Review of the current ecological status of the SE coast Jersey Ramsar site

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Acronyms

CCW	Countryside Council for Wales
CFUs	Colony Forming Units
CPUE	Catch Per Unit Effort
Defra	Department for Environment, Food and Rural Affairs
EEC	European Economic Community
GIS	Geographical Information System
GPS	Global Position System
JNCC	Joint Nature Conservation Committee
MNCR	Marine Nature Conservation Review
Ramsar	Convention on Wetlands, signed in Ramsar, Iran, in 1971
RIS	Ramsar Information Sheet
RSPB	The Royal Society for the Protection of Birds
WEB	Waterfront Enterprise Board Limited

Executive summary

This report assesses the current ecological status of the Ramsar site located on the SE Jersey coast. It also reviews monitoring data collected since the designation of the Ramsar site in 2000, and provides comments on the current ecological status of the site itself, as well as on some areas beyond the boundaries of the existing designation. We have produced biotope maps of the Ramsar site to provide the basis of future environmental impact assessment, and have made some initial observations regarding the likely ecological implications of further development at St Helier port, especially in relation to the relocation of the fuel farm. The following summarises our main findings:

General ecological health of Ramsar site

(i) Intertidal communities of the Ramsar site exhibit exceptional biodiversity as a consequence of the biogeographical position of Jersey, combined with its tidal range of 12m. They include species typical of communities found on rocky and sandy shores similar to those on the nearby French coast, with a rich and diverse range of biotopes and some uncommon species assemblages, and are, overall, in a healthy condition. However, locally there was some evidence of intertidal communities being subjected to poor ecological conditions, particularly in response to locally intensive human recreational impacts and outfalls and / or storm water discharges. Also, we were unsure to what extent high levels of epiphtytic growth on *Zostera noltii* beds across large swathes of the east coast of Jersey, were indicative of poor health. Because this is normally an indicator of pollution and given the important role of seagrass beds as nursery areas and food for foraging waders and wildfowl, we recommend that they are monitored closely over forthcoming seasons and steps are taken to investigate this aspect further. It was notable given our past experience of working at West Park beach, that it continues to show signs of ecological responses to poor tidal mixing and eutrophication. The high organic content and relative increase in fine sediments have now resulted in settlement of large numbers of *Arenicola marina,* so that conditions at West Park beach now approximate those normally observed in estuaries, rather than on exposed southwest facing sandy shores.

(ii) Different trends in the abundance of populations of waders visiting Jersey were species specific, but as our analysis shows, populations of key species such as Brent Geese, have remained relatively stable over the past 10 years. Although the Brent Goose has experienced declines elsewhere across its range, there is no evidence of a decline in numbers visiting Jersey, and the slight increase observed may explain why Brent Geese have moved inland to forage during the winter months. Year to year changes in wader numbers cannot be considered significant in the overall scheme of things – but all the available evidence appears to show that fluctuations in numbers of waders and wildfowl are within the ranges observed over the past decade since the Ramsar site was implemented, and if anything, a slight increase overall in the number of waders visiting Jersey has been observed. To build further resilience into the ecosystem services on which these species depend, we recommend continuing efforts to protect and maintain coastal ecosystem quality, and where possible to extend the protection of areas available to waders and wildfowl for foraging and overwintering, in a situation where alternative sites elsewhere are under threat.

(iii) Seagrass beds provide important services to the Jersey coastal ecosystems and without them the biodiversity and productivity of Jersey waters would undoubtedly decline. Seagrass beds are designated habitats within European legislation (Natura 2000), with specific measures to ensure their protection and maintenance for the

benefits of wider ecosystem services and protection of habitat for species of commercial and conservation significance. Our surveys have indicated that although *Z. marina* has been mapped and extensive areas of *Z. marina* beds are within the Ramsar designation, substantial areas remain outwith the Ramsar boundary. A second species *Z. noltii* has also been mapped during this projec for the first time. *Z. noltii* differs from *Z. marina* in both its seasonal growth pattern and its distribution, but the combined footprint of the two species of *Zostera* could be used as the basis for expanding the Ramsar site boundary to improve protection of these habitats.

(iv) Analysis of water quality data at outfalls discharging into St Aubin's Bay indicates that water quality has generally shown some improvements, but that there remains a problem with eutrophication in the bay as a whole. It appears that outfalls which discharge onto the Ramsar site are regularly monitored, and some issues have been raised and dealt with regarding levels of microbial contamination. However, according to routine bathing waters monitoring data, the waters around Jersey, and specifically within the Ramsar site can be considered good quality, and well within Guideline values and UK averages, in fact often exceeding them. Undoubtedly the high tidal flows and flushing help to dissipate contamination thus improving overall bathing water quality. It is likely however, that any decline in water quality, where present, is mainly the result of surface run-off and discharge from urban areas (i.e. St Helier, Grouville), indicated by the overall decrease in Guideline standards being awarded following exceptional rainfall in 2007 and 2008.

Human uses of the Ramsar site

(v) As expected there are significant variations in the nature and intensity of human impacts across the Ramsar site. A wide range of activities are accommodated within the site including recreational water sports (such as sailing, windsurfing, kite surfing) angling, commercial fishing, aquaculture and beach based activities, such as rock pooling, walking, volley ball, cricket, bird watching, etc. These activities can mostly be accommodated without major ecological impacts, and despite trampling and rock pooling having local impacts in some areas, this is unlikely to undermine the overall ecological quality of the Ramsar site. The limited opportunity we had to observe these activities indicated that recreational uses are most intensive near to St Helier Port, with other hotspots in the vicinity of Gorey Harbour.

(vii) The port area at St Helier has already been subject to major changes as a result of reclamation, and our visit in July allowed us to assess the ecological status of the Ramsar site east of La Collette during the summer and compare with the results of observations made in 1998. This area is not only less biodiverse than the remainder of the Ramsar site, but also the quality of the biotopes has declined over the past decade. In addition the area showed signs of invasion by alien species (such as *Crepidula fornicata*) which were exceptionally numerous. This has almost certainly resulted from a combination of factors including, exposure to poorer water quality (combined outfalls / urban storm water), the high intensity of beach usage near to St Helier and reduced tidal flushing resulting from successive reclamations. This is not unusual for areas near to ports, but maintaining good environmental quality is essential if growth in tourism and residential units at the port is part of the future strategic plan.

(viii) Our surveys suggest that mitigation of human use impacts across the Ramsar site through controlling illegal activities such as spoil dumping and fly tipping, and monitoring aquaculture licences, need to continue as part of the regular Jersey State monitoring programme. There may also be a case for better management of moorings, for e.g. reduction in area, selective use of low impact designs and reduction in the number of temporary moorings, especially in the extensive areas of seagrass beds.

Also, all the management measures which are currently being progressed by Jersey government to reduce nitrogenous inputs to agriculture, to ensure better control of discharges (especially the main sewerage plant at Bellozanne) need all to be continued for the benefit of achieving good ecological status in coastal waters, not just for the Ramsar site but for the whole of Jersey coast.

(ix) Since the Ramsar designation in 2000, new information has been obtained on the characteristics of intertidal communities, notably the extent of seagrass beds and now too, biotope maps for the Ramsar site as a whole. This new information suggests that the most significant contribution to the long term sustainability of the Ramsar site could be achieved by expansion of the Ramsar site to incorporate St Catherine's Bay, where extensive seagrass beds are located. Expanding the Ramsar site would not only improve the integrity and protection of Jersey's marine and coastal resources, but also raise the profile of the contribution of seagrass beds to ecosystem productivity and wider biodiversity protection. In addition, measures similar to those which have been adopted within the Natura 2000 network should be implemented – that is, exclusion of activities which undermine marine ecosystem health and regular 'condition assessment' monitoring. This recommendation makes efficient use of the Ramsar convention infrastructure to improve protection of vulnerable but significant areas.

(x) This study constitutes just one small part of a review of the strategic development options for St Helier Port and La Collette, including the possible implications for the Ramsar site. It is clear that environmental quality from West Park beach to a point east of La Collette (i.e. Le Dicq) has been altered over the years as a result of successive reclamations, and also clear that hard structures cannot now be removed or modified. However, if further construction (such as a new fuel farm) is considered we strongly recommend that hydrodynamic studies of tidal flows and sediment deposition are undertaken in advance of developing a full scale planning application. The hydrodynamic study will test whether the presence of additional structures at St Helier port constitute a cumulative impact too far, in advance of investment in a full planning application, which itself should then be accompanied by a comprehensive EIA. Irrespective of the outcome of the strategic options study, our analysis has shown that extension of the Ramsar site is desirable on grounds of providing additional protection for sensitive and important habitats.

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1 Introduction

The natural resource base of Jersey is fundamental in delivering services to the wider population, including goods and services provided by the marine environment, and as an island nation some distance from any mainland, it is essential to consider the long term perspective and the need to maintain these services and protect their functions. In common with all countries with a coastline, Jersey's economic footprint continues to expand into the marine environment and in Jersey's case, as a small island, the problems of land availability are very acute. Despite the pressures to continue development and expansion of infrastructure and residential / tourism facilities, the question of the carrying capacity of the island is becoming an issue, as this affects the provision of all infrastructure. However, the combination of the need to improve porting facilities and release additional development land with consequences for re-locating the fuel farm to a suitable on-shore or offshore location, are amongst the development options which are being considered for the St Helier port area.

1.1 Background

In anticipation of identifying strategic options for relocating the fuel farm to mitigate restrictions on land use at La Collette, a meeting was held with WEB and the Jersey Government Planning and Environment Department to consider the environmental implications of any new relocation proposal, and in particular the implications for the Ramsar site on the south east coast of Jersey.

Initial discussions were also progressed with Defra and JNCC in relation to the processes which need to be adopted, were the need to arise for changing the boundaries of the Ramsar site, so that we have a clear understanding of exactly what is required from the outset.

The outcome of these two meetings resulted in a recommendation from ourselves that as an initial step, it will be necessary to undertake a review of the current ecological status of the Ramsar site and surrounding areas, and to undertake this work in parallel with the development of options for relocating the fuel farm. We anticipated that a review of historical information provided in the Ramsar Information sheet (RIS) and monitoring data relevant to the site designation since 2000, would together provide the basis for an update of the ecological status of the site. Then by combining aerial photographic information and walkover surveys we would be in a position to complete preliminary biotope maps of the site. This will enable us to then take forward further discussions in relation to consideration of the options for relocating the fuel farm.

More specifically, the updated ecological survey will provide the basis of considering the environmental implications of the different designs and locations for the fuel farm, at the earliest possible stage of the project, together with different mitigation options – both in terms of the fuel farm design and footprint and in terms of potential alteration of the Ramsar site boundary. If it becomes necessary to consider the alteration of the Ramsar site boundaries then a mitigation / compensation strategy can be built into our collective thinking from the inception of the project. Any changes needed to the RIS will need to be supported by updated ecological information as well as appropriate socio-economic evidence.

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2 Preliminary desktop data and literature review

2.1 Ramsar site

This section provides an overview of SE Jersey Ramsar site, its main features and purpose of the designation.

2.1.1 Characteristics of the SE Jersey Ramsar site

The SE Jersey Ramsar site is adjacent to St. Helier and extends from the port of St Helier to Gouray Harbour on the east coast, encompassing the south-east corner of the Island. It comprises various habitats: reefs, boulder fields, mud, sandy and shingle shores not covered by water at low tide, combined with shallow tidal lagoons, seagrass beds and a constellation of outlying reefs, amongst the largest intertidal reef sites in Europe (Information Sheet on Ramsar Wetlands, 2000).

A maximum spring tide range of 12 metres exposes in excess of 17.5 sq km of wave-cut rock platforms, extensive areas of reef at varying elevations, expansive rocky shores and a complex system of soft substrate gullies. The area also features a large, shallow, depositing, soft sediment bay, containing seagrass meadows, which provide important winter habitat for nationally important populations of waders and wildfowl. These factors, combined with Jersey's biogeographical position result in significant biodiversity, a rich and diverse range of biotopes and some uncommon species assemblages. The flora and fauna is characterised by limit-of-range species at the northern and southern margins of their distributions that are not present on shores either to the north or south respectively. Across the entire shore of Jersey a total of 751 species were recorded by Hiscock (1994), around 10% of all species recorded within British waters, though as the only survey of its kind on Jersey it is likely that significant gaps exist within the list.

The site contains a diverse array of habitats and micro-habitats such as :

- Extensive mud sand flats and pools stretching into shallow waters support extensive beds of eelgrasses *Zostera noltii* and *Zostera marina*.
- Intertidal rocky platforms bear luxuriant growth of fucoid species.
- Low tide levels reveal large stands of *Laminaria* species which support rich epiphytic growth.
- Shallow water-filled gullies and intertidal rockpools contain dense colonies of the non-native alga *Sargassum muticum*, first recorded in Jersey in 1980. At times *Ulva lactuca* is abundant.

A key factor in the maintenance and protection of the unique biodiverity resources of Jersey, has been the limited extent of human interference on the shores. Until the 1900's only limited sea defences existed, but during this century several seawalls were completed behind the major bays, along with St Helier port and St Catherine Breakwater. Whilst these have undoubtedly influenced the shore, in comparison to developments and impacts upon the British shores and those of Northern Europe, they have been minor, and as a result much of the shore, whilst not pristine, is in far more natural state than elsewhere. This has meant that slow growing and slow reproducing species (e.g. Ormer, whose fishery is carefully managed on Jersey) have been able to survive, when elsewhere populations have either dwindled to extinction of been exhaustively harvested.

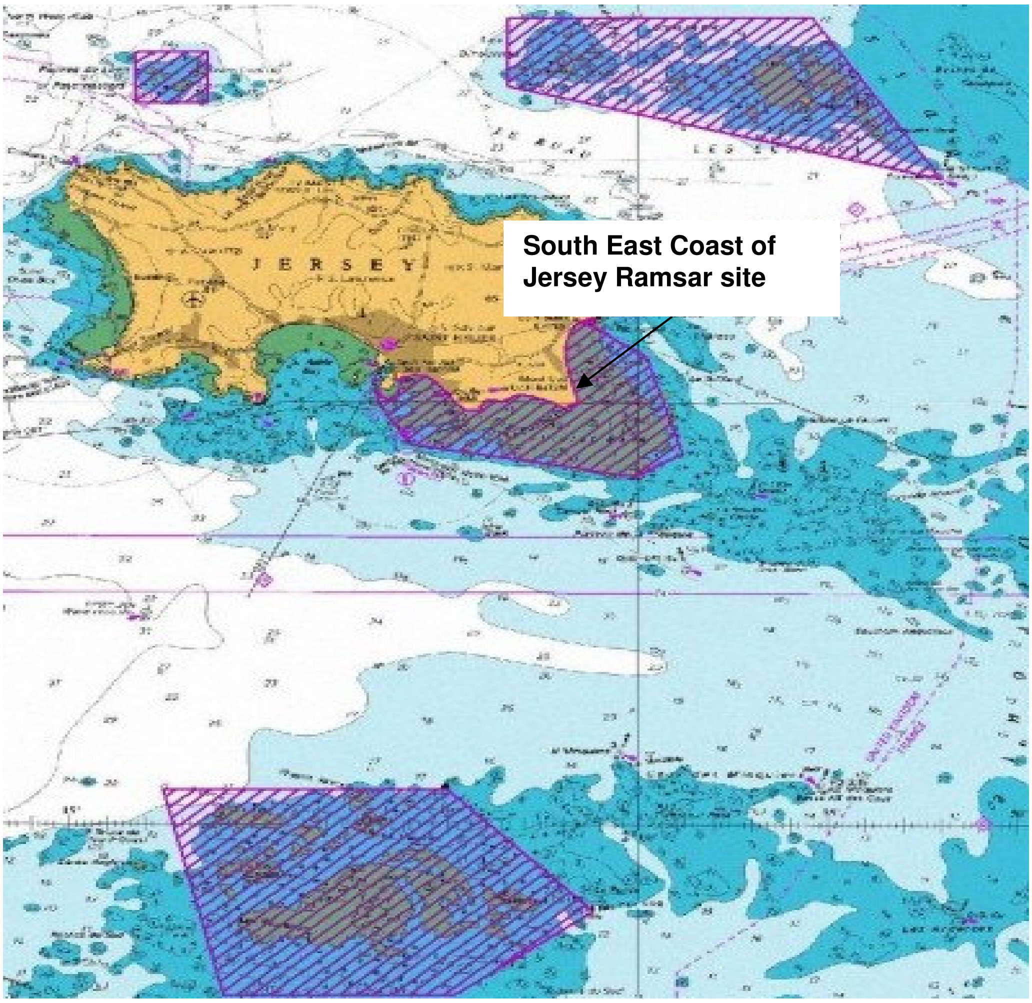

Figure 1 – Jersey Ramsar sites

2.1.2 Justification of Ramsar designation

According to the Ramsar Information Sheet for the SE Coast of Jersey Ramsar site, the area was selected because of the following criteria:

Ramsar Criterion 1 - *representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.*
The large tidal range (> 12m), a shallow sloping shore profile, a wide range of substrata and wave exposure, and the influence of the Gulf Stream and surrounding oceanographic conditions combine to produce a site considered to have great ecological value due to the diverse range of habitats, communities and species found in a comparatively small area.

Ramsar Criterion 2 *– the site supports vulnerable, endangered, or critically endangered species or threatened ecological communities*
The extensive rocky shores found within the site are identified as being of priority for conservation at an international level due to the rarity and perceived threat to this type of habitat and its associated faunal and floral communities. The extensive mudflats and sandflats found in the site are likewise considered of significant value at a European

level. *Zostera* beds found in the embayed shallow waters are of great importance to a wide range of vulnerable species in their early life.

Ramsar Criterion 3 *– the site supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.*
Jersey is situated in the Normano-Breton Gulf between England and France, on the convergence of Boreal (cold temperate) and Lusitanean (warm temperate) marine biogeographical regions. Overlap of these regions promotes increased species richness and allows species to exist at the northern and southern limits of their distributions. This enables the site to support some species which are rare or absent from British coasts as they are normally associated with the warmer waters of southern Europe, e.g. ormer *Haliotis tuberculata*, as well as species that are normally associated with the colder northern waters of the United Kingdom, e.g. beadlet anemone *Actinia equina*.

Ramsar Criterion 4 – *the site supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions***.**
The Normano-Breton Gulf experiences huge movements of water diurnally with a relatively closed anticlockwise current around Jersey. This factor, when combined with the warming influence of the Gulf Stream and the physical characteristics of the site assists in enhancing the local recruitment and subsequent offshore migration of many animals that have planktonic early life stages, especially commercially important Crustacea. The large areas of rocky shore are important to many species, providing shelter, protection and food for both larval and adult stages. Similarly the rich infaunal communities of the sand and mudflats are important for their range of mollusc and worm species. These areas are important nurseries for a wide variety of organisms. *Zostera* beds and wide, shallow gullies dividing the rocky platforms also provide critical habitat for many other forms and stages of life, as do the extensive and diverse algal communities found within the site.

Ramsar Criterion 7 – *the site supports significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity*
The extensive areas of shallow water and huge number of intertidal pools found within the site provide habitat for many species of fish. To date 107 species of fish have been recorded from the site and adjacent waters. The enormous water exchanges and consequent strong tidal streams combined with high and low energy wave conditions and substrate variability mean a wide diversity of species and life history stages are present. The biogeographic location of the site allied with the surrounding oceanographic circulation and physical features serve to enhance species variety and abundance. The site contributes much to the continued viability of the Golfe Normano Breton ecosystem, which undoubtedly plays a major role in the functioning of English Channel fisheries and biodiversity.

Ramsar Criterion 8 – *the site is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.*
On the south coast, several headlands of varying elevation extend into the residual inshore anticlockwise current, creating sheltered areas in their western lee. Here, recruitment of planktonic larvae onto extensive areas of rocky shore and water-filled soft sediment gullies occurs. Many species of fish take advantage of elevated summer water temperatures to feed and grow on the rich food supply in fertile, shallow waters before making an autumn migration to spawn in offshore waters. Conversely, other species are absent in summer but present in winter for similar reasons. A range of

small fish species spend their entire life within the site. Adjacent to the site is a sandbank known as the Banc du Chateau where large rafts of seabirds and the bottlenose dolphins *Tursiops truncatus* often feed on a plentiful supply of sand-eels *Ammodytes* sp. and other pelagic fish.

2.1.3 Current monitoring of the Ramsar site

2.1.3.1 Daily

- Sea temperature: A new sensor has been set to the west on a waverider buoy. Some sensors have been used by oyster farmers in the Ramsar site (Morel, pers. comm.).
- Tides from two gauges, recording date, time and height (m), to gather real time data to measure tidal surges for flood warnings.

2.1.3.2 Monthly

- Officers from the Department of Planning and Environment monitor fish farm concession areas, i.e., oysters and mussels for *Escherichia coli*, presumptive coliforms and *Salmonella*.
- Société Jersiaise Ornithology Section conduct shorebird counts within specific sectors of the site. Undertaken at least once a month, with up to 3 counts per month during the winter (from December through to March).

2.1.3.3 Biannually.

- Slipper limpet *Crepidula fornicata* tested since July 1996 for heavy metal content in January and July. Sites east of St Helier Harbour and in Grouville Bay. Sites are St Aubins Bay, Elizabeth castle, Havre des Pas, Horn Rock and Les Ecrehous
- Common limpet *Patella vulgata* and serrated wrack *Fucus serratus* are tested for Cd, Pb, Cu, Cr, Zn, As and Hg. Samples collected in March and October from La Collette/ Havre des Pas and Gorey since July 1996.
- Pollack *Pollachius pollachius* tested for radioactivity (Gross Beta and Gamma scan) spring and autumn.

2.1.3.4 Annually

- Seawater tested for radioactivity (Caesium 134 and 137, plus Tritium).
- Oyster *Crassostrea gigas* tested for radioactivity - Total beta, Gamma spectrometry and transuranics: Pu-238, Pu-239+240, Am-241 + where detected Cm-242 and Cm-243 + 244.
- Sediment (inshore and fine 200 u sieve) tested for radioactivity - Total beta, Gamma spectrometry and transuranics: Pu-238, Pu-239+240, Am-241 + where detected Cm-242 and Cm-243 + 244.

2.1.3.5 Seasonal

- Société Jersiaise Ornithology Section conduct monthly Brent Goose *Branta bernicla* counts during the winter from November through to April.
- Société Jersiaise Ornithology Section conduct fortnightly wader counts during the winter from November through to April.
- Bathing waters are monitored for a period of 20 weeks over the main tourist bathing season.
- Total coliform, faecal coliform and faecal *streptoccoci*, plus other physical and chemical parameters in compliance with EC Bathing Water Directive.

2.1.3.6 Continuous.

- Jersey's Department of Planning and Environment monitor usage of the site, commercial fisheries landings, recreational activity, farmed shellfish production, all imports and exports of farmed shellfish, occurrence and frequency of rare fish sightings and occurrence and frequency of fish kills.
- Sightings and mortalities of marine mammals recorded by the Marine Biology Section of the Société Jersiaise and the States of Jersey Department of Planning and Environment.
- Société Jersiaise Ornithology Section bird ringing project ongoing.

2.1.3.7 Current studies being undertaken

- Monitoring of populations of the ormer *Haliotis tuberculata* following significant mortality in 1999.
- Ray tagging study to assess population structure and any seasonal movements.
- Lobster plankton assessment using light traps.
- Strandline habitat action plan being prepared.
- Proposed site for bass assessment and tagging programme

For the purposes of these studies we will be focussing on the water quality monitoring and seasonal counts of waders and wildfowl as the principal sources of information to support our analysis.

2.2 Intertidal ecology

The intertidal zone in Jersey is of international importance. The overall extent and character of the rocky reefs and intertidal sediment flats is unique (Laffoley and Bossy, 1994), although large areas of both rock and sediment can also be found throughout the UK and in the North of France. Tidal range and shallow sloping shore profile are the most important factors contributing to the uniqueness of the area. The value of the shore as a habitat for wildlife is widely acknowledged. Also worth mentioning, is that most of the intertidal areas are relatively unspoiled in comparison with the continent and England. The biota of Jersey contains elements of both Lusitanean and boreal biota and its diverse fauna includes a number of species found nowhere else in the UK such as the Ormer (*Haliotis tuberculata*) and the topshell (*Gibbula pennanti*). Chambers (2008) highlighted the significant difference in number of mollusc species recorded between Jersey and Guernsey (297 and 411, respectively) and suggested that this difference is a reflection of the intense levels of shell collecting (and especially offshore dredging for specimens) that occurred on Guernsey, rather than a (highly unlikely) broad scale difference in biodiversity. It is probable (Chambers, 2008) that the Channel Islands have a coherent regional molluscan fauna with a small degree of inter-island variation.

The two major physical controls on intertidal biodiversity are i) substratum and ii) degree of exposure to wave action (Connor, 1994). Both vary considerably around Jersey (Kindleysides, 1995) and consequently a wide variety of biotopes and species are found around the shores. Substratum is the primary determinant on the occurrence of different species on the shore. Jersey rocky shores possess typical littoral bedrock communities, characterised by a variety of seaweeds, sessile fauna (e.g. sponges, anemones and barnacles) and grazing molluscs. Annelid worms, amphipods and bivalves are the most common fauna associated with the very variable soft sediment communities, the abundance and diversity of invertebrates being far higher in fine sands and muddy sands than in coarse sand. The pebble and shingle shores are highly mobile and contain few species.

The intertidal biotopes of the South East coast of Jersey have been investigated twice in the past: one was undertaken by Kindleysides in 1995 (after the reclamation of la Colette I); and the other by Mercer (1998) covering the area from La Colette to Le Dicq. Although no biotope map was produced, Kindleysides mapped the number of biotopes present at the time of his survey (Figure 2). In general, rocky shores exhibited a greater species richness and biotope diversity than the sediment shores.

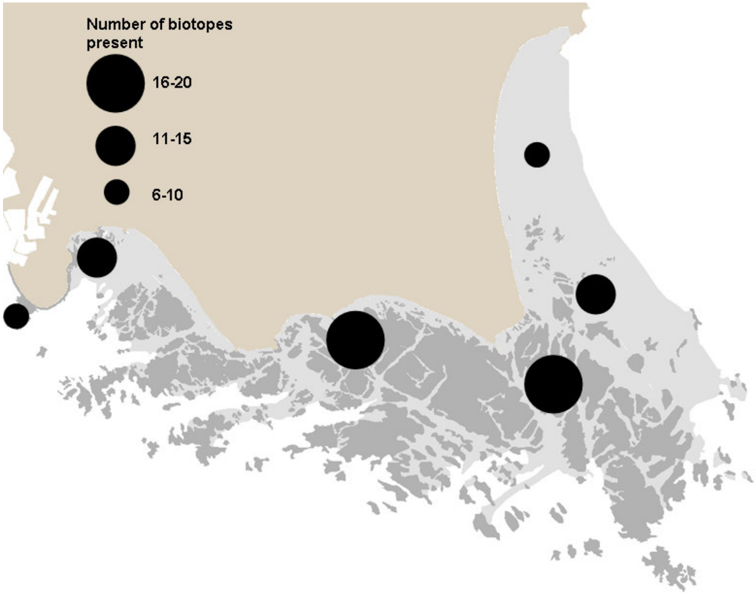

Figure 2 – Number of MNCR biotopes recorded on site-specific transects in Jersey, after Kindleysides, 1995

2.2.1 Main rocky shore communities

The two main influences on communities and biodiversity within this habitat are degree of exposure and, to a lower extent, human activity (Kindleysides, 1995). The west coast of Jersey experiences the highest wave exposure of the large intertidal areas whereas the South-East coast is more sheltered.

Rocky shore biotopes identified by previous surveys are listed in Table 1 (please note that the biotope codes used in these surveys were former MNCR codes, whereas we have used the most recent updated JNCC biotope codes for our survey).

Table 1 – Rocky shore biotopes identified in previous surveys
Sources: (1): Kindleysides (1995); (2): Mercer (1998) (La Colette area only)

Code	Habitat type	Dominant/characteristic taxa	Source
LRK.YG	Supralittoral bedrock/boulders	Yellow/grey lichens	(1), (2)
LRK.VER	Supralittoral bedrock/boulders	*Verrucaria maura* (lichen)	(1), (2)
LRK.VER.B	Supralittoral bedrock/boulders	*Verrucaria maura* and sparse barnacles	(2)
LRK.PRA	Supralittoral bedrock/boulders	*Prasiola stipitata*, *Verrucaria maura*	(2)
LRK.LPYG	Supralittoral bedrock/boulders	*Lichina pygmaea* (lichen)	(1)
LRK.PEL	Littoral bedrock/boulders	*Pelvetia caniculata* (brown algae)	(1), (2)
LRK.FSP	Littoral bedrock/boulders	*Fucus spiralis* (fucoid algae)	(1), (2)

LRK.BP	Littoral bedrock/boulders	Barnacles and limpets	(1), (2)
LRK.EPH	Littoral bedrock/boulders	Ephemeral algae	(1)
LRK.FVES	Littoral bedrock/boulders	*Fucus vesiculosus* (fucoid algae)	(1), (2)
LRK.FVES.BP	Littoral bedrock/boulders	*F. vesiculosus*, barnacles, limpets	(1), (2)
LRK.ASC	Littoral bedrock/boulders	*Ascophyllum nodosum* (brown algae)	(1), (2)
LRK.RED	Littoral bedrock/boulders	Red algae	(1)
LRK.FSE	Littoral bedrock/boulders	*Fucus serratus* (fucoid algae)	(1)
LRK.FSE.RED	Littoral bedrock/boulders	*F. serratus* and red algae	(1)
LRK.RED.MAS	Littoral bedrock/boulders	*Mastocarpus stellatus* and *Chondrus crispus*	(2)
LRKP.CHL	Littoral fringe rock pool	*Enteromorpha* spp. (green algae)	(1)
LRKP. COR	Rock pool	*Corallina officinalis* (red algae)	(1), (2)
LRKP. RSP.O	Rock pool	Red algae, sponges	(1)
LRKP.FK	Rock pool	Fucoid algae, kelps	(1)
LRKP.FK.S	Rock pool with sediment floor	Fucoid algae, kelps	(1)
LRK.LDIG	Sublittoral fringe bedrock/boulders	*Laminaria digitata* (kelp)	(1)
LRK.LDIG.T	Sublittoral fringe bedrock/boulders	*L. digitata*, ascidians	(1)

2.2.2 Soft sediment communities

Within the soft sediment biome, particle size has the greatest influence on density and diversity of the biota (Kindleysides, 1995). In isolation from other variables, coarser particle size has fewer species and individuals (Wolff, 1987). Particle size does not, however, operate independently of wave exposure and the strength of tidal currents. Additionally, the soft sediment habitat is more changeable, 'ephemeral' in comparison to the rocky shore. Where sediments are most stable, generally where exposure is lowest, richer communities develop (Thomas and Culley, 1998). This is the case for the sheltered South-East shores of Jersey (Kindleysides, 1995). Large sediment gutters between the rocks are also a characteristic feature of the shoreline, and are important for both habitat diversity within predominantly rocky shores, and species richness of the soft sediment biome as a whole.

Soft sediment biotopes identified by previous surveys are listed in Table 2

Table 2 – Soft sediment biotopes identified in previous surveys
Sources: (1): Kindleysides (1995); (2): Mercer (1998) (La Colette area only)

Code	Habitat type	Dominant/characteristic taxa	Source
LST.BAR	Pebbles/shingle	No conspicuous biota	(1)
LSND.BAR	Littoral sand	No conspicuous biota	(1), (2)
LSND.AE	Littoral sand	Amphipods	(1), (2)
LSND.AP.S	Littoral sand	Amphipods and polychaetes	(1)
LSND.AP.AR	Littoral sand	*Arenicola marina* (lugworm)	(1), (2)
LMXD.TAL	Littoral mixed rock and sediment	*Talitrus saltator* (sand hopper)	(1)
LMSND.ECH	Littoral muddy sand	*Ensis* spp. (razor fish)	(1)
LMSND.ARB	Littoral muddy sand	*A. marina*, bivalves	(1)
LMSND.LAN	Littoral muddy sand	*Lanice conchilega* (sand mason worm)	(1), (2)
LMUD.ZOS	Littoral sandy mud	*Zostera* spp. (eel grass)	(1)

2.2.3 Mixed substrata

Soft sediment and rocky substrata may overlap in certain areas. **Error! Reference source not found.** lists the mixed substrata biotopes identified by Kindleysides (1995) and Mercer (1998).

Table 3 – Mixed substrata biotopes identified in previous surveys
Sources: (1): Kindleysides (1995); (2): Mercer (1998) (La Colette area only)

Code	Habitat type	Dominant/characteristic taxa	Source
LMXD.FSP	Littoral mixed rock and sediment	*F. spiralis*	(1)
LMXD.ASC	Littoral mixed rock and sediment	*A. nodosum*	(1)
LMXD.FVES	Littoral mixed rock and sediment	*F. vesiculosus*	(1)
LMXD.FSE	Littoral mixed rock and sediment	*F. serratus*	(1), (2)
LMXD.SAR	Littoral mixed rock and sediment	Sponges, anemones, red algae	(1), (2)
LMXD.EPH	Littoral mixed rock and sediment	Ephemeral algae	(1)

2.2.4 La Collette to le Dicq - biotope map (1998)

Mercer produced a biotope map of Havre des Pas in 1998. This map is reproduced in Figure 3. As far as we are aware it is the only biotope map available for Jersey intertidal area until this project was commissioned, but only covers the limited area from La Collette to le Dicq.

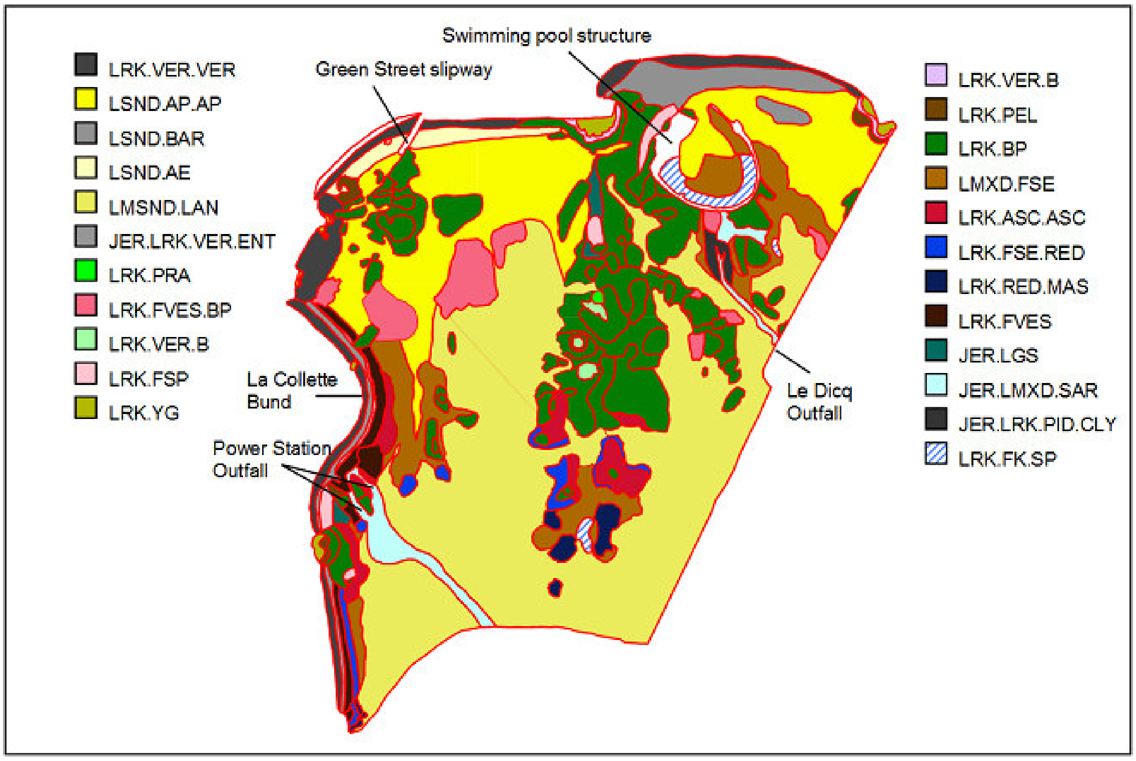

Figure 3 – Biotope map of La Collette to Le Dicq (Mercer, 1998)

2.3 Water quality data

2.3.1 Bathing waters

Bathing water quality reports from 2007 and 2008 indicate that all monitoring sites around Jersey (including those within or adjacent to the Ramsar site) meet Directive 76/160/EEC, in several cases meeting the more stringent Guideline parameters.

For the 2008 Bathing Waters report the revised European Directive standards: 2006/7/EC, and World Health Organisation (WHO) guidelines were also applied as these are currently being adopted globally in replacement of the EEC directive. They are considered more stringent and applicable to modern methods and environmental concerns, though have a ranked classification, and thus no Pass/Fail standards. Whilst designations may be less distinct this method of grading should enable better monitoring of overall trend in water quality. Within the UK, Defra's target is for all bathing waters to meet the new 2006/7/EC "Sufficient" standard (between existing Imperative and Guideline EEC standards). Currently three of Jersey's monitoring sites fail to meet this, receiving only "Poor" designation.

It was noted however that both the 2007 and 2008 Bathing Water reports recorded exceptional rainfall over the monitoring period, these two years representing the two wettest in 30 year of monitoring, both significantly higher than average. Whilst water quality at all sites remained acceptable, this has been attributed to the apparent decrease in sites meeting higher Guideline standards over Imperative standards. Research suggests that there is a connection between increased rainfall and microbial concentration, a link suggested with increase land run-off and out-flow discharge. However, further investigation would be required to confirm the origin of the microbial populations, without which this link remains uncertain.

Of the three monitoring sites within the Ramsar site, Green Island and Havre de Pas have historically been better quality than Grouville, however all received only Imperative standards in 2007 and only Green Island achieved the Guideline standard in 2008. Victoria Pool to the west, in St Aubins Bay, has historically been lower quality (failing in 2002) however in 2007 and 2008 has received Guideline standard, contrary to the overall trend. Archirondel, north of Grouville, has consistently passed the more stringent Guideline standard and as such represents the best water quality around Jersey.

All monitoring sites within the Ramsar site would achieve "Good" standard under the new 2006/7/EC directive.

Table 4 – 2008, bathing season classifications; for the three monitoring sites within the Ramsar site, and of the two sites adjacent to it.

	Directive		
Sample site	76/160/EEC	2006/7/EC	WHO
Havre des Pas	Imperative	Good	Low
Green Island	Guideline	Excellent	Low
Grouville	Imperative	Sufficient	Moderate
Archirondel	Guideline	Excellent	Negligible
Victoria Pool	Guideline	Sufficient	Low

Table 5 - Summary of compliance of Jersey bathing waters with Directive 76/160/EEC standards between 1991 and 2008. (Taken from: Assessment of bathing water quality for the States of Jersey 2008)

Year	Grouville	Havre de Pas	Sample Site Green Island	Archirondel	Victoria Pool
1991	I	I	-	G	-
1992	I	-	-	G	F
1993	I	I	G	G	I
1994	I	I	G	G	I
1995	I	G	G	G	I
1996	G	G	G	G	I
1997	I	I	G	G	I
1998	G	I	G	G	I
1999	I	I	I	G	I
2000	I	I	G	G	I
2001	G	G	G	G	I
2002	I	G	G	G	F
2003	I	G	G	G	I
2004	I	G	G	G	I
2005	G	G	G	G	I
2006	I	G	G	G	G
2007	I	I	I	G	I
2008	I	I	G	G	G

G = Guideline Pass, I = Imperative Pass, F = Imperative Fail

However it is worth noting that all three Directives are specifically related to bathing water standards during the "Bathing season" between May and September, and that water quality can only be inferred for the remaining months. Research suggests that due to environmental factors (e.g. increased rainfall, reduced sunlight hours, lower surface sea temperature) microbial activity increases during the out-of-season months and that during the summer in-season months microbial density will be reduced. Bathing waters monitoring also focuses solely on pathogenic species harmful to human health, and thus those which are most likely to originate from human contamination of the environment (i.e. sewage borne). Thus such classification may not necessarily reflect overall water quality. Additionally evidence suggests that the use of colony forming units (CFUs) as the basis for all assessment is misrepresentative of absolute microbial densities as contaminant microbes from non marine sources (i.e. the faecal coliforms and streptococci used) enter a "viable but not culturable" state whereby they can survive but do not multiply. This means that whilst CFU counts may remain low within a sample, actual concentrations of microbial cells may be significantly higher and vary independently from this count. Whilst relevance and significance of these issues remains uncertain at the present time, it does demonstrate how subjective these designations are, and also that simply achieving them may not represent a clean bill of health for the environment, merely their suitability for human bathing.

2.3.2 Drainage into coastal waters

It is clear that outfalls are recipients of both stream flow and drainage that follows rainfall events. Stream flow is connected to groundwater base flow in many of the outfalls and hence these would be expected to continually flow. For example, the Dicq outfall drains the large Longueville large catchment. The Longbeach and Beach Hotel outfall are connected to Queens Valley reservoir, hence their flow is influenced by flow through from the reservoir. Other smaller catchment outfalls are currently dry (for example, Le Hocq and the outfall b/w Fauvic and Fort Henry. In addition, during outfall sampling the colour, turbidity and whether it is low flow or dry are noted for each sampling date and location. Also the Dept of Environment monitor faecal indicator organisms at Rozel Beach Hotel, outfall b/w Fauvic and Fort Henry, Fauvic, Le Hurel, Le Hocq and the Dicq every other month (alternating with western outfalls) and the STW outfall is currently monitored weekly. An outfall monitoring project was undertaken over four years (2002-2006) and this has recently been extended to address some of the issues raised. Clearly the situation with regard to surface waters drainage is dynamic and can change as result of intensive weather events and alterations in land use. For example, a new company growing Jersey Royals on the island, has resulted in increased land area utilised for this purpose and further investigation of these aspects will be necessary if we are to understand possible knock-on effects for coastal waters.

2.3.3 Heavy metal contamination

Other forms of contamination have been investigated in the recent past by Du Feu (Head of Water Resources, Planning and Environment Department) who investigated the possibility of contamination, specifically of heavy metals (Arsenic, Cadmium, Chromium, Copper, Lead, Zinc), from the land reclamation site at La Collette. Based on samples taken between July 1993 and March 2009 (4 samples were taken per year from 5 sites along the southern coast of Jersey) with comparisons between La Collette and other sites used to indicate possible contamination.

The results of the investigation were that although a higher concentration of some heavy metals was observed at La Collette not all were significantly higher, with some actually being significantly lower than at other sites. Also there has been a general correlation between levels of metals at each site, indicating that fluctuations and trends were not site dependant and thus not a direct result (at La Collette) of contamination from the land reclamation. Additionally a significant overall increase in Arsenic concentration was observed at all sites. However, all levels, for all metals, remain within UK average values. It is unclear what has caused the overall increases in contaminant levels, although sources from vehicles within surface run-off from roads, could contribute to some of the recorded levels. Whilst these results did not indicate a specific point or cause of contamination, this should not lead to complacency and represents a standard to maintain and monitor.

2.3.4 Overview

Overall, the waters around Jersey, and specifically within the Ramsar site can be considered relatively good water quality, well within guidelines and UK averages with respect to bathing waters, and often exceeding them. Although there may be site specific or localised heavy metal contamination problems, these are receiving attention from the Environment department at the present time. Undoubtedly the high tidal flows and flushing will help to dissipate contaminations thus improving overall water quality. It is likely however that a decline in water quality, where present, is the result mainly of surface run-off and discharge from urban areas (i.e. St Helier, Grouville), indicated by the overall decrease in Guideline standards being awarded following exceptional rainfall in 2007 and 2008. Should overall rainfall return to average levels during 2009, this will enable verification of this hypothesis.

2.4 Review of ornithological data since Ramsar designation

Despite its small size, Jersey is home to a diverse variety of wetland birds and waders, and is an important habitat for migratory species, as well as to breeding colonies of endangered species. Of the 300 species of birds recorded within the Bailiwick, many species are threatened, and Jersey is home to some 100 species of breeding birds (plus additional visiting species) which are otherwise absent or rare on the mainland. The British Isles as a whole acts as a major stop off for migratory birds from Iceland and the Arctic, on their migration to and from warmer climes as far south as Africa. As such, the island acts a sanctuary for species displaced from northern habitats and the mainland where agriculture, pollution and other human activity has destroyed habitats, or otherwise displaced existing populations.

"Flag ship species" such as the Brent Goose (*Branta bernicla)*, the Razorbill (*Alca torda*), Little Egret (*Egretta garzetta*), Atlantic Puffin (*Fratercula arctica)* and Northern Fulmar (*Fulmarus glacialis*), all attract considerable attention from ornithologists, and are all "Amber Status" within the RSPB conservation standards. This status recognises that populations of these species have been in decline over the last 200 years (1800 - 1995) but have begun to recover recently (last 25 years). However, within these species the breeding population and range has reduced by between 25-49% within the last 25 years, and the number of breeding pairs are fewer than 300 (over a five year mean) within the UK. This means that the populations in Jersey represent important contributions to overall populations within the UK.

2.4.1 The Brent Goose

This small species of goose is famous for its vast annual migration from its summer breeding grounds of the arctic tundra, to its winter feeding grounds in Northern Europe and other locations around the northern hemisphere.

Annually Jersey receives an influx of these migrants from late autumn to early spring. They use this time to replenish energy reserves and prepare for the long return in late spring, therefore their main activity (aside from resting from flying and sheltering from storms) is foraging. Their diet is principally vegetation, specifically coastal grasses and algae, such as the seagrasses, *Zostera spp.*, and sea lettuce, *Ulva spp*. Globally this species is not under threat but due to its international movements, populations are sensitive to changes in food availability and disturbance; if they are unable to build up sufficient energy reserves within the winter months this can lead to unsuccessful breeding and even death of individuals. Therefore the availability of suitable nutrition at their winter destinations is crucial in their survival and distribution. Jersey's rich shores and extensive intertidal zones provide ideal shelter and foraging grounds.

The pressures on Brent Geese and concerns about maintaining and protecting their habitat have resulted mainly because of the shift in their feeding patterns. Once solely a shore species, feeding predominantly on Eelgrass (*Zostera* spp.) and some seaweeds (e.g. *Ulva lactuca*), it now seems to have shifted to grazing upon terrestrial grasses utilising pasture to supplement its diet. No one is sure what has induced this shift, however, a strong candidate is obviously the declining quality and abundance of its normal food resources such as *Zostera.* This means that the survival of this species may now be more at risk from human influence, and any further change to these resources may have serious consequences for the geese. An average of around 1200 individuals per month are counted over the winter period (2006-08, counts by Tony Paintin, www.jerseybirds.co.uk) and although numbers have remained relatively stable, the past declining trends in numbers make it even more important to continue protecting their natural habitat on Jersey.

In recent years there has been a gradual increase in global populations to around 560,000 (Birdlife International), and this increase has been reflected in counts from

Jersey (Figure 4) which show a gradual increase from around 800 to 1200 individuals per month, being observed over the last decade. This pattern is reflected from counts within the Ramsar site (Figure 5).

Whist the increase could be attributed solely to global increase, it is important to consider that Brent Geese have a number of selected destinations around the UK and northern France, and so an increase in Jersey may represent displacement from elsewhere following disturbance or food shortage. Conversely, any disturbance to the geese in Jersey may cause populations to relocate to other sites, and whilst this may not affect the global population directly, such disturbance should be minimised should environmental pressures restrict the species range.

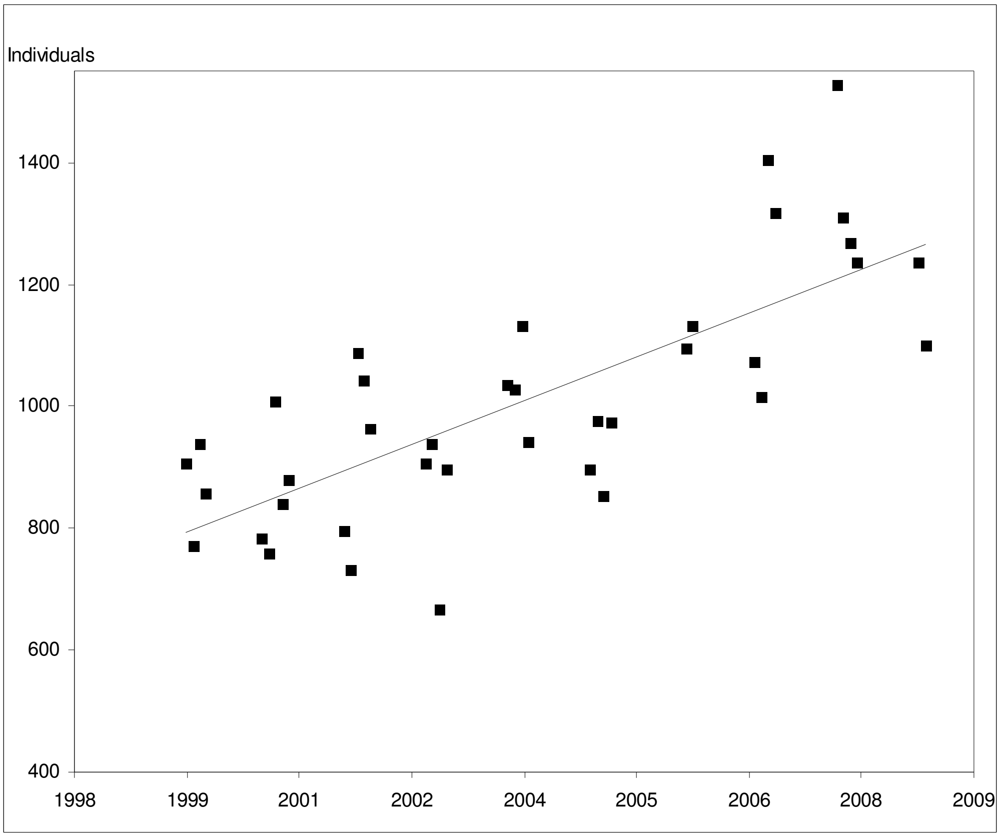

Figure 4 – Total winter Brent geese monthly counts from Dec 1999 to Dec 2008 (Counts conducted during winter months each year, at various locations on the island). Source of raw data: Jersey Birds (Trend line is also represented on the graph).

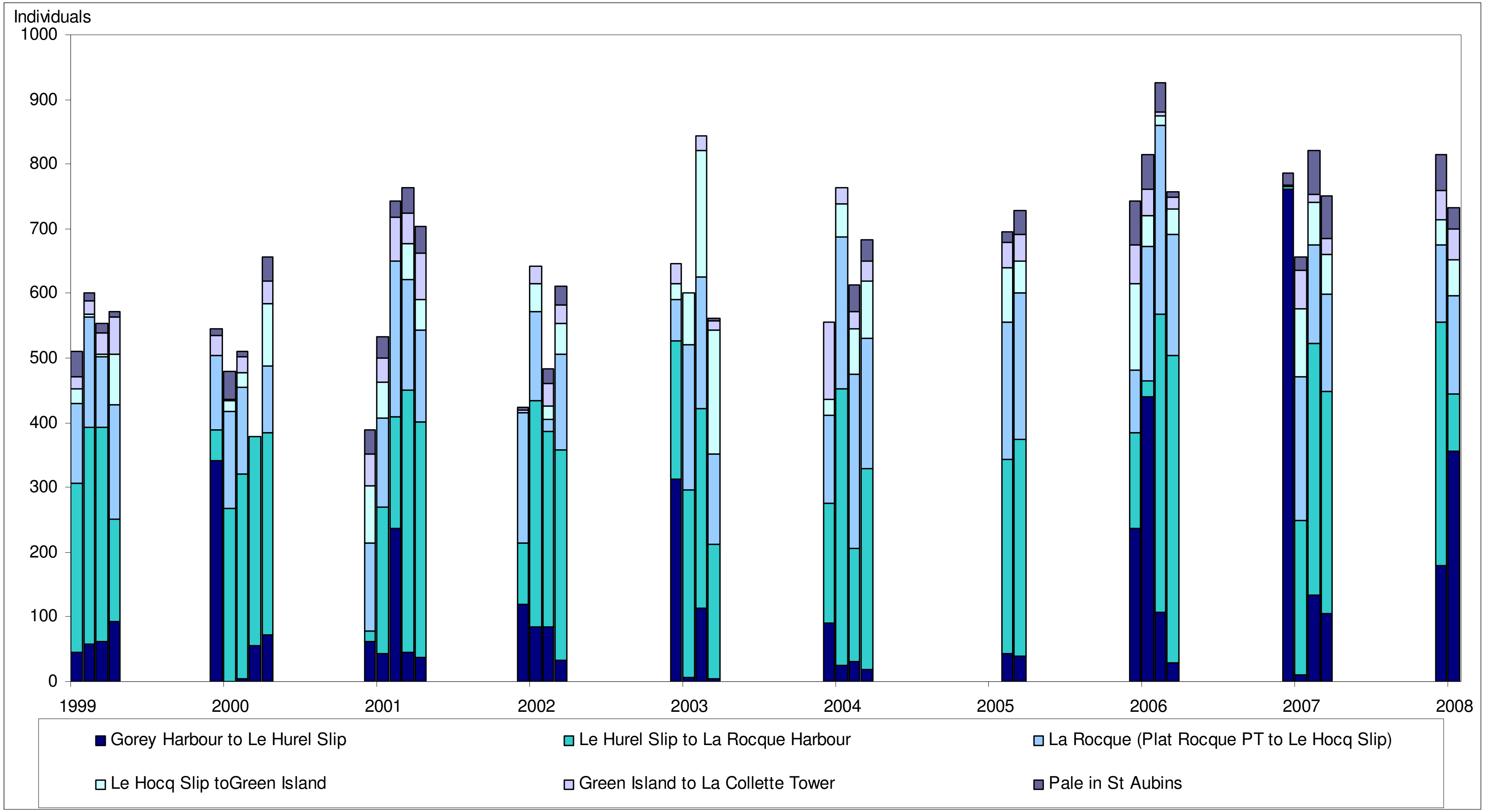

Figure 5 – Monthly winter Brent geese counts from Dec 1999 to Dec 2008. Counts conducted during winter months each year from 5 survey locations within the Ramsar site. Also including counts of Pale, in St Aubin's Bay. Source of raw data: Jersey Birds

2.4.2 Waders

Waders counts for the whole Island were also analysed (see Figure 6). For more clarity, we have averaged them per season (i.e. winter). Please note that method and locations of counting may have varied over the period studied, which may explain some of the variability of the results.
After a decline in numbers until 2002, the overall population of waders now seems to be increasing. Individual trends vary from one species to another. As far as the main species are concerned:

- Populations of Oystercatcher and Sanderling appear to be rather stable
- After a sharp decrease until 2004, populations of Dunlin are almost back to the numbers counted 10 years ago
- Counts of Grey Plover, Turnstone, Redshank and Bar-tailed godwit vary greatly from one winter to another, but populations seem to be relatively stable.
- Counts of Ringed plover have decreased until 2006 and are now increasing.
- Populations of Little Egret have increased since 2006. Counts of 1999 and 2000 (both zero) may be explained by the fact that this species was not counted during those years.

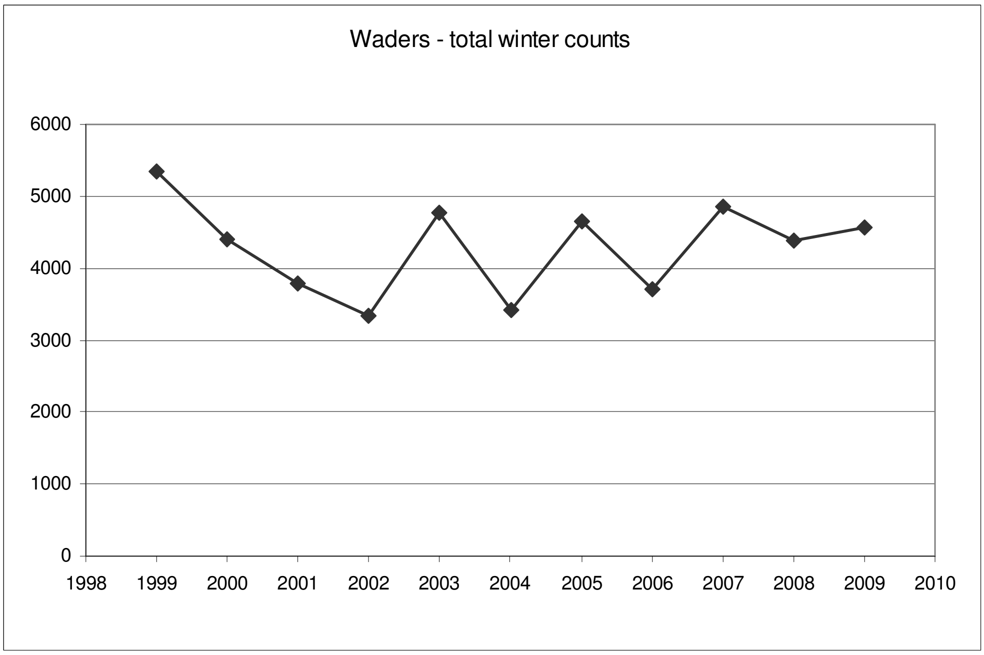

Figure 6 – Total winter counts of waders in Jersey. Source of raw data: Jersey Birds

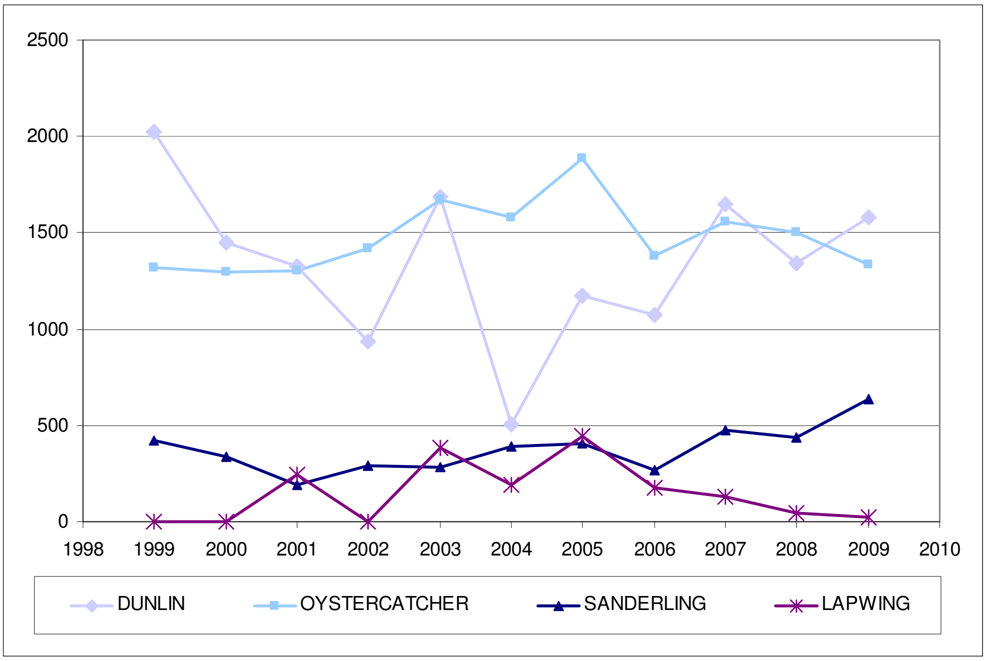

Figure 7 – Winter counts of Dunlin, Oystercatcher, Sanderling and Lapwing

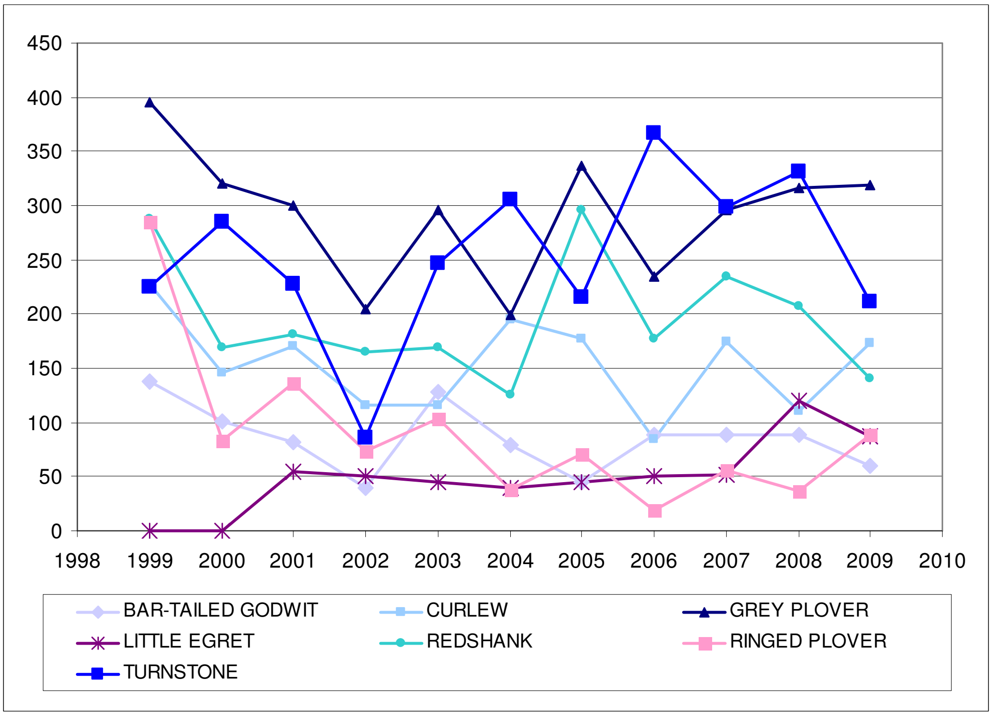

Figure 8 – Winter counts of Bar-tailed godwit, Little Egret, Turnstone, Curlew, Redshank, Grey and Ringed Plover.

2.5 Seagrass beds

Jersey's coasts are host to extensive beds of seagrass, the general name given to species from four families of marine angiosperm (flowering plants). Seagrass beds are important habitats, providing shelter and habitat for juvenile fish, invertebrate species and other economically important species. They also stabilise sediment for burrowing organisms serving as an important food source for grazing species, for example, the Brent goose as discussed above. The predominant species in the UK is *Zostera marina*, also known as Common Eelgrass, which forms mats generally with shoots up to 50cm high (but as high as 2m). In seas that are nutrient rich (as they are around Jersey) phytoplankton, and subsequent zooplankton blooms, will occur more frequently and so water turbidity is generally higher. Sustained alluvial outflow and terrestrial run-off impedes the growth of seagrass, blocking out light and halting photosynthesis. Because of this, seagrasses are sensitive to pollution and/or physical disturbance, not only does this directly impair the grasses' ability to grow but also promotes the growth of epiphytic algae and other organisms (e.g. Bryozoans, micro-algae) which further incapacitate it. Overall this means that seagrasses are sensitive to human activity and with the only survey of seagrass beds around Jersey (focussing on *Z. marina*) being completed by Jackson (2003), the exact extent of seagrass beds within the Bailiwick are unknown. Certainly observations of the second species commonly found in Jersey, *Zostera noltii* were not included in this survey, and the ecological significance of this species has yet to be determined.

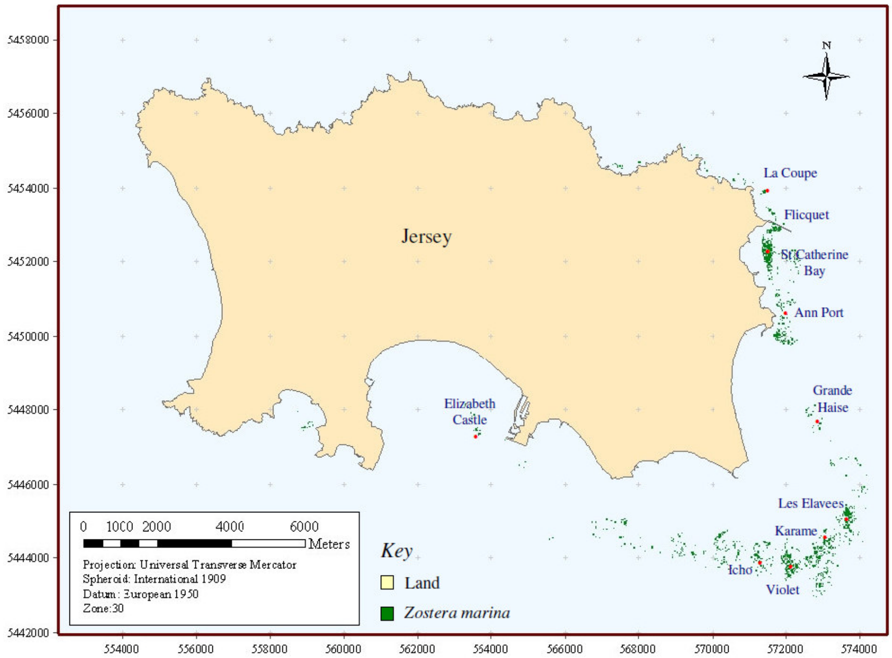

Figure 9 – Distribution of *Zostera marina* (in green) around the coast of Jersey (2000)
Source: Jackson, E.L. (2003). Importance of seagrass beds as a habitat for fishery species around Jersey. Thesis submitted to the University of Plymouth

Without seagrass beds, the biodiversity and productivity of Jersey waters would undoubtedly decline, and it is for this reason that seagrass beds are designated habitats within European legislation (Natura 2000), with specific measures to ensure their protection and maintenance for the benefits of wider ecosystem services and protection of habitat for species of commercial and conservation significance.

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3 Ramsar site biotope mapping

3.1 Methodology

3.1.1 JNCC guidance

Our work was designed and carried out in accordance with the JNCC Marine Monitoring Handbook, Procedural Guideline 1-1: Intertidal resource mapping using aerial photographs (Bunker *et al.*, 2001). Extracts of this guideline are reproduced in Annex 1. The main points are summarised below.

3.1.1.1 Background

Shore mapping aims to create maps showing the distribution of biotopes along with associated information, such as the occurrence of rare species, details of habitat, etc. Biotopes are located on the shore and matched to features shown on recent colour aerial photographs (corrected to allow an Ordnance Survey grid overlay). The biotope boundaries are then defined on the photograph (as 'polygons') and target notes made on biotopes and features of interest together with detailed quantitative data if required. Integral to the methodology is the collating of the biological data, together with aerial photographs and digitised 1:10,000 OS maps on a PC-based Geographical Information System (GIS) such as ArcView (ideally linked to a database). Shore biotopes are classified according to the national classification (Connor *et al.* 2004); however, it is important to recognise and properly describe the regional character and variants of biotopes in each area of study.

3.1.1.2 Attributes measurable by shore mapping

- distribution of individual or groups of biotopes, biotope complexes and life forms present in an area
- extent of individual or groups of biotopes, biotope complexes and life forms present in an area
- diversity of biotopes present in an area
- other attributes attached to polygons in the form of target notes, such as species information, condition of biotopes (Bunker and Bunker, 1998) and sensitivity (Cooke and McMath, 2000)

3.1.1.3 Advantages

- The maps can show the overall distribution of biotopes over large areas of shoreline and can be invaluable for developing resource management and monitoring strategies.
- The maps can highlight and help quantify large-scale changes in biotope distribution.
- Aerial photograph interpretation is a tried and tested technique.
- Data stored in a GIS are more flexible and can be interrogated in a number of ways. Entering field data directly to a PC has several advantages. As well as being quick, it cuts out sources of error which can be created by in-between paper stages.

3.1.1.4 Disadvantages

It is important that the limitations are fully understood. The colour maps produced on a GIS can appear impressive, but their accuracy together with the biotope boundaries must always be scrutinised.

- Many shore species and communities occur along a continuum and therefore biotope boundaries are often artificial and subjective.
- Mapping biotopes with strict adherence to the present national classification may not take account of regional characteristics. So it is essential that proper local descriptions are prepared.
- Small features or species of interest may be overlooked where a large area is being studied. For example, intertidal *Zostera* plants may virtually disappear from sediment flats due to winter die-back and grazing by wildfowl (Perrins and Bunker, 1998) and the low density may be missed by ground validation.
- It is difficult to represent the quality of a biotope. The importance of target notes and quantitative studies associated with mapped biotopes is stressed.
- An important biotope may not be a mappable unit resolved by the aerial photograph.

3.1.1.5 Logistics

Pre-survey

Time should be allowed before the survey to obtain aerial pictures, scan, digitise and ortho-rectify them prior to incorporation into a GIS. Proper planning of fieldwork is essential for efficient use of the limited time the whole shore is uncovered. As a guide, effective shore mapping work can be carried out for a maximum of 4 hours (2 hours either side of low water) in any period of one low water. Fieldwork should only be carried out during the two to three days either side of spring tides.

Field

The amount of shore that can be covered during a single low tide by a pair of surveyors will vary depending on a number of factors. These include the quantity of information required as well as the complexity and accessibility of the coastline (average speed of 0.6 km/hour or 2.4 km/tide assuming four hours of survey per tide).

Equipment

- clipboard (weather-writers are good for fieldwork)
- printouts of scanned aerial photographs for annotating (laminated copies are most sturdy)
- space pen or 4B pencils for annotating colour photographs
- A4 copies of Ordnance Survey maps (enlarged if necessary)
- field notebook for recording biotopes, target notes and shore profiles
- digital camera/video
- compass and hand-held differential Global Position System (GPS) (tracking facilities and an interface to download to a PC are desirable features)
- safety equipment including mobile phone, personal protective clothing, first aid kit
- tide tables

Extra equipment needed for sediment shores

- spade
- sieve (1mm mesh size)
- sample containers (if voucher specimens are to be kept)

Writing up field data

A day's worth of data from a pair of field workers will take four to six hours to 'write up'. This includes the downloading of GPS information, digitising of polygons (or preparing fair maps), writing up target notes, drawing profiles and logging of photographs.

3.1.1.6 Method

Preparation of fieldwork

Wyn *et al.* (2000) describe a technique of producing 'wire frames' by tracing recognisable features from aerial photographs prior to the field survey. The wire frame map can then be transferred onto waterproof paper and annotated in the field.

Field recording

When taking aerial photographs into the field, recorders must match biological features with those identified from aerial photographs. These features are then labelled with dominant biotopes and their extents marked on the printed aerial photographs as polygons. In particular, on rocky shores, polygons may contain more than one biotope, e.g. algal/faunal dominated zones interspersed with rock pools, overhangs, gullies, etc. Notes on subordinate biotopes in polygons together with any features of importance should also be recorded, together with positional information where possible (e.g. GPS waypoints). Profiles of shores or sketches of important features should be completed in field notebooks whenever a major change is encountered. Photography is an important adjunct to the field surveys. This gives visual information on the condition of the biotope against which gross change can be measured. A mixture of viewpoint and close-up photography is useful.

A distinction is made between *polygon attributes* and *target notes* depending upon the type of information and the way in which the notes are geo-referenced.

Polygon attributes

Polygon attributes are information attached to a polygon and recorded as standard. This information would include (where relevant):

- dominant biotope(s);
- substrata and important modifying features;
- species/community information pertaining to the polygon, particularly if this represents a significant variation on the standard biotope description;
- rare species or species of conservation significance;
- information on the quality of the biotope, e.g. if it is scoured or perhaps a particularly good example;
- subsidiary biotopes, which are too small to be mapped individually, e.g. shallow coralline pools, which are widespread over the polygon;
- any other relevant information relating specifically to a particular polygon, e.g. any anthropogenic activities such as bait digging.

These data will be stored in a spreadsheet or database linked directly to the polygons through the unique polygon ID reference code.

Target notes

Target notes contain information not collected as standard for the polygons, which can be located on the map. The data may contain:

- information on biotopes smaller than 5 x 5m which cannot be regarded as typifying the whole polygon, e.g. a significant small pool or gully in a large polygon;

- information on impacts within a localised area of a polygon (but which can encompass more than one polygon);
- artificial substrata, e.g. sewage pipes
- shore profiles showing zonation and biotope extents
- features outside the limits of the survey (dunes, land falls, etc);
- locations where photographs and /or video were recorded;

Writing up field data

Ideally, surveyors should aim to transcribe field maps, target notes, etc. directly to a PC following the survey.

3.2 Field survey

3.2.1 Preparation

A geo-referenced high-resolution aerial picture was purchased from Digimap and loaded in our GIS software, ArcView. So as to help us identify the mean low water level and mean high water level, a 1:25000 map ('Official Leisure Map') was scanned and registered in ArcView using 5 control points. Wireframes were then traced along the main features (soft sediment areas, hard rock, mixed substrata) prior to the field survey so as to optimise the design of the survey transects. A Risk Assessment was written by the team and approved by PML Health and Safety advisor.

3.2.2 Field survey

Two 4-day rocky shore surveys were carried out in 2009: 4 consecutive days during equinoctial spring tides in March 2009, and 4 consecutive days during spring tides in June 2009. The surveyors were the same during these 2 surveys, one of them recording the species and their abundance on a checklist, the other carrying the GPS, taking pictures and writing target notes. In order to cover an area as extensive as possible, field survey began 3 to 2.5 hours before low tide, and finished 2 to 3 hours after low tide. Given the nature of the shore and its complexity (mix of bedrock/gullies/sandy areas/rocky outcrops/mixed substrata), straight line mapping transects were unrealistic. Safety considerations limited the area of the low shore that it was possible to survey

Tracks of the walk-over survey are represented in Figure 10.

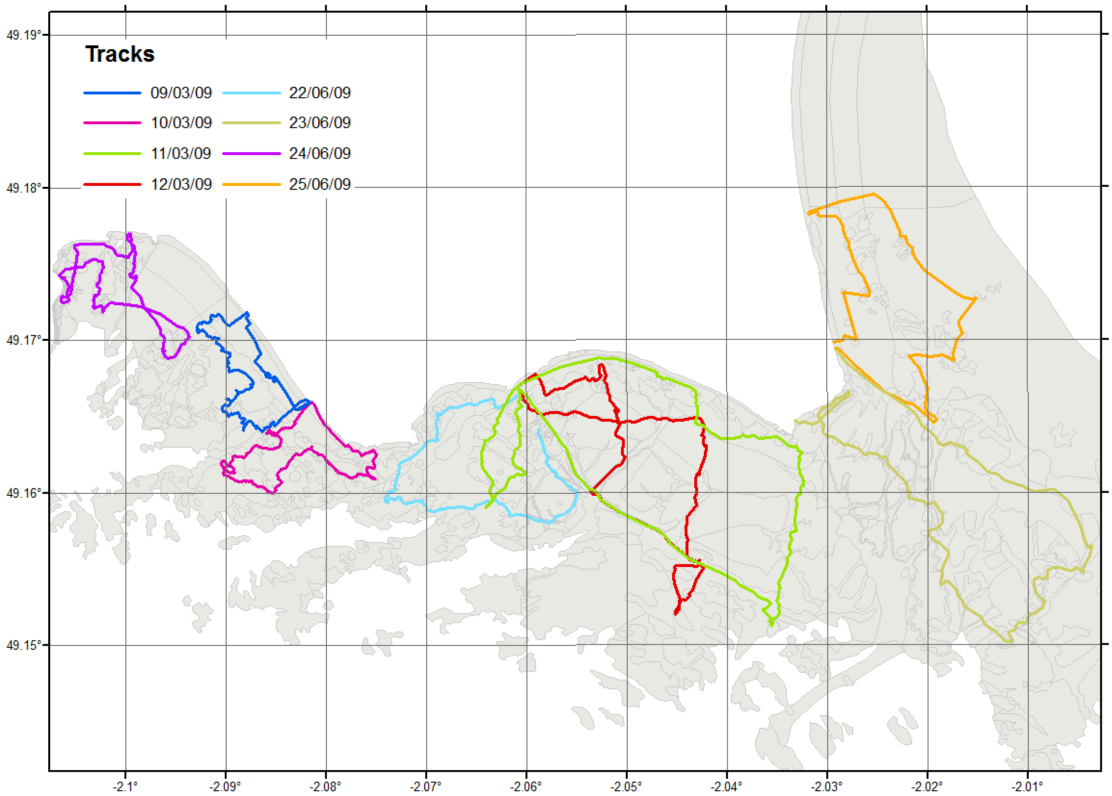


Figure 10 – Tracks walked during the survey

3.2.3 Writing up

Field notes were typed directly to a PC on the day of the survey. Waypoints coordinates and tracks were downloaded from the GPS to the same PC, as well as pictures taken during that day. Biotopes were attributed to polygons in ArcView after returning to PML.

3.3 Results

3.3.1 Species

3.3.1.1 Inventory of principal species observed during the field survey

Species	***Distribution / comments***
Porifera	
Halichondria panicea	Difficult to accurately identify, with no distinct shape or colour. Common on lower shores. Due to their encrusting nature they are hard to quantify, and are often hidden from view underneath boulders and other species (e.g. Fucoids).
Hymeniacidon perleve	As *Halichondria*
Algae	
Fucus serratus	Easily identified, very common. Typical of lower intertidal zone, below *F.vesiculosus* and *F.spiralis*
Fucus vesiculosus	With distinct bladders along fronds, can be regularly found from upper to mid-shore, alongside both *F.serratus* and *F.spiralis*.
Fucus spiralis	Most upper shore species of *Fucus*, tolerant on high levels of desiccation and variable salinity. Can be confused with *F.vesiculosus* when reproducing due to reproductive bladders, but generally easily identified,

	very common on upper shore.
Ulva spp.	There are a few very common *Ulva* species, easily identifiable by their semi-translucent, bright green colouration. It is not always easy to identify specific *Ulva* species, but all function similarly within the environment. Tolerant of varying salinity and rapid seasonal growth (spring-summer), can be found from extreme upper shore all the way down to lower shore. Key food source for many species.
Pelvetia canaliculata	Short tuft algae, typical of upper shore. Can form wide beds providing shelter for *Littorina saxatilis* and other upper shore species. Often the first macro-algae species to be found from upper shore, superseded by *F.spiralis.*
Corallina officinalis	Distinctive pink calcified tufts. Slow growing, but very robust. Usually only found within rock pools and channels on lower shore, but often abundant where present.
Ascophyllum nodosum	Similar to a Fucus species, but distinct in form. Typical of high-energy shore, where fast tidal flows or wave action is present, hence present on any part of shore like this. Often found in great densities and alongside Fucus species, it has several key associated species, such as *Littorina littoralis* and *Polysiphonia lanosa.*
Sargassum muticum	A highly invasive alien species, though appears not to have impacted the shores of Jersey to a great extent. Rapidly growing and forming dense beds (particularly in rock pools and channels) can smother native, slower growing algae, but may actually provide increased shelter for other species.
Lithothamnia spp.	Calcified encrusting algae, very hard to distinguish species, but easily identified by is bright pink colouration. As it is encrusting individuals cannot be identified, but can often cover vast areas or rock on lower shore.
Chondrus crispus	A distinctive red algae, found from mid to lower shore, particularly in shallow pools.
Mastocarpus stellatus	A small algae ranging in colour from bright green to deep red. Normally found at extreme lower shore in absence of Fucus and other macro algae.
Osmundia pinnatifida	Know as Pepper dulse for its aromatic smell, can be found on mid to lower shore. Grows in short fleshy fronds, forming clumps on boulders and outcrops.
Red algae	Unidentified/amalgamated species of “red” algae. Normally not in great densities but too numerous to individually identify individuals. Found on, under and within beds of larger algae, within pools and channels. Numerous different species, often very hard to identify but not biotope defining.
Green algae	As red algae – less problematic, see *Ulva.*
Mollusca	
Littorina littorea	Normally quite common on British shores, the common winkle was almost completely absent from the shores in jersey, with only a few individuals being observed – it may be because it is collected by the local population for food.
Littorina littoralis	With its distinctive bright yellow shell (though ranging from yellow to black) found in moderate numbers, especially within beds of *A.nodosum* and *F.serratus*.
Littorina saxatilis	Very small, and typical of upper shore. Found in large numbers within cracks and crevices of rocks and sea walls, as well as within *Pelvetia canaliculata.*
Gibbula spp.	Numerous, similar top shell species. Found across shore, often in large numbers.
Patella vulgaris	Very abundant species, tolerant of a wide range of conditions, it is important in maintaining biotopes by limiting the growth of algae.
Patella depressa	Much less common than *P.vulgaris*, found lower on shore, though functions similarly. Smaller but externally similar, requires removal to

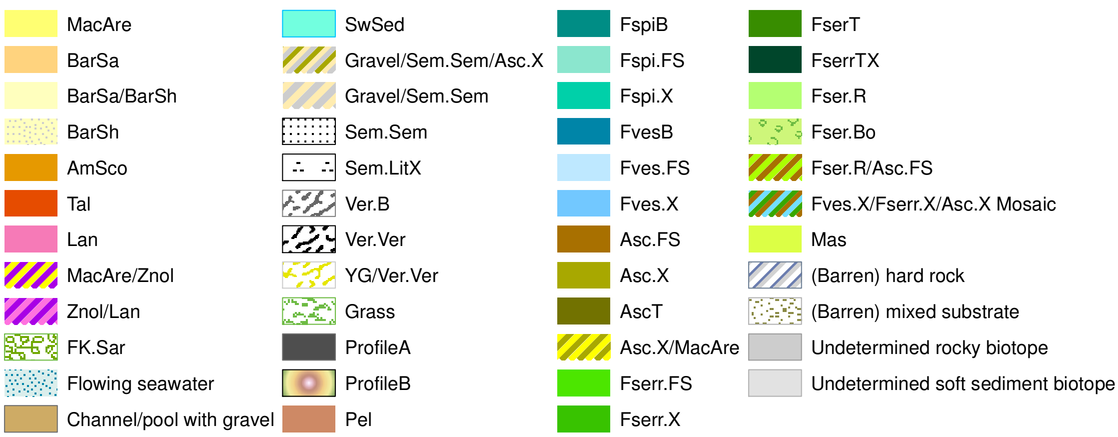
	accurately identify.
Patella ulyssiponensis	As *P.depressa*, though slightly larger and rarer.
Calliostoma zizyphinum	Rare, but well distributed. Found solitarily across mid to lower shore.
Nucella lapillus	Predatory whelk often found in great numbers where prey numbers are high. Prefers barnacles, but does prey upon limpets and mussels. Not tolerant of desiccation, but mobile and will be found on more sheltered (shady) sides of boulders and outcrops, or under algae.
Hinia reticulata	Similar to *N.lapillus*, but not as common. Characterised by its rough shell it is found mostly on sand and silt.
Crassostrea gigas	The Pacific oyster, as the name suggests is an introduced species. Fast growing up to about 15cm. Fairly common on the shores of Jersey, although likely that these are all escapees from farmed oyster beds.
Haliotis tuberculata	Very rare due to over harvesting and their slow growth. They are distinctive and grow to 10-15cm. Found on lower shore in pools.
Crepidula fornicata	Another introduced species, the slipper limpet is easily identified by its rounded shell and stacking behaviour. Not widely abundant but high densities found at Havre des Pas
Acanthocardia	Common cockles found in sandy bays and channels.
Ensis spp.	There are a few razor clam species that can be found around Jersey, however their deep burrows mean that species identification is difficult. Although large numbers of shells were seen across the shore, actual beds of *Ensis* (identified by their keyhole shaped burrows) were not common, though may be present below tidal limits.
Aplysia punctata	Very common in June, during the breeding season, found across shore, particularly in pools and channels.
Crustacea	
Chthalamus montagui	Common on upper shore, though not in as dense numbers as *S.balanoides*. Generally above upper limits of *S.balanoides* on shore.
Semibalanus balanoides	Very common on upper to mid shore. Typically forms exclusive encrustations across topes of boulders and rock, excluding algae. Their sessile nature requires them to aggregate to reproduce typically meaning where present in very high densities.
Balinus perforatus	"Large" barnacle typical of lower reaches of shore. Not found in great as great densities as other barnacle species, but relatively common. Distinctive and easily identified, though often overshadowed by algae.
Annelida	
Spirorbidae	Similar in ecology to barnacle species, *Spirobidae* are a small encrusting tube worms commonly found on the lower shore, often in great numbers, under or on macro algae such as *F.serratus* or *A.nodosum*.
Arenicola marina	Very common "lug worm", favourite of wading birds and anglers. Form dense beds on upper shore wherever fine sediment is present, though may be found anywhere on shore where suitable substrate is present. Not seen directly, but can be easily identified by characteristic "casts" left on surface.
Lanice conchilega	Common, but not as extensive as Arenicola. As the name "sand mason" suggests this worm favours sandier substrates and forms a distinctive tower, 1-2" high. Generally found on mid to lower shore wherever suitable substrate exists.
Cnidaria	
Anemonia viridis	Distinctive, often bright green and purple though can be found in a range of colours. Not as wide spread as *A.equina* but nether the less, very common across the shore. Its inability to retract its tentacles means that it is venerable to desiccation, but often found in very dense numbers in rock pools and channels lower on the shore.
Actinia equina	Common across the shore and can be found on exposed upper shore. Often found in patches around the base of boulders and outcrops.
Cereus pedunculatus	Found within sand, often attached to pebbles buried below. Well

	camouflaged but distinctive, can be found in patches lower on the shore, particularly in sand gullies.
Lichen	
Lichina pygmaea	Can be confused for a small alga, forms dark tuft like growths on rocks of upper shore.
Verrucaria maura	Present on almost all shores, found at extreme upper shore to just below high water mark. Forms thin, matt black plaque over rocks which looks almost like paint or stain.
Verrucaria mucosa	Very similar to *V.maura* though found lower on shore.

3.3.2 List and description of the biotopes present in the Ramsar site

Various biotopes have been recorded during the survey, and for the biotope map, we used the following colour code:

Biotope short code



The next paragraphs provide a short description of these biotopes, illustrated by pictures taken in the field. A full description is available on the JNCC website (http://www.jncc.gov.uk/Default.aspx?page=1584)

3.3.2.1 Soft sediment biotopes

LS.LSa.MuSa.MacAre (MacAre)
Macoma balthica and *Arenicola marina* in littoral muddy sand.
The survey revealed few bivalves, therefore this biotope should be understood here as '*Arenicola marina* in littoral fine to muddy sand'.

LS.LCS.Sh.BarSh (BarSh)
Barren littoral shingle

LS.LSa.MoSa.BarSa (BarSa)
Barren littoral coarse sand

LS.LSa.MoSa.AmSco.Eur (AmSco.Eur)
Eurydice pulchra in littoral mobile sand

LS.LSa.St.Tal (Tal)
Talitrids on the upper shore and strandline

LS.LSa.MuSa.Lan (Lan)
Lanice conchilega in littoral sand

LS.LMp.LSgr.Znol (Znol)
Zostera noltii beds in littoral muddy sand

Flowing seawater

This habitat consists of channels and streams of continuously flowing seawater which do not fit the previous FK.Sar biotope as *Sargassum muticum* is not dominant. Species present may differ according to the coarseness of the sand and other conditions, and therefore the richness and diversity of the biotopes vary, but most of the time the main recorded species was *Lanice conchilega*.

Two special cases are to be noted:

- The power station outflow stream in la Colette produces a low diversity biotope due to the warmer water, with only *Gibbula pennanti* present in significant numbers, *Asterina gibbosa* and several red algal species
- The swimming pool outflow stream produces a high diversity biotope with sponges, ascidians, red algae and a rich under boulder community.

3.3.2.2 Rockpools

LR.FLR.Rkp.FK.Sar (FK.Sar)

Sargassum muticum in eulittoral rockpools

During our survey, *Sargassum muticum* was most of the time found in channels with flowing water rather than in rockpools.

Channel/pool with gravel
No appropriate biotope code has been found to describe these very shallow gravel-floored pools and channels. Gravel is to a certain extent stabilised by a coralline crust, however this crust is not thick. Various red seaweeds and sparse fucoids can be found, as well as *Ulva lactuca* and *Sargassum muticum.*
However, as this biotope was mostly recorded in winter, it may be that it produces a SwSed biotope (see below) in summer – we haven't been able to confirm this.

LR.FLR.Rkp.SwSed (SwSed)
Seaweeds in sediment-floored eulittoral rockpools

3.3.2.3 Littoral Rock biotopes

LR.HLR.MusB.Sem.Sem (Sem.Sem)
Semibalanus balanoides, Patella vulgata and *Littorina* spp.on exposed to moderately exposed or vertical sheltered eulittoral rock

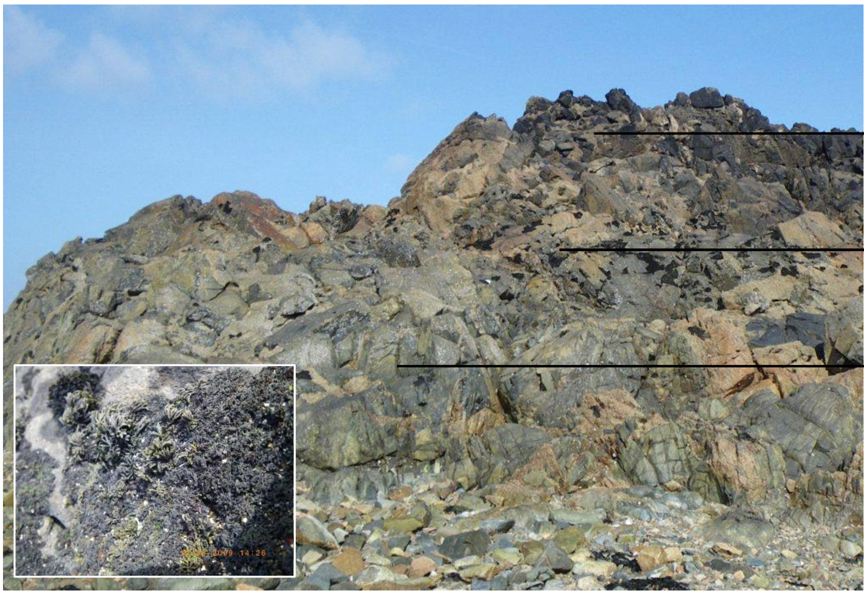
LR.HLR.MusB.Sem.LitX (Sem.LitX)
Semibalanus balanoides and *Littorina* spp. on exposed to moderately exposed eulittoral boulders and cobbles

LR.FLR.Lic.Ver.B (Ver.B)
Verrucaria maura and sparse barnacles on exposed littoral fringe rock

LR.FLR.Lic.Ver.Ver (Ver.Ver)
Verrucaria maura on very exposed to very sheltered upper littoral fringe rock

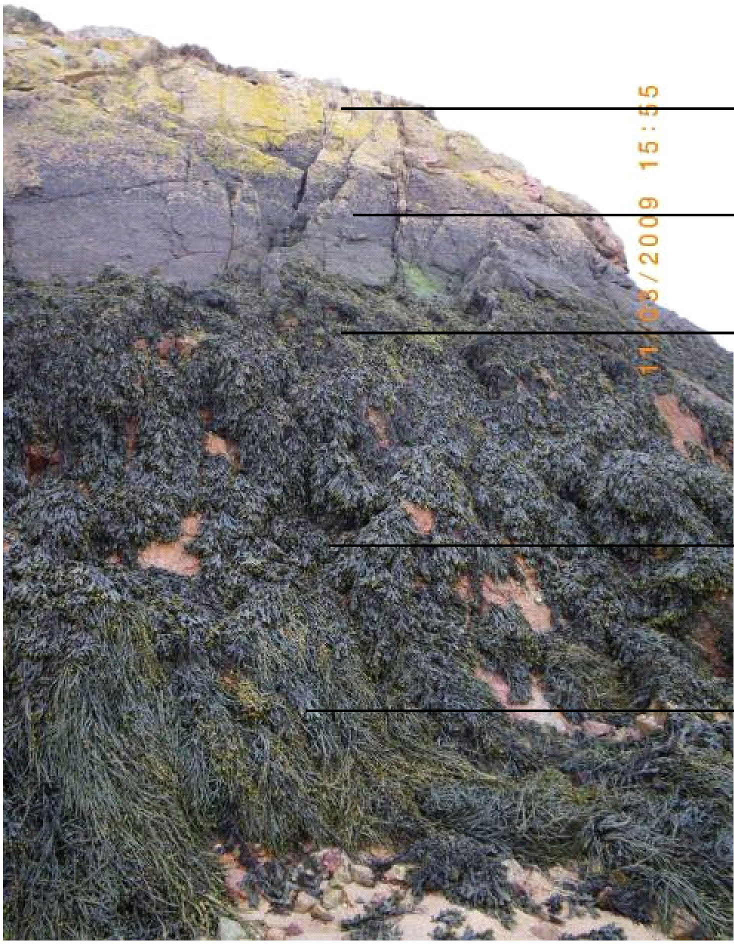
YG/Ver.Ver profile
Vertical profile with *Verrucaria maura* on upper littoral fringe rock (LR.FLR.Lic.Ver.Ver), and yellow and grey lichens on supralittoral rock (LR.FLR.Lic.YG).

Profile A



Note: Cht.Lpyg: Long-established patches of *L. pygmaea* ultimately exclude barnacles.

Profile B



LR.LLR.F.Pel (Pel)
Pelvetia canaliculata on sheltered littoral fringe rock

LR.MLR.BF.FspiB (FspiB)
Fucus spiralis on exposed to moderately exposed upper eulittoral rock

LR.LLR.F.Fspi.FS (Fspi.FS)
Fucus spiralis on full salinity sheltered upper eulittoral rock

LR.LLR.F.Fspi.X (Fspi.X)
Fucus spiralis on full salinity upper eulittoral mixed substrata

LR.MLR.BF.FvesB (FvesB)
Fucus vesiculosus and barnacle mosaics on moderately exposed mid eulittoral rock

LR.LLR.F.Fves.FS (Fves.FS)
Fucus vesiculosus on full salinity moderately exposed to sheltered mid eulittoral rock

Insert: *Littorina littoralis* on *Fucus vesiculosus*

LR.LLR.F.Fves.X (Fves.X)
Fucus vesiculosus on mid eulittoral mixed substrata

LR.LLR.F.Asc.FS (Asc.FS)
Ascophyllum nodosum on full salinity mid eulittoral rock

LR.LLR.F.Asc.X (Asc.X)
Ascophyllum nodosum on full salinity mid eulittoral mixed substrata

LR.HLR.FT.AscT (AscT)
Ascophyllum nodosum, sponges and ascidians on tide-swept mid eulittoral rock.

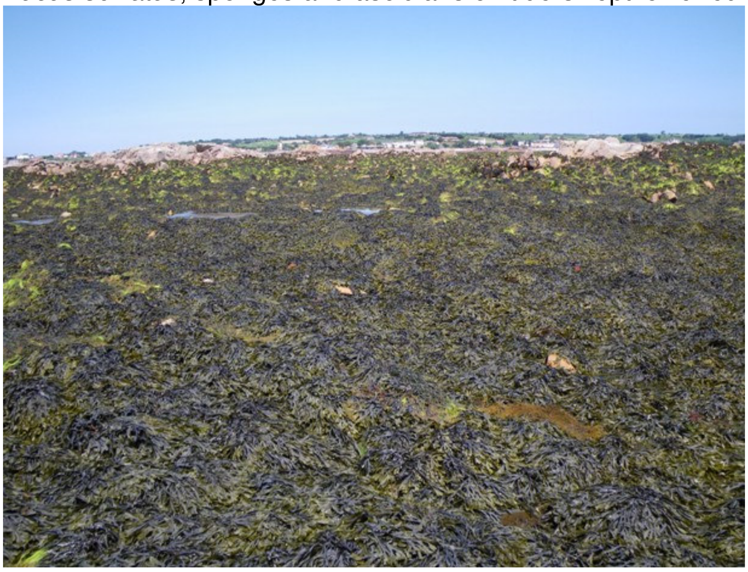
Insert: *Littorina littoralis* on *Ascophyllum nodosum*

LR.LLR.F.Fserr.FS (Fserr.FS)
Fucus serratus on full salinity sheltered lower eulittoral rock (with *Enteromorpha* on the picture)

LR.LLR.F.Fserr.X (Fserr.X)
Fucus serratus on full salinity lower eulittoral mixed substrata

LR.HLR.FT.FserT (FserT)

Fucus serratus, sponges and ascidians on tide-swept lower eulittoral rock



LR.HLR.FT.FserTX (FserTX)
Fucus serratus with sponges, ascidians and red seaweeds on tide-swept lower eulittoral mixed substrata

LR.MLR.BF.Fser.R (Fser.R)
Fucus serratus and red seaweeds on moderately exposed lower eulittoral rock

LR.MLR.BF.Fser.Bo (Fser.Bo)
Fucus serratus and under-boulder fauna on exposed to moderately exposed lower eulittoral boulders

LR.HLR.FR.Mas (Mas)
Mastocarpus stellatus on very exposed to moderately exposed lower eulittoral rock

Fser.R/Asc.FS patchwork
Fser.R and Asc.FS formed a biotope complex. *F. serratus* was found along 'channels' of flowing seawater and sandy gullies, while *A. nodosum* was growing higher on bedrock.

Fves.X/Fserr.X/Asc.X mosaic
In that case, it was difficult to determine whether *F. vesiculosus*, *F. serratus* or *A. nodosum* was dominant (the substrata being broken rock and mixed substrata), as they alternated in small patches. We therefore designed this biotope as a mosaic of Fves.X, Fserr.X and Asc.X

3.3.2.4 Biotope Map

The biotope map derived from our survey work is presented in Figure 11. For more clarity, Figure 12, Figure 13 and Figure 14 present 3 close-ups of the area. The colour code and biotope short codes used are those previously described.
References to target notes are displayed on the close-ups. Please see 3.3.2.5 for detailed target notes.

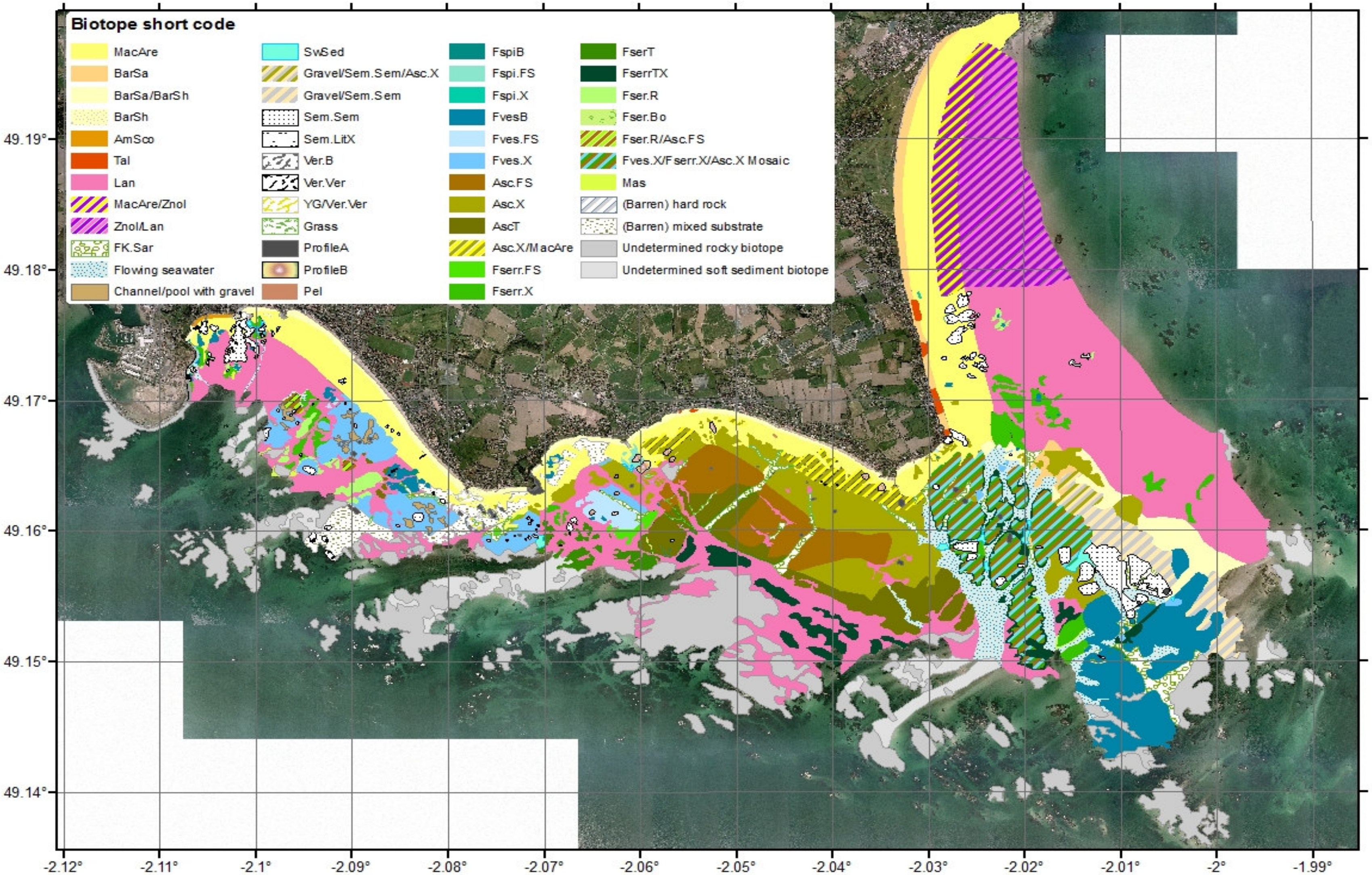


Figure 11 – Biotope map of the Ramsar site

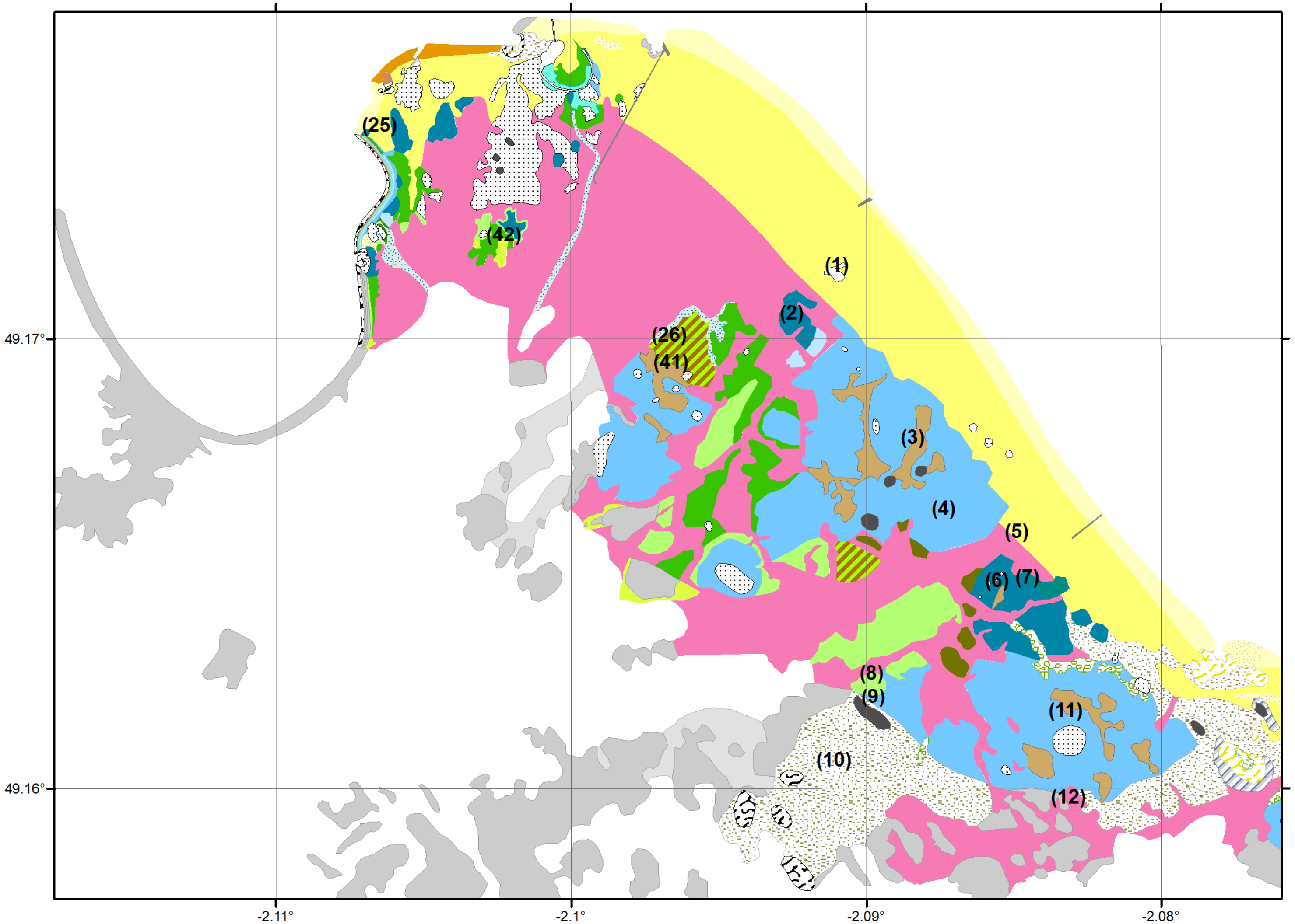


Figure 12 – Close-up 1: La Colette and La Grève d'Azette

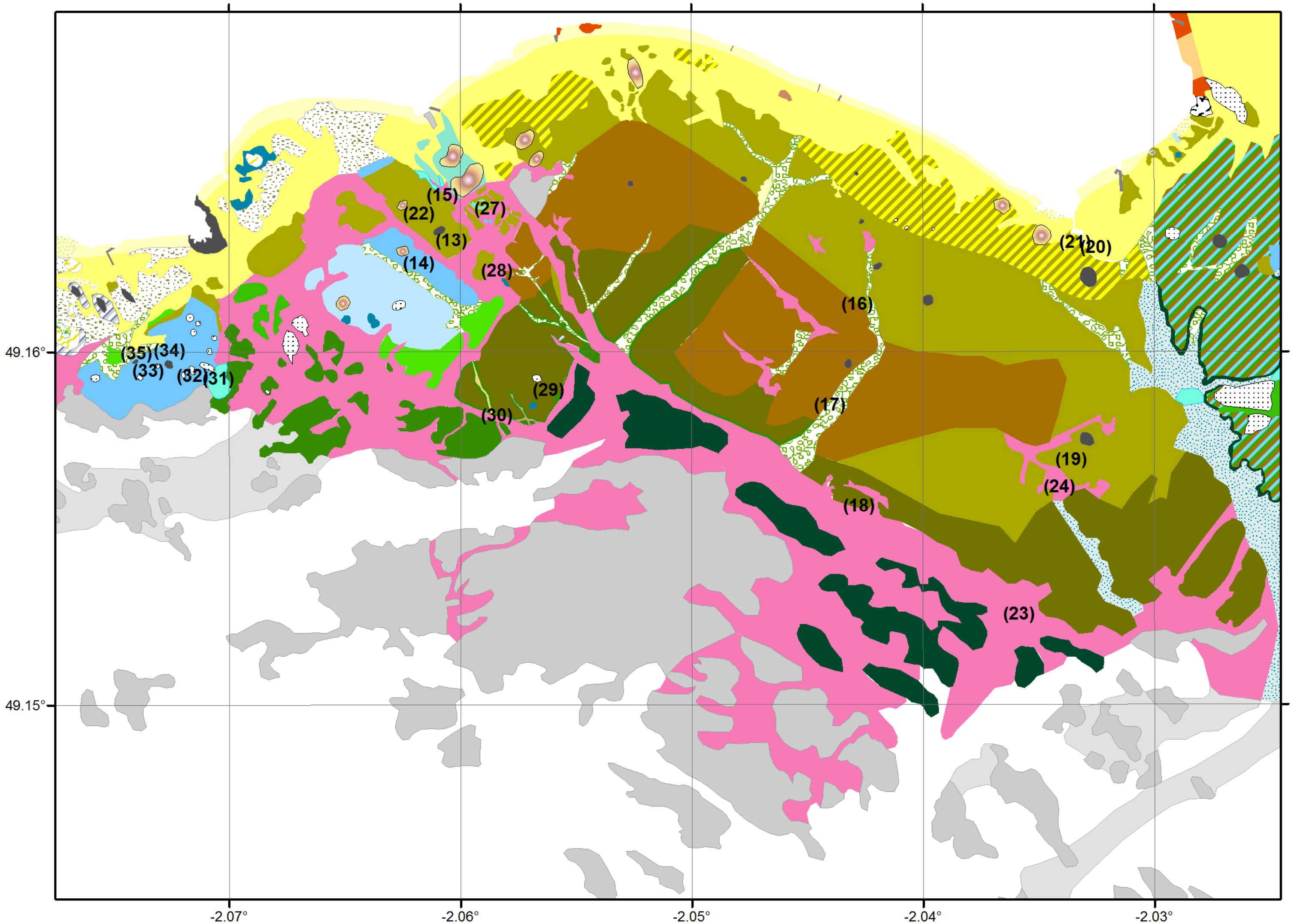


Figure 13 – Close-up 2: La Motte to La Rocque

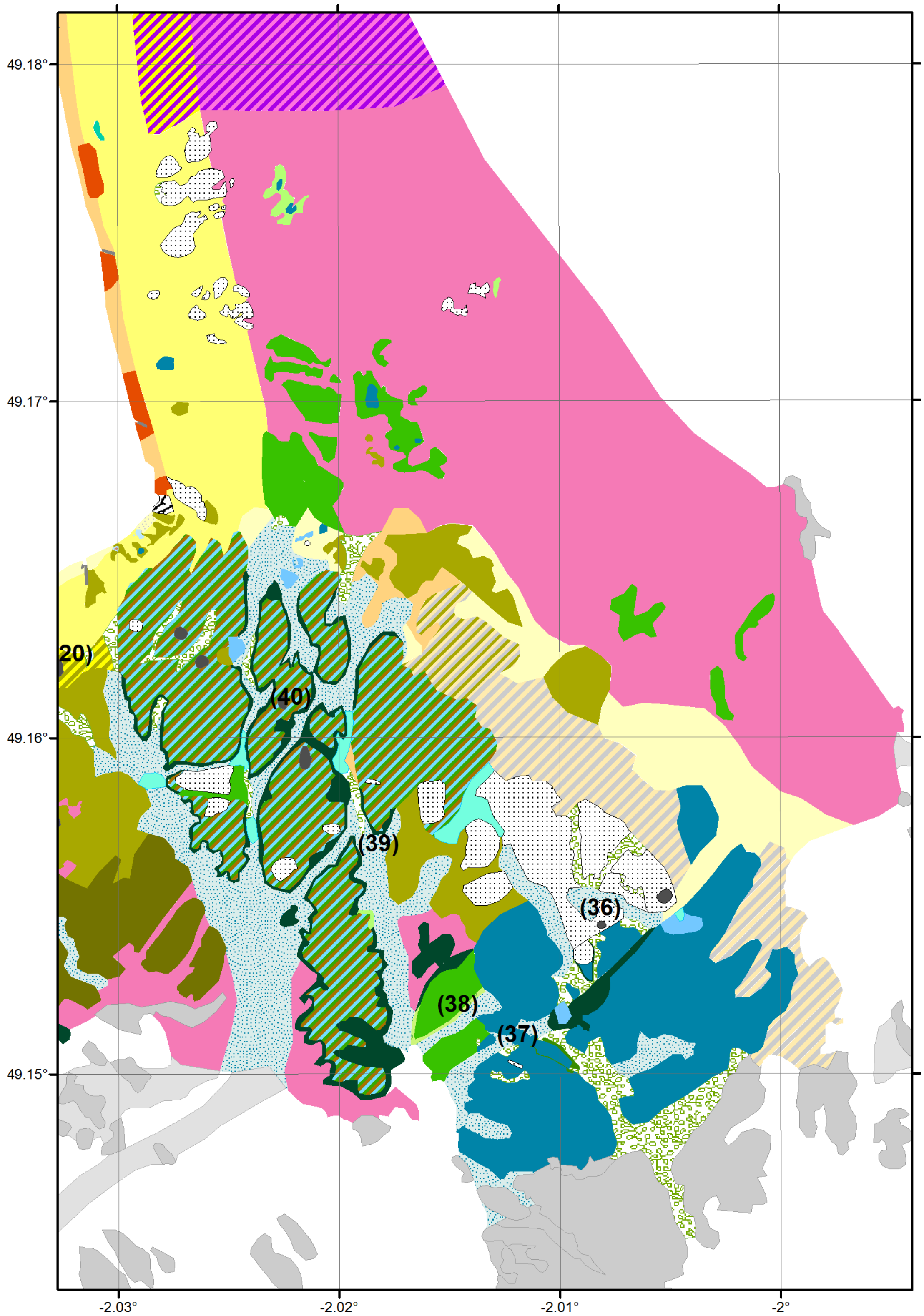


Figure 14 – Close-up 3: SE of La Rocque and South Grouville Bay

3.3.2.5 Target notes

(1) Unstable cobbles
(2) Unstable loose rock
(3) Under boulder fauna with ascidians and sponges
(4) (11) and (13) Impoverished biotopes
(5) Transition from muddy sand to medium/coarse sand
(6) Under boulder fauna
(7) Biotope complex:
    a. Dominant biotope: FspiB then FvesB
    b. Sub-biotopes: Sem.Sem on rocky outcrops and little gravel-floored pools
(8) Very diverse in terms of species
(9) Overhang with SpByAs
(10) Mixed substrata and rocky outcrops with sparse fucoids
(12) Coarse sand ripples
(15) Patches of clay
(16) Shanny, pipefish and sponges under boulders in a small pool
(17) Ascidians, sponges and porcelain crabs under boulders
(18) Burrowing anemones, sea slugs, razor clams, dog cockle, striped venus clam
(19) Pool with high biodiversity
(20) Sem.Sem on artificial structure
(21) Abundant *Enteromorpha*
(22) YG at top of profile
(23) and (24) Sandy areas with razor clams
(25) Accumulation of mud and fine sediment along the artificial boulders
(26) Patchwork of Fser.R (along flowing seawater) and Asc.FS (higher on bedrock)
(27) Various burrows, including razor clams burrows. A lot of hermit crabs and shrimps in a little pool
(28) Cor.Cor in small rockpools within FvesB
(29) Pipefish and porcelain crabs under boulders
(30) Sand eels, burrowing crabs and anemones in sand
(31) Very rich sediment-floor pool with ascidians, cushion stars and porcelain crabs under boulders, and various anemones on the boulders
(32) Crabs under boulders
(33) Scoured biotope
(34) Cor.Cor in small rockpools
(35) Orange sponge and whelk eggs under boulders
(36) Cor.Cor and beadlet anemones in small rockpools
(37) Crabs and frequent anemones in pool
(38) Ascidians and porcelain crabs under boulders
(39) Various bivalves, including dog cockle, common other shell, striped venus clam and razor clam
(40) Shrimps and crabs in gravel-floor pool
(41) Abundant slipper limpets (*Crepidula fornicata*)

3.4 Discussion

3.4.1 General comments

3.4.1.1 Seasonality

During the second week of surveying on the south-west shore of Jersey several seasonal changes in the biodiversity were observed:
Enteromorpha spp., *Ulva* spp. and other green algae were more common and widespread in June than in March.
New recruits of barnacles (in particular *Semibalanus balanoides*) were observed in June, and were really abundant on some rocks where only few adult barnacles and a lot of cyprids larvae would have been observed in March.
Amphipods, especially talitrids (sandhoppers, such as *Talitrus saltator*), that we couldn't find in March, were found in quantity in decomposing algae in summer.

These will affect counts directly, with certain species being recorded where they were previously absent (e.g. *Ulva* sp) following seasonal growth (influenced by increase temperatures, hours of light and nutrient availability, etc.), other species increasing in density (e.g. *Fucus* sp., barnacle species) following spring breeding and growth, and other species migrating into new foraging environments with increased shelter provided by algae and increased food availability. This will also have an indirect effect on perceived densities as increased coverage, particularly of large robust fucoids, will make it increasingly difficult to observe and record other, sheltered species. In extreme cases it may result in a change from one biotope to another where a seasonal species presence (talitrid amphipods) or growth (*Fucus*, *Ulva*) must be taken into consideration and thus redefine a biotope.

Therefore whilst biodiversity counts in Spring/March and Summer/June can be considered accurate they must not be directly compared without consideration. Not only may assigned biotopes differ with perceived changes but actual boundaries and composition may change seasonally; these are biological systems that are non-permanent.

Additionally, there is the factor of substrate movement; whilst confined to more mobile substrates (i.e. sand, silts), there regularly observed movements (particularly within gullies) of bodies of sand, influenced and influencing, water movements and subsequent biodiversity. Again, whilst this was not specifically recorded, it should be considered when comparing surveys conducted at separate times that some physical parameters are also non-permanent.

3.4.1.2 Representativeness – biodiversity and microhabitats

As said before, small features or species of interest may be overlooked where a large area is being studied, or may be recorded but are of such small extent as to be unmappable. This is particularly the case for under-boulder fauna and small rockpools characterised by a Cor.Cor biotope.
Shady overhangs and algal canopies are other examples of microhabitats features.
Wherever possible, mention of these cryptic or localised biotopes (often rich in biodiversity) is made on the biotope map along other target notes (for the sake of readability, only numbers are displayed, the details are listed in paragraph 3.3.2.5).

Under-boulder fauna including ascidians, sponges and porcelain crabs

If space is available beneath the boulders, there may be a rich assemblage of animals. Characteristic mobile species include the crabs *Porcellana platycheles* and *Carcinus maenas*. Also present on and beneath some boulders are the tube-forming polychaete *Pomatoceros triqueter*, spirorbid polychaetes and a few winkles and the top shell *Gibbula cineraria*. Encrusting colonies of the sponge *Halichondria panicea* are also typical of the undersides of boulders.

LR.FLR.Rkp.Cor.Cor (Cor.Cor)
Coralline crusts and *Corallina officinalis* in shallow eulittoral rockpools

More examples are provided in Appendix 2.

3.4.1.3 Biotope code: limitations

The biotopes have been allocated names according to the closest possible description available on the JNCC website. Such descriptions are reasonable broad generalities and, given the geographical extent of the UK, must encompass considerable variability. It is unsurprising, therefore, that some of the areas of seashore failed to fit exactly into a published biotope description.

What is more, a biotope code may not necessarily convey the exact description of the biotope. For example, Asc.X (*Ascophyllum nodosum* on full salinity mid eulittoral mixed substrata) is actually characterised by a canopy formed by a mosaic of *A. nodosum* and *Fucus vesiculosus*, with infaunal species such as the polychaetes *Arenicola marina* or *Lanice conchilega* occuring in the sediment between the cobbles.

3.4.2 La Colette

Although impacted by anthropogenic activities, the area of La Colette/Havre des Pas still exhibits a diversity of biotopes recurring in a very discreet area. A rich algal and faunal community is present at the very lowest extent of the rocky shore sites. The biotopes recorded are highly similar to those mapped during the survey undertaken in 1998; however the species diversity in biotopes is reduced over the 1998 survey indicating that the 'quality' of biotopes may have declined slightly. Also the *Ascophyllum nodosum* biotope recorded by Mercer (1998) at the middle of the shore in the central reef was not present on this survey. As underlined by Mercer, the site is generally too exposed for abundant growth of A. nodosum, and *p*atches of *A. nodosum* are usually lost after winter gales, and can be considered as ephemeral, and so we do not attach particular significance to this observation. The main changes in the area as a whole were the accumulation of fine sediment (muddy sand to sandy mud) along the boulders placed around the reclamation area and on the lower shore – which would normally result from reductions in speed of tidal flows. Finally, there were very large numbers of slipper limpets (*Crepidula fornicata*) at the bottom of the shore in the central reef, and this species is generally indicative of declining ecological quality, particularly in these high numbers.

The combined impacts of port activity with occasional fuel oil spills, sewerage, etc., the power station outfall (20,000m3 / hour) discharging directly onto this area and urban storm water flows inevitably result in reduced water quality with knock on effects for the marine communities. This is exacerbated to some extent by the impacts of human recreational activity on the beaches, which during the summer months appears to be quite intensive. The net result is that this area has been subjected to cumulative environmental impacts over a sustained period, which have been further confounded by the presence of the La Collette reclamation which reduces tidal flows and tidal flushing. Inevitably the ecological conditions and communities observed in this area were significantly less pristine than elsewhere on the Ramsar site, and appear to have declined since the survey in 1998.

3.4.3 Seagrass beds

Our field surveys indicated a high level of epiphytic growth on this species in winter, which may be the consequence of terrestrial run off and storm flows introducing higher nutrient loads into coastal waters. Without more detailed observations we cannot be sure how extensive this problem is, but high levels of epiphytic growth on *Z.noltii* was very widespread across the eastern beaches of the Ramsar site during the winter months. Although this could be part of the natural annual cycle, the deterioration of sea grass beds and / or reduced viability could be a contributory factor in driving Brent geese inland to feed, and so these observations need to be followed up in a more detailed study as soon as possible.

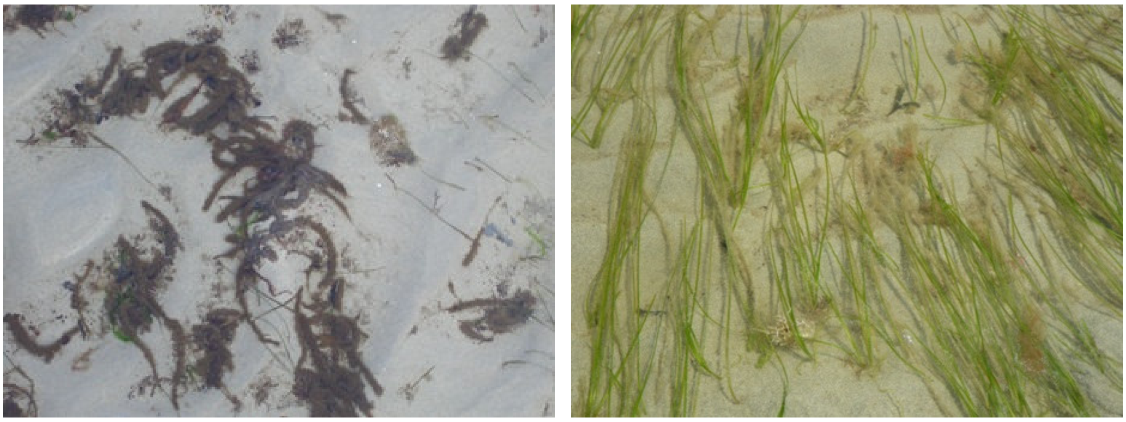


Figure 15 – *Z. noltii* with abundant epiphytes in March 2009, but far less in June 2009

3.4.4 Invasive species

Several invasive species were recorded during the survey. These include (but don't limit to):

- *Crepidula fornicata* (slipper limpet), mostly seen in La Colette area
- *Sargassum muticum*

- *Corella eumyota* (a tunicate)

3.5 Comments on Flicquet Bay

Following a brief survey of the shore at Flicquet Bay (to the immediately north of St Catherine's Breakwater), it appears that this stretch of intertidal area is largely pristine and unaffected by human activity.

Unlike the southern coast, the vertical gradient between upper and lower shore is quite steep, thus the intertidal zone is relatively narrow (<100m). Key to this profile is the large bedrock formations extending outwards from the surrounding land and cliff edges, which characterise the shore. A few sand gullies permeate to the upper shore, connecting cobble patches at the upper shore to a sandy bar at the very lowest extent of the tide, and also a larger sandy patch lies to the northern end of the bay, however it is the bedrock (probably including a number of large immovable boulders) which provides the dominant area for colonisation. Clear zoning of species can be seen, with distinct successive biotopes visible across the entire bay. Within these biotopes were high densities of individual organisms and species. Although observational only, this would seem to indicate a stable and highly productive habitat free from major disturbance and pollution.

Biotopes progressed in distinct bands down to the low tide mark from: *Verrucaria maura* lichen on the upper rock; *Pelvetia canaliculata* and *Littorina saxatilis*; *Fucus spiralis, Semibalanus balanoides* and associated fauna; *Ascophyllum nodosum* and associated fauna; *Mastocarpus stellatus* and associated fauna; finally *Arenicola marina* and *Lanice conchilega* on the terminal sand and within sand gullies (with a gradient shifting from *Arenicola* to *Lanice* down the shore). Within the bands of *Fucus*, *Ascophyllum* and *Mastocarpus,* high biodiversity was observed.

Human activity was limited in this area, a small access point at the middle of the bay providing the only direct access onto the shore, although the presence of the breakwater at the southern extent will undoubtedly influence the local currents (by design). This doesn't appear to have any direct impact to the shore (e.g. excessive sedimentation/siltation or accumulation of flotsam and jetsam) but with no historical perspective this cannot yet be completely dismissed. No boats were moored within the bay, probably due to the limited shelter and access, but also the proximity of St. Catherine's Bay and Breakwater (in which approximately 100 moorings were observed).

4 Human impacts on the Ramsar site

4.1 Human use of the site

4.1.1 Marina and non-marina boat moorings

4.1.2 Low-water fishing

Low-water fishing has been undertaken by many of Jersey's population for centuries (Crutchley, 1997). It is popular socially and is part of the traditional Jersey way of life. Many intertidal and low-water species are harvested from the south-east coast. Plaice, sand eels (harvested at Grouville Bay and La Rocque), bass (at Green Island and Havre des Pas), sole, prawns, clams, oysters, cockles, ormers, razor fish, limpets and edible winkles are collected. Many part-time or recreational fishermen harvest these species on a regular basis. Some species, such as the razor fish, are collected intensively on good spring tides.

4.1.3 Commercial fishing

As of the 31st December 2008 the fleet comprised 163 licensed fishing vessels, 97 of which were shellfish qualified. There has been a continued decrease in the size of the fleet in terms of vessel numbers, and also a reduction in terms of vessel capacity units, largely due to the loss of 3 over 10m vessels (Jersey Department of Planning and Environment, 2009).

While the crustacea fishery appeared to flourish, the whelk landings showed a drop of 247 tons or 45% to 297 tons. This may be accounted for in part by fishing effort being directed at whelks for only part of the year by some whelk fishermen who then directed their effort elsewhere. Nevertheless whelk stock assessment work has shown that the whelk stocks are in a relatively poor state particularly to the east of the Island (Jersey Department of Planning and Environment, 2009).
The main catches of finfish are skate and ray, bass, conger and dogfish.

The contribution of the fishing industry to the States revenue is marginal, with an estimated total value of £6.75m in 2008.

4.1.4 Angling and bait digging

This is a popular pastime around the coasts of Jersey, with areas such as Havre des Pas, the low water at Le Hocq, sediment channels at La Rocque, Grouville Bay and in particularly St. Catherine's breakwater being regularly fished.

4.1.5 Aquaculture

The south-east coast provides suitable conditions for the culture of oysters (*Crassostrea gigas*) and mussels (*Mytilus edulis*). A concession can be leased from the States for a small annual charge.

The location of the concessions in the south-east is shown in Figure 16.

The system for granting licences is clearly set out in legislation, Sea Fisheries (Establishment and regulation of fisheries)(Jersey) Regulations 1998. These regulations have just been rewritten as Sea Fisheries (Fisheries)(Jersey) Regulations 2001.

Basically an application is considered by the Fisheries and Marine Resources Panel who make a recommendation to the Minister. The general public then can comment of an application before the Minister makes a decision. Applications have already been refused for a number of reasons. Whilst no official reserves exist, there are sites that will not be considered for aquaculture (e.g. North of Grouville Bay due to wintering birds).

Table 6 – Farmed shellfish production, Jersey Department of Planning and Environment, 2008

Note: Area pre 2004 relates to actual area, farmed. 2005 onwards relates to total concession area granted

	2001	2002	2003	2004	2005	2006	2007
Intertidal area (ha)	*53.6*	*54.5*	*54.5*	*54.5*	*62.65*	*62.88*	*62.88*
Subtidal area (ha)	*166*	*100*	*100*	*100*	*166*	*166*	*166*
Pacific oyster (kg)	389,775	475,643	560,200	720,768	579,915	651,148	737,395
King scallop (kg)	1,914	1,544	1,351	3,571	8,484	2,540	4,100
Mussels (kg)	78,000	96,370	108,300	25,000	50,000	117,500	50,000
Total (kg)	**469,689**	**573,557**	**669,851**	**749,339**	**638,399**	**771,188**	**791,495**

In 2007, overall shellfish production was up slightly on the previous year to 791 tonnes representing an increase of 3%.

4.1.6 Rockpooling and other recreational activities

The beaches around this coast are popular with tourists, for swimming and sunbathing. Apart from the popular walk at low-tide to Seymour Tower, tourists seem to rarely venture beyond the beach at the top of the shore. However walkers (sometimes with dogs) were seen walking along the main beaches in the Ramsar site, especially in Grouville Bay.

Jet skiing and water-skiing occur in the gullies to the west, these activities can cause disturbance to both local residents and wildlife of the area. Scuba diving is common around the south-east corner of the Ramsar site and along the north coast of the island; and bird watching, windsurfing, canoeing, sailing, rowing are all important, but low impact activities.

4.1.7 Overview

Tourism and especially recreational activities associated with marine and coastal waters of Jersey, provide highly significant income for Jersey, which in 2008, generated on-island visitor expenditure of £238m, with a number of 729,700 visitors (Jersey Tourism, 2009). One of the main reasons why tourists visit Jersey is to experience the clear and unpolluted coastal waters and spacious and clean beaches, in a geographical setting which is extremely attractive and therapeutic. Jersey residents also benefit from this major asset and many residents participate in water sports and other shore based recreational activities. The most fundamental element of maintaining not only the income flow from tourism, but also retaining well educated population to run the financial economy is the quality of life on Jersey – very largely dependent on superb standards of environmental quality – which is enjoyed by residents and tourists alike. Thus protecting environmental quality across beaches and coastal waters is a highly significant component of maintaining the island's prosperity, and the Ramsar designation is a key tool to assist Jersey government in achieving this. Although many of the recreational uses of the Ramsar site can be accommodated with only minor consequences, it is important to maintain a watching brief regarding moorings management and other activities which can potentially have significant impacts on seagrass beds.

All legislation can be found via the Fisheries and Marine Resources website
www.fisheries.gov.je

4.1.8 Map of human use within the Ramsar site

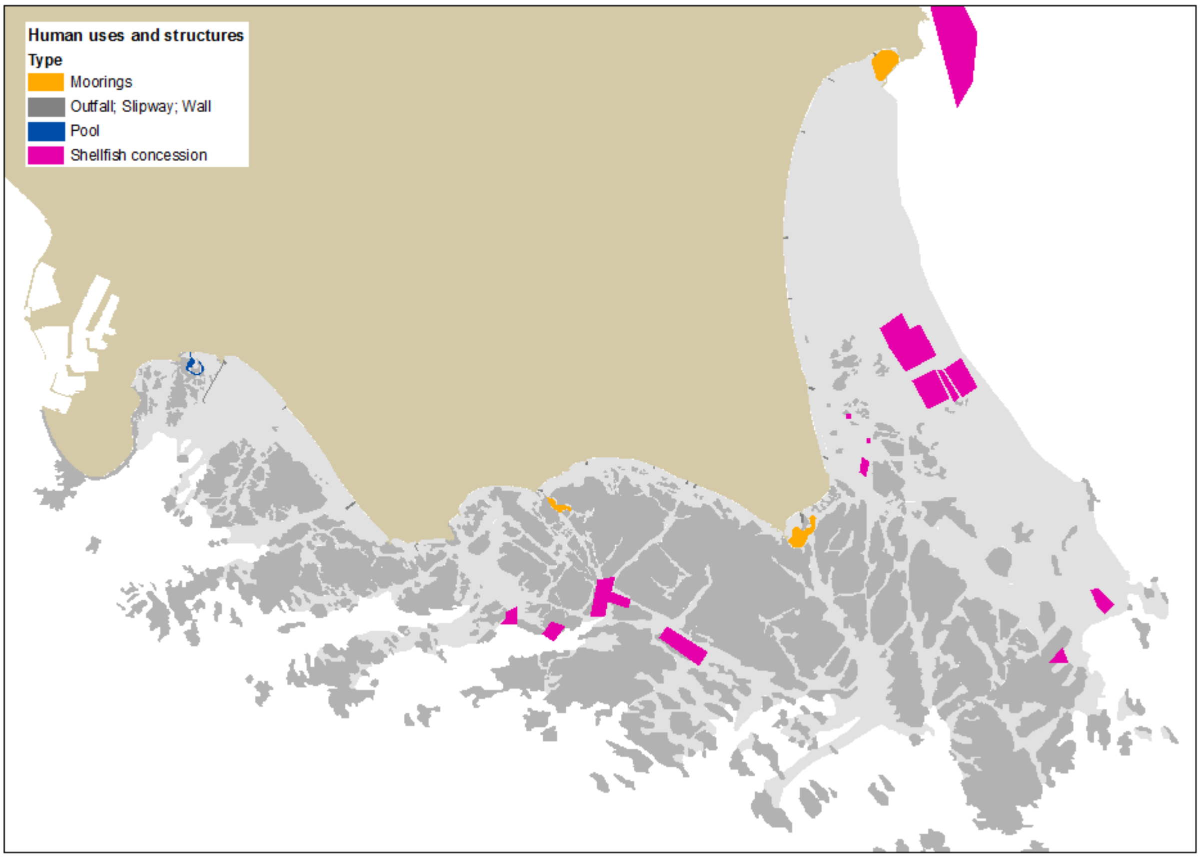


Figure 16 – Map of human uses in the Ramsar site

5 Conclusions and recommendations

(1) This report assesses the current ecological status of the Ramsar site located on the SE Jersey coast. It also reviews monitoring data collected since the designation of the Ramsar site in 2000, and provides comments on the current ecological status of the site itself, as well as on some areas beyond the boundaries of the existing designation. We have produced biotope maps of the Ramsar site to provide the basis of future environmental impact assessment, and have made some initial observations regarding the likely ecological implications of further development at St Helier port, especially in relation to the relocation of the fuel farm.

(2) As expected intertidal communities of the Ramsar site exhibit exceptional biodiversity as a consequence of the biogeographical position of Jersey combined with its atypical tidal range of 12m. They include species typical of communities found on rocky and sandy shores similar to those on the nearby French coast, with a rich and diverse range of biotopes and some uncommon species assemblages, and are, overall, in a healthy condition. However, locally there was some evidence of intertidal communities being subjected to poor ecological conditions, particularly in response to locally intensive human recreational impacts and outfalls and / or storm water discharges. Also, we were unsure to what extent high levels of epiphtytic growth on *Z. noltii* beds across large swathes of the east coast of Jersey, were indicative of poor health. **Because this is normally an indicator of pollution and given the important role of seagrass beds as nursery areas and food for foraging waders and wildfowl, we recommend that *Z.noltii* beds are monitored closely over forthcoming seasons and steps are taken to investigate this aspect further**.

(3) All the available evidence appears to show that fluctuations in numbers of waders and wildfowl on Jersey are within the ranges observed over the past decade since the Ramsar site was implemented, and if anything, a slight increase overall in the number of waders visiting Jersey has been observed. Although, these counts need to be placed in the wider geospatial and historical context to get a full understanding, in terms of the significance of Jersey in the overall picture, the emphasis needs to be on continuing to build further resilience into the ecosystem services on which these species depend. Therefore, **we recommend continuing efforts to protect and maintain coastal ecosystem quality, and where possible to extend the protection of areas available to waders and wildfowl for foraging and overwintering in a situation where alternative sites elsewhere are under threat.**

(4) Seagrass beds provide important services to the Jersey coastal ecosystems and without them the biodiversity and productivity of Jersey waters would undoubtedly decline. Seagrass beds are designated habitats within European legislation (Natura 2000), with specific measures to ensure their protection and maintenance for the benefits of wider ecosystem services and protection of habitat for species of commercial and conservation significance. Our surveys have indicated that although *Z. marina* has been mapped and extensive areas of *Z. marina* beds are within the Ramsar designation, substantial areas remain outwith the Ramsar boundary. A second species *Z. noltii* has also been mapped for the first time as part of this project and *Z. noltii* differs from *Z. marina* in both its seasonal growth pattern and its distribution. **We recommend that the combined footprint of the two species of *Zostera* be used as the basis for expanding the Ramsar site boundary to improve protection of these habitats. Essentially this would translate into an extension of the Ramsar boundary to incorporate St Catherine's bay as far as the breakwater.**

(5) This study constitutes just one small part of a review of the strategic development options for St Helier Port and La Collette, including the possible implications for the Ramsar site. It is clear that environmental quality from West Park beach to a point east of La Collette (ie. Le Dicq) has been altered over the years as a result of successive reclamations, and also clear that hard structures cannot now be removed or modified. In comparison with the rest of the Ramsar site, environmental quality is poorer in this area resulting mainly from the combined impacts of poorer water quality and eutrophication interacting with the presence of hard structures which reduce tidal flows and flushing. Consequently if further offshore construction (such as a new fuel farm) is to be considered in the national interest, **we strongly recommend that hydrodynamic studies of tidal flows and sediment deposition are undertaken in advance of developing a full scale planning application, to ascertain the implications of the cumulative impacts of development and further modification of the port area.**

(6) Irrespective of the outcome of the strategic options study, our analysis has shown that extension of the Ramsar site is desirable on grounds of providing additional protection for sensitive and important habitats, the extent of which was only partly known at the time of the Ramsar designation. Consequently **we recommend that despite the difficulties inherent in progressing alterations to Ramsar site boundaries, that an extension to the site is discussed with the relevant JNCC representative**, and based on the evidence we have presented in this report, the case for an extension be developed for submission to the Ramsar convention. It is also possible that in considering the strategic long term land use requirements of the Island, and subject to a detailed Environmental Impact Assessment, a legitimate case could be made for incursion into the Ramsar site, based upon the national interests of the Island. It will be for the respective government representatives to discuss and weigh up the significance of this aspect in driving public acceptability of further development in the port area, to achieve the optimal outcome.

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7 Appendices

7.1 Appendix 3: Changing the boundaries of a Ramsar site

7.1.1 What the Convention says

Article 2.5 of the Ramsar Convention states that “any Contracting Party shall have the right (…) because of its urgent national interests, to delete or restrict the boundaries of wetlands already included by it in the List”.

The determination of “urgent national interests” lies solely with the Contracting Party, here the UK. The UK’s government view is that a development proposal does not necessarily have to be of national significance in its own right to meet the requirements set out in Art. 4. Any benefits arising from the proposal must, however, demonstrably outweigh the acknowledged international conservation value of the site. Projects of limited regional or local significance are thus unlikely to meet this test (Defra, 2006).

A prior environmental assessment, taking into consideration the full range of functions, services, and benefits offered by the wetland, would normally be an appropriate first step when a Contracting Party is invoking the right under Article 2.5 to delete from the List or restrict the boundaries of listed wetlands, and proposing mitigation or compensatory measures under Article 4.2. Whenever possible, the assessment should be made in full consultation with all stakeholders. The Contracting Party shall also inform the Ramsar Secretariat of such changes in boundaries at the earliest possible time (Ramsar, 2007).

Article 4.2 of the Ramsar Convention states that “Where a contracting Party in its urgent national interest deletes or restricts the boundaries of a wetland included in the List, it should as far as possible compensate for any loss of wetland resources and in particular it should create additional nature reserves for waterfowl and for the protection, either in the same area or elsewhere, of an adequate portion of the original habitat.”.
The UK’s government view is that compensatory measures should provide, as a minimum, no net loss to the overall value of the national Ramsar site series either by way of quality or area (Defra, 2006).

7.1.2 Case studies: Mühlenberger Loch Ramsar site, Germany

In order to accommodate the expansion of an Airbus industrial facility, a part of the “Mühlenberger Loch” protected area and Ramsar site in Northern Germany was filled in between 2001 and 2003. The impacted area consisted of tidal freshwater mudflats that supported tidal estuary habitat, waterfowl populations, endemic plant species, and nursery functions for different fish species. In total, 171 ha of a total of 675 ha of the Ramsar site were filled. Request to do so from the German Government dated from 1999, and in 2000 the European Commission had ruled that the adverse environmental impact of extending the factory on the Ramsar site was justified on the grounds of overriding public interest.
Remediation measures were started in 2001, but were still not completed in 2008. It is actually not clear if remediation measures will ever be completed, and if they are, which form they will take and which results they will have.
There is an ongoing discussion about the appropriateness and success of the proposed measures as well as the fulfilment of Article 6(4) of the Habitats Directive involving the city of Hamburg, the European Commission, BUND Hamburg and the Federal Republic of Germany. The issue is currently being addressed in court (REMEDE project, 2008).
It therefore appears that, although the restriction of boundaries is in theory feasible, its implementation is an issue, and adequate and well planned mitigation measures are a must.

7.2 Appendix 2: JNCC guidance – Procedural Guideline 1-1: Intertidal resource mapping using aerial photographs (Bunker *et al.*, 2001)

7.2.1 Background

Shore mapping aims to create maps showing the distribution of biotopes along with associated information, such as the occurrence of rare species, details of habitat, etc. Biotopes are located on the shore and matched to features shown on recent colour aerial photographs (corrected to allow an Ordnance Survey grid overlay). The biotope boundaries are then defined on the photograph (as 'polygons') and target notes made on biotopes and features of interest together with detailed quantitative data if required. Integral to the methodology is the collating of the biological data, together with aerial photographs and digitised 1:10,000 OS maps on a PC-based Geographical Information System (GIS) such as ArcView (ideally linked to a database).
Shore biotopes are classified according to the national classification (Connor et al. 1997); however, it is important to recognise and properly describe the regional character and variants of biotopes in each area of study.

7.2.2 Purpose

7.2.2.1 Attributes measurable by shore mapping

- distribution of individual or groups of biotopes, biotope complexes and life forms present in an area
- extent of individual or groups of biotopes, biotope complexes and life forms present in an area
- diversity of biotopes present in an area
- other attributes attached to polygons in the form of target notes, such as species information, condition of biotopes (Bunker and Bunker 1998) and sensitivity (Cooke and McMath 2000)

7.2.2.2 Advantages

- The maps can show the overall distribution of biotopes over large areas of shoreline and can be invaluable for developing resource management and monitoring strategies.
- The maps can highlight and help quantify large-scale changes in biotope distribution.
- Aerial photograph interpretation is a tried and tested technique.
- Data stored in a GIS are more flexible and can be interrogated in a number of ways. Entering field data directly to a PC has several advantages. As well as being quick, it cuts out sources of error which can be created by in-between paper stages.

7.2.2.3 Disadvantages

- It is important that the limitations are fully understood. The colour maps produced on a GIS can appear impressive, but their accuracy together with the biotope boundaries must always be scrutinised.
- Many shore species and communities occur along a continuum and therefore biotope boundaries are often artificial and subjective.

- Mapping biotopes with strict adherence to the present national classification (Connor *et al.* 1997a, b) may not take account of regional characteristics. So it is essential that proper local descriptions are prepared.
- Small features or species of interest may be overlooked where a large area is being studied. For example, intertidal *Zostera* plants may virtually disappear from sediment flats due to winter die-back and grazing by wildfowl (Perrins and Bunker 1998) and the low density may be missed by ground validation.
- It is difficult to represent the quality of a biotope. The importance of target notes and quantitative studies associated with mapped biotopes is stressed.
- An important biotope may not be a mappable unit resolved by the aerial photograph.
- Photographs may not be taken at the same time as the survey, particularly at low water. However, it is important to use recent aerial photographs. On sediment shores, features can shift over short time scales (between tides in some cases) and this will affect the accuracy of maps produced.

7.2.3 Logistics

7.2.3.1 Pre-survey

Time should be allowed before the survey to obtain aerial pictures, scan, digitise and ortho-rectify4 them prior to incorporation into a GIS. If data are to be collated electronically at the time of the survey, aerial photographs for annotation must be prepared prior to the work commencing. Photos must be recorded/analysed at the start, prior to planning fieldwork.
Proper planning of fieldwork is essential for efficient use of the limited time the whole shore is uncovered. As a guide, effective shore mapping work can be carried out for a maximum of 4 hours (2 hours either side of low water) in any period of one low water. Fieldwork should only be carried out during the two to three days either side of spring tides.

7.2.3.2 Field

The amount of shore that can be covered during a single low tide by a pair of surveyors will vary depending on a number of factors. These include the quantity of information required as well as the complexity and accessibility of the coastline. Wyn et al. (2000) discuss survey speeds on different shore types and quote an average speed of 0.6 km/hour or 2.4 km/tide assuming four hours of survey per tide.
The precise equipment to be taken into the field depends upon the information required, but as a guide, a list is given below. Most of the items for general shore work are self-explanatory. A GPS is essential, especially where points of reference are unclear in the field, e.g. in the middle of an extensive sediment area or positioning or the confirmation of boundaries.
Biotopes on hard substrata do not generally require specialised equipment for sampling. However, for sediment habitats some sampling of the infauna is needed to identify the biotope. A general description of sediment biotopes can be obtained by digging over an area for conspicuous macrofauna and sieving for smaller macrofauna; voucher specimens should be kept for detailed laboratory examination.

7.2.3.3 Equipment

- clipboard (weather-writers are good for fieldwork)
- printouts of scanned aerial photographs for annotating (laminated copies are most sturdy)
- space pen or 4B pencils for annotating colour photographs
- A4 copies of Ordnance Survey maps (enlarged if necessary)5

- field notebook for recording biotopes, target notes and shore profiles
- Site Forms (the MNCR site record form)
- MNCR Biotope Forms (for new biotopes)
- collecting equipment for voucher specimens
- camera (for transparencies/prints and preferably weatherproof) or digital camera/video (or Polaroid camera)
- compass and hand-held differential Global Position System (GPS) (tracking facilities and an interface to download to a PC are desirable features)
- hand lens
- safety equipment including mobile phone, VHF radio, personal protective clothing, first aid kit, life jacket
- tide tables

Extra equipment needed for sediment shores

- spade
- sieve (1mm mesh size)
- sample containers (if voucher specimens are to be kept)

7.2.3.4 Writing up field data

A day's worth of data from a pair of field workers will take four to six hours to 'write up'. This includes the downloading of GPS information, digitising of polygons (or preparing fair maps), writing up target notes, drawing profiles and logging of photographs. All target notes, descriptions and photographs should be clearly geo-referenced either to polygons or to known locations (e.g. a GPS waypoint).

7.2.4 Method

7.2.4.1 Preparation of fieldwork

Wyn *et al*. (2000) describe a technique of producing 'wire frames' by tracing recognisable features from aerial photographs prior to the field survey.

Visible polygon boundaries are traced by laying a clear acetate sheet over an aerial photograph or by using a GIS. Other visible features, which will be useful for orientation in the field, can also be included, such as field boundaries, roads, groynes, streams, houses and access points. The wire frame map can then be transferred onto waterproof paper and annotated in the field with biotope information and polygon boundaries adjusted as required.

7.2.4.2 Field recording

When taking aerial photographs into the field, recorders must match biological features with those identified from aerial photographs. These features are then labelled with dominant biotopes and their extents marked on the printed aerial photographs as polygons.

In particular, on rocky shores, polygons may contain more than one biotope, e.g. algal/faunal dominated zones interspersed with rock pools, overhangs, gullies, etc. Guidelines for recording/mapping mixed biotopes are given in Foster-Smith and Bunker (1997); see Figure 1. Notes on subordinate biotopes in polygons together with any features of importance should also be recorded, together with positional information where possible (e.g. GPS waypoints). Profiles of shores or sketches of important features should be completed in field notebooks whenever a major change is encountered. These profiles are especially important to give information on zonation patterns on steep or vertical shores.

Biotope boundaries can be difficult to interpret from aerial photographs of sediment shores. It is important to make decisions over biotope boundaries in the field and complete polygon maps as fully as possible.

As it is impossible to cover every square metre of shore, it is important to record how much of the shore area has been visited during the survey. If the GPS has a tracking function, it can be useful to show exactly where surveyors have been. The GPS tracks can later be downloaded to a PC with appropriate software.
A map of tracks can then be produced which will give future surveyors a guide as to the intensity of survey undertaken to produce the field maps.
Photography is an important adjunct to the field surveys. This gives visual information on the condition of the biotope against which gross change can be measured. A mixture of viewpoint and close-up photography is useful.

A distinction is made between *polygon attributes* and *target notes* depending upon the type of information and the way in which the notes are geo-referenced.

7.2.4.3 Polygon attributes

Polygon attributes are information attached to a polygon and recorded as standard. This information would include (where relevant):

- dominant biotope(s);
- substrata and important modifying features;
- species/community information pertaining to the polygon, particularly if this represents a significant variation on the standard biotope description;
- rare species or species of conservation significance;
- information on the quality of the biotope, e.g. if it is scoured or perhaps a particularly good example;
- subsidiary biotopes, which are too small to be mapped individually, e.g. shallow coralline pools, which are widespread over the polygon;
- any other relevant information relating specifically to a particular polygon, e.g. any anthropogenic activities such as bait digging.

These data will be stored in a spreadsheet or database linked directly to the polygons through the unique polygon ID reference code.

7.2.4.4 Target notes

Target notes contain information not collected as standard for the polygons, which can be located on the map. The data may contain:

- information on biotopes smaller than 5 x 5m which cannot be regarded as typifying the whole polygon, e.g. a significant small pool or gully in a large polygon;
- information on impacts within a localised area of a polygon (but which can encompass more than one polygon);
- artificial substrata, e.g. sewage pipes which may be represented as lines that may cross more than one polygon;
- shore profiles showing zonation and biotope extents (especially important on steep or vertical shores);
- features outside the limits of the survey (dunes, land falls, etc);
- locations where photographs and /or video were recorded;
- location of sampling stations (e.g. where quadrats or sediment samples were recorded).

Often where there is a large area of shore to cover, it is not possible to visit every polygon and any map should make a distinction between those polygons actually visited and those mapped by extrapolation or using binoculars. The associated data file should include a field to indicate how the data were recorded (direct observation or extrapolation).

7.2.4.5 Writing up field data

Ideally, surveyors should aim to transcribe field maps, target notes, etc. directly to a PC following the survey. The availability of powerful notebook PCs has made this option easily achievable for field survey teams. Failing this, a neat paper copy of all field survey data should be made. Whatever method is used, it is important that information is transcribed carefully and that target notes, photo logs and other information are cross-referenced both to each other and to the shore map (or GPS waypoints if appropriate). It can be useful to collate the information gathered every day by a team of field workers within MNCR or CCW Site Forms (especially if it is not being entered directly into a PC).

Fair maps should be prepared by drawing out the polygon boundaries, elucidated in the field from aerial photographs. This can be achieved either on a GIS (i.e. digitising the polygons) or by making a neat copy by hand. Either way the polygons should be numbered and labelled with biotopes. Polygon attribute and target note information should be referenced to the numbered polygons and/or waypoints from the GPS (on a PC this is achieved by creating data files which are either tagged to polygons or georeferenced to waypoints). Photographs should be logged and also geo-referenced (any digital images being downloaded onto a PC). Sketches from field notebooks should be copied out in neat and geo-referenced (these can be scanned in at a later date and incorporated into the GIS if desired).

Any GPS waypoints should be accurately copied out on paper, entered, or downloaded directly onto the PC for display on maps.

Field teams may find it useful to write out the descriptions and target notes and transcribe shore profiles for stretches of coast on standard forms such as the MNCR Site Form or those produced for Phase 1 mapping by CCW (Wyn *et al.* 2000).

7.2.5 Health and safety

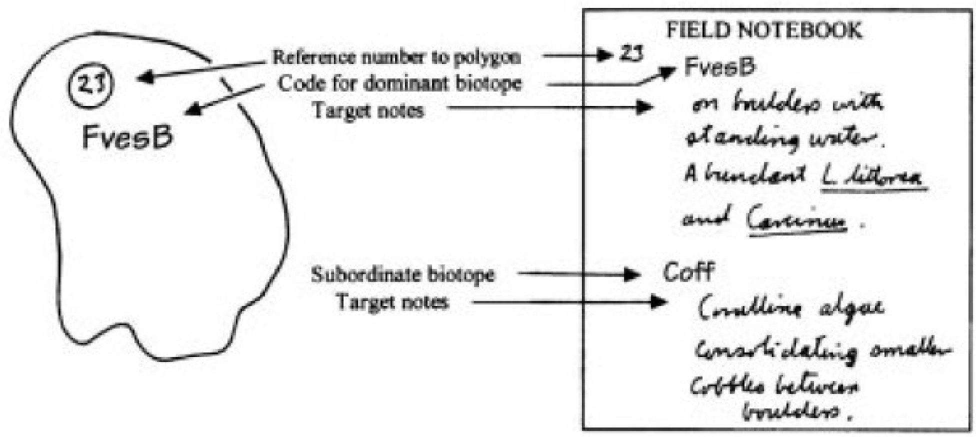
Codes of safe conduct for shore and boat work must be followed at all times and risk assessments must be prepared for the specific locations where the study is being undertaken. The fieldwork often involves exploring coastlines not known to the surveyors. A proper risk assessment prior to fieldwork is essential, especially regarding access and tide times to prevent surveyors being stranded by a rising tide.

Appropriate field survey clothing and safety equipment should be carried, along with a VHF radio or mobile telephone, first aid kits, tide tables and hats and sunscreen (also immersion suits, life jackets and/or hard hats where appropriate).

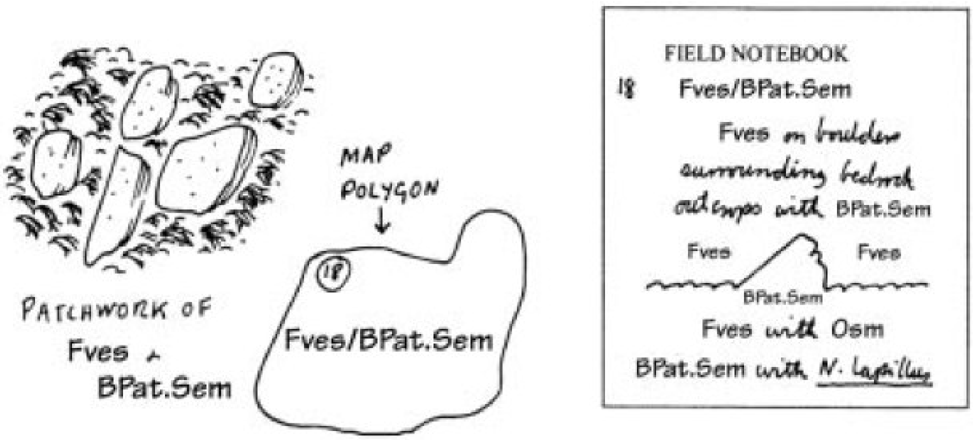
Surveyors should always work in pairs and adopt lone-worker policies in case both surveyors become trapped or incapacitated (e.g. adhere to predetermined routes and agree details for rendezvous following the survey).

Figure 17 – Different methods of recording and representing biotope mixes (after Foster-Smith and Bunker, 1997)

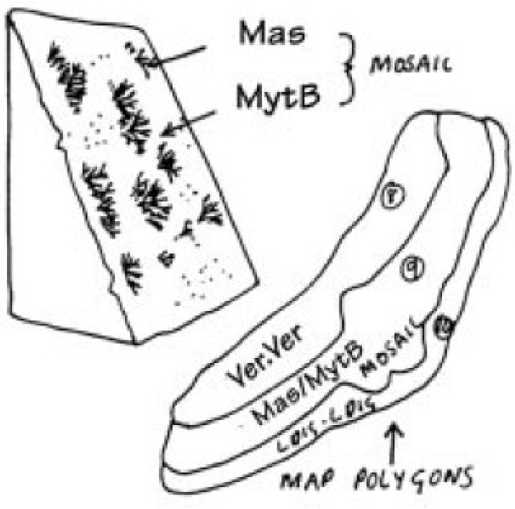
A. Homogeneous areas (polygons) illustrating the format for recording biotope information as codes and target notes

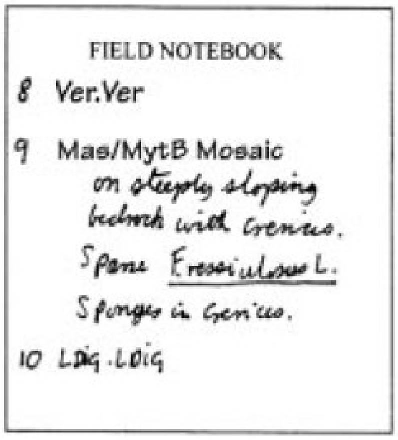


B. Areas dominated by one biotope but with a major division in a key habitat feature and/or presence of subordinate biotope
C. Biotopes form a patchwork where each patch falls below the minimum mappable size and where there is no clear predominant biotope. The biotopes are likely to be distributed according to obvious structural differences in the habitat.



D. Biotopes form a mosaic of small patches below 1m2. Often, these mosaics are the result of biological interactions leading to changes in patch distribution over time and are not directly related to structural differences in the habitat.





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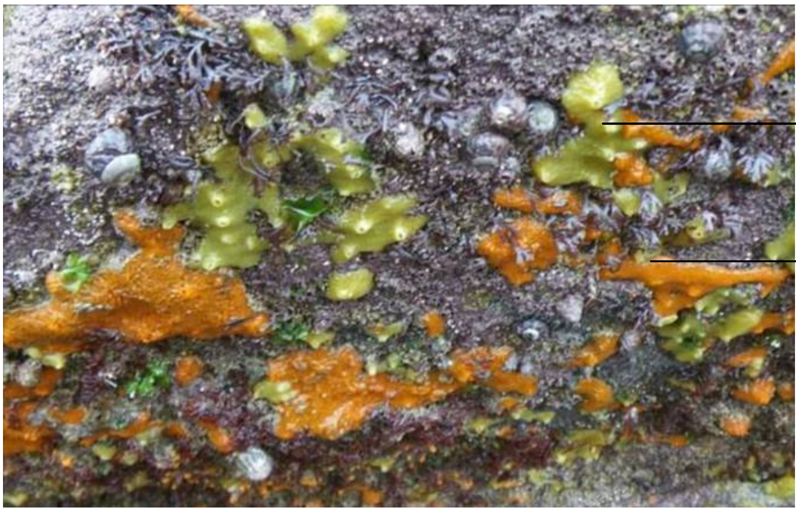
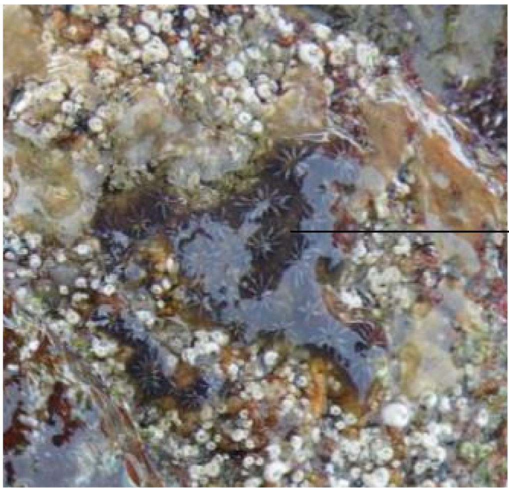
7.3 Appendix 3: Under-boulder and sediment-floor pool fauna



Halichondria panicea

Hymeniacidon perleve

Egg capsules of *Nucella lapillus*

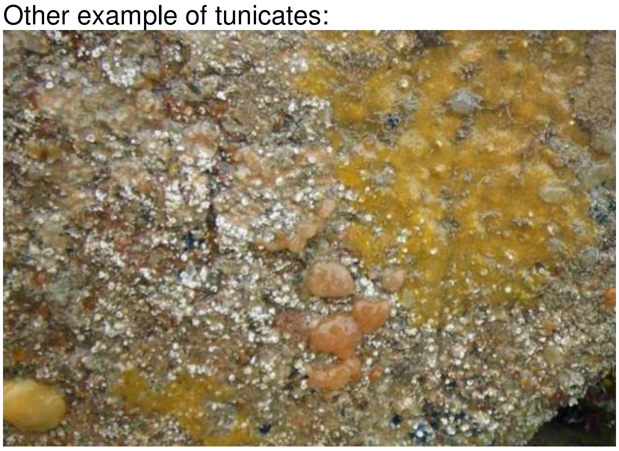


Star ascidian *Botryllus* sp.


Corella sp. *Ciona intestinalis*

Clavelina lepadiformis

Other example of tunicates:



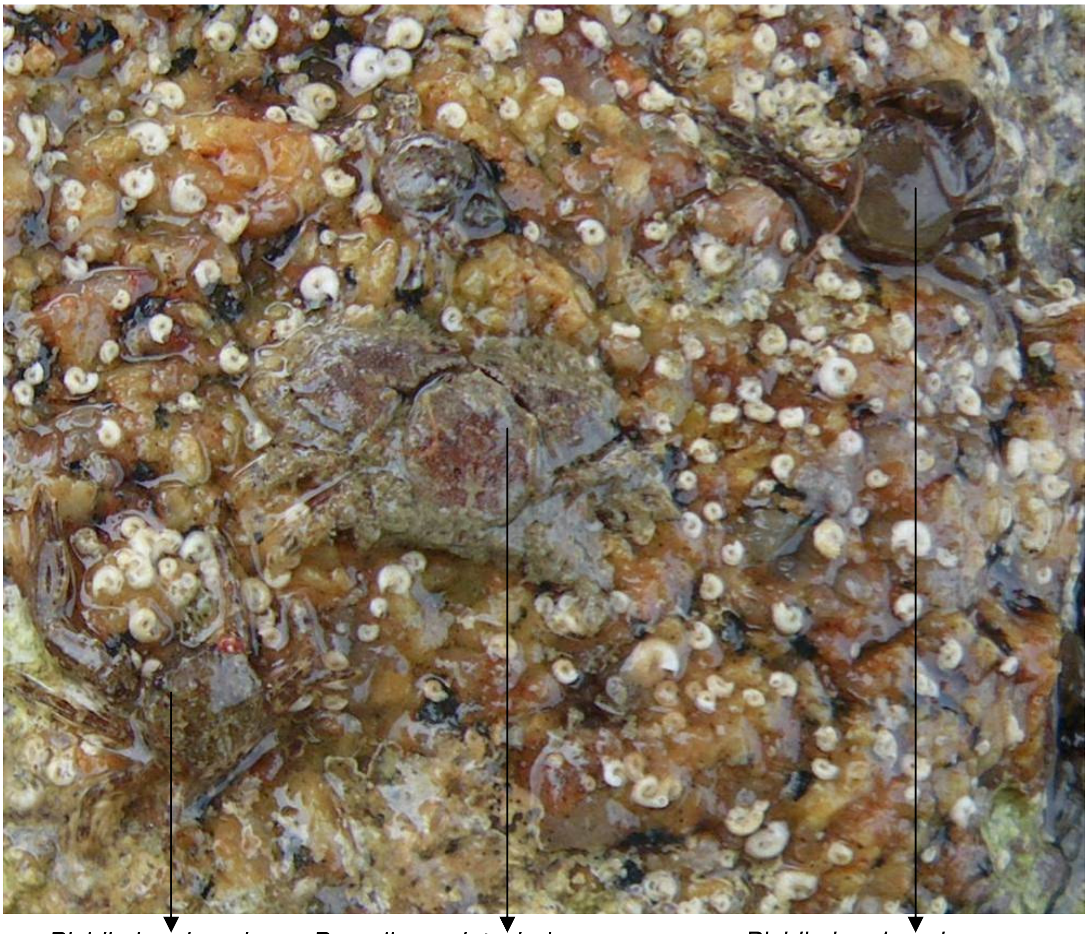

Ormer *Haliotis tuberculata*

Cushion star *Asterina gibbosa*

Shanny
Lipophrys pholis

Pipefish *Nerophis lumbriciformis*

Butterfish *Pholis gunellus*



Pisidia longicornis *Porcellana platycheles* *Pisidia longicornis*

Pilumnus hirtellus

Scorpion spider crab
Inachus sp.

Cancer pagurus

Achanthochitona sp.

Anemonia sulcata

Cereus pedunculatus

Aeolidia papillosa

Archidoris pseudoargus

Sea hare *Aplysia punctata* and eggs