Benthic Video Survey

Beinn Reithe

Version 1

Report to Loch Long Salmon Ltd

Issued by Aquatera Ltd

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[redacted]

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Aquatera Ltd
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1 INTRODUCTION

This report has been prepared by Aquatera Ltd on behalf of Loch Long Salmon Ltd (LLS), who is proposing to submit a planning application for the build, installation and operation of a semi-closed system salmon farm off the west bank of Upper Loch Long in the Firth of Clyde region. Presented are the findings of a benthic video survey that was conducted on 19 September 2020 with the aim to investigate seabed species and habitats within the application site (Figure 1.1).

Table 1.1 Proposed site details

Site details	Description
Site name	Beinn Reithe
Location (group centre)	NS 25514 99249
Site address	Loch Long, Argyll and Bute, Scotland
Maximum proposed biomass	4,000 tonnes
Proposed no. of pens and size	4 pens, 140 m surface outer circumference

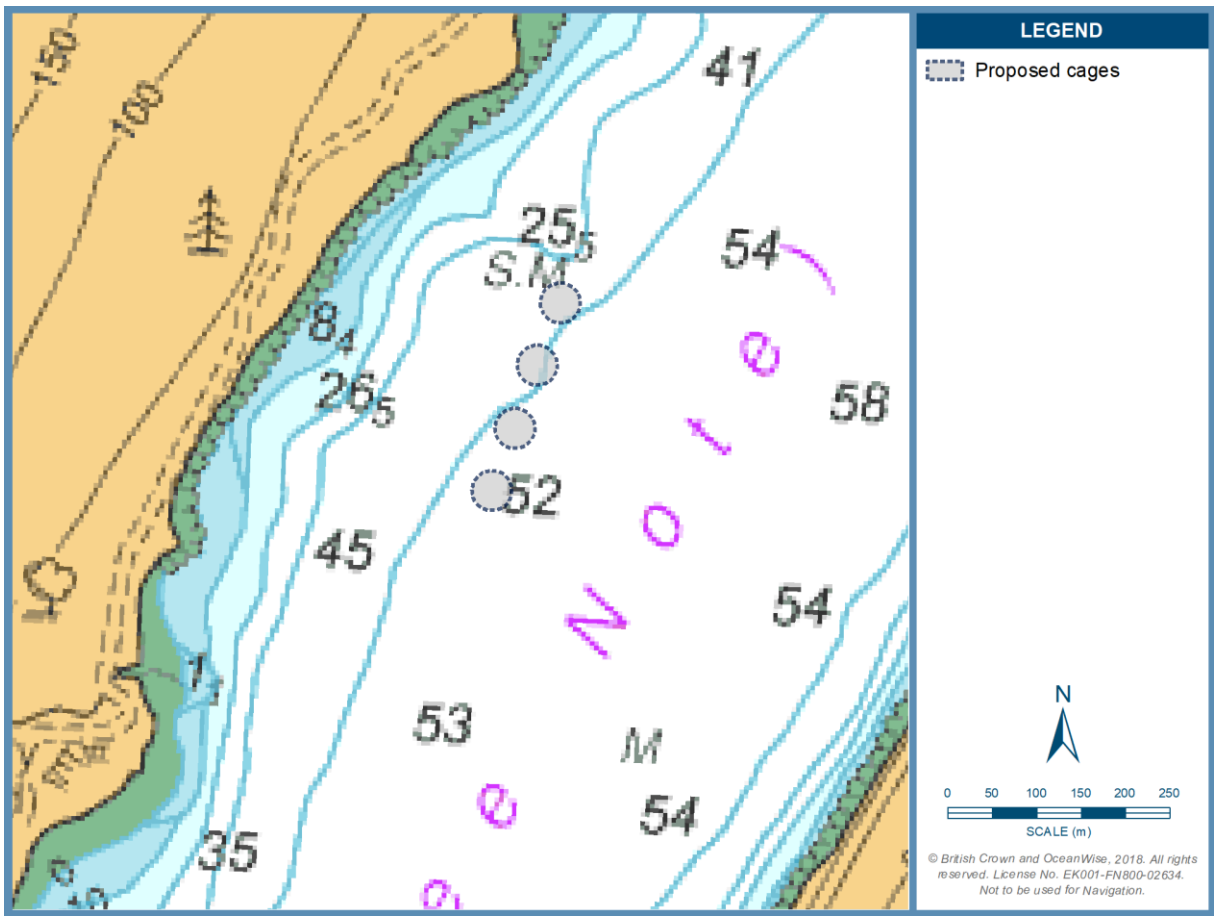


Figure 1.1 Proposed cage layout at the Beinn Reithe site

2 SURVEY METHODOLOGY

2.1 SURVEY OPERATIONS

The benthic video survey was conducted by specialist contractors Anderson Marine Surveys Ltd (AMSL) on 19 September 2020, using AMSL's 6.7 m vessel *Mollie B*. Positioning and depth data were provided by a Simrad NSS7 evo.2 chart plotter with fixes at 1s intervals logged directly to PC.

Footage capture 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. The system was also equipped with two parallel laser pointers at 20 cm separation. The camera frame was towed along pre-determined transects at approximately 0.5 knots just above the seabed and allowed to settle briefly on the seabed at frequent intervals.

2.2 SURVEY DESIGN

The survey was planned to collect video footage along four pre-determined transects to allow representative coverage of benthic habitats within the Beinn Reithe site (Figure 2.1). The main transect T1 was positioned in a northeast – southwest direction through the centre of a proposed single-file arrangement of four fish pens, with three equidistant perpendicular transects (T2-T4). At the time of the survey an ADCP (Acoustic Doppler Current Profiler) was deployed at the centre of the proposed survey area. The presence of this device and its associated moorings necessitated a significant modification of the survey design to allow the safe deployment of the camera equipment. This resulted in the division of five main transects (T1A/T1B, T2A/T2B, T3, T4 and T5A/T5B) around the survey sites as shown in Figure 2.2. The revised plan was devised to ensure reasonable geographical coverage of the survey area and to investigate the influence of water depth on the seabed conditions. Appendix A details the corresponding start and end coordinates of planned and actual transects.

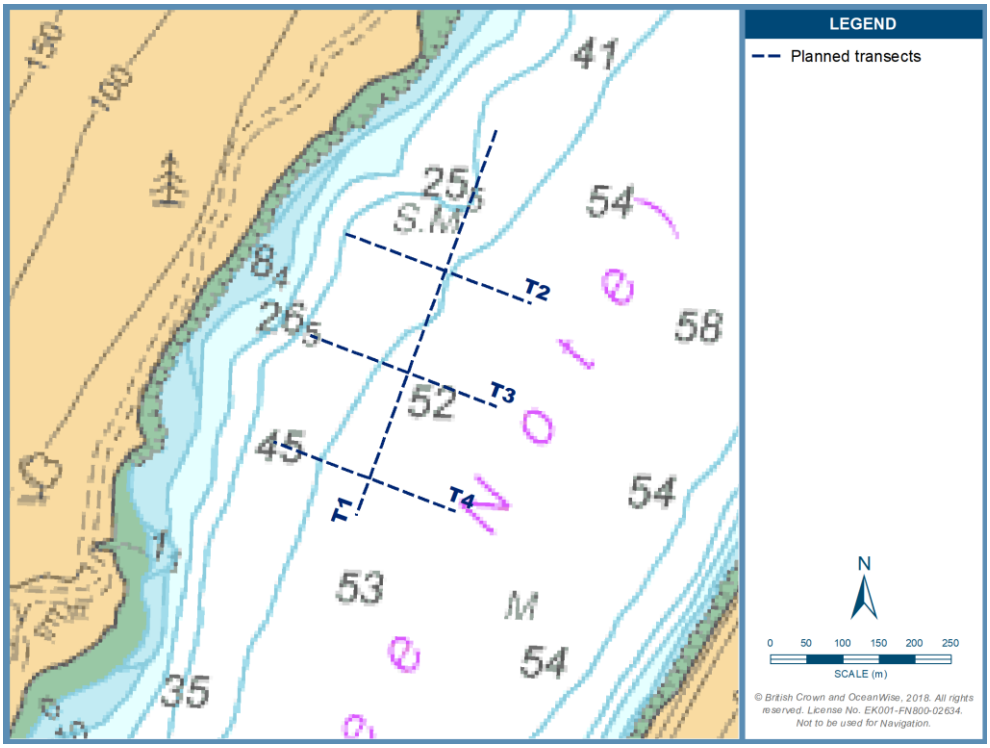


Figure 2.1 Location of planned survey transects at the Beinn Reithe site

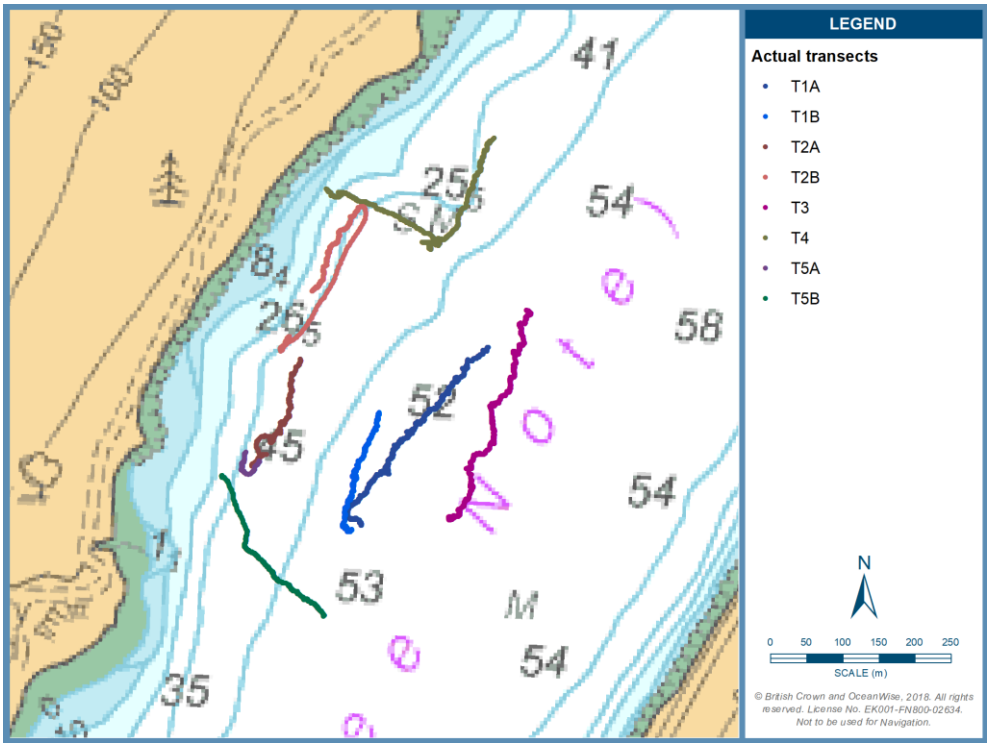


Figure 2.2 Actual transect routes of the towed video camera

2.3 VIDEO DATA INTERPRETATION

Video footage was used to describe seabed characteristics in terms of physical structure (i.e. main substrate, sediment composition) and species assemblages in the area. Where possible, species were identified to the highest taxonomic level and quantified using the Marine Nature Conservation Review (MNCR) SACFOR[1] abundance scale (Hiscock, 1996). Descriptions of physical and biological attributes of the seabed were compared to biotope complex and biotope classifications as listed in the Joint Nature Conservation Committee (JNCC) Marine Habitat Classification for Britain and Ireland (JNCC, 2015). Observed habitats were noted for their conservation status, including whether they are a Priority Marine Feature (PMF) designated as nature conservation priorities in Scotland (Tyler-Walters *et al.*, 2016).

[1] The SACFOR abundance scale: S = Superabundant, A = Abundant, C = Common, F = Frequent, O = Occasional, R = Rare.

3 SURVEY OBSERVATIONS

Throughout the survey area there were minor variations in seabed characteristics. Water depths ranged from 13 m at the northwest side of the loch at the end of transect T4 to 53 m at the middle of the loch where transects T1A/T1B and T3 were situated. The survey area was dominated by soft sediments, with muddy sand observed toward the middle of the loch and fine mud (easily prone to resuspension) along northwest transects T2A/T2B and T4. Patches of stone or shell gravel overlain with fine sediment were additionally observed at around 20 – 30 m depth along the northwest extent of the survey area.

Scarce fauna observed on stone or shell gravels in shallower regions included the sealoch anemone *Protanthea simplex*, crabs and individual sightings of the sea urchin *Echinus esculentus*. Elsewhere, numerous faunal burrows were observed in soft sediments within the survey area. Along the northwest transects T2A/T2B and T4, the Norway lobster *Nephrops norvegicus* was occasionally observed at the entrance of burrows. There was frequent *P. simplex* on sediments throughout this area, as well as locally abundant on occasional boulders and outcrops where brittle stars and sea squirts (possible *Ciona intestinalis*) and sabellid worms were observed in association. Low numbers of the burrowing anemone *Cerianthus lloydii* and firework anemone *Pachycerianthus multiplicatus* were observed in this area of seabed. Sparse crustaceans observed along northwest transects included occasional crabs (possible *Liocarcinus spp.*), hermit crabs (*Pagurus bernhardus*) and lesser numbers of squat lobsters (*Munida rugosa*). Feather stars (possible *Antedon petasus*) were observed on rare occasions along transect T4.

Throughout deeper parts of the survey area (transects T1A/T1B, T3, and southeast half of T5B), there were widespread observations of small projections from sediments indicative of the arms of burrowing brittle stars (possible *Amphiura spp.*). Other brittle stars (possible *Ophiura sp.*) were frequently observed on the sediment surface, and most particularly along transect T3. Flat burrow holes throughout deeper areas of seabed appeared to more likely belong to the frequently observed *C. lloydii*. *P. simplex* was occasionally observed on muddy sands with rare sightings of the plumose anemone *Metridium dianthus*. Sparse and scattered epifauna predominantly consisted of echinoderms (brittle stars, occasional common starfish *Asterias rubens*), crabs (possible *Liocarcinus spp*), and *P. bernhardus*. There were additional occasional sightings of common whelk *Buccinum undatum,* mud shrimp (possible *Calocaris macandreae*) and rare observations of hydroids. A small number of flatfish were observed along transect T1A/T1B.

Footage capture points from the ROV survey are plotted in Figure 3.1, with corresponding seabed images presented in Figure 3.2 to Figure 3.6. Details of all images and a description of observations recorded, including SACFOR abundance estimates where possible, are presented in Appendix B.

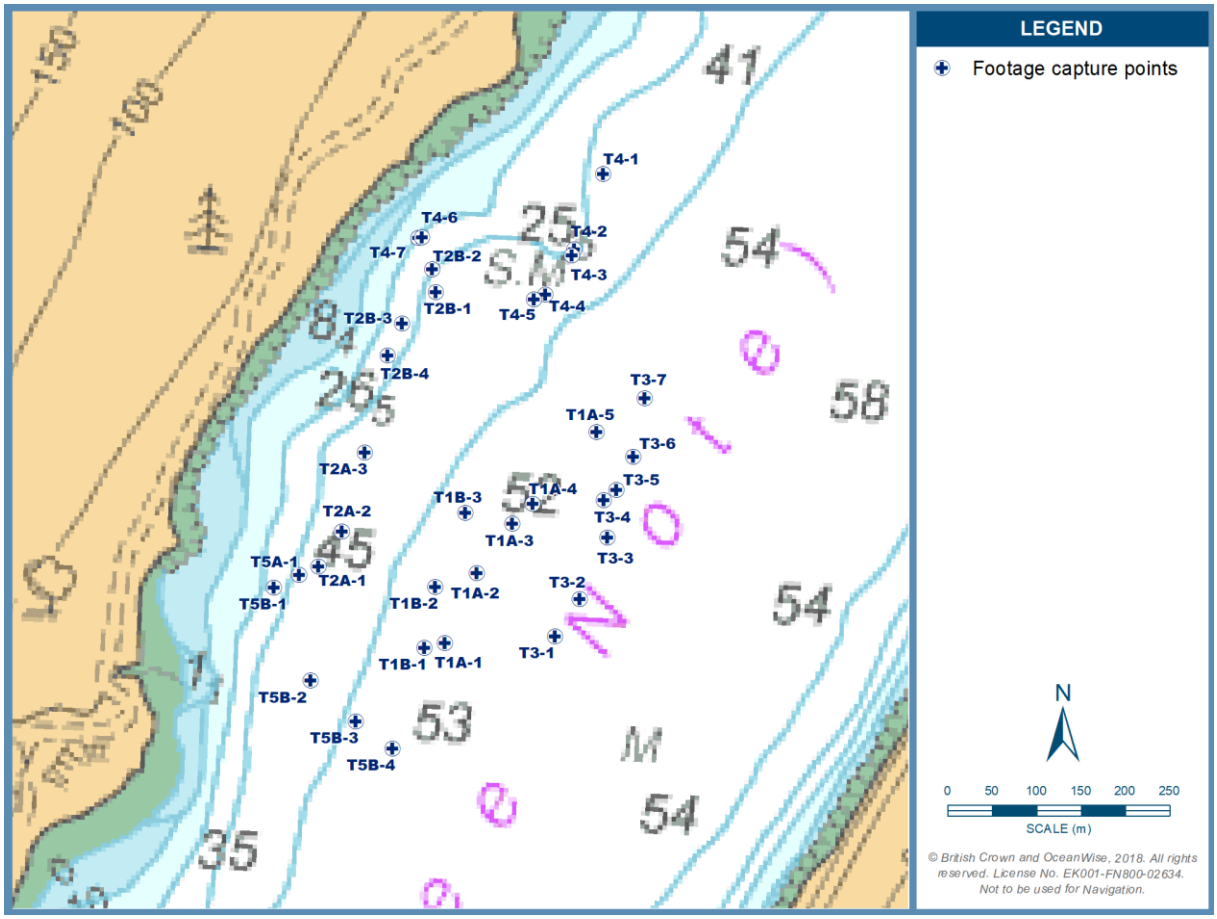


Figure 3.1 Footage capture points from the AMSL towed video camera survey conducted at Beinn Reithe, September 2020

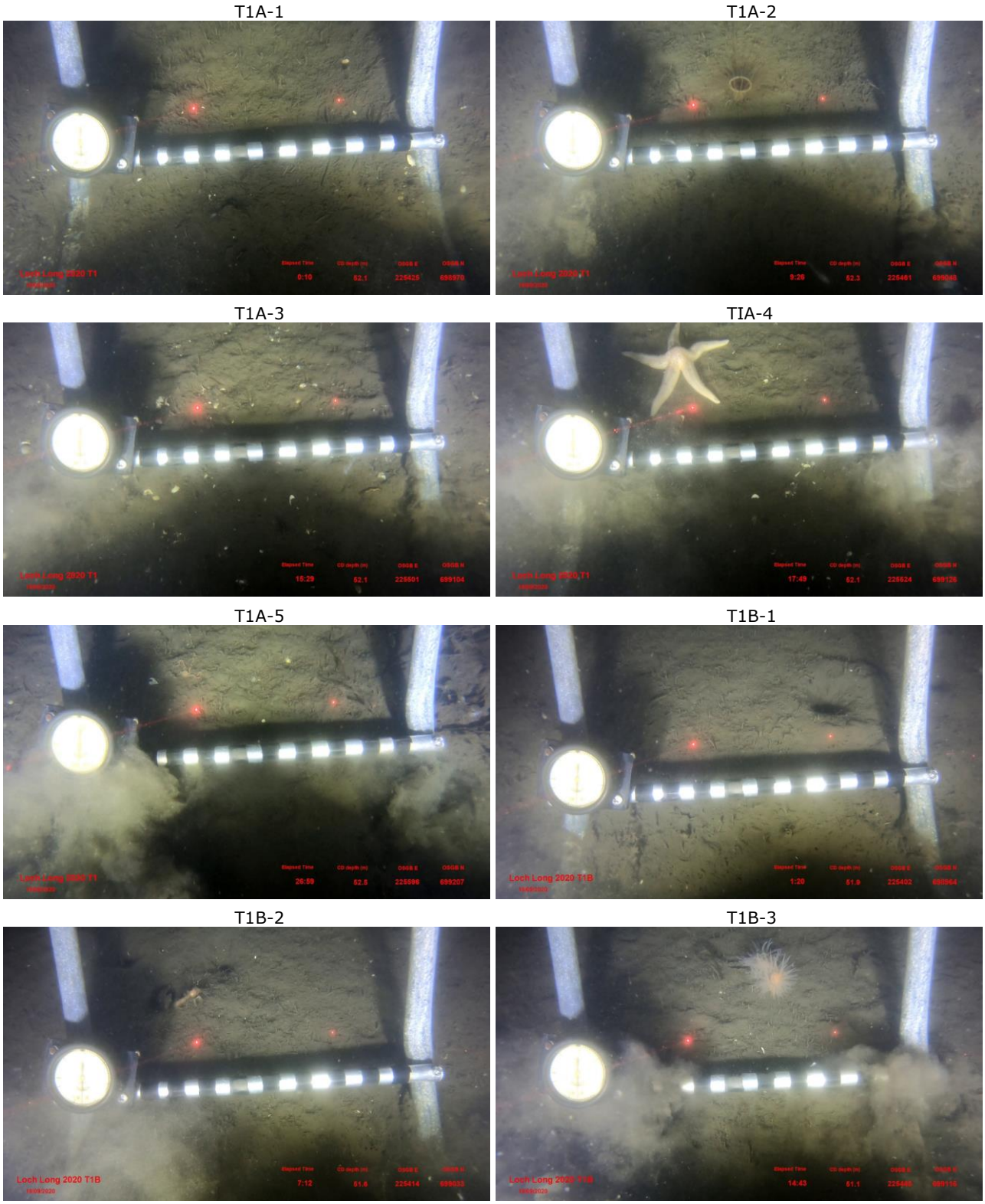
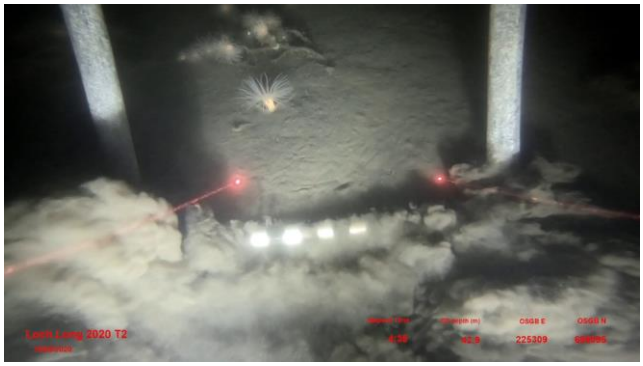


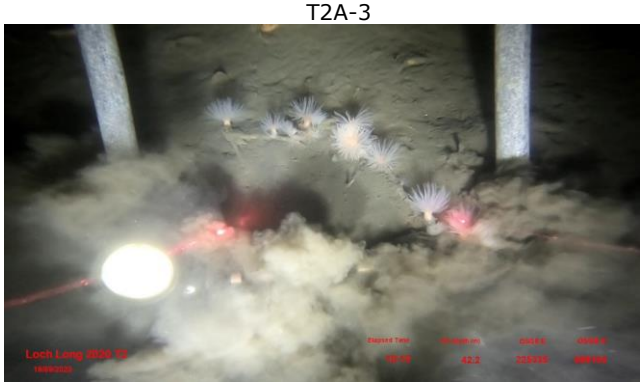
Figure 3.2 Seabed Images, Transect T1, Beinn Reithe, September 2020

T2A-1

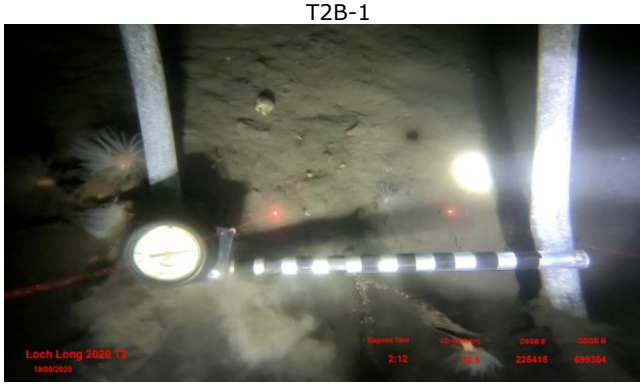
T2A-2



T2A-3



T2B-1



T2B-2

T2B-3

T2B-4

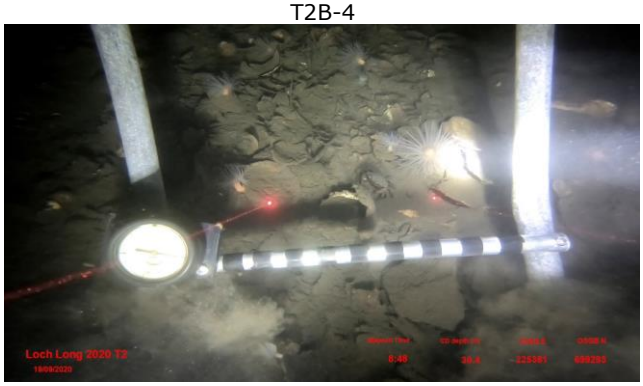
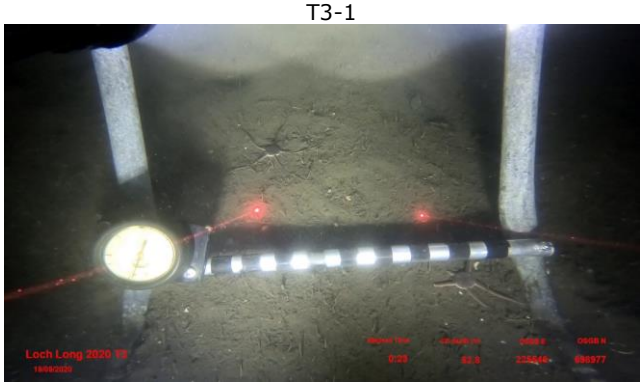
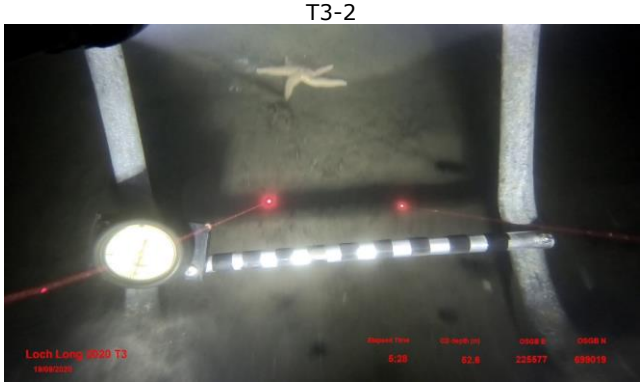


Figure 3.3 Seabed Images, Transect T2, Beinn Reithe, September 2020

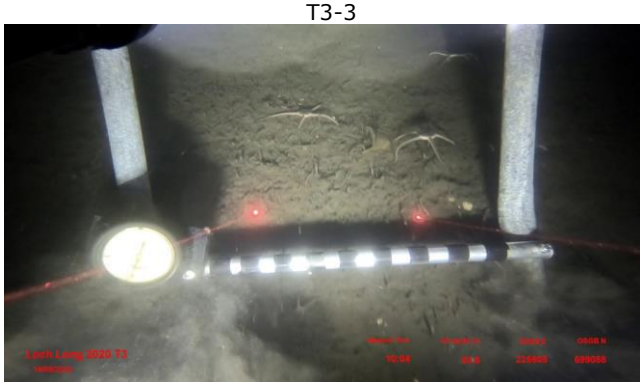
T3-1



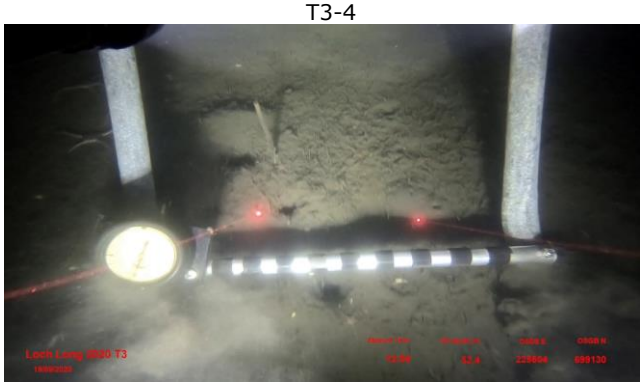
T3-2



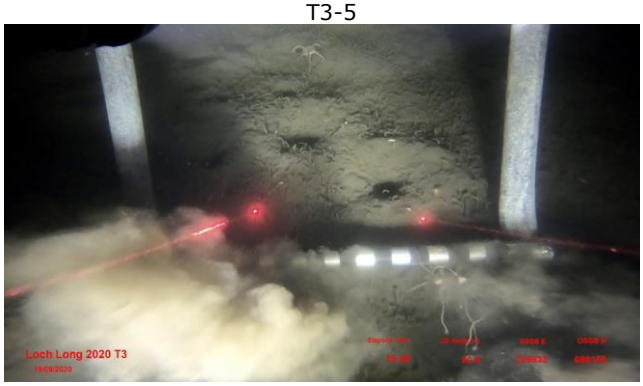
T3-3



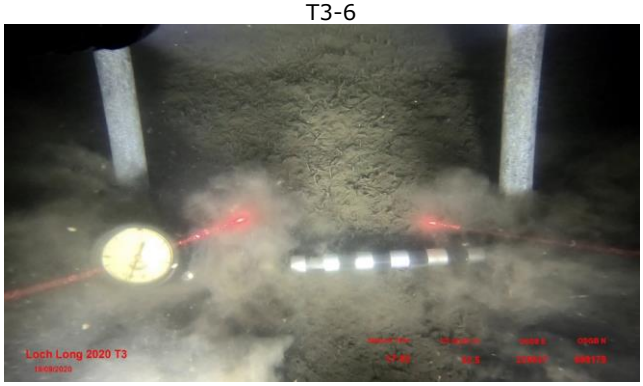
T3-4



T3-5



T3-6



T3-7

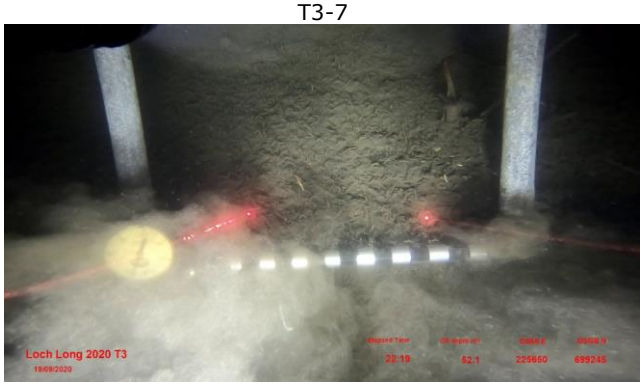
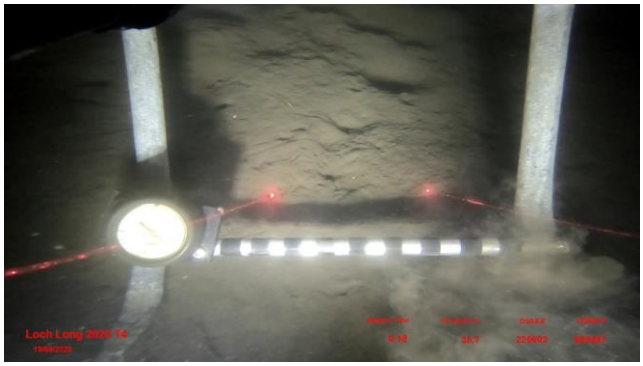
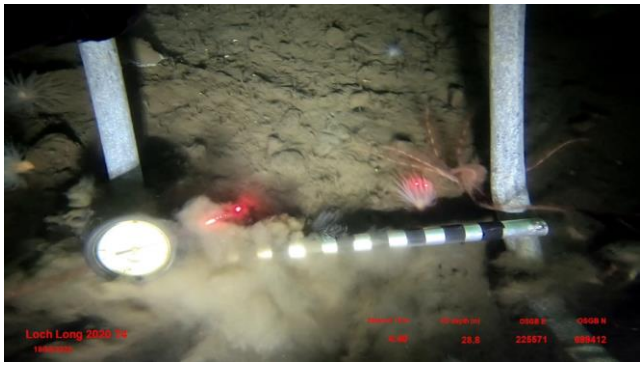


Figure 3.4 Seabed Images, Transect T3, Beinn Reithe, September 2020

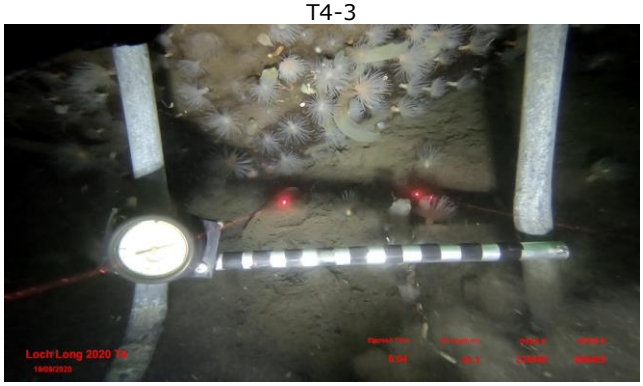
T4-1



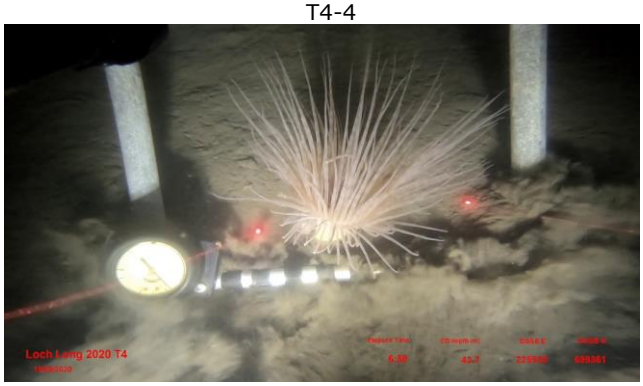
T4-2



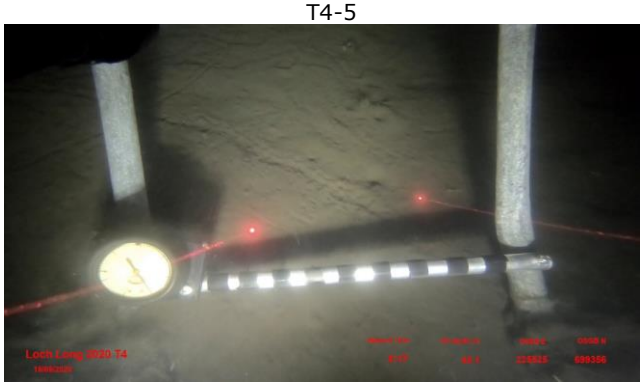
T4-3



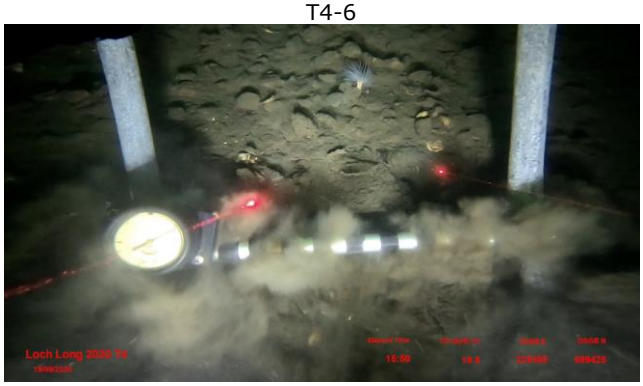
T4-4



T4-5



T4-6



T4-7

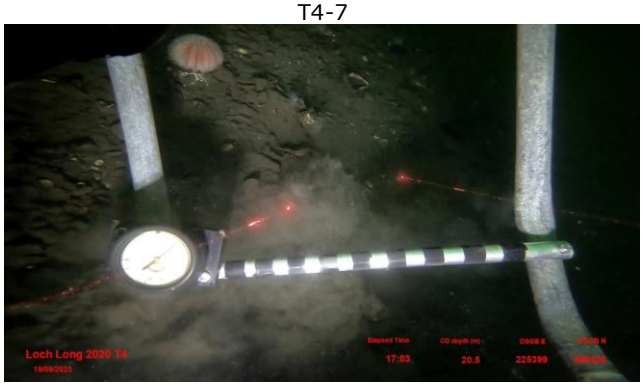
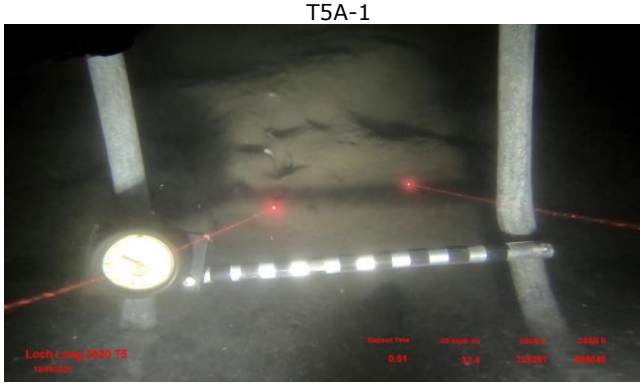
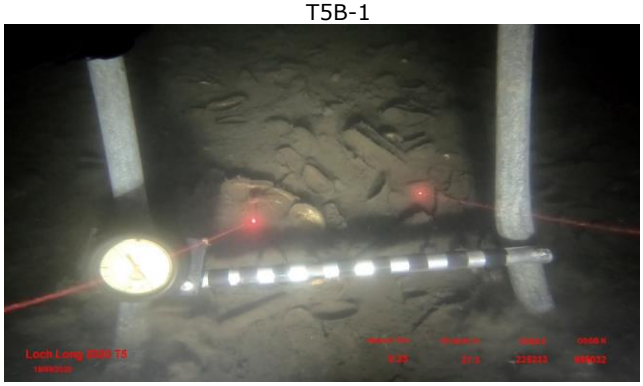


Figure 3.5 Seabed Images, Transect T4, Beinn Reithe, September 2020

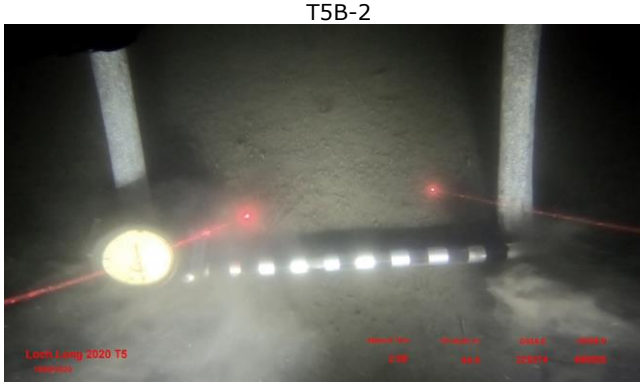
T5A-1



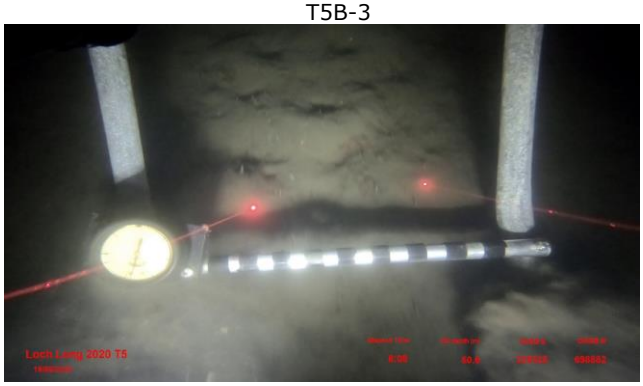
T5B-1



T5B-2



T5B-3



T5B-4

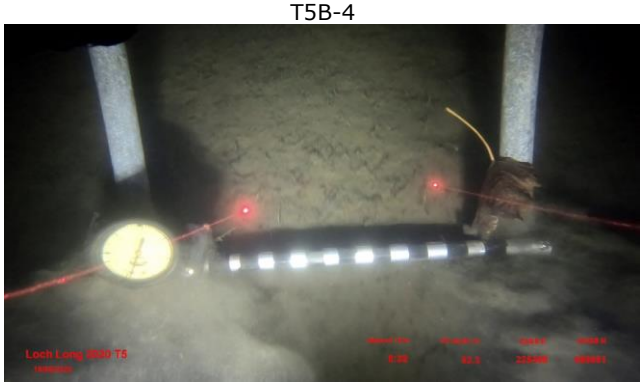


Figure 3.6 Seabed Images, Transect T5, Beinn Reithe, September 2020

4 DESCRIPTION OF BIOTOPES

4.1.1 Biotope classifications

The seabed habitats observed at the Beinn Reithe site in September 2020 displayed the characteristics of the following biotope types, as described in the JNCC Marine Habitat Classification for Britain and Ireland (JNCC, 2015):

Circalittoral fine mud (SS.SMu.CFiMu)

- It was considered the majority of the survey area shared characteristics with the **SS.SMu.CFiMu** biotope complex. Sediments throughout the majority of the survey area consisted of fine muds and muddy sands at depths greater than around 30 m. Characterising species of biotope complex that were observed during the survey included burrowing species *N. norvegicus* and *C. lloydii*, with communities of *C. lloydii* and possible *Amphiura spp.* more prevalent toward the middle of the loch along transects T1A/T1B and T3. Ubiquitous scattered epifauna associated with SS.SMu.CFiMu that were observed during the survey included *P. bernhardus*, *M. rugosa*, *Liocarcinus spp.* and *A. rubens*.
- Two biotopes are component biotopes of the 'burrowed mud' broad habitat (see below), which is a Priority Marine Feature (PMF) in Scotland's seas (Tyler-Walters et al., 2016): **SS.SMu.CFiMu.SpnMeg** (Seapens and burrowing megafauna in circalittoral fine mud) and **SS.SMu.CFiMu.MegMax** (Burrowing megafauna and *Maxmuelleria lankesteri* in circalittoral mud)
  - Particularly within the northwest of the survey area, observed features of the SS.SMu.CFiMu.SpnMeg biotope included megafaunal burrows (i.e. *N. norvegicus*) and the characterising species *P. multiplicatus*. However, no sea pens (*Funiculina quadrangularis*, *Virgularia mirabilis*, or *Pennatula phosphorea*) were observed during the survey and it is therefore considered this area of seabed does not represent a close example of this biotope.
  - No spoon worm *Maxmuelleria lankesteri* were observed on the surface of sediments nor were volcanic-like burrow mounds characteristic of the species observed in the footage. *M. lankesteri* and other characteristic infaunal species of the SS.SMu.CFiMu.MegMax biotope, such as *Nephtys hystricis*, *Chaetozone setosa*, and *Amphiura chiajei*, could not be confirmed in the visual survey and would require further benthic infaunal analysis to confirm their presence and abundance. Populations of *N. norvegicus* and *C. macandreae* were considered to be low in abundance during the each transect run (Appendix B). It is therefore considered this area of seabed does not represent a close example of this biotope.

Burrowed mud broad habitat

- The seabed throughout the majority of the survey area shared characteristics with the burrowed mud broad habitat. Key characteristics of the burrowed mud broad habitat that were recorded included prominent mounds created by burrowing crustaceans *N. norvegicus* and *C. macandreae*. Crustacean burrows were predominantly found to the northwest of the survey area along transects T2A/T2B and T4, where sediments appeared finer-grained and, in some areas, more heavily burrowed than toward the south or east of the survey area.
- Sparse fireworks anemone *P. multiplicatus* is a component species of burrowed mud habitats that was recorded in low numbers along transect T4. The tall sea pen *F. quadrangularis* and mud-burrowing amphipod *Maera loveni* are the other component species of burrowed mud habitats, however neither were observed during the survey.
- Both SS.SMu.CFiMu.SpnMeg and SS.SMu.CFiMu.MegMax are component biotopes of the burrowed mud habitat. It is considered that due to the low abundance of key characteristic species of the burrowed mud broad habitat and absence of species representing its component biotopes, the area of seabed covered by the video survey does not represent a high-quality example of this habitat.

4.1.2 Comparison with previous surveys

In 2010 NatureScot performed a drop-down camera survey throughout the Clyde Sea Area to validate the presence of PMFs and supplement existing species and habitat records. Burrowed muds were extensive throughout the Loch Long survey area, where in Upper Loch Long component biotopes SS.SMu.CFiMu.SpnMeg and SS.SMu.CFiMu.MegMax were occasionally observed in close proximity to each other (Allen *et al*. 2013). Within the Loch Long section of the 2010 Clyde Sea Area survey, populations of *P. multiplicatus* was observed in mud to sandy mud sediment often near to sea pens or macrofaunal burrows associated with the SS.SMu.CFiMu.SpnMeg biotope. Station LL66 of the 2010 Clyde Sea Area survey represented the camera drop performed nearest to the AMSL September 2020 Beinn Reithe video survey (situated in between transects T1A and T3), which revealed the presence of the SS.SMu.CFiMu biotope complex (Allen *et al*. 2013).

Beinn Reithe is currently not within any sites designated, or proposed designation, for conservation of habitats. The nearest conservation designation is approximately 7 km southwest where Loch Long branches into Loch Goil, which forms part of the Upper Loch Fyne and Loch Goil Nature Conservation Marine Protected Area (MPA). The MPA was selected for a number of PMFs including burrowed mud, horse mussel beds and ocean quahog aggregations. The sill at the entrance to the mouth of Loch Goil features large aggregations of sea cucumbers scattered in mixed muddy sediments alongside clumps of horse mussels and sea squirts (NatureScot, n.d.). The Conservation Objectives of the Upper Loch Fyne and Loch Goil MPA are to recover flame shell beds and conserve all other features to make a lasting contribution to the MPA network (NatureScot, n.d.).

5 REFERENCES

Allen, C., Axelsson, M., Dewey, S., Clark, L. (2013) Marine biological survey to establish the distribution of Priority Marine Features within the Clyde Sea area. Scottish Natural Heritage Commissioned Report No.437 [online]. Available from: https://www.nature.scot/naturescot-commissioned-report-437-marine-biological-survey-establish-distribution-priority-marine (Accessed 09/10/2020).

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Tyler-Walters, H., James, B., Carruthers, M. (eds.), Wilding, C., Durkin, O., Lacey, C., Philpott, E., Adams, L., Chaniotis, P.D., Wilkes, P.T.V., Seeley, R., Neilly, M., Dargie, J., Crawford-Avis, O.T. (2016) Descriptions of Scottish Priority Marine Features (PMFs). Scottish Natural Heritage Commissioned Report No. 406 [online]. Available from: https://www.nature.scot/snh-commissioned-report-406-descriptions-scottish-priority-marine-features-pmfs (Accessed 09/10/2020).

APPENDIX A TRANSECT LOCATIONS

Table 5.1 Planned survey transects at the Beinn Reithe site

Transect	Start		End	
	Latitude	Longitude	Latitude	Longitude
T1	56.15631	-4.80940	56.15146	-4.81217
T2	56.15495	-4.81266	56.15418	-4.80846
T3	56.15367	-4.81336	56.15288	-4.80914
T4	56.15233	-4.81408	56.15156	-4.80996

Table 5.2 Approximate start-finish transects of the video survey, detailing corresponding video files

Transect	Filename	Start		Depth (m)	End		Depth (m)
		Latitude	Longitude		Latitude	Longitude	
T1A	LL T1.MP4	56.151355	-4.812059	52	56.153601	-4.809373	53
T1B	LL T1B.MP4	56.151270	-4.812238	52	56.152738	-4.811727	51
T2A	LL T2A.MP4	56.152160	-4.814212	41	56.153344	-4.813525	42
T2B	LL T2B.MP4	56.153635	-4.813804	39	56.154211	-4.813347	29
T3	LL T3.MP4	56.151482	-4.810040	53	56.154087	-4.808555	52
T4	LL T4.MP4	56.156206	-4.809434	40	56.155484	-4.813102	13
T5A	LL T5A.MP4	56.152177	-4.814664	33	56.150179	-4.812795	52
T5B	LL T5B.MP4	56.151878	-4.815173	27	56.150179	-4.812795	52

APPENDIX B SURVEY IMAGE DETAILS AND SACFOR ESTIMATES

Table 5.3 describes substrate and biota observed in footage image captures presented in Figure 3.2 to Figure 3.6. Estimates of abundance are based on the SACFOR scale (Superabundant S; Abundant A; Common C; Frequent F; Occasional O; Rare R) and are shown with the corresponding density or percentage cover. Present (P) is used to describe biota observed in footage whose abundance could not be reliably determined.

Table 5.3 Details of images captured from the AMSL survey, Beinn Reithe, September 2020

Image ID	Time stamp (mm:ss)	Latitude	Longitude	Depth (m)	Substrate	Biota observed	SACFOR estimate	Density / % cover
T1A-1	00:10	56.151365	-4.812044	52.1	Muddy sand	Possible arms of burrowing brittle star (*Amphiura spp*.)	P	-
T1A-2	09:26	56.152078	-4.811516	52.3	Muddy sand	Burrowing anemone *Cerianthus lloydii*. Single flatfish ~30 seconds later. Possible arms of burrowing *Amphiura spp*.	O R P	1-9/100 m^2 <1/1000m^2 -
T1A-3	15:29	56.152595	-4.810910	52.1	Muddy sand with shell fragments	No conspicuous biota observed in image. *C. lloydii* present in near area covered by transect.	- F	- 1-9/10 m^2
T1A-4	17:49	56.152801	-4.810555	52.1	Muddy sand with shell fragments	Common starfish *Asterias rubens*. Possible arms of burrowing *Amphiura spp*.	O P	1-9/1000 m^2 -
T1A-5	26:59	56.153554	-4.809450	52.5	Muddy sand	Brittle star (possible *Amphiura sp.*). Possible arms of burrowing *Amphiura spp*. Small cluster of sealoch anemone *Protanthea simplex* 5 s earlier.	P P R	- - 1-9/100 m^2
T1B-1	01:20	56.151303	-4.812410	51.9	Muddy sand	Burrows present. Possible arms of burrowing *Amphiura spp*.	- P	- -
T1B-2	07:12	56.151926	-4.812262	51.6	Muddy sand	Single mud shrimp (possible *Calocaris macandreae*) Possible arms of burrowing *Amphiura spp*.	P P	- -
T1B-3	14:43	56.152683	-4.811770	51.1	Muddy sand	*P. simplex*. Possible arms of burrowing *Amphiura spp*. Common whelk *Buccinum undatum* ~40 s earlier	R P O	1-9/100 m^2 - 1-9/100 m^2
T2A-1	01:42	56.152085	-4.814383	37.1	Fine mud	*P. simplex*. Small crabs (possible *Liocarcinus spp.*)	O F	1-9/10 m^2 1-9/10 m^2

Image ID	Time stamp (mm:ss)	Latitude	Longitude	Depth (m)	Substrate	Biota observed	SACFOR estimate	Density / % cover
T2A-2	04:35	56.152444	-4.813991	42.9	Fine mud	*P. simplex.*	O	1-9/10 m^2
T2A-3	10:10	56.153252	-4.813631	42.2	Fine mud	*P. simplex*.	F	1-9/m^2
T2B-1	02:12	56.154897	-4.812463	32.6	Muddy sand	Scattered *P. simplex*. Single hermit crab (*Pagurus bernhardus*). *C. lloydii.*	F P R	1-9/m^2 - 1-9/1000 m^2
T2B-2	03:31	56.155129	-4.812545	31.4	Muddy sand	*P. simplex.*	C	1-9 / 0.1 m^2
T2B-3	06:40	56.154569	-4.813051	29.0	Muddy sand, shell fragments	Megafaunal burrows, no conspicuous biota observed in image. Squat lobster *Munida rugosa* observed ~30 s earlier.	- R	- 1-9/1000 m^2
T2B-4	08:48	56.154240	-4.813285	30.4	Coarse shell and stone material, overlain with fine sediment	*P. simplex*. *C. lloydii* observed ~15 s earlier.	O O	1-9/10 m^2 1-9/100 m^2
T3-1	00:23	56.151473	-4.810055	52.8	Muddy sand	Brittle star (possible *Ophiura sp.*). Possible arms of burrowing *Amphiura spp*.	F P	1-9/10 m^2 -
T3-2	05:28	56.151860	-4.809632	52.6	Muddy sand	*A. rubens*. Numerous burrows (thought to possibly belong to burrowing anemone *C. lloydii*).	O -	1-9/1000 m^2 -
T3-3	10:04	56.152491	-4.809179	52.6	Muddy sand	Brittle star (possible *Ophiura sp.*). Possible arms of burrowing *Amphiura spp*. Single *A. rubens* ~20 s later	F P O	1-9/10 m^2 - 1-9/1000 m^2
T3-4	12:54	56.152866	-4.809271	52.4	Muddy sand	Possible tube of peacock worm *Sabella pavonina*. Brittle star (possible *Ophiura sp.*). Possible arms of burrowing *Amphiura spp*. Numerous burrows (possibly of *C. lloydii*).	P F P -	- 1-9/10 m^2 - -
T3-5	15:45	56.152979	-4.809054	52.5	Muddy sand	Brittle star (possible *Ophiura sp.*). Possible arms of burrowing *Amphiura spp*. Numerous burrows (possibly of *C. lloydii*). Unidentified hydroid.	F P - P	1-9/10 m^2 - - -

Image ID	Time stamp (mm:ss)	Latitude	Longitude	Depth (m)	Substrate	Biota observed	SACFOR estimate	Density / % cover
T3-6	17:02	56.153318	-4.808773	52.5	Muddy sand	Possible arms of burrowing *Amphiura spp*.	P	-
T3-7	22:19	56.153915	-4.808607	52.1	Muddy sand	Possible arms of burrowing *Amphiura spp*. Unidentified burrowing worm.	P P	- -
T4-1	00:18	56.156159	-4.809528	38.7	Fine mud	Burrows, no conspicuous biota observed in image. Norway lobster *Nephrops norvegicus* observed in burrow entrance ~30 s later.	- O	- 1-9/1000 m^2
T4-2	04:40	56.155385	-4.809986	28.8	Stony material overlain with fine sediment	*P. simplex*. Feather star (possible *Antedon petasus*).	O R	1-9/10 m^2 1-9/1000 m^2
T4-3	05:04	56.155321	-4.810030	30.3	Fine mud with occasional cobbles and boulders	Dense *P. simplex* on boulder. Possible sea squirt *Ciona intestinalis*. Dense *P. simplex* and brittle stars on boulder 10 s earlier.	C F -	1-9 / 0.1 m^2 1-9/10 m^2 -
T4-4	06:58	56.154915	-4.810484	43.7	Fine mud	Fireworks anemone *Pachycerianthus multiplicatus*. Possible *A. petasus* 10 s later.	R R	<1/1000m^2 1-9/1000 m^2
T4-5	08:17	56.154865	-4.810689	45.1	Fine mud	No conspicuous biota observed in image. Crab (possible *Liocarcinus spp.*) in near area covered by transect	- O	- 1-9/100 m^2
T4-6	15:50	56.155437	-4.812825	19.5	Stony material overlain with fine sediment	*P. simplex*.	O	1-9/10 m^2
T4-7	17:03	56.155447	-4.812761	20.5	Stony material overlain with fine sediment	Sea urchin *Echinus esculentus*. *P. simplex.*	R R	<1/1000m^2 1-9/100 m^2
T5A-1	00:51	56.151987	-4.814730	32.4	Fine mud	Burrows; no conspicuous biota observed in image.	-	-
T5B-1	00:23	56.151851	-4.815171	27.3	Shells overlain with fine sediment	Possible *M. rugosa*. Crab (possible *Liocarcinus spp.*) seconds later.	R O	1-9/1000 m^2 1-9/100 m^2
T5B-2	02:58	56.150933	-4.814444	44.8	Muddy sand	Possible arms of burrowing *Amphiura spp*. *C. lloydii* in near area covered by transect.	P F	- 1-9/10 m^2

Image ID	Time stamp (mm:ss)	Latitude	Longitude	Depth (m)	Substrate	Biota observed	SACFOR estimate	Density / % cover
T5B-3	06:08	56.150538	-4.813594	50.6	Muddy sand	Burrows; no conspicuous biota observed in image. Single plumose anemone *Metridium dianthus* ~40 s earlier.	- R	- <1/1000m^2
T5B-4	08:32	56.150275	-4.812914	52.3	Muddy sand	Possible arms of burrowing *Amphiura spp*. *C. lloydii* in near area covered by transect.	P F	- 1-9/10 m^2