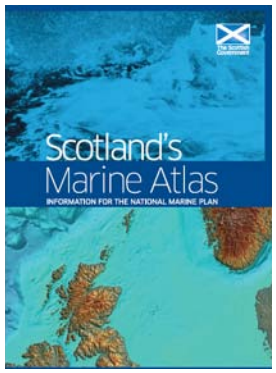

Scotland's Marine Atlas

The Scottish Government

Martyn Cox

ICAN 5 Workshop
"Coastal Atlases as Engines for Coastal & Marine Spatial Planning"
31st August 2011

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Structure of talk

- Why we prepared the Atlas?
- How the Atlas was prepared
- What's in the Atlas?
- What's available on-line?
- National Marine Plan interactive?
- Conclusions - Next steps

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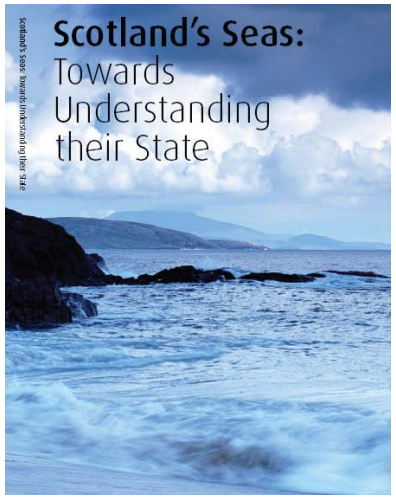
Why we prepared the Atlas?



2008

Marine (Scotland) Act 2010

2010 asp 5

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Section

PART 1

THE SCOTTISH MARINE AREA

1 The "Scottish marine area"
2 "Sea"

PART 2

GENERAL DUTIES

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4 Mitigation of and adaptation to climate change

PART 3

MARINE PLANNING

Marine plans

5 National marine plan and regional marine plans
6 Conformity of marine plans with other documents
7 Coming into effect of marine plans
8 Amendment of marine plans
9 Withdrawal of marine plans
10 Effect of withdrawal from or of marine policy statement or of national marine plan
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Delegation of functions relating to regional marine plans

12 Delegation of functions relating to regional marine plans
13 Directions under section 12: supplementary provision
14 Directions to delegates as regards performance of designated functions

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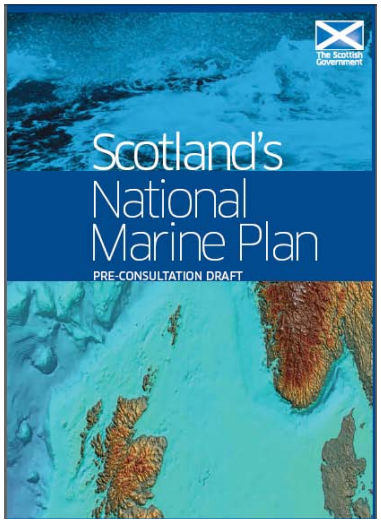
15 Decisions of public authorities affected by marine plans

2010



2011/12

MSFD
Initial
Assessments
due 2012

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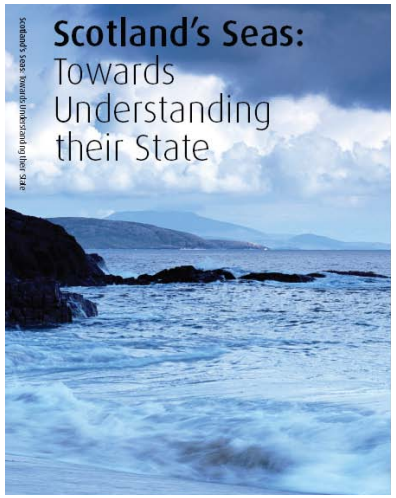
How the Atlas was prepared



Structure

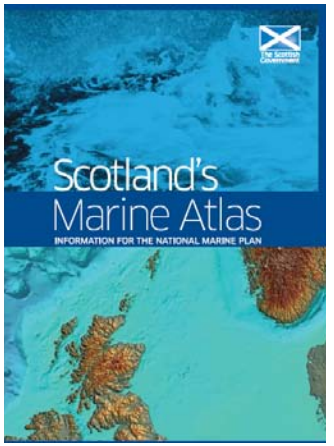
+

Scottish data

+

- Additional Scottish data & colour
- Sub-division of CP2 sea areas

=



Steering Group

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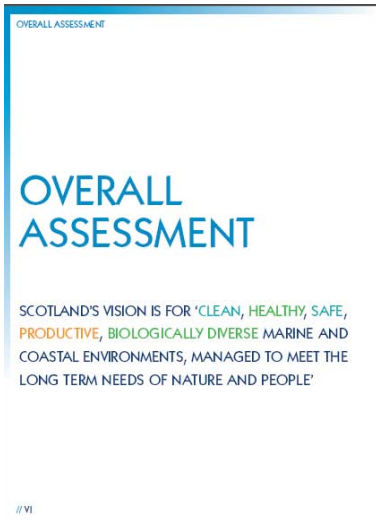
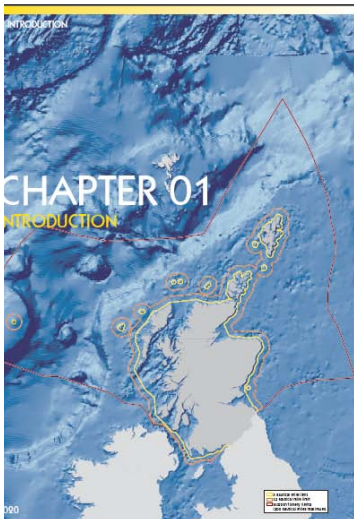
SEPA
Scottish Environment Protection Agency

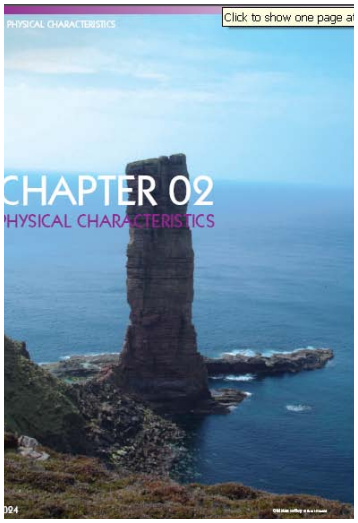
Scottish Natural Heritage
Dualchas Nàdair na h-Alba
All of nature for all of Scotland
Nàdar air fad airson Alba air fad

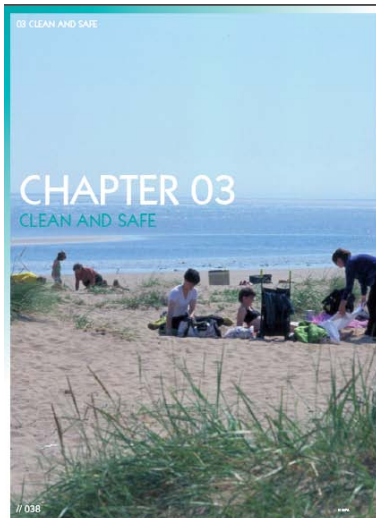
JNCC
Joint Nature Conservation Committee

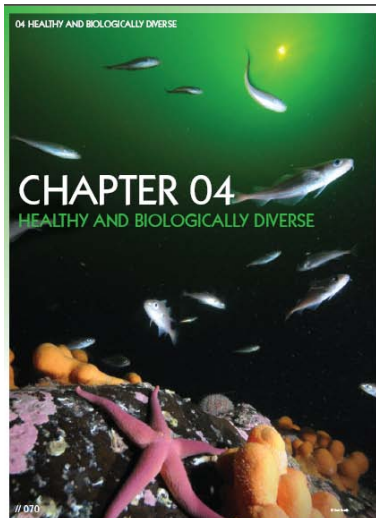
What's in the Atlas?

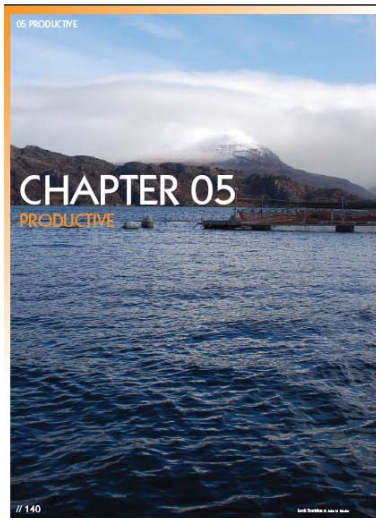


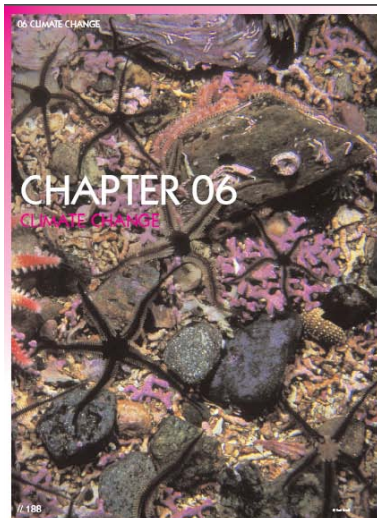












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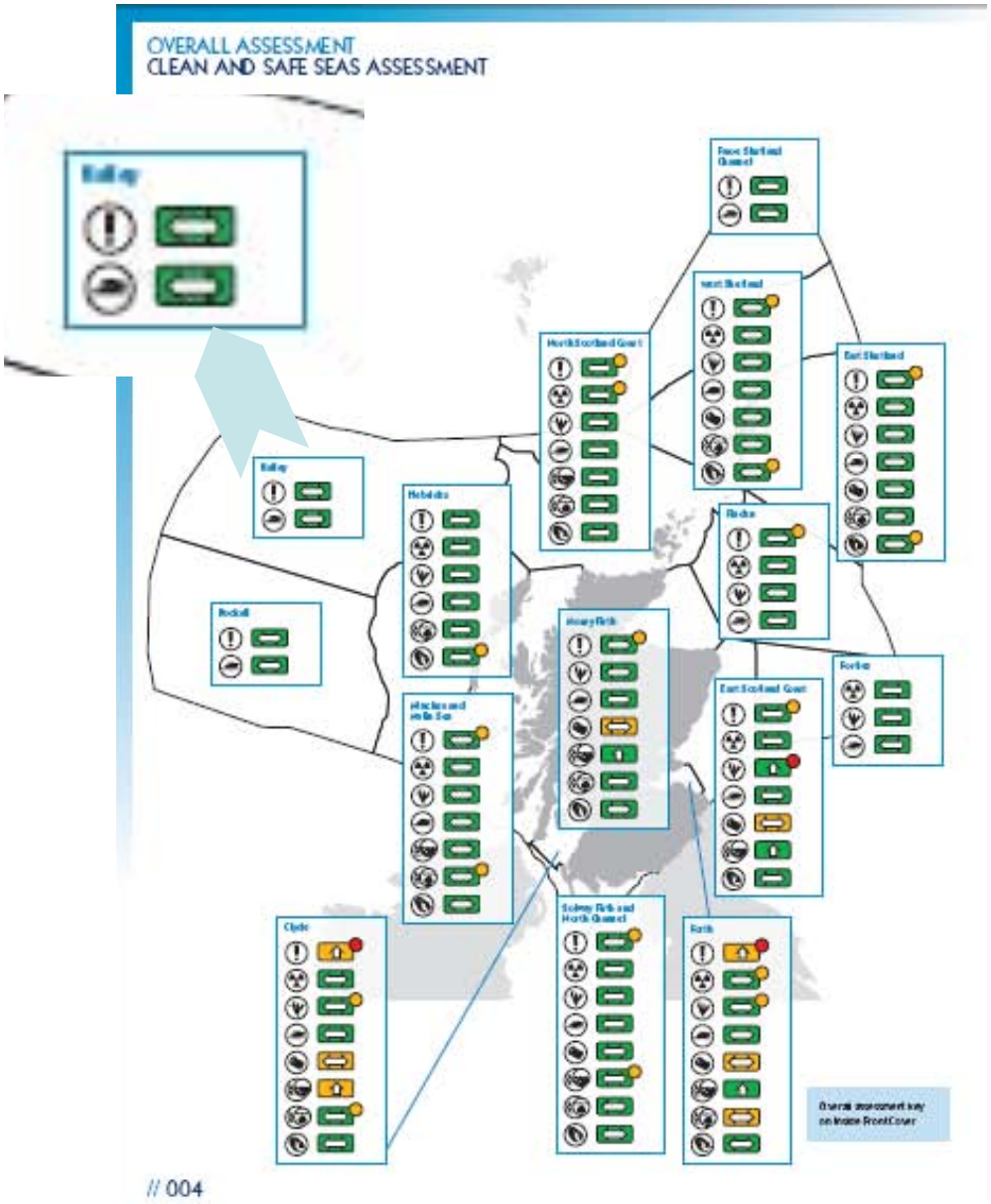
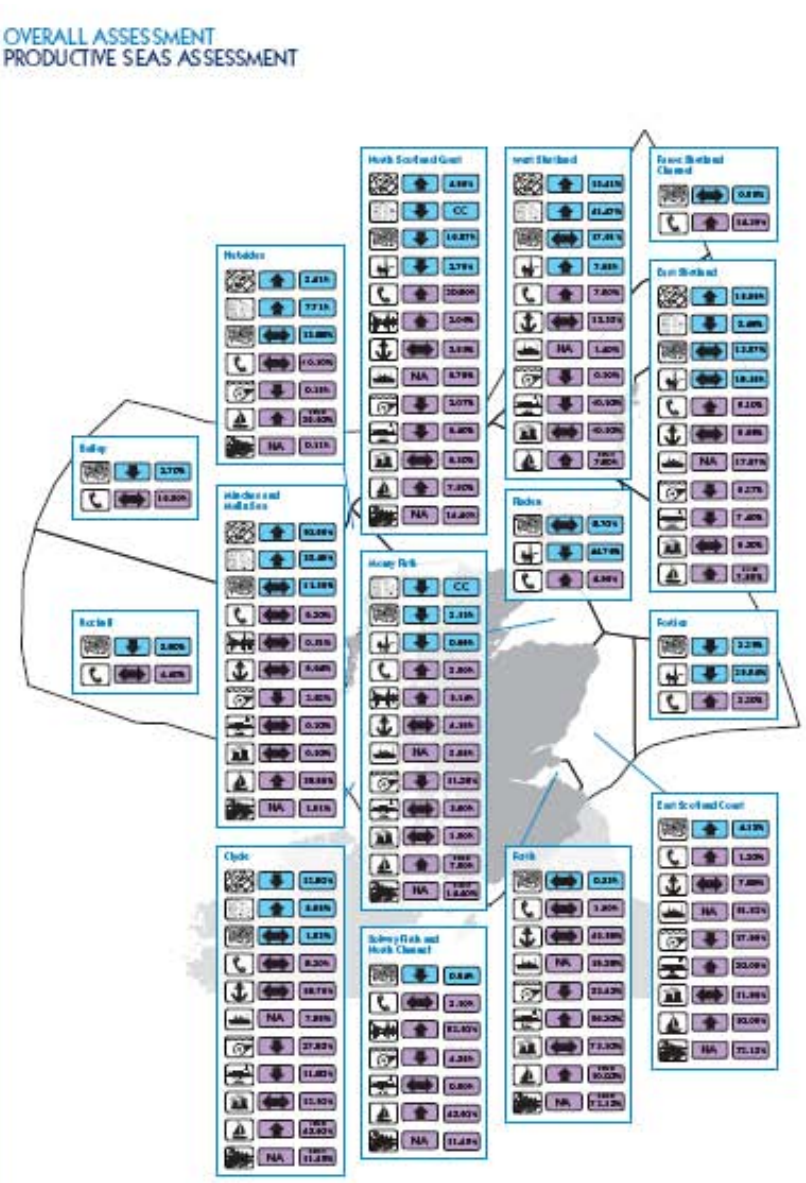
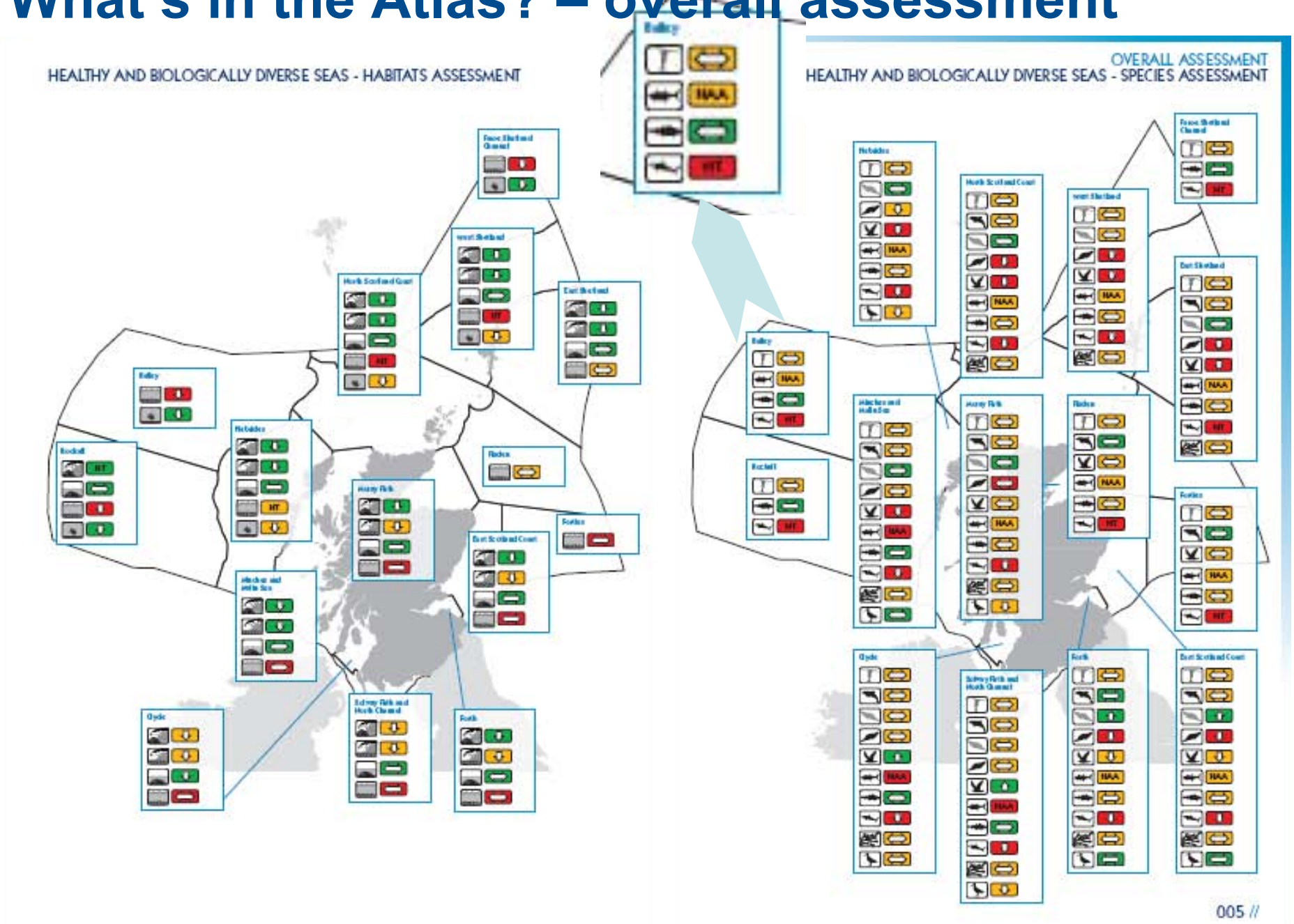
What's in the Atlas? – overall assessment

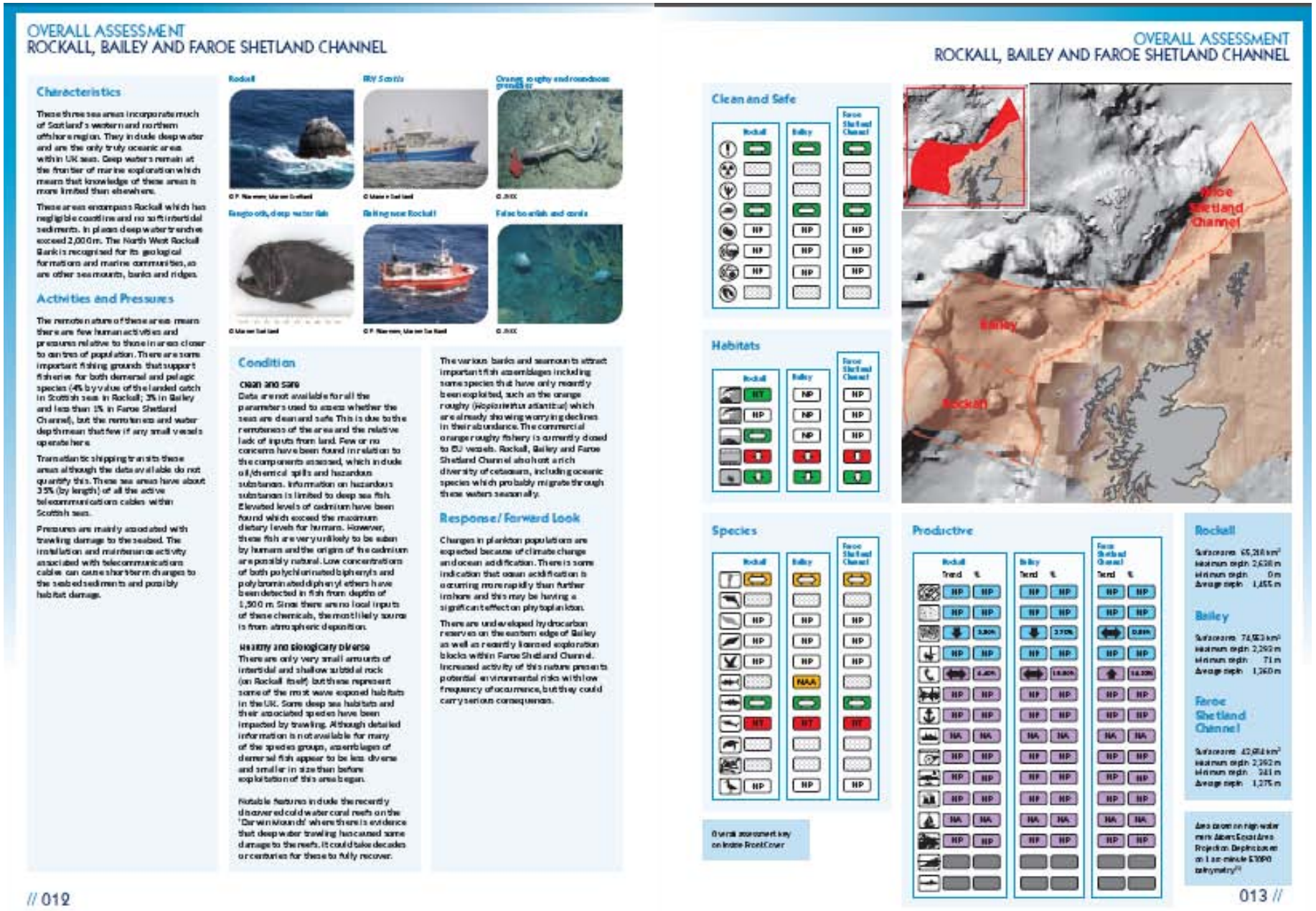




What's in the Atlas? – overall assessment



What's in the Atlas? – sea area assessment



OVERALL ASSESSMENT
ROCKALL, BAILEY AND FAROE SHETLAND CHANNEL

Characteristics

These three sea areas incorporate much of Scotland's western and northern offshore region. They include deep water and are the only truly oceanic areas within UK seas. Deep waters remain at the frontier of marine exploration which means that knowledge of these areas is more limited than elsewhere.

These areas encompass Rockall which has negligible coastline and no soft intertidal sediments. In places deep water trenches exceed 2,000 m. The North West Rockall Bank is recognised for its geological formations and marine communities, as are other seamounts, banks and ridges.

Activities and Pressures

The remote nature of these areas means there are few human activities and pressures relative to those in areas closer to centres of population. There are some important fishing grounds that support fisheries for both demersal and pelagic species (4% by value of the landed catch in Scottish seas in Rockall; 3% in Bailey and less than 1% in Faroe Shetland Channel), but the remoteness and water depth mean that few if any small vessels operate here.

Transatlantic shipping transits these areas although the data available do not quantify this. These sea areas have about 35% (by length) of all the active telecommunications cables within Scottish seas.

Pressures are mainly associated with trawling damage to the seabed. The installation and maintenance activity associated with telecommunications cables can cause short-term changes to the seabed sediments and possibly habitat damage.

Rockall

RV Scotia

Orange roughy and roundnose grenadier

Rougheye rockfish, deep water fish

Fishing near Rockall

False boarfish and corals

Condition

Clean and Safe

Data are not available for all the parameters used to assess whether the seas are clean and safe. This is due to the remoteness of the area and the relative lack of inputs from land. Few or no concerns have been found in relation to the components assessed, which include oil/chemical spills and hazardous substances. Information on hazardous substances is limited to deep sea fish. Elevated levels of cadmium have been found which exceed the maximum dietary levels for humans. However, these fish are very unlikely to be eaten by humans and the origin of the cadmium are possibly natural. Low concentrations of both polychlorinated biphenyls and polybrominated diphenyl ethers have been detected in fish from depths of 1,500 m. Since there are no local inputs of these chemicals, the most likely source is from atmospheric deposition.

Healthy and Biologically Diverse

There are only very small amounts of intertidal and shallow subtidal rock (on Rockall itself), but these represent some of the most wave exposed habitats in the UK. Some deep sea habitats and their associated species have been impacted by trawling. Although detailed information is not available for many of the species groups, assemblages of demersal fish appear to be less diverse and smaller in size than before exploitation of this area began.

Notable features include the recently discovered cold water coral reefs on the 'Darwin Mounds' where there is evidence that deep water trawling has caused some damage to the reefs. It could take decades or centuries for these to fully recover.

The various banks and seamounts attract important fish assemblages including some species that have only recently been exploited, such as the orange roughy (*Hoplostethus atlanticus*) which are already showing worrying declines in their abundance. The commercial orange roughy fishery is currently closed to EU vessels. Rockall, Bailey and Faroe Shetland Channel also host a rich diversity of cetaceans, including oceanic species which probably migrate through these waters seasonally.

Response / Forward Look

Changes in plankton populations are expected because of climate change and ocean acidification. There is some indication that ocean acidification is occurring more rapidly than further inshore and this may be having a significant effect on phytoplankton.

There are undeveloped hydrocarbon reserves on the eastern edge of Bailey as well as recently licensed exploration blocks within Faroe Shetland Channel. Increased activity of this nature presents potential environmental risks with low frequency of occurrence, but they could carry serious consequences.

OVERALL ASSESSMENT
ROCKALL, BAILEY AND FAROE SHETLAND CHANNEL

Clean and Safe

Habitats

Species

Overall assessment key on Inside Front Cover

Productive

Rockall

Surface area: 65,200 km²
Maximum depth: 2,630 m
Minimum depth: 0 m
Average depth: 1,455 m

Bailey

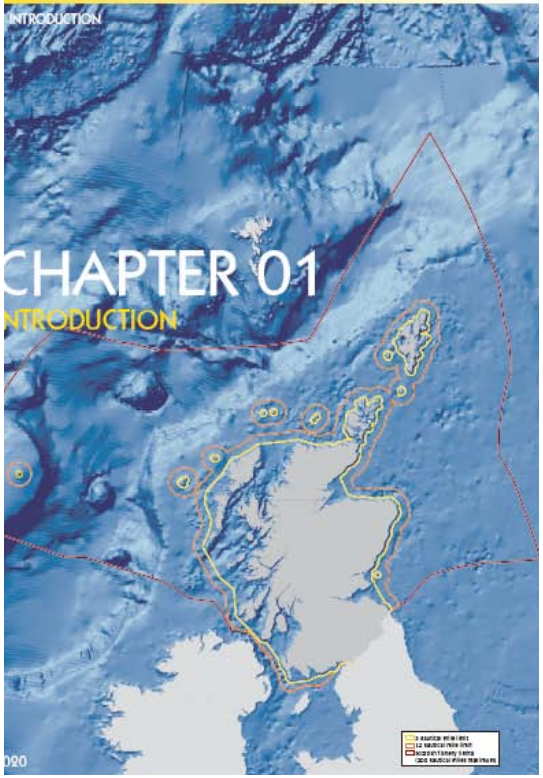
Surface area: 74,553 km²
Maximum depth: 2,292 m
Minimum depth: 71 m
Average depth: 1,260 m

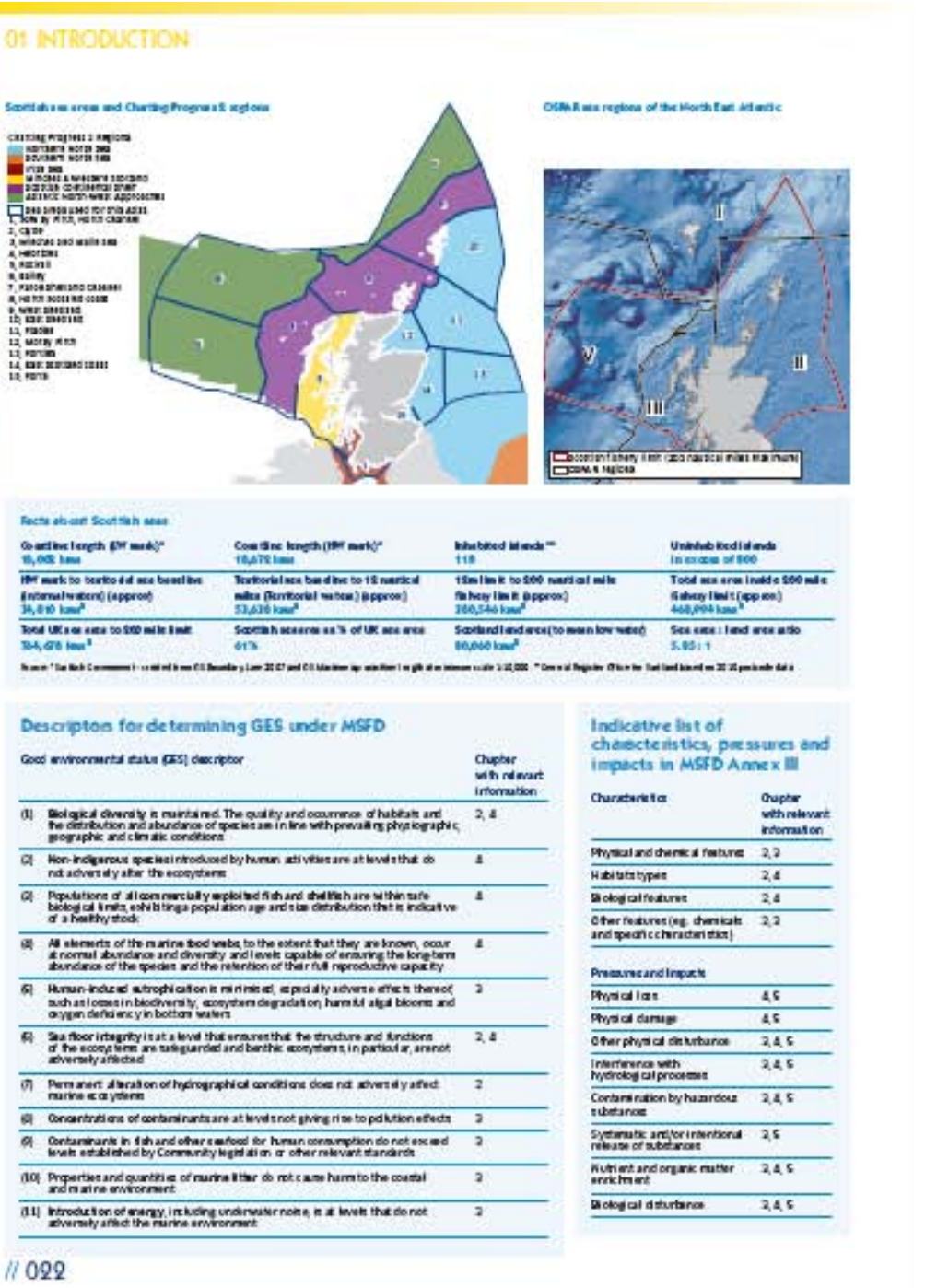
Faroe Shetland Channel

Surface area: 42,614 km²
Maximum depth: 2,292 m
Minimum depth: 161 m
Average depth: 1,275 m

Area based on high water mark. Albers Equal Area Projection. Depths based on 1 arc-minute ETOPO bathymetry[1]

What's in the Atlas?




01 INTRODUCTION

Scottish sea areas and Charting Progress 2 regions

OSPAR sea regions of the North East Atlantic

Facts about Scottish seas

Coastline length (HW mark)*	Coastline length (HW mark)*	Inhabited islands**	Uninhabited islands
16,000 kms	18,670 kms	118	in excess of 800
HW mark to territorial sea baseline (internal waters) (approx)	Territorial sea baseline to 12 nautical miles (territorial waters) (approx)	12nm limit to 200 nautical mile fishery limit (approx)	Total sea area inside 200 mile fishery limit (approx)
36,810 kms²	53,630 kms²	260,546 kms²	460,094 kms²
Total UK sea area to 200 mile limit	Scottish seas as % of UK sea area	Scotland land area (to mean low water)	Sea area : land area ratio
764,678 kms²	61%	80,060 kms²	5.85 : 1

Descriptors for determining GES under MSFD

Good environmental status (GES) descriptor		Chapter with relevant information
(1)	Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions	2, 4
(2)	Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems	4
(3)	Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock	4
(4)	All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity	4
(5)	Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algal blooms and oxygen deficiency in bottom waters	3
(6)	Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected	2, 4
(7)	Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems	2
(8)	Concentrations of contaminants are at levels not giving rise to pollution effects	3
(9)	Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards	3
(10)	Properties and quantities of marine litter do not cause harm to the coastal and marine environment	3
(11)	Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment	3

Indicative list of characteristics, pressures and impacts in MSFD Annex III

Characteristics	Chapter with relevant information
Physical and chemical features	2, 3
Habitats types	2, 4
Biological features	2, 4
Other features (eg. chemicals and specific characteristics)	2, 3
Pressures and Impacts	
Physical loss	4, 5
Physical damage	4, 5
Other physical disturbance	3, 4, 5
Interference with hydrological processes	3, 4, 5
Contamination by hazardous substances	3, 4, 5
Systematic and/or intentional release of substances	3, 5
Nutrient and organic matter enrichment	3, 4, 5
Biological disturbance	3, 4, 5

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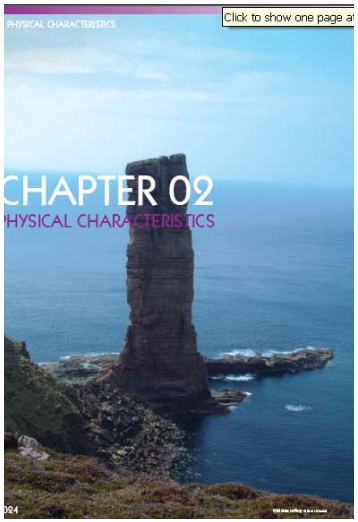
What's in the Atlas? Chapter 2



- The Scottish Scene
- Weather and Climatic Conditions
- Currents and Circulation
- Temperature, Salinity and Ocean Acidification
- Waves and Sea Level

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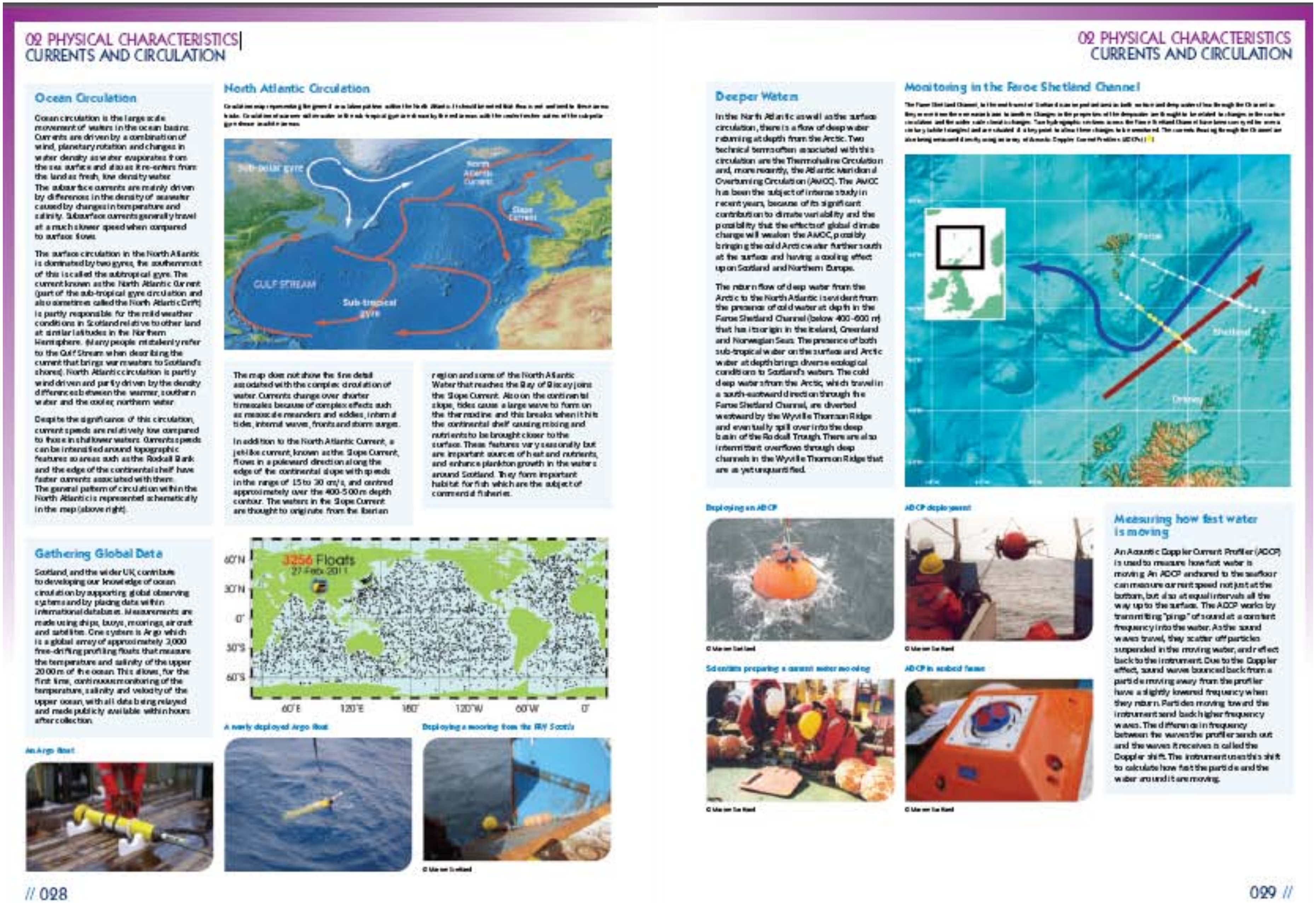
What's in the Atlas? Chapter 2



02 PHYSICAL CHARACTERISTICS | CURRENTS AND CIRCULATION

Ocean Circulation

Ocean circulation is the large scale movement of waters in the ocean basins. Currents are driven by a combination of wind, planetary rotation and changes in water density as water evaporates from the sea surface and also as it re-enters from the land as fresh, low density water. The subsurface currents are mainly driven by differences in the density of seawater caused by changes in temperature and salinity. Subsurface currents generally travel at a much slower speed when compared to surface flows.

The surface circulation in the North Atlantic is dominated by two gyres, the southernmost of this is called the subtropical gyre. The current known as the North Atlantic Current (part of the sub-tropical gyre circulation and also sometimes called the North Atlantic Drift) is partly responsible for the mild weather conditions in Scotland relative to other land at similar latitudes in the Northern Hemisphere. (Many people mistakenly refer to the Gulf Stream when describing the current that brings warm waters to Scotland's shores). North Atlantic circulation is partly wind driven and partly driven by the density differences between the warmer, southern water and the cooler, northern water.

Despite the significance of this circulation, current speeds are relatively low compared to those in shallower waters. Currents speeds can be intensified around topographic features so areas such as the Rockall Bank and the edge of the continental shelf have faster currents associated with them. The general pattern of circulation within the North Atlantic is represented schematically in the map (above right).

North Atlantic Circulation

The map does not show the fine detail associated with the complex circulation of water. Currents change over shorter timescales because of complex effects such as mesoscale meanders and eddies, internal tides, internal waves, fronts and storm surges.

In addition to the North Atlantic Current, a jet-like current, known as the Slope Current, flows in a poleward direction along the edge of the continental slope with speeds in the range of 15 to 30 cm/s, and centred approximately over the 400-500 m depth contour. The waters in the Slope Current are thought to originate from the Iberian region and some of the North Atlantic Water that reaches the Bay of Biscay joins the Slope Current. Also on the continental slope, tides cause a large wave to form on the thermocline and this breaks when it hits the continental shelf causing mixing and nutrients to be brought closer to the surface. These features vary seasonally but are important sources of heat and nutrients, and enhance plankton growth in the waters around Scotland. They form important habitat for fish which are the subject of commercial fisheries.

Gathering Global Data

Scotland, and the wider UK, contribute to developing our knowledge of ocean circulation by supporting global observing systems and by placing data within international databases. Measurements are made using ships, buoys, moorings, aircraft and satellites. One system is Argo which is a global array of approximately 3,000 free-drifting profiling floats that measure the temperature and salinity of the upper 2000 m of the ocean. This allows, for the first time, continuous monitoring of the temperature, salinity and velocity of the upper ocean, with all data being relayed and made publicly available within hours after collection.

An Argo float

A newly deployed Argo float

Deploying a mooring from the RV Scotia

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02 PHYSICAL CHARACTERISTICS
CURRENTS AND CIRCULATION

Deeper Waters

In the North Atlantic as well as the surface circulation, there is a flow of deep water returning at depth from the Arctic. Two technical terms often associated with this circulation are the Thermohaline Circulation and, more recently, the Atlantic Meridional Overturning Circulation (AMOC). The AMOC has been the subject of intense study in recent years, because of its significant contribution to climate variability and the possibility that the effects of global climate change will weaken the AMOC, possibly bringing the cold Arctic water further south at the surface and having a cooling effect upon Scotland and Northern Europe.

The return flow of deep water from the Arctic to the North Atlantic is evident from the presence of cold water at depth in the Faroe Shetland Channel (below 400-600 m) that has its origin in the Iceland, Greenland and Norwegian Seas. The presence of both sub-tropical water on the surface and Arctic water at depth brings diverse ecological conditions to Scotland's waters. The cold deep waters from the Arctic, which travel in a south-eastward direction through the Faroe Shetland Channel, are diverted westward by the Wyville Thomson Ridge and eventually spill over into the deep basin of the Rockall Trough. There are also intermittent overflows through deep channels in the Wyville Thomson Ridge that are as yet unquantified.

Monitoring in the Faroe Shetland Channel

Deploying an ADCP

ADCP deployment

Scientists preparing a current meter mooring

ADCP in seabed frame

Measuring how fast water is moving

An Acoustic Doppler Current Profiler (ADCP) is used to measure how fast water is moving. An ADCP anchored to the seafloor can measure current speed not just at the bottom, but also at equal intervals all the way up to the surface. The ADCP works by transmitting "pings" of sound at a constant frequency into the water. As the sound waves travel, they scatter off particles suspended in the moving water, and reflect back to the instrument. Due to the Doppler effect, sound waves bounced back from a particle moving away from the profiler have a slightly lowered frequency when they return. Particles moving toward the instrument send back higher frequency waves. The difference in frequency between the waves the profiler sends out and the waves it receives is called the Doppler shift. The instrument uses this shift to calculate how fast the particle and the water around it are moving.

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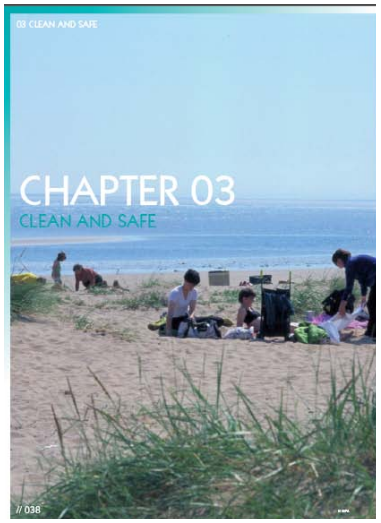
What's in the Atlas? Chapter 3



- Water Framework Directive Classification of Transitional and Coastal Waters
- Hazardous Substances
- Biological Effects of Contaminants
- Oil and Chemical Spills
- Radioactive Substances
- Microbiological Contamination
- Biotoxin Monitoring in Scotland
- Eutrophication
- Dissolved Oxygen in the Clyde and Forth Estuaries
- Marine Litter
- Silver in Intertidal Mussels
- Underwater Noise

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What's in the Atlas? Chapter 3

Hazardous substances in sediments and biota

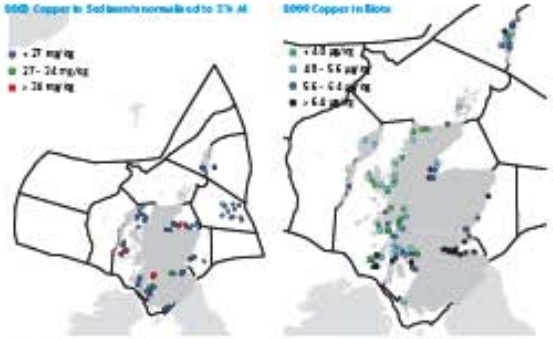
Contaminants in sediments and biota are compared with international standards developed by OSPAR[1]. Contaminant concentrations are considered to be low if they are below the Background Assessment Concentration (BAC)[2] and slightly elevated if they are greater than the BAC but less than the Environmental Assessment Criteria (EAC). Contaminant concentrations are considered to be of concern if they exceed the EAC, that is, they may cause adverse biological effects in marine species. Concentrations of trace metals and PAH are considered to be of concern towards other marine species if they exceed the Effects Range Low (ERL)[3] in sediments. Trace metals are of concern towards humans if they exceed the EC maximum acceptable dietary level in biota.

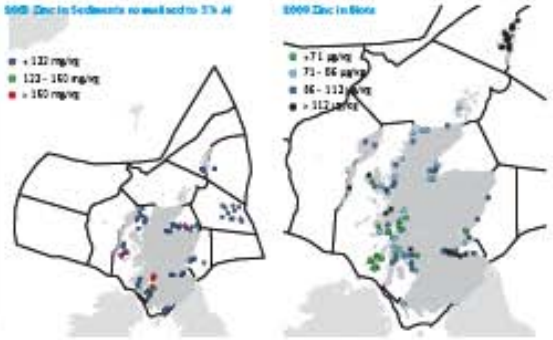
Trace metal concentrations in sediments are expressed as concentrations relative to aluminium and trace organic contaminant concentrations are expressed in concentrations relative to organic carbon to compensate for different sediment types. Trace organic contaminant concentrations in fish livers are 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 can not be assessed, but spatial comparisons can be made.

1 BACs, some times referred to as 'background concentrations', are derived from statistically representative datasets, and are based on low concentrations, which are commonly found and close to zero in unimpacted substances.

2 The Effects Range Low is the 10 per cent (or lowest) value of each contaminant above which toxic effects were observed.





OSPAR assessment criteria for contaminants in sediment, mussels and fish liver

Group	Substance	Sediment µg/kg dry weight normalised to 2.5% TOC			Mussels µg/kg dry weight			Fish µg/kg wet weight		
		< BAC	BAC - EAC	> EAC	< BAC	BAC - EAC[a]	> EAC[a]	< BAC[a]	BAC[a] - EAC[a]	> EAC[a]
PCB	CB153	< 0.19	0.19 - 40	> 40	< 0.5	0.5 - 10	> 10	< 0.1	0.1 - 1,000	> 1,000
	CB138	< 0.17	0.17 - 36	> 36	< 0.5	0.5 - 9.2	> 9.2	< 0.1	0.1 - 34	> 34
	CB52	< 0.12	0.12 - 27	> 27	< 0.75	0.75 - 8.4	> 8.4	< 0.08	0.08 - 108	> 108
Group	Substance	Sediment µg/kg dry weight normalised to 2.5% TOC			Mussels µg/kg dry weight					
		< BAC	BAC - EAL	> EAL	< BAC	BAC - EAC	> EAC			
PAH	Pyrene	< 24	24 - 488	> 488	< 5	5 - 100	> 100			
Group	Substance	Sediment µg/kg dry weight normalised to 5% Al			Mussels µg/kg dry weight			Fish µg/kg wet weight		
		< BAC	BAC - EAL	> EAL	< BAC	BAC - EAC	> EAC	< BAC	BAC - EAC	> EAC
Trace metals	Cadmium	< 210	210 - 1,200	> 1,200	< 1,540	1,540 - 3,080	> 3,080	< 10	10 - 1,000	> 1,000
	Mercury	< 70	70 - 150	> 150	< 140	140 - 2,800	> 2,800	< 20	20 - 500	> 500
	Lead	< 35,000	35,000 - 47,000	> 47,000	< 1,820	1,820 - 7,280	> 7,280	< 20	20 - 1,000	> 1,000
	Copper	< 27,000	27,000 - 34,000	> 34,000						
	Zinc	< 122,000	122,000 - 150,000	> 150,000						
PAH/EROD	γ-HCH	< 0.12	0.12 - 2.0	> 2.0	< 0.67	0.67 - 1.48	> 1.48			

Total Cadmium and Lead are measured in fish liver, whereas mercury is measured in fish flesh.
[a] BAC/EAC calculated from the BAC for sediment.
[b] BAC for fish liver is on a wet weight basis.

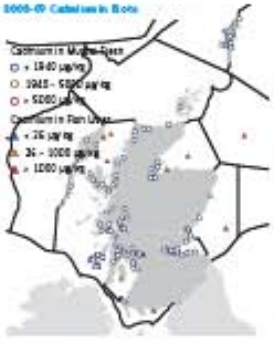
Trace metals in biota and sediments

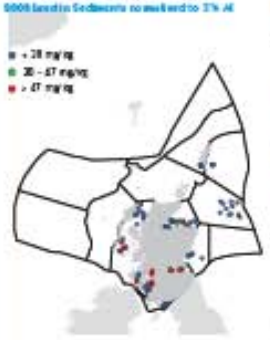
Trace metals are measured in blue mussels (*Mytilus edulis*) and fish, and these data need to be assessed separately. This is because mussels are short-lived, sessile and shore-based, with relatively low fat content, whereas fish are longer-living, motile and where livers are analysed, have higher fat content. Fish such as dab, plaice and flounder are collected in coastal waters while in deep waters offshore, other species are collected. These differences result in different metal concentrations, and for this reason, different background assessment concentrations are used. Hence while cadmium concentrations are close to background in mussels they are elevated in fish livers at all sites. Lead is close to background in mussels in less populated areas but slightly elevated in the more industrialised areas and in the majority of fish samples. Mercury is close to background in mussels at most sites on Shetland and most sites on the west coast but is elevated on the east coast and several sites on the west coast. Mercury is slightly elevated in all fish except the sample caught in the Moray Firth.

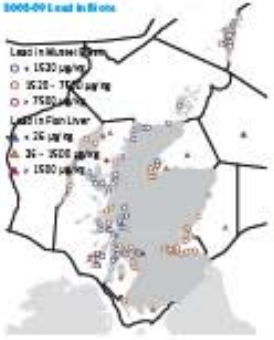
The geographical distribution of copper in mussels is similar to that for lead, although concentrations of copper are much lower. The relatively high concentrations of copper in mussels on Islay may be related to inputs from several distilleries in this area. There are relatively high concentrations of zinc in mussels on Shetland and in the Forth Estuary plus a few isolated sites on the west coast. Discharges of zinc are low in these areas, and the elevated zinc concentrations may be linked to local mineralisation.

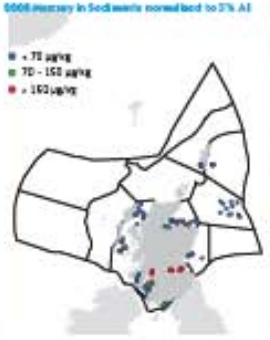
Trace metal concentrations in sediments are highest in the Inner Firth of Clyde where all samples exceed the Effects Range – Low for all metals, except cadmium. Cadmium concentrations are low in sediments compared to other metals and close to background at most sites. Forth estuary and Firth of Forth sediments all exceed the Effects Range – Low for mercury and exceed the Background Assessment Criteria or Effects Range – Low for lead. The trace metal concentration of coastal sediments is low. However, some sites exceeded the assessment criteria when normalised to aluminium, as their aluminium content was low.

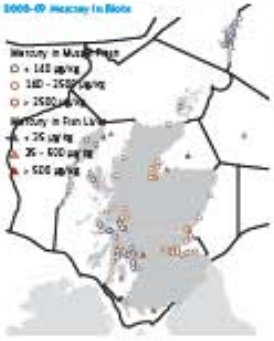
The data highlight an interesting contrast in copper and zinc concentrations in mussels and sediments between the Forth and Clyde Estuaries. Concentrations of these metals are higher in sediments in the Clyde than in the Forth, but higher in mussels in the Forth compared to the Clyde. This may be because the Forth is a more turbid estuary due to the stronger tides which mix the sediments into the water column. This will result in particulate bound metals being more available to filter feeders such as mussels.



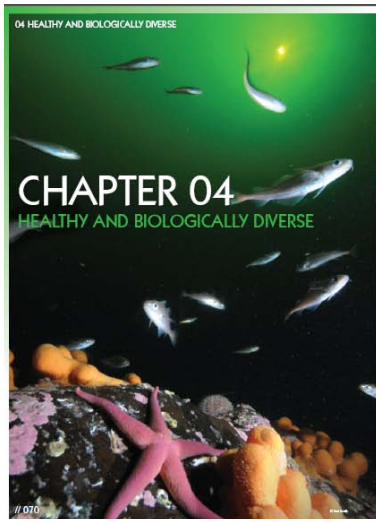








What's in the Atlas? Chapter 4



- Protected Areas
- Intertidal Rock
- Intertidal Sediments
- Subtidal Rock
- Inshore and Shelf Subtidal Sediments
- Deep Sea Habitats
- Plankton
- Commercial Fish and Shellfish Stocks
- Demersal Fish Community
- Sharks and Rays
- Seals
- Cetaceans
- Seabirds
- Waterbirds
- Occasional Visitors
- Non-Native Species in Scottish Waters

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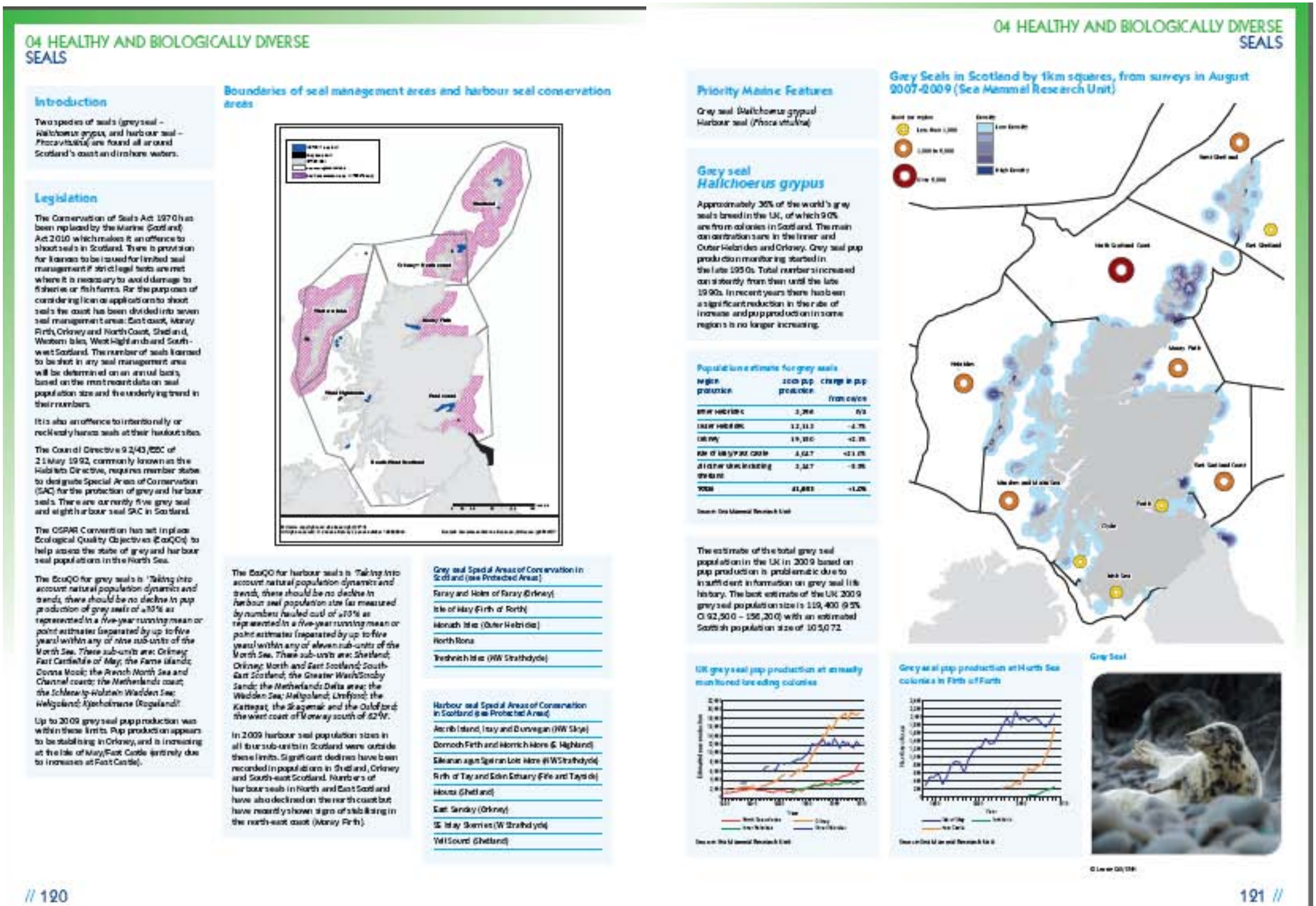
What’s in the Atlas? Chapter 4



04 HEALTHY AND BIOLOGICALLY DIVERSE
SEALS

Introduction

Two species of seals (grey seal – *Halichoerus grypus*, and harbour seal – *Phoca vitulina*) are found all around Scotland’s coast and inshore waters.

Legislation

The Conservation of Seals Act 1970 has been replaced by the Marine (Scotland) Act 2010 which makes it an offence to shoot seals in Scotland. There is provision for licences to be issued for limited seal management if strict legal tests are met where it is necessary to avoid damage to fisheries or fish farms. For the purposes of considering licence applications to shoot seals the coast has been divided into seven seal management areas: East coast, Moray Firth, Orkney and North Coast, Shetland, Western Isles, West Highlands and South-west Scotland. The number of seals licensed to be shot in any seal management area will be determined on an annual basis, based on the most recent data on seal population size and the underlying trend in their numbers.

It is also an offence to intentionally or recklessly harass seals at their haulout sites.

The Council Directive 92/43/EEC of 21 May 1992, commonly known as the Habitats Directive, requires member states to designate Special Areas of Conservation (SAC) for the protection of grey and harbour seals. There are currently five grey seal and eight harbour seal SAC in Scotland.

The OSPAR Convention has set in place Ecological Quality Objectives (EcoQOs) to help assess the state of grey and harbour seal populations in the North Sea.

The EcoQO for grey seals is *‘Taking into account natural population dynamics and trends, there should be no decline in pup production of grey seals of ≥10% as represented in a five-year running mean or point estimates (separated by up to five years) within any of nine sub-units of the North Sea. These sub-units are: Orkney; Fast Castle/Isle of May; the Farne Islands; Donna Nook; the French North Sea and Channel coasts; the Netherlands coast; the Schleswig-Holstein Wadden Sea; Helgoland; Kjørholmane (Rogaland)’.*

Up to 2009 grey seal pup production was within these limits. Pup production appears to be stabilising in Orkney, and is increasing at the Isle of May/Fast Castle (entirely due to increases at Fast Castle).

Boundaries of seal management areas and harbour seal conservation areas

The EcoQO for harbour seals is *‘Taking into account natural population dynamics and trends, there should be no decline in harbour seal population size (as measured by numbers hauled out) of ≥10% as represented in a five-year running mean or point estimates (separated by up to five years) within any of eleven sub-units of the North Sea. These sub-units are: Shetland; Orkney; North and East Scotland; South-East Scotland; the Greater Wash/Scroby Sands; the Netherlands Delta area; the Wadden Sea; Helgoland; Limfjord; the Kattegat; the Skagerrak and the Oslofjord; the west coast of Norway south of 62°N’.*

In 2009 harbour seal population sizes in all four sub-units in Scotland were outside these limits. Significant declines have been recorded in populations in Shetland, Orkney and South-east Scotland. Numbers of harbour seals in North and East Scotland have also declined on the north coast but have recently shown signs of stabilising in the north-east coast (Moray Firth).

Grey seal Special Areas of Conservation in Scotland (see Protected Areas)

- Faray and Holm of Faray (Orkney)
- Isle of May (Firth of Forth)
- Monach Isles (Outer Hebrides)
- North Rona
- Treshnish Isles (NW Strathclyde)

Harbour seal Special Areas of Conservation in Scotland (see Protected Areas)

- Ascrib Island, Isay and Dunvegan (NW Skye)
- Dornoch Firth and Morrich More (E Highland)
- Eileanan agus Sgeiran Lois Mhora (NW Strathclyde)
- Firth of Tay and Eden Estuary (Fife and Tayside)
- Mousa (Shetland)
- East Sanday (Orkney)
- SE Islay Skerries (W Strathclyde)
- Yell Sound (Shetland)

Priority Marine Features

Grey seal (*Halichoerus grypus*)
Harbour seal (*Phoca vitulina*)

Grey seal *Halichoerus grypus*

Approximately 36% of the world’s grey seals breed in the UK, of which 90% are from colonies in Scotland. The main concentrations are in the Inner and Outer Hebrides and Orkney. Grey seal pup production monitoring started in the late 1950s. Total numbers increased consistently from then until the late 1990s. In recent years there has been a significant reduction in the rate of increase and pup production in some regions is no longer increasing.

Population estimate for grey seals

region	2009 pup production	change in pup production from 08/09
Inner Hebrides	[illegible]	n/a
Outer Hebrides	[illegible]	[illegible]
Orkney	[illegible]	[illegible]
Isle of May/Fast Castle	[illegible]	[illegible]
all other sites including Shetland	[illegible]	[illegible]
Total	[illegible]	[illegible]

Source: Sea Mammal Research Unit

The estimate of the total grey seal population in the UK in 2009 based on pup production is problematic due to insufficient information on grey seal life history. The best estimate of the UK 2009 grey seal population size is 119,400 (95% CI 92,500 – 156,200) with an estimated Scottish population size of 105,072.

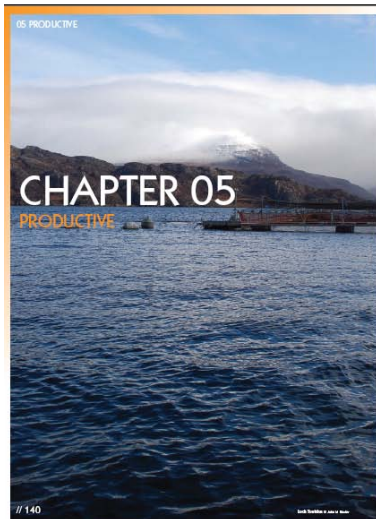
Grey Seals in Scotland by 1km squares, from surveys in August 2007-2009 (Sea Mammal Research Unit)

UK grey seal pup production at annually monitored breeding colonies

Grey seal pup production at North Sea colonies in Firth of Forth

Grey Seal

What's in the Atlas? Chapter 5



- Economic Analysis of Scotland's Core Marine Sector
- Aquaculture
- Fishing
- Salmon and Sea Trout Fishing
- Leisure and Recreation
- Historic Environment and Cultural Heritage
- Coastal Protection and Flood Defence
- Renewable Energy and Power Cables
- Carbon Capture and Storage
- Oil, Gas, Pipelines and Gas Storage
- Water Abstraction
- Maritime Transport (Ports and Shipping)
- Waste Disposal (Dredge Material)
- Waste Disposal (Waste Water Treatment and Industrial Outfalls)
- Defence (Military)
- Telecommunication Cables
- Marine Management, Education, Research and Development

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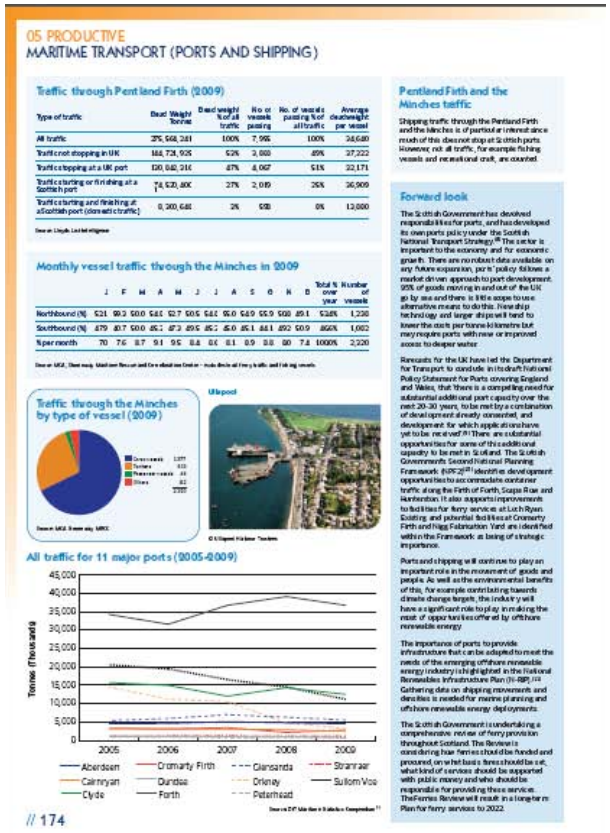
What's in the Atlas? Chapter 5



05 PRODUCTIVE
MARITIME TRANSPORT (PORTS AND SHIPPING)

Traffic through Pentland Firth (2009)

Type of traffic	Dead Weight Tonnes	Dead weight % of all traffic	No of vessels passing	No. of vessels passing % of all traffic	Average deadweight per vessel
All traffic	25,568,281	100%	7,995	100%	34,680
Traffic not stopping in UK	144,724,925	52%	2,883	49%	37,222
Traffic stopping at a UK port	130,842,356	47%	4,067	51%	32,171
Traffic starting or finishing at a Scottish port	74,620,406	27%	2,019	26%	36,909
Traffic starting and finishing at a Scottish port (domestic traffic)	8,200,681	3%	928	0%	12,000

Monthly vessel traffic through the Minches in 2009

	J	F	M	A	M	J	J	A	S	O	N	D	Total % over year	Number of vessels
Northbound (%)	52.1	49.3	50.0	54.6	52.7	50.5	54.6	55.0	54.9	55.9	50.8	49.1	53.8%	1,230
Southbound (%)	47.9	50.7	50.0	45.1	47.3	49.5	45.5	45.0	45.1	44.1	49.2	50.9	46.2%	1,002
% per month	7.0	7.6	8.7	9.1	9.5	8.4	8.6	8.1	8.9	8.8	8.0	7.8	100.0%	2,220

Traffic through the Minches by type of vessel (2009)

Ullapool

All traffic for 11 major ports (2005-2009)

Tonnes (Thousands)

Aberdeen, Cairnryan, Clyde, Cromarty Firth, Dundee, Forth, Glensanda, Orkney, Peterhead, Stranraer, Sullom Voe

Pentland Firth and the Minches traffic

Forward look

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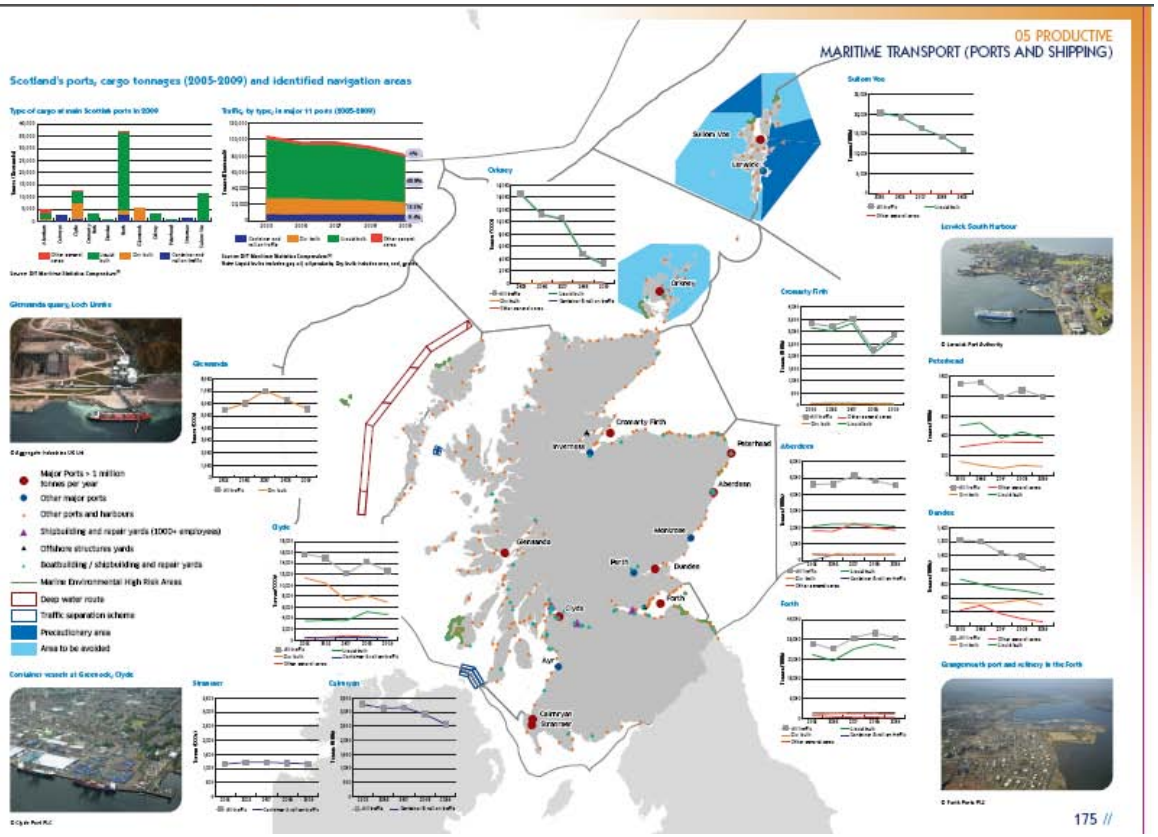

05 PRODUCTIVE
MARITIME TRANSPORT (PORTS AND SHIPPING)

Scotland's ports, cargo tonnages (2005-2009) and identified navigation areas

Glensanda quarry, Loch Linnhe

Major Ports > 1 million tonnes per year
Other major ports
Other ports and harbours
Shipbuilding and repair yards (1000+ employees)
Offshore structures yards
Boatbuilding / shipbuilding and repair yards
Marine Environmental High Risk Areas
Deep water route
Traffic separation scheme
Precautionary area
Area to be avoided

Container vessels at Greenock, Clyde

Lerwick South Harbour

Grangemouth port and refinery in the Forth

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What's in the Atlas? Chapter 6

What Is Already Happening

Since 1970 waters between 0 and 600 m have warmed and waters between 0–600 m have become more saline

Rising sea temperature has caused changes in phytoplankton growth and distribution

What Could Happen

Surface layers are likely to be stratified for a longer period during the year by the end of the century

Increased tendency for stratification could lead to offshore blooms, including *Karenia mikimotoi* which has been associated with fish kills and benthic mortalities in coastal waters

What Is Already Happening

Since 2000, breeding success of seabirds such as Arctic skua, black-legged kittiwake and shag has declined due to decreased food availability linked to climate change

Relict populations of the cold-water copepod *Calanus finmarchicus* persist in some sea lochs but are vulnerable to changing conditions

Rising sea levels are only adversely affecting a small proportion of the coast

What Could Happen

Increased tendency for stratification could lead to offshore blooms, including *Karenia mikimotoi* which has been associated with fish kills and benthic mortalities in coastal waters

What Is Already Happening

Northern limit of the honeycomb worm *Sabellaria alveolata* is extending

Rising sea levels are adversely affecting a large proportion of the low-lying parts of the coast which are vulnerable to flooding and erosion

What Could Happen

Built structures will be impacted by projected changes in wave height more so than in other regions

What Is Already Happening

Since 2000 breeding success of seabirds such as Arctic skua, black-legged kittiwake and shag has declined due to decreased food availability linked to climate change

Rising sea temperature is leading to an extension of the northern limit of seabed animals

Rising sea levels do not pose a risk to the coast which is rocky and rising

What Could Happen

Increase tendency for stratification could lead to offshore blooms, including *Karenia mikimotoi* which has been associated with fish kills and benthic mortalities in coastal waters

What Is Already Happening

Squid are becoming more abundant off north-east Scotland creating new opportunities for fisheries

Rising sea temperature has caused changes in the plankton community and the distribution of some fish species

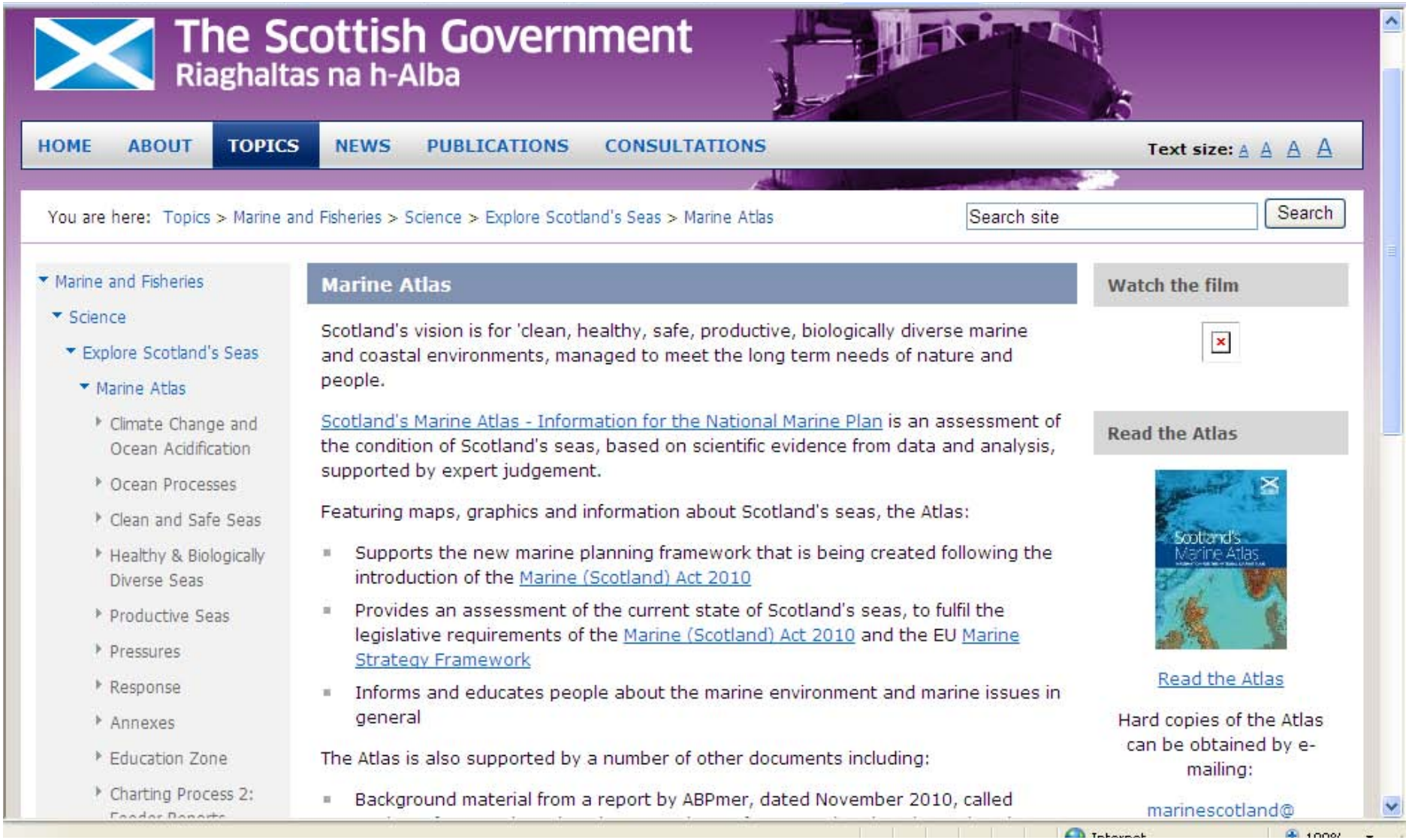
The length of the phytoplankton growing season has increased

Rising sea levels are only adversely affecting a small proportion of the coast

What Could Happen

7 – 54 cm sea-level rise projected in Edinburgh between 1990 and 2095 under a medium greenhouse gas emission scenario

What's available on-line?



www.scotland.gov.uk/marineatlas

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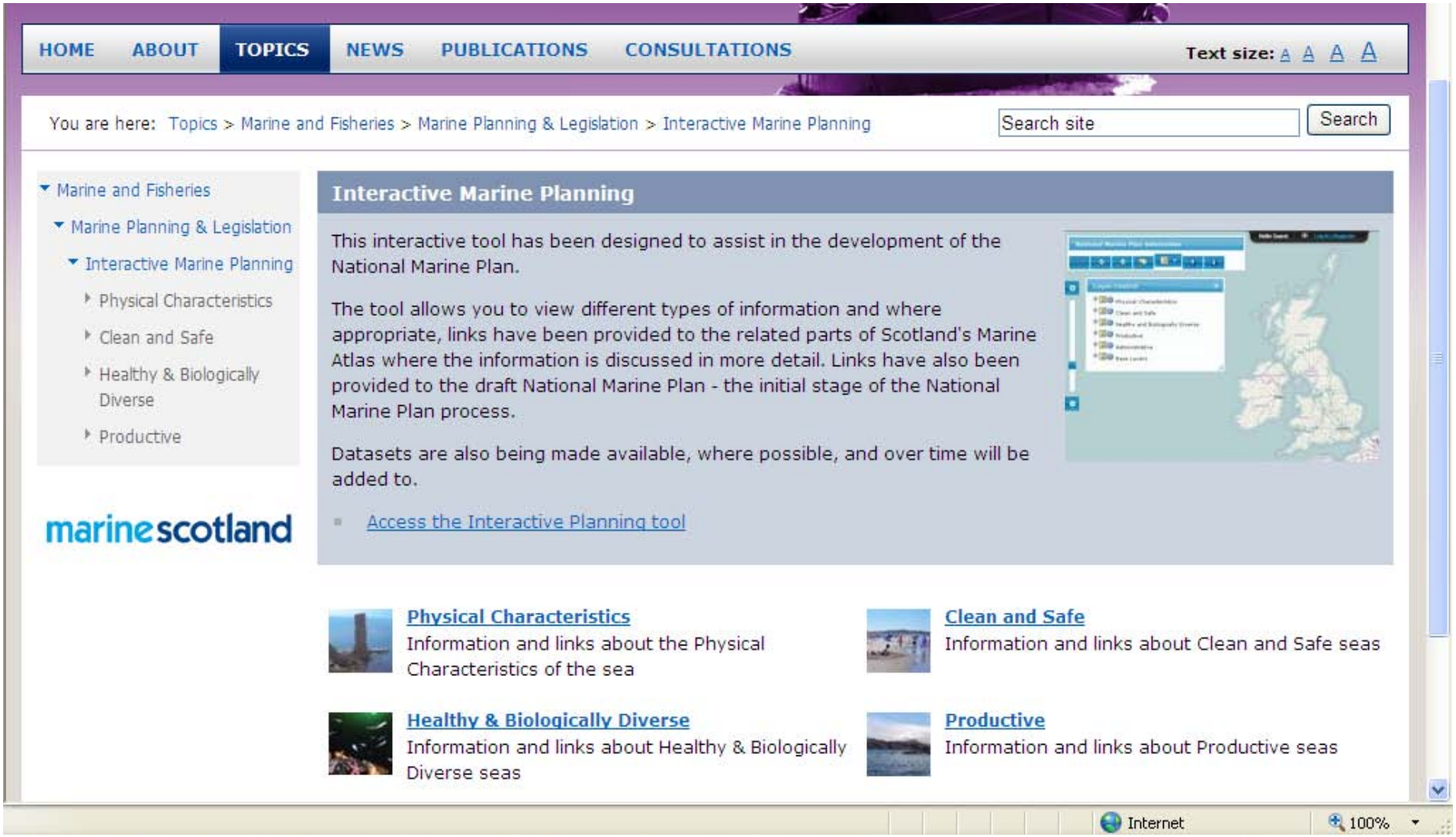
National Marine Plan interactive?



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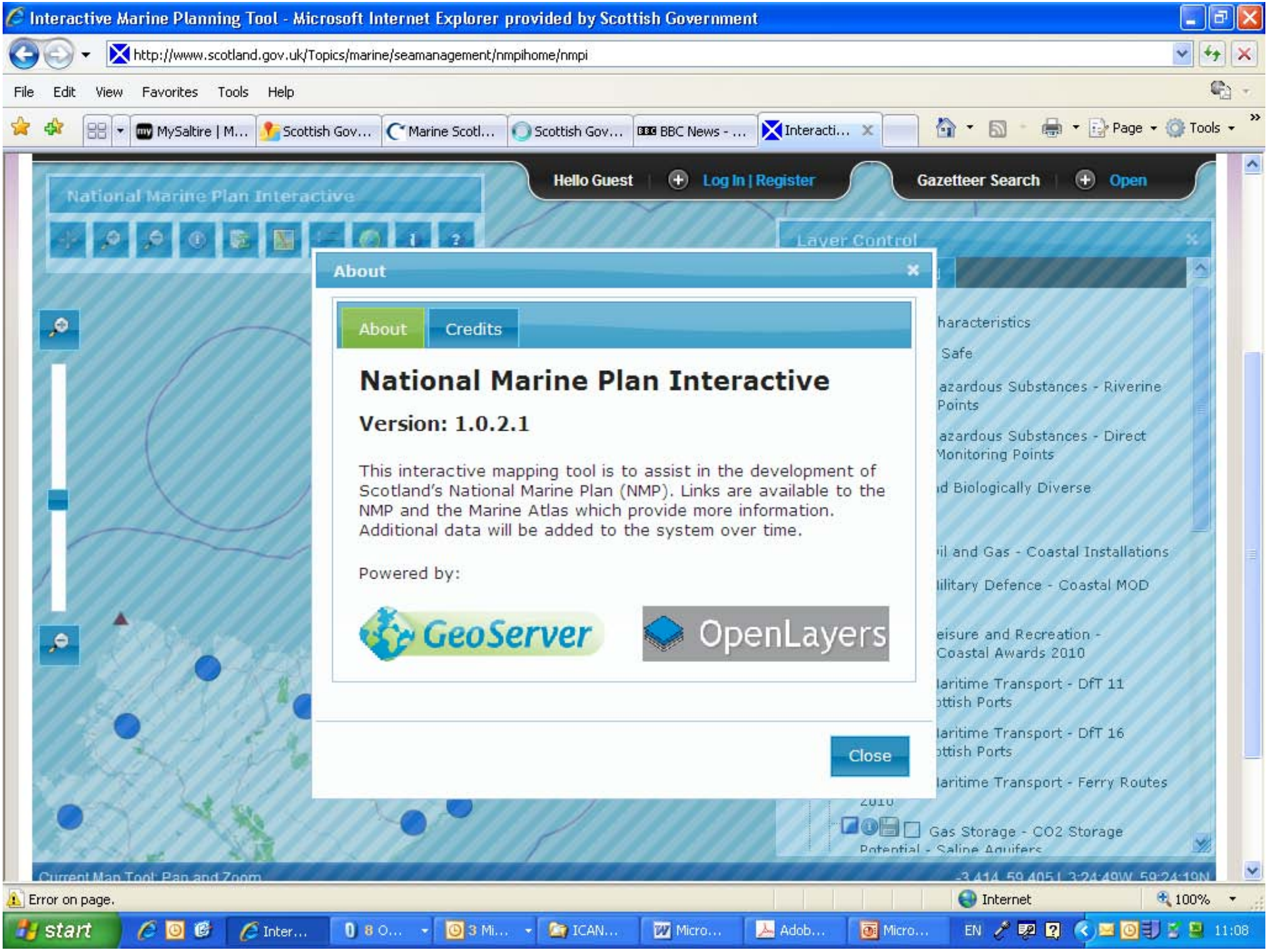
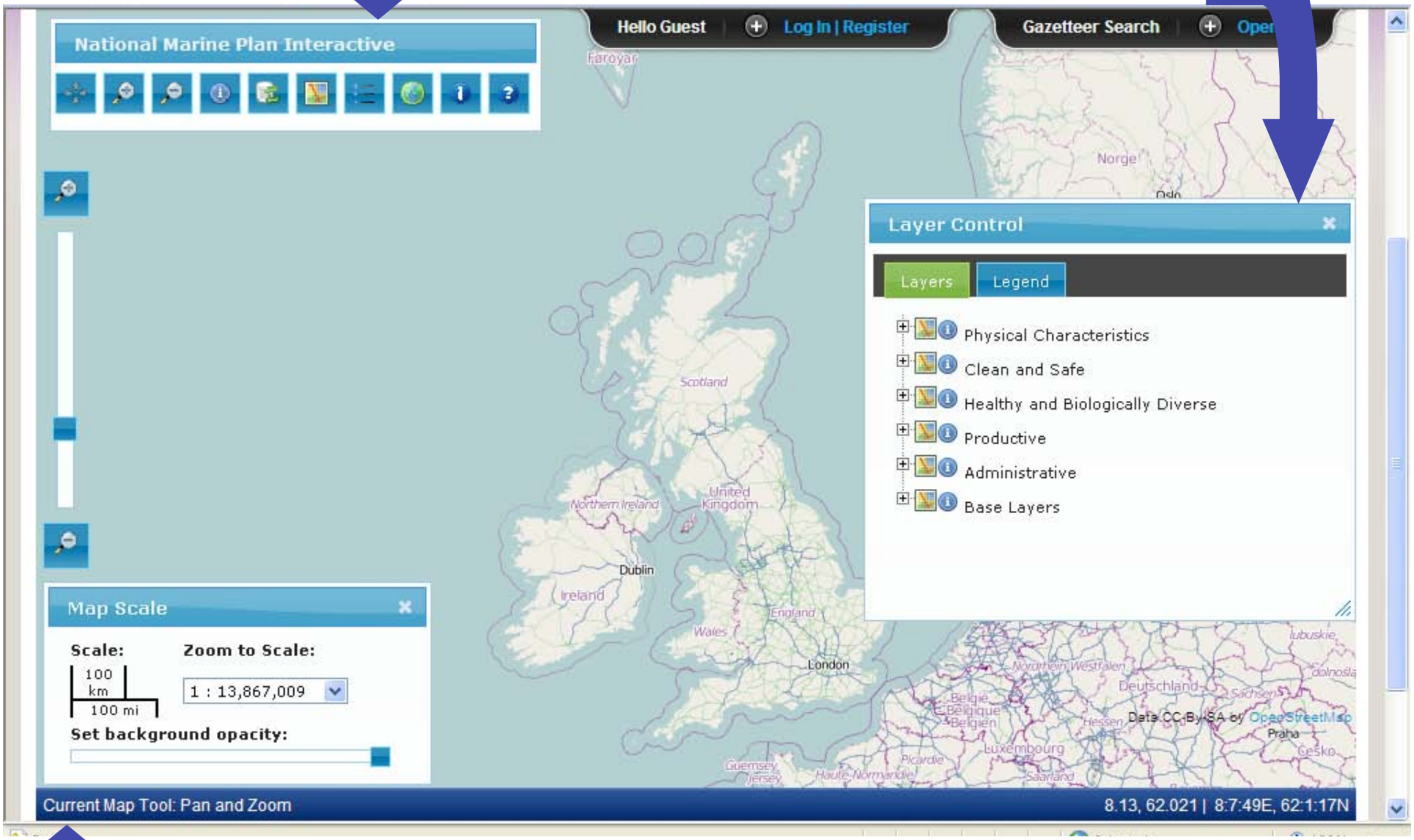

Interactive Marine Planning Tool - Microsoft Internet Explorer provided by Scottish Government
http://www.scotland.gov.uk/Topics/marine/seamanagement/nmpihome/nmpi
File Edit View Favorites Tools Help
National Marine Plan Interactive
Hello Guest
Log In | Register
Gazetteer Search
Open
Layer Control
About
About
Credits
National Marine Plan Interactive
Version: 1.0.2.1
This interactive mapping tool is to assist in the development of Scotland's National Marine Plan (NMP). Links are available to the NMP and the Marine Atlas which provide more information. Additional data will be added to the system over time.
Powered by:
GeoServer
OpenLayers
Close
Gas Storage - CO2 Storage
Current Map Tool: Pan and Zoom
Error on page.
Internet
100%
start
11:08

Control tools

Layer control



Map scale

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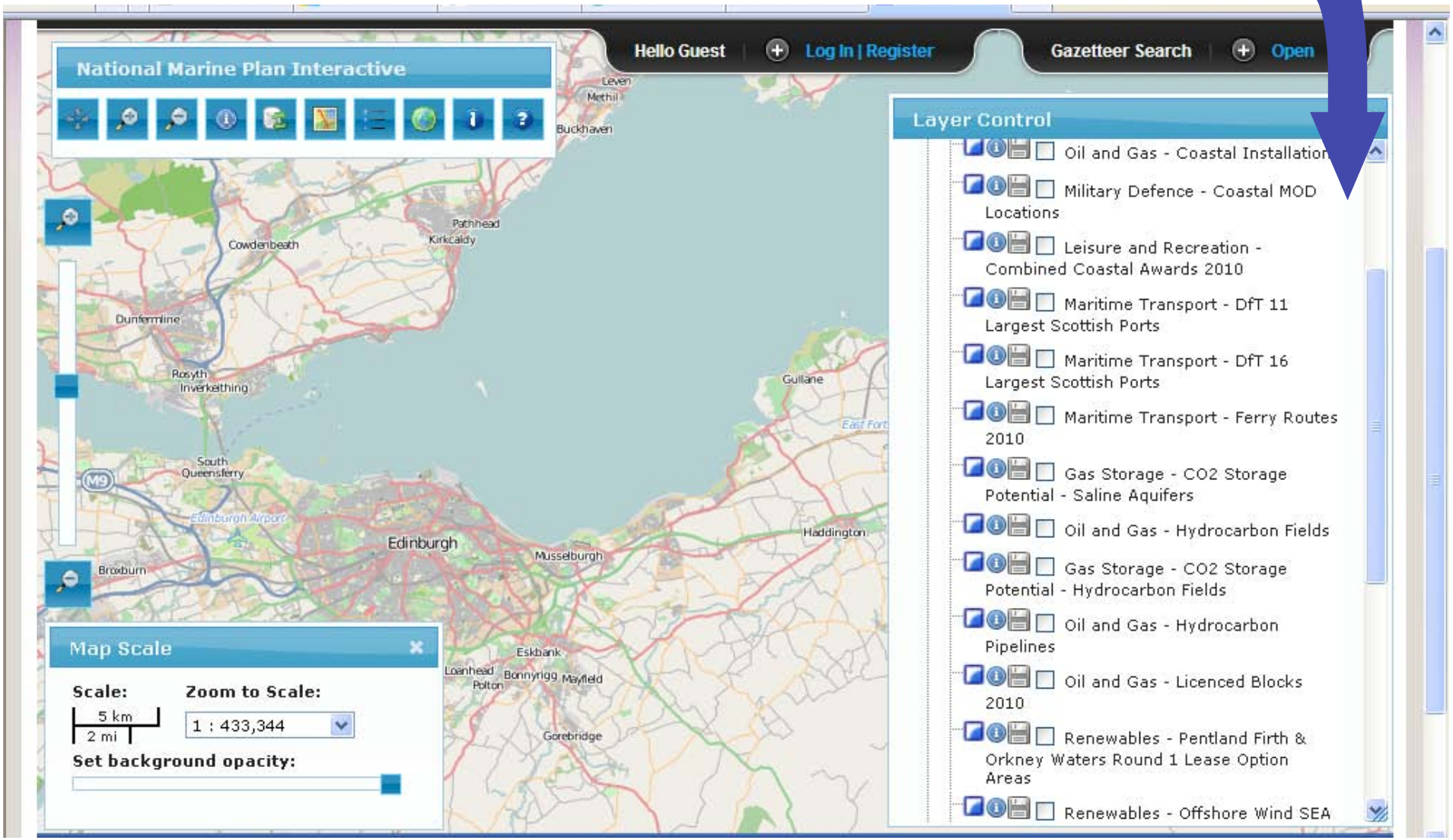
Productive layer expanded



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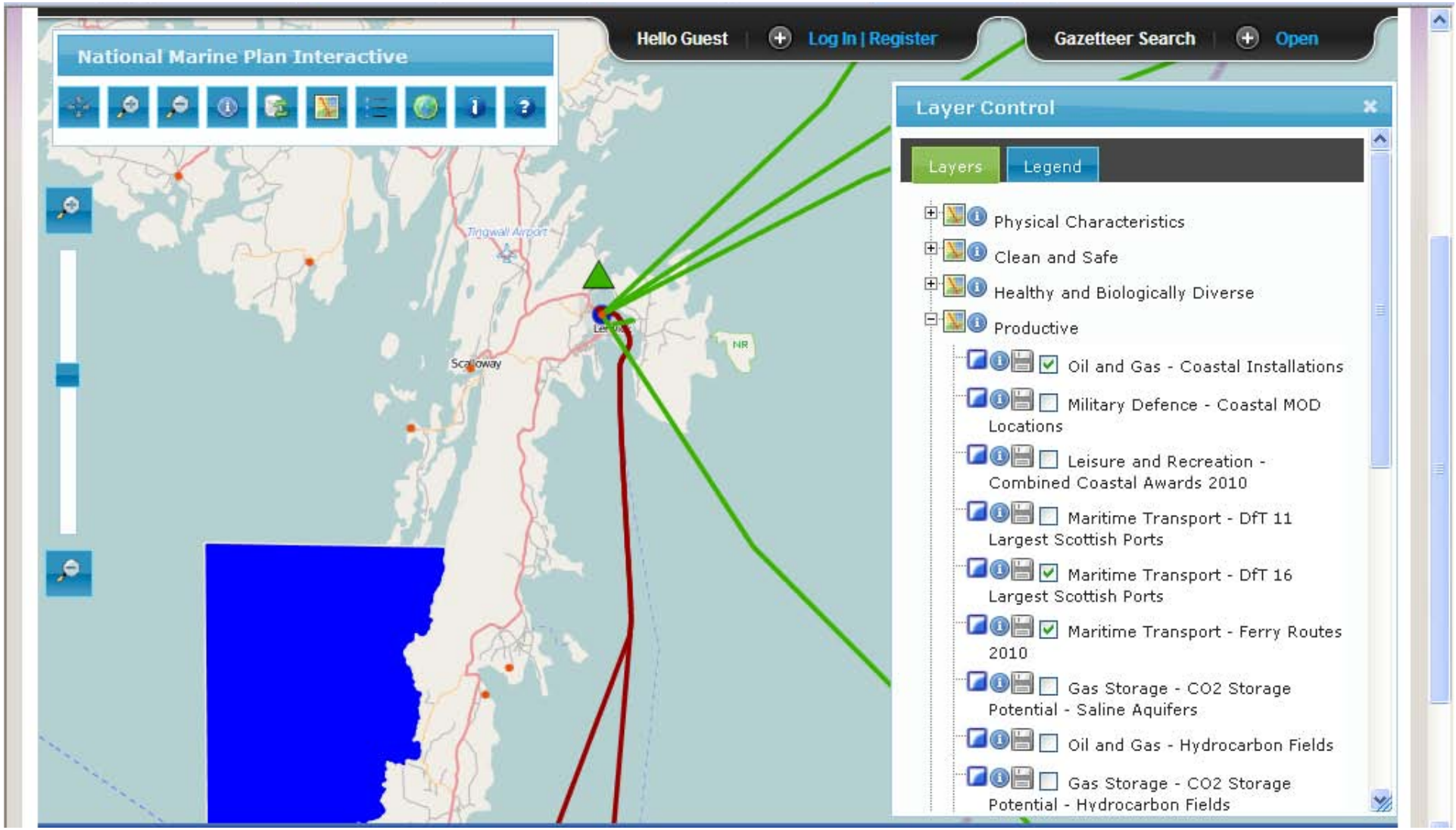
Shetland area with various layers on



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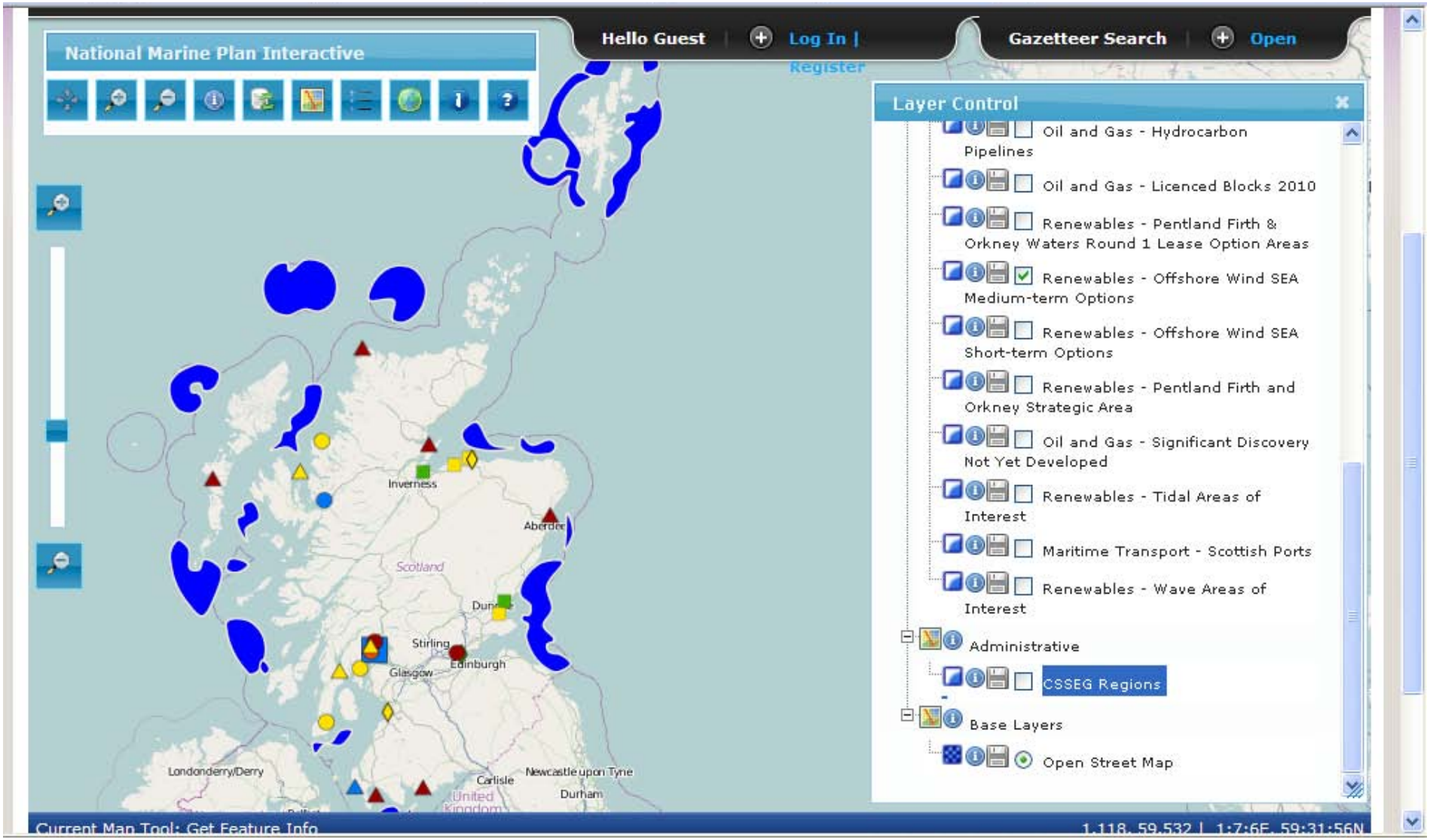
Renewables - Offshore Wind SEA Medium-term Options



Military Defence - Coastal MOD Locations

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National Marine Plan interactive - summary

Physical Characteristics	– 5 layers
Clean and Safe	– 2 layers
Healthy and Biologically Diverse	– 0 layers
Productive	– 19 layers
Administrative	– 1 layer - CSSEG Regions
Base layer	– 1 - Open Street Map

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Marine Scotland Interactive (MSI) - Microsoft Internet Explorer provided by Scottish Government

http://www.scotland.gov.uk/Topics/marine/science/MSInteractive

File Edit View Favorites Tools Help

MACCS ... MySaltir... Marine ... Mari... Staff Di... MySalti... Marine ... Scottis... Page Tools

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Related Information

- Marine Scotland topic sheets

Marine Scotland Interactive (MSI)

Marine Scotland Interactive is the new resource for providing access to spatial data held by Marine Scotland. The first phase of the Marine Scotland Interactive project concentrates on themed marine environmental data covering renewable energy, monitoring, conservation and marine spatial planning. In time new themes will be added to the site.

Marine Scotland Science (MSS) has undertaken survey and monitoring work to provide expert scientific and technical advice to support Scottish Government policies and regulatory responsibilities. Marine Scotland Interactive now holds this information in the form of maps, video clips and photographs. Full accessibility of these data is enabled through the use of freely available software and social networking sites to assist in the release of large data sets in viewer-friendly formats.

Themes
Data available arranged by theme

Data Types
Data available arranged by method of collection

Training
Explanatory videos on how to use the data available

Cruises
Marine Scotland cruises

Related Links
Links to other MSI-related information

Contact
Contact

News

- West of Lewis bathymetry data available to download
- Marine spatial planning site selection data available
- 2010 seabed video and digital stills updated into the Biotope Layer
- Pentland Firth (2009) and West of Lewis (2010) XYZ bathymetry data for the survey areas available to download

Quick Links

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YouTube

Internet 100%

start Marine S... 8 Obje... 2 Micro... Overall ... ICAN V ... Overall ... EN 12:35

Conclusions - Next steps (1)

- Hard copy atlas very well received – a wow factor
- Huge data volume together (1st time) & seas assessed
- Information base for National Marine Plan established
- Made accessible to schools
- Seeking feedback

- NMPi launched
- Basic structure established
- Populated with limited number of data layers
- Terrestrial base map there but what about marine

- MSi on line
- Making spatial data available

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www.scotland.gov.uk/marineatlas

Conclusions - Next steps (2)

- Updating the Atlas - Undecided
- How do we integrate
  - Atlas
  - NMPi
  - MSi
  - to provide what users, as well as MS wants
- NMPi could evolve but data licensing issues
- Learn from other “coastal” atlases

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www.scotland.gov.uk/marineatlas