5.2 Barents Sea Ecoregion – Fisheries overview

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Executive summary

The commercial fisheries in the Barents Sea Ecoregion target few stocks. The largest pelagic fishery targets capelin using midwater trawl. The largest demersal fisheries target cod, haddock, and other gadoids; predominantly using trawls, gillnets, longlines, and handlines. The crustacean fisheries target deep-sea prawn, red king crab, and snow crab. Most catches of crabs are from coastal areas. Harp seals and minke whales are also hunted in the region.

There are currently 12 nations with fisheries targeting the stocks in this ecoregion. Norway and Russia have the largest fleets, and dominate the landings in the region. Total landings peaked in the mid-1970s, and have been at a lower level for the last two decades. Catches of capelin have varied, from being the largest catches in the region (by weight) at some points in time to zero catches at others. Pelagic trawling in the ecoregion tends to catch only one species at a time, whereas demersal trawling normally catches several species simultaneously.

Four of the 15 stocks are included in this overview lack both maximum sustainable yield (MSY) and precautionary approach (PA) reference points for spawning-stock biomass (SSB) and fishing mortality (F). Of the remaining 11, four have been fully evaluated against MSY reference points. Three of these are fished above F_{MSY}, but only one has spawning-stock biomass below MSY $B_{trigger}$. Based on PA reference points, three stocks are assessed to be outside their safe biological limits (i.e. $F > F_{pa}$ and $SSB < B_{pa}$).

In addition to biomass removal, ecosystem effects of fisheries include abrasion, ghost fishing, damage to benthic fauna by demersal trawling, bycatch of elasmobranchs in demersal fisheries, bycatch of seabirds in gillnet and longline fisheries, and bycatch of harbour porpoise in gillnet fisheries. Several regulatory and research efforts are in place, or are being developed, to reduce the impact of fishing on the ecosystem.

Introduction

The Barents Sea ecoregion covers the shelf sea to the north of Norway and the Russian Federation (Russia henceforth) (Figure 1). Its western boundary follows approximately the shelf break towards the deep Norwegian Sea to the west, and its northern boundary follows the shelf break towards the deep Polar Ocean to the north. To the east, the ecoregion borders Novaya Zemlya and the Kara Sea. The two Arctic archipelagos of Svalbard and Franz Josef Land are situated within the ecoregion. There are relatively deep areas to the west, while the eastern parts of the ecoregion are dominated by bank areas.

This overview covers the entirety of ICES Division 27.1.a and parts of divisions 27.1.b, 27.2a, and 27.2.b (hereafter, the "27" area prefixes are omitted). The plots of total catches include all catches in ICES subareas 1 and 2, except for catches of the large pelagic stocks (Norwegian spring-spawning herring, Northeast Arctic mackerel, and blue whiting) for which there are minimal catches in the Barents Sea.

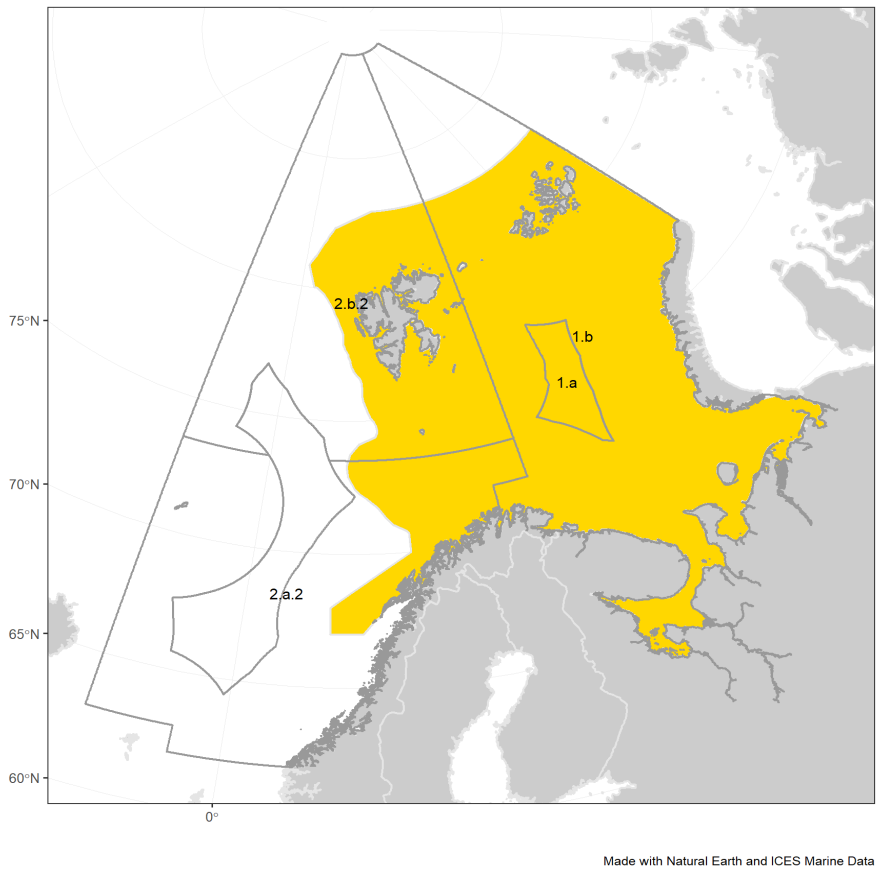


Figure 1 The Barents Sea ecoregion (highlighted in yellow).

The overview provides the following.

- A short description of each of the national fishing fleets in the ecoregion, including their fishing gears and patterns. Recreational fisheries are not included at present.
- A summary of the status of the fisheries resources, and the level of exploitation relative to agreed objectives and reference points.
- An evaluation of the impacts of fishing gear on the ecosystem with regard to 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

There are currently 12 nations with fisheries targeting the stocks in this ecoregion. The country with the highest landings is Norway, followed by Russia. Lower landings are made by Denmark, Estonia, Faroe Islands, France, Germany, Iceland, Poland, Portugal, Spain, Belarus, and the UK (Figure 2). Norway also has the highest fishing effort (note that data from Russia is lacking; Figure 3).

Prior to the establishment of exclusive economic zones in the ecoregion in the late 1970s, several nations were fishing in the area. The major fishing fleets were from Norway and Russia. Historically, landings by all nations were dominated by demersal species such as cod and haddock; redfish (beaked and golden) and Greenland halibut were, however, also important up to about 1990.

Landings of capelin, the only major pelagic fish species in the area, peaked at three million tonnes in 1977. The capelin stock “collapsed” to very low levels in the mid-1980s. Before the establishment of a minimum landing size for Norwegian spring-spawning herring, for which the Barents Sea serves as a nursery area, large catches of immature herring were also

taken in the ecoregion; this was mainly by Norwegian and Russian fishers. In recent years, Norway has fished some legal-sized herring in a restricted coastal purse-seine fishery inside four nautical miles off the Finnmark coast. In the southwestern part of the ecoregion, an international herring fishery has operated in some seasons.

Norway dominates the Northern shrimp fishery. Catches increased considerably from 2018, with much of that increase coming from fleets fishing in the international waters between the Norwegian Exclusive Economic Zone (EEZ), the Fisheries Protection Zone around Svalbard, and the Russian EEZ. Red king crab are fished by Russia in near-coastal Russian waters, and by Norway in the coastal waters of the northernmost counties of Norway, Troms and Finnmark. A fishery has developed for the snow crab in recent years; this is a species first encountered in the ecoregion in 1996. This fishery is mainly carried out by a Russian fleet, in the Russian part of the Barents Sea shelf.

Commercial hunting of Barents Sea harp seals started with vessels from northern Norway in 1867. In general, there has been a lack of capacity to take recommended TACs since 2000. Norwegian whaling, targeting minke whales, started in the late 1920s. A total quota was introduced in 1976. The effect of this was to move the catch effort from coastal areas with relatively low catch rates to the Barents Sea, as well as off the west coast of Spitsbergen. Following the moratorium on all whaling as declared by the International Whaling Commission (IWC), Norway stopped all commercial minke whale hunt temporarily after the 1987 season. The hunt was started again in 1993, and has continued in all subsequent years.

Norway

The Norwegian fleet fishing in the ecoregion consists of about 3000 active vessels; these vessels are fishing gadoids, flatfish, other demersal fish, pelagic fish, and shellfish. Small coastal vessels (the majority being < 11 m in length) fishing with gillnets and pots make up around 94% of the fleet, while the remaining 6% are predominantly ocean-going trawlers > 28 m in length. 539 Norwegian vessels participated in the 2018 quota-regulated red king crab fishery east of 26°E, consisting exclusively of coastal vessels (6–22 m in length). West of this line, fishing for red king crab is unregulated and the number of vessels unknown. The snow crab fishery in the Norwegian part of the ecoregion is still developing, because of the relatively recent westward spread of snow crab. There are currently 16 Norwegian vessels in this fishery. The harp seal hunt in the ecoregion has traditionally been conducted with large, ice-going sealers of which only 2–5 vessels remain today. Approximately 10–15 vessels participate in the minke whale hunt.

Russia

The Russian fleet operating in the Barents Sea and Norwegian Sea ecoregions is composed of about 215 vessels. 90% of these catch demersal species, including fish and crustaceans, and 15% catch pelagic species. Approximately 25% of the fleet targeting demersal species are below 34 m in length, and operate near the Russian coast using trawls and traps, catching several fish species and crabs. Vessels of size 34–65 m average around 60% of the fleet and mainly target cod, haddock, saithe, redfish, Greenland halibut, wolffish, long rough dab, and European plaice using trawls and longlines, crabs using traps, and shrimp using trawls. The industrial factory ships (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 capelin, but also catch cod, haddock, and saithe. The Russian harp seal hunt is performed using 2–3 helicopters, where the seals (generally pups) are hunted on the ice.

Denmark

The Danish fleet targets (small amounts of) demersal fish in ICES Subdivision 2.a.2. The vessels are all pelagic trawlers or combined trawl/purse-seiners, ranging in length between 60 m and 90 m.

Estonia

The Estonian fleet fishing in the area consists of 5 vessels with an average length of 64 m, operating in the Northwest Atlantic, Northeast Atlantic, and Svalbard. The fleet targets mainly Northern shrimp and Greenland halibut with bottom trawls, with cod and long rough dab as bycatch.

Faroe Islands

The Faroese fleet in the ecoregion currently consists of four vessels targeting cod, haddock, Greenland halibut, shrimp, redfish, and flatfish. These vessels are between 50 m and 80 m in length.

Germany

The German fleet operating in the ecoregion consists of about five vessels (> 40 m in length). The pelagic freezer trawlers target mainly herring, blue whiting, and redfish, while the demersal trawlers target mainly cod, saithe, and haddock.

Greenland

The Greenland fishing fleet consists of eight vessels. Two of these are 82–88 m long stern trawlers that mainly target cod, saithe, and haddock; with minor bycatches of plaice and wolffish. The remaining six vessels are pelagic trawlers and purse-seiners, 66–88 m in length that mainly fish for mackerel. One vessel targets Northern shrimp.

Iceland

The Icelandic fleet consists of nine vessels, all demersal trawlers larger than 60 m in length. These vessels target cod in accordance with bilateral agreements between Iceland and Norway, and between Iceland and Russia.

Lithuania

The Lithuanian fleet in the North Atlantic consists of two demersal trawlers > 40 m in length, targeting shrimp in the ecoregion. Another trawler > 40 m in length operates in ICES divisions 2.a and 14.b, targeting redfish with midwater otter trawl.

Poland

One Polish vessel (> 40 m in length) is active in the region, targeting cod, haddock, saithe, redfish, and Greenland halibut.

Portugal

Two Portuguese stern trawlers (> 60 m in length) operate in the area; they mainly target cod, since quotas for redfish, haddock, and pollock are small.

Spain

The Spanish fleet consists of seven vessels. Four of these are between 48–87 m in length, targeting cod with otter bottom trawls.

France

French vessels target cod, haddock, saithe, redfish, and Greenland halibut in the area. The fleet usually consists of one freezer trawler of 80 m in length, targeting cod and associated species (haddock and saithe) with otter bottom trawls.

UK

Three or four demersal vessels operate throughout the year in the ecoregion, mainly targeting species such as cod, haddock, saithe, and Greenland halibut. The average size of these vessels is around 4830 kW horse power and > 80 m in total length. There are between one and three vessels that fish for herring in Division 2.a.

Others

Smaller amounts of saithe, redfish, and Greenland halibut have been landed by Ireland, the Netherlands, and Latvia in

some years. Belarus vessels also catch a small amount of cod annually.

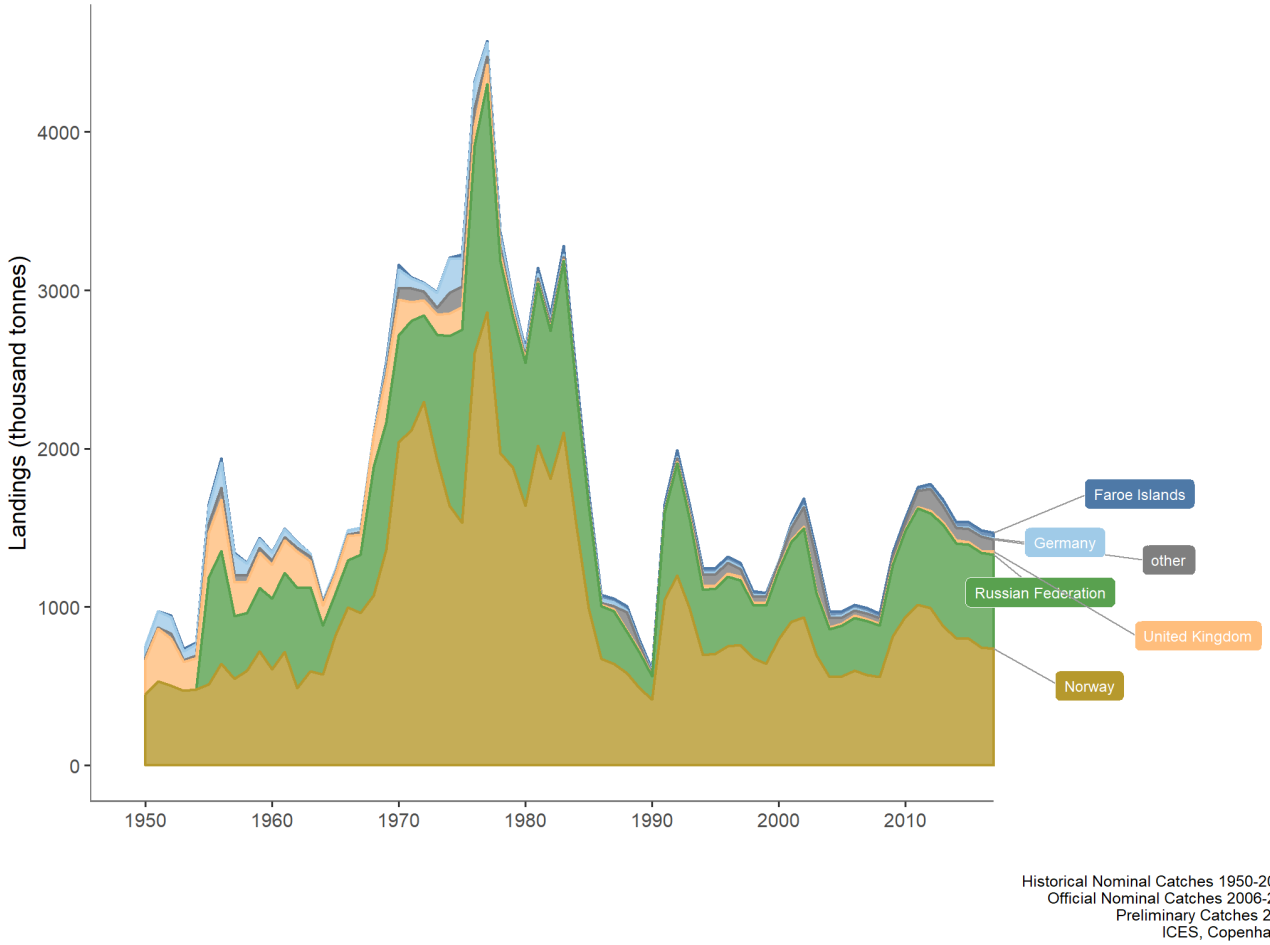


Figure 2 Landings (thousand tonnes) from ICES subareas 1 and 2. This approximates to the majority of the Barents Sea ecoregion in 1950–2018, by (current) country. The nine countries having the highest cumulative landings over the entire time-series are shown individually, and the remaining countries are aggregated and displayed as "other". Catches of herring, blue whiting, and mackerel in subareas 1 and 2 are not included.

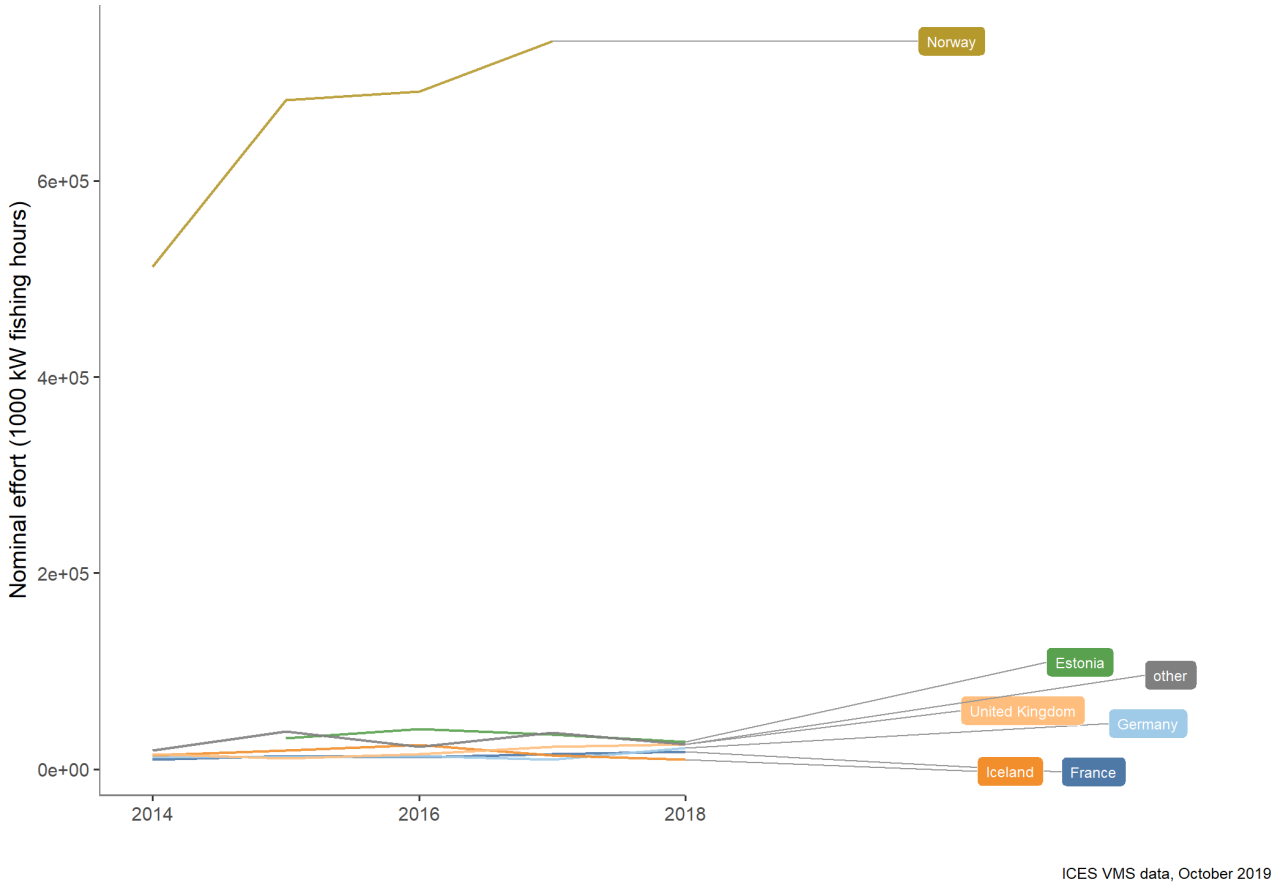


Figure 3 ICES subareas 1 and 2. Fishing effort (1000 kW hours-at-sea) in 2014–2018 for the six main countries fishing in the ecoregion. For vessels over 15 m in length only. The remaining countries are aggregated and displayed as "other". There is no Norwegian data for 2018. Data are missing for the Russian fleet.

Catches over time

Landings of pelagic species (mainly capelin) within the ecoregion showed a sharp increase in the late 1960s, then remained high until the mid-1980s. The capelin landings have fluctuated since then, reflecting alternating periods with either total fishing ban, or with TACs in the order of 0.3–1.0 million tonnes (Figure 4). Landings of demersal fish were highest both at the beginning and near the end of the time-series (Figure 4). Landings of crustaceans and "undefined" species (not assigned a specific guild) have been low, compared to landings of pelagic and demersal fish during the whole period (Figure 4). Crustacean fisheries have remained relatively stable in the last few decades; deep-water shrimp accounts for the highest landings. Other important crustacean species include red king crab and, in recent years, snow crab. Cod, haddock, and saithe account for the highest landings of demersal species (Figure 5).

It should be noted that there are several stocks not assessed by ICES for which there is or has been a significant fishery in the area. These include polar cod, wolffishes, plaice, and anglerfish. The catches of those species are much larger than the catches of greater forkbeard, starry ray, and roundnose grenadier. The latter three species have never had any significant catches in the Barents Sea.

Since 2000, catches of harp seals have generally been lower than the TAC. A ban implemented on all pup catches closed the Russian hunt in the White Sea during the 2009–2013 period. This ban was removed before the 2014 season; because of climatic conditions, however, there was no hunting in the White Sea from 2014. The Norwegian hunt in the area has also been small since 2007, with some increased effort in 2018 and early 2019.

Norwegian landings of minke whales peaked in the late 1950s, when around 4000 animals were taken per year. Landings decreased after this 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.

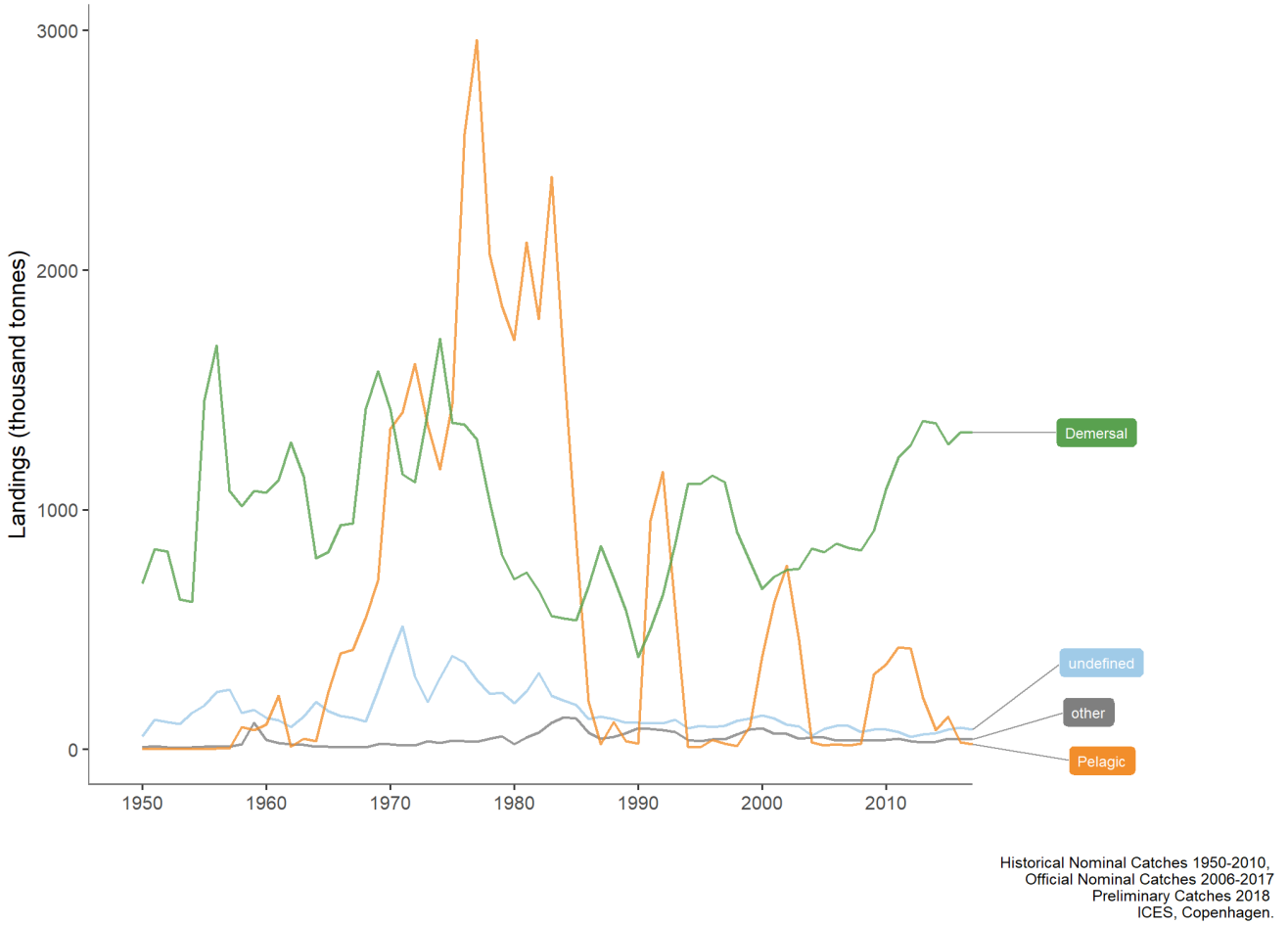


Figure 4 Landings (thousand tonnes) from ICES subareas 1 and 2 in 1950–2018, by fish category. Table A1 in the Annex details the species that belong to each fish category. The "other" category mainly contains crustaceans (mostly *P. borealis*) and elasmobranchs. Catches of herring, blue whiting, and mackerel in areas 1 and 2 are not included.

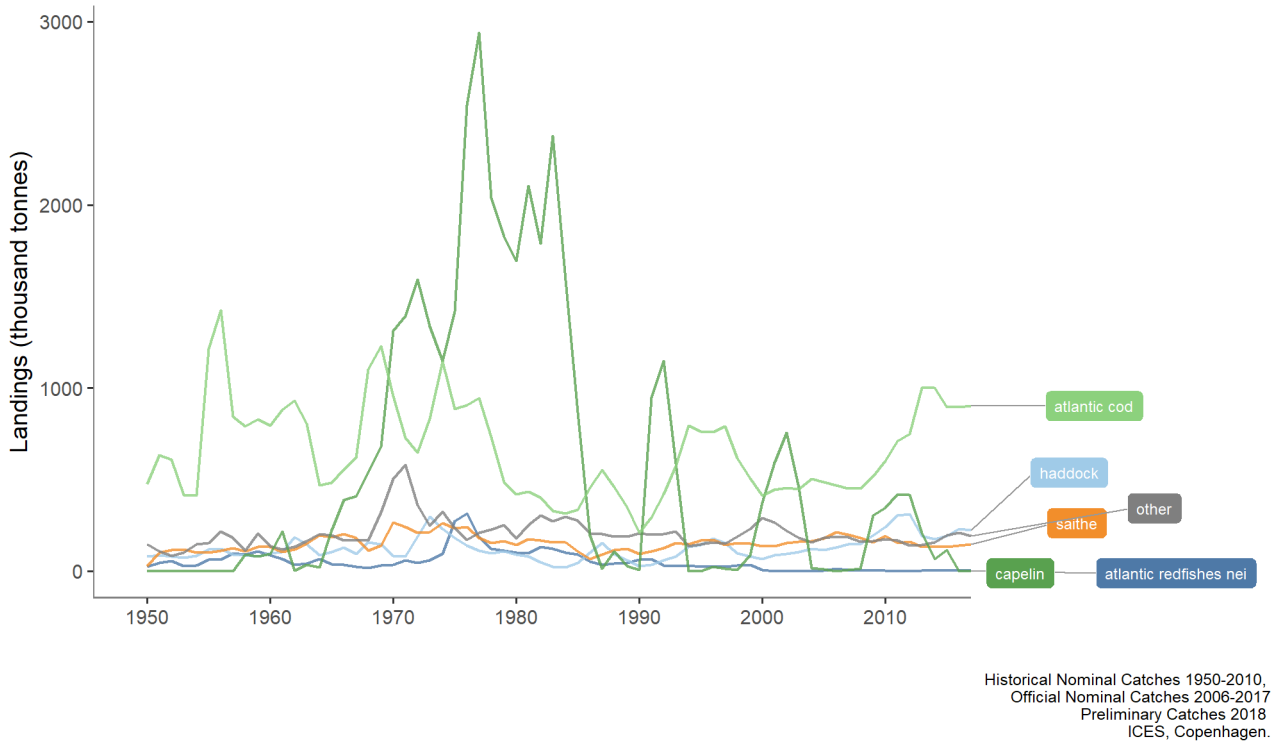


Figure 5 Landings (thousand tonnes) from ICES subareas 1 and 2 in 1950–2018, by species. The five species having the highest cumulative landings over the entire time-series are displayed separately; the remaining species are aggregated and labelled as "other". Catches of herring, blue whiting, and mackerel in areas 1 and 2 are not included.

Discards

Norway launched a discard ban on cod and haddock in 1987. This was gradually expanded to other species and from 2009 an obligation to land all catches was introduced, albeit with certain exemptions. Discarding is, nevertheless, a problem, e.g. in haddock fisheries where discards are highly related to the abundance of haddock close to, but below, the minimum legal catch size. Documentation of redfish (mainly beaked redfish) taken as bycatch and then discarded in the Norwegian shrimp fishery since 1984 shows that shrimp trawlers removed significant numbers of juvenile redfish during the early 1980s. After sorting grids became mandatory in 1993, bycatch and discard of redfish was substantially reduced. The bycatch and discard of cod and haddock in shrimp fisheries consists mainly of 1- and 2- year-olds, but is generally small compared to other reported sources of mortality, like catches and discards in the demersal fisheries.

Description of the fisheries

Demersal trawlers account for the majority of landings and fishing effort (Figure 6), targeting cod, haddock, Greenland halibut, and northern shrimp at the southern and central fishing banks and along the shelf break into the Norwegian Sea (Figure 7). The spatial distribution of effort along the Norwegian coast and in the eastern Barents Sea is not mapped here; the reason for this is a lack of VMS data from small vessels in the coastal fleet, and from Russian vessels in the eastern Barents Sea. Static gears (longlines and gillnets) account for the next highest levels of effort; these fisheries mostly target cod, haddock, and wolffish along the coasts (predominantly with small vessels not shown in Figure 7) and at the Central Bank. The traditional fishery for cod in the spawning season takes place from small boats using longlines, gillnets, handlines, and Danish seine in the Lofoten area. In years during which a fishery for capelin is allowed, this takes place prior to spawning in spring with purse-seiners (Norway) or pelagic trawl (Russia and, to a lesser degree, Norway) along the Norwegian and Russian coasts (Figure 7).

Northern shrimp have been caught almost exclusively in recent years in the central Barents Sea. Although this has been an important shrimp fishing area in the past, fishing activity then was more widely distributed; in the early 2000s significant catches were also made around Svalbard. A minor proportion of northern shrimp is caught along the Norwegian coast and within the fjords; local shrimp populations that are distinct from the Barents Sea population are found in those areas, but

are managed as a common stock unit. The distribution of red king crab is constrained to coastal areas in the southeastern part of the ecoregion, where almost all red king crab catches occur. In Norwegian waters, most of the red king crab landings originate in the fjords in the Finnmark area. Snow crab is mainly caught in the central Barents Sea, in Norwegian and Russian waters.

The Norwegian hunt of harp seals is directed towards weaned pups (beaters) or older animals on their moulting grounds in the southeastern Barents Sea. Hunting takes place in the Russian EEZ, but Norwegian vessels are not permitted to access areas inside the Russian 12 nautical mile line. Russian hunting also targets weaned pups, and occurs on the whelping grounds in the White Sea.

The Norwegian minke whale hunt targets whales while they are at feeding grounds at high latitudes. Currently, most minke whales are caught along the coasts of northern Norway, further out in the Barents Sea, and off the west coast of Spitsbergen. Prior to 1987 whaling occurred in the entire Barents Sea, but Norwegian whalers have not had access to the EEZ of Russia since the hunt was resumed in 1993. Russia has never hunted whales in the Barents Sea.

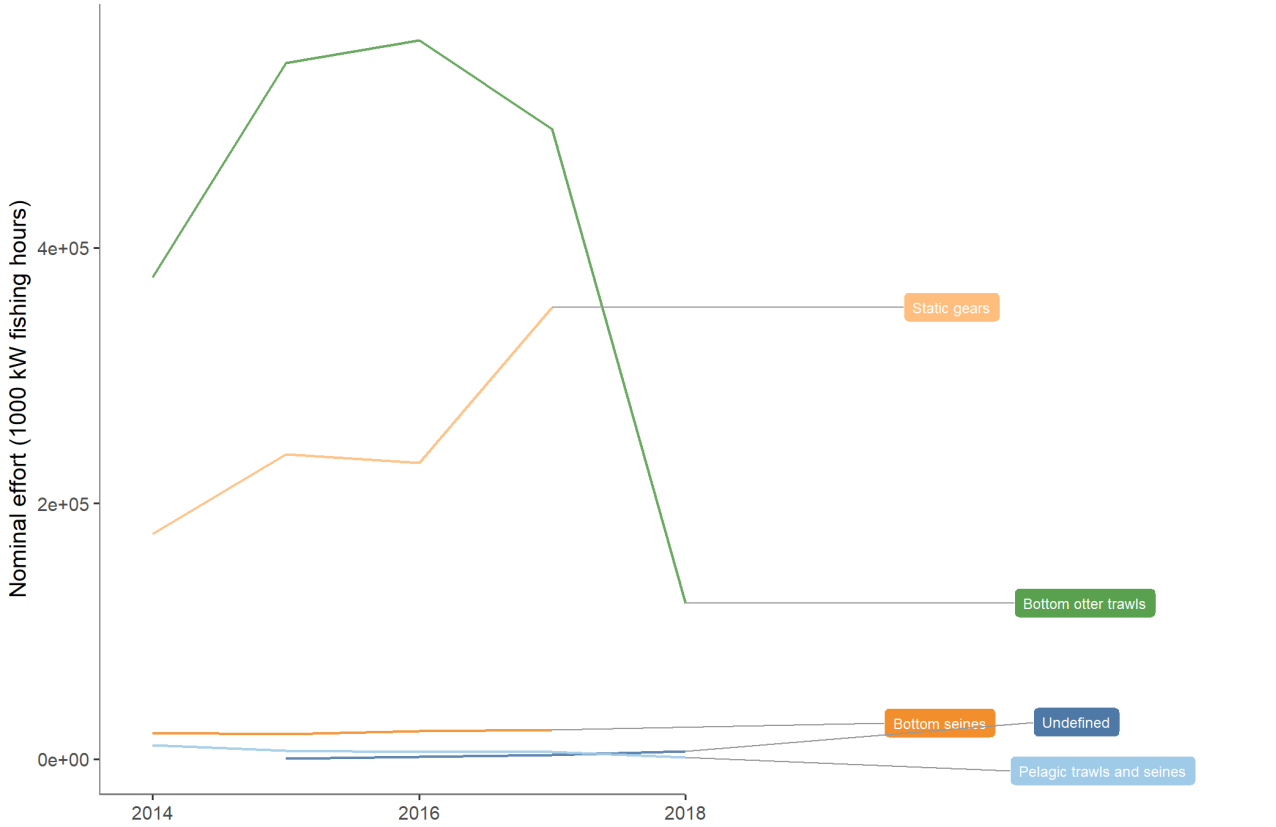


Figure 6 ICES subareas 1 and 2. Fishing effort (1000 kW hours-at-sea) in 2014–2018 by gear type. For vessels over 15 m in length only. Data are missing for the Russian fleet, and for the Norwegian fleet in 2018.

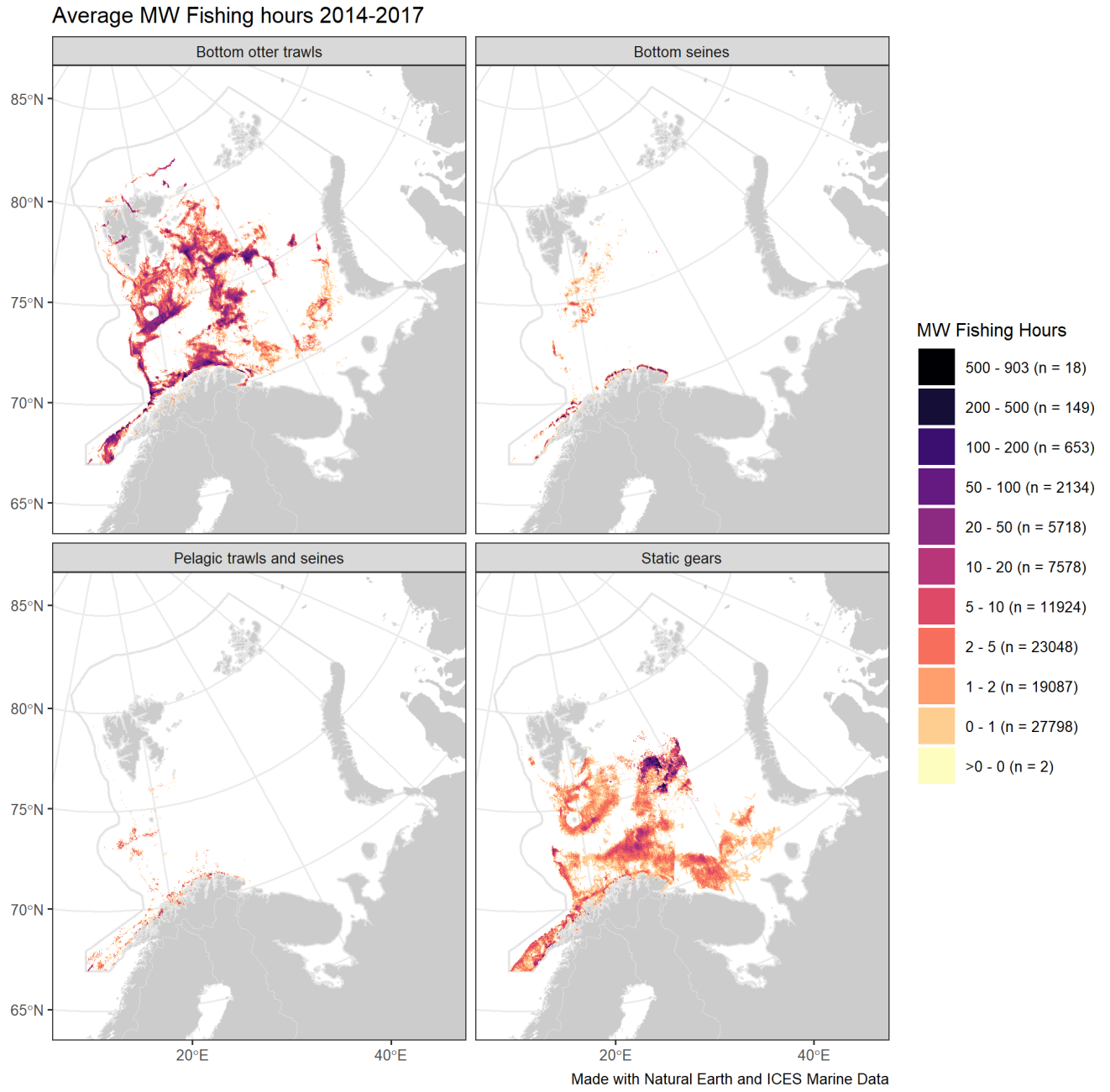


Figure 7 Spatial distribution of average annual fishing effort (mW fishing hours) in the Barents Seas ecoregion from 2014 to 2017, by gear type. Fishing effort data are only shown for vessels > 12 m in length, with vessel monitoring systems (VMS). This will bias the distributions, particularly in coastal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

Bottom trawl

The most widespread gear used in the central ecoregion is bottom trawl. The Russian and Norwegian bottom trawl fleet catches show spatial and temporal differences in the composition and size of both species. In the northeastern part of the ecoregion, the major part of Russian catches consists of cod, whereas the Norwegian catches also include shrimp. Shrimp trawlers can alternate between single, double, and triple trawls depending on the conditions at the specific fishing grounds. In the westernmost part of the ecoregion, bottom trawl catches consist of Greenland halibut and beaked redfish in addition to cod and haddock. The Norwegian trawl fishery along the southern coast is dominated by saithe.

Longline and line fisheries

Longline is used in the Norwegian demersal fishery, both in the coastal fleet and in the ocean-going fleet that operates further out in the Barents Sea. The Russian longline fishery has increased in recent years, and mainly targets cod and wolffish.

Purse-seine and pelagic trawl

The Norwegian pelagic fleet mostly uses purse-seine in the capelin fishery.

The Russian pelagic fleet and some smaller Norwegian vessels use pelagic trawl for capelin. Bycatch of cod has been of concern, especially when fishing close to the coast. When strong year classes of herring (ages 0–3) were present in the Barents Sea, the capelin fishery had to be temporarily closed because of bycatch of undersized herring.

Crab pots

Red king crab and snow crab are fished with pots along the Norwegian and Russian coasts and in the central Barents Sea, respectively. Bycatch is low and there are minimum landing sizes for red king crab both in Norway and Russia; 13 cm (males) and 12 cm (females) carapace width in Norway, and 15 cm carapace width in Russia.

Seal and whale hunting

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

Other fisheries

Other gears more common along the coast include handline and bottom seine. Less frequently used gears are floatline (used in a small but directed fishery for haddock along the coast of Finnmark, Norway).

Fisheries management

The Barents Sea ecoregion includes all or parts of the EEZs of Russia and Norway, as well as most of the Fisheries Protection Zone around Svalbard. Management is conducted in accordance with the fisheries policies of Russia and Norway, and catch opportunities for stocks in the area are agreed during meetings of the Joint Norwegian–Russian Fisheries Commission. National authorities manage activities in coastal waters (i.e. within 12 nautical miles of the coast) of Russia and Norway. The status of Svalbard waters is partly unresolved. All nations that have historically fished in the Svalbard area are still active in the area, but Norway monitor and regulate the zone. Located centrally in the Barents Sea is a small area beyond national jurisdiction; this area of high seas is called "the Loophole" (ICES Division 1.a) and the fishing there is managed based on agreements by the North East Atlantic Fisheries Commission (NEAFC) and by coastal states. A small salmon fishery is managed nationally, based on agreements at the North Atlantic Salmon Conservation Organization (NASCO). International fisheries advice and advice on harp seals is provided by ICES.

Total allowable catch (TAC) is the main fishery management tool in the ecoregion. TACs were introduced for most stocks in the later part of the 1980s.

Several technical measures are in place in the ecoregion. It is mandatory in all groundfish trawl fisheries to use a sorting grid to avoid catching undersized fish. There are two exceptions: an area open for targeting redfish, and an area in the southwestern part of the ecoregion, where trawling without sorting grids is permitted to catch haddock from 1 January to 30 April. From 2011 onwards, the minimum mesh size for bottom-trawl fisheries for cod and haddock is 130 mm for the entire Barents Sea. At the same time, a change/harmonization of the minimum legal catch size for cod from 47 cm (Norway) and 42 cm (Russia) to 44 cm, and for haddock from 44 cm (Norway) and 39 cm (Russia) to 40 cm, took place. It has been mandatory since 1992 to use a sorting grid in the shrimp fishery.

Spatial management also occurs, both for fisheries and ecosystem reasons, with permanent and temporary closed areas to protect e.g. juvenile fish and deep-water coral reefs. The Norwegian government has implemented an "Integrated Management Plan for the Marine Environment of the Barents Sea–Lofoten Area", which is a framework for the sustainable use of natural resources and goods derived from the area, including fishing.

Red king crab and snow crab fisheries are managed separately by Norway and Russia. Red king crab is a coastal fishery in Norway, and there are two spatial management regimes: east of 26° longitude the management aim is to maintain a long-term fishery through a TAC, while west of 26°E there is a free non-legislated fishery with a discard ban aimed at limiting further spread, and keeping the stock as low as possible. Norway and Russia share exclusive access to the snow crab fishery but manage their fisheries with separate TACs.

The Joint Norwegian–Russian Fisheries Commission manages seal hunting. Fisheries of saithe are managed by Norway. Minke whale quotas are set by Norway.

Commercial minke whaling is based on the International Whaling Committee's (IWC) 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

The Barents Sea Fisheries overview contains 15 stocks for which ICES provided advice for 2019. These encompass the following categories: ten demersal, one elasmobranch, one crustacean, and three pelagic stocks.

Fishing mortalities and spawning-stock sizes have been evaluated against maximum sustainable yield (MSY) and precautionary approach (PA) reference points, and the status of the stocks has also been assessed relative to safe biological limits, i.e. $F < F_{pa}$ and $SSB > B_{pa}$ (Figure 9). Out of the seven stocks with F_{MSY} reference points, three were fished above F_{MSY} target levels in 2018; cod, haddock, and golden redfish (red colour in Figure 8), while only one of these stocks – the golden redfish – had an SSB below MSY $B_{trigger}$. Based on PA reference points, three stocks are assessed to be outside their safe biological limit (SBL); capelin, cod, and golden redfish (see also Table A1 in the Annex). The stocks have also been evaluated against the EU Marine Strategy Framework Directive (MSFD) indicators for fishing mortality and spawning-stock biomass,

which correspond to F_{MSY} and MSY $B_{trigger}$ (Figure 9).

Four species lack all reference points (Table A2 in the Annex); the majority of species have some, but not all, reference points. Some stocks with missing reference points are "data-limited stocks", which means that there are no forecasts of stock development (ICES categories 3, 5, and 6). However, stocks in ICES categories 1 and 2, for which quantitative assessments are available, make up the majority of the landed biomass (Figure 9). 64% of the landings in 2018 were from stocks fished slightly above F_{MSY} (mainly cod and haddock), and only 5% of the landings came from stocks with fishing mortality below or at F_{MSY} (D3C1; Figure 9). The remaining landings were from stocks without a full set of MSY reference points. Because of the relatively high spawning-stock biomass of cod and haddock, 68% of the landings nevertheless came from stocks with SSBs above MSY $B_{trigger}$ (D3C2; Figure 9).

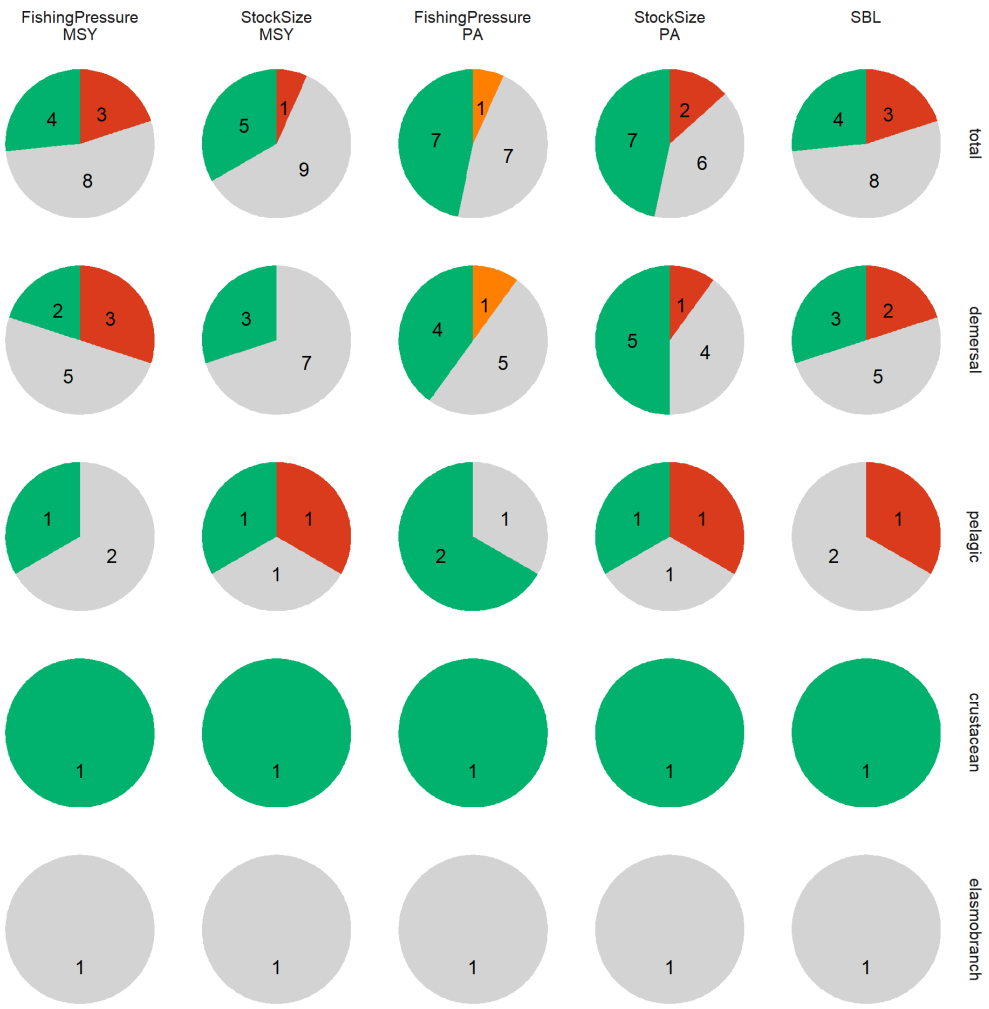


Figure 8 Status summary of Barents Sea stocks in 2019, relative to the ICES maximum sustainable yield (MSY) approach and precautionary approach (PA). Grey represents unknown reference points. For the MSY approach: green represents a stock that is either fished below F_{MSY} or where the stock size is greater than MSY $B_{trigger}$; red represents a stock status that is either fished above F_{MSY} or where 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 fished between F_{pa} and F_{lim} or has a stock size between B_{lim} and B_{pa}; red represents a stock that is fished above F_{lim} or where 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.

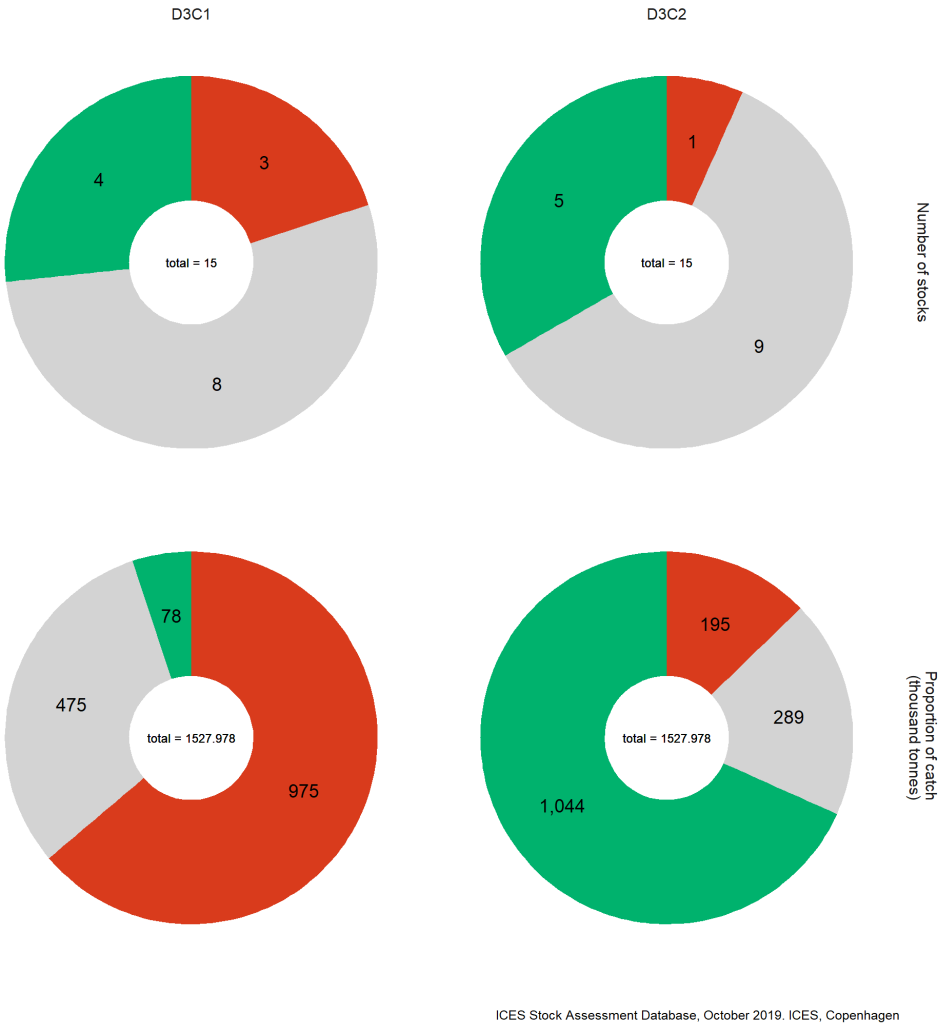


Figure 9 Status summary of Barents Sea stocks in 2019, relative to the EU Marine Strategy Framework Directive (MSFD) assessment criteria of the level of pressure of fishing activity (D3C1) and reproductive capacity of the stock (D3C2). Green represents the proportion of stocks that are either fished below F_{MSY} or where 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 where 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 northern shrimp stock has been assessed against MSY and PA reference points, and is considered to be well above safe biological limits. The stock biomass has been above $B_{trigger}$ and fishing mortality below F_{MSY} throughout the history of the fishery (Figure 10). There is no ICES assessment for red king crab or snow crab, though they are assessed nationally. In the Norwegian zone, red king crab has been fished above F_{MSY} in recent years and stock biomass is likely to have fallen below B_{pa}. Snow crab on the Norwegian shelf is currently estimated to be below B_{pa}, but fished above F_{MSY}. Because of the recent development of the fishery only a short time-series exists, leading to high uncertainty around the status of this stock.

The average ratio of fishing mortality (F) to F reference points for category 1 demersal stocks has been above 1 throughout the history of the fishery. In the last decade, the main reason for this has been the golden redfish fishery that has been conducted above long-term sustainable levels (Figure 10). Fishing mortalities on cod and haddock were reduced to F_{MSY} or lower after 2007, and the SSB of both stocks have been well above MSY $B_{trigger}$ since then; this is despite declining trends in SSBs in the last years.

The ratio of SSB to stock status reference points for the pelagic beaked redfish shows an increasing trend over the time-series, with SSB remaining above MSY $B_{trigger}$ since the mid-1990s (Figure 10). In recent years, the ratio has stabilized.

Capelin SSB has fluctuated over time, falling to at or below MSY $B_{trigger}$ every decade since the mid-1980s, followed by periods with high SSB (Figure 10).

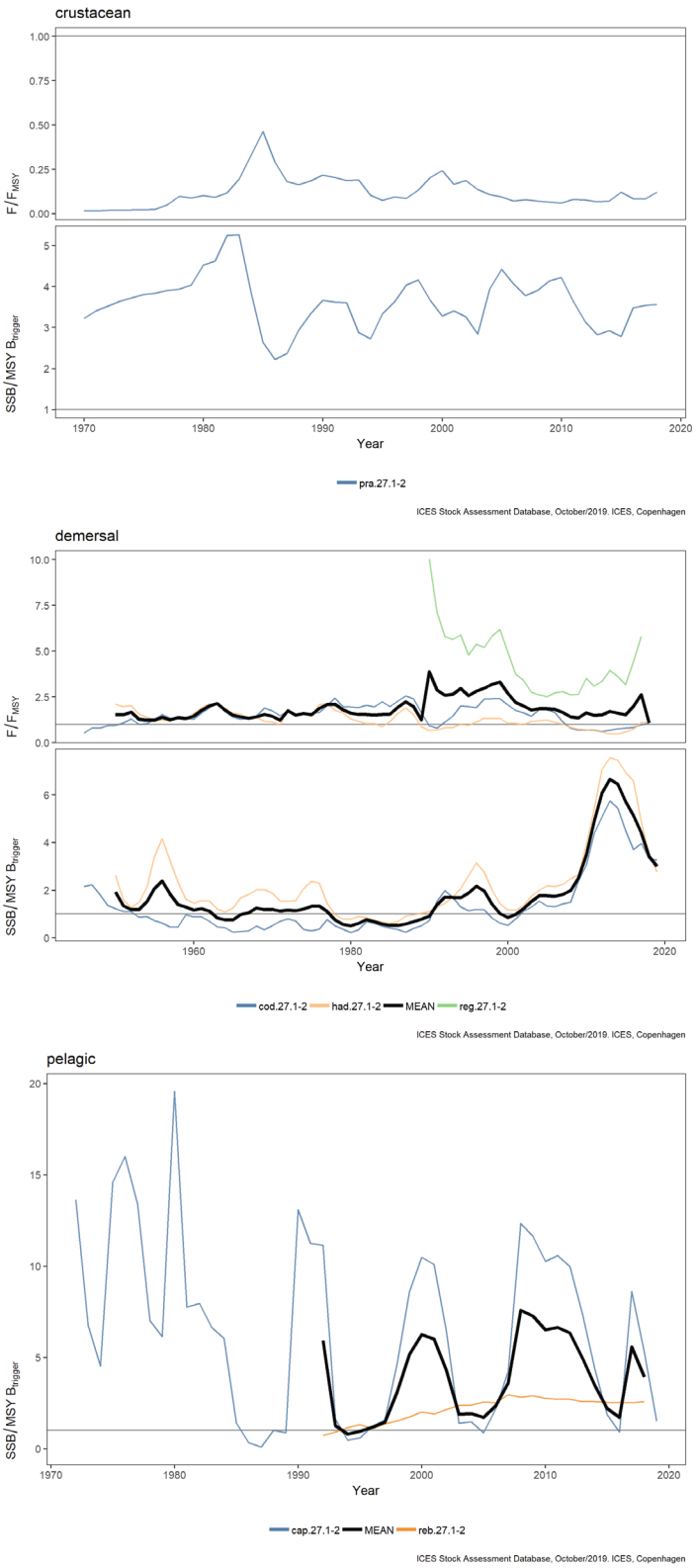
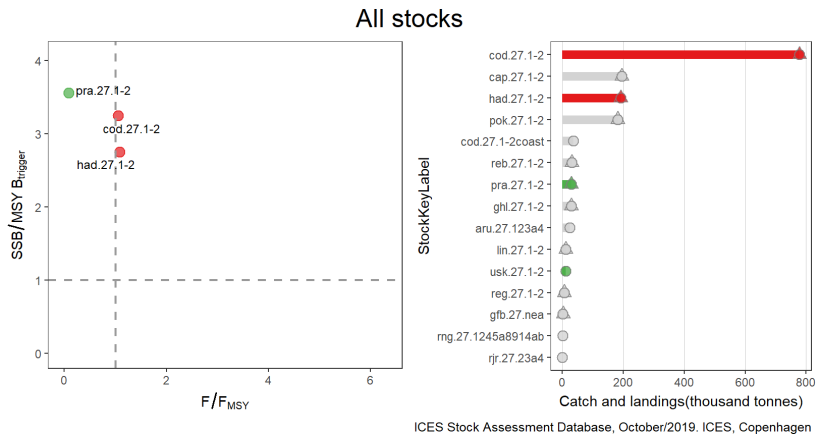
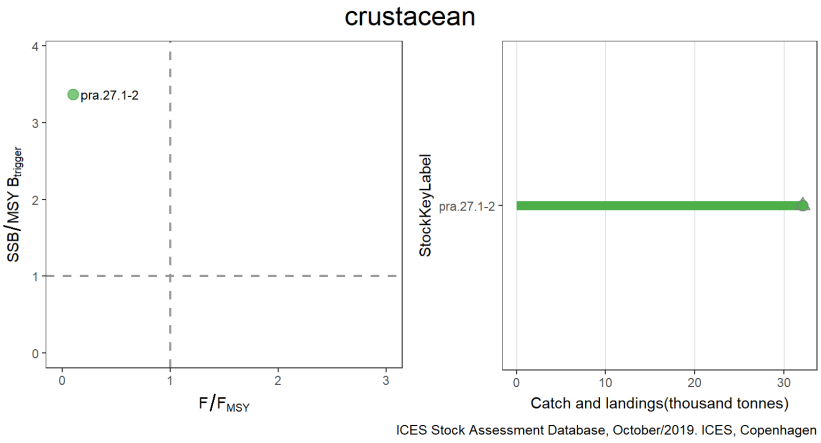


Figure 10 Temporal trends in F/F_{MSY} and SSB/MSY $B_{trigger}$ for Barents Sea crustacean, demersal, and pelagic stocks. Only stocks with defined MSY reference points are considered. Stocks for which only proxy reference points are available are not shown. For full stock names, see Table A1 in the Annex.

European eel cannot be assessed against any PA or MSY reference points. Recruitment of European eel has declined sharply in recent decades because of a range of potential threats. Eels in low abundances migrate through the Barents Sea, but there is currently no significant marine fishery targeting eel there.

The stock status relative to F_{MSY} and MSY $B_{trigger}$ is shown, for all fish and crustacean stocks with MSY reference points, in Figure 11. The northern shrimp stock has over three times MSY $B_{trigger}$, and is fished below F_{MSY}.





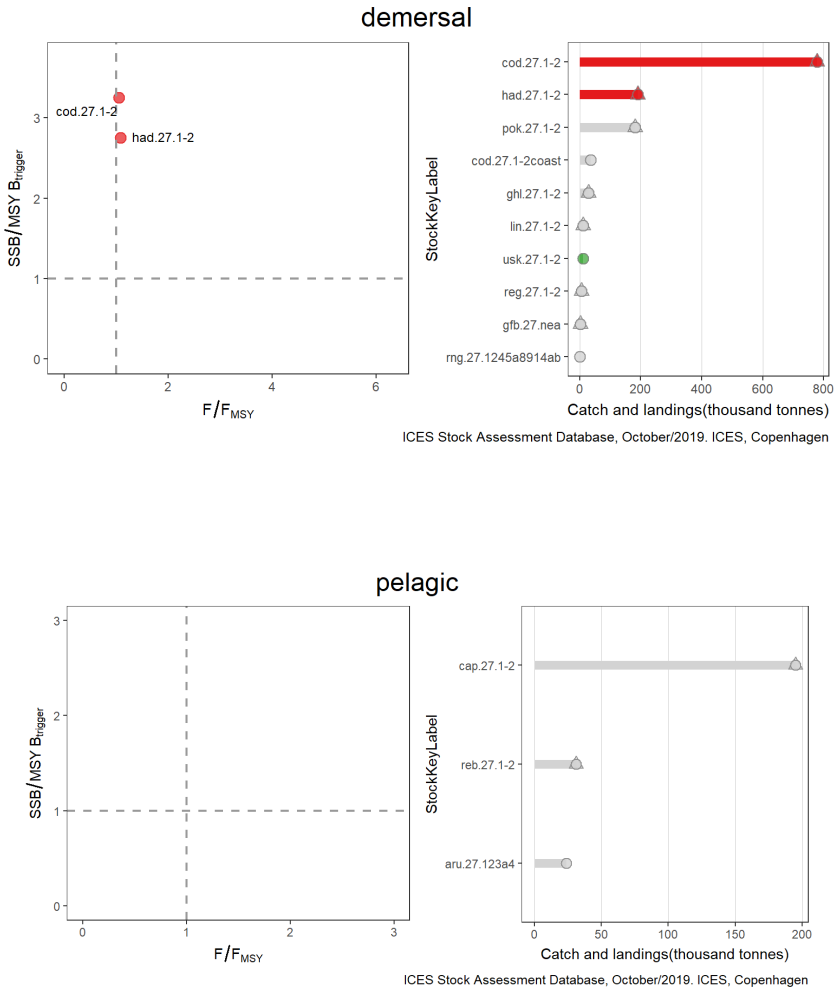


Figure 11 Status of Barents Sea stocks, relative to the joint distribution of exploitation (F / F_{MSY}) and stock size (SSB / MSY $B_{trigger}$) [left panels, by individual stocks] and catches (triangles) / landings (circles) from these stocks in 2019 [right panels]. Stocks for which only proxy reference points are available are not shown on the left plot. The left panels only include stocks for which MSY reference points have been defined. 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 the highest catch and landings across fisheries guilds in 2019. For full stock names, see Table A1 in the Annex.

Mixed fisheries

Fishing operations typically catch more than one species at a time, although some fishing operations are more species-selective than others. For example, pelagic trawling tends to catch only one species, whereas demersal trawling normally catches several species simultaneously. Mixed fisheries, in the sense that more than one species is targeted during the fishing operation, are much less widespread in the Barents Sea than in some other ecoregions but do occur, for instance, in the demersal trawl fishery for cod and haddock.

Species interaction

Commercially exploited species (fish, invertebrates, mammals) are part of the marine foodweb and interact in various ways, including through predation and competition. The main top predators in the ecosystem are cod, harp seal, and minke whale. They all feed on young cod as well as on capelin, herring, and the krill and amphipod prey of these species

(Figure 12). Since fishing and hunting mortality rates have been reduced on most species over the last two decades, natural mortality, including cannibalism, has the potential to change; this influences the abundance and yield of other stocks. The abundance of some mammal species has increased in parts of the ecoregion, although more slowly than in fish stocks.

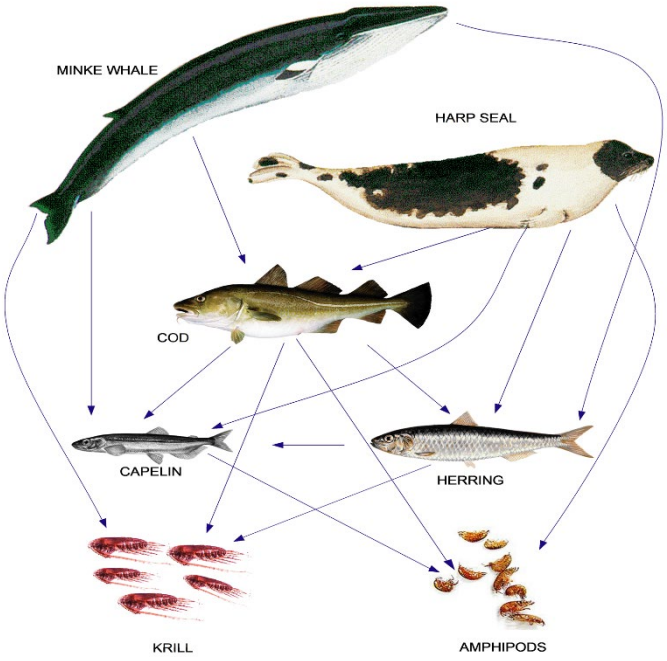


Figure 12 Interactions between commercial species and their prey in the Barents Sea foodweb. The arrows indicate central predator–prey relationships, with the arrows pointing from predator to prey.

Effects of fisheries on the ecosystem

Physical disturbance

Abrasion of the seabed by mobile bottom-contacting fishing gears has been investigated to describe the extent, magnitude, and effects of fishing on benthic habitats in the western-central Barents Sea (data are lacking from the eastern Barents Sea). Gear-use is concentrated along the coast of the Norwegian mainland and on the banks in the central and western Barents Sea, with lower activity in deeper areas (Figure 13). The fishing intensity west of Svalbard has increased in the period from 2011 to 2017.

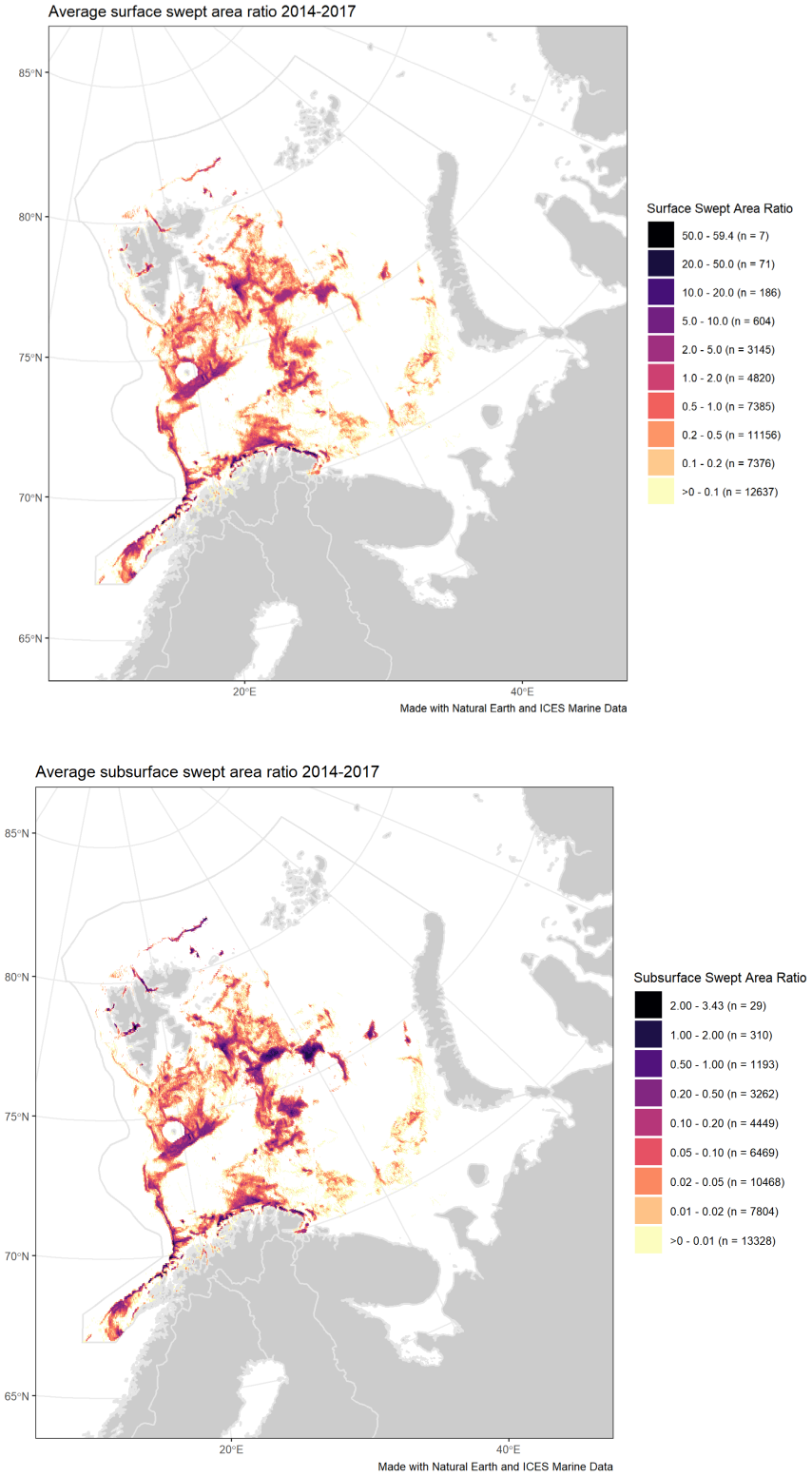


Figure 13 Average annual surface (top) and subsurface (bottom) disturbance by mobile bottom-contacting fishing gear (bottom otter trawls, bottom seines, dredges, and beam trawls) in the Barents Seas ecoregion during 2014–2017, expressed as average swept-area ratios (SAR). No data for Russia are available. Data from the years 2014–2017 were used to produce the figure, because of a lack of Norwegian data for 2018.

Ghost fishing

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; this is also known as ghost fishing. Ghost fishing is more problematic in deeper waters; because of lower rates of biofouling and tidal scouring, these gears continue to fish effectively. Investigations made by the Norwegian Institute of Marine Research has shown that the number of gillnets lost increases with depth.

Lost or abandoned crab pots are common in the ecoregion and often go unreported. Efforts to introduce biodegradable parts in the pots, and conventions for marking the end of strings to keep track of lost pots, are ongoing. The Norwegian Directorate of Fisheries has organized retrieval surveys for lost fishing gear annually since 1980.

Bycatch of protected, endangered, and threatened species

The vulnerability of large benthic animals to bottom trawling has been evaluated using a trait-based approach. The biomass-weighted vulnerability of megabenthos generally increases from south to north; the southern benthos communities are dominated by mobile species with low height above the seabed (e.g. crabs and other crustaceans, sea stars, and snails), while large upright species dominate the northern communities (e.g. basket stars, sea lilies, sponges, sea pens, and cauliflower corals).

Elasmobranchs may be taken as bycatch in demersal fisheries. The most abundant skate in the area is the starry ray (also known as thorny skate), which is widespread in the Barents Sea and adjacent waters. Bottom-trawl fisheries targeting cod and haddock, and longline fisheries targeting cod, wolfish, and Greenland halibut have an elasmobranch bycatch, which is generally discarded. Data from the Norwegian Reference Fleet indicate that the most commonly landed skates today are larger specimens of thornback ray, spinytail skate, and Arctic skate. These are not abundant in the ecoregion and the information on stock status is lacking. Thornback ray may be locally abundant in some fjords. Further studies are required, particularly for the larger-bodied elasmobranchs, which are generally considered to be more vulnerable to overfishing. Since 2010, all dead or dying skates and other fish in the catches should be landed, whereas live specimens can be discarded as they may survive. Sharks are also taken as bycatch in the area, but data are sparse.

Documentation of the scale of seabird bycatch in the ecoregion is incomplete. Unusual incidents, like the bycatch of large numbers of guillemots during spring cod fisheries, have been documented. Gillnet fishing primarily affects coastal and pelagic diving seabirds, while the surface-feeding species will be most affected by longline fishing. The effect of fishing on the bird population will vary with the time of year, the status of the affected population, and the sex and age structure of the birds killed. Even a low bycatch may be a threat to red-listed species such as common guillemot, white-billed diver, and Steller's eider. Several bird-scaring devices have been tested for longlining, and there is evidence that the bird-scaring line reduces bird bycatch. Estimates suggest that fulmars, cormorants, puffins, black guillemot, and razorbills were particularly impacted by fishing; for some local populations of black guillemot and fulmars, however, the loss was concluded to be a small fraction of the populations.

The harbour porpoise is common in the ecoregion and is most abundant in coastal waters. The harbour porpoise is subject to bycatch in the gillnet fishery (targeting cod, monkfish, and saithe), and bycatch is estimated to be around 7000 individuals across the whole area; the impact on population is, however, not known.

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Annex

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

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

Table A1 Status summary of the Barents Sea ecosystem stocks in 2019, in regards to the ICES maximum sustainable yield (MSY) approach and precautionary approach (PA) for stocks within the Barents 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	Reference point	GES	SBL	Fishing pressure	Stock size	D3C1	D3C2
aru.27.123a4	Greater silver smelt (*Argentina silus*) in subareas 1, 2, and 4, and in Division 3.a (Northeast Arctic, North Sea, Skagerrak and Kattegat)	Pelagic	3.2	2019	PA	MSY	?	?	✓	?	✓	?
						PA			✓	?	✓	?
cap.27.1-2	Capelin (*Mallotus villosus*) in subareas 1 and 2 (Northeast Arctic), excluding Division 2.a west of 5°W (Barents Sea capelin)	Pelagic	1.8	2019	MP	MSY	✗	✗	?	✗	?	✗
						PA			?	✗	?	✗
cod.27.1-2	Cod (*Gadus morhua*) in subareas 1 and 2 (Northeast Arctic)	Demersal	1	2019	MP	MSY	✗	✗	✗	✓	✗	✓
						PA			o	✓	✗	✓
ghl.27.1-2	Greenland halibut (*Reinhardtius hippoglossoides*) in subareas 1 and 2 (Northeast Arctic)	Demersal	1	2019	PA	MSY	?	?	?	?	?	?
						PA			?	✓	?	✓
had.27.1-2	Haddock (*Melanogrammus aeglefinus*) in subareas 1 and 2 (Northeast Arctic)	Demersal	1	2019	MP	MSY	✗	✓	✗	✓	✗	✓
						PA			✓	✓	✓	✓
lin.27.1-2	Ling (*Molva molva*) in subareas 1 and 2 (Northeast Arctic)	Demersal	3.2	2019	PA	MSY	?	?	✓	?	✓	?
						PA			✓	?	✓	?

Stock	Stock description	Fisheries guild	Data category	Assessment year	Advice category	Reference point	GES	SBL	Fishing pressure	Stock size	D3C1	D3C2
pok.27.1-2	Saithe (*Pollachius virens*) in subareas 1 and 2 (Northeast Arctic)	Demersal	1	2018	MP	MSY	?	✓	?	?	?	?
						PA			✓	✓	✓	✓
pra.27.1-2	Northern shrimp (*Pandalus borealis*) in subareas 1 and 2 (Northeast Arctic)	Crustacean	1.6	2018	MSY	MSY	✓	✓	✓	✓	✓	✓
						PA			✓	✓	✓	✓
reb.27.1-2	Beaked redfish (*Sebastes mentella*) in subareas 1 and 2 (Northeast Arctic)	Pelagic	1	2018	PA	MSY	?	?	?	✓	?	✓
						PA			?	✓	?	✓
reg.27.1-2	Golden redfish (*Sebastes norvegicus*) in subareas 1 and 2 (Northeast Arctic)	Demersal	1	2018	PA	MSY	?	✗	✗	?	✗	?
						PA			?	✗	?	✗
						MSY	?	?	?	?	?	?
						PA			?	?	?	?
usk.27.1-2	Tusk (*Brosme brosme*) in subareas 1 and 2 (Northeast Arctic)	Demersal	3.2	2019	PA	MSY	✓	✓	✓	✓	✓	✓
						PA			✓	✓	✓	✓

Table A2 List of those stocks in the Barents Sea ecoregion in 2019 that do not have reference points.

Stock	Stock description	Fisheries guild	Data category	Assessment year	Advice category
cod.27.1-2coast	Cod (*Gadus morhua*) in subareas 1 and 2 (Norwegian coastal waters cod)	Demersal	3	2018	MP
gfb.27.nea	Greater forkbeard (*Phycis blennoides*) in subareas 1-10, 12 and 14 (the Northeast Atlantic and adjacent waters)	Demersal	3.2	2018	PA
rjr.27.23a4	Starry ray (*Amblyraja radiata*) in Subareas 2 and 4, and Division 3.a (Norwegian Sea, North Sea, Skagerrak and Kattegat)	Elasmobranch	3.14	2019	PA
rng.27.1245a8914ab	Roundnose grenadier (*Coryphaenoides rupestris*) in subareas 1, 2, 4, 8, and 9, Division 14.a, and in subdivisions 14.b.2 and 5.a.2 (Northeast Atlantic and Arctic Ocean)	Demersal	6.2	2019	PA

Table A3 Scientific names of species.

Common name	Scientific name
Arctic skate	*Amblyraja hyperborean*
Beaked redfish	*Sebastes mentella*
Black guillemot	*Cepphus grille*
Cormorants	*Phalacrocorax spp.*
Capelin	*Mallotus villosus*
Cod	*Gadus morhua*
Common guillemot	*Uria aalge*
European eel	*Anguilla anguilla*
European plaice	*Pleuronectes platessa*
Golden redfish	*Sebastes norvegicus*
Greenland halibut	*Reinhardtius hippoglossoides*
Haddock	*Melanogrammus aeglefinus*
Harbour porpoise	*Phocoena phocoena*
Harp seal	*Pagophilus groenlandicus*
Herring	*Clupea harengus*
Long rough dab	*Hippoglossoides platessoides*
Mackerel	*Scomber scombrus*
Minke whale	*Balaenoptera acutorostrata*
Monkfish	*Lophius piscatorius*
Northern fulmar	*Fulmarus glacialis*
Northern shrimp	*Pandalus borealis*
Pollock	*Angursa bicuspis*
Puffin	*Fratercula arctica*
Razorbill	*Alca torda*
Red king crab	*Paralithodes camtschaticus*
Saithe	*Pollachius virens*
Snow crab	*Chionoecetes opilio*
Spinytail skate	*Bathyraja spinicauda*
Steller's eider	*Polysticta stelleri*
Thornback ray	*Raja clavata*
Thorny skate (starry ray)	*Amblyraja radiate*
White-billed diver	*Gavia damsii*
Wolffish	*Anarhichas* sp.