An Outline of the Ecology and Sensitivity of Marine Habitats in Jersey, Channel Islands

Marine Resources (Government of Jersey)

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Contents

1.0- Introduction

There are many different habitats and species in Jersey's waters that are sensitive to human pressures. The aim of this report is to provide a descriptive overview of the habitats (biotopes) that have been identified in Jersey's marine environment and to assess their vulnerability to pressures and threats resulting primarily (but not exclusively) from human activity. The assessment was undertaken primarily on the habitat groups (and biotopes therewithin) identified by the Ecosystem Services Report (Marine Resources, 2023b) using data from pre-existing evaluations for a range of threats and pressures using the Marine Evidence based Sensitivity Assessment (MarESA) methodology.

1.2- The Structure of this Report

This report provides an introduction to the ecology and biology of Jersey's marine habitats and species using several levels of complexity and detail. A descriptive overview of intertidal and subtidal habitats is given in Section 2.0 which leads into a more detailed dissection and analysis of biotopes (with key species) with the habitat groups identified in the Ecosystem Services Report (Marine Resources, 2023b). This includes an assessment of the likely sensitivity of each habitat group to a selected range of potential and relevant environmental threats using MarESA-based data (Section 3.0 and 4.0). The final section offers the results of a spatial assessment of Jersey's marine waters for the same habitat groups and threats.

1.3- Habitats and Biotopes: A Definition

The terms 'habitat', 'biotope' and 'species' are frequently used in many reports and papers concerning marine science and management including this one. Given the importance that has been afforded to these concepts by the Marine Spatial Plan, what is meant by the terms 'habitat', 'biotope' and 'species' is defined as follows:

'Habitat' is a general term that denotes either a single biotope (see below) or a collection of biotopes that share key characteristics which may include substrate, species (individually or communities) and parameters such as depth. Habitat names are often descriptive rather than purely scientific and so can be used in non-specialist literature or presentations. As an example, in this report the habitat 'hard ground' encompasses two similar biotopes (CR.HCR.Xfa and SS.SCS.CCS.PomB) which represent offshore rocky substrates with little or no sediment covering. A list of habitat terms used in this report are given in Table 11 and a map of benthic habitats is shown in Figure 25. For further information on the concept of defining habitats see Elliott et al. (2016).

'Biotope' is a specialist term that relates to a habitat classification scheme developed by the Joint Nature Conservation Committee (JNCC). The scheme is hierarchical and classifies biotopes using several factors such as substrate, depth, exposure, features (such as 'overhangs', 'caves', etc.) and species (Connor et al. 2004).

Biotopes are labelled using a composite coding system that reflects the biotope's hierarchical position and complexity (in terms of descriptive components). The JNCC biotope classification also forms the basis of the European EUNIS habitat system which uses letters and numbers to denote a biotope's position and complexity. Although the JNCC classification labelling is used preferentially in reference to individual biotopes in this report, these labels are directly interchangeable with the coding of EUNIS (e.g. SS.SMp.Mrl = A5.51).

'Species' is used in the taxonomic sense with a species being defined by its Latin binomial name for example, *Laminaria digitata*. Common (vulgar) names are sometimes used as an alternative to the species binomial name for example, American slipper limpet for *Crepidula fornicata*. The naming of species is in accordance with established taxonomic rules but new research, advances in genetics, etc., means that species names may be liable to change. This means that species names used in any publication have the potential to change over time. The species names used in this report were, at the time of writing, recorded as valid by the WoRMs (World Register of Marine Species) database.

1.4- Habitat Classification and Presence

The habitat groups used in this report are taken from (Marine Resources, 2023b). Jersey's marine substrates consist of sands, gravels, boulders and rock that are further classified into habitats based on their exposure, depth and their living components such as seaweeds, seagrasses, polychaetes, bivalves, and turf communities. An assessment of Jersey's marine habitats using a combination of the JNCCs and EUNIS habitat classification systems revealed 66 habitats that were grouped into 14 key habitat types (Table 1.4.1; Figure 1.4.1). The intertidal zone contains many habitat types, but these have been grouped with their corresponding subtidal habitats, i.e. subtidal and intertidal seagrass, as, for the purposes of this assessment, they are affected to a similar degree by the same human activities.

Name	Description	EUNIS codes
Rock: barnacle communities	Intertidal and subtidal rock that is dominated by barnacles and limpets.	A1.112, A1.1131, A1.1133
Rock: seaweed communities	Intertidal and subtidal rock that is dominated by seaweed, such as *Fucus* spp. and *Ascophyllum nodosum*.	A1.125, A1.211, A1.212, A1.214, A1.2142, A1.215, A1.3122, A1.313, A1.3132, A1.314, A1.3142, A1.3152, A1.451
Rockpool communities	Pools of various shapes and sizes within rocky intertidal areas.	A1.4111, A1.4121, A1.413, A1.4131, A1.421
Rock: kelp	Kelp and associated seaweed species on rock substrate. Includes both kelp forest and kelp park.	A3.12, A3.125, A3.126, A3.211, A3.214, A3.2142, A3.222, A3.223, A3.2231
Sediment: sparse fauna	Fine, medium and coarse sediments with sparse infauna. Typically high energy sites with mobile sediments.	A2.211, A2.22, A2.221, A2.2221, A2.223, A2.224, A2.225, A2.226, A2.231, A5.231, A2.111
Sediment: robust fauna	Coarse sand and gravel with robust infauna. Typically moderate energy sites. Characterised by infaunal polychaetes, mobile crustacea and bivalves.	A5.133, A5.135, A5.142, A5.145
Sediment: rich fauna	Fine and mixed sediments with rich infauna such as tube building amphipods and polychaetes and diverse bivalve communities.	A5.234, A5.24, A5.33, A5.433, A5.451
Sediment: seaweed	Sediment with high coverage of seaweeds, such as *Sargassum muticum*, *Chorda filum* and kelps.	A3.315, A5.52
Sandmason worms	Sediments dominated by sandmason worms.	A2.245, A2.421, A5.137
Seagrass	Sediments dominated by seagrass	A2.6111, A5.5331
Maerl	Free growing coralline red algae that grows in branched and noduled structures that accumulates on the seafloor.	A5.51
Slipper limpets	Sediments with a high coverage (>50%) of slipper limpets (*Crepidula fornicata*).	A5.431
Hard ground: stable	Subtidal bedrock and boulders that are stable and have a high faunal diversity in terms of encrusting and filter feeding	A3.7, A4.13

	species, such as sponges, seasquirts, bryozoans, hydroids, anemones and corals.	
Hard ground: unstable	Unstable cobbles and pebbles characterised by fast growing species such as barnacles and bryozoans.	A5.141

Table 1.4.1 – A list of habitat groups and their constituent EUNIS codes.

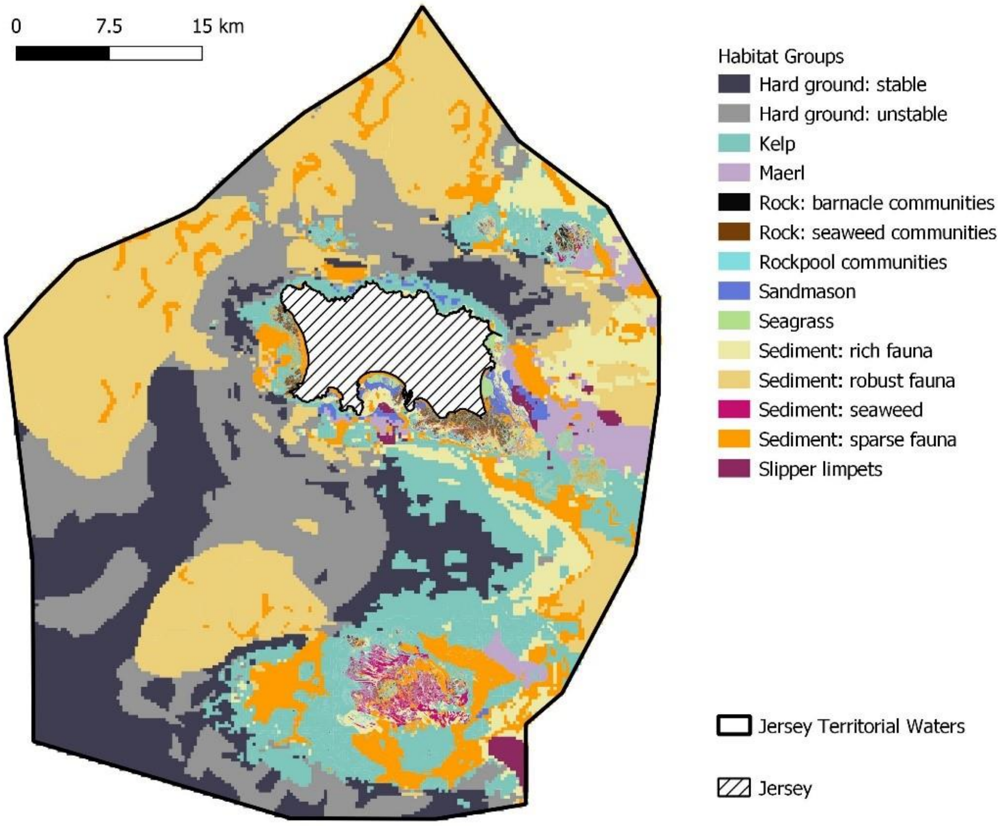

Figure 1.4.1. The spatial extent of Jerseys marine habitat types.

2.0- Jersey's Marine Environment: An Overview

The island of Jersey is the largest and most southerly of the British Channel Islands, being situated on the southern side of the English Channel about 130 km south of England but only 30 km east of the French Normandy coast. Jersey is a self-governing British Crown Dependency with a land area of 120 km^2 and a permanent population of 105,000 people. The island has a temperate climate and an economy that is largely based on financial services plus smaller contributions from other sectors including tourism, agriculture and fisheries.

The Bailiwick of Jersey is in an L-shaped enclave of the English Channel formed by the coastlines of western Normandy and northern Brittany. This L-shaped sea area is known as the Norman-Breton Gulf (NBG) and, as well as Jersey, hosts the other British Channel Islands (Guernsey, Alderney, Sark and Herm), the French archipelago of Chausey and several large uninhabited offshore reefs. Four of these offshore reefs (Les Minquiers, Les Écréhous, Les Dirouilles and Paternosters) are dependencies of Jersey which, with the island of Jersey, generate a territorial sea area of 2,455 km^2 (Figure 2.0.1).

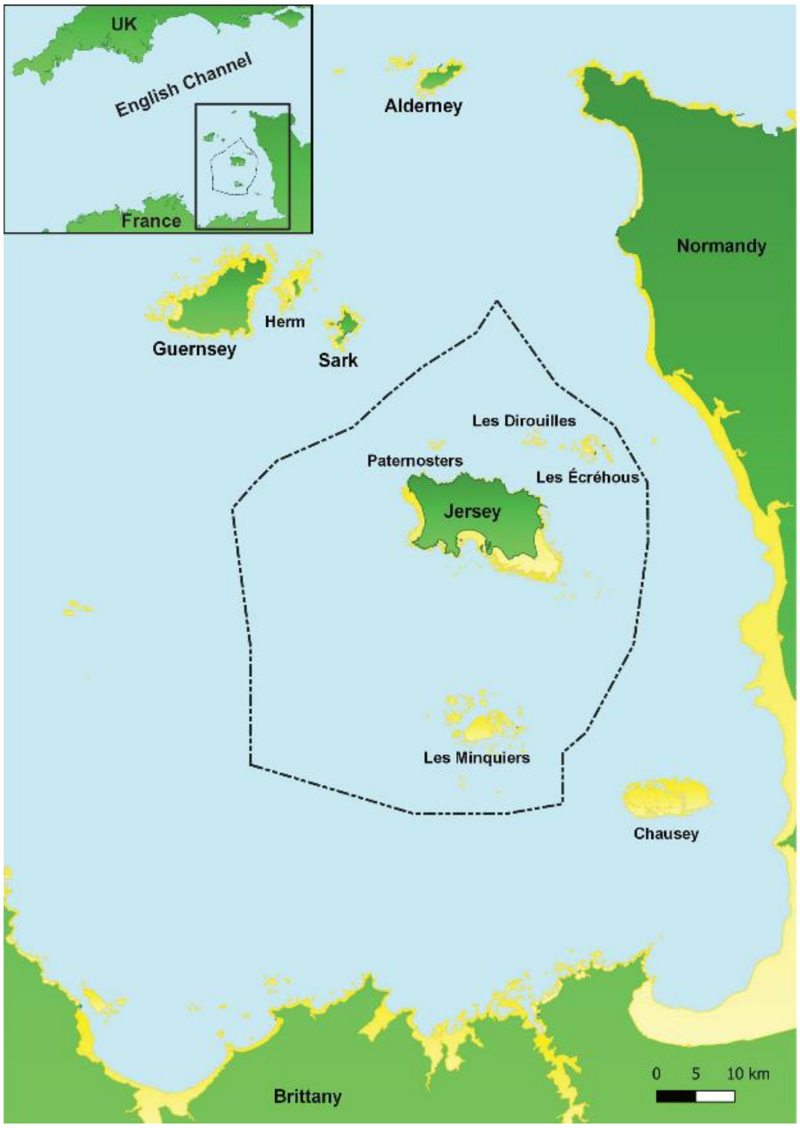

Figure 2.0.1 - The location of Jersey within the Normano-Breton gulf and in relation to the other Channel Islands and the French mainland. The extent of Jersey's Bailiwick is shown by the dashed line.

2.1- Geography and Oceanography

The seabed topography within the NBG controls regional oceanography which, in turn, heavily influences the distribution, location and diversity of habitats and species. This topography is unusual and reflective of the region's geological history, especially in relation to ancient tectonics and, more recently, changes in sea level. Of particular importance are the gulf's islands, archipelagos and reefs whose geography directs the patterning and strength of tidal currents and hence also the movement and accumulation of nutrients, pelagic species and sediment. To understand the ecology and ecosystem service functioning of Jersey's territorial seas requires knowledge of the region's geography and oceanography, especially the role played by the reefs and sedimentary basins.

The geology of the NBG is formed from a combination of ancient Precambrian basement rocks (circa 750 to 600 million years) which were overlain or intruded by Palaeozoic sedimentary and igneous rocks (535 to 420 million years). Ancient tectonic activity and the later emplacement of granitic batholiths has created a patchwork of Precambrian geological provinces (defined by regional faults) and younger lower Palaeozoic and Palaeogene sediments. Erosion across millions of years has produced a network of wide sedimentary basins separated by taller topographic features. It is this arrangement of topographic highs (islands and reefs) and low, wide sedimentary basins that form the present shape of the NBG. It is probable that the erosional origin of this landscape dates back 100 million years or more (Bishop and Bisson, 1989; Nichols and Blampied, 2016).

The NBG, like all coastal areas, has been heavily influenced by sea level change over a geological timescale. Periods of higher sea levels, such as exists today, would see the NBG flooded by marine waters with just the resistant, taller igneous areas remaining as islands or intertidal reefs. Conversely, lower sea levels would leave the NBG exposed as a fully terrestrial landscape many kilometres from the coast.

During periods of lower sea level, rivers running off the Normandy and Brittany mainland would pick out weaker rocks and fault lines, eroding them into wide, shallow river valleys. By the end of the last Ice Age, around 12,000 BP (before present), the NBG had a topography in which tall, flat plateaus of igneous rock were separated by a series of drainage basins and river terraces. A rapid sea level rise during the Holocene led to a progressive drowning of these drainage basins until, around 2,000 BP, the NBG assumed its current seascape of islands and reefs separated by wide tracts of fully marine waters. This means that the marine sediments in Jersey's territorial seas were deposited during the past 8,000 years (Chambers and Nichols, 2014).

The modern regional undersea topography is reflective of this Ice Age drainage network and within Jersey waters what were river basins have been drowned by the sea to create three distinct sedimentary basins, lying wholly or partially within the island's territorial borders. The importance of these sedimentary basins (and the reefs that separate them) to regional biodiversity and ecology has only recently been recognised. They may also play a major role in the regional Blue Carbon framework and will be referred to later in this report. The basins have been labelled as: Les Écréhous Basin; Canger Basin; and Les Sauvages Basin (Chambers *et al.* 2022).

The edges of these four sedimentary basins are defined either by emergent coastlines (e.g. Jersey and Normandy) or by prominent subtidal ridges of rock with an approximate east-west trend (e.g. Les Écréhous, Les Anquettes and Les Minquiers). Water depths within the basins are generally shallow (<20 metres above chart datum) and shallower still (<10 metres) over the ridges that separate them. All the basins are in the eastern part of Jersey's territorial seas (Figure 2.1.1).

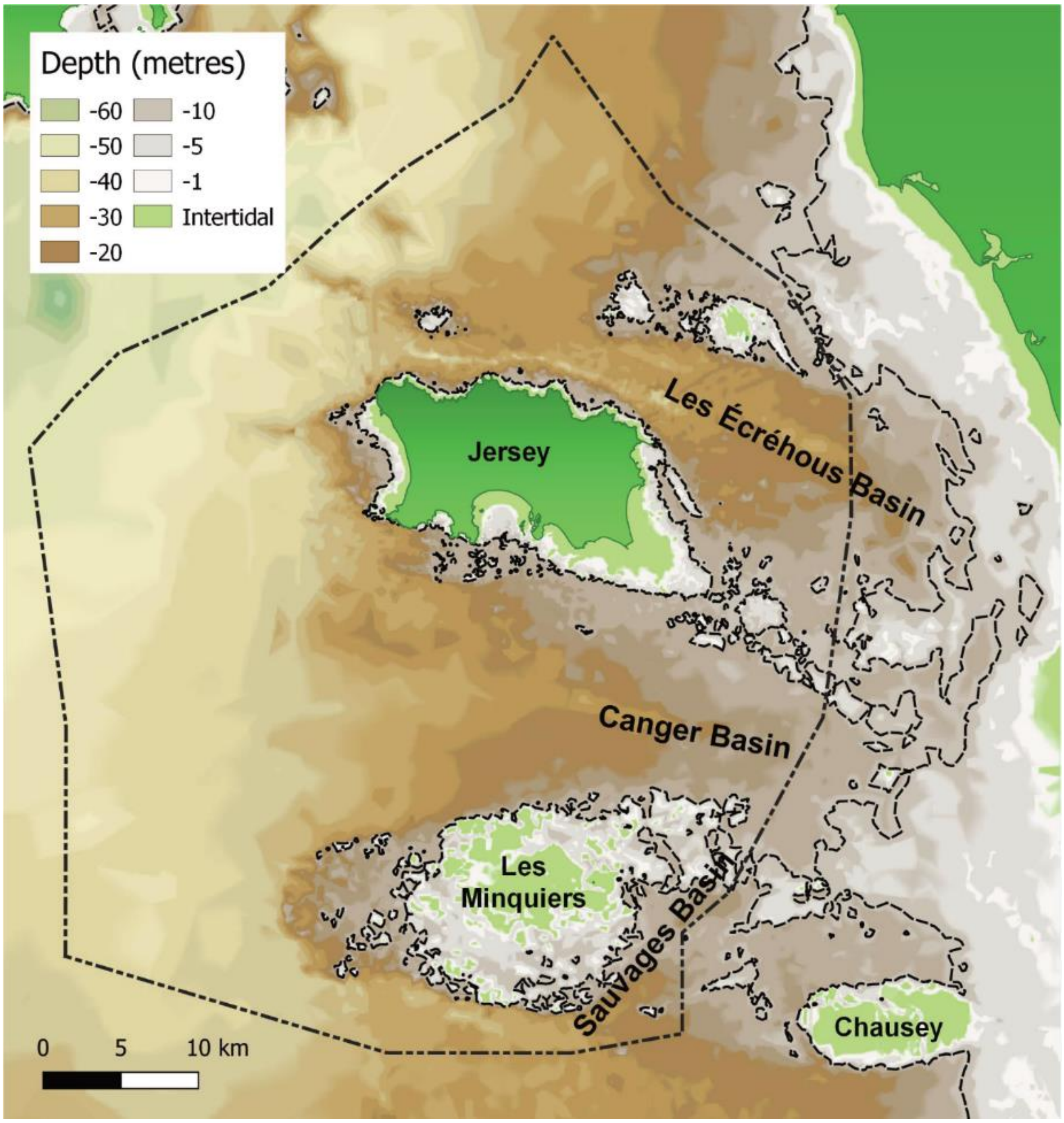

Figure 2.1.1 - A bathymetric chart of the Bailiwick of Jersey and adjacent waters. Depths are measured to chart datum. The three principal sedimentary basins are indicated as is the island of Jersey and the offshore reefs of Les Minquiers and Chausey.

These basins remain tectonically active producing regular earthquakes including some which have caused minor structural damage. Regional tectonics and a rising sea level mean that Jersey's sedimentary basins are actively accumulating sediment with geotechnical surveys reporting sedimentary thicknesses of 40+ metres between the east coast of Jersey and Normandy. Coring work suggests that Holocene marine sediments occupy the top one to four metres (depending on location) of seabed thickness below which occur Pleistocene rivers terrace deposits (Lefort *et al.* 2020).

The seabed area to the west of Jersey is flatter and less complex with a greater exposure to high energy weather, waves and currents. Water depths are greater but remain relatively shallow (<50 metres below chart datum) with a westward sloping seabed that is flatter and dominated by bedrock, cobble which, in places, is covered by patches of mobile sand and gravel. In these areas a predominance of rocky seabed and mobile coarse sediments creates a different ecology to Jersey's sedimentary basins and therefore also gives them a differing role in the regional ecological framework.

Additional to Jersey's subsea topography is an unusual oceanographic regime which is controlled by the island's location in relation to the Normandy and Brittany coastlines. The L-shape formed by the Normandy and Brittany coasts creates a dead end for tidal waters entering the NBG from the English Channel. This causes the incoming tidal wave to push up against the French coastline producing some of the largest tidal ranges in the world (12.2 metres at St Helier but up to 13 metres around St Malo). The squeeze of sea water towards the Bay of Mont St Michel and the presence of so many islands and reefs create strong tidal currents (>5 knots) and a complicated circulation pattern around the reefs and islands.

For sea water to navigate its way into, across and then out of the NBG entails it passing through a network of gyres and eddies generated around topographic features such the offshore reefs and islands. Computer modelling and drogue surveys suggest that sea water entering the Jersey area from the English Channel may circulate around the island for up to eight weeks before being pushed out into the Channel (Figure 2.1.2; Greenaway, 2001; Jegou and Salomon, 1990).

The combination of long residency times, complex residual currents, a high tidal range and a paucity of freshwater from rivers, serve to homogenise the salinity and temperature of the marine waters around Jersey. This creates a distinct and largely separate water body in the south-east part of the NBG which is demarcated by a sharp tidal front (sometimes called the Guernsey Front) that almost exactly follows the sea border between Jersey and Guernsey. This division of sea waters is well defined by differences in temperature, productivity and turbidity, so much so that the two waters bodies may be clearly visible on satellite images.

The northern water body around Guernsey is deeper, clearer, colder and more stratified while the southern water body around Jersey and the Bay of Granville is warmer, more turbid and without stratification. This division and its associated oceanographic properties have an influence on regional sedimentary, productivity and biodiversity patterns which will likely be reflected in the generation, distribution and storage of organic and inorganic carbon resources.

The important role that local topography and oceanography plays in maintaining the health of Jersey's marine environment is only starting to be appreciated and recognition of connectivity between ecosystem functions and services (such as biodiversity, pollution, fisheries and blue carbon) is at an early stage. The definition, quantification and holistic modelling of Jersey's marine resources is no small task but is important if the island is to ensure that its maritime environment is to remain ecologically and economically productive and sustainable for the long-term.

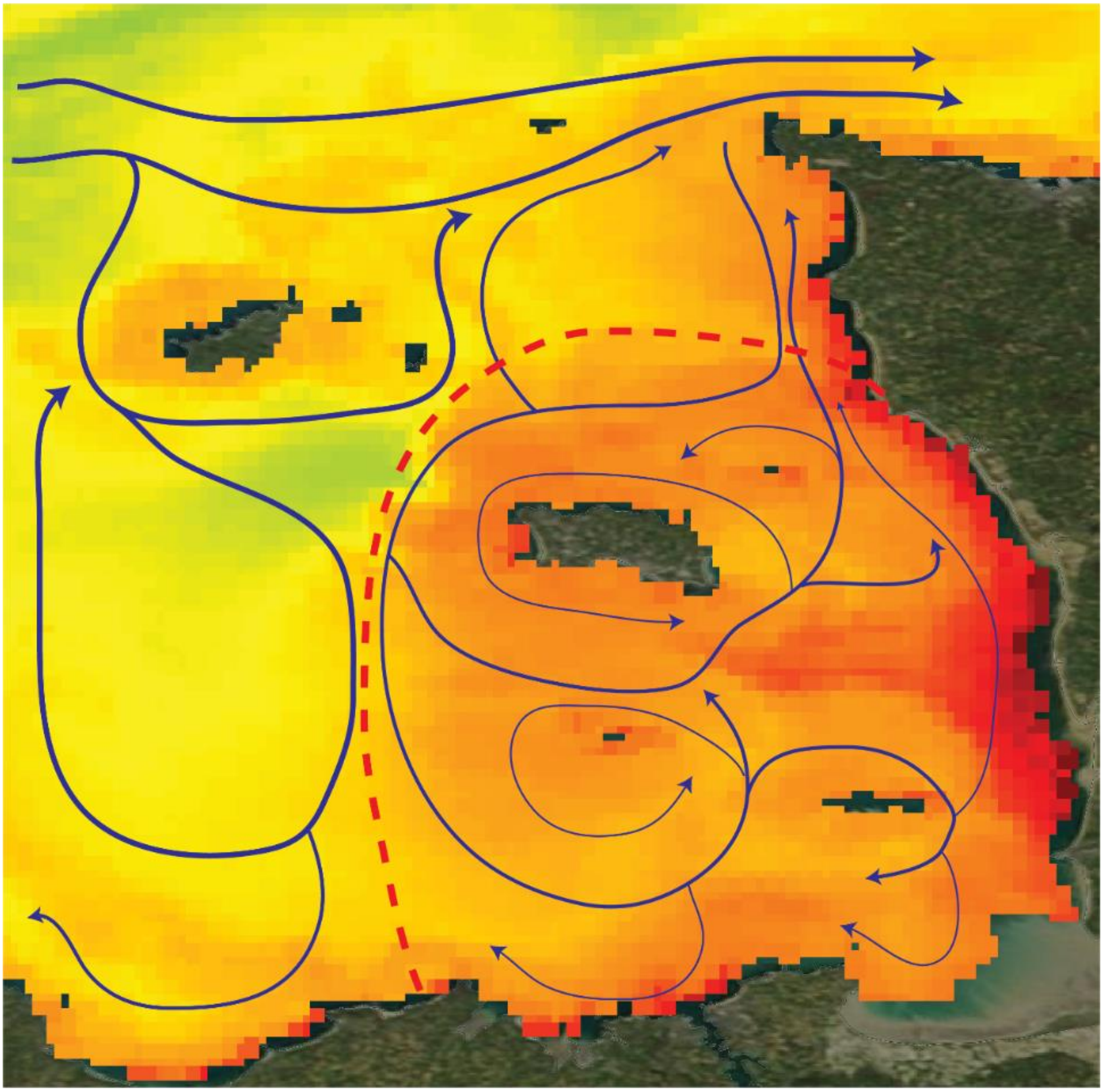

Figure 2.1.2 – A NASA satellite image (24 March 2020) showing the concentration of chlorophyll-a at the sea surface. This image illustrates a differentiation between the sea waters of the Bay of Granville and the wider English Channel (dashed red line). Residual tidal currents(indicated) mean that water entering the Bay of Granville may be trapped there for weeks or months before re-entering the English Channel (Greenaway, 2001).

2.2- Intertidal Ecology: An Overview

This section offers an overview of Jersey's intertidal habitats and species, including those parts of the offshore reefs and rocks that dry at low tide.

2.2.1- Intertidal Zonation

To live successfully on the seashore, plants and animals must be able to survive exposure to terrestrial predators (such as birds and humans), the actions of the sun and wind, extremes of air temperature and the action of waves. Although it is a tough environment, the seashore is an area of high productivity and so there are benefits to being able to survive there.

The distribution of animals on the seashore is primarily controlled by height above the low water mark. The higher up the shore an animal or plant lives, the longer it will be exposed to the air at low tide, increasing the dangers of desiccation and predation. In general, hardier species live higher up the shore which means that intertidal areas may have several distinct zones formed from plant and animal species that have different tolerances. Documenting such zones can be a useful guide to the biological potential of a site but the zones themselves are not uniform and will differ between locations. Their number, location and complexity are dependent on geology, geography and level of exposure.

Figure 2.2.1.1 shows the effect of site exposure on the zonation of species and biotopes across Les Minquiers. This suggests that sheltered sites have a greater diversity of seaweed and animal species than more exposed areas, a phenomenon that applies to most coastal areas in Europe. In Jersey the most exposed areas of seashore are those that face westwards towards the prevailing Atlantic winds and waves, or which are adjacent to deeper water such as the north coast and offshore reefs. In general terms, seashore habitats/biotopes are classified using their height above chart datum, substrate and biological properties (species, etc.). A summary of the key habitat features and species in relation to seashore height and substrate is given below.

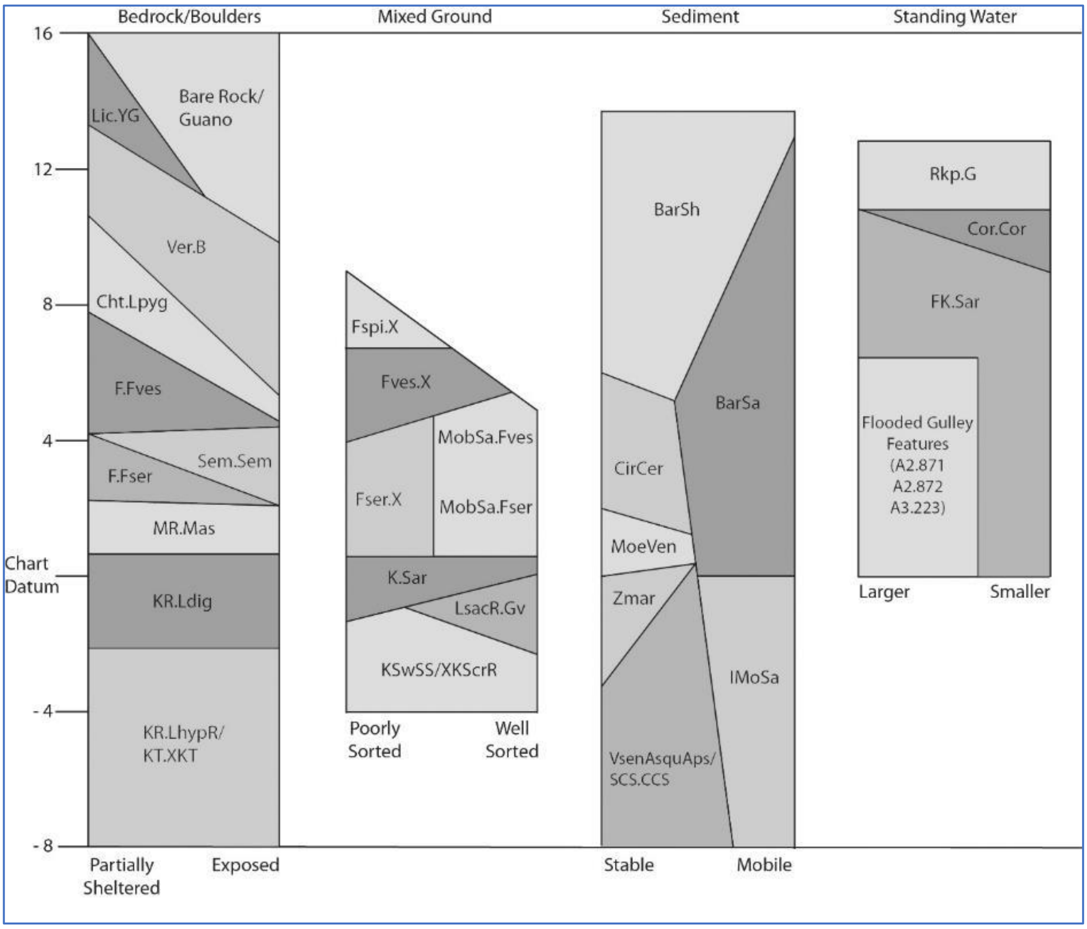

Figure 2.2.1.1 – The effect of physical parameters, such as site exposure, to the height zonation of selected biotopes at Les Minquiers. The letter codes refer the JNCC's biotope habitat classification. (After Chambers et al. 2016)

2.2.2- Upper Rocky Shore Communities

Much of Jersey's upper shore area is dominated by exposed rock in the form of cliffs, bedrock or boulders. Areas that go above the high-water mark may have developed a 'splash zone' area in which the marine environment grades, usually via coastal lichen species, into maritime coastal habitats containing salt resistant plants and animals.

The lower part of the splash zone and extreme upper shore rock surfaces are usually covered with the distinctive black lichen *Verrucaria maura*. This lichen forms a distinctive black band at the top of all the tall rocks and can be indicative of more exposed locations. Towards the base of the *Verrucaria* zone the barnacle *Chthamalus* will start to occur, initially as individuals but increasing in density down the shore. At the base of the *Verrucaria* zone the tufted lichen *Lichina pygmaea* will occur in patches, often accompanied by the gastropods *Patella vulgata, Osilinus lineatus* and *Littorina saxatilis*. In more sheltered places the seaweeds *Pelvetia canaliculata* and *Fucus spiralis* may be found at, or just below, the level of *Lichina pygmaea*. These seaweeds tend to occur in small patches and are rarely well-developed with *Fucus spiralis* becoming stunted in exposed parts of the coast.

2.2.3- Middle Shore Rock Communities

Deciding exactly where the upper shore ends and the middle shore begins is not always easy as the vertical extent of some characteristic upper shore species, such as *Verrucaria* and *Chthamalus*, may vary depending on the exposure and steepness of a location.

On wave-cut platforms and cliff areas the middle shore is often dominated by barnacle-encrusted rock surfaces. These are typically made from dense communities of *Semibalanus balanoides* but in the upper part of the middle zone there may be an overlap with *Chthamalus* species, especially in more exposed locations.

Many middle shore rock surfaces may have 80 percent plus coverage of *Semibalanus balanoides* and at some less exposed locations the barnacles will grow to several centimetres long, creating a thick, honeycomb-like layer. Associated with such barnacle mosaics are compact and hardy species such as *Patella*, *Gibbula umbilicalis, Nucella lapillus, Osilinus lineatus* (toward the upper part of the zone) and the cyanobacterium *Rivularia bullata*, which may often be the only large algae present. Barnacle dominated habitats tend to form in more exposed areas and on steep surfaces, where it is difficult for other species to gain a foothold; in some locations this habitat occupies not just the whole of the middle shore, but much of the lower shore too.

Sheltered rocky beaches will have a middle shore area dominated by *Fucus vesiculosus* below which will occur thick carpets of *Ascophyllum nodosum*. In exposed areas *F. vesiculosus* will occur in small, stunted patches rather than a clearly definable zone. *F. vesiculosus* is resistant to the actions of strong currents and can therefore be found clinging to rocks within areas of tidal-swept sand or mixed sediment where other seaweeds find it hard to cope. The species associated with *F. vesiculosus* habitats are much the same as those found in the barnacle zones that often frame it. However, where the seaweed occurs in denser, thicker layers it is possible to find a wider range of species which can live on or under the cover provided by the wrack.

2.2.4- Lower Shore Rock Communities

The lowest sector of the seashore is usually more diverse than areas higher up, it being subject to less stress (in the forms of aerial exposure and waves) than intertidal areas higher up. Even so, it can still be (relative to subtidal) a tough place for plants and animals to survive.

In less exposed areas the start of the lower shore is marked by a dense covering of *Fucus serratus* seaweed which may form a zone up to a couple of metres in extent. The canopy of *F. serratus* will shelter cracks and under boulder voids from exposure to the sun and wind allowing various species of anemone, mollusc, crustacean and worms to shelter at low water. Additional seaweeds found with *F. serratus* may include *Osmundea pinnatifida, Codium tomentosum* and *Chondrus crispus* as well as some opportunistic green species of *Ulva*.

Where wave action is more active, the covering of *Fucus serratus* often becomes less dense or, in areas of large rocks and boulders, patchy leaving areas of barnacle dominated rock in between. The rock surface itself remains a hard place to live (especially steep surfaces, which the fucoid seaweeds dislike) and many of the obvious species are those that may also be found high up the shore such as *Patella* spp., *Nucella lapillus, Gibbula* spp. and *Semibalanus balanoides*, although these may be joined by *Calliostoma zizyphinum, Porcellana platycheles* and *Ocenebra erinacea*.

Particularly large overhangs or under boulder voids may develop their own particular community of sponges, sea squirts (ascidians), encrusting worms, anemones, bryozoans and short-tufted seaweeds. These form a continuous carpet across the rock surface, taking advantage of the permanent shade provided by the topography of the rocks.

The very lowest seashore areas will often have a zone of rock and boulders which are dominated by a mixture of the short red seaweeds *Chondrus crispus* and *Mastocarpus stellatus*. This zone (which does not occur everywhere) is only exposed on the biggest tides and nestles between the zones dominated by *Fucus serratus* (higher up the shore) and *Laminaria* (lower down the shore).

The stubbiness and low, spreading nature of *Chondrus* and *Mastocarpus* discourages widespread barnacle mosaics but does allow sponges to form on the rock surface. The effect is often to produce what looks like a dense dark-looking turf across the tops of boulders and rocks. These seaweeds may be home to hundreds of *Gibbula pennanti* and an assortment of anemones (especially *Anemonia viridis*) and gastropods but, as with the *Fucus serratus* zone, a majority of life is to be found hiding in crevices, below rocks or under overhangs. The very lowest part of this zone may be dominated by the seaweed *Furcellaria lumbricalis* which, while sometimes abundant, does not quite form a distinctive enough zone to warrant mapping as a separate habitat. Low rocks that are periodically covered by sand may be covered by sizeable patches of the seaweed *Rhodothamniella floridula* which can cope with sediment inundation.

The lowest rocky seashore zone is usually formed from forests of *Laminaria digitata* and *Laminaria ochroleuca* whose distinctive stalked forms will begin to emerge from the sea just before low water on big spring tides. *Laminaria* will grow even in quite exposed places and so most areas of the extreme lower shore in Jersey waters possesses this characteristic fringing zone.

Laminaria is rarely exposed to the air and is transitional between the intertidal and shallow marine environments. As well as the usual crevice and under-boulder fauna, the gnarled holdfasts of *Laminaria* provide shelter for small animals and a growing surface for various encrusting sponges, bryozoans and hydroids, while the stalks may be home to communities of *Helcion pellucidum*. Amongst the base of these plants low water fishermen will find lobsters (*Homarus gammarus*), ormers (*Haliotis tuberculata*) and conger eels (*Conger conger*).

The *Laminaria* zone is usually the most diverse of the rocky shore biotopes and, being at the base of the intertidal zone, is generally protected from prolonged exposure to weather and waves. It may extend a few metres below the absolute low water mark (chart datum) after which it will usually grade into thicker kelp forests formed by *Laminaria hyperborea*.

2.2.5- Sediment Dominated Shore Communities

Large areas of Jersey's south-east coast and offshore reefs have mobile, coarse sandbanks which have a low biodiversity. Highly mobile clean sands may contain only a handful of species such as sandeels and the Mint

Sauce Worm (*Symsagittifera roscoffensis*). Others will grade into sandmason worm beds (*Lanice conchilega*) that may contain many species of burrowing polychaete and clam species such as *Ensis* spp., *Spisula* spp., *Donax variegatus, Glycymeris glycymeris* and *Venus verrucosa*. These may be accompanied by the gastropod *Gibbula magus*, sandeel species and the regionally rare bivalve *Mactra glauca*.

More sheltered areas will have stable areas with a high content of fine sand and silt. This firmer, more binding sediment will be home to all the above listed species but will also have a diverse range of free living and tube-forming worms, burrowing crustaceans and other animals such as cockles (*Cerastoderma edule*), lugworms (*Arenicola marina*) and ragworms (*Nephtys* spp.). On the very lower shore there may be more unusual species such as spoon worms (*Golfingia* spp.) and burrowing sea cucumbers (*Leptosynapta* spp.). These habitats are important nursery areas for juvenile crustaceans, worms and molluscs which in turn provide food for fish.

Associated with some of these stable sand communities are seagrass beds (*Zostera noltei, Z. marina*), which may form extensive communities across the middle and lower shore (*Z. noltei*) and shallow subtidal (*Z. marina*). The most extensive areas of seagrass are along the south and east coast of Jersey although *Z. marina* may also be found at Les Écréhous and Les Minquiers.

2.2.6- Retained Water: Rock Pools

When the tide retreats it will often leave areas of water trapped in hollows, rock crevices or behind barrier features within gullies. These trapped pools of water provide shelter against dehydration, suffocation and predation and so are used by many plants and animals as a means of surviving on the seashore while the tide is out. Rock pools, ponds and flooded gullies can contain much marine life and, depending on their size, depth and seashore position, may be high biodiversity features.

Rock pools may range in diameter and depth from a few centimetres to a metre or more and may occur at all levels of the shore. As small habitat features which are present in their tens or hundreds within small areas of seashore, a majority of the rock pools encountered during surveying were not recorded or mapped. However, a sample of rock pools were examined during each survey session and their species and key features noted.

The main factors governing the constituent biological communities of rock pools are their height on the seashore and their dimensions. On the very upper shore area of the tallest rocks may be small rock pools right at the top of the tidal range which may be flooded by the sea just a few times a month. If these pools are starved of incoming water for lengthy periods they may become deoxygenated and, with the addition of guano, be stagnant. Few animals can tolerate these pools and, in the absence of grazers such as limpets, *Ulva* spp. may coat the entire pool and grow to a considerable length.

At around the high-water neap tide mark the rock pools receive a change of water twice daily and have a wider range of life. However, the action of grazing animals such as limpets (*Patella vulgata*) means that few seaweeds can establish themselves although some will grow in the back of the limpets' shells, where they cannot be grazed. Generally, such pools are dominated by the coralline seaweeds *Corallina officinalis* and *Sargassum muticum* which are resistant to grazing. Clumps of *Corallina* may in turn become home to other animals such as small molluscs and brittlestars.

The bigger and deeper the rock pool, the more life it will contain. Deeper rock pools present more of a challenge to grazing animals and so may contain a good variety of seaweeds (such as *Bifurcaria, Sargassum, Ulva* and *Chondrus*) as well as mobile animals such as prawns, crabs and small fish. Some gastropods, such as *Gibbula*, will rest on the edge of the rock pool, dipping in and out to rehydrate themselves when necessary.

The middle and lower shore may contain areas of flatter bedrock with wider depressions that are floored by a thin layer of sand or gravel. Rock pools within these depressions may be wide and shallow with many small rocks or boulders in them. Many are dominated by the non-native brown seaweed *Sargassum* but around and underneath this there may be several species of other seaweeds which will be home to molluscs, sponges, crabs and a host of much smaller organisms such as hydroids, amphipods, copepods, etc. Those rock pools that contain large stones or boulders are the most diverse as these provide shelter around their edges and underneath on which light-avoiding species such as sea squirts, anemones, bryozoans, crustaceans and fish may be found.

A single rock pool like this may contain over fifty readily identifiable species and probably dozens more that can only be seen with a hand lens or microscope. The presence of loose rocks is particularly important to this biodiversity and it is imperative that if rocks are turned over, then they must be returned to their original position. It will take between five and ten years for a turned rock to regain all its wildlife and in the meantime the animals for which many people like to fish (such as ormers, crabs and lobsters) will be absent.

The lower shore may contain the largest rock pool features (called 'flooded gullies' locally) of all, which form in rocky seashore areas where some form of barrier retains behind it a considerable volume of water. These seashore features are almost unknown in the UK and seem to be a function of local seashore topography in conjunction with a large tidal range.

In Jersey some flooded gully systems occupy areas of several hectares and can be a metre or more in depth. They can look like elongate swimming pools and act like massive aquariums, containing marine life such as large fish and lobsters that would normally be more at home in the open sea. There is a fine line between a very large rock pool and a small flooded gully but in general terms a rock pool has water that is still while a flooded gully will have a visible current formed as its retained water slowly drains down shore.

A typical vegetated gully may contain a diverse array of sea life including large brown seaweeds (especially *Sargassum*, *Halidrys* and *Cystoseira*) and many species of red seaweed. The seaweeds and depth of water provide shelter for many species of fish, including sizeable ones such as bass and wrasse, as well as many types of mollusc, crustacean, echinoderm, etc. Exposed bedrock presents the opportunity for encrusting organisms, such as limpets and barnacles, while cracks, crevices and spaces beneath boulders create spaces for shy animals (such as crabs and gastropods) and more delicate encrusting animals, such as sponges and sea squirts. Finally, the gravel and sand that usually underlie these gullies may be home to a variety of burrowing annelids (including colourful tube worms), anemones and bivalves. Flooded gullies may be the most diverse intertidal habitat on the lower shore and are mainly found on the west and south coasts of Jersey and on Les Minquiers and Les Écréhous.

2.2.7- Threats to the Intertidal Area

Jersey has approximately 36 km^2 of intertidal habitats to which may be added another 40 km^2 for the offshore reefs and isolated drying rocks. Much of this is in good or very good condition with little sign of degradation by natural or man-made causes. To have intertidal areas in a good state of health is important for wildlife as they form important nursery and feeding areas for a variety of species, including commercial fish/shellfish and seabirds (Blampied et al. 2022).

A study of aerial photographs taken between 1933 and 2020 suggests that there has been little obvious change to most intertidal habitats although there are changes in sand cover and depth in some areas such as Havre-des-Pas. Much of Jerseys east and south-east coast, plus the offshore reefs, has been recognised as a wetland of international importance under the Ramsar Convention. It also has habitats (principally *Zostera* beds) that are listed as threatened habitats under the OSPAR Convention, to which Jersey is a signatory. Intertidal areas along the north, east and south-coast, and in Les Ecrehous and Minquiers, are listed as Marine

Protected Areas (MPAs) under OSPAR and are included in areas where the use of mobile fishing gear is prohibited. A study into the ratios of Carbon, Nitrogen and Phosphorus within the blades of seagrass from beds across the Channel Islands was undertaken in 2017. The results showed the health of seagrass in this region was greater health than that of seagrass beds in the UK (Marine Resources, pers. comm.).

Although Jersey's intertidal areas are in good general condition, they have been associated with events or decisions that could have had a serious impact on their quality. The worst of these was the 1978 wrecking of the oil tanker *Amoco Cadiz* on the Portsall Rocks in Finistère, spilling 200,000 tonnes of crude oil into the sea. The resultant oil slick affected large areas of the North Brittany coast but it did not reach as far as Jersey although some oil-affected birds did wash up. Other near misses include proposals to license commercial aggregate extraction from the sandbanks and a desire to use large areas of Les Minquiers for oyster aquaculture. In both these instances the historical fishing issues between Jersey and France prevented the schemes from progressing.

Low water fishing techniques, such as vraicing and ormering, occur in many areas but, if practiced sensibly, this is thought to have a relatively low impact on the intertidal environment. Some areas along the south-east coast are vraicing by low water fishermen in search of praire (*Venus verrucosa*) and sandeels. Fishing for ormers and lobsters is widely practised and there are persistent complaints about fishers not returning rocks. It can take between five and ten years for a rock to recover its full biodiversity if left the wrong way up.

Other issues affecting the intertidal area are litter (monofilament fishing lines, cans, wrappers, barbecues, bottles, etc.) although these issues tend to occur infrequently. Litter washing in from offshore locations tends to be more of a problem. There is a potential threat associated from invasive species which is covered in detail in a 2017 report (States of Jersey, 2017).

2.3 – Subtidal Ecology

This section offers an overview of those habitats and species that live below chart datum (lowest astronomical tide).

2.3.1 – Subtidal Rocky Substrates

For the purposes of this summary, a relatively simple subtidal zonation has been created for the rocky subtidal areas around Jersey. This starts at or just above chart datum with a fringe of the oarweeds *Laminaria digitata* and *Laminaria ochroleuca* which may extend for a couple of metres into the subtidal (see above for a fuller description). This *Laminaria* fringe mostly occurs in very shallow water rocky locations, including exposed or very exposed locations.

Below about two to five metres the oarweed fringe gives way to *Laminaria hyperborea* which may form dense kelp forests that extend ten to 14 metres below chart datum, depending on water clarity. Kelp forest is a high biodiversity habitat which provides growing space for other seaweeds and encrusting organisms and shelter for a wide variety of fish, crustaceans and other organisms. The plants also absorb some of the energy from waves and currents, protecting rocks from erosion and sheltering organisms that live on it. As well as being of general ecological value, kelp habitats are important nursery areas for a wide variety of fish and shellfish.

Below about 14 metres *Laminaria hyperborea* forests begin to thin out, often into kelp park which may extend to 20 metres. Rocky substrates below this will lack dense seaweed cover and will often be dominated by scour tolerant encrusting organisms such as short red seaweeds, sponges, barnacles, bryozoans, anemones and ascidians. The degree to which these cover the surface depends on the exposure of the site, the steepness of the rock surface and whether there are any cracks or voids present. Generally, the more exposed and steep the site, the fewer species will be present while an increased number of voids and cracks will increase biodiversity.

As well as encrusting organisms, rocky substrates may be home to a variety of robust molluscs (especially gastropods), decapods (especially crabs and lobster), brittlestars and bottom dwelling fish such as rays, wrasse and catsharks. The rarest species, such as the Sunset Cup-coral (*Leptopsammia pruvoti*) and Pink Sea Fan (*Eunicella verrucosa*) are all associated with deeper water (>15 metres) rocky areas.

2.3.2 – Subtidal Sedimentary Substrates

Obvious infralittoral sedimentary features within Jersey's marine environment are the large subtidal sand and sandy-gravel banks that form when tidal currents slow, depositing their sediment load across the seabed. These features are often 'banner banks' which form downstream of headlands or large obstacles such as rocks or reefs. The sand is highly mobile and may form complex patterns of ripples, megawaves and streaks. There is often little permanent life associated with these features other than fish species such as sandeels, mackerel and flatfish. Evidence from hydrophones suggests that subtidal topographic features such as sandbanks are aggregation areas for dolphins.

In very shallow areas (less than five metres below chart datum), the seabed may be a rich complex of sedimentary habitats built from coarse sand, gravel and shell fragments. Seabed areas with relatively stable sand or gravel will sometimes have a high concentration of burrowing bivalves (*Ensis, Glycymeris, Spisula* and *Venus*) and, in more sheltered areas, sandmason worms (*Lanice conchilega*). The most sheltered areas of all may have seagrass (*Zostera marina*) beds and, if small rocks or pebbles are present, areas with lengthy brown seaweeds such as Wireweed (*Sargassum muticum*) and Sea Oak (*Halidrys siliquosa*).

Channels between larger rocks may contain a mix of bedrock, loose rocks and sediment allowing scour tolerant species of seaweed, such as Sugar Kelp (*Saccharina latissima*) and Netted Wing Weed (*Dictyopteris polypodioides*) to grow with shorter red seaweeds to a complex network of weed cover over sediment. Other than *Laminaria* and a handful of other species, larger brown seaweeds are generally absent below three metres and the sediment may be barren of algae or have short red seaweeds, often growing on larger pebbles or rocks. Often these areas are a mix of sandy gravel and broken shell which will have a burrowing fauna of bivalves, echinoderms, tube anemones and crustaceans, especially crabs and hermit crabs. Many species of fish will be found in these habitats including catsharks, wrasse, weever fish and rays.

The fringes of rocky reefs may have a range of complex and diverse habitats including maerl beds which preferentially accumulate near to topographic features. Maerl beds are high biodiversity areas built from a mixture of living and dead calcareous algae species (e.g. *Lithothamnium coralloides*) which grows very slowly. Maerl beds may take hundreds or thousands of years to develop and have a complex physical and biological structure that encourages a wide range of species to live there. For these reasons maerl is listed as a key habitat in most marine classification schemes and is regarded as a threatened biotope in the OSPAR and Bern Conventions. The wholesale destruction of maerl beds off Brittany and Normandy has made the conservation of maerl areas within Jersey territorial waters regionally important and steps have been taken by the Government of Jersey to conserve maerl areas off Jersey's south-east coast.

In deeper water to the west and north of Jersey are wider areas of sand and gravel which may be mobile or semi-mobile depending on location and tidal activity. These areas may have populations of robust bivalves, echinoderms and fish which makes them popular areas for vessels trawling and dredging for scallops and rays. In deeper water seabed areas with very strong tidal activity, the seabed may be either bedrock (see above) or a mix of immobile cobble and boulders which has many of the same biological characteristics of bedrock. Rarer are banks of smooth, rounded pebbles which accumulate close to obstacles or within reef complexes and which may be barren of life, other than encrusting algae and fish. However, there is an area of subtidal sediment to the north of Jersey associated with a ridge feature that is punctuated with boulders and characterised by a slow growing soft coral, dead man's fingers (*Alcyclonium digitatum*), and various sponges (predominantly finger sponge, *Adreus fascicularis*) and bryozoans (such as horn wrack, *Flustra foliacea* and potato crisp bryozoan, *Pentapora foliacea*).

2.3.3 – Threats to Subtidal Habitats

The principal threats to subtidal habitats are chemical pollution, seabed extraction/mining, climate change, non-native species and certain fishing activities. Currently the perceived threat from chemical pollution and seabed mining are thought to be minimal. The effects of climate change, such as a rising sea level and temperature, are of concern and being quantified through projects such as the Jersey Sea level Rise Report (States of Jersey, 2017), Shoreline Management Plan (Government of Jersey, 2020) and Carbon Neutral Roadmap (Government of Jersey, 2022).

The spread of the American slipper limpet (*Crepidula fornicata*) represents a serious threat to shallow marine sedimentary areas within Jersey waters where their coverage may reach 100%. Other non-native species, such as the seaweed *Sargassum muticum* and leathery sea squirt (*Styela clava*) have impacted and changed aspects of subtidal habitats but not to the same degree as slipper limpets.

The most widespread threat to the subtidal comes from mobile fishing gear such as trawls and dredges (Thrush and Dayton, 2002), as these can cause considerable damage to the seabed by destabilising sediment, over-turning rocks, burying animals and plants and killing organisms such as seaweeds, molluscs, crustaceans, corals, sponges, etc. Seabed habitats will usually recover from the damage caused by mobile fishing gear but this may take years or, in the case delicate, complex and slow-growing biotopes such as seagrass or maerl, decades. If disruption is regular then some communities of sessile organisms (sponges, sea fans, etc.) or maerl beds may be unable to recover fully.

Static fishing gear, moorings and anchoring can also impact sedimentary and rocky habitats usually through abrasion or rope damage to epifauna such as sponges and sea fans. The scale of impact is dependent on several factors but in most instances, it will be localised and temporary allowing the seabed to recover quickly. However, the location of swing moorings in seagrass areas has led to quantifiable damage off parts of Jersey's east coast.

3.0 – Habitat Sensitivity

This section contains a summary of the sensitivity displayed by the habitat groups listed in Table 1.4.1 using environmental pressure assessment results within Marine Evidence-based Sensitivity Assessment (MarESA) biotope reviews. This assessment work was undertaken and published as part of the Marine Biology Association of the United Kingdom. The MarESA methodology uses a standardised and systematic review process to produce an evidence base which captures key evidence relating to the sensitivity of species and habitats to the threats and pressures listed in Table 3.0.1.

Threat	Pressure	Benchmark
Biological	Target Species Removal	Benthic species and habitats: removal of species targeted by fishery, shellfishery or harvesting at a commercial or recreational scale.
	Invasive Non-native Species	The introduction of one of more invasive non-native species (INNS)
	Microbial Pathogens	The introduction of relevant microbial pathogens or metazoan disease vectors to an area where they are currently not present
Chemical	De-oxygenation	Benthic species/habitat: exposure to dissolved oxygen concentration of less than or equal to 2mg/l for 1 week (a change from WFD poor status to bad status)
	Organic Enrichment	A deposit of 100gC/m^2/yr
Hydrological	Salinity Change	An increase/decrease in one MNCR salinity category above the usual range of the biotope/habitat
	Temperature Change	A 5°C increase/decrease in temp for one month period, or 2°C for one year
	Sea Level Rise	
Physical	Smothering	deposition of up to 5 cm of fine material added to the seabed in a single, discrete event
	Disturbance Surface	Damage to sub-surface seabed

	Disturbance Subsurface	Damage to seabed surface features (species and habitats)
	Light Shading	Change in incident light via anthropogenic means
	Seabed Change	Change from sedimentary or soft rock substrata to hard rock or artificial substrata or vice-versa
	Water Clarity	A change in one rank on the Water Framework Directive scale (e.g. from clear to intermediate) for one year.

Table 3.0.1 – The threats and pressures included in the spatial sensitivity assessment (See Tyler-Walters *et al.* 2023)

MarESA assessments for habitats (biotopes) follows a multistage process which begins with an evidence review (using standardised sources and keywords) from which is derived key biological and ecological characteristics that are used to categorise resistance and resilience to a list of benchmarked environmental pressures. The combination of resistance and resilience is used to provide a categorised sensitivity assessment which reflects a biotope's ability to cope with and recover from changes associated with key threats and pressures. In each case the assigned category is accompanied by a confidence assessment (High, Medium, Low) based on the quality, applicability and concordance (consistency between studies) of the evidence. The assessment categorisation for resistance, resilience and sensitivity is defined as follows:

Resistance represents the ability of a biotope to cope with disturbance or stress without materially affecting its key characteristics. The ranking is based on the estimated percentage loss/decline of the biotope extent, density or biodiversity.

Resilience represents the ability of a biotope to recover from disturbance or stress. The ranking is based on the recovery time (in years) required for a biotope to recover to its pre-impact state (Table 3.0.2).

	Resistance	**Resilience**
None	75% loss	--
Very Low	--	>25 years
Low	25 to 75% loss	10 to 25 years
Medium	<25% loss	2 to 10 years
High	Negligible loss	<2 years

Table 3.0.2 – The MarESA categories used to assess the resistance and resilience of individual biotopes. Resistance is classified according to loss of key biotope characteristics. Resilience is classified against recovery time for a biotope. (After Tyler-Walters *et al.* 2023.)

Sensitivity uses a combination of resistance and resilience assessments to determine the overall ability of a biotope to tolerate changes in environment (resistance) and the impact brought on by disturbance or stress (resilience). This produces a rank between Not Sensitive and Highly Sensitive (Table 3.0.3).

In some cases, it is not possible to produce a sensitivity classification because of a lack of evidence/assessment or because the threat/pressure is not relevant to the biotope. In such instances the biotope may be classed as: No Evidence; Not Assessed; or Not Relevant.

Resilience	Resistance			
	None	**Low**	**Medium**	**High**
Very Low	High	High	Medium	Low
Low	High	High	Medium	Low
Medium	Medium	Medium	Medium	Low
High	Medium	Low	Low	Not sensitive

Table 3.0.3 – The MarESA classification of sensitivity using a combination of categories derived from resistance and resilience. (Tyler-Walters et al. 2023)

This report utilises the MarESA written assessments and the sensitivity scores to provide an outline summary of the resistance, resilience and sensitivity of each of the habitat groups identified in the Ecosystem Services report (Marine Resources, 2023b). Most of the habitat groups contain more than one biotope which means that there may be several separate MarESA assessments available for each group. The habitat groups are based on shared characteristics (substrate, location, species, etc.) between their constituent biotopes which usually provides a similarity between the assessments for resistance, resilience and sensitivity.

When constructing summaries for each habitat group, MarESA assessments were used from those biotopes which were considered to be most characteristic of (and dominant by area) within the group; these are marked with an asterisk in the biotope tables. The 'Habitat Group Sensitivity Summaries' are built from information listed within the MarESA evidence base that can be applied across the habitat group to offer a collective assessment of its sensitivity. Descriptions of the assessed sensitivity for the Jersey habitat groups is given in Sections 3.1 to 3.14.

An overview of a habitat group's sensitivity to selected threats (those most relevant to Jersey seas and which have sufficient MarESA assessment data) is given in Tables 3.0.4 to 3.0.6. This was created by assigning each sensitivity category (Table 3.0.3) a numerical score reflective of its severity. This score ranged from one (no sensitivity) to six (high sensitivity). Categories reflecting a lack of evidence/ assessment or where the pressure is not relevant were not scored. This converts the sensitivity category for each biotope into a numerical score for the constituent biotopes within each habitat group. This score can then be averaged for the group and rounded down to provide a whole number that can then be converted back into a sensitivity description using the same scale.

Threat	Rock: barnacles	Rock: seaweeds	Rockpool: communities	Rock: kelp	Hard ground: stable	Hard ground: unstable
Target Species Removal	High	Medium	Medium	Medium	--	--
Invasive Non-native Species	High	High	High	High	--	Not sensitive
Microbial Pathogens	Low	Not sensitive	Not sensitive	Medium	--	Not sensitive
De-oxygenation	Not sensitive	Not sensitive	Medium	Medium	Not sensitive	--

Organic Enrichment	Not sensitive	Medium	Not sensitive	Medium	Not sensitive	Not sensitive
Salinity Change	--	Medium	Medium	Medium	--	Low
Temperature Change	Not sensitive	Medium	Not sensitive	High	Low	Low
Sea Level Rise	--	Medium	--	Not sensitive	--	--
Smothering	Medium	Medium	Medium	Low	Low	Not sensitive
Disturbance Surface	High	High	Medium	Medium	Low	Low
Disturbance Subsurface	--	High	Low	--	--	Low
Light Shading	--	Low	Low	Medium	Not sensitive	Not sensitive
Seabed Change	High	High	High	High	High	High
Water Clarity	Low	Medium	Low	Medium	Low	Not sensitive

Table 3.0.4 – MarESA sensitivity categorisation in relation to selected threats of rock-dominated habitat groups.

Threat	**Sediment: sparse fauna**	**Sediment: robust fauna**	**Sediment: rich fauna**	**Sediment: seaweeds**
Target Species Removal	Medium	Medium	Low	Low
Invasive Non-native Species	High	High	High	High
Microbial Pathogens	Not sensitive	Low	Low	Medium
De-oxygenation	Low	Medium	Low	Medium
Organic Enrichment	Not sensitive	Not sensitive	Not sensitive	Low
Salinity Change	Low	Medium	Medium	Medium
Temperature Change	Low	Low	Low	High
Sea Level Rise	Not sensitive	--	--	--
Smothering	Low	Low	Low	Not sensitive
Disturbance Surface	Low	Low	Medium	Medium
Disturbance Subsurface	Low	Medium	Medium	Medium
Light Shading	Low	Low	Not sensitive	--
Seabed Change	High	High	High	High
Water Clarity	Low	Low	Low	Not sensitive

Table 3.0.5 – MarESA sensitivity categorisation in relation to selected threats of sediment-dominated habitat groups.

Threat	**Sandmason worms**	**Seagrass**	**Maerl beds**	**Slipper limpets**

Target Species Removal	Medium	Medium	High	Low
Invasive Non-native Species	High	High	High	--
Microbial Pathogens	Medium	High	--	Not sensitive
De-oxygenation	Low	Not sensitive	High	Not sensitive
Organic Enrichment	Not sensitive	Medium	High	Not sensitive
Salinity Change	Medium	Medium	--	--
Temperature Change	Medium	Medium	Medium	Low
Sea Level Rise	--	Medium	--	--
Smothering	Low	Medium	High	Low
Disturbance Surface	High	High	High	Low
Disturbance Subsurface	High	High	High	Low
Light Shading	Not sensitive	High	--	Not sensitive
Seabed Change	High	High	High	High
Water Clarity	Not sensitive	High	Medium	Not sensitive

Table 3.0.6 – MarESA sensitivity categorisation in relation to selected threats of biogenic habitat groups.

3.1- HG 1.1- Rock: barnacle communities

A1.112*	*Chthamalus* spp. on exposed upper eulittoral rock
A1.1131*	*Semibalanus balanoides*, *Patella vulgata* and *Littorina* spp. on exposed to moderately exposed or vertical sheltered eulittoral rock
A1.1133	*Semibalanus balanoides* and *Littorina* spp. on exposed to moderately exposed eulittoral boulders and cobbles

* = this biotope is considered to be characteristic of this habitat group and is described below.

Biotope Descriptions

EUNIS: A1.112 (JNCC: LR.HLR.MusB.Cht)

Chthamalus spp. on steep exposed upper eulittoral rock.

Characterised by patches of *Lichina pygmaea* with barnacles (principally *Chthamalus* spp.), this habitat is normally associated with steep or well-drained areas of hard rock face on the upper shore, around the high-water mark. It marks the upper end of the barnacle range and can extend to just below high-water spring tide mark, above which a greater diversity of lichens and plants starts to dominate. This biotope often occupies small areas or thin bands on the upper shore often within LR.FLR.Lic.Ver (B3.113) with which it is associated and which is found in greater extent on similar rock surfaces. Directly above this biotope are the lichen dominated habitats such as LR.FLR.Lic.Ver and LR.FLR.Lic.YG.

EUNIS: A1.1131 (JNCC: LR.HLR.MusB.Sem.Sem)

Semibalanus balanoides on exposed to moderately exposed or vertical sheltered eulittoral rock.

This is the commonest rocky shore biotope in Jersey waters. Its principal species can tolerate very exposed conditions and moderate scouring by sand and will cover large areas of rock. This is a broad biotope that can begin a short way below the HWMN mark and stop just above HWEST, especially in exposed locations. The practical necessities of remote mapping mean that we have not sought to subdivide this biotope but towards its upper limit one may expect to find the addition of *Lichina pygmaea*, *Osilinus lineatus* and *Chthalamus* spp. On some lower shore areas *Semibalanus* will form dense mosaics where individuals may reach heights of 2 cm, collectively forming a carpet of sharp barnacles across rock surfaces. This biotope frequently grades upwards into LR.FLR.Lic.Ver and, down shore, into biotopes dominated by *Fucus* species (LR.MLR.BF.Fser, LR.LLR.F.Fves) and *Laminaria* (IR.MIR.KR.Ldig). Within the biotope may be rock pools dominated by Sargassum (LR.FLR.Rkp.FK.Sar). It may also border LR.LLR.F.Fves.

Habitat Group Sensitivity Summary

Key species within this habitat group are barnacles (particularly *Semibalanus balanoides* and *Chthalamus* spp.), which may form 100% cover in some areas, and the limpet *Patella vulgata* whose grazing ability allows other species to take advantage of the bare rock surface. The absence of either of these species, but especially limpets, is likely to change the structure of these habitats, allowing them to become overrun by seaweeds. Periodic changes in limpet density can lead to temporary or cyclic changes in the presence of seaweeds which may result in a change in habitat dominated by barnacles to a habitat dominated by seaweeds.

MarESA based assessments for this habitat group suggest that it has a high resilience with a recovery time of two to four years after events that impact areas of <25% of the total area. Recovery rates vary between species with barnacles and lichens generally recovering at a quicker rate than mollusc species. It may be several years before some species' populations, such as limpets, return to a natural size distribution after repopulating a site. This habitat is often found in exposed situations with little seaweed which provides a high resilience to INNS colonisation but also an ability to withstand temperature changes and some surface disturbance.

Key References:

Tillin, H.M., 2015. *Chthamalus* spp. on exposed eulittoral rock. In Tyler-Walters H. Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Marine Biological Association of the United Kingdom.

Tillin, HM and Hill, JM, 2016. *Semibalanus balanoides* on exposed to moderately exposed or vertical sheltered eulittoral rock. In Tyler-Walters H and Hiscock K (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Marine Biological Association of the United Kingdom.

3.2- HG 1.2- Rock: seaweed communities

A1.125*	*Mastocarpus stellatus* and *Chondrus crispus* on very exposed to moderately exposed lower eulittoral rock
A1.211	*Pelvetia canaliculata* and barnacles on moderately exposed littoral fringe rock
A1.212*	*Fucus spiralis* on full salinity exposed to moderately exposed upper eulittoral rock
A1.214*	*Fucus serratus* on moderately exposed lower eulittoral rock
A1.2142	*Fucus serratus* and under-boulder fauna on exposed to moderately exposed lower eulittoral boulders
A1.215	*Rhodothamniella floridula* on sand-scoured lower eulittoral rock
A1.3122	*Fucus spiralis* on full salinity upper eulittoral mixed substrata
A1.313*	*Fucus vesiculosus* on moderately exposed to sheltered mid eulittoral rock
A1.3132	*Fucus vesiculosus* on mid eulittoral mixed substrata
A1.314*	*Ascophyllum nodosum* on very sheltered mid eulittoral rock
A1.3142	*Ascophyllum nodosum* on full salinity mid eulittoral mixed substrata
A1.3152	*Fucus serratus* on full salinity lower eulittoral mixed substrata
A1.451	*Enteromorpha* spp. on freshwater-influenced and/or unstable upper eulittoral rock

* = this biotope is considered to be characteristic of this habitat group and is described below.

Biotope Descriptions

EUNIS: A1.125 (JNCC: LR.HLR.FR.Mas)

Mastocarpus stellatus and *Chondrus crispus* on very exposed to moderately exposed lower eulittoral rock.

This biotope occurs as a distinctive but narrow band of red seaweed species on the lowest part of the shore below the *Fucus serratus* zone (LR.MLR.BF.Fser) but above the start of the *Laminaria* zone (IR.MIR.KR.Ldig). The short vertical extent of this biotope can make it difficult to map on steep surfaces although on lower shore wave cut platforms it can become more extensive and may be densely populated with gastropod molluscs such as *Gibbula pennanti*. In many areas the lowest part of this biotope may become dominated by *Furcellaria lumbricalis* which can sometimes form a distinctive zone just above areas dominated by Laminaria. Excellent examples of this biotope may be seen at L'Etacq on Jersey. It is associated with: LR.HLR.MusB.Sem; LR.MLR.BF.Fser; IR.MIR.KR.Ldig.

EUNIS: A1.212 (JNCC: LR.MLR.BF.FspiB)

Fucus spiralis on exposed to moderately exposed upper eulittoral rock.

An upper shore biotope usually found just below LR.FLR.Lic.Ver. Associated with rocky habitats, the biotope is dominated by *Fucus spiralis* which in exposed locations may be stunted and twisted and can be confused with *Fucus vesiculosus* which grows lower on the shore. With limited periods of immersion by sea water each day, this biotope has a low diversity of animal and plant life. The small rockpools may occur with red and green seaweeds which can support greater diversity. Rock pools, primarily LR.FLR.Rkp.G and LR.FLR.Rkp.FK.Sar, may be found on flatter areas of this biotope. These often form along fissures opened in the rock by erosion. Other nearby biotopes might include: LR.FLR.Lic.Ver; LR.LLR.F.Fves; LR.HLR.MusB.Sem.Sem.

EUNIS: A1.214 (JNCC: LR.MLR.BF.Fser)

Fucus serratus on moderately exposed lower eulittoral rock.

This biotope often occupies swathes of the lower intertidal zone, especially in more sheltered areas. In terms of biomass *Fucus serratus* is a key middle and lower shore species and its presence often marks biodiverse areas. The seaweed's strong holdfast and thick moisture retaining coverage makes the rocks below habitable for a variety of marine life. Over 45 species have been recorded within this habitat with crabs and anemones being common alongside the ubiquitous barnacles and limpets. The topography of Jersey's seashore assists this habitat as the gradient is often shallower on the lower shore than it is towards the high-water mark. There are many middle and lower shore biotopes which border this biotope and two subcategories that are noted separately in this chapter: LR.MLR.BF.Fser.R and LR.MLR.BF.Fser.Bo. There are also connections to be made with the lower energy variant of this biotope LR.LLR.F.Fserr.

EUNIS: A1.313 (JNCC: LR.LLR.F.Fves)

Fucus vesiculosus on moderately exposed to sheltered mid eulittoral rock.

This fucoid dominated biotope is often the first habitat to display a wider diversity of animals when descending the shore. The demarcation between this biotope and neighbouring ones containing *Fucus spiralis* and *Fucus serratus* is usually sharp and may take place in less than a metre. The raised nature of *Fucus vesiculosus* provides cover for a range of gastropod molluscs and green seaweeds. However, in areas of high exposure and strong tidal currents (such as the offshore reefs) this biotope is less biologically diverse than more sheltered sites. This biotope is associated with LR.LLR.F.Asc; LR.MLR.BF.Fser and other biotopes containing *Fucus vesiculosus* such as LR.LLR.F.Fves.x. There may be many rockpools of varying size and depth the commonest of which are: LR.FLR.Rkp.Cor.Bif and LR.FLR.Rkp.FK.Sar.

EUNIS: A1.314 (LR.LLR.F.Asc)

Ascophyllum nodosum on very sheltered mid eulittoral rock.

This biotope is similar to *F. vesiculosus* (above) but is dominated by *A. nodosum* is a brown alga that grows densely over rock substrate and provides shelter for a range of gastropod molluscs (*Patella* spp. and *Littorina littorea*) and green seaweeds, in addition to barnacles and coralline crusts. The whelk *Nucella lapillus* can be found preying on the barnacles and limpets. In sheltered areas the epiphytic red seaweed *Vertebrata lanosa* is often found growing on the *A. nodosum* fronds. In more exposed locations there may be *Fucus vesiculosus* and Ulva intestinalis growing amongst the *A. nodosum* canopy. Similar to the *F. serratus* above, in areas of high exposure and strong tidal currents (such as the offshore reefs) this biotope is less biologically diverse than more sheltered sites.

Habitat Group Sensitivity Summary

This habitat group is intertidal and dominated by brown seaweeds such as *Fucus* spp. and *Ascophyllum nodosum* with, on the lower shore, the red seaweeds *Mastocarpus stellatus* and *Chondrus crispus*. The level of seaweed cover is often high (100% with *Ascophyllum nodosum*) with the canopy providing shelter and food for a variety of species during both high and low water. In some intertidal areas there may be a patchwork of seaweed and barnacle covered rock with key species such as *Semibalanus balanoides* and *Patella* spp. occurring across both habitats. Rock areas with high seaweed coverage can contain a range of other species which survive either in or on the seaweed or are kept damp at low water on rock surfaces and crevices beneath the canopy.

Habitats within this group are commonly exposed to the air across low water for long periods of time and so have a high level of resilience. However, any significant loss of seaweed canopy has the potential to impact this habitat group resulting in reduced diversity through desiccation, bleaching and loss of substrate.

Denuded rock areas may become colonised by grazing species, such as limpets, or opportunistic seaweed species, such as *Ulva*, preventing the regrowth of fucoid and other species. When large areas of this habitat group are adversely affected, a full recovery of species and habitat structure may take upwards of a decade to occur. For smaller areas recovery can be quicker and occur within two years.

Key References:

Tillin, H.M., 2016. *Mastocarpus stellatus* and *Chondrus crispus* on very exposed to moderately exposed lower eulittoral rock. In Tyler-Walters H. and Hiscock K. Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Marine Biological Association of the United Kingdom.

Perry, F., and d'Avack, E. 2015. *Fucus spiralis* on exposed to moderately exposed upper eulittoral rock. In Tyler-Walters H. Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Marine Biological Association of the United Kingdom.

d'Avack, E.A.S., and Garrard, S. L. 2015. *Fucus serratus* on moderately exposed lower eulittoral rock. In Tyler-Walters H. and Hiscock K. Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Marine Biological Association of the United Kingdom.

Perry, F., and d'Avack, E. 2015. *Fucus vesiculosus* on moderately exposed to sheltered mid eulittoral rock. In Tyler-Walters H. Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Marine Biological Association of the United Kingdom.

Perry, F. and Hill, J.M., 2020. *Ascophyllum nodosum* on very sheltered mid eulittoral rock. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Marine Biological Association of the United Kingdom.

3.3- HG1.3- Rockpool communities

A1.4111	Coralline crusts and *Corallina officinalis* in shallow eulittoral rockpools
A1.4121*	*Sargassum muticum* in eulittoral rockpools
A1.413*	Seaweeds in sediment-floored eulittoral rockpools
A1.4131	Sediment-floored eulittoral rockpools with few/no seaweeds added
A1.421	Green seaweeds (*Enteromorpha* spp. and *Cladophora* spp.) in shallow upper shore rockpools

* = this biotope is considered to be characteristic of this habitat group and is described below.

Biotope Descriptions

EUNIS: A1.4121 (JNCC: LR.FLR.Rkp.FK.Sar)

Sargassum muticum in eulittoral rock pools.

Sargassum rich pools are found from the upper shore down to the low water spring tide mark. In these pools *Sargassum* appears to have out-competed other seaweeds to become the dominant species. The raft of *Sargassum* often appears dense but underneath there may be a good diversity of short seaweeds and marine fauna. It is possible that the shading provided by Sargassum supports some shy species that would normally be limited to deeper pools or overhangs. There are thousands of these rock pools across Jersey's intertidal area but they are most common in open rocky shore areas with little weed cover. It may be associated with almost any rocky shore biotope but is principally found within expanses of LR.HLR.MusB.Sem.Sem.

EUNIS: A1.413 (JNCC: LR.FLR.Rkp.SwSed)

Seaweeds in sediment-floored eulittoral rockpools.

Often referred to in Jersey as 'flooded gullies', this biotope is common in the Channel Islands but rare elsewhere. Some may be hundreds of metres in length and more than a metre deep. Those gullies which develop a dense seaweed cover are home to a great variety of life including large fish and other species normally seen above the low water mark. They are important ecological features which are generally restricted to lower shore areas on the south and west of Jersey plus Les Ecréhous and Les Minquiers. They are a notably diverse and important littoral habitat which are rarely observed outside the Channel Islands. This biotope is associated with wide crevices and gullies in lower shore rocky areas where retained seawater can drain towards the sea. Gullies or large rock pools with no sign of active drainage may be classified as LR.FLR.Rkp.SwSed. The fringes of many gully systems may be the biotopes LS.LSa.MoSa.BarSa.Fser and LS.LSa.MoSa.BarSa.Fves.

Habitat Group Sensitivity Summary

Rockpools are an intertidal habitat which may range from the shallow seawater depressions typical of rocky shores to the flooded gully complexes found on Jersey's wave cut platforms which may be a kilometre or more in length and tens of metres wide. The diversity of life within rockpools varies enormously and will depend on shore height, area and depth, substrate and whether crevices and loose rocks are present.

Smaller rockpools in the middle and lower shore are often dominated by encrusting seaweeds, such as *Corallina*, and a variety of green and foliose seaweeds (such as *Cladophora* and *Codium*), anemones, limpets and various gastropod and small decapods. Larger, deeper pools may have *Sargassum*, *Laminaria* and fish species. Flooded gully complexes may have a considerable diversity of marine life ranging from schools of medium-sized fish through to seagrass, ormers and burrowing bivalves. Upper shore pools tend to be less diverse but may contain densities of *Codium*, *Bifurcaria* and *Ulva* seaweed species.

Rockpool habitats can experience a range of environmental impacts and pressures which may include extremes of temperature, storms and impact from low water fishing such as not returning stones. In general terms, rockpools are considered to be resilient habitats which can be expected to recover from a moderate scale of disruption within two years although actual recovery rates depend on the degree of disruption, seashore position and the species affected. For example, turf species such as *Corallina* may recover in as little as two years whereas it can take between five and ten years for the underneath of an unreturned stone to recover a full diversity of species.

Rockpools can be vulnerable to colonisation by non-native species, especially seaweeds, with recent examples in Jersey waters including *Sargassum*, *Grateloupia* and the bryozoan *Watersipora*. In recent years there have been reports of bleaching in some middle and upper shore rockpools during summer heatwave events. Temperature logger measurements made in several lower shore coastal rockpools on Jersey's southern coast found an annual range of 2 to 26^{o}C. This is liable to be higher in smaller, upper shore rockpools.

Key References:

Tillin, H.M. and Budd, G., 2018. Coralline crusts and Corallina officinalis in shallow eulittoral rockpools. In Tyler-Walters H. and Hiscock K. *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Plymouth: Marine Biological Association of the United Kingdom.

Perry, F., and Tyler-Walters, H., 2016. Seaweeds in sediment-floored eulittoral rockpools. In Tyler-Walters H. and Hiscock K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Marine Biological Association of the United Kingdom.

3.4- HG 1.4- Rock: Kelp

A3.12	Sediment-affected or disturbed kelp and seaweed communities
A3.125*	Mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock
A3.126	*Halidrys siliquosa* and mixed kelps on tide-swept infralittoral rock with coarse sediment
A3.211*	*Laminaria digitata* on moderately exposed sublittoral fringe rock
A3.214*	*Laminaria hyperborea* and foliose red seaweeds on moderately exposed infralittoral rock
A3.2142*	*Laminaria hyperborea* park and foliose red seaweeds on moderately exposed lower infralittoral rock
A3.222	Mixed kelp with foliose red seaweeds, sponges and ascidians on sheltered tide-swept infralittoral rock
A3.223	Mixed kelp and red seaweeds on infralittoral boulders, cobbles and gravel in tidal rapids
A3.2231	Mixed seaweeds on intertidal boulders, cobbles and gravel in gully bottlenecks

* = this biotope is considered to be characteristic of this habitat group and is described below.

Biotope Descriptions

EUNIS A3.125 (JNCC IR.HIR.KSed.XKScrR)

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

This is a shallow water (<20 metres below chart datum) biotope associated with the fringe of rocky areas, gently sloping seabed and boulder fields where thin layers of mobile sands overlie the bedrock. Movement of sand limits seaweed species tolerant of high energy conditions such as kelps (*Laminaria* spp.), sugar kelps (*Saccorhiza*) and *Desmarestia* together with tougher red species such as *Plocamium cartilagineum*. Fauna will be similar to IR.HIR.KSed being mostly encrusting ‘turf’ species such as sea squirts, anemones, tube worms, etc. Cracks and holes in rock may be home to larger animals such as lobsters, crabs, ormers and conger eels.

In Jersey waters this biotope is primarily associated with tide swept areas of reef, often downstream from obstacles such as rocks, rough ground, etc., where turbulent water causes sediment to be deposited, suspended and redeposited. Bedrock will often be just below the surface and although there can be some infauna (notably the bivalve *Glycymeris glycymeris*) most marine life is associated with areas of rocks and seaweed.

EUNIS: A3.211 (JNCC: IR.MIR.KR.Ldig)

Laminaria digitata on moderately exposed sublittoral fringe rock.

This biotope fringes much of the extreme lower shore of the reef and is exposed only on the largest of tides. The dense cover of *Laminaria* provides protection and shelter and is a diverse habitat for other seaweeds, molluscs, crustaceans and a variety of encrusting organisms. This biotope occupies a large part of the infralittoral zone and is ecologically important, providing cover and food for a large number of species including economically important ones such as large fish (bass, conger, wrasse, etc.), molluscs (ormers, oysters, scallops) and crustaceans (lobster and crabs). Its protection is important as part of the reef’s long term environmental sustainability. This *Laminaria* biotope is a relatively thin zone which grades subtidally into other rocky biotopes such as IR.MIR.KR.Lhyp. Higher up the shore this biotope will often adjoin LR.HLR.FR.Mas, LS.LSa.MoSa.BarSa.Fser or LR.HLR.MusB.Sem.Sem.

EUNIS A3.214 (JNCC IR.MIR.KR.Lhyp)

Laminaria hyperborea and foliose red seaweeds on moderately exposed infralittoral rock.

A shallow water (<20 metres below chart datum) biotope associated with moderate to steeply inclined bedrock and boulders. The biotope is defined by dense growths of the brown seaweed *Laminaria* (kelp) particularly *L. hyperborea* although the shallow subtidal (<3 metres) and in more sheltered areas may be populated with *L. digitata* and *L. ochrolucea*. Deeper than circa 12 to 15 metres this biotope will have a lower density of Laminaria and will be classified as kelp park (IR.MIR.KR.Lhyp.Pk).

Kelp forest is viewed as a key habitat because of its beneficial ecosystem services, especially in relation to biodiversity and nursery provision. The stipes of individual plants may support a variety of short red seaweeds and their holdfasts may be utilised by small crustaceans, worms and encrusting bryozoans. The rock to which kelp plants are attached is often scoured and shaded from sunlight making this species poor for other seaweeds but more favourable for encrusting organisms such as sponges, bryozoans, hydroids and ascidians. The shelter and protection provided by kelp forests (including crevices, holes and overhangs in the bedrock/boulders) means that this biotope supports a wide variety of fish, crustaceans, molluscs and other species.

In Jersey waters, kelp forests are associated with the shallow subtidal fringe and offshore rocky reefs. It may be the dominant shallow water habitat on the edge of the island's offshore reefs and immediately offshore from headlands and cliffs.

EUNIS A3.2142 (JNCC IR.MIR.KR.Lhyp.Pk)

Laminaria hyperborea park and foliose red seaweeds on moderately exposed lower infralittoral rock.

Kelp park reflects a deeper water, less densely foliated, version of kelp forest with the boundary between the two often being gradational. Local and regional studies (e.g. Kerambrun, 1984) suggest that kelp park starts to form at around 12 to 15 metres below chart datum and that it ceases at around 20 metres depth where kelp plants will occur individually, rather in aggregations.

The principal kelp species is *Laminaria hyperborea* which may be accompanied by hardier species of red and brown seaweeds. As the density of kelp plants lessens with increasing depth, so the rocky substrate can become encrusted with barnacles, anemones, hydroids, ascidians, sponges and sometimes sea fans and cup corals.

The ecosystem service and other provisioning services associated with kelp forests can be applied to kelp park with the biotope being considered a key habitat. Kelp park is integrally associated with kelp forest and will occur in the same areas, where the water depth is deep enough.

Habitat Group Sensitivity Summary

Kelp species (*Laminaria* spp.) typically range from the extreme lower shore to a depth of circa 20 metres. Dense stands are referred to as kelp forest which in shallow water (<3 metres) will typically be dominated by *Laminaria digtata* and *L. ochroleuca* and, below about 3 metres, *L. hyperborea*. In shallow waters kelp forest may reach a density of 19 plants per m^2 until, below about 15 metres, the density thins to fewer than 13 plants per m^2 to create kelp park. Below 20 metres kelp will often occur as isolated plants in conjunction with smaller resilient brown seaweeds such as *Dictyopteris* (Kerambrun, 1984).

Kelp forest and kelp park are key habitats capable of delivering across a range of ecosystem services and functions. Kelp forest is notable for its high productivity and standing stock (living biomass) of organic carbon making an important blue carbon habitat. The detritus exported from kelp forests is an important food source for a variety of organisms and in Jersey waters is suspected to be a component of the organic carbon buried in basin areas.

The forest canopy provides shelter for juvenile fish and crustaceans, including commercial species, and *Laminaria* stipes that may be colonising a diverse range of epiphytic seaweeds. The shading effect of kelp forests allow encrusting animals such as sponges, hydroids and ascidians to colonise the bedrock between holdfasts. For these, and other reasons, kelp forest is listed within the OSPAR Convention, threatened habitat subject to assessment and conservation measures.

An absence of mechanical harvesting (a prohibited activity) and mobile gear means that the primary threat to kelp forest and park habitats in Jersey waters comes from climate change and in particular rising sea temperatures. *Laminaria* species are boreal and temperature sensitive with warmer water decreasing growth rates, overall length and increasing mortality and loss through tissue weakening. Given the key role that kelp habitats play in the maintenance of regional biodiversity, the carbon cycle and provisioning for commercial fisheries, any loss of biomass or structural density is of concern. The upper sea temperature tolerance for *Laminaria* species is thought to be circa 21°C.

Kelp habitats may be impacted from the use of static gear, such as pots and nets, as a combination of tidal range and strong currents can cause abrasion or loss of plants due to the action of ropes. However, the area of kelp forest in relation to the level and location of potting/netting activity suggests that while there will be some impact, it is unlikely to present a structural risk to the overall functioning of kelp forest. Much of the activity is adjacent to the kelp areas, rather than on it, and gear will be moved periodically, allowing denuded or damaged areas an opportunity to recover.

Areas of kelp that have been subject to widespread disturbance (e.g. through harvesting) may recover plant growth in two to six years although full habitat recovery, including development of an epiphytic understory, may take up to ten years. A general absence of sea urchins in Jersey's waters may lead to faster recovery times than has been reported in other parts of Europe. Aggregations of urchins can have a powerful grazing effect on subtidal rock. Another issue possibly absent from Jersey waters is competition from the INNS seaweed species *Undaria pinnatifida* which in other areas has been in competition with *Laminaria* species. Although *Undaria pinnatifida* is present in Jersey's marine environment, it appears to be limited to lower shore habitats.

Key References:

Jasper, C. and Hill, J.M. 2018. *Laminaria digitata* on moderately exposed sublittoral fringe rock. In Tyler-Walters H. and Hiscock K. Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Marine Biological Association of the United Kingdom.

Stamp, T.E. 2015. *Laminaria hyperborea* and foliose red seaweeds on moderately exposed infralittoral rock. In Tyler-Walters H. Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United KingdomKerambrun, L, 1984. *Contribution a l'étude de la fertilitl'é des fonds rocheux côtiers de Bretagne*. Unpublished PhD Thesis, University of Western Brittany.

3.5- HG 2.1- Sediment: sparse fauna

A2.111	Barren littoral shingle
A2.211	Talitrids on the upper shore and strandline
A2.22	Barren or amphipod-dominated mobile sand shores
A2.221*	Barren littoral coarse sand
A2.2221	Oligochaetes in full salinity littoral mobile sand
A2.223	Amphipods and *Scolelepis* spp. in littoral medium-fine sand
A2.224	Barren littoral coarse mobile sand and isolated rocks/boulders with Fucus vesiculosus added
A2.225	Standing water/pools on barren littoral coarse mobile sand added
A2.226	Barren littoral coarse mobile sand and isolated rocks/boulders with Fucus serratus added
A2.231*	Polychaetes in littoral fine sand
A5.231	Infralittoral mobile clean sand with sparse fauna

* = this biotope is considered to be characteristic of this habitat group and is described below.

Biotope Descriptions

EUNIS: A2.221 (JNCC: LS.LSa.MoSa.BarSa)

Barren littoral coarse sand.

Intertidal mobile sandbanks are unstable, subject to strong tidal currents, have low nutrient value and retain little moisture. For this reason, they are generally inhospitable to marine life other than a few species that can cope with life in loose sand. Of particular note are sand eel species (*Hyperoplus* spp. and *Ammodytes* spp.) and Mint Sauce Worms (*Symsagittifera roscoffensis*). The latter like coarse sand and often form colonies in the wetter grooves of otherwise barren areas in the middle and lower shore. Although well-known from Jersey, the discovery of dense colonies of Mint Sauce Worms on Les Minquiers was unexpected. Mobile sand can be associated with several rocky shore biotopes which may form adjacently, but especially LR.LLR.F.Fves, LR.MLR.BF.Fser and LR.HLR.MusB.Sem.Sem. Within the sands, two provisional habitats have been described: LS.LSa.MoSa.BarSa.Fves and LS.LSa. MoSa.BarSa.Fser.

EUNIS A5.231 (JNCC SS.SSa.IFiSa.IMoSa)

Infralittoral mobile clean sand with sparse fauna.

This is a high energy biotope formed from well-sorted unconsolidated coarse to medium sand which will become mobile during periods of strong tidal currents and storms. The sand will usually exhibit large bedform structures such as megaripples, sand waves (often large), scour and streaks. In areas of very strong tidal flow, elongate 'banner banks' (sometimes composed of gravelly sand) may form downtide from large seabed obstacles such as reefs or headlands (e.g. L'Écrevière Bank and Le Banc du Château). The mobile nature of this habitat means that it is generally species poor with few attached or encrusting organisms and a limited burrowing fauna. Scavenging fish species and some polychaete and crustacean species can tolerate the shifting sands.

Within Jersey's territorial waters areas of mobile sand/gravel occur as shallow water (<20 metres below chart datum) banner banks or more extensive sand patches that form in tide-swept areas on the open seabed (>15 metres below chart datum) or within reefs (<15 metres below chart datum). With the latter some intermixing or gradation with the biotope IR.HIR.KSed.XKScrR is possible.

Habitat Group Sensitivity Summary

This habitat group comprises of a series of sediments (intertidal and subtidal) which are characterised by coarse, usually clean, unconsolidated sands and gravels which may be subject to reworking or redistribution due to tidal currents and storm events. Often the sand will be shaped into topographic features, such as banks and dunes, that can reach a considerable size and depth. Examples include the Banc du Chateau (east coast), L'Ecreviere Bank (Ecrehous) and the Great and Little Banks off Corbiere. The sand itself may be species poor with little in the way of seaweed or permanently burrowing animals. However, areas of mobile sand can attract mobile species that can take use of the strong tidal currents and loose sand for feeding or cover. As such this habitat group may be home to crab species, small crustaceans (amphipods, mysids) and some rapidly burying bivalves such as razorfish. The greatest diversity of life is probably from fish species which are attracted to features such as sandbanks because of feeding opportunities, both on detritus and each other. Common species include sandeels, weever fish, various flatfish species, catsharks and tope and, higher in the water column, mackerel, garfish and top predators such as dolphins and pelagic sharks.

Habitats within this group are subject to considerable disturbance through the action of tidal currents, waves and periodic storm activity. Similarly, associated species must also be robust and able to cope with sudden changes in sediment type, depth and location; many species may migrate in and out of this habitat group from other areas. These properties mean that this habitat group has a high resilience and can recover quickly from disturbance whether caused by natural or anthropogenic means. Indeed, in some high energy areas it may be that the habitat is subject to constant disturbance to a point where it can never reach a condition of stability.

Potentially destructive activity such as cable burial and mobile fishing gear may have little impact on this habitat group although, if levels of fishing activity is not managed sufficiently, it may impact the population of species that are taken as catch or bycatch. Wholesale removal of the habitat through mineral extraction or mining has the potential to heavily impact this habitat group and others as the natural rebuilding of dredged sandbanks, etc., may remove sediment from other habitats such as beaches. Given the association between this habitat group and certain key species, such as sandeels, wholesale removal may impact other predatory species, such as seabirds and dolphins, and commercial fisheries.

Key References:

Tillin, H.M., Tyler-Walters, H. and Garrard, S. L. 2019. Infralittoral mobile clean sand with sparse fauna. In Tyler-Walters H. Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Marine Biological Association of the United Kingdom.HG 2.2 - Sediment: robust fauna

3.6- HG 2.2- Sediment: robust fauna

A5.133*	*Moerella* spp. with venerid bivalves in infralittoral gravelly sand
A5.135*	*Glycera lapidum* in impoverished infralittoral mobile gravel and sand
A5.142*	Circalittoral coarse sediment
A5.145*	*Branchiostoma lanceolatum* in circalittoral coarse sand with shell gravel

* = this biotope is considered to be characteristic of this habitat group and is described below.

Biotope Descriptions

EUNIS A5.133 (JNCC SS.SCS.ICS.MoeVen)

Moerella spp. with venerid bivalves in infralittoral gravelly sand.

This biotope is predominantly a mixed coarse substrate of sand, gravel, shell and, in places, fine sand, silt and maerl. It is typical of strong tidal regimes in shallow water areas (<15 metres below chart datum) but is relatively stable. This may be a diverse habitat with a dense burrowing fauna of bivalve molluscs, burrowing crustaceans, anemones, worms, echinoderms, etc. The epifauna may also be diverse with gastropod and bivalve molluscs, crabs, rays, demersal and semi-demersal fish species.

In Jersey waters the largest extents of this biotope form in offshore parts of sedimentary basins such as along the eastern sea border with France where the sediment can accumulate to a depth of several metres. Smaller patches form within the offshore reef complexes such as off the south-east coast and Les Minquiers, often down tide from seabed obstacles such as rock ridges and sandbanks.

EUNIS A5.135 (JNCC SS.SCS.ICS.Glap)

Glycera lapidum in impoverished infralittoral mobile gravel and sand.

The identification and extent of this biotope in Jersey waters is based mostly on survey work undertaken during the 1970s. This biotope has many of the same characteristics as SS.SCS.CCS.Blan (see below) and forms in strong tidal current regimes in the shadow of seabed obstacles such as sandbanks and reefs. Its sediment is less stable and more subject to scour than that of SS.SCS.CCS.Blan leading to a more restricted fauna. There is a possible correlation between this biotope and the offshore oyster beds that once existed regionally but which were fished to extinction during the Victorian era (Société Jersiaise, pers. comm.).

In Jersey waters this biotope is closely associated with the fringes of offshore sandbanks and the margins of topographic features especially to the north and west of Jersey and north-west of Les Minquiers.

EUNIS A5.142 (JNCC SS.SCS.CCS.MedLumVen)

Mediomastus fragilis, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel.

This represents a sedimentary biotope found offshore (generally >15 metres below chart datum) which is dominated by coarse sand and gravel but with a variable contribution of shell material and finer sediment. This coarse mixed sediment substrate forms in areas that are subject to strong tidal currents, the combination of which can produce a diverse burrowing fauna of polychaetes, anemones, echinoderms and robust molluscs (especially bivalves) plus an epifauna of gastropod molluscs, crabs and fish.

In Jersey waters this biotope is associated with basin fringes where it is clustered around the 002 ° W line to the north of Les Écréhous, south of Jersey and east of Les Minquiers. As such it is indicative of deeper water exposed basin fringes where sediment starts to accumulate and stabilise. This biotope is often found between the similar but more stable SS.SCS.ICS.MoeVen (down tide) and the less stable IR.HIR.Ksed (up tide).

EUNIS A5.145 (JNCC SS.SCS.CCS.Blan)

Branchiostoma lanceolatum in circalittoral coarse sand with shell gravel.

This is an offshore biotope found deeper than approximately 20 metres in areas influenced by strong tidal currents. The substrate is dominated by mobile coarse sand and gravel which can have a moderately diverse burrowing fauna of molluscs (bivalves), polychaetes and echinoderms. The instability of the sediment tends to limit sessile epifauna but it can support benthic and semi-demersal fish species including commercial species such as rays and flatfish. There may be areas of more mobile sand that display high tidal energy bedforms such as sand waves, scour and streaks.

Within Jersey waters this biotope is indicative of offshore sand and gravel banks that will form in association with significant topographic features such as islands, offshore reefs and shoals. It will often grade into SS.SCS.ICS.Glap in the direction of the dominant tidal current. The offshore position of this biotope means that it has not been widely studied and much of what is known about this biotope comes from local studies from the 1970s and 1980s.

Habitat Group Sensitivity Summary

This habitat group includes extreme lower shore biotopes although in general it is subtidal. It is characteristic of high energy sedimentary areas and is represented by a varying mixture of coarse sand, gravel and shell debris which may be poorly sorted. Although for the most part stable, events such as storms may lead to sediment movement or scouring. The location of this habitat group can mean that it grades into sandmason worm, maerl, seagrass or slipper limpet beds. It may also border sandbanks or other high energy mobile sedimentary features.

Characteristic species are robust bivalve molluscs (*Tellina, Dosinia, Goodallia, Spisula, Ensis*) and worms (*Nephtys, Glycera* and *Owenia*) which may be accompanied by a range of other burrowing or tube dwelling animals such as crabs, shrimps and brittlestars. Seaweeds such as *Sargassum* or *Polysiphonia* may be present in shallow water areas where stones can act as holdfasts although it is not uncommon for seaweeds bearing stone to be dragged along the seabed by tidal currents. Some biotopes within this habitat group may hold a considerable diversity and density of species. Some hard clam species, such as those within the venerid family, may live for more than 20+ years which may affect a habitat's rate of restoration.

As stable sedimentary habitats, this group may be impacted by physical disturbance resulting from storm events, strong currents or anthropogenic activities such as anchoring, cable burial, dredging and trawling. Recovery may be influenced by local factors such as wave action, currents and sediment availability (Desprez, 2000). Studies looking at the effects of mobile fishing gear and mineral extraction suggests that recovery from disturbance may take between two to six years although in some cases of mineral extraction recovery took longer than this (Gilkinson et al. 2005; Boyd et al. 2005; Mouleaert and Hostens, 2007). Opportunistic species, such as small crustaceans, worms and some bivalves, will recover first and may dominate the habitat two years after disturbance. Slower growing species, such as venerid bivalves, may take considerably longer (10 years+) to reach pre-disturbance densities and other parameters such as species' abundance and richness may also remain altered for several years.

Key References:

Tillin, H.M. 2022. *Moerella* spp. with venerid bivalves in infralittoral gravelly sand. In Tyler-Walters H. Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Marine Biological Association of the United Kingdom.

Tillin, H.M. 2022. *Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel. In Tyler-Walters H. Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Marine Biological Association of the United Kingdom.

Tillin, H.M. 2016. *Branchiostoma lanceolatum* in circalittoral coarse sand with shell gravel. In Tyler-Walters H. Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom

3.7- HG 2.3- Sediment: rich fauna

A5.234	Semi-permanent tube-building amphipods and polychaetes in sublittoral sand
A5.23*	Infralittoral fine sand
A5.24*	Infralittoral muddy sand
A5.33	Infralittoral sandy mud
A5.433	*Venerupis senegalensis*, *Amphipholis squamata* and *Apseudes latreilli* in infralittoral mixed sediment
A5.451*	Polychaete-rich deep Venus community in offshore mixed sediments

* = this biotope is considered to be characteristic of this habitat group and is described below.

Biotope Descriptions

EUNIS A5.23 (JNCC SS.SSa.IFiSa)

Infralittoral fine sand.

A medium to low energy biotope characterised by medium and fine sand that has been moderately or well-sorted. It is primarily associated with more sheltered bays and near-shore shallow coastal areas where a combination of depth and coastline topography serve to lower the tidal current velocity. As such it is usually a fringe habitat, primarily associated with basin margins and wide bays. The substrate is generally stable with bedform features that may include sand ripples and small waves. The action of storms can create larger, usually temporary, features such as scour marks and larger sand waves.

The sedimentary stability of this biotope encourages a diverse burrowing fauna of annelids, burrowing crustaceans, molluscs, echinoderms, etc. In sheltered bays anoxia may be just a few centimetres below the surface, restricting the depth that some organisms can live. More exposed areas (such as St Ouen's Bay) may have no anoxic layer but a lower diversity of species due to increased sediment mobility.

Epifauna and bentho-pelagic species may include a variety of fish, gastropods, large to small crustaceans, burrowing anemones, etc. Algae is not common where suitable attachment points (generally loose rocks or bedrock) occur. Sheltered intertidal lower shore areas may have dwarf eelgrass (*Zostera noltei*).

Within Jersey waters this biotope is primarily associated with the island's coast where it dominates wide, horseshoe-shaped bays along the south and east coasts. The west and north-west of the island also has this biotope although it is more affected by waves and storms. Inshore this will grade into intertidal sand flats while offshore it may grade into a variety of higher energy coarse grained sedimentary habitats but especially SS.SCS.ICS.Slan (sandmason worms). On the east and south coasts it may grade into SS.SMp.SSgr.Zmar (seagrass beds).

EUNIS A5.24 (JNCC SS.SSa.IMuSa)

Infralittoral muddy sand.

This is a biotope that is dominated by well-sorted fine sand which has a small silt component. It is stable, often water saturated with minor bedforms such as small ripples. Within the Normano-Breton Gulf this is primarily an intertidal habitat associated with large bays and estuaries in more sheltered positions. The biota associated with this habitat is similar to SS.SSa.IFiSa and, as such, this also represents an important feeding habitat for fish and seabirds, and a nursery habitat for a variety of species.

Around the Channel Islands muddy sand environments are mostly intertidal and do not extend far into subtidal areas. There may be areas of the French coast, such as the Bay of St Malo, where it is subtidal and performs an important ecosystem service. Around Jersey it is primarily restricted to the coves and bays of the east and south coasts (especially St Aubin's Bay).

EUNIS A5.451 (JNCC SS.SMx.OMx.PoVen)

Polychaete-rich deep Venus community in offshore mixed sediments.

This biotope is similar to SS.SCS.ICS.MoeVen and consists of mixed coarse sand, gravel and shell material but with a small content of finer sediment and maerl. The burrowing fauna is dominated by large quantities of the dog cockle (*Glycymeris glycymeris*), burrowing/tube forming polychaetes, crustaceans, sipuncilids and smaller bivalves. The epifauna may also be diverse and include gastropod molluscs, crustaceans and demersal and semi-demersal fish. Short reds seaweeds may occur in more stable areas where there are suitable attachment points.

Within Jersey waters this biotope occurs in the central part of Les Écréhous basin where it forms a well-defined band between less stable seabed and more scoured areas and more stable, often higher biodiversity biotopes such as SS.SCS.ICS.MoeVen and SS.SMp.Mrl. This is a commercially important biotope that contains significant quantities of scallops, whelks and bivalves.

Habitat Group Sensitivity Summary

This habitat group is characterised by moderately to poorly sorted coarse sediment such as gravelly sand often with a clay/silt component (circa 5%) and varying quantities of shell debris. The habitat is seaweed poor but has a notably diverse burrowing fauna which may include dense populations of hard clam species such as *Venerupis* spp., *Venus verrucosa*, *Glycymeris glycymeris*, *Lutraria* spp., etc., associated with which are burrowing crustaceans, echinoderms, worms, sipuncilids and other macrofauna. Additionally, there is a diverse microfauna of small crustaceans (such as tanaids, ostracods and amphipods), gastropod molluscs, foraminiferids, etc.

The stable and diverse nature of this sedimentary habitat group affords it an importance across a range of ecosystem services and functions including its potential for organic carbon burial (sequestration), biodiversity and as a nursery area for commercial and other species. Principal threats come from surface and subsurface disruption by mobile fishing gear and from usually short-term events such as anchoring or cable burial.

Recovery periods of between three and five years have been cited in connection with this habitat group (Tillin, H.M. and Rayment, W., 2001). Population recovery is quickest for polychaetes and other soft-bodied animals which attain maturity and density in two to three years; the growth and recovery rate of bivalves varies but structural species such as *Venerupis* may take up to five years (Olafsson et al. 1994).

Key References:

Tillin, H.M. 2022. Polychaete-rich deep Venus community in offshore gravelly muddy sand. In Tyler-Walters H. Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Marine Biological Association of the United Kingdom.

3.8- HG 2.4 - Sediment: Seaweed

A3.315*	*Sargassum muticum* on shallow slightly tide-swept infralittoral mixed substrata
A5.52*	Kelp and seaweed communities on sublittoral sediment

* = this biotope is considered to be characteristic of this habitat group and is described below.

Biotope Descriptions

EUNIS: A3.315 (JNCC: IR.LIR.K.Sar)

Sargassum muticum on shallow slightly tide-swept infralittoral mixed substrata.

Sargassum muticum is the most noticeable invasive non-native species to have colonised Jersey's marine environment in recent decades. This biotope is dominated by it and is generally found on the fringe of rocks and reefs between the extreme lower shore and about two metres below chart datum. It is most well developed in areas of mixed sediment and large rocks in tide-swept locations. On initial inspection, *Sargassum* may appear to form a dense monoculture, but a good diversity of green and red seaweed and many molluscs and crustaceans may live on or around it. It is suspected that *Sargassum* has replaced some native species of brown seaweed, such as *Cystoseira* spp. and kelp by virtue of its rapid growth.

Principal Species: *Sargassum muticum, Chorda filum, Laminaria digitata, Fucus serratus, Palmaria palmata; Boergeseniella fruticulosa*

EUNIS A5.52 (JNCC SS.SMp.KSwSS)

Kelp and seaweed communities on sublittoral sediment.

This biotope occurs on offshore (>15 metres below chart datum), low gradient hard substrate (bedrock or boulders) in areas subject to strong tidal currents. The substrate is dominated by bedrock or boulders over which may lie patches of coarse sand, broken shell or gravel. This sediment is normally of shallow thickness, unstable and periodically mobile. Brown and red seaweeds may be present (often sparsely) on boulders or raised areas of bedrock. The biotope is generally of lower biodiversity but is often an important nursery area for fish such as wrasse, seabass, bream and other bentho-pelagic species.

Locally this biotope occurs on rocky seabed areas that are lower infralittoral (>15 metres below chart datum). Above this depth *Laminaria* generally forms denser stands and, on steeper rock areas, will be represented by the biotopes IR.MIR.KR.Lhyp and IR.MIR.KR.Lhyp.Pk. In shallower water there will often be more dense vegetation, the classification of which will more probably be represented by IR.HIR.KSed.XKScrR.

Within Jersey waters this biotope generally occurs in two areas. (1) The shallow water and low gradient areas associated with the fringe of offshore rocky reefs (especially subtidal plateau areas) which are subject to strong tidal and sediment movement. (2) Exposed/high energy areas on the seaward edge of basin entrances or downstream from strong topographic features such as reefs.

Habitat Group Sensitivity Summary

This subtidal habitat group encompasses a broad range of biotopes which are characterised by mixed sediments, the presence of *Laminaria* (generally *L. saccharina* and *L. hyperborea*), *Sargassum*, *Chorda filum* and other seaweeds which may be attached to infrequent stones, boulders or outcrops. This is typical of reef edge areas where tidal currents may cause coarse sands and gravels to accumulate near to the interface between the base of rock outcrops and lower gradient areas of seabed. The presence of seaweed means that this is generally a shallow subtidal habitat group which is rarely found deeper than 15 metres below chart datum.

The sedimentary component of this habitat group varies depending on the strength of tidal currents and the effect of outcrops which may produce complex mosaics of sheltered and scoured sands and gravel. In this respect, the sedimentary habitats may have similar characteristics to the sediment habitat groups described above. This makes the sensitivity difficult to predict of individual areas as more high energy habitats may be less sensitive than more sheltered ones with a rich infauna. The association with reef fringe areas, the presence of seaweed cover and the complexity of sedimentary habitats has been associated with fish species such as sandeels, bass, bream and mullet. Some of these reef fringe areas have been listed as potential aggregation areas for juvenile fish. This may explain the popularity of reef edges with recreational anglers.

Determining the sensitivity of this habitat group is complex due to the variation in sedimentary diversity. Many of the key seaweed species in this habitat group (such as *Laminaria spp.*, *Sargassum muticum*, *Chorda filum* and *Halidrys siliquosa*) can regenerate and recover quickly after disturbance. Some, such as *Sargassum*, are seasonal and will die back in the autumn/winter followed by a rapid early spring regrowth to lengths of several metres or more. In this respect (and providing there are still suitable attachment points such as rocks) recovery of the seaweed canopy following disturbance may be rapid, taking less than a year. This means that the cover offered by dense strands of seaweeds will be maintained within a year of disturbance. However, recovery rates for burrowing fauna following severe disturbance may be longer and, as per other sedimentary habitats, take between two and five years.

Key References:

Perry, F., Tillin, H.M. and Garrard, S. L. 2015. *Sargassum muticum* on shallow slightly tide-swept infralittoral mixed substrata. In Tyler-Walters H. Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Marine Biological Association of the United Kingdom.

Stamp, T.E., Hiscock, K. and Williams, E. and Mardle, M.J., 2022. *Saccharina latissima* and *Chorda filum* on sheltered upper infralittoral muddy sediment. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Marine Biological Association of the United Kingdom.

3.9- HG 3.1- Hard ground- stable

A3.713	Crustose sponges and colonial ascidians with *Dendrodoa grossularia* or barnacles on wave-surged infralittoral rock
A4.13*	Mixed faunal turf communities on circalittoral rock

* = this biotope is considered to be characteristic of this habitat group and is described below.

Biotope Descriptions

EUNIS A3.713 (JNCC IR.FIR.SG.CrSp)

Crustose sponges on extremely wave-surged infralittoral cave or gully walls

This habitat occurs on walls, or massive boulders, in caves or gullies that are subject to severe wave-surge. The sponge *Halichondria panicea* is a characterising species that forms extensive thin crusts on the walls and boulders, with smaller patches of other sponges, small turfs of robust hydroids, patches of barnacles, coralline crusts and tube-building spirorbid polychaetes. Starfish and brittlestars may be present, as well as crab species such as *Cancer pagurus* and *Necora puber* and anemones can be found in cracks and crevices or under boulders.

EUNIS A4.13 (JNCC CR.HCR.XFa)

Mixed faunal turf communities on circalittoral rock.

This is a deeper water (>20 metres below chart datum) biotope dominated by bedrock, boulders, cobble and other hard, immobile rock substrata. A combination of depth with moderate to strong tidal streams and periodic exposure to wave energy leads to a general absence of vegetation and sediment. There may be a restricted fauna of encrusting sponges, bryozoans, ascidians, barnacles, hydroids and other species. Other possible species could include crustaceans, echinoderms and benthic or semi-demersal fish, sometimes in quite large numbers. Dense aggregations of brittlestars may occur in some areas with some sediment cover and so could lead to a separate classification of SS.SMx.CMx.OphMx (brittlestar beds on sublittoral mixed sediment).

Within Jersey waters this biotope is associated with exposed seafloor areas that are subject to high tidal streams, especially at the entrance to the main sedimentary basins, off headlands and to the south-west of Jersey. The inaccessibility and depth of this habitat means it has not been widely studied or sampled.

Habitat Group Sensitivity Summary

Hard ground dominates large areas of circalittoral (>20 metres below chart datum) seabed to the north, south and west of Jersey. It is generally bedrock or cobble possibly with larger stones or boulders. The habitats experience low light and are often subject to high energy tidal currents which prevent sediment from settling or accumulating. For these reasons, a majority of species in association with this habitat are either robust, such as crabs, gastropod molluscs and echinoderms, or are attached to the rock surface itself including sponges, bryozoans, barnacles, hydroids, cup corals, ascidians, anemones and tube worms. Fish species tend to be transitory but include wrasse, rays, catsharks and gadiformes. Seaweed cover will be negligible which means that this habitat is dominated by secondary producers and generally considered to have a low biodiversity.

Most of the species associated with this habitat are either mobile or capable of rapidly colonising areas of bare rock. Some, such as barnacles, have a relatively short lifespan (under two years) and will grow rapidly after colonising an area. As such, this habitat group is capable of a rapid recovery, possible less than a year, following a disruptive event such as a winter storm or scouring by sediment movement. The lack of sediment and seaweed means there is a low potential for blue carbon with most hard ground areas being classified as BC4 (low organic carbon productivity and burial potential) in the 2022 report (Chambers et al. 2022).

Key threats and pressures affecting this group are generally natural in origin and include movement or scouring from storm events and scouring/abrasion from the movement of sediment. Anthropogenic activities will likely have a minimal impact including from fishing gear. Non-native species are present, especially the leathery sea squirt (*Styela clava*), but do not dominate the habitat. Given that the seabed temperature in Jersey is near identical to that at the surface, there is a potential threat from a general rise in sea temperature or, conversely, a phase of extreme cold in the winter.

Key References:

Readman, J.A.J., 2016. Crustose sponges and colonial ascidians with *Dendrodoa grossularia* or barnacles on wave-surged infralittoral rock. In Tyler-Walters H. Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Marine Biological Association of the United Kingdom.

3.10- HG 3.2- Hard ground- unstable (A5.141)

A5.141*	*Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles

* = this biotope is considered to be characteristic of this habitat group and is described below.

Biotope Descriptions

EUNIS A5.141 (JNCC SS.SCS.CCS.PomB)

Pomatoceros triqueter with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles.

This biotope forms in deeper water (>20 metres below chart datum) areas subject to strong tidal currents and wave exposure. It is subject to scouring leaving a seafloor that is dominated by cobble and pebble with a limited and often unstable coarse sediment cover of coarse sand or gravel. Being high energy, sediment poor and beyond the light depth of most seaweeds means that fauna will be either encrusting species (bryozoans, sponges, hydroids, tube worms, etc.) or mobile animals able to cling to the seabed or live in any interstitial gaps (crabs, anemones, starfish, gastropods, etc.). Larger fish species, such as rays, may be found here but in general this is a lower biodiversity habitat.

In Jersey waters this biotope covers large areas of low gradient exposed seabed areas immediately to the west and north of the island and to the west of Les Minquiers. As such it is typical of the open plain areas of seabed that fringe topographic features and have a limited and generally unstable sedimentation regime. To the west and north of this region this biotope merges into offshore sandbanks typified by SS.SCS.CCS.Blan and SS.SCS.ICS.Glap. Although it has some differences to exposed bedrock habitats such as CR.HCR.XFa, this biotope occurs in the same conditions and has many of the same processes and functions.

Habitat Group Sensitivity Summary

This habitat group is dominated by one biotope (A5.141; SS.SCS.CCS.PomB) which has many of the same species and characteristics as the Hard Ground (Stable) group. A primary difference between the two is the presence of coarse sediment, such as gravelly sand or pebbles, which may accumulate on the seabed but may be subject to movement due to the tidal cycle, storms or other events. The presence of unstable sediment means that animals that are fixed to rock surfaces, such as barnacles and sponges, may be subjected to burial or scouring. Conversely, the movement of sediment may expose bare area of rocks that can be rapidly colonised by animals. Sediment accumulating around rocks and boulders may attract tubular sea anemones including the as yet unnamed ‘Dorothy’. The resilience and sensitivity of this habitat to distribution is similar to that of Hard Ground (Stable) as are the potential threats and pressures.

Key References:

Tillin, H.M. and Tyler-Walters, H., 2023. *Spirobranchus triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Marine Biological Association of the United Kingdom.

3.11 - HG 4- Sandmason Worms

A2.245*	*Lanice conchilega* in littoral sand.
A2.421	Cirratulids and *Cerastoderma edule* in littoral mixed sediment
A5.137*	Dense *Lanice conchilega* and other polychaetes in tide-swept infralittoral sand and mixed gravelly sand

* = this biotope is considered to be characteristic of this habitat group and is described below.

Biotope Descriptions

EUNIS: A2.245 (JNCC: LS.LSa.MuSa.Lan)

Lanice conchilega in littoral sand.

Areas of stable middle to lower sediment can allow a multiplicity of burrowing organisms to take hold. The tube of the Sandmason worm (*Lanice conchilega*) protrudes above the sand and is a visible indicator of sediment stability. Areas with Sandmason worms may be highly diverse and are particularly important for burrowing organisms such as worms, bivalves and crustaceans. This biotope is ecologically important and on many coasts is associated with feeding seabirds and, at high tide, fish. Although Sandmason worms are individually not uncommon on Les Minquiers, dense aggregations of them are rare. Sandmason worms may be present in several biotopes but it is generally only dense beds (>30+ m^2) that get classified as LS.LSa.MuSa.Lan. There is some overlap (and often gradation down the shore) between this biotope and SS.SCS.ICS.MoeVen and LS.LMx.Mx.CirCer which can make assigning the correct biotope in the field problematic.

EUNIS: A2.421 (JNCC: LS.LMx.Mx.CirCer)

Cirratulids and *Cerastoderma edule* in littoral mixed sediment.

This biotope is associated with coarse, stable sediment with a high sand content on the middle and upper lower shore areas. It is a common beach habitat that will form in less exposed locations such as in the lee of large rocks, etc. Its key characteristic is a low density of burrowing polychaetes and molluscs, including the cockle *Cerastoderma edule*. On Jersey seashores this biotope will often have pebbles or large stones associated with it, to which opportunistic seaweeds, such as *Ulva* spp., may grow in the spring and summer. This is a productive and diverse biotope that is important for foraging seabirds and as a nursery area for early stage crustaceans. On the extreme lower shore this biotope may grade into SS.SCS.ICS.MoeVen which has a greater density of burrowing fauna. Higher up the shore it may grade into lower diversity or even barren sands or, more rarely, into LS.LSa.MuSa.Lan with which it shares some species and characteristics.

EUNIS A5.137 (JNCC SS.SCS.ICS.Slan)

Dense *Lanice conchilega* and other polychaetes in tide-swept infralittoral sand and mixed gravelly sand.

This biotope is mostly found on the sheltered fringes of basins and some shallow marine areas. It is characterised by a stable substrate of medium to coarse sand (plus low gravel/fine sand content) with a high density of the sandmason worm (*Lanice conchilega*) whose cemented tubes protrude above the sediment surface. The density of *L. conchilega* is around 50 to 100 ind./m^2 on the middle and lower shore but this may increase to more than 500 ind./m^2 offshore. Studies in Jersey and Chausey suggest that *L. conchilega* beds have burrowing species richness/abundance that is statistically similar to seagrass beds. It is probable that *L. conchilega* beds are undervalued as a key habitat and that their importance in provisioning ecosystem services to both natural and human activities has not been fully recognised (Godet et al. 2008; Société Jersiaise, pers. comm.).

In Jersey *L. conchilega* beds dominate the wide, sheltered bays and sandy areas along the south and east coasts from St Aubin's to St Catherine's Bays. These beds start on the middle and lower shore and continue into the subtidal where they may grade into other high value habitats such as maerl and seagrass. Offshore beds occur at St Brelade's Bay, in north coast bays (e.g. Bouley Bay) and the east coast where they are often associated with the edges of maerl beds (SS.Smp.Mrl).

Habitat Group Sensitivity Summary

Sandmason worm beds are a specialist habitat that straddles lower shore and shallow marine areas. The substrate is dominated by coarse substrates which may vary from well-sorted medium sand (generally intertidal) to a moderately sorted mixture of sand, gravel and shell material (generally subtidal). Within this will occur aggregations of sandmason worm (*Lanice conchilega*) tubes which may reach densities of 200+ individuals per square metre. These aggregations can stabilise sediment and encourage the presence of other polychaete species, bivalves (such as cockles and razorfish), burrowing echinoderms and other species. Intertidal sandmason worm beds are associated with high densities of wading and feeding seabirds; subtidal beds may have high concentrations of fish species including commercial species such as rays.

This combination of stability, diversity, biomass and provisioning has led to sandmason worm areas being recognised as a key habitat by the Jersey authorities. Similarly, Godot et al. (2008) found sandmason worm habitats on the archipelago of Chausey to be high functioning which hold a particular importance to feeding birds and in the provisioning of habitats utilities by invertebrates and fish including commercial species such as whelks, scallops, crabs and flatfish. Concern was expressed at damage to sandmason worms resultant from mesh-based clam farming with a recommendation that the habitat should be subject to conservation measures (Godot et al. 2008).

Additionally, sandmason worm beds have a high biomass of organic carbon with a shallow anoxic layer and may be potentially important in the burial and sequestration of blue carbon. Although an important habitat in its own right, sandmason worm areas often transition into, or form patches within, seagrass (intertidal and subtidal), maerl and high-density clam areas. Sandmason worm habitats can also be subject to inundation by the American slipper limpet (*Crepidula fornicata*) and loss of the habitat to slipper limpets presents a serious threat in some shallow marine areas (Blanchard, 2009).

Principal threats to sandmason worm beds come from physical disruption and invasive non-native species. The portion of worm tubes that protrude above the sediment surface are vulnerable to surface disturbance caused by friction from mooring ropes, etc., while the density of burrowing fauna, such as bivalves and polychaetes, presents a vulnerability to subsurface disruption caused by dredging, cabling and extraction. Disturbance through scouring or storm damage is also a possibility. Small areas subject to disturbance may recover reasonably quickly via repopulation from neighbouring areas; large scale disruption may take up to four years to recover (Callaway et al. 2010). Studies on Chausey by Godot et al. (2008) suggested that clam farming presented a threat to the viability and functionality of sandmason worm beds.

Areas of sandmason worm habitat located off Jersey's east coast have a high density of American slipper limpets which in some areas have reached 100% cover, permanently obliterating the habitat. Colonisation by slipper limpets is probably facilitated by a similar habitat preference to the sandmason worm (shallow, low gradient sandy sediment) and by an association with dredging and trawling activity, both of which are thought to play a role in the distribution and settlement of the slipper limpet within the Bay of Granville region (Blanchard, 2009). Once a benthic habitat has been smothered by slipper limpets, there is little prospect of recovery.

Key Source:

Tillin, H.M., Marshall, C.M., and Garrard, S. L. 2016. Cirratulids and *Cerastoderma edule* in littoral mixed sediment. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Marine Biological Association of the United Kingdom.

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3.12- HG 5- Seagrass

A2.6111*	*Zostera noltei* beds in littoral muddy sand
A5.5331*	*Zostera marina* beds on lower shore or infralittoral clean or muddy sand

* = this biotope is considered to be characteristic of this habitat group and is described below.

Biotope Descriptions

EUNIS A2.6111 (JNCC LS.LMp.LSgr.Znol)

Zostera noltei beds in littoral muddy sand.

Seagrass (eelgrass) meadows are internationally recognised as a key habitat which have a high ecosystem service value in terms of biodiversity, coastal health, climate change and human activities including fisheries. Beds are especially associated with wading bird species, such as brent geese, which feed on associated fauna or the grass itself. Dwarf eelgrass (*Z. noltei*) is typically present from the lower to upper middle shore on sheltered sandy areas with well-sorted fine sand as the sediment retains water and stops the roots from drying out. An anoxic layer is usually present below 5 cm sediment depth. The infaunal community is characterised by the polychaetes *Scoloplos armiger*, *Pygospio elegans* and *Arenicola marina*, oligochaetes and the bivalves *Cerastoderma edule* and *Macoma balthica*. Individual blades may support a dense concentration of diatom and ectoproct species.

EUNIS A5.5331 (JNCC SS.SMp.SSgr.Zmar)

Zostera marina beds on lower shore or infralittoral clean or muddy sand.

Seagrass (eelgrass) meadows are internationally recognised as a key habitat which have a high ecosystem service value in terms of biodiversity, coastal health, climate change and human activities including fisheries. Within Europe seagrass meadows are variable but locally they are characterised by dense occurrences of *Zostera marina* which colonises gravelly coarse sand (generally within offshore reefs) or mixed sand, gravel and silt (generally more inshore locations). Seagrass meadows will bridge the intertidal and subtidal on the extreme lower shore and offshore to a depth of about five metres. This biotope is separate to the intertidal seagrass meadows (*Zostera noltei*) that are found in St Aubin’s Bay and along Jersey’s east coast.

Local and international studies have found seagrass meadows to be species rich especially for fish and crustaceans which use this habitat as a nursery area. Current studies are looking at seagrass meadows for its carbon burial/sequestration potential and as an indicator of coastal water quality.

Within Jersey waters seagrass meadows are a fringe littoral habitat found in topographically complex areas with a high tidal flow. The largest expanse of seagrass runs south from St Catherine’s Breakwater along the east coast to Icho Tower. Outside of this seagrass tends to occur as small to large isolated patches within reef complexes or on the edge of wide bays. In the 1930s European seagrass meadows suffered a catastrophic decline (probably disease inspired) which, in Jersey, saw their overall area decrease by 90%. Starting circa 2006, local seagrass beds began to expand spreading into tide swept areas of sand and gravel so that it currently occupies around 50% of the area that it did in 1933 (Société Jersiaise, pers. comm.).

The diversity of life within Eelgrass beds is high for burrowing fauna and pelagic species such as fish and cephalopods. The burrowing fauna is similar to that found in SS.SCS.ICS.MoeVen, which may frequently fringe Eelgrass beds.

Habitat Group Sensitivity Summary

Seagrasses are classed as a key habitat by OSPAR, United Nations and the Jersey authorities and are notable for a range of ecosystem services and for their biodiversity, sensitivity to pollution/disturbance and function as a nursery area for a range of species including commercial fish, cephalopods and crustaceans. This habitat group includes two habitat types: intertidal seagrass beds (*Zostera noltei*) which is found in wide sandy bays on the island's east and south coasts; and lower shore/shallow subtidal beds (*Zostera marina*) which are found along the east and south coasts and at Les Minquiers and Les Ecréhous.

Historical aerial images suggest that between 1933 and 1944 Jersey lost up to 95% of its lower shore *Zostera marina* beds from the south-east coast. The cause was a 'wasting disease' that affected seagrass beds in many parts of Europe producing similar levels of mortality (Godot *et al.* 2008). By 1997 seagrass recovery was only at 20% of its 1933 figure but since 2003 these seagrass beds have expanded so that they are currently around 70% of the pre-War level. This expansion is unusual as in most parts of Europe seagrass beds are static or contracting. Chemical analysis of *Z. marina* from across the Channel Islands suggest that all seagrass areas sampled are healthier than any similarly sampled across the United Kingdom. The healthiest samples of all were collected in Les Ecréhous (Government of Jersey, 2017, unpublished data; Jones *et al.* 2016).

Intertidal seagrass (*Z. noltei*) can change considerably in its area and density from year to year which suggests that it is highly sensitive to environmental changes. Annual monitoring between 2013 and 2021 suggests that intertidal seagrass in Grouville Bay had expanded by approximately 34% (88.2ha to 118.6ha) and that the seagrass area in St. Catherine's and St Aubin's Bay varies considerably between years. The St Aubin's Bay seagrass occurs in two discrete beds and shows the greatest variation with aerial photography suggesting that in the 1960s there was a single seagrass bed of much greater extent than the current two single beds.

Seagrass is highly sensitive to a range of anthropogenic and environmental parameters. Principal threats come from physical disruption (such as moorings), pollution and disease. The seagrass blades that protrude above the sediment surface are vulnerable to surface disturbance caused by friction from mooring ropes, etc., while the density of roots and associated burrowing fauna, such as bivalves and polychaetes, presents a vulnerability to subsurface disruption caused by dredging, cabling and extraction. Disturbance through scouring or storm damage is also a possibility. Seagrass health is highly dependent on light availability and growth can be affected by changes in water turbidity. Excess nitrates from land runoff can affect the health of seagrass also (Burkholder et al. 1992). Small areas subject to disturbance may recover reasonably quickly via expansion from neighbouring areas, or slowly through reseeding from neighbouring areas. Disease is harder to monitor and predict, it is unclear if all the seagrass beds in Jersey are genetically diverse enough to allow for resilience in the event of a disease. Genetic sampling is necessary to understand how vulnerable the seagrass beds are to future disease.

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3.13- HG 6- Maerl

A5.51*	Maerl beds

Biotope Descriptions

EUNIS A5.51 (JNCC SS.SMp.Mrl)

Maerl beds.

Maerl beds are internationally recognised as a threatened key habitat which requires a high level of protection. This biotope can be divided into several subcategories based on the species of maerl present and sediment type. However, although some of this information is available for Jersey waters, here the biotope is being used in its broader sense of 'maerl bed' which, following the OSPAR definition, means that at least 20% of the substrate is formed from living maerl thalli. As well as living and dead maerl, this biotope is characterised by mixed coarse sediment, often with a significant amount of finer sand and silt, plus broken shell. It generally forms in shallower water (>15 metres below chart datum) sheltered areas that are subject to strong tidal currents.

Maerl beds are covered by the OSPAR Convention (plus several other agreements) and are regarded as internationally important habitats. As well as having an exceptional diversity and abundance of species, maerl beds are important for their settling, nursery and carbon capture provisioning. Studies around Jersey suggest that maerl beds are the most diverse and fragile of the island's marine habitats.

Within Jersey waters maerl beds are primarily basin fringe deposits that have developed in association with significant topographic features such as offshore reefs. In deeper water maerl beds will grade into coarse bivalve-dominated habitats (SS.SCS.ICS.MoeVen and SS.SMx.OMx.PoVen) and in shallower water will grade into more sandy habitats such as SS.SCS.ICS.Slan. On the east and south coast areas of maerl are being subsumed by the invasive species *Crepidula fornicata* (SS.SMx.IMx.CreAsAn).

Habitat Group Sensitivity Summary

Maerl is classed as a key habitat by OSPAR and the Jersey authorities and is notable for a range of ecosystem services and for their biodiversity, sensitivity to pollution/disturbance and function as a nursery area for a range of species including commercial fish, shellfish (primarily scallop) and crustaceans. Maerl is a slow-growing (< 1mm a year) coralline red algae that forms branching and nodular structures on the seafloor. There are two different species of maerl in Jersey's waters but identification is an involved and expensive process so the maerl beds in Jersey are assumed to be a mix of *Lithothamnion corallioides* and *Phytomatolithon calcareum*. The structure maerl forms on the seafloor supports greater biodiversity than surrounding less complex substrate such as sand. Mollusc biodiversity is particularly high on and within maerl beds, and the high density of king scallop (*Pecten maximus*) associated with maerl means it has been a target for scallop dredging practices.

Maerl is highly sensitive to a range of anthropogenic and environmental parameters. Principal threats come from physical disruption (such as from scallop dredging), pollution and climate change. Maerl is extremely intolerant to smothering, which can occur following dredging, as maerl requires light to survive. As a photosynthesising alga, maerl health is highly dependent on light availability and growth can be affected by changes in water turbidity. Extraction is also a threat elsewhere in the world but is not permitted in Jersey waters. The branching structure of maerl is vulnerable to surface disturbance caused by abrasion from scallop dredging (Hall-Spencer et al. 2003), anchoring damage will also have a negative impact but as maerl is typically in depths below 10 m and also does not occur in popular anchorages in bays this is less of a problem. Disturbance through scouring or storm damage is also a possibility. The biomass diversity of burrowing fauna, such as bivalves and polychaetes, presents a vulnerability to subsurface disruption caused by dredging, cable laying and extraction. Areas of maerl subject to disturbance are unlikely to recover for many years due to the slow growth rate of maerl. While dead maerl can still provide structure on the seabed for many years, supporting infaunal diversity, live maerl is more important as the living component of the maerl provides an environmental cue to many species and promotes their settlement, especially in the case of scallops (Kamenos *et al.* 2004).

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3.14 - HG 7- Slipper Limpets

A5.431*	*Crepidula fornicata* with ascidians and anemones on infralittoral coarse mixed sediment

Biotope Descriptions

EUNIS A5.431 (JNCC SS.SMx.IMx.CreAsAn)

Crepidula fornicata with ascidians and anemones on infralittoral coarse mixed sediment.

This biotope is a biogenic derivative of the invasive species *Crepidula fornicata* (American slipper limpet; now normally called the slipper limpet) which was unknown in the region prior to the 1960s. By the 1980s slipper limpets had become widespread and common across the Bay of Granville and, in the right circumstances, were forming dense aggregations covering large areas of seabed. As layers of dead slipper limpets accumulated, fine sediment and excretions from the limpets became trapped with the dead shells, creating anoxic conditions which stifled existing seabed life. The result is a low diversity habitat of low value which supports only a handful of species.

Slipper limpet beds are found in shallow (<15 metres below chart datum) basin fringe areas. On some Jersey slipper limpet beds the surface coverage of shells may be 100% to a thickness of several centimetres. In areas where coverage hasn't reached this stage there may be open patches of sediment, often of maerl or Sandmason worms (*L. conchilega*), between the accumulations of shell.

The presence and spread of slipper limpet habitats is of serious concern, not least because of the association with key habitats such as maerl. Recent research suggests that deep accumulations form in areas that have been subjected to commercial dredging over many years and, given its association with current and former scallop grounds around Jersey, this may be the case here too.

Habitat Group Sensitivity Summary

The American slipper limpet (*Crepidula fornicata*) was introduced to Europe in the nineteenth century although within the Normano-Breton Gulf the first specimens were not found until the 1960s. By the 1980s the slipper limpet was common and starting to dominate some seabed habitats (Le Hir et al. 1986). It has continued to expand to the point where some seabed areas are entirely dominated by slipper limpets, creating a seabed habitat that did not exist half a century ago (States of Jersey, 2017).

Slipper limpets are hardy animals with a wide environmental tolerance, few predators and a high reproductive and growth rate. They may be found intertidally but their preference is shallow stable marine sedimentary habitats which they can quickly overwhelm. Habitats that seem particularly vulnerable include sandmason worm and maerl beds especially in areas with a historic tradition of mobile fishing gear use (see below).

The coverage of slipper limpets on seabed areas can approach 100% producing an accumulation of empty shells many centimetres deep. The loose shells will then become cemented together via the accumulation of faecal matter and fine sediment creating an impenetrable barrier that smothers any existing burrowing fauna. Slipper limpet beds have a low biodiversity with little surface fauna other than a few species of anemone and ascidian and mobile species or crab and fish. Leloup et al. (2008) viewed slipper limpets as a trophic dead end within the food chain as nothing eats them.

Slipper limpets spread through planktonic larvae and by the action of trawling and dredging via specimens being moved to new locations and disruption of the seabed which is thought to favour the establishment of slipper limpets while other species are recovering. Blanchard (2009) estimated that the Bay of St Malo has around 150 tonnes of slipper limpets and that all attempts to eradicate or control their spread has failed. A Government of Jersey threat assessment of marine non-native species ranked slipper limpets at number three because of their potentially damaging effect on biodiversity and the economy as displaced species includes scallops, whelks, rays and flatfish. The spread of slipper limpets in subtidal areas is difficult to monitor.

As a disruptive invasive species, the threats and pressures to slipper limpet beds are of less concern than for other native habitat groups in that checks on the habitat and a reduction in area are considered desirable. The resilience and recovery rate for slipper limpets are high and, with no major predators or diseases to counter growth, the habitat is not sensitive to most threats and pressures other than those, such as reclamation, that would obliterate the seabed.

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