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 (cap.27.1-2) using midwater trawl. The largest demersal fisheries target cod (cod.27.1-2), haddock (had.27.1-2), and other gadoids; predominantly using trawls, gillnets, longlines, and handlines. The crustacean fisheries target deep-sea prawn, red king crab, and snow crab. Harp seals and minke whales are also hunted in the region.

Twelve nations currently have fisheries targeting the stocks in this ecoregion. Norway and Russian Federation (Russia henceforth) 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.

In addition to biomass removal, the 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.

Supporting data used in the Barents Sea fisheries overview can be accessed at https://doi.org/10.17895/ices.advice.21640814

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 approximately follows the shelf break towards the deep Norwegian Sea to the west, and its northern boundary follows the shelf break towards the deep Arctic 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, 27.2.a, and 27.2.b (hereafter, the "27" area prefixes are omitted). All catches within Division 1.b are, however, taken in the Barents Sea ecoregion, as there are no catches in the northernmost part, which belongs to the Arctic Ocean ecoregion. 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.

Due to the temporary suspension of Russian Federation from ICES activities, ICES did not conduct assessments for the following stocks in 2022: cod.27.1-2, had.27.1-2, reb.27.1-2, cap.27.1-2, and pra.27.1-2. The results of the bilateral Norwegian-Russian assessments for these stocks are not included in this overview.

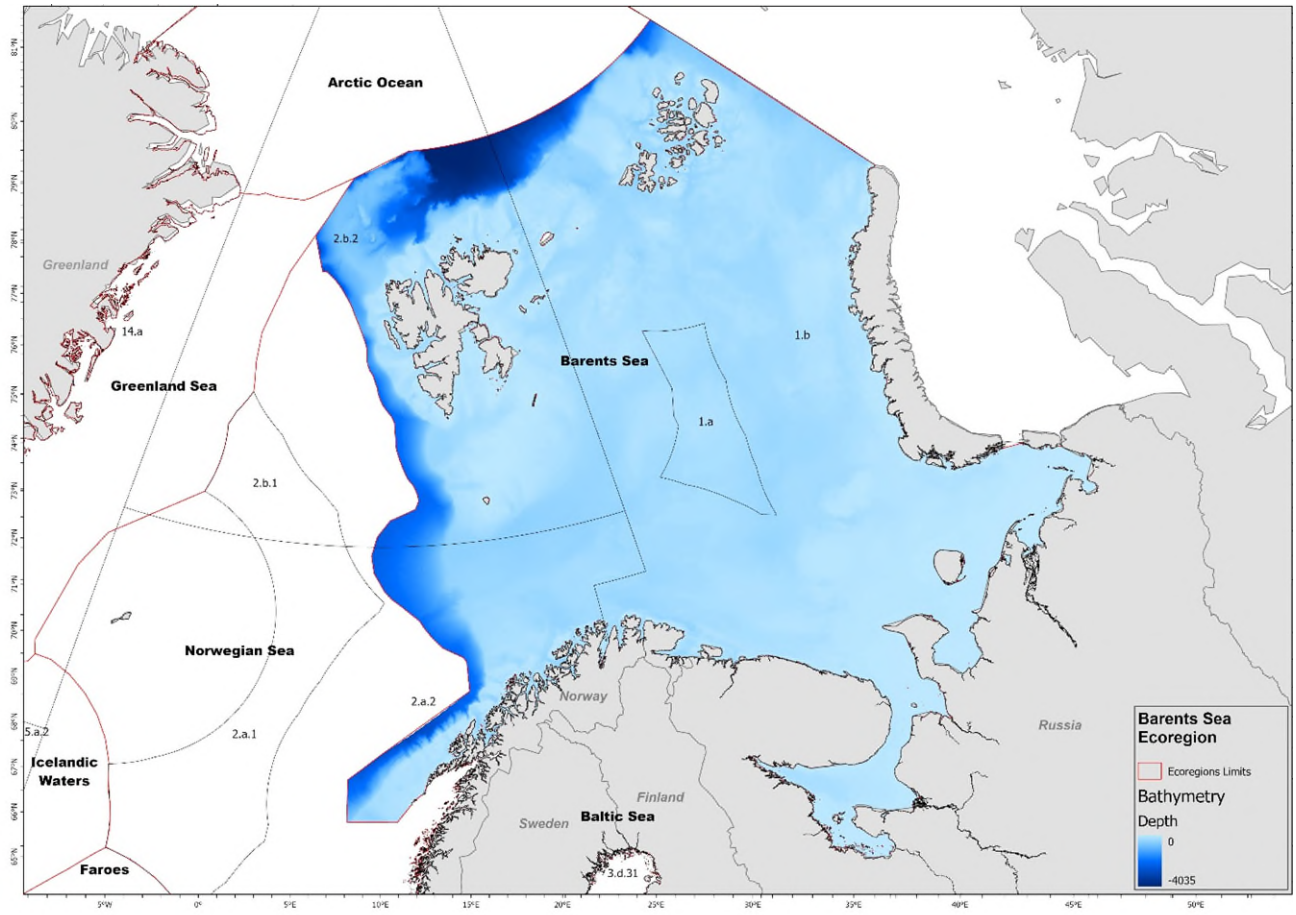


Figure 1 The Barents Sea ecoregion and ICES statistical areas.

This overview provides the following.

- a short description of each of the national commercial fishing fleets in the ecoregion, including their fishing gears, and spatial and temporal patterns of activity;
- a summary of the status of the fisheries resources and the level of exploitation relative to agreed objectives and reference points;
- a description of mixed-fisheries interactions in the ecoregion; and
- an evaluation of the effects of fishing gear on the ecosystem in terms of the seabed and on the bycatch of protected, endangered, and threatened species.

The scientific names of all species described in this overview are listed in Table A2 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 numbers of landings are made by Denmark, Estonia, Faroe Islands, France, Germany, Greenland, Iceland, Poland, Portugal, Spain, Belarus, and UK (Figure 2).

Prior to the establishment of exclusive economic zones (EEZ) 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 (ghl.27.1-2) 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.

Catches from the northern shrimp (pra.27.1-2) fishery increased considerably from 2018, with much of the increase coming from fleets fishing in the international waters between the Norwegian 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 Finnmark and Tromsø, the northernmost counties of Norway. A fishery has developed for the snow crab in recent years; this is a species first encountered in the ecoregion in 1996.

Commercial hunting of Barents Sea harp seal 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 fish gadoids (cod, haddock, and saithe), other demersal fish, pelagic fish, and shellfish. Small coastal vessels (the majority < 11 m in length) fishing with gillnets, handline and pots make up around 94% of the fleet, while the remaining 6% are predominantly ocean-going trawlers > 28 m in length. Between six and seven hundred Norwegian coastal vessels (6–22 m in length) participate in the quota-regulated red king crab fishery east of 26°E. West of this line, fishing for red king crab is unregulated and the number of vessels unknown. The snow crab fishery in the Norwegian EEZ 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 between only two and five 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. Ninety percent of the vessels catch demersal species, including fish and crustaceans, and 15% catch pelagic species. Approximately 25% of the fleet targeting demersal species consists of boats below 34 m in length and operates 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 (pok.27.1-2), redfish, Greenland halibut, wolffish, long rough dab, and plaice using trawls and longlines, traps (for crab), and trawls (for shrimp). The industrial factory ships (ten 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 two to three 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 five 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 Greenlandic 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 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. Belarussian vessels also catch a small amount of cod annually.

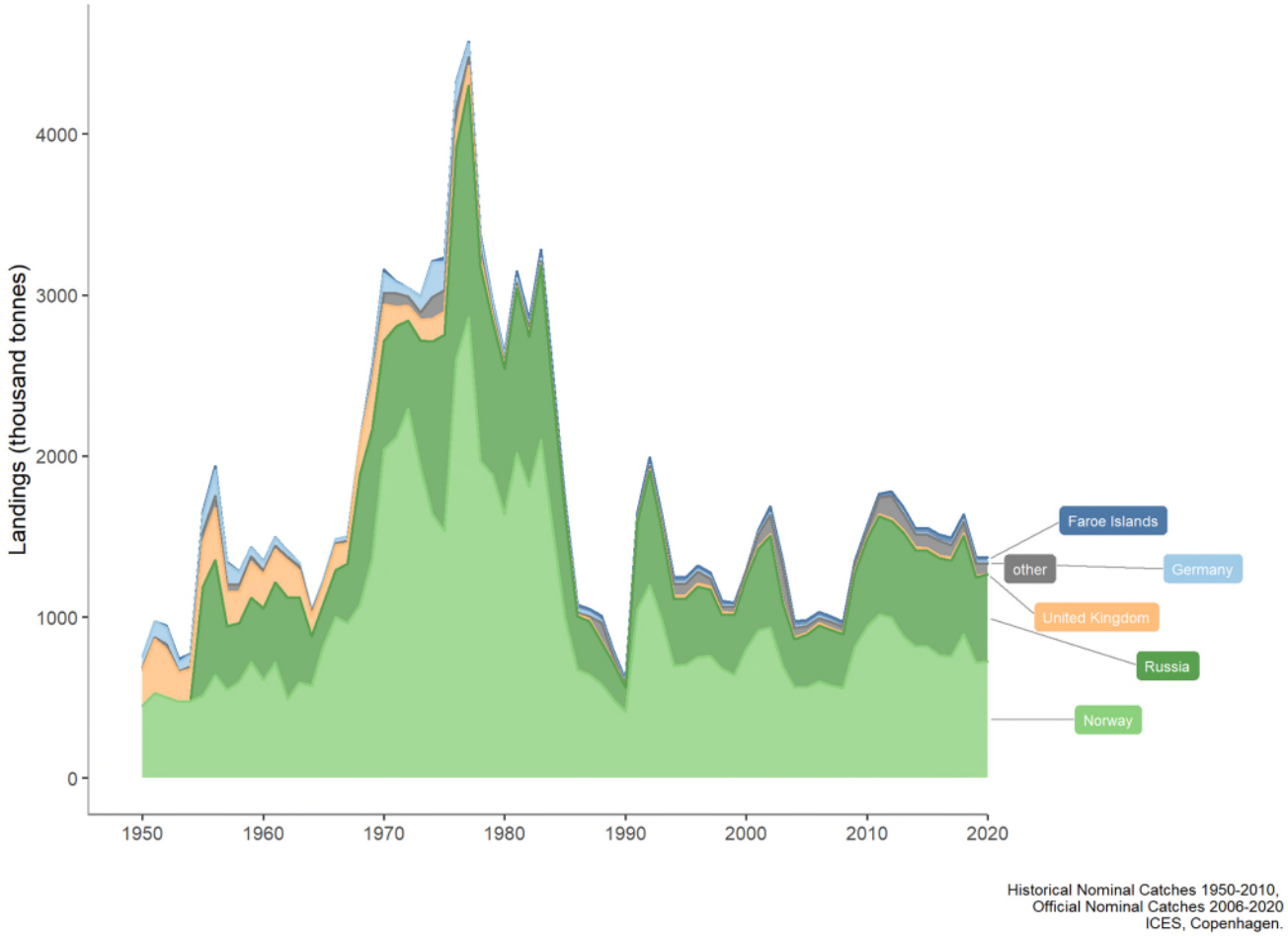


Figure 2 Landings (thousand tonnes) from ICES subareas 1 and 2. This approximates to the majority of the Barents Sea ecoregion in 1950–2020, by (current) country. The five countries with the highest cumulative landings over the entire time-series are shown individually, and the remaining countries are aggregated and displayed as "other". Catches of herring, blue whiting, and mackerel in subareas 1 and 2 are not included.

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. Capelin landings have fluctuated since then, reflecting alternating periods with either a total fishing ban, or with TACs in the order of 0.3–1.0 million tonnes (Figure 3). Landings of demersal fish were highest both at the beginning and near the end of the time-series (Figure 3). 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 3). 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 4).

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 these 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 seal 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; however, because of climatic conditions, 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 whale peaked in the late 1950s, when around 4000 animals were taken per year. Landings decreased after this to 1500–2000 animals per year 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.

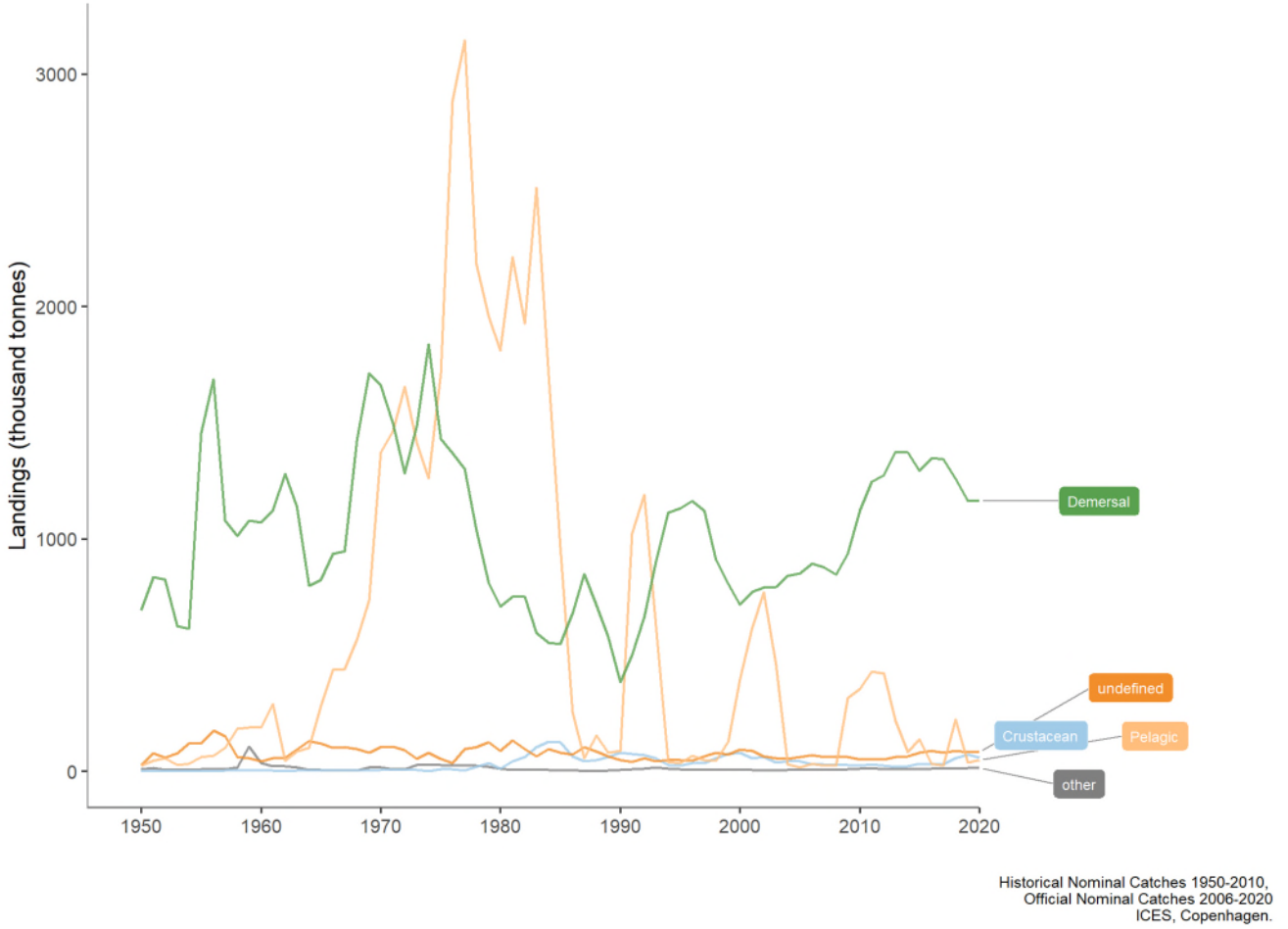


Figure 3 Landings (thousand tonnes) from ICES subareas 1 and 2 1950–2020, by fish category. Table A1 in the Annex details the species that belong to each fish category. The "other" category mainly contains crustaceans (mostly northern shrimp [*Pandalus borealis*]) and elasmobranchs. Catches of herring, blue whiting, and mackerel in subareas 1 and 2 are not included.

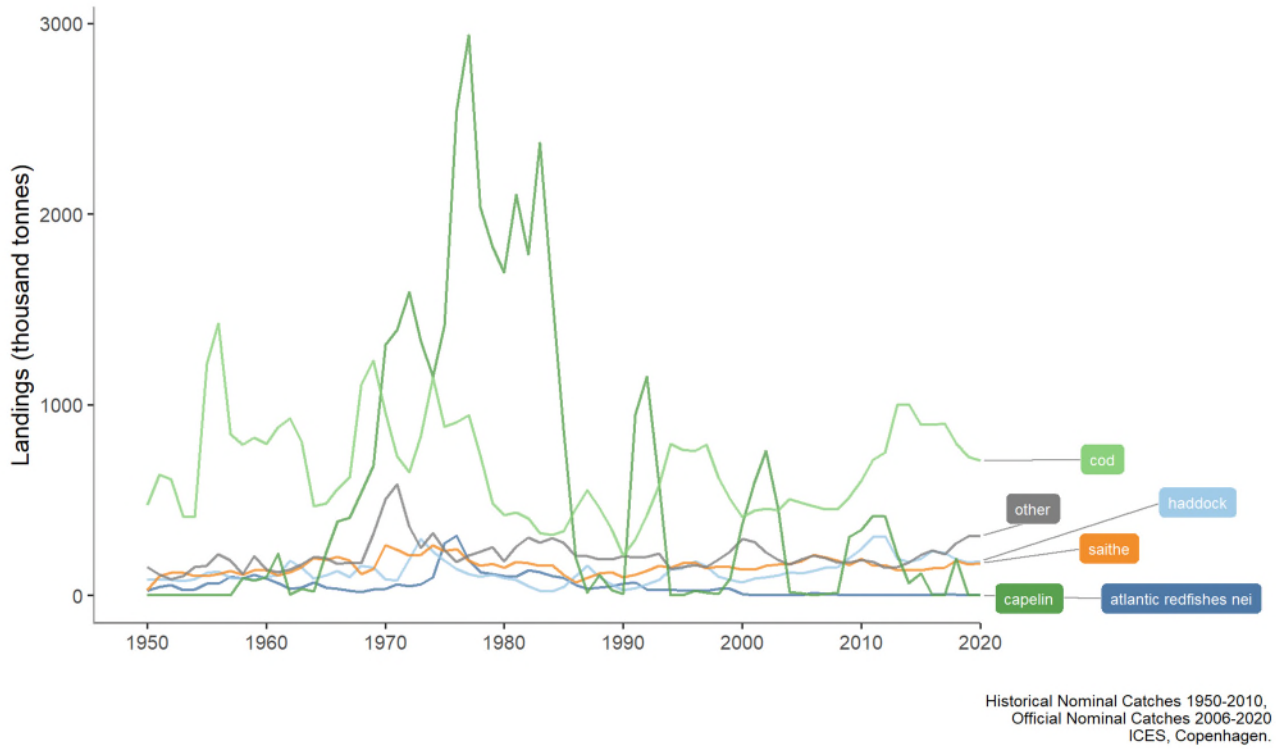


Figure 4 Landings (thousand tonnes) from ICES subareas 1 and 2 1950–2020, by species. The five species with the highest cumulative landings over the entire time-series are displayed separately; the remaining species are aggregated and labelled as "other". Catches of herring, blue whiting, and mackerel in subareas 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; reb.27.1-2) 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 discards of redfish were 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

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 5) and on 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 5).

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.

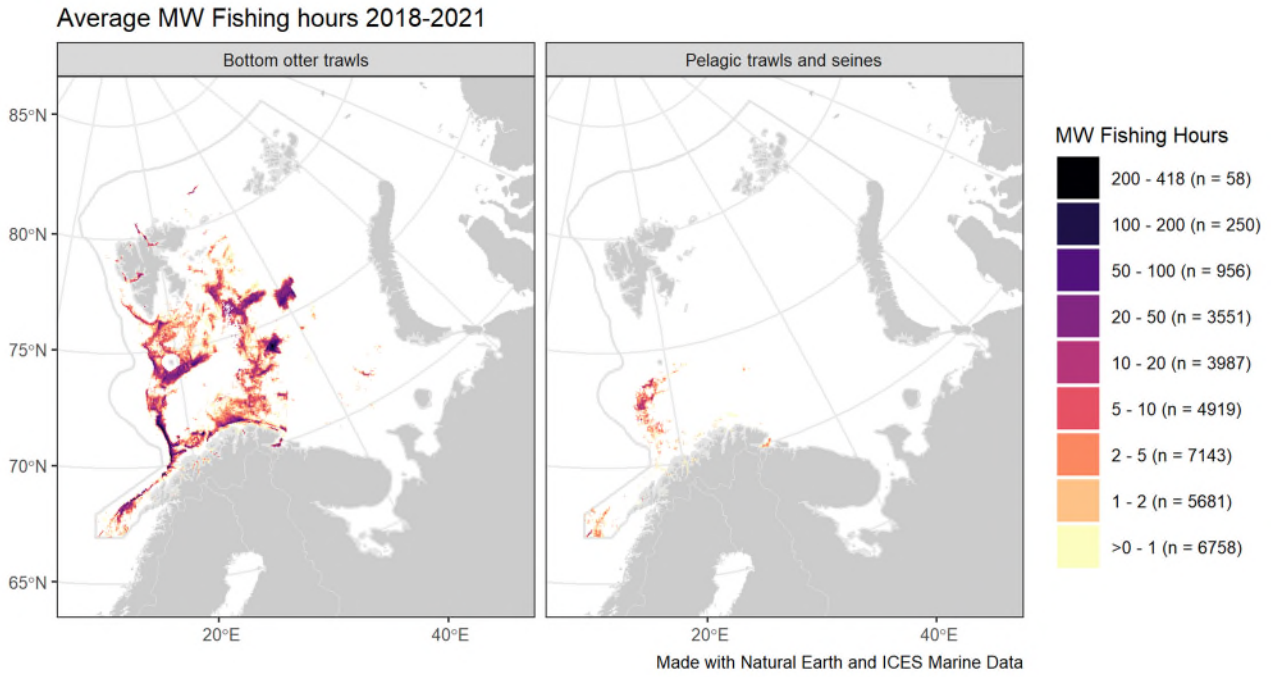


Figure 5 Spatial distribution of average annual fishing effort (mW fishing hours) in the Barents Seas ecoregion by gear type. Fishing effort data are only shown for vessels > 15 m in length with vessel monitoring systems (VMS) report[1]. This will bias the distributions, particularly in coastal areas.

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, haddock, and saithe.

Longline and line

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

[1] Details on countries submitting data can be found at https://data.ices.dk/accessions/allaccessions.aspx?search=vms

wolffish.

Purse-seine and pelagic trawl

The Norwegian pelagic fleet mostly uses purse-seine in the capelin fishery. Part of the saithe catch is also taken by purse-seine.

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. In Norway there is also a minimum landing size for snow crab of 9.5 cm carapace width.

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.

Recreational

In this ecoregion there is only information on recreational fishing in Norwegian waters. Marine recreational fisheries can be divided into the marine angling tourism sector and local marine recreational fisheries in Norway. While non-resident marine angling tourists can only use handheld hook-and-line fishing tackle, resident marine recreational fishers can use a range of fishing gears including gillnets, longlines, pots, jigging machines and handheld hook-and-line fishing tackle. In addition, resident marine recreational fishers can sell a limited amount of their catch. Popular target species are cod, saithe, halibut, ling (lin.27.1-2), wolffish, and redfish.

Other fisheries

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

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 the 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 monitors and regulates 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 in the ecoregion 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 latter 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°E 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.

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. Minke whale quotas are set by Norway.

Status of the fishery resources

The Barents Sea fisheries overview contains 11 stocks for which ICES provided advice for 2022. These are categorized as: eight demersal, one elasmobranch, one crustacean, and one pelagic stock. Due to the temporary suspension of Russian Federation from ICES activities, ICES did not conduct assessments for the following stocks in 2022: cod.27.1-2, had.27.1-2, reb.27.1-2, cap.27.1-2, and pra.27.1-2. The results of the bilateral Norwegian–Russian assessments for these stocks are not included in this overview.

Fishing mortalities and spawning-stock sizes have been evaluated against maximum sustainable yield (MSY) and precautionary approach (PA) reference points, and stock status has also been assessed relative to safe biological limits, i.e. $F < F_{pa}$ and $SSB > B_{pa}$ (Figure 6). All three stocks with F_{MSY} reference points were fished at or below F_{MSY} target levels in 2021. One stock— golden redfish— had an SSB below MSY $B_{trigger}$. Based on PA reference points, golden redfish is assessed to be outside its safe biological limit (SBL; see also Table A1 in the Annex). The stocks have also been evaluated against the reference points F_{MSY} and MSY $B_{trigger}$ (Figure 7).

Five stocks lack all reference points (Table A1 in the Annex); the majority of stocks 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 and reference points are available, make up the majority of the landed biomass. This is not reflected in Figure 7 due to the lack of ICES assessments for the major category 1 stocks in 2022. Twenty-six percent of the landings (of stocks with 2022 ICES assessments) in 2021 were from stocks fished at or below F_{MSY} (D3C1; Figure 7). The remaining landings were from stocks lacking the F_{MSY} reference point. Stocks with SSB < MSY $B_{trigger}$ (golden redfish) made up 6% of the landings of stocks with 2022 ICES assessments (D3C2; Figure 7).

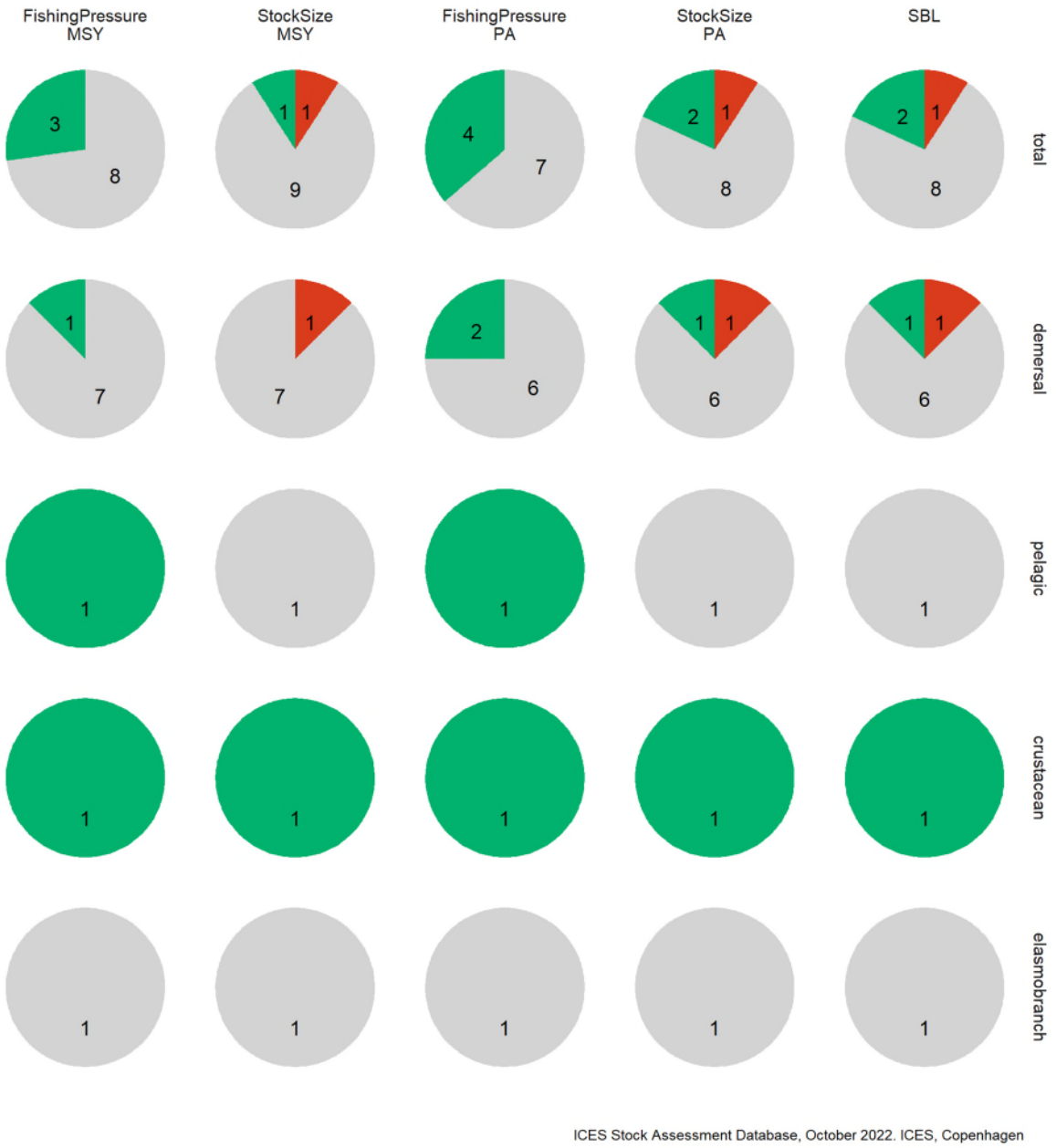


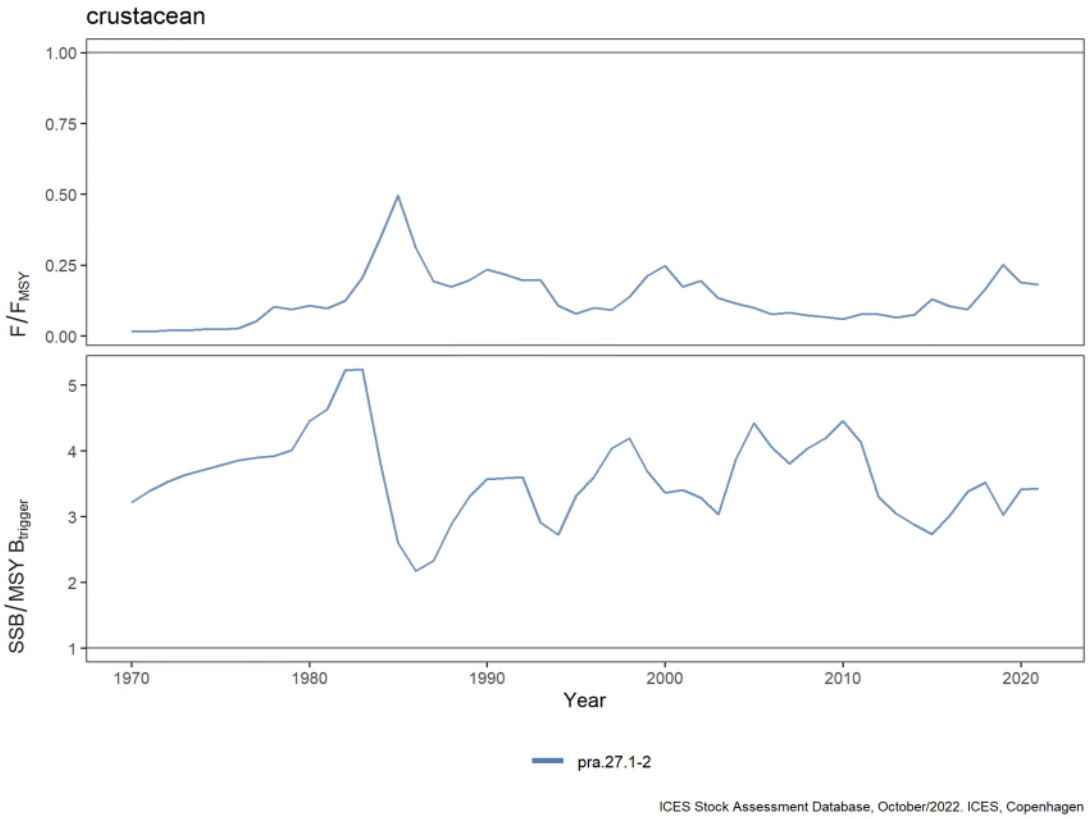
Figure 6 Status summary of Barents Sea stocks in 2022, relative to ICES maximum sustainable yield (MSY) approach and precautionary approach (PA). For the MSY approach: green represents a stock that is either fished below F_{MSY} or whose size is greater than MSY $B_{trigger}$; red represents a stock that is either fished above F_{MSY} or whose size is lower than MSY $B_{trigger}$. For the PA: green represents a stock that is fished at or below F_{pa} while its size is equal to or greater than B_{pa}; red represents a stock that is fished above F_{lim} or whose size is less than B_{lim}. Stocks with a fishing mortality at or below F_{pa} and a 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. The stocks cod.27.1-2, had.27.1-2, ghl.27.1-2, reb.27.1-2, and cap.27.1-2 were not assessed in ICES in 2022 and are excluded from this figure. Grey represents unknown reference points. For stock-specific information, see Table A1 in the Annex.

Figure 7 Status summary of Barents Sea stocks in 2022. Green represents the proportion of stocks that are either fished below F_{MSY} or where stock size is greater than MSY $B_{trigger}$. Red represents the proportion of stocks that are either fished above F_{MSY} or where stock size is lower than MSY $B_{trigger}$. Grey represents the proportion of stocks without MSY reference points. The stocks cod.27.1-2, had.27.1-2, ghl.27.1-2, reb.27.1-2 and cap.27.1-2 were not assessed in ICES in 2022 and are excluded from this figure. 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 MSY $B_{trigger}$ and fishing mortality below F_{MSY} throughout the history of the fishery (Figure 8). There is no ICES assessment for red king crab or snow crab, though both are assessed nationally. In the Norwegian EEZ, red king crab has been fished above F_{MSY} in recent years while stock biomass is estimated to be above B_{lim}. Snow crab has established itself relatively recently on the Norwegian shelf, and stock size is assumed to be increasing despite being fished above F_{MSY}. The recent emergence of the fishery, only a short time-series exists, leads 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 most of the history of the fishery. In the last decade, the main reason for this has been the northern Norwegian coastal cod (cod.27.1-2coastN) fishery that has been conducted above long-term sustainable levels (Figure 8). Fishing mortalities on cod and haddock were reduced to F_{MSY} or lower after 2007, and the SSB of both stocks has been well above MSY $B_{trigger}$ since then; this is despite declining trends in SSBs in the last years. However, fishing mortality has increased in recent years for both stocks and was slightly above F_{MSY} in 2021. For saithe the fishing mortality has been below F_{MSY} since 2013, and SSB has been well above MSY $B_{trigger}$ since 2000.

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 8). In recent years, the ratio has stabilized. Capelin SSB has fluctuated over time, falling below B_{lim} in periods every decade since the mid-1980s followed by periods with high SSB (Figure 8).



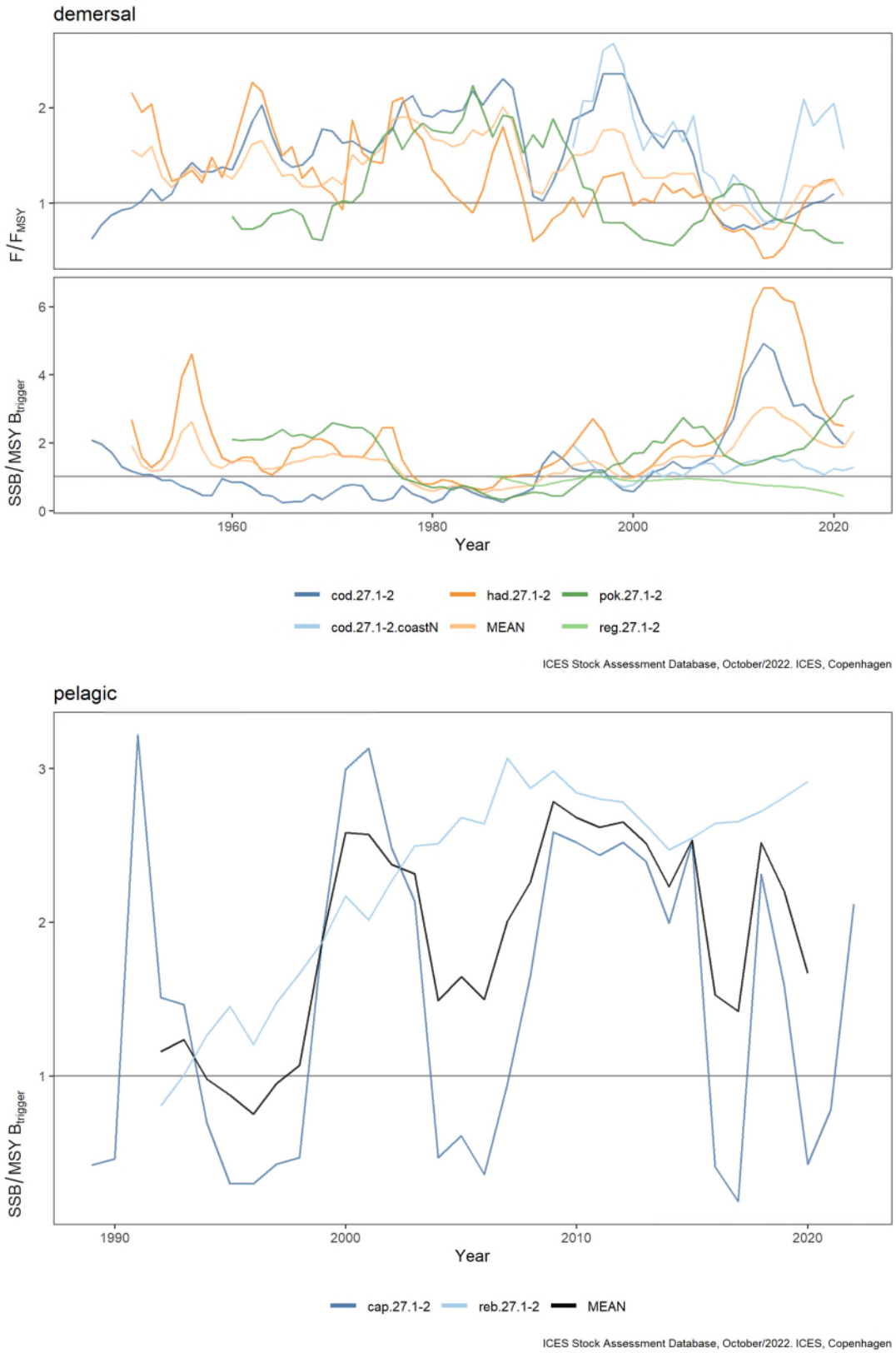
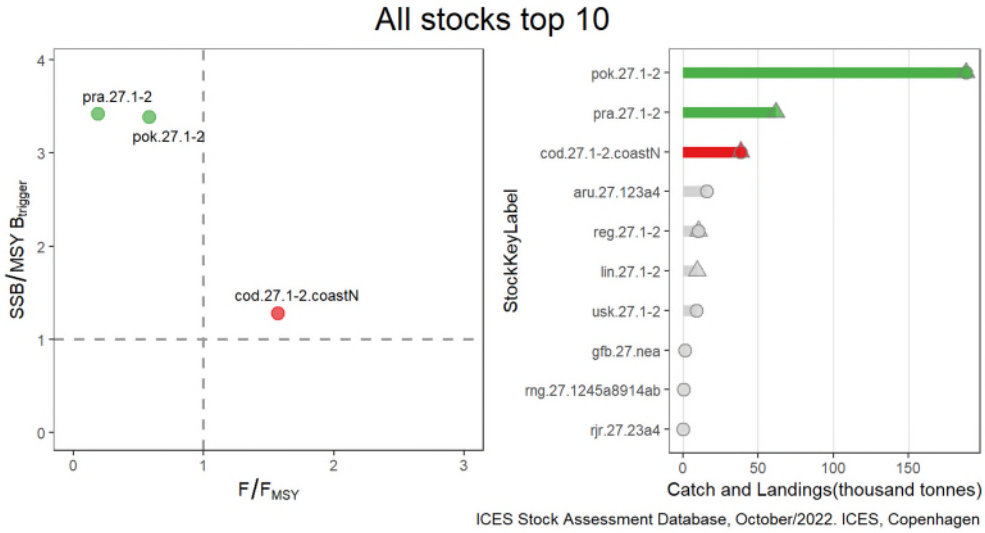
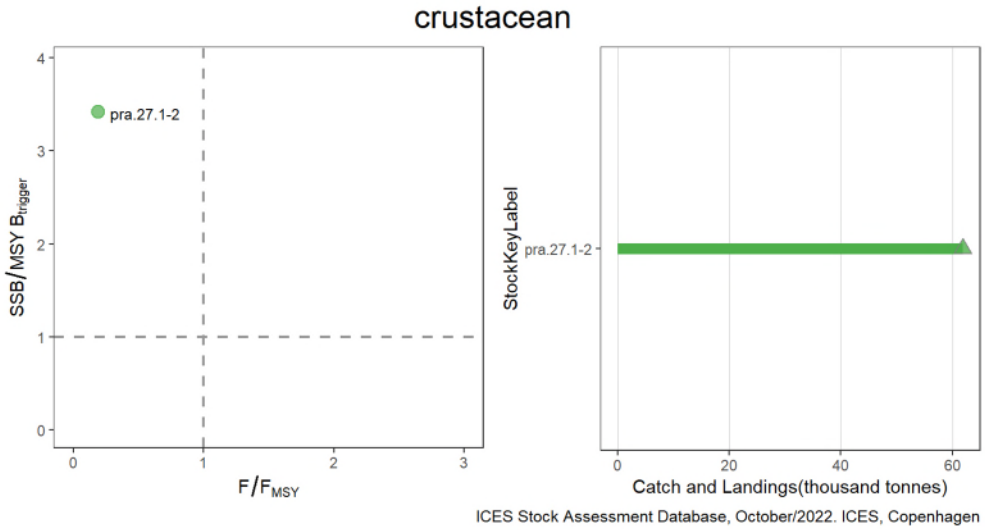


Figure 8 Temporal trends in F/F_{MSY} and SSB/MSY $B_{trigger}$ for Barents Sea crustacean, demersal, and pelagic stocks. Only stocks with defined MSY reference points are considered, with exception of the cod.27.1-2coastN and pok.27.1-2 stocks, where stock status is shown relative to F_{MGT}. Stocks for which only proxy reference points are available are not shown. For full stock names, see Table A1 in the Annex. The stocks cod.27.1-2, had.27.1-2, ghl.27.1-2, reb.27.1-2 and cap.27.1-2 were not assessed in ICES in 2022. Results from the latest ICES assessment are therefore shown.

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 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 9. The northern shrimp stock size is at present more than three times MSY $B_{trigger}$, and is fished below F_{MSY}.





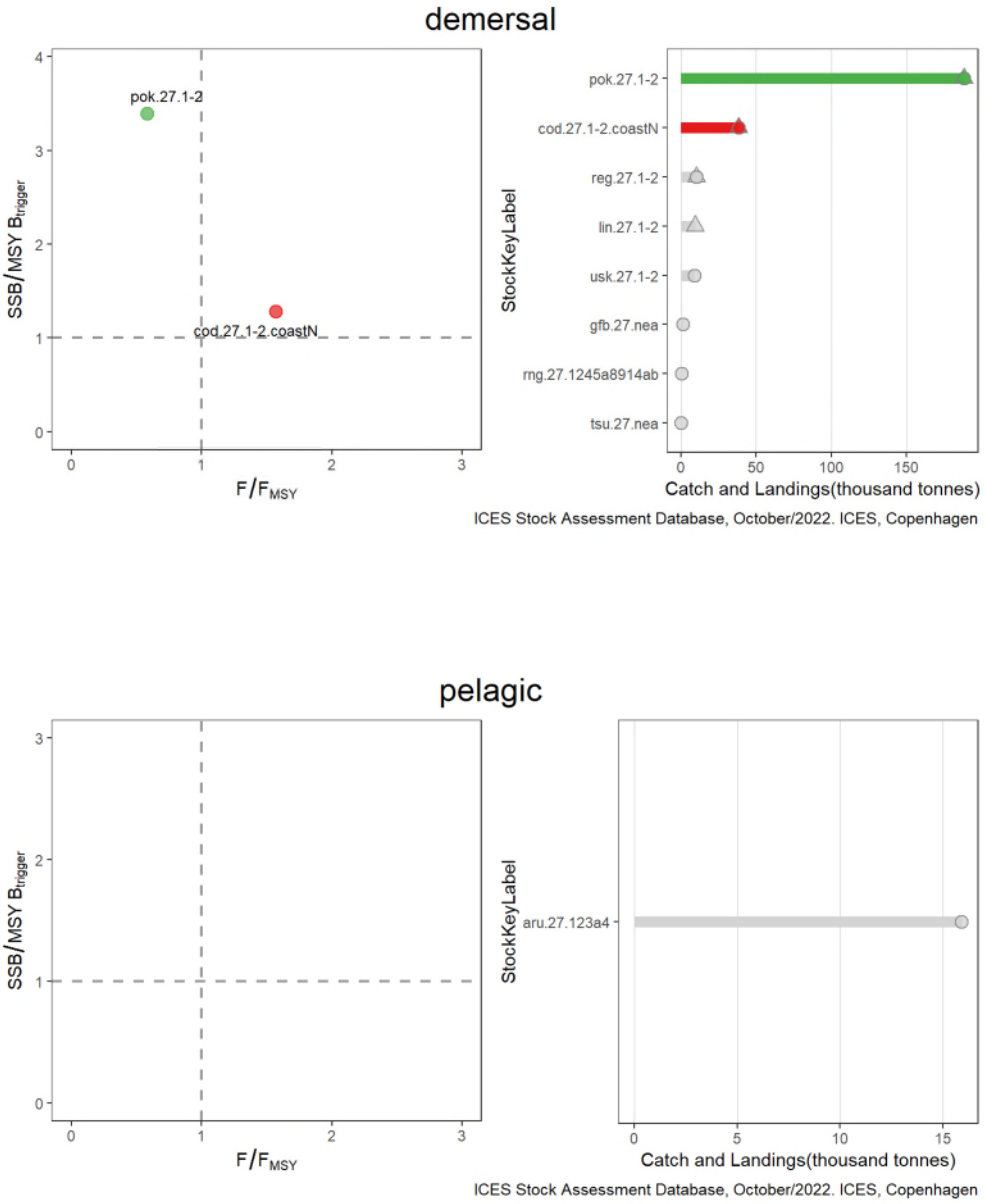


Figure 9 Status of Barents Sea stocks, relative to the joint distribution of exploitation (F / F_{MSY}) and stock size (SSB / MSY $B_{trigger}$ [left panels, by individual stocks]) and catches (triangles)/landings (circles) from these stocks in 2021 [right panels]. Stocks for which only proxy reference points are available are not shown on the left plot. The left panels only include stocks for which MSY reference points have been defined, with exception of the cod.27.1-2coastN and pok.27.1-2 stocks, where stock status is shown relative to F_{mgt}. Stocks in green are exploited at or below F_{MSY} while their size is also at or above MSY $B_{trigger}$. Stocks in red are either exploited above F_{MSY} or their 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 stocks with the highest catch and landings across fisheries guilds in 2021. The stocks cod.27.1-2, had.27.1-2, ghl.27.1-2, reb.27.1-2, and cap.27.1-2 were not assessed in ICES in 2022 and are excluded from this figure. For full stock names, see Table A1 in the Annex.

Mixed fisheries

Fishing gear operations that harvest multiple types of fish simultaneously are defined as mixed fisheries, although some fishing operations are more selective than others. For example, pelagic trawling tends to catch only one species, whereas demersal trawling normally catches several species simultaneously.

Species interaction

Commercially exploited species (fish, invertebrates, and 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 10). 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.

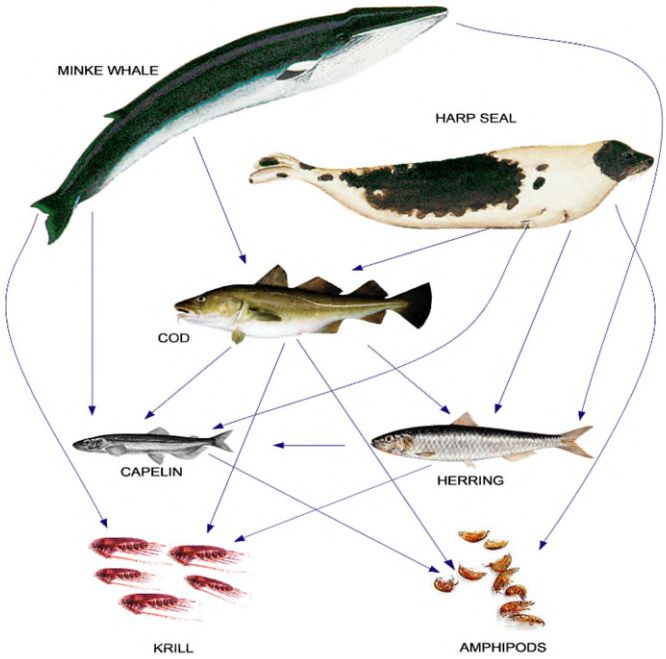
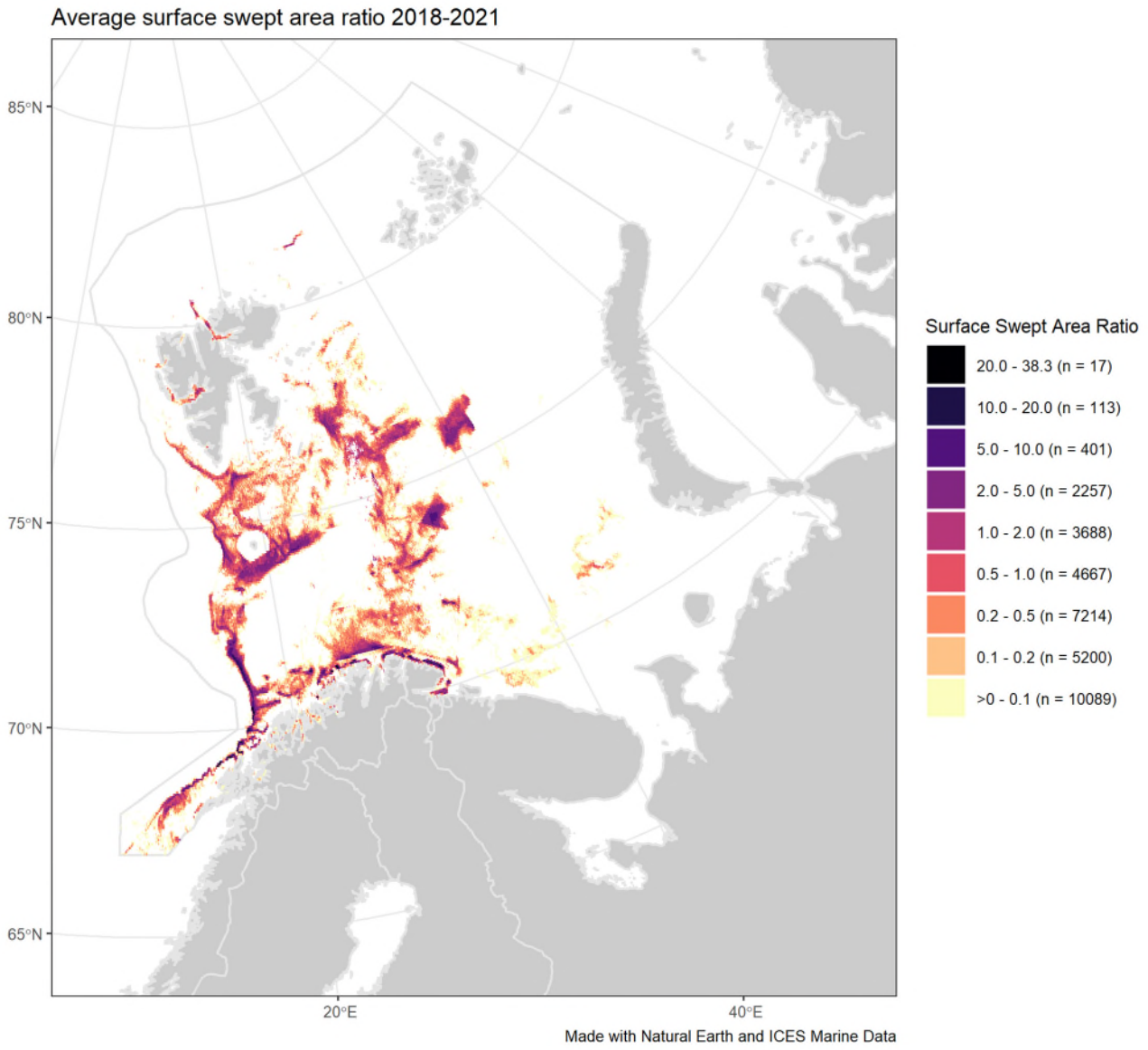


Figure 10 Interactions between commercial species and their prey in the Barents Sea foodweb. The arrows indicate central predator–prey relationships, with the arrows pointing from predator to prey.

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.



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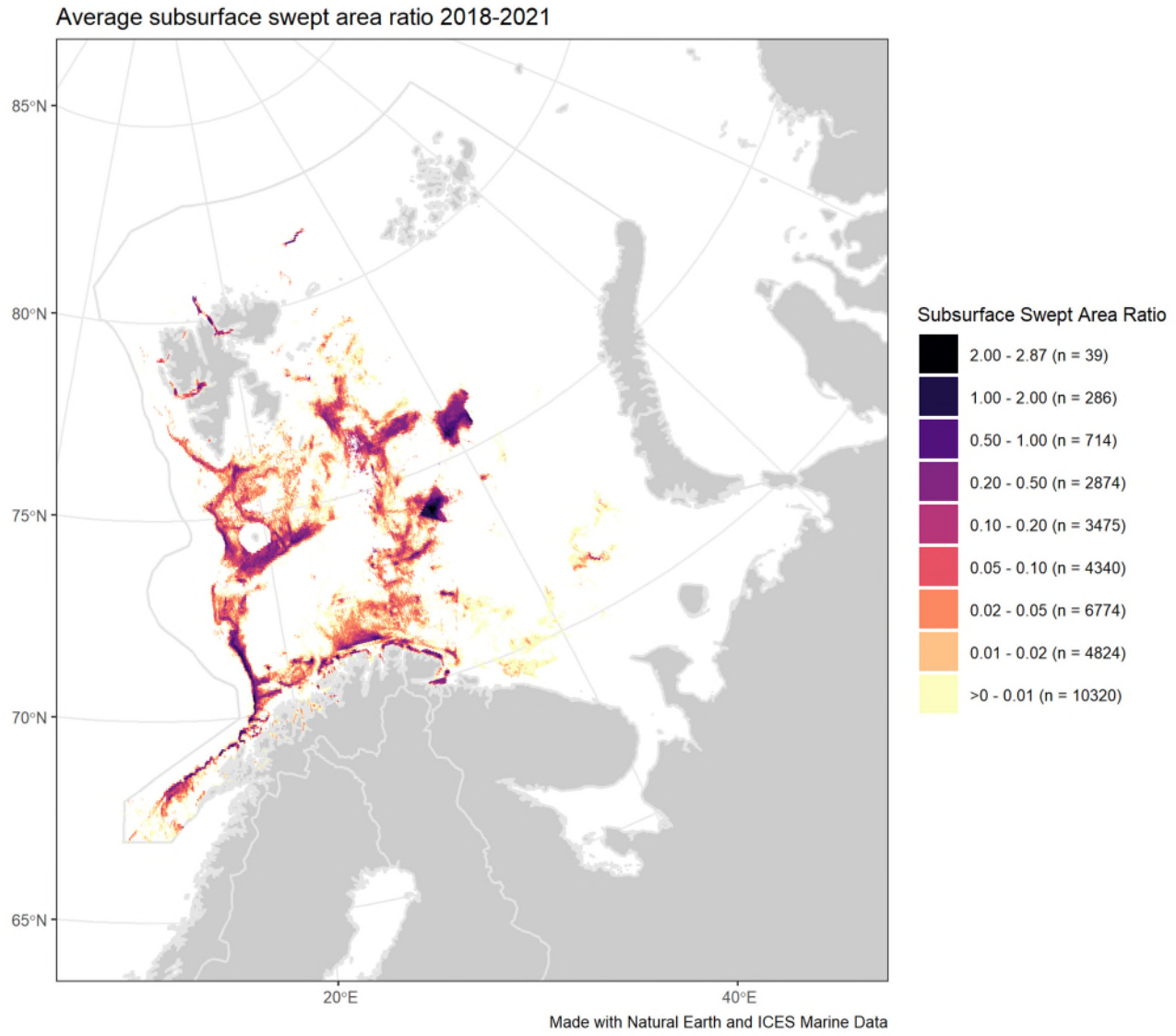

Figure 11 Average annual surface (top) and subsurface (bottom) disturbance by mobile bottom-contacting fishing gear (bottom otter trawls, bottom seines, dredges, and beam trawls) in the Barents Sea ecoregion, expressed as average swept-area ratios (SAR)[2].

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 where, because of lower rates of biofouling and tidal scouring, these gears continue to fish effectively. Investigations made by the Norwegian Institute of Marine Research (IMR) 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.

[2] Details on countries submitting data can be found at https://data.ices.dk/accessions/allaccessions.aspx?search=vms

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 the thorny skate), which is widespread in the Barents Sea and adjacent waters. Bottom-trawl fisheries targeting cod and haddock, and longline fisheries targeting cod, wolffish, and Greenland halibut take elasmobranchs as 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 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

Table A1 Status summary of the Barents Sea ecosystem stocks in 2022, with regards to 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 whose size is greater than MSY $B_{trigger}$; red represents a stock status that is fished above F_{MSY} or whose size is less than MSY $B_{trigger}$. For the PA: green represents a stock that is fished below F_{pa} or whose size is greater than B_{pa}; yellow represents a stock that is fished between F_{pa} and F_{lim} or whose size is between B_{lim} and B_{pa}; red represents a stock that is fished above F_{lim} or whose size is less than B_{lim}.

Stock Code	Stock Description	Species Scientific Name	Species Common Name	Fisheries Guild	Data Category	Assessment Year	Advice Category	Approach	Fishing Pressure	Stock Size
aru.27.123a4	Greater silver smelt in subareas 1, 2, and 4, and in Division 3.a	*Argentina silus*	Greater silver smelt	Pelagic	3.2	2021	PA	Maximum sustainable yield	✓	?
								Precautionary approach	✓	?
cap.27.1-2	Capelin in subareas 1 and 2, excluding Division 2.a west of 5°W	*Mallotus villosus*	Capelin	Pelagic	1.8	2021	MP	Maximum sustainable yield	?	?
								Precautionary approach	?	✓
cod.27.1-2	Cod in subareas 1 and 2	*Gadus morhua*	Cod	Demersal	1	2021	MP	Maximum sustainable yield	✓	✓
								Precautionary approach	o	✓
cod.27.1-2coastN	Cod in subareas 1 and 2, north of 67°N, northern Norwegian coastal cod	*Gadus morhua*	Cod	Demersal	1	2022	MP	Maximum sustainable yield	?	?
								Precautionary approach	?	?
gfb.27.nea	Greater forkbeard in subareas 1-10, 12 and 14	*Phycis blennoides*	Greater forkbeard	Demersal	3.2	2022	PA	Maximum sustainable yield	?	?
								Precautionary approach	?	?
ghl.27.1-2	Greenland halibut in subareas 1 and 2	*Reinhardtius hippoglossoides*	Greenland halibut	Demersal	1	2021	PA	Maximum sustainable yield	?	?
								Precautionary approach	✗	✓
had.27.1-2	Haddock in subareas 1 and 2	*Melanogrammus aeglefinus*	Haddock	Demersal	1	2021	MP	Maximum sustainable yield	✗	✓
								Precautionary approach	✓	✓
lin.27.1-2	Ling in subareas 1 and 2	*Molva molva*	Ling	Demersal	3.2	2021	PA	Maximum sustainable yield	✓	?
								Precautionary approach	✓	?
pok.27.1-2	Saithe in subareas 1 and 2	*Pollachius virens*	Saithe	Demersal	1	2022	MP	Maximum	?	?

Stock Code	Stock Description	Species Scientific Name	Species Common Name	Fisheries Guild	Data Category	Assessment Year	Advice Category	Approach	Fishing Pressure	Stock Size
								sustainable yield		
								Precautionary approach	✓	✓
pra.27.1-2	Northern shrimp in subareas 1 and 2	*Pandalus borealis*	Northern shrimp	Crustacean	1.6	2021	MSY	Maximum sustainable yield	✓	✓
								Precautionary approach	✓	✓
reb.27.1-2	Beaked redfish in subareas 1 and 2	*Sebastes mentella*	Beaked redfish	Pelagic	1	2020	PA	Maximum sustainable yield	?	✓
								Precautionary approach	✓	✓
reg.27.1-2	Golden redfish in subareas 1 and 2	*Sebastes norvegicus*	Golden redfish	Demersal	1	2022	PA	Maximum sustainable yield	?	✗
								Precautionary approach	?	✗
rjr.27.23a4	Starry ray in Subareas 2 and 4, and Division 3.a	*Amblyraja radiata*	Starry ray	Elasmobranch	3.14	2019	PA	Maximum sustainable yield	?	?
								Precautionary approach	?	?
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	*Coryphaenoides rupestris*	Roundnose grenadier	Demersal	6.2	2019	PA	Maximum sustainable yield	?	?
								Precautionary approach	?	?
tsu.27.nea	Roughsnout grenadier in subareas 1-2, 4-8, 10, 12, 14 and Division 3.a	*Trachyrincus scabrus*	Roughsnout grenadier	Demersal	6.3	2020	PA	Maximum sustainable yield	?	?
								Precautionary approach	?	?
usk.27.1-2	Tusk in subareas 1 and 2	*Brosme brosme*	Tusk	Demersal	3.2	2021	PA	Maximum sustainable yield	?	?
								Precautionary approach	?	?

Table A2 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.