



MONITORING BYCATCHES IN NORWEGIAN FISHERIES

Species registered by the Norwegian Reference Fleet 2015-2018



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Monitoring bycatches in Norwegian fisheries
Overvåking av bifangst i Norske fiskerier

Subtitle (English and Norwegian):

Species registered by the Norwegian Reference Fleet 2015-2018
Arter registrerte av den Norske Referanseflåten 2015-2018

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Summary (English):

The Norwegian Reference Fleet is a group of active fishing vessels, selected as an approximate stratified random sample of vessels from the Norwegian fishing fleet, and tasked with providing information about catches and general fishing activity to the Institute of Marine Research. Fisheries data is collected by the crew members themselves, an approach commonly known as self-sampling of catches. This report aims to give an overview of how the Norwegian Reference Fleet record their catches and presents the reported catch composition with regards to number of species. A total of 271 species have been recorded by the Norwegian Reference Fleet between 2015 and 2018. There are an additional 39 records of unidentified species, which can occur because of excessive damage limiting an identification or a known misidentification that cannot be rectified.

Summary (Norwegian):

Referanseflåten er en gruppe aktive fiskefartøy, valgt ut som en tilnærmet stratifisert tilfeldig utvalg (stratified random sample) av fartøy fra den Norske fiskeflåten. Disse fiskefartøyenes hovedoppdrag for Havforskningsinstituttet er å bidra med informasjon om fangster og drift av fiskeriene. Fiskeridata er innsamlet ved såkalt «self sampling», hvor mannskapet om bord på fiskefartøyene selv utfører prøvetaking og dataregistrering. Formålet med denne rapporten er å redegjøre for hvordan Referanseflåten registrerer sine fangster og å presentere total fangstsammensetning i forhold til antall arter. Totalt har Referanseflåten registrert 271 arter mellom 2015 og 2018. I tillegg er det 39 registreringer av ikke identifiserte arter, som enten var ødelagte individer som ikke kunne identifiseres eller en bekreftet feilidentifisering som ikke kunne rettes.

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1 - Background and objectives

Monitoring bycatches in fisheries has become an integral part of fisheries management with regards to sustaining healthy ecosystems and the fisheries they support (Bellido et al. 2011). The Institute of Marine Research (IMR) in collaboration with the Norwegian fishing fleets, has developed the Norwegian Reference Fleet, a self-sampling programme used as a platform for supporting stock assessments with additional biological data including fishing effort, catch composition and bycatches. Since it was established in 2000, the data have been routinely used in stock assessments, but so far there have been relatively few publications on bycatch issues based on these data (e.g. Fangel et al. 2015; Bjørge & Moan 2017; Bærum et al., 2019). The aim of this report is to document the scope of sampling by the Norwegian Reference Fleet and provide an overview of the available data with regards to species reported in catches. A summary of species registered by the Norwegian Reference Fleet are provided in this report, along with the full dataset available for download (<http://metadata.nmdc.no/metadata-api/landingpage/19d05ab8e0afe1ceac1b2be3ddf68612>). Also included is an overview of the fisheries and fishing vessel categories that are prioritised in the Norwegian Reference Fleet, and the procedures used for reporting and sampling catches.

2 - The Norwegian Reference Fleet

2.1 - Aims of the project

The Norwegian Reference Fleet is a group of active fishing vessels tasked with providing information about catches and general fishing activity to the Institute of Marine Research. The fleet consists of both high-seas and coastal vessels that cover most of Norwegian waters. The High-seas Reference Fleet began in 2000 and was expanded to include coastal vessels in 2005. The four main goals of the Norwegian Reference Fleet are to:

1. Support stock assessments with biological data including:
 - Length composition of catches (length and weight measurements for all species captured)
 - Age composition of catches (otolith and scale collected)
 - Quality control and facilitation of data for stock-assessment
2. Document the fishing effort and catch composition of total catches, including bycatch, discards and catches of non-commercial species, seabirds and sea mammals to provide data for the monitoring of biodiversity, fishing effort and catch per unit effort (CPUE) over time
3. Provide a platform for the collection of additional samples from fisheries.
4. Increase collaboration and strengthen dialogue between researchers and the fishing industry.

2.2 - Vessel selection

The selection of vessels in the Norwegian Reference Fleet is required by law to follow an open tender process. The tender lists a series of criteria which are based on prioritised fisheries, vessel specifications and fishing gears (full description in Appendix Tables A1 and A2). These criteria prioritise data needed for stock assessments for commercially important stocks and reflect both spatial and temporal variation of fishing fleets. If multiple vessels are eligible under a certain category, then the contract is awarded randomly. The goal of the tender specifications and selection process is to approximate stratified random sampling, such that the Norwegian Reference Fleet is representative of the general fleet activity. A contract lasts for a period of four years, although renewal is possible if the vessel is still eligible.

For the larger vessels (>28m vessel length) in the Norwegian fishing fleet, the fisheries prioritised in the High-seas Reference Fleet are:

- demersal fisheries for cod, haddock and saithe north of latitude 62°N.
- demersal fisheries for cod, haddock and saithe south of latitude 62°N.
- beaked redfish trawl fishery.
- Greenland halibut fishery.
- ling and tusk fisheries with gillnet and longline.
- wolfish fishery with longline in the Barents Sea.
- pelagic fisheries with purse seine for herring, mackerel and saithe.
- industrial trawl fisheries south of latitude 62°N and in the North Sea targeting sandeel, Norwegian pout and blue whiting for fish-meal production.
- pelagic trawl fisheries for herring, mackerel, blue whiting and silver smelt.

For the smaller vessels (<28m vessel length) in the Norwegian fishing fleet, the fisheries prioritised in the Coastal Reference Fleet are:

- demersal fisheries for cod, haddock and saithe north and south of latitude 62°N (with particular focus on the Norwegian coastal cod component).
- Greenland halibut fishery.
- wrasse fishery with pots supplying cleaner fish to fish-farms.
- anglerfish fishery with gillnet.
- shrimp trawl fishery in the Skagerrak and North Sea.

In general, the demersal fisheries have been prioritised in both the High-seas and Coastal Reference Fleet, although for different reasons. Larger vessels in the demersal fisheries process their catches on board, meaning that at-sea sampling is necessary for obtaining length and age data of catches before they are processed. The fisheries prioritised in the Coastal Reference Fleet represent the most important fisheries in this sector of the Norwegian fishing fleet, which primarily target demersal species.

Vessels in the Norwegian Reference Fleet have the possibility to shift fisheries and target species, as long as it is in the constraints of the contract. This flexibility prevents excessive replacement of vessels due to vessels making small changes to their harvesting strategies, and because of the unpredictable nature of some fisheries. This means that there is a likelihood that not all prioritised fisheries will be covered by the Norwegian Reference Fleet each year. In addition, coastal fishing vessels are very adaptable to changes in the fisheries and can switch fishing gears and harvest strategies on very short timescales. Therefore, the Coastal Reference Fleet often provide additional data outside of the scope of the requirements and prioritised fisheries for each vessel category.

In 2019, the High-seas and Coastal Reference Fleet consisted of 16 and 22 vessels respectively (Appendix Tables A3 and A4). The number of vessels in the Norwegian Reference Fleet has been relatively stable throughout the period 2015–2019, with some vessels leaving the fleet after the contract period or for other reasons such as the fishing company selling the vessel. In each case, tenders were made to replace these vessels, although not always immediately after the contract was terminated.

2.3 - Sampling protocol and data handling

New vessels entering the Norwegian Reference Fleet are equipped with the necessary equipment and crew members are trained by IMR staff to ensure standardised sample processing and measurements. Alongside constant reporting of fishing activity and retained catches, bycatches and discards are also reported at regular intervals. The routine for documenting bycatches and discards in catches, and the sampling effort varies between fisheries and vessels (Appendix B). Bycatch of seabirds, sea mammals and rare fish species (e.g. porbeagle and basking shark) are also recorded for every fishing operation. From 2019, registering bycatch of corals and sponges is also included in the procedures.

Fishers are motivated to follow the protocol both through payment and an understanding of the importance of the collected data for stock assessment and management of the fisheries. Payment is effort based, with a price both for number of fish measured and number of species recorded in each catch, in order to give an incentive for fishers to use more time to follow the procedures correctly. The fishing vessels commitment to carry out this task is also outlined in the contract. There is an agreement between fishers, IMR and the relevant authorities

that these data shall not be requested for enforcement purposes. This ensures that vessels can honestly report their catches without risk of prosecution, ensuring the data reflects the true catches. It is important to note that to date, this agreement has not been compromised.

Data are recorded electronically and regularly delivered to a database at IMR, where assigned IMR staff run quality control checks before approval. IMR staff are in regular contact with crew and skippers, and visit the vessels to provide support for self-sampling. Crew are also given training on species identification and new equipment both at sea and on land, and are issued the necessary literature to assist in species identification. If crew are uncertain about a species, they are encouraged to send photographs or samples to IMR for verification by taxonomists.

3 - Species registered by the Norwegian Reference Fleet

Data from Norwegian Reference Fleet vessels targeting Norwegian fish stocks between 2015 and 2018 is shown in Figure 1. Data from 2019 were incomplete at the time of publication and are therefore not included in this report. Species lists were generated for fishing gears used by the High-seas and Coastal Reference Fleet, divided between two areas north and south of 62°N latitude. Not all fishes were identified to species level, and are therefore grouped separately, whilst animals in other species groups were identified to different taxonomic levels.

A comprehensive list of registered species has been archived by the Norwegian Marine Data Centre at IMR (<http://metadata.nmdc.no/metadata-api/landingpage/19d05ab8e0afe1ceac1b2be3ddf68612>), and is summarised by species group in Figure 2. Tables 1-4 list the 30 most common species registered by vessel category. For each fishing gear, Table 2 lists the fisheries represented by target species. A total of 271 species have been recorded in 33,381 fishing operations by the Norwegian Reference Fleet between 2015 and 2018. There are an additional 39 records of unidentified species, which occur from issues flagged during quality control that cannot be rectified.

The list includes both landed and discarded species, but it is important to note that the Norwegian Reference Fleet do not record whether an animal was dead or alive when discarded. Reported quantities of catches are not provided as they are based on the relevant sampling protocols for a fishing gear. Therefore, reliable estimates of total catches for any given species in a fishery require dedicated methods for extrapolation, which is out of the scope of this report.

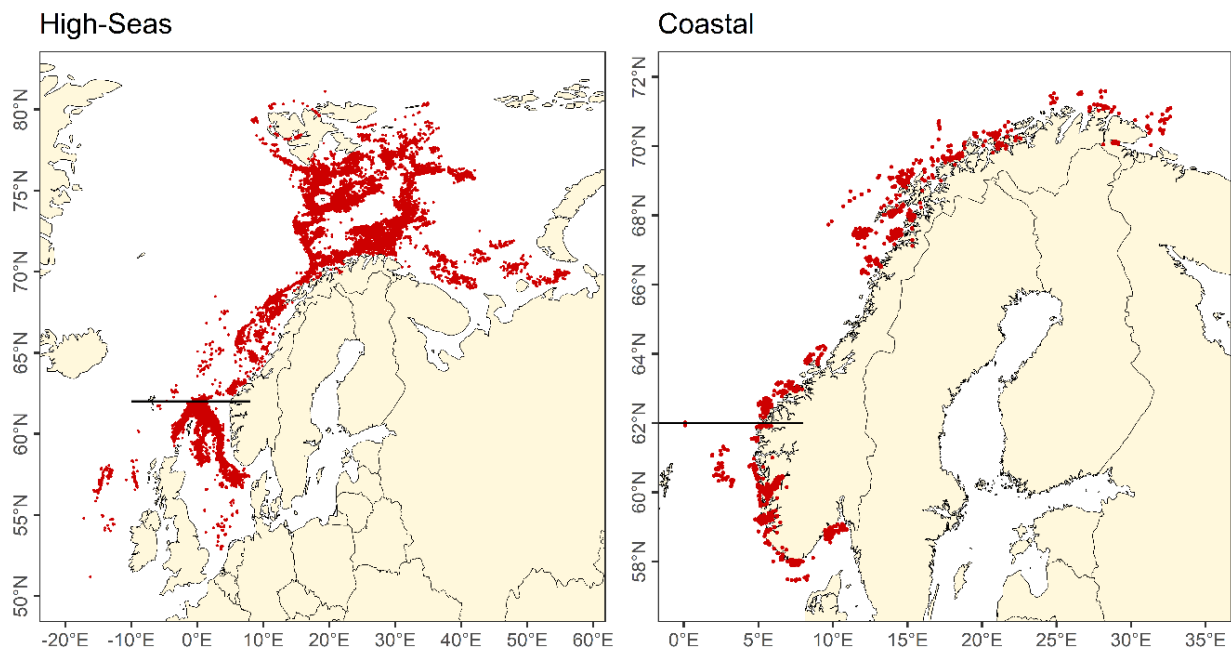


Figure 1 Locations of samples taken by the High-Seas and Coastal Reference Fleet between 2015 and 2018. Black horizontal line is at 62 °N latitude showing the division of north and south areas.

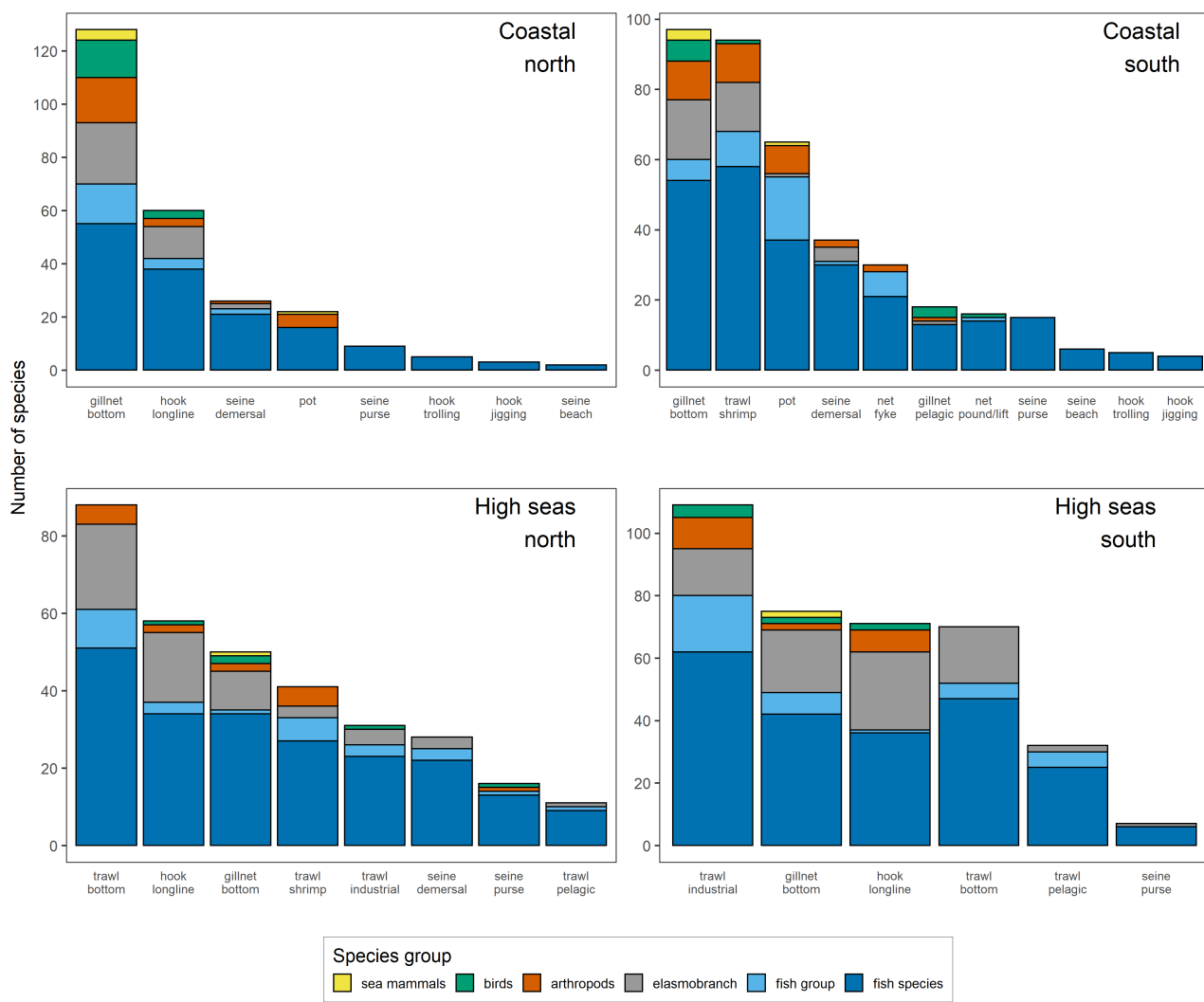


Figure 2. Summary of species registered by the Norwegian Reference Fleet. North/south is relative to 62°N latitude.

Table 1. List of the most common species registered in total catches by the High-seas Reference Fleet, **north** of 62°N latitude. Species are listed in descending order with the most regular occurring species in the top row.

Gillnet bottom-set	Hook longline	Seine demersal	Seine purse	Trawl bottom	Trawl industrial	Trawl pelagic	Trawl shrimp
Atlantic cod	Atlantic cod	Atlantic cod	Saithe	Atlantic cod	Blue whiting	Saithe	Deep sea shrimp
Saithe	Haddock	Saithe	Atlantic herring	Haddock	Greater argentine	Atlantic herring	Long rough dab
Haddock	Starry skate	Haddock	Atlantic cod	Golden redfish	Saithe	Redfishes	Deepwater redfish
Ling	Spotted catfish	Ling	Haddock	Saithe	Atlantic herring	Blue whiting	Capelin
Golden redfish	Northern wolffish	Tusk	Mackerel	Deepwater redfish	Redfishes	Greater argentine	Polar cod
Tusk	Long rough dab	Atlantic halibut	Capelin	Starry skate	Haddock	Spurdog	Sclerocranium
Pollack	Tusk	Golden redfish	Bluefin tuna	Greenland halibut	Argentines	Atlantic cod	Spotted sn blenny
Long rough dab	Atlantic catfish	Atlantic catfish	Gulls	Spotted catfish	Mackerel	Haddock	Atlantic hookear sculpin
Atlantic halibut	Golden redfish	Anglerfish (monk)	Tusk	Long rough dab	Golden redfish		Snakeblenny
Greenland halibut	Greenland halibut	Lumpsucker	Anglerfish (monk)	Atlantic catfish	Lanternfishes		Atlantic cod
Rabbitfish	Round skate	European plaice	Atlantic halibut	Lumpsucker	Porbeagle shark		Atlantic poacher
Blackmouthed dogfish	Atlantic halibut	Long rough dab	Blue whiting	Northern wolffish	Velvet belly		Lycodes
Starry skate	Ling	Redfishes	Ling	Atlantic halibut	European hake		Sea tadpole
European hake	Saithe	Greater argentine	Lumpsucker	Tusk	Ling		Greenland halibut
Atlantic herring	Deepwater redfish	European hake	Red king crab	Flounder	Silvery pout		Snailfishes
Anglerfish (monk)	Rough rattail	Lemon sole	Salmons	Greater argentine	Anglerfish (monk)		Shrimps
Spurdog	Spinytail skate	Spotted catfish		Ling	Atlantic cod		Haddock

Gillnet bottom-set	Hook longline	Seine demersal	Seine purse	Trawl bottom	Trawl industrial	Trawl pelagic	Trawl shrimps
Whiting	Rabbitfish	Whiting		Blue whiting	Blackmouthed dogfish		Prawns
European plaice	Greater forkbeard	Deepwater redfish		Round skate	Dealfish		Spotted catfish
Greater forkbeard	Esmark's eelpout	Flatfishes		Whiting	Deepwater redfish		Threespot eelpout
Spotted catfish	Blackmouthed dogfish	Starry skate		Spinytail skate	Greater forkbeard		White barracudin
Deepwater redfish	Arctic skate	Rabbitfish		Norway redfish	Long rough dab		Eelpouts
Northern wolffish	Velvet belly	Grey gurnard		Greater forkbeard	Norway pout		Glacial eelpout
Megrim	Norway redfish	Righteye flounders		Rabbitfish	Norway redfish		Snow crab
Rough rattail	Blue skate	Greater forkbeard		Lemon sole	Pollack		Golden redfish
Atlantic catfish	European plaice	Skates and rayes		Pollack	Spurdog		Starry skate
Norway redfish	Blue ling	Spurdog		Megrim	Whiting		Atlantic catfish
Lumpsucker	Roundnose grenadier			Anglerfish (monk)			Barracudin
Redfishes	Spurdog			Esmark's eelpout			Bigeye sculpin
Round skate	Whiting			European hake			Shorthorn sculpin

Table 2. List of the most common species registered in total catches by the High-seas Reference Fleet, **south** of 62°N latitude. Species are listed in descending order with the most regular occurring species in the top row.

Gillnet bottom-set	Hook longline	Seine purse	Trawl bottom	Trawl industrial	Trawl pelagic
Atlantic cod	Ling	Atlantic herring	Saithe	Blue whiting	Blue whiting
Saithe	Haddock	Mackerel	Ling	Norway pout	Mackerel
Haddock	Atlantic cod	Saithe	European hake	Saithe	Norway pout
Ling	Tusk	Atlantic cod	Atlantic cod	European hake	Atlantic herring
European hake	Saithe	Grey gurnard	Haddock	Silvery pout	Horse mackerel
Anglerfish (monk)	Small-spotted catshark		Mackerel	Atlantic cod	Argentines
Whiting	Cuckoo ray		Grey gurnard	Ling	Saithe
Pollack	Blue skate		Anglerfish (monk)	Argentines	European hake
Mackerel	Whiting		Tusk	Horse mackerel	Silvery pout
Starry skate	Pollack		Megrim	Anglerfish (monk)	Ling
European plaice	Spurdog		Atlantic herring	Haddock	Anglerfish (monk)
Tusk	European hake		Lemon sole	Witch	Atlantic cod
Spurdog	Anglerfish (monk)		Horse mackerel	Argentine	Whiting
Small-spotted catshark	Atlantic catfish		Blue whiting	Mackerel	Long rough dab
Witch	Starry skate		Greater argentine	Velvet belly	Argentine
Atlantic halibut	European conger eel		Starry skate	Whiting	Haddock
Megrim	Grey gurnard		Pollack	Atlantic herring	Pollack
Horse mackerel	Blackmouthed dogfish		Whiting	Long rough dab	Velvet belly
Atlantic catfish	Greater forkbeard		Atlantic halibut	Pollack	Hakes
Grey gurnard	Shagreen ray		Cuckoo ray	Pearlside	Atlantic catfish
Long rough dab	Triglops		Triglops	Blackmouthed dogfish	Boarfish
Tub gurnard	Rabbitfish		Witch	Blue-mouth redfish	Greater argentine

Gillnet bottom-set	Hook longline	Seine purse	Trawl bottom	Trawl industrial	Trawl pelagic
Atlantic herring	Longnosed skate		Greenland halibut	Spurdog	Rockfishes
Cuckoo ray	Atlantic halibut		Deepwater redfish	Poor cod	Triglops
Longnosed skate	Thornback ray		Greater forkbeard	Sand eel	Witch
Lemon sole	Blue-mouth redfish		Atlantic catfish	Atlantic catfish	
Spotted ray	Deepwater redfish		Blackmouthed dogfish	Tusk	
Turbot	European plaice		Golden redfish	Grey gurnard	
Dab	Golden redfish		Long rough dab	Greater forkbeard	
Starry smooth-hound	Sandy ray		Roundnose grenadier	Norway lobster	

Table 3. List of the most common species registered in total catches by the Coastal Reference Fleet, **north** of 62°N latitude. Species are listed in descending order with the most regular occurring species in the top row.

Gillnet bottom-set	Hook longline	Other	Pot	Seine demersal	Seine purse
Edible crab	Haddock	Mackerel	Edible crab	Atlantic cod	Atlantic herring
Atlantic cod	Saithe	Saithe	Tusk	Haddock	Mackerel
Stone crab	Atlantic cod	Pollack	European plaice	Saithe	Saithe
Saithe	Tusk	Atlantic herring	Atlantic cod	European plaice	Atlantic cod
Haddock	Golden redfish	Horse mackerel	Red king crab	Anglerfish (monk)	Pollack
Ling	Atlantic halibut	Atlantic cod	European lobster	Lumpsucker	Horse mackerel
Atlantic halibut	Ling	Whiting	Atlantic catfish	Atlantic halibut	European hake
Pollack	Whiting		European conger eel	Megrim	Haddock
Anglerfish (monk)	Velvet belly		Shorthorn sculpin	Atlantic catfish	Whiting
Tusk	Blackmouthed dogfish		Common harbour seal	Ling	
Rabbitfish	Mackerel	Rabbitfish	Saithe	Dab	
Golden redfish	Norway redfish		Norway lobster	Norway pout	
European hake	Rabbitfish		Atlantic halibut	Spotted catfish	
Megrim	Atlantic catfish		Common dragonet	Turbot	
European plaice	Greenland halibut		Fourbeard rockling	Tusk	
Lemon sole	Skates and rayes		Hooknose	Grey gurnard	
Whiting	Grey gurnard		Ling	Pollack	
Blackmouthed dogfish	Starry skate		Shore rockling	Whiting	
Norway redfish	Pollack		Stone crab	Redfishes	
Starry skate	Greater forkbeard			Brill	
Lumpsucker	European hake			Golden redfish	
Spurdog	Spotted catfish			Lemon sole	
Grey gurnard	Deepwater redfish			Thornback ray	
Poor cod	Anglerfish (monk)			Norway lobster	

Gillnet bottom-set	Hook longline	Other	Pot	Seine demersal	Seine purse
Velvet belly	Spurdog			Rockfishes	
Thornback ray	Redfishes			Spotted ray	
Greater forkbeard	Rough rattail				
Small-spotted catshark	Horse mackerel				
Mackerel	European plaice				
Atlantic herring	Edible crab				

Table 4. List of the most common species registered in total catches by the Coastal Reference Fleet, **south** of 62°N latitude. Species are listed in descending order with the most regular occurring species in the top row.

Gillnet bottom-set	Gillnet pelagic	Net fyke	Other	Pot	Seine demersal
Stone crab	Mackerel	Atlantic cod	Mackerel	Corkwing	Atlantic cod
Atlantic cod	Atlantic herring	Ballan wrasse	Horse mackerel	Goldsinny wrasse	Haddock
Pollack	Saithe	Corkwing	Pollack	Ballan wrasse	European plaice
Ling	Garfish	Cuckoo wrasse	Saithe	Cuckoo wrasse	Anglerfish (monk)
Rabbitfish	Lumpsucker	Goldsinny wrasse	Greater sand eel	Edible crab	Pollack
Edible crab	Pollack	Pollack	Atlantic herring	Smallmouthed wrasse	Grey gurnard
Saithe	Spurdog	Poor cod	Atlantic salmon	European eel	Dab
Haddock	European hake	Smallmouthed wrasse	Whiting	Green shore crab	Turbot
Anglerfish (monk)	Razorbill	Bullheads and sculpins	Atlantic cod	Atlantic cod	Atlantic halibut
European hake	Trout	Green shore crab	Grey gurnard	European lobster	Saithe
Spurdog	Atlantic cod	Yarrell's blenny	Garfish	Bullheads and sculpins	Lemon sole
Velvet belly	Atlantic salmon	European eel	Red mullet	Pollack	Spurdog
Megrim	Ballan wrasse	Black goby	Sand lances	Poor cod	Brill
Norway redfish	Common eider	Edible crab	Blue whiting	Saithe	Ling
Tusk	Cuckoo wrasse	Viviporous eelpout	Cormorants	Tadpole fish	Megrim
Witch	Edible crab	Shanny	Poor cod	Shanny	Whiting
Blackmouthed dogfish	Northern fulmar	Ling	Rainbow trout	Black goby	European hake
Grey gurnard	Whiting	Saithe		Viviporous eelpout	John dory
Poor cod		Lemon sole		Ling	Skates and rayes
Lemon sole		Righteye flounders		Fivebeard rockling	Thornback ray

Gillnet bottom-set	Gillnet pelagic	Net fyke	Other	Pot	Seine demersal
Blue ling		Common topknot		Gobies	Tub gurnard
Blue whiting		Eels		Munida	Atlantic catfish
Starry skate		Whiting		Butterfish	Flounder
Horse mackerel		Zoarcoids		Hyas	Greater weever
Atlantic halibut		Butterfish		Yarrell's blenny	Lumpsucker
Long rough dab		Flatfishes		Three-bearded rockling	Rabbitfish
Mackerel		Goatfishes		Shorthorn sculpin	Righteye flounders
Turbot		Pricklebacks		Common topknot	Stone crab
Whiting		Tadpole fish		Rocklings	Witch
Longnosed skate		Trout		Norway bullhead	Edible crab

Table 5. Description of target species for each fishing gear used by the Norwegian Reference Fleet. Area is relative to 62°N latitude.

Gear type	Area	Fleet	Vessel categories	Target Species
Hook jigging	North	Coastal	Gillnet/longline vessels north Gillnet/longline vessel south	Cod, saithe
	South	Coastal	Gillnet/longline vessel south	Cod, saithe, pollock, mackerel
Hook longline	North	High-seas	Longline/gillnet vessel	Cod, haddock, saithe, wolffish, ling, tusk, Greenland halibut
	South	High-seas	Longline/gillnet vessel	Cod, haddock, saithe, ling, tusk
	North	Coastal	Gillnet/longline vessels north	Cod, haddock, saithe, ling, tusk, Greenland halibut
Hook trolling	North	Coastal	Gillnet/longline vessel south	Mackerel
	South	Coastal	Gillnet/longline vessel south	Mackerel
Gillnet bottom-set	North	High-seas	Longline/gillnet vessel Gillnet vessel (Barents Sea)	Cod, haddock, saithe, ling, tusk, Greenland halibut
			Gillnet vessel (North Sea)	Cod
	South	High-seas	Longline/gillnet vessel Gillnet vessel (North Sea)	Cod, haddock, saithe, ling, tusk
	North	Coastal	Gillnet/longline vessels north.	Cod, haddock, saithe, ling, tusk, Greenland halibut, anglerfish
			Gillnet/longline vessel south Shrimp trawler (9-15m)	Cod, haddock, saithe
	South	Coastal	Gillnet/longline vessel south	Cod, haddock, saithe, ling, tusk
Shrimp trawler (9-15m)			Cod, haddock, saithe	
Gillnet pelagic	South	Coastal	Gillnet/longline vessel south	Mackerel
Net fyke	South	Coastal	Gillnet/longline vessel south	Wrasse, cod??
Net pound/lift	South	Coastal	Gillnet/longline vessel south	Mackerel
Pot	North	Coastal	Demersal seine vessel south	Mackerel
			Gillnet/longline vessel south	Wrasse, brown crab, <i>Nephrops</i>
	South	Coastal	Gillnet/longline vessel south	Wrasse, brown crab, <i>Nephrops</i>
			Demersal seine vessel south	<i>Nephrops</i>
Seine demersal	North	High-seas	Demersal/purse seine vessel	Cod, haddock
	North	Coastal	Demersal seine vessel north Demersal seine vessel south	Cod, haddock, saithe
	South	Coastal	Demersal seine vessel south	Cod, haddock, saithe
Shrimp trawler 9-15m			Cod	
	North	High-seas	Demersal/purse seine vessel	Saithe, herring, mackerel, sprat, horse mackerel
			Industry trawler	Herring
				Gillnet/longline vessels north

Gear type	Area	Fleet	Vessel categories	Target Species
Seine purse	North	Coastal	Demersal seine vessel south Gillnet/longline vessel south	Herring, mackerel
			Demersal seine vessel south	Mackerel, horse mackerel
	South	Coastal	Gillnet/longline vessel south	Mackerel
Seine beach	North	Coastal	Gillnet/longline vessels north.	Herring
	South	Coastal	Gillnet/longline vessel south	Mackerel
Trawl demersal	North	High-seas	Demersal factory trawler	Cod, haddock, saithe, Greenland halibut, beaked redfish
	South	High-seas	Demersal factory trawler	Saithe, Greenland halibut
Trawl industrial	North	High-seas	Industry trawler	Blue whiting, silver smelt, saithe
	South	High-seas	Industry trawler	Sandeel, Norwegian pout, blue whiting, saithe
Trawl pelagic	North	High-seas	Demersal factory trawler	Beaked redfish
			Industry trawler	Herring, mackerel
	South	High-seas	Industry trawler	Herring, mackerel, blue whiting, sprat
Trawl shrimp	North	High-seas	Demersal factory trawler	Shrimp
	South	Coastal	Shrimp trawler 9-15m Shrimp trawler 15-28m	Shrimp

4 - References

Bellido JM, Santos MB, Pennino MG, et al (2011) Fishery discards and bycatch: solutions for an ecosystem approach to fisheries management? *Hydrobiologia* 670:317–333. <https://doi.org/10.1007/s10750-011-0721-5>

Bjørge A, Moan A (2017) Revised estimates of harbour porpoise (*Phocoena phocoena*) bycatches in two Norwegian coastal gillnet fisheries. ICES By-catch WG. SC/24/BYCWG/08

Bærum KM, Anker-Nilssen T, Christensen-Dalsgaard S, et al (2019) Spatial and temporal variations in seabird bycatch: Incidental bycatch in the Norwegian coastal gillnet-fishery. *PLoS One* 14. <https://doi.org/10.1371/journal.pone.0212786>

Fangel K, Aas Ø, Vølstad JH, et al (2015) Assessing incidental bycatch of seabirds in Norwegian coastal commercial fisheries: Empirical and methodological lessons. *Glob Ecol Conserv* 4:127–136. <https://doi.org/10.1016/j.gecco.2015.06.001>

5 - Appendices

5.1 - Appendix A: General information on the Norwegian Reference Fleet

Table A1. Vessel requirements in the High-Seas Reference Fleet

Category	Vessel requirements	Prioritised fisheries
Demersal factory trawler	<p>Length >39m</p> <p>Permit and quota for fishing with trawl for cod, haddock, saithe, north of 62°N</p> <p>Permit and quota for fishing with trawl for saithe, south of 62°N</p> <p>One or more vessels with licence for shrimp-trawl north of 62°N</p> <p>One vessel >53 m and equipped for fillet production</p> <p>One or more vessels equipped also for pelagic trawl</p>	<p>Cod, haddock, saithe with demersal trawl north of 62°N outside 12 nautical miles</p> <p>Saithe with demersal trawl south of 62°N outside 12 nautical miles</p> <p>Beaked redfish with pelagic/demersal trawl</p> <p>Greenland halibut with demersal trawl</p> <p>Shrimp trawl in the Barents Sea outside 12 nautical miles</p>
Gillnet vessel fishing mainly in the North Sea	<p>Length 28–40m</p> <p>Permit and quota for fishing with conventional gear (gillnet, longline, demersal seine) for cod south of 62°N</p> <p>Primary fishery for the vessel must be gillnet targeting cod in the North Sea</p>	<p>Cod, haddock, saithe with gillnet south of 62°N outside 12 nautical miles</p>
Gillnet vessel fishing mainly in the Barents Sea	<p>Length 28–40m</p> <p>Permit and quota for fishing with conventional gear (gillnet, longline, demersal seine) for cod, haddock, saithe north of 62°N</p> <p>Primary fishery for the vessel must be gillnet targeting cod in the Barents Sea and saithe on the fishing banks north of 62°N</p>	<p>Cod, haddock, saithe with gillnet north of 62°N outside 12 nautical miles</p> <p>Greenland halibut with gillnet</p>

Category	Vessel requirements	Prioritised fisheries
<p>Longline and combined longline/gillnet vessel</p>	<p>Length >35m</p> <p>Permit and quota for fishing with conventional gear (gillnet, longline, demersal seine) for cod, haddock, saithe north of 62°N</p> <p>Two vessels with permit and quota for fishing with conventional gear (gillnet, longline, demersal seine) for saithe south of 62°N</p> <p>One vessel with permit and quota for fishing with conventional gear (gillnet, longline, demersal seine) for cod south of 62°N</p> <p>Primary fishery for the vessel must be longline targeting cod, haddock, ling, tusk, Greenland halibut and wolffish</p> <p>Two vessels fishing directly saithe with gillnet both north and south of 62°N</p> <p>One or more vessels with activity annually west of 4°W</p> <p>One or more vessels fishing cod, ling and tusk in the North Sea</p>	<p>Cod, haddock, saithe with longline/gillnet north of 62°N outside 12 nautical miles</p> <p>Cod, saithe with longline/gillnet south of 62°N outside 12 nautical miles</p> <p>Ling and tusk with longline north and south of 62°N outside 12 nautical miles</p> <p>Wolffish in the Barents Sea</p> <p>Greenland halibut with longline/gillnet</p> <p>Ling, tusk with longline/gillnet west of 4°W</p>
<p>Demersal seine/ purse seine vessel</p>	<p>Length >28m</p> <p>Permit and quota for fishing with conventional gear (gillnet, longline, demersal seine) for cod north of 62°N</p> <p>Permit and quota for fishing with purse seine for saithe north of 62°N</p> <p>Primary fisheries for the vessel must be with demersal seine for cod and with purse seine for saithe north of 62°N</p>	<p>Cod, haddock, with demersal seine north of 62°N outside 4 nautical miles</p> <p>Saithe with purse seine north of 62°N</p> <p>Norwegian Spring spawning herring with purse seine</p> <p>North Sea herring with purse seine Mackerel with purse seine</p>

Category	Vessel requirements	Prioritised fisheries
<p>Industry trawler (vessel targeting species primarily used for fish- meal production)</p>	<p>Licence for pelagic trawl</p> <p>Primary fisheries for the vessel must be with trawl for sandeel, Norwegian pout and blue whiting in the North Sea</p> <p>One vessel with permit and quota for fishing silver smelt with pelagic trawl north of 62°N</p>	<p>Sandeel with trawl in the North Sea/ south of 62°N</p> <p>Norwegian pout/blue whiting mixed fishery with trawl in the North Sea/ south of 62°N</p> <p>Saithe as retained bycatch in the North Sea/ south of 62°N trawl fishery</p> <p>Blue whiting with pelagic trawl outside 12 nautical miles</p> <p>Mackerel with pelagic trawl outside 12 nautical miles</p> <p>Norwegian Spring spawning herring with pelagic trawl outside 12 nautical miles</p> <p>North Sea herring with pelagic trawl outside 12 nautical miles</p> <p>North Sea sprat with pelagic trawl outside 12 nautical miles</p> <p>Capelin with pelagic trawl</p> <p>Silver smelt with pelagic trawl north of 62°N</p>

Table A2. Vessel categories in the Coastal Reference Fleet. See Figure A1 for map of statistical areas

Category	Vessel requirements	Prioritised fisheries
Gillnet/longline vessels north Home harbours in statistical areas 03, 04, 05, 00, 06 & 07	Length 9–16m Home adresse and carries out most of its fishing in one of the areas described under the vessel category Active in the predominant coastal fisheries for the area Main fishing gear is gillnet/longline	Cod, haddock, saithe with gillnet/longline coastal north of 62°N Ling and tusk with gillnet/longline coastal north of 62°N Anglerfish with gillnet north of 62°N Greenland halibut coastal fishery with gillnet/longline north of 62°N
Gillnet/longline vessel south Home harbours in statistical areas 28, 08 & 09	Length 9–16m Home adresse and carries out most of its fishing in one of the areas described under the vessel category Active in the predominant coastal fisheries for the area Main fishing gear is gillnet/longline	Cod, haddock, saithe with gillnet/longline coastal south of 62°N Anglerfish with gillnet south of 62°N Mackerel coastal fishery with gillnet/jigging/other gears Wrasse pot fishery
Demersal seine vessel north Home harbour in statistical area 03	Length 9–16m Home adresse and carries out most of its fishing in one of the areas described under the vessel category Active in the predominant coastal fisheries for the area Main fishing gear is demersal seine	Cod, haddock, saithe with demersal seine coastal north of 62°N
Demersal seine vessel south Home harbour in statistical area 08	Length 9–16m Home adresse and carries out most of its fishing in one of the areas described under the vessel category Active in the predominant coastal fisheries for the area Main fishing gear is demersal seine	Cod, haddock, saithe with demersal seine coastal south of 62°N Mackerel coastal fishery with seine/other gears

Category	Vessel requirements	Prioritised fisheries
<p>Shrimp trawler – Skagerrak and North Sea</p> <p>Home harbours in statistical areas 08 & 09</p>	<p>Length 9–15m</p> <p>One vessel with length 15–28m</p> <p>Home adresse and carries out most of its fishing in one of the areas described under the vessel category</p> <p>Active in the coastal shrimp fishery</p> <p>Main fishing gear is shrimp trawl</p>	<p>Shrimp fishery in the Skagerrak and North Sea</p>

Table A3. List of vessels in the High-Seas Reference Fleet between 2015 and 2019

Vessel category	2015	2016	2017	2018	2019
Demersal factory trawler	Andenesfisk 1 (LJWI)	Andenesfisk 1 (LJWI)	Andenesfisk 1 (LJWI)	Havbryn (LDBT)	Gadus Neptun (LDDG)
	Havbryn (LDBT)	Havbryn (LDBT)	Havbryn (LDBT)	Hermes (LLOP)	Havbryn (LDBT)
	Hermes (LLOP)	Hermes (LLOP)	Hermes (LLOP)	Ramoen (LDNV)	Hermes (LLOP)
	Ramoen (LMLT)	Vesttind (LLDH)	Ramoen (LDNV)		Ramoen (LDNV)
	Vesttind (LLDH)				
Gillnet vessel fishing mainly in the North Sea	Nesejenta (3WYO)	Nesejenta (3WYO)	Nesejenta (3WYO)	Nesejenta (3WYO)	Nesejenta (3WYO)
	Skjongholm (LHSQ)	Skjongholm (LHSQ)	Skjongholm (LHSQ)	Skjongholm (LHSQ)	Skjongholm (LHSQ)
Gillnet vessel fishing mainly in the Barents Sea	Kato (LLJC)	Kato (LLJC)	Kato (LLJC)	Kato (LLJC)	Kato (LLJC)
Longline/gillnet vessel	Carisma Viking (LLPZ)	Carisma Viking (LLPZ)	Atlantic (LIYX)	Atlantic (LIYX)	Atlantic (LIYX)
	Nesbakk (LJZJ)	Nesbakk (LJZJ)	Nesbakk (LJZJ)	Nesbakk (LJZJ)	Nesbakk (LJZJ)
	O.Husby (LJQG)	O.Husby (LJQG)	O.Husby (LJQG)	O.Husby (LJQG)	O.Husby (LJQG)
	Vonar (LMCJ)	Vonar (LMCJ)	Vonar (LMCJ)	Vonar (LMCJ)	Vonar (LMCJ)
Demersal /purse seine vessel	Hovden Viking (JWLM)	Hovden Viking (JWLM)	Kamilla Grande (JWLM)	Kamilla Grande (JWLM)	Hovden Viking (LEYN)
	Skagøysund (LMUR)	Skagøysund (LMUR)	Skagøysund (LMUR)	Skagøysund (LMUR)	Skagøysund (LMUR)
Industry trawler	Cetus (LLYM)	Cetus (JXML)	Cetus (JXML)	Håflu (LEQI)	Cetus (LFFK) Håflu (LEQI)
	Herøyfjord (LMHM)		Håflu (LEQI)	Vikingbank (LLAS)	Vikingbank (LLAS)

Table A4. List of vessels in the Coastal Reference Fleet between 2015 and 2019. See Figure A1 for map of statistical areas

Category	Statistical area	2015	2016	2017	2018	2019
Gillnet/longline vessels north.	03	Solgløtt (LM2890)	Solgløtt (LM2890)	Solgløtt (LM2890)	Solgløtt (LM2890)	Solgløtt (LM2890)
	04	Odd Yngve (LM2864)	Odd Yngve (LM2864)	Odd Yngve (LM2864)	Odd Yngve (LM2864)	MT Senior (LG7408)
		Øyværing (LM8662)	Øyværing (LM8662)	Øyværing (LM8662)	Øyværing (LK3925)	Øyværing (LK3925)
	05	Ægir (LK5045)	Ægir (LK5045)	Ægir (LK5045)	Ægir (LK5045)	Ægir (LK5045)
		Vornesværing (LK5647)	Vornesværing (LK5647)	Vornesværing (LK5647)		Braken (LM7459)
	00/05	T.Sivertsen (LK5948)	T.Sivertsen (LK5948)	T.Sivertsen (LK5376)	T.Sivertsen (LK5376)	T.Sivertsen (LK5376)
		Hellskjær (LM8308)	Hellskjær (LM8308)	Hellskjær (LM8308)	Hellskjær (LM8308)	
00	Rånes Viking (LK5016)	Rånes Viking (LK5016)	Rånes Viking (LK5016)	Rånes Viking (LK5016)	Rånes Viking (LK5016)	
	Økssund (LK6737)	Økssund (LK6737)	Økssund (LK6737)	Økssund (LK6737)	Økssund (LK6737)	
06	Haldorson (LK4789)	Haldorson (LK4789)	Haldorson (LK4789)	Haldorson (LK4789)	Haldorson (LK4789)	
07	Tramsegg (LK7141)	Tramsegg (LK7141)	Tramsegg (LK7141)	Tramsegg (LG3690)	Tramsegg (LG3690)	
	Haaværbuen (LM5498)	Haaværbuen (LM5498)	Sørhav (LG4010)	Sørhav (LG4010)	Sørhav (LG4010)	
	Øygutt (LK5160)	Leon Olai (LK2759)				
Demersal seine vessel north	03	Charmi (LK3293)	Charmi (LK3293)		Kristian Gerhard (LK7556)	Kristian Gerhard (LK7556)
Gillnet/longline vessel south	28	Vester Junior LM5970)	Vester Junior LM5970)	Vester Junior LM5970)	Vester Junior LM5970)	Vester Junior LM5970)
		Britt Evelyn (LK6966)	Britt Evelyn (LK6966)	Britt Evelyn (LK6966)	Britt Evelyn (LK6966)	Britt Evelyn (LK6966)
	08	Austbris (LK9305)	Austbris (LK9305)	Austbris (LK9305)	Austbris (LK9305)	Trellevik (LG4914)
Ramona (LK6606)		Ramona (LK6606)	Ramona (LK6606)	Ramona (LK6606)	Fjorden (LK6326)	
Repsøy (LK3270)		Repsøy (LK3270)	Vicma (LG9311)	Eggøy (LM8940)	Eggøy (LM8940)	

Category	Statistical area	2015	2016	2017	2018	2019
	09	Skogsøyjenta (LK5485) Vesleper (LM7915)	Skogsøyjenta (LK5485)	Skogsøyjenta (LK5485)	Skogsøyjenta (LK5485)	Skogsøyjenta (LK5485)
Demersal seine vessel south	08	Molinergutt (LG7405)	Molinergutt (LG7405)	Molinergutt (LG7405)	Molinergutt (LG7405)	Molinergutt (LG7405)
Shrimp trawler (9-15m)	09	Brattholm (LK7238) Tormo (LM3995)	Brattholm (LK7238) Tormo (LM3995) Mostein (LK5352)	Brattholm (LK7238) Tormo (LM3995) Mostein (LK5352)	Grepan Junior (LK5485) Tormo (LM3995) Mostein (LK5352)	Brattholm (LH2820) Tormo (LM3995)
Shrimp trawler (15-28m)	08/09					Guldringnes (LKZZ)

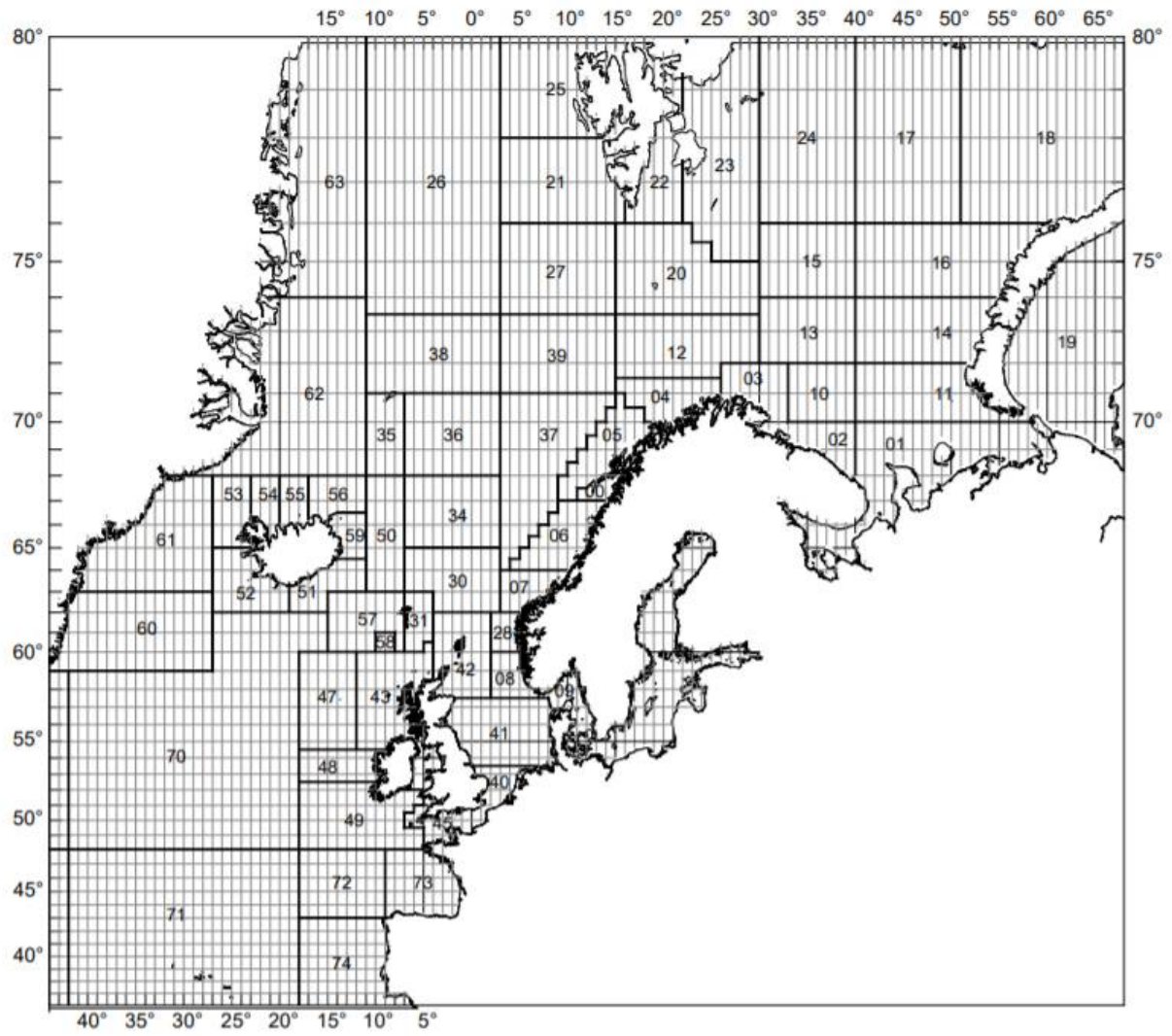


Figure A1. Map of statistical areas defined by the Norwegian Directorate of Fisheries

5.2 - Appendix B: Sampling protocols

Table B1. Protocol for catch registration and sampling in the High-Seas Reference Fleet

Gear type	Catch registration	Sampling
Demersal trawl	<p><u>Every haul</u> – the processed (landed) catch is registered and bycatch of seabirds, sea-mammals and seldom fish species (e.g. porbeagle and basking shark). From 2019 registering bycatch of corals and sponges is also included in the procedure.</p> <p><u>One haul every other day</u> - total catch is registered, including all bycatch species and discards of both commercial and bycatch species. From 2019 discards are registered separately from the retained catch per species that is processed for fishmeal.</p>	<p><u>One haul every other day</u> – length and weight measurements are taken of up to 20 individuals of all species in the catch, both landed and from discards</p> <p><u>One haul per week</u> – Otolith samples are taken for important demersal species</p>
Shrimp trawl	<p><u>Every haul</u> – the processed (landed) catch is registered and bycatch of seabirds, sea-mammals and seldom fish species (e.g. porbeagle and basking shark). From 2019 registering bycatch of corals and sponges is also included in the procedure.</p> <p><u>One haul every other day</u> - total catch is estimated from 3 basket samples from the catch and registered, including all bycatch species and discards of both commercial and bycatch species. From 2019 discards are registered separately from the retained catch per species that is processed for fishmeal.</p>	<p><u>One haul every other day</u> – length and weight measurements are taken of up to 50 individuals of all species in the catch, both landed and from discards</p>
Demersal seine	<p><u>Every other haul</u> – the processed (landed) catch is registered and bycatch of seabirds, sea-mammals and seldom fish species (e.g. porbeagle and basking shark).</p> <p><u>One haul every other day</u> - total catch is registered, including all bycatch species and discards of both commercial and bycatch species.</p>	<p><u>One haul every other day</u> – length and weight measurements are taken of up to 20 individuals of all species in the catch, both landed and from discards</p> <p><u>One haul per week</u> – Otolith samples are taken for important demersal species</p>

Gear type	Catch registration	Sampling
Pelagic trawl and purse seine	<p><u>Every other haul/cast</u> – the processed (landed) catch is registered and bycatch of seabirds, sea-mammals and rare fish species (e.g. porbeagle and basking shark).</p> <p><u>Every alternate haul/cast</u> - total catch is registered, including all bycatch species and discards of both commercial and bycatch species.</p> <p><u>End of trip</u> – if the onboard pumping of the catch is a closed system. Total catch, including bycatch species.</p> <p>Hauls/casts with zero catch or slipping of all/part of the catch is also registered</p>	<p><u>Every other haul/cast</u> –samples length and weight measurements for all species in the catch. Number of individuals in a sample dependent upon the species</p> <p><u>Every other haul/cast</u> –frozen sample of target species for length/age determination and other important variables. For some pelagic species frozen samples are taken for each catch.</p> <p><u>One catch per week</u> – Otolith samples are taken for important demersal species</p>
Industrial trawl (Target species: Sandeel, Norwegian pout & Blue whiting)	<p><u>Every haul</u> – the landed catch is separated in to catch to consume and catch that is pumped into the holding tanks for fish-meal production, and registered by species. Bycatch of seabirds, sea-mammals and seldom fish species (e.g. porbeagle and basking shark) is also registered. From 2009 registering bycatch of corals and sponges is also included in the procedure.</p> <p><u>One haul every other day</u> - total catch is registered, including all bycatch species and discards of both commercial and bycatch species. Species composition catch that is pumped into the holding tanks is estimated from 3 basket samples of following the IMR sampling procedure for catch sampling.</p>	<p><u>Every other haul</u> – frozen sample of some target species for length/age determination and other important variables. For some species frozen samples are taken for each catch.</p> <p><u>One haul every other day</u> – length and weight measurements are taken of samples of all species in the catch, both landed and from discards. The number of individuals in a sample dependent upon species.</p> <p><u>One haul per week</u> – Otolith samples are taken for important demersal species</p>
Long-line/gillnet	<p><u>Every daily catch</u> – the processed (landed) catch is registered and bycatch of seabirds, sea-mammals and seldom fish species (e.g. porbeagle and basking shark). Effort is recorded in number of hooks/gillnets, but not soak time.</p> <p><u>Every other day</u> – for a representative portion of the total gear hauled that day (approximately 16,000 hooks or 100 gillnets), total catch is registered, including all bycatch species and discards of both commercial and bycatch species. Effort is recorded in number of hooks/gillnets and soak time.</p>	<p><u>One haul every other day</u> – length and weight measurements are taken of up to 20 individuals of all species in the catch, both landed and from discards</p> <p><u>One haul per week</u> – Otolith samples are taken for important demersal species</p>

Table B2. Protocol for catch registration and sampling in the Coastal Reference Fleet

Gear type	Catch registration	Sampling
All gear types	<p><u>Each day</u> – total catch is registered, including all bycatch species and discards of both commercial and bycatch species.</p> <p><u>Shrimp trawl</u> – from 2019 registering bycatch of corals and sponges is also included in the procedure.</p> <p><u>Splitting the catch</u> – if the day's catch is taken from multiple fishing operations from different depths, fishing area or different gear types, then the catch should be split and registered separately. For example, two gillnets used the same day with different mesh-sizes and set at different depths.</p>	<p><u>One catch per week</u>– length and weight measurements are taken of up to 20 individuals for each species in the catch, both landed and from discards. Otolith samples are taken for important demersal species</p>



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