

# Distribution of the commercial fishery for Greenland halibut and Northern shrimp in Baffin Bay



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# Distribution of the commercial fishery for Greenland halibut and Northern shrimp in Baffin Bay

by

Ole A. Jørgensen and Nanette Hammeken Arboe



Technical report no. 91, 2013  
Pinngortitaleriffik, Greenland Institute of Natural Resources



## Eqqikaaneq

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## Sammenfatning

Fiskeriet efter rejer og hellefisk er de eneste fiskerier af væsentlig økonomisk betydning nord for 68°N. Fiskeriet efter rejer foregår i Disko Bugten og udenskærs i Baffin Bugten. Udenskærs fiskes der først og fremmest sydvest for Disko og nord for 72°N. Fangsterne nord for 68°N, inklusiv Disko Bugt, udgør 60-75% (82.000 – 96.000 ton) af de samlede vestgrønlandske fangster. Godt og vel halvdelen af fangsterne tages udenskærs i Baffin Bugten. Fiskeriet topper i 3. kvartal. Fiskeriet foregår på 250-300 m. Fiskeriet efter hellefisk finder sted omkring de to indenskærs områder Upernavik, Uummannaq og i Disko Bugt samt udenskærs i Baffin Bugten. Fangsterne har været ret konstante i de seneste år og har ligger på ca. 20.000 tons i de indenskærs områder og ca. 6.500 tons i Baffin Bugten og har udgjort ca. 60% af de samlede fangster af hellefisk i Grønland. Fiskeriet i Baffin Bugten foregår med trawl på ca. 1000 m dybde vest for Disko og topper i 3. kvartal.

## Summary

The fishery for Northern shrimp and Greenland halibut are only two fisheries of significant economic importance north of 68°N. The fishery for Northern shrimp takes place offshore in Baffin Bay and in the inshore area of Disko Bay. Offshore the fishery is concentrated south west of Disko Island and around 72°N. The catches north of 68°N including Disko Bay constitutes about 60-75% (82.000 t-96.000 tons) of the total West Greenland catches. Slightly above half of the catches are taken

offshore in the Baffin Bay. The fishery peaks in 3. quarter. The fishery takes place at 250-300 m. The fishery for Greenland halibut takes place both in the inshore areas around Upernavik, Uummannaq and Disko Bay and offshore in Baffin Bay. The catches have been relatively constant in recent years and have been around 20.000 tons in the inshore areas and around 6.500 tons in Baffin Bay and have constituted about 60% of the total catches of Greenland halibut in Greenland waters. The fishery in Baffin Bay is conducted by trawlers at about 1000 m depth west of Disko Island and peaks in 3. quarter.

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# 1. Introduction

The fishery for Greenland halibut and Northern shrimp are the only two fisheries of significant economic importance north of 68°N. The fishery for Greenland halibut takes place both offshore and inshore, while the fishery for Northern shrimp takes place offshore and in the inshore area of Disko Bay.

## 1.1 Greenland halibut

### Biology

The Greenland halibut (*Reinhardtius hippoglossoides*) is a flatfish species, widely distributed in the North Atlantic. At West Greenland it is found from Cape Farewell (59°N) in south to Qaanaaq in north (77°30'N) both inshore and offshore at depths down to at least 2000 m.

The main spawning area is believed to be located in the Davis Strait on the southern slope of the ridge between Greenland and Baffin Island probably at depths > 1500 m. From the spawning area eggs and larvae drifts north along the west coast of Greenland or are brought into Canadian waters by a deflection of the West Greenland current. The larvae that drift northward along the west coast of Greenland reach the settling area in September-November and settle (goes from pelagic stage to a bottom dwelling stage) at 250-400 m depth.

Traditionally larvae settle in Disko Bay on the shelves of northern part of St. Hellefiske Bank, Disko Bank (Smidt 1969, Jørgensen 1997a, Steenberg et al. 2013), and probably on the banks in Baffin Bay to a varying extent, depending on the hydrographic conditions (water temperature and the velocity of the West Greenland current).

From the settling areas the Greenland halibut gradually migrates towards deeper water as they grow (Jørgensen 1997a, Steenberg et al. 2013). Offshore in the Davis Strait (Jørgensen 1997a) and in the Baffin Bay (Unpublished tagging data from Greenland Institute of Natural Resources) Greenland halibut gradually migrates towards the spawning area in the Davis Strait.

The Greenland halibut stocks located in the inshore areas are probably composed of fish that originally have settled or migrated on the inside of the banks in the Baffin Bay and gradually moved into the fjords as they grow. The Greenland halibut that end up in the Disko Bay and Northwest Greenland fjords remains there and do not contribute to the spawning in Davis Strait (Boje 2002). No significant spawning has been observed in the area, and the stocks are dependent on recruitment from offshore spawning areas.

There is little information on spawning in the Baffin Bay (Simonsen & Gundersen 2005) and although spawning may take place in Baffin Bay it was estimated that the egg and larval mortality is so high due to the low water temperatures that the chance of successful spawning in Baffin Bay is considered low (Steenberg et al. 2013).

### Surveys

During the years there have been conducted a number of bottom trawl surveys aimed at Greenland halibut in Baffin Bay both by Greenland and Canada (Jørgensen 2011, Treble 2011). The most recent survey in Greenland waters in 2010 covered depths between 400 and



1500 m to 75° 30' N. Greenland halibut were found in the entire area (Fig. 1) and has previously been found to 76° 30' N (Jørgensen 2002). The biomass is equally split between Greenland Canadian waters. Greenland survey data from 2010 showed that the biomass was evenly distributed throughout the survey area (Jørgensen 2011).

Surveys are also conducted in inshore areas by gill net and loglines but these surveys are only useable for estimation of CPUE (Catch per unit effort) (Nygaard &Boje 2012).

### Catches

Since the collapse of the cod stock in the mid 80'ies the Greenland halibut resource comprised the major groundfish resource in recent years and the export of Greenland halibut constitute about 25 % of the total export from Greenland only exceeded by the export of shrimp (Statistics Greenland, Statistics for 2011) and the contribution from the fishery to the economy especially in the three inshore areas Upernavik, Uummannaq and Disko Bay is substantial. (Delaney et al. 2012).

The catches at Northwest Greenland have been relatively constant in recent years amounting to 6.500 tons offshore in Baffin Bay (same amount in Canadian waters) and about 20.000 tons inshore including Disko Bay (Anon. 2012b). The Greenland halibut catches in the Greenland part of Baffin Bay including the inshore areas constitutes about 60% of the total Greenland halibut catches in Greenland waters (Anon. 2012a, Anon. 2012b) .

## 1.2 Northern shrimp

### Biology

The Northern shrimp (*Pandalus borealis*) occurs on the continental shelf off West Greenland. The species is distributed from Cape Farewell (60°N) to Qaanaaq (77°30'N) (Bergström 2000). The fishery for Northern shrimp has historically taken place from Cape Farewell to Upernavik (73°N) while the distribution and density of Northern shrimp north of 73°N is not well described (Hammeken Arboe 2012).

Northern shrimp is found at depths between 50 m and 1000 m, with the highest densities between 150 m and 500 m (Kingsley 2011). The preferred habitat is muddy bottom and the temperature optimum for Northern shrimp is between 2°C and 4°C. Northern shrimp usually migrates into the water column at night to feed and return to the bottom during the day (Bergström 2000).

Shrimps are omnivores, i.e. they live on many different types of food: worms, dead organic material, algae and zooplankton (Horsted & Smidt 1956), and they are themselves food for large fish such as cod and Greenland halibut (Parsons 2005).

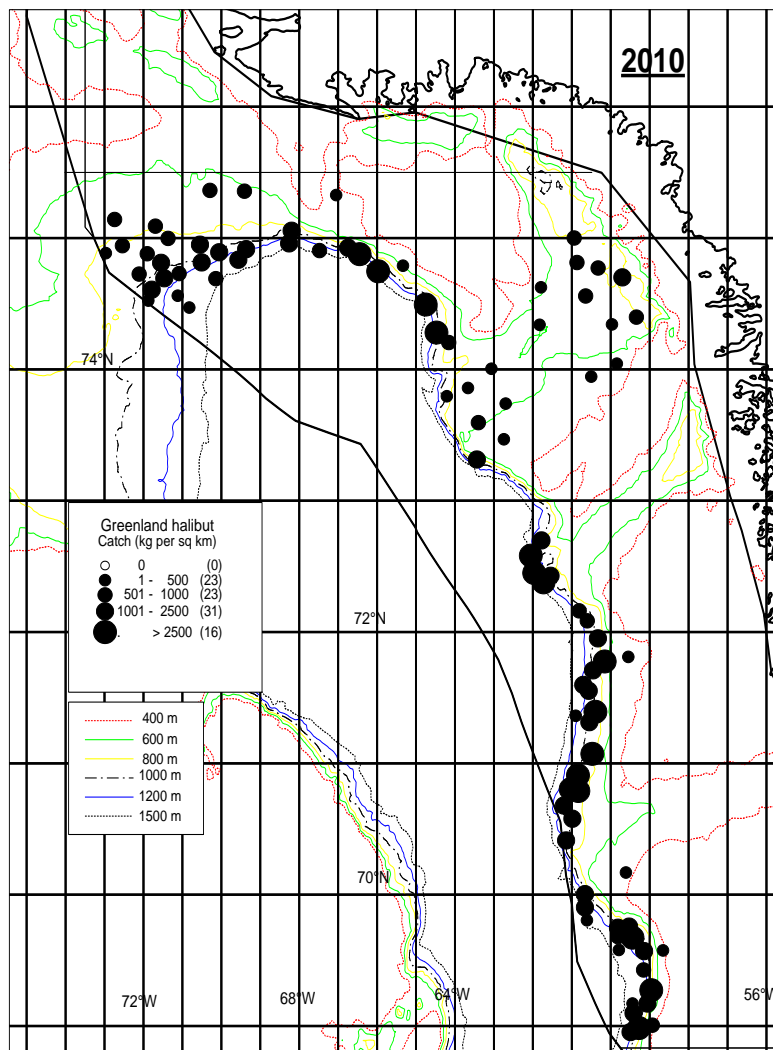


Fig. 1. Distribution of survey trawl catches of Greenland halibut in 2010.

Northern shrimp is a protandric hermaphrodite (changes sex during the life span). In West Greenland waters, the juveniles mature as males when they are about 3 years. They function as males for 2-3 years, and then undergo a transition to females at an age of 5 to 6 years (Horsted and Smidt 1956, Wieland 2004). The maximum age for Northern shrimp is more than 8 years (Savard et al. 1994).

Mating and spawning occur in July - September, the egg-bearing period lasts 8 to 10 months, depending on the bottom temperature. The larvae hatch in April - June the following year (Shumway et al. 1985, Bergström 2000, Horsted 1978). When the hatching time approaches, the female migrates to relatively shallow water (< 150 meters). The newly hatched larvae live in the upper part of the water column. During spring and summer, the larvae passes through six planktonic stages in three to four months. In the last larval stages, the larvae settle at the bottom as immature shrimps (Shumway et al. 1985, Bergström 2000, Storm & Pedersen 2003).

Hatching is believed to take place along the entire coast of West Greenland (Storm & Pedersen 2003). Due to the northbound West Greenland current which dominates the West Greenland shelf (Ribergaard et al. 2004) larval drift from hatching areas (spawning grounds) to settling areas can cover distances of up to 500 km (Storm & Pedersen 2003). The banks north of 64°N and the Disko Bay are believed to be important nursery areas for larvae and juvenile shrimps (Storm & Pedersen 2003, Ribergaard et al. 2004, Wieland 2005).

### Surveys

Since 1988 the Greenland Institute of Natural Resources has carried out annual bottom trawl surveys aimed at Northern shrimp on the West Greenland shelf covering depths from 150 m to 600 m in offshore areas. In 1991 the inshore area of Disko Bay was included in the survey. In 1994 the southernmost areas was included in the survey area and the survey area has since then covered the area from Cape Farewell (59°N) to Upernavik (72°30'N) (Fig. 2) (Kingsley et al. 2012).

In 2003 the estimated biomass of Northern shrimp in West Greenland waters peaked at 600.000 tons. Since then the biomass has been declining due to a decrease in the biomass in the offshore areas. The total biomass of Northern shrimp in West Greenland waters was estimated to be 190.000 tons in 2012 (Kingsley et al. 2012).

The proportion of the total biomass of Northern shrimp found in the offshore areas north of 68°N has constituted between 35% and 60% since 2001. In the Disko Bay area the biomass has constituted in average 23% of the total biomass since 1991 and the mean densities of Northern shrimp (t/km<sup>2</sup>) is significantly higher than in the offshore areas (Fig. 2). In 2011 and 2012 35% and 48%, respectively, of the total biomass was found in the Disko Bay area. Since 1988 more than half of the total biomass of Northern shrimp has been found in the inshore and offshore areas north of 68°N and the biomass has concentrated even more in this area since 2005 (Kingsley et al. 2012).

### Catches

The export of Northern shrimp constitutes a value of about 55 % of the total export from Greenland (Statistics Greenland 2011).

The catches of Northern shrimp taken inshore (Disko Bay area) and offshore in the Baffin Bay has been rather constant the last 5 years amounting to 90.000 tons. This corresponds to 60 - 75% of the total catches in West Greenland waters. The proportion of catches taken inshore in Disko Bay has constituted at least one third and up to 75 % of the catches taken in the whole area north of 68°N since the beginning of the 1990'ties (Hammeken Arboe 2012).

## 2. Materials and methods

The analysis of data is based on a set by set catch information. All vessels in the offshore fishery and the shrimp fishery in the Disko Bay are obliged to fill in log books with information about catch by species, start and end time, start and end position and start and end depth of the fishing operation, gear type (trawl, long line, gill net etc.), name of the vessel, vessel size and motor power, among others, for each fishing operation and report it to Greenland Fisheries License Control (GFLK). In the inshore fishery for Greenland halibut logbooks have been mandatory for vessels greater than 30'ft (9,4m) since 2008. Small boats,

dog sledges and non factory vessels are obligated to report landing, gear and effort data by statistical area to GFLK.

Catch data are summarized by statistical squares ( $\frac{1}{4}$  degree longitude \*  $\frac{1}{8}$  degree latitude) and plotted in Mapinfo (ver. 7).

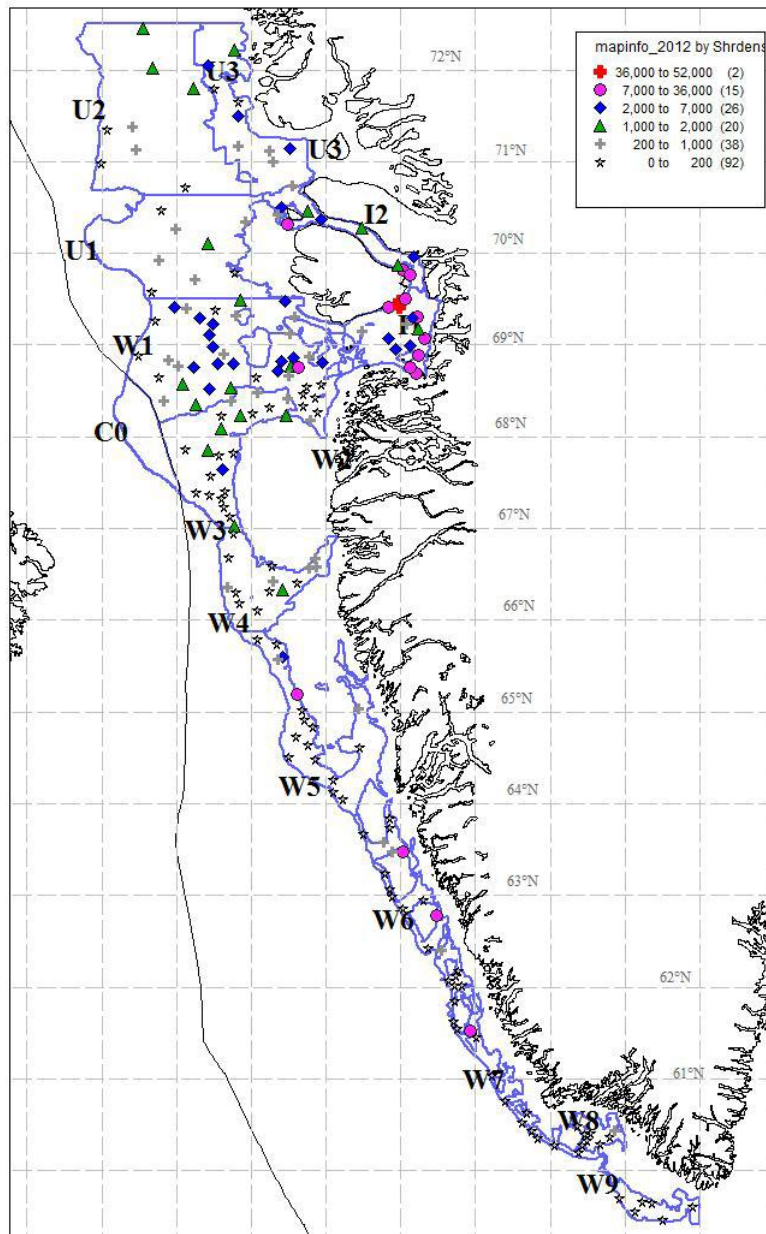


Fig. 2. Survey area and survey catches of Northern shrimp (from Kingsley et al. 2012)

### 3. Results

#### 3.1 Greenland halibut offshore

##### Description of the fishery

Before 2000 off shore catches of Greenland halibut in Baffin Bay (NAFO Div. 1AB) were small and sporadic. Catches, mainly in Div. 1A, increased gradually from 96 tons in 2000 to 6.223 tons in 2006 and have remained at that level since then (Fig. 3). An equal amount is taken in the Canadian part of Baffin Bay. The fishery has been conducted to about 75°N but catches north of 70°30'N have been limited (Fig. 4). In recent years the fishery has been concentrated west of Disko south of 70°N (Fig. 5 and 6). The stock is even distributed in the area and if the stock decreases or the TAC (Total Allowable Catch) is increased in the future it is likely that the trawl fishery will expand further north.

The catches in Greenland waters have mainly been taken by large trawlers (1067 – 2578 BT) from Greenland, Russia and Faroe Islands (Jørgensen and Treble 2012) using single and twin trawl. The mean fishing depth is 969 m (min. 630 m max. 1324 m, q1(25%) 890 m and q3(75%) 1050 m). The fishery peaks in 3. and 4. quarter, where 65,5% and 32,5%, respectively, of the catches are taken. The fishery in 1. and 2. quarter is limited with 1,4% and 0,6%, respectively, of the total catches (Fig.7).

In 2000 there was a small longline fishery with a total catch of about 75 tons west of Disko in the area where the trawl fishery now takes place (Fig. 8). There has not been any offshore longline fishery since then.

In 2002 and 2003 546 tons and 837 tons, respectively, were taken by gill net. The gill net fishery took place between 71°N and 74°N with the main effort around 72°N (Fig. 9). There has not been any off shore fishery with gill since 2003 and offshore gill net fishery is currently banned.

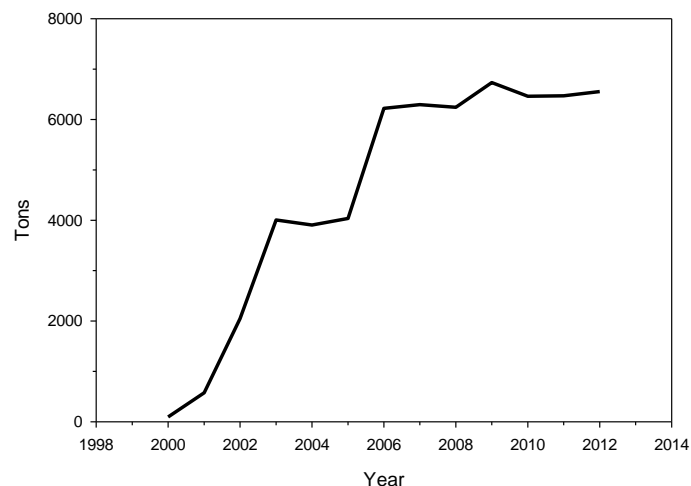


Fig.3. Catches of Greenland halibut off shore in Greenland waters in Baffin Bay (2012 data are preliminary).

With the increasing fuel pieces and concern about the trawls impact on the sea bed the fishery using static gears might, however, be resumed. In the Canadian part of the Baffin

Bay about 50% of the catches have been taken by gill net in recent years (Jørgensen & Treble 2012).

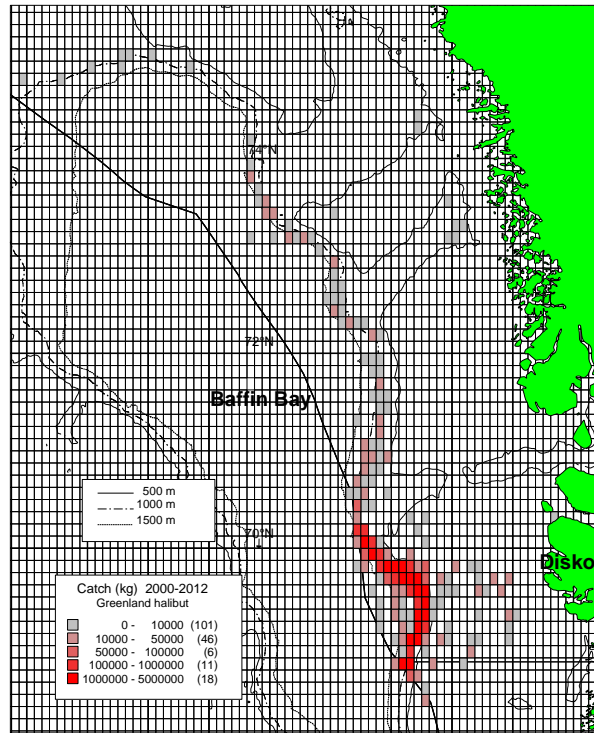


Fig. 4. Distribution of Greenland halibut of catches by trawl in 2000-2012. All data pooled.

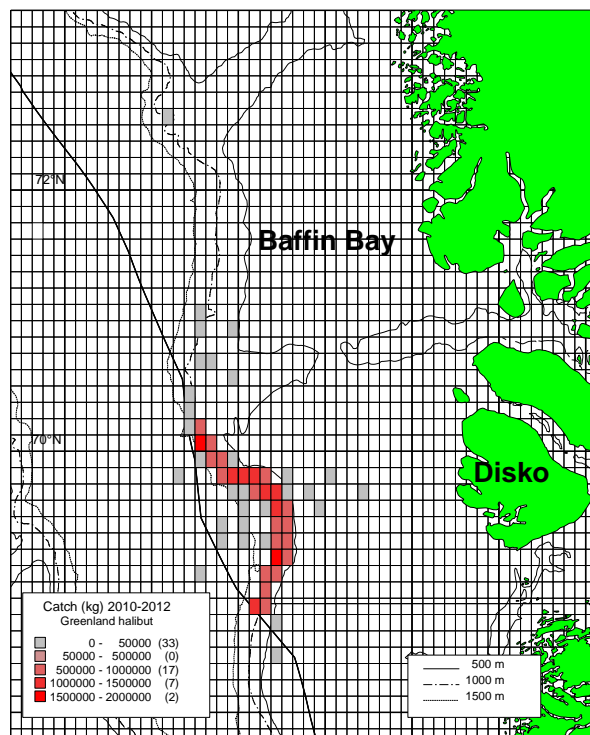


Fig. 5. Distribution of catches of Greenland halibut by trawl in 2010-2012. All data pooled.

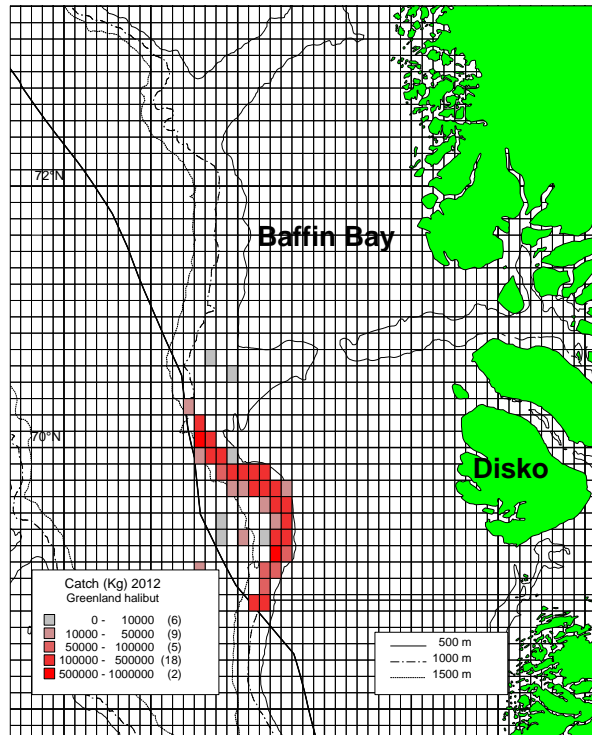


Fig. 6. Distribution of catches of Greenland halibut by trawl in 2012 (preliminary data).

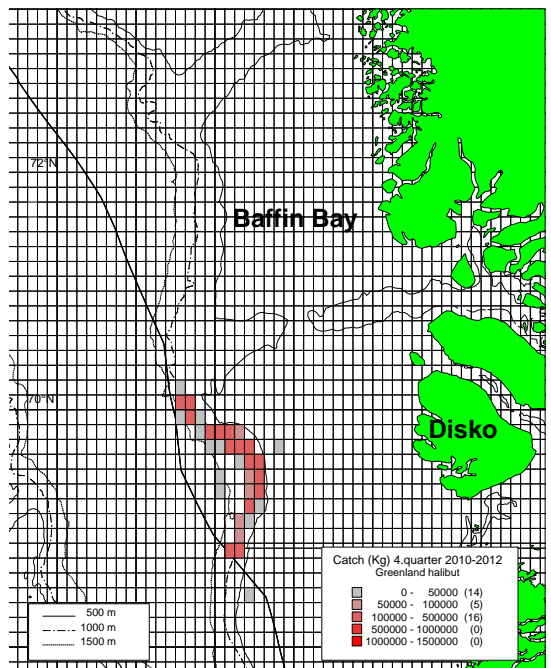
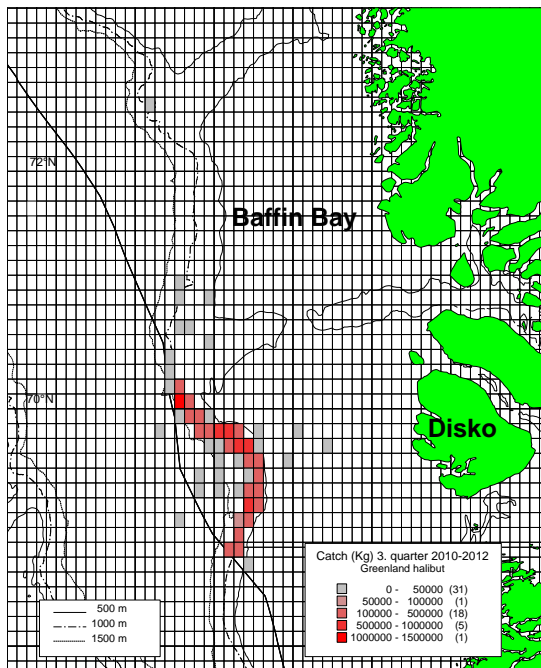
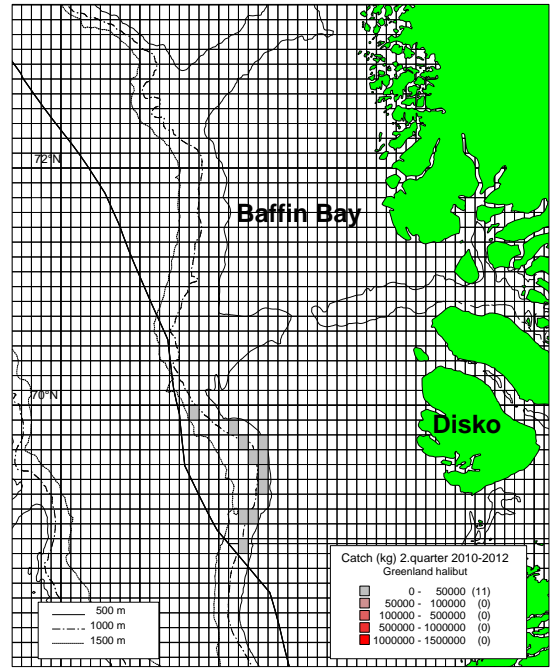
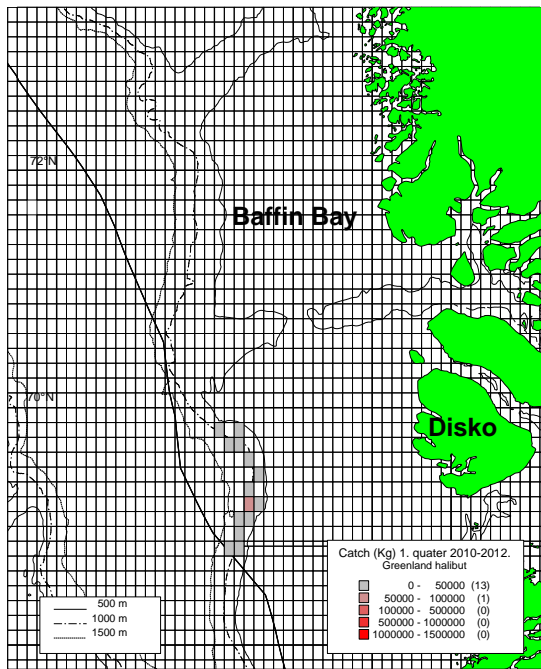


Fig. 7. Catches of Greenland halibut by quarter. Data from 2010-2012 pooled.



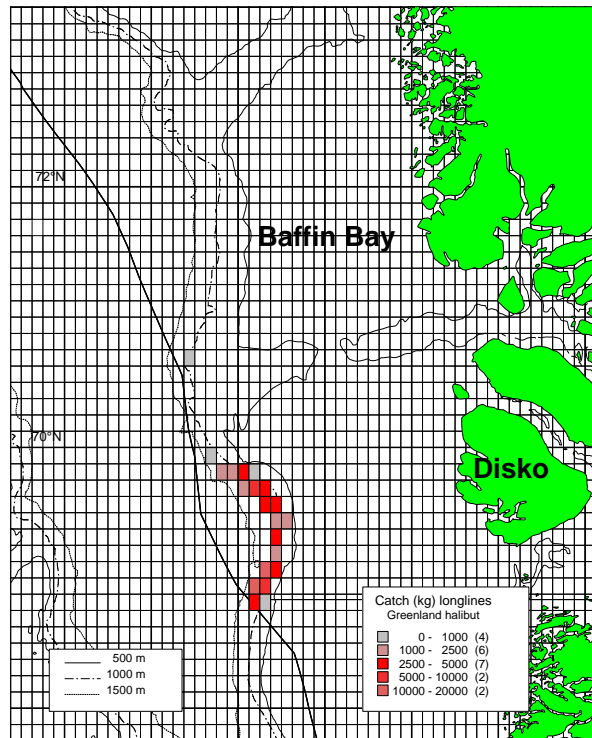


Fig. 8. Distribution of catches of Greenland halibut taken by longline in 2000.

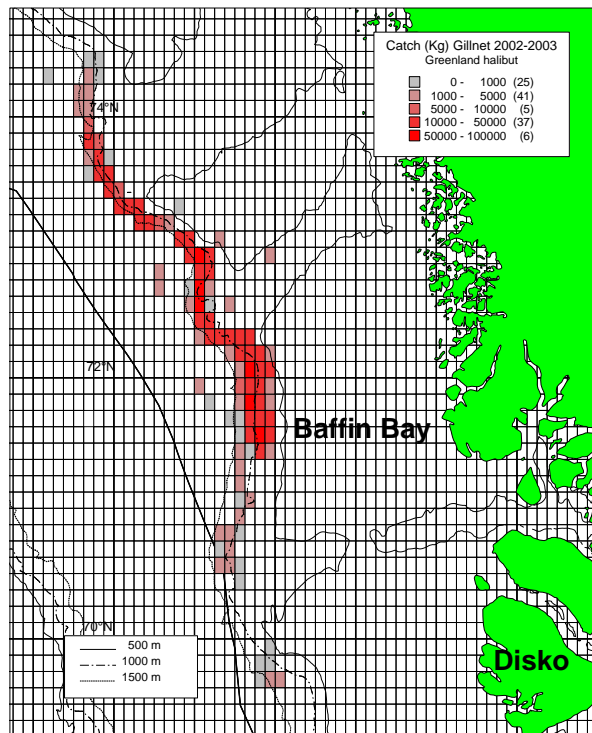


Fig. 9. Distribution of catches of Greenland halibut taken by gill net in 2002-2003. Data pooled.

### 3.1 Greenland halibut inshore

#### Description of the fishery

The inshore fishery in NAFO Division 1A is concentrated in three main areas: Disko Bay, Uummannaq and Upernavik and the total landings have been about 20.000 tons in recent years (Fig. 10). The fishery is traditionally performed with longline from small open boats (dinghies) or by dog sledges. In the recent 10-15 years bigger vessels (>25 feet) have entered the fishery, but vessel larger than 125 BT are not allowed to fish inside the 3-mile line (inshore). Typically the fishery is carried out in the inner parts of the ice-fjords at depths between 500 and 800 m. In the middle of the 1980s gillnets were introduced to the inshore fishery, and were used more commonly in the following years. Today 90-99 % of the total landings are, however, taken by longlines. The gillnet fishery is regulated by a minimum mesh-size of 110 mm (half meshes), while there are no gear regulations on the longline fishery (Nygaard & Boje 2012).

The distribution of the catches inshore of Greenland halibut taken by vessels greater than 30 ft. and reported to GFLK as log books are shown in Fig 11. The fishery with dinghies and dog sledges is conducted in the same areas as the fishery by larger vessels.

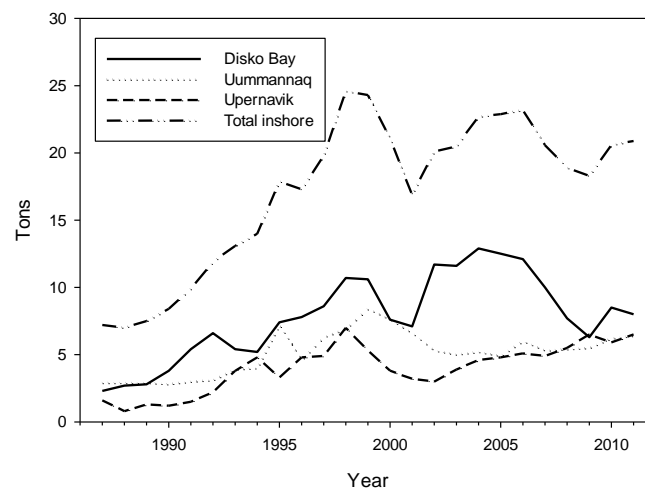


Fig. 10. Total catches and catches by area in the inshore Fishery in NAFO Div. 1A.

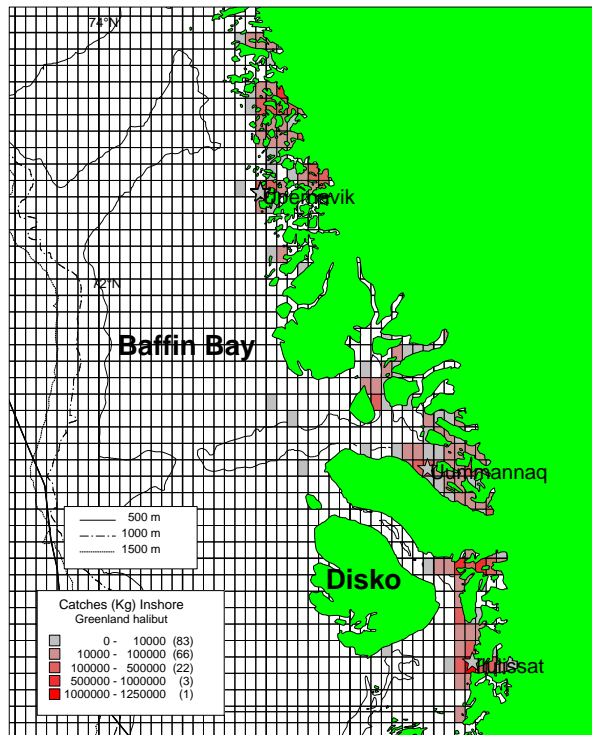


Fig. 11. Catches inshore of Greenland halibut taken by vessels greater than 30 ft. Data from 2010-2012 pooled.

### 3.3 Northern shrimp

#### Description of the fishery

In 1970 a multinational offshore fishery aimed at Northern shrimp was initiated. In the beginning, the fishery concentrated on the wide shelf west and southwest of Disko Bay (Area 6; Fig. 12), but as the fishery expanded in the 1980s, Disko Bay (Area 1-3), Holsteinsborg Deep (Area 7) and northern areas (Area 0 and 4-5) were included in the fishery. During the late 1980s the fishery expanded southwards to Area 8-13. Since the late 1990s the fishery has moved northward and the fishery is now concentrated in Disko Bay and offshore in Baffin Bay (Area 0 and 3-5) (Fig. 13) (Hammeken Arboe 2012).

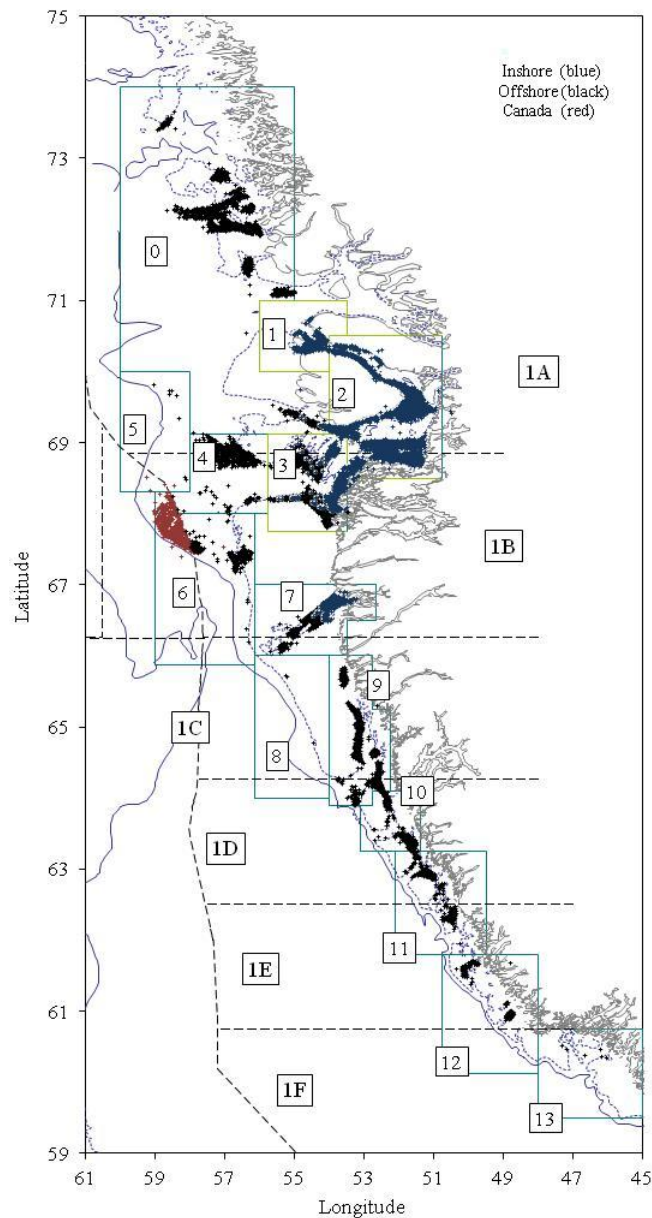


Fig. 12. Distribution of the inshore and offshore shrimp fishery on a haul by haul basis by fishery areas in the Greenland fishery from July 2011 through June 2012. (Inshore fleet: 12165 hauls. Offshore fleet and Canada: 11435 hauls) (From Hammeken Arboe 2012).

Catches in the Baffin Bay area (north of 68°N) has constituted between 60% and 75% of the total catch taken in West Greenland waters during the last 5 years amounting to between

82.000 tons and 96.000 tons (Fig. 13). From the late 1990s to 2007 the catches in the Disko Bay area have been between 15.000 tons and 20.000 tons. Since 2008 the catches in the Disko Bay area have been between 30.000 tons and 44.000 tons. The increase in catches taken by the inshore fleet in the Disko Bay Area is consistent with results from the survey, in which the proportion of survey biomass in the Disko Bay has increased significantly since 2005 (Kingsley et al. 2012; Hammeken Arboe 2012).

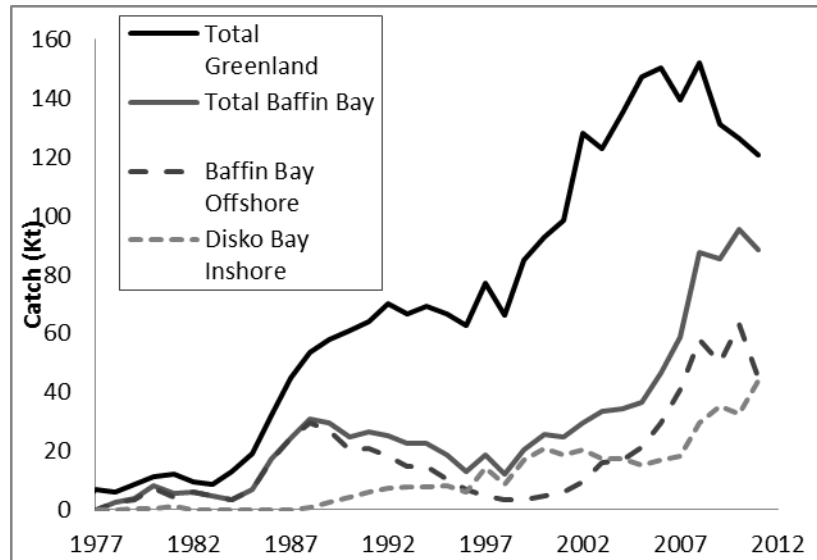


Fig. 13. Catches of Northern shrimp 1997-2011.

From 1981 until 2003 the West Greenland fishery was prosecuted by Greenlandic vessels in NAFO Subarea 1 and to Canadian vessels in NAFO Div. 0A, but in 2003 a quota on 1000 tons offshore at West Greenland was allocated to EU vessels. The quota has been increased since then then and is now on 4000 tons (Hammeken Arboe 2012).

In recent years catches offshore have mainly been taken by 8-10 large (1860-3377 BT) factory trawlers from Greenland using single and twin trawl. The offshore fleet has to stay 3 n.mi. outside the baseline and is excluded from five closed areas - 'shrimp boxes'. Further, there are a few (2139-2340 BT) sea-going factory trawlers that are fishing on a coastal quota but also participate in the offshore fishery (G.H. 2002). About 30 small trawlers (most of them less than 250 BT) constitute the inshore fleet. They are fishing on a coastal quota but are allowed to fish everywhere including Disko Bay (Area 1-2; Fig. 12) and the five 'shrimp boxes' (Hammeken Arboe 2012). These trawlers fish with a single trawl. The coastal fleet generally ices the catch and lands it for processing. Greenland factory vessels with on-board production licenses are required to land 25% of their catches (Hammeken Arboe 2012).

The mean fishing depth in the off shore area in Baffin Bay is 299 m (min. 50 m, max. 624 m, q25% 260 m, q75% 355 m). In the inshore areas the mean fishing depth is 257 m (Kingsley 2011)

The fishery for Northern shrimp peaks in 3. quarter where about 31.7 % of the catches are taken, but the fishery has been rather evenly distributed throughout the recent three years with 17.5 %, 21.7% and 29% of the catches in 1., 2., and 4. quarter, respectively (Fig.16). The access to the more northern grounds is restricted by sea-ice in the early part of the year.

The distribution of the off shore fishery for Greenland halibut and the fishery for northern shrimp is shown in fig 17.

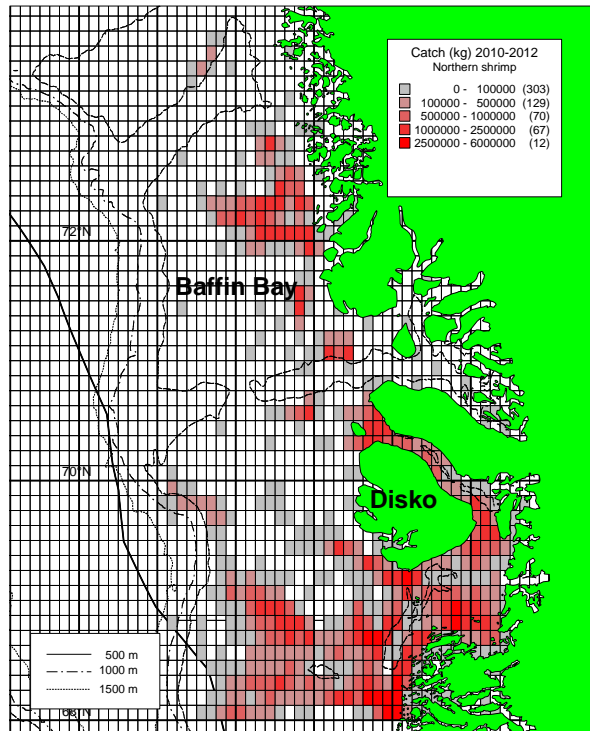


Fig. 14. Distribution of catches of northern shrimp. Data from 2010-2012 pooled.

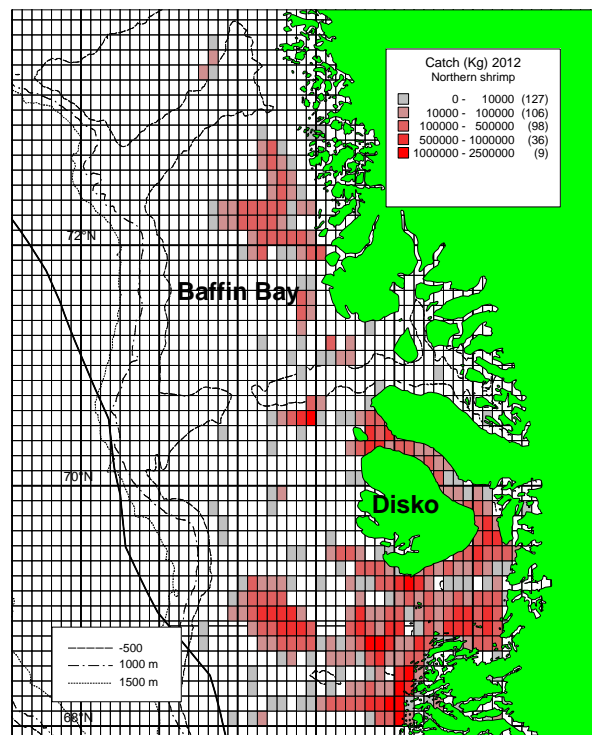


Fig. 15. Distribution of catches of northern shrimp in 2012. Data are preliminary.

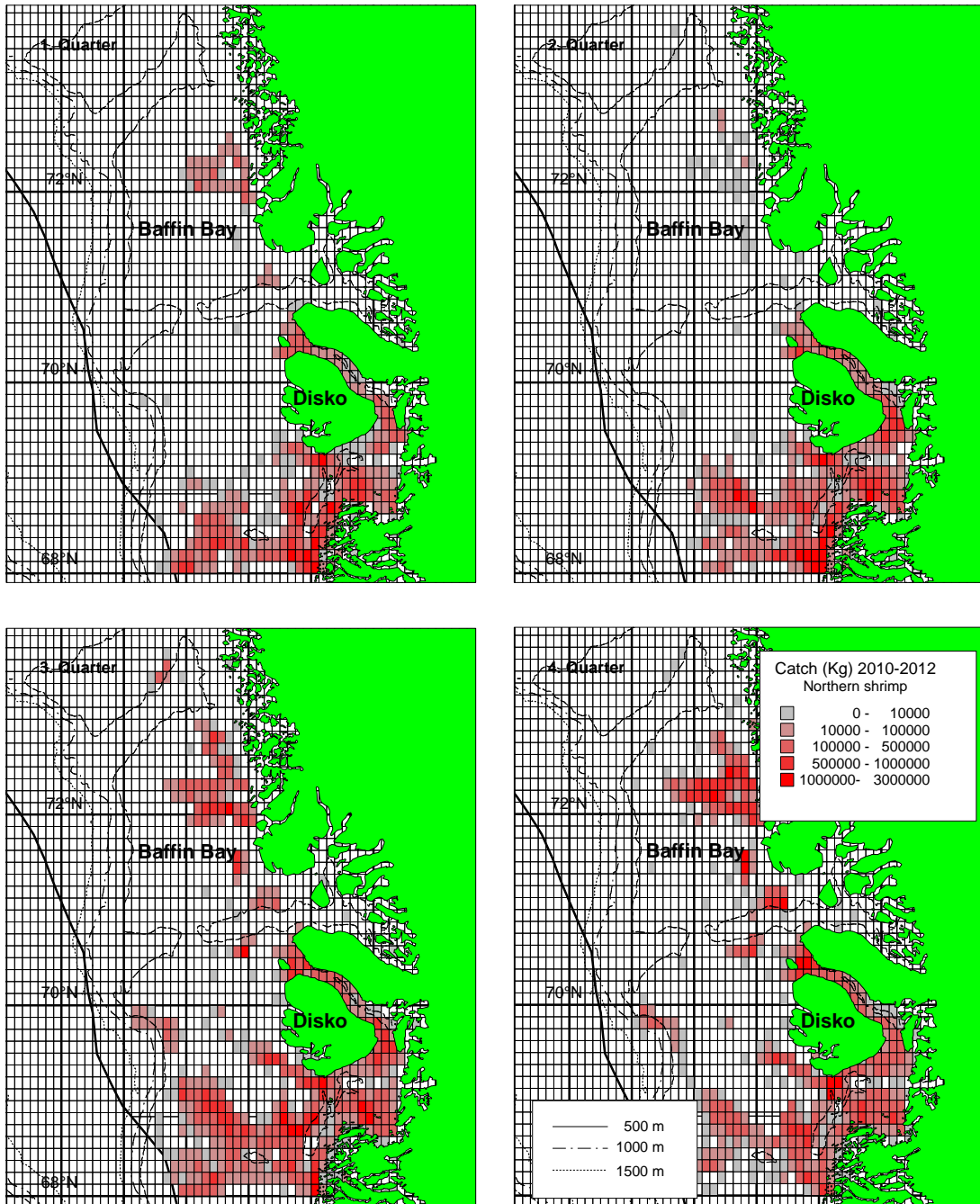


Fig. 16. Distribution of catches of northern shrimp by quarter. Data from 2010-2012 pooled.

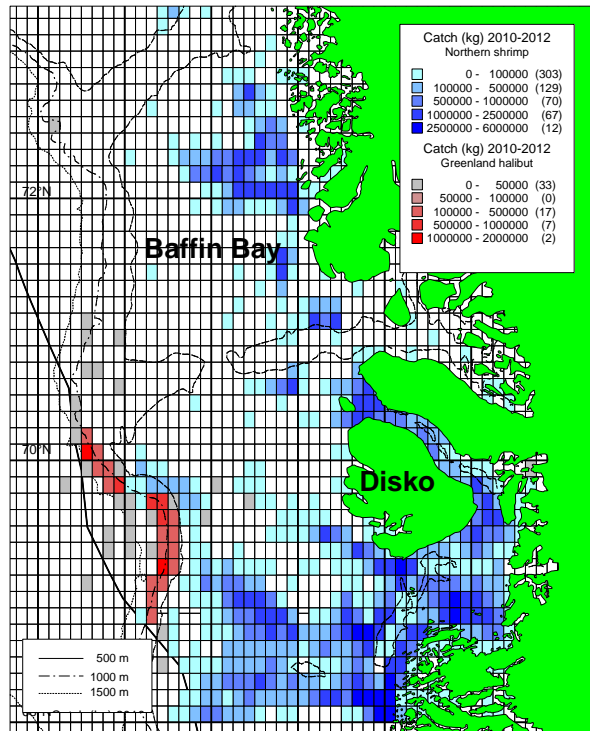


Fig. 17. Distribution of catches of northern shrimp and Greenland halibut (off shore). Data from 2010-2012 pooled.

#### 4. Acknowledgement



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