ANDERSON MARINE SURVEYS

Report To: Loch Duart

Issued By: *SJA*

Date: 11 April 2022

Lochmaddy Caolas Loch Portain video survey

Introduction

The Caolas Loch Portain site is located in Lochmaddy, North Uist (Figure 1), and is currently in production. Lochmaddy (Loch nam Madadh) is a designated Special Area of Conservation (SAC), with protected features including reefs and subtidal sandbanks[1]. This report describes findings of a video survey of the site vicinity carried out in March 2022; with reference to general seabed habitat (biotopes) and condition, visible biota, and the presence of any Priority Marine Features[2]. Survey information will be submitted to NatureScot / Marine Scotland in support of accurate defining of sensitive features (or indeed their absence) around the farm site.

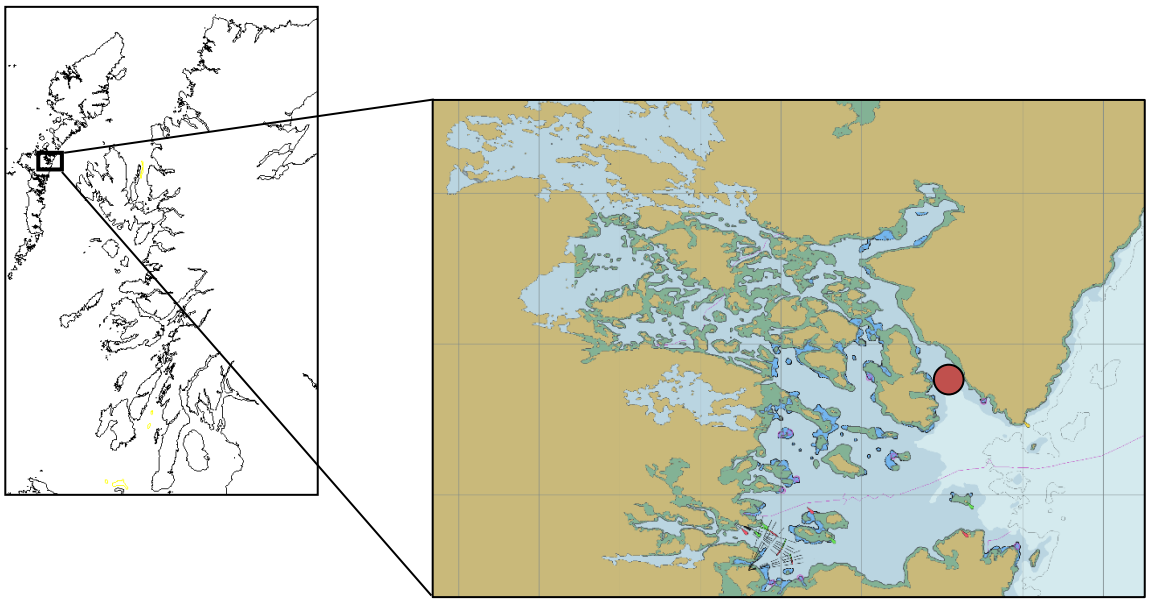


Figure 1. Lochmaddy CLP general location

[1] NatureScot (2021). Conservation and Management Advice. Loch nam Madadh SAC. March 2021
[2] As defined by Tyler-Walters et al (2016)

Methods

Survey operations were carried out on 30-31 March 2022 from AMSL's 6.7m survey vessel *Mollie B*. Positioning and depth data were provided by a Simrad NSS7 evo.2 with fixes at 1s intervals logged directly to PC.

Video survey was carried out using a camera frame fitted with a Bowtech DIVECAM-550C-AL-I4 camera, GoPro video camera and two high intensity LED lights. A series of short drops, duration 1-2 minutes, were carried out at 94 locations (Figure 2), with the camera frame allowed to rest briefly on the seabed at intervals during each drop.

Site descriptor, position, elapsed time and depth overlays were added to the video post-survey, and deployment and recovery periods edited from the final video files in mp4 format. Still images of representative biotopes from each drop were captured from the video.

Video footage has been examined and interpreted for each individual drop. Fauna was identified using standard sources (primarily Southward and Campbell 2006, Naylor 2011, Porter 2012, Wood 2013, Hayward and Ryland 2017, Bowen et al. 2018).

Seabed biotopes have been identified consistent with The Marine Habitat Classification for Britain and Ireland (v 04.05) (Connor et al. 2004). Where several biotopes were recorded at a site (for example, scattered boulders with *Caryophyllia smithii* and *Swiftia pallida* CR.MCR.EcCr.CarSwi.LgAs on circalittoral muddy sand SS.Ssa.CMuSa), both biotopes were recorded at the relevant positions.

Biotopes were mapped using Nearest Neighbour gridding at 5m resolution in Surfer (v23.2).

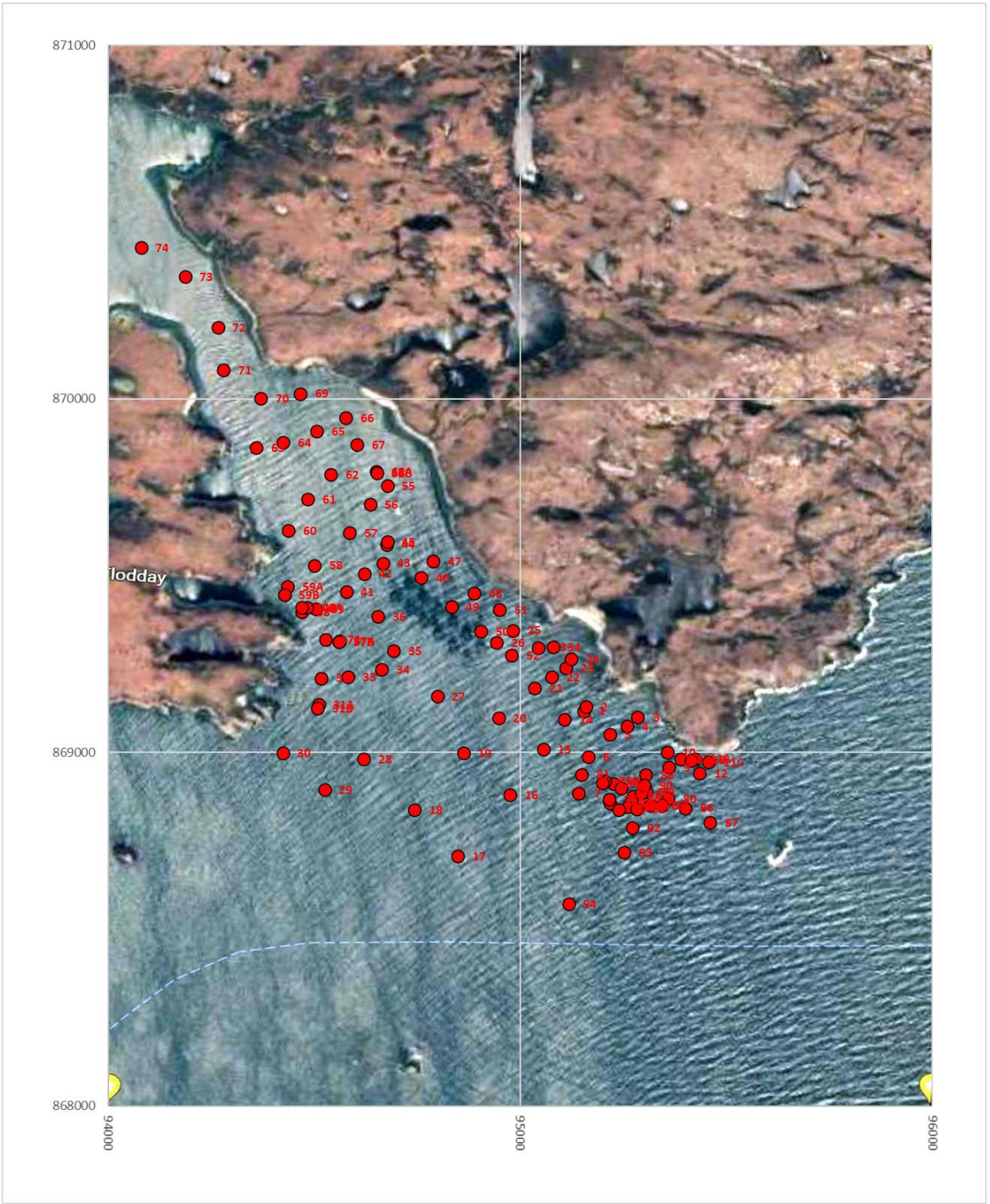


Figure 2. Video drop locations and site numbering (imagery date 25/04/2019)

Results

Depths recorded throughout the survey have been corrected to chart datum and are shown as a contoured bathymetry plot in Figure 3. Recorded depths varied from 1.1 to 43.1 mCD.

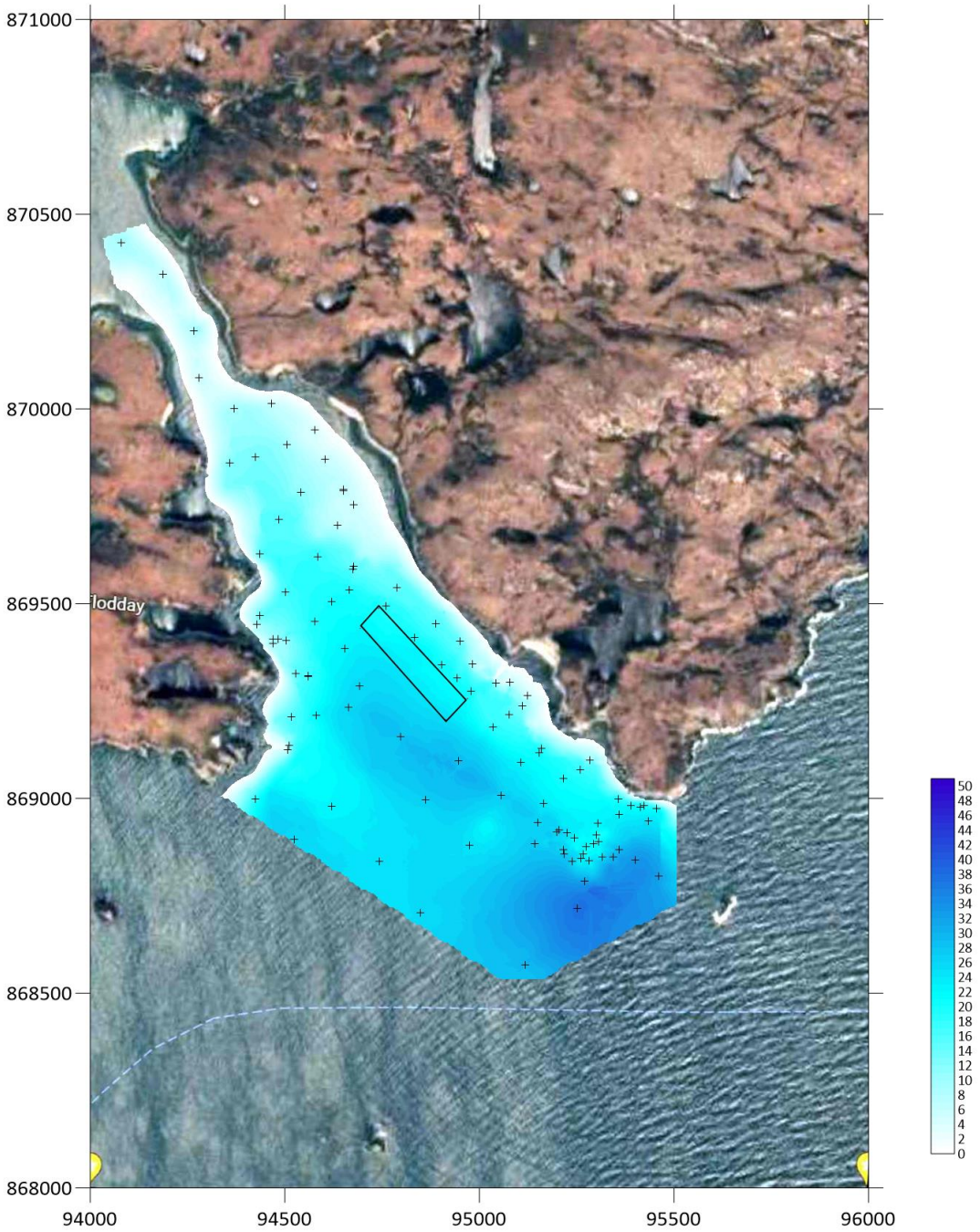


Figure 3. Contoured bathymetry, depths in mCD. Rectangle shows measured cage grid corners

A total of 14 biotopes were recorded:

IR.MIR.KR.Lhyp.Ft	*Laminaria hyperborea* forest and foliose red seaweeds on moderately exposed upper infralittoral rock
IR.HIR.Ksed.XKScrR	Mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock
IR.FIR.SG.CC.Mo	Coralline crusts and crustaceans on mobile boulders or cobbles in surge gullies
SS.SCS.ICS	Infralittoral coarse sediment
SS.Ssa.IMUSa	Infralittoral muddy sand
SS.SMu.IFiMu.PhiVir	*Virgularia mirabilis* in soft stable infralittoral mud
SS.Ssa.IMuSa.AreISa	*Arenicola marina* in infralittoral fine sand or muddy sand
SS.SCS.CCS	Circalittoral coarse sediment
SS.SSa.CFiSa	Circalittoral fine sand
SS.SMu.CSaMu.AfilMysAnit	*Amphiura filiformis* in circalittoral sandy mud
SS.Ssa.CMuSa	Circalittoral muddy sand
SS.Smu.CFiMu.SpnMeg	Seapens and burrowing megafauna in circalittoral fine mud
CR.MCR.EcCr.CarSwi.LgAs	*Caryophyllia smithii*, *Swiftia pallida* and large solitary ascidians on exposed or moderately exposed circalittoral rock
CR.MCR.EcCr.CarSp	*Caryophyllia smithii*, sponges and crustose communities on wave-exposed circalittoral rock

In general, the north of the survey area in shallower water depths was characterised as infralittoral (i.e. with light penetration sufficient for significant algal growth), with kelp forest or park (IR.MIR.KR.Lhyp.Ft and IR.HIR.Ksed.XKScrR) where suitable substrate (rock, boulders or cobbles) were available. Infralittoral coarse sediment (SS.SCS.ICS) and muddy sands (SS.Ssa.IMUSa) in this area were frequently covered by a layer of detached kelp detritus.

The northernmost site (LM74), in Loch Portain, had a relatively dense population of the seapen *Virgularia mirabilis*, in unusually shallow depth (9.6mCD) and was characterised as *Virgularia mirabilis* in soft stable infralittoral mud (SS.SMu.IFiMu.PhiVir).

One site (LM45) in 14.4mCD had a silted boulder substrate, with limited red coralline algal crust, and was characterised as coralline crusts and crustaceans on mobile boulders or cobbles in surge gullies (IR.FIR.SG.CC.Mo).

Sites (LM46, LM49) where casts of the lugworm *Arenicola marina* were observed were characterised as *Arenicola marina* in infralittoral fine sand or muddy sand (SS.SMu.CSaMu.AfilMysAnit).

Sites south of the cage group, in water depths >16mCD, were generally characterised as circalittoral (too deep for significant algal growth). Sediments included coarse (16 sites), fine sand (two sites), sandy mud (two sites), muddy sand (23 sites) and fine mud (10 sites). Of these, the brittlestar *Amphiura filiformis* was abundant at two sandy mud sites (LM35 and LM37A) characterised as *Amphiura filiformis* in circalittoral sandy mud (SS.SMu.CSaMu.AfilMysAnit). Deeper muddy sites were densely burrowed by crustacea (identified on the basis of burrow entrance morphology as *Calocaris macandreae* and *Nephrops norvegicus*) and were characterised as seapens and burrowing megafauna in circalittoral fine mud (SS.Smu.CFiMu.SpnMeg). Burrows typical of the thalassinid crustacean *Callianassa subterranea* were also observed in circalittoral muddy sand, and possibly also those of *Upogebia spp*. in coarse sediments.

The burrowing anemone *Arachnanthus sarsi* was tentatively identified at one burrowed mud site (LM94) where it was relatively common (densities 1-2/m^2).

Two circalittoral rock biotopes were identified. A distinct area of exposed bedrock and boulders, in water depths 19 – 24mCD approximately 420m southeast of the cage group, had dense populations of the cup coral *Caryophyllia smithii* and soft coral *Swiftia pallida*, and was characterised as *Caryophyllia smithii*, *Swiftia pallida* and large solitary ascidians on exposed or moderately exposed circalittoral rock (CR.MCR.EcCr.CarSwi.LgAs). The colonial ascidian *Diazona violacea* was also present in this habitat. *Caryophyllia* was also present on rock surfaces at two shallower sites west of the cage group (LM31A and 37C), which were characterised as *Caryophyllia smithii*, sponges and crustose communities on wave-exposed circalittoral rock (CR.MCR.EcCr.CarSp).

Individual site locations, depths and biotopes are tabulated below.

site	OSGB E	OSGB N	Depth (mCD)	Biotope
24	95123	869265	5.0	IR.MIR.KR.Lhyp.Ft
25	94981	869345	8.8	IR.MIR.KR.Lhyp.Ft
53	95043	869297	5.4	IR.MIR.KR.Lhyp.Ft
54	95079	869298	5.4	IR.MIR.KR.Lhyp.Ft
56	94635	869702	6.5	IR.MIR.KR.Lhyp.Ft
65	94505	869908	10.2	IR.MIR.KR.Lhyp.Ft
66	94577	869946	4.1	IR.MIR.KR.Lhyp.Ft
67	94603	869871	5.8	IR.MIR.KR.Lhyp.Ft
68A	94650	869794	6.6	IR.MIR.KR.Lhyp.Ft
70	94370	870001	9.4	IR.MIR.KR.Lhyp.Ft
71	94280	870081	5.0	IR.MIR.KR.Lhyp.Ft
72	94266	870201	10.5	IR.MIR.KR.Lhyp.Ft
23	95111	869238	10.2	IR.HIR.Ksed.XKScrR
38	94469	869397	10.1	IR.HIR.Ksed.XKScrR
39	94505	869406	12.0	IR.HIR.Ksed.XKScrR
40A	94483	869410	11.4	IR.HIR.Ksed.XKScrR
40B	94469	869409	10.2	IR.HIR.Ksed.XKScrR
59B	94428	869446	10.5	IR.HIR.Ksed.XKScrR
69	94466	870015	5.8	IR.HIR.Ksed.XKScrR
45	94677	869596	14.4	IR.FIR.SG.CC.Mo
3	95284	869099	10.0	SS.SCS.ICS
55	94677	869753	5.7	SS.SCS.ICS
57	94585	869621	17.8	SS.SCS.ICS
68B	94652	869790	6.4	SS.SCS.ICS
73	94186	870345	6.7	SS.SCS.ICS
47	94788	869541	14.2	SS.Ssa.IMUSa
48	94888	869449	15.7	SS.Ssa.IMUSa
60	94436	869627	15.5	SS.Ssa.IMUSa
61	94484	869716	15.3	SS.Ssa.IMUSa

62	94540	869786	11.5	SS.Ssa.IMUSa
63	94359	869862	12.3	SS.Ssa.IMUSa
64	94424	869876	12.1	SS.Ssa.IMUSa
74	94079	870427	9.6	SS.SMu.IFiMu.PhiVir
46	94760	869495	18.7	SS.Ssa.IMuSa.AreISa
49	94833	869413	20.8	SS.Ssa.IMuSa.AreISa
1	95153	869117	20.3	SS.SCS.CCS
2	95159	869129	19.3	SS.SCS.CCS
4	95258	869074	17.7	SS.SCS.CCS
5	95216	869051	20.1	SS.SCS.CCS
8	95390	868981	20.9	SS.SCS.CCS
9	95359	868958	21.9	SS.SCS.CCS
10	95357	868999	19.8	SS.SCS.CCS
11B	95415	868978	21.7	SS.SCS.CCS
12	95435	868941	24.5	SS.SCS.CCS
14	95107	869093	22.0	SS.SCS.CCS
21	95035	869182	18.3	SS.SCS.CCS
22	95076	869214	15.4	SS.SCS.CCS
32	94517	869210	15.5	SS.SCS.CCS
36	94654	869384	22.4	SS.SCS.CCS
42	94621	869506	20.0	SS.SCS.CCS
51	94949	869403	13.9	SS.SCS.CCS
35	94692	869288	25.3	SS.SSa.CFiSa
37A	94561	869314	17.2	SS.SSa.CFiSa
27	94798	869159	27.2	SS.SMu.CSaMu.AfilMysAnit
34	94663	869234	25.8	SS.SMu.CSaMu.AfilMysAnit
6	95164	868988	23.7	SS.Ssa.CMuSa
7	95142	868884	27.5	SS.Ssa.CMuSa
15	95055	869008	26.4	SS.Ssa.CMuSa
17	94848	868707	25.7	SS.Ssa.CMuSa
26	94942	869310	19.3	SS.Ssa.CMuSa
29	94525	868894	25.0	SS.Ssa.CMuSa
30	94424	868999	18.8	SS.Ssa.CMuSa
31B	94508	869124	5.2	SS.Ssa.CMuSa
33	94581	869212	21.9	SS.Ssa.CMuSa
37B	94559	869312	17.0	SS.Ssa.CMuSa
41	94578	869455	19.4	SS.Ssa.CMuSa
43	94666	869535	19.2	SS.Ssa.CMuSa
44	94675	869588	15.6	SS.Ssa.CMuSa
50	94904	869343	20.3	SS.Ssa.CMuSa
52	94979	869275	19.7	SS.Ssa.CMuSa
58	94501	869529	16.7	SS.Ssa.CMuSa
59A	94436	869469	13.5	SS.Ssa.CMuSa
76A	95218	868857	27.2	SS.Ssa.CMuSa
80	95359	868869	29.4	SS.Ssa.CMuSa

85	95344	868850	30.1	SS.Ssa.CMuSa
86	95400	868843	32.8	SS.Ssa.CMuSa
87	95460	868801	32.0	SS.Ssa.CMuSa
88	95305	868937	22.7	SS.Ssa.CMuSa
18	94743	868838	24.6	SS.Smu.CFiMu.SpnMeg
19	94861	868997	26.9	SS.Smu.CFiMu.SpnMeg
20	94947	869097	28.5	SS.Smu.CFiMu.SpnMeg
28	94620	868980	22.5	SS.Smu.CFiMu.SpnMeg
75B	95204	868919	26.0	SS.Smu.CFiMu.SpnMeg
81	95149	868938	25.9	SS.Smu.CFiMu.SpnMeg
82	95199	868913	24.9	SS.Smu.CFiMu.SpnMeg
92	95271	868787	32.4	SS.Smu.CFiMu.SpnMeg
93	95251	868718	37.0	SS.Smu.CFiMu.SpnMeg
94	95117	868572	29.5	SS.Smu.CFiMu.SpnMeg
11A	95424	868982	20.0	CR.MCR.EcCr.CarSwi.LgAs
11C	95456	868973	20.6	CR.MCR.EcCr.CarSwi.LgAs
13A	95267	868857	19.6	CR.MCR.EcCr.CarSwi.LgAs
13B	95262	868846	22.3	CR.MCR.EcCr.CarSwi.LgAs
16	94975	868880	24.5	CR.MCR.EcCr.CarSwi.LgAs
75A	95225	868912	23.3	CR.MCR.EcCr.CarSwi.LgAs
76B	95216	868867	26.9	CR.MCR.EcCr.CarSwi.LgAs
77	95239	868838	26.6	CR.MCR.EcCr.CarSwi.LgAs
78	95316	868849	24.0	CR.MCR.EcCr.CarSwi.LgAs
79	95307	868889	20.8	CR.MCR.EcCr.CarSwi.LgAs
83	95244	868899	21.1	CR.MCR.EcCr.CarSwi.LgAs
84	95274	868876	21.0	CR.MCR.EcCr.CarSwi.LgAs
89	95294	868884	21.3	CR.MCR.EcCr.CarSwi.LgAs
90	95301	868906	19.5	CR.MCR.EcCr.CarSwi.LgAs
91	95282	868840	22.2	CR.MCR.EcCr.CarSwi.LgAs
31A	94510	869136	12.5	CR.MCR.EcCr.CarSp
37C	94527	869320	14.7	CR.MCR.EcCr.CarSp

Representative stills of each biotope are shown in Figure 4, and the biotope map in Figure 5.

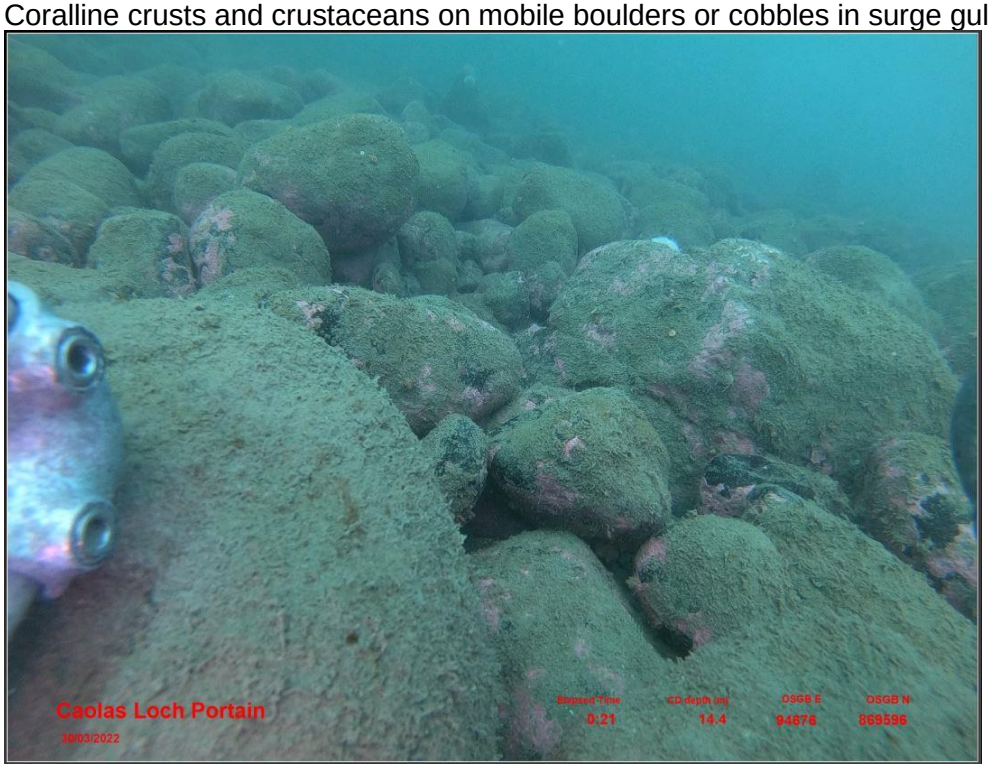
IR.MIR.KR.Lhyp.Ft

Laminaria hyperborea forest and foliose red seaweeds on moderately exposed upper infralittoral rock

IR.HIR.Ksed.XKScrR

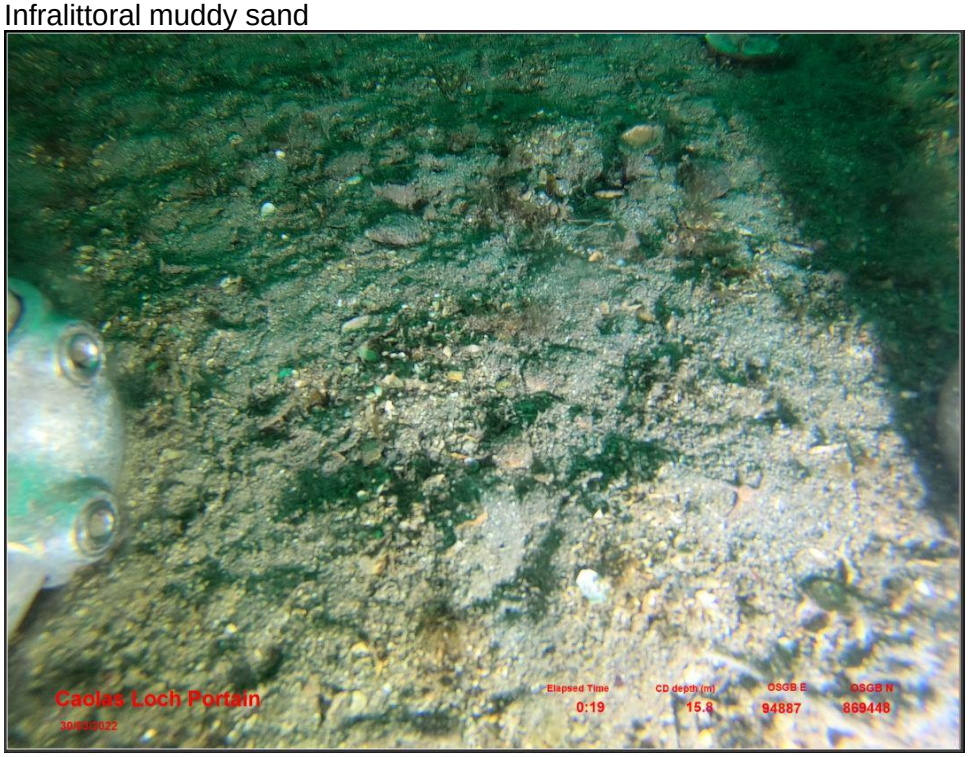
Mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock

IR.FIR.SG.CC.Mo
Coralline crusts and crustaceans on mobile boulders or cobbles in surge gullies

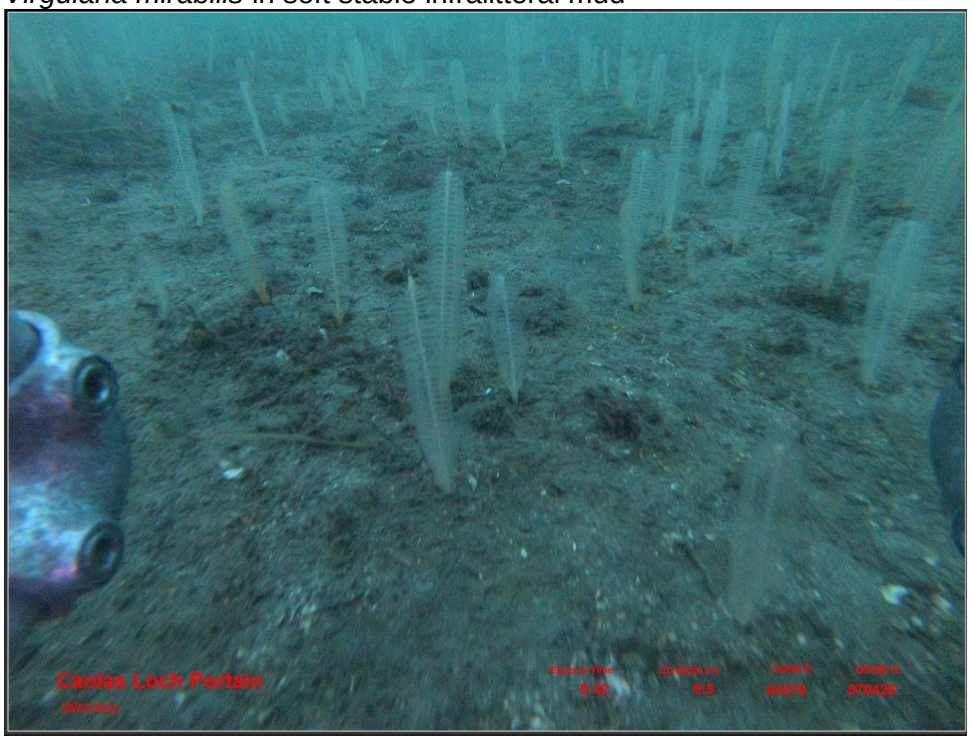


SS.SCS.ICS
Infralittoral coarse sediment

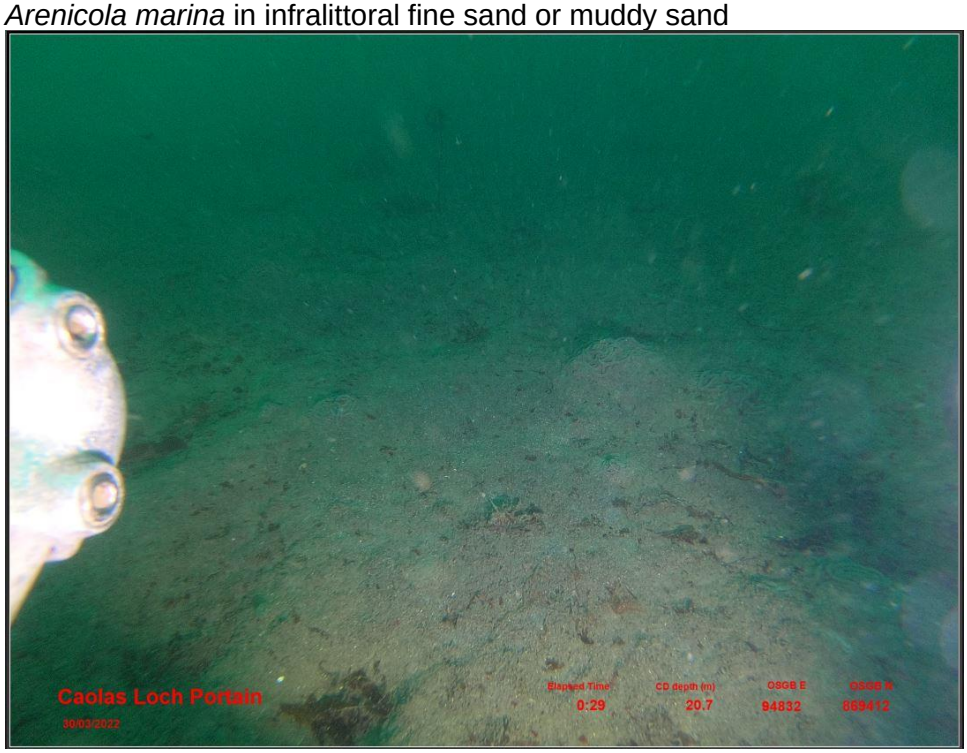
SS.Ssa.IMUSa
Infralittoral muddy sand



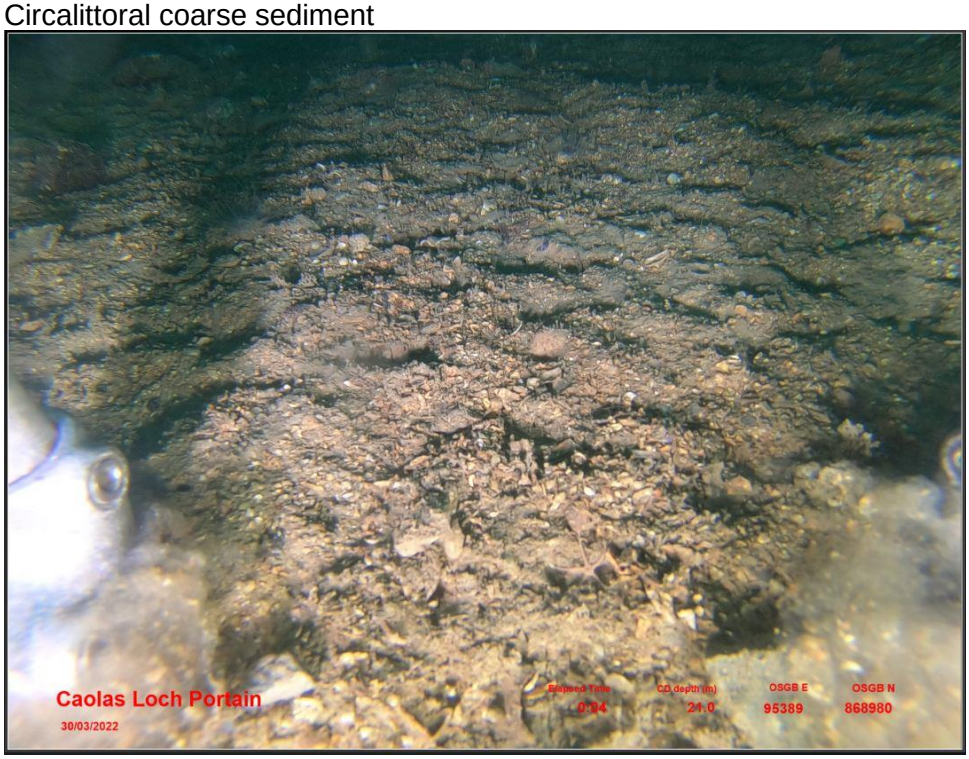
SS.SMu.IFiMu.PhiVir
Virgularia mirabilis in soft stable infralittoral mud



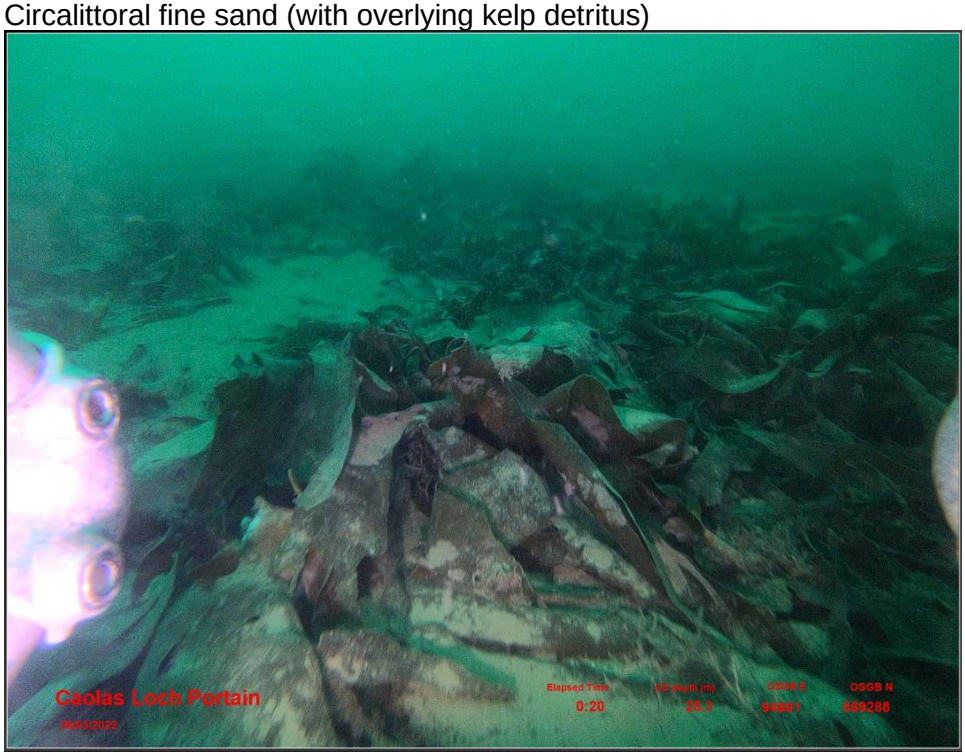
SS.Ssa.IMuSa.ArelSa
Arenicola marina in infralittoral fine sand or muddy sand



SS.SCS.CCS
Circalittoral coarse sediment

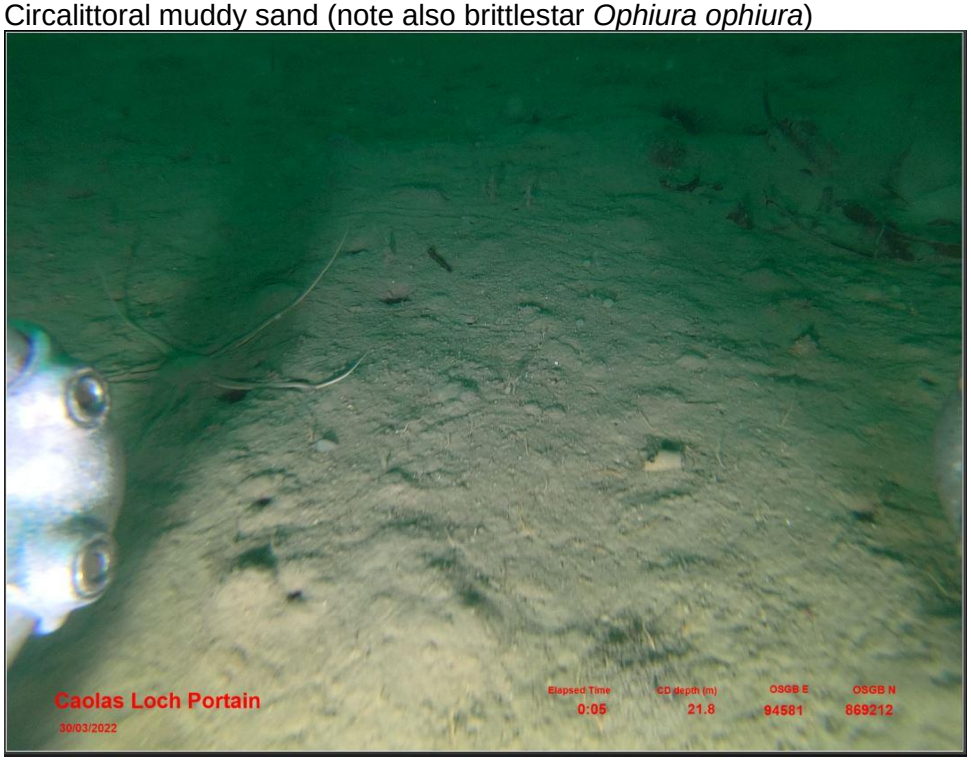


SS.SSa.CFiSa
Circalittoral fine sand (with overlying kelp detritus)

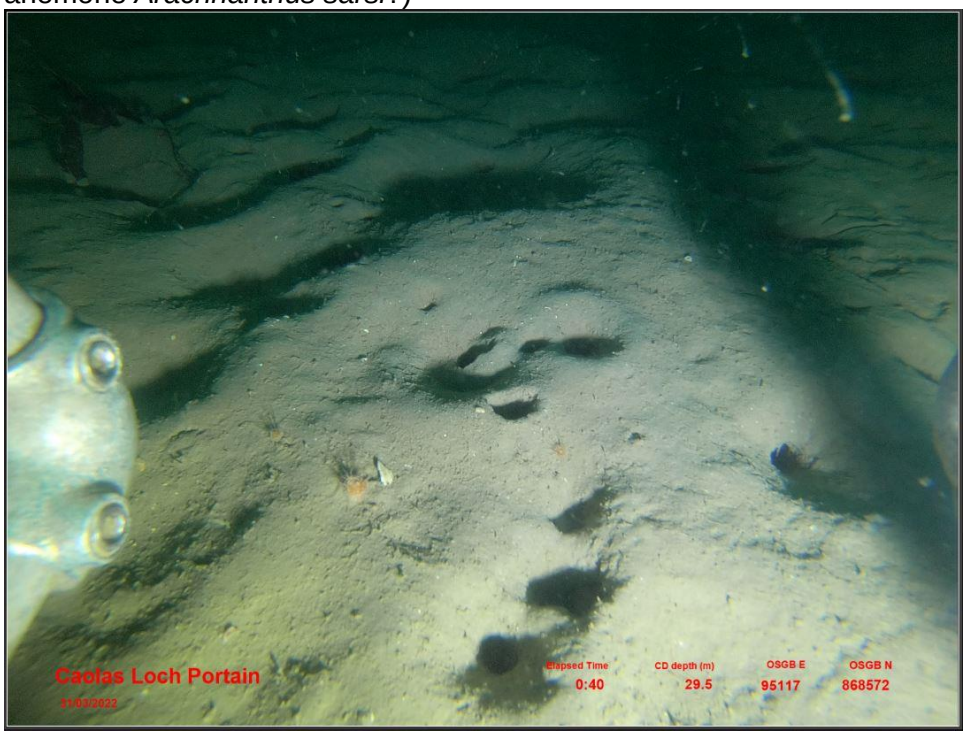


SS.SMu.CSaMu.AfilMysAnit
Amphiura filiformis in circalittoral sandy mud

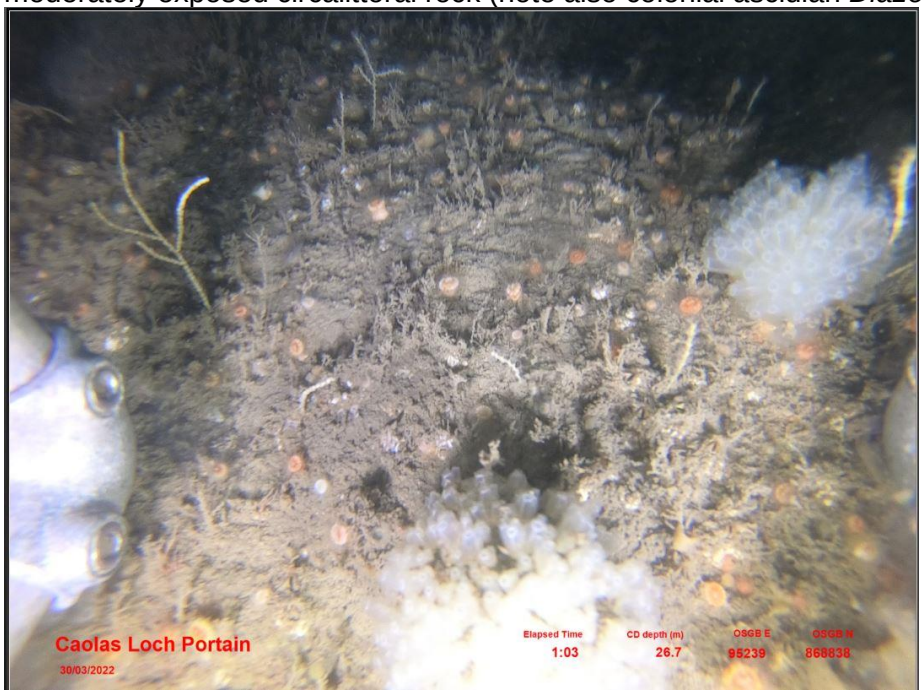
SS.Ssa.CMuSa
Circalittoral muddy sand (note also brittlestar *Ophiura ophiura*)



SS.Smu.CFiMu.SpnMeg
Seapens and burrowing megafauna in circalittoral fine mud (note also burrowing anemone *Arachnanthus sarsi*?)



CR.MCR.EcCr.CarSwi.LgAs
Caryophyllia smithii, *Swiftia pallida* and large solitary ascidians on exposed or moderately exposed circalittoral rock (note also colonial ascidian *Diazona violacea*)



CR.MCR.EcCr.CarSp
Caryophyllia smithii, sponges and crustose communities on wave-exposed circalittoral rock (note also plumose anemone *Metridium senile*)

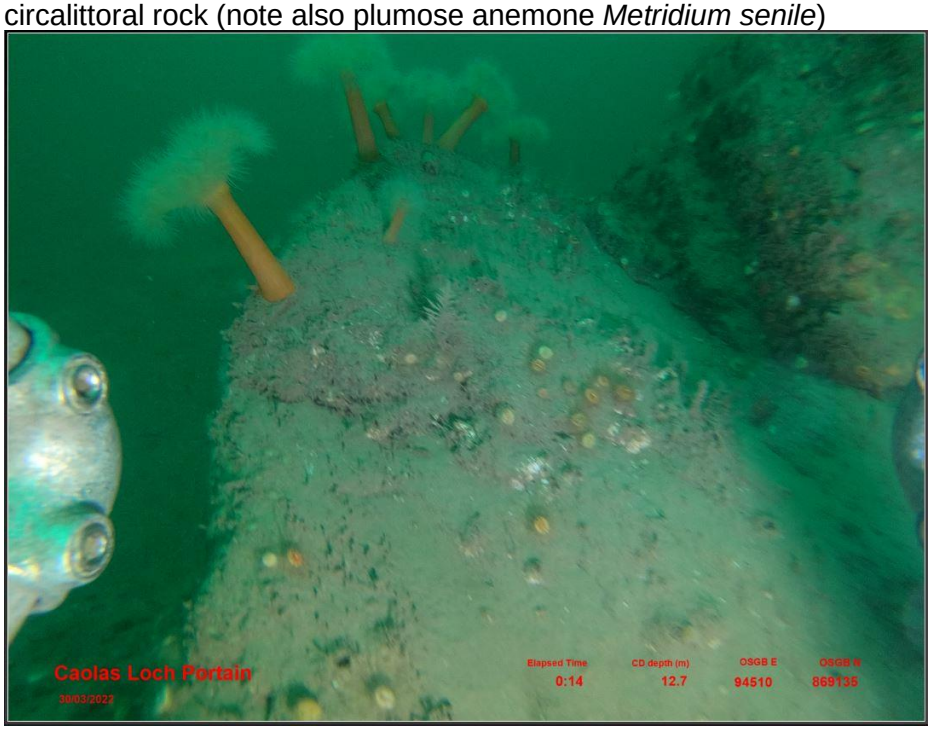
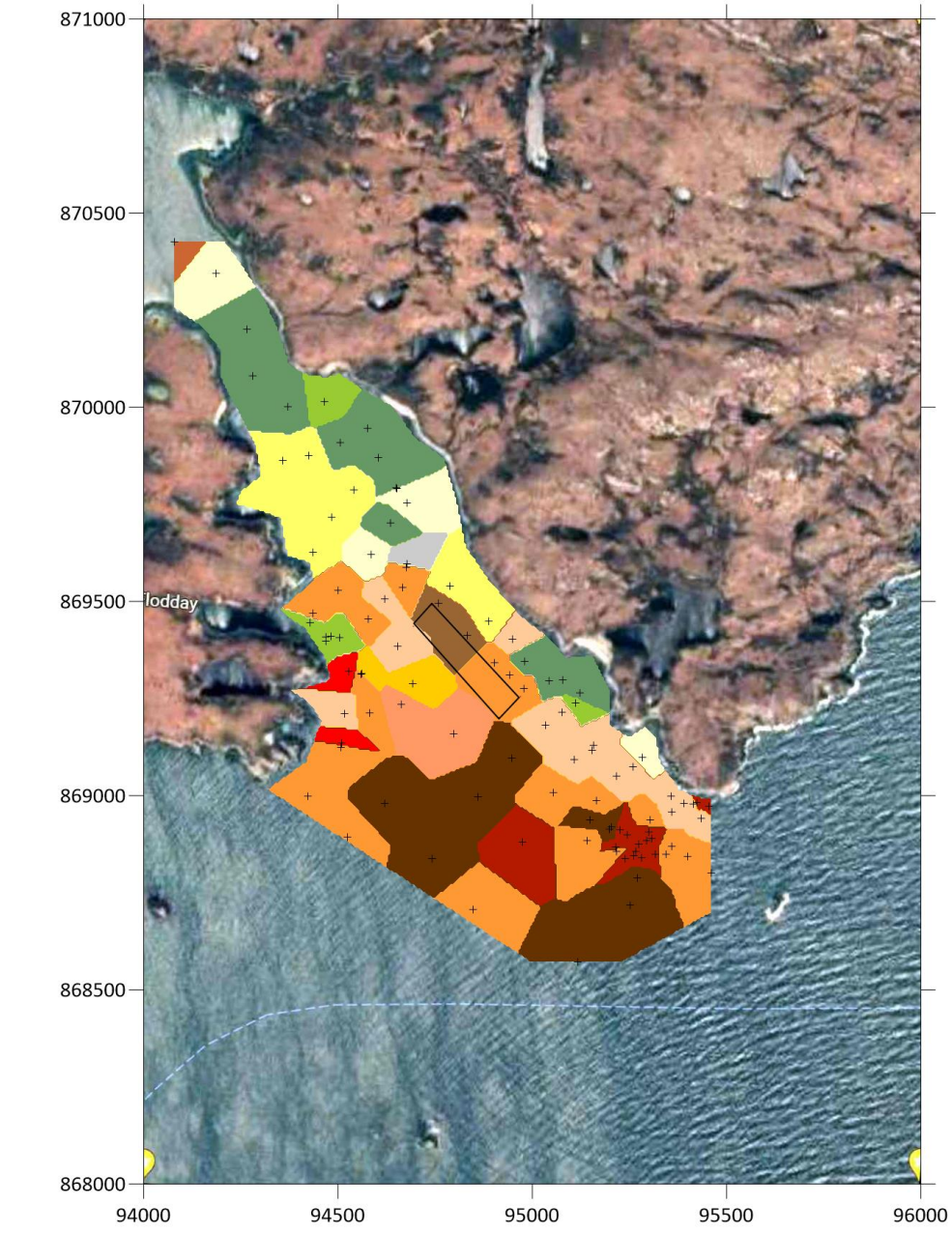


Figure 4. Representative stills of each biotope



CR.MCR.EcCr.CarSp	Caryophyllia smithii, sponges and crustose communities on wave-exposed circalittoral rock
CR.MCR.EcCr.CarSwi.LgAs	Caryophyllia smithii, Swiftia pallida and large solitary ascidians on exposed or moderately exposed circalittoral rock
SS.Smu.CFiMu.SpnMeg	Seapens and burrowing megafauna in circalittoral fine mud
SS.Ssa.CMuSa	Circarcalittoral muddy sand
SS.SMu.CSaMu.AfilMysAnit	Amphiura filiformis, Mysella bidentata and Abra nitida in circalittoral sandy mud
SS.SSa.CFiSa	Circalittoral fine sand
SS.SCS.CCS	Circalittoral coarse sediment
SS.Ssa.IMuSa.AreISa	Arenicola marina in infralittoral fine sand or muddy sand
SS.SMu.IFiMu.PhiVir	Philine aperta and Virgularia mirabilis in soft stable infralittoral mud
SS.Ssa.IMUSa	Infralittoral muddy sand
SS.SSA.IFiSa	Infralittoral fine sand
SS.SCS.ICS	Infralittoral coarse sediment
IR.FIR.SG.CC.Mo	Coralline crusts and crustaceans on mobile boulders or cobbles in surge gullies
IR.HIR.Ksed.XKScrR	Mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock
IR.LIR.K.Lsac.Pk	Laminaria saccharina park on very sheltered lower infralittoral rock
IR.MIR.KR.Lhyp.Ft	Laminaria hyperborea forest and foliose red seaweeds on moderately exposed upper infralittoral rock

Figure 5. Biotope map

Discussion

Biotope mapping and site check work was carried out in the area in 2015 by Moore *et al* (2016). They recorded a similar range of biotopes in Caolas Loch Portain, with eight biotopes recorded at nine sites by a combination of diving, grab sampling and drop camera. In particular, bedrock and boulders on sand off Weaver's Point and Madadh Mór between depths of 18 and 26 m supported dense *Caryophyllia smithii* and a fairly sparse accompanying fauna including *Swiftia pallida* (locally common) and hydroid patches (CR.MCR.EcCr.CarSwi.LgAs). This biotope also supported the sponge *Axinella infundibuliformis*, and ascidians *Ascidia mentula* and *Diazona violacea*, all of which were also recorded by this survey.

This reef biotope was recorded by Moore *et al* (2016), and also by this survey, close to Weaver's Point and the reef area further offshore was not described by Moore although it does appear on subsequent predictive habitat maps (as habitat MC1: circalittoral rock) for the area (e.g. EUNIS 2019).

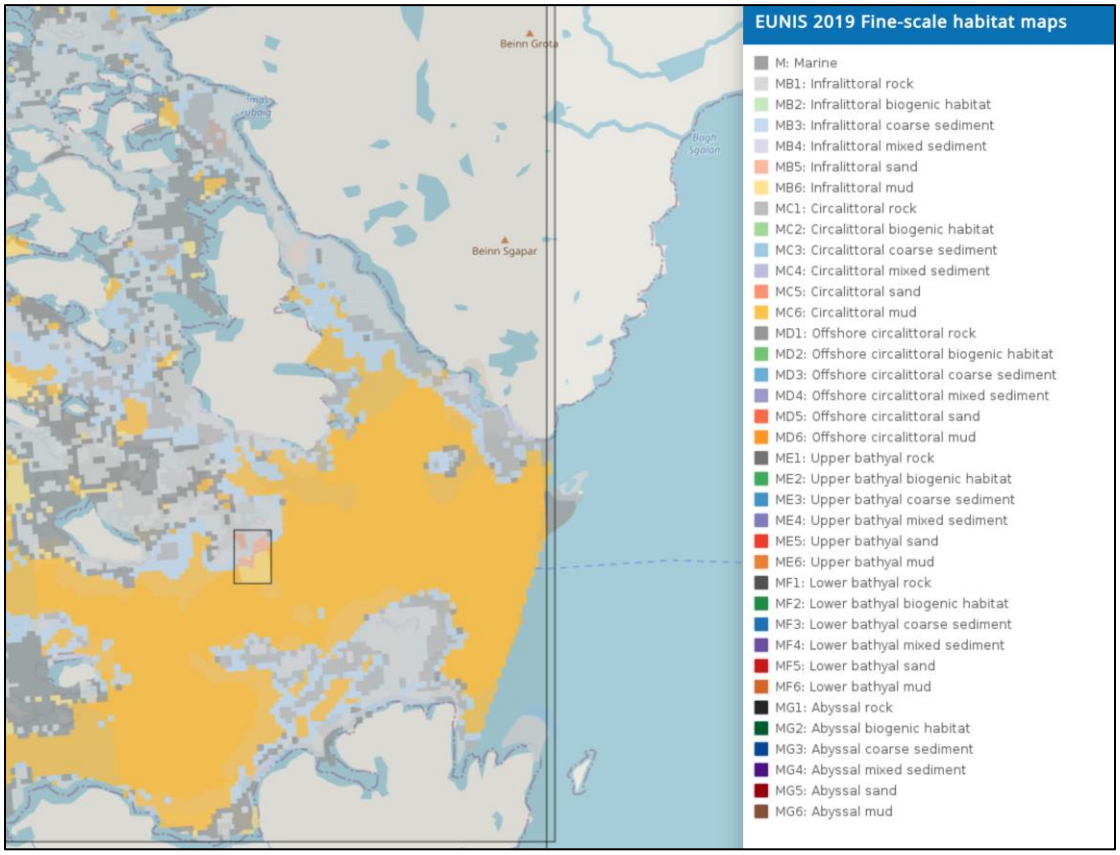


Figure 6. EUNIS 2019 fine-scale habitat map (source https://www.emodnet-seabedhabitats.eu/)

Following the video survey described above, a preliminary investigation of the extent of this reef feature was conducted using downscan sonar, with the hardness quantified by Peak SV[3] (Figure 7).

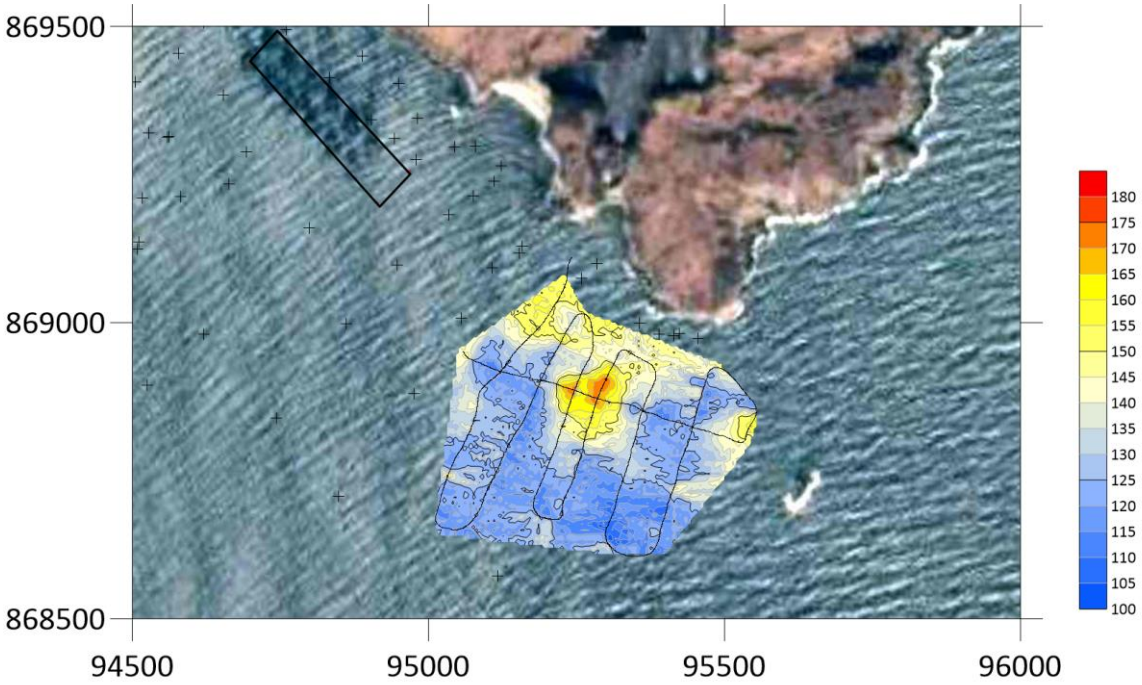


Figure 7. Contoured Peak SV over reef structure. NB Peak SV is a dimensionless descriptor of bottom hardness over the dataset, with hard substrates (rock) shown red and soft substrates (mud) blue

The area of the reef (peak SV>150) is estimated as 10,253 m^2 and the distance from cage group edge as 424m.

Five additional biotopes were recorded by this survey, which were not previously recorded by Moore et al (2016) – this is expected, given survey of 94 rather than 9 sites. Three of these (SS.SMu.CSaMu.AfilMysAnit, SS.Ssa.IMuSa.ArelSa and SS.SMu.IFiMu.PhiVir) are sub-categories of previously recorded sandy mud or mud biotopes, with the addition of a characteristic species (*Amphiura filiformis*, *Arenicola marina* and *Virgularia mirabilis* respectively). One (CR.MCR.EcCr.CarSp) is the circalittoral reef biotope, with the exception of the sea fan *Swiftia pallida* which was not recorded on the reef sites east of Flodday. The last (IR.FIR.SG.CC.Mo) is essentially infralittoral boulders without macroalgae, and is not a good fit for the biotope description (which is based on surge gullies with a higher level of wave action).

Overall, therefore, the recorded biotope distribution is very consistent with previous mapping, given the higher resolution of sites. However, there are some discrepancies with the National Marine Plan interactive (NMPi) mapping produced by

[3] Peak SV measures the strength of the sonar return as it is reflected off the bottom, and is highly correlated to the hardness of the bottom. E1 and E2 parameters were also assessed, but present no additional information in this case

Marine Scotland, which shows more extensive areas of Northern sea fan and sponge communities (Priority Marine Feature, see below).

Limitations of the biotope approach to habitat and community description are well recognised. In relation to this survey, it can be (briefly) noted that:

- Distinction between sedimentary habitats (without quantitative particle size analysis of samples) is subjective and imprecise. In particular, nearly all sedimentary habitats could be described as mixed, although the biotope descriptions contain various terms (for example "muddy sand" and "sandy mud") within the sublittoral coarse sediment (SCS) , sublittoral sand (SSa) and sublittoral mud (SMu) categories. However, simply describing all subtidal sediments as sublittoral mixed sediment (SMx) is not very useful.

- Distinction between infralittoral and circalittoral biotopes, which is at a high level in the biotope hierarchy, is necessarily imprecise especially in habitats without macroalgae. This results in a somewhat arbitrary distinction of very similar habitats (e.g. muddy sands) on the basis of water depth.

- A key issue is whether the objective is to identify all examples of a biotope within the survey area – in which case individual boulders with *Caryophyllia smithii* are described as CR.MCR.EcCr.CarSp reef – or to assess the more general ecological characteristics – in which case the site may be assessed as circalittoral muddy sand (SS.Ssa.CMuSa) with scattered boulders. This is essentially a question of scale, which (by implication) is extremely variable within the biotope description system.

- Some combinations of important species/ecological community/habitat are not defined as biotopes – for example fine sand burrowed by *Callianassa subterranea*, which is widespread and common in areas used for aquaculture, is not defined as a specific biotope although it is distinctive and easily identified by burrow morphology.

Four Priority Marine Features (PMFs), as defined by Tyler-Walters *et al* (2016) were identified in Caolas Loch Portain:

- Burrowed Mud (probably the component biotope SEAPENS AND BURROWING MEGAFAUNA IN CIRCALITTORAL FINE MUD (SS.SMu.CFiMu.SpnMeg) although seapens were rarely recorded in the deeper burrowed mud, and the *Virgularia* population in Loch Portain does not fit this PMF

- Kelp Beds (probably the biotope type LAMINARIA HYPERBOREA AND FOLIOSE RED SEAWEEDS ON MODERATELY EXPOSED INFRALITTORAL ROCK (IR.MIR.KR.Lhyp), although this is somewhat subjective given the diversity of kelp bed biotopes)

- Northern sea fan and sponge communities (component biotope MIXED TURF OF HYDROIDS AND LARGE ASCIDIANS WITH SWIFTIA PALLIDA AND CARYOPHYLLIA SMITHII ON WEAKLY TIDE-SWEPT CIRCALITTORAL ROCK (CR.HCR.XFa.SwiLgAs))

- BURROWING SEA ANEMONE – ARACHNANTHUS SARSI (tentatively identified at site LM94, Figure 7)

Figure 7. Burrowing anemone tentatively identified as PMF *Arachnanthus sarsi*, site LM94

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