Brownsea Island Lagoon Condition Assessment – Interpretative Survey Report 2015

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1. Executive Summary

Natural England (NE) commissioned APEM to carry out a biological survey of the saline lagoon on Brownsea Island, within the Poole Harbour SPA and SSSI. Coastal lagoon communities are a key attribute of the SPA and SSSI coastal lagoon features

The aim of this survey is to make a preliminary assessment of change within the lagoon absed on historical data. The methods employed within this study followed previous monitoring activities reporting on quantitative and qualitative characteristics of five key lagoonal quality features: benthos, nekton, flora & fauna amongst vegetation, epifauna and physicochemical condition.

Results of sampling were compared with the previous survey of the lagoon undertaken by Herbert *et al.* (2010). These data were then used to indicate whether any changes in physicochemical parameters or biota were evident to make a preliminary assessment of change since this prevous survey.

Six sampling stations were selected to correspond with historical sampling stations whilst a further six were added to provide greater coverage and detail on the condition of the lagoon. The sampling consisted of qualitative Phase I and quantitative Phase II survey. For the Phase I survey, the main biota present in and around the lagoon were recorded including the main vegetation taxa present, and records were taken of conspicous invertebrate fauna and megafauna (e.g. insects and birds). Preliminary biotope maps for the lagoon were produced *in situ* based on observed sediment types and biota which were further refined based on the results of the quantitative sampling. During the Phase I survey, notes were also taken relating to the nature of any isolating barriers and the presence of any potential anthropogenic pressures.

The Phase II survey consisted of recording physicochemical parameters in the water column, collecting and analysing *in situ* semi-quantitative sweep net samples of the nekton, recording taxa found on vegetation, collecting benthic core samples for subsequent laboratory analysis (enumeration and biomass) and obtaining samples for particle size analysis. Core data were analysed to determine simiarity across invertebrate communities recorded at different stations using SIMPROF in PRIMER v6. The communtiy of organisms present in the lagoon was discussed and the presence of any lagoon specialists and/or non-native species was highlighted.

Across the lagoon physicochemical data were found to be within the range expected of lagoonal systems and broadly comparable with the findings of Herbert *et al.* (2010), although sediments were found to be slightly coarser in nature in the current survey.

Brownsea Island lagoon is a percolation lagoon with movement of water through the gravel below the dyke between the lagoon and adjacent littoral habitats. There were also two sluices to the southeast that provided more direct connection to the sea and woodland, marsh and freshwater pools to the west. The extent of the lagoon basin determined from aerial imagery was calculated in GIS to be 16.7 Ha.

The main body of the lagoon was dominated by a biotope in the complex: Sublittoral mud in low or reduced salinity (lagoons) SS.SMu.SMuLS (Connor *et al*. 2004) that included large numbers of the Starlet anemone (*Nematostella vectensis*). The lagoon margin especially along the western boundary of the lagoon included the biotope *Phragmites australis* swamp and reed beds' SS.SMP.Ang.S4. Following Bamber *et al*. (1997) the subtidal biotopes in the lagoon would be ENLag.IMS.Ann and ENLag.Veg.

The biological communities appear to have remained relatively similar between the current survey and that of *Herbert et al.* (2010). There appears to have been a slight increase in biodiversity manifested through higher taxon counts at comparable stations, although given the increased number of sampling stations a full comparison across the entire lagoon was not feasible. Station BS8 appeared notably impoverished in regards to the biotic community relative to other sampling stations, which likely derives from its partial separation from the main lagoon. The presence of Capitella as a main species here suggests organic enrichment, possibly a result of bird excrement. Station BS12 was close to a sluice and to a site previously sampled qualitatively; it included species that reflect greater saline influence.

This preliminary condition of assessment based on historical data from Herbert *et al.* (2010) indicated that the lagoon has remained in similar condition over the last five or so years. The increased sampling stations in the current survey indicated a greater range of species than previously recorded and the results confirm that the lagoon is home to a range of lagoonal specialist taxa as well as a significant population of the nationally rare starlet anemone (*N. vectensis*).

2. Introduction

2.1 Background

Coastal saline lagoons are a Priority Habitat under the EU Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the “Habitats Directive”). As such, they can be features of sites conservation importance such as Special Areas of Conservation (SACs).

Natural England (NE) commissioned APEM to carry out a biological survey of the saline lagoon on Brownsea Island, within the Poole Harbour SPA and SSSI. Coastal lagoon communities are a key attribute of the SPA and SSSI coastal lagoon features and include lagoon specialist species and habitats for birds. Coastal lagoons have been recognised as habitat of biodiversity importance and as such recognised by the UK former Biodiversity Action Plan.

Brownsea Island is located within the centre of Poole Harbour. The saline lagoon is on the north east side of Brownsea Island and extends about 800 m north to south, adjacent to the coast (Main Channel of Poole Harbour); it is about 400 m wide. The island is a particularly important feeding and roosting area for wintering birds as well as the only known nesting site for sandwich terns and common terns in the harbour.

The lagoon is primarily managed by the Dorset Wildlife Trust. Water exchange within the lagoon is managed via a sluice in the south-eastern corner of the lagoon and on the east side by a wind-pump. The lagoon is fed by small streams that discharge through reed beds into the west side of the lagoon. Water levels rarely exceed 0.3m across the lagoon.

This interpretative report outlines the methods used, survey area and sampling design, the results of the sampling undertaken and provides an initial assessment of feature condition against historical data.

2.2 Objectives

The aim of the Project was to establish the condition of the biotopes and communities of the lagoon and compare with previous studies, with reference to Common Standards Monitoring (CSM) (lagoons). The survey plan was to record and map marginal and submerged biotopes, species composition of conspicuous biota, open water nekton, vegetation and associated fauna and benthic habitats, as well as granulometry and salinity data from the subtidal habitats. The specific objectives of the survey were to:

i) carry out a Phase I habitat and biotope survey;
ii) carry out quantitative (Phase II) sampling of the lagoon at suitable locations;
iii) conduct a range of water quality measurements;
iv) undertake *in situ* counts of marine megafauna such as birds and fish;
v) record any species amongst the vegetation; and
vi) record anthropogenic influences impacting on identified features.

2.3 Historical data

The most recent biological survey of Brownsea Island Lagoon was by Bournemouth University in 2009 (Herbert *et al.,* 2010). At each of six stations across the lagoon, they made *in situ* records of salinity and biota from submerged vegetation and sweep net samples, and collected three 10 cm diameter cores for benthos and a 6 cm diameter core for granulometry. English saline lagoons including Brownsea Island Lagoon were reviewed by Smith & Laffoley (1992) and Downie (1996) and Bamber (1997).

3. Methods

The proposed survey approach focused on developing a cost effective sampling strategy using qualitative Phase I and quantitative (Phase II) sampling techniques. The survey design aimed to obtain standardized information on the features of the lagoon including extent, barrier condition, sources of freshwater or saline inputs and also the habitat features and marine communities present within the lagoon environment.

The surveys were completed on the 15th and 16th September 2015.

3.1 Survey permissions

Access permissions for the survey were initially researched by Natural England. APEM liaised with Dorset Wildlife Trust manager Chris Thain for site access, use of their punt and to agree survey timing. It was agreed to mitigate disturbance to local wildlife, bird watchers and tourists visiting the island by avoiding intensive activity during midday (between 10.30 and 16.00).

A license (L/2015/00303) to collect protected species (*Nematostella vectensis*, *Gammarus insensibilis*, *Victorella pavida*, *Tenellia adspersa*), that may potentially have been present in *the* lagoon samples, was obtained from the Marine Management Organization (MMO). Another license (2015-14687-SCI-SCI) was obtained from Natural England for potential intertidal disturbance.

3.2 Survey design

3.2.1 Sampling locations

Aerial imagery, provided by Natural England, was used to produce preliminary wire-frame maps of the distribution of broad scale habitats in preparation for Phase I mapping (Wyn *et al.,* 2006). They also helped to identify appropriate sampling points and help consider access locations across the sites for the field team to use.

Phase I biotope mapping was carried out to provide 100% coverage of the lagoon. Detailed records and samples were collected from 12 stations via Phase II survey. A preliminary map of proposed sampling stations was provided to Natural England before the survey. Further details can be found in the full field report (Worsfold *et al.,* 2015).

The final design included some flexibility in case more suitable or interesting locations were noted in the field during the Phase I survey work. Additionally it was noted that some station positions may require alteration in the field, in preference to those originally proposed, due to considerations of access. The final station array was therefore decided by the lead surveyor *in situ* and all final sampling locations were located using a handheld GPS. Additionally the Dorset Wildlife Trust site manager for Brownsea Island Lagoon, Chris Thains, joined the survey team to provide detailed local knowledge, including advice for any relocation of sampling locations.

The 12 actual stations that were sampled are indicated below in Figure 1 with coordinates presented in Table 1. Projected coordinate system for the eastings and northings was British National Grid (OSGB 1936).

Table 1: Final sampling locations for Brownsea Island lagoon survey

Station	Easting	Northing
BS1	402753	88373
BS2	402964	88378
BS3	403070	88238
BS4	403098	87952
BS5	403153	87890
BS6	402767	88142
BS7	402931	88291
BS8	403109	88101
BS9	403019	87747
BS10	402764	87983
BS11	402792	87959
BS12	403141	87786

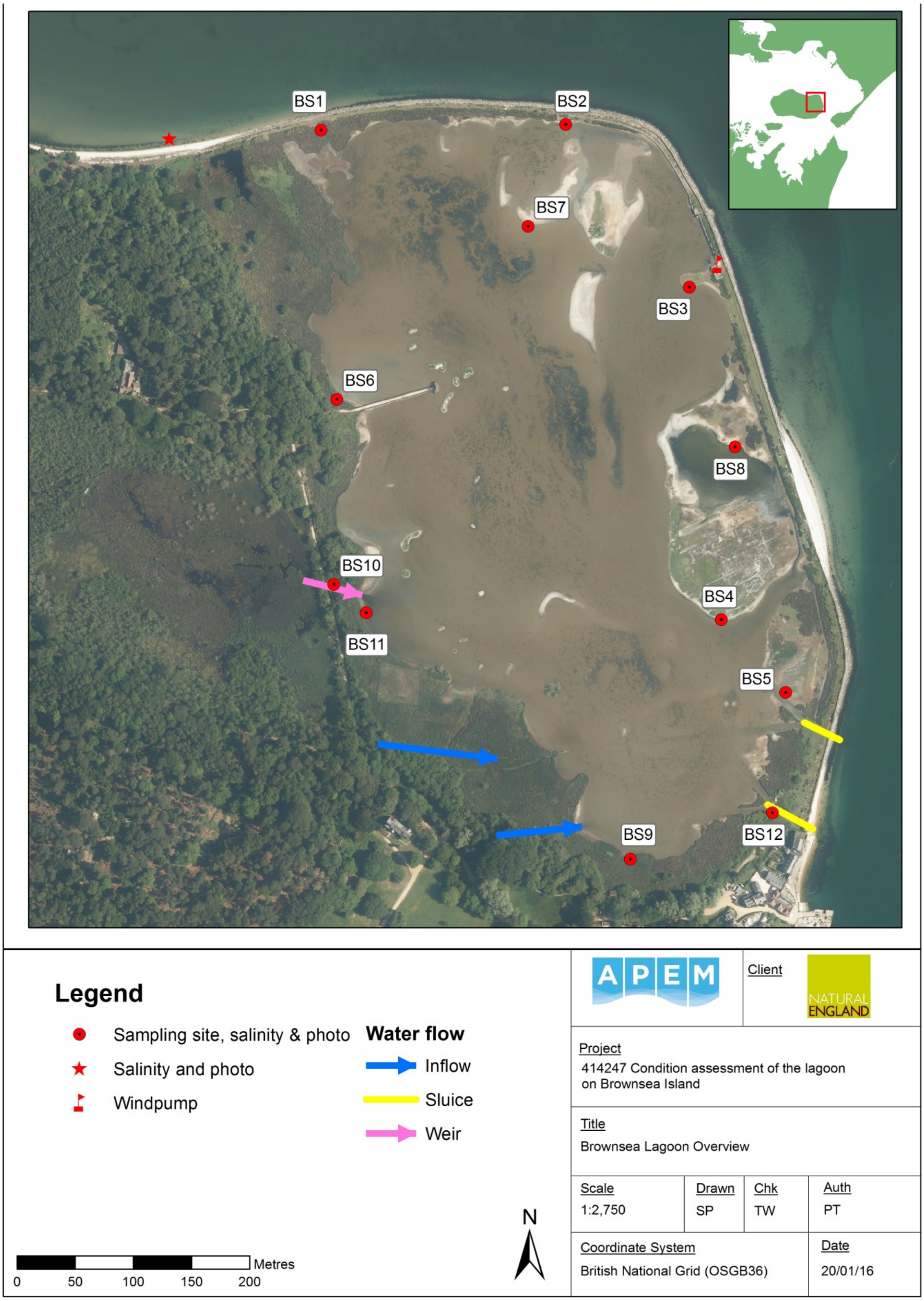

Figure 1: Locations of sampling stations within the Brownsea Island lagoon

3.3 Survey design

3.3.1 *Phase I survey*

The Phase I survey recorded the range and extent of biotopes present in intertidal areas by assigning biotopes *in situ* with reference to standard guidance (Wyn *et al*. 2006) and using standard biotope descriptions, as applicable (Connor *et al*. 2004, Parry 2015). A hand held GPS (accuracy 5 m or better) was used to plot the positions of biotope boundaries, photographs, *in situ* records and sampling points.

A broad habitat description was provided for the lagoon, using standard JNCC Marine Nature Conservation Review (MNCR) survey and site forms. Photographs were taken to show the entire perimeter, as well as survey activity, samples, conspicuous biota and any anthropogenic influences.

Notes were made on the wire frame maps providing details including location, main habitat and substratum types, depth range, aspect, perimeter, and conspicuous biota. A hand-held refractometer (Barsoom Automatic Temperature Compensation Salinity Refractometer) was used to measure salinity and a calibrated multiparameter probe (HM Digital ORP-200 Waterproof Meter) to measure temperature, pH and water column redox potential. Biotopes were mapped using GPS and photographs and additional qualitative salinity and species records were also made on the maps.

The type of lagoon and the condition of the sluice gates were recorded as part of the site assessment. This included an indication of sluice gate location, water inputs/outputs, directions of water flow and characteristics of the isolating barrier. These records were supplemented with input from the management teams of each lagoon, either in the field or by telephone. In addition to recording salinity, pH, temperature and redox within the lagoon and at significant points around the lagoon; measurements were also taken from the sea outside of the lagoon (i.e. within Poole Harbour to provide a comparison).

Potential anthropogenic pressures were identified and recorded (where applicable, GPS coordinates of the potential pressures were noted).

Conspicuous biota were recorded in the field, on a SACFOR scale, for submerged and emergent habitats. Target notes were made regarding the presence of any megafauna (e.g. birds, dragonflies). Habitats not targeted for quantitative sampling, such as logs and reeds at the water's edge, were examined for conspicuous biota. Particular attention was given to protected, invasive and non-native species, such as starlet sea anemones (*Nematostella vectensis*) (Reitzel *et al.,* 2008). Species that could not be readily identified in the field were retained for later identification in APEM's laboratories.

3.3.2 *Phase II survey*

At each Phase II sampling station, the following data were recorded:

- Date;
- Time;
- Position (using hand held GPS);
- Depth (recorded for each core sample);
- Substratum type;

- Anthropogenic influences
- Water column redox, salinity, temperature and pH

Images were also taken of the station location, any conspicuous biota and the samples collected.

Sampling at each station comprised the following with details including the number of replicates provided below:

- Taking records of submerged vegetation and its associated fauna;
- Sweep net samples for nekton; and
- Core samples for benthos and particle size distribution

Fauna amongst vegetation

Submerged vegetation was not extensive but qualitative samples were examined for attached fauna at some stations. Collection of some samples was required for confirmation of the plant taxa present and for more comprehensive species lists. Small portions of vegetation were also found in some of the sweep net samples.

Sweep net samples

Sweep net samples were collected by making three broad sweeps at arm’s length (Figure 2), using a standard (0.5 mm mesh) pond net to make a single sample. One sample was collected from three steps out into the water at each station. In practice, it was found necessary to preserve and take these samples to the laboratory for accurate identification and realistic abundance data, which was recorded using the SACFOR scale (Hiscock, 1996). The net was washed in the lagoon between samples and examined between stations to avoid contamination.

Figure 2: Sweep net sampling at Station BS9

Coring survey

Quantitative subtidal core samples were collected using a 0.01 m^2 hand held core pushed into the sediment to a depth of 15 cm (Dalkin & Barnett 2001). Core sampling was based on the methodologies within the Marine Monitoring Handbook (Davies *et al.* 2001) which are directly referenced within the CSM guidance. Three core samples were taken the same depth at each station for biological analysis.. The corer was washed in the lagoon between samples and examined between stations to avoid contamination. Each sample was placed into a robust plastic bag, labeled and photographed before being sealed for later processing. Within 24 hours of collection, the biological core samples were sieved over a BS410 standard 0.5 mm mesh and preserved in buffered 4% formaldehyde solution. Samples were processed in accordance with the National Marine Biological Analytical Quality Control Scheme (NMBAQC) best practice guidance for sample collection, preservation, tracking and transportation for invertebrate samples (Worsfold & Hall 2010). The samples were then couriered to the third party analytical laboratories.

Figure 3: PSA sample from Station BS2

One additional core sample was collected at each station for particle size analysis (PSA). This sample was collected from one step in from the margin and placed into a dedicated, labelled sample container, supplied by National Laboratory Services (NLS). The PSA samples were frozen within 24 hours of collection and kept frozen until transportation to NLS for analysis. NMBAQC guidance for sample collection, preservation, tracking and transportation for PSA samples was followed (Mason 2011).

3.4 Laboratory processing

3.4.1 Macrobiota

To standardise the sizes of organisms recorded, and to separate preservative from the biota, all samples were washed over a 0.5 mm sieve in a fume cupboard. All biota retained in the sieve were then extracted, identified and enumerated, where applicable.

Taxa were identified to the lowest possible practicable taxonomic level using the appropriate taxonomic literature. For certain taxonomic groups (e.g. nemerteans, nematodes, and certain oligochaetes), higher taxonomic levels were used due to the widely acknowledged lack of appropriate identification tools for these groups. The National Marine Biological Analytical Quality Control (NMBAQC) Scheme has produced a Taxonomic Discrimination Protocol (TDP) (Worsfold & Hall 2010) which gives guidance on the most appropriate level to which different marine taxa should be identified, and this guidance was adhered to for the laboratory analysis. Where required, specimens were also compared with material maintained within the laboratory reference collection. Nomenclature followed the World Register of Marine Species (WoRMS), except where more recent revisions were known to supersede WoRMS.

All samples were subject to internal quality assurance procedures and, following analysis, were subject to formal Analytical Quality Control (AQC).

3.4.2 *Particle Size Analysis*

Sub-sampling and PSA was performed in accordance with NMBAQC Best Practice Guidance (Mason 2011), with the modification that the wet separation was performed at 2 mm rather than 1 mm, to determine the ‘gravel’ to ‘sand and mud’ proportions by weight. A combination of dry sieving and laser diffraction was used depending upon the characteristics of the sediment.

3.5 Data analysis

3.5.1 *Particle Size Distribution*

The particle size data from all survey replicates were combined as consistent size fractions and entered into GRADISTAT (Blott & Pye 2001) to produce sediment classifications, following Wentworth (1922) and Folk (1954) (Figure 4). Summary statistics were also calculated including mean particle size and sorting (Table 4). The full raw data set is presented in Appendix 1.

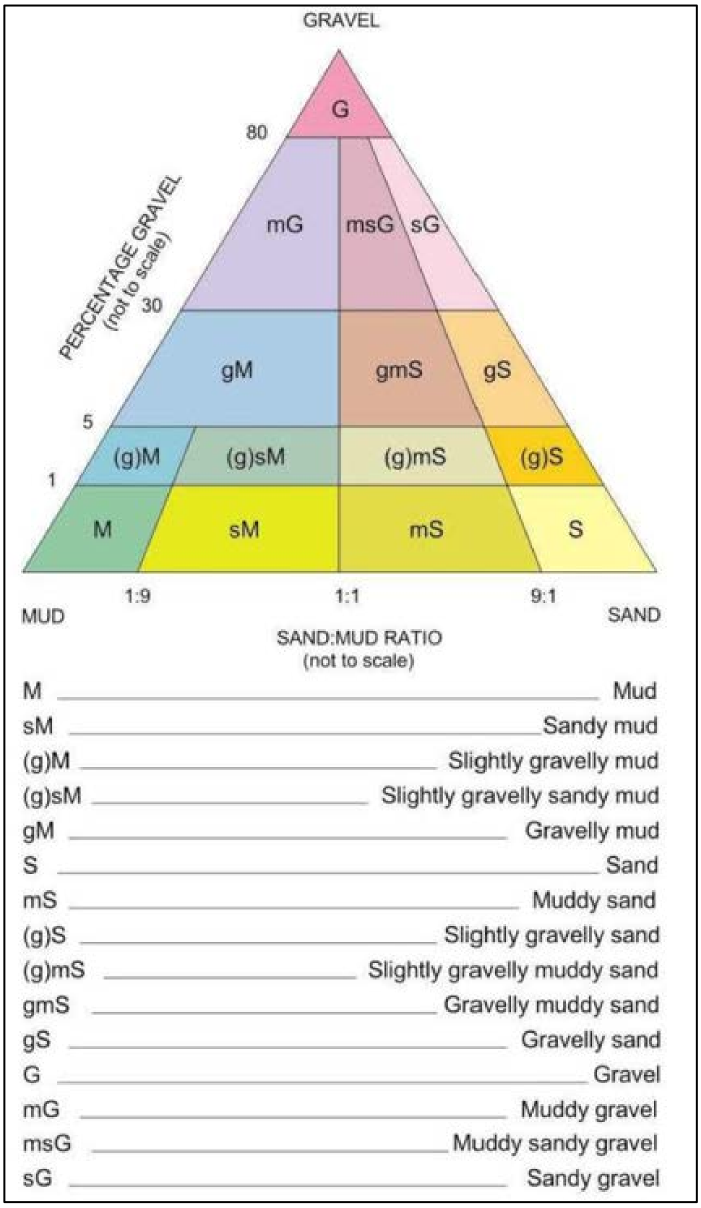

Figure 4: Folk sediment classification pyramid (Folk, 1954).

3.5.2 Macrobiota

Truncation of the macrobiota data was undertaken before calculation of univariate and multivariate statistics. Juveniles were combined with adults of the same recorded taxon name for calculation of numbers of taxa and epitokes were also combined for the same taxon name.

For analyses based on numbers of individuals, non-countable taxa, copepods, fish and fragments of individuals were also omitted from analysis.

3.5.3 *Univariate analysis*

Univariate community analyses were undertaken using the PRIMER (version 6) software package. Biological diversity within a community was assessed based on taxon richness (total number of taxa present) and evenness (considers relative abundances of different taxa). The following metrics were calculated:

- **Shannon-Wiener Diversity Index (*H'*(log$_e$):** This is a widely used measure of diversity accounting for both the number of taxa present and the evenness of distribution of the taxa (Clarke & Warwick 2006).

- **Margalef's species richness (*d*):** This is a measure of the number of species present for a given number of individuals.

- **Pielou's Evenness Index (*J'*):** This represents the uniformity in distribution of individuals spread between species in a sample. High values indicate more evenness or more uniform distribution of individuals. The output range is from 0 to 1.

- **Simpson's Dominance Index (1-λ):** This is a dominance index derived from the probability of picking two individuals from a community at random that are from the same species. Simpson's dominance index ranges from 0 to 1 with lower values representing a more diverse community without dominant taxa.

Where mean values have been calculated per station, the standard deviation has been provided.

3.5.4 *Multivariate analysis*

Macrofaunal data were subjected to multivariate analysis using the PRIMER (version 6) software package (Clarke & Warwick 2006).

Multivariate analyses were computed from resemblance or similarity matrices. The particle size data resemblance matrix was calculated using Euclidean Distance following normalisation. For the macrofaunal data set, the Bray-Curtis measure of similarity was used following a square root transformation of the data to reduce the influence of highly abundant or dominant species.

Cluster Analysis

CLUSTER analysis was utilised to provide a visual representation of sample similarity in the form of a dendrogram. CLUSTER analysis was conducted in conjunction with a SIMPROF (similarity profile) test to determine whether groups of samples were statistically indistinguishable at the 5% significance level, or whether any trends in groupings were apparent. Black lines on the dendrogram indicate statistical distinctions between sampling stations, whilst red lines indicate that the samples were statistically inseparable.

Non-Metric Multidimensional Scaling (nMDS)

Non-metric multidimensional scaling (MDS) is a type of ordination method which creates a 2- or 3-dimensional 'map' or plot of the samples from the Primer resemblance matrix. The plot generated is a representation of the dissimilarity of the samples (or replicates), with distances between the replicates indicating the extent of the dissimilarity. For example, replicates that are more dissimilar are further apart on the MDS plot. No axes are present on the MDS plots as the scales and orientations of the plots are arbitrary in nature.

Each MDS plot provides a stress value which is a broad-scale indication of the usefulness of plots, with a general guide indicated below (Clarke & Warwick, 2006):

<0.05	Almost perfect representation of rank similarities;
0.05 to <0.1	Good representation;
0.1 to <0.2	Useful representation;
0.2 to <0.3	Should be treated with caution;
>0.3	Random.

SIMPER

Where differences between groups of samples were found, SIMPER analysis (in Primer v6) was used to determine which taxa were principally responsible for the differences between the statistically distinct groups of stations. The aim was to characterise the typical assemblage responsible for the grouping.

4. Results

4.1 Phase I survey

Across the lagoon and its margins, a total of eight biotopes were recorded (Table 2) with further detail of their distribution provided in Section 4.1.2.

Table 2: Biotopes recorded during the survey

JNCC Biotope	EUNIS Code	EUNIS Level 2	EUNIS Level 3	EUNIS Level 4	EUNIS Level 5	EUNIS Level 6	Area (Ha)	Name
LS.LMu.#	A2.3#	A2	A2.3	-	-	-	0.675	Littoral mud. Undescribed lagoonal biotope
LS.LMx.#	A2.4#	A2	A2.4	-	-	-	0.003	Littoral mixed sediments. Undescribed lagoonal biotope
LS.LMp Sm.SM8	A2.5513	A2	A2.5	A2.55	A2.551	A2.5513	1.359	*Salicornia* spp. pioneer saltmarshes
LS.LMp.Sm.#	A2.547	A2	A2.5	A2.54	A2.547	-	0.164	Sub-communities of *Puccinellia maritima* saltmarsh with *Limonium vulgare* and *[Armeria maritima*. Variant dominated by *Armeria maritima*
SS.SMu.SMu LS	A5.31	A5	A5.3	A5.31	-	-	15.833	Sublittoral mud in low or reduced salinity (lagoons)
SS.SMp.Ang. NVC S4 and LS.LMp.Sm.#	A5.541 and A2.53C	A5 and A2	A5.5 and A2.5	A5.54 and A2.53	A5.541 and A2.53C	-	6.220	*Phragmites australis* swamp and reed beds / Marine saline beds of *Phragmites australis*
SS.SMp.KSw SS.#	A5.52#	A5	A5.5	A5.52	-	-	1.315	Kelp and seaweed communities on sublittoral sediment (undescribed biotope with *Gracilaria* sp. on lagoonal mud)
LS.LMp.Sm.#	A2.53#	A5	A5.5	A5.53	-	-	1.295	Saltmarsh (*Bolboschoenus maritimus* stands)

'#' = variant biotope

4.1.1 Physical structure and management

Brownsea Island lagoon is a percolation lagoon with movement of water through the gravel below the dyke between the lagoon and adjacent littoral habitats. The dyke extended along about half the perimeter of the lagoon to the north and east. The lagoon was originally created by the building of this dyke to enclose an area that was previously agricultural or estuarine. There were also two sluices to the southeast (Figure 5) that provided more direct connection to the sea. There was woodland, marsh and freshwater pools to the west with several inputs of fresh water along the western margin of the lagoon (Figure 6). The extent of the lagoon basin determined from aerial imagery was calculated in GIS to be 16.7 Ha.

Figure 5: A sluice at Brownsea Island Lagoon

Figure 6: Freshwater input at Brownsea Island Lagoon

4.1.2 Ecological characteristics

The main body of the lagoon was dominated by a biotope in the complex: Sublittoral mud in low or reduced salinity (lagoons) SS.SMu.SMuLS (Connor *et al*. 2004) that included large numbers of the Starlet anemone (*Nematostella vectensis*) (Figure 7). There were also patches of *Gracilaria* embedded in and growing out from the mud that represented an undescribed biotope in the complex SS.SMp.KSwSS: kelp and seaweed communities on sublittoral sediment.

The lagoon margin especially along the western boundary of the lagoon included the biotope *Phragmites australis* swamp and reed beds' SS.SMP.Ang.S4, where there was standing water around the reeds; this graded into LS.LMp.Sm (A2.53C) marine saline beds of *Phragmites australis* in the drier areas. The lagoon margins also included occasional patches of sea club rush (*Bulboschoenus maritimus*), as a biotope not yet defined in the literature. There were also areas with two other saltmarsh communities; some were dominated by samphire (*Salicornia ramosissima*), a biotope closest to LS.LMp Sm.SM8: *Salicornia* spp. pioneer saltmarshes; another was dominated by *Armeria maritima* and did not fit any described biotope well but was close to A2.547: Sub-communities of *Puccinellia maritima* saltmarsh with *Limonium vulgare* and *Armeria maritima*. At the waters edge, there were patches of bare mud and muddy sand, particularly in areas intensively used by water birds. These have been recorded as littoral, although the variability in their cover by water was more likely to have been determined by weather conditions or management systems than by the tides.

An alternative classification system is referred to in the Condition Assessment Guidance for lagoons based on Bamber *et al*. (1997) which refers to lagoon biotopes as ENLag.Veg or ENLag.IMS.Ann and variations thereof (for full detailed list of classification see Appendix 2) . Following Bamber *et al*. (1997) the subtidal biotopes in the lagoon would be ENLag.IMS.Ann and ENLag.Veg. ENLag.IMS.Ann is characterised by an annelid worm dominated community. The annelids *Baltidrilus costatus* and *Tubificoides benedii* were abundant at most core sample stations and *Hediste diversicolor* was also common at several stations (see Section 3.2.4). The amphipod *Corophium volutator* and starlet anemone (*N. vectensis*) were also widespread and common.

The biotope ENLag.Veg is characterised by a community associated with submerged vegetation, irrespective of substratum or plant species. Submerged vegetation comprised patches of *Chaetomorpha linum* and *Gracilaria* cf. *vermiculophylla*, with occasional *Ulva* spp. on the margins. These supported cryptofauna, such as *Monocorophium insidiosum*, *Idotea chelipes* and *Melita palmata*. Sweep net samples also included *I. chelipes*, starlet anemone (*Nematostella vectensis*) and other benthic species (incidental catches from the sediment), as well as the lagoon prawn *Palaemon varians*.

There were many birds in and around the lagoon, including spoonbills, oystercatchers, mute swans, moorhens, common and sandwich terns. There were occasional pieces of wood at the margin with talitrids (*Orchestia gammarellus*) and enchytraeid oligochaetes. Data for the sweep net and core samples are provided in Section 4.2.2 below.

4.1.3 Anthropogenic influences

Anthropogenic influences were not great at Brownsea lagoon. The lagoon was separated from marine habitats to the north and east by a narrow dyke. There were walkways around many parts of the lagoon and many visitors. There was evidence of restructuring of islands for bird use and bird hides were present. There was very occasional litter, including fishing tackle.

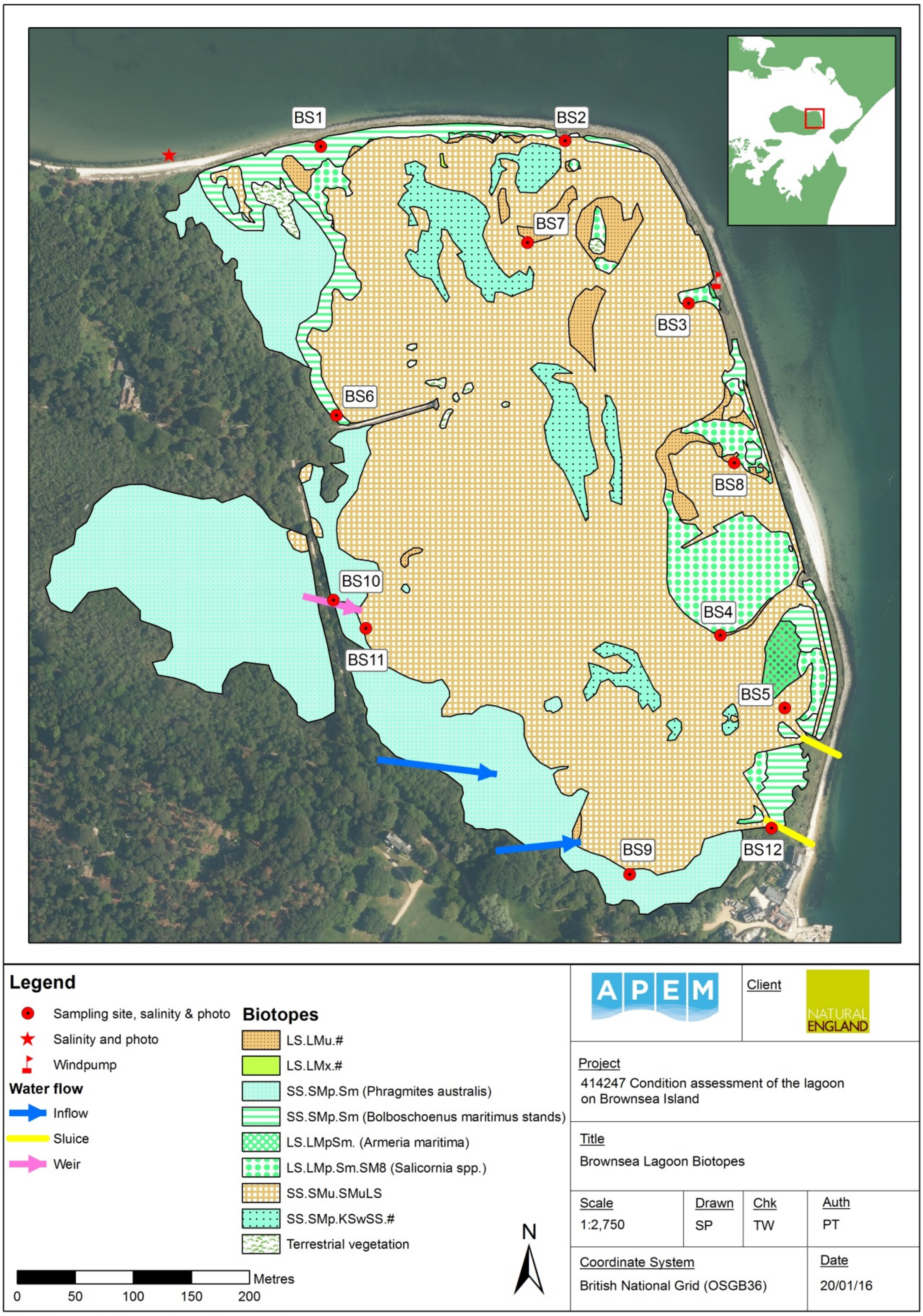

Figure 7: Biotopes recorded within the Brownsea Island lagoon

4.2 Phase II survey

Three core samples and single PSA samples were obtained and photographed at twelve sample sites, along with sweep net samples. Five stations (BS1 to BS5) were repeated from the previous survey. Although also targeted, Station BS6 could not be sampled as it was positioned at the end of a jetty; the jetty was entirely fenced off to create a secluded bird hide so that the original station could only have been accessed by wading from the shore; it was also disturbed by dredging (C. Thain pers comm.). Six new stations (BS7 to BS12) were added to cover a range of habitats.

The new Station BS8 provides characterisation of a pool that was partially separated from the main lagoon, with a different character. The new Stations BS10 and BS11 characterised a point of freshwater input: one in the input channel, one near it in the main lagoon. Samples were collected at water depths between 3 cm and 20 cm.

4.2.1 Physico-chemical characteristics

Salinity ranged from 3 at Station BS11 to 30 at Station BS8. Lower salinity was recorded at Stations BS9 and BS10 (5 and 4 respectively). These lower salinity stations were typically furthest from the sea and had some freshwater inputs in places. In contrast, all other stations were ≥20, except Station BS6 (15). To provide context, salinity recorded outside of the lagoon (see Figure 1 for location) at 16:20 on the 15th September on a falling tide was 35.

Temperature across the lagoon sampling stations varied from 13.3°C at Station BS5 to 18.9°Cat Station BS1. Higher temperatures were also recorded at BS2 (17.8°C) and BS12 (18.8°C) with all remaining stations ≤15.2°C.

Redox measurements taken across the lagoon were shown to be variable in nature, ranging from -63 mV at Station BS5 to 160 mV at Station BS1. Stations BS8 and BS9 were the only other two locations to record negative values for redox. Overall redox values were typically highest amongst those stations located around the North West area of the lagoon. Full water quality data is presented in Appendix 3.

Mean particle size ranged from 3508.0 µm at Station BS4 to 36.0 µm at Station BS9. Very high mean particle size was also recorded at Station BS3 (2417.2 µm) with all other stations below <200µm mean particle diameter. Both BS3 and BS4 were extremely poorly sorted and found to comprise 56.5% and 57.1% gravel with all other stations ≤15.8%, and the majority below 1%. These locations were either poor or very poorly sorted. All stations except BS3 and BS4 were described as either gravelly or slightly gravelly sandy mud or muddy sand. Station BS3 was found to be muddy gravel and BS4 was muddy sandy gravel. Raw sediment sample data is presented in full in Appendix 1.

Table 3: Physicochemical data recorded at each sample station.

Station	Water depth (cm)	Salinity	Redox (mV)	Temp (°C)
BS1	9	20	160	18.9
BS2	12	22	132	17.8
BS3	15	22	103	13.1
BS4	11	20	57	15.2
BS5	3	35	-63	13.3
BS6	3	15	141	13.6
BS7	6	22	89	14
BS8	9	30	-13	14.7
BS9	7	5	-11	14.2
BS10	20	4	40	14
BS11	16	3	19	14
BS12	-	20	79	18.8

Table 4: Particle Size Analysis data recorded at each sample station.

Station	Mean (µm)	Gravel (%)	Sand (%)	Mud (%)	Folk*	Sorting
BS1	59.3	0.8	49.3	49.9	(g)sM	Very poor
BS2	41.2	0.5	38.9	60.6	(g)sM	Poor
BS3	2417.2	56.5	19.1	24.5	mG	Extremely poor
BS4	3508.0	57.1	26.8	16.1	msG	Extremely poor
BS5	121.9	2.7	61.8	35.5	(g)mS	Very poor
BS6	43.8	0.4	38.9	60.7	(g)sM	Very poor
BS7	199.3	0.8	76.0	23.1	(g)mS	Very poor
BS8	165.7	15.8	49.4	34.9	gmS	Very poor
BS9	36.0	0.3	33.8	65.9	(g)sM	Very poor
BS10	116.1	12.3	49.3	38.4	gmS	Very poor
BS11	59.9	0.4	49.2	50.4	(g)sM	Poor
BS12	117.4	10.3	50.2	39.5	gmS	Very poor

* Folk (1954) classifications: mG = muddy gravel; msG = muddy sandy gravel; (g)sM = Slightly gravelly sandy mud; gsM = gravelly sandy mud; (g)mS = Slightly gravelly muddy sand

4.2.2 SACFOR data from sweep nets

The number of taxa recorded in sweep net samples at stations ranged from three to nine (Appendix 4). The most commonly sampled species in sweep net samples from Brownsea Island lagoon was the cryptogenic lagoonal specialist *Monocorophium insidiosum* (recorded in ten samples), whilst the nationally rare starlet anemone *Nematostella vectensis, Corophium volutator* and *Ecrobia ventrosa* (spire snail) were recorded across eight samples. Both the latter two taxa are known lagoonal specialists. *M. insidiosum* was found to be superabundant at Stations BS1, BS4 and BS5 but was absent from BS6, BS10 and BS11. *Nematostella* was present in superabundance at Stations BS1, BS5 and BS9 but absent entirely from BS2, BS6 and BS10 through BS12. The full raw data from the sweep net samples are provided in Appendix 4.

4.2.3 Population summary statistics from core samples

Raw data from the core samples are provided in Appendix 5.

The mean number of taxa within the Brownsea Island lagoon stations ranged from 2.7 ± 1.5 SD at Station BS8 to 14.7 ± 4.0 SD at Station BS3. The mean number of taxa remained >10.0 at almost 50% of sampling stations (BS1, BS4, BS5 and BS12). Low taxon abundance was also recorded at Stations BS10 and BS11, both located along the western perimeter of the lagoon and targeting freshwater input areas.

Trends in mean abundance broadly followed trends in taxon richness across most stations. One exception was that, despite having by far the lowest taxon richness, Station BS8 had a greater mean abundance than either Station BS10 or BS11. However, despite an abundance of 3,733 individuals per m^2, Station BS8 also had an extremely high SD relative to other sampling stations (± 3,731 SD). Shannon-Weiner index values for diversity suggested that, within the lagoon, communities were generally not particularly diverse and in some instances were notably impoverished. The greatest diversity was recorded at Stations BS3 and BS4 (2.0 ± 0.2 and 0.1 SD respectively) to just 0.3 ± 0.2 SD at BS8.

The results for the Pielou's Evenness and Simpson's dominance indices indicated that the evenness of the benthic communities varied with low evenness recorded at Station BS8, providing evidence that a small number of taxa dominated assemblages at this location (Table 5). With the exception of Station BS8, both evenness and dominance values became much more comparable amongst remaining sampling stations. This indicated that across much of the lagoon benthic communities were generally well distributed, but within the vicinity of BS8, which was partially separated from the main body of the lagoon, the community was less well distributed.

Table 5: Population summary statistics data for each sample station. SD, Standard Deviation

Station	Mean no. taxa (number ± SD)	Mean abundance (m^2, ± SD)	Margalef's species richness (*d*)	Mean Pielou's Evenness (*J'*)	Mean Shannon Wiener Diversity (*H'*(log_e))	Mean Simpson's Dominance (1-λ)
BS1	10.0 ± 3.0	20,400± 10,484	1.7 ± 0.4	0.73 ± 0.04	1.7 ± 0.2	0.76 ± 0.07
BS2	9.0 ± 2.6	24,567 ± 11,558	1.5 ± 0.4	0.75 ± 0.08	1.6 ± 0.2	0.74 ± 0.05
BS3	14.7 ± 4.0	20,700 ± 9,379	2.5 ± 0.	0.76 ± 0.05	2.0 ± 0.2	0.82 ± 0.05
BS4	11.7 ± 2.5	41,000 ± 10,315	1.8 ± 0.5	0.84 ± 0.06	2.0 ± 0.1	0.85 ± 0.02
BS5	13.7 ± 1.5	49,767 ± 9,364	2.0 ± 0.3	0.67 ± 0.06	1.7 ± 0.1	0.71 ± 0.04
BS6	5.0 ± 1.0	14,633 ± 6,417	0.8 ± 0.3	0.55 ± 0.02	0.9 ± 0.1	0.49 ± 0.02
BS7	8.3 ± 2.1	22,033 ± 2,597	1.4 ± 0.4	0.66 ± 0.11	1.4 ± 0.1	0.64 ± 0.04
BS8	2.7 ± 1.5	3,733 ± 3,731	0.4 ± 0.4	0.23 ± 0.20	0.3 ± 0.2	0.13 ± 0.12
BS9	6.0 ± 0.0	13,233 ± 4,562	1.0 ± 0.1	0.69 ± 0.09	1.2 ± 0.2	0.64 ± 0.07
BS10	3.3 ± 1.2	1,833 ± 1,361	0.9 ± 0.0	0.63 ± 0.25	0.7 ± 0.1	0.37 ± 0.07
BS11	3.3 ± 0.6	667 ± 252	1.3 ± 0.3	0.85 ± 0.09	1.0 ± 0.2	0.58 ± 0.07
BS12	13.0 ± 3.0	45,367 ± 23,093	1.9 ± 0.4	0.76 ± 0.01	1.9 ± 0.2	0.81 ± 0.03
Min	**2.7**	**667**	**0.8**	**0.23**	**0.3**	**0.13**
Max	**14.7**	**49,767**	**2.6**	**0.85**	**2.0**	**0.85**

4.3 Multivariate analysis of biological assemblages

Cluster analysis was initially run on the replicate data and a total of 8 SIMPROF groups were identified; in many cases replicates from the same stations were grouped together. To facilitate interpretation of the data, cluster analysis was run again using mean values per station and these results have been presented here. Cluster analysis of station data indicated that the communities of organisms present within core samples were separated into three distinct SIMPROF groups *a* to *c* (Figure 8). The accompanying MDS plot provides an alternative visual representation of the groupings observed in the cluster analysis (Figure 9). A stress value of 0.07 for the MDS plot indicates that it was a good ordination providing a useful visual representation of the data (Clarke & Warwick, 2001).

The plot indicates that Station BS8 (group a) was mostly dissimilar to all other stations sharing only *circa* 10% similarity; this was due to very low abundance at this station. However only 12% similarity was shared between the two remaining groups (*b* and *c*) indicating that in terms of the biological assemblages, these groups were also very dissimilar. Group *c* comprised Stations BS10 and BS11, which were located along the western perimeter of the lagoon and targeted sources of freshwater inputs. The remaining nine stations belonged to a single cluster group (b).

Only a handful of taxa were recorded across Stations BS10 and BS11 and SIMPER analysis indicated that Chironomidae, *Baltidrilus costatus* and *Tubificoides benedii* were important for the similarity of these two stations. Similarity within stations belonging to group *b* derived mainly from similar trends in *Nematotsella vectensis, B. costatus*, Corophiidae and *Hediste diversicolor*, contributing 64% of similarity. Differences in trends of these taxa thereby accounted for much of the dissimilarity between different clusters of stations. The most dissimilar Station of group b (BS12) was noticeably different in its biota, with a higher diversity of polychaete worms. The increased diversity of polychaetes may suggest some form of organic enrichment, although this was not visually apparent and remains difficult to verify absent any sediment chemistry analysis. It may also be that the mixed sediment type, in combination with other environmental parameters has created favourable conditions for more polychaete species.

Full data from the SIMPER analysis output is presented in Appendix 6.

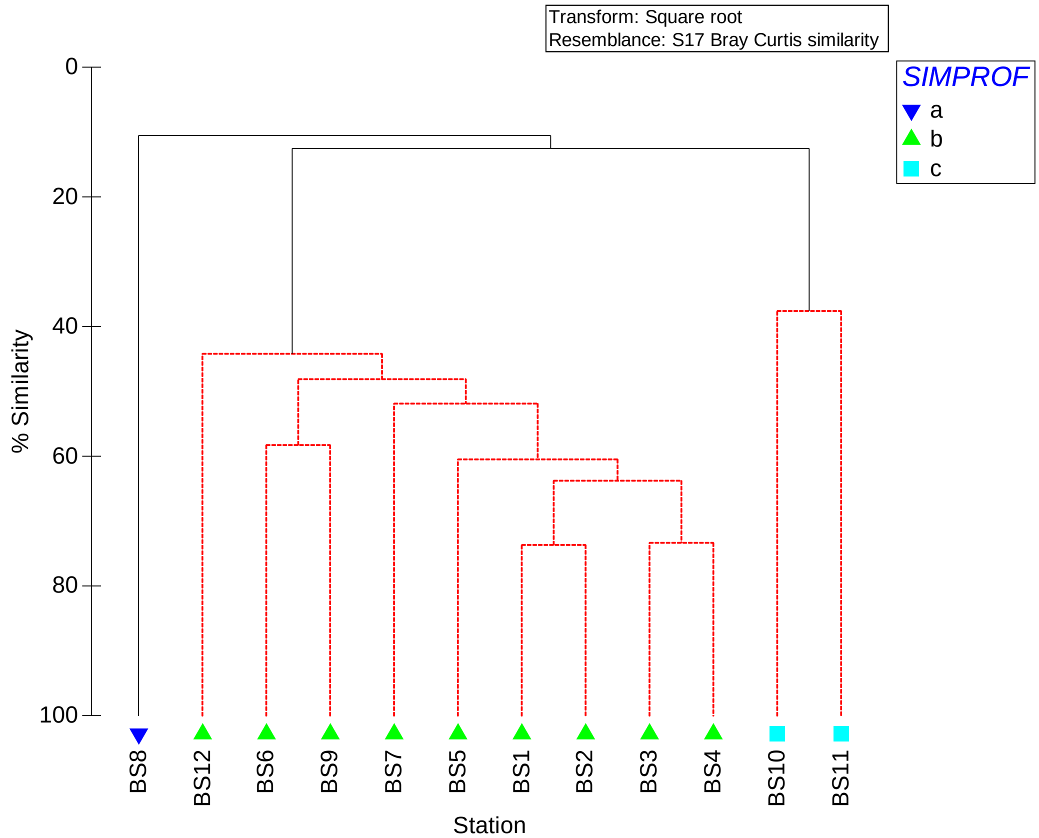

Figure 8: SIMPROF cluster dendrogram based on the square root transformed mean abundance data for each station

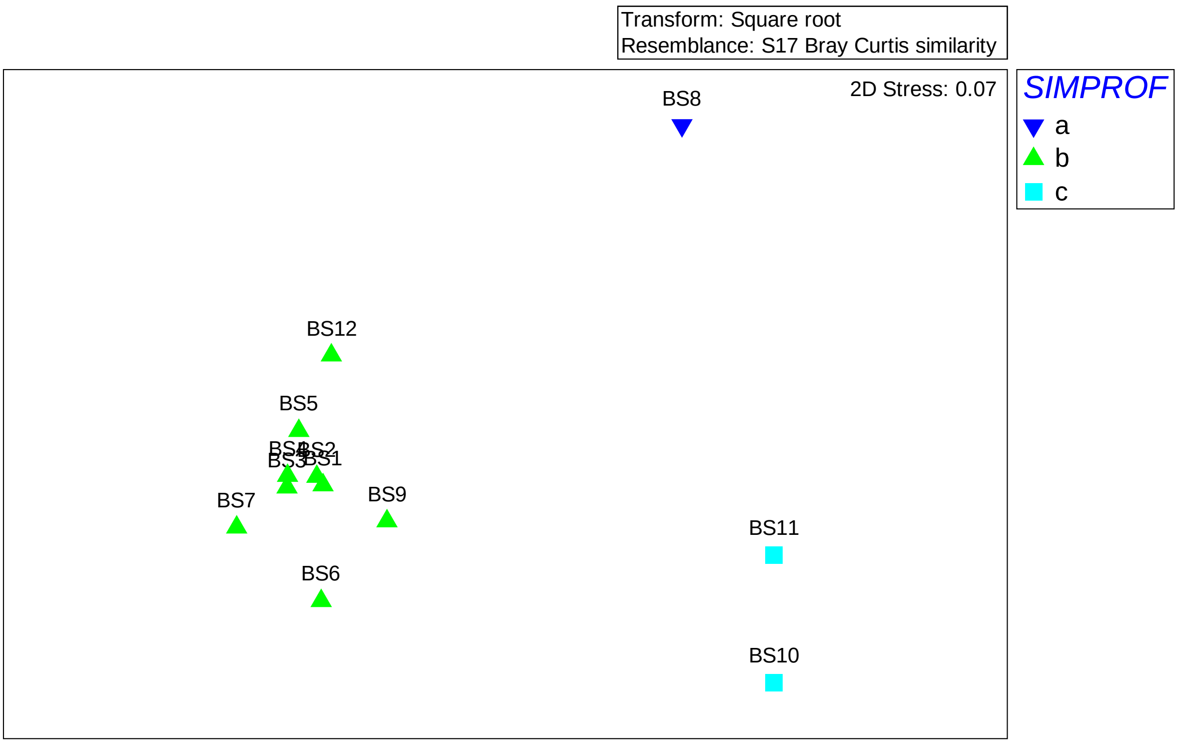

Figure 9: SIMPROF 2D Multidimensional Scaling (MDS) ordination based on the square root transformed mean abundance data for each station

4.4 Notable species

4.4.1 Non-native species

New records of non-native species are made for British waters in most years and the native status of many known species requires further research (Katsanevakis *et al.*, 2013). An initial review (Eno *et al.,* 1997) required update, using newly published papers and reviews for other countries (e.g. Gollasch & Nehring, 2006). The most recent review for Britain and Ireland (Minchin *et al.,* 2013) contains omissions; references to other information are necessary. The starlet anemone (*Nematostella vectensis*), found in the lagoon, has been shown to be non-native (Reitzel *et al.,* 2008) and the amphipod *Monocorophium insidiosum* should be considered cryptogenic, as it has a wide global distribution (Prato & Biandolino, 2006), including areas where it is considered non-native (Heiman *et al.,* 2008) and it is often associated with artificial habitats (Minchin, 2007). The polychaete genus *Streblospio* includes a non-native species (*S. benedicti*) that is very similar to the native *S. shrubsolii* and external confirmation would be desirable. The polychaetes *Polydora cornuta* and *Tharyx* 'species A' should also be considered cryptogenic. The New Zealand mud snail (*Potamopyrgus antopodarum*) was recorded at several stations. Confirmation of identity is needed for an alga recorded as *Gracilariopsis longissima* in 2009 (Herbert *et al.,* 2010), and found during the present survey (Figure 10), but which may be the non-native *Gracilaria vermiculophylla* (see Thomsen *et al.,* 2007).

Figure 10: Gracilariaceae observed at Station BS2

4.4.2 Species of conservation importance

The conservation value of many species is continually under review and more information on distribution and ecology is needed for most. Of the species found in the current survey, the starlet anemone (*N. vectensis*) is protected and classed as nationally rare (Sanderson, 1996). The Crustacea *Idotea chelipes*, *Monocorophium insidiosum* and *Palaemon varians* and the mollusc *Ecrobia ventrosa* are considered to be lagoon specialists.

4.4.3 Other noted species

The polychaete *Capitella*, found particularly at Station BS8 is considered representative of organic enrichment.

4.5 Comparison with historic data

The previous survey acquired samples from sampling locations BS1 to BS6; as BS6 was relocated during the current survey, discussions relating to changes since 2010 will focus primarily on Stations BS1 to BS5 (unless otherwise stated) which were sampled in the exact same location during 2015.

Salinity measurements from the current survey were found to be broadly comparable with those from the Herbert *et al.* (2010) survey with salinity across Stations BS1 to BS5 was found to range between 22 and 29 in 2010 (Herbert *et al.,* 2010). The range was slightly expanded for the current survey, between 20 and 35. The salinity range remained acceptable for supporting *N. vectensis* populations but remains close to the overall threshold at which mortality may be induced – 16 to 35 (Herbert *et al.,* 2010).

The previous study undertaken by Herbert *et al.* found sediment composition within the lagoon to be variable, with coarser sediments present along the eastern edge, whilst Station BS2 possessed finer sediments. Overall Herbert *et al.* (2010) concluded that stations were classified as either sand or muddy sand. Although many of the sampling stations within the current survey were either muddy or sandy in nature, there was an increase in gravel content with most sediments described as being slightly gravelly sandy mud or muddy sand, with Stations BS3 and BS4 classed as muddy gravel and muddy sandy gravel, respectively.

The current survey results indicated that 33 taxa were recorded from the acquired core samples across the entire survey area but, for Stations BS1 to BS5, this was reduced to 27 species. This was broadly comparable with the 23 species recorded from the core samples of Station BS1 to BS6 during the Herbert *et al.* (2010) survey, suggesting that diversity has remained relatively unchanged within the last five years. The slight increase may simply be a product of natural variation or may reflect the slightly greater variation in sediment types providing additional niche space to be occupied by a few new species.

Additionally, the 2010 report found an additional 4 species recorded in samples of seaweed and in net samples around the sluice. However, these were not noted to occur within the current survey data at Station BS12 located near the sluice. Within the resampled stations (BS1 to BS5) the fauna comprised 9 annelids, 10 crustacea, 3 mollusca and 4 other species including insect larvae and the Schedule 5 protected anemone species *N. vectensis*. The current data recorded a higher number of annelid taxa (10) but fewer crustacean taxa (seven) and the same number of mollusc taxa. However, there was an increase in the contributions of other taxonomic groups which included bryozoans, insects, nematodes and nemerteans. Overall the taxonomic composition has remained broadly similar since 2010.

In 2010 lagoonal specialist species such as *N. vectensis, Ecrobia ventrosa (formerly Ventrosia ventrosa)* and the amphipod crustaceans *Monocorophium insidiosum* (formerly *Corophium insidiosum*) and *C. volutator* were recorded. These lagoonal specialists were also recorded within the current survey.

Populations of *N. vectensis* were found to be greater during the current survey than was observed in 2010. Across Stations BS1 to BS5 in 2010 the mean abundance of *N. vectensis* was 3,217 per m^2, whereas for the current survey, it was 7,307 per m^2. Notably, there was significantly higher abundance for Stations BS3 and BS4 (almost ten times greater than in 2010), although all stations recorded increases of at least three times (Table 6).

Table 6: Comparison of current and historic abundances of *Nematostella vectensis*

Survey Year	BS1	BS2	BS3	BS4	BS5	Mean
2010	4,444	4,825	254	762	5,799	**3,217**
2015	2,933	1,367	2,033	6,000	24,200	**7,307**

Regarding the biotopes present within the Brownsea lagoon, using the ENLAG classification (Bamber *et al.,* 1997) the 2010 report identified two biotopes to be present; ENLag.Veg and ENLag.IMS.Ann. The same biotopes were also determined to be present for the current survey.

4.6 Assessment of change

The Brownsea lagoon lies within the Poole Harbour SPA and SSSI (Unit 57), but is not a SAC supporting habitat for a SPA and is not a SSSI of itself, and as such a formal assessment of condition could not be undertaken. However, based on the previous study by Herbert *et al.* (2010) as discussed above, an initial assessment of change can be formally made. This is presented below in Table 7.

Table 7: Standards for defining favourable condition for attributes of the Brownsea lagoon based on common Standards Monitoring Guidance against previous historical reports (Herbert *et al.* 2010)

Attribute	Common Standards Monitoring Target	Actual Value for Brownsea Island Lagoon	Is target met? Justification & Notable Comments (incl. comparisons with previous data)
Extent of feature	Maintain the following extents of lagoon feature: The extent of the lagoon identified by Herbert *et al.* in 2010 was 17.8 Ha.	The extent recorded in a GIS based on interpretation of aerial imagery collected in June 2014 was 16.7 Ha.	Yes. The extent recorded for the lagoon was slightly reduced compared to historical extent values but likely to be within the expected natural variability for the system. Furthermore, as the historic report did not clearly define how area was measured or calculated this result may be a product of considered this is likely due to human variability in interpretation/measurement of lagoon extent boundaries. Overall it should perhaps be considered that the extent of the lagoons has remained stable.
Extent of water	At least 60% of the basin filled with water at all states of the tide and all year.	There is little tidal fluctuation in the lagoon. Water depth is managed on site by the Dorset Wildlife Trust via a sluice in the south-eastern corner of the lagoon and on the east side by a wind-pump. The lagoon is fed by small streams that discharge through reed beds into the west side of the lagoon.	Yes At least 60% of the water of the lagoon persisting at all times of year and states of tide.
Isolating barrier – presence and nature	No change in structure of dyke. This will maintain the percolation route into the lagoon system. Sluices in good condition	The dyke appears stable and to be maintaining percolation into the lagoons. Sluices in good condition	Yes. The integrity of all sluices, connecting pipework and drains for the lagoon has been maintained and they are in good working condition. Percolation flow has been maintained where required.

Attribute	Common Standards Monitoring Target	Actual Value for Brownsea Island Lagoon	Is target met? Justification & Notable Comments (incl. comparisons with previous data)
Salinity regime	Average seasonal salinity, and seasonal maxima and minima, should not deviate significantly from an established baseline. Average salinity throughout a site would be expected to lie within a range of between 15 and 40.	Salinity within Brownsea lagoon ranged from 15 to 35.	Yes. Salinity within lagoons was within the range 15-40. It should also be noted that the salinity readings only indicate the conditions during the day of survey; the community living in the lagoon will be the result of an integration of the conditions over a longer period of time.
Water Depth	Average water depth should not deviate significantly from an established baseline, subject to natural change: Water depth at Brownsea lagoon not specified within the historic report.	Water depth was recorded at stations within the lagoon margins and was determined to be <30cm. Although sampling within the centre of the lagoon was not feasible, visual observations indicated water level to be even lower – with access restricted due to the muddy conditions and a lack of water preventing use of a punt to access the centre of the lagoon. Consequently, depth data indicates a maximum depth of 30cm, with average depth impossible to determine	Cannot be confirmed. Data collected not sufficient to assess as a reference baseline was not available. Data produced by the current study can be used as partial evidence to define baseline in the future.
Biotope composition of lagoon	Maintain the variety of biotopes identified for the site, allowing for succession/ known cyclical change: Herbert *et al.* (2010) observed ENLag.IMS.Ann and ENLag.Veg biotopes to be present.	ENLag.IMS.Ann and ENLag.Veg biotopes present.	Yes. The historically recorded biotopes are still the dominant biotopes within the lagoons.
Extent of sub-feature or representative/ notable biotopes	No change in extent of the biotope(s) identified for the site, allowing for succession/known cyclical change.	Extents of biotopes mapped during the survey based on aerial imagery and *in situ* Phase I and Phase II survey can be calculated from the GIS outputs of the project.	Unknown, cannot be confirmed. Insufficient previous extent data are available to enable a robust comparison of sub-feature/biotope extent. The current study will form a baseline with

Attribute	Common Standards Monitoring Target	Actual Value for Brownsea Island Lagoon	Is target met? Justification & Notable Comments (incl. comparisons with previous data)
			which to assess this target in the future.
Distribution of biotopes	Maintain the distribution of biotopes, allowing for succession/known cyclical change.	Distribution of biotopes mapped during the survey based on aerial imagery and *in situ* Phase I and Phase II survey can be calculated from the GIS outputs of the project.	Unknown, cannot be confirmed. No previous data are available to enable a robust comparison of sub-feature/biotope distribution. The current study will form a baseline with which to assess this target in the future.
Species composition of representative 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. Expect to find following characterising species identified Herbert *et al.* (2010) *Nationally rare species:* Cnidaria: *Nematostella vectensis* *Lagoonal specialists:* Mollusca: *Ventrosa ventrosa* (currently *Ecrobia ventrosa*), Crustacea: *Corophium insidiosum* (currently *Monocorophium insidiosum*), *Corophium volutator*	Taxa recorded during the current survey are compared in detail with those recorded during previous surveys in Section 3.3 of this report. The same species found in Herbert *et al.* (2010) were noted to occur within the current survey data, including a range of lagoonal specialists taxa and the nationally rare *N. vectensis.* Abundance of these taxa was generally similar although there was some variation at certain locations for some taxa between the historic data and the current survey results. Overall, the species composition within the lagoon appeared to have remained similar. The addition of further sampling stations elicited a greater array of taxa than in Herbert *et al.* (2010).	Yes The key consideration is that the main community composition within lagoons remained consistent across surveys resulting in the allocation of the same notable lagoon biotopes as reported by Herbert *et al.* (2010). There appears to be some variation in invertebrate abundances at some of the stations with respect to specific characterising species identified in Herbert *et al.* (2010) but overall the composition remained similar and changes in abundance were typically positive, representing an increase since the previous survey. Variation between surveys is to be expected in terms of the types and number of taxa recorded due to differences in a range of factors including sampling approach. Overall, the number of taxa recorded during the current survey was greater than recorded in previous survey. The lagoons surveyed supported numerous lagoon specialist taxa and, supported relatively diverse communities.

Attribute	Common Standards Monitoring Target	Actual Value for Brownsea Island Lagoon	Is target met? Justification & Notable Comments (incl. comparisons with previous data)
			It was notable that the starlet anemone *Nematostella vectensis* (a protected lagoon specialist) was recorded in abundance.
Species population measures - Population structure of a species	Not specified	No data collected	Unknown, cannot be confirmed. No data were collected to assess this attribute.

5. Discussion

In general, based on comparison of taxon lists with the previous assessment in 2010 (Herbert *et al.*), the biological communities appear to have remained relatively similar. There appears to have been a slight increase in biodiversity manifested through higher taxon counts at comparable stations, although given the increased number of sampling stations a full comparison across the entire lagoon was not feasible. Station BS8 appeared notably impoverished in regards to the biotic community relative to other sampling stations, which likely derives from its partial separation from the main lagoon. The presence of *Capitella* as a main species here suggests organic enrichment, possibly a result of bird excrement. Station BS12 was close to a sluice and to a site previously sampled qualitatively; it included species that reflect greater saline influence. It would be beneficial to confirm the identity of the possibly non-native *Streblospio* and gracilariacean taxa.

It is recommended that future surveys continue to use the 12 sampling stations, rather than just the six from Herbert *et al.* (2010), as the extra coverage yielded greater detail and reliability of results and was also able to highlight subtle spatial variations in both physico-chemical and faunal characteristics. The sampling strategy applied during the current survey provides a fully repeatable method for future survey of the lagoon to enable direct comparison of both qualitative and quantitative data, and this design will facilitate the application of robust statistical techniques for future assessments.

As the main exchange of the lagoon with the sea is via percolation, Brownsea lagoon is relatively isolated and self-contained and therefore expected to be subject to variation in physico-chemical parameters throughout the year e.g. temperature changes, or changes in salinity due to heavy rainfall events. Such natural variability is expected to influence the taxa present within lagoons and, where available, sluicing can provide a management option to modify water levels within lagoons and influence water quality including salinity levels. The physicochemical measurements taken during the current survey were generally in line with those expected in lagoonal systems and were broadly comparable with values obtained during previous studies. For the current study, measurements were taken on a single occasion, however, it is recommended that, where possible, water chemistry is measured across the year to determine more long term trends (especially for salinity), as the communities of organisms within the lagoon are determined by physico-chemical conditions over an extended period of time. For example, reduced salinity at Station BS6 may have derived from various freshwater inputs or could have been a product of other influences, but this remained unclear based on a single measurement.

Consideration of natural temporal variation in lagoon communities is important when assessing their status, but the single sampling event for the current and previous studies is likely sufficient to determine the broad biotopes present within lagoons based on both the JNCC classification system of Connor *et al*. (2004) and the lagoon specific classification system of Bamber (1997). There are expected to be considerable fluctuations in relative abundances of different taxa throughout the year and across years.

The current study also provides a baseline for biotope extent and distribution for the lagoon based on GIS mapping. Utilising updated aerial imagery and the GIS outputs of future surveys it will be possible to rapidly compare basin extent and the extent and distribution of specific biotopes within each lagoon system to assess future change.

In summary, the current report sets out a logical and methodical approach to repeat future survey work in Brownsea Island Lagoon and provides extensive data on the current condition of the lagoon. This preliminary condition of assessment based on historical data from Herbert *et al.* (2010) indicated that the lagoon has remained in similar condition over the last five or so years. The increased sampling stations in the current survey indicated a greater range of species than previously recorded and the results confirm that the lagoon is home to a range of lagoonal specialist taxa as well as a significant population of the nationally rare starlet anemone (*N. vectensis*).

6. References

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Appendix 1 – Raw data from Particle Size Analysis samples

	BS1	BS2	BS3	BS4	BS5	BS6	BS7	BS8	BS9	BS10	BS11	BS12
Analyst comment	Gravelly sandy mud	Gravelly sandy mud	Muddy gravel	Muddy sandy gravel	Gravelly muddy sand	Gravelly sandy mud	Gravelly muddy sand	Gravelly muddy sand	Gravelly sandy mud	Gravelly mud	Gravelly sandy mud	Gravelly muddy sand
Sorting Coefficient	2.58	1.8	4.43	4.23	2.45	2.23	2.32	3.62	2.07	3.14	1.92	2.96
Particle Diameter : Median	0.0443	0.0325	11.4	11.4	0.144	0.0281	0.274	0.122	0.0242	0.082	0.0436	0.0879
Grain Size Inclusive Mean	0.0419	0.0291	1.71	2.46	0.0863	0.031	0.141	0.117	0.0254	0.0821	0.0424	0.083
Particle Diameter : Mean	0.155	0.0739	10.7	13.4	0.583	0.0945	0.318	2.31	0.0744	1.51	0.107	0.845
Kurtosis	0.756	0.993	0.578	0.73	0.745	0.899	0.981	1.1	0.958	1.25	1.01	0.97
Grain Size Inclusive Kurtosis	0.592	0.503	0.67	0.603	0.597	0.536	0.507	0.467	0.515	0.421	0.495	0.511
Inclusive Graphic Skewness :- {SKI}	-0.065	-0.0947	-0.793	-0.704	-0.412	0.0903	-0.593	0.0586	0.0656	0.145	-0.0305	0.0556
<0.98 microns : {>10 phi}	1.45	0.336	0.173	0.123	0.34	0.515	0.314	0.942	0.636	0.19	0.208	0.149
0.98 to 1.38 microns : {10 to 9.5 phi}	1.06	0.445	0.203	0.136	0.369	0.595	0.304	0.637	0.725	0.303	0.357	0.264
1.38 to 1.95 microns : {9.5 to 9 phi}	1.37	0.663	0.315	0.216	0.573	0.912	0.471	0.843	1.11	0.494	0.536	0.466
1.95 to 2.76 microns : {9 to 8.5 phi}	2.3	1.34	0.66	0.453	1.14	1.83	0.923	1.39	2.12	0.926	0.982	0.958
2.76 to 3.91 microns : {8.5 to 8 phi}	3.83	2.77	1.35	0.92	2.23	3.66	1.7	2.36	3.99	1.77	1.88	1.94
3.91 to 5.52 microns : {8 to 7.5 phi}	4.8	4.24	2.01	1.36	3.19	5.3	2.28	3.1	5.53	2.59	2.74	2.92
5.52 to 7.81 microns : {7.5 to 7 phi}	5.77	5.87	2.75	1.85	4.17	6.99	2.84	3.89	7.12	3.64	3.87	4.09
7.81 to 11.1 microns : {7 to 6.5 phi}	6.25	6.99	3.29	2.2	4.73	8.02	3.04	4.3	8.25	4.66	5.21	5.14
11.1 to 15.6 microns : {6.5 to 6 phi}	6.01	7.34	3.39	2.23	4.6	8.02	2.72	4.11	8.6	5.3	6.58	5.63
15.6 to 22.1 microns : {6 to 5.5 phi}	6.05	8.46	3.51	2.26	4.6	8.34	2.54	4.13	9.37	6.02	8.39	6.13
22.1 to 31.3 microns : {5.5 to 5 phi}	5.82	10.2	3.48	2.2	4.64	8.43	2.69	4.35	9.56	6.28	9.64	6.11
31.3 to 44.2 microns : {5 to 4.5 phi}	5.23	11.9	3.37	2.15	4.89	8.12	3.27	4.83	8.85	6.21	10	5.72
44.2 to 62.5 microns : {4.5 to 4 phi}	4.71	12	3.31	2.07	5.05	7.52	3.63	5.32	7.79	6.35	10.2	5.42
62.5 to 88.4 microns : {4 to 3.5 phi}	4.79	9.86	3.2	1.84	4.34	6.57	2.98	5.3	6.65	6.74	10	5.14
88.4 to 125 microns : {3.5 to 3 phi}	5.93	6.55	3.01	1.76	3.22	5.48	2.06	4.8	5.39	7	9	4.75
125 to 177 microns : {3 to 2.5 phi}	7.73	3.99	2.81	2.63	4.57	4.75	3.87	4.65	4.18	6.9	6.88	4.93
177 to 250 microns : {2.5 to 2 phi}	8.46	2.75	2.54	4.29	9.7	4.51	9.87	5.57	3.47	6.57	4.72	6.29
250 to 354 microns : {2 to 1.5 phi}	7.5	1.97	2.11	5.49	14.7	4.37	17	7.27	3.12	6.21	3.38	8.05
354 to 500 microns : {1.5 to 1 phi}	5.3	0.96	1.27	4.76	13.1	3.41	18.6	7.67	2.16	5	2.48	7.71
500 to 707 microns : {1 to 0.5 phi}	3.21	0.218	0.38	2.69	6.23	1.65	12.7	5.41	0.686	2.84	1.58	4.76
707 to 1000 microns : {0.5 to 0 phi}	1.22	0	0.0129	0.729	0.66	0.129	4.26	1.8	0.0397	0.632	0.536	1.29
>1000 microns : {<0 phi}	1.19	1.09	56.8	57.6	2.92	0.891	1.89	17.3	0.648	13.4	0.813	12.1
<1000 microns : {>0 phi}	98.8	98.9	43.2	42.4	97.1	99.1	98.1	82.7	99.4	86.6	99.2	87.9
1000 to 1400 mic : {0 to -0.5phi}	0.433	0.594	0.414	0.583	0.203	0.482	1.04	1.59	0.326	1.11	0.385	1.81
1400 to 2000 mic : {-0.5 to -1.0phi}	0.296	0.251	0.387	0.562	0.125	0.261	0.374	1.43	0.194	0.832	0.202	1.83
2000 to 2800 mic : {-1.0 to -1.5phi}	0.148	0.133	0.28	0.415	0.107	0.105	0.17	1.25	0.052	0.863	0.0734	1.54
2800 to 4000 mic : {-1.5 to -2.0phi}	0.148	0.118	0.37	0.386	0.117	0.0201	0.168	1.06	0	1.11	0.0673	1.3
4000 to 5600 mic : {-2.0 to -2.5phi}	0.0686	0	0.208	0.744	0.0955	0.0226	0.0286	0.663	0.0757	1.39	0.0306	0.951
5600 to 8000 mic : {-2.5 to -3.0phi}	0.0329	0	1.06	1.81	0.0545	0	0.108	1.14	0	1.51	0	0.797
8000 to 11200 mic : {-3.0 to -3.5phi}	0.0658	0	3.26	2.78	0.037	0	0	1.81	0	0.356	0.055	2.37
11200 to 16000 mic : {-3.5 to -4.0phi}	0	0	15.4	7.82	0.803	0	0	3.61	0	1.59	0	0.858
16000 to 22400 mic : {-4.0 to -4.5phi}	0	0	17.8	17.3	1.38	0	0	0	0	4.64	0	0.681
22400 to 31500 mic : {-4.5 to -5.0phi}	0	0	17.7	10.6	0	0	0	4.79	0	0	0	0
31500 to 45000 mic : {-5.0 to -5.5phi}	0	0	0	14.7	0	0	0	0	0	0	0	0
45000 to 63000 mic : {-5.5 to -6.0phi}	0	0	0	0	0	0	0	0	0	0	0	0
>63000 microns : {< -6.0 phi}	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 2 – Bamber et al. (1997) lagoon biotope classification

Biotope	Definition
ENLag.Veg	Community associated with submerged vegetation (irrespective of plant species and substratum), characterized by *Idotea chelipes, Corophium insidiosum, Sphaeroma* spp., *Gammarus* spp. and *Hydrobia* spp. The lagoonal *Lineus viridis* occur amongst vegetation, as do juvenile *Cerastoderma glaucum* and all of the gastropods at some point their life cycle. The vegetation is commonly not attached, but drifts within the lagoon. Characterising species – *Ruppia spp. and/or Ulva lactuca and/or Enteromorpha spp. and/or Chaetomorpha linum with I. chelipes, Sphaeroma spp., C.insidiosum, Gamamrus spp. and Ecrobia ventrosa.* Sporadically occurring associates – *L. viridis, Nematostella vectensis, Conopeum seuratti, Hydrobia acuta negelctum* (formerly H*ydrobia neglecta*), *C. glaucum* and *Rissoa membranacea*
ENLag.Veg.Pot	Low salinity (normally <10%) variant of ENLag.Veg wherein the predominant macrophytes is *Pomatogen pectinatus.* The diversity of associated animals is low, coroxids are more common.
ENLag.Veg.Zos	Variant biotope of ENLag.Veg with substantial beds of *Zostera* spp.
ENLag.IMS.Ann	Fine sediment biotope characterized by *Tubificoides pseudogaster* (*or possibly T. diazi* or *T. benedii*), *C. glaucum, Corophium volutator, Abra tenuis* and chironomids, with *Arenicola marina* where the sediment depth is sufficient. This is the preferred biotope for *N. vectensis.* Characterising species – *T. psudogaster, C. glaucum, C. volutator, A. tenuis, Nereis diversicolor, Captiella captitata,* chironomids and hydrobiids Sporadically occurring associates – *N. vectensis, T. benedii, Microdeutopus gryllotalpa, Polydora ciliata* and *Pygospio elegans.*
ENLag.IMS.Ann.Soft	Where the muddy fraction of the superficial sediment is deep enough (approx. 1-0cm) the lugworm A. marina becomes dominant and associated species, notably annelids and *C. glaucum* occur at a higher density. *Sagartia troglodytes* is a sporadically occurring associate taxon.
ENLag.IMS.Ann.Hard	Where the superficial softer sediment is minimal, and therefore the substratum constitutes firm sands, the annelids and chironomids tend to disappear and the fauna is dominated by *C. volutator* and *A. tenuis.*
ENLag.IMS.Ann.Imp	A number of lagoons have impoverished benthic infauna (either few taxa or very low abundance of individuals), typically deriving from recent disturbance events in small lagoons (anthropogenic) or due to low salinity conditions. In the case of the latter *Potamopyrgus antipodarum* may be the only hydrobiid. Prediminatly gravel substrata can also have an impoverished ENLag.IMS.Ann community, often with only *C. glaucum* or no fauna at all.
CMU.Beg	Occurs sporadically in very small patches in association with decaying plant matter at lagoonal margins in the Autumn. The biotope is temporary only and has no associated species
Others	Opportunistic taxa associated with the water column, notably *Palaemonetes varians,* mysids, *Pomatischistus microps, Gasterosteus aculeatus* and corixids, are of sporadic occurrence on most lagoon systems. Both prawns and mysids decline with reductions in salinity.

Appendix 3 – Water quality data

Station	Depth (cm)	Temperature (°C)	Salinity	Redox Potential (mV)
BS1	9	18.9	20	160
BS2	12	17.8	22	132
BS3	15	13.1	22	103
BS4	11	15.2	20	57
BS5	3	13.3	35	-63
BS6	3	13.6	15	141
BS7	6	14	22	89
BS8	9	14.7	30	-13
BS9	7	14.2	5	-11
BS10	20	14	4	40
BS11	16	14	3	19
BS12	-	18.8	20	79

Appendix 4 – Raw data from sweep net samples

Taxa ID		BS1	BS2	BS3	BS4	BS5	BS6	BS7	BS8	BS9	BS10	BS11	BS12	BS1 VEG	BS2 VEG	BS3 VEG
Animalia	eggs											P				
Philaenus									R							
Gerris odontogaster											R					
Pyralidae	larva											R				
Nematostella vectensis		S		R	A	S		F	R	S					A	
Turbellaria									F							
Nematoda						R	R									
Hediste diversicolor					R								R			
Streblospio		R		R		R				A						
Manayunkia aestuarina						R										
Nais											R					
Paranais litoralis						O			F			S				
Baltidrilus costatus							R									
Tubificoides benedii		R														
Enchytraeidae							F									A
Acari																R
Orchestia gammarellus		R					R									R
Melita palmata					R									O	R	
Monocorophium insidiosum		S	O	A	S	S		C	R	C			O		A	
Corophium volutator		S	C	R	S		C	F		F					A	
Idotea chelipes				S										O	A	
Palaemon varians		O									R					
Chironomidae	larva	O								C	R					
Chironomidae	pupa									O						
Dolichopodidae	larva					O										
Ecrobia ventrosa		S	R		F	S		A		O			R		R	
Abra tenuis						F										
Gracilaria					P									P		P
Ulva intestinalis					P											
Ulva					P					P						
Chaetomorpha linum															P	P
Lemna												P				

Appendix 5 – Raw data from core samples

WCS Code	Taxa	Identifier	BS1A	BS1A	BS1B	BS1B	BS1C	BS1C	BS2A	BS2A	BS2B	BS2B	BS2C	BS2C	BS3A	BS3A	BS3B	BS3B	BS3C	BS3C	BS4A	BS4A	BS4B	BS4B	BS4C	BS4C	BS5A	BS5A	BS5B	BS5B	BS5C	BS5C	BS6A	BS6A	BS6B	BS6B	BS6C	BS6C
	Cnidaria																																					
D0662	ACTINIARIA				1													1				2																
D0761	*Nematostella vectensis*		4		43	6	33	2	9	1	7	6	15	3	3		15	12	20	11	58	5	49	32	23	13	213	11	182	53	187	80	58		95		137	2
	Nemertea																																					
G0001	Nemertea												1																									
	Nematoda																																					
HD0001	Nematoda				1				1																		1		6									
	Annelida																																					
P0458	Nereididae	Juvenile						1	1						5		7	5	58	1	9		3	8	5													
P0462	*Hediste diversicolor*			6		11		13		3		6		5		6		13		8	1	31		23		29		5		3		6	2			4		2
P0753	*Polydora cornuta*														3		8		4	7		2		1														
P0776	*Pygospio elegans*																								1													
P0797	*Streblospio*		1			2	5		24	2			4	7	1		3		5	2	14		2	1	12	1	4	1	10	2	7	3	1				2	
P0847	*Tharyx "species A"*																										1											
P0907	*Capitella capitata*																																					
P0919	*Mediomastus fragilis*																																					
P1294	*Manayunkia aestuarina*								5					1											3		3											
P1425	Tubificidae								1				1												5	1				1								
P1498	*Tubificoides pseudogaster*												6				1		1			1			3	2							1					
P1479	*Baltidrilus costatus*		20		22	19	30	11	150	26	37	4	54	17	41		8	1	47	8	92	6	43	64	47	15	25	4	42	5	31	6	5				20	
P1490	*Tubificoides benedii*		12		29	64	28	24	15	14	9	14	1	16	2	1	1	2	3	4		1					27	5	34	52	17	29						
P1501	Enchytraeidae				1																1																	
	Crustacea																																					
R2412	Ostracoda				2		7								4		1		3						7		14		21		101							
S0604	Corophiidae		44		24	19	50	20	58	12	32	8	27	40	10		22	5	39	4	19	7	35	41	62	12	21	8	26		15	4	18		41		50	
S0612	*Monocorophium insidiosum*						1		5				2		15		3	1	11		28	3	20	33	20	10	42		6	5	34	3						
S0616	*Corophium volutator*				3	43		4	15	12		1	19	41	1	1		1	20	2	17	20	14	93	21	33	9		5	7	5	16				1		
S0869	*Lekanesphaera hookeri*																	1																				
S0934	*Idotea*																	1		1																		
S0938	*Idotea granulosa*																	1		1																		
S1321	*Palaemon varians*																																					
	Hexapoda																																					
-	Chironomidae	Larvae															1					1																
-	Chironomidae	Pupa																																				
-	Diptera	Larvae				1																																
	Mollusca																																					
W0088	Gastropoda																																					
W0385	*Peringia ulvae*																																					
W0387	*Ecrobia ventrosa*		1		1		1	2							4	49	16	28	9	46	19		27	39	32	8	9	1	13		4	5						
W0393	*Potamopyrgus antipodarum*													1				1									2			4		3						
W1560	Bivalvia																										5		6	2	33	8						
	Bryozoa																																					
Y0013	Crisia																	P																				
Y0172	*Conopeum reticulum*																																					

WCS Code	Taxa	Identifier	BS7A	BS7A	BS7B	BS7B	BS7C	BS7C	BS8A	BS8A	BS8B	BS8B	BS8C	BS8C	BS9A	BS9A	BS9B	BS9B	BS9C	BS9C	BS10A	BS10A	BS10B	BS10B	BS10C	BS10C	BS11A	BS11A	BS11B	BS11B	BS11C	BS11C	BS12A	BS12A	BS12B	BS12B	BS12C	BS12C
	Cnidaria																																					
D0662	ACTINIARIA																																					
D0761	*Nematostella vectensis*		9	3	15	4	8	2			1				44		30	1	111														8		13	1	4	
	Nemertea																																					
G0001	Nemertea																																					
	Nematoda																																					
HD0001	Nematoda		4		4		2																		3								8		1		2	
	Annelida																																					
P0458	Nereididae	Juvenile	6	2	22																												4	17	10	5	6	18
P0462	*Hediste diversicolor*		7	21		26	18	25								4		18		10										1				5	1	24	1	4
P0753	*Polydora cornuta*																																					
P0776	*Pygospio elegans*																																					
P0797	*Streblospio*		1	1			2								12		5	1	11														8	3	28	16	5	1
P0847	*Tharyx "species A"*																																67	34	137	63	8	1
P0907	*Capitella capitata*								2		6		2	5																						1		
P0919	*Mediomastus fragilis*						1																															
P1294	*Manayunkia aestuarina*																																6		16			
P1425	Tubificidae																3																		36	25		
P1498	*Tubificoides pseudogaster*																	2															1		55	24	2	
P1479	*Baltidrilus costatus*														36	5	38	8	49	1		1					6		2		1		10	17	13	25	66	24
P1490	*Tubificoides benedii*		1						1		1								2					1							1		17	47	15	79	34	33
P1501	Enchytraeidae																																					
	Crustacea																																					
R2412	Ostracoda								23		71								1												1		55		84		89	
S0604	Corophiidae		19	13	20	5	8																		1								1		1			
S0612	*Monocorophium insidiosum*		2																																			
S0616	*Corophium volutator*			2	20	4	12	5														1											1	3		2		
S0869	*Lekanesphaera hookeri*																																					
S0934	*Idotea*																																					
S0938	*Idotea granulosa*																																					
S1321	*Palaemon varians*																					3																
	Hexapoda																																					
-	Chironomidae	Larvae													2	1	1					24		2	7	11	1	1		1	2	1				1		
-	Chironomidae	Pupa																													1							
-	Diptera	Larvae																										1										
	Mollusca																																					
W0088	Gastropoda																								1													
W0385	*Peringia ulvae*																																			1		
W0387	*Ecrobia ventrosa*		58	76	57	66	72	30							1																		53	4	41	1	28	2
W0393	*Potamopyrgus antipodarum*		1					7																														
W1560	Bivalvia																																					
	Bryozoa																																					
Y0013	Crisia																																					
Y0172	*Conopeum reticulum*																																	P				

Appendix 6 – SIMPER analysis outputs

Similarity Percentages - species contributions

One-Way Analysis

Data worksheet
Name: Data5
Data type: Abundance
Sample selection: All
Variable selection: All

Parameters
Resemblance: S17 Bray Curtis similarity
Cut off for low contributions: 90.00%

Factor Groups

Sample	SIMPROF
BS1	b
BS2	b
BS3	b
BS4	b
BS5	b
BS6	b
BS7	b
BS9	b
BS12	b
BS8	a
BS10	c
BS11	c

Group b
Average similarity: 52.52

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Nematostella vectensis	6.81	10.72	1.86	20.41	20.41
Baltidrilus costatus	5.99	9.12	1.57	17.36	37.76
Corophiidae	4.91	7.46	1.17	14.20	51.96
Hediste diversicolor	3.97	6.33	2.37	12.05	64.01
Streblospio	2.56	4.00	2.47	7.62	71.63
Corophium volutator	3.34	3.80	1.12	7.23	78.86
Ecrobia ventrosa	4.02	3.30	0.72	6.28	85.14
Tubificoides benedii	3.50	3.02	0.78	5.76	90.90

Group a
Less than 2 samples in group

Group c
Average similarity: 37.55

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Chironomidae	2.68	21.39	#######	56.95	56.95
Baltidrilus costatus	1.15	8.08	#######	21.53	78.47
Tubificoides benedii	0.58	8.08	#######	21.53	100.00

Groups b & a
Average dissimilarity = 89.63

Species	Group b Av.Abund	Group a Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Nematostella vectensis	6.81	0.58	12.44	1.42	13.88	13.88
Baltidrilus costatus	5.99	0.00	11.06	1.88	12.34	26.22
Corophiidae	4.91	0.00	9.50	1.51	10.60	36.82
Ostracoda	2.32	5.60	8.99	1.72	10.03	46.85
Hediste diversicolor	3.97	0.00	7.45	2.12	8.31	55.17
Ecrobia ventrosa	4.02	0.00	6.91	0.89	7.71	62.88
Corophium volutator	3.34	0.00	5.74	1.43	6.40	69.28
Tubificoides benedii	3.50	0.82	4.88	1.03	5.45	74.73
Streblospio	2.56	0.00	4.67	2.22	5.21	79.94
Capitella capitata	0.06	2.24	4.35	2.69	4.86	84.80
Monocorophium insidiosum	1.97	0.00	3.00	0.92	3.34	88.14
Tubificidae	1.53	0.00	2.49	0.92	2.78	90.92

Groups b & c
Average dissimilarity = 87.52

Species	Group b Av.Abund	Group c Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Nematostella vectensis	6.81	0.00	14.28	1.52	16.32	16.32
Baltidrilus costatus	5.99	1.15	9.72	1.98	11.11	27.43
Corophiidae	4.91	0.29	9.56	1.54	10.92	38.35
Ecrobia ventrosa	4.02	0.00	7.19	0.91	8.22	46.57
Hediste diversicolor	3.97	0.29	7.17	2.01	8.19	54.76
Corophium volutator	3.34	0.29	5.58	1.41	6.37	61.14
Tubificoides benedii	3.50	0.58	5.19	1.03	5.93	67.07
Streblospio	2.56	0.00	4.88	2.24	5.58	72.65
Chironomidae	0.32	2.68	4.80	1.59	5.49	78.14
Ostracoda	2.32	0.29	3.33	0.89	3.80	81.94
Monocorophium insidiosum	1.97	0.00	3.10	0.95	3.54	85.48
Tubificidae	1.53	0.00	2.59	0.95	2.96	88.45
Tharyx "species A"	1.19	0.00	1.57	0.37	1.79	90.24

Groups a & c
Average dissimilarity = 88.98

Species	Group a Av.Abund	Group c Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Ostracoda	5.60	0.29	32.56	16.84	36.60	36.60
Chironomidae	0.00	2.68	15.83	2.03	17.79	54.39
Capitella capitata	2.24	0.00	13.79	7.36	15.49	69.88
Baltidrilus costatus	0.00	1.15	7.46	1.24	8.39	78.27
Nematostella vectensis	0.58	0.00	3.56	7.36	4.00	82.27
Nematoda	0.00	0.50	2.79	0.71	3.13	85.40
Palaemon varians	0.00	0.50	2.79	0.71	3.13	88.53
Hediste diversicolor	0.00	0.29	1.95	0.71	2.19	90.73

Further information

Natural England evidence can be downloaded from our **Access to Evidence Catalogue**. For more information about Natural England and our work see **Gov.UK**. For any queries contact the Natural England Enquiry Service on 0300 060 3900 or e-mail **enquiries@naturalengland.org.uk** .

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