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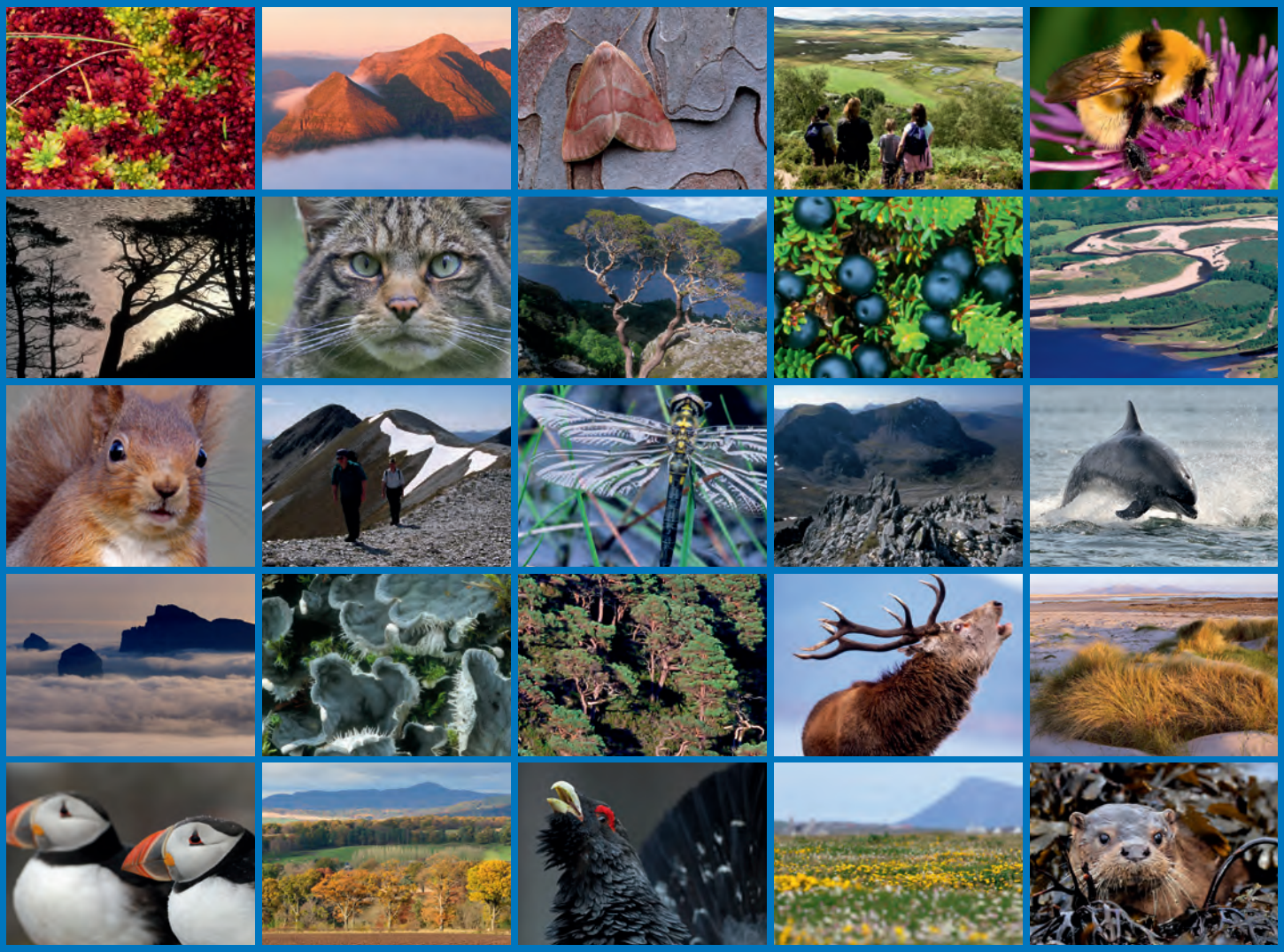
Commissioned Report No. 922

2015 site condition monitoring survey and biotope mapping of the intertidal sediment flats of Loch Paible, North Uist (Balranald Bog and Loch nam Feithean SSSI)



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COMMISSIONED REPORT

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2015 site condition monitoring survey and biotope mapping of the intertidal sediment flats of Loch Paible, North Uist (Balranald Bog and Loch nam Feithean SSSI)

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COMMISSIONED REPORT

Summary

2015 site condition monitoring survey and biotope mapping of the intertidal sediment flats of Loch Paible, North Uist (Balranald Bog and Loch nam Feithean SSSI)

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Keywords

Benthos; mudflat; sandflat; monitoring; survey; biotope; mapping; SSSI; SCM.

Background

In addition to terrestrial, freshwater, avian and coastal features, Balranald Bog and Loch nam Feithean SSSI is also noted for its sediment flats within Loch Paible. The principal purpose of the current study was to carry out site condition monitoring (SCM) of the site in order to identify any deterioration in the condition of the mudflat feature and to form a judgement on its current condition. SCM was inaugurated at this site in 2004, which provides a baseline for the current study. The approach taken to achieve this aim was to resurvey the two representative, relocatable transects established in 2004.

As there has been no previous mapping of the distribution of sediment flat habitats within the SSSI, this formed an additional objective of the current study. The SCM survey results were therefore supplemented by additional ground truthing to map the distribution of sediment flat biotopes.

Main findings

- There was no evidence for a decline in the extent of the mudflat feature within the SSSI.

- All biotopes recorded during the baseline survey (revised in the light of enhanced knowledge of the habitats of Loch Paible) were still present at the same locations in 2015. There was little temporal change in the distribution of biotopes. At one location, **LS.LSa.FiSa.Po** was recorded as extending farther up the shore in 2015, but this may have resulted from interpretational differences between the surveys due to the diffuse visible nature of the transition between biotopes.

- Little temporal change in species composition was recorded at four of the six monitoring stations along the relocatable transects. Marked temporal differences were recorded at the other two stations, but in both cases this was due to enhancement of the infaunal community with additional species, resulting in more than doubling of the taxon richness. This change is considered not to represent a decline in the condition of the biotope.

- No significant temporal changes were recorded in sediment composition or oxidation reduction profile.

- Temporal topographical change along the transects was minor, apart from at the bottom of one transect located in an area of naturally high hydrodynamic activity as exemplified by the presence of megaripples.

- No significant impacts on the condition of the feature from anthropogenic activities were observed.

- The conclusion from the 2015 SCM survey is that the mudflat feature of the Balranald Bog and Loch nam Feithean SSSI should be assigned to the condition category "Favourable Maintained".

- Biotope mapping of the sediment flats revealed the presence of five sedimentary biotopes in total, although three biotopes were strongly dominant. The inner region of the loch was floored by slightly muddy sand supporting dense *Hediste diversicolor* and a filamentous green algal mat, as well as *Corophium volutator*, *Pygospio elegans*, *Malacoceros fuliginosus*, *Peringia ulvae*, *Fabricia stellaris* and oligochaetes (**LS.LSa.MuSa.HedMacEte**). The upper shore area in the outer region of the loch consisted of flat, clean, fine sand generally supporting an impoverished version of the fauna found in the inner region (**LS.LSa.MuSa**). On the mid shore in the vicinity of the entrance channel to the loch, clean, rippled, fine to medium sand supported a fauna similar to that elsewhere in the loch but including species characteristic of well-drained sands, such as *Ophelia rathkei*, *Eurydice pulchra* and *Bathyporeia pilosa* (**LS.LSa.FiSa.Po**).

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Acknowledgements

We would like to thank Laura Steel (SNH) for her contribution to the planning and management of this survey.

1. INTRODUCTION

Loch Paible lies within the Balranald Bog and Loch nam Feithean SSSI on the west side of North Uist (Figure 1). The site includes nationally important examples of coastal systems and nutrient-rich lochs and marshland supporting a rich and diverse fauna and flora. The SSSI is also an RSPB reserve, being an important area for wintering, migrating and breeding birds, especially wildfowl. Several species of wading birds occur at levels of international importance (dunlin, ringed plover, turnstone) and of national importance (lapwing, oystercatcher, redshank, shoveler, snipe). Loch Paible also lies within the North Uist Machair SAC and the North Uist Machair and Islands Ramsar and SPA sites.

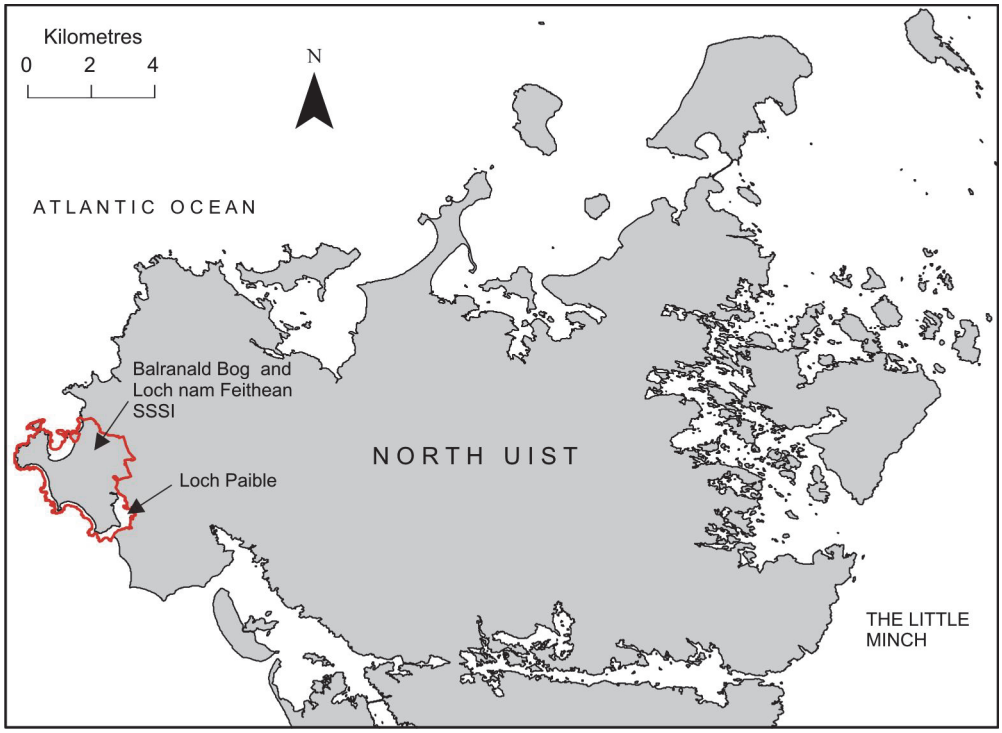

Figure 1. Location of Loch Paible within the Balranald Bog and Loch nam Feithean SSSI

Most of Loch Paible is floored by intertidal sediment flats, which form the focus of this report. The principal objective of the work was to carry out site condition monitoring (SCM) of the SSSI in order to assess the condition of the notified mudflats feature. In order to promote a uniform approach to the monitoring of the condition of features, guidance has been drawn up on the general approach to be taken in condition monitoring (JNCC, 1998) and for specific habitats, such as littoral sediment (JNCC, 2004). JNCC (2004) lists ten attributes of littoral sediment habitats and corresponding targets that could form the basis of site condition monitoring (Table 1). An appropriate subset of these targets have been incorporated into the monitoring plan for the SSSI and are detailed in the Site Attribute Table (Annex 2).

A further aim of the 2015 work was to produce a biotope map of the sediment flat habitats of the SSSI.

The only previous study of the sediment flats of Loch Paible was a baseline site condition monitoring survey in 2004 (Moore *et al*., 2005), involving the establishment of a series of six relocatable stations along two transects across the sediment flats. These were believed to reflect the biological and environmental diversity of the sedimentary habitats (Figure 2). Each transect was initially divided into a number of zones that appeared to represent the different shore levels, physicochemical conditions and/or perceived biological characteristics

(possibly constituting different biotopes), with a sample station identified within each zone. At each station one 3.4 cm diameter core sample was taken for particle size analysis and eight pooled 10.3 cm diameter cores for faunal analysis, which was supplemented by a 1 m^2 dig-over for the identification of larger infaunal species. The depth of the anaerobic layer was recorded and photos and videos taken, including five replicate photo quadrats of the sediment surface. The transect profile was measured using a surveyor's level to record height and distance of all stations and zone boundaries from the permanent transect marker, and to record the height in relation to sea level, and hence chart datum.

Table 1. Generic attributes that should be used to define the condition of littoral sediment features in SCM. The first four are mandatory. Targets exclude naturally-induced changes.

Attribute	Target
Extent	No change in extent of littoral sediment habitat
Biotope composition	Maintain the variety of biotopes identified for the site
Distribution of biotopes	Maintenance of the distribution of biotopes
Sediment character: sediment type	No change in composition of sediment types across the feature
Sediment character: redox layer	Black layer depth should not deviate in relation to the baseline
Sediment character: organic carbon content	Organic carbon content should not increase in relation to baseline
Extent of sub-feature	No change in extent of the littoral sediment biotope(s) identified for the site
Species composition of representative or notable biotopes	No decline in biotope quality as a result of change in species composition or removal of notable species
Species population measures: - population structure of a species - presence or abundance of specified species	Maintain age/size class structure of a (named) species. Maintain presence or abundance of positive indicator species. No increase in presence or abundance of negative indicator species.
Topography	No alteration in topography of the littoral sediment

Three sediment flat biotopes were recorded in 2004 (Moore *et al*., 2005). Along a transect at the head of the loch slightly muddy sand supported dense *Hediste diversicolor*, with *Pygospio elegans*, *Peringia ulvae*, *Corophium volutator* and oligochaetes (**LS.LMu.MEst.HedMac**). A transect in the outer region of the loch traversed a substrate of unrippled fine sand on the upper shore and rippled fine sand on the middle shore. The upper band harboured a species-poor community dominated by *H. diversicolor*, *Pygospio* elegans and oligochaetes (**LS.LSa.MuSa**). The lower band supported a richer community, with additionally *Arenicola marina*, *Cerastoderma edule* and *Eteone longa* (**LS.LSa.MuSa.HedMac.Ete**).

Anthropogenic influence on the sediment flats is thought to be slight, amounting to the collection of cast seaweed for fertiliser and possibly some minor fertiliser runoff from the surrounding land, although fertiliser usage is low (Moore *et al*., 2005). Some recreational usage of the sands takes place (mainly walkers and birdwatchers) but the remote setting suggests this will be at a low level. During the 2004 survey (Moore *et al*., 2005) it became apparent that the upper shore is used by vehicles, with several wheel tracks evident.

2. METHODS

2.1 Site condition monitoring

The methodology followed that employed in the 2003 baseline survey (Moore *et al*., 2005). Survey transects were worked at the same two locations (Figure 2), with a total of 6 stations, representing perceived different habitat zones, relocated along the transects using dGPS. Although the notified sediment flat feature for the Balranald Bog and Loch nam Feithean SSSI is 'mudflats', a mudflat biotope graded into a sandflat biotope along one of the transects and so both habitat types were considered to fall within the remit of the 2015 survey work (see Discussion section for further comment). Zone boundaries from 2004 were also relocated and marked, as were any perceived changes in these boundaries.

The vertical height of stations and zone boundaries was determined relative to the permanent transect marker at the head of the transect using a surveyor's level. As the transect markers had been levelled to the water's edge in 2004, all heights could be expressed in relation to chart datum. The surveyor's level was also employed to measure the horizontal distances of stations and boundaries from the transect marker.

At each station, eight cores of 10.3 cm diameter and 15 cm depth were taken for analysis of the infauna, along with a single core of 3.4 cm diameter and 20 cm depth for particle size analysis (PSA). The eight infaunal cores were pooled in a single bucket and sieved on site using a 1 mm mesh. These samples were preserved in 5% buffered formalin in seawater until analysis. The PSA samples were transferred from the core to labelled bottles and kept in these until analysis. At one station on each transect four replicate samples for infaunal analysis were taken, the stations being the same as those similarly selected for the baseline survey. Each sample consisted of eight pooled cores, as above.

At each station a record was made of any surficial biota by photographing five replicate, randomly placed 0.25 m^2 quadrats, and by noting incidental visual records. In addition, approximately 1 m^2 of sediment was dug-over, using a spade, to a depth of about 30 cm to check for the presence of any infauna which might not have been effectively sampled by the cores (e.g. larger bivalves and polychaetes), and estimates of their density made using the SACFOR semi-quantitative scale (Hiscock, 1996). Specimens from this dig-over were noted and some retained for confirmation of identity.

All position fixing employed the WGS84 datum.

The macrobenthos from the core samples was sorted, identified and counted by Fugro EMU Ltd. (Edinburgh). All other faunal samples were processed by Colin Moore.

The silt/clay fraction of the sediment samples was separated by puddling a sample of known weight, which had been soaked overnight in sodium hexametaphosphate (6.2 g/l in distilled water), through a 63 μm sieve. Sediment retained on this sieve was oven dried and then dry sieved using a sieve stack of -4 to 4 phi at 0.5 phi intervals. The sediment grain size parameters, median grain size and phi quartile deviation, were obtained by interpolation of the cumulative weight percentage curves.

Beach profiles, based on surveyor's level measurements of intertidal height and range were graphed using Microsoft Excel.

Based on the physico-chemical characteristics of the sediment and the characterisation of the fauna obtained from cores and *in situ* observations, each transect station, and the zone along the transect represented by that station, was assigned a biotope according to the 2004 habitat classification system (Connor *et al*., 2004). To aid this process and to facilitate

temporal comparisons with data from the baseline survey, species data for all stations were transformed to the SACFOR abundance scale and investigated using non-metric multidimensional scaling of the SACFOR abundances employing Bray-Curtis similarity and Primer software (Primer-E Ltd, Ivybridge).

2.2 Biotope mapping

To aid biotope mapping aerial imagery from May 2011 was employed within ArcGIS 10.2 for preparation of a wireframe map of the sediment flats, which involved their division into 18 polygons (Figure 2). This was based on regional variation in the appearance of the imagery, which was assumed to, at least in part, reflect variation in habitat type. Data from the 2004 SCM transects (Moore *et al*., 2005) was also used in the process.

The wireframe map with aerial imagery was available in the field on a series of laminated sheets. It was also uploaded to a large-screen, sunlight-readable, differential GPS receiver (Garmin Montana 600). The sediment flats were surveyed by one team of two recorders on 01 July 2015 and two teams of two recorders on 02 July 2015, largely within three hours either side of low water springs, by walking each of the polygons, employing target notes at fixed locations to record the characteristics of the habitat (Figure 2, Annex 3 - Tables 3.1, 3.2). The seaward boundary of the survey area was set in the entrance channel to the loch at the point where sediment flats were replaced by narrow, relatively exposed, sandy beaches. Where appropriate, descriptions of habitats between target point positions were also recorded, with the surveyors' track continuously recorded by a GPS data logger. Field data collected to aid subsequent biotope identification included physical habitat characteristics, biotic surface features and, at most sites, the infauna. This was examined by digging over an area of c. 1 m^2, with retention of specimens where necessary for laboratory identification, supplemented by sieving sediment from an area of c. 0.07 m^2 (based on spade width measurements) using a 1 mm mesh. Field observations were supplemented by still and video photography. The wireframe laminates were used for sketching the distribution of perceived habitats in the field and to aid investigation of conspicuous features on the aerial imagery. Biotope ascription to areas was deferred until the results of infaunal analysis were available and, in view of the limited information available at individual target sites, biotopes were assigned to areas, rather than individual sites. MDS ordination of biotic data at target sites was employed to aid this process. Preliminary sketches of the distribution of biotopes were produced within ArcGIS 10.2 using the drawing facility, with the finalised map converted into biotope polygons. To provide context, the adjacent saltmarsh habitat was incorporated into the final map based on the results of a June 2012 SNH survey. The biotope mapping GIS project employed the OSGB 1936 coordinate system and British National Grid projection.

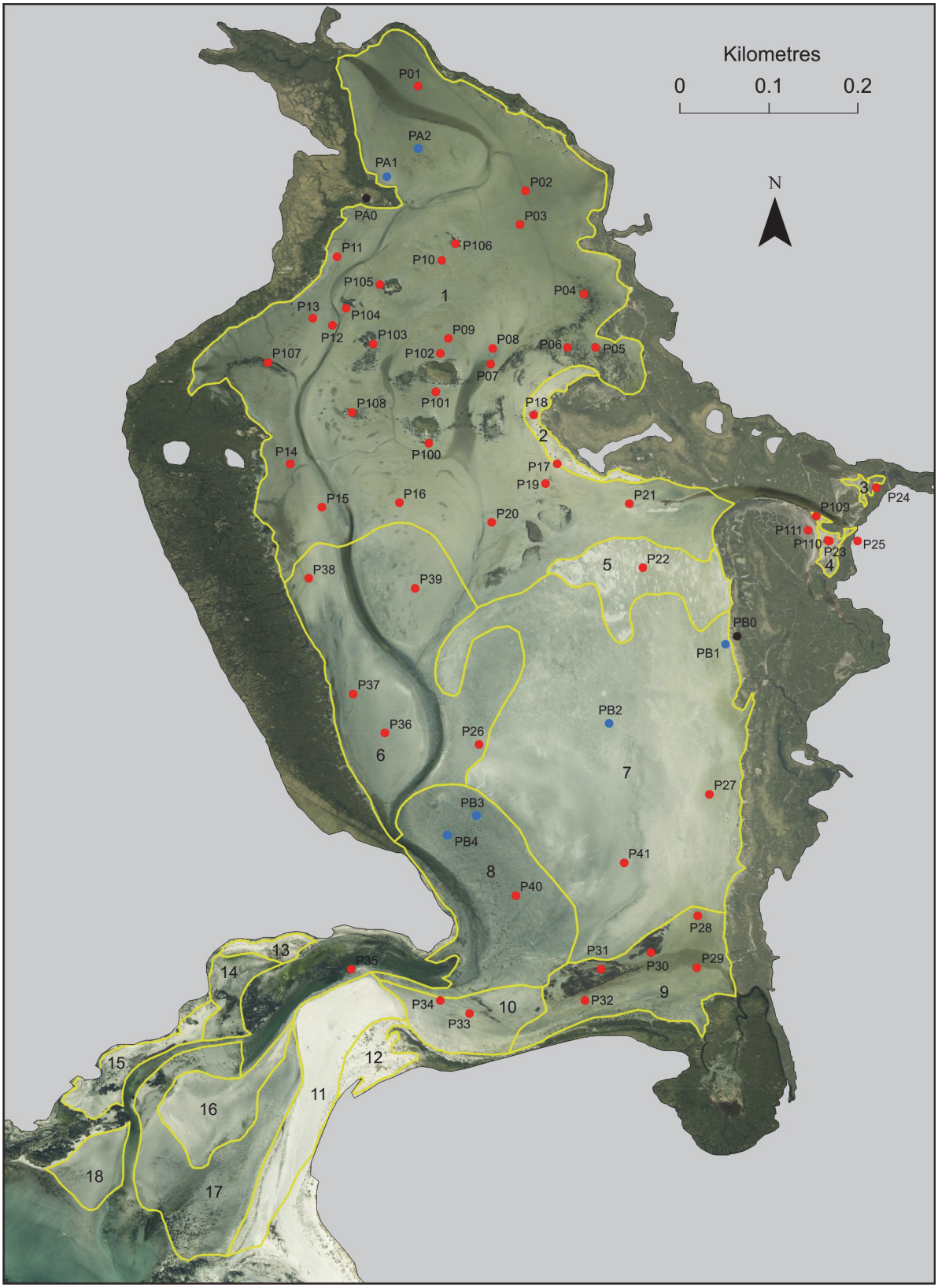

Figure 2. Wire frame map of Loch Paible overlying 2011 aerial imagery, showing numbered polygons in yellow, 2015 target note sites (red circles), 2015 SCM transect stations (blue circles) and transect marker locations (black circles). Land in grey.

3. RESULTS

3.1 Site condition monitoring

Profile, positional and sedimentary information recorded along the transects are given in Table 1.1 (Annex 1), while the transect profiles, together with those from the 2004 baseline survey, are graphed in Figures 4 - 5, which also show the transect zones with allocated biotopes. Some modifications to the 2004 biotope assignments have been made in the light of the availability of the considerable amount of additional data from the 2015 biotope mapping survey, providing far more detailed coverage of the habitats in the loch. The results from particle size analysis of the sediment at each transect station are given in detail in Table 1.2 (Annex 1), graphed in Figure 1.1 (Annex 1) and presented as summary descriptors in Table 1.3 (Annex 1).

Infaunal abundance from core sampling is shown in Table 1.4 (Annex 1) and SACFOR estimates of the abundance of biota from surface observations and the digging over of sediment in Table 1.5 (Annex 1). These data sets have been combined and expressed as SACFOR values in Table 1.6 (Annex 1).

MDS ordination of the SACFOR values from this latter table is presented in Figure 3, which also includes the data from the 2004 survey. This shows a general similarity in species composition between sites allocated to the same biotope (although final biotope ascription also took into account specific characterising species and environmental factors) and between the same transect stations in different years. Exceptions are present in the case of stations PA1B and PB2 which are discussed in sections 3.1.1 and 3.1.2.

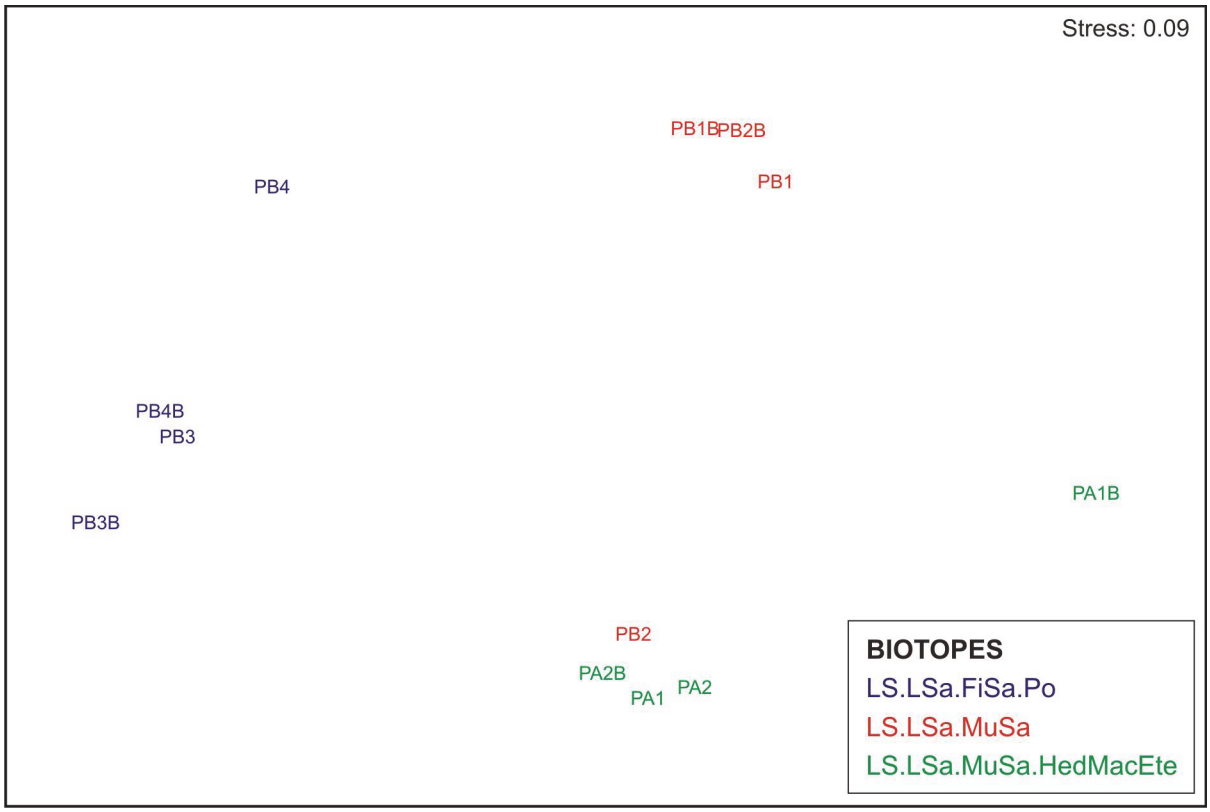

Figure 3. Non-metric multidimensional scaling ordination of macrofaunal abundance data (transformed to SACFOR scale) from Loch Paible SCM transect stations from the current survey and from the 2004 baseline survey. Station labels are colour coded to correspond with the assigned biotopes. Baseline survey station labels have the suffix 'B'.

Taxon richness values derived from core samples, surface observations and sediment digovers at survey stations are compared for both 2004 and 2015 in Table 2.

Table 2. Taxon richness recorded at the SCM transect stations in 2004 and 2015.

Station	Survey	
	2004	2015
PA1	7	15
PA2	18	20
PB1	4	5
PB2	5	13
PB3	9	9
PB4	8	7

3.1.1 Transect PA (Figure 4)

Saltmarsh at the top of the transect gave way to a sediment flat of waterlogged, slightly muddy fine sand (4 - 6% silt/clay content) supporting a dense filamentous green algal mat dominated by *Cladophora* sp., which continued unchanged to the Dig-mhór channel at the bottom of the transect. The distinction between an upper and lower zone in 2004 based on the presence of standing pools of water in the latter zone was not recognised in 2015. The fauna was very similar at both stations examined in 2015, PA1 and PA2 (Figure 3), with dense *Hediste diversicolor*, spionids (*Pygospio elegans* and *Malacoceros* sp.), *Corophium volutator*, *Peringia ulvae* and oligochaetes. *Cerastoderma edule* was recorded at both stations and *Macoma balthica* at PA2. The complement of dominant faunal taxa along the transect was basically similar in 2004 and 2015 (Figure 3), although far lower taxon richness was recorded at station PA1 in 2004 (see Table 2), leading to the separation of this station (coded PA1B) on the MDS plot (Figure 3). Although an algal mat was unrecorded along the transect in 2004, contemporaneous photographs show the presence of sparse patches of filamentous green algae, especially in the lower zone.

Statistical comparisons of the infaunal taxa within the replicated core samples at station PA2 revealed no temporal change in taxon richness but significant increases in the abundance of *Corophium volutator*, *Peringia ulvae*, *Fabricia stellaris* and nematodes (Mann-Whitney test, $p<0.05$), the latter two increases possibly due to the development of the dense algal mat.

In 2004 the habitat along transect PA was considered to represent a transition between **LS.LSa.MuSa.HedMacEte** and **LS.LMu.MEst.HedMac**, to which it was referred. However, it is now considered that in view of the very low mud content of the sediment along the transect and indeed throughout the inner region of the loch, the area is better referred to the former biotope, both in 2004 and 2015.

There was little temporal change in the profile of the sediment flat along the transect. A minor difference of 0.1 m at the bottom of the transect may have been due to differing levels of water within the channel. The saltmarsh/sediment flat boundary was recorded 0.4 m farther down the transect in 2015, which may indicate minor saltmarsh extension, although this may lie within the range of measurement error. Sediment composition changed very little between the survey years (Table 1.3, Annex 1). An anaerobic layer was not observed in either year (Table 1.1, Annex 1).

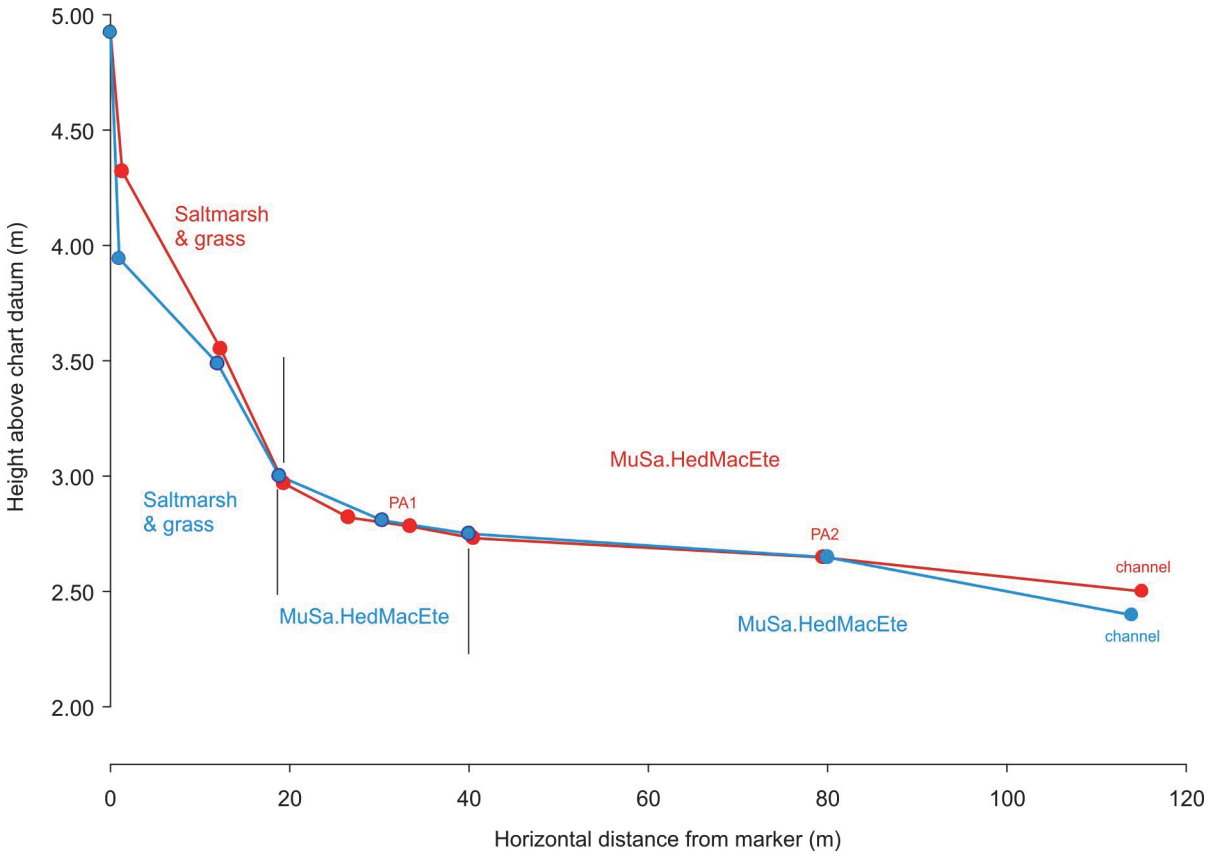

Figure 4. Comparison of profiles of transect PA in 2015 (red) and 2004 (blue), showing component zones, delineated by vertical lines, and corresponding biotopes.

3.1.2 Transect PB (Figure 5)

In contrast to PA this transect passed through an area of clean sand with a silt/clay content <1% (Table 1.3, Annex 1). Following a band of saltmarsh at the head of the transect, three sediment flat zones were recognised, although zonal boundaries were indistinct.

The upper two zones consisted of flat, waterlogged fine sand. Station PB1 in the uppermost zone exhibited an impoverished version of the faunal community found along transect PA, with dense *Hediste diversicolor* accompanied by *Pygospio elegans*, *Corophium volutator* and oligochaetes. With progression down the shore into the next zone, taxon richness increased from 5 at PB1 to 13 at PB2 (Table 2) and the fauna more closely resembled that found along transect PA (see Figure 3), with dense *Hediste diversicolor* and *Pygospio elegans*, accompanied by *Corophium volutator*, *Arenicola marina*, *Peringia ulvae*, oligochaetes, *Cerastoderma edule* and *Macoma balthica*. The only visual indication of a boundary between the two zones was the appearance of fairly dense (common) *Arenicola marina*. Both these upper zones have been assigned to the biotope **LS.LSa.MuSa**. Although they have affinities with **LS.LSa.MuSa.HedMacEte** found along transect PA (particularly station PB2), they differ in the clean nature of the sediment. The two upper zones were also assigned to **LS.LSa.MuSa** in 2004, although the distinction between them was on the basis of drainage, with the upper zone composed of damp sand and the lower zone containing large areas of standing water. Such a distinction was not apparent in 2015, the zonal boundary in 2015 being based on differences in the density of *Arenicola marina* casts. This species was not recorded in the upper zones in 2004. The infaunal community at station PB1 was very similar in both years but was more diverse at station PB2 in 2015 (Table 2) leading to the temporal distinction of the communities discernible on the MDS plot (Figure 3).

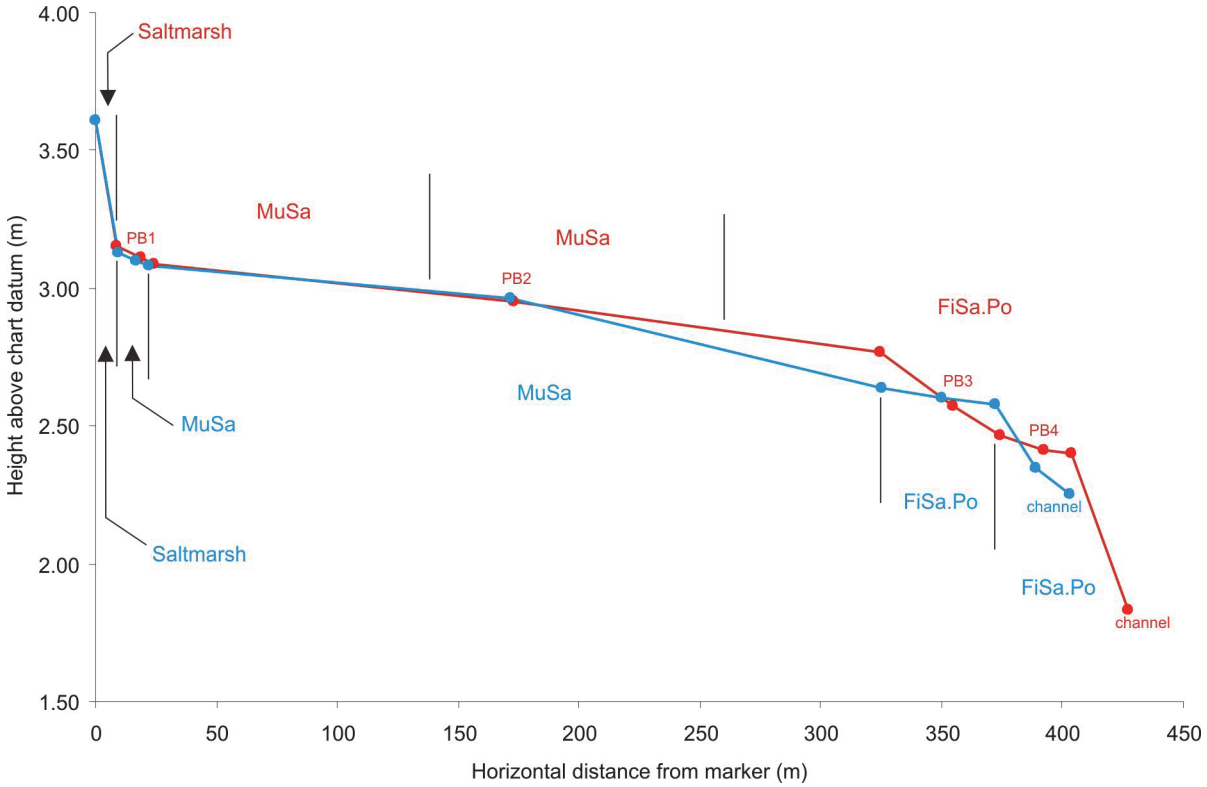

Figure 5. Comparison of profiles of transect PB in 2015 (red) and 2004 (blue), showing component zones, delineated by vertical lines, and corresponding biotopes.

The sand of the lowest zone of the transect was densely rippled and coarsened from fine sand at station PB3 to medium sand at PB4, with rippling superimposed upon megaripples with a wavelength of c. 4 m in the lower half of the zone. The sand was generally damp but with scattered pools of standing water, particularly in megaripple troughs. The fauna was dominated by *Capitella* spp. with *Arenicola marina* and sparse bivalves. *Hediste diversicolor* was present but at lower density than elsewhere in the loch. The presence of *Eurydice pulchra* and *Bathyporeia pilosa* within the zone, as well as *Ophelia rathkei* in similar habitat nearby, combined with the mobility of the sediment indicated by the wave forms, suggested the assignation of **LS.LSa.FiSa.Po**. In 2004 the lower region of the transect (comprising two zones) was assigned to **LS.LSa.MuSa.HedMacEte**. *Eurydice pulchra*, *B. pelagica* and *O. rathkei* were unrecorded but the fauna was otherwise similar to that found in 2015 and distinct from that of **LS.LSa.MuSa.HedMacEte** along transect PA (see Figure 3). There is insufficient evidence to indicate that a real temporal change in biotope has occurred and so the lower region of transect PB is referred to **LS.LSa.FiSa.Po** in both years. The division of this region into two zones in 2004 was based on the presence of large areas of standing water in the upper part, but this distinction could not be sustained in 2015. The recorded upper margin of the **LS.LSa.FiSa.Po** zone differed in the two surveys by 65 m, but this may be due to the diffuse nature of the transition, with an area of patchy rippled and flat sand being observed here in 2015.

Statistical comparisons of the infaunal taxa within the replicated cores at station PB3 revealed no temporal change in taxon richness but a significant increase in the abundance of *Capitella* spp. from a mean of 37 m^{-2} in 2004 to 401 m^{-2} in 2015 (Mann-Whitney test, $p<0.05$). This is perhaps related to the presence of a layer of decaying macroalgae in the sand at a depth of around 20 cm.

Virtually no temporal topographical change was recorded in the upper two zones of the transect. Over most of the lowest zone change was slight (<15 cm); however, the Dig-mhór

channel at the bottom of the transect was recorded as being 0.57 m lower in 2015. This may at least in part reflect differences in the volume of water in the channel during the two surveys, although aerial imagery available between 2004 and 2011 indicates a significant degree of redistribution of sediment in this area exemplified by marked temporal variation in the route of the channel. This was 24 m farther southwest in 2015 than in 2004. The saltmarsh/sediment boundary was recorded 0.3 m farther up the transect in 2015, which may signify minor saltmarsh edge erosion or could lie within the range of measurement error.

Sediment composition was similar in both years along the transect, except for the lowest station PB4, where it changed from fine sand (MD_{μ} = 218 µm) to medium sand (MD_{μ} = 287 µm). An anaerobic layer was not observed in either year (Table 1.1, Annex 1), although dark patches were noted at stations PB2, PB3 and PB4 in 2015.

3.2 Biotope mapping

Habitat descriptions recorded at target note sites are provided in Tables 3.1 and 3.2 (Annex 3). Figure 6 shows an MDS ordination plot of the SACFOR values of the biota recorded at the target note and SCM sites from the current survey. This was employed, in combination with physical data and consideration of characterising species, to aid in the identification and discrimination of biotopes. The resulting biotope map is given in Figure 7.

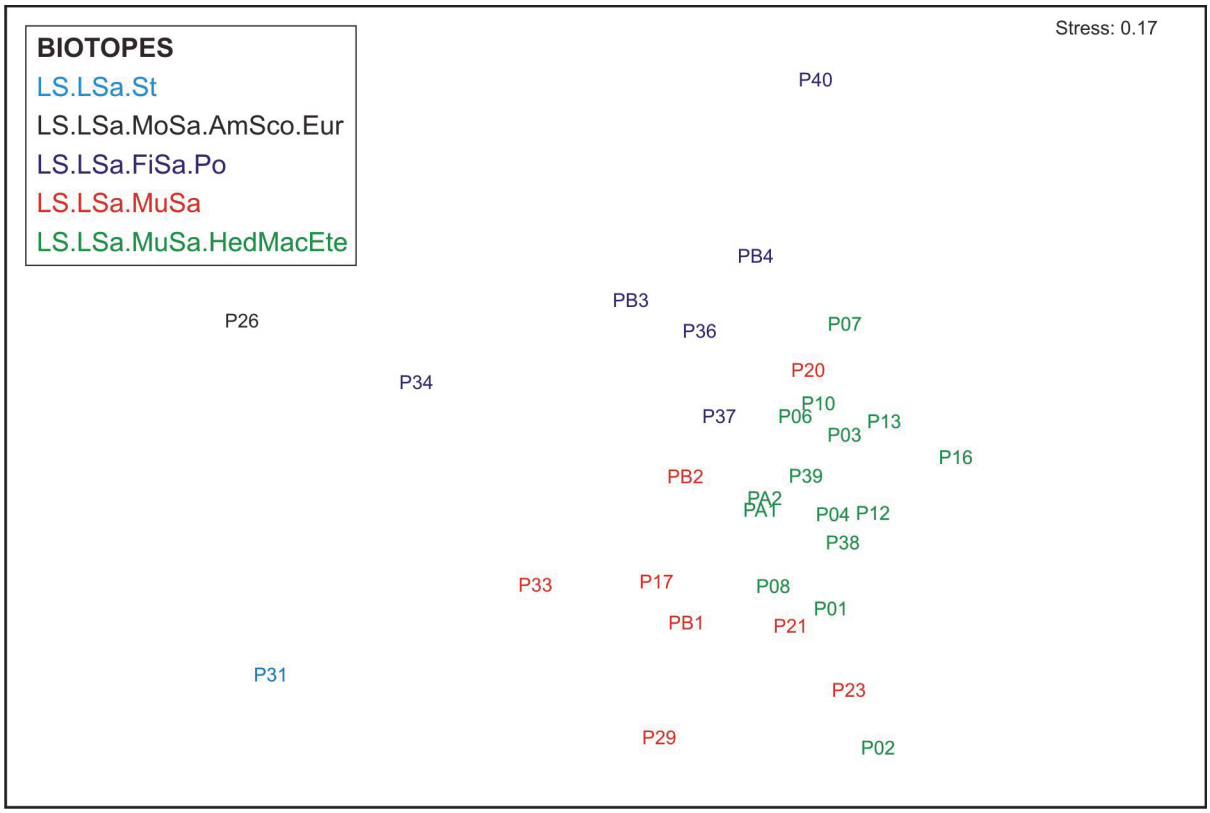

Figure 6. Non-metric multidimensional scaling ordination of biotic data (transformed to SACFOR scale) from Loch Paible target note and SCM transect stations from the current survey. Station labels are colour coded to correspond with the assigned biotopes of the regions in which they are located.

Loch Paible opens into the Atlantic Ocean via a narrow entrance channel. The main body of the loch is composed of a broad outer region and a narrower inner region, the boundary marked by a saltmarsh promontory on the eastern side of the loch northwest of Cuithe

Lianaclett. The sediment flats are almost entirely above mid-tide level and are traversed by the channel of the stream, Dig-mhór. In addition there are a number of drainage channels, which largely dry at low tide, except for some localised areas of pooling, especially at Cuithe Lianaclett and west of the eastern promontory.

Sediments of the inner region were found to be composed principally of fine sand, accompanied by a small admixture of silt and clay. Based on the few measurements available from the current survey, the mud content in the uppermost part of the loch was around 4 - 6%. The sediment here in this upper shore habitat was predominantly waterlogged, unrippled, slightly muddy sand with no distinct black layer present within the top 30 cm. Localised patches of slightly elevated, damp sediment were also present. The sediment supported a dense filamentous green algal mat dominated by *Cladophora* sp., accompanied locally by macroalgal debris, which is probably responsible for areas of dark marbling visible on the aerial imagery (e.g. in the vicinity of sites P04 and P107 - Figure 2).

The fauna was dominated by abundant *Hediste diversicolor*, as well as *Corophium volutator*, *Pygospio elegans*, *Malacoceros fuliginosus*, *Peringia ulvae*, *Fabricia stellaris* and oligochaetes. *Eteone* spp., *Macoma balthica* and *Cerastoderma edule* were recorded at several of the sites, as was *Arenicola marina* which formed dense populations locally, particularly in the wetter, slightly depressed areas. The area has been assigned to the biotope **LS.LSa.MuSa.HedMacEte**.

The muddy sand region described above merged into an area of clean fine sand, which occupied most of the upper shore, outer region of the loch on the eastern side. The sand was flat, generally waterlogged, and throughout most of the area exhibited no distinct black layer within the surface 30 cm. Filamentous green algae were very sparse in this area, but dense patches of macroalgal debris including kelp occurred in the south-eastern corner of the region near the entrance channel (in the vicinity of sites P30, P31 - dark patches in Figure 2). Here, a grey layer was visible close to the sand surface (c. 0.1 cm depth) and there was a smell of hydrogen sulphide. Dense macroalgal debris was also observed along the banks of the drainage channel at Cuithe Lianaclett. The fauna of much of the upper shore area in the outer region of the loch appeared to constitute an impoverished version of that found in the inner region. High densities of *Hediste diversicolor*, *Pygospio elegans* and oligochaetes were widely recorded, but the other taxa listed above for the inner region were either infrequently observed or present at lower density. In particular, *Arenicola marina*, *Malacoceros fuliginosus*, *Eteone* spp., *Peringia ulvae* and bivalves were generally absent. The characteristics of the habitat are not a close fit to any of the sand or muddy sand littoral biotopes and are considered to be best referred to the biotope complex **LS.LSa.MuSa**. Organically enriched sediment in the vicinity of the macroalgal debris patches noted above was virtually azoic, with only sparse oligochaetes observed at the southern location and no fauna recorded at the Cuithe Lianaclett site. These areas have been referred to the strandline biotope **LS.LSa.St**.

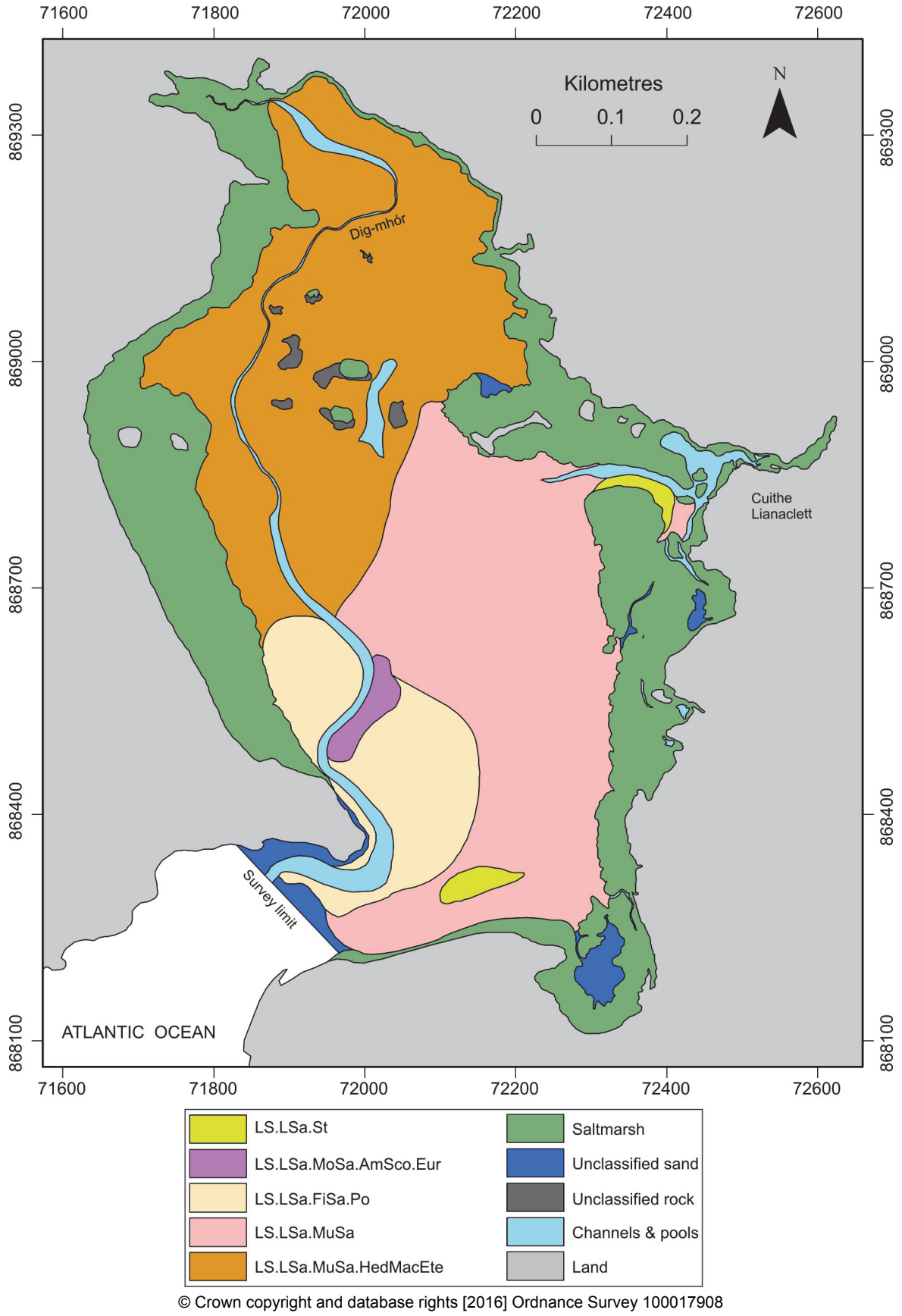

Figure 7. Distribution of sediment flat biotopes and adjacent habitat types within Loch Paible (Balranald Bog and Loch nam Feithean SSSI).

Tidal currents are accelerated in the vicinity of the narrow entrance channel to the loch and this will be responsible for the marked changes in the nature of the sediment in the mid shore, south-western area of the outer region. The clean, fine to medium sand was found to be densely rippled over much of this area, with these ripples superimposed upon megaripples. The sand exhibited no distinct black layer and was mostly damp but with pools of standing water in places, especially in the troughs of megaripples. The sand supported a similar suite of species to that found elsewhere in the loch but with some additions, omissions and density differences. The fauna was dominated by *Pygospio elegans* and *Capitella capitata*, with *Hediste diversicolor* present but at lower density than elsewhere. Adult bivalves were infrequently recorded and *Corophium volutator* and *Peringia ulvae* were absent. Several species characteristic of well-drained sand were present including *Ophelia rathkei*, *Eurydice pulchra* and *Bathyporeia pilosa*. The faunal complement lies somewhere between the biotopes **LS.LSa.MuSa** and **LS.LSa.FiSa.Po**, but the physical habitat is much closer to the latter, to which most of the area has been referred. The fauna of one large patch of dry sand was apparently restricted to frequent *E. pulchra* and *B. pelagica*, indicative of the biotope **LS.LSa.MoSa.AmSco.Eur**.

3.3 Anthropogenic impacts

During the site condition monitoring and biotope mapping surveys minimal evidence of anthropogenic activities impacting on the sediment flats was identified. This included the disposal of fencing wire over an area of around 10 m^2 at one location (site P103, Figure 2) amongst scattered boulders on sand in the inner region of the loch (Figure 8). A cluster of five fishing creels (Figure 8) was present in the south of the outer region at site P30 (Figure 2). This was in the vicinity of an area of accumulating kelp and other macroalgal debris and so had probably been imported into the loch in the same way.

Figure 8. Anthropogenic items observed during the 2015 survey work: fencing wire (upper photo), creels (lower photo).

4. DISCUSSION

The notified sediment flat feature for the Balranald Bog and Loch nam Feithean SSSI is termed 'mudflats'. The extent of this feature can be seen in Figure 7, where it includes the muddy sand (**LS.LSa.MuSa** and **LS.LSa.MuSa.HedMacEte**) biotopes. However, there is a gradation between muddy sand and clean sand biotopes and it is suggested that consideration be given to also notifying the ecologically linked 'sandflats' present in this site. Both mudflat and sandflat habitats were incorporated into the 2004 baseline SCM survey (Moore *et al*., 2005) and this broader approach has been retained in the 2015 SCM work.

Existing guidance proposes that monitoring of the condition of littoral sediment features should consider ten attributes of which four require compulsory assessment (JNCC, 2004). Seven attributes have been selected for monitoring within the Balranald Bog and Loch nam Feithean SSSI by SNH and these are listed in the Site Attribute Table (SAT) provided in Annex 2 of this report.

Following monitoring of the feature, its condition is assessed by assignment to one of seven categories (SNH, 2010):

- Favourable Maintained - the attribute targets set for the natural features have been met, and the natural feature is likely to be secure on the site under present conditions.
- Favourable Recovered - the condition of the natural feature has recovered from a previous unfavourable condition, and attribute targets are now being met.
- Unfavourable Recovering - one or more of the attribute targets have not been met on the site, but management measures are in place to improve the condition.
- Unfavourable No Change - one or more of the attribute targets have not been met, and recovery is unlikely under the present management or other activity on the site.
- Unfavourable Declining - one or more of the attribute targets have not been met, evidence suggests that condition will worsen unless remedial action is taken.
- Partially Destroyed - something has happened on the site which has removed part of the natural features, there is no prospect of restoring the destroyed area.
- Totally Destroyed - the natural feature is no longer present, there is no prospect of restoring it.

This section derives an assessment of condition following consideration of the degree to which the targets set for each of the measured attributes have been met. For each attribute, the targets, methods for assessment of adherence to the target, and the results of assessment are summarised in Annex 3.

4.1 Extent

Extensive coverage of the loch during the biotope mapping work revealed the absence of any land reclamation or shoreline developments. No anthropogenic activities were identified that are likely to have caused a change in the extent of the mudflat feature in the loch. The transect profiles also indicate that there has been no significant reduction in extent of the habitat at the two locations examined, although minor localised variations in the position of the saltmarsh/sediment flat boundaries were recorded (+/- 0.4 m). Saltmarsh is also a notified feature of the SSSI.

4.2 Sediment character: sediment type

The Site Attribute Table sets a target limit for temporal change in sediment composition of +/- 10% for sand and silt/clay. The maximum change recorded in 2015 was 3% for both sediment fractions.

4.3 Sediment character: oxidation reduction profile

The Site Attribute Table sets a target limit for the depth of the black layer at >20 cm. Although darkened patches of sediment were visible at some sites in 2015, no black layer was observed within 30 cm of the sediment surface at any of the SCM transect sites.

4.4 Biotope composition

All biotopes found in 2004 (employing the updated biotope allocations described in sections 3.1.1 and 3.1.2) were present along the relocatable transects in 2015.

4.5 Distribution and spatial pattern of biotopes

All biotopes found in 2004 were present in the same sequence along both of the SCM transects in 2015. Biotope boundaries along the transects appeared very similar in both years, apart from **LS.LSa.FiSa.Po**, which was recorded as extending 65 m farther up transect PB in 2015. However, it was considered that this apparent difference may be due to interpretational differences in the two surveys due to the diffuse nature of the transition.

4.6 Species composition of representative biotopes

The SAT prescription is that there should be no decline in biotope quality due to changes in species composition or loss of notable species. There was little change in species composition at four of the six monitoring stations. Marked temporal differences were recorded at the other two stations, but in both cases this was due to enhancement of the infaunal community with additional species, resulting in more than doubling of the taxon richness. This change is considered not to represent a decline in the condition of the biotope.

4.7 Topography

Little temporal change in topography was recorded along both SCM transects, apart from at the bottom of transect PB. This is in an area of naturally high hydrodynamic activity as exemplified by the presence of megaripples, which leads, *inter alia*, to significant temporal variation in the course of the channel at the bottom of the transect.

4.8 Overall condition assessment

As a result of the 2015 site condition monitoring of the Balranald Bog and Loch nam Feithean SSSI it is concluded that the site should be assigned to the condition category "Favourable Maintained".

4.9 Recommendations

The most recent aerial imagery available was from 2011. Some of the features visible on the imagery were not present in 2015, temporal variation in the routing of channels was evident and some of the textural detail on the imagery could not be related to corresponding patterns observed in the field. Contemporary imagery would probably have improved the usefulness and accuracy of the wireframe mapping and the accuracy of the final biotope mapping. It would also permit some assessment of temporal change in the extent of the sediment flats.

All the major biotopes present on the sediment flats (as revealed by the biotope mapping survey) were represented along the SCM transects and these transects also provided reasonable geographical coverage of the sediment flats. It is therefore recommended that future monitoring should retain the current selection of transects.

Little temporal change in topography was recorded along the SCM transects and this might be expected in the case of relatively sheltered sediment flats. Temporal change which does occur will be generally due to natural variability in wave and current action. The importance of monitoring transect profiles lies chiefly in its potential for aiding understanding of any identified temporal change in other measures of the condition of the habitat, such as modification of species or biotope attributes. Consideration could be given to the omission of profiling from future routine monitoring of the Loch Paible sediment flats, but with adoption where the likelihood of significant temporal change is high, based on known anthropogenic activities or distinct changes in visual appearance. With continued improvements in the affordability and simplicity of sub-decimetre, GPS-derived height measurement, the cost/benefit ratio of incorporating transect profiling in the monitoring programme is likely to greatly decrease.

5. REFERENCES

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ANNEX 1: SITE CONDITION MONITORING DATA

Table 1.1. Transect profile, positional and habitat data. Distance given is horizontal distance with tape distance in brackets.

Feature	Distance from marker (m)	Height above CD (m)	Position	Substrate	Moisture	Depth black layer (cm)	Biogenic features	Biotope	General notes including comments on change
TRANSECT PA (01 July 2015)									
Peg	0.00	4.92	57.59297 -7.49362	Bedrock outcrop			Lichens		
Rock base	1.26 (1.40)	4.32	57.59299 -7.49361	Bedrock outcrop/grass			Lichens / grass		Taller grass zone possibly also saltmarsh. Vegetation around base of rock appears to have accreted more since 2004
Grass / saltmarsh boundary	12.24 (12.40)	3.55	57.59306 -7.49348	Grass / saltmarsh			Grass / saltmarsh		Taller grass zone possibly also saltmarsh
Saltmarsh / sediment boundary	19.31 (19.50)	2.97	57.59311 -7.49342	Saltmarsh / sediment			Saltmarsh / sediment (with accumulated decomposing kelp & pink bacterial mats near boundary)		
Upper boundary green algal mat	26.51 (26.7)	2.82	57.59315 -7.49334	Fine sand. Very slightly muddy			Upper boundary of area covered by green filamentous algal mat		Not noted in 2004, presumably because green algal mat not recorded in 2004

Table 1.1 continued

Feature	Distance from marker (m)	Height above CD (m)	Position	Substrate	Moisture	Depth black layer (cm)	Biogenic features	Biotope	General notes including comments on change
Station PA1	33.5	2.79	57.59320 -7.49328	Unrippled, flat slightly muddy, fine sand	Waterlogged. Standing water on surface	>30	Filamentous green algal mat with dense *Hediste diversicolor*, spionids, *Corophium volutator*, *Peringia ulvae* and oligochaetes	LS.LSa.MuSa.HedMacEte	Algal mat not recorded, and lower infaunal taxon richness in 2004
Zone 1 / 2 boundary 2004	40.5	2.73	57.59324 -7.49318	Unrippled, flat slightly muddy, fine sand			Not assessed		No clear boundary noted in 2015, but 2004 boundary only based on higher water table in zone 2
Station PA2	79.5	2.65	57.59351 -7.49274	Unrippled, flat slightly muddy, fine sand	Waterlogged. Standing water on surface	>30	Filamentous green algal mat with dense *Hediste diversicolor*, spionids, *Corophium volutator*, *Peringia ulvae* and oligochaetes. *Macoma balthica* present	LS.LSa.MuSa.HedMacEte	Algal mat not recorded in 2004, otherwise biota similar
Zone 2 / channel boundary	115.0	2.50	57.59375 -7.49238	Unrippled, flat slightly muddy, fine sand			Not assessed		
TRANSECT PB (02 July 2015)									
Peg	0.0	3.61	57.58886 -7.48601	Saltmarsh			Saltmarsh		
Saltmarsh / sediment boundary	9.0 (9.0)	3.15	57.58880 -7.48613	Saltmarsh / flat fine sand			Narrow band of decomposing kelp with patches of pink bacterial mats		

Table 1.1 continued

Feature	Distance from marker (m)	Height above CD (m)	Position	Substrate	Moisture	Depth black layer (cm)	Biogenic features	Biotope	General notes including comments on change
Station PB1	19.0 (19.0)	3.11	57.58877 -7.48623	Flat fine sand	Waterlogged	>30	Dense *Hediste diversicolor* with *Pygospio elegans*, *Corophium volutator* and oligochaetes	LS.LSa.MuSa	Fauna similar to 2004
Zone 1 / 2 boundary 2004	24.0 (24.0)	3.09	57.58872 -7.48630	Flat fine sand			Not assessed - appears identical to PB1		No obvious boundary in 2015, but 2004 boundary only based on higher water table in zone 2
Zone 1 / 2 boundary 2015	138.0		57.58808 -7.48781	Flat fine sand			Increasing abundance of *Arenicola* downshore reaches level noted for PB2 (C)		No height for this point as transition only recognised on day after profiling
Station PB2	173.0	2.95	57.58788 -7.48828	Flat fine sand	Waterlogged	>30 but dark patches	Dense *Hediste diversicolor* and *Pygospio elegans* with *Corophium volutator*, *Arenicola marina*, *Peringia ulvae*, oligochaetes, *Cerastoderma edule* and *Macoma balthica*	LS.LSa.MuSa	Infaunal community less diverse in 2004 and apparently lacking *Arenicola*
Zone 2 *Arenicola* decreasing			57.58755 -7.48889	Flat fine sand			Gradual decrease of *Arenicola* abundance downshore from PB2, dropping to F by this position		No height for this point as transition only recognised on day after profiling

Table 1.1 continued

Feature	Distance from marker (m)	Height above CD (m)	Position	Substrate	Moisture	Depth black layer (cm)	Biogenic features	Biotope	General notes including comments on change
Zone 2 / 3 boundary 2015	260.0		57.58737 -7.48934	Flat sand/rippled sand (patchy)			*Arenicola* (O, locally F)		Transition from relatively flat sand of upper shore to the pronounced rippling of the middle shore. No height for this point as transition only recognised on day after profiling
Zone 2 / 3 boundary 2004	324.5	2.77	57.58701 -7.49024				Not assessed - appears similar to PB3		No clear boundary noted here in 2015 although the patchy rippling higher on shore becomes continuous by this point
Station PB3	354.5	2.57	57.58684 -7.49063	Pronounced ripples of fine sand (wavelength ~10 cm). Upper boundary of area with sand waves	Damp. Pools of standing water in troughs of sand waves	>30 but dark patches & smell of anoxia.	Dense *Capitella* spp. with *Arenicola marina* and sparse bivalves. Layer of decaying macroalgae at c. 20 cm depth	LS.LSa.FiSa.Po	Significant increase in *Capitella* density in 2015
Zone 3 / 4 boundary 2004	374.5	2.47	57.58673 -7.49090				Not assessed - appears similar to PB3		No distinct boundary, but 2004 boundary only based on higher water table in zone 3

Table 1.1 continued

Feature	Distance from marker (m)	Height above CD (m)	Position	Substrate	Moisture	Depth black layer (cm)	Biogenic features	Biotope	General notes including comments on change
Station PB4	392.5	2.41	57.58662 -7.49114	Pronounced ripples of medium sand (wavelength ~10 cm) superimposed on sand waves (wavelength ~4 m) which are orientated perpendicular to drainage channel	Damp. Pools of standing water in troughs of sand waves	>30 but dark patches & smell of anoxia.	Dense *Capitella* spp. with sparse *Arenicola marina* and bivalves. Layer of decaying macroalgae at c. 20 cm depth	LS.LSa.FiSa.Po	Apparent reduction in *Arenicola* & *Cerastoderma* density in 2015
Zone 4 / channel boundary 2004	403.5	2.40	57.58659 -7.49129	Rippled sand with sand waves			Not assessed		Channel shifted towards western shore since 2004
Zone 4 / channel boundary 2015	427.5	1.83	57.58644 -7.49160	Rippled sand with sand waves			Not assessed		Channel shifted towards western shore since 2004

Table 1.2. Particle size analysis of sediments at stations along two intertidal transects (PA, PB) in 2015, showing percentage of total sediment sample collected by sieves at 0.5 phi interval mesh sizes.

Sieve (phi)	Station					
	PA1	**PA2**	**PB1**	**PB2**	**PB3**	**PB4**
-3.5	0.00	0.00	0.00	0.00	0.00	0.00
-3.0	0.00	0.00	0.00	0.00	0.00	0.00
-2.5	0.00	0.00	0.00	0.00	0.00	0.00
-2.0	0.00	0.00	0.00	0.00	0.00	0.00
-1.5	0.00	0.00	0.00	0.02	0.00	0.00
-1.0	0.00	0.00	0.00	0.05	0.00	0.13
-0.5	0.15	0.10	0.02	0.03	0.20	0.23
0.0	0.05	0.09	0.03	0.11	0.07	0.20
0.5	0.14	0.16	0.20	0.20	0.29	0.63
1.0	0.37	0.38	1.43	0.75	0.96	3.55
1.5	1.48	1.54	9.91	5.04	8.05	19.77
2.0	7.81	6.43	31.00	16.76	35.93	37.30
2.5	24.34	21.75	45.81	35.19	38.20	26.51
3.0	46.74	44.51	10.16	34.45	14.67	10.54
3.5	10.43	14.33	1.31	5.87	1.40	0.99
4.0	4.17	4.86	0.09	0.98	0.11	0.08
>4.0	4.31	5.85	0.04	0.54	0.12	0.08

Table 1.3. Particle size characteristics of sediments at stations along two intertidal transects (PA, PB) in 2015. MDØ = median grain diameter in phi units, MDμ = median grain diameter in microns, QDØ = phi quartile deviation. Also shown are temporal changes in the percentage values of silt/clay, sand and gravel between the 2004 baseline survey and 2015.

Station	2015						Temporal change (%)		
	$MD_{ø}$	**$MD_{μ}$**	**$QD_{ø}$**	**% silt/clay**	**% sand**	**% gravel**	**silt/clay**	**sand**	**gravel**
PA1	2.70	154	0.25	4.31	95.69	0.00	-3.17	3.21	-0.03
PA2	2.70	154	0.30	5.85	94.15	0.00	-0.56	0.56	0.00
PB1	2.10	233	0.25	0.04	99.96	0.00	-1.75	1.75	0.00
PB2	2.40	189	0.35	0.54	99.46	0.00	-1.20	1.20	0.00
PB3	2.10	233	0.35	0.12	99.88	0.00	-1.13	1.27	-0.14
PB4	1.80	287	0.35	0.08	99.92	0.00	-1.09	1.85	-0.76

Table 1.4. Abundance of infauna at stations along two intertidal transects (PA, PB). Abundance given is the number in samples of 8 pooled cores of total area 0.0667 m^2. Four replicate samples were taken at one station along each transect, and single samples elsewhere.

Taxon	Sample											
	PA					PB						
	1.1	2.1	2.2	2.3	2.4	1.1	2.1	3.1	3.2	3.3	3.4	4.1
NEMERTEA spp.								2		3	3	
NEMATODA spp.	140	69	6	182	123		38					
Eteone longa agg.										1		
Nereididae sp. juv.	2	8	2									
Hediste diversicolor	100	50	75	191	145	55	29	2	1	3	7	2
Malacoceros sp.	58	27	19	1	37							3
Pygospio elegans	499	150	144	69	273	606	837	2	1	6	4	1
Capitella spp.	1							8	36	8	55	15
Fabricia stellaris	700	508	456	1404	978		817					
Manayunkia aestuarina			1	8								
Paranais litoralis				2								
Baltidrilus costatus	226	92	46	236	128	14	13					
Tubificoides pseudogaster agg.	15	8	1	12	16							
Enchytraeidae spp.	20	12		38	14	9	29	8		21		
Bathyporeia pilosa							25					1
Corophium volutator	56	131	100	115	192	1	3					
Eurydice pulchra								1				
Portunidae sp. juv.		1										
Peringia ulvae	228	305	314	147	284		1					
Cerastoderma edule		2	4				2	1	1			
Macoma balthica		2	1		1		1					
Chironomidae spp.							1					

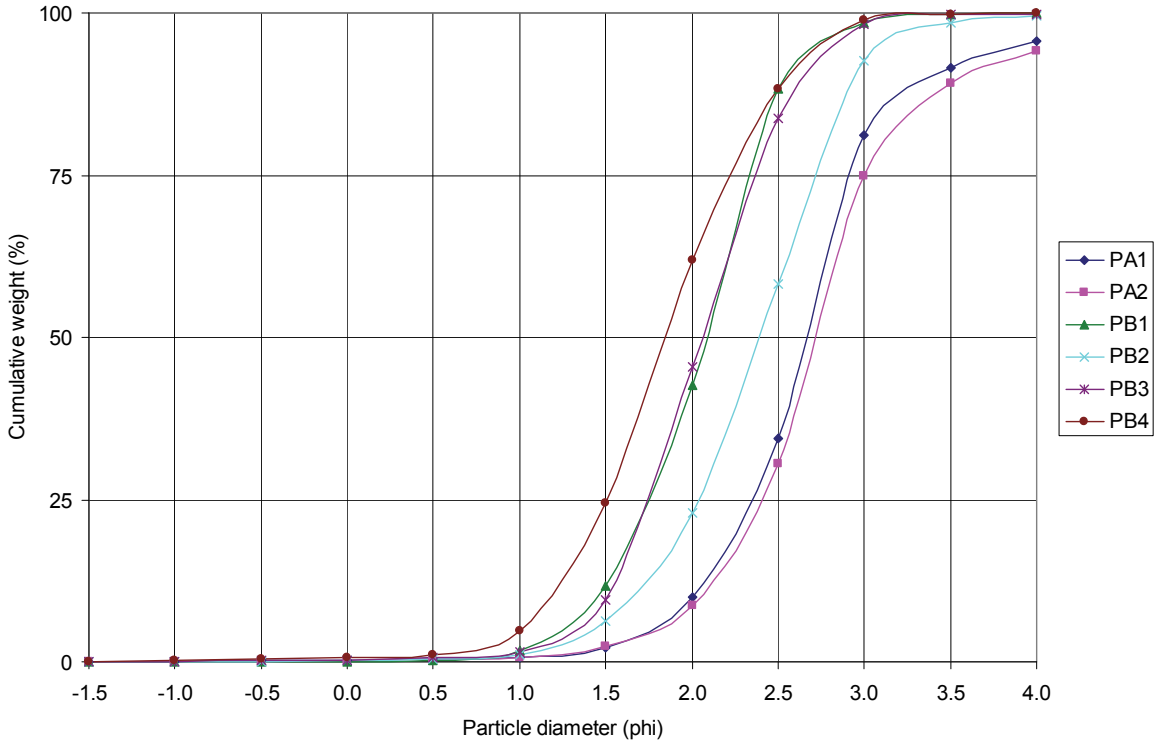
Table 1.5. Abundance of biota at stations along 2 transects (PA, PB). SACFOR abundances are given derived from visual observation of biota when digging over a total area of sediment of c. 1 m^2 or by estimating the abundance of Arenicola casts.

Taxon	**Station**					
	PA1	**PA2**	**PB1**	**PB2**	**PB3**	**PB4**
Hediste diversicolor	A	A	C	F		F
Capitella capitata					F	F
Arenicola marina		P		C	C	O
Fabricia stellaris		P		P		
Bathyporeia pilosa				P		
Corophium volutator	O	O				
Peringia ulvae	C	C				
Littorina saxatilis		P				
Cerastoderma edule	F				F	
Macoma balthica						F
Cladophora sp.	S	S				
Cyanophyta sp.	R	R				

Table 1.6. Abundance of biota at stations along 2 transects (PA, PB). SACFOR abundances are given derived from all sampling methods employed, including core sampling, visual observation of biota when digging over a total area of sediment of c. 1 m^2 and by estimation of the abundance of Arenicola casts.

Taxon	Station					
	PA1	**PA2**	**PB1**	**PB2**	**PB3**	**PB4**
NEMERTEA spp.					C	
NEMATODA spp.	A	A		C		
Eteone longa agg.					F	
Nereididae sp. juv.	C	C				
Hediste diversicolor	S	S	A	A	C	C
Malacoceros sp.	A	A				C
Arenicola marina		P		C	C	O
Pygospio elegans	A	A	C	S	F	F
Capitella spp.	C				A	A
Fabricia stellaris	A	A		S		
Manayunkia aestuarina		F				
Paranais litoralis		O				
Baltidrilus costatus	A	A	F	C		
Tubificoides pseudogaster agg.	C	C				
Enchytraeidae spp.	C	C	C	C	C	
Bathyporeia pilosa				C		F
Corophium volutator	C	A	F	F		
Eurydice pulchra					O	
Portunidae sp. Juv.		F				
Peringia ulvae	A	A		F		
Littorina saxatilis		P				
Cerastoderma edule	F	C		C	F	
Macoma balthica		C		C		F
Chironomidae spp.				F		
Cladophora sp.	S	S				
Cyanophyta sp.	R	R				

Figure 1.1. Cumulative weight of sediment retained on sieves at 0.5 phi intervals for stations along transects PA and PB.



ANNEX 2: SITE ATTRIBUTE TABLE FOR THE MUDFLAT FEATURE OF BALRANALD BOG AND LOCH NAM FEITHEAN SSSI, WITH THE RESULTS OF THE 2015 SITE CONDITION MONITORING SURVEY. * DENOTES NON MANDATORY ATTRIBUTE

Attribute	Target	Prescription	Result
Extent	No decrease in extent of littoral sediment.	At 6 year intervals review activities and events with the potential to reduce extent of feature such as land reclamation and shoreline redevelopment. Evaluate fixed-position shore transect profiles at 6 year intervals for local changes in extent. At 18 year intervals confirm that there has been no change in overall littoral extent (e.g. by siltation or erosion) with aerial photography.	No activities identified likely to have caused change in the extent of the mudflat feature. Transect profiles also indicate no significant reduction in extent of the habitat at the two locations examined.
Biotope composition of littoral sediment	Maintain the variety of biotopes identified for the site, allowing for natural succession/ known cyclical change.	Visual survey, dig-over of 1 m^2 area and core sampling at fixed stations along relocatable transect lines carried out every 6 years. The following biotopes (or equivalents) will be found within the SSSI: **LS.LSa.MuSa.HedMacEte**, **LS.LSa.MuSa**, **LS.LSa.FiSa.Po**	All biotopes found in 2004 (employing updated biotope allocations) were present along the relocatable transects in 2015.
Sediment character: sediment type	No change in composition of sediment type across the feature, allowing for natural succession/known cyclical change.	Core samples to a sediment depth of c. 20 cm at each of 6 stations will be taken every 6 years. Percentage of silt/clay and sand as defined in Hiscock (1996) should not deviate by +/- 10% at each station	The maximum change recorded in 2015 was 3% for both silt/clay and sand fractions.
Distribution of biotopes	Maintain the distribution of biotopes, allowing for natural succession/ known cyclical change.	Visual survey, dig-over of 1 m^2 area and core sampling at fixed stations along relocatable transect lines carried out every 6 years. The following biotopes will be found at the indicated relocated transects: Transect PA - **LS.LSa.MuSa.HedMacEte** Transect PB - **LS.LSa.MuSa** and **LS.LSa.FiSa.Po**	All biotopes found in 2004 were present in the same sequence along both of the SCM transects in 2015. Biotope boundaries along the transects appeared very similar in both years, apart from **LS.LSa.FiSa.Po**, which was recorded as extending 65 m farther up transect PB in 2015. However, it was considered that this apparent difference may be due to interpretational differences in the two surveys due to the diffuse nature of the transition.

Attribute	Target	Prescription	Result
* Species composition of representa-tive or notable biotopes	No decline in biotope quality due to changes in species composition or loss of notable species, allowing for natural succession/known cyclical change.	Change in species composition and diversity to be assessed by visual survey, dig-over of 1 m^2 area and replicated core sampling at the fixed stations PA2 and PB3 every 6 years.	There was little change in species composition at four of the six monitoring stations. Marked temporal differences were recorded at the other two stations, but in both cases this was due to enhancement of the infaunal community with additional species, resulting in more than doubling of the taxon richness. This change is considered not to represent a decline in the condition of the biotope.
* Topography	No change in topography of the littoral sediment, allowing for natural responses to hydrodynamic regime.	Marked changes in topography to be identified by reprofiling along the transects PA and PB every 6 years. Activities and events with the potential to modify profiles to be reviewed every 6 years.	Little temporal change in topography was recorded along both SCM transects, apart from at the bottom of transect PB in an area of naturally high hydrodynamic activity.
* Sediment character: Oxidation-reduction profile (Redox layer)	Average depth to the top of the black layer should not decrease in relation to baseline.	A visual estimation of the depth of anaerobic layer will be taken at 6 stations distributed along 2 relocatable transect every 6 years. The depth of the black layer will be a minimum of 20 cm.	Although darkened patches of sediment were visible at some sites in 2015, no black layer was observed within 30 cm of the sediment surface at any of the SCM transect sites.

Hiscock, K. 1996. *Marine Nature Conservation Review: Rationale and Methods.* Peterborough: JNCC

ANNEX 3: BIOTOPE MAPPING DATA - TARGET NOTES

Table 3.1. Temporal, locational and sediment data collected at target note sites.

Site	Date	Latitude (WGS84)	Longitude (WGS84)	Easting (BNG)	Northing (BNG)	WPT No.	Time (BST)	Substrate	Moisture	Surface features	Black layer
P01	01/07/2015	57.59414	-7.49283	71961	869313	144	09:54:59	Slightly muddy sand	Standing water	Flat	>30 cm but grey band at c. 0.2 - 2 cm
P02	01/07/2015	57.59317	-7.49066	72082	869195	145	10:10:27	Slightly muddy sand	Standing water	Flat	>30 cm but grey band at c. 0.2 - 2 cm
P03	01/07/2015	57.59282	-7.49071	72076	869157	146	10:18:21	Very slightly muddy sand	Standing water	Flat	Grey band at c. 0.2 - 2 cm, then clean
P04	01/07/2015	57.59218	-7.48941	72148	869079	147	10:45:13	Slightly muddy fine sand	Standing water	Flat	
P05	01/07/2015	57.59165	-7.48911	72161	869019	148	11:09:43				
P06	01/07/2015	57.59163	-7.48963	72129	869019	149	11:15:24	Very slightly muddy fine sand	Damp sand	Faintly rippled	>30 cm
P07	01/07/2015	57.5914	-7.49105	72043	869000	154	11:43:37	Very slightly muddy fine sand	Standing water with large pool - visible on aerial	Hummocked	>30 cm
P08	01/07/2015	57.59156	-7.49103	72045	869018	155	11:51:10	Very slightly muddy fine sand	Damp	Flat	>30 cm
P09	01/07/2015	57.59162	-7.49188	71995	869029	156					

Table 3.1 continued

Site	Date	Latitude (WGS84)	Longitude (WGS84)	Easting (BNG)	Northing (BNG)	WPT No.	Time (BST)	Substrate	Moisture	Surface features	Black layer
P10	01/07/2015	57.5924	-7.49211	71988	869117	157	12:38:17	Very slightly muddy fine sand	Standing water	Lugworm hummocked	>30 cm
P11	01/07/2015	57.59235	-7.49408	71870	869121	158	12:59:32				
P12	01/07/2015	57.59166	-7.49407	71865	869044	159	13:11:41	Very slightly muddy fine sand	Damp	Flat	>30 cm
P13	01/07/2015	57.59172	-7.49445	71843	869052	160	13:30:42	Slightly muddy fine sand	Standing water	Flat	Grey band at 0.2 - 2 cm
P14	01/07/2015	57.59023	-7.49465	71817	868888	161	13:40:25				
P15	01/07/2015	57.58982	-7.49399	71853	868839	162	13:45:20				
P16	01/07/2015	57.58993	-7.49254	71940	868844	163	13:55:02	Very slightly muddy fine sand	Standing water	Lugworm hummocked	>30 cm
P17	01/07/2015	57.59045	-7.48965	72118	868888	164	14:13:30	Clean fine sand	Damp; water table at 7 cm	Flat	No distinct black layer
P18	01/07/2015	57.59092	-7.49016	72091	868943	165	14:30:20				
P19	01/07/2015	57.59024	-7.48983	72105	868866	166	14:35:25	Clean fine sand			
P20	01/07/2015	57.58981	-7.49079	72044	868822	167	14:45:59	Clean fine sand	Waterlogged; some standing water		>30 cm
P21	01/07/2015	57.59011	-7.48824	72199	868843	168	15:04:15	Clean fine sand	Waterlogged sand	Flat	
P22	01/07/2015	57.58947	-7.48789	72214	868771	169	15:17:07	Clean fine sand	Waterlogged	Flat	Light grey at c. 0.2 cm
P23	01/07/2015	57.58989	-7.48443	72424	868801	170	15:30:15	Slightly muddy fine sand	Waterlogged	Flat	>30 cm

Table 3.1 continued

Site	Date	Latitude (WGS84)	Longitude (WGS84)	Easting (BNG)	Northing (BNG)	WPT No.	Time (BST)	Substrate	Moisture	Surface features	Black layer
P24	01/07/2015	57.59047	-7.48363	72477	868861	171	15:48:28	Saltmarsh adjacent to pool			
P25	01/07/2015	57.58992	-7.48389	72456	868801	172	15:56:59				
P26	01/07/2015	57.58756	-7.49068	72030	868572	173	16:32:22	Clean fine sand	Dry	Flat but very faint rippling; well rippled in S half of patch	>30 cm
P27	02/07/2015	57.58725	-7.4863	72289	868516	174	09:46:07	Clean fine sand	Standing water	Flat	
P28	02/07/2015	57.58601	-7.48632	72276	868379	175	09:49:55	Clean fine sand	Standing water	Flat	
P29	02/07/2015	57.58549	-7.48626	72275	868321	176	09:53:40	Clean fine sand	Standing water	Flat	0.1 cm (grey)
P30	02/07/2015	57.58561	-7.48716	72223	868338	177	10:07:53	Clean fine sand			
P31	02/07/2015	57.5854	-7.48806	72167	868319	178	10:14:30	Clean fine sand; sulphurous smell	Damp	Flat	0.1 cm (grey)
P32	02/07/2015	57.58507	-7.48831	72149	868284	179	10:35:28	Clean fine sand	Standing water but drier patches	Flat	0.1 cm (light grey)
P33	02/07/2015	57.58484	-7.49045	72019	868269	180	10:45:27	Clean fine sand	Damp; water table c. 10 cm	Flat	Unclear, probably >30 cm
P34	02/07/2015	57.58495	-7.49103	71986	868284	181	11:00:49 and 11:23:55	Clean fine sand	Damp	Very well rippled	>30 cm
P35	02/07/2015	57.58519	-7.49274	71886	868319		11:07:35				

Table 3.1 continued

Site	Date	Latitude (WGS84)	Longitude (WGS84)	Easting (BNG)	Northing (BNG)	WPT No.	Time (BST)	Substrate	Moisture	Surface features	Black layer
P36	02/07/2015	57.5876	-7.49247	71924	868585	182	11:48:13	Clean fine sand	Waterlogged; standing water	Rippled with flat patches	
P37	02/07/2015	57.58797	-7.49313	71888	868629	183	12:10:43	Clean fine sand	Damp - dry	Very well marked ripples	>30 cm
P38	02/07/2015	57.58909	-7.49413	71838	868759	184	12:29:22	Slightly muddy fine sand	Damp, some standing water	Flat	
P39	02/07/2015	57.58908	-7.49211	71958	868748	185	12:44:16	Very slightly muddy fine sand	Standing water	*Arenicola* hummocked	>30 cm
P40	02/07/2015	57.58607	-7.48977	72071	868402	186	13:04:20	Clean fine sand	Pools, waterlogged	Rippled sand with megaripples	>30 cm
P41	02/07/2015	57.58649	-7.48779	72193	868439	187	13:23:34	Clean fine sand	Waterlogged	Flat	Unclear; bands of light grey
P100	02/07/2015	57.59055	-7.49208	71973	868911	284	11:32:54	Saltmarsh, bedrock & boulders			
P101	02/07/2015	57.59107	-7.49204	71981	868969	285	11:39:14	Saltmarsh, bedrock & boulders			
P102	02/07/2015	57.59146	-7.49200	71986	869012	286	11:44:14	Saltmarsh			
P103	02/07/2015	57.59151	-7.49327	71911	869023	287	11:50:34	Bedrock & boulders			
P104	02/07/2015	57.59184	-7.49384	71880	869063	288	11:55:49	Bedrock			
P105	02/07/2015	57.59211	-7.49325	71918	869090	289	11:58:56	Saltmarsh, bedrock & boulders			
P106	02/07/2015	57.59258	-7.49190	72003	869136	290	12:03:09	Bedrock			
P107	02/07/2015	57.59123	-7.49522	71792	869002	291	12:08:59	Soft fine sand			

Table 3.1 continued

Site	Date	Latitude (WGS84)	Longitude (WGS84)	Easting (BNG)	Northing (BNG)	WPT No.	Time (BST)	Substrate	Moisture	Surface features	Black layer
P108	02/07/2015	57.59080	-7.49357	71887	868946	292	12:16:36	Bedrock & boulders			
P109	02/07/2015	57.59013	-7.48472	72409	868829	293	13:34:42	Firm fine sand			
P110	02/07/2015	57.58990	-7.48447	72422	868802	294	13:39:06	Firm fine sand. Waterlogged & flat.			
P111	02/07/2015	57.58998	-7.48485	72400	868813	295	13:42:14	Soft mulch of decomposing kelp forming a layer (~10 cm thick) on firm fine sand.			

Table 3.2. Habitat notes, biological data and imagery acquired at target note sites. SACFOR abundances obtained from surface features, digover and, at some sites, sieving of sediment. Biotope column gives biotopes subsequently assigned to the region in which the site was located. Photo file names with prefix of 'SNH_PAIBLE_2015_' and suffix of '.jpg'. Video file names with suffix of ".mp4".

Site	Habitat notes	Biota SACFOR	Sample	Biotope	Notes	Photos	Video	Team
P01		*Hediste diversicolor* A, *Pygospio elegans* F, *Fabricia stellaris* F, Naididae sp. F, *Heterochaeta costata* C, *Corophium volutator* F, *Carcinus maenas* P, *Peringia ulvae* A, *Fucus vesiculosus* R, Fil green algae F, *Cladophora* sp. F	Y	HedMacEte	Similar to PA transect but less green algae	DSCN005-7		CM, KT
P02		*Hediste diversicolor* A, *Corophium volutator* P, *Peringia ulvae* P, Fil green algae A	N	HedMacEte	Same biotope as P01 but close to boundary between start of *Arenicola* to south	DSCN008-10		CM, KT
P03		*Hediste diversicolor* A, *Malacoceros fuliginosus* A, *Pygospio elegans* C, *Arenicola marina* C, *Fabricia stellaris* F, *Corophium volutator* S, *Carcinus maenas* P, *Peringia ulvae* C, *Cerastoderma edule* C, *Macoma balthica* A, Fil green algae A	Y	HedMacEte	Possible biotope change as lugworms C-A	DSCN011-14	DSCN0015	CM, KT
P04		*Eteone* sp. P, *Hediste diversicolor* A, *Malacoceros fuliginosus* A, *Pygospio elegans* C, *Capitella capitata* C, *Fabricia stellaris* C, *Heterochaeta costata* C, *Corophium volutator* S, *Carcinus maenas* P, Fil green algae S	Y	HedMacEte	Black on aerial image will be green algal mat and possibly algal detritus	DSCN0016-20	DSCN0021	CM, KT
P05			N	HedMacEte	As P04			CM, KT
P06		*Eteone* sp. P, *Hediste diversicolor* C, *Malacoceros fuliginosus* C, *Pygospio elegans* F, *Arenicola marina* A, *Fabricia stellaris* F, *Heterochaeta costata* F, *Bathyporeia pilosa* F, *Corophium volutator* S, *Peringia ulvae* F, *Macoma balthica* juv. C, Fil green algae P	Y	HedMacEte	Depressed area with dense small *Arenicola* area delimited by 4 waypoints: 50 - 53	DSCN0022-6	DSCN0027	CM, KT

Table 3.2 continued

Site	Habitat notes	Biota SACFOR	Sample	Biotope	Notes	Photos	Video	Team
P07	Densely lugworm hummocked	*Eteone longa* C, *Hediste diversicolor* A, *Malacoceros fuliginosus* A, *Pygospio elegans* C, *Capitella capitata* C, *Arenicola marina* A, *Tubificoides benedii* F, *Corophium volutator* C, *Crangon crangon* C, *Carcinus maenas* P, *Cerastoderma edule* A, *Macoma balthica* A, Fil green algae P, *Cladophora* sp. P	Y	HedMacEte	Area is a mosaic of dense *Arenicola* (P07) and higher areas of drier sand with dense fil. green algae (P08).	DSCN0028-31		CM, KT
P08		*Hediste diversicolor* S, *Pygospio elegans* A, *Fabricia stellaris* A, *Heterochaeta costata* A, *Peringia ulvae* F, *Cerastoderma edule* F, Fil green algae A, *Cladophora* sp. A	Y	HedMacEte	Polygon 2 is the same biotope. Area is a mosaic of dense *Arenicola* (P07) and higher areas of drier sand with dense fil. green algae (P08).	DSCN0032-37	DSCN0038	CM, KT
P09			N	HedMacEte	Similar to P07. Island just south is saltmarsh.			CM, KT
P10		*Eteone* sp. P, *Hediste diversicolor* A, *Malacoceros fuliginosus* S, *Pygospio elegans* A, *Capitella minima* C, *Arenicola marina* A, *Fabricia stellaris* F, *Heterochaeta costata* F, *Corophium volutator* F, *Carcinus maenas* P, *Peringia ulvae* A, *Cerastoderma edule* A, *Macoma balthica* A, Fil green algae R	Y	HedMacEte	Patchy area of dense lugworms in lower damper patches and drier sand areas with fil. green algae - as with P07 and P08.	DSCN0039-43		CM, KT
P11			N	HedMacEte	Same biotope as site P04	DSCN0044-46		CM, KT
P12		Nemertea sp. C, *Eteone* sp. P, *Hediste diversicolor* A, *Malacoceros fuliginosus* S, *Pygospio elegans* A, Tubificidae spp. C, *Heterochaeta costata* C, *Tubificoides benedii* C, *Corophium volutator* C, *Peringia ulvae* C, Fil green algae R	Y	HedMacEte	Ribbon of largely algally-free sand alongside channel ("A" on map)	DSCN0047-51		CM, KT

Table 3.2 continued

Site	Habitat notes	Biota SACFOR	Sample	Biotope	Notes	Photos	Video	Team
P13		Nemertea sp. C, *Eteone* sp. P*, Hediste diversicolor* S, *Malacoceros fuliginosus* A, *Pygospio elegans* C, *Capitella capitata* C, *Arenicola marina* C, *Fabricia stellaris* A, Sabellidae sp. A, Tubificidae spp. A, *Corophium volutator* A, *Carcinus maenas* P, *Peringia ulvae* P, *Cerastoderma edule* P, Fil green algae S, *Cladophora* sp. S, Cyanophyta spp. P	Y	HedMacEte	Extensive area	DSCN0052-56		CM, KT
P14			N	HedMacEte	Same biotope as P13			CM, KT
P15			N	HedMacEte	Same biotope as P12			CM, KT
P16		*Hediste diversicolor* A, *Arenicola marina* A, *Corophium volutator* C, *Peringia ulvae* A, *Cerastoderma edule* P, *Macoma balthica* A, Fil green algae F	N	HedMacEte	Mosaic of mostly dense lugworms in lower wet areas (in which sampled) and smaller higher areas of damp sand with dense fil. green algae as before.	DSCN0057-63		CM, KT
P17		*Hediste diversicolor* A, *Pygospio elegans* A, *Fabricia stellaris* A, Oligochaeta spp. indet. C, Tubificidae spp. P, Enchytraeidae spp. P, *Bathyporeia pilosa* F, *Corophium volutator* A, Chironomidae spp. F, Fil green algae O, Cyanophyta spp. O	Y	MuSa	Relatively dry sand band at top of shore	DSCN0064-69	DSCN0070	CM, KT
P18			N	MuSa	Northern boundary of dry sand band.			CM, KT
P19			N	MuSa	Transition to waterlogged sand lower down shore but possibly same biotope as previous			CM, KT

Table 3.2 continued

Site	Habitat notes	Biota SACFOR	Sample	Biotope	Notes	Photos	Video	Team
P20		Nemertea sp. C, *Eteone longa* C, *Hediste diversicolor* A, *Malacoceros fuliginosus* S, *Pygospio elegans* A, *Capitella capitata* C, *Arenicola marina* C, *Heterochaeta costata* C, *Corophium volutator* F, *Crangon crangon* C, *Carcinus maenas* P, *Cerastoderma edule* juv. C, *Macoma balthica* juv. C, Fil green algae R	Y	MuSa	Some drier patches	DSCN0071-77		CM, KT
P21		*Hediste diversicolor* S, *Pygospio elegans* A, Sabellidae sp. P, Tubificidae spp. C, *Heterochaeta costata* C, *Corophium volutator* C, *Peringia ulvae* P, Fil green algae R, Cyanophyta spp. R	Y	MuSa	Same biotope as P17? Probably same biotope as top of transect PB.	DSCN0078-84		CM, KT
P22		Fil green algae O	N	MuSa	Same as previous biotope. Dappling on aerial image will be relatively damp and drier patches.			CM, KT
P23	Patches of drift kelp	*Hediste diversicolor* A, *Heterochaeta costata* C, *Corophium volutator* A, Fil green algae R	Y	MuSa		DSCN0085-89		CM, KT
P24			N	saltmarsh	Adjacent to polygon 3 which is a pool			CM, KT
P25			N		View of polygon 4	DSCN0091-94	DSCN0090	CM, KT
P26		*Bathyporeia pilosa* F, *Eurydice pulchra* F, Fil green algae R	Y	Eur	Large dry sand patch. Walked periphery of patch from 16:40:06 to 16:45:52	DSCN0095-100		CM, KT
P27			N	MuSa	Same biotope as PB1.			CM, KT
P28			N	MuSa	Same biotope as PB1.			CM, KT
P29		*Hediste diversicolor* A, Naididae sp. F, *Heterochaeta costata* C, Enchytraeidae spp. C, Chironomidae spp. F, Fil green algae O, *Percursaria percursa* O	Y	MuSa	Possibly same as PB1 but distinct grey layer and smell of sulphide.	DSCN0101-107	DSCN0108	CM, KT
P30			N	MuSa	5 old creels	DSCN0109-112		CM, KT

Table 3.2 continued

Site	Habitat notes	Biota SACFOR	Sample	Biotope	Notes	Photos	Video	Team
P31	Dense algal debris	Enchytraeidae spp. F, Fil green algae R	Y	St	Black marking on aerial will be algal debris. Muddy sand in channel could be different biotope - also much algal debris and great smell of H2S.	DSCN0113-117		CM, KT
P32		Fil green algae O	N	MuSa	Probably same biotope as PB1	DSCN0118-123		CM, KT
P33		*Pygospio elegans* S, *Fabricia stellaris* F, Oligochaeta spp. indet. C, Tubificidae spp. C, *Heterochaeta costata* C, Enchytraeidae spp. C, *Bathyporeia pilosa* F, Fil green algae F, *Cladophora* sp. F	Y	MuSa	Some dense patches of rotting macroalgae in places.	DSCN0124-129	DSCN0130	CM, KT
P34		*Pygospio elegans* A, *Ophelia rathkei* F, Enchytraeidae spp. C, *Bathyporeia pilosa* F, *Eurydice pulchra* F, *Cerastoderma edule* C	Y	Po		DSCN0131-136	DSCN0137	CM, KT
P35			N	Po	Start of walk along southern boundary of rippled sand at 11:07:35, stopping at 11:11:16. Polygon "B" (P34 biotope)			CM, KT
P36		*Hediste diversicolor* C, *Malacoceros fuliginosus* A, *Pygospio elegans* A, *Ophelia rathkei* F, *Capitella capitata* C, *Arenicola marina* A, *Fabricia stellaris* F, Enchytraeidae spp. F, *Eurydice pulchra* F, *Cerastoderma edule* juv. C, *Macoma balthica* juv. C, Fil green algae R	Y	Po		DSCN0138-144		CM, KT

Table 3.2 continued

Site	Habitat notes	Biota SACFOR	Sample	Biotope	Notes	Photos	Video	Team
P37		Nemertea sp. C, *Hediste diversicolor* C, *Pygospio elegans* A, *Arenicola marina* F, *Heterochaeta costata* C, *Macoma balthica* juv. C, Fil green algae R, *Cladophora* sp. R	Y	Po	Differs from P36 in drier and well rippled and very sparse *Arenicola*. Polygon 6 is mosaic of wetter patches (as P36) and drier areas (as P37).	DSCN0145-150	DSCN0151	CM, KT
P38		Nemertea sp. C, *Hediste diversicolor* A, *Malacoceros fuliginosus* S, *Pygospio elegans* A, *Heterochaeta costata* C, *Corophium volutator* A, Fil green algae S, *Cladophora* sp. S	Y	HedMacEte		DSCN0152-158		CM, KT
P39		Nemertea sp. C, *Hediste diversicolor* A, *Pygospio elegans* A, *Arenicola marina* A, *Fabricia stellaris* A, *Heterochaeta costata* A, *Corophium volutator* C, *Peringia ulvae* F, *Macoma balthica* juv. C, Fil green algae R, Cyanophyta spp. R	Y	HedMacEte		DSCN0159-166	DSCN0167	CM, KT
P40	Much algal debris in sand, including kelp	*Malacoceros fuliginosus* C, *Capitella capitata* A, *Macoma balthica* juv. C, Fil green algae R	Y	Po	Biotope probably same as PB transect bottom (PB4)	DSCN0168-175		CM, KT
P41		*Arenicola marina* F. NO DIGOVER	N	MuSa	Same biotope as top of PB transect.	DSCN0176-182		CM, KT
P100	Saltmarsh and rocky reef biotopes (YG, Ver, Pel & Fspi)		N	Saltmarsh & LR	Wpt just S of small island with bedrock & boulders on S side, saltmarsh on top of island and forming the N margin (i.e. seaward side with fucoid covered rock and inshore side with accreted saltmarsh.)	ASCN0099-107		DH, JB

Table 3.2 continued

Site	Habitat notes	Biota SACFOR	Sample	Biotope	Notes	Photos	Video	Team
P101	Saltmarsh and rocky reef biotopes (YG, Ver, Pel & Fspi)		N	Saltmarsh & LR	Wpt just S of small island with bedrock & boulders on S side, saltmarsh on top of island and forming the N margin (i.e. seaward side with fucoid covered rock and inshore side with accreted saltmarsh.)	ASCN0109-116		DH, JB
P102	Saltmarsh		N	Saltmarsh	Wpt just N of same small island as described for wpt 285.	ASCN0118-124		DH, JB
P103	Rocky reef biotopes (YG, Ver, Pel & Fspi)		N	LR	To N of wpt is bedrock with YG & Ver. To S of wpt is boulders with fucoids. Pile of discarded fencing wire adjacent to rocks.	ASCN0125-132		DH, JB
P104	Rocky reef biotopes (YG, Ver, Pel & Fspi)		N	LR		ASCN0134-139		DH, JB
P105	Saltmarsh and rocky reef biotopes (YG, Ver, Pel & Fspi)		N	Saltmarsh & LR	Wpt just S of small island with bedrock & boulders on S side, saltmarsh on top of island and forming the N margin (i.e. seaward side with fucoid covered rock and inshore side with accreted saltmarsh.)	ASCN0143-149		DH, JB

Table 3.2 continued

Site	Habitat notes	Biota SACFOR	Sample	Biotope	Notes	Photos	Video	Team
P106	Rocky reef biotopes (Ver, Pel & Fspi)		N	LR		ASCN0152-157		DH, JB
P107	Drift algae 30-40%	Filamentous green algal mat (S)	N	HedMacEte	Shallow drainage channel with algal mats & drift algae giving a dark appearance.	ASCN0159-167		DH, JB
P108	Rocky reef biotopes (YG, Ver, Pel & Fspi)		N	LR	Bedrock outcrop fringed by boulders.	ASCN0169-175		DH, JB
P109	Brown 'nodules / soft bumpy crust' of algae (90%). Clumps of filamentous algae (~1%).		N	channel	Drainage channel with water depth ~5 cm. Probably fresh / brackish.	ASCN0177-182		DH, JB
P110	Drift algae c. 10%	*Corophium volutator* (F)	N	MuSa	Area of channel (not submerged) surrounded by saltmarsh and areas of decomposing drift algae.			DH, JB
P111	Patches of pink bacterial mat.		N	St	Sample of decomposing kelp collected.	ASCN0184-191		DH, JB

ANNEX 4: PHOTO AND VIDEO LOGS FOR SCM SURVEY

Table 4.1. Log of photographs taken along the two relocatable transects in Loch Paible. All photographs taken by Dan Harries using Nikon Coolpix S32 camera with 4.1 mm lens. Image size 4160 x 3120 pixels with 300 x 300 dpi resolution.

Image identifier	Site code	Date and time (UT)	Latitude (WGS84)	Longitude (WGS84)	Description	Bearing (degrees T)
SNH_PAIBLE_2015_SCM_0009.JPG	PA1	2015-07-01 10:37:36	57.59320	-7.49328	Sediment flat habitat detail	Unknown
SNH_PAIBLE_2015_SCM_0010.JPG	PA1	2015-07-01 10:37:58	57.59320	-7.49328	Sediment flat habitat detail	Unknown
SNH_PAIBLE_2015_SCM_0011.JPG	PA1	2015-07-01 10:38:02	57.59320	-7.49328	Sediment flat habitat detail	Unknown
SNH_PAIBLE_2015_SCM_0012.JPG	PA1	2015-07-01 10:38:08	57.59320	-7.49328	View of sediment flat	0
SNH_PAIBLE_2015_SCM_0013.JPG	PA1	2015-07-01 10:38:28	57.59320	-7.49328	View down sediment flat transect	90
SNH_PAIBLE_2015_SCM_0014.JPG	PA1	2015-07-01 10:38:36	57.59320	-7.49328	View up sediment flat transect	270
SNH_PAIBLE_2015_SCM_0015.JPG	PA1	2015-07-01 10:39:02	57.59320	-7.49328	0.25 m^2 quadrat on sediment flat #1	Unknown
SNH_PAIBLE_2015_SCM_0016.JPG	PA1	2015-07-01 10:39:20	57.59320	-7.49328	0.25 m^2 quadrat on sediment flat #2	Unknown
SNH_PAIBLE_2015_SCM_0017.JPG	PA1	2015-07-01 10:39:38	57.59320	-7.49328	0.25 m^2 quadrat on sediment flat #3	Unknown
SNH_PAIBLE_2015_SCM_0018.JPG	PA1	2015-07-01 10:39:52	57.59320	-7.49328	0.25 m^2 quadrat on sediment flat #4	Unknown
SNH_PAIBLE_2015_SCM_0019.JPG	PA1	2015-07-01 10:40:12	57.59320	-7.49328	0.25 m^2 quadrat on sediment flat #5	Unknown
SNH_PAIBLE_2015_SCM_0023.JPG	PA2	2015-07-01 11:07:28	57.59351	-7.49274	View down sediment flat transect	90
SNH_PAIBLE_2015_SCM_0024.JPG	PA2	2015-07-01 11:07:36	57.59351	-7.49274	View of sediment flat	180
SNH_PAIBLE_2015_SCM_0025.JPG	PA2	2015-07-01 11:07:42	57.59351	-7.49274	View up sediment flat transect	270
SNH_PAIBLE_2015_SCM_0026.JPG	PA2	2015-07-01 11:07:50	57.59351	-7.49274	View of sediment flat	0
SNH_PAIBLE_2015_SCM_0027.JPG	PA2	2015-07-01 11:07:58	57.59351	-7.49274	Sediment flat habitat detail	Unknown
SNH_PAIBLE_2015_SCM_0028.JPG	PA2	2015-07-01 11:08:02	57.59351	-7.49274	Sediment flat habitat detail	Unknown
SNH_PAIBLE_2015_SCM_0029.JPG	PA2	2015-07-01 11:08:12	57.59351	-7.49274	Sediment flat habitat detail	Unknown
SNH_PAIBLE_2015_SCM_0030.JPG	PA2	2015-07-01 11:08:18	57.59351	-7.49274	Sediment flat habitat detail	Unknown
SNH_PAIBLE_2015_SCM_0031.JPG	PA2	2015-07-01 11:08:36	57.59351	-7.49274	0.25 m^2 quadrat on sediment flat #1	Unknown
SNH_PAIBLE_2015_SCM_0032.JPG	PA2	2015-07-01 11:08:48	57.59351	-7.49274	0.25 m^2 quadrat on sediment flat #2	Unknown
SNH_PAIBLE_2015_SCM_0033.JPG	PA2	2015-07-01 11:09:02	57.59351	-7.49274	0.25 m^2 quadrat on sediment flat #3	Unknown
SNH_PAIBLE_2015_SCM_0034.JPG	PA2	2015-07-01 11:09:14	57.59351	-7.49274	0.25 m^2 quadrat on sediment flat #4	Unknown
SNH_PAIBLE_2015_SCM_0035.JPG	PA2	2015-07-01 11:09:32	57.59351	-7.49274	0.25 m^2 quadrat on sediment flat #5	Unknown

Table 4.1 continued

Image identifier	Site code	Date and time (UT)	Latitude (WGS84)	Longitude (WGS84)	Description	Bearing (degrees T)
SNH_PAIBLE_2015_SCM_0037.JPG	PB4	2015-07-01 14:45:02	57.58662	-7.49114	View up sediment flat transect	45
SNH_PAIBLE_2015_SCM_0038.JPG	PB4	2015-07-01 14:45:08	57.58662	-7.49114	View of sediment flat	135
SNH_PAIBLE_2015_SCM_0039.JPG	PB4	2015-07-01 14:45:16	57.58662	-7.49114	View down sediment flat transect	225
SNH_PAIBLE_2015_SCM_0040.JPG	PB4	2015-07-01 14:45:22	57.58662	-7.49114	View of sediment flat	315
SNH_PAIBLE_2015_SCM_0041.JPG	PB4	2015-07-01 14:45:28	57.58662	-7.49114	Sediment flat habitat detail	Unknown
SNH_PAIBLE_2015_SCM_0042.JPG	PB4	2015-07-01 14:45:38	57.58662	-7.49114	Sediment flat habitat detail	Unknown
SNH_PAIBLE_2015_SCM_0043.JPG	PB4	2015-07-01 14:45:40	57.58662	-7.49114	Sediment flat habitat detail	Unknown
SNH_PAIBLE_2015_SCM_0044.JPG	PB4	2015-07-01 14:45:46	57.58662	-7.49114	Sediment flat habitat detail	Unknown
SNH_PAIBLE_2015_SCM_0045.JPG	PB4	2015-07-01 14:46:04	57.58662	-7.49114	0.25 m^2 quadrat on sediment flat #1	Unknown
SNH_PAIBLE_2015_SCM_0046.JPG	PB4	2015-07-01 14:46:14	57.58662	-7.49114	0.25 m^2 quadrat on sediment flat #2	Unknown
SNH_PAIBLE_2015_SCM_0047.JPG	PB4	2015-07-01 14:46:24	57.58662	-7.49114	0.25 m^2 quadrat on sediment flat #3	Unknown
SNH_PAIBLE_2015_SCM_0048.JPG	PB4	2015-07-01 14:46:34	57.58662	-7.49114	0.25 m^2 quadrat on sediment flat #4	Unknown
SNH_PAIBLE_2015_SCM_0049.JPG	PB4	2015-07-01 14:46:44	57.58662	-7.49114	0.25 m^2 quadrat on sediment flat #5	Unknown
SNH_PAIBLE_2015_SCM_0052.JPG	PB3	2015-07-01 15:11:26	57.58684	-7.49063	View up sediment flat transect	45
SNH_PAIBLE_2015_SCM_0053.JPG	PB3	2015-07-01 15:11:32	57.58684	-7.49063	View of sediment flat	135
SNH_PAIBLE_2015_SCM_0054.JPG	PB3	2015-07-01 15:11:36	57.58684	-7.49063	View down sediment flat transect	225
SNH_PAIBLE_2015_SCM_0055.JPG	PB3	2015-07-01 15:11:42	57.58684	-7.49063	View of sediment flat	315
SNH_PAIBLE_2015_SCM_0056.JPG	PB3	2015-07-01 15:11:48	57.58684	-7.49063	Sediment flat habitat detail	Unknown
SNH_PAIBLE_2015_SCM_0057.JPG	PB3	2015-07-01 15:11:54	57.58684	-7.49063	Sediment flat habitat detail	Unknown
SNH_PAIBLE_2015_SCM_0058.JPG	PB3	2015-07-01 15:12:04	57.58684	-7.49063	Sediment flat habitat detail	Unknown
SNH_PAIBLE_2015_SCM_0059.JPG	PB3	2015-07-01 15:12:10	57.58684	-7.49063	Sediment flat habitat detail	Unknown
SNH_PAIBLE_2015_SCM_0060.JPG	PB3	2015-07-01 15:12:22	57.58684	-7.49063	0.25 m^2 quadrat on sediment flat #1	Unknown
SNH_PAIBLE_2015_SCM_0061.JPG	PB3	2015-07-01 15:12:30	57.58684	-7.49063	0.25 m^2 quadrat on sediment flat #2	Unknown
SNH_PAIBLE_2015_SCM_0062.JPG	PB3	2015-07-01 15:12:38	57.58684	-7.49063	0.25 m^2 quadrat on sediment flat #3	Unknown
SNH_PAIBLE_2015_SCM_0063.JPG	PB3	2015-07-01 15:12:46	57.58684	-7.49063	0.25 m^2 quadrat on sediment flat #4	Unknown
SNH_PAIBLE_2015_SCM_0064.JPG	PB3	2015-07-01 15:12:56	57.58684	-7.49063	0.25 m^2 quadrat on sediment flat #5	Unknown
SNH_PAIBLE_2015_SCM_0067.JPG	PB2	2015-07-02 08:45:10	57.58788	-7.48828	View up sediment flat transect	45
SNH_PAIBLE_2015_SCM_0068.JPG	PB2	2015-07-02 08:45:18	57.58788	-7.48828	View of sediment flat	135

Table 4.1 continued

Image identifier	Site code	Date and time (UT)	Latitude (WGS84)	Longitude (WGS84)	Description	Bearing (degrees T)
SNH_PAIBLE_2015_SCM_0069.JPG	PB2	2015-07-02 08:45:30	57.58788	-7.48828	View down sediment flat transect	225
SNH_PAIBLE_2015_SCM_0070.JPG	PB2	2015-07-02 08:45:36	57.58788	-7.48828	View of sediment flat	315
SNH_PAIBLE_2015_SCM_0071.JPG	PB2	2015-07-02 08:45:48	57.58788	-7.48828	Sediment flat habitat detail	Unknown
SNH_PAIBLE_2015_SCM_0072.JPG	PB2	2015-07-02 08:45:58	57.58788	-7.48828	Sediment flat habitat detail	Unknown
SNH_PAIBLE_2015_SCM_0073.JPG	PB2	2015-07-02 08:46:04	57.58788	-7.48828	Sediment flat habitat detail	Unknown
SNH_PAIBLE_2015_SCM_0074.JPG	PB2	2015-07-02 08:46:14	57.58788	-7.48828	Sediment flat habitat detail	Unknown
SNH_PAIBLE_2015_SCM_0075.JPG	PB2	2015-07-02 08:46:28	57.58788	-7.48828	0.25 m^2 quadrat on sediment flat #1	Unknown
SNH_PAIBLE_2015_SCM_0076.JPG	PB2	2015-07-02 08:46:46	57.58788	-7.48828	0.25 m^2 quadrat on sediment flat #2	Unknown
SNH_PAIBLE_2015_SCM_0077.JPG	PB2	2015-07-02 08:47:02	57.58788	-7.48828	0.25 m^2 quadrat on sediment flat #3	Unknown
SNH_PAIBLE_2015_SCM_0078.JPG	PB2	2015-07-02 08:47:20	57.58788	-7.48828	0.25 m^2 quadrat on sediment flat #4	Unknown
SNH_PAIBLE_2015_SCM_0079.JPG	PB2	2015-07-02 08:47:38	57.58788	-7.48828	0.25 m^2 quadrat on sediment flat #5	Unknown
SNH_PAIBLE_2015_SCM_0082.JPG	PB1	2015-07-02 09:23:08	57.58877	-7.48623	View up sediment flat transect	45
SNH_PAIBLE_2015_SCM_0083.JPG	PB1	2015-07-02 09:23:16	57.58877	-7.48623	View of sediment flat	135
SNH_PAIBLE_2015_SCM_0084.JPG	PB1	2015-07-02 09:23:20	57.58877	-7.48623	View down sediment flat transect	225
SNH_PAIBLE_2015_SCM_0085.JPG	PB1	2015-07-02 09:23:32	57.58877	-7.48623	View of sediment flat	315
SNH_PAIBLE_2015_SCM_0086.JPG	PB1	2015-07-02 09:23:44	57.58877	-7.48623	Sediment flat habitat detail	Unknown
SNH_PAIBLE_2015_SCM_0087.JPG	PB1	2015-07-02 09:23:50	57.58877	-7.48623	Sediment flat habitat detail	Unknown
SNH_PAIBLE_2015_SCM_0088.JPG	PB1	2015-07-02 09:24:00	57.58877	-7.48623	Sediment flat habitat detail	Unknown
SNH_PAIBLE_2015_SCM_0089.JPG	PB1	2015-07-02 09:24:04	57.58877	-7.48623	Sediment flat habitat detail	Unknown
SNH_PAIBLE_2015_SCM_0090.JPG	PB1	2015-07-02 09:24:30	57.58877	-7.48623	0.25 m^2 quadrat on sediment flat #1	Unknown
SNH_PAIBLE_2015_SCM_0091.JPG	PB1	2015-07-02 09:24:44	57.58877	-7.48623	0.25 m^2 quadrat on sediment flat #2	Unknown
SNH_PAIBLE_2015_SCM_0092.JPG	PB1	2015-07-02 09:24:56	57.58877	-7.48623	0.25 m^2 quadrat on sediment flat #3	Unknown
SNH_PAIBLE_2015_SCM_0093.JPG	PB1	2015-07-02 09:25:06	57.58877	-7.48623	0.25 m^2 quadrat on sediment flat #4	Unknown
SNH_PAIBLE_2015_SCM_0094.JPG	PB1	2015-07-02 09:25:10	57.58877	-7.48623	0.25 m^2 quadrat on sediment flat #4	Unknown
SNH_PAIBLE_2015_SCM_0095.JPG	PB1	2015-07-02 09:25:24	57.58877	-7.48623	0.25 m^2 quadrat on sediment flat #5	Unknown

Table 4.2 Log of video imagery collected along the two relocatable transects in Loch Paible. All imagery collected by Dan Harries using Nikon Coolpix S32 camera and HD (1920 x 1080 pixel) resolution.

Image identifier	Date and time (UT)	Video time code (start)	Video time code (end)	Latitude start (WGS84)	Longitude start (WGS84)	Latitude end (WGS84)	Longitude end (WGS84)	Description
Marker_to_PA1_PA2_boundary.mp4	2015-07-01 10:48:14	00:00:00	00:07:22	57.59320	-7.49328	57.59324	-7.49318	Sediment flat transect from marker peg to zone 1/2 boundary
PA1_PA2_boundary_to_channel.mp4	2015-07-01 11:05:10	00:00:00	00:05:25	57.59324	-7.49318	57.59375	-7.49238	Sediment flat transect from zone 1/2 boundary to bottom
PB4_to_PB3.mp4	2015-07-01 14:51:22	00:00:00	00:03:23	57.58662	-7.49114	57.58684	-7.49063	Sediment flat transect from station PB4 to PB3
PB3_to_PB3_PB2_boundary.mp4	2015-07-01 15:19:32	00:00:00	00:05:27	57.58684	-7.49063	57.58701	-7.49024	Sediment flat transect from station PB3 to 2004 upper boundary of zone 3
Station_PB2.mp4	2015-07-02 08:53:02	00:00:00	00:04:31	57.58788	-7.48828	57.58788	-7.48828	Sediment flat around station PB2
PB1_to_marker.mp4	2015-07-02 09:30:38	00:00:00	00:01:31	57.58877	-7.48623	57.58886	-7.48601	Sediment flat transect from station PB1 to marker peg
PB1_to_PB2_PB3_boundary.mp4	2015-07-02 10:03:48	00:00:00	00:07:48	57.58877	-7.48623	57.58701	-7.49024	Sediment flat transect from station PB1 to 2004 upper boundary of zone 3

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