongst the sands and gravels. The invasive non-native red alga *Heterosiphonia japonica* was also found at a SACFOR abundance of Frequent on the shells, pebbles and cobbles.

The fauna was dominated by the large mobile starfish *Marthasterias glacialis* and small mobile *Pomatoschistus* gobies. Decapods such as *Cancer pagurus*, *Necora puber* and Paguridae roamed over the sediment, whilst cobbles were colonised by *Testudinalia testudinalis*, *Gibbula magus*, *Spirobranchus* sp., *Ascidiella aspersa* and *Celleporella hyalina*. Within the sediment surface, tubes of *Chaetopterus variopedatus* protruded with and the anemones *Sagartiogeton* spp. and *Cerianthus lloydii* were found. Figure 3 shows representative images from the Pladda site.

Figure 3. Illustrative shots of Pladda maerl bed (PL34) showing medallions of Phymatolithon calcareum *and empty shells, and* Scinaia interrupta *in the left image.*

3.2.2 Holy Isle South (station HI22)

SS.SMp.KSwSS.LsacR.Gv This was another shallow station was at about 8 m BCD, and differed from the station at Pladda in its algal complement only by the lack of the large kelp fronds of *Saccorhiza polyschides* and the amount of live maerl present. Live maerl was sparse at this site, being recorded as rare (R) and 2 % (avg. of 20 quadrats, see Annex 1 Table B) compared to Common (C) with 29 % (avg) at Pladda. The combined live maerl and maerl gravel component of the substrate made up 97 % of the substrate here, similar to the 92 % at Pladda.

The fauna differed from that at Pladda in that there were several large bivalve species, notably *Dosinia exoleta*, *Polititapes rhomboides* and *Pecten maximus.* These were often present at the surface of the sediment. This in turn has led to increased numbers of the starfish *Asterias rubens* and *Marthasterias glacialis* in the biotope. These differences aside, the biotopes were very similar. Figure 4 shows representative images from the Holy Isle South site.

Figure 4. Illustrative shots of the Holy Isle South (HI22) site, showing maerl gravel with scattered shells, and a Luidia luidia *star fish on the left.*

3.2.3 Holy Isle North (stations HIN04 and HIN02)

SS.SMp.KSwSS.LsacR.Gv Physically similar to the Holy Isle South station, the stations north of Holy Isle, HIN04 inside the No-Take Zone (NTZ) and HIN02 outside the NTZ, were of the same biotope with some differences in dominant biota. 86 and 85 taxa respectively were recorded on the transects, and Table 3 shows that the conspicuous dominant taxa were very similar between the sites. In terms of the algal component, the main difference between the sites was the amount of *Heterosiphonia japonica* present at each site; Super-Abundant at HIN04, whilst only Common at HIN02. Both these sites contained very low quantities of live *Phymatolithon calcareum* maerl (< 3 %), and were dominated by encrusting corallines and *Saccharina latissima*. Small amounts of *Lithothamnion glaciale* maerl (< 1 %) were also recorded at HIN04. The presence of *Lithothamnion glaciale* has been confirmed by thin section analysis of the maerl.

In faunal terms the main differences between HIN04 and HIN02 were the presence and absence of several large bivalves such as *Pecten maximus* or *Polititapes rhomboides*. Both *Aequipecten opercularis* and *Pecten maximus* were recorded at HIN02, outside the NTZ and were not recorded at HIN04, inside the NTZ on this occasion.

The biotope fauna was dominated by large echinoderms (*Marthasterias glacialis, Asterias rubens, Luidia ciliaris* and *Porania pulvillus*) and bivalves (*Pecten maximus,* with *Polititapes rhomboides*, and *Ensis* sp. also present) as well as mobile decapod crustaceans (*Necora puber* and *Cancer pagurus)*. *Chaetopterus variopedatus* and sedentary ascidians (*Ascidiella aspersa* and *Corella parallelogramma*) punctuated the sediment surface. Individuals of *Limaria hians* were found at both stations, though no flame shell beds were found in the vicinity during a subsequent search by two of the divers. Figure 5 shows images representative of the Holy Isle North sites.

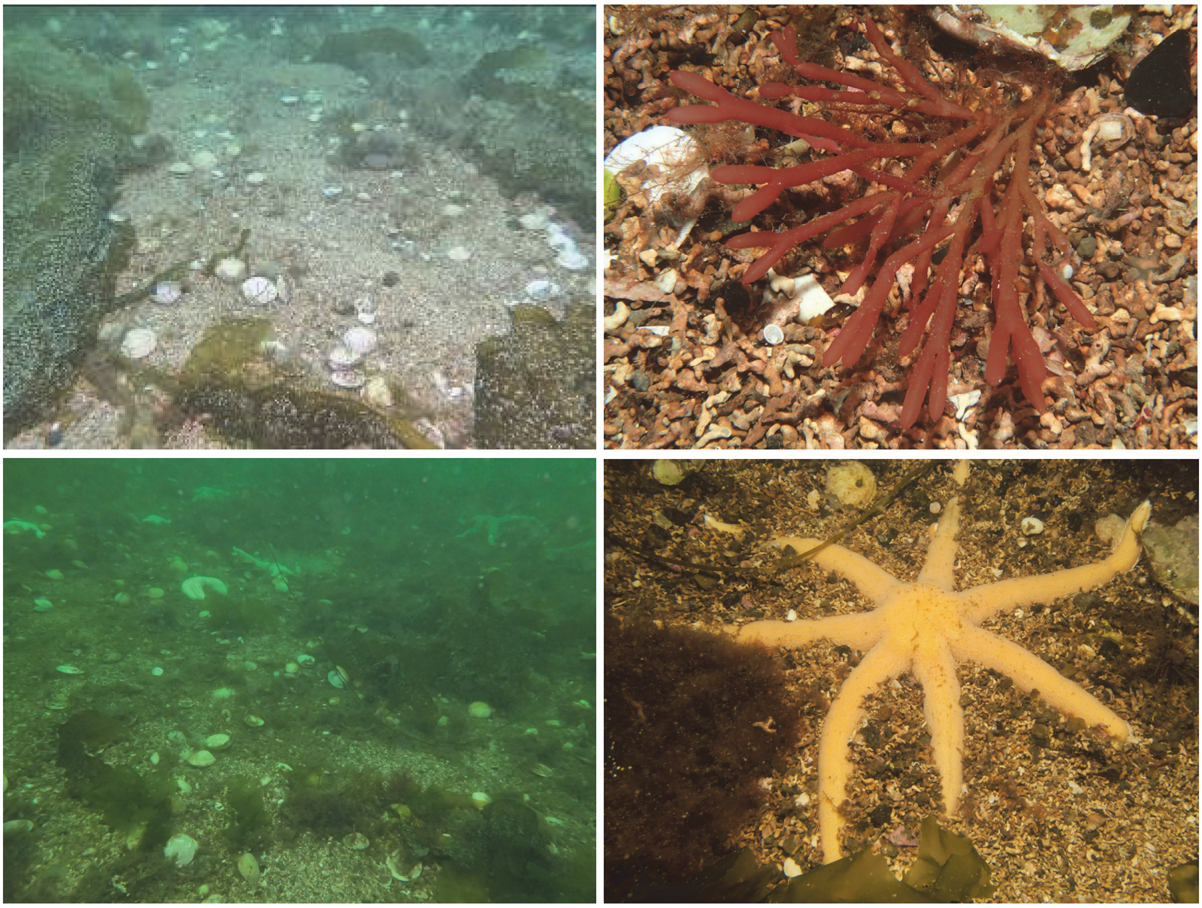

*Figure 5. Illustrative shots of the northern Holy Isle sites HIN02 (top row) and HIN04 (bottom row), showing maerl gravel and associated species (*Scinaia interrupta *top row and* Luidia luidia *bottom row).*

3.2.4 Lamlash Bay North (station LBN)

SS.SMp.Mrl.Lgla This was by far the densest maerl bed surveyed in South Arran. It was dominated by live *Lithothamnion glaciale* maerl with cover of between 55 - 75 %. There was, however, also a considerable over-growth of *Bonnemaisonia hamifera (Trailliella intricata*) red alga across the bed, which is of concern. Other dominant algae included *Saccharina latissima*, *Cutleria multifida*, *Corallina officinalis* and *Heterosiphonia japonica*. The fauna was very similar to that found in the other maerl beds with large echinoderms, such as *Asterias rubens* and *Marthasterias glacialis. Astropecten irregularis* was also present and recorded only at this station during the survey. Several decapod crustaceans not recorded at other stations (*Galathea intermedia*, *Liocarcinus depurator, Pandalus montagui* and *Anapagurus hyndmanni)* were seen. Sedentary fauna included the tube worms *Chaetopterus variopedatus*, *Spirobranchus* spp., spirorbinae and *Hydroides norvegicus* and ascidians such as *Ascidiella aspersa*. Figure 6 shows images representative of the Lamlash Bay north site.

This dense maerl bed had not previously been known to SNH but was shown to the survey team by local conservationists. Since it contains substantially more live maerl than any other bed currently known in the Clyde the survey team delineated its extent by conducting dives along it, and marking the position where live maerl cover dropped below 5 %. They found the bed to be a well-defined band between roughly the 7 and 12 m depth contour BCD of the steeply sloping seabed, stretching for a total of 250 m from NW to SE (Figure 7).

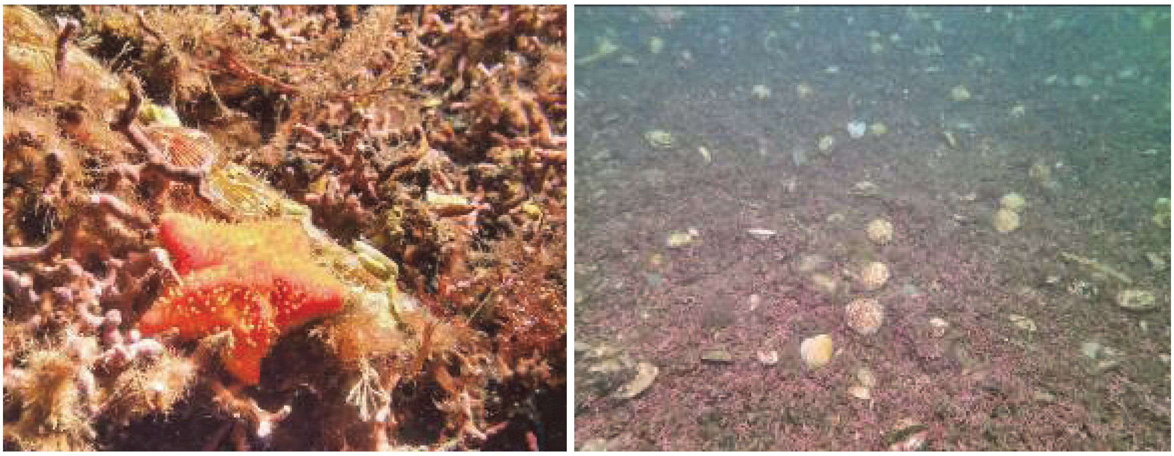

*Figure 6. Illustrative shots of the Lamlash Bay North maerl bed (LBN), showing dense live maerl thalli, scattered shells, and a cushion star (*Porania pulvillus*).*

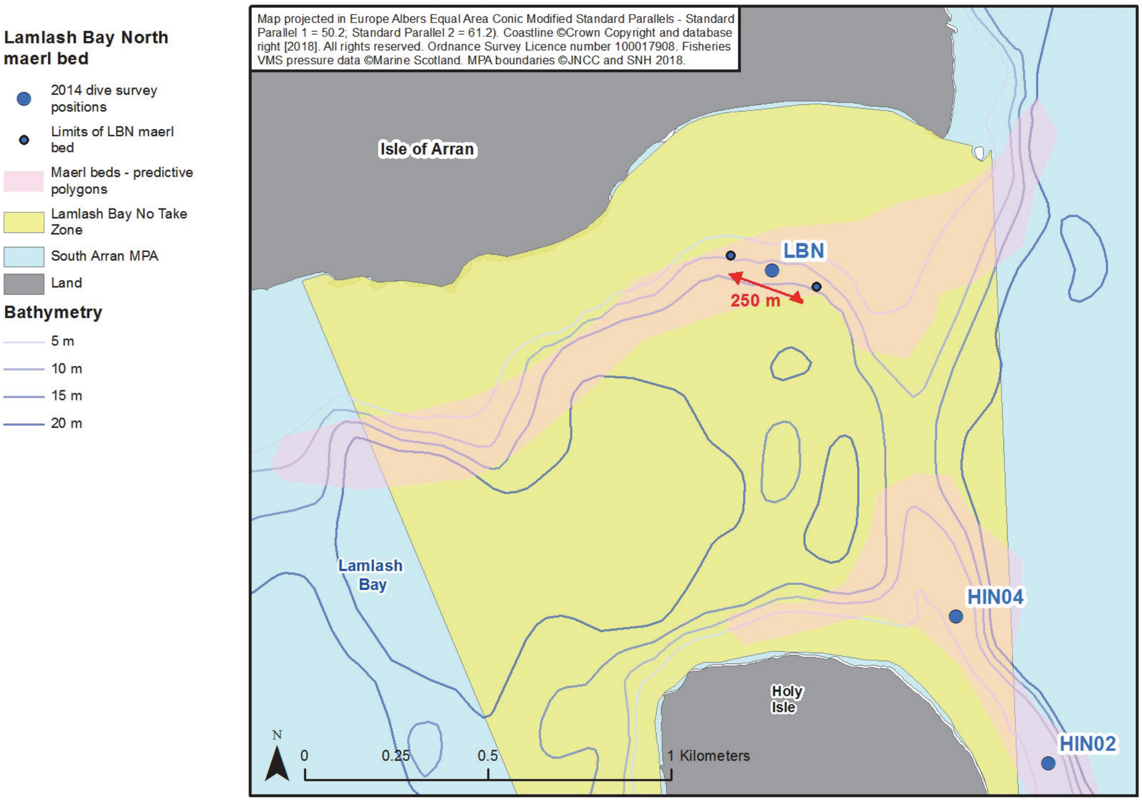

Figure 7. Details of the Lamlash Bay North (LBN) maerl bed.

3.2.5 Microscopic epiphytic maerl algae

Tables 4 and 5 present the summary results of the maerl algae sample analysis (5 x 10 cm^2 per site). The species list is presented in Annex 1 Table D. Forty-seven algal species / taxa were recorded and eleven faunal taxa. Table 4 shows numbers per site. Nineteen of the microscopic algal taxa were not recorded by the diving Phase II survey. These new taxa are presented in Table 5 below, and include the endemic maerl epiphyte *Gelidiella calcicola.* These data add to the knowledge base of the maerl bed quality within the South Arran MPA.

Table 4. Number of epiphytic algal and faunal taxa recorded on the maerl thalli.

	PL34					HI22					HI04				
All taxa	12	12	16	18	13	11	17	14	10	15	25	20	12	19	17
Animal taxa	2	1	1					1			5				
Algal taxa	10	11	15	18	13	11	17	13	10	15	20	20	12	19	17
Mean	14.2					13.4					18.6				

Table 4 continued.

	LBN					HI02				
All taxa	14	13	15	12	14	18	12	17	14	12
Animal taxa			1			2		2	3	
Algal taxa	14	13	14	12	14	16	12	15	11	12
Mean	13.6					14.6				

Table 5. Epiphytic algae found on maerl / maerl gravel sediments.

Additional algal species recorded only by microscopic analysis of maerl samples		
Acrosorium venulosum	*Falkenbergia*	*Ptilota gunneri*
Aglaothamnion byssoides	*Gelidiella calcicola*	*Sphacelaria plumosa*
Aglaozonia sp.	*Griffithsia corallinoides*	*Trailliella intricata*
Audouinella sp.	*Halarachnion ligulatum*	*Ulva lactuca*
Cladophora sp.	*Plocamium cartilagineum*	*Ulva* sp. (Tubular)
Cystoclonium purpureum	*Polysiphonia harveyi*	
Ectocarpaceae	*Ptilothamnion sphaericum*	

3.2.6 Whiting Bay seagrass bed (station WBZ)

SS.SMp.SSgr.Zmar The seagrass bed was found in a shallow sandy bay at a depth of ~ 4.5 m (BCD). Table 3 presents the SACFOR abundances of the dominant taxa recorded during the Phase II survey and the full list is presented in Annex 1 Table C.

The bed is made up of a mosaic of patches of dense seagrass fronds interspersed by smaller areas of sand. The *Zostera marina* shoot density within the seagrass patches was 89 shoots m^{-2} at the survey site at north end of Whiting Bay.

In terms of algae, the biotope was dominated by *Heterosiphonia japonica* and *Saccharina latissima*, with numerous small red, brown and green algal species occurring at low abundances. Twenty-two algal taxa were recorded during the survey.

Thirty seven faunal taxa were recorded by the divers and this community was dominated by large mobile crustaceans such as *Pagurus bernhardus, Macropodia rostrata, Liocarcinus depurator, Carcinus maenas* and *Necora puber*. The infaunal community of the sand contained several megafaunal species, of which the most notable were dense aggregations of *Echinocardium cordatum* and what was thought to be the echiuroid *Echiurus echiurus,* though no live specimens were obtained for confirmation. Figure 8 shows the typical proboscis marks in the sand.

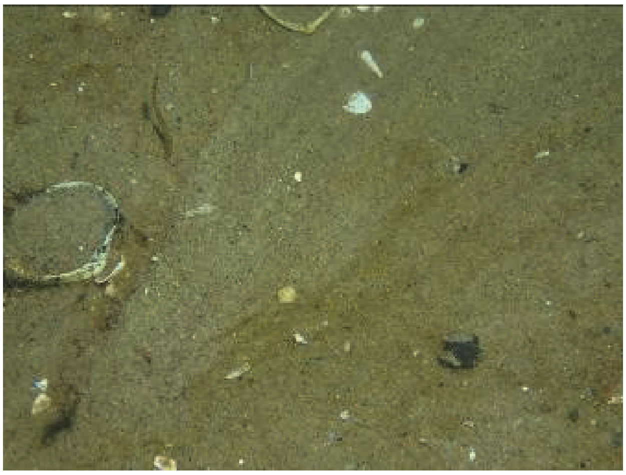

Figure 8. Proboscis marks typical of Echiurus echiurus *in the Whiting Bay seagrass bed.*

Bivalves such as *Ensis arcuatus* were also noted in the sediment, as were the tubes of the polychaete *Chaetopterus variopedatus*.

The leaves of the *Zostera marina* plants were frequently covered with dense aggregations of *Rissoa lilacina* and *Rissoa parva*, whilst the surface of the sand was dominated by *Ophiura ophiura, Asterias rubens*, tubed anemones, several other starfish and numerous small fish (e.g. *Pomatoschistus* sp., *Pholis gunnellus*). Occasional pebbles and cobbles were colonised by barnacles (*Balanus crenatus*), bryozoans (*Celleporella hyalina*), ascidians (*Ascidiella aspersa*), and tubed polychaetes (*Spirobranchus* sp.).

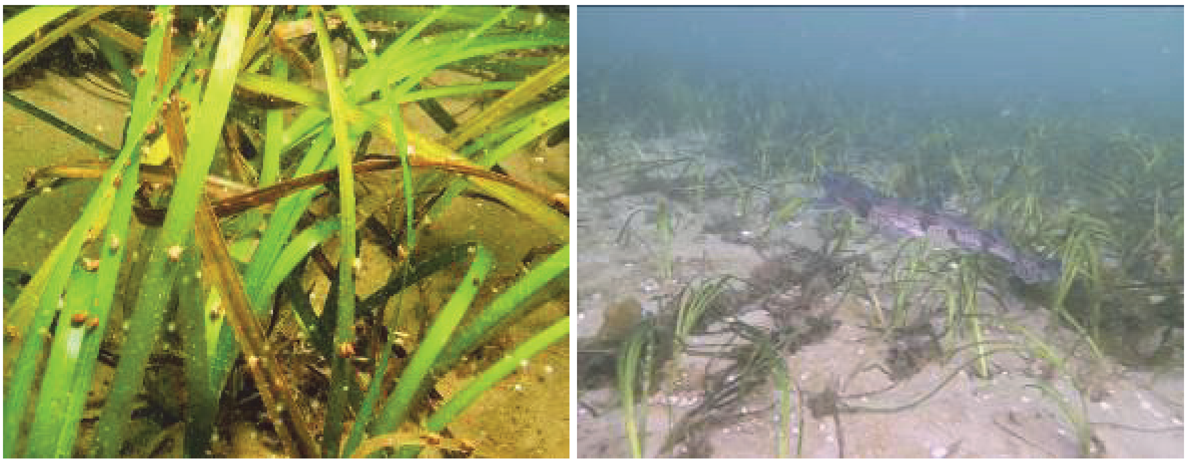

Figure 9. Illustrative shots of the Zostera marina *bed in Whiting Bay.*

3.3 Particle size distribution

The results of particle size distribution and loss on ignition analyses (assessing organic matter) of the infaunal cores are presented in Annex 1 Table F.

The particle size distributions confirmed the divers' *in situ* observations that the survey sites lie along a gradient of exposed, semi-exposed and sheltered sites. Cores from Pladda (PL34), the exposed site, were made up of coarse sediments, dominated by pebbles, gravel and very coarse sand. Cores from the semi-exposed Holy Isle sites (HI22, HIN04 and HIN02) contained fine gravels and coarse sands with slightly greater silt and clay components as well as an increased organic matter fraction. Cores from the sheltered

Lamlash Bay North (LBN) site still contained a fine gravel / coarse sand fraction (due to the maerl component), but also had far greater amounts of silt and clay (~ 16 %) and organic matter (~ 3 %).

3.4 Macrobenthic infauna

Analysis of the >1 mm macrobenthic infauna revealed a diverse community of invertebrates within the maerl and maerl gravel sediments. The table of taxa and their abundances for each core is shown in Annex 1 Table G. In total 130 taxa were identified in the 25 cores. The data were analysed with the marine invertebrate community analytical computer package PRIMER 6.

3.4.1 Univariate analysis of core data

To calculate indices of community diversity, a univariate analysis (the Diverse protocol of PRIMER 6) was conducted on all individual cores, and at site mean values are shown in Table 6. Values for all indices were highest for either the Lamlash Bay (LBN) cores or for the Pladda (PL34) cores, and lowest for Holy Isle sites.

Pielou's evenness statistic showed that station HIN02 was the least even, i.e. most dominated community, with nematodes, the spionid *Aonides paucibranchiata* and the brittlestar *Amphipholis squamata* being the most likely candidate taxa for this effect. This pattern is supported by the Shannon-Wiener and the Simpson's diversity indices, which yield the highest diversity scores for LBN and the lowest for HIN02.

Table 6. Mean univariate characteristics of the site core data.

Stn.	S	N	d	J'	H'(loge)	1-Lambda'	S Tot
PL34	31 (26-34)	106 (83-142)	5.87	0.86	2.83	0.92	52
HI22	25 (21-28)	56 (35-92)	5.66	0.91	2.78	0.93	50
LBN	30 (24-35)	61 (45-77)	6.78	0.93	3.09	0.96	71
HIN02	26 (22-32)	104 (46-183)	5.27	0.76	2.43	0.85	58
HIN04	32 (25-38)	94 (73-105)	6.07	0.81	2.70	0.89	60

S - Mean total taxa: taxa with non zero counts. (Range shown in brackets)
N - Mean total individuals: The mean number of individuals per core. (Range shown in brackets).
d - Mean Margalef's richness for each sample. (S-1)/Log(N) - it is a measure of the number of taxa present, making some allowance for the number of individuals.
J' - Mean Pielou's evenness - this is a measure of equitability, a measure of how evenly the individuals are distributed among the different taxa.
H'(loge) - Mean Shannon-Wiener diversity index
1-Lambda'- Mean Simpson's diversity index
S Tot - Total number of taxa recorded in all five cores per site

3.4.2 Multivariate analysis of the core data

Further trends in the infaunal community were illustrated using multivariate analysis of the data. A Bray Curtis similarity analysis was performed to produce a similarity matrix. This was run through a group average clustering routine in PRIMER 6 to produce a dendrogram illustrating groupings in the data (Figure 10).

As expected from the epifaunal and floral characteristics, the Pladda site and the Lamlash Bay North site separate out from the Holy Isle sites. The infaunal communities they support clearly both have a greater intra-group similarity than inter-group similarity. The Holy Isle

South site HI22 also separates out, and although the two northern sites HIN02 and HIN04 are generally very similar, there are a few outliers, such as HIN04#4, HIN02#1 and HIN02#5.

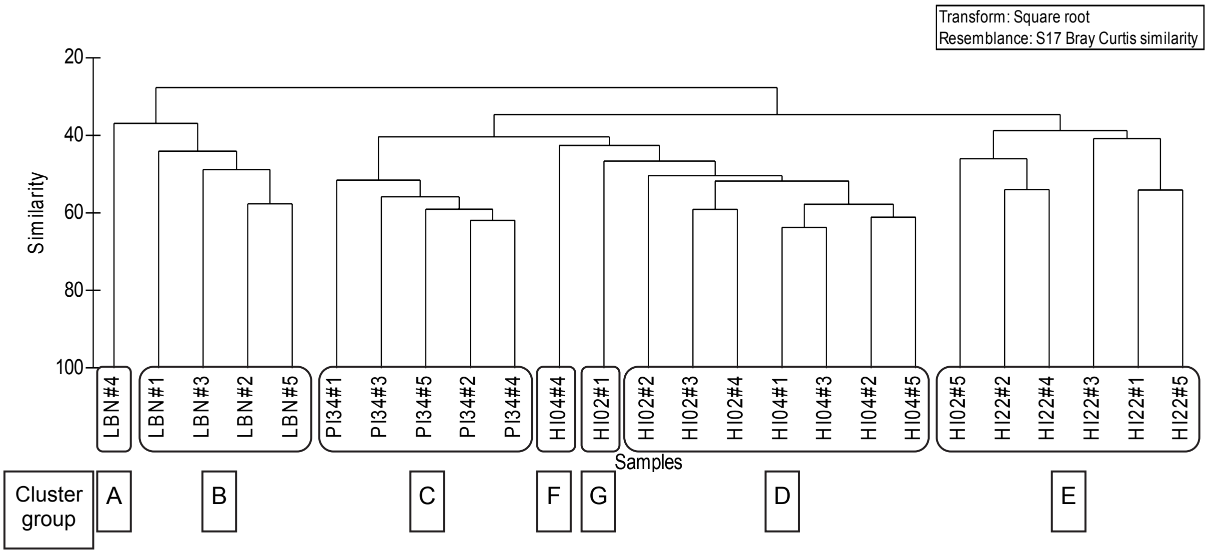

Figure 10. Infaunal cores macrobenthic data – group average clustering Bray Curtis similarity.

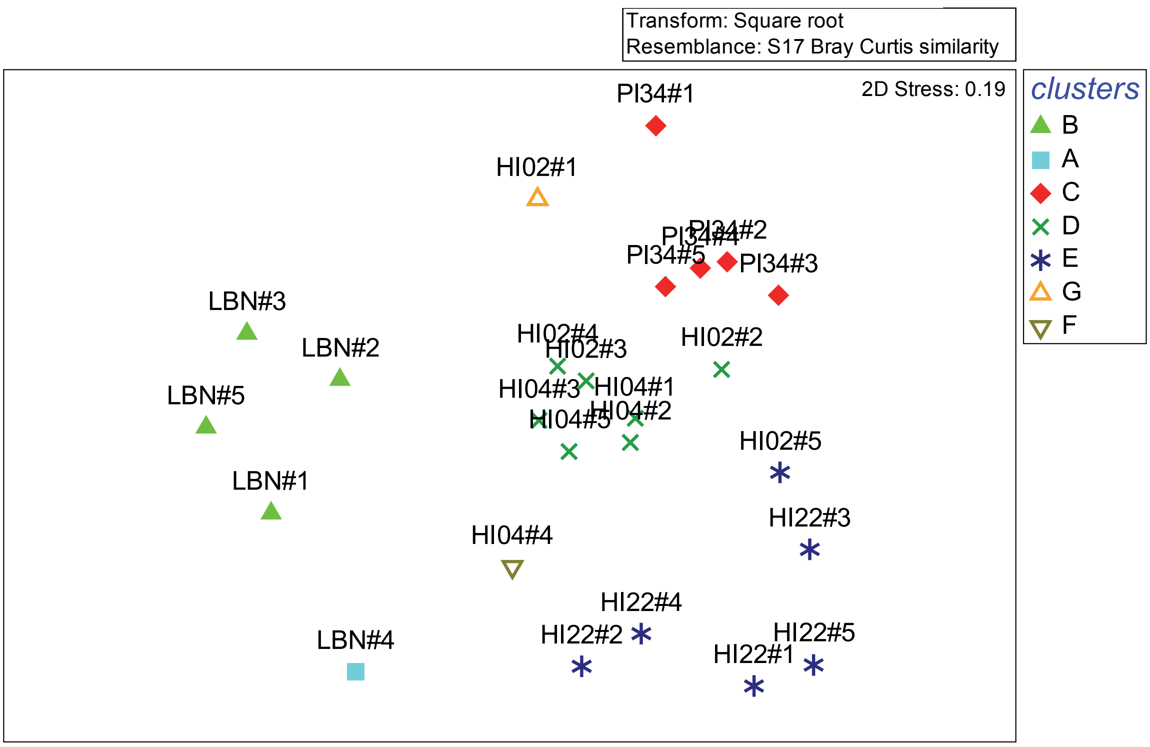

Figure 11. Infaunal cores macrobenthic data - two dimensional MDS plot.

A multidimensional scaling (MDS) analysis (Figure 11), a means of visualising similarity across samples, produces similar groupings as the dendrogram, where the cores from Pladda and Lamlash Bay separate out from a looser cluster of Holy Isle cores.

To determine the taxa responsible for the clustering patterns, the Bray Curtis similarities were subjected to a SIMPER analysis within PRIMER 6. The results are shown in the following Tables 7 - 10. Only taxa with a similarity percentage contribution of over 5%, or making up the top cumulative 50%, are included.

Clusters with fewer than two samples could not be analysed through SIMPER, but their dissimilarities from the nearest clusters were determined. The dendrogram (Figure 10) illustrates that the samples LBN#5, HIN02#1, HIN04#4 (A, F and G) are outliers, and Tables 11 - 13 present the taxa that create the dissimilarities from their nearest clusters. This analysis shows that the exclusion of LBN#5 from Group B, and the exclusion of HIN02#1 and HIN04#4 from Group D, are caused by the presence or absence of a few otherwise common taxa, which reflects the patchy nature of species distribution in the marine environment.

Table 7. SIMPER taxa for Group B clustered cores.

Group B - Lamlash Bay North					
Average similarity: 47.84					
Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Galathea intermedia	2.27	5.65	7.37	11.81	11.81
Ophiothrix fragilis	2.39	5.2	7.2	10.88	22.69
Amphipholis squamata	1.73	3.67	4.22	7.67	30.37
Lysianassa plumosa	1.6	3.43	4.19	7.16	37.53
Nematoda	1.29	2.92	5.5	6.11	43.64
Socarnes erythrophthalmus	1.64	2.92	5.5	6.11	49.74
Clausinella fasciata	1.1	2.73	10.79	5.71	55.46
Dosinia exoleta	1.43	2.52	0.91	5.27	60.73

Table 8. SIMPER taxa for Group C clustered cores.

Group C - Pladda PL34					
Average similarity: 55.29					
Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Nematoda	4.03	7.84	4.95	14.18	14.18
Socarnes erythrophthalmus	2.83	5.29	3.65	9.57	23.74
Animoceradocus semiserratus	2.07	3.91	3.44	7.08	30.82
Dosinia exoleta	2.1	3.79	3.02	6.85	37.67
Pisione remota	2.09	3.44	2.75	6.23	43.9
Polygordius	2.01	3.03	2.21	5.48	49.39
Clausinella fasciata	1.33	2.37	7.33	4.28	53.67

Table 9. SIMPER taxa for Group D clustered cores.

Group D - HI04 and HI02 #2#3#4					
Average similarity: 53.79					
Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Nematoda	5.34	12.1	10.87	22.49	22.49
Amphipholis squamata	2.83	5.9	3.23	10.98	33.47
Aonides paucibranchiata	2.22	4.8	6.28	8.92	42.39
Sphaerosyllis bulbosa	1.98	4.16	5.13	7.73	50.12
Dosinia exoleta	2.04	3.89	2.3	7.24	57.36

Table 10. SIMPER taxa for Group E clustered cores.

Group E - HI22 and HI02 #5					
Average similarity: 41.96					
Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Nematoda	1.69	5.02	4.07	11.97	11.97
Mediomastus fragilis	1.26	4.06	4.59	9.68	21.65
Amphipholis squamata	1.92	3.28	1.08	7.81	29.46
Thracia villosiuscula	1.3	3.24	1.28	7.73	37.19
Polygordius sp.	1.33	3.22	1.3	7.67	44.86
Clausinella fasciata	1.24	3.05	1.27	7.26	52.12
Lysidice unicornis	1.02	2.62	1.34	6.24	58.35
Aonides paucibranchiata	1.07	2.49	1.36	5.93	64.28

Table 11. The taxa producing the top 20% of the <u>dissimilarity</u> between A & B.

Groups B & A						
Average dissimilarity = 63.17		LBN#5				
Species	Group B Av.Abund	Group A Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Galathea intermedia	2.27	0	2.99	8.35	4.73	4.73
Podarkeopsis helgolandicus	0	1.73	2.3	12.34	3.64	8.37
Socarnes erythrophthalmus	1.64	0	2.16	1.65	3.43	11.79
Leptochiton cancellatus	0	1.41	1.88	12.34	2.97	14.76
Thracia villosiuscula	0	1.41	1.88	12.34	2.97	17.73
Spirobranchus lamarcki	1.34	0	1.76	1.15	2.79	20.52

Table 12 The taxa producing the top 20% of the <u>dissimilarity</u> between F & D.

Groups D & F						
Average dissimilarity = 56.51		HI04#4				
Species	Group D Av.Abund	Group F Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Spirobranchus triqueter	0.29	3.46	3.76	7.84	6.65	6.65
Sphaerosyllis bulbosa	1.98	0	2.35	4.44	4.16	10.81
Amphipholis squamata	2.83	1	2.22	2.15	3.92	14.73
Mediomastus fragilis	0.69	2.24	1.85	2.2	3.27	18.01
Moerella donacina	0	1.41	1.68	15.61	2.98	20.98

Table 13 The taxa producing the top 20% of the <u>dissimilarity</u> between G & D.

Groups G & D						
Average dissimilarity = 53.44	HI02#1					
Species	Group G Av.Abund	Group D Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Nematoda	8.72	5.34	3.73	3.8	6.98	6.98
Aonides paucibranchiata	5.48	2.22	3.57	5.96	6.69	13.67
Enchytraeidae	3.61	1.28	2.57	2.55	4.8	18.47
Spirobranchus lamarcki	2.24	0.14	2.31	4.81	4.32	22.79

4. DISCUSSION

4.1 Study of maerl beds in the South Arran MPA

The South Arran MPA contains expansive areas of coarse sediment biotopes, often containing high percentages of dead maerl and maerl gravel. The distribution of dead and live maerl suggests that live maerl beds may once have extended from the Iron Rock Ledges area to north of Drumadoon Point and from the Pladda area past the eastern shore of Holy Isle to Clauchlands Point (Moore, 2014a) (Figure 12).

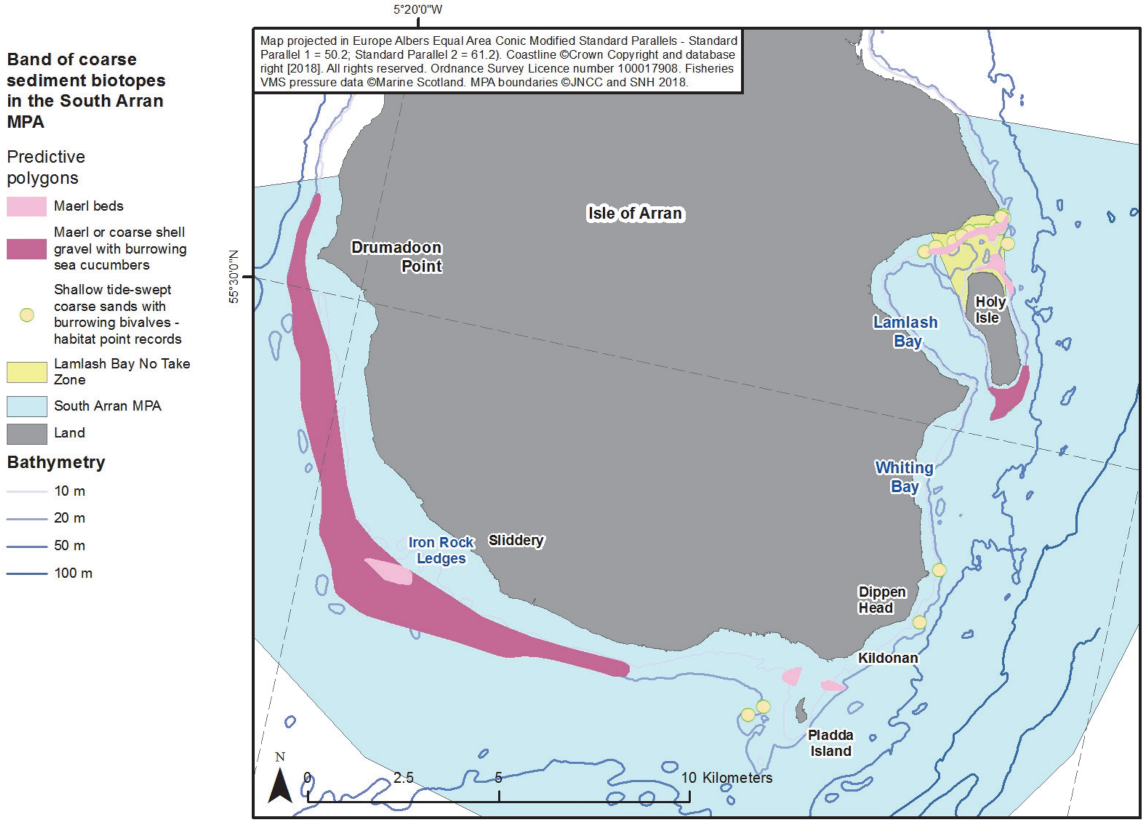

Figure 12. Distribution of coarse sediment biotopes with dead and live maerl around the South Arran MPA.

To be able to define ares of maerl beds as an MPA protected feature, it was necessary to engender some distinguishing criteria to split up the habitat continua between maerl beds and maerl gravel areas, which after a review of the relevant data by Colin Moore in 2014, was set at 5% live material (O on the SACFOR scale) for this MPA (Moore, 2014a). To take account of the patchiness and gradation between maerl beds and other coarse gravel habitats, the areas mapped as the 'maerl bed' protected feature for the South Arran MPA (SNH, 2014) are surrounded by 'maerl recovery areas, which perhaps represent areas of historically richer maerl with the greatest likelihood for recovery and suitability for conservation management given the vegetative propagation of maerl (see Moore, 2014a).

Contemporary maerl beds have been recorded in depths of 4 - 25 m in the MPA; along the northern coastline of Lamlash Bay, off the north-eastern and southern shores of Holy Isle, along the south coast of Arran at Kildonan and on the south-west coast at Sliddery (Axelsson *et al.,* 2010; Allen, 2013.; Moore, 2014b; Howson, 2014; Munro *et al.,* 2014.). The proportion of live maerl on the majority of these beds is very low (1 - 5 %, Munro *et al.,* 2014), with the notable exception of two pockets of rich maerl studied here, where live maerl coverage reaches 30% and 75%.

Prior to the 2014 drop down video survey (Morris-Webb, 2015) and the following dive survey described in this report, there were no extant records of dense maerl beds with proportions of live maerl above 20% in the South Arran MPA, or indeed the Clyde Sea area. The two dense beds studied here, off Pladda and in Lamlash Bay, prove that maerl beds in the Clyde Sea area can indeed be made up of large well developed live fragments at high percentages - and thereby create the complex three-dimensional structure which forms the basis of much of the biotope's diversity and value as a nursery habitat for many marine animals including commercial species of fish and shellfish such as queen scallops (Kamenos *et al.,* 2004). It proves that the Clyde's environmental regime is indeed suitable for such beds, and lends substantial strength to the argument that much of the maerl gravel around Arran derives from degraded, previously dense, maerl beds. Moore (2014a) noted that the correlation between lower levels of scallop dredging and higher levels of live maerl around the South of Arran, and the presence of dense dead, relatively unbroken maerl and high levels of scallop dredging off the south of Holy Isle, are suggestive, though not proof, of dredging impact. The relationship between scallop dredging and degradation of maerl beds has been confirmed by studies in other locations in the Clyde such as Hall-Spencer and Moore (2000) and Hauton, *et al.* (2003), and Kamenos *et al* (2003). The two rich maerl beds mapped in 2014 both lie in areas which are relatively inaccessible to dredgers. The Pladda bed is located in a shallow bay protected by a bank of boulders, and the Lamlash Bay bed is confined to a bend in a steep slope on the north side of the channel between Holy Isle and Arran, which would have been awkward to dredge.

Since it is now obvious that the environment in the South Arran MPA is indeed suitable to support full-coverage live beds of well-formed fragments, this is a realistic target for recovery, albeit very long term.

Three different maerl habitats were encountered in the South Arran MPA. The bed of *Phymatolithon calcareum* at Pladda, formed by large medallions of maerl, on the exposed south coast of the island; the maerl gravel areas on the semi-exposed coast of Holy Isle which were also dominated by sparse *Phymatolithon calcareum*, and the more sheltered maerl bed in Lamlash Bay which was dominated by twigs of *Lithothamnion glaciale* (see Figure 3 and Figure 7). Since maerl species are difficult to identify to species level without specialised laboratory methods it had not previously been known that the Pladda and Lamlash Bay beds were made up of different species. This finding further emphasises the complexity of the South Arran ecosystem, which contains niches for a variety of diverse biotopes.

Of concern, particularly around Holy Isle, are the large amounts of the non-native algal species *Dasysiphonia japonica* on both maerl beds and '*Trailliella intricata'* (the tetrasporophyte phase of *Bonnemaisonia hamifera*) on the live maerl in Lamlash Bay.

4.2 Comparison of the 'maerl bed' and 'maerl gravel' biotopes

This survey studied two sites on mapped 'maerl beds' (PL32 and LBN) and three in areas of coarse sediment north and south of Holy Isle (HIN04 and HIN02 north, and HI22 south). Comparison of the biological diversity of associated communities shows clearly that there is a difference between intact 'maerl beds' and maerl gravel areas. Values of all univariate community indices were higher at the two maerl bed sites than at the three coarse sediment sites (e.g. mean Shannon Diversity H' was 3.09 for LBN and 2.83 for PL32 versus 2.78, 2.43 and 2.70 at the Holy Isle sites). Some of the differences in the composition of the biological communities between the Holy Isle sites and Pladda and Lamlash Bay are caused by the different exposure regimes - sheltered in Lamlash Bay via medium exposure around Holy

Isle to exposed at Pladda. This is especially true for the epifloral and sessile epibenthic communities. Biological diversity of the infaunal communities, however, seems to be correlated with the presence of live maerl.

A comparison of the effects of maerl bed quality on highly mobile epifauna (especially fish) would be highly beneficial to assess the ecosystem value to the MPA, and to describe it in ways meaningful to most people. It is possible that the patches remaining today are too small and isolated to show an effect at that level, but further studies to investigate this are currently underway, such as baited camera studies investigating the use of different habitats around South Arran by juvenile gadoid fish (Elliott *et al.,* 2015).

Comparing the two sites north of Holy Isle, which were very close to each other but just either side of the NTZ boundary (HIN04 and HIN02) did not expose meaningful differences which could be ascribed to effects of the NTZ. No activity data exists; however, to confirm to what degree pressures on these spatially very close sites actually differed. The conspicuous dominant taxa were very similar and the two transects appeared to be part of one continuum. It was notable that individual flame shells (*Limaria hians)* were seen at both of these stations, though a search in the vicinity of the transects did not reveal beds of adults. Given the presence of solitary individual adults and juvenile flame shells, it is possible that flame shell bed patches do exist in the shallows around the coast of Holy Isle.

4.3 Macrobenthic infauna - comparison to other Arran and UK maerl bed records

Previous core data on infaunal diversity of maerl beds around Arran is restricted to a series of single 10.3 cm diameter core samples, collected from three discrete **SS.SMp.Mrl.Pcal.R** maerl bed survey stations off Clauchlands Point on the northern coastline of Lamlash Bay between 4 - 11 m depth in 2010 (Munro *et al.,* 2014).

The 2010 infaunal core samples were assigned to the 'shallow tide-swept coarse sands with burrowing bivalves' protected feature biotope (**SS.SCS.ICS.MoeVen**) on the basis of the key characterising species present within the sediment. Infaunal taxon richness ranged from 35 - 82 taxa (35, 62 and 82) with infaunal abundances between 96 - 724 (96, 372 and 724) ind. / 0.01 m^2. These core samples were collected as part of baseline monitoring of the NTZ and were processed using a 0.5 mm mesh sieve, resulting in the representation of a greater number of small invertebrate taxa (especially polychaete worms) than would have been recorded using a 1 mm sieve (Munro *et al.,* 2014). The latter has been used more frequently in recent comparative studies of maerl bed infaunal diversity (e.g. Moore *et al.,* 2011). Because of the very small sample size in 2010 and the methodological differences it is impossible to say whether the differences in taxon richness and abundances reflect actual temporal or spatial trends when compared to the findings or this study (S mean 29 range 21-38, N mean 84 range 35-183).

Grab samples collected by SNH in 2013 along the maerl / maerl gravel band south-west off Arran were also assigned to the biotopes **SS.SCS.ICS** and **SS.SCS.ICS.MoeVen** (Allen *et al.,* 2014). Infaunal diversity of two single day grabs processed through a 1 mm sieve collected within the maerl beds east of Pladda and west of Sliddery was very high with Shannon Diversity (H') values of 5.29 and 5.09, and 105 and 77 species (Allen *et al.*, 2014). Again, quantitative comparison with the 2014 core data is complicated by the methodological differences, but creates the impression that the infaunal communities of this survey do not stand out for their diversity and richness.

Moore *et al*. (2011) collated results of 12 similar Scottish maerl bed studies. The infaunal sampling effort in those was slightly smaller than in this study, with only four cores taken per site instead of five. Site-wise infaunal taxon richness described by Moore, of between 56 and 122 species leaves Arran's maerl beds on the low side with between 50 and 71 taxa, and the mean infaunal abundance values of between 72 and 453 described by Moore compared to Arran's 56 to 106, also leave Arran slightly on the low side.

Further context is provided by studies of beds using similar techniques in the Sound of Arisaig (Moore *et al*., 2004, Moore *et al.,* 2015), Loch nam Madadh (Moore *et al*., 2006), Loch Laxford (Moore *et al*., 2010), and Fetlar to Haroldswick (Hirst *et al.* 2013). Infaunal taxon richness of cores collected at these sites ranged from 30 to 109 species per sample, which the range of 21 - 38 species in the 2014 Arran cores compares to unfavourably. This may be a reflection of the very small size of the dense maerl bed patches in Arran, which remain in only a few inaccessible corners of a heavily dredged coastline.

Diversity indices follow the same trend, with the 2014 Arran beds yielding Shannon Wiener diversities of H' = 2.43 - 3.09 compared to H' 2.9 - 5.22 in the above mentioned studies.

The numbers of epifaunal and floral taxa recorded on the South Arran maerl beds appear to contradict the depauperate trend above, with Arran's beds counting between 68 and 89 taxa compared to 33 to 109 taxa on of the other beds from Arisaig (x5), Loch Maddy (x4) and Loch Laxford (x3).

On a UK level, compared to a maerl bed in Milford Haven, South Wales, the South Arran 2014 samples rank quite favourably. One hundred and thirty taxa were recorded overall in the 25 cores taken at the five Arran dive sites. Milford Haven, for a similar sampling effort, over five sampling occasions, returned between 86 and 142 taxa in a similar 25 cores, with an overall mean of 107 taxa per sampling occasion. This indicates the importance Scotland plays for maerl beds on a UK level, with many excellent examples found here, but also puts into perspective the 'poorer' Arran beds, which are still quite rich when compared to beds further south.

Of interest in the macrobenthic cores were the records of small flame shell *L. hians* specimens at both HIN04 and LBN. These core records supplement the diver observations of individuals of this species at HIN04 and HIN02 (see also Section 4.2).

4.4 Whiting Bay seagrass bed

The diver survey of the seagrass bed in Whiting Bay revealed that the bed, while patchy, compares very favourably with other seagrass beds on the Scottish west coast. Diver MNCR phase 2 style surveys of two beds in Wester Ross using a similar methodology yielded average shoot densities of 46/m^2 with 49 epibenthic taxa, and 113/m^2 with 56 epibenthic taxa (Moore *et al*. 2011), compared to the 89 shoots m^{-2} and 60 epibenthic taxa recorded here.

The abundant echiuran(?) seen in the sediments within the *Echinocardium caudatum* beds perhaps warrants further investigation.

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ANNEX 1: RAW DATA

Table A. Site characteristic data for all dive sites

Site name	**Pladda**	**Holy Isle South**	**Holy Isle North**	**Lamlash Bay North**	**Holy Isle North**	**Whiting Bay**
Site code	**PL34**	**HI22**	**HIN04**	**LBN**	**HIN02**	**WBZ**
Survey date	21/09/2014	22/09/2014	23/09/2014	24/09/2014	25/09/2014	26/09/2014
Latitude	55.43635	55.51077	55.53867	55.54600	55.53563	55.49758
Longitude	-5.12493	-5.06212	-5.07758	-5.08857	-5.07232	-5.08833
Transect bearing	240	220	140	100	320	n/a
Personnel						
Phase 2 survey	FB/JM	FB/JM	FB/JM	FB/JM	FB/JM	FB/JM
Coring	TM	TM	TM	TM	TM	n/a
Maerl/seagrass quadrats	LK/JAT	LK/JAT	LK/JAT	LK/JAT	LK/JAT	LK/JAT
Photography	FB/JAT/LK	FB/JAT/LK	FB/JAT/LK	FB/JAT/LK	FB/JAT/LK	FB/JAT/LK
Video	LK	TM	TM	TM	TM	TM
Substrata %						
Bedrock / boulders	0	0	0	0	0	0
Cobbles	0.5	0.1	0	0	0	0
Whole shell	30	18.78	23.85	15	20	5
Pebbles	5.5	0.1	0.1	0	1	2
Live maerl	20	0.01	0.05	55	1	0
Maerl gravel	30	80	70	25	74	0
Gravel	10	0	0	0	0	1
Sand	4	1	3	0	2	92
Mud	0	0.01	3	5	2	0
Total (calc)	**100**	**100**	**100**	**100**	**100**	**100**
Depth BCD (m)	7.5	7.8	6.2	9.8	6	4.4
Sediment features (1 - 5)						
Surface relief (even-uneven)	2	2	3	2	2	1
Firmness (firm-soft)	3	3	3	4	3	3
Stability (stable-mobile)	3	3	3	2	3	2
Sorting (well-poor)	4	3	4	3	3	4
Sediment features (presence)						
Mounds / casts	N	N	N	N	N	N
Burrows / holes	N	Y	N	Y	N	Y
Tubes	Y	Y	Y	Y	Y	Y
Algal mat	N	N	Y	Y	Y	N
Waves / dunes (>10 cm high)	N	N	N	N	N	N
Ripples (<10 cm high)	N	N	N	N	N	N
Subsurface black layer	N	N	N	?	N	N
Subsurface coarse layer	N	N	N	N	N	N
Subsurface clay / mud	N	N	Y	Y	Y	N
Surface silt / flocculent	N	N	N	N	N	N

Table B. Quadrat records of Site Maerl Abundance

Site	PL34	21/09/2014		HI22	22/09/2014		HIN04	23/09/2014		LBN	24/09/2014		HIN02	25/09/2014	
Quadrat	% live maerl	% total maerl / maerl gravel	diver	% live maerl	% total maerl / maerl gravel	diver	% live maerl	% total maerl / maerl gravel	diver	% live maerl	% total maerl / maerl gravel	diver	% live maerl	% total maerl / maerl gravel	diver
L1	30	95	LK	1	98	LK	1	100	LK	85	95	LK	0.5	100	LK
L2	25	95	LK	2	100	LK	3	100	LK	80	95	LK	1	100	LK
L3	15	90	LK	1	99	LK	3	100	LK	80	95	LK	0.5	95	LK
L4	40	95	LK	2	95	LK	1	95	LK	90	100	LK	0.5	100	LK
L5	20	95	LK	2	95	LK	2	100	LK	70	90	LK	0	95	LK
L6	30	95	LK	2	100	LK	1	100	LK	80	85	LK	0.5	100	LK
L7	20	90	LK	1	98	LK	1	95	LK	80	95	LK	0	100	LK
L8	15	90	LK	1	100	LK	2	100	LK	80	95	LK	0.5	100	LK
L9	45	90	LK	5	100	LK	3	100	LK	70	80	LK	1	100	LK
L10	30	95	LK	1	100	LK	2	100	LK	50	90	LK	1	100	LK
R1	60	90	JAT	5	100	JAT	2	100	JAT	50	95	JAT	1	100	JAT
R2	25	95	JAT	2	80	JAT	1	100	JAT	70	85	JAT	1	100	JAT
R3	25	90	JAT	3	100	JAT	2	95	JAT	70	80	JAT	1	95	JAT
R4	45	90	JAT	2	95	JAT	1	100	JAT	80	85	JAT	1	100	JAT
R5	30	80	JAT	2	100	JAT	5	95	JAT	60	75	JAT	1	100	JAT
R6	25	85	JAT	3	100	JAT	3	100	JAT	75	85	JAT	1	100	JAT
R7	25	100	JAT	2	90	JAT	2	100	JAT	85	95	JAT	2	100	JAT
R8	20	100	JAT	3	95	JAT	5	100	JAT	80	90	JAT	1	100	JAT
R9	30	90	JAT	4	100	JAT	5	100	JAT	85	100	JAT	2	100	JAT
R10	20	95	JAT	2	98	JAT	3	90	JAT	90	100	JAT	2	100	JAT
Mean	28.75	92.25		2.3	97.15		2.4	98.5		75.5	90.5		0.925	99.25	

Table C. Abundance (SACFOR) data for the fauna and flora of the maerl and Zostera biotopes

Scientific name accepted	Sp Code	AphiaID accepted	Authority accepted	Notes	Spec. checked	Photos	PL34	HI22	HIN04	LBN	HIN02	WBZ
No. of recorded taxa	**193**						**68**	**83**	**86**	**89**	**85**	**60**
Porifera (white 'Pennar' sponge)	C000001	558	Grant, 1836					R		R		
Suberites	C002180	132072	Nardo, 1833	A few small colonies			R		R	R		
Halichondria bowerbanki	C004810	165801	Burton, 1930		Y (not spicules)			x1				
Amphilectus fucorum	C005960	150225	(Esper, 1794)	A couple of small colonies				R				
Haliclona	C008540	131834	Grant, 1836		Y				R		R	
Hydractinia echinata	D003350	117644	(Fleming, 1828)			Y		R				R
Sertularella gayi	D006670	117902	(Lamouroux, 1821)	A couple of small colonies on shells							R	
Clytia hemisphaerica	D007030	117368	(Linnaeus, 1767)	On *Polysiphonia elongata*	Y					P		
Obelia sp.	D007280	117034	Péron & Lesueur, 1810		Y					R		
Obelia dichotoma	D007300	117386	(Linnaeus, 1758)						R		R	
Obelia geniculata	D007310	117388	(Linnaeus, 1758)	On mature *Saccharina latissima* fronds				R	R	R	R	
Cerianthus lloydii	D010750	283798	Gosse, 1859			Y	F	A	F	R	O	R
Sagartiogeton laceratus	D012470	100999	(Dalyell, 1848)				O					
Sagartiogeton undatus	D012480	101002	(Müller, 1778)		Y	Y	O					R
Lineus longissimus	G000780	122528	(Gunnerus, 1770)					R				
Echiurus echiurus	O000040	110377	(Pallas, 1766)	Long mottled orangey pink proboscis (3 mm wide, blunt end) extending for up to 10" from burrow, creating radial marks around burrow								C

Polynoidae	P000420	939	Kinberg, 1856					P				
Alentia gelatinosa	P000600	130722	(M. Sars, 1835)		Y					P		
Lepidonotus squamatus	P001330	130801	(Linnaeus, 1758)		Y			P				
Chaetopterus	P013720	129229	Cuvier, 1830			Y	F	F	O	C	C	O
Terebellidae	P020000	982	Johnston, 1846						x1			x1
Myxicola infundibulum	P022270	130932	(Montagu, 1808)					R	R		R	
Hydroides norvegicus	P022880	131009	Gunnerus, 1768		Y	Y			R	C	O	R
Spirobranchus	P023020	129582	Blainville, 1818			Y	F	O	F	C	F	O
Spirobranchus lamarcki	P023030	560033	(Quatrefages, 1866)		Y						P	
Spirobranchus triqueter	P023040	555935	(Linnaeus, 1758)		Y			P	P	P	P	
Spirorbinae	P023550	989	Chamberlin, 1919			Y	O	O	O	C	O	
Balanus balanus	R001090	106213	(Linnaeus, 1758)			Y		P				
Balanus crenatus	R001100	106215	Bruguière, 1789		Y	Y		P				R
Ericthonius punctatus	S009440	102408	(Bate, 1857)		Y							P
Pandalus montagui	S023220	107651	Leach, 1814 [in Leach, 1813-1814]			Y				O	x1	
Anapagurus hyndmanni	S024470	107217	(Bell, 1846)					R		O	x1	
Pagurus bernhardus	S024650	107232	(Linnaeus, 1758)			Y		R	O	O	O	C
Pagurus cuanensis	S024680	107235	Bell, 1846							x1		
Galathea sp. (juv)	S024840	106834	Fabricius, 1793				P					
Galathea intermedia	S024860	107150	Liljeborg, 1851		Y	Y				C		
Munida rugosa	S024950	107160	(Fabricius, 1775)									x1
Pisidia longicornis	S025020	107188	(Linnaeus, 1767)						P	P		
Hyas araneus	S025590	107322	(Linnaeus, 1758)						x1	x1		
Inachus dorsettensis	S025760	107327	(Pennant, 1777)		Y	Y			O	C	x1	

Macropodia rostrata	S025850	107345	(Linnaeus, 1761)		Y				O	O	x1	C
Cancer pagurus	S026460	107276	Linnaeus, 1758			Y	O	O	F	O	F	
Liocarcinus corrugatus	S026680	107386	(Pennant, 1777)			Y				x1?		
Liocarcinus depurator	S026690	107387	(Linnaeus, 1758)					x1		O		C
Necora puber	S026720	107398	(Linnaeus, 1767)			Y	F	F	F	C	F	F
Carcinus maenas	S026900	107381	(Linnaeus, 1758)									O
Polyplacophora	W000500	55	Gray, 1821	On dead shells				P			P	
Polyplacophora (patterned)	W000500	55	Gray, 1821	On dead shells					P			
Leptochiton cancellatus	W000560	140201	(Sowerby, 1840)	On dead shells	Y		P		P			
Lepidochitona cinerea	W000740	140143	(Linnaeus, 1767)	On dead shells	Y					P		
Testudinalia testudinalis	W001250	234208	(O. F. Müller, 1776)	On dead shells	Y		F		P	P	P	
Tectura virginea	W001260	153552	(O. F. Müller, 1776)	On dead shells	Y					F	C	
Gibbula magus	W001890	141790	(Linnaeus, 1758)		Y	Y	O	F		R	O	
Lacuna vincta	W002440	140170	(Montagu, 1803)		Y		P			P		
Rissoa lilacina	W002810	141358	Récluz, 1843		Y			P	P	P	P	C
Rissoa parva	W002850	141365	(da Costa, 1778)		Y		P					C
Trivia arctica	W007370	141741	(Pulteney, 1799)			Y				x1		
Buccinum undatum	W008440	138878	Linnaeus, 1758									x1
Aplysia punctata	W011020	138758	(Cuvier, 1803)		Y			x1		P	P	
Onchidoris pusilla	W013370	140643	(Alder & Hancock, 1845)		Y					P	P	
Limacia clavigera	W013580	140830	(O. F. Müller, 1776)		Y				R		P	
Limaria hians	W017390	140235	(Gmelin, 1791)		Y				R		R	
Chlamys varia	W018000	236719	(Linnaeus, 1758)			Y				R		

Aequipecten opercularis	W018050	140687	(Linnaeus, 1758)	Mostly juveniles	Y			R		O	O	
Pecten maximus	W018090	140712	(Linnaeus, 1758)			Y		O		x1	F	
Pecten maximus (juv)	W018090	140712	(Linnaeus, 1758)						R		F	
Pododesmus patelliformis	W018200	153027	(Linnaeus, 1761)		Y						O	
Ensis sp.(siphons)	W020220	138333	Schumacher, 1817						O		O	
Ensis arcuatus	W020230	160539	Schumacher, 1817									C
Dosinia exoleta	W021660	141911	(Linnaeus, 1758)		Y			F			P	
Polititapes rhomboides	W021810	745846	(Pennant, 1777)	Dead shells common	Y		R	F	O			
Chamelea gallina	W021890	141907	(Linnaeus, 1758)									x1
Crisiidae	Y000030	110806	Johnston, 1838							R		
Crisia denticulata	Y000270	111695	(Lamarck, 1816)		Y				R			
Crisia eburnea	Y000280	111696	(Linnaeus, 1758)		Y						R	
Tubulipora plumosa	Y000530	111765	Thompson in Harmer, 1898	Frequent on some mature *Saccharina latissima* fronds	Y				P		R	
Fenestrulina malusii	Y005230	111418	(Audouin, 1826)	Common on dead *Dosinia* shells	Y					R	R	
Celleporella hyalina	Y005710	111397	(Linnaeus, 1767)	On mature *Saccharina latissima* fronds	Y	Y	O	O	O	O	O	O
Aetea truncata	Y006450	111067	(Landsborough, 1852)	On *Phyllophora crispa*	Y					P		R
Membranipora membranacea	Y006640	111411	(Linnaeus, 1767)	On mature *Saccharina latissima* fronds				O	O	O	O	O
Electra pilosa	Y006780	111355	(Linnaeus, 1767)	On mature *Saccharina latissima* fronds	Y			O	O	O	O	O
Cradoscrupocellaria reptans	Y008380	738997	(Linnaeus, 1758)	Common on *Desmarestia aculeata* plants	Y	Y	R	R	R	R	R	R

Scrupocellaria scrupea	Y008400	111249	Busk, 1852		Y						R	
Scrupocellaria scruposa	Y008410	111250	(Linnaeus, 1758)	On dead bivalve shell	Y					R	R	
Antedon bifida	ZB00110	124201	(Pennant, 1777)					R				
Astropecten irregularis	ZB00410	123867	(Pennant, 1777)			Y		x1	x1	O		x1
Luidia ciliaris	ZB00670	123920	(Philippi, 1837)			Y		x1	F		O	x1
Porania pulvillus	ZB01010	125166	(O.F. Müller, 1776)			Y			F	O	O	
Crossaster papposus	ZB01490	124154	(Linnaeus, 1767)			Y			x1	O	x1	
Henricia sp.	ZB01640	123276	Gray, 1840			Y			O			
Asterias rubens (juv)	ZB01900	123776	Linnaeus, 1758		Y			O	O	O	O	O
Asterias rubens	ZB01900	123776	Linnaeus, 1758	Incl. some enormous flabby individuals		Y		O	C	O	x1	
Marthasterias glacialis	ZB02000	123803	(Linnaeus, 1758)			Y	C	O	F	O	F	
Ophiothrix fragilis	ZB02350	125131	(Abildgaard, in O.F. Müller, 1789)		Y			P	R	P		
Amphipholis squamata	ZB03000	125064	(Delle Chiaje, 1828)		Y			P				
Ophiura albida	ZB03130	124913	Forbes, 1839		Y			P				
Ophiura ophiura	ZB03150	124929	(Linnaeus, 1758)						x1			F
Echinoidea (juv)	ZB03380	123082	Leske, 1778	In dead bivalve shells	Y					P		
Echinus esculentus	ZB03620	124287	Linnaeus, 1758					x1				
Echinocardium cordatum	ZB04070	124392	(Pennant, 1777)									C
Clavelina lepadiformis	ZD00060	103552	(Müller, 1776)				R	R				
Aplidium punctum	ZD00640	103662	(Giard, 1873)		Y				R			
Diplosoma listerianum	ZD00970	103579	(Milne-Edwards, 1841)	Particularly on mature *Saccharina latissima* fronds		Y	R	O	R	R	R	
Ciona intestinalis	ZD01170	103732	(Linnaeus, 1767)	Mostly hidden inside valves of dead bivalve shells				R	R		R	

Corella parallelogramma	ZD01350	103743	(Müller, 1776)					R	O		O	
Ascidiella aspersa	ZD01410	103718	(Müller, 1776)		Y	Y	O	F	O	O	C	O
Ascidiella scabra	ZD01430	103719	(Müller, 1776)		Y			R				
Botryllus schlosseri	ZD02090	103862	(Pallas, 1766)				R					
Scyliorhinus canicula	ZF00400	105814	(Linnaeus, 1758)									x1
Diplecogaster bimaculata	ZG01240	236458	(Bonnaterre, 1788)		Y					x1		
Agonus cataphractus	ZG04480	127190	(Linnaeus, 1758)							x1		
Ctenolabrus rupestris	ZG06050	126964	(Linnaeus, 1758)								P	
Pholis gunnellus	ZG06800	126996	(Linnaeus, 1758)					O		O	x1	F
Callionymus reticulatus	ZG07020	126795	Valenciennes, 1837			Y		O	O	O	O	
Gobiusculus flavescens	ZG07280	126898	(Fabricius, 1779)								x1	
Pomatoschistus	ZG07410	125999	Gill, 1863			Y	C	F	F	F	F	C
Limanda limanda (juv)	ZG08910	127139	(Linnaeus, 1758)									x1
Pleuronectes platessa	ZG09030	127143	Linnaeus, 1758									R
Rhodophyta (enc)	ZM00010	852	Wettstein, 1901	On pebbles			R	R	R	R	R	
Acrochaetiaceae	ZM00960	143661	Fritsch ex W.R. Taylor, 1957		Y			R				R
Scinaia interrupta	ZM01820	146401	(A.P.de Candolle) M.J.Wynne, 1989		Y	Y	F	O	O	R	O	
Asparagopsis armata (Falkenbergia rufolanosa)	ZM02020	144438	Harvey, 1855				R		R			
Bonnemaisonia asparagoides	ZM02080	144440	(Woodward) C.Agardh, 1822				R					
Bonnemaisonia hamifera (Trailliella intricata)	ZM02110	144442	Hariot, 1891		Y	Y			R	S	R	

Palmaria palmata	ZM02420	145771	(Linnaeus) Weber & Mohr, 1805		Y		R				R	
Dilsea carnosa	ZM02560	145222	(Schmidel) Kuntze, 1898			Y	R					
Dudresnaya verticillata	ZM02610	145226	(Withering) Le Jolis, 1863				R					
Callophyllis laciniata	ZM03230	145262	(Hudson) Kützing, 1843		Y		R					
Peyssonnelia	ZM03640	144051	Decaisne, 1841				R	R	R		R	
Corallinaceae (enc)	ZM03840	143691	Lamouroux, 1812			Y	O	O	O	O	O	R
Corallina officinalis	ZM04040	145108	Linnaeus, 1758		Y				R	O		
Lithothamnion glaciale	ZM04610	145170	Kjellman, 1883						R	S		
Phymatolithon calcareum	ZM04910	145199	(Pallas) W.H.Adey & D.L.McKibbin, 1970			Y	C	R	R		O	
Pneophyllum fragile	ZM05050	145206	Kützing, 1843		Y							R
Coccotylus truncatus	ZM05830	145654	(Pallas) M.J.Wynne & J.N.Heine, 1992		Y		R					
Phyllophora crispa	ZM05840	145660	(Hudson) P.S.Dixon, 1964		Y					R	R	
Erythrodermis traillii	ZM05880	145655	(Holmes ex Batters) Guiry & Garbary, 1990		Y			R				
Chondrus crispus	ZM06110	145625	Stackhouse, 1797			Y				R		
Polyides rotunda	ZM06250	145668	(Hudson) Gaillon, 1828				R					
Rhodophyllis divaricata	ZM06930	145617	(Stackhouse) Papenfuss, 1950		Y		R	R	R	R	R	
Cruoria cruoriiformis	ZM07010	145611	(P.L.Crouan & H.M.Crouan) Denizot, 1968		Y		R?	R?	R?	R?	R?	

Chylocladia verticillata	ZM07400	145808	(Lightfoot) Bliding, 1928				R					R
Lomentaria clavellosa	ZM07520	145825	(Lightfoot ex Turner) Gaillon, 1828		Y		R	R	R	R	R	R
Lomentaria orcadensis	ZM07530	145830	(Harvey) F.S.Collins, 1937				R					
Aglaothamnion bipinnatum	ZM07850	144489	(P.L.Crouan & H.M.Crouan) Feldmann & G.Feldmann, 1948		Y				P			
Callithamnion corymbosum	ZM07890	144526	(Smith) Lyngbye, 1819									R
Ceramium secundatum	ZM08239	144562	Lyngbye, 1819		Y		R	R				R
Compsothamnion thuyoides	ZM08340	144573	(Smith) Nägeli, 1862		Y					R		
Halurus flosculosus	ZM08460	144595	(J.Ellis) Maggs & Hommersand, 1993					R				
Pterothamnion plumula	ZM08880	144683	(J.Ellis) Nägeli, 1855		Y		R	R	R			
Ptilota gunneri	ZM08930	144686	P.C.Silva, Maggs & L.M.Irvine, 1993			Y				R		
Ptilothamnion sphaericum	ZM08985	144690	(P.L.Crouan & H.M.Crouan ex J.Agardh) Maggs & Hommersand, 1993		Y				R			
Seirospora interrupta	ZM09080	144697	(Smith) F.Schmitz, 1893		Y		R					
Spermothamnion repens	ZM09170	144702	(Dillwyn) Rosenvinge, 1924		Y			R	R		R	R

Spermothamnion strictum	ZM09180	144704	(C.Agardh) Ardissone, 1883		Y		R	R	R			
Sphondylothamnion multifidum	ZM09230	144705	(Hudson) Nägeli, 1862		Y		R			R		
Apoglossum ruscifolium	ZM09400	144737	(Turner) J.Agardh, 1898						R	R	R	
Cryptopleura ramosa	ZM09500	144743	(Hudson) L.Newton, 1931		Y			R		R	R	
Delesseria sanguinea	ZM09550	144744	(Hudson) J.V.Lamouroux, 1813		Y		R		R	R	R	
Hypoglossum hypoglossoides	ZM09850	144756	(Stackhouse) F.S.Collins & Hervey, 1917		Y		R	R				
Membranoptera alata	ZM09900	144758	(Hudson) Stackhouse, 1809				R					
Haraldiophyllum bonnemaisonii	ZM09950	144755	(Kylin) A.D.Zinova, 1981				R					
Nitophyllum punctatum	ZM10020	144770	(Stackhouse) Greville, 1830		Y		R	R				
Heterosiphonia japonica	ZM10380	232226	Yendo, 1920		Y	Y	F	F	S	O	C	F
Heterosiphonia plumosa	ZM10390	144732	(J.Ellis) Batters, 1902		Y		R	R	R		R	
Chondria dasyphylla	ZM10560	144799	(Woodward) C.Agardh, 1817		Y							R
Odonthalia dentata	ZM10970	144839	(Linnaeus) Lyngbye, 1819		Y		R					
Polysiphonia elongata	ZM11050	144628	(Hudson) Sprengel, 1827		Y		R	R	P	R	R	R
Polysiphonia fucoides	ZM11170	144639	(Hudson) Greville, 1824		Y		R	R				R
Polysiphonia stricta	ZM11300	144672	(Dillwyn) Greville, 1824		Y			R	R	R		R
Pterosiphonia parasitica	ZM11370	144851	(Hudson) Falkenberg, 1901		Y		R	R	R	R	R	

Rhodomela confervoides	ZM11450	144854	(Hudson) P.C.Silva, 1952		Y					R	R	
Bacillariophyceae	ZN	148899			Y							R
Cutleria multifida	ZR03890	145297	(Turner) Greville, 1830		Y				R			
Cutleria multifida (Aglaozonia)	ZR03890	145297	(Turner) Greville, 1830	Common on dead bivalve shells	Y		R	R	R	O	O	R
Sphacelaria	ZR04120	144272	Lyngbye, 1818		Y		R	R	R	R		
Dictyota dichotoma	ZR04570	145367	(Hudson) J.V.Lamouroux, 1809		Y		R	R	R	R	R	
Desmarestia aculeata	ZR04970	145307	(Linnaeus) J.V.Lamouroux, 1813		Y		O	F	R	R	R	R
Desmarestia ligulata	ZR04990	145309	(Stackhouse) J.V.Lamouroux, 1813				R					
Striaria attenuata	ZR05370	548021	(Greville) Greville, 1828		Y							R?
Colpomenia peregrina	ZR06050	145856	Sauvageau, 1927	Found on 1 dead shell	Y		R					
Chorda filum	ZR06250	145722	(Linnaeus) Stackhouse, 1797		Y			R	R		R	
Saccharina latissima	ZR06360	234483	(Linnaeus) C.E.Lane, C.Mayes, Druehl & G.W.Saunders, 2006			Y	F	C	C	F	C	F
Saccorhiza polyschides	ZR06460	145735	(Lightfoot) Batters, 1902			Y	O					
Halidrys siliquosa	ZR07160	145540	(Linnaeus) Lyngbye, 1819				R					
Chlorophyta (fluff)	ZS00001	801	Pascher, 1914						R			
Ulva clathrata	ZS02140	156078	(Roth) C.Agardh, 1811		Y				R			

Ulva (flat)	ZS02400	144296	Linnaeus, 1753				O	R	R	R	R	R
Ulva (tubular)	ZS02400	144296	Linnaeus, 1753									R
Chaetomorpha aerea	ZS03310	145020	(Dillwyn) Kützing, 1849		Y							R
Cladophora (fine)	ZS03380	143996	Kützing, 1843		Y							R
Derbesia	ZS03960	143814	Solier, 1846		Y				R	R	R	
Zostera marina	ZZ	145795	Linnaeus, 1753									A

Table D. Microscopic analysis of 10 cm2 maerl samples

Site	PL3 4.A	PL3 4.B	PL3 4.C	PL3 4.D	PL3 4.E	HI2 2.A	HI2 2.B	HI2 2.C	HI2 2.D	HI2 2.E	HI0 4.A	HI0 4.B	HI0 4.C	HI0 4.D	HI0 4.E	LBN ..A	LBN ..B	LBN ..C	LBN ..D	LBN ..E	HI0 2.A	HI0 2.B	HI0 2.C	HI0 2.D	HI0 2.E
Algae																									
Sphondylothamnion multifidum			P																						
Acrosorium venulosum							P			P	P		P		P		P								
Aglaothamnion byssoides											P	P													
Aglaozonia sp.																						P	P	P	
Apoglossum ruscifolium					P					P										P			P		
Audouinella sp.				P																					
Ceramium secundatum					P						P														
Cladophora sp.										P															
Corallina officinalis																P	P	P	P						
Coralline crusts	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Cryptopleura ramosa	P	P														P	P		P		P				P
Cystoclonium purpureum														P	P										
Dictyota dichotoma			P	P				P	P					P			P		P	P		P		P	
Ectocarpaceae												P													
Falkenbergia	P	P					P		P																
Fine green threads						P	P			P	P	P		P							P	P	P	P	P
Gelidiella calcicola			P	P						P		P		P	P	P		P							
Griffithsia corallinoides						P																			
Halarachnion ligulatum			P	P																					
Halurus flosculosus									P	P															
Heterosiphonia japonica	P		P	P	P	P	P	P	P	P	P	P	P	P	P	P		P	P	P	P	P		P	P

Site	PL3 4.A	PL3 4.B	PL3 4.C	PL3 4.D	PL3 4.E	HI2 2.A	HI2 2.B	HI2 2.C	HI2 2.D	HI2 2.E	HI0 4.A	HI0 4.B	HI0 4.C	HI0 4.D	HI0 4.E	LBN ..A	LBN ..B	LBN ..C	LBN ..D	LBN ..E	HI0 2.A	HI0 2.B	HI0 2.C	HI0 2.D	HI0 2.E
Heterosiphonia plumosa																						P			
Hypoglossum hypoglossoides		P	P																						P
Lomentaria clavellosa	P			P	P							P			P			P							
Phyllophora sp. juv				P				P										P					P		
Plocamium cartilagineum											P			P	P					P			P		
Polysiphonia elongata	P			P	P		P					P		P							P				
Polysiphonia fucoides					P		P	P		P		P		P	P		P			P	P	P	P	P	
Polysiphonia harveyi					P		P	P		P	P	P		P	P										P
Polysiphonia stricta											P		P									P	P	P	
Pterosiphonia parasitica	P		P	P	P	P	P				P		P	P	P	P	P	P		P			P		
Pterothamnion plumula		P		P							P					P							P		P
Ptilothamnion sphaericum											P										P				
Ptilota gunneri																				P					
Red crusts	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Rhodomela confervoides							P				P	P	P		P	P		P	P		P			P	
Rhodophyllis divaricata		P				P	P	P					P	P		P	P			P	P	P	P		
Scinaia interrupta			P	P		P						P													
Spermothamnion repens			P	P				P	P	P	P	P	P	P	P				P	P	P	P	P		P
Spermothamnion strictum		P	P	P		P	P	P	P	P	P	P	P		P		P	P			P		P	P	P
Sphacelaria plumosa							P					P		P				P	P						P
Sphacelaria sp.		P					P	P			P	P		P	P	P									
Sphondylothamnion multifidum											P			P											

Site	PL3 4.A	PL3 4.B	PL3 4.C	PL3 4.D	PL3 4.E	HI2 2.A	HI2 2.B	HI2 2.C	HI2 2.D	HI2 2.E	HI0 4.A	HI0 4.B	HI0 4.C	HI0 4.D	HI0 4.E	LBN ..A	LBN ..B	LBN ..C	LBN ..D	LBN ..E	HI0 2.A	HI0 2.B	HI0 2.C	HI0 2.D	HI0 2.E
Trailliella intricata																P	P	P	P	P	P				
Ulva lactuca				P	P																				
Ulva sp. (flat)			P								P	P									P				
Ulva sp. (tubular)												P													
Maerl dead	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Maerl live	P	P	P	P	P	P	P	P	P	P			P	P	P	P	P	P	P	P	P				
Animals																									
Ascidiella aspersa																								P	
Ciona intestinalis																		P							
Crisidia cornuta											P														
Echinus esculentus juv (present in most samples)																					P		P	P	
Fenestrulina malusii											P														
Gibbula magus	P																								
Lepidochitona cancellata (present in most samples)	P	P	P					P													P				
Plagioecia patina											P														
Psammechinus miliaris juv.																							P	P	
Scrupocellaria scruposa											P														
Tubulipora liliacea											P														
Taxa	12	12	16	18	13	11	17	14	10	15	25	20	12	19	17	14	13	15	12	14	18	12	17	14	12
Mean	14.2					13.4					18.6					13.6					14.6				

Table E. Zostera marina shoot density

Quadrat	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
no. of shoots	21	23	26	24	24	18	24	23	24	27	18	12	20	20	24	22	23	24	15	21	22	17	20	28
Quadrat	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	Mean	
no. of shoots	22	18	15	21	24	34	20	11	20	15	20	18	32	28	35	28	36	34	16	25	20	15	22.33	

Mean density m^{-2} = 89.30 shoots (quadrat = 0.25 m^2)

Table F. Maerl InFAUNA core site Particle Size Distribution analyses

Arran maerl core PSD	Size	PL34	HI22	HIN04	LBN	HIN02
Medium pebble (gravel)	> 8 mm	9.94	0.00	2.31	0.99	0.00
Small pebble (gravel)	4-8 mm	14.43	4.89	7.47	7.71	0.43
Granule	2-4 mm	38.29	33.61	45.88	20.44	11.91
Sand - very coarse	1-2000 µm	33.89	39.21	39.41	37.86	68.25
Sand - coarse	500-1000 µm	2.01	9.28	1.32	9.49	11.15
Sand - medium	250-500 µm	0.06	4.36	0.20	2.74	2.14
Sand - fine	125-250 µm	0.01	1.58	0.06	0.62	0.59
Sand - very fine	63-125 µm	0.03	1.15	0.12	3.41	0.71
Silt & Clay	< 63 µm	1.31	5.92	3.23	16.74	4.82
% Organic Matter (by LOI)		1.75	2.67	2.78	3.12	2.57

Table G. Macrobenthic infaunal taxa from Infaunal cores

AphiaID	Accepted scientific name	Authority accepted	Notes	PL34 #1	PL34 #2	PL34 #3	PL34 #4	PL34 #5
	Cnidaria							
283798	*Cerianthus lloydii*	Gosse, 1859						
100665	Edwardsiidae	Andres, 1881						
	Platyhelminthes							
793	Platyhelminthes							
	Nemertea							
152391	Nemertea					1		1
	Nematoda							
799	Nematoda			13	24	14	26	8
	Sipuncula							
2032	Golfingiidae	Stephen & Edmonds, 1972	Juvs	1				
410724	*Golfingia vulgaris*	(de Blainville, 1827)						
136060	*Nephasoma minutum*	(Keferstein, 1862)	?		1	3	2	
	Annelida							
130707	*Pisione remota*	(Southern, 1914)		1	5	10	7	2
939	Polynoidae	Kinberg, 1856	scale-less/juvs	4	5	3	2	3
130770	*Harmothoe impar*	(Johnston, 1839)						
130818	*Malmgreniella mcintoshi*	(Tebble & Chambers, 1982)					1	
147008	*Malmgrenia andreapolis*	McIntosh, 1874						1
130816	*Malmgreniella lunulata*	(Delle Chiaje, 1830)			1		3	2
130599	*Pholoe baltica*	Örsted, 1843						
130601	*Pholoe inornata*	Johnston, 1839						
931	*Phyllodocidae*	Örsted, 1843	damaged					1
130616	*Eteone longa*	(Fabricius, 1780)						
130683	*Pseudomystides limbata*	(Saint-Joseph, 1888)						
130631	*Eulalia mustela*	Pleijel, 1987						
129446	*Eumida*	Malmgren, 1865						
130641	*Eumida bahusiensis*	Bergstrom, 1914	?					
130644	*Eumida sanguinea*	(Örsted, 1843)		1		2		
129296	*Glycera*	Savigny, 1818	juvs					
130123	*Glycera lapidum*	Quatrefages, 1866			1	3	1	1
131083	*Ephesiella peripatus*	(Claparède, 1863)						
130197	*Podarkeopsis helgolandicus*	(Hilbig & Dittmer, 1979)						
152249	*Psamathe fusca*	Johnston, 1836						
130185	*Nereimyra punctata*	(Müller, 1788)						
131288	*Eurysyllis tuberculata*	Ehlers, 1864				1		
157583	*Syllis cornuta*	Rathke, 1843		1	2	8	5	
131458	*Syllis variegata*	Grube, 1860				1		
335151	*Trypanosyllis coeliaca*	Claparède, 1868			6		3	1

AphiaID	Accepted scientific name	Authority accepted	Notes	PL34 #1	PL34 #2	PL34 #3	PL34 #4	PL34 #5
131379	*Sphaerosyllis bulbosa*	Southern, 1914		2	2		1	2
130417	*Platynereis dumerilii*	(Audouin & Milne Edwards, 1834)						
129838	*Pareurythoe borealis*	(M. Sars, 1862)				1		
130467	*Nothria conchylega*	(Sars, 1835)						
742232	*Lysidice unicornis*	(Grube, 1840)						
607402	*Hilbigneris gracilis*	(Ehlers, 1868)	spp complex					
130041	*Protodorvillea kefersteini*	(McIntosh, 1869)		8	1	3	4	
130044	*Schistomeringos neglecta*	(Fauvel, 1923)			1			
130585	*Paradoneis lyra*	(Southern, 1914)						
131106	*Aonides oxycephala*	(Sars, 1862)						
131107	*Aonides paucibranchiata*	Southern, 1914			4	2	4	2
129914	*Chaetopterus variopedatus*	(Renier, 1804)						
129972	*Monticellina dorsobranchialis*	(Kirkegaard, 1959)						
129745	*Macrochaeta clavicornis*	(M. Sars, 1835)						
129892	*Mediomastus fragilis*	Rasmussen, 1973						
129220	*Notomastus*	Sars, 1850		1	1			
130327	*Praxillura longissima*	Arwidsson, 1906		1				
130309	*Microclymene tricirrata*	Arwidsson, 1906						
130291	*Euclymene droebachiensis*	(Sars, 1872)						
130980	*Scalibregma inflatum*	Rathke, 1843						
129472	*Polygordius*	Schneider, 1868		1	3	10	1	10
130544	*Owenia fusiformis*	Delle Chiaje, 1844						
131574	*Trichobranchus glacialis*	Malmgren, 1866						
131474	*Amphitrite cirrata*	(Müller, 1771 in 1776)						
131480	*Amphitritides gracilis*	(Grube, 1860)						
131516	*Pista cristata*	(Müller, 1776)				1		
154972	*Pista lornensis*	(Pearson, 1969)						
196385	*Polycirrus norvegicus*	Wollebaek, 1912				1		
131009	*Hydroides norvegicus*	Gunnerus, 1768						
560033	*Spirobranchus lamarcki*	(Quatrefages, 1866)		3			2	1
555935	*Spirobranchus triqueter*	(Linnaeus, 1758)						
137570	*Tubificoides amplivasatus*	(Erséus, 1975)						
2038	Enchytraeidae	Vejdovský, 1879		1				1
	Crustacea							
1078	Ostracoda	Latreille, 1802				1		
102882	*Monoculodes carinatus*	(Bate, 1857)			1			
102918	*Pontocrates arenarius*	(Bate, 1858)		1	5			1
103008	*Parapleustes bicuspis*	(Krøyer, 1838)				7		1
102981	*Metaphoxus fultoni*	(Scott, 1890)				3	1	1

AphiaID	Accepted scientific name	Authority accepted	Notes	PL34 #1	PL34 #2	PL34 #3	PL34 #4	PL34 #5
102611	*Lysianassa plumosa*	Boeck, 1871						
148560	*Socarnes erythrophthalmus*	Robertson, 1892		15	8	4	4	12
102132	*Atylus vedlomensis*	(Bate & Westwood, 1862)			1	1		1
102135	*Dexamine spinosa*	(Montagu, 1813)						
102137	*Guernea (Guernea) coalita*	(Norman, 1868)		2				
101669	*Cheirocratus*	Norman, 1867	females					
101470	*Leptocheirus*	Zaddach, 1884		1			1	
102036	*Leptocheirus hirsutimanus*	(Bate, 1862)						
102039	*Leptocheirus pectinatus*	(Norman, 1869)		4	2	6		6
102043	*Microdeutopus anomalus*	(Rathke, 1843)						
148603	*Monocorophium sextonae*	(Crawford, 1937)						
101864	*Phtisica marina*	Slabber, 1769				2		
531364	*Animoceradocus semiserratus*	(Bate, 1862)		6	2	6	2	7
118842	*Conilera cylindracea*	(Montagu, 1804)						
1133	Tanaidacea	Dana, 1849		1				
136443	*Leptognathia paramanca*	Lang, 1958						
1137	*Cumacea*	Krøyer, 1846				1		
106791	*Processidae*	Ortmann, 1896	juv.					
106687	*Paguroidea*	Latreille, 1802	juvs					
107150	*Galathea intermedia*	Liljeborg, 1851						
106837	*Pisidia*	Leach, 1820	juv.					
107327	*Inachus dorsettensis*	(Pennant, 1777)						
107318	*Eurynome aspera*	(Pennant, 1777)						
110467	*Vaunthompsonia cristata*	Bate, 1858						
118426	*Cymodoce*	Leach, 1814						
	Mollusca							
234208	*Testudinalia testudinalis*	(O. F. Müller, 1776)						
140199	*Leptochiton asellus*	(Gmelin, 1791)						
140201	*Leptochiton cancellatus*	(Sowerby, 1840)				3	3	1
140132	*Callochiton septemvalvis*	(Montagu, 1803)						
139959	*Emarginula fissura*	(Linnaeus, 1758)						
605961	*Parthenina decussata*	(Montagu, 1803)						
151894	*Euspira nitida*	(Donovan, 1804)						
140744	*Philine aperta*	(Linnaeus, 1767)	juvs					
140640	*Onchidoris muricata*	(O. F. Müller, 1776)						
140589	*Nucula nitidosa*	Winckworth, 1930						
140590	*Nucula nucleus*	(Linnaeus, 1758)						
140472	*Musculus discors*	(Linnaeus, 1767)						

AphiaID	Accepted scientific name	Authority accepted	Notes	PL34 #1	PL34 #2	PL34 #3	PL34 #4	PL34 #5
140467	*Modiolus modiolus*	(Linnaeus, 1758)	juvs		1			2
140235	*Limaria hians*	(Gmelin, 1791)						
140283	*Lucinoma borealis*	(Linnaeus, 1767)						
141662	*Thyasira flexuosa*	(Montagu, 1803)						
140161	*Kellia suborbicularis*	(Montagu, 1803)						
345281	*Kurtiella bidentata*	(Montagu, 1803)						
146952	*Tellimya ferruginosa*	(Montagu, 1808)						
147021	*Moerella donacina*	(Linnaeus, 1758)						
181343	*Parvicardium pinnulatum*	(Conrad, 1831)			1		1	1
139012	*Parvicardium scabrum*	(Philippi, 1844)	juvs	1	1	1	1	
138159	*Spisula*	Gray, 1837	broken					
141577	*Arcopagia crassa*	(Pennant, 1777)						
147022	*Moerella pygmaea*	(Lovén, 1846)		2	8			
140873	*Gari tellinella*	(Lamarck, 1818)			1		1	3
138636	*Dosinia*	Scopoli, 1777						
141911	*Dosinia exoleta*	(Linnaeus, 1758)		6	8	5	1	4
138645	*Tapes*	Megerle von Mühlfeld, 1811	juvs					
181364	*Venerupis corrugata*	(Gmelin, 1791)						
745846	*Polititapes rhomboides*	(Pennant, 1777)						
141909	*Clausinella fasciata*	(da Costa, 1778)		1	1	2	5	1
141929	*Timoclea ovata*	(Pennant, 1777)		1	1			
140103	*Hiatella arctica*	(Linnaeus, 1767)		1				
141651	*Thracia villosiuscula*	(MacGillivray, 1827)		1	4	5		1
	Echinodermata							
123080	Asteroidea	de Blainville, 1830	juvs					
123084	Ophiuroidea	Gray, 1840	juvs	18	4	23	8	3
125131	*Ophiothrix fragilis*	(Abildgaard, in O.F. Müller, 1789)		4		1	1	1
125064	*Amphipholis squamata*	(Delle Chiaje, 1828)			4	5		1
123082	Echinoidea	Leske, 1778	juvs	1		2		
124273	*Echinocyamus pusillus*	(O.F. Müller, 1776)						
124418	*Spatangus purpureus*	O.F. Müller, 1776			1			
123479	*Cucumaria*	de Blainville, 1830	juv					
124685	*Neopentadactyla mixta*	(Östergren, 1898) Deichmann, 1944		1				
124465	*Leptosynapta inhaerens*	(O.F. Müller, 1776)	juvs					
	Tunicata							
103718	*Ascidiella aspersa*	(Müller, 1776)						
103719	*Ascidiella scabra*	(Müller, 1776)						
	Phoronida							
128545	*Phoronis*	Wright, 1856						
	Pisces							

AphiaID	Accepted scientific name	Authority accepted	Notes	PL34 #1	PL34 #2	PL34 #3	PL34 #4	PL34 #5
126928	*Pomatoschistus minutus*	(Pallas, 1770)						
			Number of Taxa	31	32	34	26	31
			Number of individuals	105	111	142	91	83
			% total maerl	92	93	92	93	92
			Mean			92.4		
			% live maerl	7	8	7	8	10
			Mean			8		

AphiaID	Accepted scientific name	HI22 #1	HI22 #2	HI22 #3	HI22 #4	HI22 #5	LBN #1	LBN #2	LBN #3	LBN #4	LBN #5
	Cnidaria										
283798	*Cerianthus lloydii*		1					1		1	1
100665	Edwardsiidae										
	Platyhelminthes										
793	Platyhelminthes								1		
	Nemertea										
152391	Nemertea	1				1		1		1	2
	Nematoda										
799	Nematoda	3	2	1	8	2	1	3	2	3	1
	Sipuncula										
2032	Golfingiidae										
410724	*Golfingia vulgaris*										
136060	*Nephasoma minutum*										
	Annelida										
130707	*Pisione remota*										
939	Polynoidae		3			1				4	
130770	*Harmothoe impar*						1		1	1	1
130818	*Malmgreniella mcintoshi*									1	
147008	*Malmgrenia andreapolis*										
130816	*Malmgreniella lunulata*			1	1		1			2	
130599	*Pholoe baltica*		2		1			1	1	1	1
130601	*Pholoe inornata*	2			1						
931	*Phyllodocidae*										
130616	*Eteone longa*										
130683	*Pseudomystides limbata*										
130631	*Eulalia mustela*										
129446	*Eumida*										
130641	*Eumida bahusiensis*			1		1					
130644	*Eumida sanguinea*										2
129296	*Glycera*	1									
130123	*Glycera lapidum*			1		2					

AphiaID	Accepted scientific name	HI22 #1	HI22 #2	HI22 #3	HI22 #4	HI22 #5	LBN #1	LBN #2	LBN #3	LBN #4	LBN #5
131083	*Ephesiella peripatus*						1			1	1
130197	*Podarkeopsis helgolandicus*		1							3	
152249	*Psamathe fusca*		1				2	2		1	
130185	*Nereimyra punctata*									1	
131288	*Eurysyllis tuberculata*		1			1					
157583	*Syllis cornuta*										
131458	*Syllis variegata*										
335151	*Trypanosyllis coeliaca*		2	1					1		6
131379	*Sphaerosyllis bulbosa*										
130417	*Platynereis dumerilii*					1			1		
129838	*Pareurythoe borealis*										1
130467	*Nothria conchylega*									1	
742232	*Lysidice unicornis*	1		1	1	2				1	
607402	*Hilbigneris gracilis*					1	2		1		
130041	*Protodorvillea kefersteini*										
130044	*Schistomeringos neglecta*										
130585	*Paradoneis lyra*										
131106	*Aonides oxycephala*										
131107	*Aonides paucibranchiata*	1	1	1		1	2				
129914	*Chaetopterus variopedatus*								1		
129972	*Monticellina dorsobranchialis*									1	
129745	*Macrochaeta clavicornis*										
129892	*Mediomastus fragilis*	2	1	1	2	3					
129220	*Notomastus*										
130327	*Praxillura longissima*										
130309	*Microclymene tricirrata*										
130291	*Euclymene droebachiensis*								1		
130980	*Scalibregma inflatum*	2				1	1			1	
129472	*Polygordius*	2		6	3	1		1			
130544	*Owenia fusiformis*					1					1
131574	*Trichobranchus glacialis*						1	1	1	3	
131474	*Amphitrite cirrata*									1	
131480	*Amphitritides gracilis*										
131516	*Pista cristata*	1		1		1				1	
154972	*Pista lornensis*						1		2		1
196385	*Polycirrus norvegicus*		1	1							
131009	*Hydroides norvegicus*		1		2	1		2	3	1	2
560033	*Spirobranchus lamarcki*			1				7	3		1
555935	*Spirobranchus triqueter*				1			1	2	3	2
137570	*Tubificoides*										

AphiaID	Accepted scientific name	HI22 #1	HI22 #2	HI22 #3	HI22 #4	HI22 #5	LBN #1	LBN #2	LBN #3	LBN #4	LBN #5
	amplivasatus										
2038	Enchytraeidae										
	Crustacea										
1078	Ostracoda										
102882	*Monoculodes carinatus*										
102918	*Pontocrates arenarius*										
103008	*Parapleustes bicuspis*			1							
102981	*Metaphoxus fultoni*		1		1						
102611	*Lysianassa plumosa*			1			3	1	2	1	5
148560	*Socarnes erythrophthalmus*						1	2	10		1
102132	*Atylus vedlomensis*			4		2					
102135	*Dexamine spinosa*										
102137	*Guernea (Guernea) coalita*										
101669	*Cheirocratus*										
101470	*Leptocheirus*										
102036	*Leptocheirus hirsutimanus*						1				
102039	*Leptocheirus pectinatus*			1				4			2
102043	*Microdeutopus anomalus*							1		1	2
148603	*Monocorophium sextonae*										
101864	*Phtisica marina*										
531364	*Animoceradocus semiserratus*	1						2			
118842	*Conilera cylindracea*										
1133	Tanaidacea										
136443	*Leptognathia paramanca*								1		
1137	Cumacea										
106791	Processidae										1
106687	Paguroidea	1									
107150	*Galathea intermedia*						3	6	6		6
106837	*Pisidia*							1			
107327	*Inachus dorsettensis*									1	
107318	*Eurynome aspera*								1		
110467	*Vaunthompsonia cristata*						3		1		3
118426	*Cymodoce*										
	Mollusca										
234208	*Testudinalia testudinalis*								1		1
140199	*Leptochiton asellus*		1		1					1	
140201	*Leptochiton cancellatus*		3	1	1					2	
140132	*Callochiton septemvalvis*									1	
139959	*Emarginula fissura*										1

AphiaID	Accepted scientific name	HI22 #1	HI22 #2	HI22 #3	HI22 #4	HI22 #5	LBN #1	LBN #2	LBN #3	LBN #4	LBN #5
605961	*Parthenina decussata*										
151894	*Euspira nitida*										
140744	*Philine aperta*	1					1	2			3
140640	*Onchidoris muricata*										
140589	*Nucula nitidosa*										1
140590	*Nucula nucleus*								1		
140472	*Musculus discors*							1			
140467	*Modiolus modiolus*							1	2	1	
140235	*Limaria hians*									1	
140283	*Lucinoma borealis*										1
141662	*Thyasira flexuosa*										1
140161	*Kellia suborbicularis*								1		
345281	*Kurtiella bidentata*										
146952	*Tellimya ferruginosa*										
147021	*Moerella donacina*				1						
181343	*Parvicardium pinnulatum*		3		2				2		
139012	*Parvicardium scabrum*		1	1	1		2		1		
138159	*Spisula*										
141577	*Arcopagia crassa*			3	1	1					
147022	*Moerella pygmaea*					1					
140873	*Gari tellinella*	1									
138636	*Dosinia*		18						9		
141911	*Dosinia exoleta*	4	1		1		3	4		4	4
138645	*Tapes*		12	5	7	4					
181364	*Venerupis corrugata*				1					1	
745846	*Polititapes rhomboides*			2							
141909	*Clausinella fasciata*	1	4	3	3	1	1	2	1		1
141929	*Timoclea ovata*										
140103	*Hiatella arctica*										
141651	*Thracia villosiuscula*	3	5		2	1				2	
	Echinodermata										
123080	Asteroidea										
123084	Ophiuroidea	4	4	15	6	8			1	1	1
125131	*Ophiothrix fragilis*			1			4	5	3	3	13
125064	*Amphipholis squamata*		22	1	1	4	1	3	6	1	3
123082	*Echinoidea*	1		1		1	3	1	1		3
124273	*Echinocyamus pusillus*	1		1		1	2				
124418	*Spatangus purpureus*	1			1	1					
123479	*Cucumaria*										
124685	*Neopentadactyla mixta*										
124465	*Leptosynapta inhaerens*										1
	Tunicata										

AphiaID	Accepted scientific name	HI22 #1	HI22 #2	HI22 #3	HI22 #4	HI22 #5	LBN #1	LBN #2	LBN #3	LBN #4	LBN #5
103718	*Ascidiella aspersa*										
103719	*Ascidiella scabra*							1			
	Phoronida										
128545	*Phoronis*						4				
	Pisces										
126928	*Pomatoschistus minutus*			1							
	Number of Taxa	21	24	28	24	27	24	26	32	35	34
	Number of individuals	35	92	59	50	46	45	57	71	54	77
	% total maerl	92	93	93	94	92	95	95	94	94	95
	Mean	92.8					94.6				
	% live maerl	2	1	2	1	1	12	13	12	14	10
	Mean	1.4					12.2				

AphiaID	Accepted scientific name	HI02 #1	HI02 #2	HI02 #3	HI02 #4	HI02 #5	HI04 #1	HI04 #2	HI04 #3	HI04 #4	HI04# 5
	Cnidaria										
283798	*Cerianthus lloydii*				2					1	
100665	Edwardsiidae							1			
	Platyhelminthes										
793	Platyhelminthes										
	Nemertea										
152391	Nemertea							1	9		1
	Nematoda										
799	Nematoda	76	36	20	36	3	19	35	25	17	32
	Sipuncula										
2032	Golfingiidae										
410724	*Golfingia vulgaris*									1	
136060	*Nephasoma minutum*										
	Annelida										
130707	*Pisione remota*		1								1
939	Polynoidae	2		2				1			
130770	*Harmothoe impar*	1		1							1
130818	*Malmgreniella mcintoshi*	1			2			2		2	
147008	*Malmgrenia andreapolis*										
130816	*Malmgreniella lunulata*		1				3	1	3	1	2
130599	*Pholoe baltica*			1		1			2	3	2
130601	*Pholoe inornata*	1					2	1	2	2	1
931	*Phyllodocidae*										
130616	*Eteone longa*	1									
130683	*Pseudomystides limbata*		1								
130631	*Eulalia mustela*	1									

AphiaID	Accepted scientific name	HI02 #1	HI02 #2	HI02 #3	HI02 #4	HI02 #5	HI04 #1	HI04 #2	HI04 #3	HI04 #4	HI04# 5
129446	*Eumida*								1	1	
130641	*Eumida bahusiensis*										
130644	*Eumida sanguinea*										
129296	*Glycera*								1		
130123	*Glycera lapidum*	1	1	1		1	2	2		1	1
131083	*Ephesiella peripatus*										
130197	*Podarkeopsis helgolandicus*									1	
152249	*Psamathe fusca*				1						
130185	*Nereimyra punctata*										
131288	*Eurysyllis tuberculata*										
157583	*Syllis cornuta*										
131458	*Syllis variegata*										
335151	*Trypanosyllis coeliaca*		1		2	1	1	1			1
131379	*Sphaerosyllis bulbosa*	15	3	4	5	1	2	7	2		6
130417	*Platynereis dumerilii*									1	
129838	*Pareurythoe borealis*										
130467	*Nothria conchylega*										
742232	*Lysidice unicornis*					3		1			1
607402	*Hilbigneris gracilis*		1								1
130041	*Protodorvillea kefersteini*		5	1		3					
130044	*Schistomeringos neglecta*										
130585	*Paradoneis lyra*							1			
131106	*Aonides oxycephala*							1			1
131107	*Aonides paucibranchiata*	30	8	4	3	6	8	6	4	5	3
129914	*Chaetopterus variopedatus*										
129972	*Monticellina dorsobranchialis*										
129745	*Macrochaeta clavicornis*			1	2						
129892	*Mediomastus fragilis*					1	2	1	1	5	2
129220	*Notomastus*	3		1				1			
130327	*Praxillura longissima*										
130309	*Microclymene tricirrata*							1			3
130291	*Euclymene droebachiensis*										
130980	*Scalibregma inflatum*		1	1			1	2			
129472	*Polygordius*	1	2	1	3	2	1	1		5	
130544	*Owenia fusiformis*										
131574	*Trichobranchus glacialis*										1
131474	*Amphitrite cirrata*										
131480	*Amphitritides gracilis*							1			
131516	*Pista cristata*		2							1	

AphiaID	Accepted scientific name	HI02 #1	HI02 #2	HI02 #3	HI02 #4	HI02 #5	HI04 #1	HI04 #2	HI04 #3	HI04 #4	HI04#5
154972	*Pista lornensis*										
196385	*Polycirrus norvegicus*		2		1	1	1	1	2	1	
131009	*Hydroides norvegicus*	1	1		1	1			1		2
560033	*Spirobranchus lamarcki*	5						1			
555935	*Spirobranchus triqueter*			1	1					12	
137570	*Tubificoides amplivasatus*					3			1		
2038	*Enchytraeidae*	13	8	3	1			1	2		1
	Crustacea										
1078	*Ostracoda*										
102882	*Monoculodes carinatus*										
102918	*Pontocrates arenarius*										
103008	*Parapleustes bicuspis*		1			2	1				
102981	*Metaphoxus fultoni*	1					1	2	1		
102611	*Lysianassa plumosa*	2		1			2		2	1	1
148560	*Socarnes erythrophthalmus*	1	9				4		1		1
102132	*Atylus vedlomensis*	1	2	1							
102135	*Dexamine spinosa*									1	
102137	*Guernea (Guernea) coalita*										
101669	*Cheirocratus*		1	1							
101470	*Leptocheirus*										
102036	*Leptocheirus hirsutimanus*										
102039	*Leptocheirus pectinatus*										
102043	*Microdeutopus anomalus*										
148603	*Monocorophium sextonae*									1	
101864	*Phtisica marina*										
531364	*Animoceradocus semiserratus*	1			1	2					
118842	*Conilera cylindracea*		1								
1133	*Tanaidacea*										
136443	*Leptognathia paramanca*										
1137	Cumacea										
106791	Processidae										
106687	Paguroidea							1			
107150	*Galathea intermedia*							2		1	
106837	*Pisidia*										
107327	*Inachus dorsettensis*										
107318	*Eurynome aspera*										
110467	*Vaunthompsonia cristata*										
118426	*Cymodoce*		1								
	Mollusca										

AphiaID	Accepted scientific name	HI02 #1	HI02 #2	HI02 #3	HI02 #4	HI02 #5	HI04 #1	HI04 #2	HI04 #3	HI04 #4	HI04# 5
234208	*Testudinalia testudinalis*	3	1				1	2	2	1	
140199	*Leptochiton asellus*										3
140201	*Leptochiton cancellatus*		2	1					4	1	2
140132	*Callochiton septemvalvis*										
139959	*Emarginula fissura*										
605961	*Parthenina decussata*									1	
151894	*Euspira nitida*								1		
140744	*Philine aperta*										
140640	*Onchidoris muricata*	1									
140589	*Nucula nitidosa*										
140590	*Nucula nucleus*										
140472	*Musculus discors*										
140467	*Modiolus modiolus*										
140235	*Limaria hians*									1	
140283	*Lucinoma borealis*										
141662	*Thyasira flexuosa*										
140161	*Kellia suborbicularis*										
345281	*Kurtiella bidentata*	1									
146952	*Tellimya ferruginosa*				1						
147021	*Moerella donacina*									2	
181343	*Parvicardium pinnulatum*				1	1					
139012	*Parvicardium scabrum*	3	2					1	2	2	1
138159	*Spisula*			1							
141577	*Arcopagia crassa*		2			1					
147022	*Moerella pygmaea*					1	1	1			
140873	*Gari tellinella*	1			1						
138636	*Dosinia*										
141911	*Dosinia exoleta*		1	7	7	2	1	4	4	4	9
138645	*Tapes*	5	3	8			4	4	4	6	3
181364	*Venerupis corrugata*										
745846	*Polititapes rhomboides*	1					1			1	
141909	*Clausinella fasciata*			2	2		3	2	4		
141929	*Timoclea ovata*										
140103	*Hiatella arctica*										
141651	*Thracia villosiuscula*	2	1		1	2		2			3
	Echinodermata										
123080	Asteroidea	1							1		
123084	Ophiuroidea	3	13	1				1	3	3	2
125131	*Ophiothrix fragilis*	2		1	3		4	1	6	1	1
125064	*Amphipholis squamata*	2	5	14	13	8	5	3	12	1	8
123082	*Echinoidea*						1		2	1	
124273	*Echinocyamus pusillus*			1			2	3			1

AphiaID	Accepted scientific name	HI02 #1	HI02 #2	HI02 #3	HI02 #4	HI02 #5	HI04 #1	HI04 #2	HI04 #3	HI04 #4	HI04# 5
124418	*Spatangus purpureus*										
123479	*Cucumaria*									1	
124685	*Neopentadactyla mixta*										
124465	*Leptosynapta inhaerens*										
	Tunicata										
103718	*Ascidiella aspersa*							1			
103719	*Ascidiella scabra*									1	
	Phoronida										
128545	*Phoronis*										
	Pisces										
126928	*Pomatoschistus minutus*										
	Number of Taxa	32	31	26	22	21	25	38	29	36	31
	Number of individuals	183	119	81	90	46	73	101	105	91	98
	% total maerl	93	94	92	93	92	98	99	98	98	97
	Mean	92.8					98				
	% live maerl	1	2	0	0	0.5	0	1	0	0	1
	Mean	0.7					0.4				

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