12.2 Norwegian Sea ecoregion – Fisheries overview

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Executive summary

The largest landings in this ecoregion are by Norway, the Russian Federation (Russia henceforth), Faroe Islands, and Iceland, mainly by pelagic fisheries. Other nations also have fisheries in the area. The number of fishing vessels is declining while the size of the remaining vessels is increasing. The annual catch in the ecoregion has varied between 700 000 tonnes to almost 1 million tonnes.

The pelagic fisheries, using purse seine and pelagic trawls, account for the largest catches by weight and target herring, blue whiting, mackerel, and other pelagic species. The largest demersal fishery targets cod, haddock, and saithe using trawls, purse seine, and gillnets. Smaller fisheries target other gadoid species, Greenland halibut, and redfish. Landings of pelagic species within the ecoregion in the last decades have been variable, mainly due to the fluctuations in landings of herring and capelin. The demersal fisheries, dominated by cod, display less pronounced fluctuations than the pelagic fisheries. Information about discards is sparse, but the total weight of discards is considered low in both the pelagic and the demersal fisheries. Harp seals and minke whales are hunted in the region.

Status summary of Norwegian Sea stocks relative to the ICES maximum sustainable yield (MSY) approach and precautionary approach (PA) is known for 50% of the 23 stocks assessed by ICES in this ecoregion. Only 22% of the stocks are fished below F_{MSY}, accounting for nearly 13% of the total catch. 30% of the stocks have a biomass above MSY $B_{trigger}$, accounting for 86% of the total catch. Demersal stocks have shown a trend of declining fishing mortality since the mid-1990s, and the average F/F_{MSY} ratio is now close to 1. The mean SSB/MSY $B_{trigger}$ ratio of demersal stocks has been decreasing over the last decade, but mean SSB remains above MSY $B_{trigger}$. The average F/F_{MSY} ratio for pelagic stocks has been decreasing since 2000 and is now close to 1. The mean SSB/MSY $B_{trigger}$ ratio for pelagic species has shown a slight increase over the last two decades and is above MSY $B_{trigger}$.

In addition to biomass removal, ecosystem effects of fisheries include abrasion, ghost fishing, and bycatch of protected, endangered, and threatened species.

Introduction

The Norwegian Sea connects with the Northeast Atlantic Ocean 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 to the shallower North Sea along the 62˚N parallel between Norway and the Faroe Islands, and to the northeast with the shallower Barents Sea (Figure 1). The Norwegian Sea covers more than 1.1 million km^2, consisting of two deep basins (between 3000 m and 4000 m deep), the Norwegian Basin and the Lofoten Basin, separated by the Vøring plateau (between 1000 m and 3000 m deep). The Norwegian Sea is separated from the Greenland Sea to the north by the Mohn Ridge. To the west, the basin slope forms the transition to the somewhat shallower Iceland Sea. The warm North Atlantic Current ensures relatively stable and high water temperatures, so that unlike the Arctic seas, the Norwegian Sea is ice-free throughout the year.

The Norwegian Sea ecoregion covers parts of ICES Subarea 2 and a small part of ICES Division 14.a. Fisheries statistics used in this overview are taken from the entire Subarea 2.

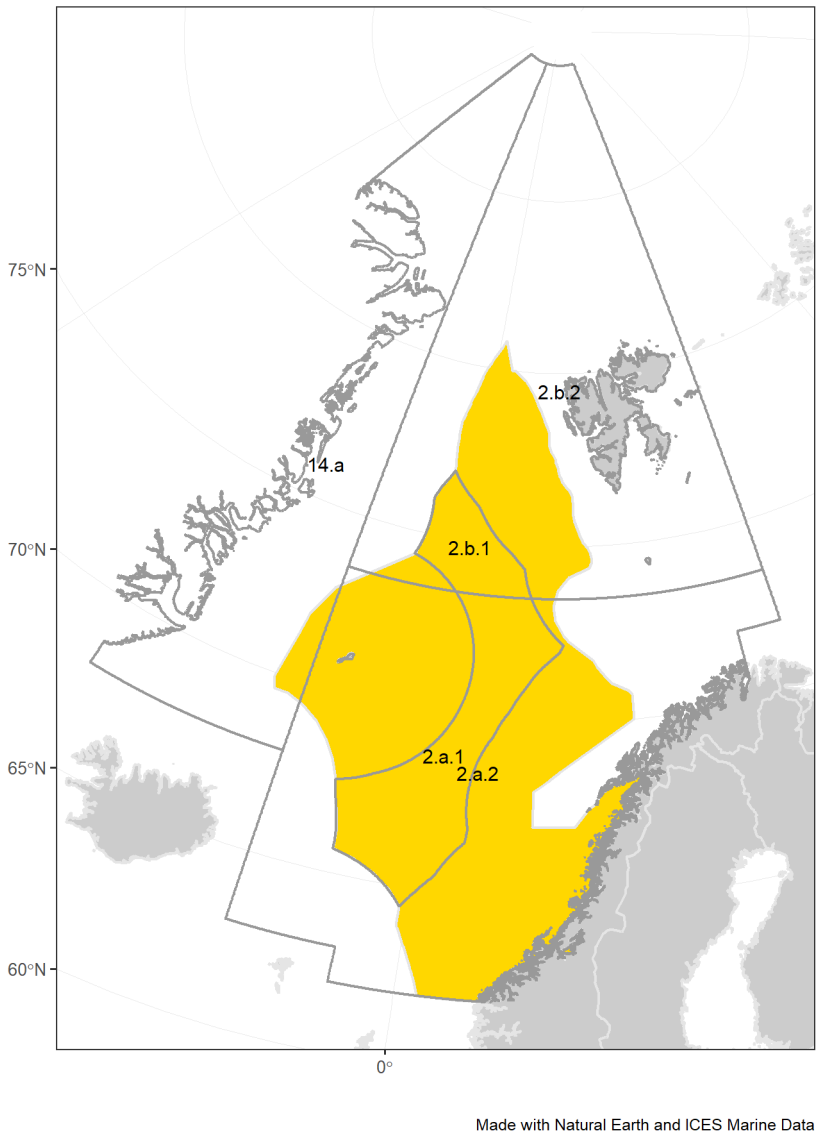


Figure 1 The Norwegian Sea ecoregion (highlighted in yellow).

The overview provides:

- a short description of each of the national fishing fleets in the ecoregion, including their fishing gears and patterns. At present recreational fisheries are not included;
- a summary of the status of the fisheries resources and the level of exploitation relative to agreed objectives and reference points; and
- an evaluation of the impacts of fishing gear on the ecosystem in terms of physical contact on subsurface and bottom habitats, and on the bycatch of protected species.

Scientific names of all species are included in Table A3 in the Annex.

Who is fishing

Many nations currently have fisheries targeting the marine stocks within this ecoregion. The largest landings are by Norway, Russia, Faroe Islands, and Iceland. Lesser amounts are landed by the United Kingdom and others (Figure 2). The largest

nominal effort is by Norway (Figure 3). Pelagic fishing by multinational fleets is the major activity in the ecoregion. The number of fishing vessels is declining while the size of the vessels are increasing.

Norway

The Norwegian commercial fleet has the highest fishing activity in the shelf area, particularly along the coast of Norway and along the continental shelf edge. The Norwegian fleet fishing the ecoregion consists of about 2300 active vessels fishing pelagic fish, demersal fish (gadoids and other), and shellfish. Small coastal vessels (the majority < 15 m) fishing with beach seine, gillnets, and pots make up around 87% of the fleet, while the remaining are mainly ocean-going trawlers and purse seiners > 28 m in length. The highest catch volume (82% of the total catch) is taken by the bigger vessels, with pelagic fish as the most abundant species in the landings.

Harp and hooded seals are hunted with 2–5 large ice-going vessels. The minke whale hunt has continued in all years since 1993. Approximately 10–15 vessels participate in the minke whale hunt.

Russia

The Russian fleet in the Norwegian Sea and adjacent waters (mostly Barents Sea) is composed of about 215 vessels; 90% of these catch demersal species, including fish and crustaceans, and 15% catch pelagic species, including herring, blue whiting, and mackerel. Larger vessels (34–65 m) average around 60% of the fleet and mainly target cod, haddock, saithe, redfish, Greenland halibut, wolfish, long rough dab, and plaice using trawls and longlines, and shrimp using trawls. The industrial vessels (10 vessels of 65–100 m; 20 vessels > 100 m) are predominantly trawlers that use bottom and midwater trawls. They account for most of the landings of herring, blue whiting, and mackerel, but also catch cod, haddock, and saithe.

Iceland

The Icelandic fleet is composed of about 19 large vessels (> 65 m). They all target pelagic fish in the ecoregion (herring, mackerel, and blue whiting) and can operate with pelagic trawls and purse seines. All the catches in the ecoregion are caught by pelagic trawls. Two of the vessels freeze the catches on board while the others bring the catches ashore in RSW tanks.

United Kingdom

The UK fishery operating in the Norwegian Sea ecoregion fish mainly in ICES Division 2.a, using bottom and midwater trawls with the occasional gillnetting and purse seining. The 8–13 vessels operating in this area catch a variety of demersal and pelagic species. For bottom otter trawls, the smaller vessels (between 26 m and 40 m overall length), mainly target anglerfish, Greenland halibut, and redfish, while the larger ones (70 m–90 m) target cod, together with small amounts of saithe and haddock. The midwater trawlers, with overall length between 64 m and 114 m, target herring, mackerel, and blue whiting.

Faroe Islands

The Faroese fleet in the ecoregion consists of 12 large (> 55 m) vessels targeting pelagic species (herring, mackerel, and blue whiting) with pelagic trawl (mainly) or purse seine. Two of the vessels freeze the catch on board while the rest use refrigerated sea water (RSW) tanks to bring the catch ashore. In addition, a handful of smaller trawlers (35–50 m without RSW tanks) deliver the catch to the larger vessels at sea.

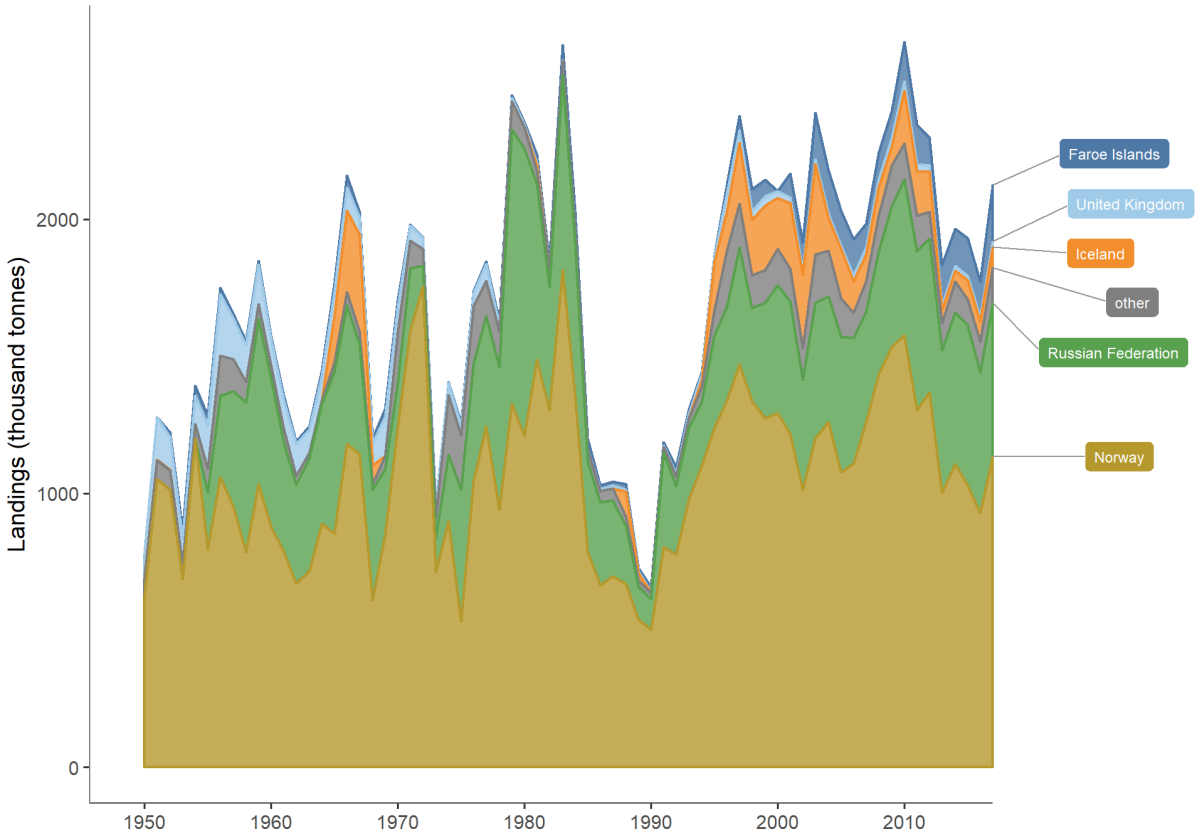


Figure 2 Landings (thousand tonnes) from ICES Subarea 2. This approximates to the majority of the Norwegian Sea ecoregion in 1950–2018, by (current) country. The five countries having the highest landings are shown individually and the remaining countries are aggregated and displayed as "other". Only a minor part of the cod and haddock catches included in this figure are taken in the Norwegian Sea ecoregion.

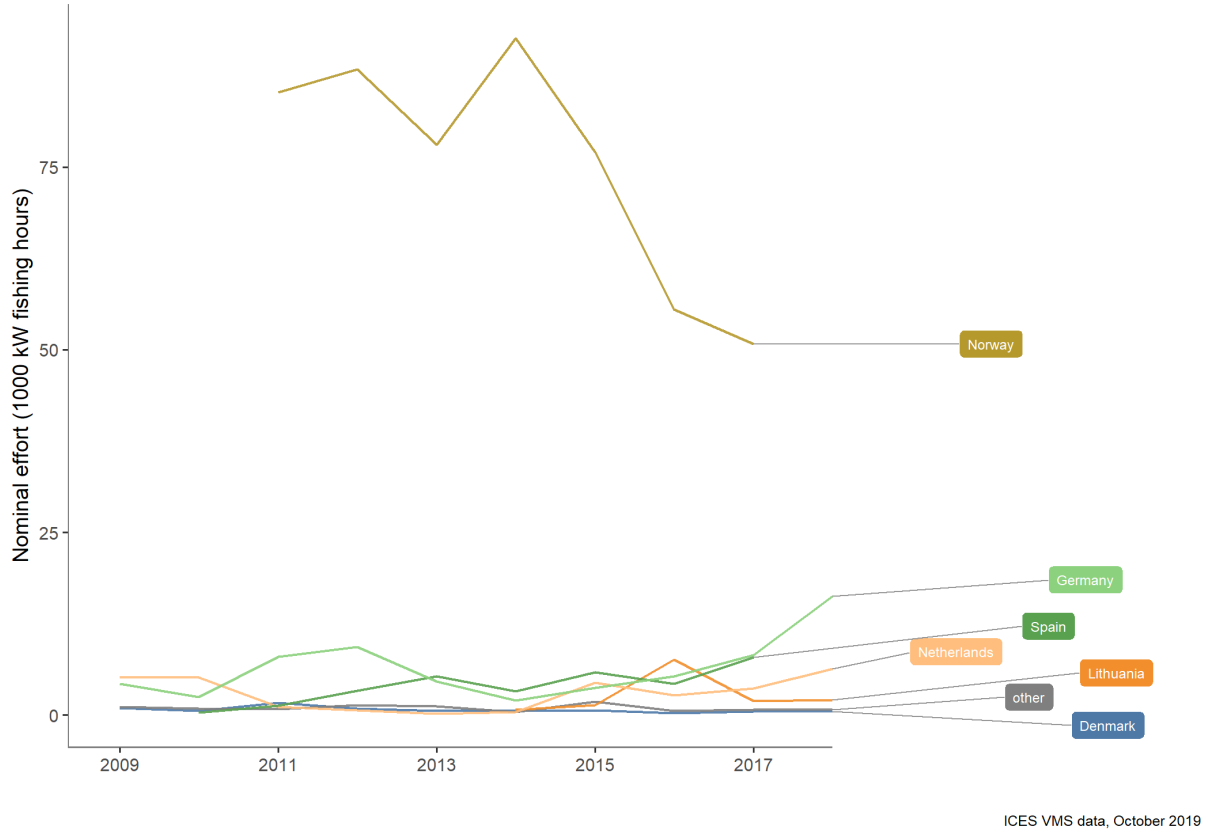


Figure 3 ICES Subarea 2. Fishing effort (1000 kW days-at-sea) in 2009–2018 for the main countries fishing in the ecoregion. There is no data from Norway for 2018.

Catches over time

Landings and discards are considered separately below. Data on landings have been collected for many years, whereas information on discards have only been collected consistently during the most recent years.

Landings

Fisheries in the ecoregion catch a large diversity of species. These have been categorized into species that are pelagic, demersal, crustacean, elasmobranchs, and benthic (e.g. flatfish).

The activities in the ecoregion is dominated by pelagic and demersal fisheries. Landings of pelagic species within the ecoregion in recent decades show large fluctuation, with peaks in the mid-1960s, early 1980s, and early 2000s (Figure 4), mainly brought on by fluctuations in the landings of herring and capelin (Figure 5). These fluctuations in landings correspond to the large fluctuation in stock size of herring and capelin over the last decades.

The demersal fisheries also have fluctuations, although less pronounced than the pelagic fishery, with peaks in the mid-1950s, early 1970s, and mid-1990s. The demersal fisheries are dominated by saithe which, to a large extent is responsible for the pattern in catches (Figure 4).

Since the 1970s, catches of harp seals have generally been lower than the TAC. Hooded seals were protected in 2007 due to low population level. Norwegian landings of minke whales peaked in the late 1950s, when around 4000 animals were taken per year. After this, landings decreased to 1500–2000 animals in the 1970s and early 1980s, until the moratorium on whaling temporary halted the hunt between 1987 and 1993. Thereafter, landings have been much lower, averaging around 500 animals per year.

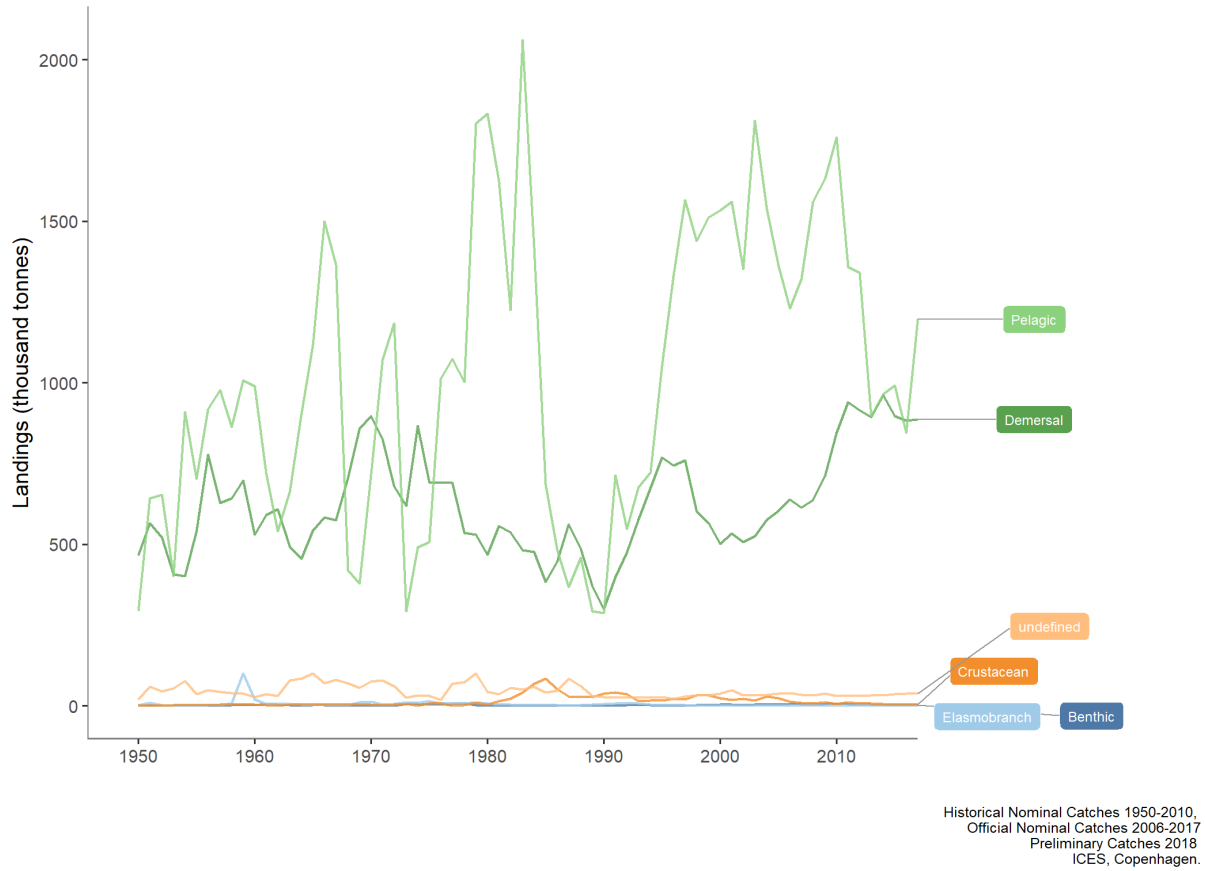


Figure 4 Landings (thousand tonnes) from ICES Subarea 2 in 1950–2018, by fish category. Table A1 in the Annex details the species that belong to each fish category. The demersal fish catches in this figure are dominated by cod and haddock. Only a minor part of those catches are taken in the Norwegian Sea ecoregion.

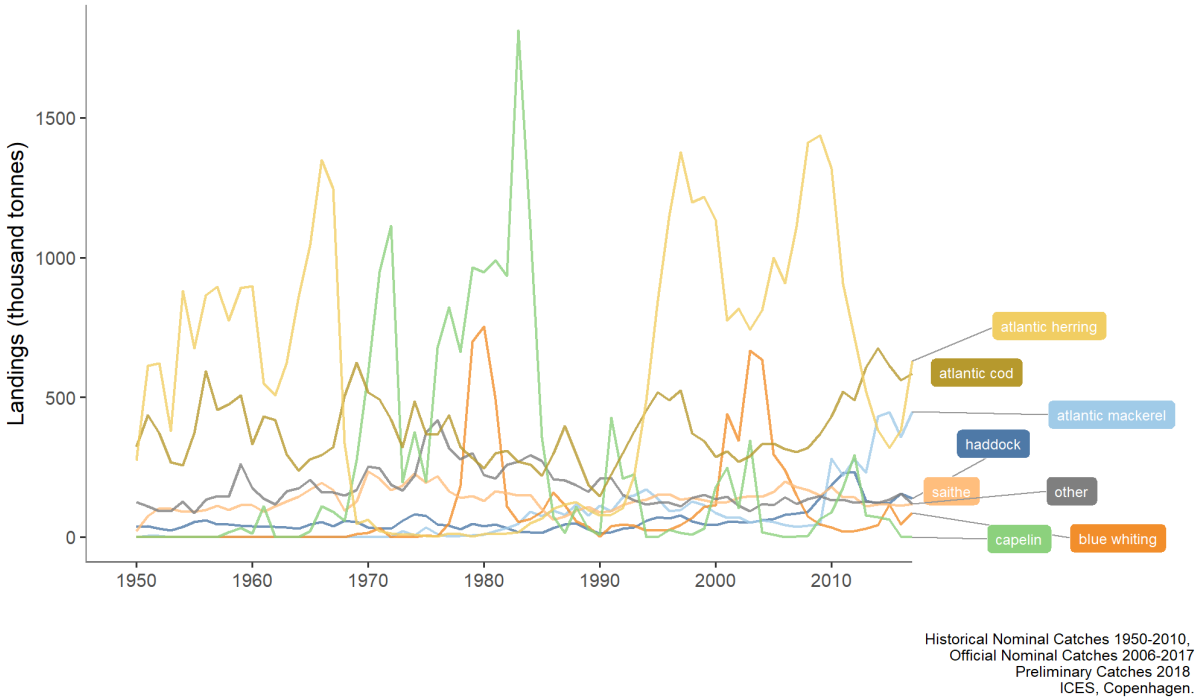


Figure 5 Landings (thousand tonnes) from ICES Subarea 2 in 1950–2018, by species. The six species having the highest cumulative landings over the entire time-series are displayed separately; the remaining species are aggregated and labelled as "other". Only a minor part of the cod and haddock catches included in this figure are taken in the Norwegian Sea ecoregion.

Discards

Information about discards is sparse. The discard rate for elasmobranchs is high. This is partly due to a high bycatch of spurdog and skate species, mainly in Norwegian, Irish, and Faroe Island fisheries. Large skates are often landed whereas smaller species and individuals are almost always discarded; for spurdog decisions about landing vs discard are not quite as clear.The total discard weight is low in both pelagic and demersal fisheries.

Description of the fisheries

A multinational fishery currently operates in the ecoregion using different fishing gears, including static gear, pelagic trawls and seines, bottom otter trawl, and bottom seines. The most commonly used equipment is bottom otter trawl, followed by static gear and pelagic trawl and seines (Figures 6 and 7). The annual catch in the ecoregion varies between 700 000 tonnes to almost 1 million tonnes (2012) from the stocks of Norwegian spring-spawning (NSS) herring, mackerel, blue whiting, Northeast Arctic (NEA) saithe, redfish, and greater silver smelt.

Several pelagic species such as Atlantic herring, Atlantic mackerel, and blue whiting have wide-ranging migrations and move into the ecoregion to feed on the plankton during spring to autumn. During this period of the year, purse seine and pelagic trawl are the main gear in the fishery for the major pelagic species throughout the southern part of the ecoregion. Additionally, in some years, there is a fishery for herring in the northeastern part of the ecoregion during the fourth quarter. The herring fishery operates (a) in the first quarter of the year during fish migration to the spawning grounds along the Norwegian coast, (b) in the third quarter while the fish are feeding in the central part of the Norwegian Sea, and (c) in the fourth quarter during the return migration to the wintering areas. In later years, most of the fishery has been in the fourth quarter of the year. Most of the mackerel fishery takes place in the third quarter while the mackerel are feeding in the Norwegian Sea. The fishery for blue whiting is mostly concentrated on the spawning grounds outside the ecoregion (west of Ireland and Scotland), but a minor part of the fishery on blue whiting takes place during the second half of the year with pelagic trawl.

Along the eastern part of the ecoregion, otter trawl is the major gear in the fishery for demersal species (cod, haddock, and saithe), particularly focusing the fishery on coastal banks along the Norwegian coast. The highest concentrations of

fisheries using static gears such as longlines and gillnets are found in the same area, although less connected to the coastal banks.

Fisheries for Greenland halibut occur along the continental ridge. Fisheries for redfish, ling, blue ling, and tusk occur on coastal banks along the Norwegian coast.

The Norwegian hunt of harp seals is directed toward weaned pups (beaters) or older animals on their moulting grounds in the ice-filled areas east of Greenland (the West Ice). When hooded seals were hunted, it was a pure pup hunt. The Norwegian minke whale hunt targets whales while they are at feeding grounds at high latitudes, including the areas around Jan Mayen.

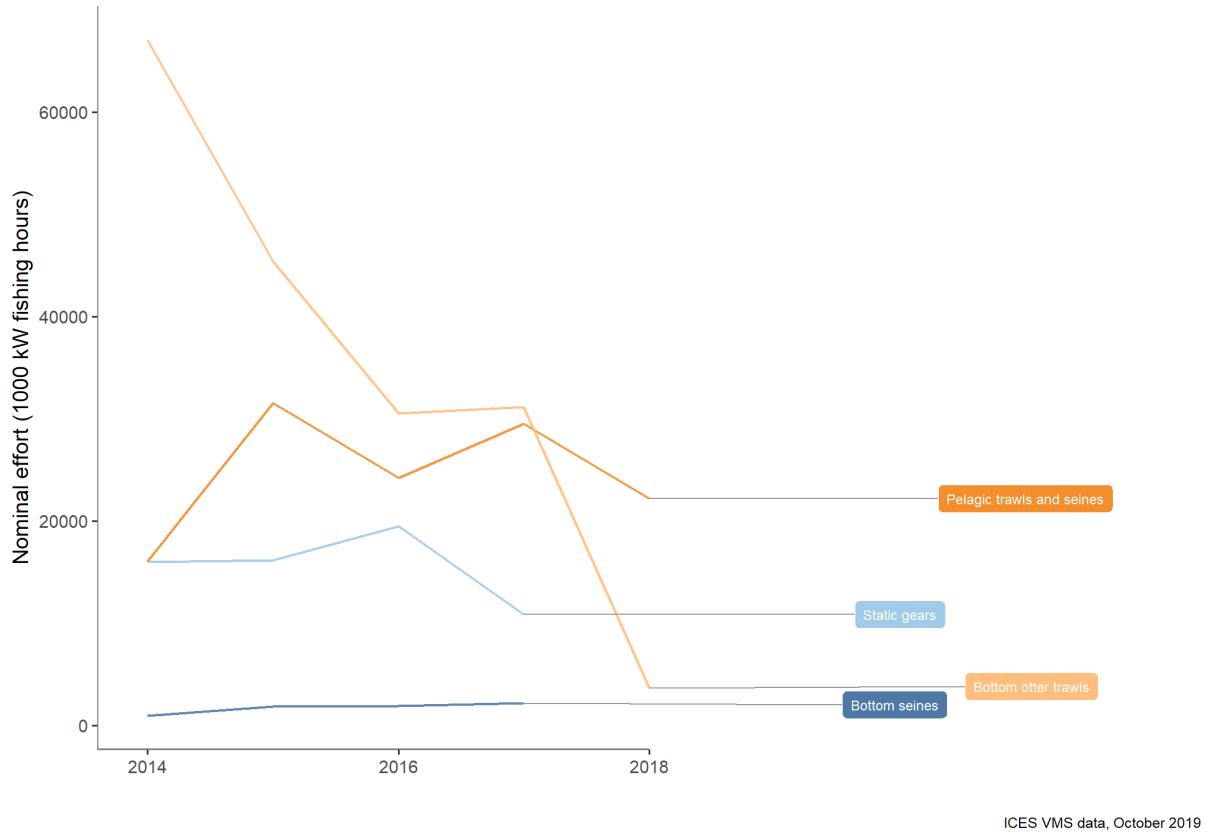


Figure 6 ICES Subarea 2. Fishing effort (thousand kW hours-at-sea) in 2014–2018 by gear type for vessels over 15 m. There is no Norwegian data for 2018. Only a minor part of the effort with bottom otter trawl shown in the figure is applied in the Norwegian Sea ecoregion.

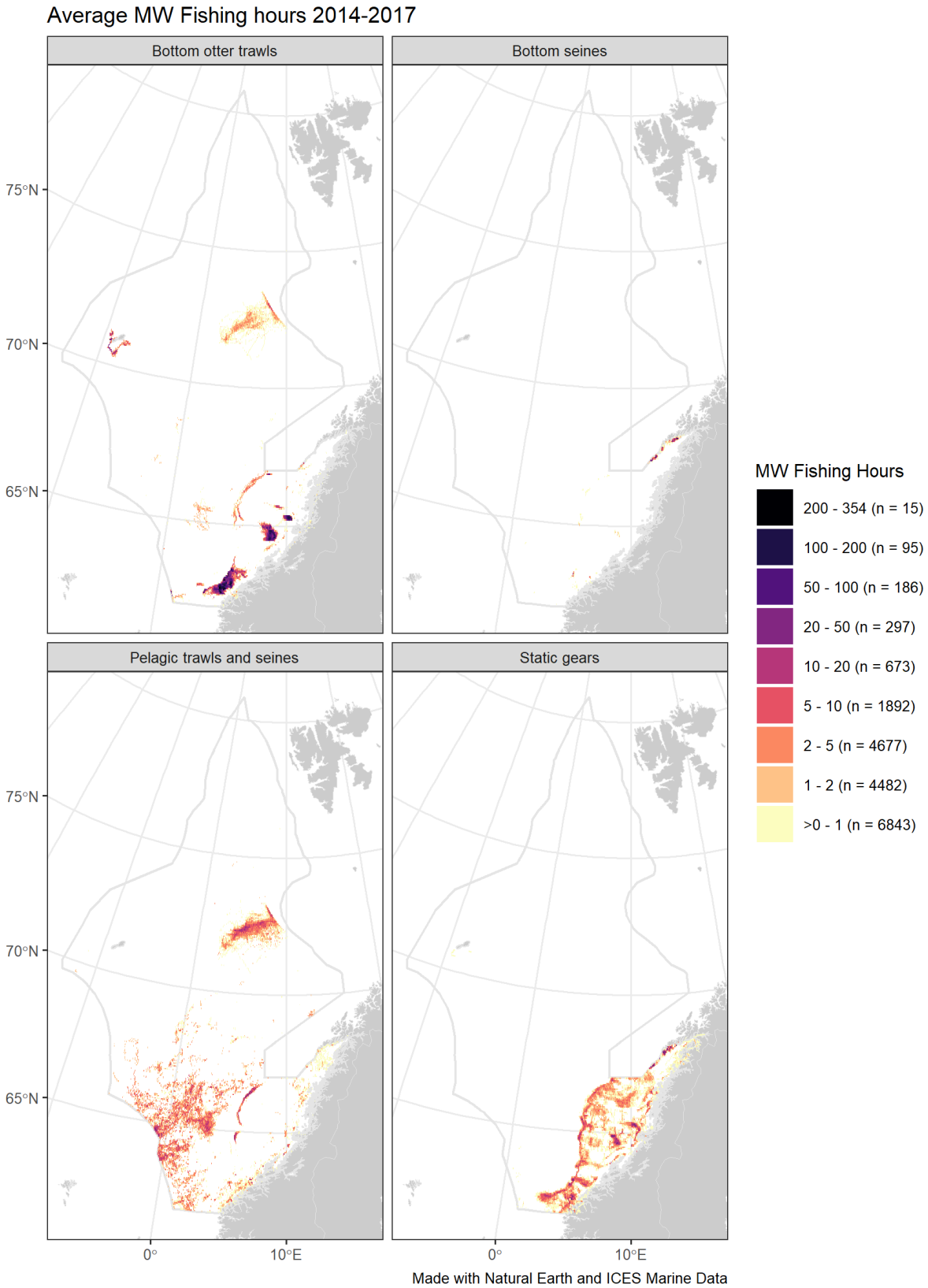


Figure 7 Spatial distribution of average annual fishing effort (mW fishing hours) in the Norwegian Sea ecoregion during 2014–2017, by gear type. Fishing effort data are only shown for vessels > 12 m with vessel monitoring systems (VMS); this will bias the distributions, particularly in coastal areas. No data for Russia are available. Data from the years 2014–2017 were used to produce the figure due to a lack of Norwegian data for 2018.

Ling

In 2018, 98% of the catches of ling in Subarea 2 were taken by Norway. Other countries participating in the fishery were Russia, Faroe Islands, France, and Germany. The fishery for ling is demersal and 49% of the catches are taken in the longline fishery, 46% in the gillnet fishery, and 5% by other gears (mainly trawl). There is no quota for the Norwegian ling fishery, but vessels participating in the fishery in Subarea 2 are required to have a license. No minimum length applies in the Norwegian EEZ.

Tusk

In 2018, 92% of all tusk caught in Subarea 2 were landed by Norway. Other countries participating in the fishery were Russia, Faroe Islands, France, and Germany. The fishery for tusk is demersal and 89% of the catches are taken in the longline fishery, 9% in the gillnet fishery, and 1% by other gears (mainly trawl). There is no quota for the Norwegian tusk fishery, but vessels participating in the fishery in Subarea 2 are required to have a license. No minimum length applies in the Norwegian EEZ.

Blue ling

In 2018, 51% and 46% of all blue ling caught in Subarea 2 were landed by Norway and Faroe Islands, respectively. Other countries participating in the fishery were France and the United Kingdom. The fishery for blue ling is demersal and 80% of the catches are taken in the gillnet fishery, 15% in the trawl fishery, and 5% in the longline fishery. Direct fishing for blue ling in the Norwegian Sea is prohibited. A 10% admixture of blue ling as bycatch is allowed.

Greenland halibut

The majority of the catches of Greenland halibut in the ecoregion are taken along the continental ridge outside the coast of Norway. A smaller proportion is caught around Jan Mayen. The Joint Norwegian–Russian Fisheries Commission has decided on a distribution key for Greenland halibut, giving Norway a share of 51%, Russia 45%, and 4% to other countries. The catches are mainly taken by trawls (60%), longline (30%), and gillnets (10%).

Beaked redfish

Beaked redfish have been targeted by a pelagic fishery outside the Norwegian economic zone since 2004. Direct fishing has been permitted within the Norwegian EEZ since 2014, with bottom trawls as well as with pelagic trawl. There is no directed fishery for beaked redfish with other gears. 50% of the reported catch in 2018 was taken by Norway, and 27% by Russia. Only EU countries and the Faroe Islands were fishing the international waters. The Norwegian and Russian catches are mainly from the Norwegian EEZ or taken as bycatch in the Svalbard zone. 80 Norwegian boats reported catches of beaked redfish, with 99.95% of the catch taken by bottom trawl. Since the different species of redfish are difficult to distinguish from one another, especially when they are young, all bycatch regulations apply to both beaked and golden redfish. The minimum length is 30 cm outside and 32 cm within 12 NM from the coast, with a bycatch of 10% per haul allowed. Allowed bycatch in fishing for other fish is 20% for trawls outside 12 NM, and 10% for trawls within 12 NM and other gear. Vessels using conventional gear and of less than 21 m in length are allowed 30% bycatch from 1 August to 31 December. All these regulations are weight per week. Bycatch of juvenile redfish is limited to three individuals per 10 kg of shrimp.

Golden redfish

Golden redfish is on the Norwegian red list and direct fishing is prohibited, except fishing with handline from boats under 15 m in length; these fisheries account for 1% of the total catch. Bycatch regulations are the same as for beaked redfish because of the morphological similarity of the two species, especially when they are small. Despite a zero catch advice for 2017–2018, catches in 2018 were over 5000 tonnes, 67% of which were reported by Norway. There were 1531 boats that reported catches of common redfish in 2018. The largest proportion of catches are with bottom trawls (62%) followed by gillnet set yarns (23%).

Greater silver smelt

Greater silver smelt is caught in a pelagic fishery using trawl and seines. Over 99% of the catches in subareas 1 and 2 are caught in a targeted fishery by Norwegian midwater and bottom trawlers. Landings have increased since 2012.

Elasmobranchs

While no fisheries target elasmobranchs in this ecoregion, they are caught in various demersal fisheries. The total landings for Subarea 2 have been between 200 and 500 tonnes per year since 2010. All skate species in the ecoregion may be taken as bycatch, with only larger individuals thought to be landed. The main species landed tend to be larger specimens of longnosed skate, spinytail skate, and thornback ray. Discards of skates vary between species, but are assumed to be almost 100% for fish below 50 cm. For round ray and thorny skate, nearly all fish are probably discarded, whereas discarding of thornback ray by the coastal fleet is expected to be negligible.

Haddock

Haddock catches in the ecoregion peaked between 2009 and 2013, simultaneous with a peak in stock abundance. Most of the Norwegian landings of haddock are reported to have been caught along the coast of Norway, south of Lofoten down to 62°N. Most of the catches are taken with gillnets, demersal trawl, and longline.

Saithe

In 2018, Norwegian catches account for 28% of the total saithe landings in the ecoregion. Within the ecoregion, 96% of the catches are taken in ICES Subdivision 2.a.2. 61% of these catches are landed in quarter 1. The main fishing gears used are bottom trawls (39% of catches), set nets (35%), purse seine (20%), and bottom seine (6%).

Herring

The fishery on Norwegian spring-spawning herring in the ecoregion has fluctuated greatly. The stock collapsed in 1960 but has since recovered and the fishery is now managed by a management strategy agreed upon by the Coastal States (Norway, Russia, Iceland, Faroe Islands, and EU). Most of the landings in 2018 were taken by Norway, followed by Iceland, Faroe Islands, Russia, and Denmark. Several other countries catch smaller amounts of herring. The landings are taken by purse seine (51%) and pelagic trawl (49%).

Mackerel

Landings of mackerel have fluctuated less than the herring landings but have been on a high level in recent years. At present no long-term management strategy for mackerel is agreed by all parties involved in the mackerel fishery, but Coastal State Delegations from Norway, the EU, and the Faroes have agreed on an arrangement for a long-term management strategy for mackerel. The major landings of mackerel in 2018 in the ecoregion are taken by Iceland, Russia, Greenland, Faroe Islands, and Norway. Landings are mostly with pelagic trawl (83%) and purse seine (17%).

Blue whiting

A long-term management strategy on blue whiting was agreed by the European Union, the Faroe Islands, Iceland, and Norway in 2016. Landings of blue whiting are mostly from outside the ecoregion, but some fishery takes place within the region during the second half of the year. However, in some years (such as around 1980 and the early 2000s) a significant fraction of the blue whiting catch was taken within the ecoregion. The blue whiting fishery has fluctuated, with total landings above 2 million tonnes in the early 2000s, declining to a minimum of 100 000 tonnes in 2012. Since then landings have been increasing. The major fishing nations in the ecoregion are Iceland, Russia, Faroe Islands, Germany, and Norway. Landings are mainly taken with pelagic trawl (99%).

Capelin

In the ecoregion, there have been no landings of capelin in recent years, but during the 1980s and 1990s landings were high (above 500 000 tonnes). Major fishing nations are Iceland, Norway, and Faroe Islands.

Seal and whale hunting

In the Norwegian seal hunt, seals are shot on ice with rifles from vessels. Minke whales are hunted using 50 mm or 60 mm harpoon cannons.

Fisheries management

The Norwegian Sea ecoregion includes parts of the Exclusive Economic Zones (EEZs) of Norway, part of the Fisheries Protection Zone around Svalbard, and the North East Atlantic Fisheries Commission (NEAFC) regulatory area of the Norwegian Sea. Management of the pelagic stocks in the region is conducted by Coastal States and catching opportunities for pelagic stocks in the area are agreed during Coastal States meetings. National authorities manage activities in coastal waters (i.e. within 12 nautical miles) outside the coast of Norway. The status of Svalbard waters is partly unresolved. Norway claims jurisdiction of the sea area around Svalbard based on the Svalbard Treaty from 1920 and has established a 200 nautical mile wide "fishery protection zone" around the archipelago. All nations that historically have been fishing in the Svalbard area still fish there, but Norway exercises control in the zone.

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 (RMP). The RMP requires catch history and abundance estimates as input and calculates annual quotas for six-year periods.

Status of the fishery resources

Fishing mortalities and spawning stock sizes have been evaluated against maximum sustainable yield (MSY) and precautionary approach (PA) reference points, and the status of these stocks has also been assessed relative to safe biological limits, i.e. $F < F_{pa}$ and $SSB > B_{pa}$ (Figure 8). Of the pelagic stocks 25% are fished at or below the F_{MSY} target level, while 38% are fished above the target level. 50% of the pelagic stocks are above MSY $B_{trigger}$. The status for many of the demersal stocks are unknown, but 18% are fished at or below F_{MSY} and 27% above F_{MSY}. About 27% of the demersal stocks are above MSY $B_{trigger}$. The status of most elasmobranch stocks is unknown, but one species is fished below the F_{MSY} target level.

Approximately 22% of the total number of stocks are sustainably fished (i.e. D3C1, where $F < F_{MSY}$); these account for around 13% of the total landings (Figure 9). Around 30% of the stocks were assessed to be above MSY $B_{trigger}$ (D3C2); these accounted for 86% of the total biomass caught.

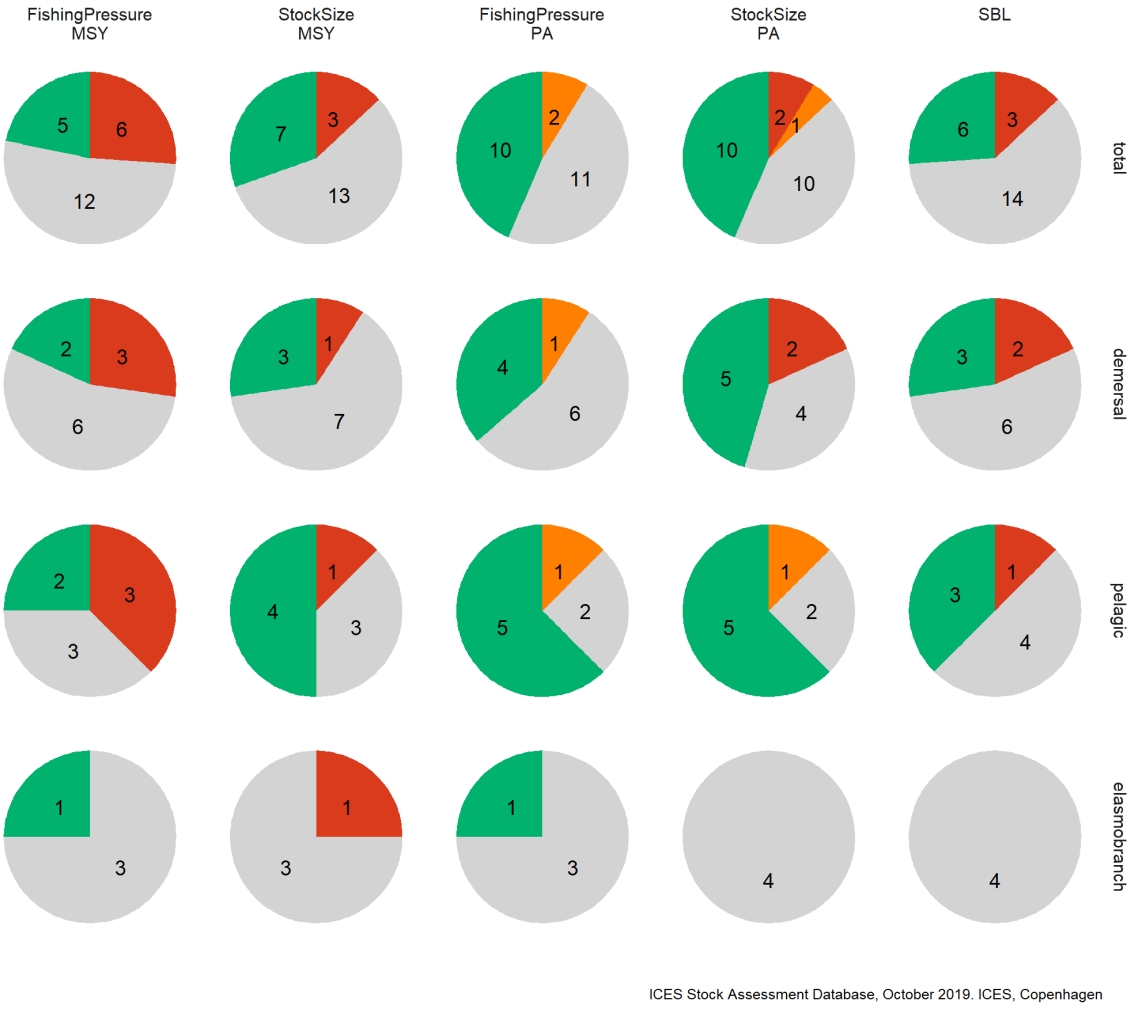


Figure 8 Status summary of Norwegian Sea stocks in 2019 relative to the ICES maximum sustainable yield (MSY) approach and precautionary approach (PA). Grey represents unknown reference points. For the MSY approach: green represents a stock that is either fished below F_{MSY} or the stock size is greater than MSY $B_{trigger}$; red represents a stock status that is either fished above F_{MSY} or the stock size is lower than MSY $B_{trigger}$. For the PA: green represents a stock that is fished at or below F_{pa} while the stock size is equal to or greater than B_{pa}; orange represents a stock that is either fished between F_{pa} and F_{lim} or the stock size is between B_{lim} and B_{pa}; red represents a stock that is fished above F_{lim} or the stock size is less than B_{lim}. Stocks having a fishing mortality below or at F_{pa} and a stock size above B_{pa} are defined as being inside safe biological limits. If this condition is not fulfilled the stock is defined as being outside safe biological limits. For stock-specific information, see Table A1 in the Annex.

Figure 9 Status summary of Norwegian Sea stocks in 2019 relative to the EU Marine Strategy Framework Directive (MSFD) assessment criteria of the level of pressure of fishing activity (D3C1) and reproductive capacity of the stock (D3C2). Green represents the proportion of stocks that are either fished below F_{MSY} or the stock size is greater than MSY $B_{trigger}$, for criteria D3C1 and D3C2. Red represents the proportion of stocks that are either fished above F_{MSY} or the stock size is lower than MSY $B_{trigger}$, for criteria D3C1 and D3C2. Grey represents the proportion of stocks without MSY reference points. For stock-specific information, see Table A1 in the Annex.

The SSB relative to biomass reference points of spurdog decreased from the 1980s until 2006. The stock was depleted and in danger of collapse and the TAC was reduced significantly. After a zero TAC was introduced in 2011, the SSB ratio has increased but is still below the target level.

The mean fishing mortality ratio for the demersal stocks shows a declining trend since the mid-1990s, largely driven by changes in mortality of golden redfish (Figure 10). The mean fishing mortality is now at the F_{MSY} target. The SSB ratio shows an increasing trend over the same period with a decrease the last few years. The mean values remain above MSY $B_{trigger}$.

For pelagic stocks, the mean fishing mortality ratio has declined since 2000 and is now close to 1. The mean biomass ratio for pelagic species has shown a slight increase and is above 1.

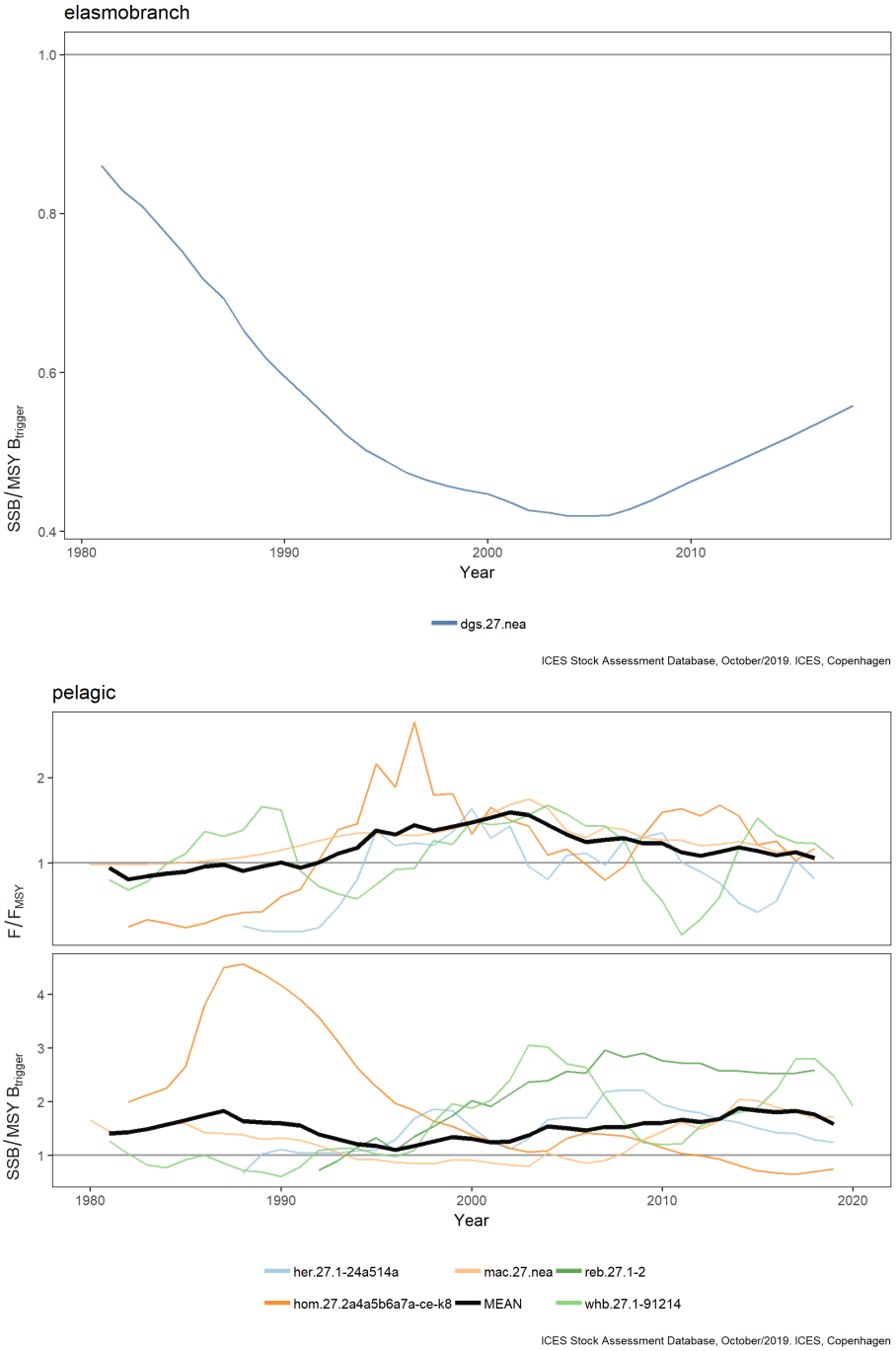


Figure 10 Temporal trends in F/F_{MSY} and SSB/MSY $B_{trigger}$ for Norwegian Sea elasmobranch, demersal, and pelagic stocks. Only stocks with defined MSY reference points are considered. Stocks for which proxy reference points are available only are not shown. For full stock names, see Table A1 in the Annex. Only a minor part of the cod and haddock catches are taken in the Norwegian Sea ecoregion.

The stock status relative to F_{MSY} and MSY $B_{trigger}$ is shown for all stocks and partitioned by stock groups in Figure 11. Herring and tusk are the only stocks with good environmental status (Figure 11). The remaining stocks are either exploited above F_{MSY} or the stock size is below MSY $B_{trigger}$. The majority of the stocks are found in the upper right quadrant, indicating that although their SSB is at or above the target level, the fishing mortality is above the target level. Horse mackerel have a SSB below the target level. Although the cod and haddock stocks have an SSB that is almost three times MSY $B_{trigger}$ they are fished slightly above F_{MSY}. None of the stocks are in the bottom right quadrant of the stock status plot that usually indicates a stock in need of rebuilding.

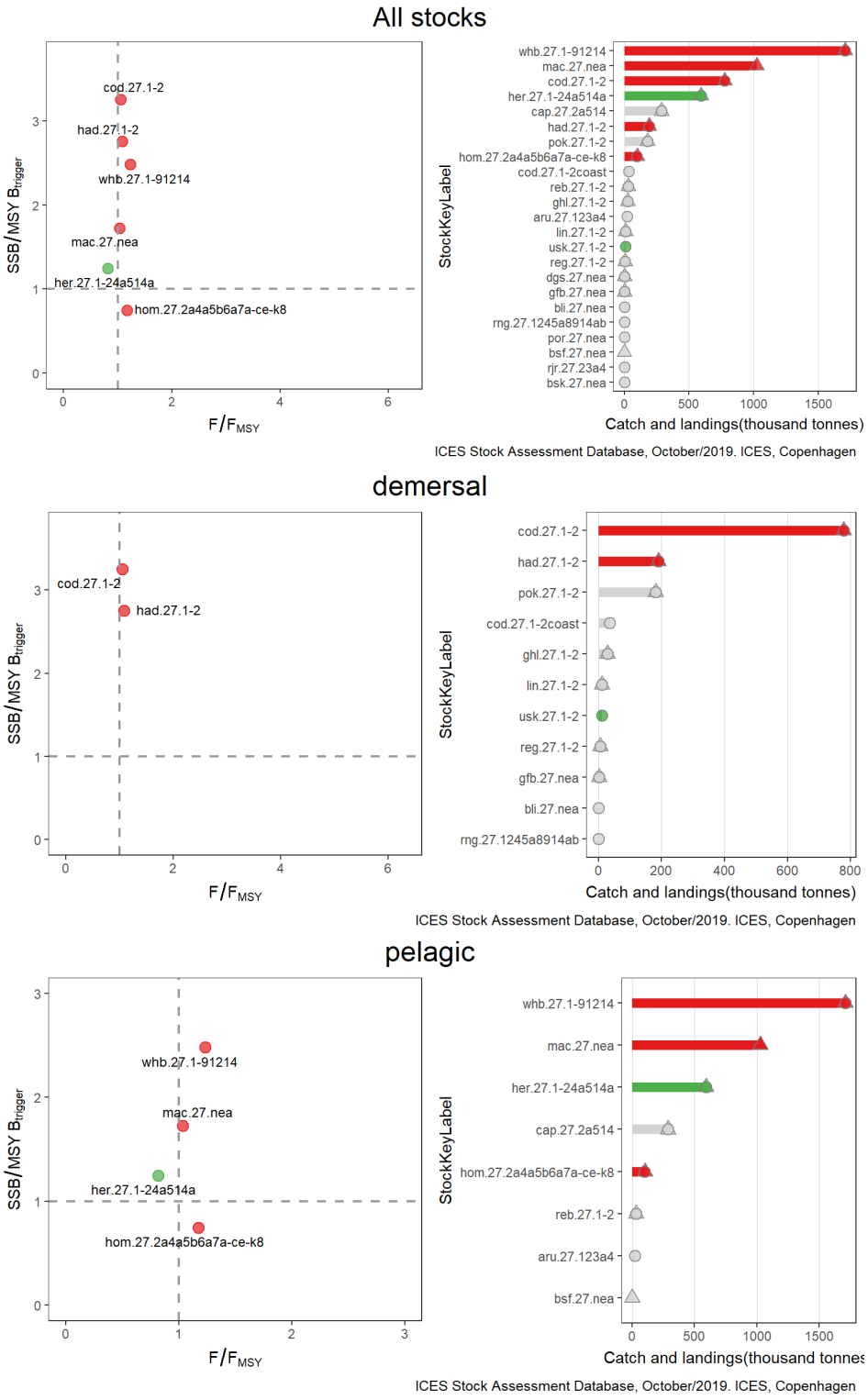


Figure 11

Status of Norwegian Sea stocks relative to the joint distribution of exploitation (F/F_{MSY}) and stock size ($SSB/MSY\ B_{trigger}$) [left panels, by individual stocks] and catches (triangles) / landings (circles) from these stocks in 2019 [right panels]. The left panels only include stocks for which MSY reference points have been defined (MSY where available). Stocks for which proxy reference points are available only, are not shown on the left plots. Stocks in green are exploited at or below F_{MSY} while the stock size is also at or above MSY $B_{trigger}$. Stocks in red are either exploited above F_{MSY} or the stock size is below MSY $B_{trigger}$, or both. Stocks in grey have unknown/undefined status in relation to reference points. "All stocks" refers to the ten stocks with highest catch and landings across fisheries guilds in 2018. For full stock names, see Table A1 in the Annex.

Mixed fisheries and incidental bycatch

Fishing operations typically catch more than one species at a time, although some are more species selective than others. Pelagic trawling and purse seining tend to catch mostly one species, with only minor proportions of bycatch. Demersal trawling, bottom seining, and longlining tend to catch a mixture of species. These technical interactions may vary through time and space (e.g. interactions might vary between day and night, or between different times of year, or between different areas). Most fisheries data are aggregated based on species, gear, mesh size range, ICES rectangle, and calendar quarter which may create perceived interactions that do not occur, while more subtle interactions are missed.

Tusk, ling, blue ling, and redfish

Currently the major fisheries are the Norwegian longline and gillnet fisheries, but bycatches of ling are taken by other gears, such as trawls and handlines. Around 50% of the Norwegian landings are taken by longlines and 45% by gillnets, partly in the directed ling fisheries and partly as bycatch in fisheries for other groundfish. Other nations catch ling as bycatch in their trawl fisheries.

Tusk is primarily bycatch in the ling and cod fisheries. Currently the major fisheries in Subarea 2 are the Norwegian longline and gillnet fisheries, but there are also bycatches by other gears, e.g. trawls and handlines. For other nations, tusk is bycatch in their trawl and longline fisheries.

Blue ling is primarily caught as bycatch in the longline and gillnet fisheries on ling, tusk, and saithe.

A directed demersal and pelagic fishery on beaked redfish has been permitted in the Norwegian Economic Zone since 2014. Reasonable catch rates and low bycatches of other species were reported for this fishery. The golden redfish is only caught as bycatch, predominantly in the gillnet fishery for saithe and bottom trawl fishery for beaked redfish. Most of the catches taken by countries other than Norway are taken in mixed fisheries together with saithe and cod.

Species interaction

The Norwegian Sea is the feeding ground for some of the largest fish stocks in the world, including Norwegian spring-spawning (NSS) herring, blue whiting, and the Northeast Atlantic (NEA) mackerel. These planktivorous stocks are often referred to as the "pelagic complex" due to their substantial spatial and dietary overlap. Due to their high abundances, they can potentially have a strong ecological impact on the ecosystem and each other. The degree of competition between the species depends both on the dietary overlap and the spatial distribution of feeding activities.

Herring, one of the largest commercially exploited stocks in the ecosystem, is also a key prey species for several predators. Numerous studies on killer whales shows that they follow the herring. When the herring stock is large, killer whales feed almost exclusively on herring. In other areas, they take different prey and they are capable of catching seals and even young baleen whales. A change in herring abundance may force the killer whales to a dietary shift towards other fish species and marine mammals. As herring makes a large part of the minke whale and Atlantic puffin diets, increasing fishing mortality of herring may influence the abundance and yield of minke whale and lead to a further decline in stock abundance of the Atlantic puffin. Herring, along with blue whiting, are also important prey items for Greenland halibut, and for gadoids like ling and tusk. A high mortality rate on herring and blue whiting may affect the abundance of these species that have an important ecological role along the shelf edge. Other interactions also exist, though not as strong as the ones between herring and marine mammals.

The Greenland halibut and redfishes are a part of the diet of many marine mammals, including sperm whale, bottlenose whale, harp seals, and hooded seals. Juvenile redfish and Greenland halibut are also important prey items for cod.

Most populations of seabirds in the ecoregion have decreased steeply over the last decade and many have decreased almost constantly since monitoring began three to five decades ago. No single factor explains all these trends; however, long-term breeding failures for species feeding in pelagic waters such as Atlantic puffin, black-legged kittiwake, common guillemot, and Northern fulmar indicate that much of the problem along the mainland coast is related to drastic changes in the availability of 0-group fish (especially herring), and also linked to variations in ocean climate.

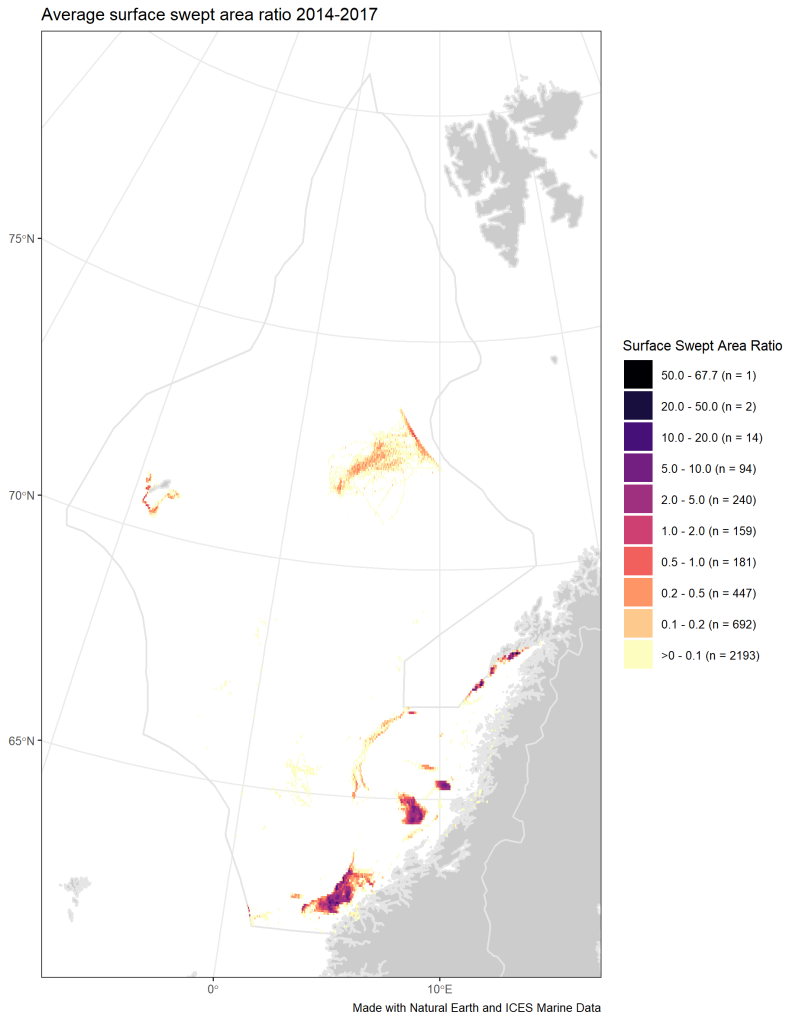
Effects of fisheries on the ecosystem

Physical disturbance

Abrasion occurs from towed bottom-contacting gear with some damage to benthic organisms and habitats. The extent, magnitude, and impact of mobile bottom-contacting fishing gear on the seabed and benthic habitats varies geographically across the Norwegian Sea. This gear type is used mainly on the shelf in the southern part of the ecoregion (Figure 12). Bottom trawling along the Norwegian continental slope is regulated through closed areas to avoid extended damage to fragile and vulnerable benthic communities and reef-building organisms.

Ghostfishing

Abandoned, lost, or discarded fishing gear is a significant problem in all fisheries. These gears continue to catch or trap fish, birds, and mammals for a long time, also known as ghostfishing. Ghostfishing is more problematic in deeper waters (e.g. Greenland halibut fishery) because of lower rates of biofouling and tidal scouring so gears continue to fish effectively. The magnitude of ghostfishing in the Norwegian Sea is not quantified.



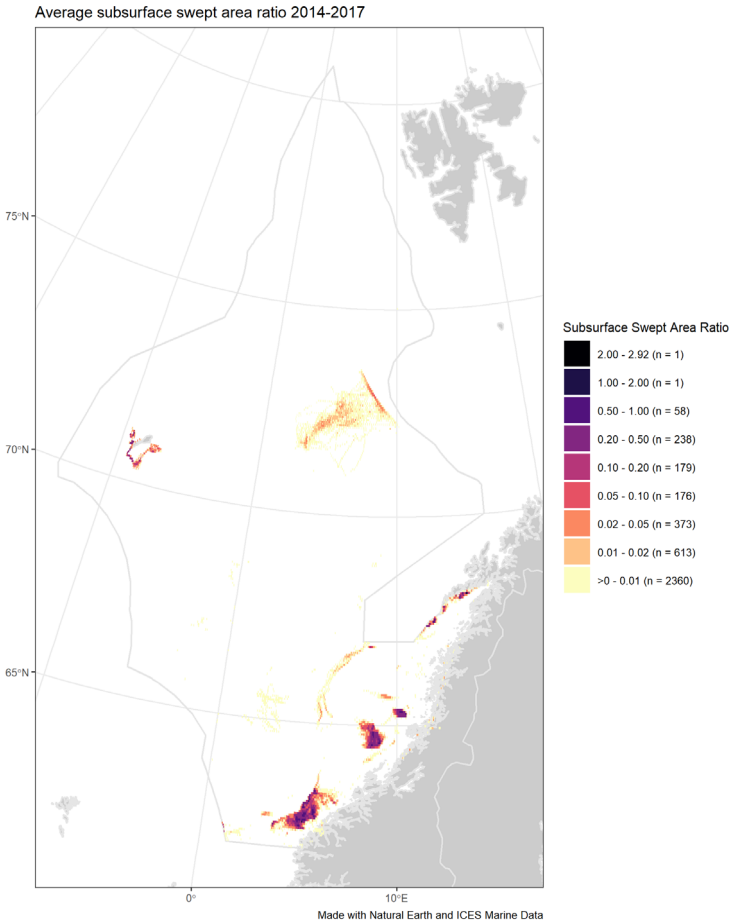


Figure 12 Average annual surface (top panel) and subsurface (bottom panel) disturbance by mobile bottom-contacting fishing gear (bottom otter trawls, bottom seines, dredges, beam trawls) in the Norwegian Sea ecoregion during 2014–2017, expressed as average swept-area ratios (SAR). No data for Russia is available. Data from the years 2014–2017 were used to produce the figure due to a lack of Norwegian data for 2018.

Bycatch of protected, endangered, and threatened species

Marine mammals that get entangled in fishing gear may drown or die at a later time due to injuries or to being partially entangled in parts from the fishing gear. In the Norwegian Sea, the largest bycatch of marine mammals occurs in the bottom set gillnet fisheries targeting cod and monkfish. Harbour porpoises, harbour seals, and grey seals are frequently killed in these fisheries. Around 2000 harbour porpoises are taken in Norwegian commercial fisheries each year. Surveys of grey seals have shown a 50–60% reduction in pup production between 2007 and 2015 in mid-Norway, probably as a result of increased bycatches in gillnet fisheries for monkfish and cod. Bycatch of seals in coastal areas is uncertain (due to unreliable species identification) but believed to be in the order of around 200 per species. Bycatch of larger whales are less frequent. The number of bycatches of sperm whale and humpback whale in Norwegian fisheries are usually less than 10 individuals annually (per species), and many of those are released alive.

Among the marine mammals, the blue whale, Norther Atlantic right whale, and the harbour porpoise are on the OSPAR list of threatened species in the Norwegian Sea. There is no quantification about the bycatch of these species at the ecoregion level, but as threatened species even a low number might be a significant problem.

Several species of elasmobranchs in the ecoregion are considered endangered or threatened. Spurdog is one of the most frequent bycatches among the elasmobranchs; 1156 tonnes were landed from the Norwegian Sea in 2010–2018. The annual bycatch of porbeagle and basking shark amounted to 56 tonnes and 24 tonnes, respectively.

Around 80 000 eels are caught as bycatch in the coastal trap fisheries for wrasse, but the majority of these are released unharmed. Eels migrate through the Norwegian Sea, but there is currently no significant marine fishery targeting eel.

Sources and references

Huse, G., Holst, J. C., Utne, K., Nøttestad, L., Melle, W., Slotte, A., *et al*. 2012. Effects of interactions between fish populations on ecosystem dynamics in the Norwegian Sea – results of the INFERNO project. Marine Biology Research, 8: 415–419. http://doi.org/10.1080/17451000.2011.653372.

ICES. 2017. ICES Ecosystem Overviews. Norwegian Sea Ecoregion. Published 10 April 2017. 15 pp. https://doi.org/10.17895/ices.pub.3108.

ICES. 2019a. Arctic Fisheries Working Group (AFWG). ICES Scientific Reports, 1:30. 930 pp. http://doi.org/10.17895/ices.pub.5292.

ICES. 2019b. Working Group on Elasmobranch Fishes (WGEF). ICES Scientific Reports, 1:25. 964 pp. http://doi.org/10.17895/ices.pub.5594.

ICES. 2019c. Working Group on the Biology and Assessment of Deep-sea Fisheries Resources (WGDEEP). ICES Scientific Reports, 1:21. 988 pp. http://doi.org/10.17895/ices.pub.5262.

ICES. 2019d. Norwegian Sea Ecoregion – Fisheries overview data. https://doi.org/10.17895/ices.data.5696

McBride, M. M., Filin, A., Titov, O., and Stiansen, J. E. (Eds.) 2014. IMR/PINRO update of the "Joint Norwegian–Russian environmental status report on the Barents Sea Ecosystem" giving the current situation for climate, phytoplankton, zooplankton, fish, and fisheries during 2012–13. IMR/PINRO Joint Report Series, 2014(1). 64 pp. ISSN 1502-8828. http://doi.org/10.13140/2.1.5177.8883.

Norwegian Government. 2016. Update of the integrated management plan for the Norwegian Sea. Meld. St. 35 (2016–2017) Report to the Storting (white paper). 110 pp. https://www.regjeringen.no/en/dokumenter/meld.-st.-35-20162017/id2547988/.

Read, A. J., Drinker, P., and Northridge, S. 2006. Bycatch of marine mammals in U.S. and global fisheries. Conservation Biology, 20(1): 163–169. https://doi.org/10.1111/j.1523-1739.2006.00338.x.

Skjoldal, R., Dalpadado, P., and Dommasnes, A. 2004. Food webs and trophic interactions. *In* The Norwegian Sea Ecosystem. Skjoldal, H. R., Sætre, R., Ferno, A., Misund, O. A., and Røttingen, I. (editors). Trondheim: Tapir Academic Press. 559 pages.

Recommended citation: ICES. 2019. Norwegian Sea ecoregion – Fisheries Overview. *In* Report of the ICES Advisory Committee, 2019. ICES Advice 2019, Section 12.2. 26 pp. https://doi.org/10.17895/ices.advice.5707.

Annex

Supporting data used in the Norwegian Sea Fisheries overview is archived at ICES (2019c).

The following annex table is a status summary of the Norwegian Sea ecoregion stocks in 2019.

Table A1 Status summary of the Norwegian Sea ecosystem stocks in 2019, in regards to the ICES maximum sustainable yield (MSY) approach and precautionary approach (PA) for stocks within the Norwegian Sea ecoregion. Grey represents unknown reference points. For the MSY approach: green represents a stock that is fished below F_{MSY} or the stock size is greater than MSY $B_{trigger}$; red represents a stock status that is fished above F_{MSY} or the stock size is less than MSY $B_{trigger}$. For the PA: green represents a stock that is fished below F_{pa} or the stock size is greater than B_{pa}; yellow represents a stock that is fished between F_{pa} and F_{lim} or the stock size is between B_{lim} and B_{pa}; red represents a stock that is fished above F_{lim} or the stock size is less than B_{lim}. SBL = safe biological limits; MSFD = EU Marine Strategy Framework Directive; D3C1 = MSFD indicator for fishing mortality; D3C2 = MSFD indicator for spawning-stock biomass; GES = good environmental status.

Stock	Stock description	Fisheries guild	Data category	Assessment year	Advice category	SBL	GES	Reference point	Fishing pressure	Stock size	D3C1	D3C2
aru.27.123a4	Greater silver smelt in subareas 1, 2, and 4, and in Division 3.a	Pelagic	3.2	2019	PA	?	?	MSY	✓	?	✓	?
								PA	✓	?	✓	?
bli.27.nea	Blue ling in subareas 1, 2, 8, 9, and 12, and divisions 3.a and 4.a	Demersal	5.3	2019	PA	?	✗	MSY	?	✗	?	✗
								PA	?	✗	?	✗
cap.27.2a514	Capelin in subareas 5 and 14 and Division 2.a west of 5°W	Pelagic	1.8	2018	PA	?	?	MSY	?	?	?	?
								PA	?	✓	?	✓
cod.27.1-2	Cod in subareas 1 and 2	Demersal	1	2019	MP	✗	✗	MSY	✗	✓	✗	✓
								PA	o	✓	o	✓
dgs.27.nea	Spurdog in subareas 1–10, 12, and 14	Elasmobranch	1.2	2018	MSY/PA	?	✗	MSY	✓	✗	✓	✗
								PA	✓	?	✓	?
ghl.27.1-2	Greenland halibut in subareas 1 and 2	Demersal	1	2019	PA	?	?	MSY	?	?	?	?
								PA	?	✓	?	✓
had.27.1-2	Haddock in subareas 1 and 2	Demersal	1	2019	MP	✓	✗	MSY	✗	✓	✗	✓

Stock	Stock description	Fisheries guild	Data category	Assessment year	Advice category	SBL	GES	Reference point	Fishing pressure	Stock size	D3C1	D3C2
								PA	✓	✓	✓	✓
her.27.1-24a514a	Herring in subareas 1, 2, 5 and divisions 4.a and 14.a, Norwegian spring-spawning herring	Pelagic	1	2019	MP	✓	✓	MSY	✓	✓	✓	✓
								PA	✓	✓	✓	✓
hom.27.2a4a5b6a7a-ce-k8	Horse mackerel in Subarea 8 and divisions 2.a, 4.a, 5.b, 6.a, 7.a–c,e–k	Pelagic	1	2019	MSY	✗	✗	MSY	✗	✗	✗	✗
								PA	o	o	o	o
lin.27.1-2	Ling in subareas 1 and 2	Demersal	3.2	2019	PA	?	?	MSY	✓	?	✓	?
								PA	✓	?	✓	?
mac.27.nea	Mackerel in subareas 1–8 and 14 and Division 9.a	Pelagic	1	2019	MSY	✓	✗	MSY	✗	✓	✗	✓
								PA	✓	✓	✓	✓
pok.27.1-2	Saithe in subareas 1 and 2	Demersal	1	2019	MP	✓	?	MSY	?	?	?	?
								PA	✓	✓	✓	✓
reb.27.1-2	Beaked redfish in subareas 1 and 2	Pelagic	1	2018	PA	?	?	MSY	?	✓	?	✓
								PA	✓	✓	✓	✓
reg.27.1-2	Golden redfish in subareas 1 and 2	Demersal	1	2018	PA	✗	✗	MSY	✗	?	✗	?
								PA	?	✗	?	✗
rjr.27.23a4	Starry ray in subareas 2 and 4, and Division 3.a	Elasmobranch	3.14	2019	PA	?	?	MSY	?	?	?	?
								PA	?	?	?	?
rng.27.1245a8914ab	Roundnose grenadier in subareas 1, 2, 4, 8,	Demersal	6.2	2019	PA	?	?	MSY	?	?	?	?

Stock	Stock description	Fisheries guild	Data category	Assessment year	Advice category	SBL	GES	Reference point	Fishing pressure	Stock size	D3C1	D3C2
	and 9, Division 14.a, and in subdivisions 14.b.2 and 5.a.2							PA	?	?	?	?
usk.27.1-2	Tusk in subareas 1 and 2	Demersal	3.2	2019	PA	✓	✓	MSY	✓	✓	✓	✓
								PA	✓	✓	✓	✓
whb.27.1-91214	Blue whiting in subareas 1–9, 12, and 14	Pelagic	1	2019	MP	✓	✗	MSY	✗	✓	✗	✓
								PA	✓	✓	✓	✓

Table A2 List of those stocks in the Norwegian Sea ecoregion in 2018 that do not have a full set of reference points.

Stock	Stock description	Fisheries guild	Data category	Assessment year	Advice category
bsf.27.nea	Black scabbardfish in subareas 1, 2, 4–8, 10, and 14, and divisions 3.a, 9.a, and 12.b	Pelagic	3.2	2018	PA
bsk.27.nea	Basking shark in subareas 1–10, 12, and 14	Elasmobranch	6.3	2019	PA
cod.27.1-2coast	Cod in subareas 1 and 2	Demersal	3	2019	MP
gfb.27.nea	Greater forkbeard in subareas 1–10, 12, and 14	Demersal	3.2	2018	PA
por.27.nea	Porbeagle in subareas 1–10, 12, and 14	Elasmobranch	6.3	2019	PA
rjr.27.23a4	Starry ray in subareas 2 and 4, and Division 3.a	Elasmobranch	3.14	2019	PA
rng.27.1245a8914ab	Roundnose grenadier in subareas 1, 2, 4, 8, and 9, Division 14.a, and in subdivisions 14.b.2 and 5.a.2	Demersal	6.2	2019	PA

Table A3 Scientific names of species.

Common name	Scientific name
Atlantic puffin	*Fratercula arctica*
Baleen whale	*Mysticeti*
Basking shark	*Cetorhinus maximus*
Beaked redfish	*Sebastes mentella*
Black-legged kittiwake	*Rissa tridactyla*
Black scabbardfish	*Aphanopus carbo*
Blue ling	*Molva dypterygia*
Blue whale	*Balaenoptera musculus*
Blue whiting	*Micromesistius poutassouu*
Bottlenose whale	*Hyperoodon ampullatus*
Capelin	*Mallotus villosus*
Cod	*Gadus morhua*
Common guillemot	*Uria aalge*
European eel	*Anguilla anguilla*
Golden redfish	*Sebastes norvegicus*
Greater forkbeard	*Phycis blennoides*
Greenland halibut	*Reinhardtius hippoglossoides*
Greater silver smelt	*Argentina silus*
Grey seal	*Halichoerus grypus*
Haddock	*Melanogrammus aeglefinus*
Harbour porpoise	*Phocoena phocoena*
Harbour seal	*Phoca vitulina*
Harp seal	*Pagophilus groenlandicus*
Herring	*Clupea harengus*
Hooded seal	*Cystophora cristata*
Horse mackerel	*Trachurus trachurus*
Humpback whale	*Megaptera novaeangliae*
Killer whale	*Orcinus orca*
Ling	*Molva molva*
Long nosed skate	*Raja oxyrinchus*
Long rough dab	*Hippoglossoides platessoides*
Mackerel	*Scomber scombrus*
Minke whale	*Balaenoptera acutorostrata*
Monkfish	*Lophius* sp.
Northern fulmar	*Fulmarus glacialis*
North Atlantic right whale	*Eubalaena glacialis*

Common name	Scientific name
Plaice	*Pleuronectes platessa*
Porbeagle	*Lamna nasus*
Rays and skates	*Rajidae*
Redfish	*Sebastes* sp.
Roundnose grenadier	*Coryphaenoides rupestris*
Round ray	*Rajella fyllae*
Saithe	*Pollachius virens*
Sole	*Solea solea*
Sperm whale	*Physeter microcephalus*
Spinytail skate	*Bathyraja spinicauda*
Spurdog (Piked dogfish)	*Squalus acanthias*
Thornback ray	*Raja clavate*
Thorny skate	*Amblyraja radiate*
Tusk	*Brosme brosme*
Whiting	*Merlangius merlangus*
Wrasse	*Labrus* sp.