12.1 Norwegian Sea ecoregion – Ecosystem overview

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Ecoregion description

The Norwegian Sea ecoregion covers the Norwegian Sea and part of the Greenland Sea, separated by a ridge.

The Norwegian Sea ecoregion consists of three management zones as it includes parts of the Norwegian exclusive economic zone (EEZ), part of the Fisheries Protection Zone around Svalbard, and the North East Atlantic Fisheries Commission (NEAFC) regulatory area of the Norwegian Sea. The fisheries in the ecoregion are managed by Norway and NEAFC. Responsibility for the management of salmon fisheries rests with the North Atlantic Salmon Conservation Organization (NASCO), and with the International Commission for the Conservation of Atlantic Tunas (ICCAT) for large pelagic fish. Fisheries advice is provided by the International Council for the Exploration of the Sea (ICES). The Joint Norwegian–Russian Fisheries Commission manages seal hunting, based on advice from ICES. Commercial minke whaling is based on the International Whaling Committee's (IWC's) Revised Management Procedure. Marine mammal issues are also considered in cooperation under the North Atlantic Marine Mammal Commission (NAMMCO). Environmental issues are managed by Norwegian agencies and through OSPAR, with advice being provided by Norwegian agencies, OSPAR, and ICES. International shipping is managed under the International Maritime Organization (IMO). Oil and gas related activities are managed through Norwegian governmental licences. Seismic investigations occur annually and are prohibited in the Norwegian sector during the spawning periods of Northeast Atlantic (NEA) cod (*Gadus morhua)* and Norwegian spring-spawning (NSS) herring (*Clupea harengus*).

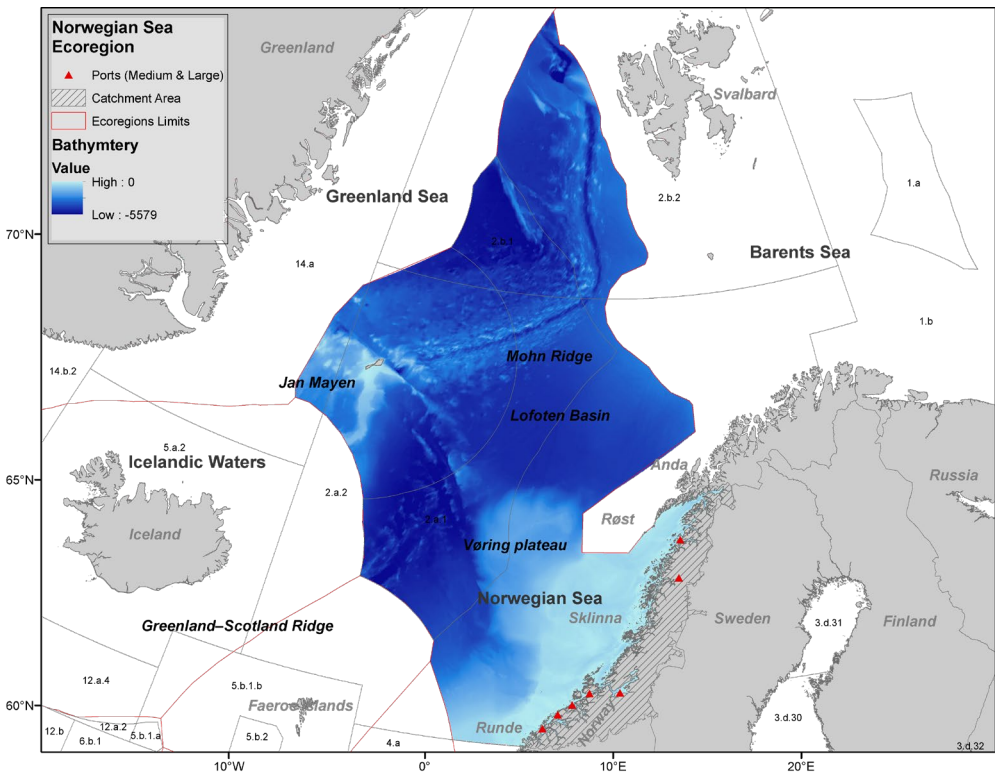

Figure 1 The Norwegian Sea ecoregion limits, ICES areas, catchment area, depth gradient, and major ports.

The Norwegian Sea, the Greenland Sea and the Iceland Sea comprise the Nordic seas, which are separated from the rest of the North Atlantic by the Greenland–Scotland Ridge. The Norwegian Sea connects with the Faroes ecoregion to the southwest, the Icelandic Waters ecoregion and Greenland Sea to the west along the edge to the shallower Iceland Sea between the Faroe Islands, and northwards to Jan Mayen. To the south it borders the North Sea ecoregion, and to the east with the Barents Sea ecoregion (Figure 1). The Norwegian Sea ecoregion consists of two deep basins (between 3000 and 4000 m deep), the Norwegian Basin and the Lofoten Basin, separated by the Vøring Plateau (between 1000 and 3000 m deep).

The Norwegian Sea is a transition zone for warm and saline Atlantic waters entering from the south, and cold and fresher Arctic waters entering from the north. The major current, the Norwegian Atlantic Current, is a poleward extension of the Gulf Stream and the North Atlantic Current that acts as a conduit for warm and saline Atlantic water from the North Atlantic to the Barents Sea and Arctic Ocean.

NOTE: this Ecosystem Overview focuses on the offshore ecoregion. Information relating to coastal elements is included where available and will be expanded in the future.

Key signals within the environment and the ecosystem

- Water flowing into the Norwegian Sea from the south has been colder and fresher in 2016–2020 than previously, but overall cooling has been limited due to reduced heat loss driven by increased strength of westerly winds bringing in warmer air.
- Annual primary production has been higher (on average around 30%) in 2013–2019 compared to 2003–2012, possibly due to increased inflow of cold and fresh Arctic water containing elevated concentrations of nutrients.
- The biomass of major pelagic stocks in the ecoregion - Norwegian spring-spawning herring, mackerel (*Scomber scombrus*) and blue whiting (*Micromesistius poutassou*) - have all declined in recent years.
- Pelagically-feeding seabirds breeding along the Norwegian coast have declined substantially since the start of monitoring in 1980. Common guillemot (*Uria aalge*) is at high risk of extinction as a breeding species in the area.
- For marine mammals, a long-term shift in summer distribution from the Norwegian Sea to the Barents Sea has occurred in recent years. Pup production is at low level or declining for hooded seal (*Cystophora cristata*), grey seal (*Halichoerus grypus*) and harp seal (*Pagophilus groenlandicus*).
- Bycatch levels of harbour porpoise (*Phocoena phocoena*) population in coastal gillnet fisheries might exceed internationally adopted thresholds.

Pressures

The four most important pressures on the Norwegian Sea ecoregion, excluding climate change, are selective extraction of species, abrasion, underwater noise, and introduction of contaminating compounds (Figure 2). The first three of these pressures are linked to human activities in the region (fishing, maritime transport, and oil and gas production), while contaminating compounds are mainly introduced from sources outside the Norwegian Sea. The main pressures described below are defined in the ICES glossary of human pressures.

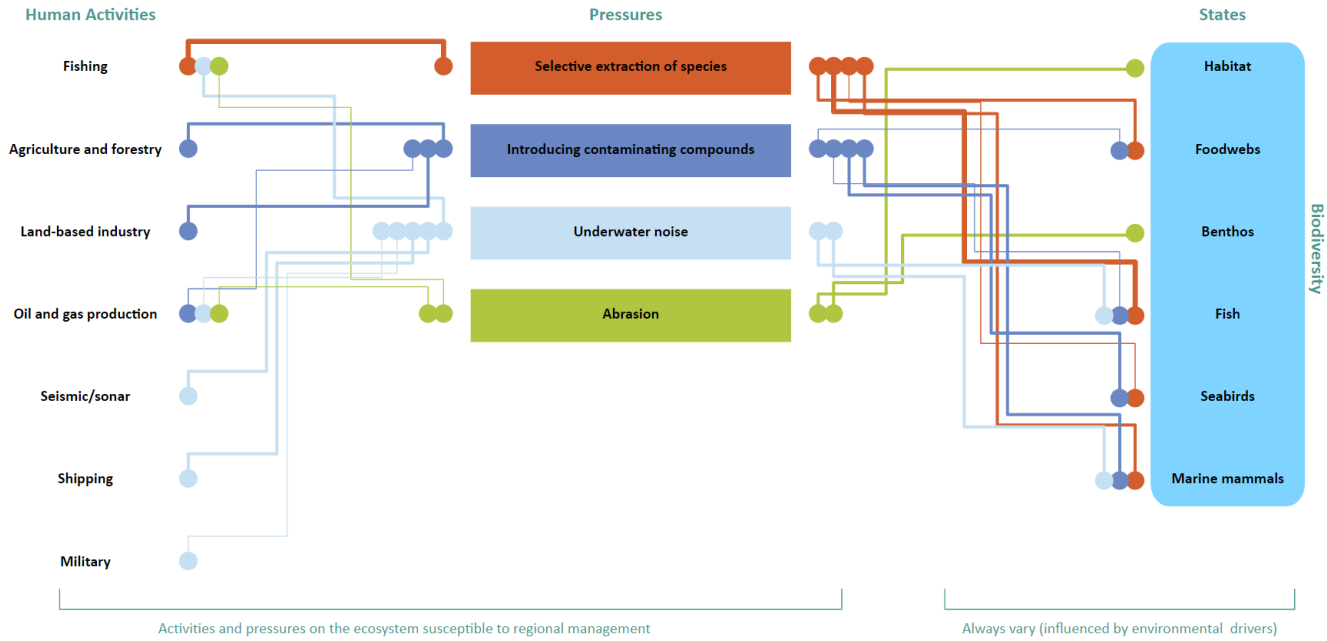

Figure 2 Norwegian Sea ecoregion overview with the major regional pressures, human activities, and state of the ecosystem components. The width of lines indicates the relative importance of individual links (the scaled strength of pressures should be understood as a relevant strength between the human activities listed and not as an assessment of the actual pressure on the ecosystem).

Selective extraction of species, including non-target catch

Fishing is the main human activity contributing to selective extraction of species, which is the most important pressure in the Norwegian Sea ecoregion. Four nations report the majority of landings from the Norwegian Sea ecoregion. These are, in order of importance, Norway, the Russian Federation, Faroe Islands, and Iceland. It is estimated that approximately 2550 vessels in all size categories (< 15 m to > 100 m) operate in the ecoregion. The major fishing gears applied are bottom otter trawls, static gears, and bottom seines along the Norwegian coast, and pelagic trawls and seines in the open sea. Fishing effort by Norwegian vessels has declined in recent years. For a detailed description of commercial fisheries in the Norwegian Sea ecoregion see the ICES Fisheries Overview for the ecoregion (https://doi.org/10.17895/ices.advice.7603). In addition to the fisheries, there is also limited whaling directed at the minke whale (*Balaenoptera acutorostrata*) stock.

Landings

The majority of landings come from pelagic fish stocks, with minor landings from demersal stocks, and negligible landings from benthic, elasmobranch, and crustacean stocks. Since 1950, annual landings of the major six stocks targeted by commercial fisheries range from 0.7 million tonnes to 1 million tonnes. Five of the six major stocks are pelagic: NSS herring, mackerel, blue whiting, beaked redfish (*Sebastes mentella)*, and greater silver smelt (*Argentina silus)*; and one is demersal, Northeast Arctic saithe (*Pollachius virens*). Norwegian annual landings of minke whales have ranged from 429 to 736 individuals during 2010–2019. The number of whaling vessels is currently decreasing.

Impacts on commercial stocks

Fishing mortality (F) for the three major pelagic stocks in the ecoregion - NSS herring, mackerel, and blue whiting - has been highly variable since the 1980s, fluctuating above and below the reference point (F_{MSY}), at a level that produces maximum sustainable yield (MSY). According to the most recent assessment, F is above reference point for NSS herring and blue whiting, but below for mackerel (Figure 3).

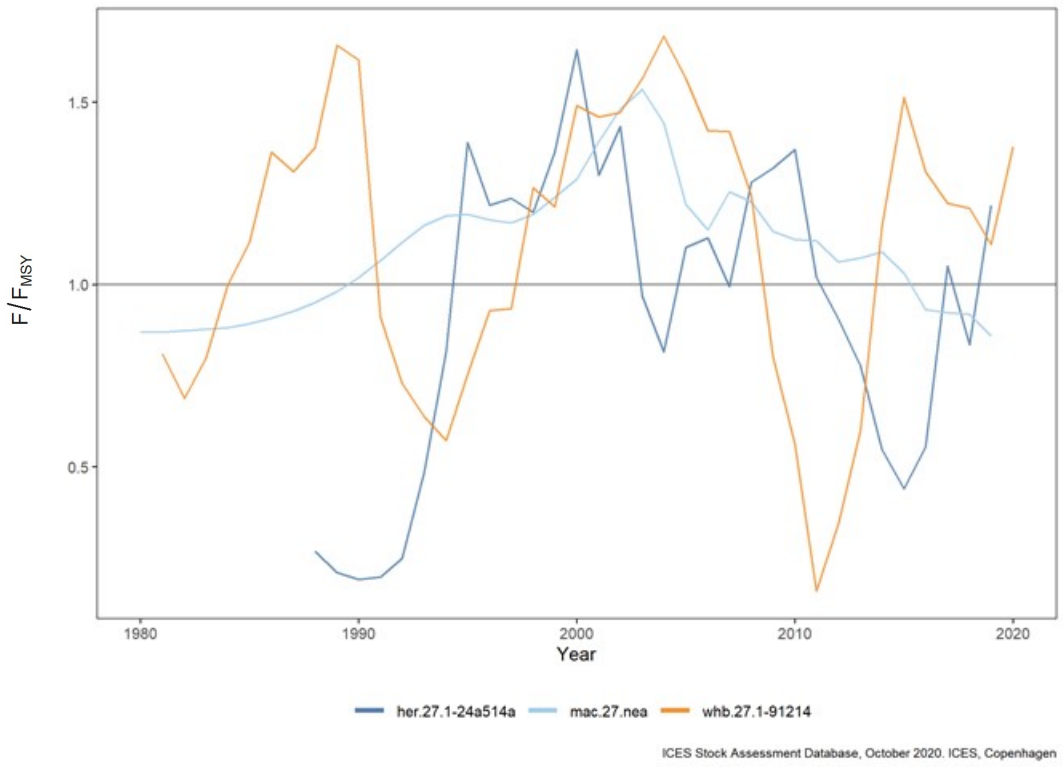

Figure 3 Time series of annual relative fishing mortality (F to F_{MSY} ratio) for the three major pelagic fish stocks; Norwegian spring-spawning herring, mackerel, and blue whiting.

Impact on threatened and declining fish species

Seven fish species on the OSPAR list of threatened and declining species are currently listed for the Norwegian Sea (see Table 1). None of these species have targeted fishery today. Most of the species remain vulnerable to bycatch by various fishing gear. Reported annual bycatch is 24 tonnes of basking shark (*Cetorhinus maximus)* and 56 tonnes of porbeagle (*Lamna nasus)*. Approximately 80 000 eels (*Anguilla anguilla)* are caught annually and the majority are released unharmed. Reported spurdog (*Squalus acanthias)* bycatch is 1156 tonnes for the 2010–2018 period.

Impact on seabirds and marine mammals

Coastal fisheries are mainly responsible for seabird and marine mammal bycatch. Harbour porpoises, harbour seals (*Phoca vitulina*), and grey seals frequently drown in fishing gear. The annual harbour porpoise bycatch in the Norwegian coastal water gillnet fisheries in the 2006–2018 period ranged from 1151 to 6144 individuals, with an average of about 2900. This exceeds the sustainable anthropogenic removal threshold, defined using a potential biological removal (PBR) framework. From 2013 to 2018, however, a significant reduction occurred which brought the annual average down to about 1600 individuals, which is below both ASCOBANS 1.7% limit as well as the PBR threshold. A possible reason for this decline is reduced effort in the monkfish fishery. There are very few records of larger marine mammals, such as sperm whale (*Physeter macrocehpalus*) and humpback whale (*Megaptera novaeangliae)*, being killed or injured by fishing gear. For seabirds, high bycatch rates have been observed in gillnet fisheries and more moderate rates in longline fisheries along the Norwegian coast.

Introduction of contaminating compounds

The ecoregion remains relatively clean, with low pollution levels. The contaminating compounds in the ecoregion originate from three sources: coastal sources, sources from outside the ecoregion, and from the local oil and gas industry.

The pollutants likely to be having the greatest effects on the biota are persistent organic pollutants (POPs) and heavy metals; the major sources of these are found outside the ecoregion. In general, the levels of most POPs are declining in the Arctic, indicating reduced primary emissions.

Both toothed and baleen whale are highly migratory species, and therefore accumulate contaminants along their migratory routes. Toothed whales in general are particularly prone to the accumulation of high levels of not only POPs, but also heavy metals, due to their high trophic level and generally low capacity for metabolization of pollutants. Killer whales (*Orcinus orca*) are considered particularly vulnerable, and seal-eating individuals in the eastern part of the Norwegian Sea have been shown to have levels of POPs and mercury above thresholds for health effects. In hooded seals, levels of POPs have been shown to be below known threshold levels for effects on reproductive capacity and the immune system, but above levels for effects on thyroid hormone levels, which may affect growth. High levels of POPs have been found in pilot whales (*Globicephala melas*) and white sided dolphins (*Lagenorhynchus acutus*) around the Faroe Islands, and in pilot whales, threshold levels for liver damage are exceeded for mercury, this is likely to be similar in the Norwegian Sea. The effects on pollutants on seabirds have not been studied sufficiently in the Norwegian Sea ecoregion. Studies just outside the ecoregion, however, indicate that POP concentrations may present health issues in glaucous gull (*Larus hyperboreus*) in Svalbard, and adverse population effects in common eider (*Somateria mollissima*) on Store Grindøya when combined with other stressors. Pollution levels in the major pelagic fish stocks in the Norwegian Sea are fairly low.

The release of pollutants in produced water from petroleum activities (oil releases to the sea, phenols, PAHs, radioactive compounds, etc.) are fairly stable over time; in some cases, their release is slowly rising and the organic acid content is declining. Haddock (*Melanogramus aeglefinus*) caught northwest of Kristiansund and at the Halten Bank have been found to have levels of DNA adducts, a measure of exposure to PAHs, similar to those seen in the North Sea. A recent review in the North Sea concluded that fish and mussels caged close to offshore produced water discharges show mild acute effects, and petrogenic bile metabolites in caged fish show exposure 10 km from produced water discharges.

Concentration of contaminants in coastal areas are related to local human activities. Increased activities in the aquaculture sector have caused increased emissions of copper along the coast of western Norway but it is unclear whether this is spread to the open parts of the Norwegian Sea. Input of contaminants from river run-offs to coastal areas is negligible.

Underwater noise

The sources of sound in the Norwegian Sea are mostly located relatively close to the Norwegian coast. The Norwegian Sea is exposed to anthropogenic sound from sources such as shipping, fishing vessels, seismic airguns, and military sonars.

In Norwegian waters, the majority of seismic surveys occur in the North Sea, but a number also occur in the Norwegian Sea every year; this is to search for new oil and gas fields, as well as to estimate remaining reserves within existing fields. Sound from seismic air guns are characterized by low frequencies and high sound levels, resulting in sound that under certain circumstances can propagate several thousand kilometres. Furthermore, seismic sound is in the frequency range audible to most fish and marine mammals. This means that not only can surveys within the Norwegian Sea be audible to animals there, but also surveys taking place in the North Sea and Barents Sea. Seismic sound has the potential to disturb both fish and marine mammals.

Sonars are occasionally used in the Norwegian Sea during naval exercises. The only fish species common in the Norwegian Sea that can detect sonar signals, herring, are not negatively affected at individual or population levels. The ways in which sonar signals affect marine mammals in the Norwegian Sea has been studied intensively in the past decade, and various effects such as avoidance, cessation of feeding, and changes in vocalisation and diving have been documented. Out of the mammal species common in the Norwegian Sea, killer whales, minke whales and sperm whales are the most sensitive, while humpback whales and pilot whales are less disturbed by naval sonars. Bottlenose whales (*Hyperoodon ampullatus*), which are not common in the Norwegian Sea, are the most sensitive of the marine mammal species investigated. Naval exercises with sonar activity are planned to avoid areas and periods of high abundance of marine mammals.

The Norwegian Sea houses at least one major shipping lane (Figure 4). Ship noise is less intense than seismic and sonar noise, but contributes to increasing background noise levels even far from the major shipping lanes due to long range sound propagation at low frequencies. Shipping noise can be detected by, and potentially disturb, both fish and marine mammals.

Offshore wind farms are not yet established in the Norwegian Sea, but there are currently plans for several sites. Such wind farms will increase noise during both the construction and operation phases.

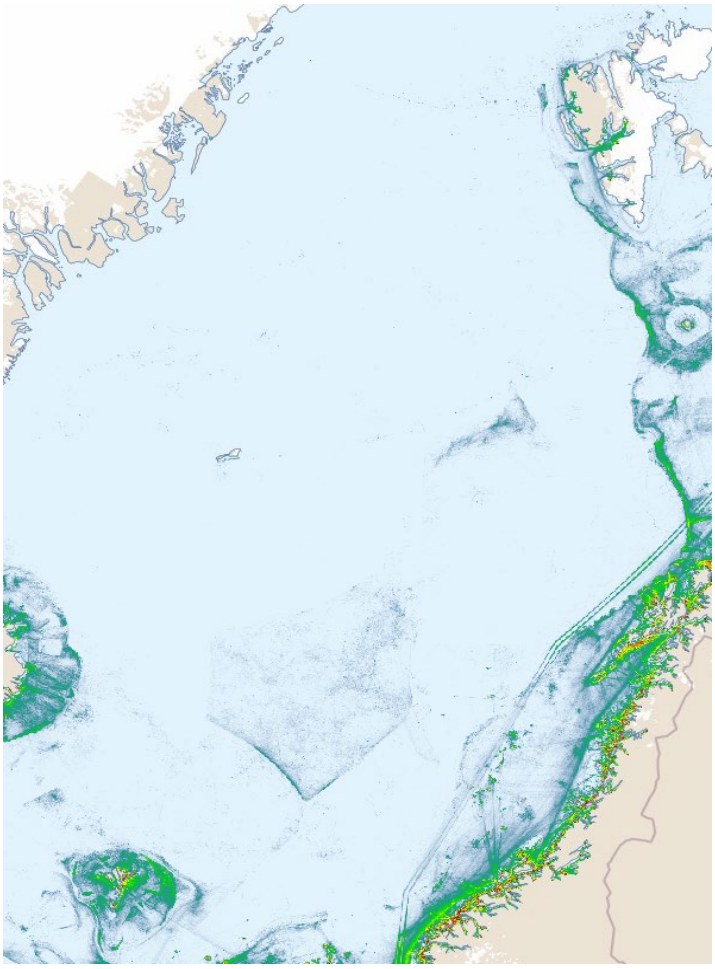

Figure 4 Accumulated ship traffic density in 2019 in the Norwegian Sea, based on AIS data and created in the framework of EMODnet Human Activities, an initiative funded by the EU commission (https://emodnet.eu/en). Downloaded from BarentsWatch (https://kart.barentswatch.no/arealverktoy?epslanguage=no).

Abrasion

Abrasion is caused by towed bottom-contacting gear and offshore oil and gas operations; it affects benthic organisms and habitats. The physical disturbance of benthic habitats by bottom trawl fishing gear is described using vessel monitoring system (VMS) and logbook data. The extent, magnitude, and effects of mobile bottom-contacting fishing gear on the seabed and benthic habitats varies spatially across the Norwegian Sea, according to the large seabed mapping project MAREANO. Such fishing gear is seldomly used in the Norwegian Sea, and is limited to the shelf in the southern part of the ecoregion (Figure 5). Coral reef areas are protected from bottom fishing.

Using VMS and logbook data, ICES estimates that mobile bottom trawls used by commercial fisheries in the >12 m vessel category have been deployed over approximately 26 075 km^2 of the ecoregion in 2018, corresponding to about 2.2% of the ecoregion's spatial extent (Figure 5).

Offshore oil and gas operations are presently limited to the south-eastern part of the ecoregion (Figure 6).

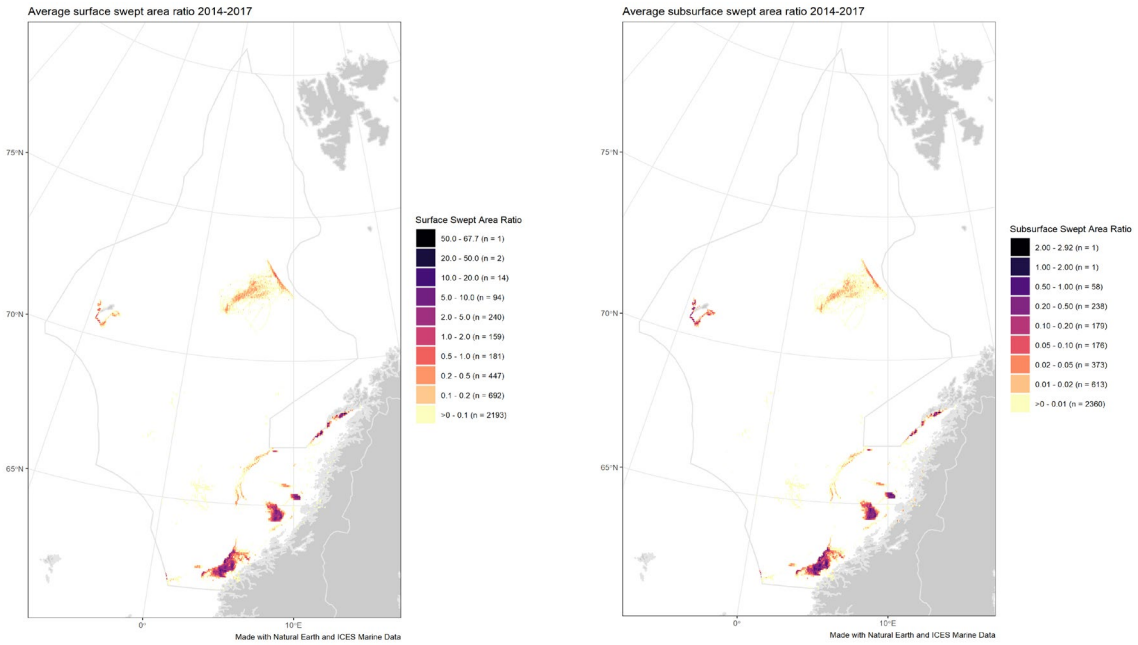

Figure 5 Average annual surface (left) and subsurface (right) disturbance by mobile bottom-contacting fishing gear (bottom otter trawls, bottom seines, dredges, beam trawls) in the Norwegian Sea ecoregion during 2014–2017, expressed as average swept-area ratios (SAR). No data for Russia or Faroes Islands is available. Data from the years 2014–2017 were used to produce the figure, due to the lack of Norwegian data for 2018.

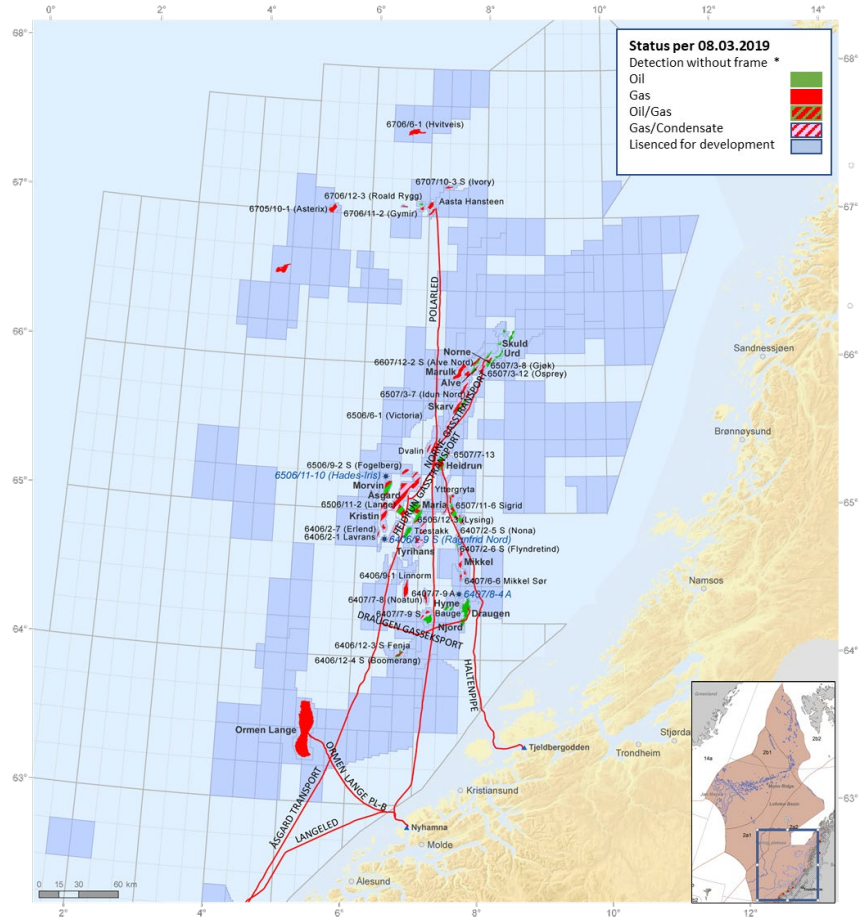

Figure 6 Active oil and gas activities in the Norwegian Sea, March 2019. Red lines are gas pipelines. Areas that are not marked as licensed for development (pale blue), are currently closed (Source: Norwegian Petroleum Directorate, http://www.npd.no/en/).

Other pressures

Additional pressures that pose a lower risk to the offshore areas of the ecoregion include marine litter (including lost fishing gear), sealing, smothering, selective extraction of non-living resources, and nutrient and organic enrichment.

Climate change impacts

Climate forcing is affecting the physical oceanography of the ecoregion. The Norwegian Sea is influenced by the amounts and properties of Atlantic water flowing in from the south through the Gulf Stream. It is also influenced by the advection of Arctic Water from the Greenland and Iceland Seas. Understanding of the governing mechanisms relating to exchanges between the Atlantic and Arctic regions of the Norwegian Sea remains limited.

The long-term climate variability of the Norwegian Sea follows the Atlantic Multidecadal Oscillation (AMO), which is measured as the mean surface temperature of the Atlantic Ocean between equator and 60°N. Long-term AMO data indicate that warm phases have grown warmer and cold phases less cold, consistent with anticipated and observed warming conditions in the ecoregion. The local evidence suggests an increase in the integrated relative heat content of the 0–1000 m depth layer since the early 2000s and a recent freshening (Figure 7), which is linked to the general freshening of Atlantic water, and increased inflow of the Arctic water to the ecoregion. (Figure 7). The recent freshening was associated with only a slight cooling, probably due to reduced heat loss to the atmosphere as a result of enhanced generally relatively warm westerly winds.

Warming of the Norwegian Sea is expected to affect ecosystem structure and processes, but these remain to be investigated in the ecoregion.

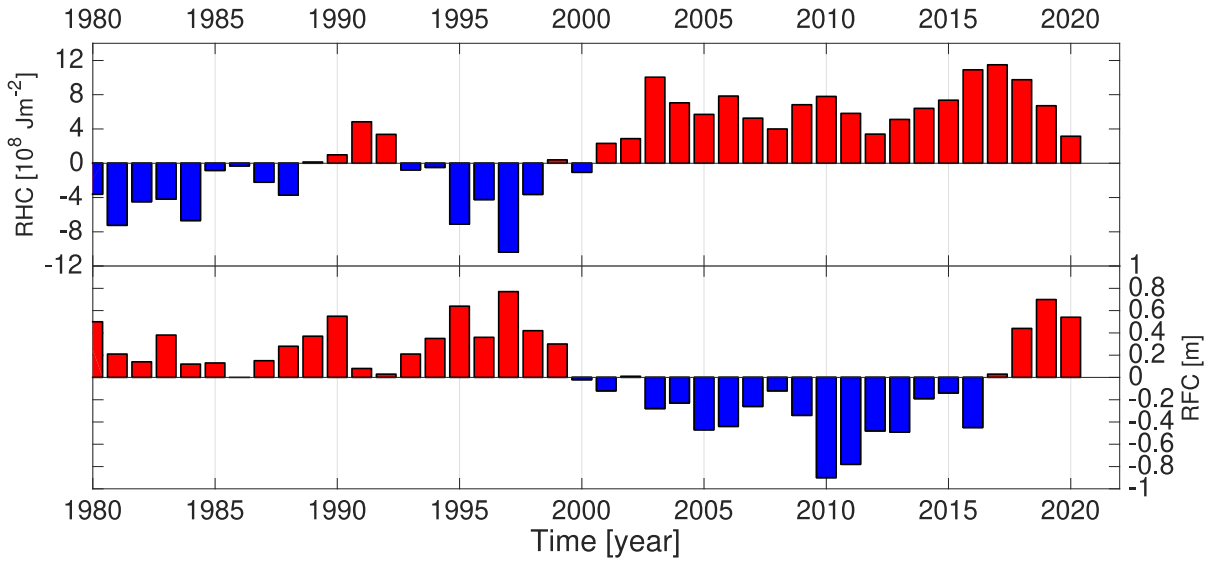

Figure 7 A subset of climate indicators for the Norwegian Sea: a) Relative Heat Content and b) Relative Freshwater Content.

State of the ecosystem

Habitats

The majority of the shelf consists of fine muds and sandy muds, with coarser sediments on the shelf slope (Figure 8). Habitat mapping has located several vulnerable habitats, including coral and sponge communities. There is little information from the deep-water areas because mapping has been carried out in the continental shelf and slope.

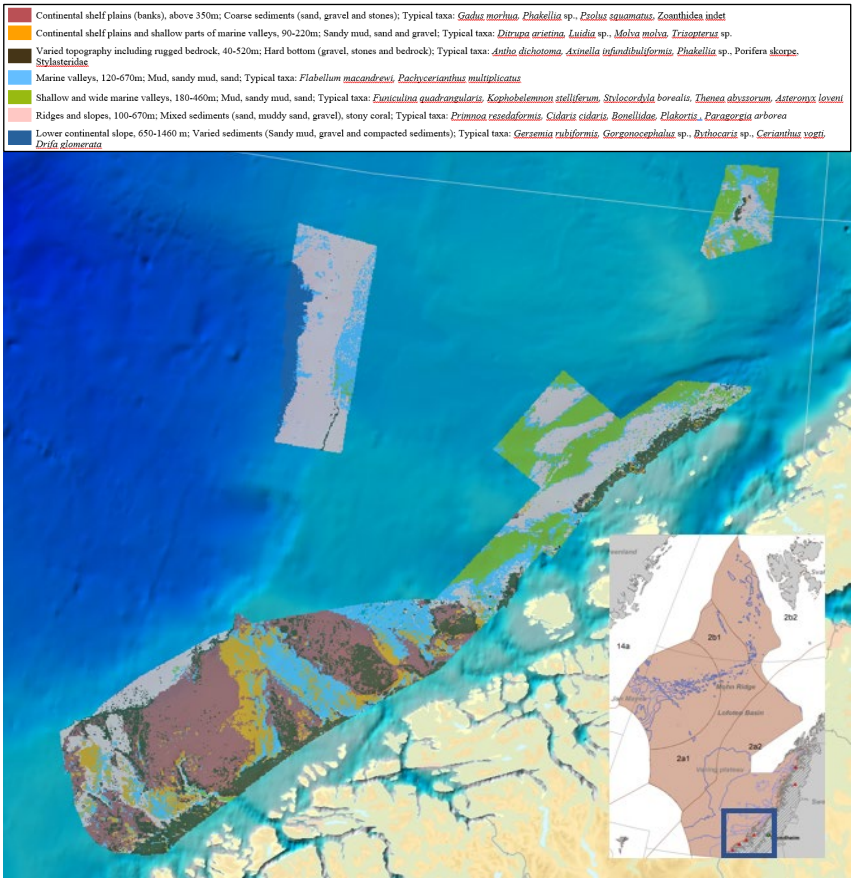

Figure 8 Habitat types mapped in the Norwegian Sea by the MAREANO project (https://mareano.no/en).

Primary productivity

In recent years, annual primary production has been higher, in general, compared to earlier in the time series (Figure 9). This may be caused by increased inflow of cold and fresh Arctic water that has higher nutrient concentrations. Spring blooms have also tended to end later in recent years (Figure 9).

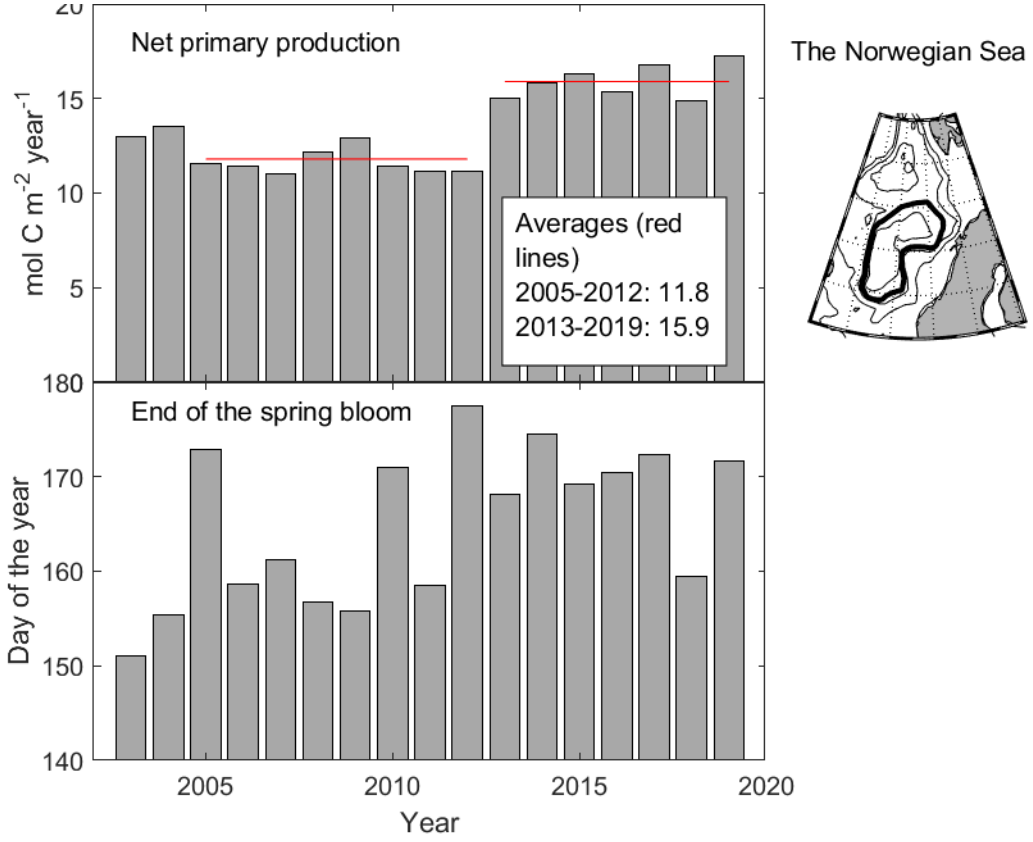

Figure 9 Estimated net yearly primary production (upper panel) and date for end of the spring bloom (lower panel) in the Norwegian Sea.

Zooplankton

There has been a general increase in zooplankton biomass both in spring and summer since 2010, with high variability across years and sub-areas of the ecoregion (Figure 10).

Changes in the occurrence and abundance of ecologically important copepod taxa have also been observed, possibly related to reduced inflow of Arctic water into the southwestern part of the Norwegian Sea. Higher-than-average heat content in the Norwegian Sea, timing effects, and top-down effects from large pelagic fish stocks and carnivorous zooplankton also influence the observed dynamics, but their relative importance is unknown.

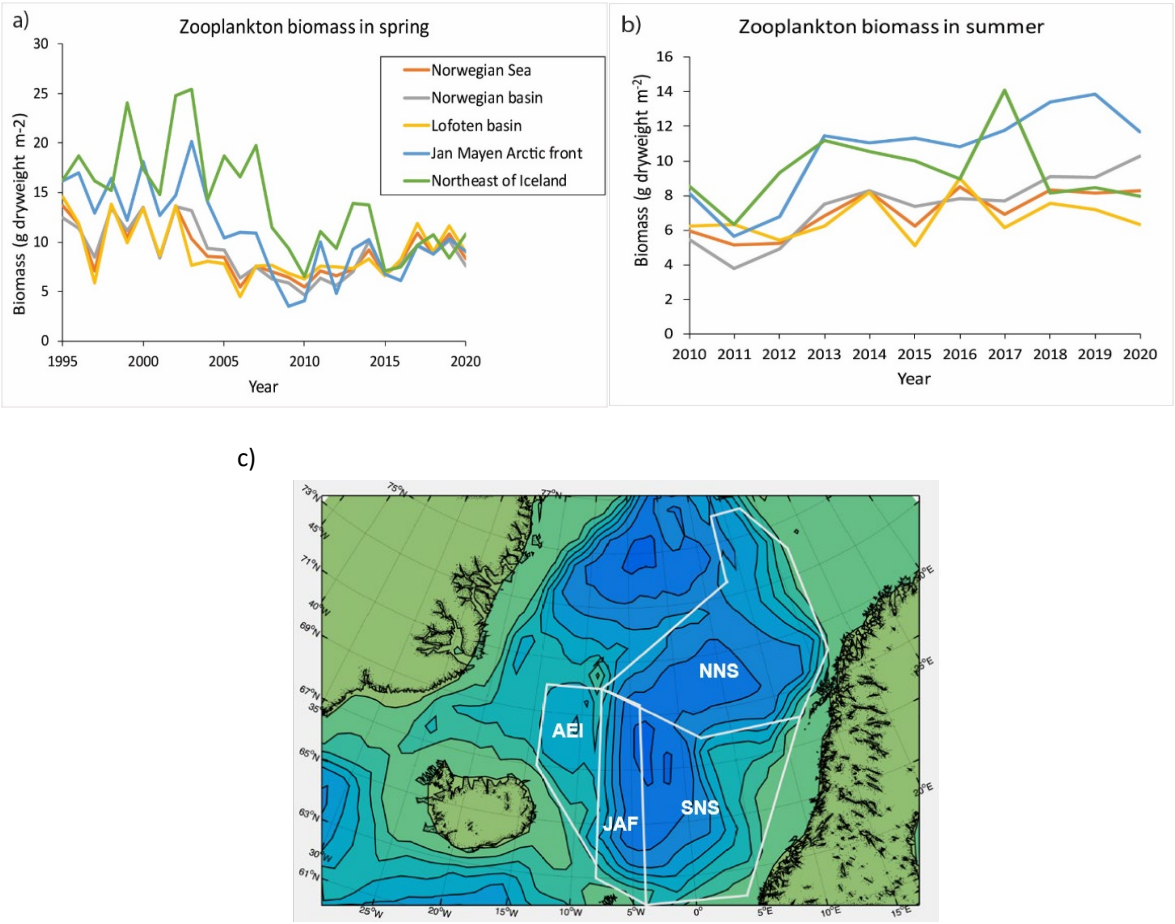

Figure 10 Indices of zooplankton biomasses (g dry weight m^{-2}) in the upper 200 m of the water column in the Norwegian Sea and adjacent water: a) in May during the time period 1995–2020, b) in July/August during the time period 2010–2020. The total area has been divided into 4 sub-areas (delineation shown in panel c); Red: southern Norwegian Sea including the Norwegian Sea Basin (SNS in panel c); Blue: Northern Norwegian Sea including the Lofoten Basin (NNS); Black: the Jan Mayen Arctic front area (JAF); Green: the area East of Iceland (AEI); Grey: the mean index of the sub-areas southern- and northern Norwegian Sea.

Fish

The spawning stock biomass (SSB) of the three dominant pelagic stocks in the Norwegian Sea ecoregion - NSS herring, mackerel, and blue whiting - has been above the biomass reference point for the majority of the period since 1980 but with a different temporal pattern between stocks. In 2020 SSB was similar for all three stocks, ranging from 3.2 to 3.7 million tonnes (Figure 11a). Since the late 1980s, combined SSB of the three stocks peaked at 15.6 million tonnes in 2016 and had declined by 34% in 2020. Herring SSB peaked in 2008 and had declined by 53% in 2020. Mackerel SSB peaked in 2014 and had declined by 29% in 2020. Blue whiting SSB last peaked in 2016 and has since declined by 48%.

For herring, the decline during the past decade is associated with below average recruitment (Figure 11b). During the same period, all new year-classes of mackerel have been above average size (Figure 11b). Blue whiting's sharp decline in SSB in most recent years is associated with fishing mortality above F_{MSY} and poor recruitment (Figure 11b).

Since the mid-2000s, the status of mackerel in the ecoregion has been influenced (or characterised) by a westward expansion and subsequent retraction of its summer feeding grounds into Icelandic and Greenland waters.

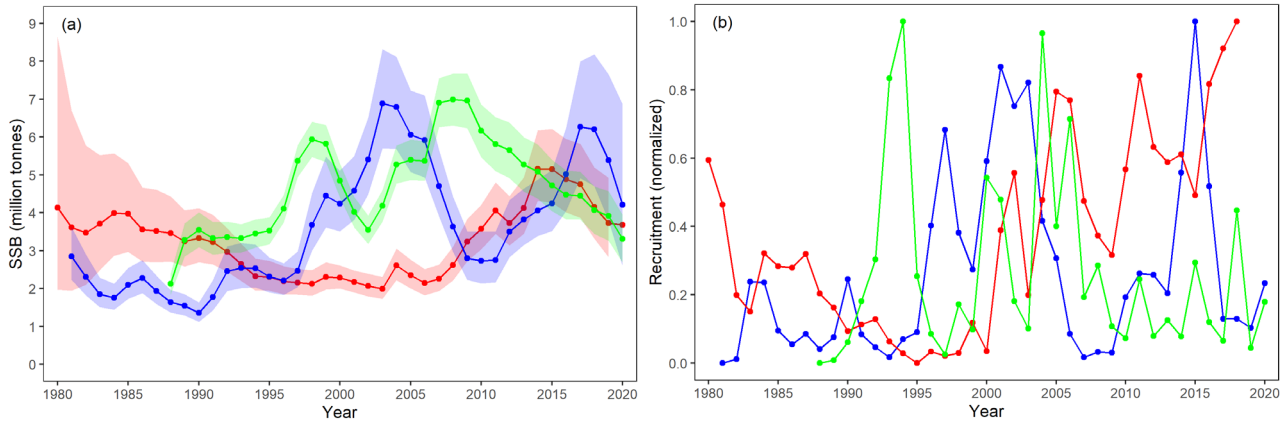

Figure 11 a) Estimated spawning stock biomass (lines) including 95% confidence intervals (shaded areas) for Norwegian spring-spawning herring (green), mackerel (red), and blue whiting (blue) from 1980 to 2020. b) Estimated year-class size at recruitment for Norwegian spring-spawning herring (age 2; green), mackerel (red), and blue whiting (age 1; blue) from 1981 to 2020, values normalized to the maximum of one and minimum of zero.

Cod and haddock SSB shows an increasing trend until 2013/2014, with a decrease in the last few years. However, the mean SSB for cod, haddock, and saithe are at full reproductive capacity above the biomass reference point. Beaked redfish has recovered from low levels in the early 1990s. Biomass levels have been generally stable since the mid-2000s at about four times the early 1990s-levels. The golden redfish remains depleted and is on the Norwegian red list.

There is no analytical assessment for the greater silver smelt for SSB. The acoustic biomass index for the fish was higher in recent years (2014, 2016, and 2018) than in 2009 and 2012.

Seabirds

Three species of seabirds feeding in the pelagic part of the ecosystem were selected as indicator species for the eastern part of the Norwegian Sea: the black-legged kittiwake (*Rissa tridactyla*, hereafter kittiwake), Atlantic puffin (*Fratercula arctica*, hereafter puffin), and common guillemot. These species were selected because they feed in different parts of the pelagic ecosystem. Time series of their population development in the eastern Norwegian Sea were derived from their estimated breeding numbers in 2013 and annual monitoring of trends in selected breeding colonies (Runde, Sklinna, Røst and Anda (only kittiwake and puffin).

The breeding population of kittiwakes in the eastern Norwegian Sea has declined by 78% since monitoring started in 1980. Several large colonies have already disappeared, and more risk extinction within a few decades. In the same area and period, the breeding population of puffins has declined by 75% and that of common guillemots by as much as 99%. The

remaining population of common guillemots breeds in areas sheltered from predation and is currently relatively stable, but the species is at high risk of extinction as a breeding species along a large part of the Norwegian mainland coast (Figure 12).

Jan Mayen in the north-western Norwegian Sea holds only < 10,000 pairs of kittiwakes, < 5000 pairs of puffins, and < 1000 pairs of common guillemots. Common guillemot numbers have shown a declining trend since 2011, when monitoring started.

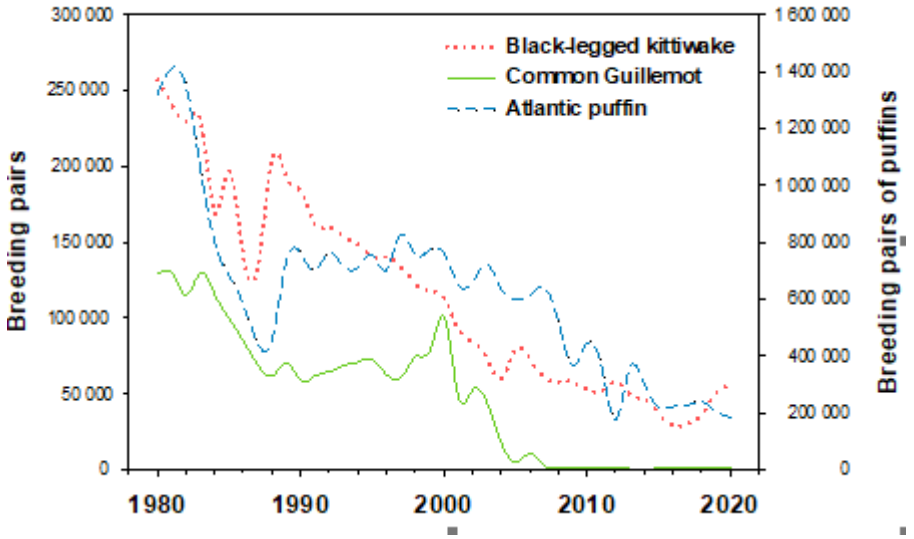

Figure 12 Population trends for seabirds breeding in the Norwegian part of the eastern Norwegian Sea since 1980: black-legged kittiwake (red line), common guillemot (green line) (both left vertical axis), and Atlantic puffin (blue line) (right vertical axis).

The largest changes in seabird numbers in the eastern Norwegian Sea are linked to ocean climate variability; these are most likely caused by substantial changes in prey abundance and availability, with dire consequences for reproductive success and recruitment. This has also affected survival rates to some extent, and populations can occasionally be severely hit by extreme weather events. Still, an increasing number of studies document effects of other natural and man-induced changes that may also contribute to the variation in seabird breeding performance. These include factors such as competition with fisheries and increased predation from white-tailed eagles (*Haliaeetus albicilla*), as well as contaminants and human disturbance.

Marine mammals

Out of the 23 species of marine mammals (7 pinnipeds, 1 polar bear, 6 baleen whales and 9 toothed whales) occurring regularly in the ecoregion, 9 are of particularly importance: minke whale, fin whale (*Balaenoptera physalus*), humpback whale, and sperm whale dominate in biomass, but are mainly present in summer and autumn; hooded seal and bottlenose whale have a partial distribution in the Arctic; and harbour porpoise, grey seal, and harbour seal are resident on the continental shelf of Norway. Killer whale may occur all over the Norwegian Sea year-round, but are mainly associated with the herring and mackerel migrations. All these marine mammal species have been substantially affected by historic harvesting and bycatch levels, but only minke whales, and grey and harbour seals are currently hunted.

Relative abundance indicators suggest stable occurrence of the deep diving sperm whales over the 2002–2018 period. During the same period, abundance estimates for both harbour porpoises and killer whales have been highly variable in the Norwegian Sea ecoregion but show no clear trend. Abundance trends are not available for bottlenose whales, but primary observations of this deep diving species have doubled recently (survey observations during 2014–2018 compared to previous survey in 2002–2013).

Abundance of the Northeast Atlantic hooded seal population has continued to decline after protection in 2007. Over the past decade, declines in harbour and grey seals observed in Central Norway have led to their full protection in some areas.

Fin and humpback whales have shown strong recoveries in the Northeast Atlantic over the past decades, but many appear to travel through the Norwegian Sea to the Barents Sea ecoregion. Northeast Atlantic minke whales have maintained healthy and stable population sizes under the recent harvesting regime, but distribution among these two ecoregions may vary between years.

Non-indigenous species

There are ten non-indigenous species (NIS) reported from the Norwegian Sea with two (Pacific salmon, *Oncorhynchus gorbuscha* and the dinoflagellate *Karenia mikimotoi*) established in open parts of the sea. In addition, the invasive comb jelly (*Mnemiopsis leidyi)* has been occasionally observed (last in 2014). Most NIS have been reported from coastal regions where monitoring is in place. In general, the Norwegian Sea ecoregion is relatively poorly monitored for NIS, and there are therefore uncertainties associated with the occurrence of NIS in the ecoregion.

Threatened and declining species and habitats

Table 1 Threatened and declining species in the Norwegian Sea, according to OSPAR.

Scientific name	Common name
Invertebrates	
Nucella lapillus	Dog whelk
Ostrea edulis	Flat Oyster
Seabirds	
Larus fuscus fuscus	Lesser black-backed gull
Pagophila eburnea	Ivory gull
Rissa tridactyla	Black-legged kittiwake
Uria lomvia	Thick-billed murre (or Brünnich's guillemot)
Fish	
Anguilla anguilla	European eel
Cetorhinus maximus	Basking shark
Dipturus batis	Common skate
Lamna nasus	Porbeagle
Petromyzon marinus	Sea lamprey
Salmo salar	Salmon
Squalus acanthias	[Northeast Atlantic] spurdog
Marine mammals	
Balaenoptera musculus	Blue whale
Balena mysticetus	Bowhead Whale
Eubalaena glacialis	Northern right whale
Phocoena phocoena	Harbour porpoise

Table 2 Threatened and declining habitats in the Norwegian Sea, according to OSPAR.

Habitats
Coral gardens
Deep-sea sponge aggregations
Intertidal mudflats
Lophelia pertusa reefs
Modiolus modiolus beds
Seamounts
Zostera beds

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Those maps and GIS products, produced by the ICES Secretariat, provided by WGINOR or as indicated in the figure caption. Data used stems from:

1. Exclusive Economic Zones. Marineregions.org (VLIZ).
2. Depth contours. General Bathymetric Chart of the Oceans (GEBCO).
3. Ecoregions. International Council for the Exploration of the Sea (ICES).
4. Ports. Norwegian Institute of Marine Research (IMR).
5. ICES Areas. International Council for the Exploration of the Sea (ICES).
6. Catchment Area. European Environment Agency (EEA). European Topic Centre on Inland, Coastal and Marine waters (ETC/ICM).
7. Habitat types. MAREANO project (https://mareano.no/en).

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Annex A

Table A1 Stocks with analytical assessments and guilds in the Norwegian Sea ecoregion. Detailed information on the fisheries of the Norwegian Sea is provided on the Norwegian Sea Fisheries Overview (https://doi.org/10.17895/ices.advice.7603)

Stock code	Stock name	Fishery guild
cod.27.1-2	Cod (*Gadus morhua*) in subareas 1 and 2 (Northeast Arctic)	demersal
ghl.27.1-2	Greenland halibut (*Reinhardtius hippoglossoides*) in subareas 1 and 2 (Northeast Arctic)	demersal
had.27.1-2	Haddock (*Melanogrammus aeglefinus*) in subareas 1 and 2 (Northeast Arctic)	demersal
pok.27.1-2	Saithe (*Pollachius virens*) in subareas 1 and 2 (Northeast Arctic)	demersal
reg.27.1-2	Golden redfish (*Sebastes norvegicus*) in subareas 1 and 2 (Northeast Arctic)	demersal
dgs.27.nea	Spurdog (*Squalus acanthias*) in Subareas 1-10, 12 and 14 (the Northeast Atlantic and adjacent waters)	elasmobranch
reb.27.1-2	Beaked redfish (*Sebastes mentella*) in subareas 1 and 2	pelagic
cap.27.2a514	Capelin (*Mallotus villosus*) in subareas 5 and 14 and Division 2.a west of 5°W (Iceland and Faroes grounds, East Greenland, Jan Mayen area)	pelagic
her.27.1-24a514a	Herring (*Clupea harengus*) in subareas 1, 2, 5 and divisions 4.a and 14.a, Norwegian spring-spawning herring (the Northeast Atlantic and Arctic Ocean)	pelagic
hom.27.2a4a5b6a7a-ce-k8	Horse mackerel (*Trachurus trachurus*) in Subarea 8 and divisions 2.a, 4.a, 5.b, 6.a, 7.a-c,e-k (the Northeast Atlantic)	pelagic
Aru.27.123a4	Greater silver smelt (*Argentina silus*) in subareas 1, 2, and 4, and in Division 3.a	pelagic