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Denmark/Greenland Research Report for 2010

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This report presents information on preliminary catch statistics from the commercial Greenland fishery in 2010. Furthermore, the report gives a brief overview over the research carried out in 2010 by the Greenland Institute of Natural Resources.

WEST GREENLAND (NAFO SUBAREA 1)

A. Status of the fisheries

Provisional statistics for the fisheries from 2007 to 2010 are presented in Table 1. Additional information on the status of the fisheries is as follows:

1. Shrimp

The shrimp stock off West Greenland is distributed in NAFO SA 1 (Div. 1A-1F), but a small part of the habitat, and of the stock, intrudes into the eastern edge of Div. 0A (east of 60°30' W). Northern shrimp is found mainly in depths between 150 and 600 m. The stock is assessed as a single population. The Greenland fishery exploits the stock in SA 1, Canada in Div. 0A.

Three fleets, one from Canada and two from Greenland (vessels above and below 75 GRT) have participated in the fishery since the late1970s. The Canadian fleet and the Greenland offshore fleet (> 75 GRT) have been restricted by areas and quotas since 1977. The fishery by the Greenland coastal fleet (< 75 GRT) was unrestricted until 1997, when quota regulation was imposed. Mesh size is at least 44 mm in Greenland, 40 mm in Canada. Sorting grids to reduce by-catch of fish are required in both of the Greenland fleets (but dispensation from this has been granted for all vessels under 75 GRT since 2001 for safety reasons) and in the Canadian fleet. Discarding of shrimps is prohibited.

The annual TAC advised for the entire stock for 2004-2007 was 130 000 tons live-caught weight, which was reduced to 110 000 tons for 2008-2010. The advised TAC for 2011 is 120 000 tons.

The TAC set by the Greenland authorities for SA 1 was 134 000 tons in 2007, 127 300 tons in 2008 and 114 570 tons in 2009 and 2010. The TAC for SA 1 for 2011 is 124 000 tons. A TAC of 18 417 tons was set by the Canadian authorities for Div. 0A east of 60°30'W for 2007-2011.

Greenland requires that logbooks should record catch live weight, but for shrimps sold to on-shore processing plants an allowance is made for crushed and broken shrimps in reckoning quota draw-downs, which are based on weight sold, not on weight caught. Total catch - live weight and logbook reports - can therefore legally exceed the enacted TAC.

Catches peaked in 1992 at 105 000 tons, but then decreased to around 80 000 tons by 1998 owing to management measures. Since then increases in allowed takes have been accompanied by increased catches. The logbook recorded catches in 2005 and 2006, around 157 000 tons, were the highest recorded. Total catch for 2007 was 144 200 tons, total catch for 2008 was 152 750 tons and for 2009 was 135 300 tons. Total catch

for 2010 is approximately 138 500 tons.

The overall combined index of standardized catch rates (CPUE) for the 3 fleets fluctuated without trend by a factor of 2 between 1976 and 1987. It then dropped precipitously to the lowest levels in the series in 1990–91, and stayed fairly flat until 1996. Since then, the unified CPUE index increased markedly and sustainedly for 9 years, reaching a plateau in 2004–2008, to turn downward in 2009.

According to logbook records, 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. However, these southern areas have since become less important and the fishery is now again concentrated in Division 1B - more so than at any time since the late 1980s.

2. **Greenland halibut**

The total catches of Greenland halibut by Greenland vessels in NAFO Subarea 1 (excluding Div. 1A inshore) amounted in to 8 233 tons in 2010. 5 682 tons were taken off shore in Div. 1AB (north) and 2 189 tons were taken off shore in Div 1C -1F (south), mainly in Div. 1D. The offshore catches were exclusively taken by trawlers (Fig. 1), while the inshore catches were taken mainly by gill net.

The inshore fishery in for Greenland halibut is concentrated in NAFO division 1A (Disko Bay 8.458 tons, Uummannaq 6.226 tons) and Upernavik (5 941 tons). In the other inshore NAFO areas combined amounts to 362 tons in 2010. The fishery is conducted by long lines and gill nets.

Commercial fisheries data. CPUE data, based on logbooks reported to the Greenland authorities, were available from four Greenland trawlers. The CPUE for all vessels combined increased in Div. 1AB from 0.88 ton/hr in 2009 to 0.93 ton/hr in 2010 which is the second largest level since 2002 (1.09 ton/hr) when the catches exceeded 1 000 tons, and the CPUE has generally been rather stable in recent years.

In Div. 1CD the CPUE for three Greenland vessels fishing there has been fluctuating between 0.55 ton/hr and 0.85 ton/hr since 2000. In 2010 the CPUE was 0.78 ton/hr compared to 0.56 ton/hr in 2009

Length frequency samples were available from Greenland trawlers fishing in Div. 1A and Norwegian trawlers sampled by Greenland in 1CD.

3. **Cod**

Cod in Greenland derives from three stock components, labeled by their spawning areas: I) an offshore Greenland spawning stock, II) inshore West Greenland fiords spawning populations, and III) Icelandic spawned cod that drift to Greenland with the Irminger current. It is not feasible to sample and assess stock status of the various stock components are assessed together and the stocks are assessed by ICES see the North-western Working Group (NWWG) report, April 2011 and ACFM report 2011. Presently no management objectives have been set for this stock. Management considerations from the ACFM were that "A main management objective should be to establish a robust offshore spawning stock comprised of several year-classes that may improve the likelihood of future good recruitment. Such an objective could be a basis for a biomass reference point and thus determine reopening of the fishery in the future. In addition spatial criteria on distribution of spawning grounds could be included in the definition of such a reference point/basis, e.g. requirements of established spawning stocks at both East and West Greenland."

The cod fishery in Greenland consists of two components, an offshore fishery and an inshore fishery. The offshore fishery completely collapsed in 1993. From 1994 to 2001 no directed offshore cod fishery has taken place. In the 2000s catches have gradually increased with maximum catches in 2008. Since 2008 offshore areal closures have been implemented in order to protect the spawning stock. In 2010 offshore catches was therefore found exclusively off southeast Greenland (ICES XIVb south of 62^{o}N) except for a small experimental fishery in West Greenland which caught 290 tons. Total offshore catches in 2010 amounted to 2,700 tons. The inshore cod fishery at West Greenland is during 1992-2006 assumed to be based on self-sustained fjord populations. From 1993 to 2001 the inshore catches were low – in the range 500-2,000t. The inshore fishery was until 2009 under no restrictions other than minimum landing size of 40 cm. In 2010 a TAC of 8,500 tons was allotted to the inshore fisheries. In 2010 the catches from the coastal fleet amounted to 9,300, which is 21% above last years

catches. The coastal fleet catches peaks during summer where the dominant pound net fishery takes place.

The offshore Greenland spawning component has not been fished during the last 15 years. Surveys and exploratory fishery now suggest dense concentrations of large spawning cod in East Greenland north of 63°N. The area is limited in distribution compared to the spawning grounds observed historically. Recruitments in the offshore area have improved since the end of the 1990s although it is still low compared to the recruitments before the stock was depleted. Inshore spawning occurs in many fiords and recruitment has increased in recent years in the areas surveyed. Recruitment is now well above the lows observed in the late 1990's.

4. Salmon

Atlantic salmon migrates to Greenland from most salmon producing countries around the North Atlantic and in Greenland only one spawning population Atlantic salmon is known. The modern fishery for Atlantic salmon fishery in Greenland waters started around 1960 and peaked in the early seventies at a catch level of more than 2000 tons a year. The fishery was quota regulated from 1972, but due to declining stocks NASCO in June 1998, agreed that no commercial fishery for salmon should be allowed, but that the catch at West Greenland should be restricted to *'that amount used for internal consumption in Greenland, which in the past has been estimated at 20 tonnes'*. Since then export of salmon from Greenland has been banned. The salmon caught along the shores of West Greenland are mostly (>90%) non-maturing 1SW salmon, most of which are destined to return to home waters in Europe or North America as MSW fish if they survive. In 2010 total nominal catches amounted to 40 tons including 2 tons from East Greenland.

5. Capelin

The capelin fishery in West Greenland is carried out inshore and in the spawning season only (May-July). Catches are low and have been for the last decade with highest catches being 267 tons in 2004 and in 2010 catches were 90 tons. The main part of the catches is produced as whole frozen fish for bait and local consumption, while a smaller part is dried and stored as food for sledge dogs in the winter season. The majority of the catches were taken are taken in the northern part of West Greenland (NAFO 1A and 1B).

6. Redfish

Two species of redfish of commercial interest occur off West Greenland inshore and offshore, golden redfish (*Sebastes marinus* L.) and deep-sea redfish (*Sebastes mentella* Travin). Relationships to other North Atlantic redfish stocks are unclear. Redfish catches in West Greenland are reported as redfish (unspecified, mainly by-catch), golden redfish and beaked redfish (pelagic redfish). In 2010 logbook reported by-catch by Greenlandic shrimp vessels of un-specified redfish amounted to 75 t and the catches of golden redfish taken in other fisheries amounted to 166 t . There is no forecast for golden and deep-sea redfish stocks in West Greenland and the advice from NAFO is "no direct fishery".

Pelagic redfish

The aggregations of pelagic redfish *S. mentella* found in the NAFO Convention Area belong to the same stock of pelagic redfish from the Irminger Sea. The stock is assessed by ICES (NWWG report 2011) and the assessment covers the pelagic redfish in ICES Divisions Va, Vb, and XIV and in the NAFO Div. 1F, 2H and 2J. ACFM has advised for 2010 that catches of deep pelagic *S. mentella* are set at 20 000 t as a starting point for the adaptive part of the management plan.

The pelagic fishery on *S. mentella* in NAFO Div. 1F started in 1999. Since 2000, significant catches were taken in NAFO Divisions 1F and 2J, up to 32 000 t (20% of total catches) in 2003. In 2010, however, only 1074 t were taken in the NAFO area 1F. The Greenland fleet has reported a total catch of deep pelagic *S. mentella* of 1 932 tons in 2010, caught only in ICES Divisions.

7. Grenadiers

There are two species of grenadiers of commercial interest in Greenland: roundnose grenadier and roughead grenadier. All catches are, however, reported as roundnose grenadier. The catch reported is taken as by-catch in the Greenland halibut fishery. 4 tons roughead grenadier and less than a ton of roundnose grenadier has been reported in 2008 from the inshore fisheries in NAFO Div. 1A. And less than a ton in the offshore fishery for Greenland halibut in SA1. No grenadier catches have been reported for 2010. No forecast – the biological advice is "no direct fishery".

8. **Snow Crab**

The snow crab stock for the fisheries is distributed in the Div. 0A along the west coast of Greenland. 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. Large vessels (greater than 75 GRT) may only fish in all offshore areas (outside the basis-line). Total allowable catch (TAC) restrictions have been imposed since 1995, but have only limited the catch in some areas since 2004.

The number of vessels with licenses to participate in the snow crab fishery increased from 1999 to 2002 from approximately 120 vessels to 392 vessels. Since then the number of both large and small vessels have decreased substantially as the abundance of the resource has also declined. In 2010 number of permits were 96, where by 32 were active in the snow crab fishery.

The total catch in NAFO Subarea 1 peaked in 2001 with approximately 15.000 tons. From 2001 to 2010 total catch decreased approximately 86% to 2.100 tons (table 1). Most of the landings are based on fishery in the management areas Disko Bay-Uummannaq, Sisimiut and Nuuk-Paamiut. The total fishing effort (trap hauls) has declined by 95% since 2001 (from 3,416 to 220 thousand trap hauls during 2001-2010). The decline has been mostly due to a declining number of participants in the fishery.

9. **Scallops**

Total catches of scallops in NAFO Subarea 1 amounted to 398 tons in 2010. A total quota for scallops in 2010 was set at 1.920 tons. All catches are taken in inshore areas in Div. 1A, 1B, 1C and 1D. New fishing grounds near Sisimiut (1B) was found in 2003 and quotas for two new areas was introduced in 2004.

10. Lumpfish

Total catches 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 since being 8.482 tons in 2010.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° N.

B. **Special Research Studies**

1. **Environmental Studies**

a. **Hydrography Studies**

A survey of oceanographic stations along the West Greenland standard sections was carried out in summer 2010. Results are presented in NAFO scr.doc. In winter 2009/10, the North Atlantic Oscillation (NAO) index was exceptionally negative describing weakening westerlies over the North Atlantic Ocean. Often this results in warmer conditions over the West Greenland region. The air temperature was much higher than normal during winter – especially over the southern Baffin Bay. The annual air temperature was even more extreme with record high temperature anomaly at Nuuk almost exceeding the existing record twice.

The general settings in the region have traditionally been presented with offset in the hydrography observed over the Fylla Bank. Here, time series of mid-June temperatures on top of Fylla Bank show temperatures 0.5°C above average conditions in 2010 but with low salinities. At the southern sections on top of the shelf a thick low saline pool of Polar Water was observed from Cape Farewell to Maniitsoq and to a lesser degree on top of Fylla Bank suggesting above normal presence of Polar Water on the southern sections. The presence of Irminger Water in the West Greenland waters was high in 2010. Pure Irminger Water (waters of Atlantic origin) could be traced north to the Sisimiut section. The mean (400–600 m) temperature west of Fylla Bank (st.4) was high and the salinity record high. For the same depth interval at Maniitsoq (st.5) and Sisimiut (st.5), the salinities were the second highest observed yet with very high temperature. In the Disko Bay off Ilulissat (st.3), the bottom temperature and salinity has decreased since 2009 to only about average, but still generally above values before mid-1990. This was surprising as high salinities and temperatures were observed further south off West Greenland.

2. Biological Studies

a) Shrimp

The series of annual stratified trawl surveys, initiated in 1988 and converted to a semi-systematic design in 1999, was continued in 2010. In July-August 2010 270 research trawl hauls were made throughout the distribution area of the West Greenland shrimp stock, including areas in Subarea 0 and the inshore areas in Disko Bay and Vaigat.

The survey biomass indices indicated a fairly stable stock size from 1988 to 1997. Survey estimates of total biomass of Northern shrimp off West Greenland showed little variation over the initial ten-year period, but after a comparatively low estimate of 178 000 tons in 1997 the biomass increased steadily to 598 000 tons in 2003. This peak value was followed by unbroken decline to 350 000 tons in 2007 and a further abrupt decline, by 20%, in 2008. Total biomass in 2010 was at the 2007 level at 345 182 tons. The decline in total biomass observed since 2003 occurred predominantly in the southern part of the west Greenland shrimp grounds; indices of the location and distribution of the survey biomass show that the distribution has contracted since 2001–3 and moved northward since 1999. Fishing effort in 2009 and 2010 in the southernmost part of the West Greenland grounds was low.

Numbers of age-2 shrimps from the research trawl survey peaked in 2001, but then continually decreased and in 2007 reached a record low, at about 7% of the 2001 peak. In 2010 the level is still below the long term average, but the recruitment index must be evaluated.

b) Greenland halibut

A Greenland offshore trawl survey for Greenland halibut was initiated in 1997. The survey is a continuing of the joint Japanese/Greenland survey carried out in the period 1987-95. In 1997-2010 the survey covered NAFO Div. 1C and 1D between the 3 nm line and the 200 nm line or the midline against Canada at depths between 400 and 1500 m. In 2010 there were made 66 successful hauls in Div. in Div. 1CD.

In 2001 the survey area was expanded to include NAFO Div. 1B-1A (to 74°N) and in 2004 a survey was conducted in the northern part of the Baffin Bay (73°N-77°N) (Div. 1A) at depths down to 1500 m. In 2010 was conducted a survey in Div. 1A to 75°30’ where 93 successful hauls were made.

A longline survey for Greenland halibut in the inshore areas of Disko Bay, Uummannaq, and Upernavik was initiated in 1993.

Since 2001 a gillnet survey was initiated in the Disko Bay area. In 2008 a total of 36 gillnet settings were made along 4 transects. Each gillnet was compiled of 4 different nets, each with a different mesh size (46, 55, 60 and 70 mm stretch meshes). The distribution pattern showed a markedly higher density of Greenland halibut in the mouth of the ice fjords.
In 2010 a gillnet survey was conducted in Disko Bay, the annual longline survey was not conducted in Upernavik.

c) Cod survey

A survey using gangs of gill nets with different mesh-sizes has been developed and used since 1985 with the objective of assessing the abundance of age 2 and age 3 cod in the inshore areas. The indices in all areas (NAFO 1B, 1D and 1F) are generally above the levels observed during the 1990’s. In 2010 recruitment indices for age 3 cod (2007 YC) was highest recorded since 1992.

An annual stratified random trawl survey has been conducted since 1988 in West Greenland between 59º15’N and 72º30’N and the inshore area of Disko Bay from the 3 mile limit down to the 600 m. The main purpose of the survey is to evaluate the biomass and abundance of the Northern shrimp (*Pandalus borealis*), but since 1992 data on fish species have been included. Since 2008 the survey also covers the East Greenland area to Dohrn Bank at 67^{o}N.

Until 2001 the survey biomass indices of cod was below 1,000 tons but increased to about 2,300 tons in 2004 and continued to increase thereafter with highest biomass indices in 2007 and 2008 with estimated biomass and abundance indices at 28,481 tons and 53.4 mill individuals. The total offshore stock has however declined in 2009 compared to 2008 with 85% in biomass and 70% in abundance in West Greenland. This was mainly caused by a decrease in the abundance of the 2003 and 2005 YC in West Greenland, which were the dominating YC in previous years. In 2010 the biomass has increased with 56% due to the growing of the 2007 YC which was also observed in 2009.

d) **Snow crab**

Annual monitoring program (trap survey) was initiated in 1997 in Disko Bay (Div. 1A) and Sisimiut (Div. 1B). Since 2001 annual offshore trap survey has been conducted in more southern areas in West Greenland (Div. 1C and 1D). Large and small meshed conical traps are used. All snow crab were enumerated by sex, carapace width and carapace condition. The chelae height was measured in males and the abdomen width in females, respectively for maturity determination. Ovary contents, clutch weight, sperm load and egg development stage in females was also determined and females were sampled in relation fecundity studies.

The objective of both monitoring programs is to assess the abundance of snow crab in inshore and offshore waters of Greenland. Results from this survey are presented in the Technical Report Series of the Greenland Institute of Natural Research. In general the stock and recruitment prospects are at a low level in all areas.

e) **Marine mammals**

Studies of white whale and narwhal continued in 2010 and details are being reported to JCCM and NAMMCO. In 2010 also studies of minke whale, fin whale and humpback whale continued. Monitoring study on large cetaceans is being reported to IWC. Studies of harp and hooded seals are being reported to the Joint ICES/NAFO Working Group on Harp and Hooded Seals.

f) **Special studies**

A Ph.D. project, initiated in 2004, is studying the reproductive potential of snow crab in the coastal waters of West Greenland. The present study will use existing data and data collected in fieldwork surveys in Div. 1A, 1B and 1D. Exploited and non-exploited stocks will be examined as well as temperature effects. Life history traits will be related to aspects of snow crab reproductive potential at three study sites: Disko Bay (north), Sisimiut (middle) and Nuuk (south). The study will contribute to a better understanding of the reproductive potential in the snow crab fisheries resource, and provide essential base line information for adaptive management and conservation strategies.

GREENLAND FISHERY IN OTHER NAFO SUBAREAS

A. **Status of the fisheries**

In 2010 one Greenland vessels was engaged in shrimp fishery at Grand Bank (NAFO Div. 3L) and reported catch from 3L amounted to 534 tons. 0 tons was reported from Flemish Cap (NAFO Div. 3M).

References

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Table 1. Estimated catches (tons) by Greenland vessels at West Greenland (NAFO Subarea 1) in 2007-2010.

	NAFO SA					
	Div. 1A, B, C, D, E, F				Div 3M	Div 3L
Species	Estimated catch 2007*	Estimated catch 2008*	Estimated catch 2009*	Estimated catch 2010*	Catch 2010	Catch 2010
American Plaice	nd	nd	nd	0		
Arctic char	16	nd	19	nd		
Atlantic halibut	nd	8	5	6		
Atlantic salmon	25	26	26	38		
Atlantic cod	13.313	21.921	10.958	12.000		
Capelin	33	138	184	90		
Crabs	2.189	2.354	3.165	2.098		
Greenland cod	597	405	161	nd		
Greenland halibut	27.976	31.680	24.603	29.222		
Grenadiers	25	0	nd	nd		
Haddoc	0.3	nd	nd	nd		
Lumpfish	8.800	6.436	6.447	8.482		
Polar cod	nd	6	nd	nd		
Redfish (unspecified - bycatch mainly)	257	265	124	75		
Pelagic redfish	513	0	0	0		
Redfish golden	85	107	226	166		
Saithe	6	1	nd	nd		
Scallops	1.392	756	511	398		
Shark	1	nd	nd	nd		
Shrimp (P.boreallis)	144.190	152.749	135.319	138.500	0	534
Shrimp (P.montagui)	2.003	53	88	2.594		
Skate	0	0	nd	0		
Wolffishes	879	1.152	1.130	1.315		
Fish not specified	nd	nd	nd	nd		
Sum total	202.300	218.057	182.966	194.984		534

* Catch figures from recent years are provisional.

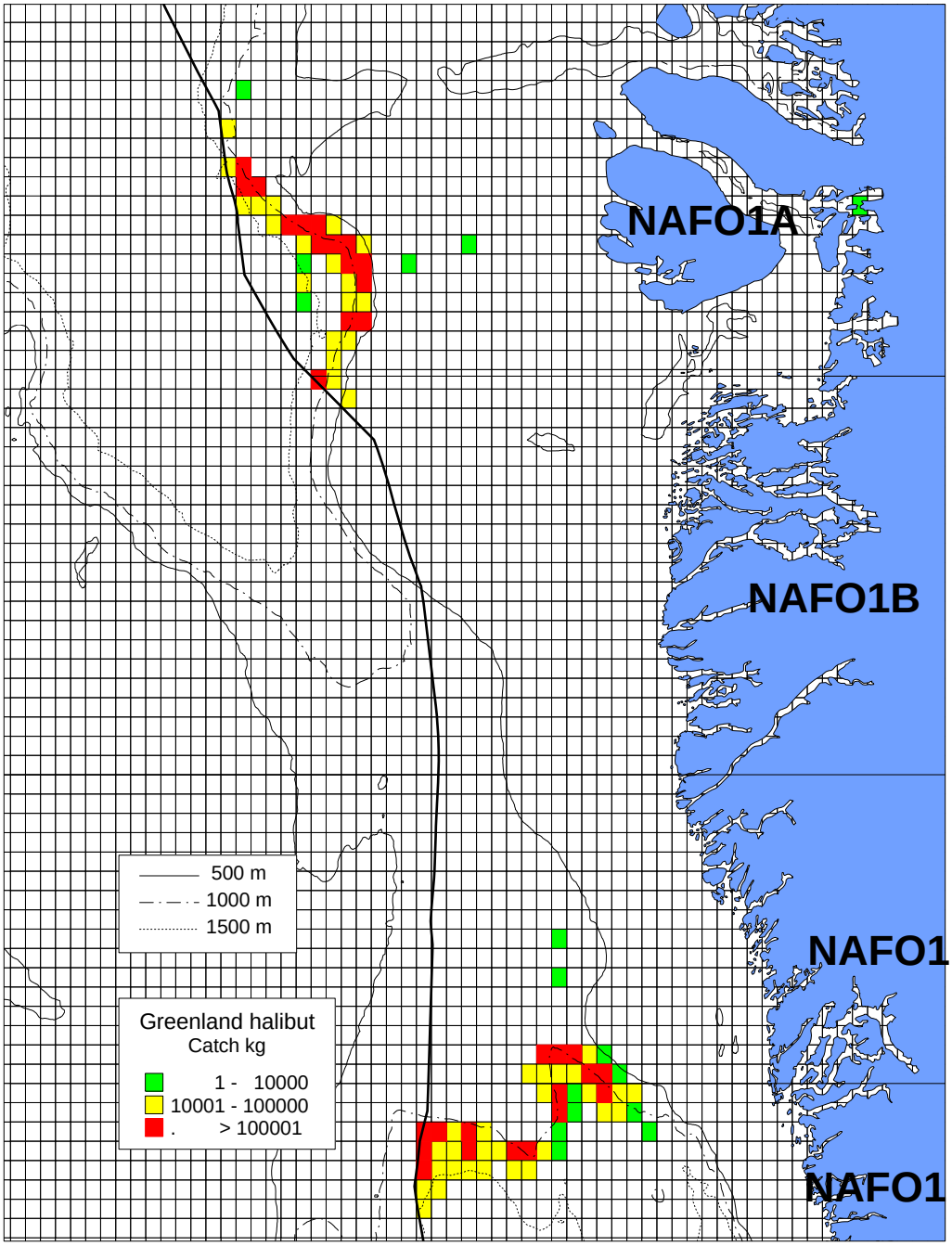

Fig. 1. Distribution of the offshore catches of Greenland halibut in SA 1 in 2010 by statistical square. All nations.