# REVIEW OF EXISTING KNOWLEDGE ON MARINE MAMMAL BY-CATCH IN GREENLAND



THE GOVERNMENT OF GREENLAND MINISTRY OF FISHERIES & HUNTING MAY 2017

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# **1. INTRODUCTION**

This paper contains an updated review on fishery in Greenland based on document NAMMCO/15/MC/BC/9 from 2007 by the Ministry of Fisheries and Hunting (APN).

The paper emphasise landings, use of different fishing gear, distribution of adjacent marine mammal species, and the fishery's potential for spatial and temporal overlap with marine mammals. We then use this information; and reported marine mammal by-catches, to discuss the risk of by-catch of marine mammals in general in Greenlandic waters.

It is a working document on the existing knowledge about marine mammal by-catch in Greenland, which is of help in improving by-catch monitoring in a member country of the North Atlantic Marine Mammal Commission (NAMMCO). It includes the following bullet points:

- *description of the area fisheries, including species, areas, seasons and gear type; regulatory regime;*
- *description of existing by-catch monitoring programs, including methodology and coverage;*
- known or estimated magnitude of marine mammal by-catch by species and fishery, using direct and indirect evidence;
- *future plans to improve by-catch monitoring.*

# 2. REGULATORY REGIME OF FISHERIES

Fisheries in Greenland are regulated primarily by the Parliamentary Law nr 18 of the 31<sup>st</sup> of October 1996 on Fisheries with later amendments<sup>1</sup>. This law covers all fisheries activities in Greenland waters, as well as the commercial fishing activities of Greenlandic boats operating outside Greenland.

Fisheries are regulated through a system of licences that limits the target species, the area, the time of the year used for fishing and/or the amount of fish to be caught. Several species have total allowable catches in accordance with international advice. There are also a number of executive orders dealing with specific fisheries.

The Greenlandic fishery regulation on technical conservation measures (Government of Greenland Executive Order No. 12 of 9 November 2011 on Regulation of Fisheries through Technical Conservation Measures) and the by-catch regulation (Government of Greenland Executive Order No. 14 of December 6, 2011 on Fishing Bycatches) very much reflects the international agreements on these matters in many aspects. A general ban on discard as well as an obligation to record and report all catches including birds and mammals applies for all Greenlandic and foreign vessels operating in Greenland waters. From 2016 this includes even small vessels i.e. below 6m length, as explained in more detail below.

<sup>&</sup>lt;sup>1</sup> Danish translation and overview of amendments is available at <u>http://lovgivning.gl/da-DK/Lov?rid={633775EA-C4B9-401C-99D6-892817ED86B1}</u>

Large fishing vessels are covered by control schemes ensuring that their activities can be monitored remotely through vessel monitoring systems and frequent reporting of catches (Government of Greenland Executive Order No. 18 of December 9, 2010 on Surveillance of Off-shore Fisheries, Greenland Home Rule Government Executive Order No. 21 of 30 May 2001 on Satellite Monitoring of Fishing Vessels). A fishery observer scheme is also enforced for all large Greenland vessels and for foreign vessels operating inside the Greenlandic EEZ (Greenland Home Rule Government Executive Order No. 3 of 18 March 2004 on the tasks and powers of Fisheries Observers). The observer scheme aims for a minimum coverage of 50 % of fishing trips in key fisheries and fisheries where there is a risk that one or more rules are not respected.

In Greenland, buyers of fish are responsible for the reporting of catches landed by individual fishermen from small vessels to the Greenlandic Fisheries License Control Authority, Government of Greenland. Previously only catches received by buyers had to be reported, but from April 2016 a new executive order on catch reporting (Government of Greenland Executive Order no. 7 of 4 April 2016 on reporting of purchases of fish and fishery products) has made it compulsory for the fishermen and buyers to report all catches, including by-catches which are not passed to the buyers. This includes all marine mammals, birds, fish or any other family of species.

The new executive order is a large step forward in systematically collecting data about by-catches in fisheries from the fishery it-self, with by-catch data now stored and available for analysis in the fisheries database.

Defined areas are closed for fishing, e.g. Melville Bay in North West Greenland and to some degree the National Park in North East Greenland. There are also other protected areas, which are closed for fishing and defined in our species and protected area legislations (e.g. Government of Greenland Executive Order No. 12 of 9 November 2011 on Regulation of Fisheries through Technical Conservation Measures). There are also the possibility for closure of areas for trawling in case of conflicts between narwhal and beluga hunting and fishing.

## **3. FISHERIES**

The Ministry of Fisheries and Hunting in Greenland regulates the catch of 20 species belonging to 18 genuses of fish, crustaceans and molluscs (table 1), as well as some minor experimental fisheries. The fleet consists of offshore vessels varying in size from approx. 200 GT up to 5000 GT; and coastal fishery vessels ranging from 5 GT to 200 GT in size as well as dinghies in the coastal fisheries below 5 GT / 6m total length. There is no coastal fishery of any commercial importance in East Greenland.

Species (English)	Danish name	Latin name
Shrimp	Reje	Pandalus borealis
Greenland halibut	Hellefisk	Reinhardtius hippoglosoides
Scallop	Kammuslinger	Chlamys Islandica
Snow crab	Den Store grønlandske krabbe	Chionecetes opilio
Redfish golden	Stor rødfisk	Sebastes marinus
Redfish beaked	Dybhavsrødfisk	Sebastes mentella
Cod	Torsk	Gadus morhua
Capelin	Lodde	Mallotus villosus
Atlantic salmon	Laks	Salmo salar
Lumpfish	Stenbider	Cyclopterus lumpus
Mackerel	Makrel	Scomber scombrus
Spotted wolffish	Plettet havkat	Anarhichas minor
Arctic char	Fjeldørred	Salvelinus alpinus
Atlantic herring	Sild	Clupea harengus
*Atlantic halibut	Helleflynder	Hippoglossus hippoglossus
*Grenadier common	Almindelig skolæst	Coryphaenoides rupestris
*Grenadier northern	Nordlig skolæst	Macrorurus berglax
*Striped wolffish	Stribet havkat	Anarhichas lupus
*Polar cod	Polartorsk	Boreogadus saida
*Saithe	Sej	Pollachius virens

*Table 1.* English, Danish and Latin names of selected fish and invertebrates species caught in Greenland. Marked with \* are species, that mainly is included as by-catches in other fisheries.

Besides these commercially and/or culturally important species, there are occasional catches of other species, such as blue whiting (*Micromesistius potassou*), American plaice (*Hippoglossoides platessoides*) and greater argentine (*Argentina spp.*).

The fisheries in West and East Greenland waters are diversified into geographical areas as indicated in figure 3.1 (NAFO/ICES). Here follows a short overview of the most important species, with mention of area (all distribution maps are from

http://www.fao.org/figis/geoserver/factsheets/species.html), fishing season, gear type, and regulatory regime for the fisheries and potential for by-catch. This overview is summarised in tables 2 and 3.



**Figure 3.1**. Map of Greenland and surrounding waters including exclusive economic zone (EEZ), 3Nm limits separating the coastal fleet from the offshore vessels and NAFO/ICES regulatory areas and subareas.

## Shrimp

Northern shrimp (*Pandalus borealis*) is common in all waters around Greenland, but is mainly targeted on the shelf in West Greenland at depths between 150 and 600m.



# Aquatic Species Distribution Map Viewer

Catches of shrimp gradually increased throughout the 1980's and 1990's and reached a level around 157,000 tons by 2005-2006. Since then catches have gradually decreased and the total catches were at 70,899 tons in 2015 (68,875 tons of *P. borealis* and 2,024 tons of *P. montagui*).

The early fishery was concentrated in NAFO Division 1B, but from the late 1980s the fishery spread southwards and by 1996–98 Divisions 1C–1F were producing nearly 70 % of the catches. Since then the range of the fishery has contracted northwards. This is especially due to increased fishing in the Disko Bay area and a decrease in the shrimp stock in the southern parts of West Greenland.

The fleet is separated into segments where large factory vessels operate offshore and smaller vessels are allowed to fish in the Disko Bay and a small part inshore in division 1B. The vessels operating offshore (> 75 GRT) have been restricted by areas and quotas since 1977.

The coastal fleet (< 75 GRT) was unrestricted until 1997, when quota regulation was imposed. To reduce by-catch of undersized fish, large sharks and more, sorting grids have been mandatory since 2001. Exemptions from the mandatory sorting grids was granted for vessels operating inshore until 2011, but today sorting grids are mandatory for all vessels targeting shrimp. The grid has a maximum bar distance of 22 mm. Inspectors have observed a few seals entangled in shrimp trawls, but it is unknown whether these observations preceded the sorting grids.

No by-catches of seals or whales are recorded from this fishery and the risk for entangling marine mammals is evaluated to be low.

## Greenland halibut

The stocks of Greenland halibut (*Reinhardtius hippoglosoides*) in the area are assessed as several isolated populations. Greenland halibut in East Greenland (ICES XIV) are considered to be a shared population with Icelandic and Faroese stocks. Greenland halibut in NAFO subarea 1 offshore is a population shared with Canada in NAFO (0AB). The inshore stocks in NAFO subarea 1A are considered isolated from the offshore stocks.

# **Aquatic Species Distribution Map Viewer**



The total catches of Greenland halibut in NAFO Subarea 1 amounted to almost 40,000 tons in 2015 of which 15,000 tons were taken offshore in the Greenlandic EEZ and 25,000 tons were taken inshore (23,059 in division 1A inshore, 1,527 in division 1BCDEF and 138 t in the Qaanaaq district (1A)).

The offshore catches were exclusively taken by trawlers (Fig.3.1), while the inshore catches were taken by small vessels mostly using longlines or gillnets. Gillnets are only allowed during the winter season. Gillnets and longlines are mostly set at depths between 300 and 600m. Trawl fishery is banned inshore, with the exception of shrimp trawl fishery in the Disko bay and a small area inshore in division 1B.

There are no records of by-catches of marine mammals in this fishery. Data reported via regulation from 2016 is under review.

#### **Scallops**

Scallops (*Chlamys islandica*) live in the seabed at depths of 20-60 meters. They favour areas with strong tidal currents. They are fished only in West Greenland, on banks located between Nuuk and Upernavik. Scallops can be fished year round, but the fishery is restricted by quota. In 2015 the total catches were 735 tons. The gear used in this fishery is bottom dredge, and the potential for by-catch in the fishery is regarded as low.

There are no records of by-catches of marine mammals in this fishery.

#### Snow crab

Snow crab (*Chionoecetes opilio*) is distributed along the west coast of Greenland from division 1A to 1F. The fishery is conducted mainly by Greenland vessels. Since 2004, the crab resource has been managed in 6 areas (from North to South: Upernavik, Uummannaq-Disko Bay, Sisimiut, Maniitsoq-Kangaamiut, Nuuk-Paamiut and Narsaq-Qaqortoq). The fishing fleet is dominated by small vessels (less than 75 GRT), which have exclusive rights for fishing inshore within the basis-line as well as offshore.



## **Aquatic Species Distribution Map Viewer**

The total catch in NAFO Subarea 1 peaked in 2001 with approximately 15,100 tons. From 2001 to 2006 total landings decreased markedly to 2,200 tons, and since annual landings have remained stable at approximate 2,100 tons. Most of the landings are based on fishery in the management areas Nuuk-Paamiut, Disko Bay-Uummannaq and Sisimiut and total fishing effort (trap hauls) has declined by more than 90 % since 2001 (from 3,416 to about 319 thousand trap hauls during 2001-2014). This fishery is carried out with crab pots.

Humpback whales and bowhead whales have occasionally been entangled in the lines attached to the pots (table 4).

## Redfish

In West Greenland, redfish has only been taken as by-catch in other fisheries in recent years. A directed fishery has reappeared in East Greenland in recent years almost exclusively taken by bottom trawlers besides an insignificant longline fishery.



# **Aquatic Species Distribution Map Viewer**

The Greenland authority operates the quota uptake by categorising the catches in three types of redfish; 1) Fish caught by bottom trawl and longlines on the bottom are called *Sebastes norvegicus*, 2) Fish caught pelagic in the Irminger Sea are called *Sebastes mentella* and 3) fish caught as by-catch in the shrimp fishery are called *Sebastes sp*. Total catches in 2015 of *S. mentella* and *S. norvegicus* combined were 8539 t (Table I). Samples from the industry the 2015 landings were split 70:30 based on 11 industrial samples, and subsequently, 5 977 t was estimated as *S. mentella* and 2 562 t as *S. norvegicus*.

There are no records of by-catches of marine mammals in this fishery.

## Cod

The cod (*Gadus morhua*) fishery in Greenland consists of two components, an offshore fishery and an inshore fishery. The offshore fishery completely collapsed in 1993. In the 2000s catches have gradually increased. Between 2008-2010 offshore areal closures were implemented in order to protect the spawning stock in offshore areas. In 2011, 2012 and 2013 an experimental fishery (5,000 tons) was allowed in order to collect information on the distribution and composition of the cod stock. In 2014 a management plan was implemented and the TAC was increased.

Total offshore catches amounted to 20,600 tonnes in 2015. Catches rose especially in NAFO subdivision 1D and 1E that comprises Dana Bank where a total of 4,500 tons was fished. In

management area East (NAFO subdivision 1F and ICES Subarea 14) the catches amounted to 15,800 tons with 4,000 tons (including Norway: 134 tons) being fished in NAFO subdivision 1F.

The Greenland inshore commercial cod fishery in West Greenland started in the 1920s. Since 2009 catches have gradually increased again reaching 25,200 tons in 2015 which is the highest recorded since 1990.



# Aquatic Species Distribution Map Viewer

The majority of the landings of cod taken inshore (vessels below 40 GRT) is by use of stationary pound nets. A further 30 % is taken with handline, long lines and set gillnets. In general, pound nets have very low levels of by-catch of other fish species than cod.

There is a potential for by-catch in this fishery. Pound nets are among the fishing gear involved in entanglement of large baleen whales, especially humpback whales (table 4).

## Capelin

In some years an intensive fishery for Capelin (*Mallotus villosus*) takes place between 66° and 69° N in East Greenland. In offshore waters of East Greenland, as well as in the international waters between Iceland, Greenland and Jan Mayen (Norway), capelin can be fished between June 20<sup>th</sup> and April 30<sup>th</sup> the following year. The fishery is carried out with purse seines or pelagic trawl and although numerous whales are observed in this area, no by-catches have been reported.

In West Greenland capelin is only utilized in small scale fishery where capelin is scooped up with handnets at the beaches.

There is no by-catch of other species in the smallscale fishery.



# **Aquatic Species Distribution Map Viewer**

#### Atlantic salmon

The majority of the salmon (*Salmo salar*) caught in Greenland belongs to stocks that spawn in Europe or North America. Since 1998 export of salmon from Greenland has been banned by law, and the fishery has been reduced to an internal subsistence fishery within Greenland. The majority of the salmon is caught in the central and southern parts of West Greenland.

## Aquatic Species Distribution Map Viewer



In most years the season has started in august and ended in October or when the quota was taken. In 2016 the reported catches were 27 tons.

Salmon is mainly caught with gillnets fixed perpendicular to the beach, but driftnetting is allowed within the 3 nautical limit for professional fishermen and hunters.

Incidents of seals and harbour porpoises being caught in the floating salmon nets have been observed (unpublished, R. Nygaard, pers.comm.), however there are no records of by-catches of marine mammals in this fishery.

#### Lumpfish

Lumpfish (*Cycloperus lumpus*) are caught in gillnets near the beaches within a short period of time in the spring. Typically the gillnets are set near beaches at depths between 4-10 meters. The allowed catchments of lumpfish is restricted to the period from February 28<sup>th</sup> and July 1<sup>st</sup>. Total landings of lumpfish in NAFO Subarea 1 increased from 1,200 tons in 2000 to almost 9,000 tons in 2003. Catches have remained at this level until 2011 where catches increased to 11,443 tons. Catches are taken in inshore areas in Div. 1A, 1B, 1C, 1D, 1E and 1F with the majority being caught in 1D. The fishery is conducted over a short time period of one to two months and over a vast coastline from 59° N to 72°.



# Aquatic Species Distribution Map Viewer

There is a potential for by-catch in this fishery. Gill nets are among the fishing gear involved in bycatches of seals and small cetaceans (table 5).

#### Mackerel

A substantial fishery for mackerel (*Scomber scombrus*) has developed in East Greenland in recent years. The fishery is conducted by pelagic trawlers and by-catch of Bluefin tuna (*Thunnus thynnus*)

has been registered. When the season ends late in the summer the fleet turns its attention towards herring (*Clupea harengus*) in mainly in the area between East Greenland, Jan Mayen and Iceland.

There are no records of by-catches of marine mammals in this fishery.

Except for the redfish and occasionally the capelin fishery in East Greenland, other fish species according to the abovementioned list (table 1) are mainly taken as by-catch in the Greenland halibut fishery.

Species	Areas (West Greenland)	Season	Gear type	Regulation	*Active	*Landings	Potential mammalian
					boats 2016	in tons 2016	by-catch
Shrimp	Offshore; Inshore Disko Bay	Year round	Shrimp trawl	Licences	15	68,931	Low risk. None registered after sorting grid was mandatory.
Greenland halibut	1.000-1.500 m depth off Nuuk & Oegertarsuag;	Peak in late summer, ends in	Trawl	Licences	274	15,609	Data from 2016 under
	Inshore Disko, Uummannaq and Upernavik. Qaanaaq	November	Gill net/ long-line	Open boats/dog sledge	1000	,	review
Scallop	Inshore from Nuuk to Upernavik.	Year round	Dredgers	Licences	4	735	Low risk. None registered.
Snow crab	Inshore from Upernavik and southwards	April - December	Crab pots	Licences	43	2,160	Entanglement of humpback and bowhead whales
Redfish	Offshore Southwest Greenland	June-October	Trawlers	Licences		9	Unknown, none registred.
Cod	Mainly inshore Offshore SW Greenland	Year round, peak June and July	Pound nets, hand lines, long-lines and set gillnets	Licences	NA	37,685	Entanglement of humpback whales (pound nets)
Capelin	Inshore, mostly Disko Bay and further north	May-July	Handnets	Licences	0	0	Very low risk
Atlantic salmon	Inshore	August 15 – October 31	Gill net Open boats	Licences	14	27	Unknown, none registred
Lumpfish	Inshore, 59°-72°N	March 01 – July 15	Gill net	Licences	NA	NA	Data from 2016 under review
Arctic char	Fresh water and close to a few rivers in central West Greenland	June 15 – September 25	Gill net		NA	NA	Low risk. None registered

## Table 2. Overview of main regulated fisheries in West Greenland

\*figures in estimated live weight from Greenland Fishery License Control Authority. Shrimp figures are from 2015. Division between East and West are in some cases based on estimation as quota types on which catches are recorded sometimes include both East and West.

Species	Areas (East Greenland)	Season	Gear type	Regulation	*Active boats 2005	*Landings in tons 2016	Potential mammalian by-catch
Shrimp		Year round; peak Dec-Apr.	Shrimp trawl	Licences	14	575	Low risk. None registered after sorting grid was mandatory
Greenland halibut		Year round	Trawl	Licences	14	8.325	Data from 2016 under review
Redfish	Offshore Irminger Sea	June-October	Trawlers	Licences	12	60	Unknown, none registred
Cod	Mainly offshore	Year round, peak June - July	Pound nets, hand lines, long lines and set gillnets	Licences	1	14.214	Entanglement of humpback whales (pound nets)
Capelin	Offshore 66°-69°N	Offshore: June 20 - April 30	Purse seines	Licences	2	0	Unknown, none registred
Lumpfish		March 01– July 15	Gill net	Licences	NA	NA	Data from 2016 under review
Mackerel		June – August	Trawl	Licenses	NA	36,211	Unknown, none registred
Herring		July-August	Trawl	Licenses	NA	NA	Unknown, none registred

## Table 3. Overview of main regulated fisheries in East Greenland

\*figures in estimated live weight from Greenland Fishery License Control Authority. Shrimp figures are from 2015. Division between East and West are in some cased based on estimation as quota types on which catches are recorded sometimes include both East and West.

# 4. REGULATORY REGIME OF MARINE MAMMALS

In Greenland, there is no private ownership of land, sea or living resources. Hunting grounds and living resources are open to harvest and use by Greenlandic citizens, subject to hunting licenses (Full time or spare time license).

Hunting is regulated and administered by the Ministry of Fisheries and Hunting, and supervised by the Greenland Fisheries Licence Control Authority. Locally, a team of wildlife officers control hunting and coastal fishing activities, making sure that conservation measures of protected areas and species are observed, and passing on information to the local community. The wildlife officers work in close cooperation with the municipalities, the police, Arctic Command Greenland, and the Government of Greenland.

Greenland has the required national legislation (species specific executive orders) and a quota regulated hunt on marine mammals based on newest stock assessment and scientific advice from the responsible recognised international and regional organisations as the International Whaling Commission (IWC), the North Atlantic Marine Mammal Commission (NAMMCO) and the Joint Commission on Narwhal and Beluga (JCNB).

All catches have to be reported to the hunting database at the Ministry of Fisheries and Hunting. Bycatches of marine mammals are reported and dealt with in the appropriate organisations and expert working groups. Data by fisheries inspectors collected from the fisheries shows low numbers of marine mammal by-catches.

The Government of Greenland has issued one act The Parliamentary Law nr 12 of the 29th of October 1999 on Hunting<sup>2</sup>, with three later amendments that affect hunting of all animals, including marine mammals. Other acts that indirectly affect marine mammals include an act on animal welfare from 2003 and an act on nature protection from the same year.

In addition, there are species specific executive orders that directly affect the protection and taking of marine mammals. Reporting of by-catches is a legal requirement stated in the species specific executive orders of large whales, narwhal and beluga and seals.

The Home Rule Act on Hunting and its revisions have the goal to ensure a responsible and sustainable harvest of wild mammals and birds. There is a well-developed process for stakeholder participation in harvest management that includes the Organisation of Fishermen and Hunters (KNAPK), the municipalities, the Greenland Institute of Natural Resources and other relevant Ministries.

<sup>&</sup>lt;sup>2</sup> Danish translation and overview of amendments is available <u>http://lovgivning.gl/lov?rid={1A6BE69B-3B89-4173-BAC1-1C61736FF93C}</u>

# 5. OVERVIEW OF DISTRIBUTION OF MARINE MAMMALS IN GREENLANDIC WATERS

The figure below (Fig. 4.1-4.5) gives an overview of the distribution of the five different seal species found in Greenlandic and adjacent waters. It should be noted that the map overview in figure 4.1-4.5 does not diversify among high and low density areas, nor is any diversification with regards to temporal distribution indicated. However, the known distribution of the species clearly indicate that there obviously exist a risk of entanglement of these kinds of marine mammals in relation to fisheries, based on geography only. This should not under any circumstances evoke as surprise, as many of the target species of the fisheries directly pertain to the mammal's diet.



**Figure4.1.** Distribution of ringed seal (*Phoca hispida*) in Greenlandic waters (grey), modified from <u>http://nammco.wpengine.com/marinemammals/</u>.



**Figure4.2.** Distribution of hooded seal (*Cystophora cristata*) in Greenlandic waters (light purple), modified from <u>http://nammco.wpengine.com/marinemammals/</u>.



**Figure4.3.** Distribution of harp seal (*Phoca groenlandica*) in Greenlandic waters (dark blue), modified from <u>http://nammco.wpengine.com/marinemanmals/</u>.



**Figure 4.4.** Distribution of harbour seal (*Phoca vitulina*) in Greenlandic waters (dark green), modified from <u>http://nammco.wpengine.com/marinemammals/</u>. Light green historical or rare occurrence.



**Figure4.5.** Distribution of bearded seal (*Erignathus barbatus barbatus*) in Greenlandic waters (dark purple), modified from <u>http://nammco.wpengine.com/marinemammals/</u>.

The five true seals (Phocidae) species found in the waters surrounding Greenland are distributed among three genera. Harbour seals (*Phoca vitulina*) occur along the entire west coast, particularly along the southern part up to Upernavik County, and in Southeast Greenland up to Ittoqqortoormiit. The species has never been as abundant as the other Greenlandic seals<sup>3</sup>. It stays in areas near the coast and is Greenland's only seal that sheds and breeds on land.

Ringed seals (*Phoca hispida*) and bearded seals (*Erignathus barbatus*), both of which are associated with sea ice, occur along all of Greenland's coasts. However, the most proximate occurrences of ringed seals are in Northwest and East Greenland. Bearded seals usually occur singly and are not abundant anywhere, but are rather evenly distributed throughout most if the Arctic.

Harp seals (Phoca groenlandica) and hooded seals (Cystophora cristata) are among the migrant seals. They breed on pack ice both west and east of Greenland and after the breeding season, migrate north along Greenland's west and east coasts. Harp seals give birth to their offspring in February-March on dense pack ice concentrations in the Greenland Sea around Jan Mayen and by Newfoundland. After their annual shed, harp seals disperse out over the northern Atlantic Ocean. Harp seals arrive in Southwest Greenland in large number in May-June and later, during the summer and fall, disperse along the coasts northward to Qaanaaq and Ittoqqortoormiit County. In the late fall harp seals leave the northern regions and most go back to the breeding sites, some however, primarily young animals, winter in the waters of the Arctic. Hooded seals give birth to their offspring at the end of March on pack ice concentrations in three regions: Greenland Sea around Jan Mayen, in the middle of the Davis Strait and by Newfoundland. Hooded seals form the latter two breeding sites migrate to West Greenland and Arctic Canada as well as Southeast Greenland and the Denmark Strait. In mid-summer, from the middle of June to the end of July, hooded seals gather on pack ice to complete their annual shed north of Jan Mayen and in the Denmark Strait. After shedding, hooded seals disperse across large parts of the northern Atlantic Ocean.

As for the seals, a geographical overview by maps of the distribution of whales and dolphins commonly occurring in Greenlandic waters have been included in figure 4.6. The overview is generalized, however it gives a true picture of the areas where the different species expectably can be found, thus where the risk of potential by-catch may persist.

<sup>&</sup>lt;sup>3</sup> Teilmann, J. & R. Dietz, 1993. Status of the harbour seal (*Phoca vitulina concolor* L.) in Greenland. Canadian Field Naturalist 108 (2): 139-155.



**Figure4.6.** Distribution of whales and dolphins commonly occurring in Greenlandic waters. A: Blue whale, sei whale; B: fin whale, humpback whale, minke whale; C: bowhead whale; D: Northern bottlenose whale, killer whale, sperm whale; E: white-sided dolphin, long-finned pilot whale; F: beluga; G: narwhale; H: white-beaked dolphin; and I: harbour porpoise (recently observations (dots) and common occurrence in light red).

Whales (Cetacea) are represented by fifteen species in Greenland; nine toothed whales and six baleen whales. Male sperm whales (*Physeter* macrocephalus) occur in small numbers by West Greenland and a bit more abundantly by East Greenland. In West Greenland, humpbacked whales (*Megaptera novaengliae*) are principally found between Paamiut and Sisimiut. A few hundred individuals of Bowhead whales (*Balaena* mysticetus) can be found in late winter and early spring on the west coast around Sisimiut and Qeqertarsuaq. In some years sei whales (*Balaenoptera* borealis) occur off of Southwest Greenland and between Southeast Greenland and Iceland<sup>4</sup>. Blue whales (*Balaenoptera* musculus) only occur sporadically in West Greenland, northward to Uummannaq, but are principally found between Paamiut and Sisimiut<sup>4</sup>. The five species mentioned above are completely protected and are listed in CITES Appendix I.

Minke whales (*Balaenoptera acutorostrata*) occur along Greenland's entire west coast, both in sheltered and open (unsheltered) waters. In recent years minke whales have been most abundant in Southwest Greenland. In East Greenland minke whales are found near the coast, especially nearby Tasiilaq and Ittoqqortoormiit. Fin whales (*Balaenoptera phusalus*) are found by West Greenland up to Upernavik, both on banks and in coastal regions. By East Greenland they are primarily found outside the pack ice belt<sup>5</sup>. The hunting of minke, fin, humpback and bowhead whales in Greenland is by quota and internationally is considered to be aboriginal/subsistence catch. Minke and fin whales are listed in CITES Appendix II and I, respectively.

<sup>&</sup>lt;sup>4</sup> Born et al., 1998. Grønlands fugle, havpattedyr og landpattedyr – en status over vigtige resurcer, 1. oktober 1998 [Birds, marine mammals and terrestrial mammals of Greenland – status of important resources, 1<sup>st</sup> October 1998]. Pinngortitaleriffik/Grønlands Naturinstitut: 70 pp.

<sup>&</sup>lt;sup>5</sup> Anonymous, 1995. Grønlands havpattedyr: forvaltning og forskning. Status pr. 1. januar 1995 [Greenland's marine mammals: management and research. Status as of 1<sup>st</sup> January 1995]. Havpattedyrafdelingen, Grønlands Fiskeriundersøgelser: 54 pp.

Beluga whales (*Delphinapterus leucas*) migrate along Greenland's west coast. In the spring they migrate across the northern part of Baffin Bay to summer sites in North Canada. In Avernasuaq the beluga whales occur along the ice edge early in the spring and through the fall in the open water period. Like beluga whales, narwhales (*Monodon monoceros*) conduct yearly migrations. In March narwhals can be found under the pack ice in the central Davis Strait and the southern part of Baffin Bay. During the winter and spring they occur along the coast of West Greenland, where they are particular abundant by the southern passage to Qeqertarsuup Nunua. During summer, narwhals concentrate by Inglefield Bredning in Avanersuaq and Melleville Bay on the west coast. The fjords between Tasiilaq and Ittoqqortoormiit in East Greenland are important sheltered water summer regions where narwhals occur from about May to November. They are rare south of Aasiaat. Some narwhals winter in the North Water in the northern part of Baffin Bay. Narwhals are common in Upernavik and Uummannaq County in autumn<sup>6</sup>. During winter they can also be found at the entrances to the abovementioned fjords in East Greenland<sup>7</sup>. Both species are listed in CITES Appendix II.

Harbour porpoises (*Phocoena phocoena*) occur along Greenland's entire west coast, but are thought to occur primarily in the areas off Paamiut, Maniitsoq and Nuuk, and on rare occasions, by Southwest Greenland.

Several species are guests around Greenland in small numbers during the summer. Killer whales, or orcas, (*Orcinus orca*) visit Greenland's coasts up to Qaanaaq and Ittoqqortoormiit, while bottlenose dolphins (*Hyperoodon ampullatus*) reach Qeqertarsuaq and Danmarkshavn during their regular summer visits. Long-finned pilot whales (*Globicephala maelaena*) occur along Greenland's west coast in late summer up to Qeqertarsuaq, while white-sided dolphins (*Lagenorhunchus acutus*) and white-beaked dolphins (*L.albirostris*) are rare summer guests in the waters around South Greenland up to Sisimiut and Tasiilaq/Ammassalik.

## 6. MAGNITUDE OF MARINE MAMMAL BY-CATCH

In Greenland, spare time hunters and full time hunters can catch certain seal species and small cetacean species year round under defined legal restrictions and by their type of hunting license.

Until a new online reporting system was taken in use by 2013, by-catches of seals and small cetaceans were required to be reported as catches in the paper reporting scheme *Piniarneq*. Given that the vast majority of the fishermen who deploy fishing gear have a hunting licence, there is reason to believe that most by-catches of seals and small cetaceans is consumed or sold in the same way as the animals that are shot with rifle during regular hunting. Or is misreported, given the fact that seals can be caught legally as part of the traditional subsistence hunt by use of seal-nets.

Other species registered as by-catch in Greenland include the entanglement of large whales as humpback-, minke-, bowhead and fin whales in fishing gear, with the highest number reported are the humpback whale. An average registration of three large whales annually is registered as entanglements in Greenland in the period 1998-2016, data reported to the IWC (table 4). Reported

<sup>&</sup>lt;sup>6</sup> Heide-Jørgensen, M.P., 1994. Distribution, exploitation and population status of white whales (*Delphinapterus leucas*) and narwhals (*Monodon monoceros*) in West Greenland. Meddr Grønland, Biosci. 39: 135-149.

<sup>&</sup>lt;sup>7</sup> Dietz *et al.*, 1994. Occurrence of narwhals (*Monodon monoceros*) and white whales (*Delphinapterus leucas*) in East Greenland. Meddr. Grønland, Biosci. 39: 69-86.

entanglements have occurred in relation to crab pot fisheries, stationary pound nets and set gillnets. In the first case, the whales have been captured in the lines between the submerged pots and floating/marking buoys.

The reported by-catch in Greenland of a modest number of whales per year, probably reflect an insignificant problem when considering consequences of by-catch on sustainability of the big marine mammals (whales).

None the less the Greenland Government has in collaboration with the International Whaling Commission in June 2016 had a training course for local fishermen and wildlife officers on a "Fishermen assisted release program", when large whales are by-caught in fishing gear.

Year	Reported entanglements in Greenland fisheries					
	Humpback whale	Minke whale	Fin whale	Bowhead whale		
1998	1	3				
1999	1					
2000	2	2				
2001	2					
2002	3	1	1			
2003	1					
2004	2					
2005	5					
2006						
2007	3			2		
2008	3	1				
2009		1				
2010	1					
2011	1			2		
2012	2					
2013	1			1		
2014	1					
2015	10					
2016	3	1	1			

Table 4. Overview of reported by-catches of marine mammals in Greenland fisheries

The meat of by-caught whales is distributed among government organisations, such as hospitals and schools, and among the public that gathers where the whales are being flensed. The flensing of a whale is an important social and cultural event. The by-catch benefits the community in the form of free meat and work for whaling and flensing crews. However, the affected fishermen do not gain any economical profit on the by-catch although they in some cases can apply and be reimbursed for the lost or damaged gear. On the contrary they actually find the by-catch as an expense as they are not reimbursed for lost catches of target species (fish or crabs) or the extra working hours consequently following entanglement of mammals in their fishing gear. Likewise the whaling crew

makes less money in euthanizing a by-caught whale than by selling the edible products. When the by-caught whale is distributed to the local community, the market for selling products is furthermore decreased. The governmental costs amounts to tens of thousands of Danish kroner (DKK) associated with each by-caught humpback whale. Nationally, the entanglement of humpback whales is used as an argument to apply for higher quotas for this species.

# 7. POTENTIAL RISK OF MARINE MAMMALIAN BY-CATCH IN GREENLAND FISHERIES

The evaluation of potential risk for marine mammal by-catch in the fisheries in Greenland and adjacent waters is made on the basis of investigation of spatial and temporal conduction of fisheries with different gear and the expected spatial and temporal presence of mammals on the banks/localities of fishery.

Although there is still some uncertainty of domestic registration of mammalian by-catch in fishery, we find it necessary to use native experience, reports from *Piniarneq* and data from the new legislation of 2016 as well as elsewhere as background information and knowledge in the risk evaluation. Thus, we have diversified the risk regarding gear type in three groups: red, yellow and green – from high risk to low risk, respectively, as stated in the table below (table 5).

Gear type	Estimated	Comments
	risk	
Bottom	Green	Low risk. No by-catch registered.
dredges		
Bottom	Yellow	Cetaceans follow the vessels and catches what falls out of the trawls. Grid
trawl		is not mandatory for halibut bottom trawling, but is used in some cases to
		avoid Greenland shark. No by-catch registered.
Shrimp	Green	Low risk. None registered after sorting grid was mandatory.
trawl		
Crab pots	Yellow	Entanglement of humpback and bowhead whales reported.
Pelagic	Green	Large pelagic trawls are dragged at high speed in the surface, potential for
trawl		by-catches. No by-catch registered.
Gill nets	Red	Footnote <sup>8</sup>
Long-line	Green	No by-catch registered.
Pound nets	Red	By-catch of large whales reported.
Hand lines	Green	No by-catch registered.
Seine	Green	Large fishing gear, potential for by-catches. No by-catch registered.

Table 5. Estimated grouping of mammalian by-catch risk

Then, based on the spatial overlap between fishery and abundance of mammals, we find that risk for entanglement of seals and/or whales in fishing gear certainly exists. As we regard set gill nets and

<sup>&</sup>lt;sup>8</sup> North Atlantic Marine Mammal Commission; Management Committee Working Group on Bycatch. National Progress Reports: Bycatch Reporting for 2005. NAMMCO/16/MC/BC/4.

pound nets as being the highest risk gear types, the use of such gear in coastal fisheries for Greenland halibut, cod, salmon and lumpfish is probably human activities where the risk for entanglement of mammals are the highest. Fisheries using gill nets and pound nets are mainly taking place during six months from May-October. This period directly overlaps the period when the harp seals and hooded seals, along with the big baleen whales are most abundant in the near shore Greenlandic waters.

Based on the fact that entanglement of humpback and bowhead whales have occurred in relation with crab pot fishery we find that there is also a direct overlap in crab fishery and abundance of common "summer whales" in Greenland (humpback, fin, bowhead, and sei whales). In addition, as mentioned previously, several whale species are rare guests around Greenland during summer.

The scenario regarding the "Greenland winter whales" (Beluga whales and narwhals) distribution along the West Greenland coast during winter overlaps the winter fisheries of shrimps, Greenland halibut and cod, especially in the Disko bay.

As no mammalian by-catch incidents with other gear type has ever before been reported in Greenland, it is quite difficult to evaluate the risk of such incidents. However, due to this fact we find it appropriate – at this stage – to term other fishing gear as "low risk" gear types regarding mammalian by-catch.

## 8. EXISTING BY-CATCH MONITORING PROGRAMS

It is obligatory for fishing vessels to deliver standardised logbooks to the Ministry of Fisheries and Hunting. The latest version of these logbooks includes an item for by-catch of marine mammals. However, reporting marine mammal by-catch is voluntary. In contrast, it is mandatory to report by-catch of commercially important species of fish. To date, the data on marine mammal by-catch from the fisheries logbooks is not entered into any electronic database.

With the new fishery legislation in 2016 strongly supported by the fishing industry in the MSC branding it became compulsory for the fishermen and buyers to report all catches, including by-catches which are not passed to the buyers. In this data all by-caught marine mammals are also included.

Herby systematically collecting data about by-catches in fisheries from the fishery it-self, with bycatch data now stored and available for analysis in the fisheries database. Data from 2016 is now under review.

With a new online reporting system (www.sullissivik.gl) taken in use by 2013, by-catches of seals and small cetaceans were no longer required to be reported as catches as in the paper reporting scheme *Piniarneq*. However the majority of full time hunters still used the paper reporting scheme *Piniarneq* up until 2017, when another online system (www.aalipi.gl) now made online reporting mandatory.

The reporting scheme *Piniarneq* used for reporting of catches and by-catches was modified in 2015 giving by-catches its own table in the scheme, it was further modified in 2016 giving a row for marine mammals. Prior to the season of 2016 it was only possible to report by-catches of guillemot

(*Uria lomvia* and *Uria aalge*) and eider (*Somateria mollissima* and *Somateria spectabilis*) in the paper reporting scheme *Piniarneq*.

The number of marine mammals actually registered as by-catches in fisheries are modest (table 4), and whether this is a consequence of lack of voluntarily reporting, or inclusion of the by-caught mammals in the hunting statistics, is currently unknown. However, we find reason to believe that by-catches of seals and smaller whales by undecked and smaller decked vessels are probably recorded in the yearly hunt reports that hunters need to deliver to the Ministry of Fisheries and Hunting in order to renew their licences, and thus enters into the hunting statistics.

The Ministry of Fisheries and Hunting covers the financial expenses associated with by-catch of large whales. Therefore, this type of by-catch is usually reported. Expenses covered by the government include costs associated with transport, flensing and distribution of the meat from the entangled whale, if a fresh carcase is recoverable. If the large whale is entangled and alive, the government pays for a local whaling boat equipped with harpoon to put down the animal. Meat and other products from by-caught large whales cannot be sold; the meet is distributed without charge in the community.

The by-catch of large whales is usually reported by the fisheries and hunting inspectors or by the municipality where the incident occurs.

## 9. FUTURE PLANS TO IMPROVE BY-CATCH MONITORING

At present, there are no concrete plans to improve the monitoring of marine mammal by-catch. One step ahead that has been discussed would be to also include fisheries logbook data on marine mammal by-catch in the electronic fisheries database maintained by the Greenland Fishery License Control Authority in the Ministry of Fisheries and Hunting.

Interviews or questionnaires may help to find out if by-catch of small cetaceans and seals is common or not, and if this by-catch is normally reported in the hunting statistics, as we believe. Furthermore interviews with hunters reporting by-catch data since 2013 and comparison of data from *Pinianeq* and the fishing industry buyers is underway for 2016.

It should be noted that even though plans for improvement on by-catch monitoring are lacking, it is truly in the interest of the government of Greenland to act positively on the issue of mammalian by-catch in fisheries. However, by accepting the fact that Greenland is in a very unique position by our strong cultural traditions on hunting and gatherer activities, the government is surely aware of the special challenges in implementation of monitoring programmes, which can be useful and valuable for marine mammal management and further improvements in the future. Besides improving by-catch monitoring, the government of Greenland is positively minded regarding further development towards mitigation of entanglement of marine mammals in fishing gear.