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Denmark/Greenland Research Report for 2008

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This report presents information on preliminary catch statistics from the commercial Greenland fishery in 2008. Furthermore, the report gives a brief overview over the research carried out in 2008 by the Greenland Institute of Natural Resources.

**WEST GREENLAND (NAFO SUBAREA 1)**

**A. Status of the fisheries**

Provisional statistics for the fisheries from 2006 to 2008 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 on the west Greenland shelf in Div. 0A and Subarea 1 in depths between 150 and 600 m. The fishery is now prosecuted by Greenland, EU and Canada. The Greenland and EU fishery exploits the stock in Subarea 1 (Divs 1A–1F), while the Canadian fleet has been restricted to Div. 0A since 1981.

Three fleet components, one from Canada and two from Greenland (vessels above and below 80 GRT) participated in the fishery since the late-1970s. The Canadian fleet and the Greenland large-vessel fleet have been restricted by areas and quotas since 1977. The fishery by the Greenland small-vessel fleet was unrestricted until January 1997, when quota regulation was imposed. In 2007, the advised TAC for the entire stock was 134 000 tons: the Greenland authorities set a TAC for Subarea 1 of 134 000 tons, and a TAC of 18 417 tons was set by the Canadian authorities for Div. 0A east of 60°30'W for the same year. Sorting grids to reduce fin-fish by-catch are required to be fitted to trawls in the Greenland large-vessel fleet and the Canadian fleet (maximum 22 mm bar spacing in the Greenland zone; 28 mm in the Canadian). Discarding of shrimp is prohibited

Overall annual catch increased from about 10 000 tons in the early 1970s to more than 105 000 tons in 1992. Moves by the Greenlandic authorities to reduce effort and fishing opportunities elsewhere for the Canadian fleet caused catches to decrease to about 80 000 tons by 1998. Total catches subsequently increased, in step with increases in both catch rates and estimated survey biomass, to peak at values near 155 000 tons in 2005–06. Total catch in 2007, although lower, was still over 141 000 tons, but 2008 catch was lower again.

Catch rates (CPUE) are still high in historic terms, but declined from 2007 to 2008, and the stock is being fished in a shrinking area. Survey biomass peaked in 2003 and has since continually declined, to less than half the peak value by 2008. Estimated numbers of small shrimps peaked in 2001, but then decreased steadily for 6 years to about 7% of the peak value by 2007; however, this index of future recruitment did increase in 2008, to about 27% of the peak value. The catches of over 140 000 tons taken in 2004–07 are no longer sustainable, and NAFO advised TACs of 110 000 tons for both 2008 and 2009.

## 2. Greenland halibut

The total catches of Greenland halibut by Greenland vessels in NAFO Subarea 1 (excluding Div. 1A inshore) amounted to 7 005 tons in 2008. 5 524 tons were taken off shore in Div. 1AB(north) and 1 429 tons were taken off shore in Div 1C -1F (south), mainly in Div. 1D, while 51 tons was taken inshore in Div. 1B-1F. The offshore catches were exclusively taken by trawlers (Fig. 1.), while the inshore catches were taken mainly by gill net.

The inshore fishery in Div. 1A in 2007 was concentrated in three areas in Disko Bay (8 819 tons ) Uummannaq (5 426 tons) and Upernavik (5 478 tons). 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 five Greenland trawlers. The CPUE for the large trawlers that have participated in the fishery in recent years in Div 1AB increased from 0.87 ton/hr in 2003 to 0.95 ton/hr 2004 and further to 1.1 ton/hr. in 2005 and stayed at that level in 2006 (1.06). CPUE was back at the 2004 level, 0.94 ton/hr, in 2007 and decreased further to 0.86 ton/hr in 2008.

In Div. 1CD the CPUE increased gradually from 0.75 ton/hr in 2003 to 0.99 ton/hr in 2005 and stayed at that level in 2006 (1.02 tons/hr). CPUE decreased to 0.90 ton/hr in 2007. The decrease was caused by a reduction on about 30% compared to 2006 for one of the trawlers. The other trawler showed an increase in CPUE compared to 2006. In 2008 the CPUE increased again to 0.96 ton/hr. A small trawler had increasing CPUE between 2005 and 2006 in Div. 1CD. In 2007 CPUE in 1CD decreased to slightly above the 2005 level to increase again in 2008 to slightly below the 2006 level.

Length frequency samples were available from a Greenland trawler fishing in Div. 1AB and 1CD and from a German trawler fishing in Div. 1D sampled by Greenland.

## 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 2008 and ACFM report 2008. Management considerations from the ACFM were that "A multi-annual management plan should include monitoring the trajectory of the stock, clearly stating specified reopening criteria, and monitoring the fishery when it is reopened. 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. From 2001 catches increased steadily and offshore catches amounted to 4841 tons in 2007. In 2008 the offshore area north of the 63° parallel was closed for directed cod fisheries and the 2008 offshore catches were therefore found exclusively off south Greenland (71% in NAFO 1F; 26% in ICES XIVb). 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. Inshore catches have since increased to reach 7388 tons in 2006 and 11693 t in 2007. In 2008 the catches from the coastal fleet amounted to 12,270. Relative to 2007 catches increased by 44% in the northern divisions 1ABCD and declined by 36% in the southern divisions of 1EF. 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. The landings by the coastal fleet component have increased by a factor of ten over the last decade".

#### 4. **Salmon**

The salmon caught in the West Greenland fishery 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. The abundance of non-maturing 1SW salmon has declined steadily during the last 30 years both in the Southern European and the North American continental areas. The percentage of North American salmon in the West Greenland catch has increased from less than 50% prior to the 1980's to more than 80% in recent years. In 2008 the percentage of salmon with North American origin was 86%.

In West Greenland total nominal catches in 2008 amounted to 26 tons. The advice generated by ICES (WGNAS report 2009) is in response to terms of reference posed by the North Atlantic Salmon Conservation Organization (NASCO), pursuant to its role in international management of salmon. NASCO's present management is directed towards reducing exploitation to increase spawning escapement to allow river-specific CLs to be achieved. The first measurable outcome of management at West Greenland is that the exploitation in the fishery has declined. To date the objective of simultaneous attainment of conservation limits in Labrador, Newfoundland, Quebec and Gulf of St Lawrence has not been achieved. Nor has there been a 10% or 25% increase in spawners to either Scotia-Fundy or the USA. The objective of consistently meeting the conservation limits for the Southern NEAC MSW complex has not as yet been achieved.

#### 5. **Capelin**

The capelin fishery in West Greenland is carried out inshore and in the spawning season only (May-July). The main part of the catches amounted a total of 138 tons in 2008 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 in Div. 1A. There are no data from catches in 2007.

#### 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). Reported catches of Golden redfish in 2008 was 28 tons. 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 2009) 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 2009 that catches of 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 2008, however, only 117 t were taken in the NAFO area. The Greenland fleet has reported a total catch of pelagic *S. mentella* of 1106 tons in 2008, 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 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. From 2004 to 2008 the number of active license holders in all management areas decreased by approx. 80 %.

The total catch in NAFO Subarea 1 peaked in 2001 with approximately 15.000 tons. From 2001 to 2007 total catch decreased approximately 86% to 2.1000 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 90% since 2001 (from 3,416 to 348 thousand trap hauls during 2001-2007). 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 756 tons in 2008. A total quota for scallops in 2007 was set at 2.220 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 has remain on this level since until 2006. Catches in 2007 decreased to 2.977 tons, followed by an increase in 2008 to 8.733 tons. Catches are taken in inshore areas in Div. 1A, 1B, 1C, 1D, 1E and 1F. 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 2008. Here, time series of mid-June temperatures on top of Fylla Bank show below average conditions in 2008 with noticeable low salinities.

The Irminger water (water of Atlantic origin) was warmer than normal, and their salinities were above normal and even 35 or more at Cape Farewell and Cape Desolation. The mean (400–600 m) salinity and temperature west of Fylla Bank (st.4) was both above normal. However, mean temperatures and salinities for the same depth interval for Maniitsoq and Sisimiut were among the highest observed consistent with the large scale settings in the Subpolar North Atlantic. The presence of Polar Water was also above normal in 2008. The extension of multiyear-ice (“Storis”) encountered during the survey was above normal. The salinity above the entire shelf were low with generally low surface and subsurface temperatures. West of Fylla Bank a clear cold Polar Water core was observed, which had very low temperature and salinity. The core is still clear further north west of “Sukkertop Banke” and “Store Hellefiskebanke”. All together this suggest above normal presence of Polar Water.

### 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 2008. In July-August 2008 205 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. 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 2008 in the southernmost part of the West Greenland grounds was almost nil.

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. An increase in this index of future recruitment in the 2008 survey, to 27% of the peak value, is not expected to affect recruitment before 2010–2011, and recruitment to the fishable stock in the near future is expected to correspond to the low age-2 numbers seen in the 2005–2007 surveys.

Developments in assessment methods have included investigations, so far not concluded, into the incorporation of the index of future recruitment into the assessment model, and improved treatment, when standardising CPUE series, of the overpacking correction that was imported into the catch-data series in 2004

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 1997-2005 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 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 2008 there were made 70 successful hauls in Div. 1CD.

During the 2008 survey 1615 Greenland halibut were tagged with floy-tags in Div. 1C

A longline survey for Greenland halibut in the inshore areas of Disko Bay, Uummannaq, and Upernavik was initiated in 1993. No longline survey was conducted 2002 due to technical problems. In 2008 a gillnet survey was conducted in Disko Bay, the annual longline survey was not conducted in Uummannaq.

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.

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.

An annual stratified random trawl survey has been conducted since 1988 in West Greenland between 59°15'N and 72°30'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.

Until 2001 the survey biomass of cod was below 1,000 tons but increased to about 2,300 tons in 2004 and continued to increase thereafter. In 2008 biomass and abundance indices were estimated at 28,481 tons and 53.4 mill individuals, corresponding to +0% and +2% when compared to the 2007 values. Since 2005 then the biomass and abundance has been dominated by the 2003 and the 2005 year-classes. The 2005 year-class size is measured at 33% of the 2003 year-class, measured at age 2. The two dominating year-classes differ with respect to distribution. The 2003 year-class was almost exclusively found in the most southern area of

NAFO Div. 1F whereas the 2005 year-class appears rather evenly distributed along West Greenland. The very southern distribution of the 2003 year-class is similarly reflected in the commercial fisheries that almost entirely took place in Div. 1F.

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. 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 2008 surveys in Div. 1A and 1B were conducted in May/June with the commercial crab vessel "Nanna L". Results suggest that the resource show signs of recovery of the stock in the management area Sisimiut. However, 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 2008 and details are being reported to JCCM and NAMMCO. In 2008 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 2008 one Greenland vessels was engaged in shrimp fishery at Grand Bank (NAFO Div. 3L) and reported catch from 3L amounted to 488 tons. 0 tons was reported from Flemish Cap (NAFO Div. 3M).

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**Table 1.** Estimated catches (tons) by Greenland vessels at West Greenland (NAFO Subarea 1) in 2006-2008.

| Species  | NAFO SA                |                       |                       |            |            |
|--|------------------------|-----------------------|-----------------------|------------|------------|
|  | Div. 1A, B, C, D, E, F |                       |                       | Div 3M     | Div 3L     |
|  | Estimated catch 2006*  | Estimated catch 2007* | Estimated catch 2008* | Catch 2008 | Catch 2008 |
| American Plaice                                    | nd                     | nd                    | nd                    |            |            |
| Arctic char  | 54                     | nd                    | nd                    |            |            |
| Atlantic halibut                                   | 14                     | nd                    | 20                    |            |            |
| Atlantic salmon                                    | 22                     | 25                    | 26                    |            |            |
| Atlantic cod                                       | 7.813                  | 13.313                | 12.270                |            |            |
| Capelin  | 72                     | 49                    | 138                   |            |            |
| Crabs  | 3.482                  | 2.488                 | nd                    |            |            |
| Greenland cod                                      | 1.085                  | 309                   | 405                   |            |            |
| Greenland halibut                                  | 31.160                 | 27.976                | 31.680                |            |            |
| Grenadiers   | 20                     | 30                    | 0                     |            |            |
| Haddock  | nd                     | nd                    | nd                    |            |            |
| Lumpfish   | 8.754                  | 2.977                 | 8.733                 |            |            |
| Polar cod  | 2                      | nd                    | 6                     |            |            |
| Redfish (unspecified - bycatch maily)              | nd                     | nd                    | 28                    |            |            |
| Pelagic redfish                                    | 744                    | 1.961                 | 0                     |            |            |
| Redfish golden                                     | 287                    | 114                   | 0                     |            |            |
| Saithe   | 0                      | 5                     | 1                     |            |            |
| Scallops   | 1.905                  | 1.304                 | 756                   |            |            |
| Shark  | nd                     | nd                    | nd                    |            |            |
| Shrimp ( <i>P.boreallis</i> )                      | 150.533                | 139.631               | 126.221               | 0          | 488        |
| Shrimp ( <i>P.montagui</i> )                       | nd                     | nd                    | nd                    |            |            |
| Skate  | nd                     | nd                    | nd                    |            |            |
| Wolffishes   | 644                    | 654                   | 1152                  |            |            |
| Fish not specified                                 | nd                     | nd                    | nd                    |            |            |
| Sum total  | 206.591                | 190.836               | 181.436               |            | 488        |
| * Catch figures from recent years are provisional. |                        |                       |                       |            |            |

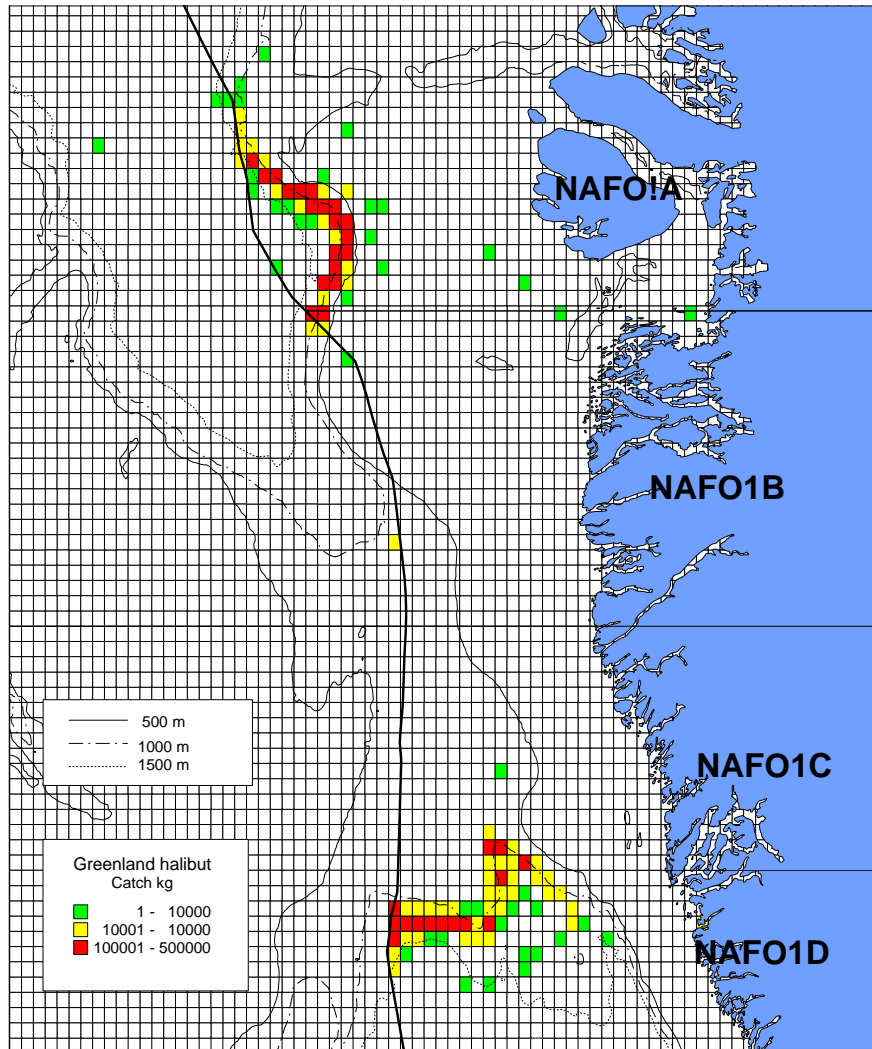


Fig. 1. Distribution of the offshore catches of Greenland halibut in SA 1 in 2008 by statistical square. All nations.