

10.2 Greenland Sea ecoregion – Fisheries overview

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Executive summary

A total of around 60 vessels currently operate in the Greenland Sea ecoregion. In addition to the Greenland fleet, EU, Faroe Islands, Norway, and Russia are fishing in the ecoregion.

As the ecoregion is within the Greenland Exclusive Economic Zone (EEZ), the management of marine resources are under Greenland authority. Fisheries targeting widely distributed fish stocks (e.g. herring [her.27.1-24a514a], mackerel [mac.27.nea], and capelin [cap.27.1-2]) are managed by the North East Atlantic Fisheries Commission (NEAFC) or coastal state agreements. The fisheries of Greenland halibut (ghl.27.561214) and golden redfish (reg.27.561214) have been managed bilaterally with Iceland during the past decade.

Fishing activity is mainly concentrated in the southern part of the region, south of 70°N. The primary pelagic species are capelin, herring, and mackerel, fished by pelagic trawl and purse-seine. The most important demersal fisheries are the bottom-trawl fisheries for Atlantic cod (cod.2127.1f14), Greenland halibut, golden redfish, and beaked redfish (reb.2127.dp). Northern shrimp is the main exploited invertebrate species in this ecoregion.

The Greenland halibut stock has been relatively stable over the past decade and is currently at full reproductive capacity with a sustainable fishing pressure in accordance with maximum sustainable yield (MSY). Atlantic cod is highly influenced by the inflow of eggs and larvae from Icelandic waters that occasionally contribute with large year classes. The cod stock is at full reproductive capacity, though with low recruitment. Two species of redfish, golden redfish and beaked redfish, are caught on the continental shelf and slopes in the ecoregion. While the golden redfish stock size has been at full reproductive capacity for more than a decade, the stock status of beaked redfish is unknown.

For herring and mackerel, the average ratios of fishing mortality (F) to F_{MSY} have been close to 1 throughout the time-series. Also, the stocks have been on the positive side of the biological reference points.

Introduction

The Greenland Sea ecoregion covers the shelf and surrounding waters within the Greenland EEZ (Figure 1). The region is located along the entire eastern coast of Greenland, from the Arctic Ocean to the Oceanic Northeast Atlantic ecoregions and along the Norwegian Sea and the Icelandic Waters ecoregions. The ocean and coastal shelves are strongly influenced by cold low saline water from the north and warm high saline water from the south; further details can be found in the Greenland Sea ecosystem overview (ICES, 2020a).

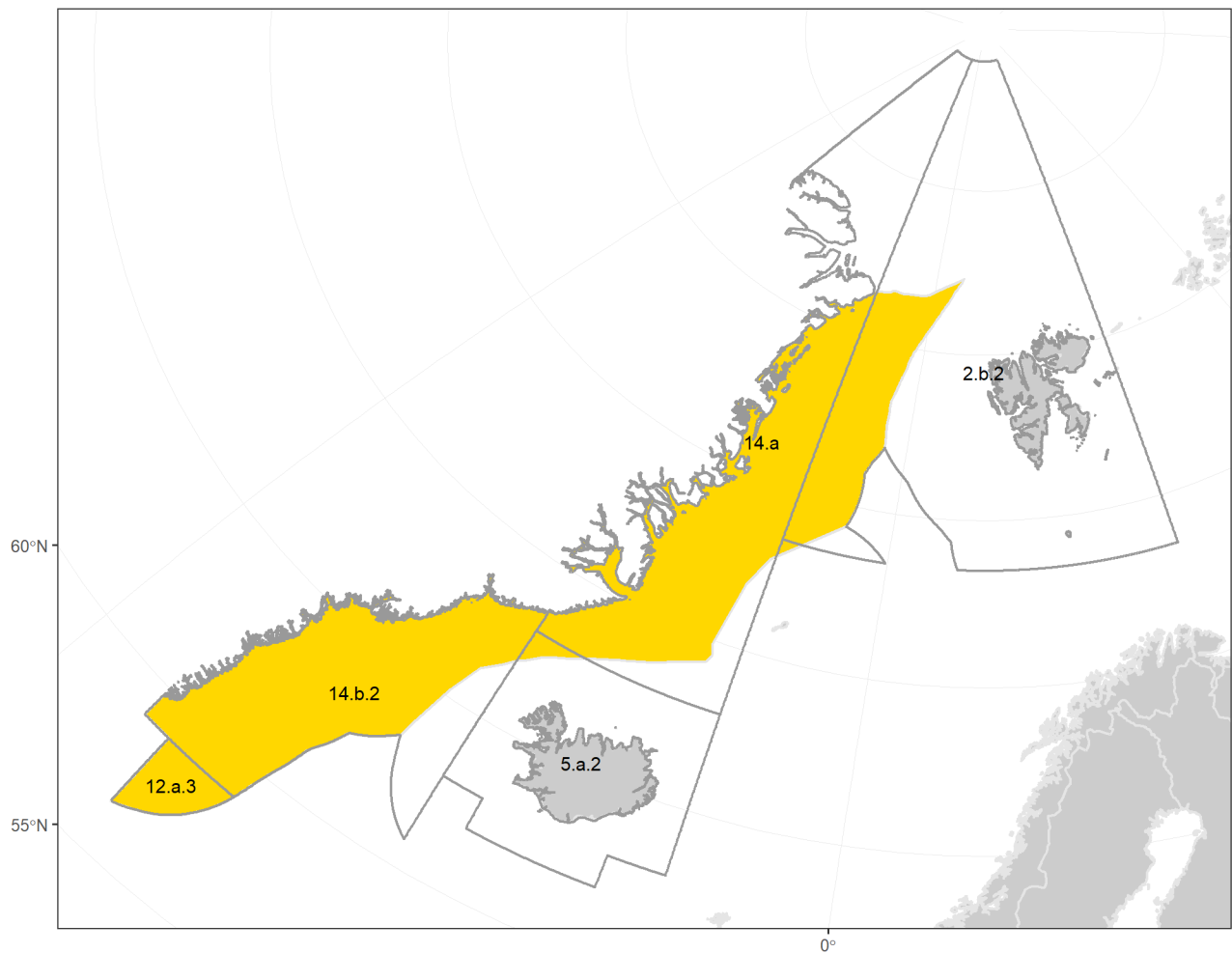


Figure 1 Greenland Sea ecoregion (highlighted in yellow) and ICES statistical areas. ICES divisions 2.b.2 and 5.a.2 are not included in the present overview since catches from these divisions are only of little relevance for the Greenland Sea ecoregion.

The current overview covers ICES divisions and subdivisions 14.a, 14.b.2, 12.a.3, 2.b.2, and 5.a.2 (Figure 1). The catch statistics include all catches in ICES divisions and subdivisions 12.a.3, 14.a, and 14.b.2 as official catch statistics for the area cannot be broken down to smaller units of the ecoregion. The overview provides:

- a short description of each of the national commercial fishing fleets in the ecoregion, fishing gears, and patterns. Information on whale and seal hunting is not included in this overview;
- a summary of the status of the resources and the level of exploitation relative to agreed objectives and reference points;
- an evaluation of the effects of fishing gear on the ecosystem through physical contact on subsurface and bottom habitats, and on the bycatch of protected species.

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

Who is fishing

A multinational fishery currently operates in the Greenland Sea ecoregion, using different types of fishing gears and targeting several species. Apart from an insignificant inshore fishery with small boats, the fishing is operated by large fish industrial factory ships in the length range of 50–100 meters. The fleet fishing on the eastern coast of Greenland amounts to about 60 vessels in recent years (Figure 2). The demersal fisheries mainly deploy bottom trawl and longliners, while the pelagic fishery is carried out with trawl.

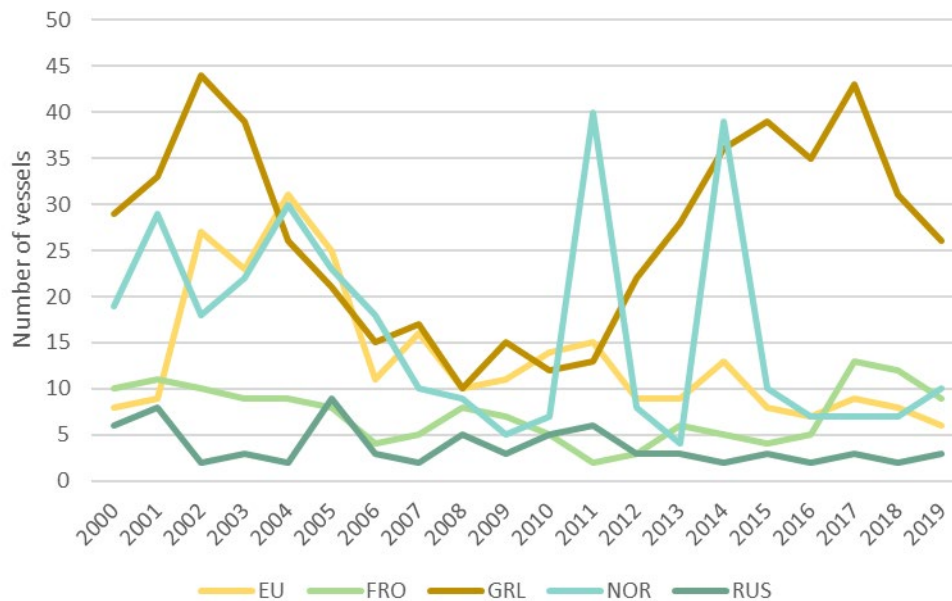
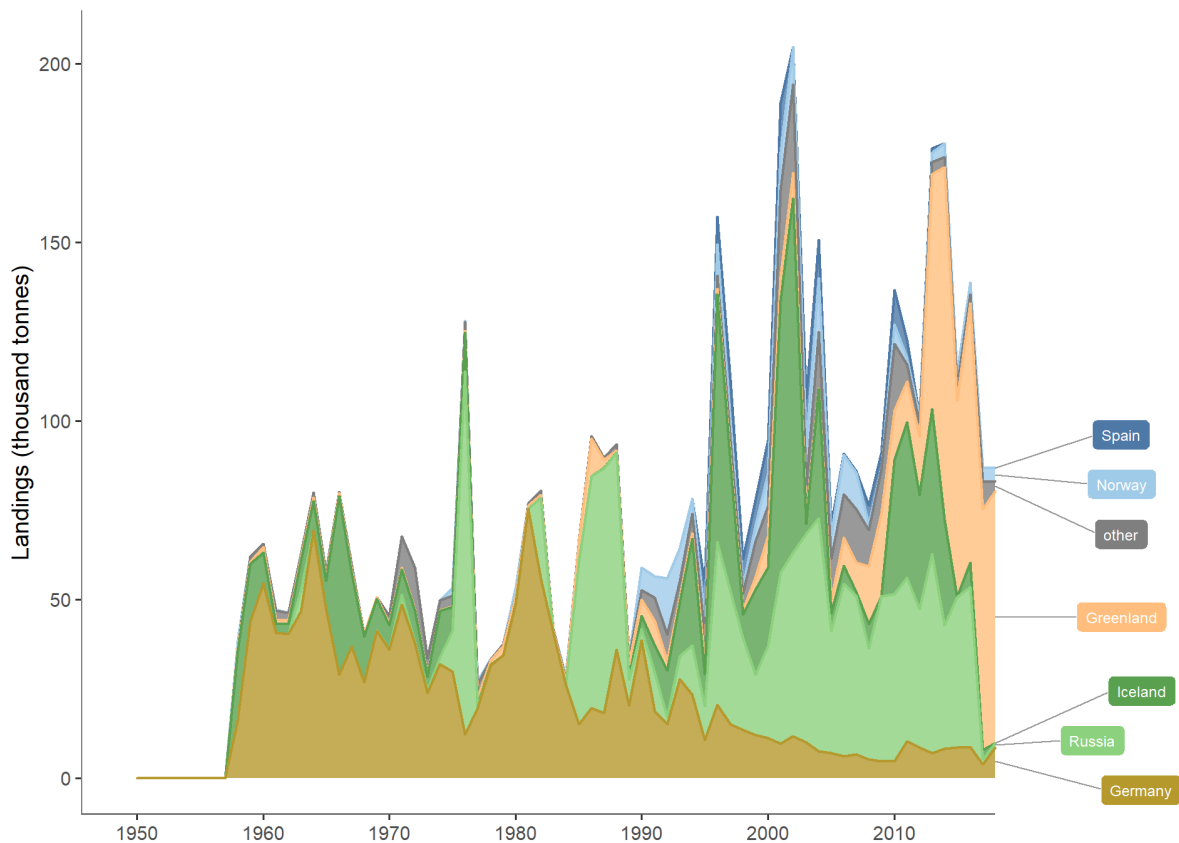


Figure 2 The number of vessels from various nations fishing within the Greenland EEZ from 2000 to 2019.

Apart from the Greenland fleet, the marine resources in Greenland waters are exploited by the EU Member States, Faroe Islands, Norway, and Russia. The number of vessels changes with the availability of the resource, e.g. with the increase of some pelagic stocks in 2011 and 2014 (Figure 2). Foreign vessels are allowed to fish within the Greenland EEZ through coastal state and bilateral agreements. Before the establishment of the 200 nautical mile EEZ in 1976, foreign fishery had free access to Greenland waters; however, little fishery took place at that time (Figure 3).

Greenland accounts for most of the active vessels in both the demersal and the pelagic fisheries. From 2012 to 2015, the number of Greenlandic vessels increased notably and has since remained high compared to other nations. The largest number of foreign vessels, the EU vessels, has increased since 2009, while the number of vessels from other nations has been relatively stable in the whole period (Figure 2). Besides Greenland, EU vessels have overtime accounted for most of the bottom-trawl fishery, measured as the number of vessels registered with that gear. Longline fishing is mainly conducted by Russia and Greenland, followed by the Faroes, while EU and Norway are mainly active in the pelagic fishery.

The biomass caught by the different countries has varied through time. Nowadays, Greenland takes the majority of the catches (Figure 3). Mackerel catches in the ecoregion are taken by Greenlandic vessels and by chartered vessels from Iceland, Faroes, and Russia.



Historical Nominal Catches 1950-2010,
Official Nominal Catches 2006-2018
Preliminary Catches 2019
ICES, Copenhagen.

Figure 3 Landings (thousand tonnes) from ICES divisions and subdivisions 12.a.3, 14.a, and 14.b.2 in 1950–2018, by country. The nine countries with the highest landings are displayed separately; the remaining countries are aggregated and displayed as “other”. Please note that capelin catches are not included.

Catches over time

Presently, the annual catch in the ecoregion varies between 78 000 tonnes and 109 000 tonnes from the stocks of Northeast Atlantic (NEA) mackerel, Norwegian spring-spawning herring, cod, Greenland halibut, golden redfish, beaked redfish, and northern shrimp. The vast majority of these catches are pelagic species (Figure 4). The landings of the major commercial stocks (NEA mackerel, Norwegian spring-spawning herring, cod, and Greenland halibut) have varied over time (Figure 5), with only few fisheries until the late 1950s (Figure 5). For the past 20 years, a capelin fishery has not been conducted in the ecoregion because of TAC restrictions in the summer/autumn fishery, which is the main season for the capelin fishery in the ecoregion.

Landings

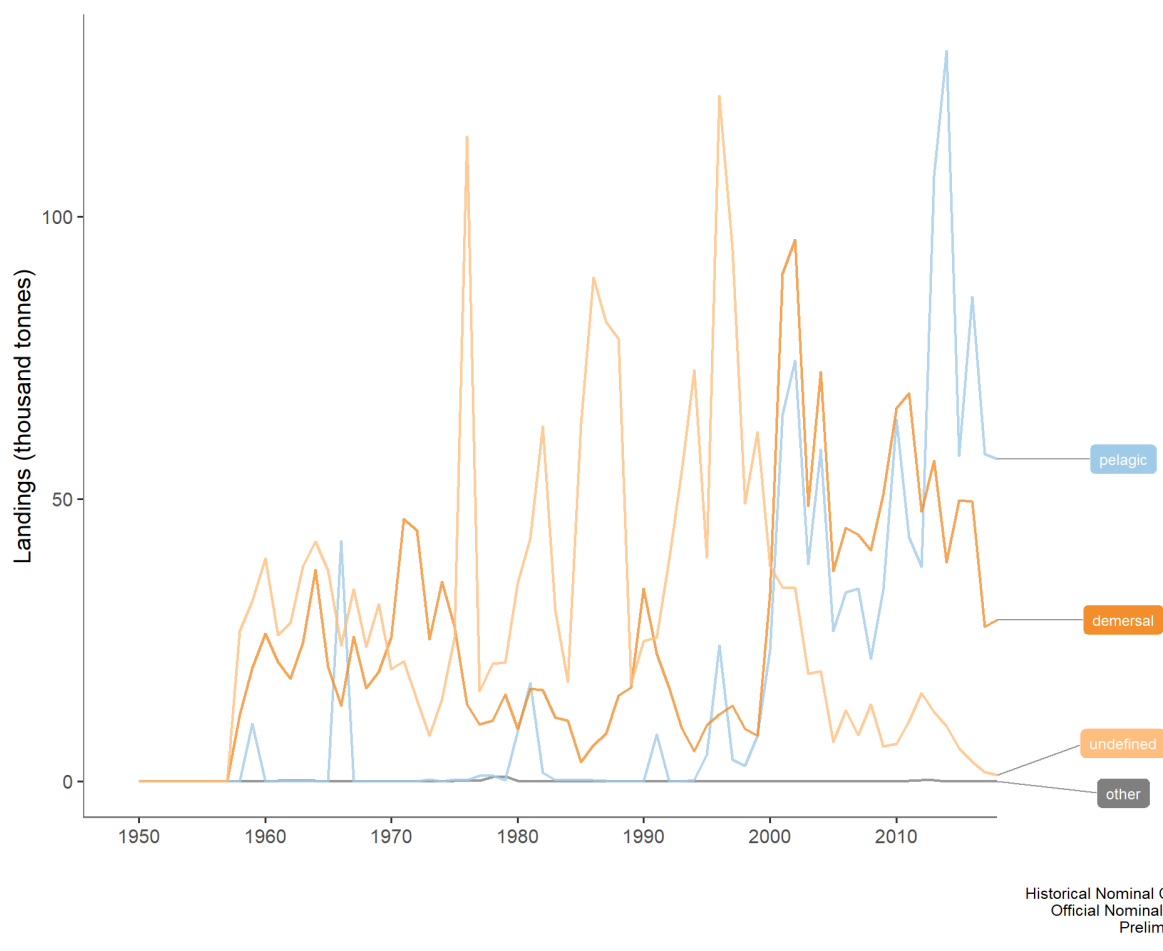


Figure 4 Landings (thousand tonnes) from ICES divisions and subdivisions 12.a.3, 14.a, and 14.b.2 in 1950–2018, by fish category. Table A1 and A2 in the Annex detail which species belong to each fish category. Please note that capelin catches are not included.

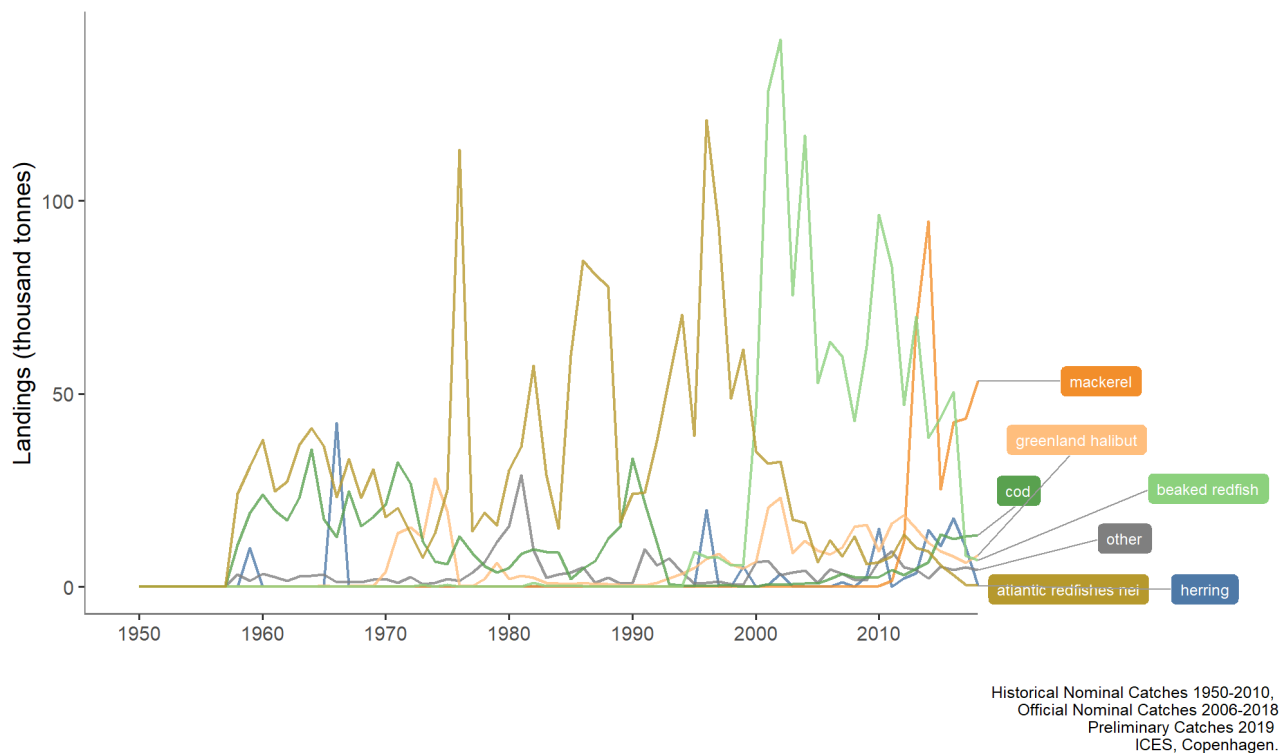


Figure 5 Landings (thousand tonnes) from ICES divisions and subdivisions 12.a.3, 14.a, and 14.b.2 in 1950–2018, by species. The ten species with the highest landings are displayed separately; the remaining species are aggregated and labelled as “other”. Please note that capelin catches are not included.

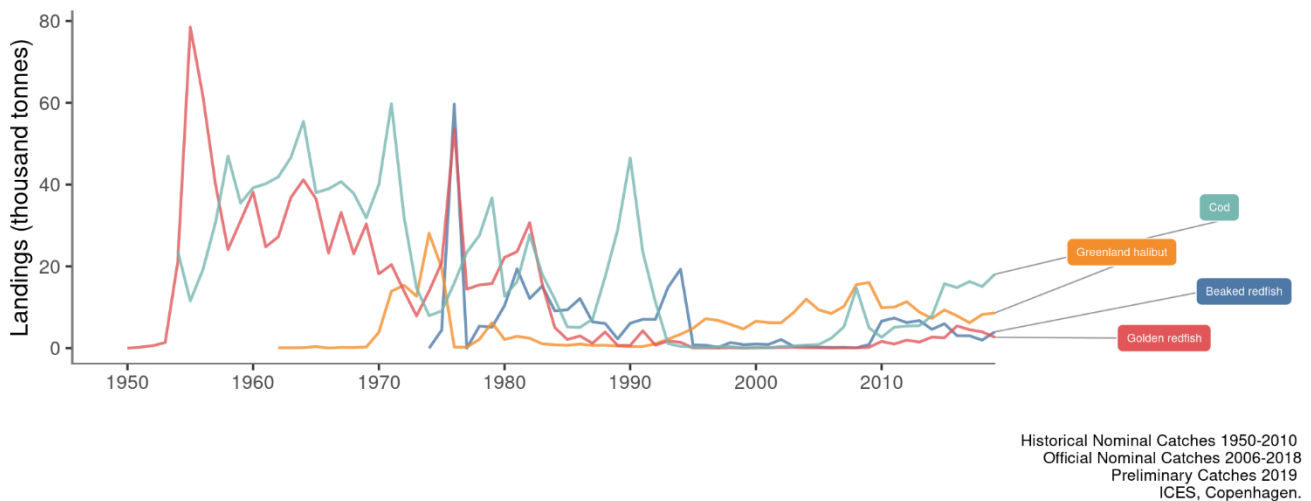


Figure 6 Landings (thousand tonnes) of four demersal species from ICES divisions and subdivisions 12.a.3, 14.a, and 14.b.2 in 1950–2019.

The cod fishery in the ecoregion started in the mid-1950s and continued until mid-1990s when it collapsed. Recent cod catches have been relatively low (Figure 6).

The catches of Greenland halibut increased from the early 1990s until the beginning of 2000 and then stabilized. In 2013, the catches decreased with the reduced fishing effort and have been stable since then (Figure 6).

The offshore northern shrimp fishery started in 1969 and increased up to the mid-1980s, reaching a catch level close to 15 000 tonnes. The catches remained at a high level until the beginning of 2000, but have decreased since then and are presently around 500 tonnes (Rigét, 2020).

Bottom-trawl catches from Greenland waters have been relatively stable during 2000–2019 while the pelagic catches have fluctuated (Figure 7). The longline fishery has increased since 2012 together with the increasing cod catches (Figure 7; ICES, 2020b).

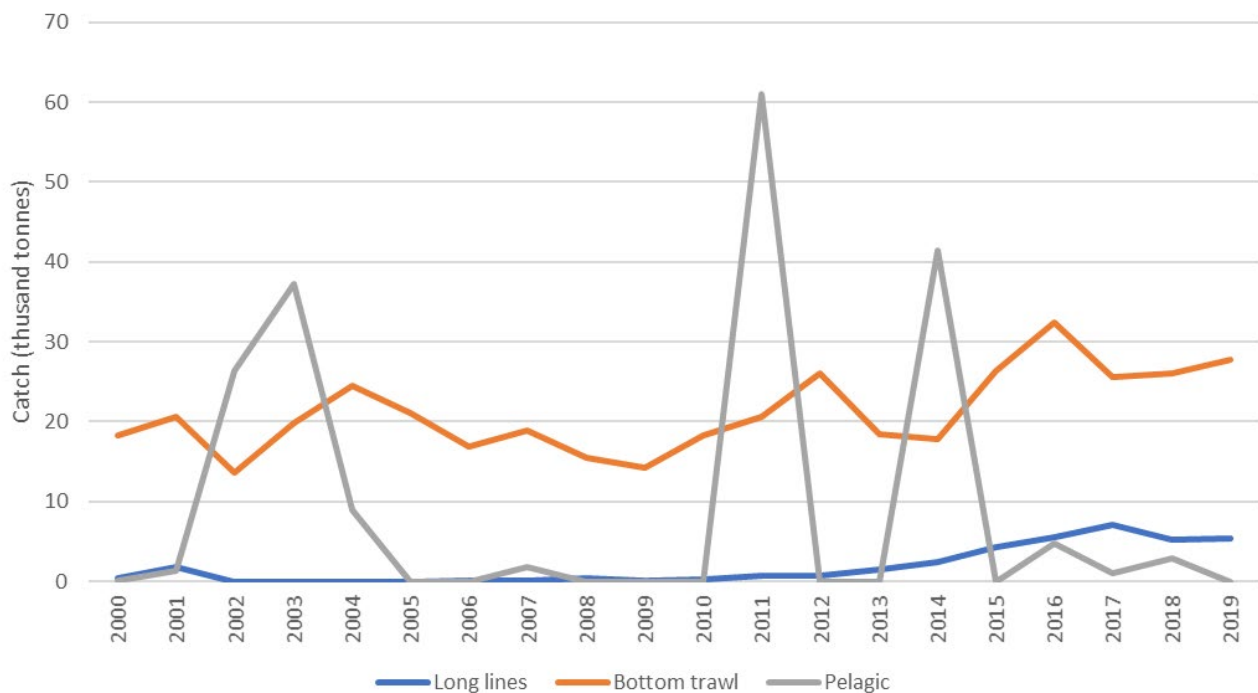


Figure 7 Commercial catches (thousand tonnes) from the Greenland Sea ecoregion in 2000–2020, by gear type.

Discards

Discarding is prohibited in Greenland and is considered negligible for most fisheries.

Description of the fisheries

Within the Greenland Sea ecoregion, the majority of the fishery is conducted in the southern part of the area, south of 70°N. Both demersal and pelagic fishery is conducted in the ecoregion. A variety of different gear types, including bottom trawl, longlines, and pelagic trawl, are used in the fishery.

Bottom otter trawl

The bottom-trawl fishery in the region mainly focuses on cod, Greenland halibut, redfish, and northern shrimp, and is conducted in the slope and shelf area in the southern part of the ecoregion (Figure 8). For all fished species the highest effort takes place south of 67°N. Minor effort takes place for cod and Greenland halibut north of 67°N.

Static gear fisheries

Longliners target demersal species like cod and, to a lesser degree, Greenland halibut. Furthermore, a small Norwegian longline fishery has for many years targeted Atlantic halibut. The longline fishery for cod in the ecoregion is distributed in the entire area south of 67°N, while the longline fishery for Greenland halibut primarily takes place in two well-defined areas within the region.

Pelagic trawl and pelagic seine fisheries

The pelagic fishery for mackerel and herring has developed rapidly in the ecoregion since the late 2000s, after changes in the migration routes of these species (Jansen *et al.*, 2016). The main fishing effort for herring has been north of 68°N, while the effort for mackerel has been focused further southwest between Greenland and Iceland (Figure 9).

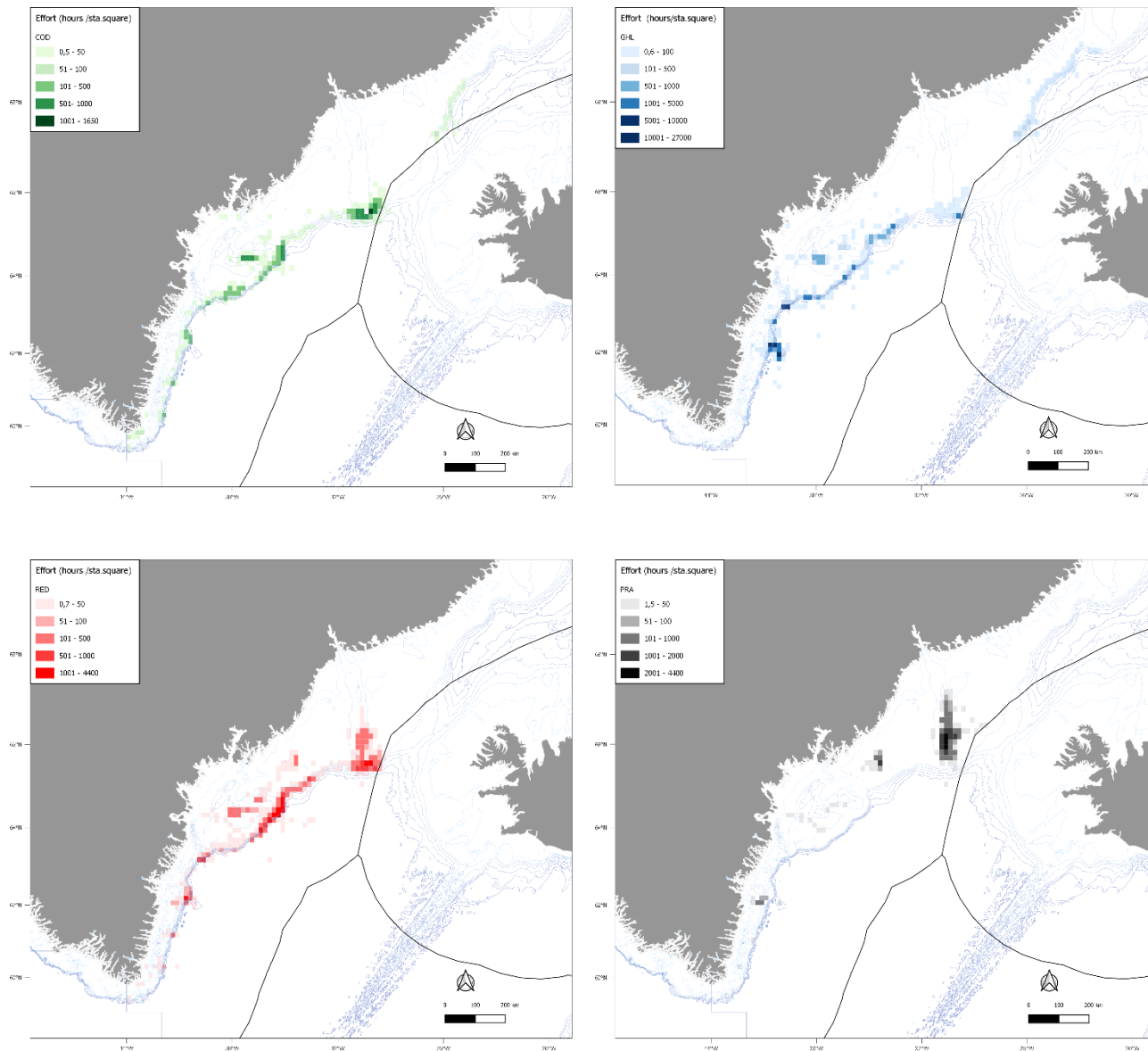


Figure 8 Spatial distribution of bottom-trawling effort during 2009–2019 for four demersal species. Upper panels: cod and Greenland halibut (GHL). Lower panels: redfish sp. (RED) and northern shrimp (PRA). Greenland and Iceland EEZs are marked.

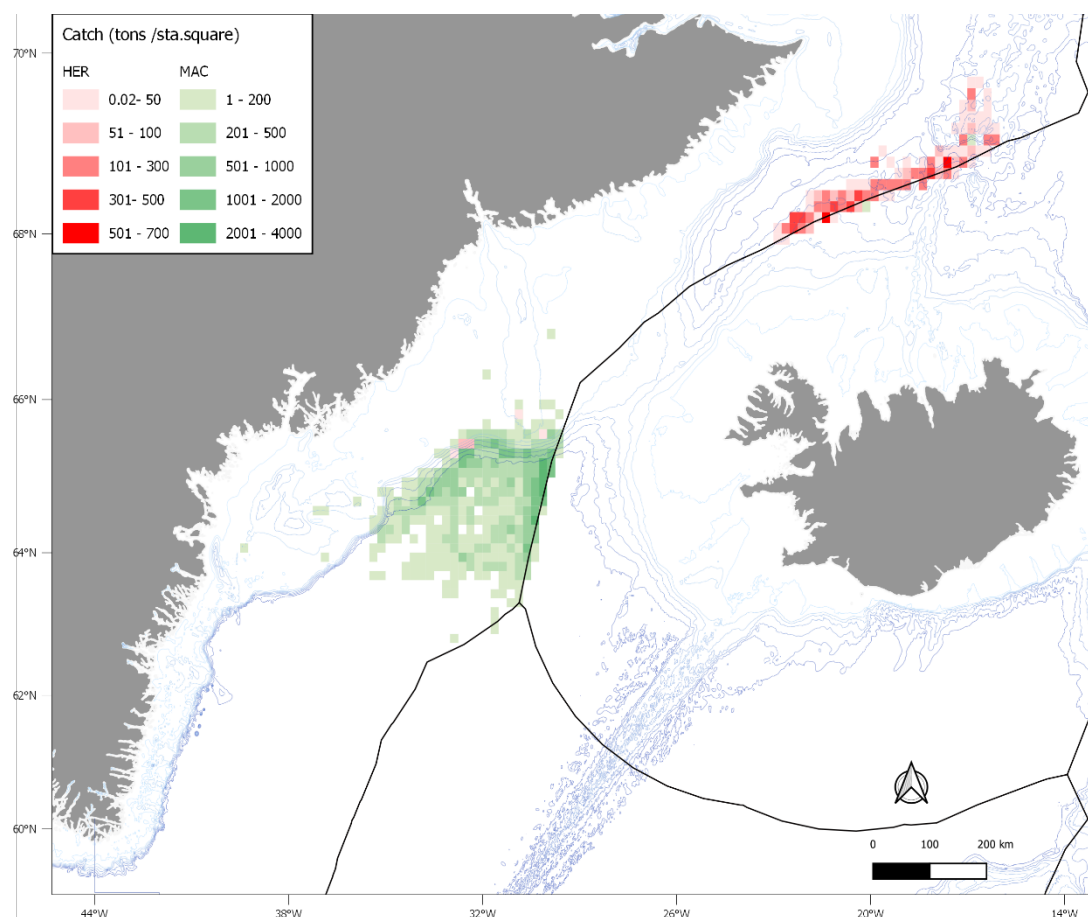


Figure 9 Spatial distribution of mackerel (MAC) and herring (HER) catch during 2017–2019. Greenland and Iceland EEZs are marked.

Fisheries management

As the ecoregion is within the Greenland EEZ, the management of marine resources are under Greenland authority. Fisheries targeting widely-distributed fish stocks (e.g., herring, mackerel, and capelin) are managed by NEAFC or coastal state agreements. Fisheries of Greenland halibut and golden redfish have been managed bilaterally with Iceland during the past decade.

Fishing is regulated by, amongst other things, quotas and licences issued by the Government of Greenland. For each owner or company, the licence states which species the relevant licensee may fish, with which vessels and in what management area the fishing may take place, and other conditions that apply to the fishery. There are two primary types of licences: a fixed-term licence and a non-time-limited licence. Each licence type may or may not be associated with a maximum catch.

Discard management measures are in place to limit bycatch. If bycatch limits are exceeded the vessels are obliged to move to another area.

Several management regulations are in place in the ecoregion to achieve a sustainable fishery. Since the 1990s sorting grids have been mandatory in the shrimp fishery to avoid bycatch of juvenile fish and shrimp as well as bycatch of larger fish, sharks, and cetaceans. Areas have regularly been closed for trawling to protect spawning concentrations of cod to rebuild the stock.

Management plans

The national management plan for the cod stock (cod.2127.1f14) is due to be adopted in 2020. There are no management plans for other stocks in the ecoregion.

Status of the fishery resources

The ecoregion contains 13 stocks for which ICES provided advice in 2020, eight demersal and five pelagic stocks. While northern shrimp is an important resource in the region, the stock is not assessed in ICES and is therefore not further included in this section.

Fishing mortalities and sizes of spawning-stock biomass (SSB) 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 10). Out of the eight stocks with F reference points, five were fished above F_{MSY} target levels in 2019 (red colour in Figure 10). Based on PA reference points, one stock 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 EU Marine Strategy Framework Directive (MSFD) indicators for fishing mortality and spawning-stock biomass, which correspond to F_{MSY} and $MSY B_{trigger}$ (Figure 11).

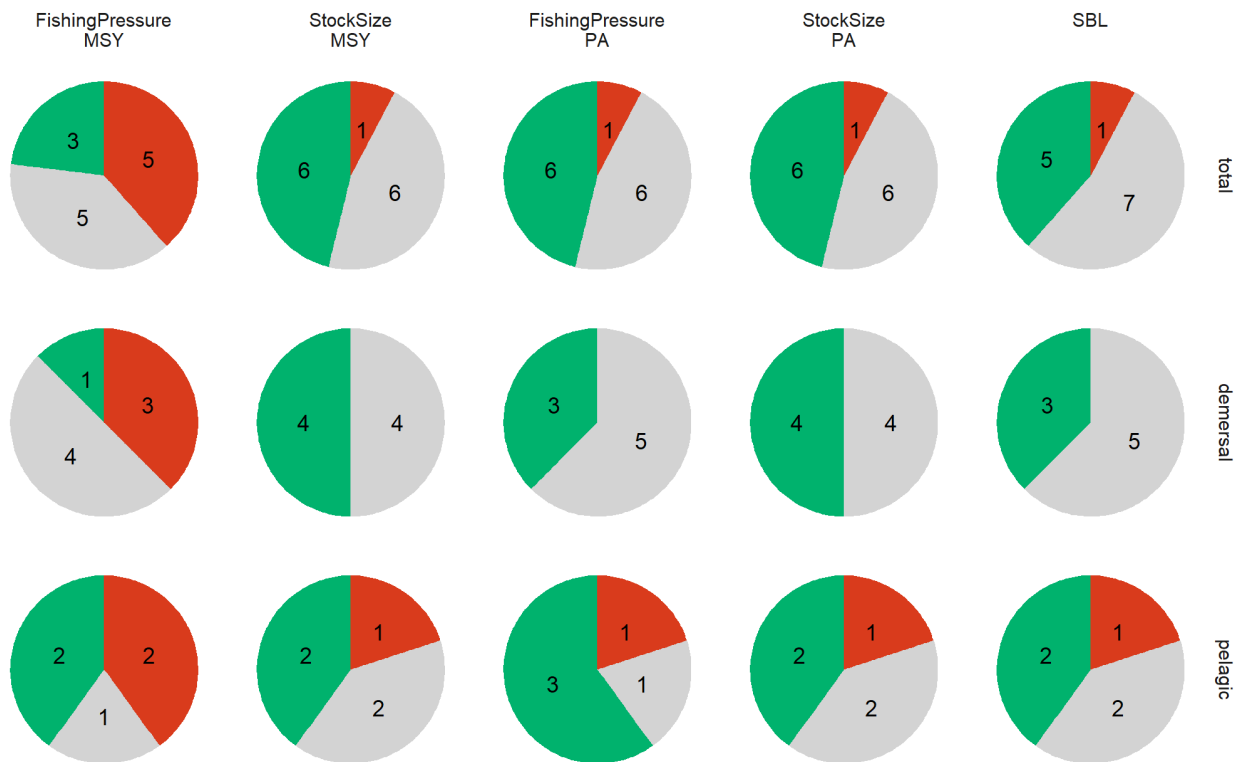
Five stocks lack all reference points (Table A2 in the Annex); the majority of species have some, but not all, reference points. Some stocks with missing reference points are “data-limited stocks”, which means that there are no forecasts of stock development (ICES categories 3, 5, and 6). However, stocks for which quantitative assessments are available, make up the majority of the landed biomass (Figure 11).

The majority of the landings in 2019 were from stocks with SSB above $MSY B_{trigger}$ (mainly mackerel), but about half of the landings came from stocks with fishing mortality above or at F_{MSY} (assessment criterion D3C1; Figure 11). The remaining landings were from stocks without a full set of MSY reference points.

Herring and mackerel are the most important pelagic stocks in the ecoregion and the average ratio of fishing mortality to F_{MSY} has been close to 1 in the entire time-series. Likewise, the stocks have been on the positive side of the biological reference points (Figure 12).

For cod, Greenland halibut, golden redfish, and tusk (usk.27.5a14) the average ratio of fishing mortality (F) to F reference points have fluctuated around 1 since the 1970s (Figure 12). In the last decade, the average has been close to 1, which has been mainly driven by the cod fishery. The average $SSB/MSY B_{trigger}$ ratio has reacted to the changes in the fishery pressure but stayed above or close to 1 throughout the time-series (Figure 12). The stock status of the beaked redfish is unknown.

The northern shrimp stock has been declining since 2003. The stock is presently at a low level.



ICES Stock Assessment Database, November 2020. ICES, Copenhagen

Figure 10

Status summary of Greenland Sea stocks relative to ICES maximum sustainable yield (MSY) approach and precautionary approach (PA), with the relevant number of stocks shown within each category. Grey represents unknown reference points. *For the MSY approach:* green represents a stock that is fished at or below F_{MSY} while the stock size is equal to or greater than $MSY B_{trigger}$; red represents a stock status that is fished above F_{MSY} or the stock size is lower than $MSY B_{trigger}$. *For the PA:* green represents a stock that is fished at or below F_{pa} while the stock size is equal to or greater than B_{pa} ; red represents a stock that is fished above F_{lim} or has a stock size lower than B_{lim} . Stocks having a fishing mortality below or at F_{pa} and a stock size at or above B_{pa} are defined as being inside safe biological limits (SBL). 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.



ICES Stock Assessment Database, November 2020. ICES, Copenhagen

Figure 11

Status summary of Greenland Sea stocks in 2020 relative to the EU Marine Strategy Framework Directive (MSFD) good environmental status (GES) assessment criteria of fishing pressure (D3C1) and stock reproductive capacity (D3C2). Green represents the proportion of stocks 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 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 lacking MSY reference points. For stock-specific information, see Table A1 in the Annex.

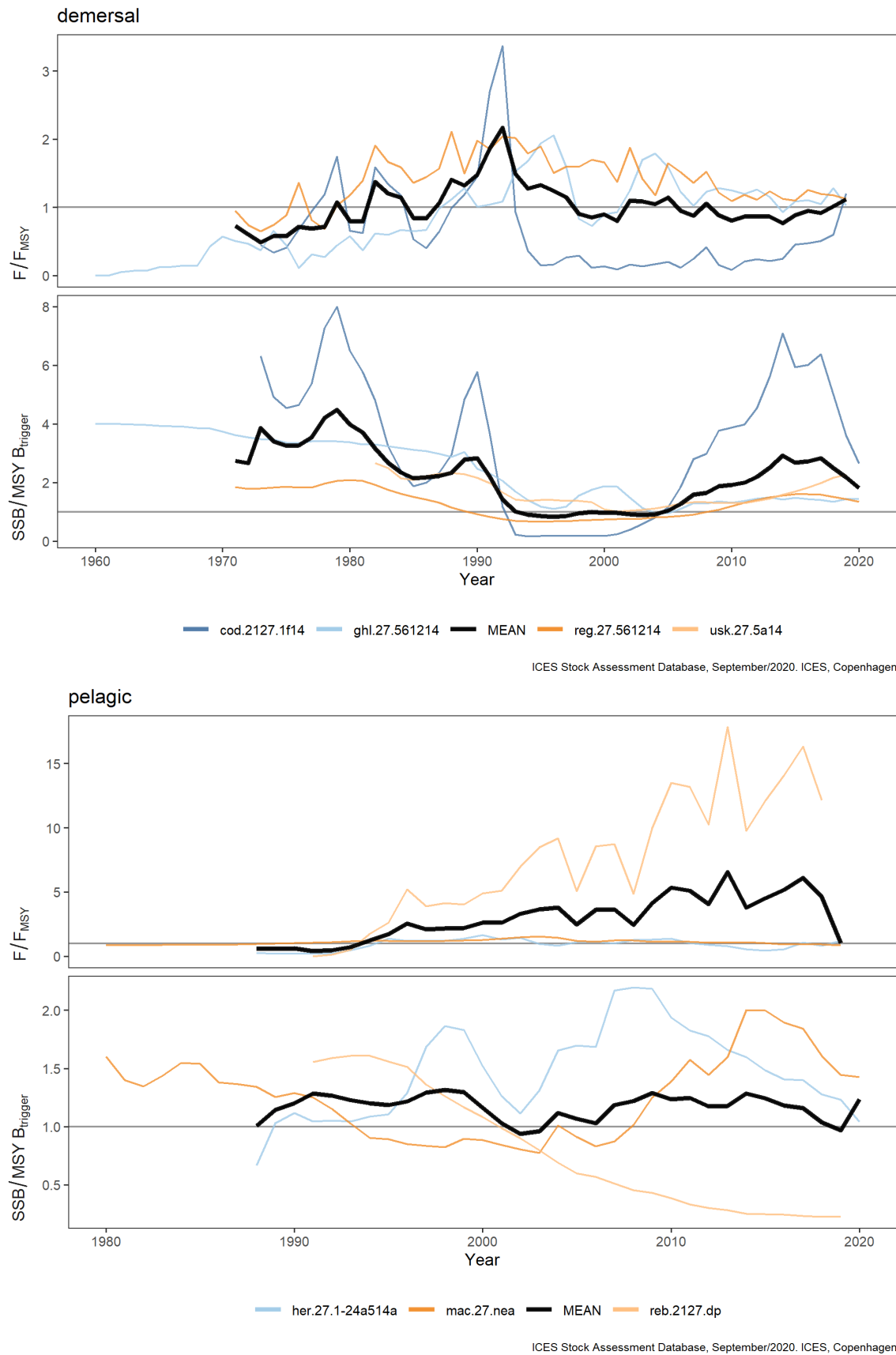
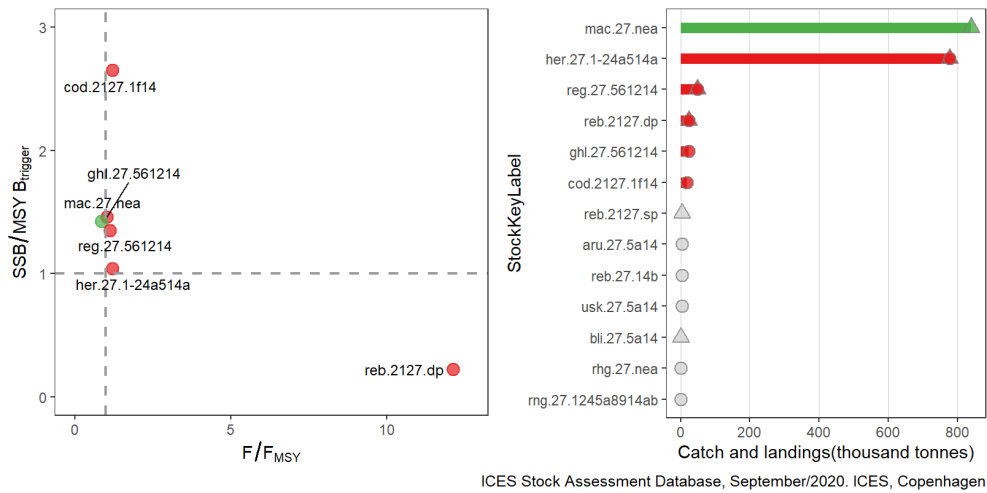


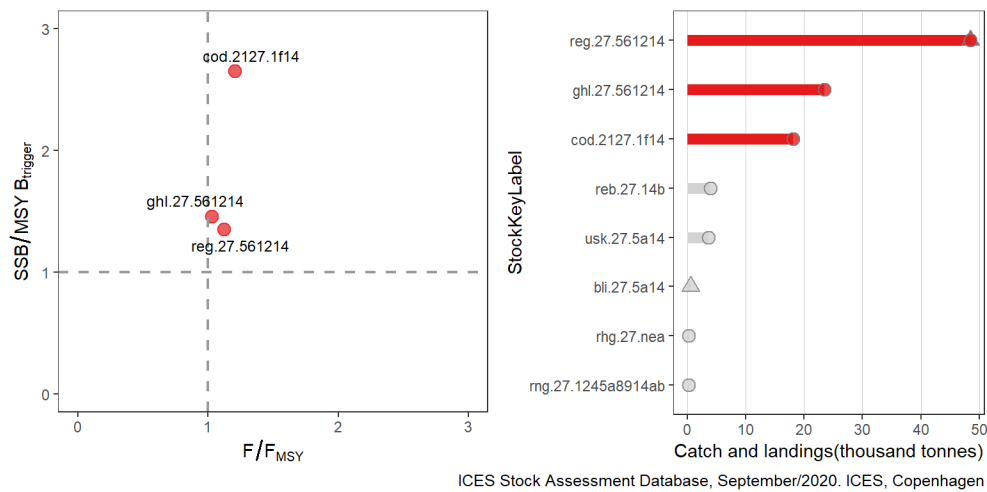
Figure 12 Temporal trends in F/F_{MSY} and $SSB/MSY B_{trigger}$ for Greenland Sea benthic, crustacean, demersal, and pelagic stocks. Only stocks with defined MSY reference points are considered. For full stock names, see Table A1 in the Annex.

Status of the stocks relative to the joint distribution of exploitation (F/F_{MSY}) and stock size ($SSB/MSY B_{trigger}$) is shown for all stocks with MSY reference points in Figure 13. Of all stocks presented, mackerel is exploited at or below F_{MSY} and has a stock size at or above $MSY B_{trigger}$. Other stocks in the region are exploited above the optimal limit or have unknown/undefined status in relation to reference points (Figure 13).

All stocks



demersal



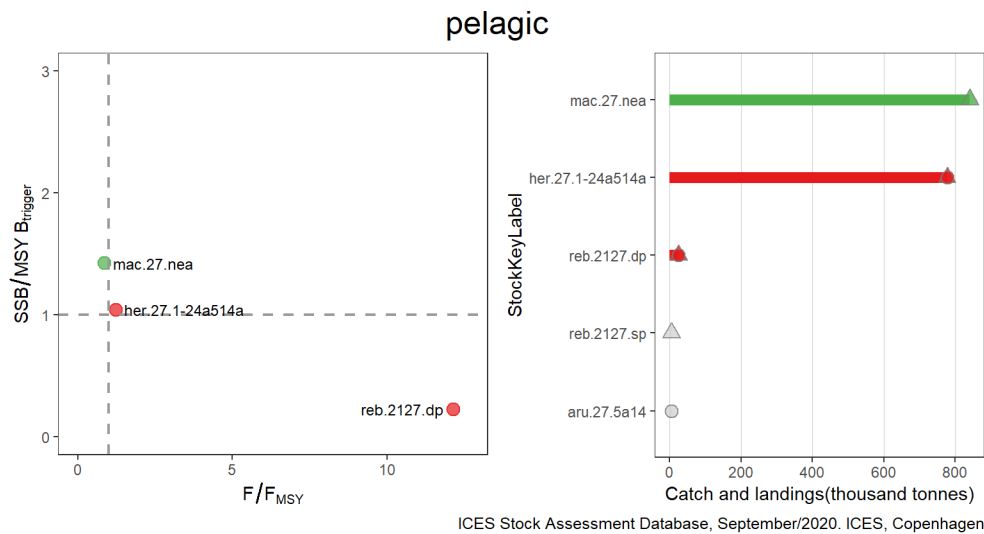


Figure 13 Status of Greenland Sea stocks relative to the joint distribution of exploitation (F/F_{MSY}) and stock size ($SSB/MSY B_{trigger}$) [left panels, by individual stocks] and catches (triangles) / landings (circles) from these stocks in 2017 [right panels]. Landings of blue whiting includes the whole Northeast Atlantic. The left panels only include stocks for which MSY reference points have been defined (MSY where available). Stocks in green are exploited at or below F_{MSY} while the stock size is also at or above $MSY B_{trigger}$. Stocks in red are either exploited above F_{MSY} or the stock size is below $MSY B_{trigger}$, or both. Stocks in grey have unknown/undefined status in relation to reference points. “All stocks” refers to the ten stocks with highest catch and landings across fisheries guilds in 2018. For full stock names, see Table A1 in the Annex.

Mixed fisheries

Cod and redfish overlap in distribution in the ecoregion and is thus often caught together. Deep-water fisheries targeting Greenland halibut and redfish also have catches of roundnose grenadier (rng.27.1245a8914ab), roughhead grenadier (rhg.27.nea), and tusk (Gordon *et al.*, 2003).

The pelagic fishery in the ecoregion has small amounts of bycatch. For instance, Atlantic bluefin tunas are occasionally caught as bycatch in the mackerel fishery.

Species interactions

The commercially exploited species in the Greenland Sea ecoregion are part of the marine food web. The species interact in various ways, including through competition and predation. The interactions between different species are to some degree understood, but potential effects propagating out through the ecosystem from the fisheries impacts are not quantified. Therefore, species interactions are not included in the assessment of fish stocks in the ecoregion.

Effects of fisheries on the ecosystem

The main effects of fisheries are due to the extraction of species, with physical disturbance of the seabed and benthic habitats by mobile bottom-contacting fishing gear. Knowledge on the effect of extraction of species on the ecosystem structure and functioning is limited, abrasion by towed bottom-contacting gear has caused damage and loss of potentially important benthic habitat. Information on benthic habitats in the ecoregion is limited, but available data reveals considerable overlap between the distribution of corals, sponges, and sea pens, and the areas trawled (Figure 14).

The elasmobranchs sailray, common skate, leafscale gulper shark, Portuguese dogfish and thorny skate occurred as bycatch in bottom-trawl fisheries in the ecoregion (Subdivision 27.14.b.2) in 2018, with thorny skate showing the highest bycatch rate (1.80 specimens per monitored days-at-sea).

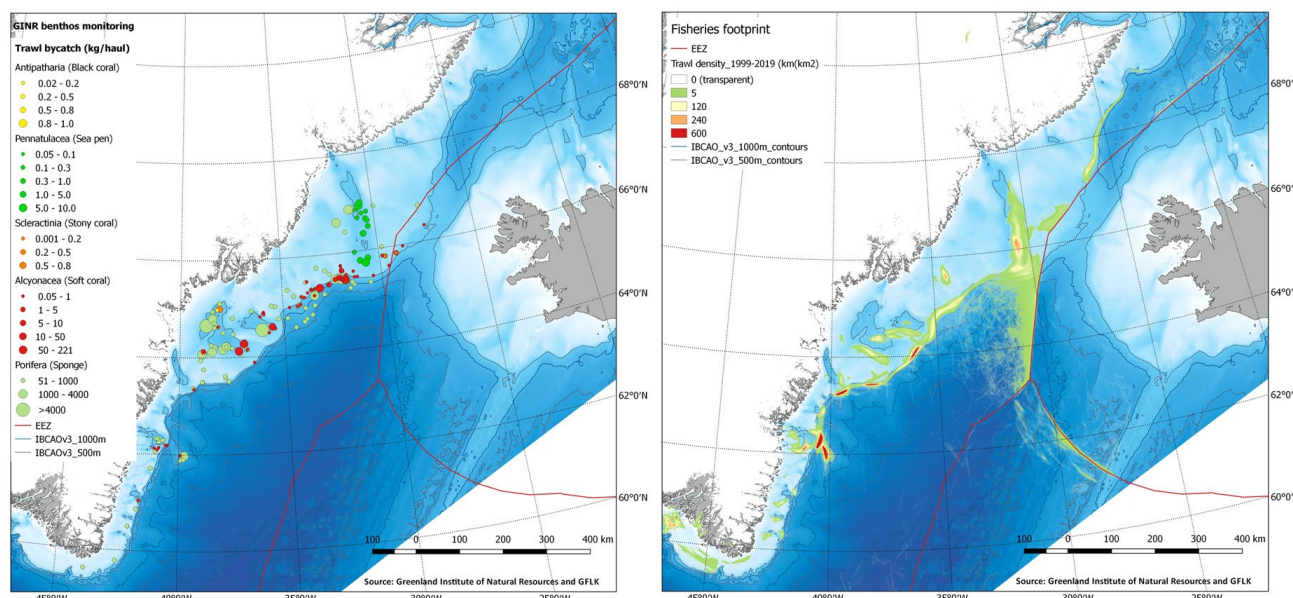


Figure 14 Left panel: Density of corals and sponges collected during trawl surveys at depths of 50–1500 m. Right panel: Fishing effort based on haul-by-haul logbook data from the Greenland Fishery License Control (GFLK) from fisheries deploying demersal and pelagic trawl gear from 1999 to 2019, all species and vessels inclusive.

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Recommended citation: ICES. 2020. Greenland Sea ecoregion – Fisheries overview. *In* Report of the ICES Advisory Committee, 2020. ICES Advice 2020, section 10.2. <https://doi.org/10.17895/ices.advice.7599>.

Annex

Supporting data used in the Greenland Sea Fisheries overview is archived at ICES (2020d).

Table A1 Status summary of the Greenland Sea ecoregion stocks in 2020, in regards to the ICES maximum sustainable yield (MSY) approach and precautionary approach (PA) for stocks within the Greenland Sea ecoregion. Grey represents unknown reference points. For the MSY approach: green represents a stock that is either fished below F_{MSY} or the stock size is greater than $MSY B_{trigger}$; red represents a stock status that is either fished above F_{MSY} or the stock size is less than $MSY B_{trigger}$. For the PA: green represents a stock that is either fished below F_{pa} or the stock size is greater than B_{pa} ; red represents a stock that is either 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; MP = management plan.

Stock	Stock description	Fisheries guild	Data category	Assessment year	Advice category	SBL	GES	Reference point	Fishing pressure	Stock size	D3C1	D3C2
aru.27.123a4	Greater silver smelt in subareas 1, 2, and 4, and in Division 3.a	Pelagic	3.2	2019	PA	?	?	MSY	✓	?	✓	?
								PA	✓	?	✓	?
cod.2127.1f14	Cod in ICES Subarea 14 and NAFO Division 1.F	Demersal	1	2020	MSY	✓	✗	MSY	✗	✓	✗	✓
								PA	✓	✓	✓	✓
ghl.27.561214	Greenland halibut in subareas 5, 6, 12, and 14	Demersal	1	2020	MSY	✓	✗	MSY	✗	✓	✗	✓
								PA	?	✓	?	✓
her.27.1-24a514a	Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a; Norwegian spring-spawning herring	Pelagic	1	2020	MP	✓	✗	MSY	✗	✓	✗	✓
								PA	✓	✓	✓	✓
mac.27.nea	Mackerel in subareas 1–8 and 14 and in Division 9.a	Pelagic	1	2020	MSY	✓	✓	MSY	✓	✓	✓	✓
								PA	✓	✓	✓	✓
reb.2127.dp	Beaked redfish in ICES subareas 5, 12, and 14, and in NAFO subareas 1 and 2	Pelagic	2.13	2019	MSY	✗	✗	MSY	✗	✗	✗	✗
reg.27.561214	Golden redfish in subareas 5, 6, 12, and 14	Pelagic	1	2020	MP	✓	✗	MSY	✗	✓	✗	✓
								PA	✓	✓	✓	✓

Stock	Stock description	Fisheries guild	Data category	Assessment year	Advice category	SBL	GES	Reference point	Fishing pressure	Stock size	D3C1	D3C2
usk.27.5a14	Tusk in Subarea 14 and Division 5.a	Demersal	1	2019	MSY			MSY				
								PA				

Table A2 List of those stocks in the Greenland Sea ecoregion in 2020 that do not have a full set of reference points.

Stock code	Stock name	Latin name	Fish category	Reference point	Year of last advice	Data category
bli.27.5a14	Blue ling in Subarea 14 and Division 5.a	<i>Molva dypterygia</i>	Demersal	PA	2019	3.3
reb.2127.sp	Beaked redfish in ICES subareas 5, 12, and 14, and in NAFO subareas 1 and 2	<i>Sebastes mentella</i>	Pelagic	PA	2019	3
reb.27.14b	Beaked redfish in Division 14.b, demersal	<i>Sebastes mentella</i>	Demersal	PA	2020	3.2
rhg.27.nea	Roughhead grenadier in subareas 5–8, 10, 12, and 14	<i>Macrourus berglax</i>	Demersal	PA	2020	6.3
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	<i>Coryphaenoides rupestris</i>	Demersal	PA	2019	6.2

Table A3 Species in the ecoregion.

Common name	Species name
Atlantic bluefin tuna	<i>Thunnus thynnus</i>
Atlantic cod	<i>Gadus morhua</i>
Atlantic halibut	<i>Hippoglossus hippoglossus</i>
Atlantic herring	<i>Clupea harengus</i>
Beaked redfish	<i>Sebastes mentella</i>
Blue ling	<i>Molva dypterygia</i>
Capelin	<i>Mallotus villosus</i>
Common skate	<i>Dipturus batis</i>
Golden redfish	<i>Sebastes norvegicus</i>
Greater silver smelt	<i>Argentina silus</i>
Greenland halibut	<i>Reinhardtius hippoglossoides</i>
Leafscale gulper shark	<i>Centrophorus squamosus</i>
Mackerel	<i>Scomber scombrus</i>
Northern shrimp	<i>Pandalus borealis</i>
Portuguese dogfish	<i>Centroscymnus coelolepis</i>
Roundnose grenadier	<i>Coryphaenoides rupestris</i>
Roughead grenadier	<i>Macrourus berglax</i>
Sailray	<i>Rajella lintea</i>
Sea pens	<i>Pennatulacea</i>
Thorny skate	<i>Amblyraja radiata</i>
Tusk	<i>Brosme brosme</i>