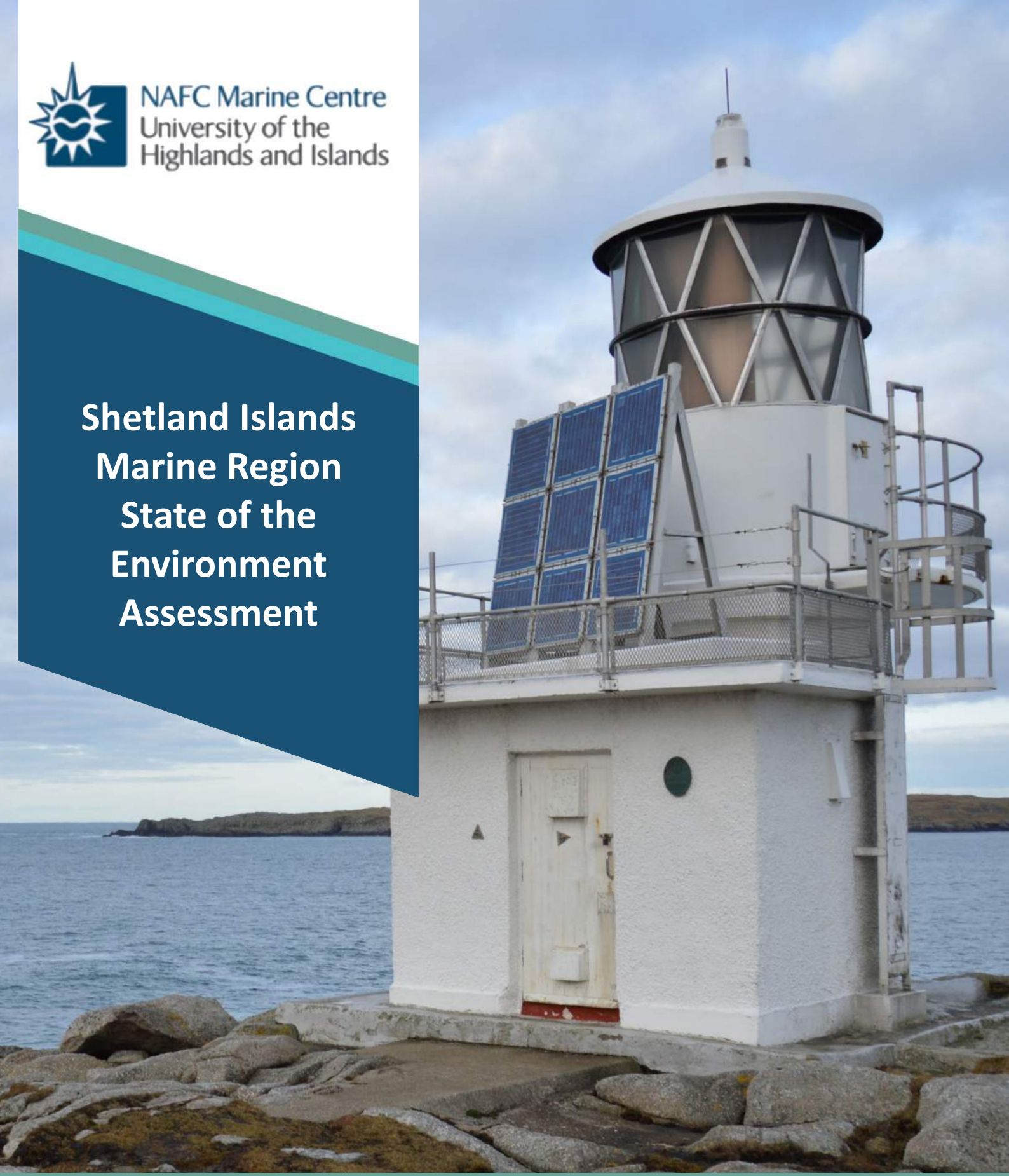
NAFC Marine Centre
University of the Highlands and Islands

Shetland Islands Marine Region State of the Environment Assessment



2017

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This assessment has been developed by NAFC Marine Centre, on behalf of the Shetland Islands Marine Planning Partnership, with guidance from the Shetland Islands Marine Planning Partnership Advisory Group (see Appendix 2 for membership). The assessment will provide a data baseline to support the development of a regional marine plan under the Marine Scotland Act (2010). Where this assessment finds differences with the national level assessment in Scotland's Marine Atlas, these have been highlighted and explained.

The contributions of Martin Cox (Marine Scotland), Dr Matthew Gubbins (Marine Scotland Science) and Dr Chris Leakey (Scottish Natural Heritage), SOTEAG, Martin Heubeck (SOTEAG) and Paul Harvey (Shetland Amenity Trust) are acknowledged for their guidance in the formation of the assessments and specific section development. Luke Batts, Charlotte Slater, Dr Richard Shelmerdine and Dr Samuel Collins (all NAFC Marine Centre UHI) are acknowledged for their contribution to early drafts and specific sections. A review of the assessment was undertaken by the Marine Alliance for Science and Technology for Scotland (MASTS) in March 2017, see Appendix 2 for review participants.

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NAFC Marine Centre
University of the Highlands and Islands

The Scottish Government

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Shetland Islands Council

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Contents

Lerwick harbour © Visit Shetland

Clean and Safe

Topic	Assessment	Trend	Confidence
Hazardous substances	Few concerns	Improving	High
Biological effects of contamination- imposex	Few concerns	Improving	High
Oil and chemical spills	Some concerns	Improving	Moderate
Microbial contamination	Some concerns	Deterioration	High
Biotoxins	Some concerns	No evidence	Moderate
Eutrophication	No concerns	Improving	High
Marine litter	Some concerns	Stable	Low
Underwater noise	Few concerns	No evidence	Low

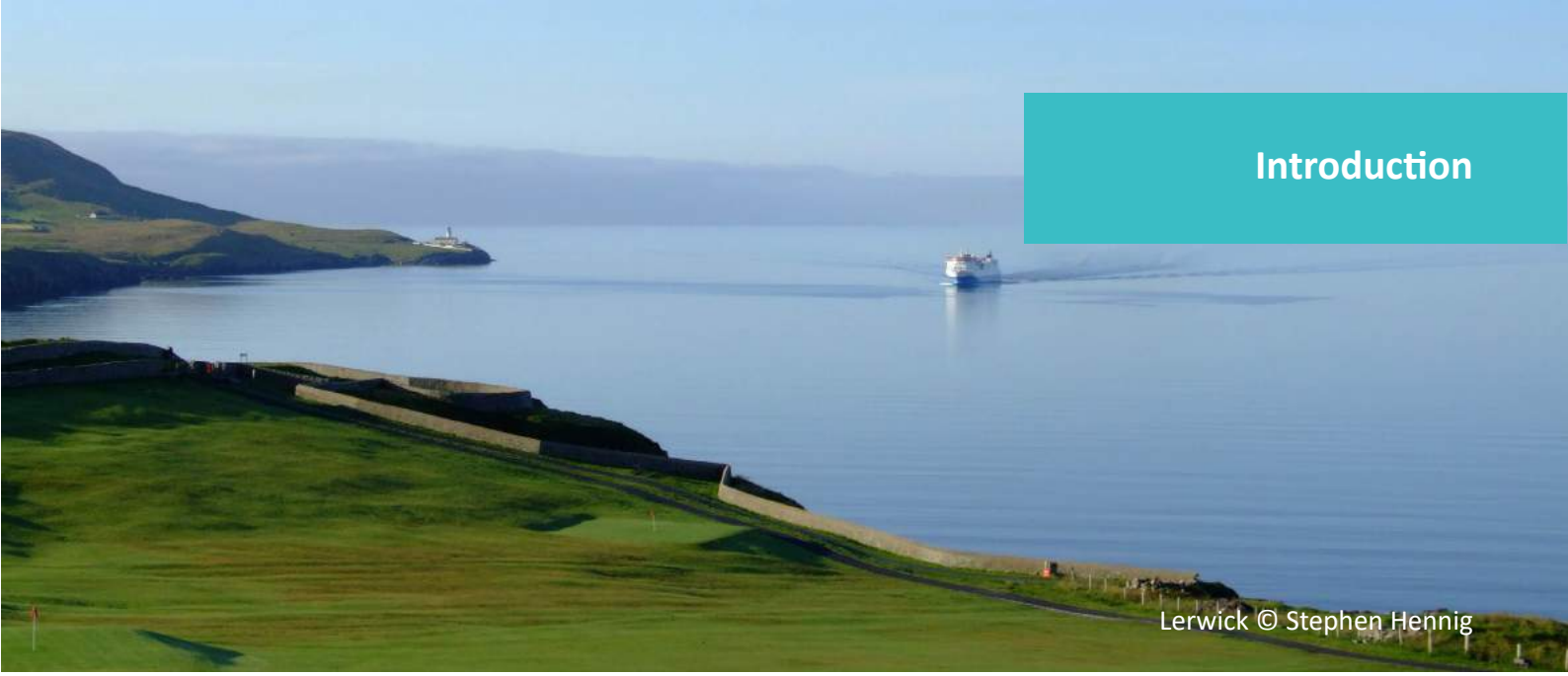
Healthy and Biologically Diverse

Species	Assessment	Trend	Confidence
Cetaceans	Some concerns	No evidence	Low
Otters	Few concerns	Stable	Moderate
Seals grey	No concerns	Stable	Moderate
Seals harbour	Some concerns	Deterioration	Moderate
Breeding birds	Many concerns	Deterioration	High
Wintering birds	Some concerns	Stable	Moderate
Sharks, rays and skate	Many concerns	No evidence	Low-moderate
Demersal fish- wild salmonids	Some concerns	No evidence	Low
Commercial fish and shellfish	Few concerns	Improving	Moderate-high
Non-native species	Some concerns	Deterioration	High

Habitat / Species	Assessment	Trend	Confidence
Intertidal sediment	Some concerns	No evidence	Low
Intertidal rock	Few concerns	Stable	Moderate
Subtidal sediments	Some concerns	No evidence	Moderate
Subtidal rock	No concerns	Stable	Low- moderate

Productive

	Economic Contribution	Employment	Production
Aquaculture- finfish	Increasing	Increasing	Stable
Aquaculture- shellfish	Increasing	Stable	Increasing
Fishing	Stable	Stable	Stable
Leisure and recreation	No evidence	No evidence	Increasing
Historic environment and cultural heritage	No evidence	No evidence	N/A
Renewable energy	No evidence	No evidence	No evidence
Oil and gas	Decreasing	Decreasing	Decreasing
Water abstraction	No evidence	No evidence	Stable
Maritime transport	Increasing	No evidence	Increasing
Waste disposal – dredge material	No evidence	No evidence	Stable
Telecommunications, electricity cables and water pipes	No evidence	No evidence	N/A
Waste water temperature and industrial outfalls	No evidence	No evidence	Increasing



This 'Shetland Islands Marine Region State of the Environment Assessment' has been developed by the NAFC Marine Centre, on behalf of the Shetland Islands Marine Planning Partnership, with guidance from the Shetland Marine Planning Partnership Advisory Group. Where there are any differences with the national level assessment in Scotland's Marine Atlas, these have been highlighted and explained.

The assessment aims to provide a baseline assessment of the Shetland marine and coastal environment out to 12 nm, using the most up-to date data available as of December 2016. Trend analysis has been undertaken to provide a baseline for future years. Changes in status are assessed against the long term trend, which for some long lived species may be several decades, for economic data shorter time series may have been considered more appropriate. It is intended that this assessment will inform policy development for the production of a marine plan for the Shetland Marine Region, to meet the criteria of the Marine (Scotland) Act 2010.

Assessment approach

For each topic an assessment has been made to rate each topic into five assessment categories:

Many concerns- the topic item shows significant signs of deterioration against baseline through both a decline in abundance/ quality against baseline or where population or condition levels are considered unacceptably low

Some concerns- the topic item shows signs of deterioration against baseline or quality is low

Few concerns- the topic item shows few signs of deterioration against baseline and is not declining in quality, quantity or abundance

No concerns- the topic item shows no signs of deterioration against baseline and is considered to have met required criteria for abundance or quality

No Evidence- there is no data available to make an accurate assessment

Data Trend

The data trend has been assessed and divided into four categories:

Improving- there is evidence that the topic item is positively increasing in abundance, condition or frequency against the long term trend

Stable- there is evidence that the topic item is not changing in abundance, condition or frequency when assessed against the long term trend

Deterioration- there is evidence that the topic item is in decline in terms of abundance, condition or frequency

No evidence- no data is available to assess the trend

Data Confidence

The data confidence has been assessed and divided into four categories:

High- long term data available, collected by experts at regular intervals

Moderate- data available does not allow a full assessment either due to infrequent data collection, or inconsistent data collection approach

Low- no or limited data assessment is possible either due to low quality data or low data collection frequency

Key Ecosystem services

Key ecosystem services are highlighted in each assessment (blue) box, with a fuller assessment included within a table in each section.

Ecosystem Services

Where knowledge permits, this assessment has adopted the 'ecosystem approach', aiming to identify where ecosystem components support ecosystem services. An ecosystem is a biological community of interacting living organisms and their physical environment. Ecosystem Services are the benefits people obtain from the ecological functions of healthy ecosystems. The UK National Ecosystem Assessment defines them as 'the benefits provided by ecosystems that contribute to making human life both possible and worth living'. This have been divided into four service types:

- Provisioning
- Supporting
- Regulating
- Cultural

The assessments are Shetland specific and include a balance of local expert opinion and an assessment of key literature[1,2].

Structure

This assessment has been divided into four sections:

- Section A- Overview
- Section B- Condition of the Region- Physical, Clean and Safe, Healthy and Biologically Diverse
- Section C- Productive
- Section D- Regional Look Forward
- Section E- Data Gaps
- Appendices

Within Section B, Clean and Safe considers the state of the marine environment primarily in terms of water quality, and identifies ecosystem services which are dependent on this quality, for example, high microbial standards are important for shellfish production, it also considers dependencies of wild species and habitats. Healthy and Biologically Diverse considers the state of biological species and habitats, and the ecosystem services they support. Section C- Productive, provides an assessment of commercial and cultural productivity within Shetland, and identifies linkages to the ecosystem components identified within Section B.

Section D, Regional Look Forward, summarises the current state of Shetland's marine and coastal environment and where possible identifies opportunities for protection, enhancement and restoration.

Section E, Data Gaps, summarises where the absence of data has prevented a full assessment.

Maps

Every effort has been made to ensure map content is up-to-date. Data sources are acknowledged on individual maps. Copyright of the NAFC Marine Centre and data owner should be upheld at all times. When viewed as a PDF all maps can be enlarged by clicking on the map. It should be noted that where data has been subject to some pre-interpreted e.g. fisheries mapping, consideration should be given to the impact of this interpretation before using the data for other purposes.

Viewing Maps

All maps are available to view on the National Marine Planning Interactive Website (NMPi)[3],
Note these maps will not be updated but represent the situation at the time of publication of this assessment.

1 Burdon D, Potts T, Barbone C, Mander L. (2017) The matrix revisited: A bird's-eye view of marine ecosystem service provision. Marine Policy, 77: 78-89.

2 Potts T, Burdon D, Jackson E, Atkins J, Saunders J, Hastings E, Langmead O. (2014) Do marine protected areas deliver ecosystem service functions that support human welfare? Marine Policy 14: 139-148.

3 **https://marinescotland.atkinsgeospatial.com/nmpi/**

A Overview

Physical Characteristics

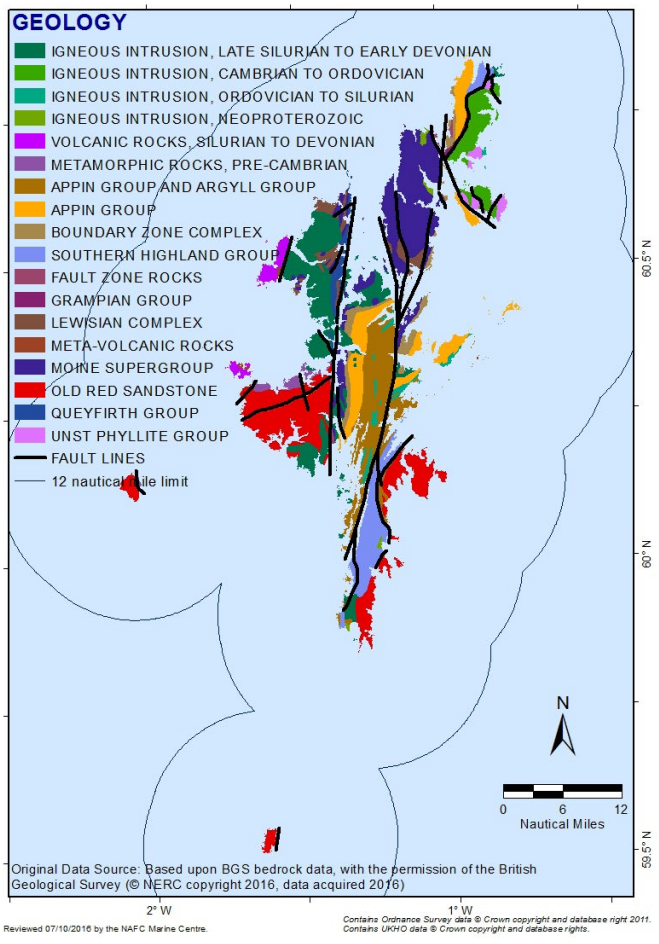
Ness of Burgi © Charlotte Slater

Overview

The Shetland Islands are the mostly northerly region within the United Kingdom, forming an archipelago comprised of over 100 islands, of which sixteen are inhabited. The islands are situated approximately 160 km from mainland Scotland, 280 km south-east of the Faroe Islands and 320 km west of Norway. The Shetland Islands form part of the division between the Atlantic Ocean to the west and the North Sea to the east. The Shetland Marine Region includes all territorial waters seaward of the mean high water of the spring tide (MHWS), out to 12 nautical miles. The area is the equivalent to 10 580 km^2 (3 899 miles^2); almost seven times the land area of the Shetland Islands (1 468 km^2 or 567 miles^2).

Geology

The geology of the islands of Shetland is complex and it has one of the greatest variety of rock types in a small area than found almost anywhere else, Map 1. This complexity has created a varied and intricate coastline which is nearly 2 200 km (1 300 miles) in length (measured at 1:30 000 scale). The oldest rocks in Shetland are almost 3 000 million years old and form the basement to a great thickness of overlying strata. The spine of mainland Shetland, together with Yell and the western side of Unst are made up of what were originally marine sediments, deposited between 1 000 and 600 million years ago. These were deformed and metamorphosed (altered) into schists and gneisses by a continental collision around 500 million years ago that created a range of high fold mountains. Erosion has since removed the peaks but the roots of these mountains are exposed in Appalachia, Nova Scotia, Greenland, Norway and Scotland, with Shetland representing Britain's most northerly remnants. The continental collision also drove a slice of the crust from beneath the ocean up onto land where it now forms the unusual "serpentine" rocks of eastern Unst and Fetlar.



Map 1: Geology of the Sheltand Islands

As the mountains eroded, vast thicknesses of sand collected in basins within the mountains, creating what we now know as the Old Red Sandstone which underlies most of west Mainland and the eastern side of the south Mainland. At around the same time,

volcanoes erupted layers of lava and ash, which can now be seen in Esha Ness and Papa Stour. Shetland's youngest rocks formed deep beneath the earth where large bodies of magma solidified as granite, diorite and gabbro. Now exposed at the surface by 300 million years of erosion they make up much of Northmavine, including Ronas Hill; the highest point in Shetland at 450 metres (1 480 ft) above sea level.

Coastal Landscape Formation

The Shetland coastline comprises an outer rocky edge, with many areas of high cliffs, particularly on the west coast and an inner coast comprising many long open inlets, or 'voes' reaching far inland. These voes mark the former courses of river valleys, some modified by glaciers, before being flooded by the sea. The steeply sloping and indented character of this drowned landscape has generally hindered the formation of large, sandy beaches around Shetland. Layers of peat, some containing tree trunks and roots, occur beneath the sand and shingle of some modern beaches. Peat layers can also be found submerged to depths of 8 to 9 metres in several of Shetland's sheltered voes, illustrating the extent of sea-level rise in the last 5 000 to 6 000 years after the end of the last glaciation.

Climate

Today Shetland has a temperate maritime climate despite Shetlands latitude of 60 degrees north (comparable with St Petersburg in Russia and the southern tip of Greenland). The effects of the northerly latitude are mitigated by the North Atlantic Drift, a powerful ocean current which warms north east Europe. Sea temperatures are relatively stable, reaching their lowest levels in March at approximately 8°C, rising to a peak in August of 13°C. Air temperatures are comparatively warm, with monthly average temperature above 3°C (compared with St Petersburg -11°C, and southern Greenland -6°C) and mean summer temperatures peaking at 12°C in August.

While land and sea temperatures are relatively stable, terrestrial and coastal habitats are influenced by the frequent windy conditions. Wind speeds are on average 9 m/s (Beaufort force 5) over the winter months and drop to less than 6 m/s (Beaufort force 3) over the summer months. Wind speeds over 18 m/s (Beaufort force 8) normally occur every month, and over the winter months wind speeds over 20 m/s (Beaufort force 9) are frequent. These storm events influence the average wave height, and Shetland experiences one of the highest wave energy environments in the world[4]. The west coast of Shetland is exposed to the full force of the Atlantic waves, with hundreds of kilometres of fetch, hurricane-force wind speeds and deep water close inshore, huge waves arrive at the cliffs unbroken. The largest recorded wave off the Shetland coast was 25 metres in height. On the west coast of Shetland the annual mean significant wave height is 4 metres, and is 3 metres on the east coast[5]. However, there is a large variation year to year, and month to month, for example, in February 1997 89% of all waves exceeded 4 metres.


Muckle Roe © Charlotte Slater

4 **http://www.landforms.eu/shetland/wave%20environment.htm**

5 Draper, L. (1991) Wave climate atlas of the British Isles. London, HMSO.

Environmental Characteristics

Sumburgh Head © Visit Shetland

The diversity of marine conditions found around the Shetland Islands provide a wealth of habitats for marine life, including species and features which are considered of international, national and local importance. These habitats, species and features support a range of ecosystem services and are also an important tourism asset.

In Shetland a number of marine habitats and species are protected through:

- 12 SPAs, of which 11 are for seabirds (in addition there are three draft SPAs for seabirds)
- 12 SACs, of which seven have a marine element
- 1 candidate SAC (Pobie Bank Reef)
- 1 Ramsar site
- 31 SSSIs notified for marine biological features
- 2 Nature Conservation Marine Protected Areas (NC MPA)
- Fair Isle Demonstration and Research Marine Protected Area
- 2 National Nature Reserves
- 6 RSPB bird reserves
- 49 local nature conservation sites
- Fair Isle holds the Council of Europe Diploma for protected areas
- 47 protected seal haulouts

In addition Shetland's geological importance has been recognised through:

- 36 SSSIs coastal sites notified for geological or geomorphological features
- Shetland Geopark

Within the Shetland marine region 50 priority marine features (species or habitats) are known to occur. While some of these are the protected features of designated sites, they are also found in other areas across Shetland. Protected areas and priority marine features (PMFs) are described in more detail in Section B- Healthy and Biologically Diverse.

There are also a number of areas protected for their landscape and scenic qualities:

- Shetland National scenic area- comprised of 7 parts
- 17 Local Landscape areas, proposed by the Shetland Islands Council (not yet designated)

Areas protected for historic or archaeological interest are detailed within Section C 'Historic environment and cultural heritage'.

Scalloway harbour © Visit Shetland

Human Habitation

Human habitation has influenced the Shetland terrestrial and coastal environment. The first evidence of human activity in the Shetland archipelago dates from around 4300 BC during the neolithic period, with evidence of a midden site at West Voe on the south coast of the Shetland mainland. As Shetland is virtually treeless, prehistoric buildings were constructed using stone. This has led to a high level of physical remains from the prehistoric era, with over 5000 recorded archaeological sites, with notable sites including Jarlshof and Mousa Broch- the latter considered one of the best preserved Iron Age Brochs or towers in Scotland, built between 400-200 BC. There is also the potential for submerged archaeology, particularly within voes and sounds, due to sea level rise around Shetland.

From 800 AD Scandinavians expanded westward, colonising Shetland, the fate of the indigenous population at this time is uncertain. This Viking period lasted from 800-1100 AD, with Shetland remaining part of the Danish and Norwegian empire until 1469, when Shetland and Orkney were pawned to Scotland. Shetland places names and culture are still heavily influenced by this Viking period and the language Norn, persisted in Shetland even after it became part of Scotland, until finally dying out in the 19th Century.

During the 15th Century, international trade became increasingly important to Shetland, with goods sold through the Hanseatic League of German merchantman. Trade focused on the sale of salted fish, butter and wool. This trade lasted until the 1707 Act of Union prohibited trade with the German merchants. This created economic depression within Shetland, with merchant lairds taking over the trading of salt fish. The economic depression and then clearances by the lairds led to a depopulation of some of Shetland's smaller islands and communities.

Continued economic depression led to a depopulation of Shetland, and in the 1960s the population dropped to only 17 000 people, from a population of over 21 000 in the 1930s. In more recent times, during the 1970s, Shetland's economic prosperity increased, first with increased profitability of the traditional industries such as fishing and knitwear, then with the discovery of oil in the east Shetland basin, resulting in the building of the Sullom Voe Terminal. During the construction phase of the terminal up to 7000 workers were accommodated in Shetland. The Sullom Voe Terminal development led to increased employment opportunity and pay. Shetland also benefited through a charge on every barrel of oil brought through the terminal. This income has been used to improve local infrastructure and to invest in new industries.

During the 1980s the development of aquaculture created a new industry in Shetland, and is now one of Shetland's largest employers, dominated by the farming of blue mussels and Atlantic salmon, and takes place across the voes and sounds throughout Shetland. Pelagic, demersal and shellfish fishing have remained important industries, creating both direct and indirect employment across Shetland. Boats have remained in local ownership, which has benefited the local community by helping to retain profits in Shetland. The Shetland demersal fleet has also benefited from the creation of a local auction, which partly through a reputation of high quality,

has helped to raise the price obtained for whitefish caught around Shetland.

New large scale infrastructure projects have created significant employment opportunities, with construction of the 'Shetland Gas Plant' from 2010 to 2016 employing over 2 000 workers at peak of construction. Production at the plant commenced in January 2016. Shetland's buoyant economic situation has seen the population increase, and in 2015 the Shetland population was 23 200[6]. In the long term (to 2039) the population is predicted to remain stable at 23 000.

It is expected that in the future, marine renewables could also provide employment opportunities, as Shetland has significant wind, wave and tidal resources. While it is expected that marine renewables could be a significant growth area, an interconnector is required to the Scottish mainland before the full potential of the industry can be realised.

6 National records of Scotland www.nrscotland.gov.uk accessed online 04/05/2017

B Condition of the Region

PHYSICAL

Climate Change

Quendale beach © Christina Kelly

The United Nations Framework Convention on Climate Change (UNFCCC) was adopted during the Rio de Janeiro Earth Summit in 1992. This Framework Convention is a universal convention of principle, acknowledging the existence of anthropogenic (human-induced) climate change and giving industrialised countries the major part of responsibility for combating it. According to the latest findings of the Intergovernmental Panel on Climate Change (IPCC), without urgent action, climate change will bring severe, pervasive and irreversible impacts on all the world's people and ecosystems. Limiting dangerous rises in global average temperature to below 2°C compared with pre-industrial levels (the below 2°C objective) will require substantial and sustained reductions in greenhouse gas emissions by all countries[7].

Current monitoring indicates that an increase in sea temperatures around the coast of Scotland has already occurred, with a rise in sea surface temperature in Shetland of approximately 1°C[8] since 1900.

The impacts of climate change include:

- Increase in sea and air temperatures
- Sea level rise due to both thermal expansion of the water and the melting of glaciers and ice caps
- Increased frequency and power of storms
- Changes in sediment erosion and accretion due to combination of the previous two effects
- Ocean acidification impacting marine life

These effects lead to changes in the physical and chemical environment which can have implications for marine life and ecosystems, causing direct and in-direct social and economic effects. Changes to the ecosystem include:

- Northward shift of cold-water species and range expansion of warm-water species
- Changes in spawning and reproduction patterns, as this is often linked to temperature
- Knock-on impacts through the food web, for example some species are dependent on the availability of specific food at certain times
- Reduction in the ability of certain species to form shells
- Increase in invasive non-native species

Potential social and economic effects include:

- Changes in commercial fish landings
- Changes in seabird populations affecting tourism and recreational opportunities
- Non-native species impacting marine industries including aquaculture, fisheries and tourism
- Erosion impacting coastal infrastructure

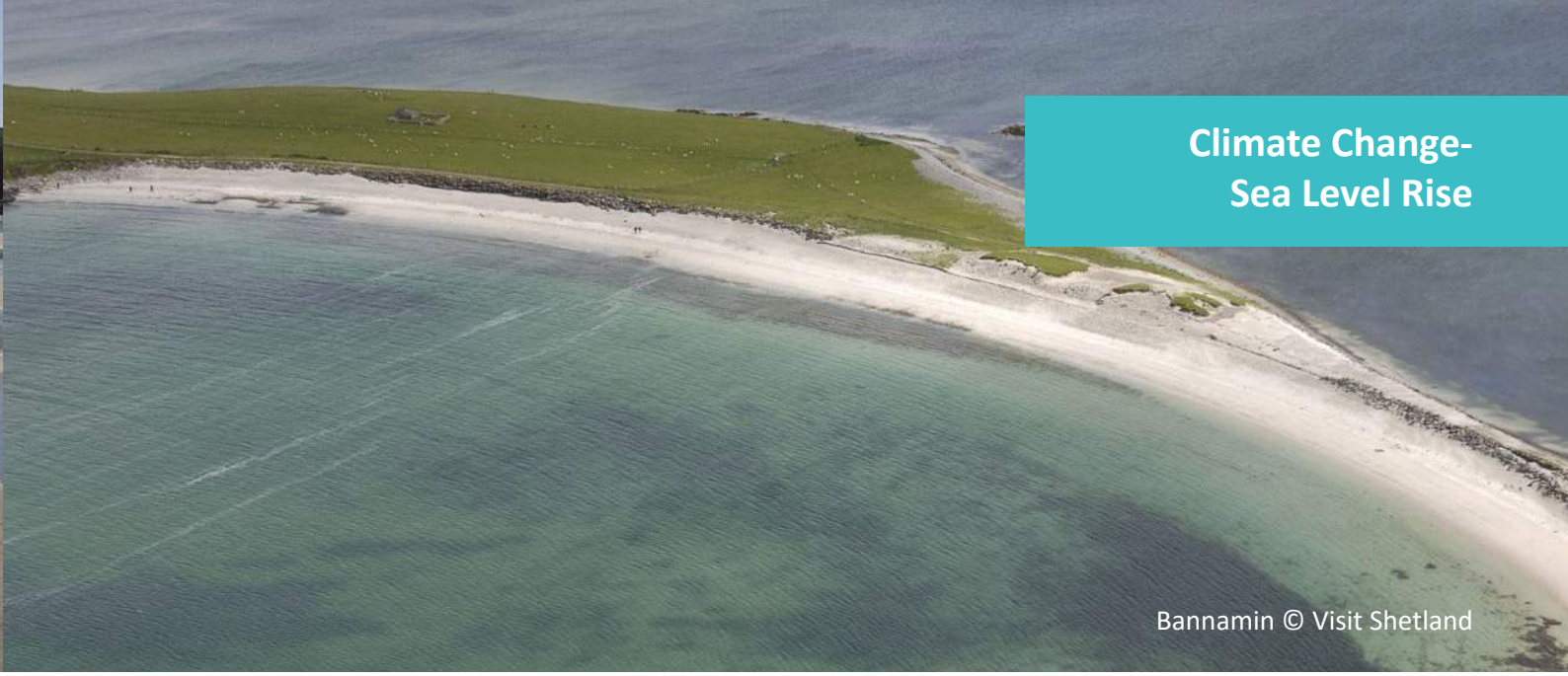
Some of these impacts are better understood than others and research is underway in many areas to gain a clearer view of how marine life may be affected.

The Shetland marine environment has the potential to contribute to a low carbon economy and reduce the atmospheric carbon levels, and hence reduce the impacts of climate change through:

- Development of low carbon technologies i.e. marine renewables
- Protection of marine habitats that act as a carbon sink e.g. kelp beds, horse mussel beds
- Protection of marine environment (habitats and morphologies) which protect vulnerable coasts and infrastructure

7 IPPC AR4 and IPCC 2013 AR5

8 **http://www.ices.dk/marine-data/Pages/default.aspx**



Climate Change- Sea Level Rise

Bannamin © Visit Shetland

The melting of the last ice-cap covering Scotland approximately 10 000 years ago has resulted in isostatic lift, where land that was pressed down under the weight of glacial ice is rebounding upwards now that the ice has melted. Consequently across much of Scotland land is currently rising faster than the sea level. However, the weight of ice over Shetland was relatively slight and the land in Shetland is sinking as mainland Scotland rises. Shetland and Orkney are therefore the only parts of Scotland where there is no known evidence of relative sea levels higher than present.

In Shetland sea level rise has shaped the appearance of the archipelago, valleys have filled with water to leave a flooded landscape of islands and inlets (voes). New landforms such as spits, bars and tombolos have been built up as the sea has reworked sediments of sand, gravel, pebbles and shingle[9].

With further changes in climate sea levels are predicted to rise further due to thermal expansion of water and the melting of glaciers, ice caps and polar ice sheets. Sea level rise is therefore of particular concern when taking a forward look to the likely levels in 2050 or 2100. It is estimated that sea level rise in Shetland will be 30 cm by 2050 and 50 cm by 2100. In addition storm surges of 1.5 metres have already been recorded.

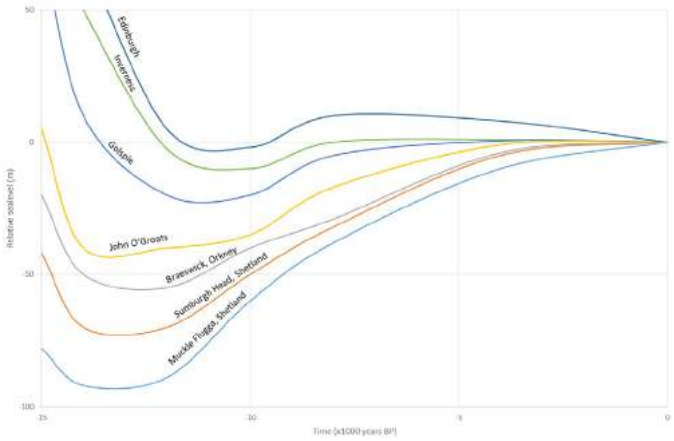


Figure 1: Relative sea level observed in different parts of Scotland from 15000 years before present adapted from Lambeck (1991)[10]

9 Shetland Amenity Trust **http://www.shetlandamenity.org** accessed online 22/06/2016

10 Lambeck, K (1991) *Glacial rebound and sealevel rise in the British Isles.* Terra Nova 3 379-389.

Flood Risk Management

Papil, Yell © Charlotte Slater

In 2015 SEPA, working with others, has produced a Flood Risk Management Strategy for each Local Plan District. The Strategy describes an agreed ambition for managing flooding and the priority of actions to be taken forward to deliver this. The Shetland Local Flood Risk Management Plan divides Shetland into a number of large areas for assessment. Of these, it identifies three areas where there are properties and/ or infrastructure that could be vulnerable to flooding; Shetland Mainland North, Shetland Mainland West, Shetland Mainland Central. Coastal flooding is the main flood risk type identified for Shetland Mainland North and Shetland Mainland West. The Flood Risk Management strategy includes a list of actions to reduce the risk of flooding in each of the areas[11].

Map 2: Shetland flood risk area © SEPA

11 Flood Risk Management Strategy – Shetland Local Plan District **http://apps.sepa.org.uk/FRMStrategies/pdf/lpd/LPD_04_Sources.pdf**

Coastal Change

Coastal erosion © Charlotte Slater

Much of Shetland's outer coastline is formed of hard rock, thus is less susceptible to coastal erosion. However, Shetland's more limited softer coastal features are susceptible to erosion due to sea level rise, a severe wave environment and restricted supply of sediment. The supply of sediment is relatively limited because sea level rise has put most marine sediment out of reach of wave action and Shetland does not have large rivers supplying reworked glacial sediment to the system. In Shetland sediment inputs are limited to a small amount of sediment from eroding bedrock and larger (but still limited) amounts from eroding glacial till.

Shetland's soft coastal features not only offer recreation and tourism provision (e.g. beaches), but also carry roads, protect agricultural land and support or protect major infrastructure, such as Sumburgh airport and ferries.

Since sediment supply is of equal significance to storminess and sea level rise as a driver of erosion and flooding, any actions that adversely affect the sediment supply to beaches and reduce the sediment residence time on beaches are to be avoided. For example, armouring of the rear of gravel and sand beaches as a method of erosion control acts to further increase sediment losses as a result of wave reflection and drawdown. Preventing erosion, particularly of glacial till shorelines, also reduces sediment inputs that would replenish beaches.

Many of Shetland's beaches have been exploited for sand extraction, and are also impacted by the effects of grazing, and a heavy wind and wave environment. This has resulted in coastal erosion in some areas (see Healthy and Biologically Diverse- Intertidal Sediments).

The National Coastal Change Assessment (NCCA) has assessed Scotland's coastline for historic and future coastal change. The assessment assessed the proportion of the Shetland coastline type and categorised as 'hard' and 'mixed' is 91%, and 8% as 'soft' and 1% as 'artificial'. Within the historical period (1890s to 1970s) most of the soft shoreline has not changed significantly (75%), accretion has occurred along 25% of soft coasts with erosion occurring along 1%. Since the 1970s there has been a greater amount of stability (95%); and with only small amounts of accretion (2%) and erosion (2%)[12].

12 National Coastal Change Assessment (NCCA)

Shetland's Seascape

Gunnister Voe © Ian Napier

Shetland's seascape has been formed over millions of years and has created a diverse and unique environment which is valued highly by residents and visitors to the islands. It is an intrinsic part of island life economically and culturally.

The coasts of Shetland can be split broadly into two categories; inner and outer coast. Two seascape character types have been mapped at a regional level which is low, rocky island coasts and remote high cliffs. At a local level twelve coastal character types (CCT) have been identified around the Shetland coastline with a further three sub types[13]. There are also numerous features such as stacks and tombolos which add to the character of Shetland's seascape.

Developed Voes and Firths- Voes and Firths which have development at the head of the voe and/ or numerous aquaculture sites on the water.

Undeveloped Voes and Firths- Voes and Firths with sparse or no onshore development or settlements and no or limited aquaculture development on the water.

Developed Island Sound- Stretch of water between two islands or an island and the mainland which has an onshore settlement and/ or aquaculture development.

Undeveloped Island Sound- Stretch of water between two island or an island and the mainland which has sparse or no onshore development and no or limited aquaculture development.

Exposed Coast: Low Rocky Shore- A stretch of coastline that is exposed to the severe storms Shetland is subjected to. Common occurrence to find some large rocks thrown far inland.

Exposed Coast: High Rock Cliffs- Exposed to extreme weather which leads to various erosional features such as caves, stacks and geos. There is usually a panoramic view from the top and the cliff faces often offer nesting spots for seabirds.

Ness and Wick Network- the network comprises of an indented coastline with sheltered wicks (bays) protected and separated by nesses (headlands) on each side. There is often settlement around the wicks.

Large Bay- a large sweeping coastline and often has a sandy beach.

Open Coast: Steep Banks- Similar to the high rock cliffs CCT, steep banks have a more gradual slope into the sea and are often vegetated with sheep managing to graze on them.

Offshore Coastal Islands- Small uninhabited islands found throughout Shetland. Many were inhabited but were abandoned due to a lack of viability. Usually low lying with low rocky shore and some used for grazing sheep through the summer.

Large Harbour- A sheltered area of water with pier infrastructure used commercially and recreationally.

Small Harbour- Lower level of activity compared to large harbours and cannot accommodate larger

13 **NAFC Marine Centre (2017) Shetland Coastal Character Assesment**

vessels. Usually has some human intervention in creating a sheltered area of water such as rock armour.

Sub types

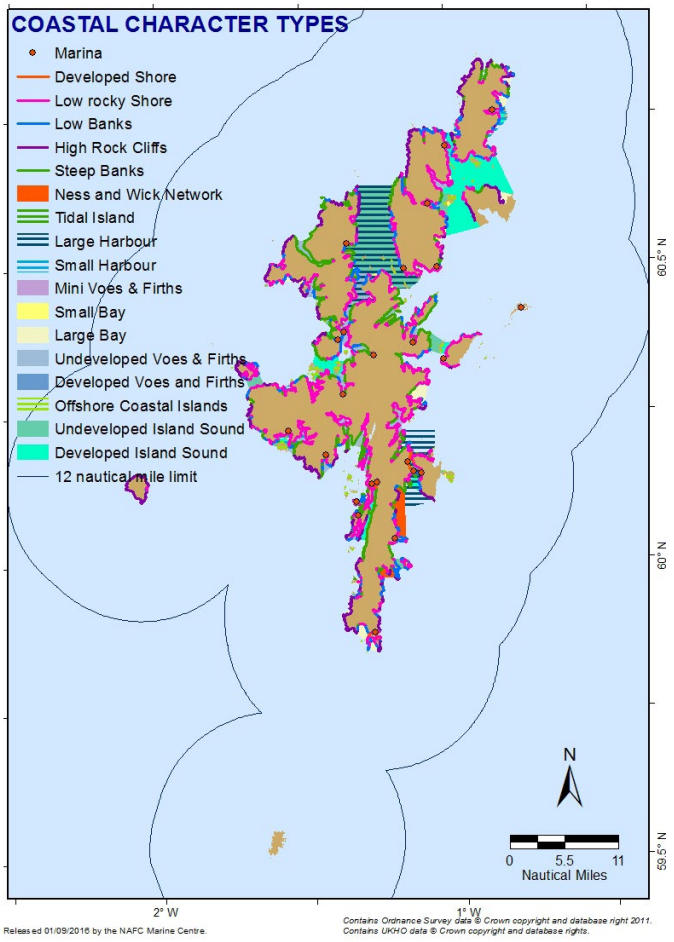
Mini Voes and Firths – Similar to a developed or undeveloped voe or firth however, usually does not have steep sides and is not very long.

Marina- Purposely designed harbour to provide mooring facilities, usually floating pontoons, for small boats and yachts.

Small Bay- Similar to a large bay but on a smaller scale. Can be important tourist hotspots.

Please refer to Map 3 to see where these CCTs can be found in Shetland.

Exposed coast- Northmavine © Rachel Shucksmith



Map 3: Shetland Coastal Character Types

CLEAN & SAFE

Introduction

Scalloway harbour © Christina Kelly

The Clean and Safe section provides an assessment of whether the waters within the Shetland Marine Region are clean, with regards to levels of contamination, and safe, with regards to whether there are hazards to marine life or human health, and whether they impact on achieving ecosystem services.

The majority of contaminants in the marine environment come from land-based sources that can either be natural, such as weathering, or the result of human activities. Discharges from industries and sewage tend to be from point sources that can be highly concentrated. However, other forms of contaminants, such as the run-off from agricultural land, can be more diffuse and spread out over a larger area. The impacts of natural and chemical contaminants, nutrient-rich run-off, and biotoxins in the waters around the Shetland coast is described and existing mitigation is discussed.

There is a range of legislation, regulation and policy in place to control and reduce the levels of contamination in the marine environment and minimise its effect. Key legislation, regulation and policy are highlighted in each topic section.

Water Framework Directive Classification of Transitional and Coastal Waters

The Water Framework Directive (2000/60/EC) (WFD) establishes a legal framework for the protection, improvement and sustainable use of rivers, lochs, transitional waters, coastal waters (out to 3 nautical miles) and groundwater which:

- Prevents further deterioration and protect and enhance the status of aquatic ecosystems including coastal waters (out to 3 nautical miles)
- Promotes sustainable water use
- Reduces pollution, and
- Contributes to mitigating the effects of floods and droughts

Implementation of the Water Framework Directive

The WFD requires the competent monitoring authority to divide surface waters into water bodies and classify them on a five point scale from 'high' to 'bad', on the basis of chemical, physical and ecological factors. The Directive requires authorities to bring all water bodies up to at least "good" status and prevent deterioration in their status. In Scotland, the work required to implement the Directive is co-ordinated by the Scottish Environment Protection Agency (SEPA) in conjunction with the Scottish Government and other partners.

Each water body is individually classified using a decision tree, according to ecological or chemical and physical parameters. Water bodies are classified for ecological quality by comparison to background conditions for each 'quality element', which are assessed over a 5-point scale: High, Good, Moderate, Poor, and Bad. Chemical 'quality elements' are assessed by comparison to numerical Environmental Quality Standards (EQS) set nationally and internationally.

Measuring Environmental Quality Element

The 'ecological status' of a water body is an expression of the quality of the structure and functioning of surface water ecosystems assessed by the condition of a number of 'quality elements'. These are key components of the biological environment (plants and animals), chemical environment (e.g. oxygen

and nutrient levels), and the hydromorphological environment (e.g. water flow, seabed condition, and shoreline). For good status, the chemical and hydromorphological elements must achieve the standards and conditions necessary for the biological elements to be in good condition.

Management Measures

To manage the implementation of the WFD Europe has been divided into river basin districts, rather than by administrative boundaries. Some are very large and cut across countries while several UK districts include a number of smaller river catchments. In Scotland, one district (the Scotland river basin district) covers the majority of the country, including Shetland. The Scottish River Basin Management Plan sets out how the district will be managed, with the current management period running from 2015 to 2021.

The Scottish river basin district is split into advisory group areas to allow improvements to be planned on a more manageable scale and to better involve local organisations and expertise. Shetland is an advisory group area and has 87 freshwater and coastal water bodies.

Data and Trends

In 2014 of the 87 water bodies in the Shetland Islands 5 were assigned a water quality status of 'high', 74 were 'good' and 9 were 'moderate', Figure 2. With regard to the overall status of the 87 bodies, 3 were assigned a 'high' status, 74 a 'good' status, and 9 a 'moderate' status and 1 a 'poor' status, Figure 3. It is expected that data for 2015 will show a small improvement in overall status. Currently Shetland is meeting its target of 100% of coastal water in good or better condition, increasing from 95% in 2008.

The most important marine and coastal issues identified for the Shetland advisory group areas are:

- diffuse source pollution linked to sewage disposal, farming and marine transport;
- a potential risk of deterioration because of the risk of marine invasive species spreading into the area.

Further information is available on the SEPA webpages, in GIS form[14], showing trend data[15] and on the river basin management process and action planning[16].

Marine Strategy Framework Directive

The Marine Strategy Framework Directive 2008/56/EC (MSFD) aims to achieve 'good environmental status' in Europe's seas by 2020. Good environmental status (GES) involves protecting the marine environment, preventing its deterioration and restoring it where practical, whilst using marine resources sustainably.

While regional marine planning may help to support measures to achieve the goals of MSFD, as well as those of other relevant pieces of EC legislation, reporting will not take place at a Shetland scale.

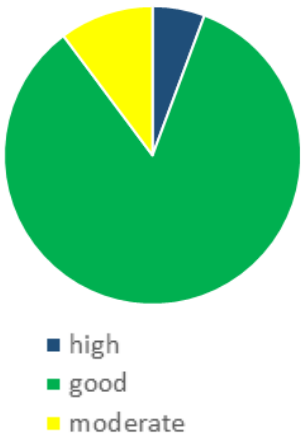


Figure 2: Water quality status of water bodies in Shetland in 2014

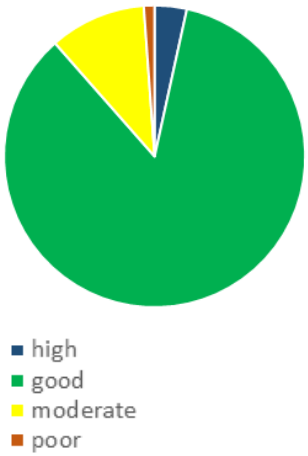


Figure 3 Overall status of water bodies in Shetland in 2014

14 **https://www.sepa.org.uk/environment/water/river-basin-management-planning/**
15 **https://www.sepa.org.uk/data-visualisation/water-classification-hub**
16 **http://www.sepa.org.uk/environment/water/river-basin-management-planning/**

Hazardous Substances

Hazardous substances are those that can accumulate in the marine environment and can accumulate at concentrations sufficient to pose a health risks to wildlife and humans. Hazardous substances are released into the marine environment as a result of human activity, such as manufacturing, pest control, and the burning of fossil fuels.

Substances of particular concern include cadmium, mercury, lead, pesticides, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and brominated flame retardants (PBDEs). The marine environment acts as a sink for these substances and, although the use of many, such as PCBs, is now banned, there are persistent traces resulting from historical use.

Sources of trace metals include terrestrial urban and industrial dischargers and, in the case of copper and zinc the inputs can be from marine finfish farms. The feed used in finfish aquaculture contains traces of copper and zinc, and in addition copper and zinc are used in net anti-fouling. The metals contained within these discharges are predominantly in particulate form, and are therefore not normally bioavailable, reducing the potential impact on marine fauna.

Information on each substances can be viewed on Marine Scotland Information pages[17].

Key Legislation, Regulation and Policy

- Water Framework Directive (2000/60/EC)
- Marine Strategy Framework Directive (2008/56/EC)
- Marine (Scotland) Act 2010
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011
- OSPAR Rivers and Discharges Programme

17 http://marine.gov.scot/themes/biological-effects
http://marine.gov.scot/themes/hazardous-substances

Assessment Hazardous Substances

Few concerns

Trend: Improving

Confidence: High- Discharge levels decreasing and within EQS, supported by monitoring data. Metal concentrations in sediments are lower in Shetland than elsewhere is Scotland, although these are also within the EQS.

Key Ecosystem Services

- Fisheries
- Aquaculture

Dependent species and habitats

- All wildlife, especially long lived species

Monitoring

Discharges of hazardous substances are required to be licensed and monitored to ensure they meet Environmental Quality Standards.

Marine waters

Hazardous substance concentrations in seawater are compared to agreed Environmental Quality Standards (EQS) that are set at levels below the concentration at which toxicity to sensitive organisms was observed in laboratory conditions.

The amounts of selected substances released into the marine environment from rivers and effluents have been quantified for the OSPAR Rivers and Direct Discharges (RID) programme since 1990 and are

required to be reported to SEPA and feed into the European Pollutant Release and Transfer Register.

Sediment and biota

Contaminants in sediments and biota are compared with international standards set by OSPAR[18]. Contaminant concentrations are considered to be low if they are below the Background Assessment Concentration (BAC) and slightly elevated if they are greater than the BAC but less than the Environmental Assessment Criteria (EAC). Contaminant concentrations are considered to be of concern if they exceed the EAC, that is, they may cause adverse effects in marine species. Concentrations of trace metals and PAH are considered to be of concern towards marine species if they exceed the Effects Range Low (ERL) in sediments. Trace metals are of concern towards humans if they exceed the EC maximum acceptable dietary level in biota.

Trace metal concentrations in sediments are expressed as concentrations relative to aluminium and trace organic contaminant concentrations are expressed in concentrations relative to organic carbon to compensate for different sediment types. Trace organic contaminant concentrations in fish livers are expressed in concentrations relative to lipid to allow for differences in fat content.

There are no standards for copper and zinc in biota, or for brominated flame retardants (polybrominated diphenyl ethers, PBDEs) in sediments and biota. Therefore the environmental significance of the concentrations found cannot be assessed but spatial comparisons can be made.

Trace metals in biota

Trace metals are measured in blue mussels (*Mytilus edulis*) and fish. Values between these species are assessed separately as mussels are shorter lived, sessile and shore based, with relatively low fat content. Whereas fish are mobile, longer lived, and when livers are analysed have a higher fat content.

Management Measures

Discharges of chemicals are primarily controlled by SEPA through the Water Environment (Controlled Activities) (Scotland) Regulations 2011 and by Marine Scotland through the Marine (Scotland) Act 2010.

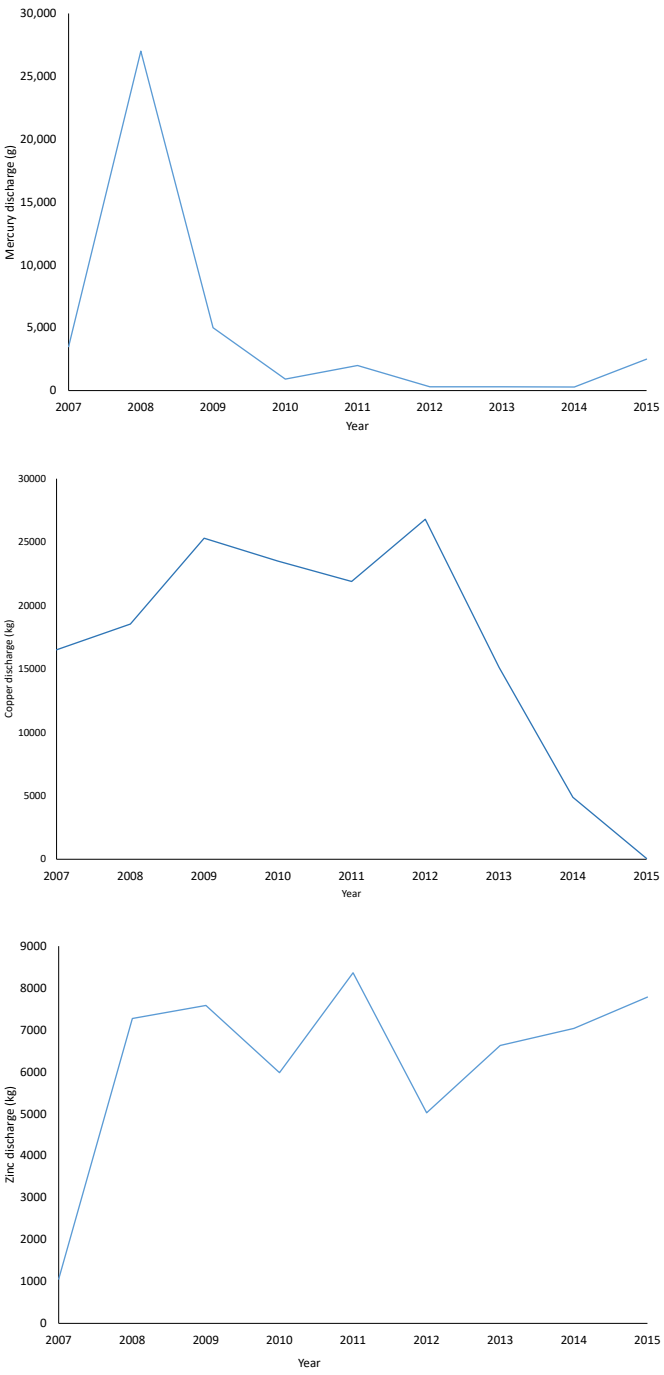


Figure 4: Metal discharge levels of mercury, copper and zinc to the marine environment in Shetland from 2007 to 2015

Data and Trends

Discharges to marine waters

Discharge levels of hazardous chemicals are recorded within the Scottish Pollution Release Inventory (SPRI)[19], where they exceed reporting thresholds. Additional discharges may occur from diffuse pollution sources, including fertilizer and road run-off. Hazardous chemicals may also be discharged via the movement of contaminated substances, for example the disposal of dredge material and the release of fish feed into the marine environment

18 **http://www.ospar.org/work-areas/hasec**

19 **http://www.sepa.org.uk/environment/environmental-data/spri/**

(which may contain elevated levels of contaminants such as PCBs).

Arsenic: Discharges of arsenic exceeding reporting thresholds for inclusion within SPRI have only occurred in 2007, 2008, 2009 and 2015. Discharges from Lerwick Sewage Treatment Works (STW)- Rova Head were reported in 2007 (24.3 kg), with no subsequent discharges. Sullom Voe Terminal has reported discharges in 2008, 2009 and 2015, with 16.94 kg reported in 2015.

Cadmium: Discharges of cadmium exceeding reporting thresholds for inclusion within SPRI have only occurred in 2008, 2010, 2011 and 2015. All discharges were reported from Sullom Voe Terminal. In 2015 total reported discharge levels were (9.96 kg,) higher than the previous reported level in 2011 (1 kg).

Copper: All copper discharges detailed within SPRI in the Shetland Marine Region are from the finfish aquaculture production sites, where it is used as an antifoulant. Reported copper discharge has declined steeply since 2012, and in 2015 only 63 kg were reported, from a peak of 25 032 kg in 2009, Figure 4.

Lead: There are no recorded lead discharges to the marine environment in Shetland within SPRI.

Mercury: Since 2008 there has been a significant decrease in mercury discharge reporting, from 27 000 g per year in 2008 to 2 500 g in 2015. All discharges within SPRI are reported from Sullom Voe Terminal, Figure 4.

Napthalene: Discharges of napthalene exceeding reporting thresholds for inclusion within SPRI have only occurred in 2013, 2014, and 2015. All discharges are recorded from Lerwick STW- Rova Head with reported levels of 2.10 kg (2013), 2.31 kg (2014) and 2.42 kg (2015).

Nickel: Discharges of nickel exceeding reporting thresholds for inclusion within SPRI have only occurred in 2007, 2008, 2009 and 2015. Discharges from Lerwick STW- Rova Head were reported in 2015 only (24.0 kg). In 2007, 2008 and 2009 Sullom Voe Terminal reported discharges, with 31 kg reported in 2009.

Zinc: Within SPRI zinc discharges within the Shetland Marine Region have been reported from the energy and finfish aquaculture sector. Zinc discharges by the energy sector dropped to 0 in 2015, however discharges by the aquaculture industry increased from 2007-2008, and from 2008 have remained relatively stable, with some year to year variability. Reported discharge levels in 2015 were 7 784 kg, Figure 4.

Sealice chemicals

Chemicals licensed to control sealice at finfish farms are; azamethiphos, cypermethrin, deltermethrin, emamectin benzoate and teflubenzuron.

Azamethiphos: Discharges of azamethiphos exceeding reporting thresholds for inclusion within SPRI show large year-to-year fluctuations, Figure 5. Discharges in 2015 were reported as 83 410 g, the second highest level within the time series.

Cypermethrin: Discharges of cypermethrin have not been reported within SPRI since 2011.

Deltermethrin: Discharges of deltermethrin exceeding reporting thresholds for inclusion within SPRI have shown steep declines since initial licensing in 2009. Reported discharge levels peaked in 2010 at 2 315g, but have since dropped to 7 g in 2015, where it was used at only one fish farm site, Figure 5.

Emamectin benzoate: Discharges of emamectin benzoate exceeding reporting thresholds for inclusion within SPRI have shown a trend of decline since a peak in 2011. Reported discharge levels were 16 325 g in 2015, Figure 5.

Teflubenzuron: Discharges of teflubenzuron exceeding reporting thresholds for inclusion within SPRI have not been recorded since 2013. The use of the chemical treatment was limited to three fish farms in 2007, one in 2009, 2010, 2012 and three in 2013 (zero in 2011).

Monitoring Data

Hazardous substance monitoring is undertaken by Marine Scotland and SEPA, and can be viewed within NMPi.

EROD- Monitoring of EROD levels has taken place in Shetland in 2012, 2013, 2015 with testing of dab (*Limanda limanda)* and plaice (*Pleuronectes platessa*). Testing indicated that levels of EROD were

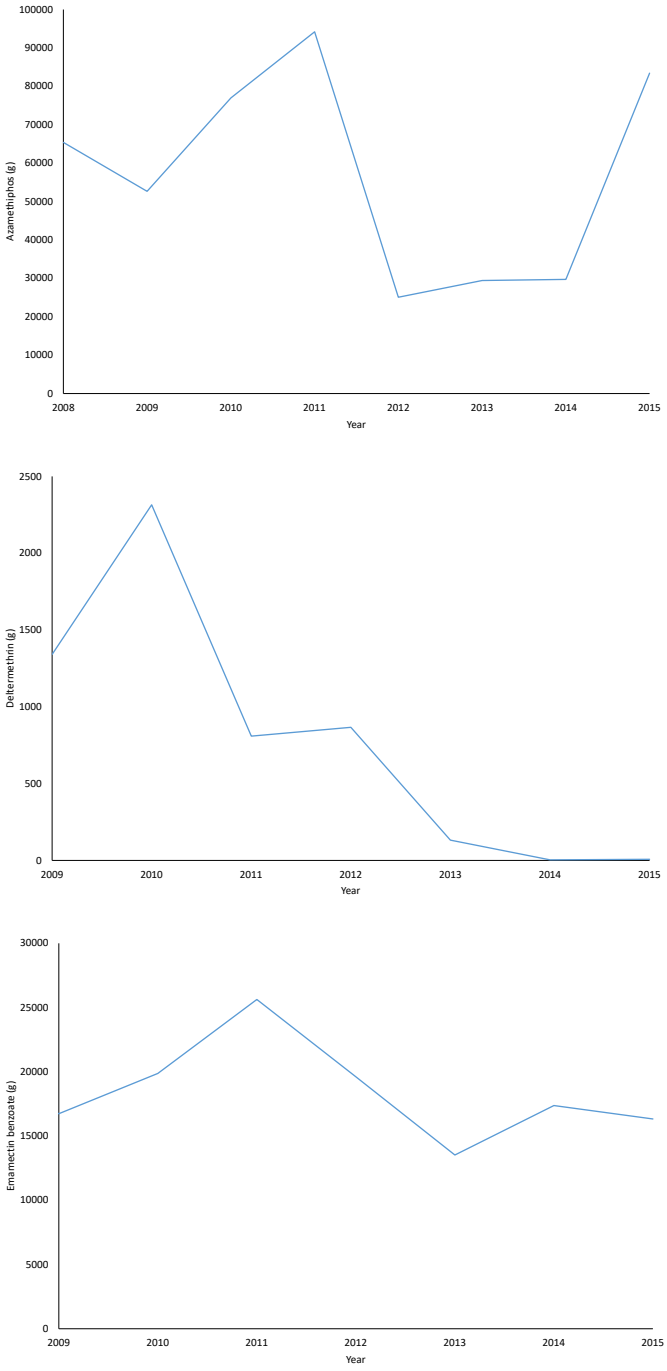


Figure 5: Sealice chemical discharges of azamethiphos, deltermethrin and Emamectin benzoate reported within SPRI 2007 to 2015

below background assessment concentration (BAC).

Polybrominated diphenyl ethers- Monitoring of Polybrominated diphenyl ethers has taken place in Shetland in 2012, 2013, 2015 with dab (*Limanda limanda),* plaice (*Pleuronectes platessa)* and blue mussels *(Mytilus edulis)*. Testing indicated that levels of *Polybrominated diphenyl ethers* were not of concern, but there is insufficient data to assess a trend.

Polychlorinated biphenyls (PCBs)- Monitoring of PCBs has taken place in Shetland in 2008, 2009, 2010, 2012, 2013, and 2015 with the testing of sediment and biota, with dab (*Limanda limanda),* plaice (*Pleuronectes platessa)* and blue mussels *(Mytilus edulis)* tested. Testing indicated that levels of PCBs were not of concern for CB153 in sediment and biota, but there is insufficient data to assess a trend. For CB118 testing in sediment indicated that levels were not of concern, but there is insufficient data to determine a trend. For CB118 testing in biota at mussel farms indicated that levels were not of concern, but there is insufficient data to determine a trend in Ronas Voe, Olnafirth, Catfirth, Vaila, Gruting Voe, east Unst and Dales Voe, but levels of CB118 were above EAC in Mid Yell. Testing at the Burra Haaf and east of Yell of dab and plaice indicated that levels were not of concern, but there is insufficient data to determine a trend.

Polycyclic aromatic hydrocarbons (PAH)- Monitoring of PAH comprises monitoring of pyrene, phenanthrene and napthalene in sediment and biota.

Napthalene monitoring in sediment and biota indicates either a downward trend of chemical levels, or levels are below levels of concern but there is insufficient data to determine a trend.

Phenanthrene monitoring in sediment and biota indicates either a downward trend of chemical levels, or levels are below levels of concern but there is insufficient data to determine a trend.

Pyrene monitoring in sediment and biota indicates either a downward trend of chemical levels, or levels are below levels of concern but there is insufficient data to determine a trend.

Metals

Cadmium- Monitoring of cadmium levels in biota around the Shetland coast indicate that although levels are within EAC, several locations are showing an upward trend in cadmium. Levels are thought to be increasing in Vaila Sound, Catfirth, Ronas Voe and Olna Firth. Testing in sediment has only taken place in the Burra Haaf, where levels are below effects range but there is insufficient data to determine a trend.

Lead- Monitoring of lead levels in biota around the Shetland coast indicate that although levels are

within EC food limits, several locations are showing an upward trend in lead levels. Levels are thought to be increasing in Vaila sound, Catfirth, Ronas Voe and Dales Voe. Testing in sediment has only taken place in the Burra Haaf, where levels are below BAC.

Mercury- Monitoring of mercury levels in biota around the Shetland coast indicate that although levels are within EC food limits, two locations are showing an upward trend in mercury levels. Levels are thought to be increasing in Vaila Sound and Catfirth. Testing in sediment has only taken place in the Burra Haaf, where levels are below BAC.
Sealice chemical- Monitoring sealice chemical levels for 'bath treatments' azamethiphos, cypermethrin and deltermethrin are not routinely undertaken, instead modelling approaches are used to set safe chemical usage.

Treatments which are applied to feed, emamectin benzoate and teflubenzuron, 'infeed treatments', are subject to sediment monitoring requirements. While monitoring undertaken by SEPA indicate that compliance with environmental quality standards are met at most sites, recent evidence suggests that there may be impacts on crustacean diversity, even when EQS criteria are met[20].

20 SARF098: Towards Understanding of the Environmental Impact of a Sea Lice Medicine– the PAMP Suite, 2016. A study commissioned by the Scottish Aquaculture Research Forum (SARF). **http://www.sarf.org.uk**

Biological Effects of Contaminants- Imposex

From the 1970s tri-butyl tin (TBT) was used in antifoulant paints on boat and ship hulls, however it leached into the marine environment, directly from the vessel hulls but also when old paint coatings were replaced with fresh paint. By the mid-1980s the impacts of TBT on the wider marine environment were being realised, with wide ranging effects on marine organisms from the cellular (apoptosis) to whole organism (mortality, growth inhibition, sexual morphology) levels[21].

Key Legislation, Regulation and Policy

- IMO Convention on the Control of Harmful Anti-Fouling Systems on Ships 2001
- EC Regulation 782/2003 on the Prohibition of Organotin Compounds on Ships
- Water Framework Directive (2000/60/EC)

Monitoring

Gastropod molluscs are considered the most sensitive receptors, where the effects of endocrine disruption can be observed through changes in sexual morphology as intersex or imposex (the imposition of male sexual characteristics on females of the species)[22]. In 2004 OSPAR established a set of biological effect assessment criteria for TBT, based on the development of imposex in gastropod species[23].

21 Gubbins, M, Huet M., Mann R.M., Minier C. 2012. Impairments of endocrine functions: case studies. Chapter 9 in Ecological biomarkers: Indicators of toxicological effects. C. Amiard-Triquet Ed. Taylor and Francis LLC.

22 Gubbins M. 2012. SOTEAG rocky shore monitoring programme. TBT contamination in Sullom Voe, Shetland. 2011 dogwhelk survey. Scottish Marine and Freshwater Science, 55, 32 pp.

23 OSPAR (2004). Proposal for assessment criteria for TBT-specific biological effects. ASMO 04/3/3. OSPAR Environmental Assessment and Monitoring Committee, Stockholm, 29 March – 2 April 2004.

Assessment Biological Effects of Contaminants

Few concerns
Trend: Improving
Confidence: High- Supported by monitoring data, with the trend of decreased imposex in Shetland also observed across Scotland.

Key Ecosystem Services

- Fisheries

Dogwhelks (*Nucella lapillus*) are one of the most sensitive species to TBT, expressing imposex following exposure to very low (<1ng/L) concentrations of TBT. Due to their sensitivity dogwhelks have been used as a sentinel monitoring species. For dogwhelks, assessment criteria are based on the Vas Deferens Sequence Index (VDSI) as a measure of imposex. The VDSI values are split into 6 assessment classes (A-F), reflecting the effects on the reproductive capability of females in the populations due to TBT, Table 1. In 2011 the assessment criteria was updated to allow for better integration of assessments across other contaminants and effect types. This includes the derivation of Background Assessment Criteria (BAC) at VDSI 0.3 and Environmental Assessment Criteria (EAC) at VDSI >2.0.

Monitoring of imposex levels is undertaken for Water Framework Directive (WFD) and OSPAR reporting purposes, with Scalloway and Lerwick harbours monitored by SEPA every 3-4 years. In addition an extensive and continuous monitoring programme for imposex in dogwhelks has also been implemented in Sullom Voe, commissioned by the Shetland Oil Terminal Environmental Advisory Group (SOTEAG)

Table 1: OSPAR biological effect assessment criteria for TBT

Assessment class	VDSI	Effects and impacts
A (<BAC)	VDSI = <0.3	The level of imposex in the more sensitive gastropod species is close to zero (0 - ~30% of females have imposex) indicating exposure to TBT concentrations close to zero, which is the objective in the OSPAR strategy of hazardous substances.
B (>BAC <EAC)	VDSI = 0.3 - <2.0	The level of imposex in the more sensitive gastropod species (~30 -~100 % of the females have imposex) indicates exposure to TBT concentrations below the EAC derived for TBT. E.g. adverse effects in the more sensitive taxa of the ecosystem caused by long-term exposure to TBT are predicted to be unlikely to occur.
C (>EAC)	VDSI = 2.0 - <4.0	The level of imposex in the more sensitive gastropod species indicates exposure to TBT concentrations higher than the EAC derived for TBT. E.g. there is a risk of adverse effects, such as reduced growth and recruitment, in the more sensitive taxa of the ecosystem caused by long-term exposure to TBT.
D (>EAC)	VDSI = 4.0 - 5.0	The reproductive capacity in the populations of the more sensitive gastropod species, such as *Nucella lapillus*, is affected as a result of the presence of sterile females, but some reproductively capable females remain. E.g. there is evidence of adverse effects, which can be directly associated with the exposure to TBT.
E (>EAC)	VDSI = > 5.0	Populations of the more sensitive gastropod species, such as dogwhelks, are unable to reproduce. The majority, if not all females within the population have been sterilized.
F (>EAC)	VDSI = -	The populations of the more sensitive gastropod species, such as dogwhelks, are absent/expired.

and funded by The Sullom Voe Association. The Sullom Voe 'Dog Whelk Monitoring Programme' was initiated in 1991, with monitoring taking place at two yearly intervals, and includes monitoring at the terminal jetties, throughout Sullom Voe, and also in the wider Yell Sound area. The monitoring programme now represents the longest consistent data set of biological effects of contaminants on marine organisms in the UK[24].

Management Measures

TBT was initially banned for boats less than 25m in length in 1988, then on all international shipping in 2003, and from the 1st January 2008 it has been an offence for any ship visiting an EU port to have TBT on its hull. New TBT inputs into the marine environment within the EU should now have fallen to zero.

Data and Trends

In Lerwick harbour (Bressay Sound) monitoring has occurred most frequently at North of Heogan (2005, 2007, 2010, 2014). In addition monitoring has been undertaken at Ness of Sound (2005), South of Heogen (2007), Kirkabister (2007) and at Taing of Ham (2007). In Scalloway harbour monitoring has taken place at East Voe- Cauldhame (2007, 2014) and Maa Ness (2007, 2010). In the most recent survey results from 2010 and 2014 all stations were classified as class C or above using the OSPAR criteria. Historically two locations in Bressay Sound (Taing of Ham and South of Heogen) only achieved a classification of class D in 2005 and 2007, however more recent monitoring has not taken place at these locations, Table 2.

The Sullom Voe monitoring programme has measured levels of imposex at 22 sites, with 19 having been monitored consistently from 1991-2015. Monitoring results indicate that from 1987 to 2015 decreases in VDSI were observed at the terminal jetties, within Sullom Voe and the wider Yell Sound area, resulting in improvements in OSPAR classification for all sites. The classification at 19 sites between 1991 and 2015

24 Moore, J.J. and Gubbins, M.J. (2014). Surveys of dogwhelks *Nucella lapillus* in the vicinity of Sullom Voe, Shetland, July 2013. A report to SOTEAG from Aquatic Survey & Monitoring Ltd., Cosheston, Pembrokeshire and Marine Scotland Science, Aberdeen. 42 pp +iv.

Table 2: OSPAR classification and WFD classification of monitoring sites within Lerwick and Scalloway harbour from 2007-2014

Site name	Sample Date	WFD Class	OSPAR Class
Bressay Kirkabister	05/07/2007	Good	C
Bressay Sound, North of Heogan	25/07/2005	Moderate	D
Bressay Sound, North of Heogan	04/07/2007	Moderate	D
Bressay Sound, North of Heogan	21/07/2010	Good	C
Bressay Sound, North of Heogan	02/10/2014	Good	C
Bressay Sound, South of Heogan	25/07/2005	Moderate	D
Bressay Taing of Ham	05/07/2007	Moderate	D
East Voe of Scalloway, Cauldhame	03/07/2007	Good	C
East Voe of Scalloway, Cauldhame	02/10/2014	High	A
Maa Ness PS, EO to East Voe of Scalloway	03/07/2007	Moderate	D
Maa Ness PS, EO to East Voe of Scalloway	20/07/2010	Good	B
Ness of Sound shore, SW of Liversbreast Pt	25/07/2005	Moderate	D
Ness of Sound shore, SW of Liversbreast Pt	25/07/2005	Good	C

Data Source: SEPA and Marine Scotland Copyright © SEPA and Marine Scotland December 2015

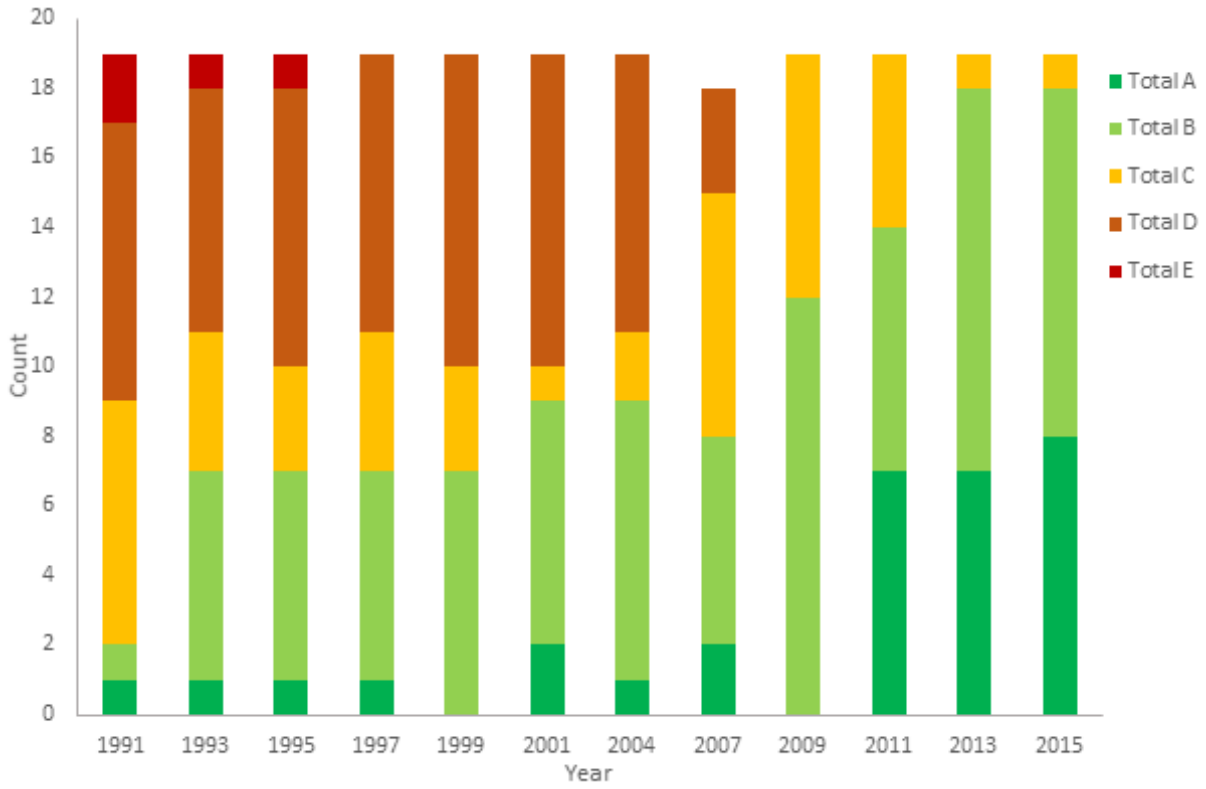


Figure 6: OSPAR classification of 19 monitoring sites within Sullom Voe and Yell Sound from 1991-2015. Data provided by SOTEAG © SOTEAG 2016

is shown in the Figure 6. One monitoring site close to the Sullom Voe Oil Terminal jetties is the only site which remains at Class C, i.e. above the EAC. Whilst no sterile females have been observed since 2009, it is thought that the continued observation of imposex is likely be due to reservoirs of residual TBT in sub-tidal sediments in the area of the terminal. It is believed that concentrations of TBT are likely to continue to decline and the observed effects on gastropods should continue to decrease[25].

25 Data provided by SEPA and Marine Scotland December 2015 Copyright © SEPA 2015

Oil & Chemical Spills


© Charlotte Slater

Oil and chemical spills can harm wildlife including birds and marine mammals. The Maritime and Coastguard Agency (MCA) exercises the UK Government's responsibilities for responding when oil or any other hazardous or noxious substance emanating from any at-sea activity threatens the UK or its surrounding waters.

Monitoring

The MCA established the Advisory Committee on Protection of the Sea (ACOPS) in 1952 and in 1965 began compiling statistics and other information on different types of marine pollution around the UK. Each year ACOPS publishes the reports of their annual survey of reported oil spills.

As part of the Shetland Oil Terminal Environmental Advisory Group's (SOTEAG's) environmental monitoring an annual 'Ornithological Monitoring Programme'[26] is undertaken. This includes monthly surveys for beached birds, performed throughout the Shetland Islands, these surveys have been undertaken for over 35 years. As part of these surveys, the number of seabird carcasses that are oiled are recorded.

Management Measures

The Sullom Voe Oil Terminal is one of only two areas in Scotland issued with a 'Standing Approval' from the Scottish Government that permits the application of an agreed quantity of oil spill treatment products, without permission from Marine Scotland, within a specific area and subject to specified conditions to ensure a rapid response in the event of an oil spill.
In 2004, the Shetland Oil Terminal Environmental Advisory Group (SOTEAG) assisted with the publication of the Guide to Oiled Wildlife Response Planning (IPIECA report series) which was updated in 2015[27]; an overview of the different components of oiled wildlife response. This report provides guidance on controlling the spread of oil, reducing the oiling of wildlife, and, if practical, capturing and removing animals at risk.

In addition to contributing to the Guide to Oiled Wildlife Response Planning, SOTEAG have also developed Oil Spill Sensitivity Maps for the Sullom

Assessment Oil and Chemical Spills

Some Concern

Trend: Improving

Confidence: Moderate - Oiled seabirds are an indirect measure of oil spills. Reported oil spills from Shetland ports indicate small scale release of diesel. Nationally the number of oiled birds detected is also decreasing. The proportion of birds found oiled along the Shetland coast is lower than the North Sea average.

Key Ecosystem Services

- Aquaculture
- Fisheries
- Tourism and recreation

Dependent species and habitats

- Marine mammals
- Birds
- Shoreline habitats and species

26 http://www.soteag.org.uk/environmental-monitoring/ornithological-monitoring/

27 International Petroleum Industry Environmental Conservation Association (2015) Oil Spill preparedness and response: an introduction

Voe Oil Terminal that identify areas most at risk from oil spills. These maps developed for the Wildlife Response Co-ordinating Committee (WRCC) can be used to inform oil spill response if needed[28]. The WRCC Oil Spill Plan for Shetland is incorporated into the Sullom Voe Harbour Oil Spill Plan and the Shetland wide Marine Pollution Contingency Plan.

Data and Trends

In the 2013 ACOPS report[29] three spills were reported in Shetland waters, up from zero in 2012. These related to small scale oil leaks, one small diesel leak in Scalloway harbour from a visiting fishing vessel, one from the grounding and subsequent sinking of a visiting trawler in Lerwick harbour (5 tonnes diesel fuel) and a small hydraulic oil leak from a pipe burying vessel in Yell Sound.

In 2015 SOTEAG's annual Ornithological Monitoring Programme recorded a total of 27 oiled birds. The proportion of oiled birds found since 1999 remains consistently lower than those found in the 1980s and 1990s, Figure 7 (5-year means in Table 3). Of eight samples of oil taken from these birds in 2015, two related to crude oil release (derived from Scottish oil production) and the remaining nine related to the accidental/ illegal release of fuel oil from bilge discharge.

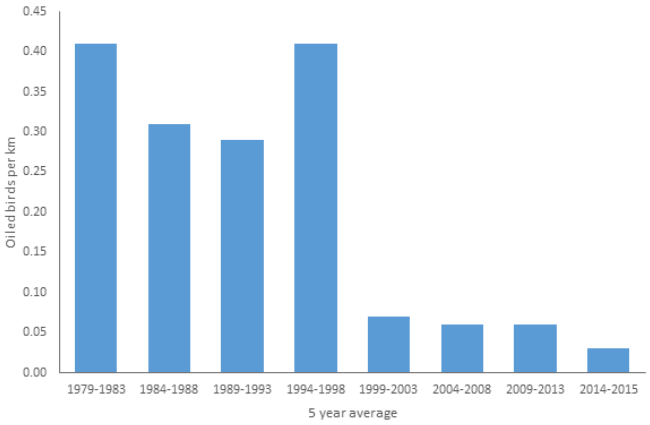


Figure 7: Number of oiled birds found per km of surveyed shoreline from 1979-2015. Data provided by SOTEAG © SOTEAG 2016

Table 3: Five year means for oiled bird mortalities in the Shetland Islands. Columns show the total number of bird corpses found per km surveyed, the percentage of those bird corpses related to oil, and the number of oiled birds per km. Data provided by SOTEAG.

5-Year Period	Bird corpse/Km	% Oiled birds	Oiled birds/Km
1979-1983	4.06	9.98	0.41
1984-1988	3.93	7.86	0.31
1989-1993	3.99	7.19	0.29
1994-1998	4.31	9.50	0.41
1999-2003	3.17	2.39	0.07
2004-2008	2.16	2.97	0.06
2009-2013	1.61	4.04	0.06

28 **http://www.soteag.org.uk/response-to-oil-spills/oil-spill-sensitivity-maps/**
29 Marine Pollution Survey 2012, **www.acops.org.uk**

Microbial Contamination

Scalloway harbour discharge pipe © Christina Kelly

Pathogens associated with the presence of faecal matter, of either human or animal origin, can pose a threat to human health from consumption of contaminated seafood and from bathing in contaminated water. Faecal indicator organisms are those bacteria that naturally occur in the gut of humans and other warm blooded animals and are used as an indicator for microbial contamination as they are easy to detect and measure, e.g. *E. coli.*

Sources of faecal indicator species include:

- Livestock
- Run-off from fields following slurry and manure spreading
- Septic tank discharges
- Sewer outflows
- Urban run-off
- Wildlife

It is very difficult to determine whether contamination is from human or animal sources and, due to the diffuse nature of many of these sources, they are difficult to identify and manage. For example, animal faeces from a single source (e.g. a farm) may not seem problematic, but the cumulative effect of multiple diffuse sources across a catchment area can have serious implications for nearby waters, particularly after heavy rainfall when surface run-off is at a maximum.

Key Legislation, Regulation and Policy

- Water Framework Directive (WFD) (2000/60/EEC)
- Water Environment (Shellfish Waters Protected Areas: Designation)(Scotland) Order 2013
- EU Food Hygiene Regulations (854/2004)

Assessment Microbial Contamination

Some concerns

Trend: Deterioration

Confidence: High- Supported by monitoring data, in comparison to the Scottish average *E.coli* levels around the Shetland coast are low, with a higher proportion of sites classified as 'A' than the Scottish average (40% in 2009).

Key Ecosystem Services

- Fisheries
- Aquaculture

Monitoring

Faecal indicators are easily detected in water systems and provide a reliable method of assessing whether a water course has been contaminated. Environmental quality standards are set for areas designated for

Table 4: Classification under Shellfish Hygiene Regulation (EC) 854/2004

Class.	Permitted Levels	Outcome
A	≤ 230 *E. coli*/100 g of flesh and intervalvular liquid	May go direct for human consumption
B	≤ 4,600 *E. coli*/100 g of flesh and intervalvular liquid in 90% of samples	Purification or relaying for 2 months (or heat treatment by approved process)
C	≤ 46,000 *E.coli*/100 g of flesh and intervalvular liquid	Must be re-laid for a period of at least 2 months, followed, where necessary, by treatment in a purification centre to meet Category A standards

shellfish cultivation. Designated shellfish waters are areas where water quality must be protected or improved, to protect shellfish growth and contribute to assuring the quality of shellfish for human consumption. Shellfish samples are collected quarterly, and the EQS must not be exceeded in 75% of samples. The standards require faecal coliform levels to be below 300 per 100ml in both shellfish flesh and intervalvular liquid. In addition there are standards for shellfish marketed for human consumption. Shellfish hygiene sites are classified A, B or C based on the *E. coli* content of the shellfish flesh, Table 4.

Management Measures

Only shellfish that have been graded Class A are made available for human consumption, with the Food Standards Scotland (FSS) co-ordinating a detection programme. River Basin Management Planning (under the Water Framework Directive) aims to reduce the levels of microbial contamination through management of discharges (e.g. sewage) and agriculture. Under the Shetland and Orkney River Basin Management Plan, a strategy is in place to increase the number of shellfish growing waters reaching the EQS to 100% by 2027 (see page 24, 'Water Framework Directive').

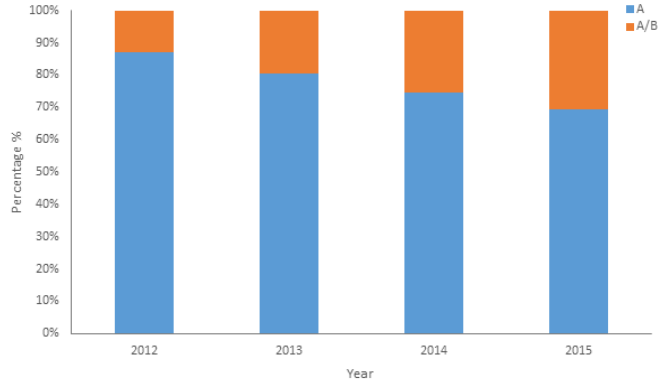


Figure 8: Proportion of shellfish harvesting areas classified A and A/B or B by the Food Standards Scotland.

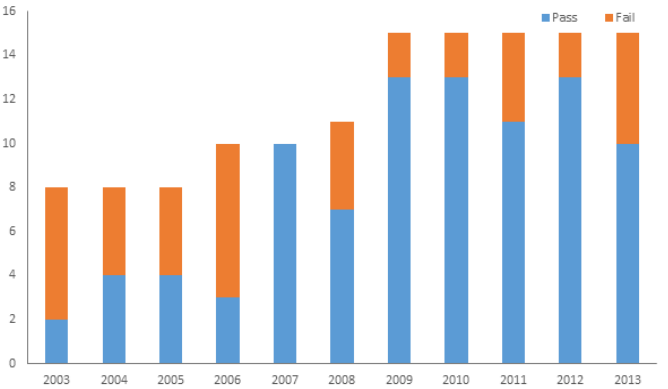
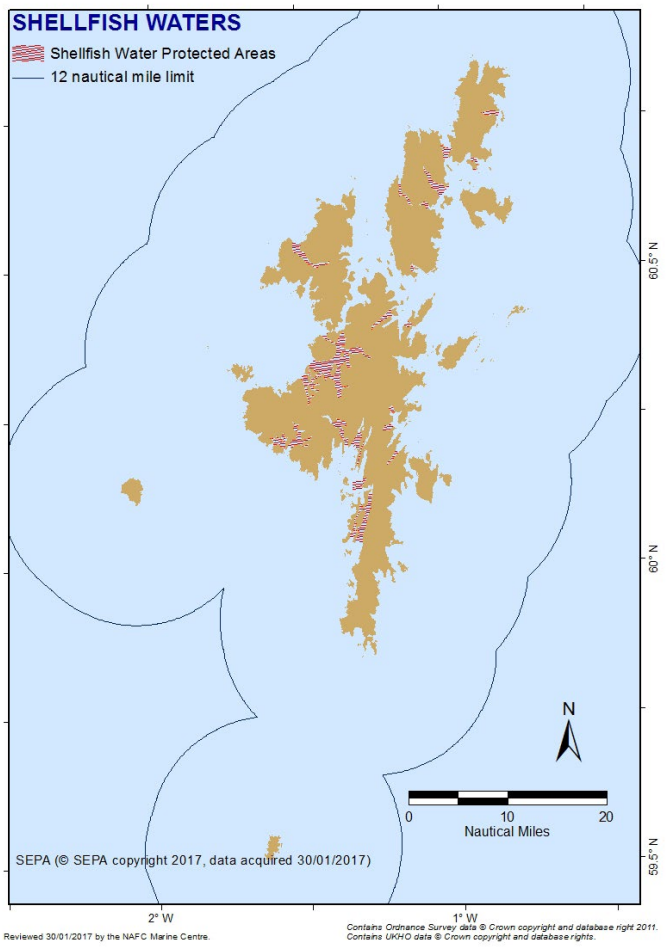


Figure 9: Proportion of designated shellfish waters achieving a pass for E. coli levels.

Data and Trends

In the Shetland Marine Region in 2013, 22 harvesting areas were assessed for faecal coliforms in shellfish flesh, of which 18 passed. Food Standards Scotland classification reports from 2012-2015 indicated that the majority of the sampling areas in Shetland achieved the highest grade 'A', with some sites alternating between A and B depending on the time of year. However, monitoring surveys from 2012-2015 indicate that the proportion and number of areas graded 'A' has decreased, Figure 8. Areas not achieving an 'A' classification in the 2015 assessment were Papa Little (Voe), Roe Sound, South of Houss Holm, South Voe, Stromness Voe and Weisdale Voe. This trend is also reflected in the designated shellfish waters monitoring which indicates that 67% of areas were meeting *E. coli* standards in 2013, down from a peak of 87% achieved in 2010 and 2012, and 100% in 2007, Figure 9. The areas that were not meeting these *E. coli* standards in 2013 were Catfirth, Dales Voe, Mid Yell, Wadbister Voe and Whalefirth.

Shellfish protected areas are shown in Map 4. It should however be noted that Shetland has much higher average water standards than elsewhere in Scotland.



Map 4: Shellfish protected areas

Biotoxins

© Mussel Harvesting- Ian Napier

Some species of phytoplankton, including diatoms and dinoflagellates, can produce naturally occurring toxins, which if consumed in sufficient quantities can be harmful to human and animal health. The main food source of marine bivalve species, such as blue mussels (*Mytilus edulis*) is phytoplankton, and they are therefore vulnerable to ingesting and accumulating these biotoxins. When consumed, affected shellfish can be harmful to human and animal health.

Key Legislation, Regulation and Policy

- EU Regulation (EC) No. 854/2004

Monitoring

Regular monitoring of toxin levels in shellfish and the occurrence of biotoxin producing phytoplankton is undertaken by the Food Standards Scotland (FSS). The biotoxin monitoring programme for shellfish is divided into two aspects: the flesh monitoring programme, where shellfish samples are tested; and the phytoplankton monitoring programme, where water samples are collected from within harvesting areas. Flesh samples indicate whether shellfish can be harvested or sold, whereas the monitoring of phytoplankton in water samples can provide an early warning for potentially high levels of toxins.

For toxin-producing phytoplankton, the FSS has set certain 'trigger levels' that, if exceeded, will identify sites at risk from biotoxins. In Scotland there are currently three major shellfish biotoxin groups that are monitored to protect human health, Table 5.

Table 5: Shellfish poisoning type and the causative phytoplankton species

Type of shellfish poisoning	***Main causative phytoplankton species***
Paralytic Shellfish Poisoning	*Alexandrium* species
Diarrhetic Shellfish Poisoning	*Dinophysus* species
Amnesiac Shellfish Poisoning	*Pseudonitzchia* species

Assessment Biotoxins

Some concerns

Trend: No evidence

Confidence: Medium - Monitoring data does not allow a trend assessment but problematic levels of biotoxins occur each year.

Key Ecosystem Services

- Fisheries
- Aquaculture

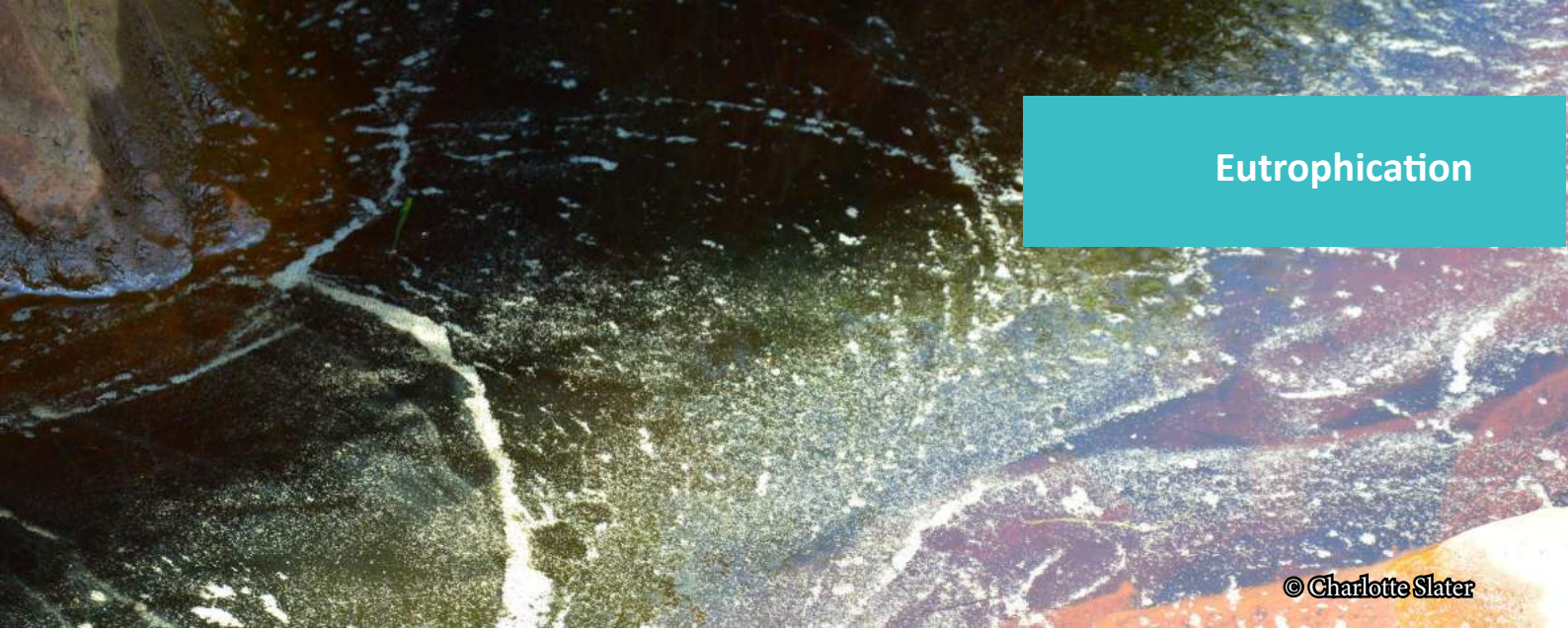
Management Measures

If biotoxin concentrations exceed regulatory limits the fishery is temporarily closed by the FSS to avoid the consumption of contaminated shellfish. The fishery is only re-opened when testing indicates that biotoxin levels have fallen below permitted levels.

Data and Trends

In 2013, a total of 662 flesh samples and 283 phytoplankton samples were analysed from Shetland. Throughout the summer of 2013, there were high natural variations in phytoplankton recorded, although these did not necessarily correlate with high biotoxin levels in mussel samples. There was variation in biotoxin levels of flesh samples, with high levels found towards the end of the summer, but these were identified quickly and the associated production areas were temporarily closed until toxins concentrations had decreased to acceptable levels.

It is not known whether biotoxin levels are changing within the Shetland area as we do not have adequate data sets to determine the presence of a trend.



Eutrophication

Dissolved forms of nitrogen and phosphorus are essential components of plant and algal growth and reproduction. Eutrophication is the enrichment of water bodies with nutrients (primarily nitrogen and phosphorus) that can lead to excessive algal and plant growth to levels that can be dangerous, if not deadly, to marine life. Human activities in coastal areas have increased the rate and extent of eutrophication events in the marine environment.

In rivers, phosphorus tends to be the limiting nutrient, but in the marine environment phytoplankton growth is usually limited by available nitrogen. The influx of nitrogen to coastal waters can trigger rapid and unnatural increases in fast-growing algae production, which can have significant impacts on the surrounding marine life and human activity.

Eutrophication is problematic if it leads to accelerated growth of plants and algae to such an extent that it creates an undesirable disturbance to the local ecosystem. Undesirable disturbances can include the following:

- Creation of oxygen depleted and toxic conditions that lead to mortality of fish and other benthic organisms
- Harmful algal blooms (HABs) that can lead to poisoning of humans, marine mammals, birds, and fish
- Changes in species composition (in both planktonic and demersal species)
- Loss of bottom-dwelling plants and algae due to reduced light levels caused by plankton blooms
- Smothering of other organisms

Nationally the surface run-off of nutrients from arable land into rivers and the subsequent outflow into the marine environment is a major source of nitrogen, where it is mainly available as nitrates. Wastewater from sewage treatment plants is the main source of phosphate, but a fairly minor contributor of nitrogen. Nutrient inputs from finfish aquaculture, which is a major industry around the shetland Islands, can also be a significant source of nitrogen[30]. Nitrogenous waste from finfish farms comprises dissolved ammonia, but also nitrogen emitted as particulate waste, potentially re-dissolving into the water column from the seabed.

Atmospheric nitrogen emissions from combustion processes and agricultural activity can also be a significant source of nitrogen to the marine environment. Deposition of nitrogen to the oceans occurs by wet and dry deposition, and the rates of both processes depend, in part, on the aerosol size distribution.

Assessment Eutrophication

No concerns

Trend: Improving

Confidence: High - Eutrophication and elevated chlorophyll levels across Scotland are generally low, with the exception of a few estuaries in central Scotland.

Key Ecosystem services

- Fisheries
- Aquaculture
- Tourism

Key Legislation, Regulation and Policy

- Water Framework Directive (WFD) (2000/60/

30 Gillibrand P, Gubbins MJ, Greathead C, IM Davies (2002) Scottish Executive Locatinal Guidelines for fish farming: Predicted levels of nutirent enhancement and benthic impact. FRS Aberdeen

EEC)
- Marine Strategy Framework Directive (MSFD) 2008/56/EEC)
- Urban Wastewater Treatment Directive (91/271/EEC)
- Nitrates Directive (91/676/EEC)
- OSPAR Eutrophication Strategy
- Locational Guidelines: Marine Fish Farms in Scottish Waters

Monitoring

Nutrient inputs to the sea from rivers, sewage and industrial waste have been monitored since 1990 for the OSPAR riverine inputs and direct discharges programme. The concentration of dissolved inorganic nitrogen (DIN) in winter is used as an index of nutrient enrichment in marine waters, as DIN usually limits algal growth in seawater[31]. The concentration of DIN is considered high if it exceeds 15 µM (more than 50% the background levels of 10 µM).

Phytoplankton growth is measured indirectly through measuring the level of chlorophyll in the water. Excessive phytoplankton growth is considered to occur when more than 10% of chlorophyll measurements between April and September are greater than 15 µg/l in inshore waters or more than 10 µg/l in offshore waters.

Management Measures

There are a number of EU directives that aim to reduce the number of human-sourced nutrient inputs into the marine environment to reduce the potential for eutrophication. Their focus includes waste water from urban environments and certain industrial sectors, and reducing water pollution caused or induced by nitrates from agricultural sources. River basin management planning will tackle diffuse pollution by identifying priority catchment areas.

In Scotland finfish farm locational guidelines[32] focus on the potential for finfish aquaculture to cause cumulative nutrient enrichment. The level of finfish aquaculture in a loch or voe based on the consented finfish tonnage, is used to predict and manage the potential cumulative nutrient enrichment and cumulative benthic impact. Based on these calculations production areas are categorised as 'Category 1', 'Category 2', and 'Category 3', with

31 Scotland's National Marine Atlas (2011) Marine Scotland

32 Gillibrand P, Gubbins MJ, Greathead C, IM Davies (2002) Scottish Executive Locational Guidelines for fish farming: Predicted levels of nutrient enhancement and benthic impact. FRS Aberdeen

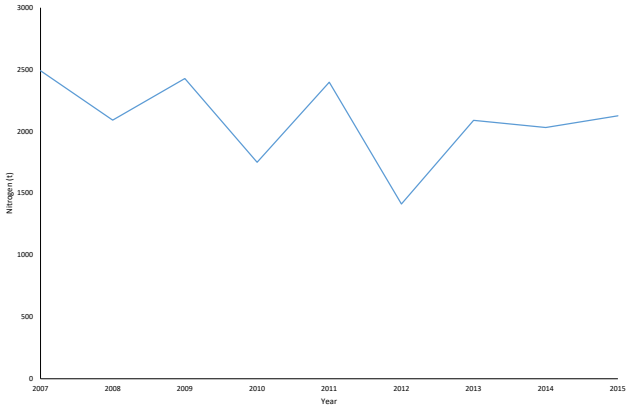


Figure 10: Nitrogen discharge levels (t) from 2007-2015 from finfish aquaculture

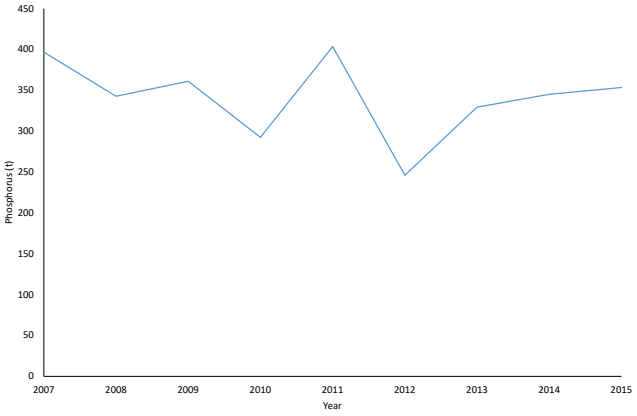


Figure 11: Phosphorus discharge levels (t) from 2007-2015 from finfish aquaculture

'Category 1' areas considered the highest risk of eutrophication and where no additional production will be permitted.

Data and Trends

Industrial discharges which exceed reporting thresholds are available via the Scottish Pollution Release Inventory (SPRI)[33]. In the SPRI the only source of total nitrogen in the inventory which exceed reporting thresholds (50 tonne) come from finfish aquaculture. The total nitrogen release from the finfish farm industry fluctuates each year depending on production levels. With production levels having declined in recent years, nitrogen discharges have shown a general trend of decline. The estimated discharge level for 2015 is 2 125 tonne, a small increase from 2014, Figure 10. Inputs of phosphorus in SPRI are predominantly from aquaculture sites, with only one other discharge recorded, from Lerwick sewage treatment works. The data suggests that discharges have declined overall, although a small increase was observed in 2015. In 2015 discharge levels were estimated at 353.4 tonnes per year, 347.4 tonnes from finfish aquaculture and 6.0 tonnes from

33 **https://www.environment.gov.scot/data/data-analysis/scottish-pollution-release-inventory/**

Lerwick sewage treatment works, Figure 11.

During the period 2007 to 2015 discharges of ammonia were only recorded in 2015 from Lerwick STW, Rova Head, with a discharge level of 12.9 tonne.

In Shetland the number of voes categorised as 'Category 1' has declined over the last 10 years, reflecting a reduction in consented tonnage in these areas. In 2016 there were 10 voes categorised as 'Category 1', however in three of these areas there were no active or licensed fish farms (although the SEPA consent remains), and in the remaining seven areas some of the sites are now used for mussel farming or no longer used for aquaculture production. It is therefore thought the risk of eutrophication in these areas is low.

In Shetland monitoring of nutrient levels by Marine Scotland suggest that DIN levels are relatively low and currently below the threshold level of 15 µM, and chlorophyll levels within expected levels. There has been a general movement of finfish farms from sheltered voes to larger and more exposed locations at voe mouths and to sounds, where water exchange levels are higher, and there is a reduced risk of eutrophication.

Marine Litter

Shetland beach © Charlotte Slater

Marine litter is a global problem which can cause considerable harm to marine wildlife (e.g. entanglement and ingestion) and to humans (e.g. sewage-related debris). There are many different sources of marine litter, but most comes from land, ships, or carried on ocean currents from distant shores. The most common type of marine litter found in both beach and offshore surveys is plastic. The versatility of plastic has led to its everyday use and today's single-use, 'throw-away' culture has led to an increase in discarded plastic waste. Plastics can remain for centuries in the marine environment, often as small micro-particles (<5 mm) that pose serious risks to marine life through ingestion and subsequent toxic effects.

Significant quantities of marine litter appear in the seas and on the beaches throughout Shetland every year. The marine litter comes from a variety of sources, both local and international. Shetland's location leaves it exposed to litter transported on prevailing winds and currents from across the North Atlantic Ocean. Therefore, despite annual efforts to clean up the local environment (e.g. Da Voar Redd Up), marine litter is a continuous problem. The continued local control of marine litter contributes greatly to maintaining clean and healthy coastlines.

Key Legislation, Policy and Regulation

- EU Marine Strategy Framework Directive (MSFD)
- A Marine Litter Strategy for Scotland

Management Measures

All member states, including the UK, will have to put in place a programme of measures by 2016 to ensure that 'properties and quantities of marine litter do not cause harm to the coastal and marine environment' by 2020. This will require a better understanding of the environmental impacts of marine litter, and if necessary, action will be taken to reduce the amount of litter in the marine environment.

Assessment Marine Litter

Some concerns

Trend: Stable

Confidence: Low- It is difficult to determine the true marine litter trend, as data is anecdotal, beach litter quantities are affected by weather and some Redd Up locations vary year to year, causing high year to year variability. Nationally, data from the MCS annual beach clean-up suggests that levels of marine litter decreased from 2015 to 2016.

Key Ecosystem Services

- Fisheries
- Tourism
- Recreation

Dependent habitats and species:

- Marine mammals
- Birds
- Fish

Marine Scotland has developed a Marine Litter Strategy[34] that aims to address these issues and provide guidance on managing the adverse impacts of marine litter. At present, responsibility for regulating marine litter is shared among several UK bodies, e.g. Local Authorities, Scottish Government, and the Maritime and Coastguard Agency.

34 Scottish Government (2014) A Marine Litter Strategy for Scotland

Community lead marine litter initiatives

In Shetland there are two community led initiatives to tackle marine litter; Da Voar Redd Up and the Fishing for Litter Scheme. Da Voar Redd Up ('The Spring Clean Up') is an annual clean-up of coastal areas and roadsides by local resident volunteers within the Shetland Islands, organised by the Shetland Amenity Trust. It takes place annually in April, with the event aiming to get the islands clean for summer visitors after the winter storms.

The Fishing for Litter scheme encourages fishermen to land any litter brought up in their fishing nets and gear. Lerwick harbour was involved in the original launch of the initiative by KIMO in 2005. The scheme has since expanded and there are 15 harbours participating across Scotland, in Shetland this includes Scalloway and Cullivoe harbours.

Data and Trends

Da Voar Redd Up

Over the 27 years Da Voar Redd Up has been running, the number of volunteers contributing to the project has steadily increased, from 400 in 1988 to 4 349 in 2014[35], Figure 12. The main type of litter collected was plastic (including mussel pegs and shotgun cartridges), which, in addition to locally generated litter, is thought to have come from a wide range of destinations that include Canada, USA, Mexico, Denmark and Russia.

The amount of litter collected reached a peak of over 100 tonnes in 2003 and in recent years has stabilised at around 60 tonnes. However, year to year fluctuations in litter levels will occur due to a range of factors including, the number of volunteers participating, the areas cleared and the impact of weather on the amount of litter found on beaches.

Fishing for litter

Nationally from 2008 to 2011, the Fishing for Litter scheme involved 162 vessels (Scotland wide) and landed 242.1 tonnes of marine litter, 50% of which was plastics and polystyrene. In Shetland 25 tonnes of marine litter were landed between 2006 and 2017. In Shetland, landing levels peaked in 2006-2007. In 2015 there were 20 vessels participating in the scheme within Shetland. In Shetland a re-launch of the scheme is planned for 2017 as active participation levels have dropped, reducing levels of marine litter landed.

35 Data Source: Shetland Amenity Trust

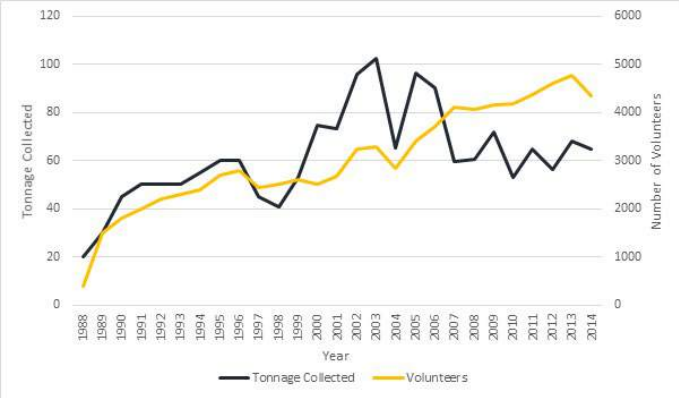


Figure 12: Tonnage of litter collected and number of participants in the 'Da Voar Redd Up' from 1991-2014.

MCS beach clean-up

In the Shetland area there are a relatively small number of beaches registered with the MCS beach clean-up scheme. However, these beaches are normally cleaned as part of the Redd Up. Analysis of MCS data for Shetland is therefore not considered appropriate.

Nationally, data from the MCS 2016 annual beach[36] clean-up suggest a slight decrease in levels of marine litter across the UK compared to 2015.

36 Marine Conservation Society (2016) Great British Beach Clean 2016 Report pp2

Underwater Noise

Lerwick harbour © Visit Shetland

Noise in the marine environment comprises sound from many different sources including, natural physical sources such as sea surface noise (wind and wave action, precipitation) earthquakes and sediment transport, and biological sounds emanating from fish, marine mammals and invertebrates, as well as anthropogenic (man-made) noise input. Anthropogenic noise can come from a range of sources, including shipping, sonar, dredging (shipping lanes, cable laying), construction, bottom towed fishing gear, recreational vessels and acoustic deterrents.

Anthropogenic noise has the potential to impact a range of marine species, in particular marine mammals and many marine fish, as sound is important for communication, searching for prey, avoiding predators and hazards, and for navigation. In addition, underwater noise has the potential to mask important acoustic cues, such as communication/ mating calls or warning of an incoming predator.

Key Legislation, Regulation and Policy

- EU Marine Strategy Framework Directive (MSFD)

Management Measures

All member states, including the UK, will have to put in place a programme of measures by 2016 to ensure that 'Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment' by 2020.

This will require a better understanding of the environmental impacts of underwater energy, and if necessary, action will be taken to reduce the anthropogenic energy and noise in the marine environment. At present there is insufficient information available to undertake an assessment of underwater noise and its impacts, therefore under MSFD the JNCC are establishing a 'noise register'[37] to assess and ultimately manage anthropogenic impulsive noise sources. In addition, a monitoring scheme is currently being designed which will monitor the trends in low frequency noise (in relation to shipping).

For licensable activities, the impacts of noise on marine life are considered during the licensing process. The JNCC has written a series of best practice guidance documents for offshore activities including

Assessment Underwater Noise

Few concerns

Trend: No evidence

Confidence: Low- It is not known whether underwater noise is currently at a level to impact marine life.

Key Ecosystem Services

- Fisheries
- Tourism

Dependent species and habitats:

- Marine mammals
- Fish

37 http://jncc.defra.gov.uk/page-7070

seismic surveying[38], pile driving[39] and explosive use[40]. Noise from shipping, fisheries and recreation is not currently licensed, however the International Maritime Organisation (IMO) has developed guidelines to reduce noise from commercial vessels[41].

An underwater noise register is being collated by ICES[42], although currently this only includes data for activities outside the Shetland Marine Region area (12 nm). Data will also be available from the JNCC website, under their 'Marine Noise Registry'.[43] For highly mobile species such as marine mammals, consideration may need to be given to noise exposure both within and outside the marine region.

Data and Trends

Insufficient data is available to assess trends in underwater noise, however increased marine activity is likely to result in increased noise levels. In Shetland, underwater noise sources include shipping, fisheries, marine recreation, dredging (occasional), acoustic deterrents (in particular those used for aquaculture purposes).

38 JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys, August 2017 **http://jncc.defra.gov.uk/pdf/jncc_guidelines_seismicsurvey_aug2017.pdf**

39 JNCC Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise s August 2010 **http://jncc.defra.gov.uk/pdf/JNCC_Piling%20protocol_August_2010.pdf**

40 JNCC guidelines for minimising the risk of injury and disturbance to marine mammals from using explosives August 2010 **https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/50007/jncc-ex-guide.pdf**

41 IMO (2014) Guidelines for the reduction of underwater noise from commercial shipping to address adverse impacts on marine life MEPC.1/Circ.833

42 ICES Impulsive Noise Register **http://underwaternoise.ices.dk/map.aspx**

43 Marine Noise Registry **https://mnr.jncc.gov.uk/**

HEALTHY AND BIOLOGICALLY DIVERSE HABITATS AND SPECIES

Introduction

Scallop on horse mussel bed © Rachel Shucksmith

This section describes the range of habitat types and key species groups, their distribution and characteristics within the Shetland Marine Region.

The Shetland coastline is characterised by a variety of sheltered inlets and exposed rocky shorelines. The diversity of marine conditions found around the coast provide a wealth of habitats for local marine life, including species and features which are considered of international, national and local importance.

The Scottish Government's Nature Conservation Strategy outlines Marine Scotland's vision and framework for marine nature conservation based on a three pillar approach:

1. Site protection
2. Species conservation
3. Wider seas policies and measures

This section provides current information on:

- Protected areas- designated sites (e.g. special areas of conservation, marine protected areas)
- Protected species within the Shetland Islands
- Wider seas biodiversity (including priority marine features)
- Non-native species

Protected Areas

Fair Isle cliffs © Visit Shetland

Shetland has internationally, nationally and locally important marine natural heritage features and designated areas. These are protected under a range of both international and national legislations and policies.

International Nature Conservation Designations

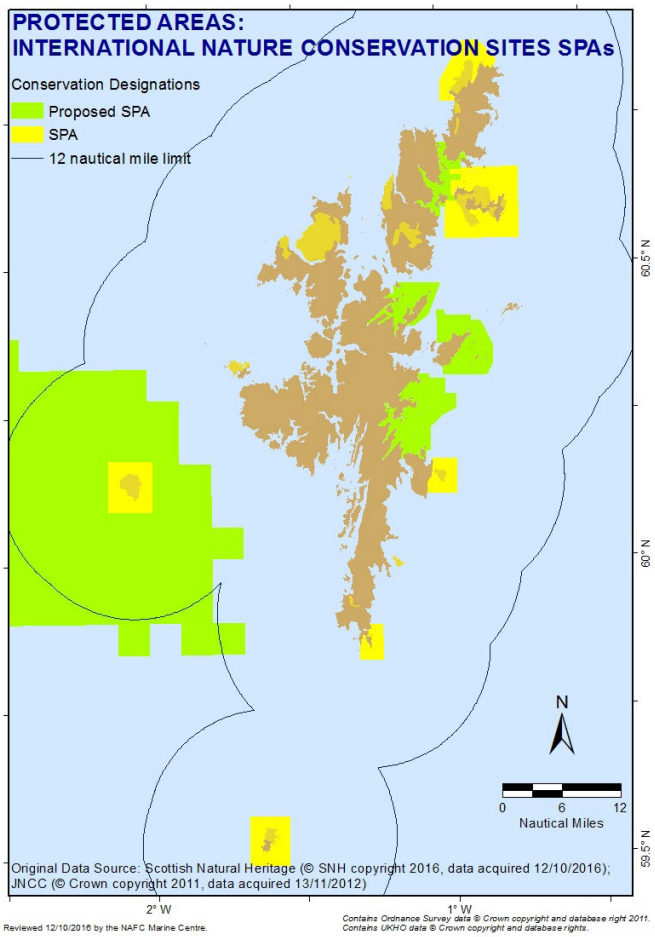
International nature conservation sites are those with protection under European law, such as Special Protection Areas (SPA) and Special Areas of Conservation (SAC), designated respectively under the two European directives, Directive 79/409/EEC ('the Birds Directive') and Council Directive 92/43/EEC ('the Habitats Directive'). SPAs and SACs taken together are commonly known as Natura 2000 sites.

Special Protection Areas (SPAs)

The Birds Directive provides member states with the responsibility of classifying SPAs to protect birds that are rare, or vulnerable, in Europe as well as all migratory birds that are regular visitors. There are currently 12 SPAs in the Shetland Islands, of which 11 are for seabirds. Of these all the qualifying species are in favourable condition at only three (18%) sites. In addition, there are three draft marine SPAs in the Shetland Marine Region. Individual species trends are discussed in 'Healthy and Biologically Diverse-Birds' sub-section.

The SPAs which have been considered in this assessment are included in Appendix 1, and include:

1. Sites that support true seabirds, i.e., truly marine birds.
2. Sites that support species, which, at times, use maritime habitats.
3. Sites that include maritime habitats, which are sometimes used by terrestrial species.



Map 5: Designated and proposed SPAs within the Shetland Marine Region

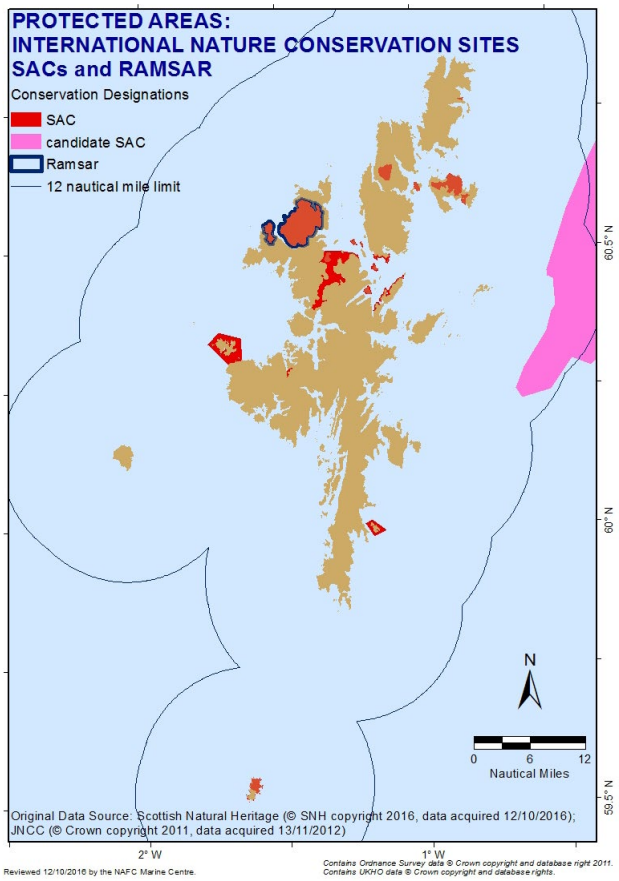
Special Areas of Conservation (SAC)

Special Areas of Conservation (SAC) are designated for particular habitats and species, listed in the annexes of the Habitats Directive. There are currently 12 SACs around the Shetland Islands, of which seven have a marine element, and one candidate SAC, the Pobie Bank Reef. In 2015 four are in favourable

condition (57%) for all its marine features, one is for some features (14%), and two are in unfavourable declining condition for all features (29%). For the features in unfavourable condition there are limited on-site remedies. The condition of individual species and habitats are discussed in their relevant subsections within 'Healthy and Biologically Diverse'.

Ramsar sites

The Ramsar Convention identifies wetland sites with international importance and aims to ensure their conservation and wise use through local and nation actions and international cooperation. In Shetland there is one Ramsar site, located at Ronas Hill – North Roe and Tingon – designated for its upland Bog area. For Ramsar sites, the Scottish Government has chosen, as a matter of policy, to apply the same considerations to their protection as if they were SPAs or SACs. This site is not designated for marine features.



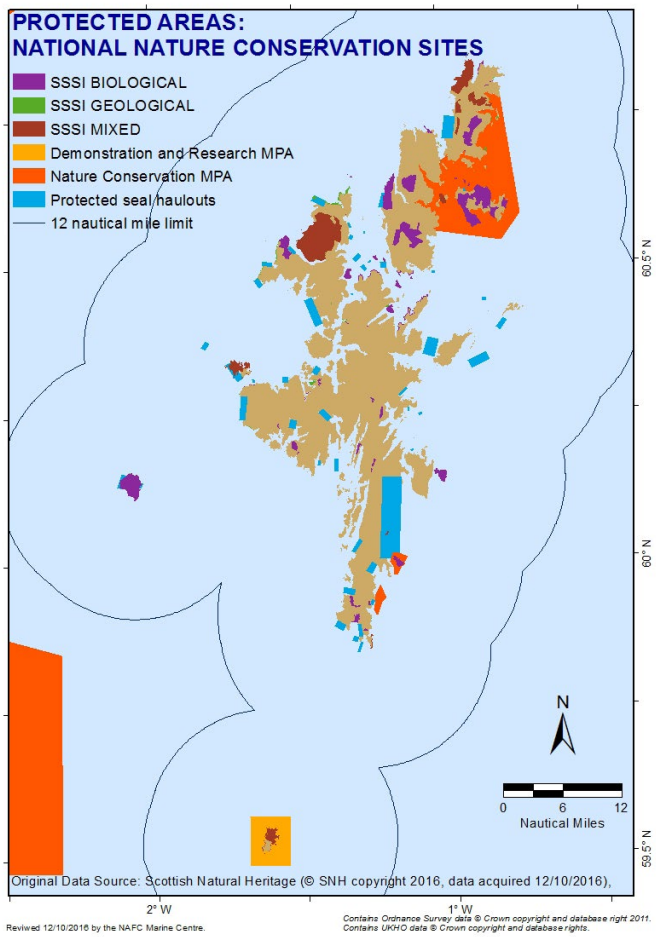
Map 6: Designated and candidate SACs and RAMSAR sites within the Shetland Marine Region

National Nature Conservation Designations

Nationally protected sites include Sites of Special Scientific Interest (SSSI) and Marine Protected Areas (MPAs). In addition, there are two National Nature Reserves (NNR), managed by Scottish Natural Heritage (SNH), and six bird reserves, managed by the RSPB.

Sites of Special Scientific Interest

The Wildlife and Countryside Act 1981, later amended by the Nature Conservation (Scotland) Act 2004, provide the mechanism for the designation of Sites of Special Scientific Interest (SSSI), but these powers only extended down to the limit of mean low water spring tide. At present there are 78 SSSI's in the Shetland Islands. Of these, 31 are notified for marine biological features, including seabirds and red-throated divers, and 36 are coastal sites notified for geological or geomorphological features. Many are also designated as Natura 2000 sites (Special Protection Areas or Special Areas of Conservation). The national network of SSSIs in Scotland forms part of the wider UK series. In 2015 all SSSIs designated for geological features were assessed as being 'favourable maintained'. Of the 23 designated for biological features all the qualifying species were in favourable condition at only six (26%) sites. Of the sites with both biological and geological features two (66%) were in favourable condition and one has at least one feature in unfavourable condition (33%).



Map 7: National Nature Conservation Sites: SSSIs, protected seal haulouts and MPAs within the Shetland Marine Region

Marine Protected Areas (MPAs)

The Marine (Scotland) Act 2010 and the UK Marine and Coastal Access Act 2009 both include powers to designate MPAs to regions of the seas and coasts where wildlife is protected from damage and disturbance. The MPAs complement the marine components of sites designated as SACs, SPAs and SSSIs.

Nature Conservation MPAs

Nature Conservation MPAs are identified for features (the collective term for species, habitats and geology) that the Scottish Government believes require additional protection. There are two nature conservation MPA areas in Shetland, 'Fetlar to Haroldswick' and 'Mousa to Boddam'.

The Fetlar to Haroldswick MPA incorporates the sea area used for foraging by black guillemots while the inlets, sounds and stretches of open coastline support a range of seabed habitats and species. This includes extensive and biologically diverse maerl and horse mussel beds, as well as more widely distributed shallow tide-swept sands with burrowing bivalves and coarser sediment communities representative of Scotland's seas more generally.

The Mousa to Boddam MPA encompasses the known extent of sandeel grounds in two distinct areas around the island of Mousa and off the coast at Boddam, south-east Shetland. The MPA contains the area of most consistent and reliable sandeel recruitment in Shetland. Around Mousa, the MPA overlaps an existing Special Area of Conservation (SAC) designated for reefs, sea caves and harbour seals.

Both the 'Mousa to Boddam MPA' and the 'Fetlar to Haroldswick MPA' sit within the Shetland carbonate production area, a key geodiversity area in Scottish waters. The Shetland carbonate production area is an internationally important example of a non-tropical shelf carbonate system. These sediments supply the carbonate sands of the coastal machair around Shetland. Machair supports specific and diverse grassland vegetation and is one of the rarest habitats in Europe.

Demonstration and Research MPAs (D&R MPAs)

The overall aim of the Demonstration and Research Marine Protected Area proposal is to demonstrate, through research and dissemination, the effectiveness of a community-led partnership approach in achieving a programme of sustainable measures.

To achieve this aim the Fair Isle Marine Environment and Tourism Initiative (FIMETI), in conjunction with stakeholders, has identified two main objectives for the D&R MPA:

- To investigate the factors affecting seabird populations on Fair Isle, particularly climate change impacts and direct human influences, by:
- Studying seabird productivity and prey availability (which will also help expand knowledge on inshore fish and invertebrate populations).
- Exploring the potential for voluntary measures through local management measures in partnership with all stakeholders.
- To demonstrate the socio-economic benefits of the marine environment and the additional benefits that MPA designation can bring to the community.

In addition FIMETI suggest that the project has wider 'spin-off benefits' for Scotland more generally, by way of:

- Exploring a model for collaborative management (co-management) of the marine environment and demonstrating how coastal communities can involve themselves in local management;
- Demonstrating that investing funding and resources into co-managed sites is a sound investment for government departments;
- MPAs are widely viewed as being in place for nature conservation but they can also contribute to the improved management of other interests. Pioneering the D&R model could demonstrate to other interest groups a positive process within which gains are to be made from the establishment of MPAs, rather than the usual perception of loss;
- The habitats around Fair Isle are representative of a large number of Northern Isles and coastal Scotland areas so biological results here are likely to be more widely applicable; and
- Fair Isle being used as a potential reference site for invasive non-native species monitoring as well as recording species whose distribution may be changing due to climate change

Protected sea haul-outs

Under Section 117 of the Marine (Scotland) Act 2010, Scottish Ministers, consulting with the Natural

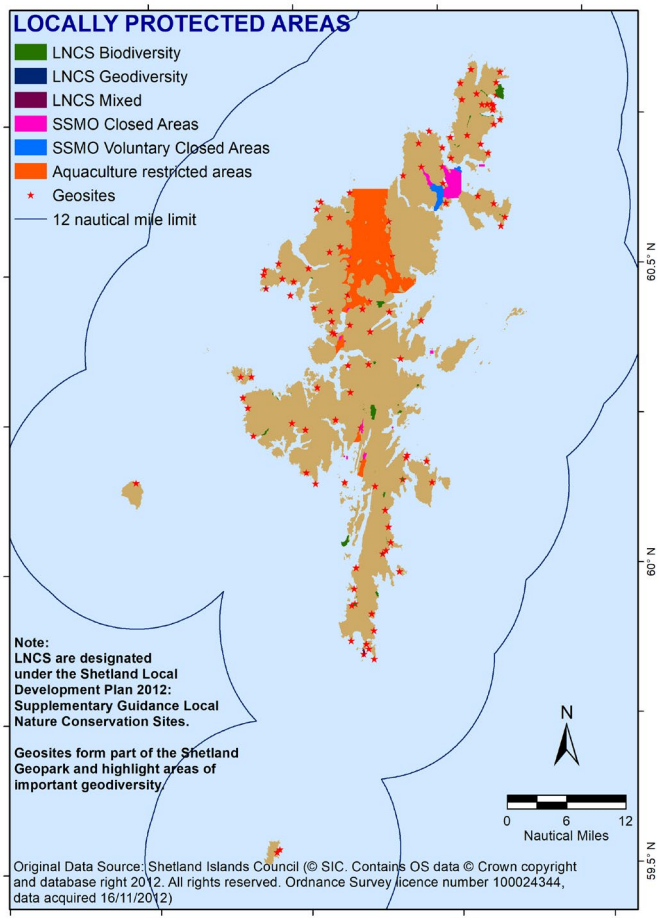
Environment Research Council (NERC), are permitted to designate specific seal haul-out sites to provide additional protection for seals from intentional or reckless harassment.

Seal haul-outs are locations on land where seals come ashore to rest, moult or breed. Marine Scotland with the Sea Mammal Research Unit (SMRU) (on behalf of NERC) have identified a number of suitable sites for protection, including key breeding sites along with a number of additional specific sites proposed by respondents. Sites were designated through The Protection of Seals (Designation of Haul-Out Sites) (Scotland) Order 2014. Additional sites were identified in 2015, and this extended the number of sites in Scotland (although no new sites were proposed in Shetland), these areas are protected through The Protection of Seals (Designation of Haul-Out Sites) (Scotland) Amendment Order 2017.

Local Nature Conservation

Local Nature Conservation Sites

The Shetland Islands Council identified a network of 49 Local Nature Conservation Sites (LNCS)[44] to highlight areas with important natural heritage features to both developers and the Council. In identifying LNCS the Council does not seek to prohibit development; they are a way of providing more information to ensure that development takes into account the important and sensitive features of these sites. They are currently all in favourable condition.



Map 8: Local Nature Conservation: LNCS sites, SSMO closed areas, aquaculture restricted areas and Geosites

Shellfish closed areas

Under the Shetland Islands Regulated Fishery (Scotland) Order 2012, the Shetland Shellfish Management Organisation (SSMO) has instigated 15 closed areas to protect horse mussel and maerl beds. This applies to all mobile equipment used to target shellfish species that are regulated by the SSMO. These closures were initially brought in on a voluntary basis but became statutory in 2011. In 2015 the SSMO introduced two additional voluntary closed areas, after new information suggested the presence of previously unknown beds, Map 8.

Aquaculture development restricted areas

The Shetland Islands Council and the Lerwick Port Authority have created a number of areas where aquaculture development is restricted, either to protect the environment or other industries (shipping), these are shown in Map 8.

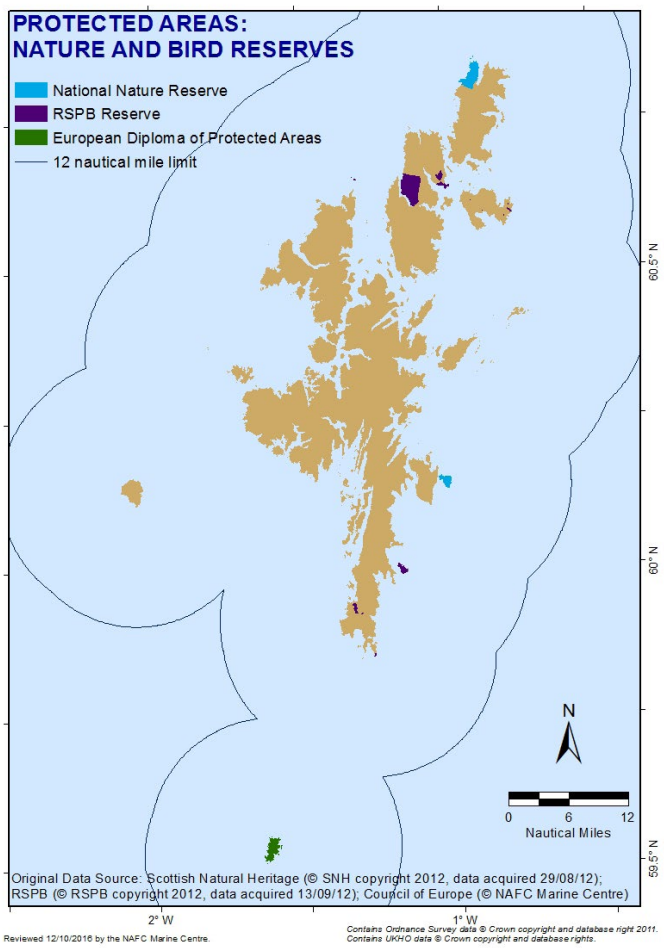
The Shetland Geopark

The geological diversity in the Shetland Islands has been recognised by achieving European and UNESCO Global Geopark status in recognition of its internationally important geological heritage which is used to further sustainable development. In 2016 there were 69 Geoparks in the European Geopark Network and 120 in the Global Network. An important aspect of the Shetland Geopark is its diversity of Geosites – sites important for their geology or geomorphology – ranging from extinct volcanoes (Eshaness) to the shifting sands at St Ninian's tombolo. Of the 107 Geosites in the Shetland Islands, 47 are geological SSSIs or part of a geological SSSI and a further five are on biological SSSIs.

Nature Reserves

Shetland has two national nature reserves (NNRs), managed by SNH, and six bird reserves managed by the RSPB. National Nature Reserves and RSPB bird reserves are areas of land set aside for nature, where the main purpose of management is the conservation of habitats and species of national and international significance, Map 9. These reserves not only highlight important natural heritage areas but also represent important tourism assets (see section

44 http://www.shetland.gov.uk/planning/documents/LNC-SinShetlandTranche1ReportFINAL.pdf



Map 9: Nature and Bird Reserves in the Shetland Marine Region

C 'Leisure, Recreation and Tourism').

The European Diploma of Protected Areas

The European Diploma of Protected Areas is a prestigious international award granted since 1965 by the Committee of Ministers of the Council of Europe to natural and semi natural areas and landscapes of exceptional European importance for the preservation of biological, geological and landscape diversity and managed in an exemplary way (Council of Europe, 2012). There have been four Diplomas awarded to sites within the UK, one of which is Fair Isle, Map 9.

Protected species and habitats

Many wildlife species are legally protected by a range of national and international legislation. These laws are designed to protect rare and vulnerable species as well as their breeding and resting places. Their presence or potential presence is an important consideration in decisions on planning applications, works licences and marine licences.

Internationally Protected Species

The EU Habitats Directive requires strict protection of a number of marine species of European importance, as listed in Annex IV of the Directive. In Shetland's marine environment these most notably include all species of cetaceans, some fish species, and the European otter, which forages in Shetland's coastal waters. The EU Habitats Directive also makes provision for the protection of select species from exploitation, as listed in Annex V of the Directive. These species are termed 'European Protected Species'. In addition seals are included within Annex II and V of the Habitats Directive which puts requirements on their management, surveillance and protection.

All species of wild birds are protected by the EU Birds Directive.

Nationally Protected Species

The Wildlife and Countryside Act 1981 (W&CA), as amended and enhanced by the Nature Conservation (Scotland) Act 2004 and The Wildlife & Natural Environment (Scotland) Act 2011 (the 'WANE Act'), provides a framework that protects animals, plants, and certain habitats in Scotland. The W&CA (as amended) details a large number of offences in relation to the killing, injuring and taking of wild birds, other animals and plants. The W&CA (as amended) also makes it an offence to intentionally or recklessly disturb a basking shark. In addition, both grey and harbour seals are protected under the Marine (Scotland) Act 2010

Wider Sea Biodiversity

Scottish Natural Heritage and the JNCC have worked together, with Marine Scotland, to develop a priority list of marine habitats and species in Scotland's seas, known as Priority Marine Features (PMFs). The list helps to deliver Marine Scotland's vision for marine nature conservation, outlined in the Marine Nature Conservation Strategy.

The list contains 81 habitats and species considered to be of conservation importance in Scotland's seas. It includes many features which are characteristic of the Scottish marine environment, ranging from horse mussel beds in coastal waters, to cold-water coral reefs of the deeper seas, and mobile species such as minke whale and basking shark. There are 50 PMF species known to be present within the Shetland Marine Region. However, it should be noted that whilst these species are identified as a priority for conservation, biodiversity outside of these features also provides a range of ecosystem services.

Cetaceans

Killer whales © NAFC Marine Centre

Whales, dolphins, and porpoises are collectively known as cetaceans. The continental shelf to the north and west of Scotland provides an ideal habitat for a highly diverse range of cetacean species. In Shetland, there have been 15 species of cetaceans observed in coastal and offshore environments, although some are seen throughout the year, others are vagrants or rare-visitors (e.g. fin whale).

Observed cetacean species with the Shetland Marine Region include:

- Harbour porpoise (*Phocoena phocoena*)
- Common dolphin (*Delphinus delphis*)
- Risso's dolphin (*Grampus griseus*)
- Striped dolphin (*Stenella coeruleoalba*)
- White-beaked dolphin (*Lagenorhynchus albirostris*)
- White-sided dolphin (*Lagenorhynchus acutus*)
- Fin whale (*Balaenoptera physalus*)
- Humpback whale (*Megaptera novaeangliae*)
- Killer whale (*Orcinus orca*)
- Minke whale (*Balaenoptera acutorostrata*)
- Pilot whale (*Globicephala melas*)
- Pygmy sperm whale (*Kogia breviceps*)
- Sperm whale (*Physeter macrocephalus*)
- Sei whale (*Balaenoptera borealis*)
- Beluga whale (*Delphinapterus leucas*)

Key Protection and Legislation

- Habitats Directive Annex IV European Protected Species (EPS)
- Habitats Directive Annex II (harbour porpoise only)
- OSPAR Threatened and/ or declining species (harbour porpoise only)
- Wildlife and Countryside Act Schedule 5

Assessment Cetaceans

Some concerns

Trend: No evidence

Confidence: Low - Across the North Sea cetaceans are thought to be in favourable condition, although some are recovering from historical exploitation, and some species are data deficient.

Key Ecosystem Services

- Tourism and nature watching
- Nutrient cycling

- Priority Marine Feature within 12 nm (harbour porpoise, common dolphin, Risso's dolphin, white-beaked dolphin, white-sided dolphin, killer whale, minke whale)
- CITES (Appendix I or II)
- BAP Priority Species
- IUCN Global Red List
- ASOBANS (Agreement on the Conservation of Small Cetaceans in the Baltic, North East Atlantic, Irish and North Seas)

Key Potential Sensitivities

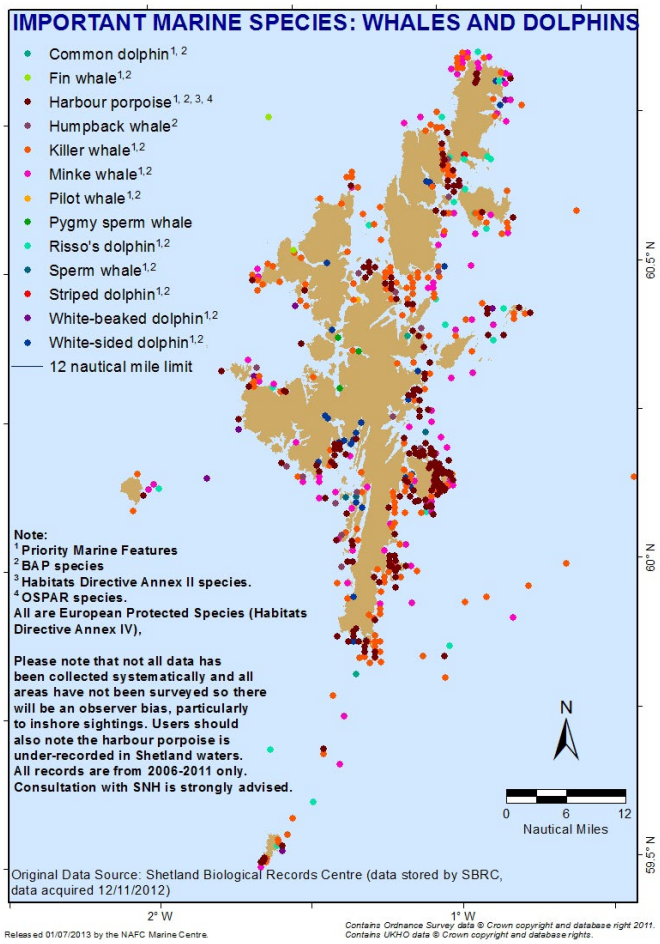
- Disturbance, in particular created by noise (e.g. shipping, oil and gas activities, acoustic deterrents, construction, renewable energy development)
- Pollution (e.g. PCBs, mercury, dioxins, biotoxins)
- By-catch (particularly harbour porpoise)
- Entanglement
- Vessel strikes
- Ingestion of marine litter
- Low population levels of some species
- Predation by other species (in particular harbour porpoises)

Distribution

Cetaceans are highly mobile species and some perform long-distance seasonal migrations to find food, to mate, or to raise young in nursery grounds. This migratory behaviour explains why not all cetaceans are year-round visitors in Shetland, as many will leave Scottish waters during migration. Of the 15 species found around the Shetland Islands, five are considered year-round visitors (killer whales, minke whale, white-beaked dolphin, harbour porpoise, and Risso's dolphins), while the remaining are either seasonal migratory species, deep-water species, or rare.

The distribution (seasonal and temporal) of cetaceans around Shetland is poorly understood as data has not been collected systematically and all areas have not been surveyed, creating an observer bias. Migratory species, such as minke whales may be sighted more frequently when they migrate south into UK waters for the summer months. The common dolphin is also known to migrate offshore in the winter and inshore in the summer.

However, headlands such as Sumburgh Head and Hermaness, and tidal sounds such as Yell Sound, Noss Sound, Melby Sound and Bluemull Sound are thought to be important foraging areas for many species. Public and professional observation records are shown in Map 10.



Map 10: Cetacean sightings in the Shetland Marine Region

Pressures and Trends in Shetland

Due to the mobile nature of cetaceans pressures in the Shetland Marine Region need to be considered in the context of the wider population. The JNCC has developed management units for 6 cetaceans in UK waters[45], with the management units relevant to Shetland either North Sea wide or Celtic and North Sea wide, Table 6. Based on post-mortem evidence, by-catch is the main known pressure on harbour

45 IAMMWG (2015) Management Units for cetaceans in UK waters (January 2015). JNCC report No. 547, JNCC Peterborough. http://jncc.defra.gov.uk/pdf/Report_547_webv2.pdf

Table 6: Population estimates and key pressures for key cetacean species found in the Shetland Marine Region since 1970

Species	Management Unit Area	Population estimate MU (95% CI)	Main identified population pressure	Shetland area pressure
Harbour porpoise	North Sea	176 360- 292 948	By-catch	Acoustic disturbance
Common dolphin	Celtic and greater North Sea	33 014– 96 920	By-catch	Acoustic disturbance
Bottlenose dolphin	Greater North Sea	0#	By-catch	Acoustic disturbance
White-sided dolphin	Celtic and greater North Sea	34 339–139 828	Acoustic disturbance	Acoustic disturbance
Risso's dolphins	Celtic and greater North Sea	Not known	By-catch*	Not-known
Minke whale	Celtic and greater North Sea	13 989 – 39 572	Entanglement	Entanglement

Sightings thought to individuals belonging to the Coastal Scottish Group
* Limited evidence

porpoise, common dolphin, bottlenose dolphin and Risso's dolphin.

Acoustic disturbance is identified as a potential impact on cetaceans, with acoustic deterrents a potential continual source of anthropogenic noise in Shetland waters. Acoustic deterrents are used on finfish farms within many voes and sounds within Shetland, but are not normally licensed in areas where potential impact on cetaceans are highlighted, such as Yell Sound and adjacent to Melby Sound. Fish farm numbers are currently stable. Noise from shipping will be greatest in the busiest areas of Shetland which are Scalloway and Lerwick harbours and their approaches. The potential growth of the marine renewables sector has the potential to introduce a new source of marine noise in the future, both during construction and operation phases. In addition, there has been increased interest for seismic surveys for oil and gas within the Shetland Marine Region, which could introduce new sources of noise to the marine environment.

In Shetland 47 strandings of cetaceans have been recorded from 2010-2015. Due to the low number of strandings records, and to the non-systematic nature of recording, it is not possible to identify any trends. The most common species recorded as strandings are; harbour porpoise (10), Rissos dolphins (9), long-finned pilot whales (7), Atlantic white-sided dolphins (6) and stripped dolphins (5). There are also stranding records of killer whales, pygmy sperm whales, sperm whales, white beaked dolphins and minke whales over this time period.

Of the stranding records from 2010-2015, the cause of stranding is not known in 70% of cases (33), natural causes account for 28% (13) of strandings and entanglement accounted for just one stranding record (2%)- a minke whale entangled in creels in 2014. In addition a humpback whale is known to have become entangled in creels in 2010 and is presumed to have died, although it was not recovered[46].

Of additional concern is the levels of contaminants such as PCBs and heavy metals, with heavy metals having been shown to reduce reproductive success in certain cetacean species. While environmental legislation has controlled the discharges of heavy metals, and the use of PCBs was banned in 1987, it is likely to take some time until an improvement in environmental quality is seen in long-lived species such as cetaceans without active re-mediation.

Ecosystem Services Cetaceans

Service type	Benefits provided	Key risks and opportunities
Cultural	Prolific coastal communities	Communities can be maintained through employment opportunities. Measures to maintain cetacean populations around the Shetland coast can provide financial stability to coastal communities.
	Tourism and nature watching	Wildlife watching provides tourism and recreational opportunities. Reducing and avoiding impacts on cetaceans can help to support these activities.

46 Source: Scottish Natural Heriage, Lerwick.

Otters
Lutra Lutra

Otter © Kathryn Allan

Otters are largely solitary, semi-aquatic mammals. In Shetland the otter population is coastal-dwelling and individuals feed almost exclusively in the sea, although they will also forage in freshwater lochs. Around the coast they forage in shallow areas, normally to no more than 10m in depth and feed on fish such as eelpout, butterfish and scorpion fish, as well as crustaceans. They need sources of freshwater to clean their fur and to drink. Otters shelter and rest either below ground in holts or above ground in couches.

Key Protection and Legislation

- Habitats Directive Annex IV European Protected Species (EPS)
- Habitats Directive Annex II- Yell Sound SAC
- SSSI Yell Sound
- Wildlife and Countryside Act Schedule 5
- Priority Marine Feature
- CITES (Appendix I)
- BAP Priority Species
- IUCN Global Red List- Near threatened

Key Potential Sensitivities

- Disturbance (e.g. terrestrial and marine developments)
- Changes in prey abundance
- Pollution (e.g. PCBs, mercury, dioxins)
- Entanglement
- Road kill
- Seaweed harvesting

Distribution

Whilst otters can be found along most of the Shetland coastline they are at their highest density in tidal sounds such as Hascosay Sound and Yell Sound, which are designated SACs for otters. Areas of high otter density are characterised by low-lying peaty coastlines, with large numbers of otter holts and easy access to fresh water. The adjacent marine areas have extensive algal beds, used for foraging. Relative frequency of otter sightings are shown in Map 11. Note not all data has been collected systematically so there will be an observer bias.

Assessment

Few concerns

Trend: Stable

Confidence: Moderate- The Shetland Amenity Trust undertakes yearly monitoring along six stretches of coast. UK context: Across the UK otters have repopulated every county, with river pollution the main cause for historical declines.

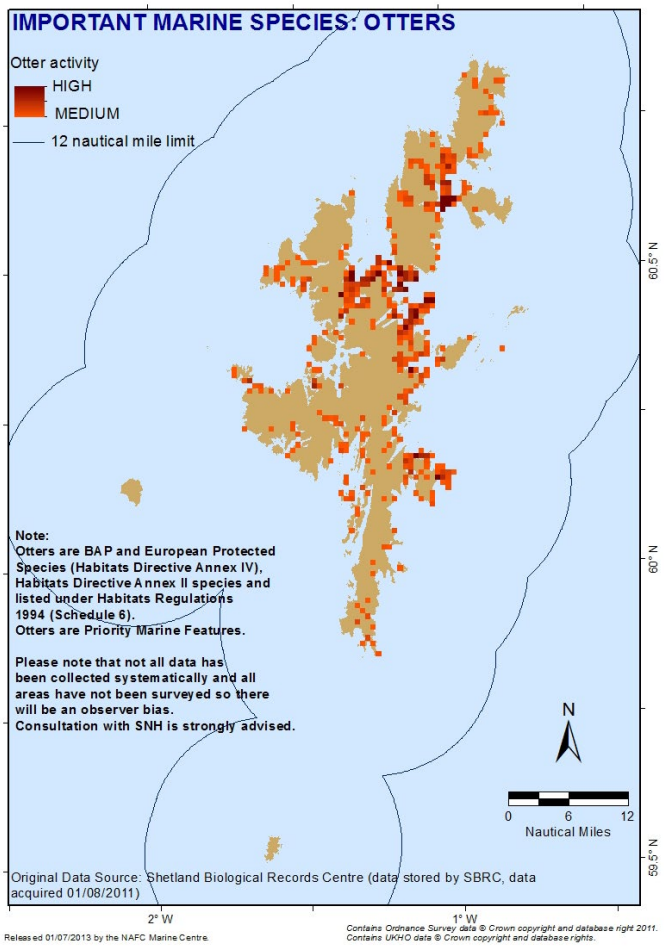
Key Ecosystem Services

- Tourism and nature watching

Pressures and Trends in Shetland

Prey availability is likely to be the primary natural determiner to otter numbers and distribution. While prey availability will be subject to natural spatial and temporal variations, it also has the potential to be influenced by a number of human induced factors including climate change, fisheries and development pressures, indirectly influencing otter numbers.

Principal non-natural issues directly affecting otter numbers are considered to be road kill and other mortalities caused by humans, with commercial eel fishing and ‘creeling’ for crustaceans identified as a threat in some areas, Figure 13.



Map 11: Otter sightings in the Shetland Marine Region

In Shetland the number of otters known to have been killed in road traffic accidents was 30 in 2016[47], this is equal to the 2015 total, and higher than at any other time since records began in 1981. Data are missing from 2012 and 2013, and cause of death was not recorded in 2004 and 2005. With a number of data years missing or incomplete it is difficult to discern a trend in road traffic deaths, and collection of corpses is not systematic. Road traffic levels are not recorded but specific projects can increase traffic, such as the construction of the Shetland Gas Plant, which lasted from 2011 to spring 2016. However, the increase in corpse number does not show clear linkage with associated traffic routes.

Figure 13: Number of otter deaths in Shetland reported to SNH from 2000-2016. Note data are missing from 2012 and 2013 and cause of death was not recorded in 2004 and 2005.

In the future road traffic is likely to increase during the construction of the proposed Viking windfarm, which could lead to increased road traffic casualties. Additional future pressure could also come from seaweed harvesting, if it grows as a sector, potentially affecting otter foraging habitat. Increased coastal development could also disturb otters resting areas.

In Shetland the otter population was estimated as 700-900 adults in 1988 . The Shetland Amenity Trust started monitoring otter numbers annually in 2010. A total of six stretches of coastline are surveyed. These surveys indicate that the species is in favourable conservation status, with the number of active holts at monitored sites approximately 20% higher than the mean number recorded between 2010-2014.

Ecosystem Services Otters

Service type	Benefits provided	Key risks and opportunities
Cultural	Prolific coastal communities	Communities can be maintained through employment opportunities. Measures to maintain otter populations around the Shetland coast can provide financial stability to coastal communities.
	Tourism and nature watching	Wildlife watching provides tourism and recreational opportunities. Reducing and avoiding impacts on otters can help to support these activities.

47 Source: Scottish Natural Heritage, Lerwick

Seals

Common seal © Kenny Gifford

There are two species of seal which breed around the Shetland Islands – the grey seal (*Halichoerus grypus*) and the harbour seal or common seal (*Phoca vitulina*). Seals, also known as pinnipeds, are marine mammals that spend the majority of their time at sea but come ashore to moult, breed, and rest. The coastline of the Shetland Islands provides important haulout sites for both grey and harbour seals, including designated haulout sites (see Map 12).

Key Protection and Legislation

- Habitats Directive Annex II - Yell Sound SAC and Mousa SAC
- Habitats Directive (Annex II and V)
- Priority Marine Feature
- BAP Priority Species (harbour seal only)
- The Marine (Scotland) Act 2010
- The Protection of Seals(Designation of Haul-Out Sites) (Scotland) Order 2014

Key Potential Sensitivities

Harbour (common) seals:

- Increased competition with grey seals
- Disease (e.g., Phocine Distemper Virus)

Grey seals and harbour (common) seals:

- Marine pollution (e.g., hydrocarbons, pathogens from sewage, PCBs, biotoxins)
- Entanglement in marine litter
- Collisions with ships and propeller strikes
- Noise and disturbance from shipping, anti-predator acoustic devices and recreational activities, both at sea and on land (disturbance at haul-out sites)
- Regulated and unregulated lethal control
- Climate change has the potential to affect the distribution and abundance of prey species and impact haul-out and pupping sites
- Killer whale predation

Assessment Seals

Grey seals

No concerns

Trend: Stable

Confidence: Moderate- Annual counts but 100% coverage is not achieved every year. Grey seal numbers have increased in many areas across Scotland, in particular Orkney.

Harbour (common) seals

Many concerns

Trend : Declining

Confidence: Moderate- Although infrequent counting makes it difficult to assess the Shetland population with a high degree of confidence, time series data spanning a period of over 20 years is available to assess trends. Population counts are considerably lower than historical maximum and although there is evidence that the population may now have stabilised, the overall trend has been one of decline. Harbour seal numbers have shown an overall decrease in numbers on the east coast of Scotland, Orkney and Shetland, with other parts of Scotland, particularly the west coast showing increases in recent years.

Ecosystem Services

- Tourism and nature watching

Distribution

Grey seals are present throughout the Shetland Islands with important pupping and nursery grounds

at Papa Stour, Uyea, Fair Isle, Mousa, and Whalsay. Population sizes can be variable, but Papa Stour, Mousa and Uyea tend to have the highest number of pups. The adult population numbers can be highly variable, but the three key haulout sites are the south west Mainland, the Out Skerries, and St. Magnus Bay.

Harbour seals can also be found throughout the Shetland Islands, with the largest haulouts in Yell Sound, St. Magnus Bay and the Deeps.

Protected haulout sites for grey and common seals are shown in Map 12.

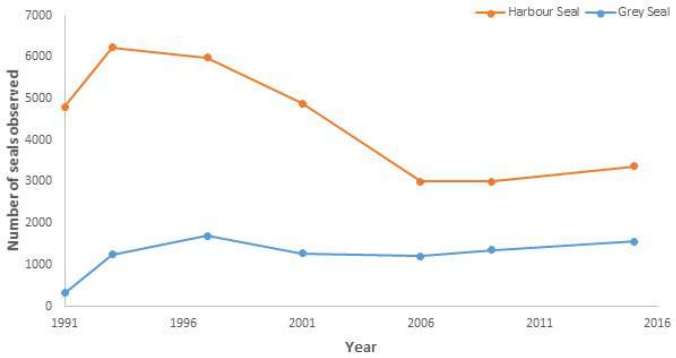
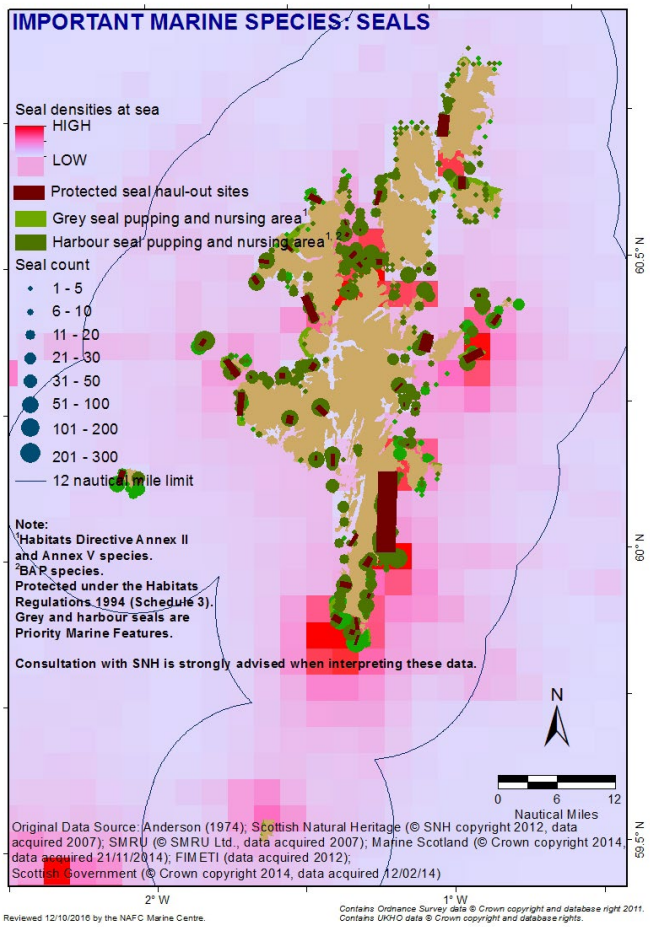


Figure 14: Total counts of harbour and grey seals (during August) around the Shetland Islands from 1991-2015 (data SNH/ SMRU 2016)



Map 12: Distribution of seals at sea and on land and protected seal haulouts within the Shetland Marine Region

Table 7: August counts of harbour seals in subregions of the Shetland Seal Management Area. The highest completed counts for each subregion are in green and the lowest counts in red. Data from aerial surveys carried out by the Sea Mammal Research Unit on behalf of Scottish Natural Heritage.

SMRU sub regions	1991	1993	1997	2001	2006	2009	2015
Southwest mainland	339	385	359	264	141	116	210
The Deeps	125	273	258	202	308	227	358
West Mainland	130	185	148	137	99	88	93
Foula*	0	3	*3*	*3*	36	*36*	18
St Magnus Bay	343	660	627	856	424	550	682
Northwest mainland	119	65	58	140	54	39	66
Yell Sound	861	929	1506	992	642	572	638
Yell	352	353	247	239	183	168	314
Unst	346	288	338	140	49	72	51
Fetlar	354	568	297	126	53	76	80
Out Skerries	280	326	140	229	16	29	10
Whalsay	416	512	397	313	98	243	181
East Mainland	286	335	281	170	192	176	321
Bressay	116	83	159	59	45	29	40
Southeast mainland	342	807	774	781	615	525	284
Mousa	388	455	402	235	83	93	23
Total	**4797**	**6227**	**5994**	**4886**	**3038**	**3003**	**3369**

*Foula not surveyed in 1997, 2001 and 2009. Count from the most recent survey used

Foraging areas have been identified for harbour seals and grey seals by the Sea Mammal Research Unit Ltd[48] through a small-scale satellite tagging study; these can be seen in the Map 12.

Pressures and Trends in Shetland

Approximately 32% of the world's population of grey seals can be found in Scotland. It is estimated that the Shetland population is 3 500. The number of grey seals observed hauled during the harbour seal surveys (summer months) was 1 588 in 2015. Note this figure is expected to be lower than the total population estimate as counts are normally undertaken during moulting or breeding, which for grey seals is in the winter, Figure 14.

Approximately 80% of the UK's harbour seal population can be found in Scotland and, within Scotland, 13% (3 369 [2015]) can been found within the Shetland Islands. Harbour seal counts in the Shetland Islands reached a peak in 1993 (6 224) but counts declined from 1993 to 2009, but since 2006 have become more stable and showed the first increase in 2015, Figure 14. Harbour seals can be found throughout the Shetland Islands, with the largest 2015 populations around Yell Sound (638), St. Magnus Bay (682) and the Deeps (358). Some areas within Shetland have shown an increase in seal numbers in recent years, including the Deeps, St Magus Bay, Yell Sound, and east mainland. While Mousa, southeast mainland, Out Skerries, Unst and Fetlar have shown large drops in observed numbers, Table 7.

A known pressure within the Shetland Marine Region (SMR) is the granting of seal management licences, with 55 licences granted for grey seals (PBR 235), 3 granted for harbour seals (PBR 18) in 2016. Across Scotland there has been a 72% reduction in the number of licences granted since the system began in 2011.

Illegal killing of harbour and grey seals has been known to be a problem in some parts of Shetland in the past, with two prosecutions. The impact of illegal killing is unknown.

Recreation and tourism has the potential to cause disturbance particularly within areas popular with visitor such as Mousa and southeast Shetland, but is less likely to be a consideration at more remote locations such as Out Skerries.

Ecosystem Services Seals

Service type	Benefits provided	Key risks and opportunities
Cultural	Prolific coastal communities	Measures to maintain seal populations around the Shetland coast can provide financial stability to coastal communities through tourism employment opportunities e.g. boat tours.
	Tourism and nature watching	Wildlife watching provides tourism and recreational opportunities. Reducing and avoiding impacts on seals can help to support these activities.

48 Jones EL, McConnell BJ, Smout S, Hammond P.S., Duck CD, Morris CD, Thompson D, Russell DJF, Vincent C, Cronin M, Sharples RJ & Matthiopoulos J (2015) Patterns of space use in sympatric marine colonial predators reveal scales of spatial partitioning. Marine Ecology Progress Series, 534, 235–249.

Breeding Birds

Black Guillemot © Richard Shucksmith

Shetland is home to internationally important colonies of breeding birds. These colonies can act as indicators of the state of the marine environment, with breeding birds reacting to changes in food availability, weather, predation and pollution.

Important bird species that rely on the sea during the breeding season observed with the Shetland Marine Region include:

- Eider duck *Somateria mollissima*
- Red-throated diver *Gavia stellata*
- Northern fulmar *Fulmarus glacialis*
- European storm petrel *Hydrobates pelagicus*
- Leach's petrel *Oceanodroma leucorhoa*
- Northern gannet *Morus bassanus*
- Great cormorant *Phalacrocorax carbo*
- European shag *Phalacrocorax aristotelis*
- Artic skua *Stercorarius parasiticus*
- Great skua *Stercorarius skua*
- Lesser black backed-gull *Larus fuscus*
- Herring gull *Larus argentatus*
- Great black-backed gull *Larus marinus*
- Black-legged kittiwake *Rissa tridactyla*
- Common tern *Sterna hirundo*
- Arctic tern *Sterna paradisaea*
- Common guillemot *Uria aalge*
- Razorbill *Alca torda*
- Black guillemot *Cepphus grylle*
- Atlantic puffin *Fratercula arctica*

Key Protection and Legislation

- EC Birds Directive
- Birds of Conservation Concern
- BAP Priority Species (Artic skua)
- OSPAR Threatened and/ or declining species

Assessment Breeding birds

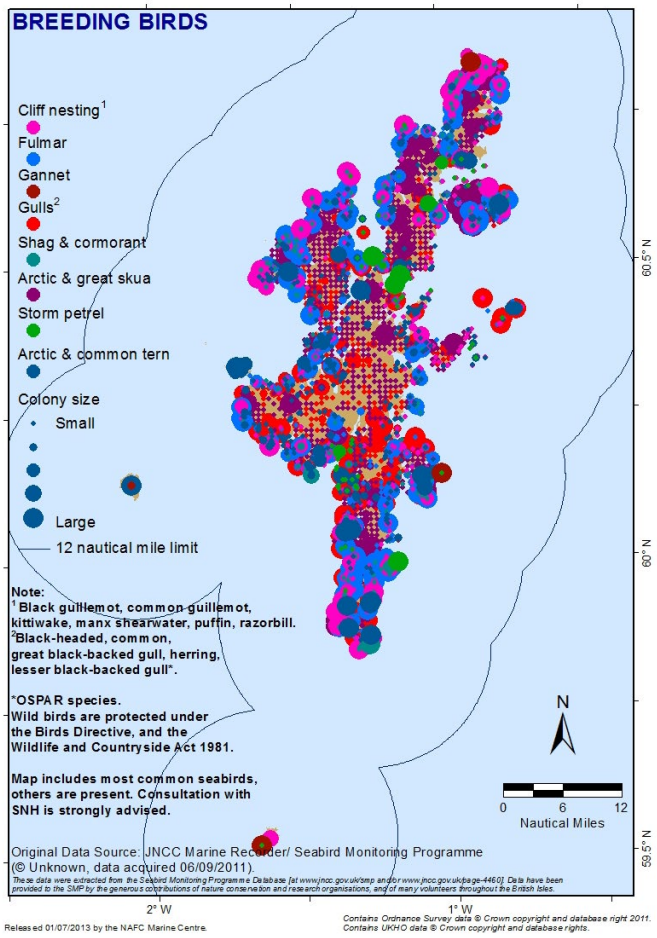
Many concerns

Trend: Species specific but many species showing deterioration

Confidence: High - Breeding bird monitoring is carried out by a number of organisations in Shetland and long-term data sets exist.

Key Ecosystem Services

- Tourism and nature watching



Map 13: Distribution of breeding bird colonies

Key Potential Sensitivities

- Oil spills (see Clean and Safe- Oil Spills)
- Pollution
- Food availability
- Changes in weather patterns
- Ingestion/ entanglement in marine litter
- Predation of chicks and eggs by mammalian and avian predators during breeding (e.g. rats, hedgehogs, otters, gulls and great skuas)
- Disturbance (on nest sites and at sea)

Distribution

Although breeding birds can be found throughout Shetland the largest colonies are found at Fair Isle, Foula, Hermaness, Mousa, Noss, Ramna Stacks and Gruney, and Sumburgh Head, all of which are classified as SPAs because of their seabird interest. Most of these colonies are found nesting on sea cliffs and steep banks, see Map 5 for SPA locations and Map 13 for breeding bird colonies.

Pressures and Trends in Shetland

Abbreviations
AON Apparently occupied nests
AOT Apparently occupied territories

Eider duck (Somateria mollissima)

Eiders are found in inshore waters around Shetland year round and breed on beaches or along the coastal strip. Surveys of eider ducks have been undertaken by SOTEAG during the late summer moulting period[49]. These surveys indicated a large decline in the population between 1977 and 2012 (17 000 in 1977, 6 000 in 1997, 5 782 in 2009, to 4 627 in 2012), since then the population appears to have stabilised. Additionally, survey results suggest a large change in the population distribution, with birds moving from traditional outer coastline locations to the inner-coastline where shellfish aquaculture is prevalent. By 2009–12 approximately two-thirds of the moulting population was associating with aquaculture sites. The cause of the observed decline is thought to be due to a combination of factors including: mortality from oil pollution, deterrence measures taken at aquaculture sites, and predation by marine mammals, especially by killer whales (*Orcinus orca*).

Red-throated diver (Gavia stellata)

Although red-throated divers breed on inland lochs, they are dependent on the inshore marine environment for their food. Shetland supports around 30-40% of the British population and breeding numbers in Shetland are considered to be stable, contrasting with significant increases (34%) across Scotland[50].

Fulmar (Fulmarus glacialis)

Monitoring of fulmar populations within the Hermaness, Noss, Foula and Fair Isle SPAs indicate that in the Seabird 2000 census the Shetland fulmar population was 61 378, a 1% change from the Seabird colony register census (1985-88) at 60 478 birds. This is consistent with monitoring undertaken by SOTEAG which found a steady increase at monitoring stations from 1977-2000, followed by fluctuations in numbers, with a peak in 2010, with a more recent gradual downward trend until the most recent count data in 2016. SOTEAG monitoring is undertaken at Sumburgh Head, Troswick Ness, Eshaness and Burravoe. Fulmar populations may, in-part be influenced in changes in fisheries discard practices.

European storm petrel (Hydrobates pelagicus)

The island of Mousa is home to the largest colony of storm petrels in the UK, with monitoring in 2008 suggesting a colony of 11 781, an increase of 118% from the previous survey in 1996, although this species is difficult to census accurately. The Mousa colony represents approximately 40% of the UK population. A small number of pairs also breed on Fair Isle, Foula, Colsay, Noss, Scalloway Isles, Yell Sound Islands and the islands off Whalsay and Unst.

Northern gannet (Morus bassanus)

Since the 2000 bird census the population of Northern gannet has increased across the UK, with a 34% increase between 2003 and 2013-2015. The population increased by 56% over the same time period although at Fair Isle, the only colony counted annually, the population has declined slightly since. The Shetland population was estimated at 42 183 AONs in 2013-2014, 17% of the Scottish total and 14% of the UK total.

Great cormorant (Phalacrocorax carbo)

Great cormorants build large conspicuous nests with coastal colonies normally situated on stacks, rocky

49 Heubeck M, Mellor M (2013) Recent changes in the status and distribution of moulting Common Eiders *Somateria mollissima* in Shetland. Seabird 26: 71-86

50 Dillion IA, Smith TD, Williams SJ, Haysom S, Eaton MA (2009) Status of Red throated divers *Gavia stellata* in Britain in 2006. Bird Study 56 (2), 147-157

islets, cliffs or rocky promontories. Although some colonies persist at the same location for long periods, others come and go, or suddenly shift location. This introduces uncertainty in population size when counts from a number of years have to be combined. Current UK population estimates are from the Seabird 2000 Census, with a UK population estimate of 7 238. The Shetland population is believed to have declined nearly 50% between the National Seabird Census in 1969-70, and 2000-01. The latest count in 2016 revealed 197 AONs, representing a further 19% decline. This contrasts with the Scottish trend of a population increase of around 25% between 1969-70 and 2000.

European Shag (Phalacrocorax aristotelis)

Scotland holds about 80% of the European shags found nesting in the UK, Shetland has previously represented up to 15% of this total. However, by 2015, population sizes at three major colonies in Shetland (Fair Isle, Foula and Sumburgh Head) declined by c. -90% since the Seabird 2000 census. Population estimates at Fair Isle declined from 663 pairs in 2001 to 204 pairs in 2013 (69%), in Foula from 2 300 pairs in 2000 to 48 pairs in 2015 (98%), and at Sumburgh Head from 252 pairs in 2002 to 111 pairs in 2016 (56%). Along other monitored stretches of coastline the population declined by 43% between 2010 and 2016. A study of European shag population and breeding dynamics at these colonies suggested that the majority of the decline could be accounted for by a combination of local food shortages and (probably) high mortality associated with prolonged gales in the late winter of 2003, 2011 and 2014[51]. European shag has recently been added to the UK Red list[52] because of severe population decline. Continued and potentially enhanced monitoring and ringing of this species is necessary.

Artic skua (Stercorarius parasiticus)

The Arctic skua is considered to have declined more than any other seabird in the UK in the period from 1986 to 2014. The Seabird 2000 census only recorded 2 100 AOT, 37% fewer than the preceding census, with the population index in 2014 estimated to be 81% lower than in 1986. In the past, Shetland has been home to over 50% of the UK (and Scottish) population. Arctic skuas in Shetland are known to have declined by 42% between the Seabird Colony Register (1985-88) and Seabird 2000, and monitoring at a small number of colonies suggests there were 47% fewer AOTs in 2016 than in 2010. Contributory factors to the national decline include competition for nesting territories with great skuas[53] (which have increased markedly), and reductions in sandeel stocks, particularly around Shetland[54]. Analysis of data from the Orkney population attributes the decline there to a scarcity of food coupled with predation by great skuas (also ultimately linked to a scarcity of alternative fish prey for great skuas)[55].

Great skua (Stercorarius skua)

The great skua, or bonxie, has a very restricted breeding range – confined to the northeast Atlantic, the World population is only around 16 000 apparently occupied territories (AOTs), of which 60% are in Scotland, concentrated in Shetland and Orkney.

The largest Shetland colony off Foula showed a decline of 28% from 2 293 AOTs to 1 657 AOTs between 2000 and 2007 but has not been surveyed since. At four other sites (Hermaness, Noss, Mousa and Fair Isle) the population increased by 27% between 2007 and 2013 while annual monitoring has revealed continued increases at the smaller colonies on Fair Isle and Mousa since 2013.

Black-legged kittiwake (Rissa tridactyla)

The UK kittiwake abundance index declined rapidly since the early 1990s, such that by 2015 the index was 60% below 1986 levels, the third lowest value in 29 years of monitoring. It is thought that the UK population has declined from 378 800 pairs to between 150 000 and 250 000 pairs. The Shetland population of kittiwakes declined 88% from 16 053 pairs in the Seabird 2000 census, to 1 981 in 2013-

51 Heubeck M, Mellor RM, Gear S, Miles WTS (2015) Population and breeding dynamics of European Shags *Phalacrocorax aristotelis* at three major colonies in Shetland, 2001-15. Seabird 28: 55-77.

52 Eaton MA, Aebischer NJ, Brown AF, Hearn RD, Lock L, Musgrove AJ, Noble DG, Stroud DA, Gregory RD (2015) Birds of Conservation Concern 4: the population status of birds in the United Kingdom, Channel Islands and Isle of Man. British Birds, 108, 708–746.

53 Furness RW, Ratcliffe N. (2004) Arctic Skua *Stercorarius parasiticus*. In: Mitchell PI, Newton SF, Ratcliffe N, Dunn TE (eds.) 2004. Seabird Populations of Britain and Ireland:160-172. Poyser, London

54 Phillips RA, Caldow RWG, Furness RW (1996) The influence of food availability on the breeding performance and reproductive success of Arctic Skuas. Ibis. 138, 410-419

55 Meek ER, Bolton M, Fox D, Remp J (2011) Breeding skuas in Orkney: a 2010 census indicates density-dependent population change driven by both food supply and predation. Seabird. 24, 1-10

2014. Counts at monitored plots suggest this decline has continued with 39% fewer pairs in 2016 than 2010. Declines in Shetland and across the UK are attributed to an increase in sea surface temperature in January, leading to changes in plankton fauna and reduced sand eel abundance.

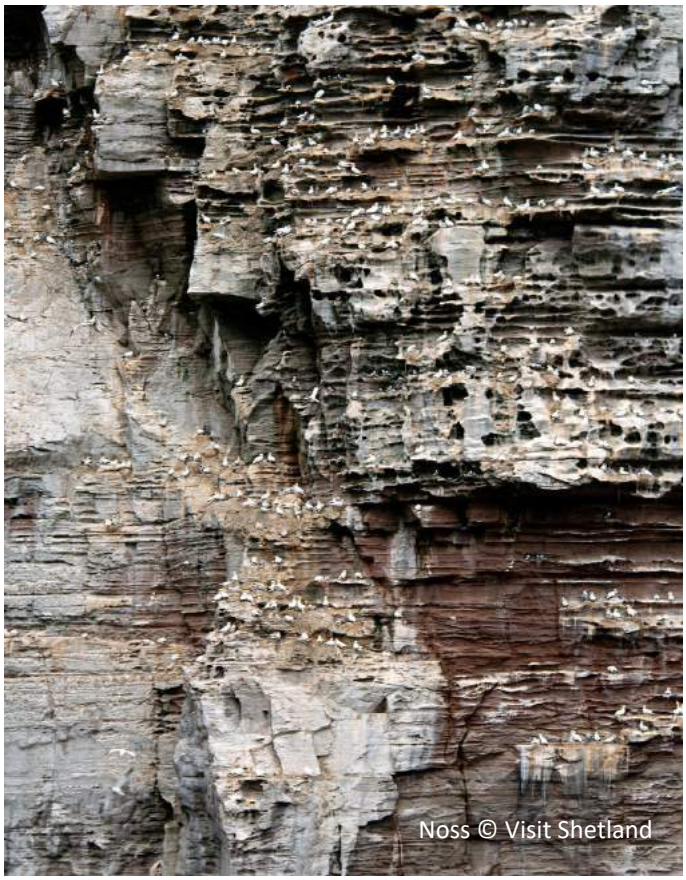
Artic tern (Sterna paradisaea)
Arctic terns are the commonest tern breeding in the UK, and around 70% of the population is believed to breed in the Northern Isles. In Shetland, Artic tern numbers have declined in recent years, along with consistently low levels of breeding success. This has been attributed largely to changes in sand eel abundance.

Common guillemot (Uria aalge)
Common guillemot populations across the UK have been predominantly stable or increased in recent years, however in Shetland populations have declined sharply, by an average of 51% across Shetland's SPAs, from a total population estimate of 153 545 attendant adults in the Seabird 200 census, to 80 794 in 2015. Indications at monitoring plots suggest the population is now stable. Changes in sand eel abundance have been identified as a key driver in this population change.

Razorbill (Alca torba)
The Shetland population of razorbills has shown a marked decline with the number of adults at Shetland's key SPAs, declining by 68% from 7 799 individuals in 2000 to 2 489 individuals in 2015. SOTEAG monitoring plots suggest the population has been stable since 2000.

Black guillemot (Cepphus grylle)
Approximately half of the UK's population breeds around the Northern Isles, with the remainder confined mainly to the coasts and islands of north and west Scotland. Their distribution within the core range is determined by the availability of suitable nest cavities that are safe from land predators. Monitoring suggests that since 2003 populations have been relatively stable across Shetland, although there has been a pattern of localised increases and decreases, presumably due to site specific factors. Black guillemots are included within the Fetlar to Haroldswick nature conservation MPA.

Atlantic puffin (Fratercula arctica)
Puffins are a difficult species to census accurately but all the anecdotal evidence points to a large scale decline across Shetland. Potential factors influencing this decline including climate change, changes in sand eel abundance and plankton timing.


Noss © Visit Shetland

Ecosystem Services Breeding Birds

Service type	Benefits provided	Key risks and opportunities
	Nutrient cycling	Reduction in breeding bird populations could alter patterns in nutrient cycling.
Cultural	Prolific coastal communities	Measures to maintain seabird populations around the Shetland coast can provide financial stability to coastal communities through tourism employment opportunities e.g. boat tours.
	Tourism and nature watching	Wildlife watching provides tourism and recreational opportunities. Reducing and avoiding impacts on seabirds can help to support these activities.

Wintering Birds- Ducks, Divers and Grebes

Red-throated diver © Richard Shucksmith

Shetland is home to internationally important wintering populations of several species, in particular:

- Eider ducks *Somateria mollissima*
- Long-tailed ducks *Clangula hyemalis*
- Red-breasted merganser *Mergus serrator*
- Great northern divers *Gavia immer*
- Slavonian grebe *Podiceps auritus*

Protection and Legislation

- EC Birds Directive - migratory species
- Birds of Conservation Concern 4

Key Sensitivities

- Pollution (e.g. oil spills)
- Food availability
- Ingestion of marine litter
- Disturbance on the water

Distribution, Pressures and Trends

The distribution of wintering birds are shown in Map 14.

Eider ducks (Somateria mollissima)

Surveys of moulting and wintering birds indicate a large change in the distribution of eiders in Shetland outside the breeding season, with birds moving from traditional outer coastline locations to the inner-coastline where shellfish aquaculture is prevalent. By 2009–2012 approximately two-thirds of the moulting population was associating with aquaculture sites. There have been a number of incidents of mussel farmers deliberately disturbing eider flocks and this may have an impact on female body condition prior to egg-laying.

Assessment Wintering birds

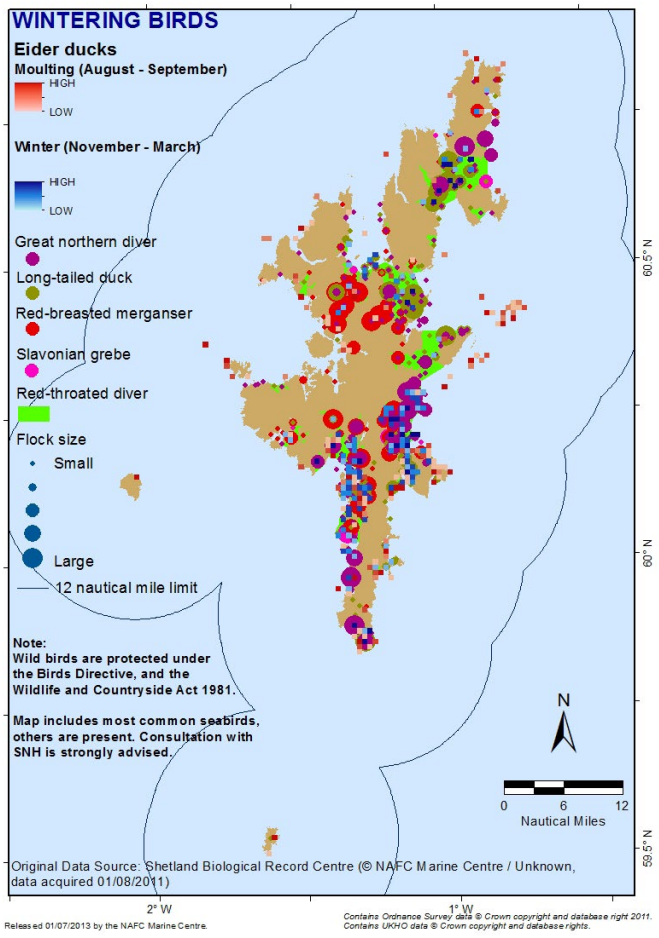
Some concerns

Trend: Stable but species specific

Confidence: Moderate - Wintering bird monitoring is carried out by a number of organisations in Shetland and long-term data sets exist for some species.

Key Ecosystem Services

- Tourism and nature watching



Map 14: Distribution of wintering bird colonies

Long-tailed ducks (Clangula hyemalis)
The majority of the UK wintering population occurs along the east coast of mainland Scotland, Shetland, Orkney and the Outer Hebrides. In recent years the largest concentration of long-tailed ducks in Shetland has occurred in the Bluemull Sound/south Unst area, where 900 were counted in 2016. These appear to be associated with aquaculture cages which is a new phenomenon. The next highest concentrations occur between Grutness and Quendale and between Lerwick and South Nesting Bay, Map 14.

Red -breasted mergansers (*Mergus serrator*)
Shetland holds a nationally important wintering population, with the highest numbers occurring in Sullom Voe, Whiteness/Weisdale and Tresta Voes, around Burra and Trondra, Cat Firth and Dales Voe (Delting), Map 14.

Great northern divers (Gavia immer)
Great northern divers occur off much of Shetland's coastline, with important concentrations in Quendale bay, around the Scalloway islands, off the north and east coasts of Whalsay, in Nesting Bay and off the east side of Unst, Map 14.

Slavonian grebe (Podiceps auritus)
In Shetland wintering Slavonian grebes occupy traditional sheltered voes with water depths of less than 20m. The main concentrations are found in Sullom Voe, between Dales Voe (Lerwick) and Gletness, and between Clift Sound and Garderhouse Voe. The population showed a marked increase from just under 100 individuals in 2000/01, to just over 200 in 2011/12, probably as a result of an increase in the Icelandic population where Shetland birds breed[56]. Disturbance from boats involved with the aquaculture industry may have led to some redistribution within Shetland.

Ecosystem Services Wintering Ducks, Divers and Grebes

Service type	Benefits provided	Key risks and opportunities
Cultural	Prolific coastal communities	Measures to maintain bird populations around the Shetland coast can provide financial stability to coastal communities through tourism employment opportunities e.g. boat tours.
	Tourism and nature watching	Wildlife watching provides tourism and recreational opportunities. Reducing and avoiding impacts on birds can help to support these activities.

56 Harvey PV, Heubeck M (2012) Changes in the wintering population and distribution of Slavonian Grebes in Shetland. British Birds 105 pp 704-715.

Elasmobranchs - Sharks, Skates and Rays

Dogfish © Rachel Shucksmith

Elasmobranchs differ from other fish by having a skeletal structure made of cartilage opposed to bone and include sharks, skates and rays. In Scotland there are over 30 species of sharks, skates and rays found in its waters, 25 of which are found in coastal waters.

Elasmobranchs are slow growing, late to reach maturity and typically have low fecundity, making them vulnerable to exploitation.

Seven species of elasmobranch have been listed as priority marine features, three of which are found within the Shetland Marine Region:

- Basking shark (*Cetorhinus maximus*)
- Common skate (*Dipturus batis* complex)
- Spiny dogfish or spurdog (*Squalus acanthias*)

Assessment Sharks, skates and rays
Many concerns
Trend: No evidence
Confidence: Low-moderate

Key Ecosystem Services
- Tourism and nature watching

Basking sharks *Cetorhinus maximus*

Basking sharks are the second largest fish in the world, and the largest fish found in British waters, growing up to 10m (33ft) in length. Found in temperate seas across the world they are known to migrate over very long distances. Although they live in open ocean they are attracted inshore to places with reliable tidal fronts, to feed on plankton. Subsequently, during the summer months, they move closer inshore, when we can see them 'basking' while feeding on the surface. Although normally solitary animals, they can occasionally be found gathered in aggregations of over 100 individuals where feeding is particularly rich.

As basking sharks swim at the surface they are easily harmed, either deliberately or accidentally. Basking sharks were historically fished commercially around Scotland, and in 1947 nearly 250 were killed. The fishery collapsed, and they received full legal protection in 1998.

Protection and Legislation

- Wildlife and Countryside Act Schedule 5

Ecosystem Services Sharks

Service type	Benefits provided	Key risks and opportunities
Cultural	Prolific coastal communities	Measures to increase elasmobranch populations around the Shetland coast can provide financial stability to coastal communities through tourism employment opportunities e.g. boat tours (in the case of basking shark)
	Tourism and nature watching	Wildlife watching provides tourism and recreational opportunities. Reducing and avoiding impacts on basking sharks can help to support these activities.

- Priority Marine Features
- CITES (Appendix II)
- OSPAR Threatened and / or declining species
- BAP Priority Species
- IUCN Global Red List- Vulnerable

Key Potential Sensitivities

- Entanglement
- By-catch
- Disturbance and collision risk from fast moving power craft e.g. jet skis

Distribution

Modelled predictions have been used to identify areas in Scotland where high densities of basking shark are most likely to occur[57]. In Shetland the areas around Foula, Sumburgh, south-east of Fair Isle, and between Whalsay and Skerries have the highest predicted densities of basking sharks, see NMPi. Locations of public observations are shown in Map 15.

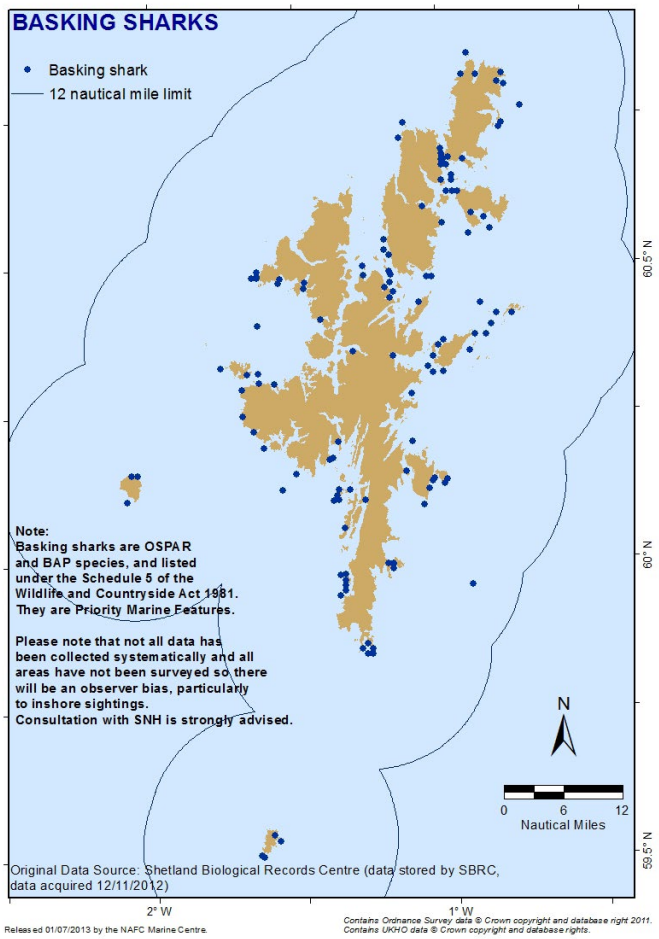
Pressures and Trends in Shetland

The historic fishery for basking sharks has reduced population levels across the UK, and given the migratory nature of this species it is likely that population levels around the Shetland coast were previously higher than seen today. Although there are now a range of protection measures in place due to the slow reproductive rate, this recovery is likely to occur over a long time period.

Public reporting of basking sharks around Shetland have increased, with species recovery and warmer sea temperatures likely to be contributing factors, as well as increased awareness and reporting frequency.

The potential growth of sectors such as marine renewables have the potential to impact basking sharks, through collision risks. The use of fast craft in the Shetland Marine Region is currently limited, and it is not thought that this currently poses a significant risk to basking sharks.

Assessment Basking Sharks
Some concerns
Trend: No evidence
Confidence: Low-moderate



Map 15: Public observations of basking sharks in the Shetland Marine Region

Common skate *Dipturus batis complex*

The common skate is the largest skate found in European waters, growing up to 3m in length. They are a long lived species, and may live for 50-100 years. This species is found in shallow coastal waters down to depths of 600 m. Historically they were found across much of the northeast Atlantic and Mediterranean, but their range is now greatly reduced due to fishing pressure and now almost extinct in the Mediterranean[58].

Protection and Legislation

- Priority Marine Feature
- OSPAR Threatened and / or declining species
- BAP Priority Species
- IUCN Global Red List- Critically endangered

Key Potential Sensitivities

- Commercial fishing pressure
- Recreational fishing

57 Paxton CGM, Scott-Hayward LAS, Rexstad E (2014) Statistical approaches to aid the identification of Marine Protected Areas for minke whale, Risso's dolphin, white-beaked dolphin and basking shark. Scottish Natural Heritage Commissioned Report No. 594

58 Hammond TR, Ellis JR (2005) Bayesian Assessment of North-east Atlantic Spurdog Using a Stock Production Model, with Prior for Intrinsic Population Growth Rate Set by Demographic Methods. Journal of Northwest Atlantic Fishery Science, 35.

- By-catch
- Loss of egg cases by physical disturbance of seabed

Distribution

The common skate is occasionally caught around the Shetland coast as by-catch. Recreational records include voes and bays (e.g. Dury Voe, Haroldswick). There is insufficient data to identify areas where the common skate occurs most frequently.

Pressures and Trends in Shetland

Although no longer targeted by commercial fisheries, as it is illegal to land any catch in the EU, common skate can be caught as by-catch and by recreational fishers. Lack of knowledge on this species distribution makes managing pressures challenging. There is insufficient data to assess population trends within the Shetland Marine Region. Reduction in fishing effort may aid recovery of this species, however, sexual maturity is not reached until 11 years old, and breeding takes place only once per year.

Assessment Common skate
Many concerns
Trend: No evidence
Confidence: Low

Spiny dogfish *Squalus acanthias*

The spiny dogfish or spurdogs are one of the most abundant shark species in the world, however in some areas overfishing has led to population declines of over 95% in the UK. Growing to 1.6m in length, it is found from the surface to 900m in depth. It is a highly migratory species, following temperature gradients with transatlantic migrations having been recorded, however they also exhibit a degree of residency, causing localised abundances in some areas.

Protection and Legislation

- Priority Marine Feature
- OSPAR Threatened and / or declining species
- BAP Priority Species
- IUCN Global Red List- Vulnerable

Key Potential Sensitivities

- Commercial fishing pressure
- By-catch
- Loss of egg cases by physical disturbance of seabed

Distribution

Spurdog was formerly widespread and abundant throughout most of the area, but is currently most abundant in the western North Sea and off Orkney and Shetland (Map 15). Large catches of juveniles have been made off Northern Scotland. Tagging experiments have shown that spiny dogfish may migrate all around the British Isles. Thus, the North Sea component is considered to represent part of a much larger stock.

Pressures and Trends in Shetland

The spiny dogfish is subject to a zero total allowable catch limit in EU waters due to population declines with the stock biomass estimated to be at approximately 5% of the biomass after the Second World War[1]. As individuals in Shetland waters form part of the wider North Sea stock they are subject to pressures beyond the Shetland Marine Region area. Reduction in fishing effort may aid recovery of this species, however, sexual maturity is not reached by females until 12 years old, and gestation takes between 18-22 months, one of the longest recorded for any vertebrate.

Assessment Spiny dogfish
Many concerns
Trend: No evidence
Confidence: Low

Demersal Fish - Wild Salmonids

Salmon © Marine Scotland

Wild salmonids are anadromous fish born in freshwater, then migrate to the ocean as juveniles where they grow into adults before migrating back into freshwater to spawn. In the Shetland Marine Region, examples are Atlantic salmon and sea trout. Catadromous fish are born in saltwater, then migrate into freshwater as juveniles where they grow into adults before migrating back into the ocean to spawn. In the Shetland Marine Region the only example are eels, however little is known about their distribution in Shetland.

Assessment Wild salmonids

Some concerns

Trend: No evidence

Confidence: Low

Key Ecosystem Services

- Fisheries
- Tourism
- Recreation

Ecosystem Services Wild Salmonids

Service type	Benefits provided	Key risks and opportunities
Provisioning	Food	Measures to increase salmon and sea trout populations around the Shetland coast has the potential to provide a commercial exploitable species, which can help to provide a sustainable food source. Opportunities exist to ensure that barriers to migration are minimised.
Cultural	Prolific coastal communities	Measures to increase salmon and sea trout populations around the Shetland coast has the potential to provide a commercial exploitable species, which can help to provide financial stability to coastal communities through employment opportunities. Opportunities exist to ensure that barriers to migration are minimised.

Atlantic salmon (*Salmo salar*)

Atlantic salmon (*Salmo salar*) are found in the temperate and Arctic regions of the northern hemisphere. Atlantic salmon spend their adult lives at sea but return to their native river to spawn. Eggs generally hatch in the spring and depending on the water temperature and the availability of food, these fish will live in the river for two to three years. They then undergo a physiological transformation which allows them to survive in marine environments, these young fish, now called "smolts", change in physical appearance, becoming silver, and start to leave the rivers during the late spring and most fish will have left the rivers by June. These fish remain in the ocean for one to four years, before returning to the rivers to spawn.

Protection and Legislation

- Habitats Directive Annex II and Annex V
- Bern Convention Appendix III
- OSPAR threatened and/ or declining species
- IUCN Global red list – lower risk/ least concern
- Priority Marine Feature
- BAP Priority Species

Key Potential Sensitivities (marine stage only)

- Commercial fishing pressure
- Recreational fishing
- Entanglement in set nets
- Sea-lice
- Disease

Distribution

Atlantic salmon can be found around the Shetland coast, however as Shetland does not have any large rivers very few come into the Shetland coast travelling to spawn in the burns. The distribution of salmon around the Shetland coast is not known.

Pressures and Trends in Shetland

Pressures within the Shetland Marine Region include the potential impacts of sea-lice and disease from farmed salmon, which is a large industry within the SMR. Salmon farm production and site number is currently stable within the SMR. A number of new approaches are being implemented to combat sea lice, including the use of cleaner fish, such as wrasse, and the use of thermal treatments to remove lice. There is insufficient data to suggest a trend of Atlantic salmon numbers within the SMR.

Assessment Atlantic salmon
Some concerns
Trend: No evidence
Confidence: Low

Sea trout (*Salmo trutta*)

Sea trout are not a species in its own right, but a migratory form of the brown trout. Sea trout are native to Scotland and are widely distributed in Scandinavia, Iceland and the Baltic. This species has two alternative life-cycle patterns - the first is the freshwater resident form referred to as 'brown trout' and the second is the anadromous (sea going) form referred to as 'sea trout'.

Sea trout, like Atlantic salmon, migrate to the sea to feed and grow before returning to fresh water to spawn. However, they do not migrate as far from the coast, instead they use feeding grounds in coastal areas. Relatively little is known about the ecology of sea trout in these coastal environments, although it is known that the length of time spent at sea varies considerably between individuals and some 'populations'. The time spent at sea can be quite short, with some fish returning to the river after just a few weeks or months between July and September. These small fish are often referred to as 'finnock'. Many adults return as larger 'maiden' fish after 12 or more months at sea and these fish can be seen in the river between May-October. Spawning takes place in their natal river and sea trout can spawn up to thirteen times in their lifetime.

Protection and Legislation

- IUCN Global red list – lower risk/ least concern
- Priority Marine Feature
- BAP Priority Species

Key Potential Sensitivities (marine stage only)

- Commercial and recreational fishing pressure
- Sea-lice
- Disease

Distribution

Sea trout can be found around the Shetland coast, and sea and brown trout can be found in Shetland's lochs and burns. The distribution of sea trout around the Shetland coast is not known.

Pressures and Trends in Shetland

There is insufficient data to suggest a trend of sea trout numbers within the SMR, however sea trout numbers are considered to be lower than historical levels. Pressures within the SMR include the potential impacts of sea-lice and disease from farmed salmon, which is a large industry within the SMR. As sea trout forage within coastal areas they are particularly vulnerable to these pressures. Salmon farm production and site number is currently stable. A number of new approaches are being implemented to combat sea lice, including the use of cleaner fish, such as wrasse, and the use of thermal treatments to remove lice.

Trout are targeted by recreational fishers, both during the freshwater and seawater phases, with the potential to reduce stock levels. In addition there have been reports of the use of illegal fish nets around the coast and in freshwater lochs.

Assessment Sea trout

Some concerns

Trend: No evidence

Confidence: Low

Commercial Fish and Shellfish Species

Mackerel © NAFC Marine Centre

The seas around Shetland are some of the most productive around Scotland and in Europe. Shetland is situated in the heart of the northern North Sea and is surrounded by many different fish stocks ranging from locally distributed shellfish stocks, to wider ranging demersal and pelagic fish stocks. Shellfish caught include a variety of crustaceans and molluscs. Demersal fish are those that live on or near the seabed and include well known species such as cod, haddock and whiting that are fished mainly with bottom trawling, Scottish seine or gill nets. Finally, pelagic species are those that are generally found in the water column or in open waters and include species such as mackerel, herring and blue whiting that are mainly caught with pelagic trawls and purse seines.

The main shellfish stocks fished locally around Shetland are king scallop, brown crab, velvet crab and lobster. These stocks are mainly fished within the 6 nautical mile limit around Shetland by Shetland registered vessels, and are managed by the Shetland shellfish Management Organisation. However, there are shellfish fisheries occurring outside the locally managed area (i.e. outside 6 nautical mile limit) and these are regulated by Marine Scotland. Further afield, in the northern North Sea, is the Nephrops fishery south east of Shetland on the Fladen grounds, however no Shetland registered vessels target Nephrops.

Demersal and pelagic stocks that are distributed around Shetland are fished by both Scottish vessels and vessels from other (mainly EU) countries. Catches are widely distributed and show large variation both within Shetland's 12 nautical mile limit and outside it as well, spanning the whole northern North Sea. These fish, as well as Nephrops, are subject to stock assessments conducted by the International Council for the Exploration of the Seas (ICES). Stock assessments use a combination of survey data and commercial catch and fishing effort data to assess the status of stocks (see Marine Scotland Atlas for more details on how stocks are assessed). Scientific advice from ICES is used to inform management decisions, principally total allowable catches and effort restrictions, which will essentially determine the amount of each fish species which can be caught each year. In recent years there has been a much more concerted effort to conserve fish stocks around Shetland and in the wider EU in general and, together with improved stock assessment techniques, this has meant that many of the fish stocks that are distributed around Shetland are being fished sustainably or moving in that direction.

Assessment commercial fish and shellfish species

Few concerns

Trend: Improving (overall)

Confidence: Moderate- High

Key Ecosystem Services

- Fisheries
- Tourism (via wildlife watching and sea angling)

Protection and Legislation

- EU Common Fisheries Policy
- Sea Fish (Conservation) Act 1967
- Inshore Fishing (Scotland) Act, 1984
- Shetland Shellfish Regulated Fishery (Scotland) Order 2012

- Priority Marine Features
- UK BAP Priority Species

Key Potential Sensitivities

- Commercial fishing pressure
- Recreational fishing
- Natural predation
- Underwater noise

Distribution

Although the seas around Shetland are considered highly productive, fish stocks are measured on a larger scale than the Shetland Marine Region level.

Pelagic fish stocks

There are a number of pelagic fish stocks that are important and relevant to Shetland. The principal stocks are North East Atlantic mackerel and North Sea herring. The former is considered a widely distributed stock that stretches from the North Sea down the west coast of Scotland and Ireland, continuing further south to the Iberian Peninsula. Scottish vessel catches of mackerel tend to be concentrated around Shetland and also along the shelf edge, however many other countries participate in the mackerel fishery, fishing around Shetland and elsewhere. The fishery tends to coincide with migratory behaviour of the mackerel stock, peaking during January - March, and October - November.

Blue whiting, like mackerel, is considered a widely distributed stock and is also an important fishery for both Scottish vessels and those from other countries. The stock size has been increasing in recent years and is above sustainable levels while fishing mortality is currently estimated as being below the level required for maximum sustainable yield.

Demersal fish stocks

Many of the demersal fish stocks that are important to Scotland and Europe are situated in the seas surrounding Shetland in the Northern North Sea. Some of the species such as anglerfish, hake, megrim and saithe are considered "widely distributed stocks" as their ranges extend further than others. With perhaps the exception of hake, these widely distributed demersal stocks are present in the waters around Shetland. The distribution of retained commercial demersal catches around Shetland in 2014 are shown in Maps 16-26.

Shellfish stocks

Around the Shetland coastline many of the important shellfish stocks, particularly crabs, are found close to shore, and are targeted by small inshore vessels. brown crabs are a notable exception and may be found further offshore.

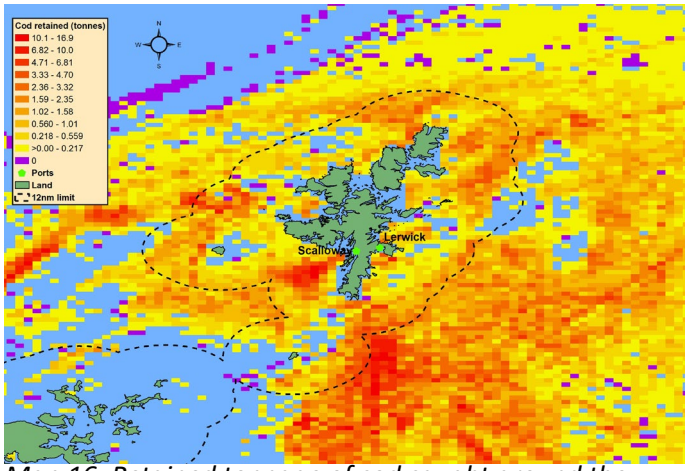
Scallops are found on mixed ground and sandy sediments, and are generally targeted within 3 nautical miles from shore, where densities are at their highest, although some grounds exist outside the 6 nautical mile limit.

Pressures and Trends in Shetland

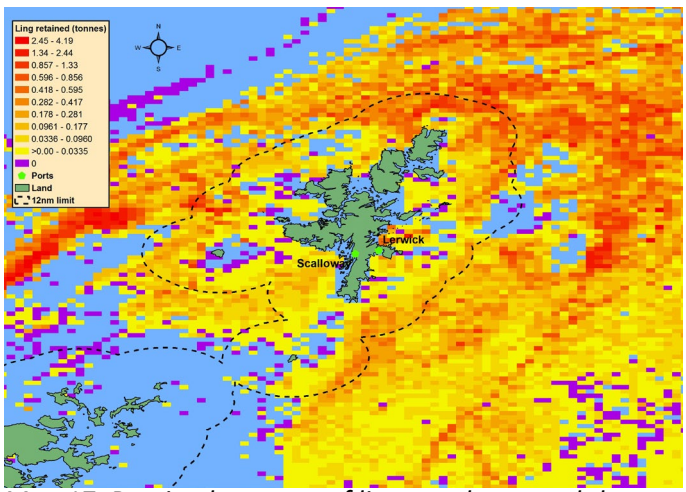
Overview

The primary pressure on fish stocks comes from commercial fishing pressure and from natural predation (e.g. seals). Reduction in fishing pressure has led to the recovery of some stocks e.g. cod from historical lows. Low natural recruitment has led to decreases in other stocks e.g. whiting.

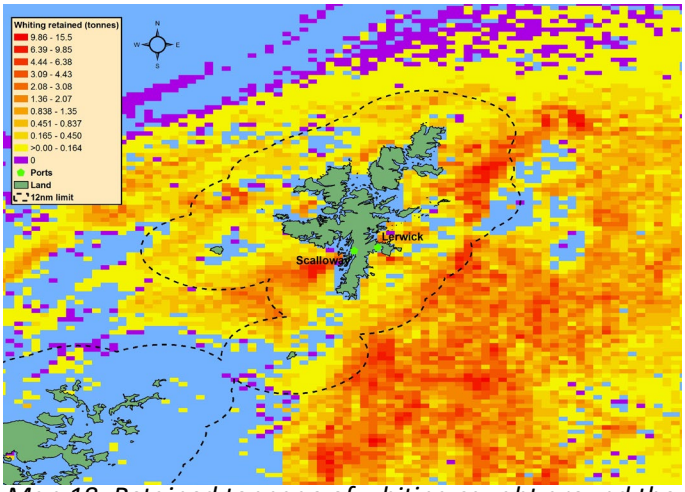
Inshore protection measures have been implemented to protect habitats known to be important nursery



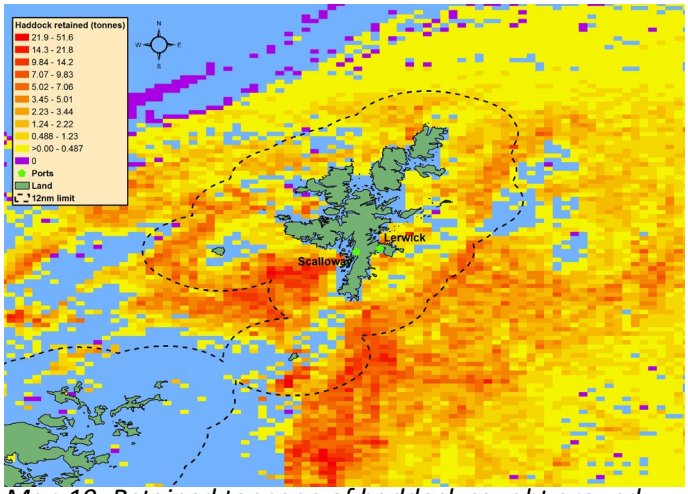
Map 16: Retained tonnage of cod caught around the Shetland area



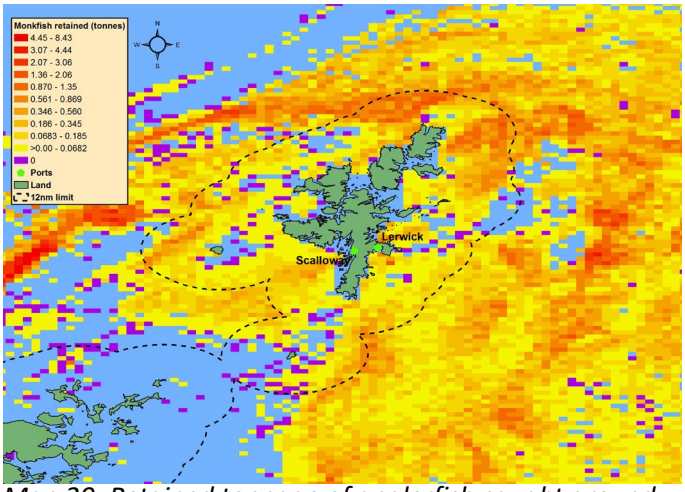
Map 17: Retained tonnage of ling caught around the Shetland area



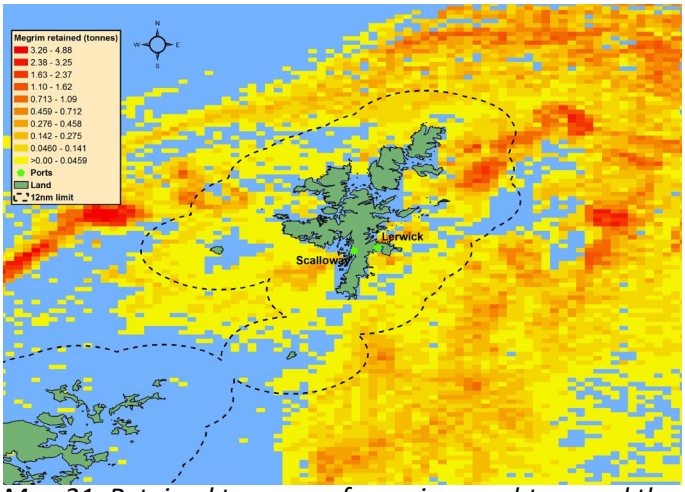
Map 18: Retained tonnage of whiting caught around the Shetland area



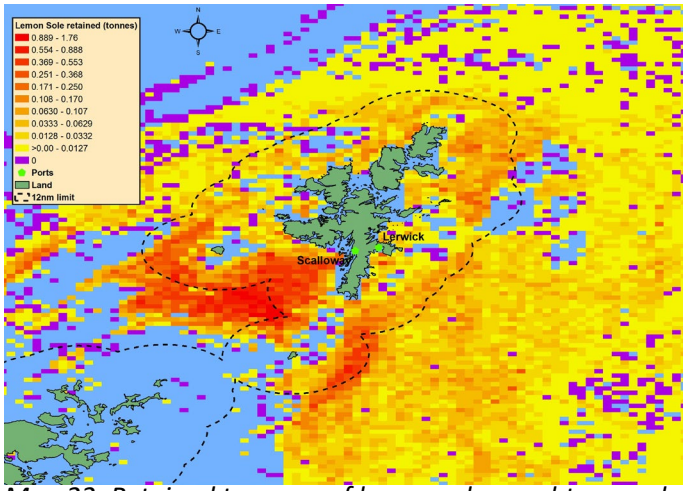
Map 19: Retained tonnage of haddock caught around the Shetland area



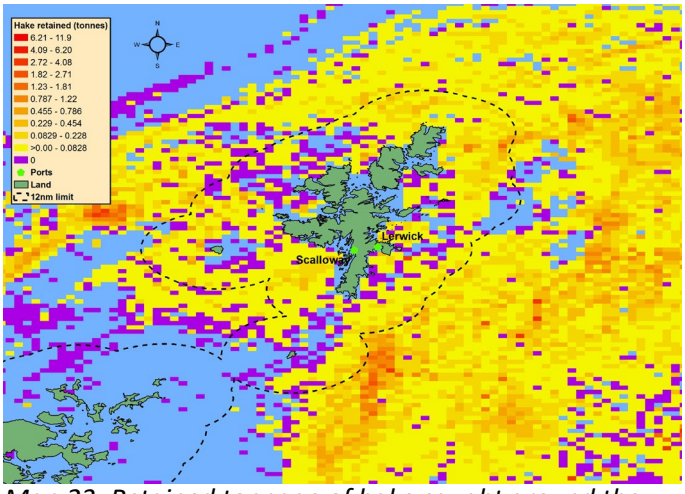
Map 20: Retained tonnage of anglerfish caught around the Shetland area



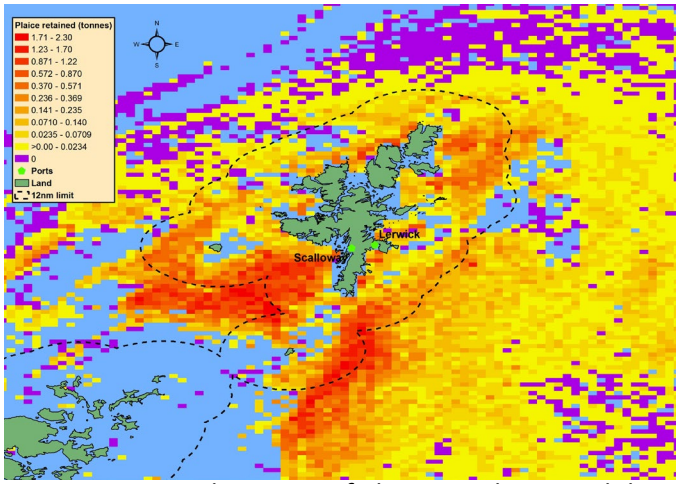
Map 21: Retained tonnage of megrim caught around the Shetland area



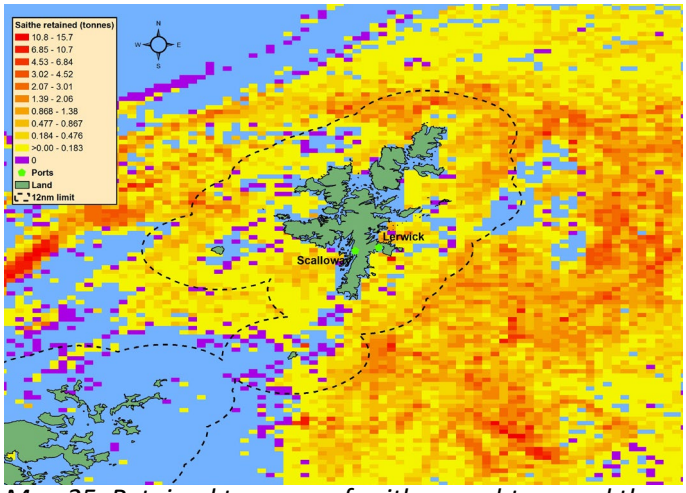
Map 22: Retained tonnage of lemon sole caught around the Shetland area



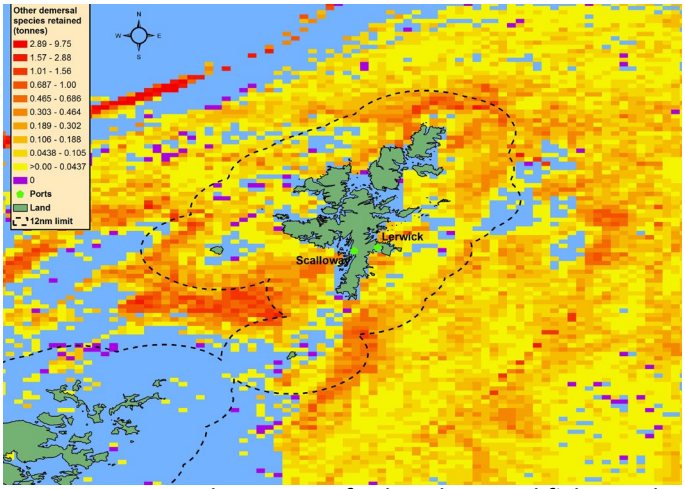
Map 23: Retained tonnage of hake caught around the Shetland area



Map 24: Retained tonnage of plaice caught around the Shetland area



Map 25: Retained tonnage of saithe caught around the Shetland area



Map 26: Retained tonnage of other demersal fish caught around the Shetland area

grounds for many species, these include the introduction of closed areas at known maerl, horse mussel and seagrass beds by the SSMO. There is also a Nature Conservation Marine Protected Area for sand eels to the south and west of Mousa.

Pelagic Stock

The most recent assessment indicates that the mackerel stock is in good health (see Table 8 for details). Herring stock estimates (Norwegian spring spawning herring in the North East Atlantic and Autumn spawners in the North Sea, Skagerrak, Kattegat and eastern English channel) are less positive, although both stocks are above the biomass reference point levels (see Table 8 for details).

The fishery for blue whiting generally operates further west than Shetland, although they can be found within the Shetland Marine Region.

Demersal stocks

ICES consider four of the key commercial stocks to be in a good condition; those of anglerfish, hake, megrim and saithe. Megrim biomass has been well above maximum sustainable yield (MSY) since 2005 with fishing mortality well below fishing maximum sustainable yield (F_{MSY}) since 2000. Hake has undertaken a population explosion in recent years, expanding significantly in numbers into the northern North Sea. Consequently, spawning stock biomass is currently much higher than MSY trigger (see Table 8 for details on anglerfish and saithe stocks).

The state of fish stocks in the North Sea that are not considered widely distributed is mixed. Cod biomass has seen a revival in recent years, with the spawning stock biomass (SSB) estimated to have increased to a point where it is now considered to be at sustainable levels. Ling has also shown positive trends in terms of stock size. In contrast, whiting SSB in recent years has been estimated to be at lower levels than in the past (see Table 8 for more details on these priority species).

A number of important demersal fish species around Shetland are not included as priority marine features, including haddock, lemon sole and plaice. Haddock stock has seen below average recruitment since 2000 and the SSB has fluctuated above the MSY trigger level until 2015 when it dropped below the trigger level. The state of the lemon sole stock is uncertain and the species is managed under the precautionary approach, as advised by ICES. The stock size index indicates that the lemon sole population has fluctuated around the same average for many years now, but catches have decreased in recent years. The plaice stock is considered to be in a healthy state, with SSB on the increase since 2006 and well above the MSY trigger level. Fishing mortality has also been decreasing dramatically in recent years and is now below F_{MSY}.

Shellfish stocks

Stocks of brown crab, velvet crab, green crab and lobster are all thought to be stable or increasing based on landings per creel. Populations of king scallops are at the long-term average. In contrast, landings per unit effort for buckies are below the long term average and are thought to be vulnerable to overfishing, Table 9.

There are a number of management measures in place, implemented by the SSMO which are detailed on their website (www.ssmo.co.uk), including gear restrictions and landing size limits.

Table 8: Stock condition of priority marine species within the Shetland Marine Region. Source: Seafish 2016

Species	Status
Anglerfish (*Lophius piscatorius*)	Anglerfish are caught around the Shetland coast, particularly in offshore areas. They mature at a large size, resulting in a large proportion of the catch consisting of immature fish. Anglerfish stocks are assessed using a data limited method and it is believed that the average biomass has been more than 60% higher in the last two years (2014–2015) than the average of the three previous years (2011–2013).
Atlantic herring (*Clupea harengus*)	Herring spawn in coastal areas on gravel substrates, making them vulnerable to anthropogenic activity. In Shetland herring is caught by pelagic trawlers during the autumn season. The stock has shown a marked decline in productivity since the late 1970s and has been fluctuating at a low level since then.
Atlantic makerel (*Scomber scombrus*)	In Shetland mackerel is targeted by the large pelagic trawlers and by small inshore vessels. The Spawning Stock Biomass (SSB) is estimated to have increased since the early 2000s and has been above maximum sustainable yield-biomass (MSY $B_{trigger}$) since 2009.
Cod (*Gadus morhua*)	Cod is widely distributed throughout the North Sea, but there are indications of subpopulations inhabiting different regions of the North Sea. Fisher observations indicate that cod has been abundant around the Shetland coast in recent years. Across the stock assessment area, fishing mortality declined from 2000 and is now estimated to be approaching F_{MSY}.
Ling (*Molva molva*)	Ling typically reside in deep waters. Limited information is available on the population structure of this data-limited species and the stock assessment is based on temporal trends in commercial catch rates. Ling are mainly taken in targeted deep-water fisheries using set gillnets and set longlines.
Saithe (*Pollachius virens*)	Saithe are a common inshore fish. The SSB has been above precautionary levels since around 1997 and the fishing mortality has fluctuated above optimum for maximum sustainable yield (F_{MSY}) from 1997 until 2013, has been below this level since that year.
Whiting (*Merlangius merlangus*)	Adult whiting are highly abundant in the south of Shetland during winter. During summer, the Scottish coast is densely populated by adult whiting. The status of the stock has declined in recent years, with SSB decreasing to near the lowest levels on record in 2013, with recruitment low since 2003 (although the 2015 recruitment appears to have increased).
Sandeels (*Ammodytes marinus* & *Ammodytes tobianus*)	Sand eel stocks are considered to be in decline, and are an important food source for many species of seabirds. There is no commercial exploitation of sand eels in Shetland waters, and stocks are influenced by the success of recruitment from the north and west of Orkney.

Table 9: Stock condition of inshore shellfish species within the Shetland Marine Region. Source: Seafish 2016

Species	Status
Brown crab (*Cancer pagurus*)	Brown crabs are found between the shoreline and depths in excess of 100m. In 2012 when landings per unit effort (LPUE (kg per creel)) was found at its lowest level in the 15 year time series, management measures were introduced including a total creel limit and no new licences introduced. LPUE has since increased dramatically and these management measures are still in place. Landings were the largest to date in 2014.
Velvet swimming crab (*Necora puber*)	Velvet crabs are normally found at shallow depths (less than 35m), close to shore on rocky tidal substrate. Since 2007 there has been a decline in LPUE (kg per creel), although since 2013 LPUE has stabilised.
Green crab (*Carcinus maenas*)	Green crabs live in a range of habitats from shallow waters to approximately 60m in depth. LPUE (kg per creel) has generally been stable since 2003. Landings started to increase in 2008 but has decreased during 2013 and 2014. This reflects the effort, which was stable since 2008 and then decreased in 2013 and 2014.
Lobster (*Homarus gammarus*)	Lobster are generally found off of rocky coastlines. Although most are found in depths less than 30m they can be found at depths up to 150m. LPUE (kg per creel) has been increasing to its highest level in 15 years of data collection.
Common whelk or buckie (*Buccinum undatum*)	Buckies can be found from the shoreline down to depths of 1200m. The LPUE (kg per creel) is currently below the long term average, and is considered vulnerable to overfishing.
King scallop (*Pecten maxumus*)	King scallops are found on mixed sediments consisting of muddy sand, sandy gravel or gravel from extreme low water to 100m+. Population analysis (Virtual Population Analysis) of scallops within the SSMO area indicated that the population increased dramatically (likely due to a strong recruitment event) from around 2005 and was stable till 2012 when the population began to decline again as recruits from 2005 left the population. The population now appears to be at around the long term average. Fishing mortality estimates for 4 to 6 year old scallops have fluctuated over the 14 year period of analysis but mortality estimates are also at the long term average.

Ecosystem Services Commercial Fish Species

Service type	Benefits provided	Key risks and opportunities
Provisioning	Food	Marine developments have the potential to affect commercial catches through reduced integrity or loss of nursery and spawning grounds, underwater noise masking fish vocalisations and loss of access to fishing grounds. Identification and protection of important nursery, spawning and fishing grounds has the potential to support sustainable catches.
Supporting services underpin the provision of other services	Prey for other species	Reduction in fish stocks has the potential to impact predator species e.g. seabirds. Measures which maintain or increase stock levels will help to protect predator species.
Cultural	Prolific coastal communities	Measures to maintain commercial catch rates will help to support coastal communities, particularly in rural Shetland by providing direct and in-direct employment.

Seabed Habitats and Species

Horse mussel bed © Richard Shucksmith

The seabed, defined here as the benthic region, begins at the shore line (intertidal or eulittoral zone) and extends downward along the surface of the continental shelf, out to sea The organisms found in this zone generally live in close relationship with the substrate bottom and many are permanently attached to the bottom.

The benthic region is split into four types:

- Intertidal sediments
- Intertidal rock
- Subtidal sediments
- Subtidal rock

Within these types important habitats and species are considered in more detail.

Protection and Legislation

- Habitats Directive Annex I habitats
- OSPAR threatened or declining habitat
- Berne Convention Appendix 1
- IUCN Red List Species
- UK BAP priority habitat
- Priority Marine Features

Key Potential Sensitivities

- Physical disturbance, loss or removal
- Habitat extraction
- Changes in water flow (and sediment regime)
- Changes in wave regimes
- Sea-level rise
- Pollution
- Erosion
- Smothering
- Changes in suspended solids (water clarity)
- Changes in siltation rates
- Nutrient enrichment
- Introduction of disease
- Introduction of non-native species

Distribution

The distribution of each habitat type is detailed within the subsequent sections.

Pressures and Trends in Shetland

The pressures and trends for each habitat type are detailed within the subsequent sections.

Summary Assessment- Seabed habitats and species

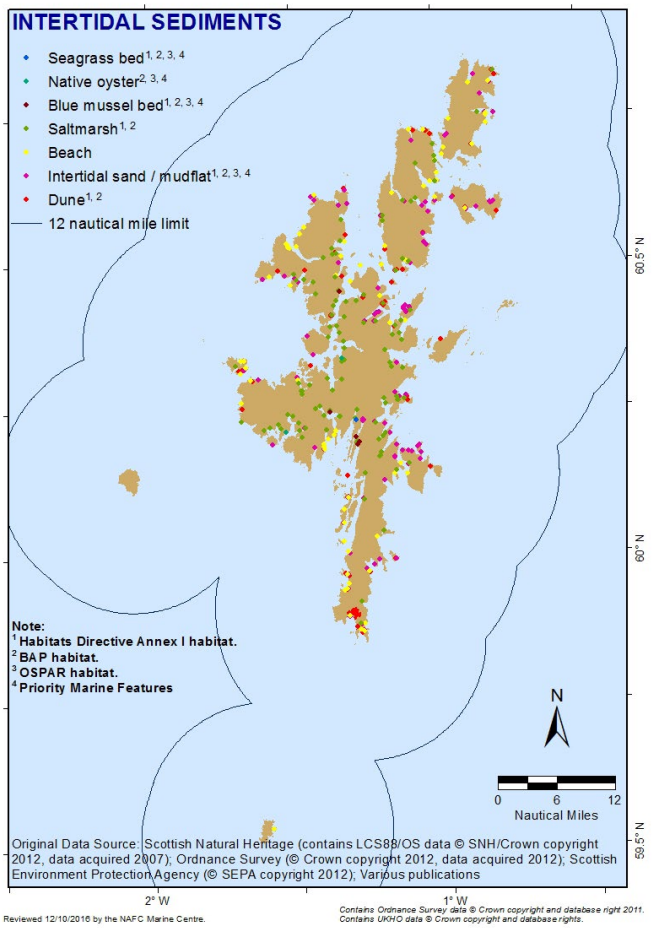
Habitat / species	Assessment	Trend	Confidence
Intertidal Sediment Overall Assessment	**Some concerns**	**No evidence**	**Low**
Intertidal sediments (sand and mudflats, sandy beaches)	Some concerns	No evidence	Low
Seagrass beds (*Zostera noltii*)	No evidence	No evidence	Low
Blue mussels (*Mytilus edulis*)	No evidence	No evidence	Low
Native oyster (*Ostrea edulis*)	Many concerns	Deterioration	Moderate
Intertidal Rock Overall Assessment	**Few concerns**	**Stable**	**Moderate**
Intertidal rock	Few concerns	Stable	Moderate
Sea loch egg wrack beds (*Ascophyllum nodosum* ecad *mackaii)*	No concerns	No evidence	Moderate
Tide-swept algal communities	No concerns	No evidence	Low-moderate
Subtidal Sediments Overall Assessment	**Some concerns**	**No evidence**	**Moderate**
Subtidal sediment	Some concerns	No evidence	Moderate
Seagrass beds	Many concerns	Deterioration	Moderate
Low or variable salinity habitats	No concerns	No evidence	Moderate
Maerl	Some concerns	Stable	Low-moderate
Horse mussel beds	Some concerns	No evidence	Moderate
Shallow tide-swept coarse sands with burrowing bivalves	Some concerns	No evidence	Low
Ocean quahog (*Artica islandica)*	No evidence	No evidence	Low
Fan mussel (*Atrina pectinate*)	No evidence	No evidence	Low
Burrowing sea anemone (*Arachnanthus sarsi*)	No evidence	No evidence	Low
Northern Feather Star (*Leptometra celtica*)	No evidence	No evidence	Low
Subtidal Rock Overall Assessment	**No concerns**	**Stable**	**Moderate**
Subtidal rock	No concerns	Stable	Low-moderate
Kelp beds	No concerns	No evidence	Low-moderate
Tide-swept algal communities	No concerns	No evidence	Low
White cluster anemone (*Parazoanthus anguicomus)*	No evidence	No evidence	Low
European spiny lobster (*Palinurus elephas)*	No evidence	No evidence	Low

Intertidal Sediments

Sandy Beach © Richard Shucksmith

The variety of exposure found around the Shetland Islands, from 'fully exposed' to 'ultra-sheltered', has led to a variety of intertidal sediment types found throughout the islands, including sand and mud flats, cobbles, and gravel.

Intertidal sediments support communities that are tolerant of exposure to air and variable temperatures and salinities, particularly the mudflats and sandflats found within voes, firths and bays. Although the communities of animals typically supported by these habitats are species poor, they are highly productive, normally comprised of burrowing worms, crustaceans, bivalve molluscs and echinoderms.



Map 27: Intertidal sediment and supported habitat distribution within the Shetland Marine Region

Overall Assessment Intertidal sediments and supported habitats

Some concerns

Trend: No evidence

Confidence: Low - A lack of monitoring makes it difficult to assess changes in these habitats.

Key Ecosystem Services

- Fisheries
- Tourism
- Recreation
- Coastal Protection

Community composition is typically more diverse where intertidal sediments support habitat-forming species, such as:

- Seagrass beds (*Zostera noltii*)
- Blue mussels (*Mytilus edulis*)
- Native oyster (*Ostrea edulis*)

The following section evaluates the intertidal mud and sand habitat with the Shetland Marine Region, then gives specific consideration to priority habitat forming species supported by these intertidal sediment environments.

Ecosystem Services Intertidal Sediments and Supported Habitats

Service type	Benefits provided	Key risks and opportunities
Provisioning	Food Commercial Fisheries- (habitat provision for juvenile, adult and spawning life stages)	Long-term habitat integrity and sustained catch rates can be maintained by measures to: • Avoid loss or damage to the most valuable habitats (e.g. mussel, oyster and seagrass beds, and sedimentary substrates) by development and activities • Promote restoration of lost biogenic habitats e.g. oyster beds • Eradicate or prevent the spread of invasive non-native species e.g. Pacific oyster through biosecurity planning • Prevent the spread of disease e.g. wasting disease or microbial pathogens (e.g. parasitic *Bonamia ostrea*) through biosecurity planning • Reduce nutrient enrichment through land run-off, aquaculture and sewage • Prevent siltation, smothering and changes in water clarity from aquaculture, sewage and land run-off • Support measures to reduce sea-level rise due to climate change
	Prevention of coastal erosion	Coastal erosion can be prevented and reduced by measures to: • Reduce or stop removal of sand at locations where erosion is occurring • Implement measures to restore beach habitats and reduce erosion rates
Regulating	Climate regulation (carbon capture and storage)	Resuspension of carbon stored in stable sediments (e.g. mud) and dead organic matter, and reduced carbon sequestration can result in reduced carbon capture and long-term storage and the release of CO_2, this can be prevented by measures to reduce physical disturbance and protect habitats.
	Pollutant / contaminant burial or neutralisation	Re-release or delayed breakdown of pollutants from physical disturbance of stable sediments can be prevented through measures to: • Avoid physical disturbance of sediments • Reduce erosion of sediments
Cultural	Prolific coastal communities	Measures to maintain productive habitats can support commercially important species and provide financial stability to coastal communities.
	Tourism and nature watching	Beaches and wildlife watching provide tourism and recreational opportunities. Maintaining habitats and preventing erosion can help to support these activities.

Intertidal mudflats LS.LMu and sandflats

Mudflats are found in the most sheltered areas of the coast around the Shetland Islands, within the upper reaches of voes. These low-energy environments allow for fine sediment deposition (e.g., silt and clay), which create important sinks for organic material. The resultant high level of organic content increases microbial activity, creating an anoxic layer close to the surface. Mudflats are highly productive areas, supporting burrowing polychaete worms, bivalve molluscs, and mud shrimps. This productivity helps to support a range of species including many juvenile fish, including commercially important species, such as plaice (see Healthy and Biologically Diverse-Commercial Species), and wintering wading birds and wildfowl (see Healthy and Biologically Diverse-Wintering Birds).

Sandy beaches

Sandy beaches, in terms of length, play a relatively minor role in the Shetland coastline, and most are relatively small. Some sandy beaches are backed by fore dunes and machair (e.g. Brekon, Yell) or sand dunes and machair (e.g. Balta Island, Unst). Although generally not as productive as sand or mudflats, sandy beaches provide recreational opportunities and protect against erosion.

Protection and Legislation

- Habitats Directive Annex 1 habitat (mudflats and sandflats)
- OSPAR threatened or declining habitat (mudflats and sandflats)
- UK BAP priority habitat (mudflats and sandflats)
- Priority Marine Features (intertidal mud only)

Key Potential Sensitivities

- Physical disturbance, loss or removal e.g. bait digging, dredging, land reclamation
- Sand extraction
- Coastal/ near shore development causing changes in water flow (and sediment regime)
- Changes in wave regimes
- Sea-level rise
- Pollution
- Recreational pressure causing erosion

Distribution

Although of a smaller scale than those found elsewhere in Scotland, mudflats, sandflats and sandy beaches are found throughout Shetland, Map 27. Mudflats and sandflats are generally found in Shetland's sheltered voes or sounds, whilst sandy beaches are found at a greater variety of locations, including at cliff bases, as pocket beaches and bars connecting islands to mainland Shetland.

Intertidal sediments- mudflats, sandflats, sandy beaches

Some concerns

Trend: No evidence

Confidence: Low - A lack of monitoring makes it difficult to assess changes in these habitats.

Pressures and Trends in Shetland

There are no known previous or current pressures on the broad habitats of mudflats and sandflats, although they are vulnerable to coastal development, including road development and flood defence. Additionally there is no monitoring data to allow an assessment of the changing condition of the flats, however, in the absence of any known pressures it is assumed that flats and beaches are in a stable condition.

In contrast, sandy beaches in Shetland are subject to a number of known current and historic pressures. The natural processes of wind and wave erosion, are exuberated by human activities, such as sand extraction, grazing pressure and trampling. Not all beaches in Shetland have been evaluated, but a Shetland beach survey conducted by the University of Aberdeen documented where beaches and their associated sand dunes or machair were being impacted by human or natural pressures, Table 10.

Erosion of important intertidal sediments from beaches is likely to continue unless both the pressure and, in some cases, re-mediation work is initiated.

Scousburgh Beach © Charlotte Slater

Table 10: Beaches surveyed in Shetland known to have been subject to erosional pressures.

Beach	Beach type	Pressures and impacts
West Voe Sumburgh (Dunrossness)	Originally beach, foredune and landward machair	Modified by construction of Sumburgh airport and road. Machair has been lost to runway. Historical sand extraction resulting in erosion.
Grutness Voe (Dunrossness)	Originally beach, fore dune and landward machair	Modified during airport construction and machair has been lost
Bay of Quendale (Dunrossness)	Beach, dune zone, and links	Beach retreat due to wave action and sand extraction
Scousburgh (Dunrossness)	Beach-dune complex	Recreational pressures including vehicle access
St Ninian's (Dunrossness)	Beach complex, dune and dune pasture at each end of the isthmus	Erosion by sheep and rabbits, bulldozed areas, sand extraction
Levenwick (Dunrossness)	Beach, dune,and machair	Degraded machair, built over and heavily grazed
Channerwick group (Channerwick, Hoswick, Cumlewick, Sandwick)	Small scale beaches lack landward and wind-blown deposits	Marine litter, small scale extraction of beach material
Sands of Mail (Cunningsburgh)	Beach backed by inactive till-cliff	Aggregate removal, historic and current
Sands of meal (Burra)	Beach backed by machair	Erosion and blow-outs potentially increased by historic sand extraction and grazing
Gulberwick	Pocket beach	Sand extraction increasing rate of till retreat
Sands of Sound (Lerwick)	Beach backed by machair	Significant sand removal for construction during WWII, removing large parts of machair
Lingness (Nesting)	Beach backed by small area of machair	Significant sand removal for construction during WWII, removing large parts of machair and beach sand
The Crook (Sandness)	Beach with no dunes and small area of machair	Historic sand and shingle extraction leading to modification of beach profile and rapid retreat of beach edge
Kirk Sand (Papa Stour)	Beach with thin machair	Beach retreat caused by wind erosion in conjunction with severe grazing and animal rubbing
Sandwick (Hillswick)	Beach	Erosion caused by sand extraction
West Sandwick (Yell)	Beach backed by sand dune and machair	Historical sand extraction and grazing by sheep and rabbits
Norwick (Unst)	Beach backed by sand dune and machair	Sand extraction but believed to be stable
Lund (Unst)	Beach backed by sand dune and machair	Erosion due to wind and wave action exacerbated by degradation of a dyke
Sandwick (Unst)	Beach backed by sand dune and machair	Erosion due to wind and wave action
Huney (Unst)	Beach backed by sand dune and machair	Erosion- cause unknown
Balta Island (Unst)	Beach backed by sand dune and machair	Sheep and rabbit grazing reduced machair turf to a close vegetative mat
Skeo Taing (Unst)	Beach backed by sand dune and machair	Erosion of machair, potentially initiated by historical development

Source: Mather, A.S., Smith, J.S., March(1973) Beaches of Shetland. Department of Geography, University of Aberdeen, for the Countryside Commission for Scotland. Reprinted 2001 by Scottish Natural Heritage as a Commissioned Report.

Priority habitats on intertidal substrate

Eelgrass beds (*Zostera noltii*)

LL.LMp.LSgr.Znol

Eelgrass is a grass-like flowering plant found on mid and upper shores in muddy sand or sandy mud on wave sheltered coasts. It is more tolerant to desiccation than other species of seagrass (*Zostera*) and, therefore, occurs higher on the shoreline.

The eelgrass roots play an important role in stabilising and binding the underlying sediment, and the plants themselves provide refuge and nursery grounds for many species, such as polychaete worms, mud shrimps, mud snails, shore crabs, and bivalves.

Protection and Legislation

- Habitats Directive Annex 1
- UK Biodiversity Action Plan Priority Habitat
- OSPAR Annex V species
- Priority Marine Features

Key Potential Sensitivities[59]

- Changes in seabed type (physical loss to land or freshwater, or physical removal)
- Changes in wave exposure
- Physical disturbance e.g. bait digging, coastal development
- Smothering
- Changes in suspended solids (water clarity)
- Siltation rates
- Nutrient enrichment e.g. aquaculture, sewage or diffuse pollution
- Wasting disease
- Non-native species e.g. *Sargassum muticum, Spartina anglica*

Distribution

Scotland is home to approximately 20% of north-west Europe's eelgrass beds. In the Shetland Islands, beds of *Z. noltii* are only known at the Loch of Hellister.

Pressures and Trends

There are no known pressures at the only bed of eelgrass in the Loch of Hellister, although the loch is adjacent to a road and subsequently could be affected by changes in road layout or drainage. There are no monitoring data to allow an assessment of the changing condition of the beds, in the absence of any known pressures it is assumed that beds are in a stable condition.

59 See FEAST website **http://www.marine.scotland.gov.uk/FEAST/index.aspx**

Assessment Eelgrass beds (Zostera noltii)
No evidence
Trend: No evidence
Confidence: Low - A lack of monitoring makes it difficult to assess changes in these habitats.

Blue mussel beds *(Mytilus edulis)*

LS.LBR.LMus.Myt
LS.LSa.St.MyFab

Blue mussel beds occur naturally in the intertidal coastline. Blue mussels are known as 'ecological engineers' as their presence in dense beds or reefs has the ability to change the physical structure of the seabed, which in turn, creates new microhabitats for smaller animals and changes the surrounding community composition. Their byssal threads help to stabilise the sediment below and their hard shells provide a surface for other animals and plants to attach to. Many animals, such as barnacles, dog whelks, sea squirts, and starfish would not be able to survive on bare muddy shores without mussel beds. In addition, intertidal mussel beds can provide important foraging areas for waders and wildfowl.

Protection and Legislation

- Habitats Directive Annex 1
- UK Biodiversity Action Plan Priority Habitat
- OSPAR threatened and/or declining habitat
- Priority Marine Features

Key Potential Sensitivities

- Changes in seabed type (physical loss to land or freshwater, or physical removal)
- Changes in wave exposure
- Physical disturbance e.g. commercial fisheries, anchoring boats and mooring chains, and bait digging
- Pollution
- Changes in water flow

Distribution

Blue mussel beds are widespread around Scotland, and Shetland has three known intertidal mussel beds; Ayres of Corsa (The Firth, Bixter), Whiteness Voe and Houb of Fugla Ness (Sullom Voe). Other more ephemeral beds may be found elsewhere around the coast.

Pressures and Trends in Shetland

There are no pressures known to occur on the Shetland blue mussel beds and although mussels may

be harvested for personal consumption (which does not require a licence), there is no known commercial harvesting.

There are no monitoring data to allow an assessment of the changing condition of the beds, however, in the absence of any known pressures, it is assumed that beds are in a stable condition.

Native oyster (*Ostrea edulis)*

SS.SMx.IMx.Ost

Assessment Blue mussel beds (Mytilus edulis)
No evidence
Trend: No evidence
Confidence: Low - A lack of monitoring makes it difficult to assess changes in these habitats.

The native oyster is typically found attached to rocks or other shells on muddy substratum in estuaries and other coastal habitats. Similar to blue mussel beds, native oysters stabilise the underlying sediments and provide hard surfaces for other species, such as sea squirts, sponges, sea slugs and small seaweeds, to live on.

Protection and Legislation

- UK BAP Priority Species
- OSPAR list of Threatened and/or Declining Species and Habitats
- Priority Marine Features

Key Potential Sensitivities[60]

- Changes in seabed type (physical loss to land or freshwater, or physical removal)
- Changes in wave exposure
- Changes in water flow
- Physical disturbance e.g. commercial fisheries, pollution, coastal developments, anchoring boats and mooring chains, and bait digging
- Genetic modification and translocation
- Introduction of microbial pathogens (disease) e.g. parasitic *Bonamia ostrea*
- Pollution, especially microbial pathogens
- Non-native species in particular the Pacific oyster, slipper limpet
- Changes in siltation rates

Distribution

Native oysters were once widespread throughout Scotland, including Shetland, but are now considered to be nationally rare with only scattered occurrences. In Shetland, the native oyster is now found in very small numbers along the west coast of the Mainland, in Gruting Voe and Gon Firth.

Pressures and Trends in Shetland

Within Shetland there are 29 areas known to have historically supported native oyster beds, most of which were located on the west coast, however, the native oyster is now absent from most of these locations. The decline of the Shetland oyster fishery is attributed to overfishing during the 1890s and severe winter weather conditions in 1914. Since the collapse of the fishery there has been no commercial exploitation of native oysters in Shetland for over 100 years. A survey in 2008, conducted by the NAFC Marine Centre on the behalf of SNH, indicated that these populations have still not recovered. Although there are now no known pressures on the remaining oyster beds, as population levels in Shetland are now so low, natural recovery is considered unlikely, hindered by lack of spat and significant habitat change. Active restoration measures are likely to be required if recovery of these beds is to occur.

Assessment Native oyster beds (Ostrea edulis)
Many concerns
Trend: Deterioration (long-term)
Confidence: Moderate - Monitoring data suggests that beds have not recovered from historic losses.


Blue mussels © Rachel Shucksmith

60 See FEAST website **http://www.marine.scotland.gov.uk/FEAST/index.aspx**

Intertidal Rock

Rocky shore © Charlotte Slater

Rocky intertidal shorelines are areas of highly diverse marine life. Unlike the homogeneous environments found on sand or mud flats, the cracks and crevices of rocky intertidal shores provide a wealth of different microhabitats that attract a wide variety of species. These microhabitats can be further diversified by numerous physical variables, including salinity, temperature, and tides, but the principal factor that characterises rocky intertidal communities is wave exposure. The different animals and plants that live on the rocky intertidal, some of which are at their geographical limits of their distribution in Shetland, have evolved to survive in highly stressful and variable conditions.

Shorelines can range from extremely exposed, as found on the western, Atlantic-facing coast of mainland Shetland (e.g., Eshaness and Sumburgh Head), to largely sheltered, such as the voes found on the eastern mainland coast (e.g., Dury voe and Dales voe). On sheltered shorelines, marine communities can be dominated by large brown algae that can cover the rock surface and prevent other organisms from attaching to the surface below. However, on more exposed, high-energy shorelines, larger plants are too fragile to survive and there tend to be smaller red algae and sessile animals, such as

Overall Assessment Intertidal Rock and Supported Habitats and Species

Few concerns

Trend: Stable

Confidence: Moderate

Key Ecosystem Services

- Fisheries
- Tourism
- Recreation
- Coastal Protection

Ecosystem Services Intertidal Rock and Supported Habitats

Service type	Benefits provided	Key risks and opportunities
Provisioning	Food Commercial Fisheries- (habitat provision for juvenile, adult and spawning life stages)	Long-term habitat integrity and sustained catch rates can be maintained by measures to: • Avoid loss or damage to the most valuable habitats by development and activities • Reduce nutrient enrichment through land run-off, aquaculture and sewage • Prevent siltation, smothering and changes in water clarity from aquaculture, sewage and land run-off • Support measures to reduce sea-level rise due to climate change
Regulatory Services	Prevention of coastal erosion	Rock coastlines prevent the erosion of softer sediment found further inland
Cultural	Prolific coastal communities	Measures to maintain productive habitats can support commercially important species and tourism (e.g. wildlife watching) providing financial stability to coastal communities.

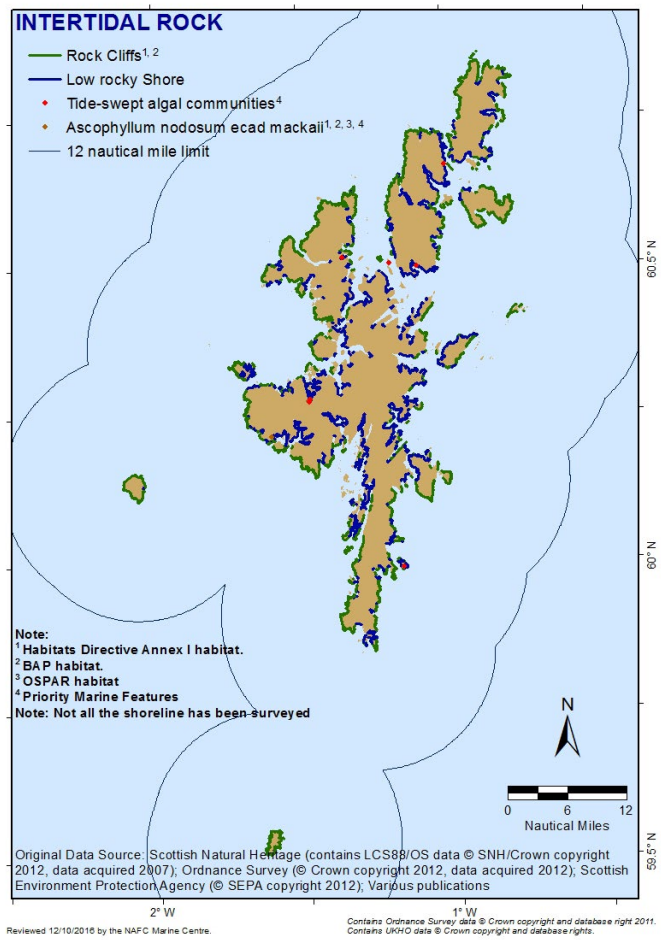
barnacles and limpets that can withstand the more extreme conditions.

Tidal range can also play an important role in the distribution of rocky intertidal species and distinct vertical zonation patterns can be observed on more steeply sloping shorelines. These zones are determined by an animal's tolerance to the length of time exposed during low tide.

Along the upper shoreline, where exposure to air and warmer temperatures is the longest, species diversity and abundance tends to be low. Along the lower shoreline, where exposure may only occur during large spring tides, species richness can be very high. There are exceptions to this, however, such as tidal rock pools that can create pockets of high species richness along the upper shore.

Community composition is typically more diverse where they support habitat forming species including:

- Sea loch egg wrack Beds
- Fucoids in tide-swept conditions



Map 28: Intertidal rock distribution and supported habitats within the Shetland Marine Region

Areas of intertidal rock and associated PMFs are shown in Map 28.

Rocky shores and reefs

Rocky shores and reefs are found around much of the Shetland coastline, from sheltered voes to exposed shorelines.

Rocky intertidal shorelines are important foraging and resting sites for larger animals, such as harbour and grey seals, otters, and species of wading birds.

Protection and Legislation

- Habitats Directive Annex 1 Habitat - reefs

Key Potential Sensitivities

- Coastal/ near shore development
- Changes in wave regimes
- Sea-level rise
- Climate change, in particular sea temperate rise
- Non-native species displacing and overgrowing native species (see Healthy and Biologically Diverse- Non-Native Species)
- Pollution (e.g. urban run-off, sewage)

Distribution

Intertidal rock represents a minimum of 917 km (approximately 60%) of the total coastline of the Shetland Islands. Whilst most of the Shetland coastline is rocky, this is particularly true of the west side of Shetland, Map 28.

Pressures and Trends in Shetland

Intertidal rock habitats are subject to localised coastal development pressure, in particular within Shetland's ports and harbours. However, where natural rocky shore areas are removed they are often replaced with rock armour. Much of Shetland's rocky coastline remains undeveloped and is not subject to any development pressures.

There are known pressures acting on Shetland's rocky reefs.

Assessment Intertidal Rock- rocky shores and reefs

Few concerns

Trend: Stable

Confidence: Moderate -A lack of monitoring makes it difficult to assess changes in these habitats but there are few known pressures.

Sea loch egg wrack beds
Ascophyllum nodosum ecad *mackaii*

Ascophyllum nodosum (eggwrack) is a large brown seaweed that is widespread, occurring in great abundance in the mid shore of semi-exposed and sheltered beaches, typically attached to bedrock and boulders. *Ascophyllum nodosum* ecad *mackaii* (crofter's wig) is a detached form and found only in very sheltered conditions, such as the upper reaches of sea lochs and voes. Individual plants rarely exceed 60 cm in diameter and are either found as small clumps on the upper shore ('turf' form) or as dense beds ('beach' form) in the mid shore. In these circumstances the entire bed is lifted off the rock as the tide advances and then settles again as it recedes. The complex three-dimensional structure provides a humid habitat for shrimps, crabs, snails, mussels, barnacles, and worms. This can only happen in places where there is minimal wave and current action, otherwise the plants would be washed away.

It should be noted that this habitat is also found on intertidal sediments.

Protection and Legislation

- Habitat Directive Annex 1 habitat included within Vadills SAC
- UK Biodiversity Action Plan Priority habitat
- Priority Marine Features

Key Potential Sensitivities

- Changes in seabed type (physical loss to land or freshwater, or physical removal)
- Changes in wave exposure
- Changes in water flow
- Changes in siltation rates
- Seaweed harvesting
- Coastal development
- Interruption of freshwater drainage to the shore

Distribution

Within the UK *Ascophyllum nodosum* ecad *mackaii* is only recorded on the west coast of Scotland, the Western Isles, Shetland, and in Stangford Lough, Northern Ireland. These habitats support much of the world population of this species form.

In Shetland *Ascophyllum nodosum* ecad *mackaii* is known to occure in the Vadills SAC, Lera Voe and Clousta Voe, see Map 28.

Pressures and Trends in Shetland

Within Shetland *Ascophyllum nodosum* ecad *mackaii* has been found in undeveloped and remote areas and are not subject to any known pressures. However, it is possible that the species is more widespread than currently known and could be vulnerable to accidental damage or removal, particularly during coastal development or during seaweed harvesting.

Assessment Sea loch egg wrack beds
No concerns
Trend: No evidence
Confidence: Low-Moderate

Tide-swept algal communities

Tide-swept algal communities are inhabited by a wide range of animals such as sea mats, sea firs, sea squirts, sea anemones, and sponges.

Tide-swept algal communities are well represented in Shetland and one is found in the intertidal:

Fucoids in tide-swept conditions LR.HLR.FT

A species rich, complex habitat in sheltered to extremely sheltered mid eulittoral to lower eulittoral rocky shores, such as narrow channels

Protection and Legislation

- Priority Marine Features

Key potential sensitivities

- Changes in seabed type (physical loss to land or freshwater, or physical removal)
- Coastal development

Distribution

Fucoids in tide-swept conditions occur in voes, embayments, and between islands throughout Shetland, Map 28.

Pressures and Trends in Shetland

Tide-swept channels and subsequent communities have remained largely unaffected by human activity and there are no known pressures on this habitat.

Assessment Tide swept algae communities
No concerns
Trend: No evidence
Confidence: Moderate

Subtidal Sediments

Maerl bed, Shetland © Rachel Shucksmith

Subtidal sediments, including muds, sands and gravels, are the most common subtidal habitat type within the UK and around the Shetland coast. Found within in a variety of conditions, from ultra- sheltered, encountered within voes and sounds and lagoons, to fully-exposed, found off of Shetland's open coast.

The strength of tidal currents and wave exposure are important determinants of the topography and stability of subtidal sediments. In Shetland, many subtidal sediments are highly mobile, and this mobility effects the associated biodiversity, with more stable sediments generally associated with the highest levels of biodiversity.

Overall Assessment Subtidal Sediments and Supported Habitats and Species

Some concerns

Trend: No evidence

Confidence: Moderate - There are a number of known pressures on subtidal sediments and supported habitats. However, a lack of monitoring data makes quantifying impacts difficult.

Key Ecosystem Services

- Fisheries
- Tourism and Recreation
- Coastal Protection

Ecosystem Services Subtidal Sediments and Supported Habitats and Species

Service type	Benefits provided	Key risks and opportunities
Provisioning	Food Commercial Fisheries- (habitat provision for juvenile, adult and spawning life stages)	Long-term habitat integrity and sustained catch rates can be maintained by measures to: • Avoid loss or damage to the most valuable habitats (e.g. seagrass, maerl and horse mussel beds) by development and activities • Eradicate or prevent the spread of invasive non-native species through biosecurity planning • Prevent siltation, smothering and changes in water clarity from aquaculture, sewage and land run-off
Regulating	Climate regulation (carbon capture and storage)	Carbon sequestration by algal habitats and mussel beds can help to regulate atmospheric CO_2 levels. Carbon sequestration can be maintained through measures to maintain these habitats.
Cultural	Prolific coastal communities	Measures to maintain productive habitats can support commercially important species and provide financial stability to coastal communities.
	Tourism and nature watching	Maintaining habitats which are used by otters, seals and foraging seabirds can help to support these activities.

Community composition is typically more diverse where subtidal sediments support habitat-forming species, such as:

- Seagrass beds (*Zostera marina* and *Ruppia marina*)
- Maerl
- Horse mussel beds (*Modiolus modiolus*)

In addition, they can be home to a variety of rare and/ or sensitive species and habitats including:

- Ocean quahog (*Artica islandica*)
- Fan mussel (*Atrina pectinata*)
- Northern sea star (*Leptometra celtica*)
- Shallow tide-swept coarse sands with burrowing bivalves
- Low and variable salinity habitats – saline lagoons

Subtidal Sediments

Although subtidal sediments are a widespread habitat, few areas of subtidal sediment are subject to specific protection. Found in a variety of habitats utilised for development and supporting a range of commercial species, this habitat is subject to a number of pressures.

Protection and Legislation

- Habitats Directive Annex 1 habitat (sandbanks that are slightly covered by seawater all the time and coastal lagoons)
- BAP priority habitat (subtidal sands and gravels; saline lagoons)

Key Potential Sensitivities

- Physical disturbance, loss or removal e.g. fishing (dredging and trawling), dredging of harbours, pipe laying
- Coastal/ near shore development causing changes in water flow (and sediment regime)
- Changes in wave regimes
- Pollution leading to anoxic conditions

Distribution

The exact distribution of subtidal sediments within the Shetland Marine Region are not known, as not everywhere has been surveyed, but survey data can be used to predict the distribution of sediment types, Map 29. This mapping indicates that subtidal muds are a comparatively rare habitat in Shetland, found mainly to the north-east of Shetland, with coarse and muddy sand found extensively off-shore. Inshore coarse sands and muddy sands occur as pockets between gravels and rock, Map 29. Lagoons have a very limited distribution and can contain a variety of rare and endemic species, Map 29.

Pressures and Trends in Shetland

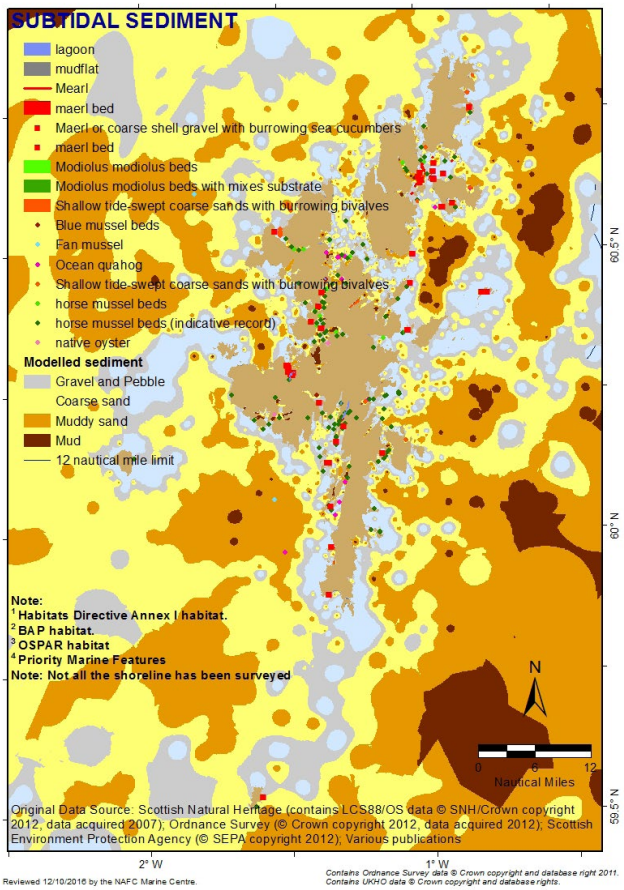
Subtidal sediments are subject to a number of pressures across Shetland. Soft sediments are commonly targeted by dredge and trawl fisheries both offshore and inshore. In addition, developments such as aquaculture sites and cables and pipelines are located in areas of soft sediment within voes and sounds.

Assessment Subtidal Sediments

Some concerns

Trend: No evidence

Confidence: Moderate- Although the locations of many pressures are known their impacts are not all monitored.



Map 29: Subtidal sediment distribution and supported habitats and species within the Shetland Marine Region

Seagrass beds

Seagrass beds are found in intertidal and shallow environments on sand and mud. Seagrass beds of the eelgrass *Zostera marina* and *Ruppia maritima* are capable of covering extensive areas that stabilise the underlying seabed and provide valuable habitats for

a variety of species, in particular important nursery grounds for many commercially important species of fish.

Protection and Legislation

- Berne Convention Appendix 1
- IUCN Red List Least Concern
- Habitats Directive Annex 1 within Vadills SAC and Sullom Voe SAC
- UK Biodiversity Action Plan Priority Habitat
- OSPAR Threatened and/ or declining habitat
- Priority Marine Features

Key Potential Sensitivities

- Changes in seabed type (physical loss to land or freshwater, or physical removal)
- Changes in wave exposure
- Physical disturbance e.g. fishing, aquaculture development
- Smothering
- Changes in suspended solids (water clarity)
- Siltation rates
- Nutrient enrichment e.g. aquaculture, sewage or diffuse pollution
- Wasting disease
- Non-native species e.g. *Sargassum muticum, Spartina anglica*

Distribution

Subtidal seagrass beds of the eelgrass *Zostera marina* are considered nationally scarce, and in Shetland are restricted to sheltered bays on the western coast of Mainland Shetland, Weisdale Voe, Whiteness Voe, off of the Burra Isles and, historically, the Vadills SAC. More commonly found around the Shetland Islands are seagrass beds of *Ruppia maritima*, found at eight locations around Shetland, Map 29.

Pressures and Trends in Shetland

Considered to be of relatively low resilience, recovery of damaged seagrass beds can take a considerable length of time, once lost, may never recover. Within Shetland *Zostera marina* beds are known to have been lost from the Vadills SAC, although monitoring data would suggest that the *Ruppia maritima* has remained. The reasons for this loss have not been investigated.

The seagrass in Whiteness and Weisdale voe is partially protected through aquaculture development restrictions (see SIC Supplementary Guidance Aquaculture Policy - Policy M4) but monitoring has not taken place to confirm the continued existence or state of these beds.

Assessment Seagrass beds
Many Concerns
Trend: Deterioration
Confidence: Moderate - Monitoring data only exists for the Vadills SAC only where it has been observed to have declined.

Low or variable salinity habitats

Saline lagoons are shallow, coastal water bodies with varying salinities that can support a diverse range of species that have wide environmental tolerances and are able to survive in these challenging habitats. The voes and sounds around the Shetland Islands create these diverse habitats, which can be found throughout the islands.

These diverse environments contain a number of priority marine habitats as well as a variety of rare and endemic species, which include:

Faunal communities on variable or reduced salinity infralittoral rock IR.LIR.IFaVs
Typically comprises dense beds of blue mussels which support barnacles, sea firs and sea mats.

Kelp in variable or reduced salinity IR.LIR.KVS
This habitat consists of wave-sheltered bedrock, boulders and cobbles and is exposed only to weak tidal streams. It is dominated by sugar kelp (*Saccharina latissima*) and various red and green seaweeds. Grazers, such as urchins and gastropods, and many other sedentary species, such as tube-dwelling polychaetes, ascidians, and barnacles are present.

Small brackish water snail (*Hydrobia acuta neglecta*)
This species is widespread throughout Europe within shallow brackish and saline coastal lagoons. It is a deposit-feeding herbivore that can be found all-year round in mud habitat, occasionally occurring in highly dense aggregations (max. density of 6 000 m^2 found in Camargue, France).

Submerged fucoids, green or red seaweeds (low salinity infralittoral rock) IR.LIR.Lag
This habitat is characterised by very shallow, submerged rocky lagoons that are dominated by dense populations of seaweed but, due to low salinity levels, contain a limited abundance of fauna. The principal species found are fucoids and green filamentous algae.

Sublittoral mud in low or reduced salinity (lagoons) SS.SMu.SMuLS
A characteristic lagoon community comprising short lived species such as blow lugworms and mud shrimps. The beaked tassel weed (*Ruppia* sp.) may also be present.

Protection and Legislation
- Habitat Directive Annex 1 habitat- Vadills SAC
- Priority Marine Features
- UKBAP Priority Habitat (except IR.LIR.IFaVS and *Hydrobia acuta neglecta*)

Assessment Low or variable salinity habitats
No Concerns
Trend: No evidence
Confidence: Moderate

Key Sensitivities
- Changes in seabed type (physical loss to land or freshwater, or physical removal)
- Changes in wave exposure
- Physical disturbance e.g. fishing, aquaculture development
- Changes in water flow and the salinity regime e.g. coastal development, land claim, water abstraction
- Susceptible to extreme weather (storms) which can eradicate small lagoons formed by sediment barriers
- Sea level rise

Distribution
Kelp in variable or reduced salinity
Very few records occur outside Scotland and in Shetland it is restricted to two saline lagoons, The Houb (Fora Ness) and Minn (Northmavine).

Small brackish water snail (*Hydrobia acuta neglecta*)
There are only scattered records of this snail throughout Scotland, with one site found in Shetland: the Loch of Hellister.

Submerged fucoids, green or red seaweeds (low salinity infralittoral rock)
This habitat is unique to Scotland and can be found at nine locations within the Shetland Islands.

Sublittoral mud in low or reduced salinity (lagoons)
Only a few records of this species are found outside Scotland and records in Shetland are restricted to the upper reaches of the Vadills.

Pressures and Trends in Shetland
There are no known pressures at the lagoon locations, however limited distribution of these habitats makes them vulnerable to any development pressure, with potentially limited larval supply affecting the ability of the habitat to recover.

Maerl
Maerl is a collective term for species of pink coralline red algae that can form extensive beds in areas with a moderate tidal flow, such as sea lochs or the straites and sounds between islands. It creates a structurally complex surface that provides a valuable habitat for a variety of plants and animals, in particular juveniles that can find refuge amongst the branches. It is known to provide an important habitat for a range of other species, including those of commercial value such as scallops.

Maerl is very hard and grows as small, unattached branched nodules on sandy seafloors. Maerl beds gradually build up as layers of dead maerl with a thin living layer on the surface, and provide an important habitat for burrowing species of bivalve, urchin, sea cucumber, and worm species. Maerl is extremely slow growing, with growth rates of up to 1 mm per year. These beds can be several metres deep and some of the larger beds may be over 1000 years old.

Protection and Legislation
- Habitat Directive Annex 1 habitat
- UK BAP Priority Species
- Priority Marine Feature
- The Fetlar to Haroldswick MPA includes maerl beds as protected features of the MPA
- SSMO Closed Areas

Sensitivities
- Physical disturbance e.g. moorings or anchors, scallop dredging, bottom trawling
- Physical removal of non-target species (e.g. during fishing activity)
- Physical changes in seabed type
- Salinity changes
- Siltation/smothering (e.g. aquaculture feed/ waste; resettlement of disturbed sediment)
- De-oxygenation (e.g. aquaculture, sewage)
- Loss/Extraction (e.g. for fertiliser)
- Non-native species in particular *Crepidula fornicate*
- Nitrogen/ phosphorous enrichment increasing the growth of ephemeral algae (e.g. due to

aquaculture, land runoff, sewage)
- Organic enrichment (e.g. finfish discharges)

Assessment Maerl beds
Some Concerns
Trend: Stable
Confidence: Low- Moderate -Although measures have been implemented to reduce potential pressures as recovery rates are low it is unlikely that maerl beds will expand in the short to medium term.

Distribution

Maerl beds (SS.SMp.Mrl)

This habitat can be found throughout the Shetland Islands, from Fair Isle up to Balta Sound in Unst, normally associated with areas of moderate tidal flow such as in sounds (e.g. Hascosay Sound), or between islands (e.g. north of Papa, Scalloway) or headlands (e.g. Fair Isle). Known maerl bed locations are shown in Map 29.

Maerl or coarse shell gravel with burrowing sea cucumbers (SS.SCS.CCS.Nmix sand)

This habitat can be found on the north-eastern coastline of Mainland Shetland, at Lunna Ness, and off the west coast of the Out Skerries. The gravel sea cucumber (*Neopentadactyla mixta*) can be found in high densities within the gravel, maerl, coarse sand mixture along with scallops, brittlestars, crabs and dragonets.

Pressures and Trends in Shetland

In Shetland, a number of measures have been implemented to reduce the key potential pressures of physical disturbance and smothering on maerl beds by aquaculture and scallop dredging. However, due to the slow recovery of maerl, recovery of damaged beds is likely to occur over very long periods.

In Shetland in 2012, the SSMO proactively initiated a series of closed areas that protect known maerl beds from accidental damage caused by scallop dredging. Reports of new records are investigated, locations surveyed, and closed if new areas are discovered, this led to the introduction of additional closed areas in 2015.

There are six aquaculture sites that are positioned adjacent to, or on known maerl bed. One site has recently been placed on long term fallow and its permission is likely to lapse, and another has recently been re-positioned to ensure that it was at sufficient distance to prevent damage to the maerl bed. There is limited opportunity for the relocation of the other four sites, and expansion or alterations to the sites would increase the area of lost maerl, with little chance of recovery.

Horse mussel beds

Horse mussels, *Modiolus modiolus*, are capable of forming dense, raised beds that can occur from 5 m to 100 m depth. They play an important role in modifying the underlying habitat, by creating a more stable surface, and provide a wealth of hard substrata and refuge habitats for a wide variety of species, such as brittlestars, crabs, sponges, sea squirts, and other commercially important species of bivalve molluscs, such as scallops.

Four key horse mussel bed communities are represented within the Shetland Islands:

***M. modiolus* beds with hydroids and red seaweeds on a tide-swept circalittoral mixed substrata**

These mussel beds support a diverse range of red seaweeds, sea firs, tube worms, and anemones.

***M. modiolus* beds on open coasts circalittoral mixed sediments**

These mussel beds support a diverse community that notably includes polychaete worms, bivalves, and brittlestars.

***M. modiolus* beds with fine hydroids and large solitary ascidians on very sheltered circalittoral mixed substrata**

These mussel beds support communities of brittlestars, scallops, crabs, and gastropods.

***M. modiolus* beds with *Clamys varia*, sponges, hydroids and bryozoans on slightly tide-swept very sheltered circalittoral mixed substrata**

These mussel beds support a variety of organisms, such as brittlestars, feather stars, sponges, sea mats and sea squirts.

Protection and Legislation

- Habitat Directive Annex 1 habitat
- BAP Priority habitat
- OSPAR threatened and/ or declining habitat
- Priority Marine Features
- Qualifying feature within the Sullom Voe SAC (but not the primary reason for designation)
- The Fetlar to Haroldswick MPA protected feature
- SSMO closed areas

Key Sensitivities

- Physical changes in seabed type
- Physical removal of non-target species (e.g. during fishing activity)
- Physical removal
- Physical disturbance (e.g. during fishing activity, dredging/trenching)

Assessment Horse mussel beds
Some Concerns
Trend: No evidence
Confidence: Moderate

Distribution

Scotland holds approximately 85% of the UK's horse mussel beds, many of which are found around the Shetland Islands, Map 29. Four key horse mussel bed communities are represented within the Shetland Islands:

M. modiolus beds with hydroids and red seaweeds on a tide-swept circalittoral mixed substrata SS.SBR.SMus.ModT

Found along the open coastline and within tide-swept channels between 5 and 50 m depth. These mussel beds can be found throughout the Shetland Islands, from Burra in the southwest to Basta Voe in the northeast, and within the Fetlar to Haroldswick MPA.

***M. modiolus* beds on open coasts circalittoral mixed sediments SS.SBR.SMus.ModX**

Found in current-swept areas at depths between 5 and 50 m. There are only two known records in the UK, one of which is found at Sullom Voe and within the Sullom Voe SAC.

***M. modiolus* beds with fine hydroids and large solitary ascidians on very sheltered circalittoral mixed substrata SS.SBR.SMus.ModHAs**

Found in more sheltered conditions at depths between 5 and 30 m, these mussel beds can be found throughout the Shetland Islands, including Fetlar to Haroldswick MPA and Sullom Voe SAC.

***M. modiolus* beds with *Clamys varia*, sponges, hydroids and bryozoans on slightly tide-swept very sheltered circalittoral mixed substrata SS.SBR.SMus.ModCvar**

Found in very sheltered conditions between 5 and 30 m depth, there are only a few records in Scotland, mostly occurring on the west coast, but they are also found in Bluemull Sound within the Fetlar to Haroldswick MPA.

Horse mussel bed, Shetland © Rachel Shucksmith

It should be noted that not all horse mussel bed records have been fully investigated and assigned a biotope code, it is therefore possible that some of these habitats exist at other locations in Shetland. Records of horse mussels not assigned a biotope code are also shown in Map 29.

Pressures and Trends in Shetland

In the Shetland Islands the SSMO have proactively closed known horse mussel beds to scallop dredging, together with a surrounding buffer area, to protect against accidental damage, see Map 8. Reports of new records are investigated and locations surveyed and closed if new areas are discovered, this led to the introduction of additional closed areas in 2015.

Monitoring of Sullom Voe SAC indicates that the effluent emissions from Sullom Voe Terminal are not affecting the beds within the voe.

There are a number of horse mussel records in the vicinity of shellfish and finfish farm sites, however it is not known whether these records represent true beds or whether they have been impacted.

Shallow tide-swept coarse sands with burrowing bivalves

Moerella spp. with venerid bivalves in infralittoral gravely sand SS.SCS.ICS.MoeVen

The coarse gravelly sands found on exposed coastlines that extend down to approximately 20 m can support an abundance of bivalve molluscs, in particular *Tellina* spp. and surf clams, and polychaete worms, tanaids, and sand hoppers.

Protection and Legislation
- Habitat Directive Annex 1 habitat
- UK BAP Priority habitat
- Priority Marine Feature

Potential Sensitivities
- Physical changes in seabed type
- Physical loss (to land or freshwater habitat)
- Physical removal of non-target species (e.g. during scallop dredging)
- Physical disturbance e.g. mobile demersal fishing gear, dredging/trenching

Distribution
There are 49 records of shallow tide-swept coarse sands with burrowing bivalves in Scotland. These habitats have a limited distribution around Scotland, with the 13 examples found within the Shetland Islands, in particular along the east coast of the Shetland Mainland, Yell, and Unst, see Map 29.

Pressures and Trends in Shetland
While these environments are quite robust, the slow growing animals that inhabit them are vulnerable to overfishing and physical disturbance. These habitats are targeted by scallop dredgers, however SSMO licence conditions prohibit suction and hydraulic dredging and the use of 'French' dredges to reduce the scale of impact on the seabed. Four records are within the recently designated Fetlar to Haroldswick MPA.

Assessment Shallow tide-swept coarse sands with burrowing bivalves
Some Concerns
Trend: No evidence
Confidence: Low

Ocean quahog (*Artica islandica*)
The ocean quahog is a long lived species, with the oldest known individual found over 500 years old. It is found in sandy and muddy sediments between 10 and 280 m depth all round Scotland. Ocean quahog are known to be a prey species of North Sea cod[61] and in the Baltic Sea some 40% of annual cod production in the period 1970 – 1985 was dependent on the ocean quahog[62].

Protection and Legislation
- OSPAR Threatened and/or declining species
- Priority Marine Feature

Key Sensitivities
- Physical changes in seabed type
- Physical loss (to land or freshwater habitat)
- Physical removal of non-target species (e.g. during fishing activity)
- Physical disturbance (e.g. during fishing activity, dredging/ trenching)
- Removal/capture (targeted or as bycatch)
- Substrate removal (e.g. dredging)
- Siltation/smothering (e.g. dredge spoil; aquaculture waste)

Distribution
The ocean quahog is found throughout Shetland, both inshore and offshore.

Pressures and Trends in Shetland
There is no spatial protection of this species, and although widespread, knowledge of relative abundance is not known. It is therefore potentially vulnerable to accidental damage and loss by activities and development.

Assessment Ocean quahog
No evidence
Trend: No evidence
Confidence: Low

Fan mussel (*Atrina pectinata*)
Found embedded in sediment and growing 30-48cm in length, the fan mussel is one the UK's largest and most threatened molluscs. Often found solitarily but also occurs as small groups or patches of individuals forming small beds.

Protection and Legislation
- Wildlife & Countryside Act 1981 Schedule 5,

61 Rees HL, Dare PJ (1993) Sources of mortality and associated life-cycle traits of selected benthic species: a review. MAFF Fisheries Research Data Report, no. 33., Lowestoft: MAFF Directorate of Fisheries Research

62 Brey T, Arntz WE, Pauly D, Rumohr H (1990) Arctica (Cyprina) islandica in Kiel Bay (Western Baltic): growth, production and ecological significance. Journal of Experimental Marine Biology and Ecology, 136, 217-235

section 9
- UK Biodiversity Action Plan Priority Species
- Priority Marine Feature

Key Sensitivities
- Physical changes in seabed type
- Physical removal of non-target species (e.g. during scallop dredging)
- Physical disturbance e.g. scallop dredging, bottom trawling, dredging/ trenching
- Removal/capture (targeted or as bycatch)
- Substrate removal (e.g. dredging)

Distribution
The present distribution and abundance of fan mussels in Shetland is not known. There are only three records from Shetland, all offshore and historical (1800s). Occasional specimens have been brought ashore by fishermen but it is not known where they were collected from.

Pressures and Trends in Shetland
There is no spatial protection of this species, and with limited records of its historic or current distribution it is difficult to assess temporal changes in its distribution, however, due to its sensitivity to a number of pressures, in particular fisheries, any changes in fishing patterns have the potential to impact this species accidental damage.

Assessment Fan mussel
No evidence
Trend: No evidence
Confidence: Moderate

Northern feather star (*Leptometra celtica*)
The Northern feather star is found at depths of 40 to over 1000 metres, and is normally found on shell gravel.


Northern feather star © Marine Scotland

Protection and Legislation
- Priority Marine Feature when 'aggregation on mixed substrata'

Key Sensitivities
- Physical changes in seabed type
- Substrate removal (e.g. dredging);
- Changes in water flow
- Physical disturbance (e.g. during fishing activity, dredging/ trenching)
- Physical removal of non-target species (e.g. during fishing activity)
- Siltation/ smothering

Distribution
The majority of the records in the UK are from the west and north coasts of Scotland. While there are records from Shetland, they have been recorded in habitats uncharacteristic of this species and would therefore require resurveying to clarify their identification.

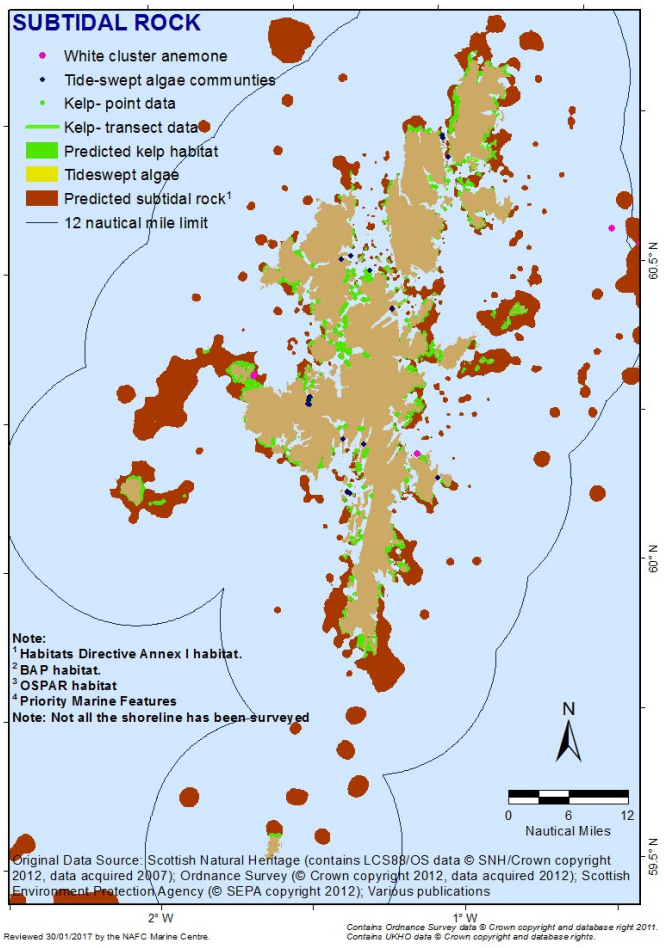
Pressures and Trends in Shetland
Lack of knowledge of the true distribution of this species makes it vulnerable to accidental damage.

Assessment Northern feather star
No evidence
Trend: No evidence
Confidence: Low

Subtidal Rock

Spiny lobster on subtidal rock © Rachel Shucksmith

Subtidal rock communities range from vertical rock walls to horizontal ledges, caves, sloping or flat bedrock, broken rock, boulder fields, and aggregations of cobbles. Subtidal rock communities are strongly affected by the availability of light. Shallow seas are typically dominated by seaweeds, while deeper areas, below the photic zone (approximately 50 m), overhanging areas or caves, communities comprise exclusively of animals. Other factors influence the composition of communities, including wave action, tidal stream strength, and salinity.



Map 30: Subtidal rock distribution and supported habitats around the Shetland coast

Overall Assessment Subtidal Rock and Supported Habitats and Species

No concerns

Trend: Stable

Confidence: Moderate - Mapping would suggest these habitats are not target for commercial activities, however the exact distribution of the habitats and species are not known.

Key Ecoystem Services

- Fisheries
- Tourism
- Recreation
- Coastal Protection

Community composition is typically more diverse where sub-tidal sediments support habitat-forming species, such as:

- Tide swept algal communities
- Kelp beds

Priority marine species found on subtidal rock habitats:

- White cluster anemone
- European spiny lobster

Ecosystem Services Subtidal Rock and Supported Habitats and Species

Service type	Benefits provided	Key risks and opportunities
Provisioning	Food Commercial Fisheries- (habitat provision for juvenile, adult and spawning life stages)	Long-term habitat integrity and sustained catch rates can be maintained by measures to: • Avoid loss or damage to the most valuable habitats (e.g. tide swept communities and kelp beds) by development and activities • Eradicate or prevent the spread of invasive non-native species through biosecurity planning • Prevent siltation, smothering and changes in water clarity from aquaculture, sewage and land run-off
Regulating	Climate regulation (carbon capture and storage)	Carbon sequestration by algal habitat can help to regulate atmospheric CO_2 levels. Carbon sequestration can be maintained through measures to maintain algal habitats.
Cultural	Prolific coastal communities	Measures to maintain productive habitats can support commercially important species and provide financial stability to coastal communities.
	Tourism and nature watching	Wildlife watching provide tourism and recreational opportunities. Maintaining habitats which are used by otters, seals and foraging seabirds can help to support these activities.

Subtidal rock, reefs and sea caves

Subtidal rock, reefs and caves are found around much of the Shetland coastline, from sheltered voes to exposed shorelines.

Subtidal rock provides an important habitat for a range of species.

Protection and Legislation

- Habitats Directive Annex 1 Reefs, submerged or partially submerged sea caves- Mousa SAC, Papa Stour SAC, Pobbie Banks cSAC

Key Potential Sensitivities

- Physical disturbance, loss or removal (e.g. pipe laying, land reclamation)
- Coastal/ near shore development causing changes in water flow (and sediment regime)
- Changes in wave regimes

Distribution

The exact distribution of sub-rock sediments around the Shetland coast are not known, as not everywhere has been surveyed, but survey data can be used to predict the distribution of seabed types, Map 30. This mapping indicates that subtidal rock can be found extensively around the Shetland coast, in particular around the south Shetland Mainland to Fair Isle, from Foula to Papa Stour, between Whalsay and Skerries, north of Unst, around Mousa and offshore at the Pobie Bank cSAC.

Pressures and Trends in Shetland

Mapping of marine activities would suggest that sub-tidal rock is subject to relatively few pressures, with these areas not targeted for dredging or trawling and not used for aquaculture purposes. Pipelines and cables have been lain on sub-tidal rock but their footprint is relatively small compared to the extent of the habitat.

Assessment Subtidal rock

Few concerns

Trend: Stable

Confidence: Low - Moderate- Although the locations of many pressures are known their impacts are not all monitored.

Subtidal rock habitat© Rachel Shucksmith

Tide-swept algal communities

Tide-swept algal communities are inhabited by a wide range of animals such as sea mats, sea firs, sea squirts, sea anemones, and sponges. In certain sites, where the substratum is more stable, kelp parks may develop, which in turn provide suitable habitat for a variety of epiphytic flora and fauna. In deeper waters, where light is a limiting factor, communities are dominated by animals and dense beds of brittlestars become more common.

Tide-swept algal communities are well represented in Shetland by three key community types:

***Halidrys siliquosa* and mixed kelps on tide-swept infralittoral rock and coarse sediment IR.HIR.KSed.XKHal-** Structurally complex and species rich, supporting a diverse community of red seaweeds, sea firs, sea mats, sea squirts, starfish, topshells, and sea anemones.

Kelp and seaweed communities in tide-swept sheltered conditions IR.MIR.KT- A community dominated by kelp (*Laminaria digitata, L. hypeborea,* and *L. saccharina*) with an understory of red seaweeds, sponges, sea squirts, and sea mats.

***Laminaria hyperborean* in tide-swept infralittoral mixed substrata IR.MIR.KR.LhypTX**
A kelp canopy that supports a diverse range of red seaweeds, along with sponges, sea squirts, sea mats, sea anemones, echinoderms, and molluscs.

Protection and Legislation

- Priority Marine Features

Key Potential Sensitivities

- Seaweed harvesting
- Changes in water flow e.g. tidal energy development

Distribution

Tide-swept algal communities are widespread throughout Shetland, particularly where there are tidal rapids in some voes and between islands (e.g. Yell Sound), see Map 30. Although the turbulent conditions are largely associated with the top 5m of the water column, some tidal streams can be felt at depths in excess of 30 m.

***Halidrys siliquosa* and mixed kelps on tide-swept infralittoral rock and coarse sediment**- Few records in Scotland and only one in the Shetland Islands (Noss), but considered to be an under-recorded habitat.

Kelp and seaweed communities in tide-swept sheltered conditions - Well represented on the western coast of the Shetland Islands, particularly off the coast of Papa Stour.

Laminaria hyperborea in tide-swept infralittoral mixed substrata- Found in the northern areas of the Shetland Islands, in Yell Sound and Bluemull Sound.

Pressures and Trends in Shetland

Tide-swept channels and subsequent communities have remained largely unaffected by human activity. In Shetland these areas are not normally targeted by fishing activity due to high tidal flows.

Assessment Tide-swept algae communities
No concerns
Trend: No evidence
Confidence: Moderate

Kelp beds

Kelp parks and forests can be found around the Shetland coast to depths of 30m. They provide an important habitat for a variety of epiphytic flora and fauna, including commercial species and providing a foraging habitat for other animals including otters.

Within the Shetland Marine Region five habitat types are recognised:

***Laminaria hyperborea* forest with a faunal cushion (sponges and polyclinids) and foliose red seaweeds on very exposed upper infralittoral rock IR.HIR.KFaR.LhypFa**

***Laminaria hyperborea* with dense foliose red seaweeds on exposed infralittoral rock R.HIR.KFaR.LhypR**

***Laminaria hyperborea* on tide -swept, infralittoral rock IR.MIR.KR.LhypT**

***Laminaria hyperborea* on tide -swept infralittoral mixed substrata IR.MIR.KR.LhypTX**

***Laminaria hyperborea* and foliose red seaweeds on moderately exposed infralittoral rock R.MIR.KR.Lhyp**

Protection and Legislation

- Priority Marine Features

Key Potential Sensitivities
- Seaweed harvesting
- Changes in water flow e.g. tidal energy developments

Distribution
Adjacent to Shetland's coastline the subtidal is dominated by rock. This rocky area provides a suitable substrate for the development of kelp beds around much of Shetland's coastline. Although the extent of the kelp beds have not been mapped, and very little has been biotope coded, the predicted extent of kelp beds are shown in Map 30, as well as records of kelp beds.

Pressures and Trends in Shetland
Kelp beds are subject to limited development pressure, and not target by fisheries or normally used for aquaculture. Seaweed harvesting has the potential to be an industry in the future.

Assessment Kelp beds
No concerns
Trend: No evidence
Confidence: Low- Moderate

White cluster anemone (*Parazoanthus anguicomus*)
The white cluster anemone usually occurs in deep water down to 400 m but can occur as shallow as 20m. It can form encrusting colonies that can grow on sponges, tube worms, corals and stones.

Protection and Legislation
- Priority Marine Feature

Key Sensitivities
- Physical disturbance e.g. scallop dredging, bottom trawling

Distribution
This nationally scarce sea anemone can be found in deep water off the north-east coast of the Shetland Islands within the Pobie Bank cSAC, and closer to shore within the Papa Stour SAC and around Green Holm to the north of Bressay, see Map 30.

Pressures and Trends in Shetland
Whilst colonies growing on overhanging rock, such as at Green Holm, are unlikely to be exposed to commercial fishing pressure, colonies growing on cold water corals or on stones could be vulnerable to demersal fishing impacts. Known locations in Shetland (Papa Stour SAC and the Pobie Bank cSAC) will be protected by site-specific management measures currently being developed. However, as this species is likely to be under-recorded, it may be exposed to past, present and future accidental damage outside of these protected areas.

Assessment White cluster anemone
Few concerns
Trend: No evidence
Confidence: Low -Under recording of this species makes accurately assessing its condition difficult.


White cluster anemone © Rachel Shucksmith

European spiny lobster (*Palinurus elephas*)
A large spiny lobster which grows up to 60cm in length. Usually found at depths of 5-70m on exposed rocky coasts, it was once a common species but is now considered to be scarce.

Protection and Legislation
- UKBAP species
- Priority Marine Feature
- Red list of threatened species- vulnerable

Key Potential Sensitivities
- Overfishing
- Loss of habitat

Distribution
There are a number of records from around the Shetland coast, primarily from exposed rocky locations, and in addition anecdotal evidence from fishermen and SCUBA divers suggests it is an infrequently occurring species found on exposed coastal areas throughout Shetland.

Pressures and Trends in Shetland
This species is no longer targeted by fishermen but

may be occasionally caught as by catch, when, due to the absence of a market, it is normally returned to the sea. Subsequently there is no stock assessment information for the Shetland Marine Region, but elsewhere in Europe low stock levels and stock fragmentation are hindering recovery.

Assessment European spiny lobster
No evidence
Trend: No evidence
Confidence: Low - There is no systematic monitoring of this species to assess stock conditions


Spiny lobster © Rachel Shucksmith

Occasional Visitors

Goose barnacle © Rachel Shucksmith

There are a number of marine species that can be considered part of the marine life around the Shetland Islands but cannot be considered permanent residents. Their occasional visits generally fall under three categories:

- **Species at the edge of their natural range** Includes those species who might be affected by climate change. Increases in water temperatures are expected to advance the northern boundaries of many marine species home range, which could increase the frequency of occurrence of a species and increase the number of occasional visitors travelling further north. Regular monitoring of these species is valuable as they can be important indicators of climate change and sea temperature rise. The NAFC Marine Centre has provided information on 'climate change indicator species' via leaflets and its website to encourage public reporting of species.
- **Seasonal, wide-ranging or migratory species that regularly enter the Shetland waters** These species can have large natural ranges, sometimes travelling thousands of miles to get to mating or feeding grounds, that cross multiple international boundaries. For example, many cetacean and elasmobranch species annually migrate large distances, often travelling north during the warmer summer months.
- **Oceanic species that roam the oceans and, from time to time, can be seen in coastal waters when conditions allow.** These species can include planktonic species, such as jellyfish, whose distribution is influenced by marine currents and wind, or other open-ocean, deep-water inhabitants that feed on planktonic species and follow them into coastal areas, such as the mauve stinger *Pelagia noctiluca*. Some planktonic species such as salps can be used as indicators of increased Atlantic water inflows into the North Sea.

By their nature, the records of 'occasional visitors' to the Shetland Islands tend to be sporadic. Locally these species are recorded by the Shetland Biological Records Centre and reporting of unusual fish species are made to the NAFC Marine Centre.

Species recorded in the Shetland Marine Region

Invertebrates

Salps
Goose barnacles *Lepas anatifera*

Reptiles

Leatherback turtle *Dermochelys coriacea*
Loggerhead turtle *Caretta caretta*

Cetaceans (see Healthy and Biologically Diverse - Cetacean section)
Northern right whale *Eubalaena glacialis*
Humpback whale *Megaptera novaeangliae*
Fin whale *Balaenoptera physalus*
Blue whale *Balaenoptera musculus*
Sei whale *Balaenoptera borealis*
Sperm whale *Physeter microcephalus*
Northern bottlenose whale *Hyperoodon ampullatus*
Sowerby's beaked whale *Mesoplodon bidens*
Striped dolphin *Stenella coeruleoalba*
False killer whale *Pseudorca crassidens*
Beluga *Delphinapterus leucas*

Pinnipeds
Bearded seal *Erignathus barbatus*
Ringed seal *Phoca hispida*
Harp seal *Phoca groenlandica*
Hooded Seal *Cystophora cristata*
Walrus *Odobenus rosmarus*

Protection and Legislation

- Habitat Directive Annex IV European protected species (cetaceans and turtles)

Pressures and Trends in Shetland

Considering the infrequent and relatively short amount of time occasional visitors will spend in the waters surrounding the Shetland Islands, it is unlikely that local activity (e.g., boating, shipping, developments) will impact their population status, although some activities can cause mortality of individuals (e.g., boat collisions, marine litter, entanglement). Both cetaceans and turtles have been reported entangled in fishing gear.


Salp bloom © Rachel Shucksmith

Non-Native Species

Schizoporella japonica © Rachel Shucksmith

Non-native species are organisms that have been introduced to a new location, outside of their natural range, by human activity. These introduction events can be intentional, such as the introduction of shellfish for aquaculture, or an accidental consequence of maritime activities, such as shipping. The vast majority of non-native species fail to survive transportation or the early stages after introduction, but some are capable of establishing new populations. Of those new populations, some become widespread and abundant, which can have detrimental effects on the local ecology, economy, and, potentially, human health. The most problematic of non-native species are known as invasive species.

Many marine activities contribute to the long and short-distance transportation of marine species. Commercial ships, oil tankers, local fishing and aquaculture vessels, recreational vessels, and cruise liners are all commonplace within the Shetland Marine Region, and are capable of transporting non-native species over local, regional, or international scales.

The commercial shipping industry is generally considered the main vector of long-distance transportation and introduction of marine non-native species. However, over more local and regional scales, the transportation of non-native species by recreational and smaller commercial vessels become more influential. Once a non-native species is introduced, local marine activity contributes considerably to the establishment and continued spread of new populations.

Assessment Non-native species

Some concerns

Trend: Deterioration- Increasing number of NNS

Confidence: High- supported by monitoring data

National Context: The number of NNS introduced to the UK is increasing, and at a faster rate. Shetland has fewer NNS compared to elsewhere in the UK.

Key Ecosystem Services

- Fisheries
- Aquaculture
- Tourism and Recreation

Impacts

The impacts of marine invasive non-native species are hard to predict but the potential for damage to native communities and local industries can be significant.

- Non-native species have the potential to displace, out-compete, and prey upon native species, as well as alter the surrounding physical environment (e.g., water clarity and fouling), which can have knock-on effects throughout the local community and threaten local biodiversity.
- Non-native species can foul artificial structures, such as aquaculture sites, marinas, and boats, which can reduce shellfish production and increase cleaning and management costs.

Marine non-native species detected within the Shetland Marine Region

There are currently 14 non-native species known to be present around Shetland, although the majority of them have only been found in marinas and ports. Although there are a number that can be found

widespread throughout the Shetland Islands (e.g., *C. mutica, C. eumyota, and D. japonica*) they have had no apparent impact.

Future risks

The high level of marine activity connecting the Shetland Islands to mainland Scotland suggests there is continuous risk of non-native species being introduced. Particularly problematic species that have been detected on mainland Scotland that are not yet present in the Shetland Islands include:

- *Didemnum vexillum* – Carpet sea squirt
- *Styela clava* – Leathery sea squirt
- *Botrylloides violaceus* – Violet sea squirt
- *Sargassum muticum* – Wireweed

Biosecurity Plan for the Shetland Islands

To address the management challenges of non-native species in the Shetland Islands and to ensure the appropriate measures are taken to prevent any detrimental impacts, a Biosecurity Plan[63] has been developed. The purpose of the Biosecurity Plan is to provide a useful and practical guidance framework for reducing the potential for non-native species introduction and minimising their associated impacts. The Plan proposes a four-stage approach to non-native species management:

1. prevention of introduction;
2. early detection of non-native species;
3. rapid managerial response (contain or potentially eradicate); and
4. controlling the impacts of established invasive non-native species.

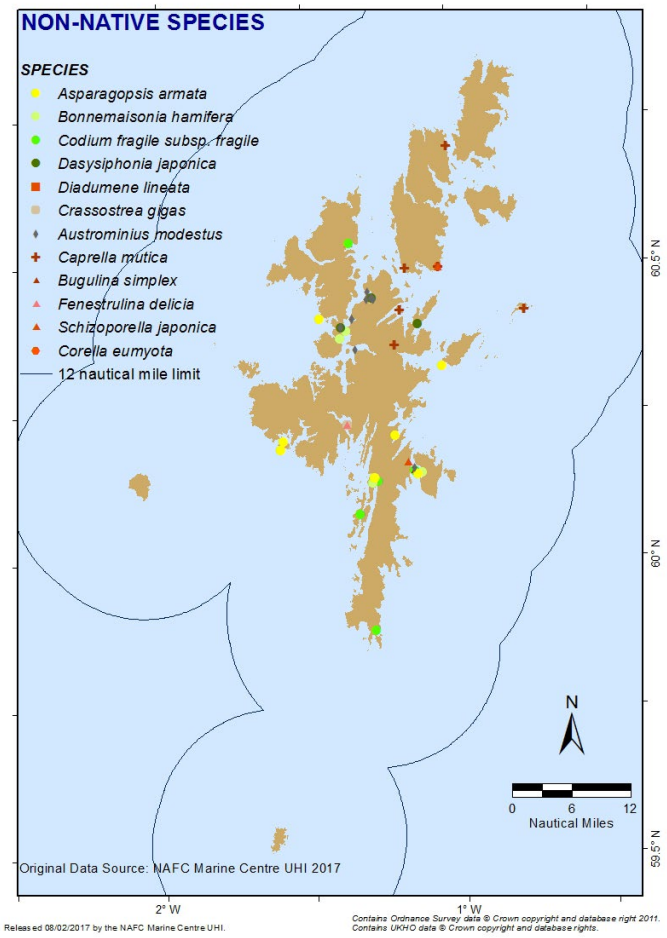
All marine activities play a role in the introduction and spread of marine non-native species, although their roles can be highly varied and a single plan for all may not be the best approach. Therefore, to address this variation, the Biosecurity Plan provides detailed guidance for each industry separately, specifically on the measures required for detecting, reporting, and managing the spread of non-native species.

Table 11: Non-native species present in the Shetland Marine Region

Species	Description
Asparagopsis armata Harpoon weed	A small red algae with densely tufted branches that can grow up to 30 cm long. Contain distinctive harpoon-like branches with barbs.
Austrominius modestus Darwin's barnacle	A small white barnacle (approx. 1cm wide) that can be found growing on hard surfaces in sheltered environments. Distinctive outer shell that contains 4 plates.
Bonnernaisonia hamifera Hook Weed	A bushy red algae, growing to approximately 20 cm long, with immediately recognisable curved hooks.
Bugula simplex Bryozoan	An erect bryozoan that forms light brown tufts approximately 3 cm in size.
Caprella mutica Japanese skeleton shrimp	A species of caprellid amphipod with a long, slender body shape, usually orange-red in colour. Adult males can grow up to 5 cm in length, females usually 1.5cm.
Codium fragile ssp. Fragile Fragile green sponge fingers	A dark green, tubular seaweed that has a soft felt-like texture. Swollen finger-shaped branches that float in water and can form bush-like structures up to 60 cm across.
Corella eumyota Orange-tipped sea squirt	A solitary sea squirt, clear in colour with orange tipped siphons and smooth to touch. Grows to approximately 4 cm in length. Clearly visible C-shaped gut.
Dasysiphonia japonica Japanese weed	A dark-red red algae with a bushy appearance that can grown to approximately 30cm in height.
Diadumene lineata Orange striped anemone	A small species of anemone (approximately 3cm in height) that can be identified by a green/brown column with orange, or less commonly yellow or white, vertical stripes.
Fenestrulina delicia Bryozoan	A white encrusting bryozoan that can be found growing on both artificial and natural substrates, in particular on shells.
Schizoporella japonica Bryozoan	An orange-red coloured encrusting bryozoan that can form colonies up to 20 cm across.

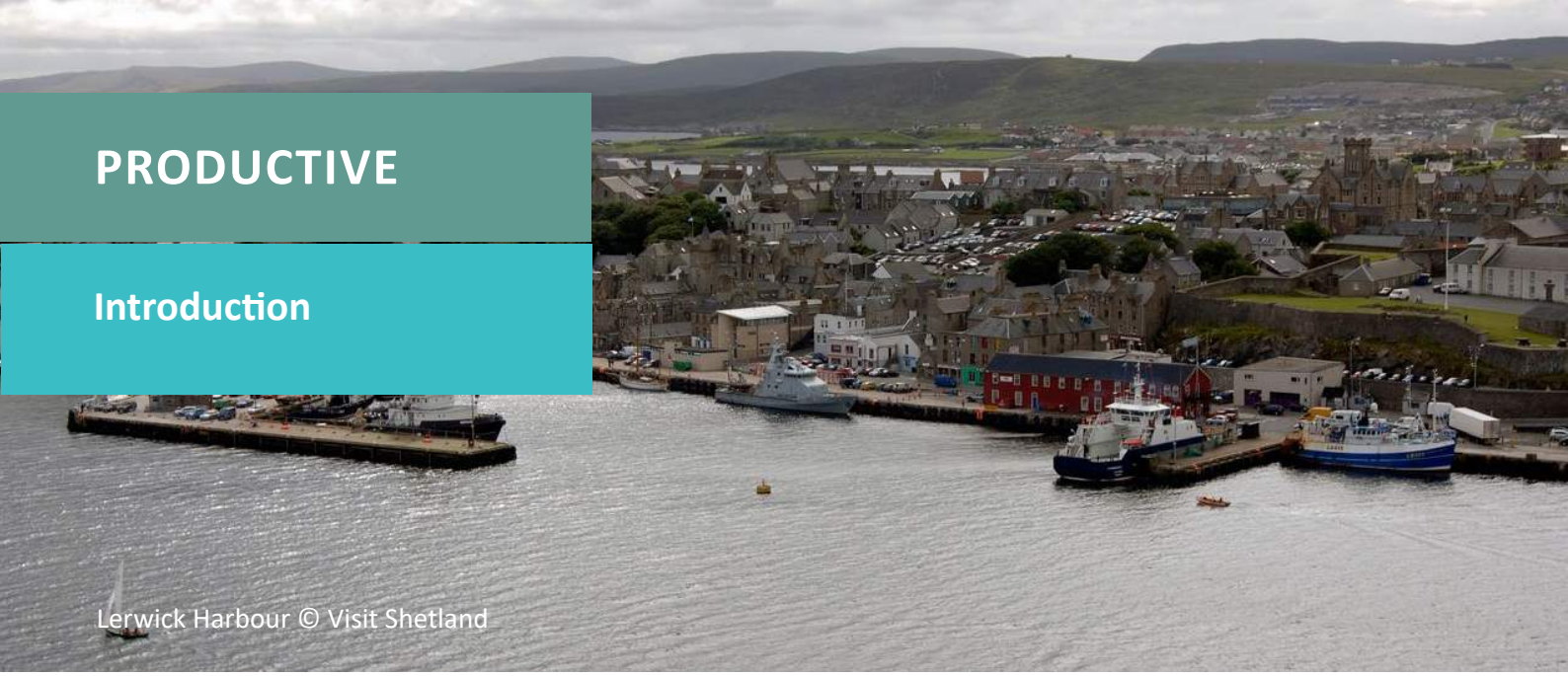
63 NAFC Marine Centre (2015) A Biosecruity Plan for the Shetland Islands. https://www.nafc.uhi.ac.uk/research/msp/biosecurity/BiosecurityPlan.pdf

Marine industry is an essential part of Shetland's economy and, therefore, the potential impact from non-native species is considerable and a precautionary approach is essential for safeguarding these important industries. The implementation of the Biosecurity Plan ensures an effective monitoring strategy is employed; any problematic non-native species are detected early and appropriately managed; conservation of local biodiversity, habitats, and ecosystems; and all local marine users are aware of codes of best practice for managing non-native species.



Map 31: Non-native species found around within the Shetland Marine Region

C PRODUCTIVE



PRODUCTIVE

Introduction

Shetland is highly dependent on the marine environment for its economic prosperity, supporting nearly 3000 jobs or 25% of all full time equivalent (FTE) employment in Shetland. The economic contribution from the marine environment is over £455 million or over 65% of the combined total economic output of the Shetland economy. Shetland enjoys low unemployment levels 0.9% in 2013, compared with 3.1% in Scotland and 2.9% across the UK.

Many of these industries are dependent on ecosystem services provided by the marine environment, including clean seas (see Section Clean and Safe) and the presence of a number of species and habitats (see Section Healthy and Biologically Diverse) for specific linkages.

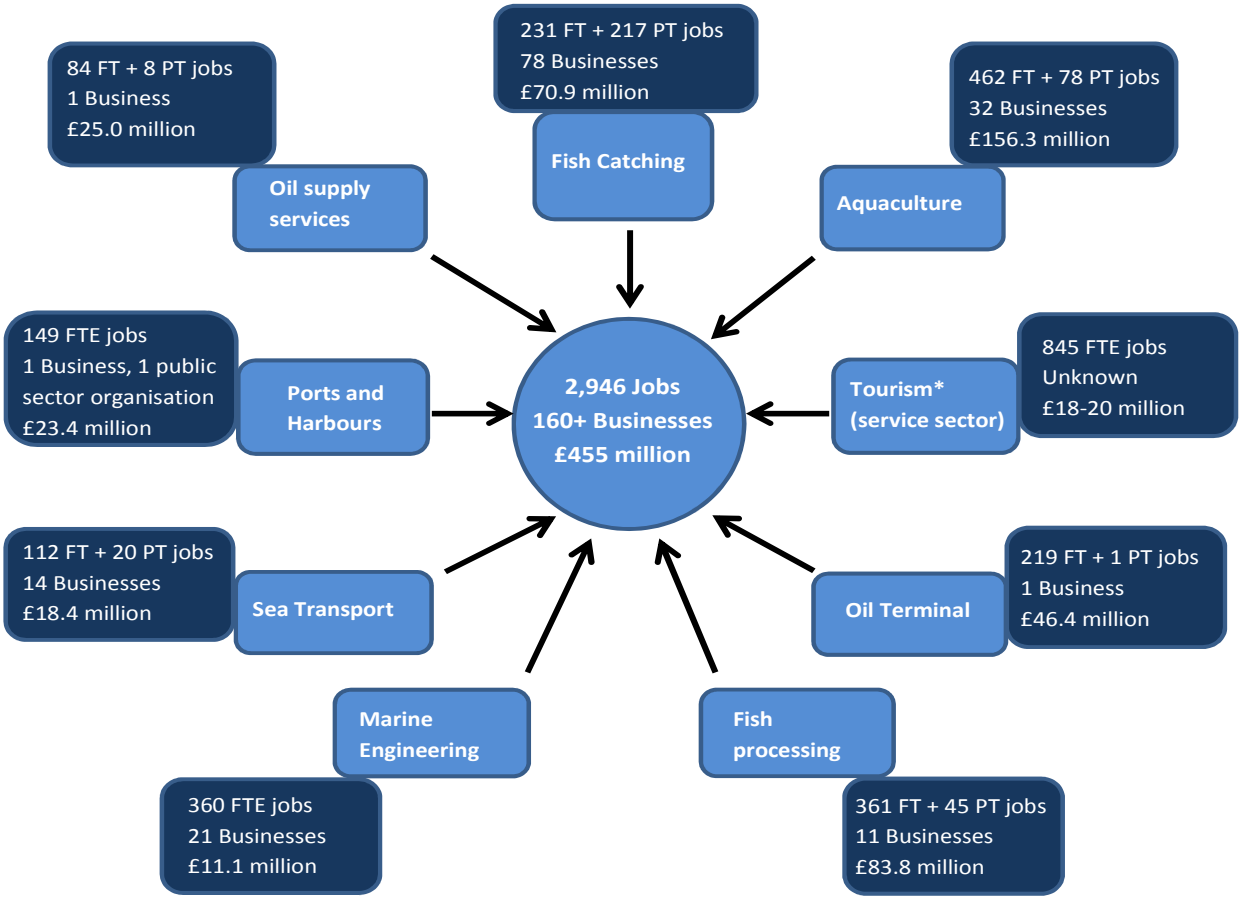


Figure 15: Employment, businesses and gross value added supported by the marine environment around the Shetland Islands in 2011

Aquaculture

Punds Voe © Charlotte Slater

In Shetland the aquaculture industry has two major components: finfish farming and shellfish farming. In addition seaweed cultivation is a newly emerging industry. This production takes place within the voes and sounds around the coastline, with production levels highest on the west coast of Shetland and within the northern isles, Maps 32 and 33. Shetland also has two salmon hatcheries and one marine research hatchery. Processing of finfish takes place in Lerwick, Yell and Scalloway, and the processing of shellfish takes place in Brae and in Walls.

Key Legislation, Regulation and Policy

- The Water Environment (Controlled Activities) (Scotland) Regulations (CAR) 2011 (as amended)
- Aquaculture & Fisheries (Scotland) Act 2013
- Marine (Scotland) Act 2010
- The Aquatic Animal Health (Scotland) Regulations 2009 (2009 Regulations)
- Town and Country Planning (Scotland) Act 1997
- Planning etc. (Scotland) Act, 2006
- Scotland's National Marine Plan
- Shetland Islands Council's Local Development Plan (LDP) and Supplementary Guidance

Socio-economic

Pressures and impacts

Positive impacts

- Largest exported product from Shetland by volume
- Largest single component of the Shetland economy by value (£)
- Fish processing (dominated by aquaculture) is the second largest component of Shetland's economy by value (£)
- Employment across Shetland, including remote communities
- Helps to maintain inter-island ferry viability and frequency to the north isles of Shetland
- Helps to maintain ferry viability and frequency between Shetland and Aberdeen
- Knowledge transfer between research centres and industry leading to improved production
- Providing healthy food and food security

Negative impacts

- Visual impact from infrastructure potentially reducing visual amenity for residents and tourists
- Potential to restrict other sea bed uses e.g. fisheries and recreation

Management Measures

Some potential socio-economic impacts from aquaculture can be mitigated or minimised through

Assessment Aquaculture

Economic contribution (£): increasing
Employment (FTE): increasing
Production (tonnes): Finfish- stable
Shellfish- increasing
Seaweed- **N/A**
National Context: Shetland has a high proportion of the Scottish finfish (26%) and shellfish production (80%), and has a greater economic dependence on aquaculture than other regions in Scotland. Growth in finfish aquaculture has stabilised in Shetland, whilst the industry has continued to grow elsewhere in Scotland. In contrast in the shellfish aquaculture industry the proportion of production taking place in Shetland has continued to grow.

careful site design and placement. All applications must adhere to the SIC Local Development Plan and its supplementary guidance which include policies which require the impact on other marine users and visual impacts to be assessed. In addition SNH provide guidance to aquaculture companies on 'The siting and design of aquaculture in the landscape: visual and landscape considerations'.[64]

Trends

Production

Finfish farming in Shetland is dominated by the production of farmed salmon, with small quantities of sea trout, cod and halibut having been produced in the past. Shetland is the largest single production area for farmed salmon in Scotland, with production levels in 2015 provisionally estimated at 45 608 tonnes[65], 26% of total Scottish production. Production levels of farmed salmon in Scotland have been relatively stable since 2005, Figure 16.

In Shetland shellfish cultivation is dominated by mussel farming, with small quantities of oysters and scallops produced in the past. In 2015 there were 132 licensed shellfish farms owned by 20 businesses, of which 91 were classified as 'active'. In 2015 Shetland produced 5 565 tonnes of farmed mussels for direct sales for human consumption and 1 768 tonnes for on growing, 77% and 96% of the total Scottish production or 80% of overall production. Production levels have shown an increasing trend since 2010, Figure 17.

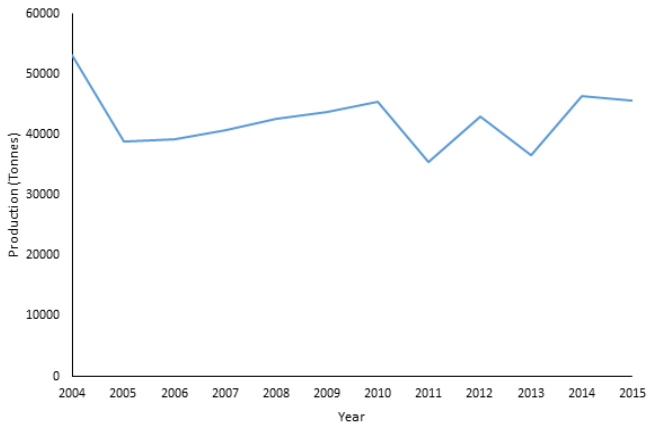


Figure 16: Finfish production within the Shetland aquaculture industry from 2004-2015

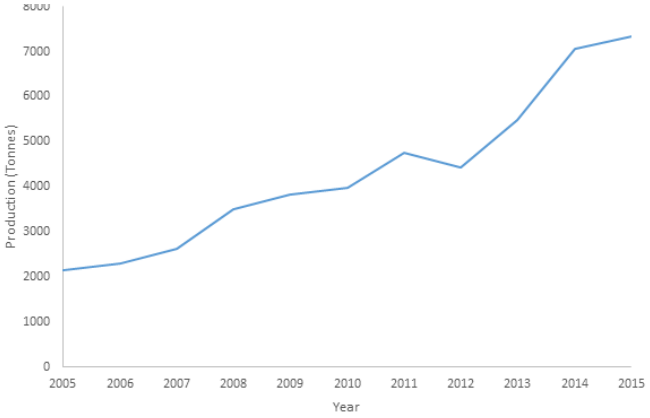


Figure 17: Shellfish production within the Shetland aquaculture industry from 2010-2015

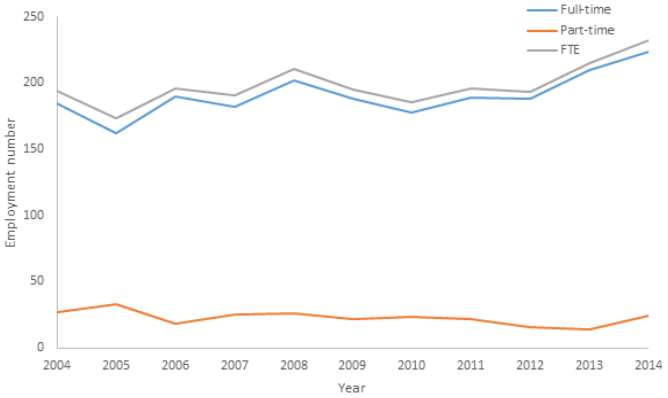


Figure 18: Finfish aquaculture employment levels (full-time, part-time, FTE) from 2004-2014

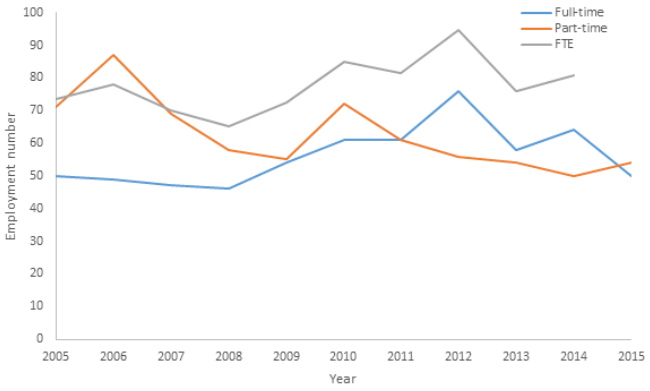


Figure 19: Shellfish aquaculture employment levels (full-time, part-time, FTE) from 2005-2015

Seaweed cultivation has the potential to be an emerging industry in Shetland, with four small scale production sites licensed in Shetland and the NAFC Marine Centre currently involved in two collaborative research projects aimed at developing seaweed farming in Shetland.

Contribution to the economy and employment

Aquaculture production is the largest single component of the Shetland economy, worth £156.3m in 2011, a 39% increase from 2003. In 2014 the industry supported 224 full time and 24 part-time jobs, as well as over 250 jobs in fish processing, marine engineering, smolt production and transportation, Figure 18 and Figure 19.

64 Scottish Natural Heritage (2011) The siting and design of aquaculture in the landscape: visual and landscape considerations. **https://www.nature.scot/siting-and-design-aquaculture-landscape-visual-and-landscape-considerations**

65 Marine Scotland (2016) Scottish fish farm production survey 2015.

Employment in the aquaculture industry is spread across the Shetland Islands, including the north isles and Whalsay, where private employment opportunities are more limited, helping to maintain population levels in more remote parts of Shetland. Finfish and shellfish transportation helps to maintain the viability of the inter-island ferries and the live line ferry link between Shetland and Aberdeen.

Environment

Pressures and Impacts

Negative

Finfish aquaculture only

- Organic waste impacting seabed communities (see Healthy and Biologically Diverse- Seabed Habitats and Species)
- De-oxygenation impacting seabed communities (see Healthy and Biologically Diverse- Seabed Habitats and Species)
- Pharmaceuticals impacting water quality and seabed habitats (see Healthy and Biologically Diverse- Seabed Habitats and Species)
- Hazardous substances- copper and zinc antifoulants (see Clean and Safe- Hazardous Substances)
- Eutrophication from nitrogen and phosphorous (see Clean and Safe- Eutrophication)
- Increase in numbers of sea-lice impacting wild salmonids (see Healthy and Biologically Diverse- Wild Salmonids)
- Increase in the number of microbial pathogens (see Healthy and Biologically Diverse- Wild salmonids)
- Potential spread of disease via well-boat movements (see Healthy and Biologically Diverse- Wild Salmonids)
- Stock escapes (see Healthy and Biologically Diverse- Wild Salmonids)

Shellfish aquaculture only

- Reduction in plankton levels reducing food availability for other species (see Healthy and Biologically Diverse- Seabed Habitats and Species)
- Settlement of cultivated species outside sites potentially impacting seabed and intertidal communities (see Healthy and Biologically Diverse- Seabed Habitats and Species)

Finfish and shellfish aquaculture

- Marine Litter impacting marine species and tourism (see Clean and Safe- Marine Litter)
- Habitat change impacting seabed communities (see Healthy and Biologically Diverse- Seabed Habitats and Species)
- Spread non-native species via boat movements and equipment exchange potentially impacting native communities and dependent industries (see Healthy and Biologically Diverse- Non-Native Species)
- Provision of a habitat for the establishment of non-native species potentially impacting native communities and dependent industries (see Healthy and Biologically Diverse- Non-Native Species)
- Management of other species that impact on aquaculture e.g. predators impacting their population levels (see Healthy and Biologically Diverse- Seals)

Management Measures

Potential environmental impacts are assessed through the licensing process, including the granting of planning permission. In addition fish farms require a CAR Licence and have to take bi-annual monitoring for benthic (seabed) impacts.

Compliance

Finfish compliance with CAR Licence requirements are assessed by SEPA annually. In 2015 compliance ratings of excellent or good were achieved at 68% of sites, with those achieving 'poor' increasing to 32% from 15% in 2014, Figure 20. Unsatisfactory benthic (seabed) results are the main cause of 'poor' compliance.

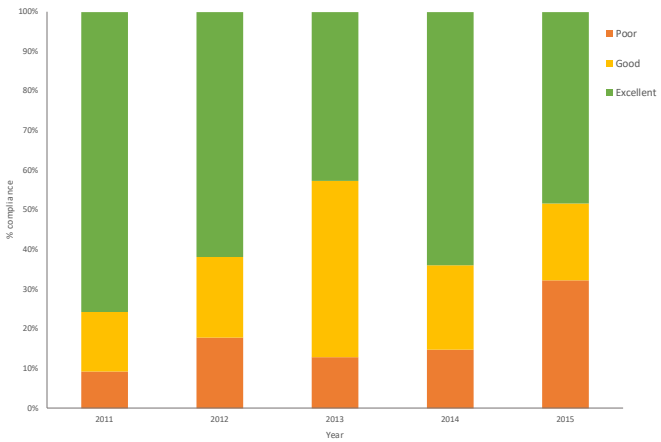


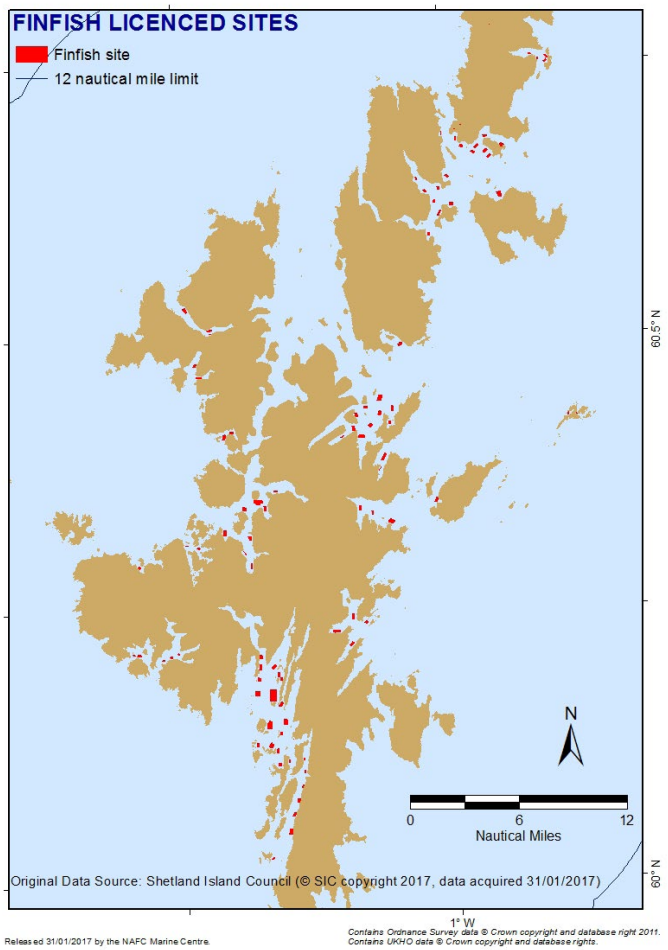
Figure 20: Compliance with SEPA CAR Licence requirements

Forward look

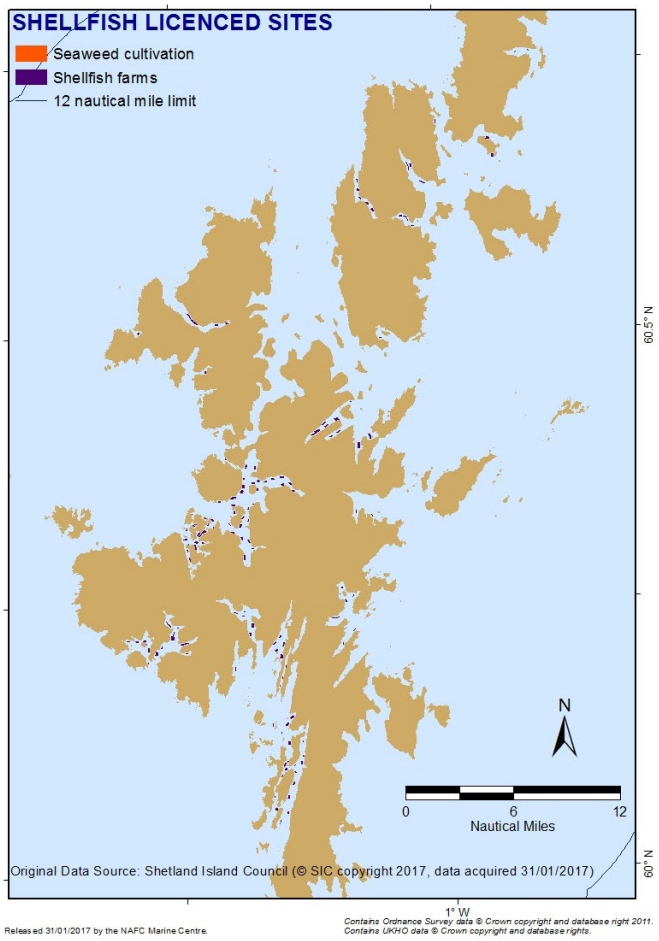
Currently there is limited potential for new shellfish or finfish sites within Shetland's voes and sounds without the revocation of existing licences. However, there are a number of unused site licences which could either be used for their existing production purpose or for the cultivation of an alternative species (e.g. seaweed). As technology advances there is also the potential for the development of offshore aquaculture.

Poor compliance levels with site licence conditions could see a reduction in permitted biomass at some sites in the future, potentially impacting production levels.

Further technological developments will help the industry combat challenges of sea lice (e.g. thermo licer, the potential use of laser technology) and seal predation.



Map 32: Finfish site locations within the Shetland Marine Region



Map 33: Shellfish and seaweed site location within the Shetland Marine Region

Collafirth© Charlotte Slater

Fishing

Fishing has taken place around Shetland for thousands of years and remains one of Shetland's most important industries. The marine fisheries sector comprises the capture of wild marine organisms (fish and shellfish) and also supports a number of shore-side industries including fish processing, sales and engineering. Currently in Shetland, catches of finfish and shellfish are dominated by the following species: mackerel and herring (pelagic); haddock, cod, whiting, saithe and monkfish (demersal); squid, velvet and brown crabs, lobster, king and queen scallops, and whelks (shellfish).

Key Legislation, Regulation and Policy

- EU Common Fisheries Policy (CFP)
- Shetland Regulated Fishery (Scotland) Order 2012
- Scotland's National Marine Plan

Socio-Economic

Potential Pressures and Impacts

Positive impacts

- Forms a significant component of Shetland's cultural heritage
- Third largest single component of the Shetland economy
- Employment across Shetland, including remote communities
- Maintains inter-island ferry viability to the north isles of Shetland from transport of fish landed in smaller ports
- Maintains ferry viability and frequency between Shetland and Aberdeen from fish transport
- Knowledge transfer between NAFC Marine Centre and industry, leading to improved stock management

Assessment Fishing

Economic contribution (£): stable
Employment (FTE): stable
Landings (tonnes):
Pelagic- variable but stable
Demersal – variable but stable
Shellfish- variable but stable
Confidence: High- supported by statistical data
National context: Shetland has a higher proportion of fisheries dependence, in terms of economic contribution and employment, than found elsewhere is Scotland. Fisheries landings in Shetland are showing a more positive trend compared to the Scottish average (value and volume).

- Providing healthy food and food security to the UK

Negative impacts

- Competition for space with other marine economic activities e.g. aquaculture and marine renewables

Management Measures

The Shetland Fishermen's Association (SFA) and the Shetland Shellfish Management Organisation (SSMO) are consulted by the Shetland Islands Council in relation to development applications. The conservation of local fisheries is important for socio-economic reasons, particularly for Shetland's more remote and fisheries dependent communities such as Whalsay.

Trends

The most important fishing grounds around Shetland are shown on Maps 34 - 36 but it should be borne in mind that the distribution of fishing activity is fluid; the relative importance of different fishing grounds can and does change over time, and fishing may spread to new areas. In addition not all fish landed in Shetland is caught within the Shetland Marine Region, and not all fish caught within the marine region is landed in Shetland.

Landings- quantity

In 2015 total landings in Shetland were 72 287 tonnes, a decrease from 2014 but higher than levels from 2012[66]. Fluctuations in total landings in Shetland are largely influenced by variation in pelagic landings (mackerel and herring), which have comprised between 75 and 82% of the total catch since 2009. Demersal landings are relatively stable, and showed a small increase in 2015, in contrast shellfish landings have shown a decline since 2009. Landings value from 2009-2015 are shown in Figure 21.

Landings- value

Total landings value in Shetland in 2015 was £60.37 million, making Shetland Scotland's (and the UK's) second largest fishing port (second only to Peterhead)

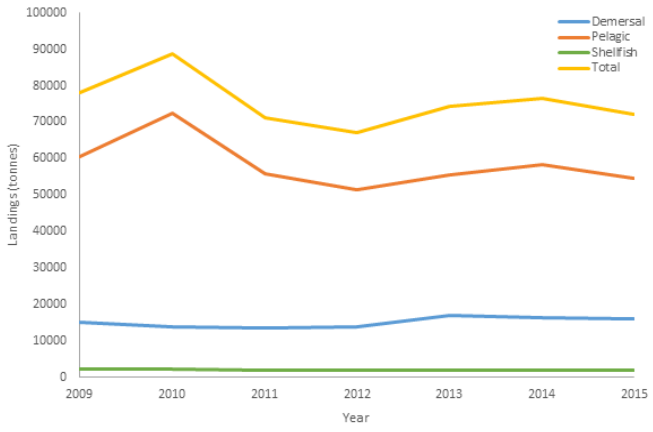


Figure 21: Total, pelagic, demersal and shellfish landings (tonnes) in Shetland from 2009-2015

Landings value is dominated by pelagic landings, £30.8 million in 2015 or 51% of total landings value. Demersal and shellfish landings represent 43% and 6% of total landings value respectively. Total landings values are heavily influenced by the fluctuations in the value of pelagic species, with the increase in landings value from 2012-2013 driven by the increased value

66 Scottish Sea fisheries statistics 2015

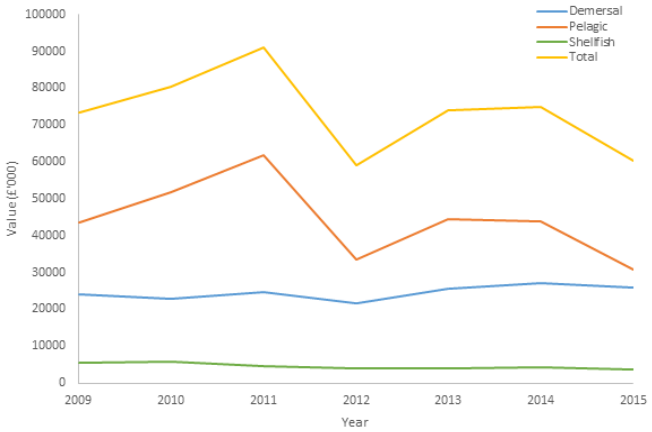


Figure 22: Total, pelagic, demersal and shellfish landings values in Shetland from 2009-2015

of pelagic species. Demersal fish landing values have been comparatively stable, fluctuating between £21.5 million in 2012 and a current value of £25.6 million in 2014. Shellfish landings value have shown a steady decline in value, decreasing from £5.5 million in 2009 to £3.6 million in 2015. Landings value from 2009-2015 are shown in Figure 22.

Contribution to the economy and employment

In 2011 the social accounting matrix estimated Shetland fish catching as having a value of £70.9 million, the third largest sector in Shetland, a 54% increase compared to 2003 (£35.9 million)[67]. This represented 6.9% of Shetland's total economic output.

In 2015 there were 179 active commercial fishing vessels in Shetland, virtually all of them are owned by local shareholder crewmen, and many are based in rural areas of Shetland where there may be few alternative opportunities for economic activity. In 2014 these vessels employed 265 full time and 121 part-time fishermen in Shetland[68], equivalent to 305 FTE. From 2010-2012 the number of full-time and irregular fishermen in Shetland remained relatively stable, varying from 231 to 236, Figure 23. The increase in number of fishermen identifying as full-time in 2015 is mirrored by a decline in the number identifying as irregular. The number of FTE fishermen has remained relatively stable since 2009.

As well as direct employment on fishing vessels, a survey undertaken by the NAFC Marine Centre in 2013 identified over 250 jobs directly supported by the fishing industry including fish processing, transport, marketing, engineering and supply.

67 Shetland Regional Accounts 2011

68 Scottish Sea fisheries Statistics 2014

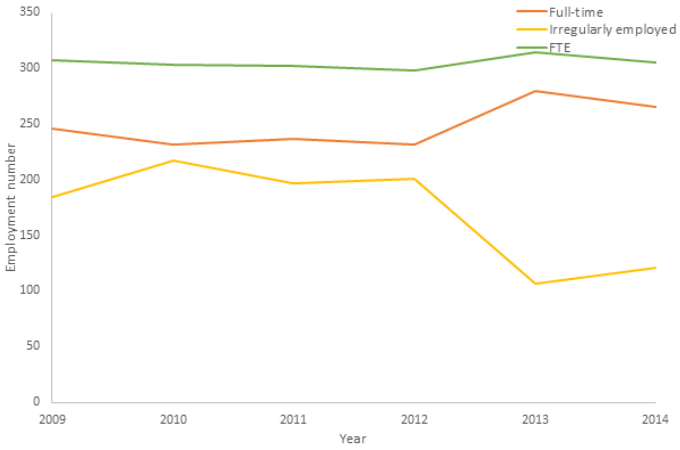


Figure 23: Full-time, part-time and FTE direct employment levels in catch fisheries in Shetland from 2009-2014

Environment

Potential Impacts and Pressures

Negative impacts

- Ghost fishing of lost gear causing entanglement of marine animals (see Clean and Safe- Marine Litter)
- Abrasion due to disturbance from gear causing damage to, or loss of habitats (see Healthy and Biologically Diverse- Seabed Habitats and Species)
- Selective removal of species potentially causing alterations to their distribution and population size (see Healthy and Biologically Diverse- Commercial Fish Stocks)
- Removal of non-target species due to non-selective extraction (by-catch) (see Healthy and Biologically Diverse- Commercial Fish Stocks)
- Indirect impacts on community structure and food webs, loss of biological productivity and biodiversity (see Healthy and Biologically Diverse- Seabed Habitats and Species)

Management Measures

Stock management

Finfish fisheries in UK waters are primarily managed through the EU Common Fisheries Policy (CFP). The CFP sets Total Allowable Catches (TAC) for most commercial species within European Waters and allocates quotas to Member States based on historic fishing rights. The Scottish Government is responsible for implementing fisheries management measures in the waters around Scotland. For stocks that move between EU and third country waters, the Commission negotiates fishing opportunities with the relevant country or countries. In Scotland and Shetland this is primarily of relevance for the pelagic stocks, which move between the EU, Norway, Iceland and Faroes.

Within 6 nautical miles of the Shetland coast, shellfish fishing is managed by the Shetland Shellfish Management Organisation (SSMO) via the Shetland Regulated Fishery (Scotland) Order 2012. The SSMO manages fishing methods and fishing gear, restricts fishing seasons, sets minimum sizes for shellfish and manages shellfish beds for stock conservation. The SSMO also undertakes the collection of data which allows a comprehensive stock assessment to be developed year on year. This allows fisheries management to be based on best possible data and analysis.

The effective management of our seas is currently being integrated with wider marine policy, including marine nature conservation. This is instrumental in delivering 'good environmental status' (GES) under the Marine Strategy Framework Directive (MSFD). GES requires populations of all commercial fish and shellfish stocks to be exploited within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock. Achieving GES will also involve better management and mitigation of the impact of fisheries on the wider marine environment, such as wider biodiversity impacts.

Nationally, the Scottish Government is currently implementing management measures to minimise fisheries impacts within Marine Protected Areas (MPAs) and Special Areas of Conservation (SAC). Local management of shellfish fisheries by the SSMO enables stock and environmental management to takes place. Since 2010 the SSMO has implemented a spatial management framework that prohibits dredge fishing for shellfish in designated areas where specific priority marine features (maerl, horse mussels, sea grass) have either been confirmed or are suspected of occurring. There are currently 15 closed areas to dredge fisheries in Shetland[69], and two voluntary closed areas see Map 8.

Forward Look

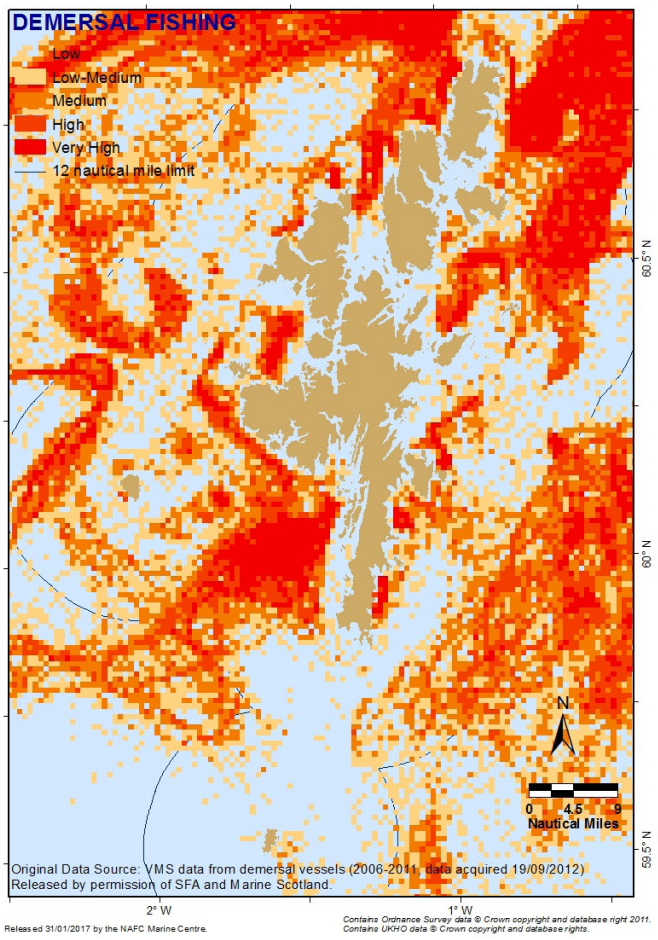
Demersal and pelagic fisheries are managed on an EU level, however many stocks levels around Shetland are currently increasing which could lead to the increased financial stability of the fishing sector and increased employment. There are currently a

69 Shelmerdine R Stone D, Mouat, B, Robinson R (2014) Implications of defining fisheries closed areas based on predicted habitats in Shetland: a proactive and precautionary approach. Marine Policy 43: 184-199.

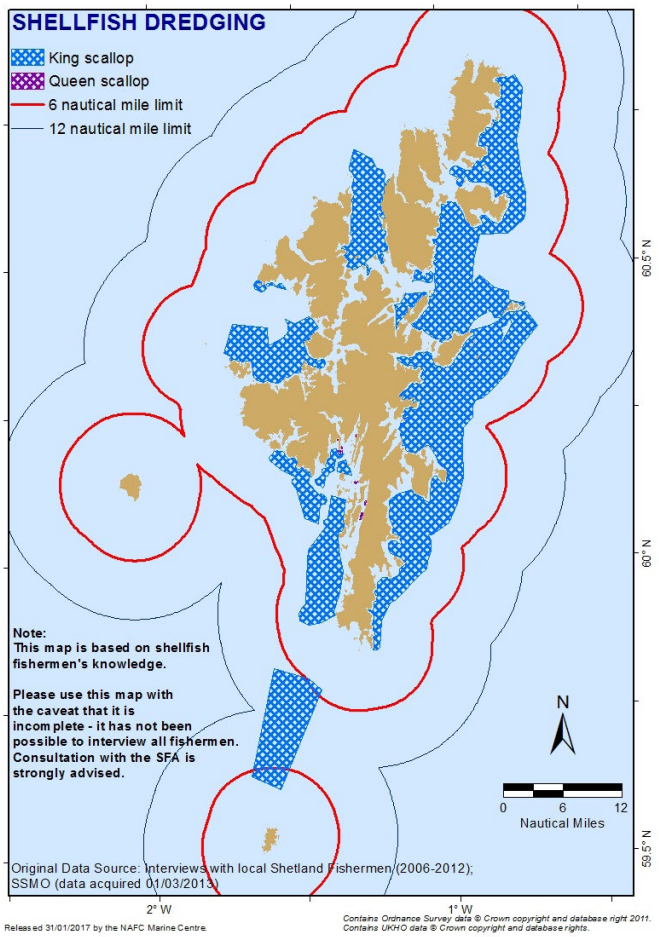
range of management measures in place, and new management measures being introduced aimed at reducing the potential environmental impacts of fisheries.

A survey undertaken by the NAFC Marine Centre in 2013 indicated that fishermen's main concerns for the future economic wellbeing of the fleet included:

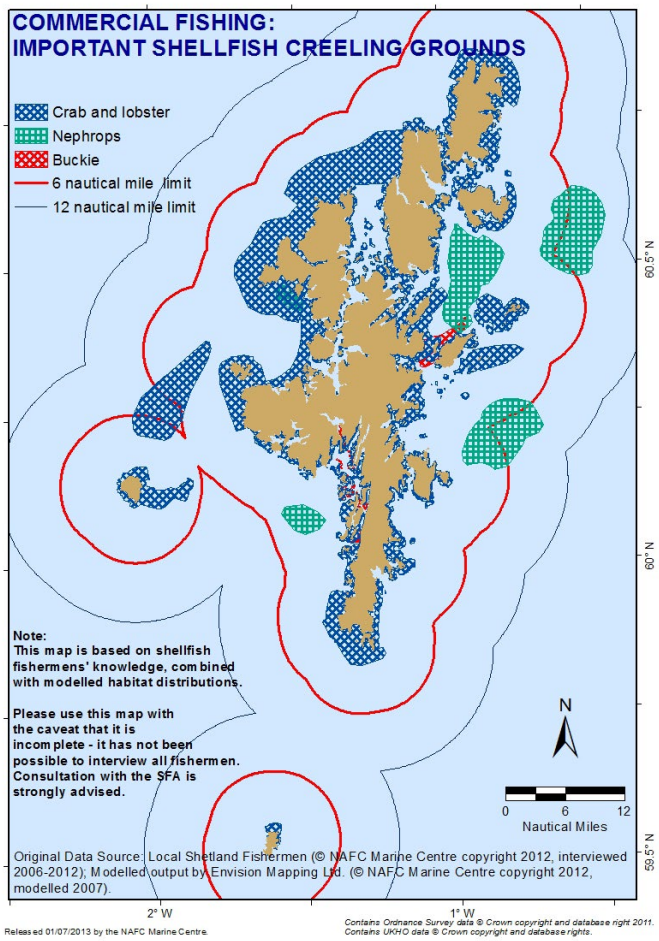
- Impacts of frequently changing fisheries management measures- quotas and days at sea e.g. CFP
- Delays in quota changes to observed stock levels leading to unnecessary discards
- Implementation of the discards ban
- Cost of quota and stability in quota price
- Financial barriers for new entrants into fisheries
- Cost of boat upgrade and replacement
- Cost of fuel, particularly as the fleet ages



Map 34: Demersal fishing areas



Map 35: Shellfish dredging areas



Map 36: Shellfish creeling areas

Leisure, Recreation and Tourism

Kayakers © Rachel Shucksmith

The Shetland Marine Region provides a variety of sporting and recreational opportunities. Marine activities include swimming, sailing, rowing, coasteering, snorkelling and SCUBA diving, sea angling, kayaking, canoeing, windsurfing and surfing, as well as exploration of underwater heritage assets such as wrecks and marine life (see also 'Productive-Historic Environment and Cultural Heritage'). Coastal recreation activities include walking and hiking, cycling, climbing, visiting heritage assets and wildlife watching. The coast also provides inspiration for a range of artistic, cultural and community activities and informal activities such as dog walking.

Marine leisure and recreational activities support and enhance the local community through social integration, improving quality of life, and providing benefits to physical and mental well-being. These activities are enhanced by a well-managed and healthy marine environment. It should be noted that marine recreation and associated facilities are also an economic asset.

Key Legislation, Regulation and Policy

- Land Reform (Scotland) Act 2003
- Common Law and the Prescription and Limitation (Scotland) Act 1973
- Scotland's National Marine Plan
- Shetland Islands Council Local Development Plan and Supplementary Guidance

Socio-Economic

Potential Pressures and Impacts

Positive:

- Employment opportunities through provision of services

Assessment Leisure, recreation and tourism

Economic contribution (£): No evidence
Visitor numbers: activity specific
Recreation and leisure opportunities: increasing
Confidence: Low

- Physical and mental health benefits to local communities and visitors

Negative:

- Conflict with other marine industries for use of space
- Conflict between different recreational and leisure users for use of space
- Potential environmental impacts affecting other marine industries (e.g. introduction of non-native species) by visiting boats (see Clean and Safe- Non-native Species)

Management Measures

The promotion of marine recreation and leisure is the responsibility of a number of organisations, including Visit Shetland and the Shetland Islands Council. Provision of coastal access is co-ordinated by the Shetland Islands Council under the Local Development Plan and its supplementary guidance, including the Shetland Core Paths Plan. The control of non-native species is managed under the 'Biosecurity Plan for the Shetland Islands'.

Trends

Whilst nearly all of the coastal environment may be used for marine recreation, important locations are shown in Maps 37 - 39 and are detailed in Table 12. Some areas such as Lerwick harbour, Brae and Walls

are used by multiple marine groups, for example sailing, rowing, windsurfing, kayaking and SCUBA diving, Map 38, whilst others are used for informal recreational purposes, e.g. walking, Map 39.

Potential impacts on the environment due to leisure and recreation include:

- erosion at heavily used sites due to walkers
- loss of habitat due to development or activities
- disturbance of wildlife e.g. visual and noise (see Clean and Safe- Noise)
- introduction and spread of non-native species impacting native communities (see Clean and Safe- Non-Native Species)
- marine litter impacting wildlife and tourism (see Clean and Safe- Marine Litter)

Potential threats to leisure and tourism:

- impacts of climate change- altering distribution of wildlife, eroding heritage assets
- impacts of development or activities reducing the quality of the marine environment e.g. setting, seabed impacts
- reduced water quality (e.g. *E.coli*) impacting water-based tourism e.g. bathing, kayaking

Management Measures

The environmental impacts of marine recreation and leisure are largely unregulated. Visitors are managed

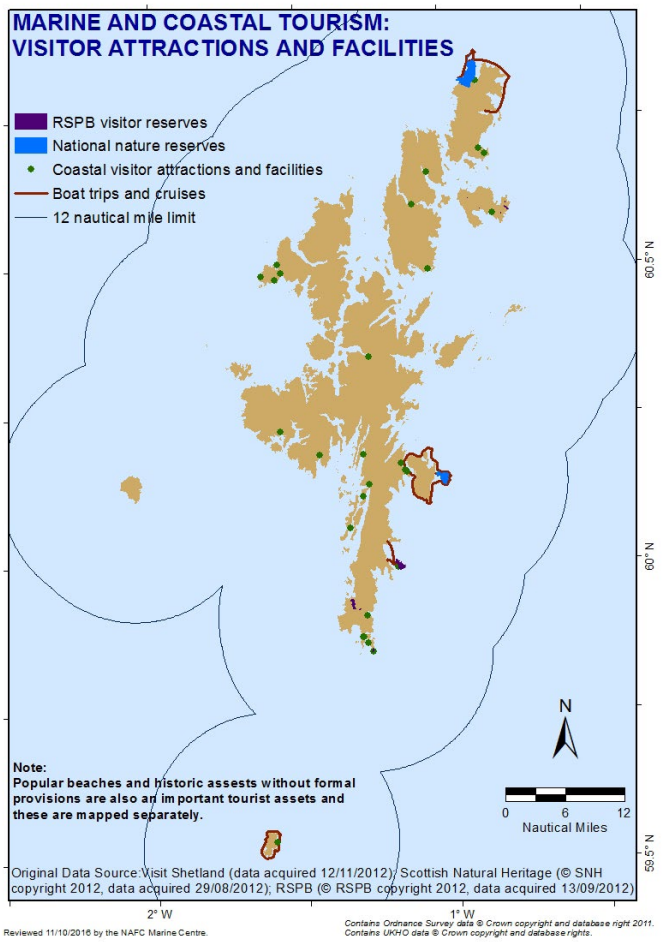
Table 12:- Leisure and recreational locations around Shetland

Type of site	Total	Commercial	Recreation	Examples
Maritime and coastal heritage visitor attractions and facilities	28	X		Jarlshof & Sumburgh Head visitor centre, Dunrossness; Unst boat museum, Unst;
Boat trips and cruises	28	X		Mousa ferry boat trips; Seals and Seabirds, Noss
Geological interpretation sites		X	X	
Wildlife reserves	6	X	X	Hermaness, Unst; Sumburgh Head, Dunrossness
Boating and rowing clubs	9		X	Walls boating club; Lerwick boating club;
Rowing locations	17		X	Lerwick harbour
Sailing locations	8		X	Brae
Cruising routes	17		X	Brae
Surfing sites	44		X	Quendale beach
Windsurfing sites	6		X	Pool of Virkie, Brae
Dive sites- wrecks	69	X	X	Giants Leg, Bressay
Dive site- scenic	49	X	X	Lunna Ness, Lunnasting;
Kayaking routes	52	X	X	Bridge End, Burra
Climbing locations	55		X	Eshaness
Sea angling locations (shore)	102		X	
Coastal footpaths- core paths	102		X	
Beaches with access	18		X	St Ninians Isle, Dunrossness
Ferry terminals	18	X		
Marinas	23	X	X	
Piers	135	X	X	
Jetties	100	X	X	
Slipways	64	X	X	
Landing stages	2	X		

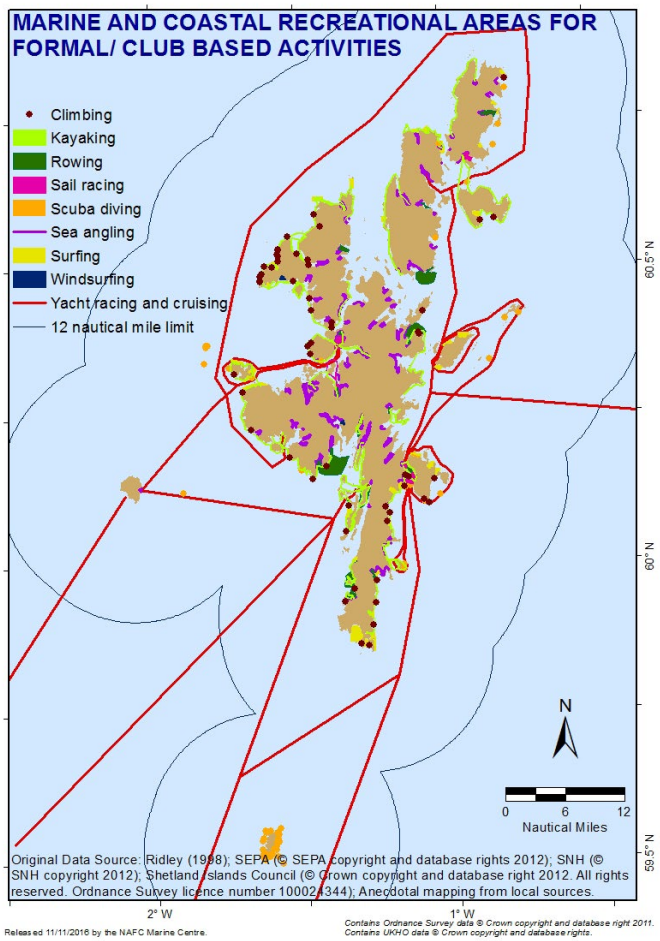
at Shetland's National Nature reserves and Bird reserves by SNH and the RSPB.

Forward Look

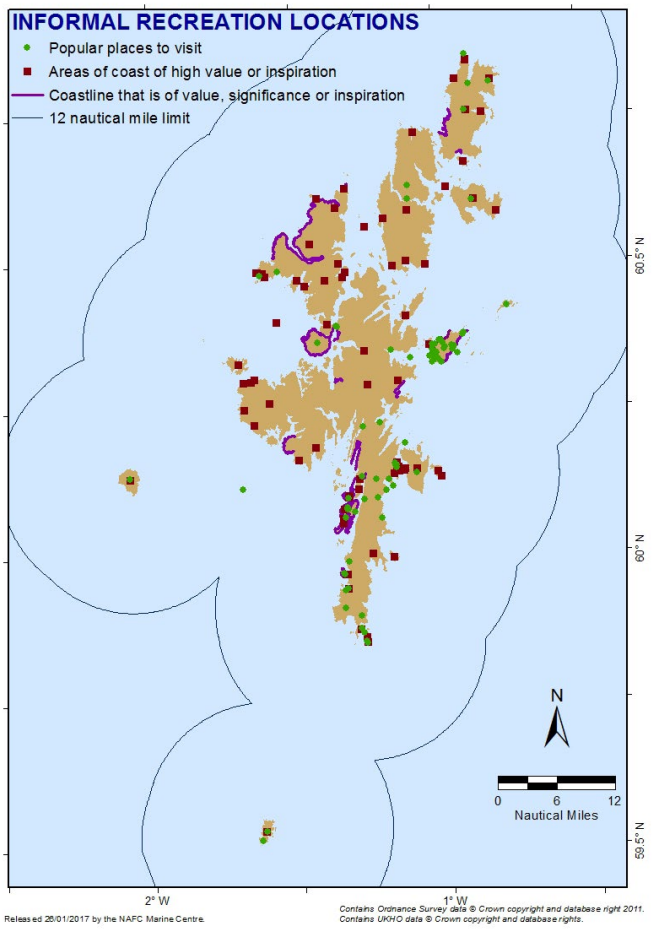
Limited availability of accommodation and cost of travel to Shetland restricts the growth of the marine and recreation sector, however the number of visitor attraction have increased over the last 5 years. In addition development of Core Paths by the Shetland Islands Council[70] has improved access for Shetland residents.



Map 37: Marine and coastal visitor attractions and facilities



Map 38: Areas used for formal or club based marine and coastal activities



Map 39: Locations used for informal marine recreation activities

70 http://www.shetland.gov.uk/developmentplans/core-pathplan.asp

Historic Environment & Cultural Heritage

Jarlshof © Charlotte Slater

The coast and seas within the Shetland Marine Region host a rich and diverse historic and cultural heritage and are a key part of what gives the islands their distinctive and unique character. It helps give a sense of place, well-being and cultural identity and enhances regional and local distinctiveness.

The historic environment includes all aspects of the environment resulting from the interaction between people and places through time, including all surviving physical remains of past human activity, whether visible, buried or submerged. Elements of the historic environment such as buildings, monuments, sites or landscapes are sometimes termed 'heritage assets'. Far less is known about heritage surviving on the seabed than about heritage assets on land. Shetland's coasts and seas contain a rich cultural heritage that includes the remains of important heritage assets of all periods from prehistory to the recent past.

Marine historic assets around our coast include: the wrecks of boats, ships, submarines and aircraft; harbours, lighthouses and other built structures; and drowned terrestrial archaeological sites and cultural landscapes. Many of these assets are unique and valuable but some are not well understood and cannot be replaced if lost or damaged.

Key Legislation, Regulation and Policy

- The Historic Environment Scotland Act 2014
- Ancient Monuments and Archaeological Areas Act 1979
- Planning Advice Note 2/2011 Planning and Archaeology
- Our Place in Time, the Historic Environment Strategy for Scotland 2014
- Scottish Historic Environment Policy 2011
- The Marine Historic Environment Strategy for the Protection, Management and Promotion of Marine Heritage 2012-15
- Scotland's National Marine Plan
- Shetland Islands Council Local Development Plan and Supplementary Guidance

Assessment Historic environment and cultural heritage

Economic contribution (£): No Evidence
Loss due to coastal erosion: increasing
Loss due to development or activities: Not known
Impacts on setting: Not known
Natural deterioration: Increasing

Socio-economic

Potential pressures and impacts

Positive:

- Tourism asset, helping to attract visitors
- Contribute to islands character, providing a sense of place
- Recreational opportunity for locals and visitors

Potential Pressures and Impacts

Potential pressures on the historic environment and cultural heritage include:

- Climate change increasing erosion of sites
- Coastal erosion causing sites to be lost
- Loss due to development or activities
- Impact on setting due to adjacent development
- Natural deterioration of historic assets

Management Measures

Historic Environment Scotland takes the lead in providing statutory protection for nationally important elements of Shetland's coastal and marine historic environment through the scheduling of ancient monuments, the listing of historic buildings, and the designation of historic shipwrecks. However, not all nationally important heritage assets have been designated and there is always the possibility of discovering new sites. In addition, Historic Environment Scotland directly manages several Properties in Care (PiC) that fall within the scope of this Plan (e.g. Jarlshof; Mousa Broch).

In coastal/ intertidal zones and inshore/ offshore waters, designated heritage assets may include scheduled monuments (designated under the Ancient Monuments and Archaeological Areas Act 1979) and Historic Marine Protected Areas (designated under the Marine (Scotland) Act 2010). In addition the Scottish Historic Environment Policy (SHEP) document sets out Scottish Ministers' policies for the historic environment, provides greater policy direction for Historic Environment Scotland and provides a framework that informs the day-to-day work of a range of organisations that have a role and interest in managing the historic environment, including the Scottish Government, Shetland Islands Council and central government bodies. The SHEP complements, and has the same authority, as the Scottish Planning Policy and other relevant ministerial policy documents. One element of SHEP includes the consideration of setting into the planning process.

Whilst Shetland's archaeology includes Scheduled Sites it also includes many other sites which are of 'schedulable' quality, in addition to sites of regional and local importance. Shetland Amenity Trust has a responsibility in maintaining an up-to-date record of these, known as the Shetland Sites and Monuments Record (SMR). The SMR currently holds information on about 8 000 sites, many of which are coastal/ marine, these are shown in Map 40. Archaeology, once designated at a site, becomes the 'dominant use' for cultural and historic reasons.

Table 13: Tourist attraction with formal visitor provision

Type of site	No of sites	Examples
Maritime and coastal heritage visitor centres/ museums / attractions	28	Jarlshof, Sumburgh; Sumburgh Head visitor centre; Unst boat museum, Unst

Number of coastal archaeology assets

Type of site	No of sites	Examples
Scheduled monuments	293	Mousa broch, Mousa
Properties in care (PiC)	7	Muness Castle
Listed buildings	343	Fishing booth, Lunna ness
Conservation areas	3	Scalloway harbour area
Shetland Monuments Record	392	Clumlie Broch, Clumlie
Gardens and designed landscapes	4	Lunna House, Lunna Ness
Maritime and coastal heritage visitor centres/ museums / attractions	28	Jarlshof, Sumburgh Unst boat museum, Unst

Submerged archaeology assets

Type of site	No of sites	Examples
Wreck site	1200	Motor torpedo boat, Lerwick harbour Queen of Sweden, Lerwick harbour
Historic MPA	1	Out Skerries historic MPA
Locally protected wrecks	12	El Gran Grifon, Fair Isle
Potentially submerged landscape	N/A	Bressay Sound

Trends

At the coast there are numerous structures of archaeological and historical interest, shown in Map 40. There are around 1200 known shipwrecks on the seabed, shown in Map 31, but only a small proportion are known in detail. Two of these wrecks are designated within an historic MPA, and the seabed around 12 wrecks is leased by Shetland Islands Council as a means of protecting the resources within them, shown in Map 41. The seabed is also of palaeo-environmental interest, particularly areas that were once dry land during ice age conditions and where there is potential for a wide range of buried deposits of archaeological interest, potential submerged archaeological locations are shown in Map 41.

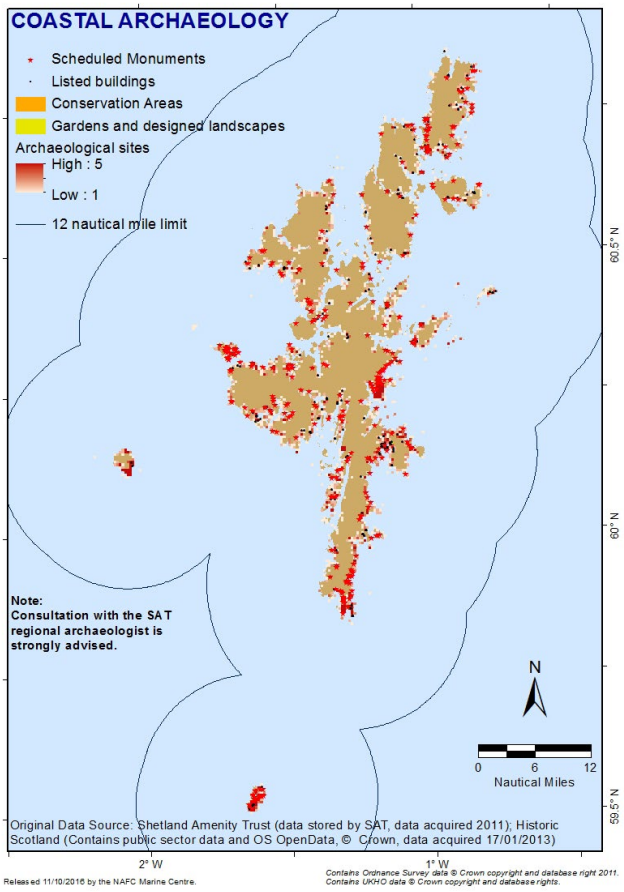
In Shetland, coastal erosion due to sea level rise is causing the loss of a number of archaeological and historic sites. At some sites livestock and pests (e.g. rabbits), and visitors can also accelerate erosion. Historic assets are also impacted by natural deterioration e.g. rusting of wrecks, and due to weather damage e.g. waves and wind. A number of archaeological and historical assets have been removed to make way for development and the setting of a number of sites has been impacted due to surrounding developments.

Visitor attractions

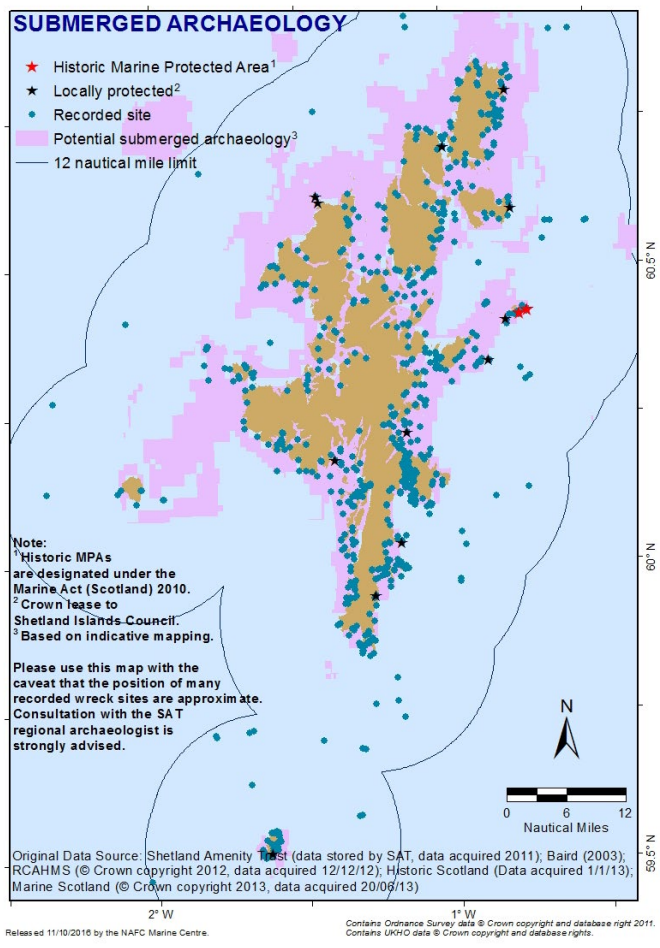
Shetland's historic and cultural heritage offer a range of visitor attractions across the islands, including castles, brochs, böds, wrecks and museums. Whilst many of these are free to visit, they help to increase tourism and provide important cultural and educational experiences for residents and visitors. Some historic assets can help to support full and part-time employment, particularly at sites with maritime and coastal heritage centres. In common with other leisure and tourism activities, active management can help to prevent negative environmental effects (see 'Productive- Leisure and Recreation'). There are 28 sites with formal provision, see Map 37.

Forward look

There are still many sites yet to be discovered or fully excavated. Coastal erosion or development are ways in which these sites may come to light. Coastal and marine heritage assets will require continued management and protection to prevent additional losses due to development and climate change.



Map 40: Coastal archaeology locations



Map 41: Potential and known submerged archaeology

Scalloway harbour © Charlotte Slater

As a result of cliff and beach erosion the shoreline of Shetland is naturally receding. Indeed, there would be no beaches if erosion were not to occur. Development near the coast creates a need for defence. Many of the defences against erosion or flooding have traditionally been 'hard engineering' works. Hard coastal defence works include dykes and groynes, rock armour, seawalls and gabions. However, these are initially expensive and utilise large quantities of raw materials. Soft coast defence works include beach nourishment and beach reinforcement by dune fencing, recharging, planting marram grass, etc. Unofficial attempts at 'soft' defences (such as beach re-enforcement by means of nets over dunes) are now discouraged, with a focus currently being placed on using methods such as dune fencing to direct wind deposited sand where required.

Key Legislation, Regulation and Policy

- Coast Protection Act 1949
- Flood Risk Management (Scotland) Act 2009
- Zetland County Council Act 1974
- Marine (Scotland) Act 2010
- Scotland's National Marine Plan
- Shetland Islands Council Local Development Plan and Supplementary Guidance

Socio-economic

Potential Pressures

Positive:

- Protection of existing residential and commercial properties
- Protection of new or existing marine infrastructure e.g. marinas, harbours, helping to support economic activities

Assessment coast protection and flood defence

Economic contribution (£): No Evidence
Total area/ number of coastal protection features: stable
National context: Shetland has relatively few areas and properties at risk of flooding compared to other parts of Scotland.

Environment

Potential Pressures

- Increased coastal erosion by changing water flow
- Seabed impacts due to changes in water flow
- Accumulation of marine litter impacting marine life (see Clean and safe- marine litter)

Management measures

The impacts of flood and coast defence measures, positive and negative, are assessed at the project stage prior to granting planning permission, a Works Licence or a Marine Licence.

Primary responsibility to protect land lies with the landowner who may undertake flood prevention works, or coast protection works with the written consent of the local authority or Coast Protection Authority respectively (which is Shetland Islands Council). The Coast Protection Act 1949 and the Flood Risk Management (Scotland) Act 2009 allow local authorities (identified as Coast Protection Authorities in the 1949 Act) to promote appropriate schemes, on land not in their ownership, when the need for coast protection works or flood prevention works (for non-agricultural land) is deemed necessary in the wider public interest. Schemes promoted under

the Coast Protection Act require ministerial approval regardless of size. The Coast Protection Authority can carry out maintenance and emergency coast defence works and are exempted from the need for consent to carry out emergency operations on a SSSI.

The Flood Risk Management (Scotland) Act 2009 allows local authorities to confirm their own flood protection schemes and they no longer have to complete a separate planning process.

The Flood Risk Management (Scotland) Act 2009 required Local Authorities to produce Local Flood Risk Management Plans by 2015. The plans detail coastal areas prone to coastal flooding, as well as areas subject to erosion. Sub-district Advisory Groups were also established by the local authority in accordance with the Flood Risk Management (Scotland) Act 2009.

Trends

Only a small number of coast protection projects undertaken in Shetland in the last 10 years.

Forward look

The Shetland Local Flood Risk Management Plan, published in 2016, prioritises flood risk management actions to protect property, businesses and infrastructure across the islands for the 6 year planning cycle until 2022. See Section A, Flood Risk Management.

Offshore wind © Marine Scotland

Shetland has significant resources for potential offshore wind, wave (Map 43) and tidal (Map 42) energy production[71], with potential marine renewable energy development areas identified by Marine Scotland[72]. However, Shetland is not currently connected to the UK electricity grid, restricting the growth of the industry.

Key Legislation, Regulation and Policy

- Electricity Act 1989
- Zetland County Council Act 1974
- Marine (Scotland) Act 2010
- Growth and Infrastructure Act 2013
- Scotland's National Marine Plan
- Shetland Islands Council Local Development Plan and Supplementary Guidance

Socio-Economic

Potential Pressures and Impacts

Positive impacts

- Creation of additional employment
- Increased energy security
- Community generation for own or grid use

Negative impacts

- Visual impact from infrastructure has the potential to affect visual amenity for local communities and impact tourism
- Potential to restrict other marine users including fisheries and recreation

Management measures

Some potential socio-economic impacts from marine renewables can be mitigated or minimised through careful design and siting. Visual impacts and impacts on other users are reduced through policies in the Shetland Islands Council Local Development Plan and its supplementary guidance. The Shetland 'Regional Locational Guidance for Marine Renewables'[73] provides information on relative constraint levels around the Shetland coast, guiding development towards areas of least constraint.

Assessment Renewable Energy

As the industry is currently in its infancy it is not possible to assess its current employment and economic contribution.

Trends

Marine renewable development in Shetland waters is currently limited, with one site in Bluemull Sound currently being developed for tidal power. There are five 30kw tidal devices consented within and in June 2016 two had been installed, see Map 42 .

Environment

Potential Pressures and Impacts

Positive impacts

- Low carbon energy production can help meet climate change targets

Negative impacts

- Potential to spread and provide stepping stones for non-native species impacting marine life and dependent industries (see Clean and Safe- Non-Native Species)
- Potential for anti-foulants to impact seabed

71 Natural Power (2011) Shetland Islands Wave and Tidal Resource

72 Marine Scotland

73 NAFC Marine Centre

habitats (see Clean and Safe- Hazardous Substances)

- Noise and vibration during construction impacting marine life (see Clean and Safe- Noise)
- Potential collision risk for seabirds, reducing population viability and impacting wildlife tourism
- Electromagnetic changes, potentially impacts on fish species including basking sharks and commercial species, impacting fisheries and tourism
- Habitat changes and damage from the construction impacting marine life and other industries (see Healthy and Biologically Diverse- Seabed Habitats and Species)

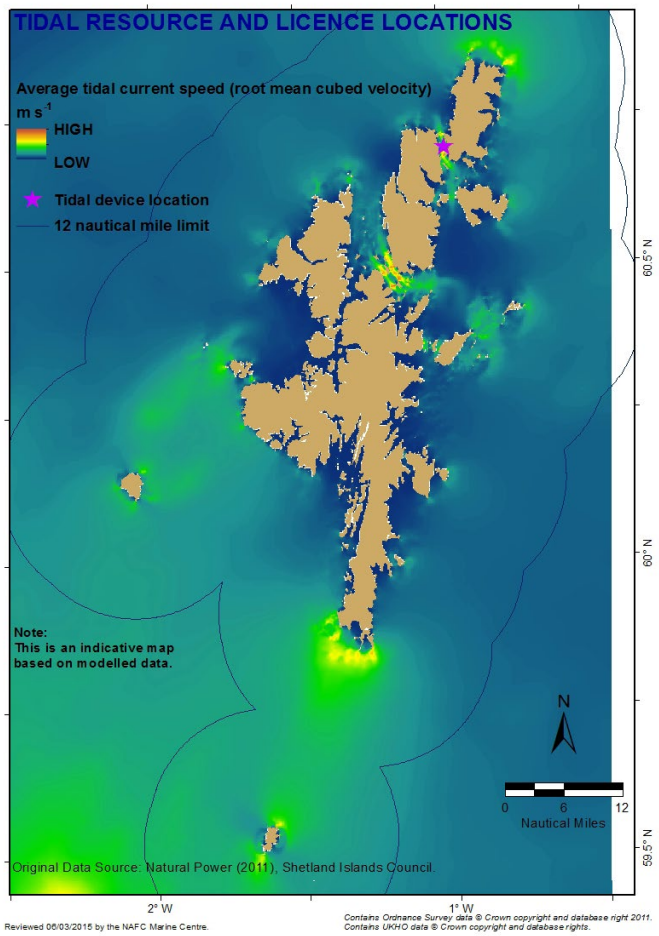
Management Measures

Nationally, the Scottish Government has developed a number of guidance documents to assess the impacts of marine renewable devices. This includes the 'Survey, deploy and monitor licensing policy guidance' which provides information to regulators, and developers, with an efficient risk-based approach for taking forward wave and tidal energy proposals. In addition the Scottish Government has produced guidance on assessing interactions between renewable developments and marine mammals 'Wave and Tidal Consenting Position Paper- Marine Mammal Impacts'[74] and bird life 'Wave and tidal Consenting Position Paper- Ornithological Impacts'[75].

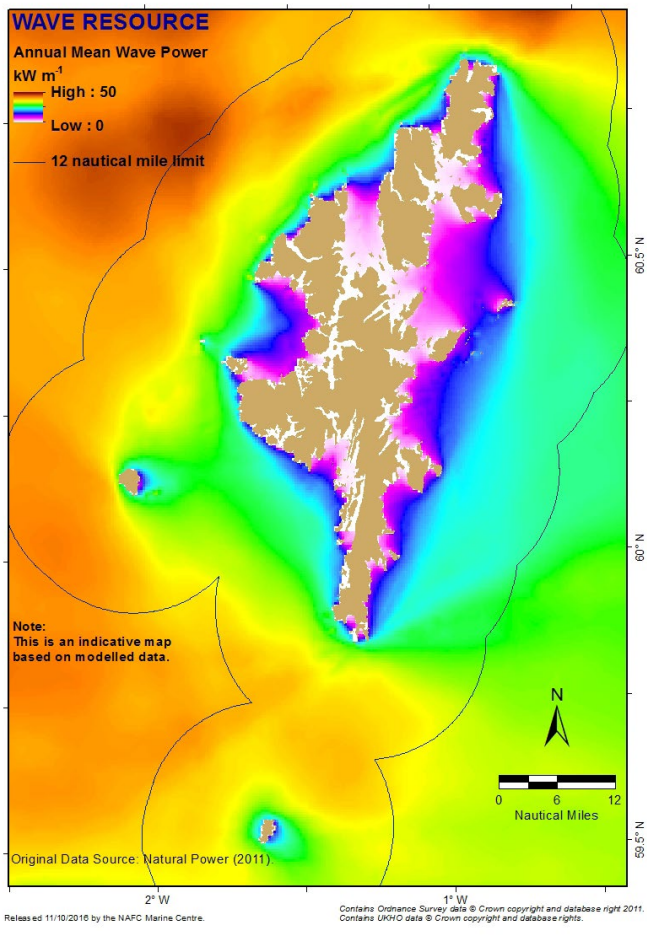
Locally the Shetland 'Regional Locational Guidance for Marine Renewables'[76] provides information on relative constraints and can help in siting developments away from environmentally, culturally and economically sensitive areas.

Forward Look

Currently there is limited potential for large scale renewable energy production without the presence of an interconnector. However, if an interconnector is put in place, Shetland has significant marine renewable potential. In addition, there is the potential for the additional development of small scale renewable energy projects.



Map 42: Relative Tidal Resource and Licence Locations



Map 43: Relative Wave Resource

74 http://www.nerc.ac.uk/innovation/activities/infrastructure/offshore/marine-mammal-impacts

75 http://www.nerc.ac.uk/innovation/activities/infrastructure/offshore/ornithological-impacts/

76 https://www.nafc.uhi.ac.uk/research/msp/regional-locational-guidance-for-marine-renewables/

Oil & Gas

Lerwick harbour © Stephan Hennig

Although there are no oil and gas fields within the Shetland Marine Region, oil and gas are pumped from offshore fields through pipelines to the east and west of Shetland, to the Sullom Voe Terminal and the Shetland Gas Plant. The oil and gas industries provide direct employment in Shetland, through employment at the Sullom Voe Terminal, and the Shetland Gas Plant. In addition Shetland is also strategically located to service and support the offshore industries, including decommissioning activity in the northern and central North Sea, as well as to the west of Shetland. Lerwick harbour has become Shetland's main decommissioning location, and the Lerwick Port Authority is seeking to expand these facilities.

Sullom Voe Terminal (SVT)

Since the discovery of oil in the East Shetland Basin in 1974 the oil and gas industries have formed important components of the Shetland economy. Sullom Voe Terminal was constructed in response to this discovery between 1975 and 1981 and occupies a 1000 acre site, and is one of the biggest oil and liquefied gas terminals in Europe. The main purpose of the SVT is to receive crude oil and gas from more than two dozen offshore fields in the East Shetland Basin in the North Sea, through the Brent and Ninian pipeline systems, and from the Atlantic Margin. The oil and gas is stored, processed and finally distributed worldwide via tankers.

Historically gas tankers used the Sullom Voe Terminal, however, since 2009 this has dropped to zero. A portion of the imported gas is used to power the terminal, as well as a third of Shetland's power demand. The remainder is exported to the Magnus platform via another pipeline where it is used for Enhanced Oil Recovery. The Terminal is currently operated by BP Exploration Operating Company Ltd on behalf of a consortium of partners.

Assessment Oil & Gas

Economic contribution (£): decreasing
Employment (FTE): decreasing
Terminal throughput (tonnes): decreasing
Confidence: High, supported by terminal statistics
National Context: A global downturn in oil prices has led to a scaling back of oil and gas sector nationally, ongoing redundancies at the SVT.

Shetland Gas Plant (SGP)

The Shetland Gas Plant (SGP) which is operated by Total, is designed to process and export gas and condensate ashore directly from the Laggan-Tormore fields via two 18" pipelines. Construction has recently been completed, with the first gas flowing to the plant in February 2016 and it officially opened in May 2016.

Pipelines

Gas and oil pipelines from the oil and gas field to the west of Shetland enter Yell Sound though the north mouth, and pipelines from the east fields enter through the north and south mouths, Map 44.

Oil Supply Services

Oil supply services are focused in Lerwick, Scatsta and Sullom Voe areas, supplying both the terminal and the offshore industry.

Key Legislation, Regulation and Policy

- Industrial Emissions Directive (IED)
- Marine and Coastal Access Act 2009
- The Pollution Prevention and Control (Scotland) Regulations (PPC 2012)
- Zetland County Council Act 1974
- Scotland's National Marine Plan
- Shetland Islands Council Local Development Plan and Supplementary Guidance

Socio-Economic

Potential Pressures and Impacts

Positive impacts

- Creation of employment both onshore and offshore
- Energy security

Negative impacts

- Visual impact from onshore infrastructure has the potential to effect visual amenity for local communities and tourism
- Potential to restrict access to other marine users, in particular fisheries from pipeline construction
- Negative environmental effects have the potential to impact marine life and marine users including fisheries, aquaculture, tourism and recreation

Management Measures

Some potential socio-economic impacts from offshore developments, in particular new pipelines, can be mitigated through consultation with the fishing industry to ensure method of burial minimises impacts on other users.

Visual impacts can be minimised through careful siting. Locating the SGP adjacent to the SVT has minimised the zone of potential visual influence.

Figure 24: Oil throughput (tonnes) at Sullom Voe Terminal 1974-2014

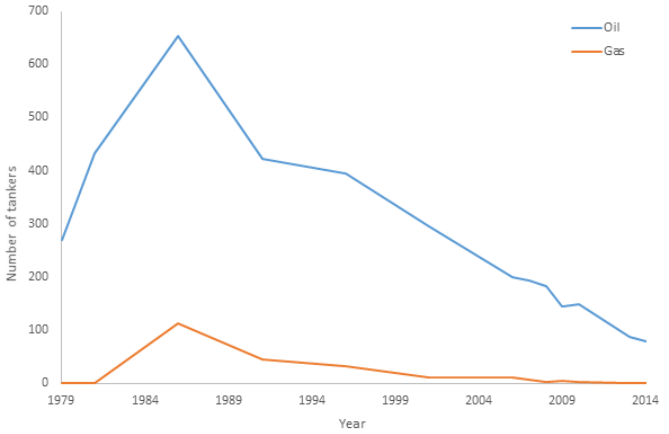


Figure 25-:Tanker number per year visiting Sullom Voe Terminal 1979-2014

Trends

Employment and economic contribution

The Sullom Voe Terminal employed 219 FTE in 2012, and was estimated to contribute £46.4 million to the Shetland economy, a fall in economic contribution of 39.5% from 2003 (corrected for inflation). In 2016 redundancies were announced by BP, with 88 jobs currently under threat at the terminal.

Oil supply services currently support 84 FTE jobs and contribute £25.0 million to the Shetland economy, an increase in economic contribution of 323% increase since 2003.

Although it is too early to assess employment trends at the Shetland Gas Plant, when fully operational it is expected it will employ around 80 people.

Production

The Sullom Voe Terminal throughput peaked in 1984 at 58 328 785 tonnes, and since then has decreased to 6 739 231 tonnes in 2014, Figure 24. Throughput of liquefied gas has also dropped and since 2009 there has been no gas tankers visiting the terminal, Figure 25.

Production at the Shetland Gas Plant has recently started, with the plant capable of processing up to 500 million standard cubic feet of gas per day.

Environment

Potential pressures and impacts

Negative

- Potential to spread and provide stepping stones for non-native species impacting marine life and other dependent industries (see Clean and safe-Non-Native Species)
- Oil contamination from accidental spills

potentially impacting marine life, including seabirds, otters and seals (see Clean and Safe- Oil Spills)
- Introduction of pollutants, synthetic and non-synthetic substances impacting marine life and other dependent industries (see Clean and Safe- Hazardous Substances, Biotoxins)
- Habitat changes and damage from the construction of pipelines impacting marine life and other dependent industries (see Healthy and Biologically Diverse- Seabed Habitats and Species)
- Noise and vibration during construction and exploration impacting marine life, in particular marine mammals (see Clean and Safe- Noise)

Management Measures

Sullom Voe Terminal and the Shetland Gas Plant are regulated by SEPA under PPC regulations. The Sullom Voe Terminal is rated as 'excellent' for compliance with its licence conditions.

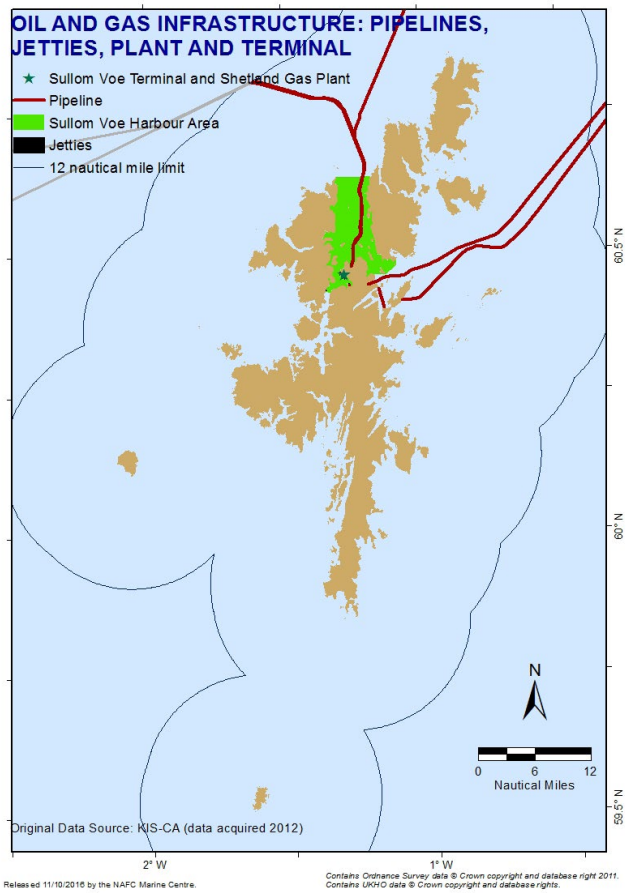
In Shetland, the Shetland Oil Terminal Advisory Group – SOTEAG, formed in 1977, examines and advises on all environmental implications surrounding the Sullom Voe Terminal during construction, commissioning and operations (including ad hoc reconstruction, site rehabilitation and new developments), through to eventual decommissioning[77]. SOTEAG has two sub-committees, the SOTEAG monitoring committee and the Wildlife response co-ordinating committee.

SOTEAG manages a comprehensive scientific monitoring programme to provide early warning of environmental change and, if appropriate, to advice on remedial action, which if neglected or unheeded, could lead to unacceptable environmental consequences[78]. This is achieved via the Monitoring Committee, compiled of independent scientific experts, who on an annual basis evaluate and analyse, environmental monitoring reports. This ensures that the health of the marine and coastal environment around the terminal is constantly maintained.

Forward Look

There have been a number of future construction plans proposed for the Sullom Voe Terminal, including a new £500 million Gas Sweetening Plant, a pipeline link from the Terminal to the Shetland Gas Plant to transfer condensate, and a site wide upgrade project. However, recent declines in oil prices mean that the timescale and size of these projects has been scaled back and BP have withdrawn plans for the proposed Gas Sweetening Plant, which would have employed 300 people during construction.

In addition planned redundancies by BP at the Sullom Voe Terminal are expected to see a 30% reduction in the permanent workforce.



Map 44: Onshore and offshore oil and gas infrastructure including pipelines, jetties, plant and terminal

77 http://www.soteag.org.uk/about-us/
78 http://www.soteag.org.uk/environmental-monitoring/

Water Abstraction

NAFC Marine Centre Hatchery © NAFC Marine Centre

In January 2017 BP announced they had sold a share in their Sullom Voe Terminal Operations to EnQuest, and it is expected that EnQuest will take over the running of the Terminal.

Water abstraction is the process of taking water from the sea and using it for an industrial purpose, then returning it to the sea. In Shetland, water is abstracted for cooling purposes and for use in seawater hatcheries.

Key Legislation, Regulation and Policy

- Water Environment (Controlled Activities) (Scotland) Regulations (CAR) 2011 (as amended)
- Zetland County Council Act 1974
- Marine (Scotland) Act 2010
- Scotland's National Marine Plan
- Shetland Islands Council Local Development Plan and Supplementary Guidance

Socio-Economic

Potential pressures and impacts

Positive:

- Supports the economy through provision of services e.g. electricity

Negative

- Environmental impacts have the potential to impact other marine users and industry
- Possible restrictions on other sea users e.g. fisheries, due to loss of space/ hazard

Trends

There are 16 licensed water abstraction points in Shetland, three are for cooling (Bressay Sound), five are for marine hatcheries (Sandwick, Scalloway and Girlsta), one is for fish processing (Lerwick) and seven are associated with the gas and oil terminals (Sullom Voe and Orka Voe).

Assessment Water Abstraction
Economic contribution: No evidence
Number of abstraction location: Increasing
Confidence: High- supported by licence data

Environment

Potential pressures and impacts

- Thermal changes impacting marine life
- Water flow changes impacting marine life
- Pollution via returned water e.g. chlorine biocides and oxidants used to limit biofouling in discharge pipes impacting marine life (see Clean and Safe-Hazardous substances)
- Species removal via cooling water inflows

Management Measures

Impacts on the marine environment and other marine users are assessed as part of the licencing process by SEPA, and requires a CAR authorisation[79]. This may be in the form of complying with general binding rules for small abstractions, a registration for small freshwater abstractions or seawater abstractions greater than 10m³.

Compliance

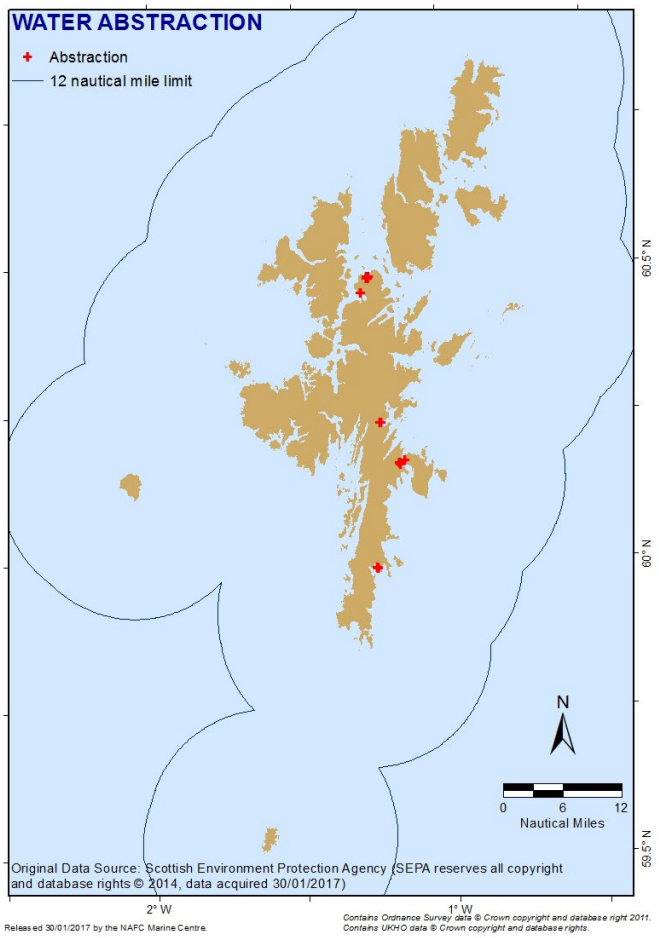
In 2014, only two water abstraction points were assessed for their compliance with licence conditions, these were both rated as 'excellent', all other abstraction points were not assessed.

79 http://www.sepa.org.uk/regulations/water/abstractions/

Forward Look

Water abstraction is important for a range of industries and economic growth. Water abstraction is likely to continue close to its current level. The replacement of Lerwick Power Station with a modern and more efficient station may reduce required extraction levels.

Transport by ship includes the transport of both freight and passengers, whether for commercial or recreational purposes.



Map 45: Waste abstraction locations

Maritime Transport (Ports and Shipping)

Scalloway harbour © Visit Shetland

Marine transport is supported by a diverse range of ancillary activities including shipbuilding and repair, the construction of ports and marinas, and activities associated with navigation including dredging. Marine transport is a significant contributor to the national and regional economies, acting as a major intermediary for imports and exports. Ports and harbours also provide key transport infrastructure between land and sea.

In Shetland the main ports and harbours are Scalloway, Sullom Voe and Cullivoe, managed by the Shetland Islands Council and Lerwick, managed by the Lerwick Port Authority (LPA). The LPA (formally the Lerwick Harbour Trust) was established by an Act of Parliament in 1877.

Key Legislation, Regulation and Policy

- Harbours Act 1964
- Lerwick Harbour Act 1994
- International Maritime Organization (IMO) standards (shipping)

Socio-Economic

Potential Pressures and impacts

Positive

- Allows export and import of goods to Shetland supporting the wider economy
- Route to Shetland for visitors, providing tourism opportunities
- Wider societal benefits including access to education, healthcare and social activities
- Employment (direct and indirect)
- Employment across Shetland, including remote communities
- Providing skilled on-shore and off-shore based jobs
- Providing infrastructure for marine based activities, including oil and gas, fisheries, aquaculture and recreation

Assessment Maritime Transport
Economic contribution: increasing
Transportation (tonnage): increasing
Vessel number: stable
Confidence: High- supported by port statistics

Negative

- Uses large areas of coastal land for port infrastructure
- Visual impact from port infrastructure reducing visual amenity for communities and tourists
- Competition for sea space, for example from shipping lanes

Management measures

Some potential socio-economic impacts from ports and shipping can be mitigated or minimised through careful design and siting. Visual impacts and impacts on other users are reduced through policies in the Shetland Islands Council Local Development Plan and its supplementary guidance.

Trends

The sea transportation industry contributes £18.4 million to the local economy through 14 businesses, 112 full-time jobs and 20 part-time jobs[80]. Ports and harbours comprise two organisations, employing 149 full-time equivalent jobs and contributes £23.4 million to the local economy.

Lerwick Harbour

Lerwick harbour is Shetland's busiest port and

80 Shetland regional accounts

although there is some year-to-year fluctuations in the number of visiting vessels, numbers are relatively stable with 3700 to 4100 vessels calling each year (excluding local fishing vessels), Figure 26. In contrast, the tonnage handled by the port has shown large increases, due to general cargo import and export. Although increases in general cargo movement has led to an overall increase in the tonnage handled by the port, oil related import and exports have declined since a peak in 1981, most likely associated with the building of the Sullom Voe Oil Terminal in the 1970s to 1980s, Figure 27 (see Productive- Oil and Gas)

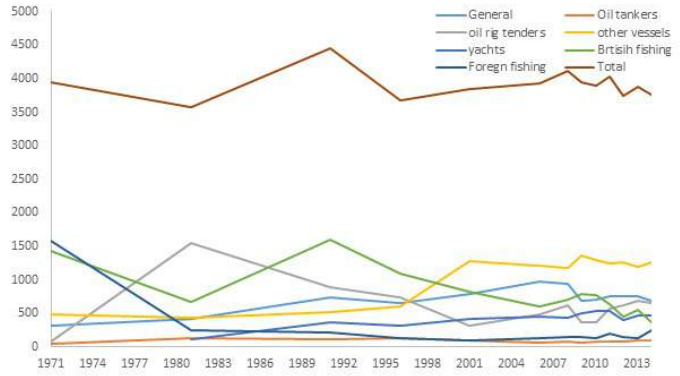


Figure 26: Shipping numbers in Lerwick harbour 1971-2014

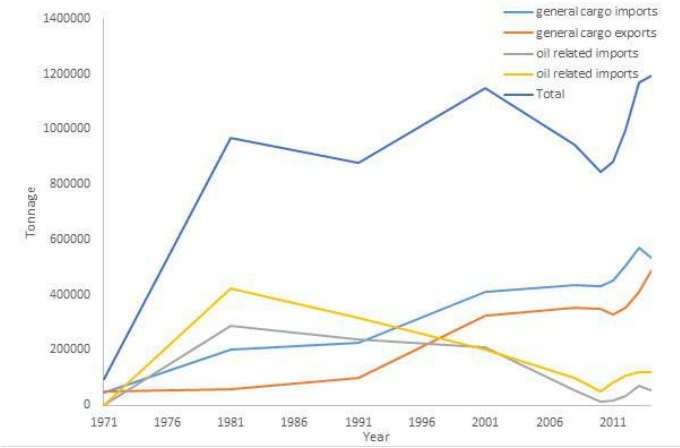


Figure 27: Tonnage handled in Lerwick harbour 1971-2014

Revenues to the port have increased rapidly from 2006, and in 2014 were at their highest level at over £13 million, Figure 28. This revenue is reinvested by the LPA and there has been over £80 million invested in the port in recent years[81].

Scalloway

Vessel numbers to Scalloway harbour are much lower than Lerwick harbour, and have decreased from a peak in 2001 of 485 to 315 in 2012, Figure

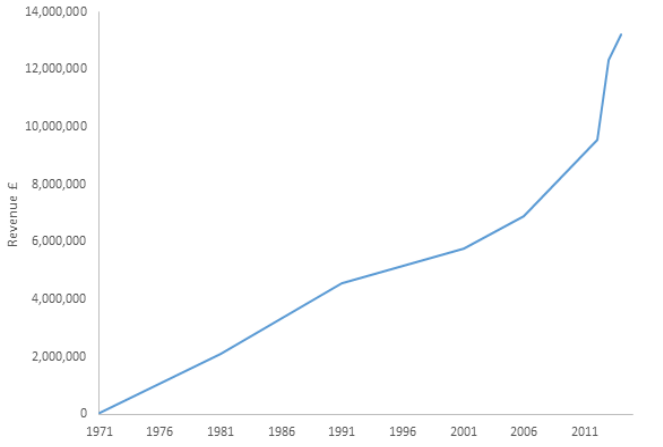


Figure 28: Lerwick Harbour Trust revenue 1971-2014

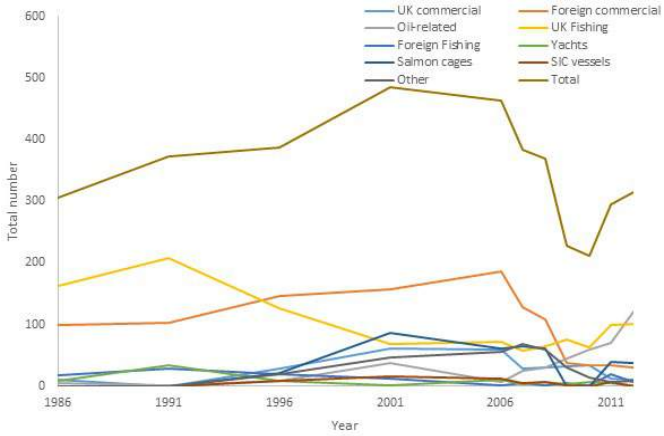


Figure 29: Shipping in Scalloway harbour 1986-2014

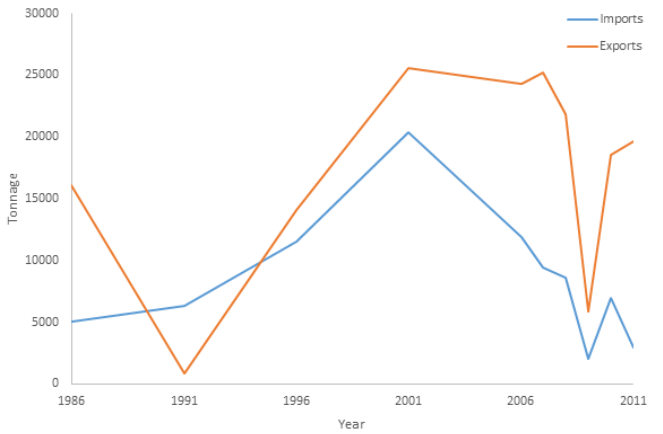


Figure 30: Tonnage handled in Scalloway harbour 1986-2011

29[82]. The decline in vessel numbers is primarily due to the reduction in foreign commercial vessels. In contrast there has been an increase in oil related vessels. Imports and exports to the harbour show large year to year fluctuations, with particularly low levels observed in 2009. Export levels increased in 2010 and 2011 but import levels have remained low, Figure 30.

81 Lerwick Port Authority 'About Us' https://www.lerwick-harbour.co.uk/about-us

82 Shetland in Statistics (2012, 2014) Shetland Islands Council

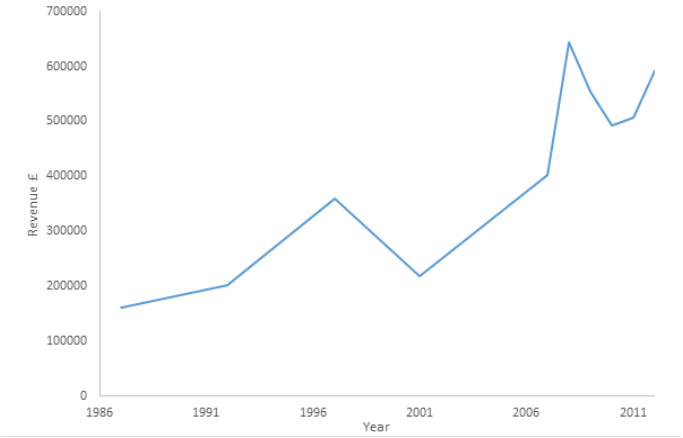


Figure 31: Scalloway Harbour revenue 1987-2012

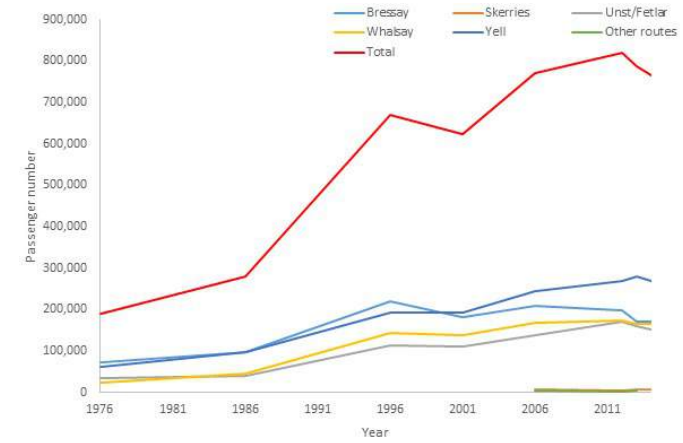


Figure 32: Internal ferry passenger numbers 1976-2014

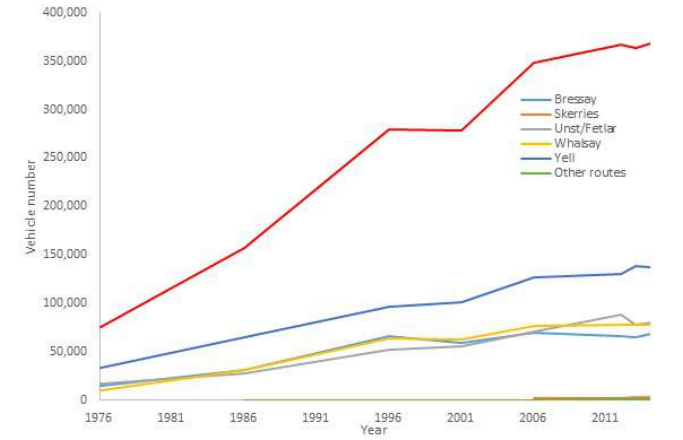


Figure 33: Internal ferry vehicle numbers 1976-2014

Revenue to the harbour has however showed an increasing trend, with revenue in 2011 £592 325, Figure 31.

Ferries

Internal: Passenger and vehicle numbers on internal ferries have shown large increases over the last 40 years, with passenger numbers 766 649 and vehicle numbers 368 637 in 2014, Figure 32 and Figure 33. This may be associated with increasing numbers of people commuting for work (both onto and off of the isles).

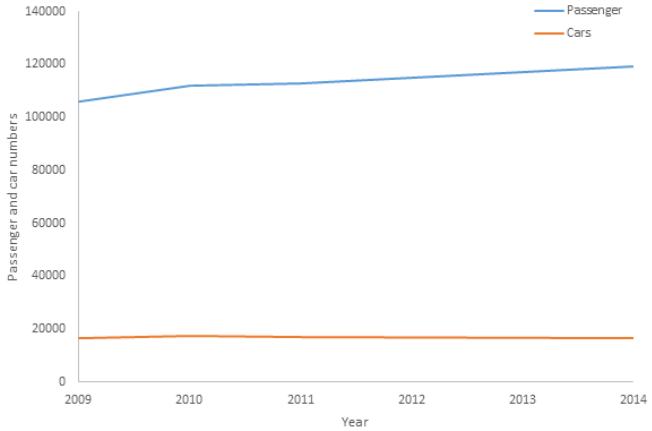


Figure 34: Aberdeen to Shetland return ferry passenger and vehicle numbers 2009-2014

External: Passenger numbers to and from Shetland via Aberdeen have shown a steady rise in number from 2009-2014. In 2014 passenger numbers were 119 198 and vehicle numbers 16 576 in 2014, Figure 34.

Transport

Patterns in marine transport around Shetland are dependent on the fluctuations in individual sectors. Automatic identification system (AIS) data can be used to identify shipping routes to and from Shetland, within Shetland and to areas of commercial interest such as fishing grounds and oil fields; Figure 46-53.

Environment

Potential Pressures and impacts

Positive

- Relative environmental benefits of movement of goods and people compared with other methods such as flying

Negative

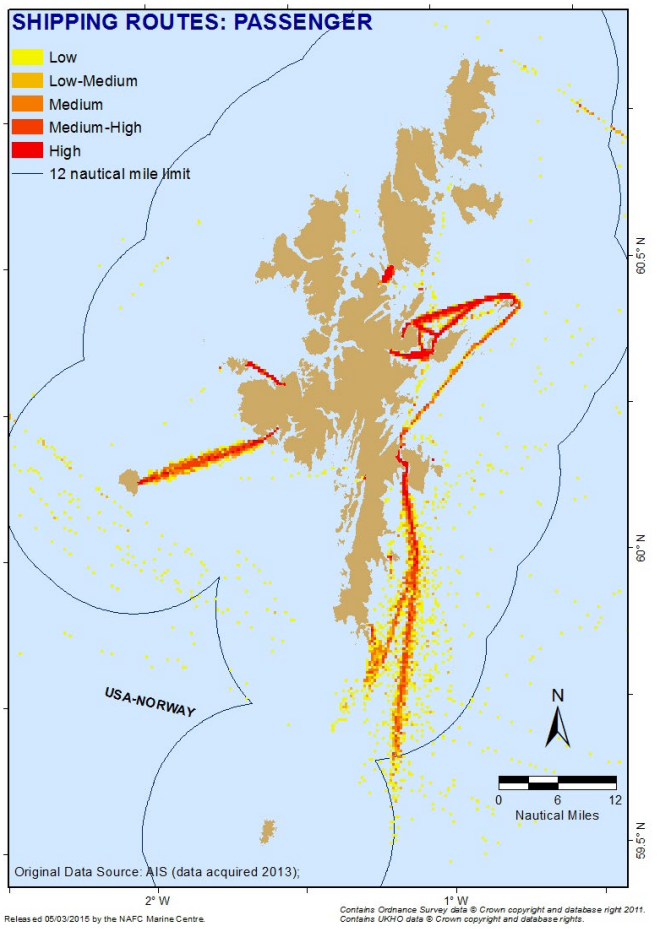
- Potential to spread and provide stepping stones for non-native species impacting the environment and other marine species (see Clean and Safe- Non-Native Species)
- Pollution and other chemical pressures impacting the environment and other marine species e.g. anti-foulants (see Clean and safe- Biotoxins, Hazardous Substances and Oil Spills)
- Marine noise impacting marine mammals and some fish species (see Clean and safe - Noise)
- Marine litter impacting marine life and tourism (see Clean and safe – Marine Litter)
- Collision risk to marine mammals from shipping (see Healthy and Biologically diverse – Cetaceans and Seals)

- Habitat change from port infrastructure and port dredging impacting seabed and intertidal species (see Healthy and Biologically diverse – Seabed Habitats and Species)

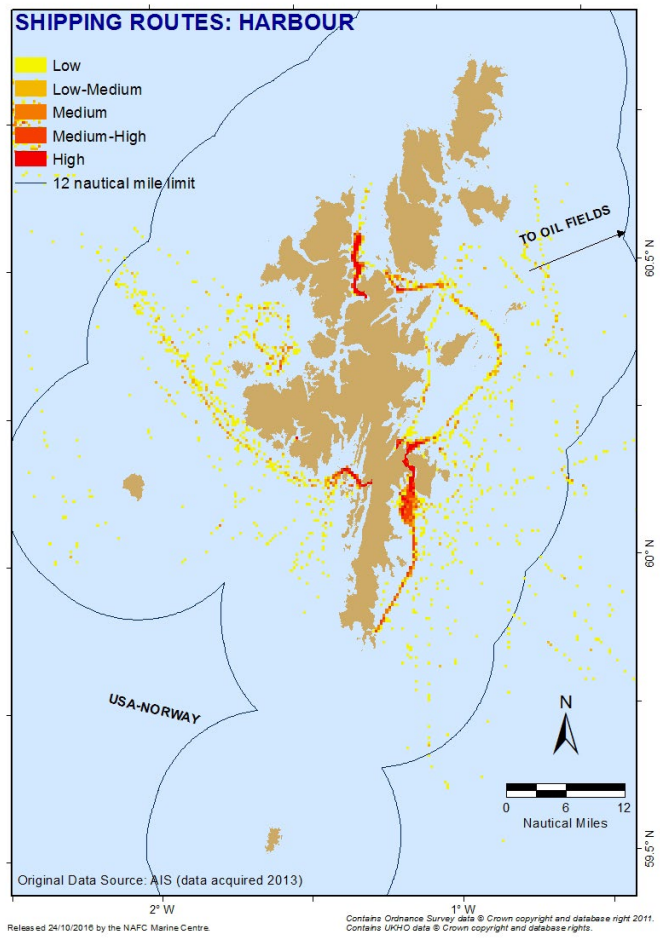
Forward Look

Marine transportation is likely to remain an important industry in Shetland. Transportation levels are likely to be affected by fluctuations in individual sectors, and affected by changes in oil prices. The recent downturn in the oil industry has the potential to cause declines in traffic to Scalloway, Lerwick and Sullom Voe. In contrast Shetland's small harbours and piers are more likely to be affected by the changes in local businesses, in particular fishing and aquaculture.

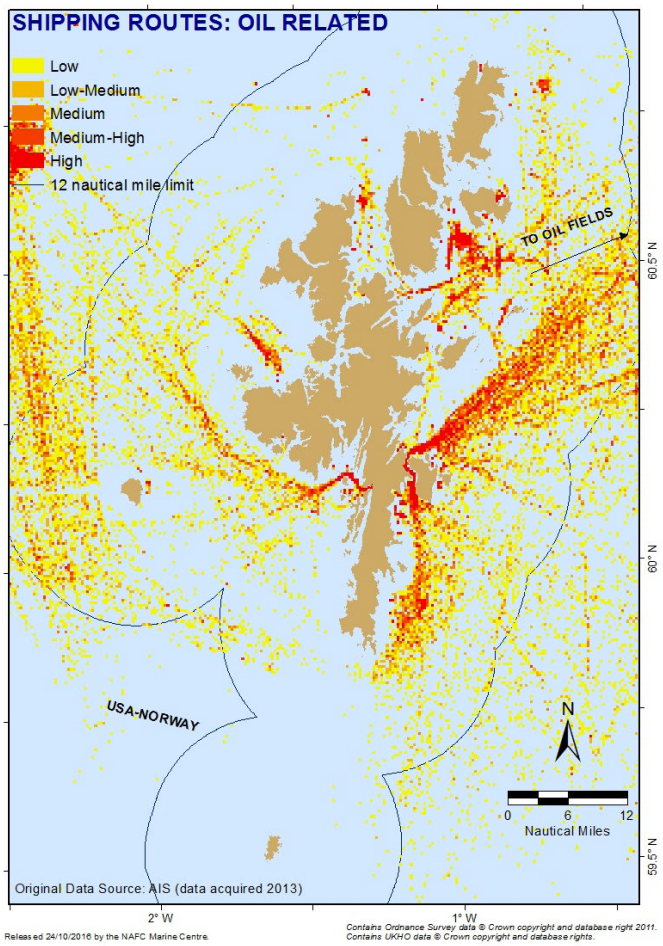
The Lerwick Port Authority has continued to invest in the development of Lerwick Harbour, including the development of a new jetty for the fishing and oil industries, which is near completion. The Shetland Islands' Council, through their Port Master Plans, have set out potential development programmes for Scalloway and Sullom Voe harbours. In Scalloway this includes the potential for additional dredging and the creation of new jetty space to serve both the potential renewables industry and the oil and gas industry. The potential future use of Sullom Voe as a deep water harbour have also been considered.



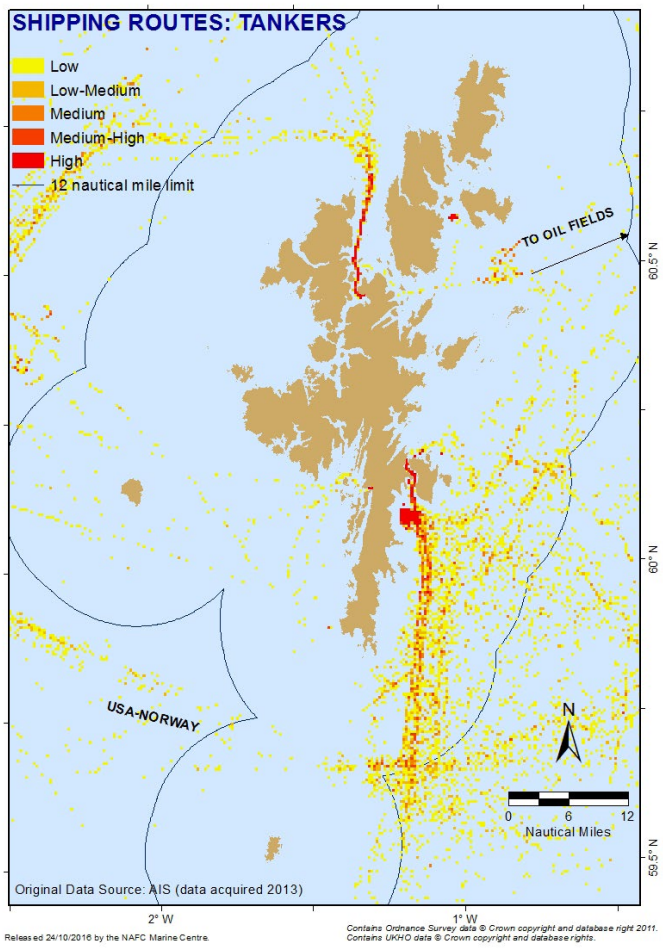
Map 46: Relative shipping intensity- Passenger Vessels



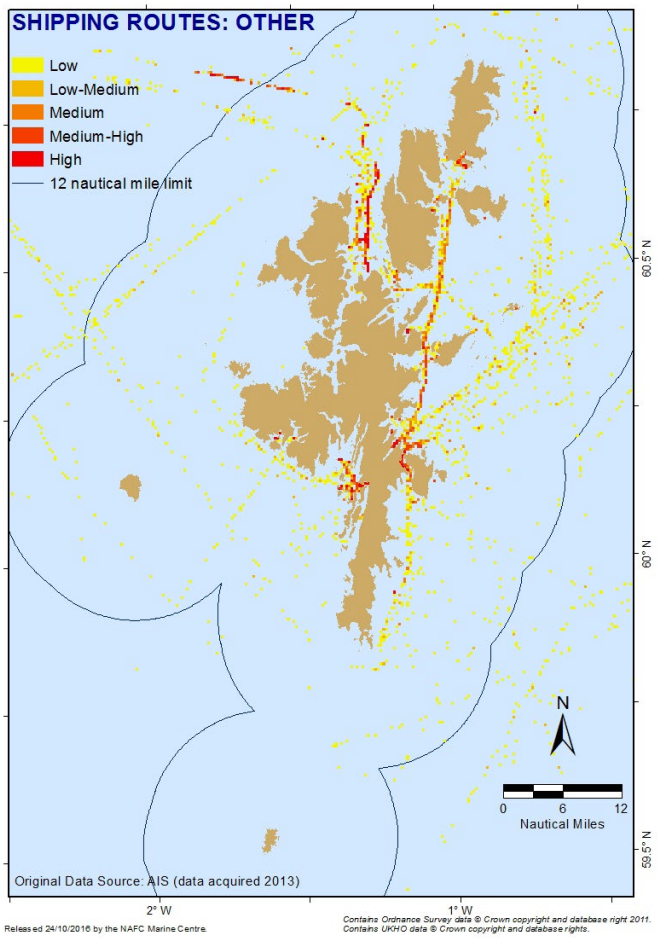
Map 47: Relative shipping intensity- Harbour Vessels



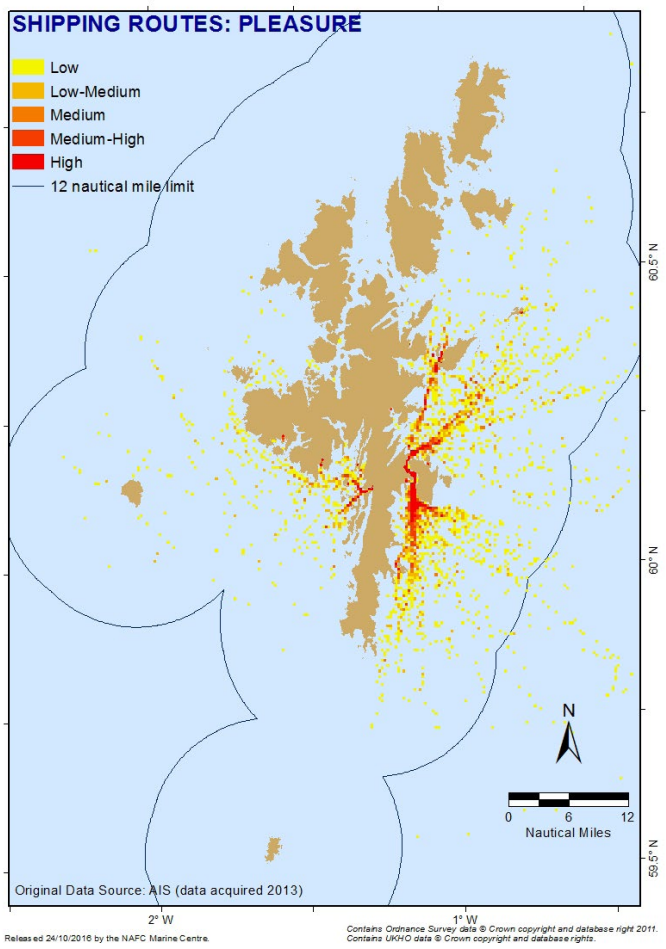
Map 48: Relative shipping intensity- Oil related



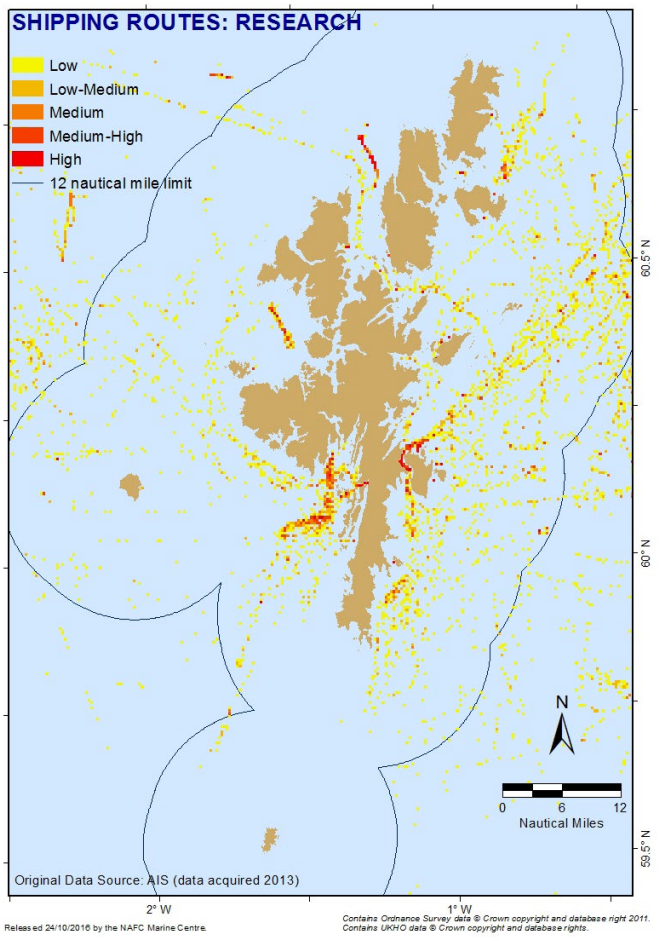
Map 49: Relative shipping intensity- Tankers



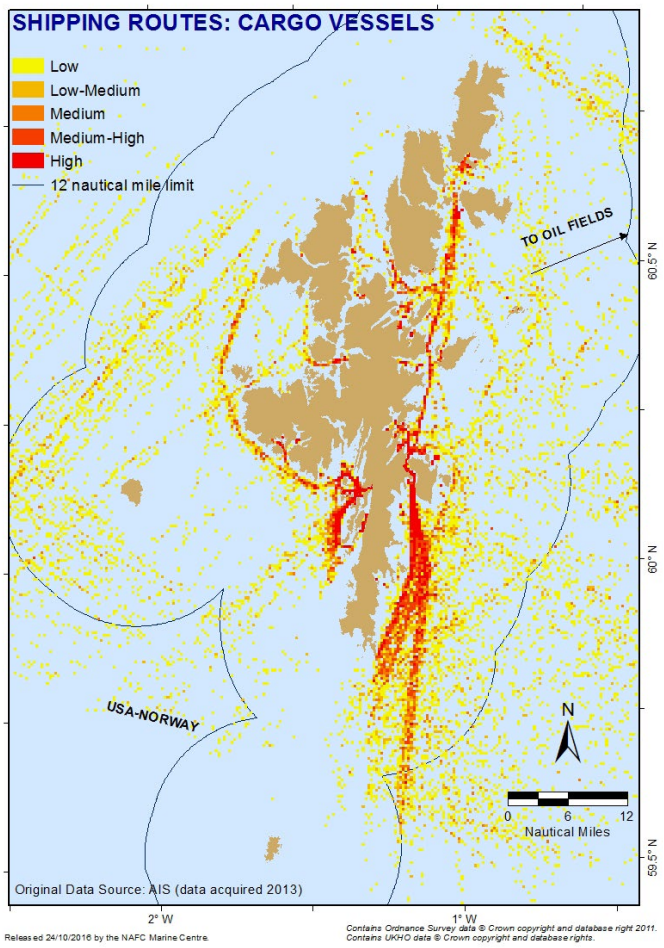
Map 50: Relative shipping intensity- Others



Map 51: Relative shipping intensity- Pleasure Vessels



Map 52: Relative shipping intensity- Research Vessels



Map 53: Relative shipping intensity- Cargo Vessels

Waste Disposal - Dredge Material

Scalloway harbour © Charlotte Slater

Dredging and the marine disposal of dredged material are activities necessary to maintain navigation into and within ports and harbours, allowing access for deeper draft vessels. Without adequate depths within harbours, shipping and trade would be severely restricted, impacting the viability of dependent industries including fisheries, aquaculture and the oil and gas industry.

Key Legislation, Regulation and Policy

- Marine (Scotland) Act, 2010
- Zetland County Council Act 1974
- UK Marine Policy Statement 2011
- Scotland's National Marine Plan
- Shetland Islands Council Local Development Plan and Supplementary Guidance

A distinction is made between capital and maintenance dredging. The initial dredging of a channel is usually referred to as 'capital dredging'. This should be in an area or down to a level (relative to Ordnance Datum) not previously dredged during the preceding 10 years. It is often permitted under the terms of the harbour legislation (the ZCC Act). Subsequent dredging to keep the channel at its desired depth is usually termed 'maintenance dredging'. Maintenance dredged material is derived from an area where the level of the seabed to be achieved by the proposed dredging is not lower (relative to Ordnance Datum), than it has been at any time during the preceding 10 years, or from an area for which there is evidence that dredging has previously been undertaken to that level (or lower) during that period. Provision is normally included in the harbour legislation or in a Revision Order if one is sought.

Assessment Waste disposal- dredge material

Economic contribution: No evidence
Number of dredge locations: stable
Number of disposal locations: stable
Volume: Variable

Some sea disposal operations are licensed annually as major ports require an annual maintenance dredge. Other ports undertake dredging operations when required, either to maintain channels, berths or in connection with construction works to upgrade or replace existing port facilities.

Socio-economic

Potential pressures and impacts

Positive

- Employment at ports and harbours maintained
- Allow ports to take deeper drafted vessels, increasing the type of vessels that can visit the harbour

Negative

- Environmental impacts have the potential to impact other marine users and industry

Trends

Most of the voes in Shetland used by large vessels are naturally deep, and therefore have never required dredging. However, capital and maintenance dredging has occurred in Lerwick and Scalloway harbours, with some of the dredged material disposed of at sea. There are six locations in Shetland designated for the disposal of dredged material, see Map 54.

In the last 10 years, disposal of dredge material has taken place once for Lerwick harbour and once for

Scalloway harbour, with the disposal of 998 240 tonnes and 1 750 tonnes for the respective ports from 2005-2012.

Environment

Potential pressures and impacts

Negative

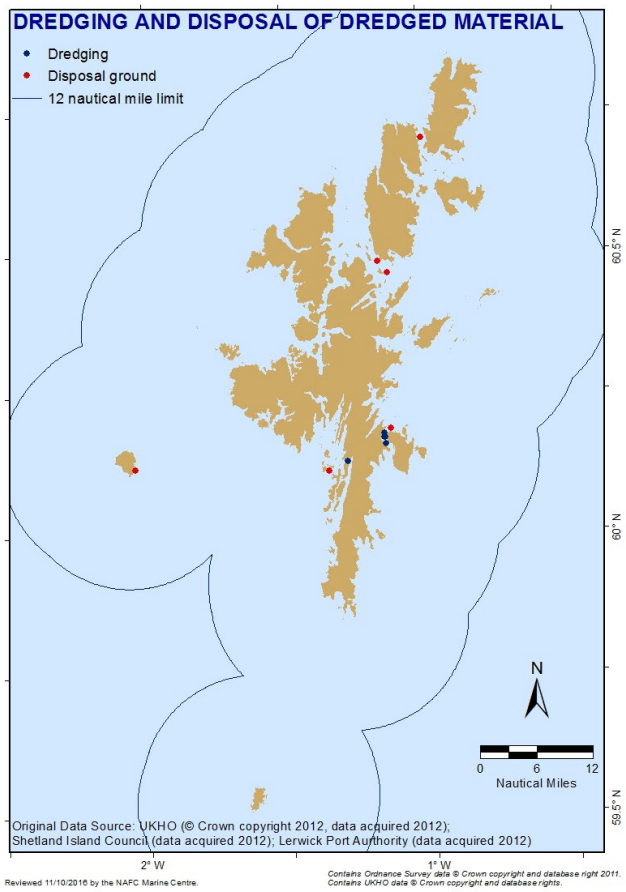
- Loss of habitat due to dredging and disposal (see Healthy and Biologically Diverse- Seabed Habitats and Species)
- Increased sedimentation impacting marine life
- Potential hydrological changes impacting seabed habitats
- Disturbance to wildlife e.g. noise, particularly if blasting is required
- Movement of potential contaminated sediment from port area (e.g. heavy metals, TBT).

Mitigation Measures

The licensing authority, Shetland Islands Council, SEPA, SNH and others work with applicants, to identify potential uses for the dredged material. The UK Marine Policy Statement 2011 requires the re-use, recycle or treatment of dredged waste over disposal, where there are no undue risks to either human health or the environment, or disproportionate costs. It should be noted that the disposal of dredging to land for beneficial use is also an option. Such proposals need to be registered with SEPA under a waste management exemption. The Best Practicable Environmental Option Assessment approach should be used to determine whether there are practicable alternatives to sediment disposal.

Forward Look

Dredging activities are focused on the Lerwick and Scalloway harbours, with both harbours undertaking one dredging campaign each in the last 10 years. Scalloway harbour is currently too shallow for some offshore support vessels, with the potential for an additional capital dredging campaign in the future, if funding is secured.



Map 54: Dredged areas and locations licenced for the disposal of dredged material

Waste Water Treatment and Industrial Outfalls

Lerwick Power Station © Charlotte Slater

Outfalls to the marine environment include industrial discharge (trade effluent), hatchery effluent, waste water treatment (e.g. sewage), and domestic sewage. In addition, seawater which has been used for thermal cooling (e.g. in power stations) may be discharged.

Key Legislation, Regulation and Policy

- Controlled Activities (Scotland) Regulations Pollution Prevention and Control (Scotland) Regulations 2012 (PPC 2012)

Socio-economic

Potential pressures and impacts

Positive

- Employment
- Allows industries to function economically

Negative

- Release of pathogens and pollutants have the potential to impact water quality which could impact other industries including shellfisheries, tourism and recreation
- Potential obstructions on the seabed impacting other marine users including aquaculture and fisheries

Trends

In Shetland there are 346 licenced discharge locations, increasing from 303 in 2012, including three hatchery, 24 waste water, two surface water and 317 sewage discharge points, Map 55. There are two thermal cooling discharge locations. Types of discharges are discussed in 'Clean and Safe'.

Assessment waster water treatment and industrial outfalls

Economic contribution: No evidence
Number of discharges: increasing
Confidence: Low- although the number and location of discharge facilities are known it is difficult to attribute an economic value.

Environment

Potential pressures and impacts

- Introduction of human and animal pathogens (bacteria, viruses or parasites), spreading disease (see Clean and Safe- Microbiology)
- Pollution and other chemicals reducing water and sediment quality (see Clean and Safe- Hazardous Substances)
- Increased nutrients e.g. nitrogen, phosphate and derivatives causing eutrophication (see Clean and Safe- Eutrophication)
- Organic waste causing deoxygenation of the seabed and overlying water, causing changes in seabed community structure (see Healthy and Biologically Diverse- Seabed Habitats and Species)
- Litter in waste water potentially harming wildlife (see Clean and Safe- Marine Litter)

Management Measures

Discharges are licenced by SEPA through the Water Environment (Controlled Activities) Scotland Regulations 2012 (CAR) or Pollution Prevention and Control Regulations for larger industrial premises. Improved water quality is managed through the River Basin Management Plan (see section Clean and Safe). A programme of measures to target localised water

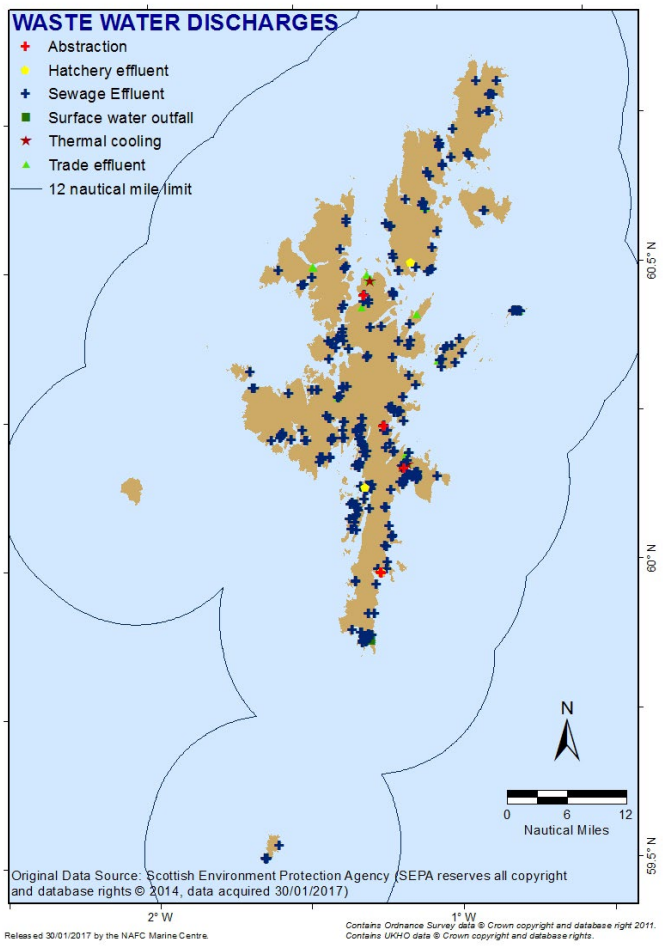
quality issues are co-ordinated under the Shetland and Orkney River Basin Management Plan, which is led by SEPA. The SEPA Compliance Assessment Scheme (CAS) was introduced and designed to demonstrate the level of compliances associated with specific Licence conditions for PPC, WML, CAR and RSA sites.

Compliance

Discharges with CAR Licence and PPC Licence requirements are assessed by SEPA. Of those assessed in 2015, compliance ratings of 'excellent' or 'good' were at all but two locations. The Sandness sewage outfall did not meet licence conditions due to physical damage to the outfall pipe caused by adverse weather conditions and the Scottish Seafarms Ltd processing facility was rated as 'poor' due to multiple failures of the Biological Oxygen Demand (BOD) limit .

Forward Look

Scottish Water has submitted a Marine Licence application for a new outfall pipe at Sandness, with an improved diffuser.



Map 55: Waste water treatment and industrial outfalls

Telecommunications, Electricity Cables and Water Pipes

Culli Voe © Richard Shelmerdine

Telecommunications, electricity cables and water pipes provide connections both between the inhabited Shetland Islands, and in the case of telecommunications, connect Shetland to the mainland. In addition, a number of international cables pass through Shetland waters, some landing on Shetland such as the SHEFA fibre optic cable, whilst others do not land in Shetland and are situated offshore, such as the 'Atlantic Crossing' cable.

Key Legislation, Regulation and Policy

- Zetland County Council Act 1974
- Marine (Scotland) Act 2010
- Submarine Cables Act, 1885
- UNCLOS (United Nations Convention on the Law of the Sea), 1982
- Telecommunications Act, 1984
- Electricity Act, 1989
- Communications Act, 2003
- Subsea Cables UK Guidelines
- Scotland's National Marine Plan
- Shetland Islands Local Development Plan and Supplementary Guidance

Socio-Economic

Potential Pressures and impacts

Positive

- Internet and telephone provision for social and business benefit
- Supplying water to island communities
- Providing energy to island communities
- Employment and research
- Electricity interconnector could allow the development of onshore and offshore renewables

Assessment Telecommunications, electricity cables and water pipes

Economic contribution: stable

Confidence: Moderate, while it is assumed the economic contribution of the existing network is stable a detailed assessment has not been undertaken.

Negative

- Restriction on other seabed use potentially impacting marine users including fisheries and aquaculture
- Seabed hazard, particular for fisheries

Management Measures

The placement of submarine cables is subject to a marine licence issued by Marine Scotland and a Works Licence, issued by Shetland Islands Council.

Trends

There are currently six submarine external telecommunications cables passing through Shetland waters, providing connections from Shetland to the UK mainland or providing international connections. There are 20 submarine telecommunication or electricity cables connecting the Shetland Isles together.

Environment

Potential pressures and impacts

Negative

Construction

- Noise and vibration during cable burial impacting marine wildlife
- Abrasion- deployment and burial of cables has

the potential to damage seabed communities (see Healthy and Biologically Diverse- Seabed habitats and Species)
- Loss of habitats and species within the cable 'footprint' (see Healthy and Biologically Diverse- Seabed Habitats and Species)

Operation
- Electromagnetic changes are thought to have the potential to impact electro-sensitive and magneto sensitive species e.g. some species of fish

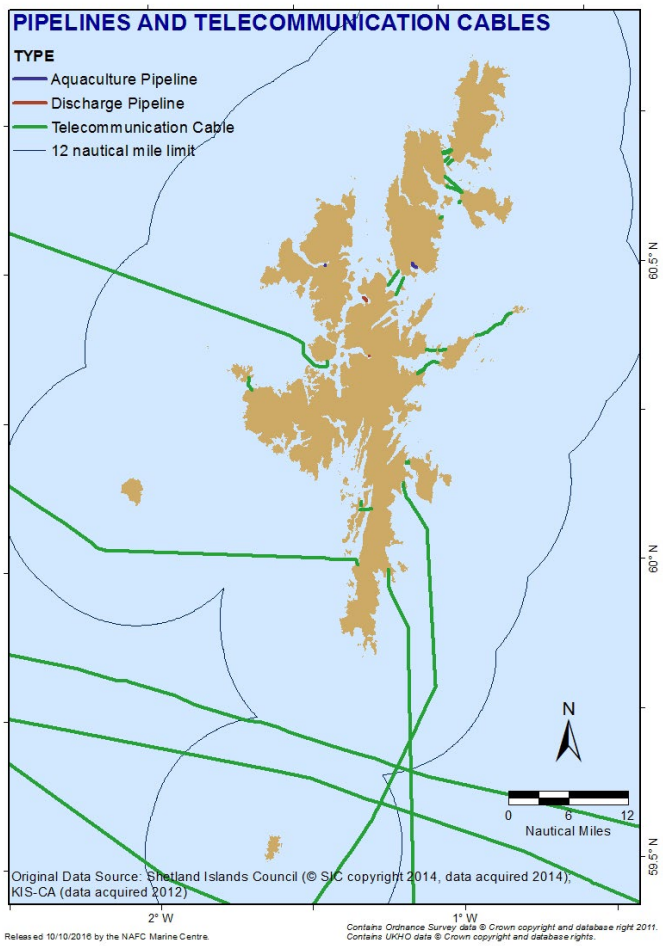
Forward Look

Telecommunications

There are currently no additional proposed telecommunication cables around the Shetland coast.

Electricity

SHEP has a programme of electricity cable maintenance and renewal, and in addition there is the potential for Shetland to be connected to the mainland UK by a new cable which would allow Shetland to export renewable energy production, helping to create a new industry. Pre-application consultation took place in 2016 and a Marine Licence application for the interconnector is expected in 2017.



Map 56: Waste water treatment and industrial outfalls

D Regional Look Forward

Levenwick © Charlotte Slater

Shetland is currently achieving most water quality standards to ensure they are as productive as possible. There are some localised concerns relating to historic contamination, such as TBT. It is expected that these levels will continue to decline. There are also some localised concerns relating to microbial contamination, primarily due to terrestrial activities (farming and sewage), which seasonally affects the harvesting of shellfish in a small number of voes. It is expected that through the SEPA led River Basin Management Plan, microbial contamination will continue to reduce, although only in the longer term.

The number of non-native species (NNS) present in Shetland continues to increase, but a biosecurity plan has been implemented to minimise potential impacts of introductions. Some NNS have the potential to cause significant environmental and economic impacts, in particular to fishing and aquaculture.

Marine litter continues to be a problem around the Shetland coast, despite a large locally co-ordinated beach and coastal cleaning programme. This continues to pose a threat to marine life, fisheries, and marine tourism.

The adoption of the SIMSP by the Shetland Islands Council and a series of closed areas by the SSMO, has meant most seabed species are currently afforded some protection, where their location is known. However, the populations of many apex predators such as seabirds, seals and cetaceans are thought to be in decline. The decline of some of the more charismatic species has the potential to impact wildlife tourism. The reasons for these declines are however thought to be primarily outside the management scope of regional marine planning.

Shetland seas remain very important to the Shetland economy. The economic value of wild fisheries and aquaculture are currently increasing. Seaweed cultivation has the potential to become a new industry to Shetland. There is the potential that in the short to medium term, the reduction in oil prices reduces the significance of this sector to Shetland. Decommissioning could become increasingly important to Shetland.

Renewable energy development could become a new component of the Shetland economy if an inter-connector is put in place between Shetland and the UK mainland, and also for local use. The growth of this sector has the potential to cause competition for marine space, particularly with the fishing sector. However it also provides opportunity for shared resource and working with other marine sectors and could provide alternative employment as the oil and gas sectors decline.

E Data Gaps

Topic	**Data Gap**
Clean and Safe	
Biotoxins	Trend
Underwater Noise	Levels
Healthy and Biologically Diverse	
Cetaceans	Population levels and distribution
Basking sharks	Population levels and distribution
Common skate	Population levels and distribution
Spiny dogfish	Population levels and distribution
Atlantic salmon	Population levels and distribution
Sea trout	Population levels and distribution
Intertidal sediments- mudflats, sandflats, sandy beaches	Trend
Eelgrass beds	Trend
Blue mussel beds	Trend
Sea loch egg wrack beds	Trend
Tide swept algae communities	Trend
Subtidal sediments	Trend
Seagrass beds	Trend
Low or variable salinity habitats	Trend
Maerl beds	Trend
Horse mussel beds	Trend
Shallow tide-swept coarse sands with burrowing bivalves	Trend
Ocean quahog	Trend
Fan mussel	Trend
Northern feather star	Trend
Tide-swept algae communities	Trend
Kelp beds	Trend
White cluster anemone	Trend
European spiny lobster	Trend
Productive	
Leisure and recreation	Trend
Historic environment and cultural heritage	Trend

Glossary

Amenity: the physical and social features of settlements and countryside that contribute to creating a comfortable and desirable living environment.

Biodiversity Action Plan (BAP): a document for use by all kinds of organisations to help sustain biodiversity.

Bathymetric (noun: Bathymetry): the depth of the seabed, analogous to topography (on land). A bathymetric reading or survey is therefore a measurement of the depth of the seabed. Such a survey is usually conducted acoustically.

Benthic (noun: benthos): the plants and animals which live on the seabed.

Biosecurity: measures or procedures intended to protect against damaging biological or biochemical elements.

Biota: the flora and fauna of a particular area, habitat, or geological period.

Biodiversity: the variety (within and between species) of living things from all sources (terrestrial, marine, aquatic).

Biological Records Centre: the core element of the Shetland Biological Records Centre (SBRC) is a comprehensive database containing up-to-date information about Shetland's wildlife. The information is available to everyone.

Biotope: a discrete physical habitat with its associated community of animals and plants.

Birds Directive: EC Directive 79/409/EEC on the Conservation of Wild Birds. This legislation was a response to increasing concern about the declines in Europe's wild bird populations resulting from pollution, loss of habitats as well as unsustainable use. The Directive recognises that habitat loss and degradation are the most serious threats to the conservation of wild birds. It therefore places great emphasis on the protection of habitats for endangered as well as migratory species (listed in Annex I), especially through the establishment of a coherent network of Special Protection Areas (SPAs) comprising all the most suitable territories for these species.

CAR (Controlled Activities Regulations): CAR (Controlled Activities Regulations) is an abbreviation for The Water (Controlled Activities) (Scotland) Regulations 2011. SEPA regulates the discharges to and abstraction from coastal waters under CAR.

Cetaceans: a marine mammal including whales, dolphins and porpoises. Belongs to the order Cetacea.

Character: A combination of features which distinguish an area. These each include architectural styles, main uses, landscape type, etc. A proposal would be 'out of character' if it introduced features not in keeping with those which make up an area's existing character.

Conservation: action(s) resulting in the preservation of the natural environment.

Cultural Heritage: includes customs, practices, places, traditions and objects which have been passed down from generation to generation and express a way of life. Can be split into tangible (physical objects and places) and intangible (customs and practices).

Cumulative: created by successive additions (for example of impacts).

Development: a use that requires a statutory consent to utilise a defined area from a competent authority to proceed. This can include new developments or alterations, extensions or changes in material use to existing developments that require a statutory consent.

Ecosystem: structure, process, functions and interaction among organisms, including humans, and their non-living environment.

Ecosystem Approach: the integrated management of multiple human activities based on knowledge of ecosystem dynamics to achieve sustainable use of ecosystem resources and maintenance of ecosystem integrity. Managed within the ecological constraints on which the environment depends.

Ecosystem Function/ Ecological Process: dynamic biological and physical processes, for example natural cycles, currents, sediment movements, nutrient cycling, community and trophic structures and migratory species movements.

Eutrophication: excessive richness of nutrients in a body of water such as a loch, often caused by fertiliser run off from fields which can cause algae growth.

FIMETI: The Fair Isle Marine Environment & Tourism Initiative. Set up by residents of Fair Isle to safeguard their heritage and marine environment.

Fishing Effort: Fishing effort limits restrict the size of the fleet that sets to sea, and the amount of time it can spend fishing. Fishing effort is calculated by multiplying the fishing capacity deployed by the period of time for which it is active. The EU uses two ways of measuring fishing capacity, one based on the size of the boat in gross tonnes, the other on the power of its engines in kilowatts. Effort limits are then set either as GT/days or KW/days. Fishing effort limits are important in preventing overfishing, and are therefore included in all multiannual plans that aim to recover depleted stocks.

Firth: A long, narrow sea inlet which usually has steep sides, similar to a voe.

F_{MSY}: Fishing at maximum sustainable yield.

Geographical Information Systems (GIS): a system for creating, storing, analysing and managing spatial data and associated attributes. Their main outputs are maps, called layers, but graphs and summary statistics can also be produced (for example in calculating what % area is designated for conservation).

Geomorphology: the study of landforms (in this case the coastline), including their origin and evolution, and the processes that shape them.

Habitat: the environment in which a species lives at any stage in its life cycle.

Habitats Directive: in May 1992, the member states of the European Union adopted the 'Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora'. The main aim of the Directive is to promote the maintenance of biodiversity and, in particular, it requires member states to work together to maintain or restore to favourable conservation status certain rare, threatened, or typical natural habitats and species. These are listed in Annex I and II respectively. One of the ways in which member states are expected to achieve this aim is through the designation and protection of a series of sites, known as Special Areas of Conservation (SACs).

Harbours Act (and Lerwick Harbour Act, 1994), 1964: the primary legislation under which harbour works are authorised.

Historic Environment Scotland: body responsible for safeguarding Scotland's historic environment. Formally Historic Scotland.

Historic Environment: evidence of human activity through time which includes all physical remnants whether buried, submerged or visible.

Impact: a human disturbance which causes a change in a population's composition, abundance, or distribution. Examples of impacts include: effect of waste discharge on eelgrass and scouring of vegetation from boating activities in shallow water.

Imposex: Imposex is the development of male sexual characteristics (the formation of a vas deferens and growth of a penis) in female dog whelks. The common dog whelk, *Nucella lapillus*, is a marine snail. It is abundant on many rocky shores, where it feeds on barnacles. Imposex is caused by exposure to Tri-Butyl Tin (TBT).

Intertidal: the area of coast between the mean high water level and mean low water level.

Local Development Plan: a detailed land-use planning document prepared by the Shetland Islands Council setting out specific policies and proposals for sustainable development.

Marine Protected Areas (MPAs): include Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Sites of Special Scientific Interest (SSSIs) and Ramsar sites as well as new designated areas under the Marine (Scotland) Act 2010. Under the 2010 Act, Scottish Ministers may designate any area as a Nature Conservation MPA, a Demonstration and Research MPA or a Historic MPA.

Marine Scotland Act, 2010: The Marine (Scotland) Act 2010 applies to the inshore area in Scotland, and to some functions in the Scottish offshore area. The Marine (Scotland) Act received Royal Assent on 10 March 2010. It provides a framework

for safeguarding the future of Scotland's seas. The 2010 Act will legislate for marine planning, licensing and conservation. The 2010 Act repealed Part II of the Coastal Protection Act 1949 only, Part I (coast protection) remains. The 2010 Act also subsumed Part II of the Food and Environment Protection Act 1985 i.e. that part relating to works and deposits.

Marine Stewardship Council (MSC): The Marine Stewardship Council's (MSC) fishery certification programme and seafood ecolabel recognise and reward sustainable fishing and seafood traceability. They ensure that MSC- labelled seafood comes from, and can be traced back to, a sustainable fishery.

MHWS (Mean High Water Spring): predicted high water heights of Spring Tide over a period of approximately 19 years.

Microbe: a microorganism, which is a fermentation or disease causing bacterium.

MSY: maximum sustainable yield. The biggest continuing average yield that can be taken from a stock under current environmental and ecological circumstances.

NAFC Marine Centre: an educational and scientific research institute that is based in Shetland and part of the University of the Highlands and Islands network.

Non-Native Species: any species which is living out with its natural distributional range which was introduced by human activity either accidentally or on purpose.

National Scenic Area (NSA): areas that are nationally important for their landscape quality. There are stricter planning controls within NSAs and planning authorities have to take care that new development does not detract from the scenic quality of the area.

Nursery Area: habitats providing shelter and food to marine fauna during the vulnerable, juvenile stages of life (for example eelgrass habitats are nurseries for many species of fish).

OSPAR: Convention for the Protection of the Marine Environment of the North- East Atlantic (Oslo and Paris Commissions).

Priority Marine Feature (PMF): comprises habitats and species which are considered to be marine nature conservation priorities in Scottish waters.

Reef: subtidal and intertidal rocky outcrops supporting diverse assemblages of marine flora and fauna.

Renewable Energy: energy created from a source which is not diminished when used such as tidal or wind power.

Saltmarsh: coastal wetland plant community dominated by herbs and low shrubs and located in the upper intertidal areas of the coast (often on the landward side). Saltmarsh areas are usually waterlogged and frequently flooded with saltwater by the tide. Saltmarsh assemblages may extend inland for several hundred kilometres and can contain other terrestrial salt tolerant plants.

Scottish Environment Protection Agency (SEPA): the public body responsible for environmental protection in Scotland. Its main aim is to provide an efficient and integrated environmental protection system for Scotland that will both improve the environment and contribute to the Scottish Ministers' goal of sustainable development. Full details are available from www.sepa.org.uk

Scottish Natural Heritage (SNH): an independent body responsible to the First Minister whose task it is to secure the conservation and enhancement of Scotland's natural heritage. SNH aims to help people to enjoy Scotland's natural heritage, understand it more fully and use it wisely so that it can be sustained for future generations.

Seascape: An area at any scale which includes the sea as a focal feature. A seascape has both experiential and physical attributes and comprehends the interrelationship between the sea, sky and land.

Sediment: organic or mineral material which has been deposited by ice, water or air.

Site of Special Scientific Interest (SSSI): areas of special interest by reason of their flora, fauna, geological or physiographical features. Notified under the Wildlife and Countryside Act, 1981.

Shetland Shellfish Management Organisation (SSMO): a body who regulate and manage shellfish fisheries within the six nautical mile limit of Shetland.

Spawning Area: habitats critical to the spawning stage of the reproductive cycle. Spawning areas are often geographically distinct from nursery areas; for example, Monkfish spawn in deeper waters but their larvae drift into sheltered coastal areas around Shetland.

Special Area of Conservation (SACs): areas identified as supporting rare, endangered and vulnerable habitats or species. Designated under European Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Flora and Fauna (the 'Habitats Directive'). Together with SPAs they form the Natura 2000 network of protected sites across the European Community.

Special Protected Area (SPA): important habitats for rare, threatened or migratory birds. Classified under European Directive 79/409/EEC on the Conservation of Wild Birds, (the 'Birds Directive').

Supplementary Guidance (to LDP): gives more detailed guidance and expands upon current policies within the Local Development Plan (LDP).

Subtidal: benthic area from the low tide line to the seaward edge of the continental slope.

Tributyltin (TBT): is the active ingredient of many products that act as biocides against a broad range of organisms. It is primarily used as an antifoulant paint additive on ship and boat hulls, docks, fishnets, and buoys to discourage the growth of marine organisms such as barnacles, bacteria, mussels and algae. An EU ban on the presence of TBT-based antifoulings on ships hulls in EU ports came into effect on 1st January 2008.

Voe: a long and narrow sea inlet usually with steep sides, similar to a firth.

Appendices

Appendix 1

List of SPAs in the Shetland Islands Marine Region with a marine component

Site Name	Designation	Condition of marine species
Fair Isle	Important breeding ground for seabirds Endemic wren species	Unfavourable N/A
Foula	Important breeding ground for wide range of bird species One of seven UK breeding grounds of Leach's petrel	Unfavourable
Mousa	Important breeding ground for seabirds, notably storm petrels and arctic terns	Unfavourable
Sumburgh Head	Important breeding site for seabirds	Unfavourable
Noss	Important cliffs for nesting seabirds Important moorland for great skua breeding	Unfavourable
Papa Stour	Important breeding ground for arctic tern and ringed plover	Unfavourable
Ronas Hill – North Roe and Tingon	Important breeding ground for red-throated diver, great skua and merlin	Favourable N/A
Ramma Stacks & Gruney	Important breeding ground for seabirds One of seven UK breeding grounds of Leach's petrel	Favourable
Otterswick & Graveland	Site of European importance as a breeding area for red-throated diver	Favourable
Fetlar	Important breeding grounds for northern waders and seabirds	Unfavourable
Hermaness, Saxa Vord & Valla Field	Important breeding grounds for a red-throated diver and a number of seabird species	Unfavourable

List of SACs in the Shetland Islands Marine Region with a marine component

Site	Designation	Condition of marine habitats or species
Fair Isle	Primary- Vegetated sea cliffs of the Atlantic and Baltic coasts Additional qualifying feature(s)- European dry heaths	Favourable maintained N/A
Mousa	Primary- Harbour seals Additional qualifying feature(s)- Reefs Submerged or partially submerged sea caves	Unfavourable declining Favourable maintained Favourable maintained
Hascosay	Primary- Blanket bog Additional qualifying feature(s)- Otter	N/A Unfavourable declining
Papa Stour	Reefs Submerged or partially submerged sea caves	Favourable maintained Favourable maintained
Sullom Voe	Large Inlets and Bays Additional qualifying feature(s)- Coastal lagoons Reefs	Favourable maintained Favourable maintained Favourable maintained
The Vadills	Primary- Coastal Lagoons	Favourable maintained
Yell Sound Coast	Primary- Otter Harbour seal	Unfavourable declining Unfavourable declining

List of Nature Conservation Marine Protected Areas in the Shetland Islands Marine Region

Name	Features Biodiversity	Features Geodiversity
Fetlar to Haroldswick	Black guillemot Circalittoral sand and coarse sediment communities Horse mussel beds Kelp and seaweed communities on sublittoral sediment Maerl beds Shallow tide-swept coarse sands with burrowing bivalves	Marine Geomorphology of the Scottish Shelf Seabed
Mousa to Boddam	Sandeels	Marine Geomorphology of the Scottish Shelf Seabed

List of Demonstration and Research Marine Protected Areas in the Shetland Islands Marine Region

Name	Reason
Fair Isle	Economic/ community demonstration

List of Historic Marine Protected Areas in the Shetland Islands Marine Region

Name	Reason
Out Skerries	Wrecks: Kennemerland Wrangler Palais

List of SSSI's in the Shetland Islands Marine Region with marine and coastal features, non-marine features within these SSSIs are shown in italics

Site	Type	Features	Condition of marine habitats or species
Balta	Geological	Coastal Geomorphology of Scotland	Favourable maintained
Breckon	Biological	Sand dunes	Favourable maintained
		Machair	Favourable maintained
		Maritime cliff	Unfavourable declining
		Eutrophic loch	*Favourable maintained*
		Bog orchid (*Hammarbya paludosa*)	*Favourable maintained*
Crussa Field & the Heogs	Biological	Breeding bird assemblage	Favourable maintained
		Arctic skua	Unfavourable declining
		Whimbrel	*Unfavourable declining*
		Calaminarian grassland and serpentine heath	*Favourable maintained*
		Mineralogy of Scotland	Favourable maintained
		Vascular plant assemblage	*Unfavourable recovering*
Dales Voe	Biological	Saltmarsh	Favourable maintained
Dalsetter	Biological	Arctic tern	Unfavourable declining
		Subalpine dry heath	*Favourable maintained*
Easter Rova Head	Geological	Non-marine Devonian	Favourable maintained
Eshaness Coast	Geological	Old Red Sandstone Igneous	Favourable maintained
Fair Isle	Mixed	Kittiwake breeding	Unfavourable declining
		Arctic skua breeding	Favourable maintained
		Guillemot breeding	Favourable maintained
		Shag breeding	Unfavourable declining
		Great skua breeding	Favourable maintained
		Seabird colony, breeding	Favourable maintained
		Fulmar breeding	Favourable maintained
		Razorbill breeding	Favourable maintained
		Moorland juniper	Favourable maintained
		Palaeozoic Palaeobotany	*Favourable maintained*
Fidlar Geo to Watsness	Geological	Non-marine Devonian	Favourable maintained

Foula	Biological	Shag breeding	Unfavourable declining
		Fulmar breeding	Unfavourable declining
		Great skua breeding	Unfavourable declining
		Arctic skua breeding	Unfavourable declining
		Puffin breeding	Unfavourable declining
		Kittiwake breeding	Unfavourable declining
		Guillemot (*Uria aalge)*, breeding	Unfavourable declining
		Leach's petrel breeding	Unfavourable declining
		Blanket bog	*Favourable maintained*
		Storm petrel breeding	Unfavourable declining
Foula Coast	Geological	Coastal Geomorphology of Scotland	Favourable maintained
Fugla Ness – North Roe	Geological	Quaternary of Scotland	Favourable maintained
Funzie	Geological	Caledonian Structures	Favourable maintained
Gutcher	Geological	Moine	Favourable maintained
Ham Ness	Geological	Ordovician Igneous	Favourable maintained
Hascosay	Mixed	Moine	Favourable maintained
		Blanket bog	*Favourable maintained*
		Dunlin breeding	*Favourable maintained*
Hermaness	Biological	Great skua breeding	Favourable maintained
		Mineralogy of Scotland	Favourable maintained
		Fulmar breeding	Unfavourable declining
		Guillemot breeding	Unfavourable declining
		Gannet breeding	Favourable maintained
		Puffin breeding	Favourable maintained
		Seabird colony, breeding	Unfavourable declining
Hill of Colvadale & Sobul	Biological	*Arctic sandwort*	*Favourable maintained*
		Whimbrel breeding	*Unfavourable declining*
		Breeding bird assemblage	Favourable maintained
		Calaminarian grassland and serpentine heath	*Favourable maintained*
		Arctic skua breeding	Favourable maintained
Lamb Hoga	Biological	Breeding bird assemblage	Favourable maintained
		Storm petrel breeding	Favourable maintained
		Manx shearwater breeding	Favourable maintained
		Great skua breeding	Favourable maintained
		Arctic skua breeding	Unfavourable declining
Lunda Wick	Geological	Mineralogy of Scotland	Favourable maintained

Melby	Geological	Silurian - Devonian Chordata	Favourable maintained
Mousa	Biological	Harbour seal	Unfavourable declining
		Storm petrel breeding	Favourable maintained
		Black guillemot breeding	Unfavourable no change
		Arctic tern breeding	Unfavourable no change
Ness of Clousta – The Brigs	Geological	Old Red Sandstone Igneous	Favourable maintained
Ness of Cullivoe	Geological	Moine	Favourable maintained
North Fetlar	Biological	*Calaminarian grassland and serpentine heath*	*Favourable maintained*
		Arctic tern breeding	Unfavourable declining
		Grey seal	Unfavourable no change
		Breeding bird assemblage	Favourable maintained
		Harbour seal	Unfavourable declining
		Red-necked phalarope breeding	Favourable recovered
		Whimbrel breeding	*Unfavourable declining*
		Great skua breeding	*Favourable*
		Arctic skua breeding	Maintained
			Favourable recovered
North Sandwick	Geological	Moine	Favourable maintained
Norwick	Geological	Caledonian Structures	Favourable maintained
Norwick Meadows	Biological	Sand dunes	Unfavourable recovering
		Valley fen	*Unfavourable no change*
Noss	Biological	Great skua	Favourable maintained
		Gannet	Favourable maintained
		Kittiwake	Unfavourable declining
		Guillemot	Unfavourable declining
		Seabird colony, breeding	Favourable maintained
		Arctic skua	Unfavourable declining
Papa Stour	Mixed	Silurian - Devonian Chordata	Favourable maintained
		Coastal Geomorphology of Scotland	Favourable maintained
		Arctic skua breeding	Unfavourable declining
		Arctic tern breeding	Unfavourable declining
		Ringed plover breeding	*Favourable maintained*
		Rocky shore	Favourable maintained
		Maritime cliff	Unfavourable declining
Pool of Virkie	Biological	Mudflats	Favourable maintained

Quendale	Biological	Machair Sand dunes *Machair loch*	Unfavourable declining Unfavourable declining *Unfavourable declining*
Qui Ness to Pund Stacks	Geological	Ordovician Igneous	Favourable maintained
Ramna Stacks & Gruney	Biological	Guillemot breeding Seabird colony, breeding Leach's petrel breeding	Unfavourable declining Unfavourable declining Favourable maintained
Sandness Coast	Biological	Rocky shore	Favourable maintained
Saxa Vord	Biological	Fulmar breeding Seabird colony, breeding Guillemot breeding	Favourable declining Favourable maintained Unfavourable declining
Skelda Ness	Geological	Mineralogy of Scotland	Favourable maintained
Skeo Taing to Clugan	Geological	Ordovician Igneous	Favourable maintained
South Whiteness	Biological	Saltmarsh *Shetland mouse-ear-hawkweed*	Favourable maintained *Favourable maintained*
St Ninian's Tombolo	Geological	Coastal Geomorphology of Scotland	Favourable maintained
Sumburgh Head	Biological	Puffin breeding Shag breeding Guillemot breeding Silurian - Devonian Chordata Seabird colony, breeding	Unfavourable recovering Unfavourable recovering Unfavourable declining Favourable maintained Favourable maintained
The Ayres of Swinister	Geological	Coastal Geomorphology of Scotland	Favourable maintained
The Clefts, Exnaboe	Geological	Silurian - Devonian Chordata Non-marine Devonian	Favourable maintained Favourable maintained
The Punds of Wick of Hagdale	Geological	Ordovician Igneous	Favourable maintained
The Vadills	Biological	*Ascophyllum nodosum ecad mackaii* Tidal rapids Saline lagoon	Favourable maintained Favourable maintained Favourable maintained
Tressa Ness to Colbinsoft	Geological	Ordovician Igneous	Favourable maintained

Trona Mires	Biological	*Basin fen*	*Favourable Maintained*
		Maritime cliff	Favourable maintained
		Arctic tern breeding	Unfavourable declining
		Red-necked phalarope breeding	*Unfavourable no change*
		Breeding bird assemblage	Favourable maintained
Uyea – North Roe Coast	Geological	Moine	Favourable maintained
Vella Field	Biological	Great skua	Favourable maintained
		Red-throated diver breeding	Favourable maintained
		Mineralogy of Scotland	Favourable maintained
Villains of Hamnavoe	Geological	Coastal Geomorphology of Scotland	Favourable maintained
Virva	Geological	Ordovician Igneous	Favourable maintained
Voxter Voe & Valayre Quarry	Geological	Moine	Favourable maintained
Ward of Culswick	Biological	Arctic skua breeding	Unfavourable declining
		Whimbrel breeding	*Unfavourable declining*
Yell Sound Coast	Biological	Otter	Unfavourable declining

List of known Priority Marine Features in the Shetland Islands Marine Region

	Habitats
1	Blue mussel beds
2	Burrowed mud
3	Cold-water coral reefs
4	Deep sea sponge aggregations
5	Horse mussel beds
6	Intertidal mudflats
7	Kelp and seaweed communities on sublittoral sediment
8	Kelp beds
9	Low or variable salinity habitats
10	Maerl beds
11	Maerl coarse shell gravel with burrowing sea cucumbers
12	Native oysters
13	Northern sea fan and sponge communities
14	Seagrass beds
15	Sea loch egg wrack beds
16	Tide-swept algal communities
17	Tide-swept coarse sands with burrowing bivalves
	Species
18	Burrowing sea anemone
19	White cluster anemone
20	Northern feather star
21	Fan mussel
22	Ocean quahog

23	European spiny lobster
24	Eel
25	Atlantic salmon
28	Sea trout
29	Anglerfish
30	Atlantic herring
31	Cod
32	Saithe
33	Whiting
34	Ling
35	Norway pout
36	Sand goby
37	Sand eels
38	Basking shark
39	Common skate
40	Spiny dogfish
41	Bottle nose dolphin
42	Harbour porpoise
43	Killer whale
44	Minke whale
45	Risso's dolphin
46	Short-beaked common dolphin
47	White-beaked dolphin
48	Harbour/common seal
49	Grey seal
50	Otter

Local Nature Conservation sites in the Shetland Marine Region

Site No.	Site Name	Primary Interest
1	Scousburgh Beach	Habitat
2	Scatness	Geology
3	Burn of Laxdale	Species
4	Loch of Voe	Species
5	Boddam Voe	Species
6	Burn of Ukinsetter, Ockraquoy	Species
7	Levenwick Marshes	Species
8	Burn of Northdale	Species
9	Long Ayre & The Wadill, Urafirth	Species
10	Ollaberry Meadow	Habitat
11	Semblister	Species
12	Baltasound	Species
13	Burn of Mailand	Species
14	Haroldswick Mires	Species
15	Loch of Bordastubble & Stourhoull	Species
16	Skeo Taing	Habitat
17	Burn of Setter	Species
18	Voe of Snarraness	Species
19	West Burrafirth	Species
20	Clickimin Loch	Habitat
21	Loch of Kirkabister	Species
22	Leebitten Intertidal	Habitat
23	Kettlaness	Species
24	Ladies Hole	Species
25	Stenness	Geology
26	Wick of Skaw	Geology
27	Belmont Quarry	Geology
28	West Sandwick	Habitat
29	Haggrister Quarry	Geology
30	Meal Beach	Species
31	Rerwick Reed Bed, Clavel	Habitat
32	Lang Lochs	Habitat
33	Loch of Benston	Species
34	Burn of Twa Roes	Species
35	Glums Meadow	Habitat
36	Bousta Cliffs	Species
37	Loch & Mires of Funzie	Species
38	Kergord	Habitat
39	Voxter Wood	Habitat
40	Tingwall Meadow	Habitat
41	Bordigarth	Species
42	Skuron	Species
43	Catfirth	Species
44	Gunna Water	Species
45	Catpund	Geology
46	Maggie Kettle's Loch	Geology
47	South Bright Rova Head	Geology
48	Clibberswick Cross Geo	Geology
49	Hill of Clibberswick	Species

List of nature reserves in the Shetland Islands Marine Region

Reserve Name	Protection	Site Area (ha)
Hermaness	NNR	978.2
Noss	NNR	343.8
Yell	RSPB Bird Reserve	1868.5
Mousa	RSPB Bird Reserve	197.3
Loch of Spiggie	RSPB Bird Reserve	114.8
Fetlar	RSPB Bird Reserve	50.3
Sumburgh Head	RSPB Bird Reserve	17.8
Ramna Stacks & Gruney	RSPB Bird Reserve	11.8

Name	Status	Name	Status
Hermaness	SSSI	Virdins Quarry	NA
Wick of Skaw	LNCS	Grut Wick Quarry	NA
Norwick	SSSI, GCR	Kirkhouse Quarry & Burn of Kirkhouse	NA
Tonga - Greff	SSSI, GCR	Burn of Lunklet	NA
Queyhouse Talc Quarry	SSSI, GCR	Ward of Tumblin quarry	NA
Clibberswick & Cross Geo	LNCS	Scord Of Sound, Weisdale	NA
The Punds to Wick of Hagdale	SSSI, GCR	Wormadale	NA
Dale of Woodwick	NA	Easter Rova Head	SSSI, GCR
Wick of Hagdale	SSSI, GCR	South Bight of Rova Head	LNCS
Nikka Vord Chromite Quarries	SSSI, GCR	Scord of Scalloway	NA
Hagdale Chromite Quarry & Horse Mill	SSSI, GCR	Ness of Clousta to the Brigs	SSSI, GCR
Keen of Hamar	SSSI	Melby	SSSI, GCR
Skeo Taing to Clugan	SSSI, GCR	Sel Ayre	SSSI, GCR
Balta Island	SSSI, GCR	Scord of Brouster	NA
Watlee Burn & Sobul	NA	Fidlar Geo to Watsness	SSSI, GCR
Lunda Wick	SSSI, GCR	Stanydale Temple	NA
Qui Ness to Punds Stack	SSSI, GCR	Skelda Ness	SSSI, GCR
Ham Ness	SSSI, GCR	Clickimin Broch	NA
Belmont Quarry	LNCS	East Voe of Quarff	NA
Tressa Ness to Colbinstoft	SSSI, GCR	Fladdabister	NA
Virva	SSSI, GCR	Burn of Aith	SSSI, GCR
Bay of Funzie	NA	Mail, Cunningsburgh	NA
Ness of Funzie	SSSI	Catpund	GCR LNCS
Breckon	SSSI	Taing of Maywick	NA
Gloup Voe & West-a-Firth	NA	St Ninian’s Isle Tombolo	SSSI, GCR
Ness of Cullivoe	SSSI	Bay of Scousburgh	NA
Gutcher	SSSI, GCR	Peerie Beach, Spiggie	NA
North Sandwick	SSSI, GCR	Dalsetter	NA
West Sandwick	NA	The Cletts, Exnaboe	SSSI, GCR
Ness of Sound	NA	Garths Ness	GCR
Hascosay	SSSI, GCR	Old Scatness	NA
Fethaland	SSSI, GCR	Jarlshof	NA
Uyea to North Roe Coast	SSSI, GCR	Ness of Burgi	LNCS
Fugla Ness	SSSI, GCR	Sumburgh Head	SSSI, GCR
Beorgs of Uyea stone axe factories	NA	Papa Stour Coast	SSSI, GCR
Brig of Collafirth	NA	Papa Stour Fishbed	SSSI, ?GCR
Collafirth Hill & Ronas Hill	SSSI	Foula Coast	SSSI, GCR
Villians of Hamnavoe	SSSI, GCR	Hildasay Granite Quarry	NA
The Blade, Ronas Voe	NA	Bressay Flagstone quarries	NA
Back of Ollaberry	NA	Muckle Hell Vent, Bressay	NA
Grind O’ Da Navir	SSSI	Mousa	NA

Braewick Beach	NA	Fair Isle	NA
Eshaness Coast	SSSI, GCR	Sloagar, Fair Isle	SSSI, GCR
Stenness	LNCS	Haggrister Quarry	LNCS
The Drongs & Isle of Westerhouse, Saint Magnus Bay	NA	Hill of Lee Quarry	NA
Maggie Kettles Loch	LNCS	Nibon	NA
Quoys of Garth, Garths Voe	SSSI, GCR	Laxo	NA
Clothister Hill Quarry	SSSI, GCR	Zoar quarry (Heads of Groken)	NA
Houb of Scatsta	NA	Basta Voe	NA
Ayres of Swinister	SSSI, GCR	Westerwick	NA
Valayre Quarry and Burn of Valayre	SSSI, GCR	Ell Wick	NA
Dales Voe	NA	Lumbister	NA

Appendix 2

Shetland Islands Marine Planning Partnership Advisory Group Membership

Delegate:
Shetland Islands Council (Chair)
NAFC Marine Centre UHI (Vice-chair)

Members:
Environment
Scottish Environment Protection Agency (SEPA)
Scottish Natural Heritage (SNH)
Shetland Amenity Trust (SAT)
Royal Society for the Protection of Birds (RSPB)

Commercial
Shetland Fishermen's Association (SFA)
Shetland Shellfish Management Organisation (SSMO)
Seafood Shetland
Scottish Salmon Producers Organisation (SSPO)
Shetland Islands Council Port and harbours
BP

Community
Shetland Islands Council Development Planning
Community Council Chair
Community Planning

Recreation
Visit Shetland

Interest Groups:
Shetland River Basin Management Planning Advisory Group
Shetland Oil Terminal Environmental Advisory Group (SOTEAG)
Shetland Islands Council Heritage Officer
Lerwick Port Authority (LPA)
Fair Isle Demonstration and Research MPA representative

MASTS review participants

Martyn Cox, Marine Scotland - co-ordinating the review process
Rachel Shucksmith, NAFC Marine Centre UHI- representing the Shetland Marine Planning Partnership
Fiona Mills, representing the Clyde Marine Planning Partnership
Sinead Sheridan, representing the Clyde Marine Planning Partnership

Lucy Greenhill, Scottish Association Marine Sciences (MASTS MSP convenor)
Dr Chris Leakey, SNH (MASTS MSP vice-convenor)

Dr David Green, University of Aberdeen
Dr Matthew Gubbins, Marine Scotland Science
Dr Tavis Potts, University of Aberdeen
Dr Paul Tett, Scottish Association Marine Sciences
Dr Jacqueline Tweddle, University of Aberdeen
Dr Tim Stojanovic, University of St Andrews