REPORT
of the 3-year (2002-2004) Joint Russian-Norwegian Research Program on Greenland halibut

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Introduction

Since 1990's stock management of the main commercial fish species in the North Atlantic has been based on the principle of the ecosystem approach. For many of the important stocks, safe biological limits such as spawning stock biomass and fishing mortality reference points have been estimated based on which a strategy of rational exploitation can be developed. As for the Greenland halibut, such reference points have not been estimated yet. To solve this problem, Russian and Norwegian scientists have implemented the joint research program initiated pursuant to the decision of the 30th Session of the Mixed Russian-Norwegian Fisheries Commission (2001). The program is sufficiently versatile to include both revision of data already accumulated and collection of new information on the Greenland halibut ecology and fishery. Results from the research conducted within the frames of this program can serve a basis for development of the long-term strategy for rational management of the Northeast Arctic Greenland halibut stock.

The content of the program and progress in the implementation of its individual parts have been discussed at a number of meetings between Russian and Norwegian experts. Some of results from the research were presented at different international fora (Appendix 1).

Amount of the biological material collected in 2002-2005 is given in Tables 1 and 2.

The report outlines the main results achieved during the implementation of the program and presents a draft of the program of the future investigations.

1. Life cycle, reproductive biology, migration and trophic relations of the Greenland halibut

The stock structure of Greenland halibut in the North Atlantic has for long been uncertain, without known genetic structure (Vis et al. 1997; Igland and Nævdal, 2001) and with tag-recaptures indicating that some mixing may occur across the Norwegian Sea (Sigurdson, 1981; Boje et al, in prep.). It is therefore an important finding for the joint program, that a new comprehensive genetic analysis do find statistically significant difference of genetic structure of Greenland halibut between regions (Knutsen *et al*, in prep.). The analyses find no genetic difference between specimens sampled from the Halten Bank to north of the Spitsbergen archipelago, but these samples were significantly different from specimens sampled at Faroe Island, Greenland and in Canadian waters. If these findings are correct, we may thus be more confident that the Northeast Arctic Greenland halibut stock (NEAGH) is a self-contained unit with limited exchange with other areas.

Spawning of the Northeast Arctic Greenland halibut occurs in autumn and winter. The main spawning grounds are located in the deep waters (500-800 m) of the continental slope between 70° and 75°N (Figure 1) (Albert et al., 2001; Nedreaas, Smirnov, 2004).

Distribution and density of the spawning concentrations are variable and depend chiefly on the number of spawners, structure of the mature part of the population as well as on oceanographic conditions in every specific year. The majority of the first maturing Greenland halibut individuals approach the area of reproduction from the north and, if the conditions are favourable, spawn mostly in its northern part (Subarea IIb), while large repeat spawners prefer more southerly areas (Subarea IIa) (Smirnov, in prep).

According to the classification of fish by the type of egg laying Greenland halibut belongs to pelagophilic species. For a lack of adipose capsule, the spawned eggs due to their hydrostatic stability stay in the near bottom water layers and are in the full power of currents. Pre-larvae hatching in March-April also lead a bathypelagic way of living (Smirnov, in prep.), which allow them avoiding adverse effect of environmental factors being the most unfavourable at this time of year at the sea surface. Only with the beginning of warming of the surface layers and development of zooplankton, Greenland halibut larvae having reached 17 mm and more in length, rise to the upper layers of the water column.

During egg and larvae drift, the first settling of individuals from newly appeared yearclasses takes place. Direction of ichthyoplankton drift and posterior distribution of juveniles is much dependent on localization of the parental stock (Ådlandsvik et al., 2004). Water circulation in the spawning areas of Greenland halibut is characterized by the fact that southern parts of the main spawning grounds located between 70° and 73°N are situated in the zone separating the Norwegian and North Cape Currents. The Norwegian Current carries its waters along the continental slope towards Spitsbergen stretching its effect over the areas north of 73°N. The North Cape Current flows to the Barents Sea. Therefore, the more females of Greenland halibut spawn south of 73°N, the higher the probability of mass juveniles penetration to the Barents Sea shelf. Prerequisites for the drift of juveniles to the southern Barents Sea are increased abundance of the spawning stock, high percentage of older age groups in the spawning stock and lowered water temperature in the area of the continental slope.

Ichthyoplankton research and data from international surveys for 0-group of commercial species indicated that until the end of 1980’s (in particular in 1979, 1980, 1983 and especially in 1987) a recurrent drift of large number of juvenile Greenland halibut to the eastern Barents Sea was observed. In 1990’s, because of low abundance of spawners against the background of high water temperature on the spawning grounds, the northern component of the drift was predominant (to Subarea IIb) (Smirnov, in prep.).

At the end of summer – beginning of autumn, juvenile Greenland halibut being 7 cm long start to switch to the bottom way of living. During the long (8-10 months) period of drift, juveniles cover great distances and their settling to the bottom occurs over a wide area in zones the most distant from the spawning grounds and being the margins of the population area.

In the Barents Sea and adjacent waters, a few main areas where bottom juveniles of Greenland halibut are concentrated were identified.

The Norwegian Current going to the West Spitsbergen Current brings juveniles to the fjords of the West and North Spitsbergen and further to the northeast along the continental slope. With the branches of the current via straits between the Spitsbergen and Franz Josef Land juveniles are brought to the northern areas of the Barents Sea shelf. The Northern Branch of the North Cape Current transports juveniles to the northern part of the Hope Island Deep and adjacent areas of the Central Bank and Hope Island area. The Main Branch of the North Cape Current and further the Murman Current deliver ichthyoplankton to the slopes of Central Basin (Nizovtsev, 1989).

The first 3-4 years of life Greenland halibut spend close to the areas of settling, as a rule in shallow waters at the depth of 100-300 m concentrating at the sites with complex bottom topography covered by soft sediments, mainly in the large bottom depressions where to Atlantic waters penetrate (Smirnov et al., 2000). During trawl surveys in 1996-2004, the densest concentrations of bottom juveniles of Greenland halibut were found in the areas with depths more than 200 m from the Erik Eriksen Strait (between the King Carl Land and Northeastern Land) to the Franz-Victoria Trough (between the Franz Josef Land and Victoria Land) (Høines and Smirnov, 2002).

With growth and maturation, the Greenland halibut gradually shift towards spawning grounds and inhabit greater depths (Figure 2).

Greenland halibut males reach maturity faster than females. At age 4-6, they mainly leave dwelling areas of juveniles. Females stay there and also in a large area that separates nursery grounds from spawning grounds 2-4 years longer (Smirnov, in prep). This is the cause for differences in the sex composition of concentrations in the reproduction areas where considerable domination of males is observed and in the margins of the distribution area where percentage of females is increased (Smirnov, in prep.).

Having reached maturity and spawned for the first time, individuals start seasonal migration between the areas of reproduction and feeding (Nizovtsev, 1989).

The most active migrants reaching the southern Norway and Murman coast are the largest individuals among which females are predominant. Analysis of tagging results and literature data indicates that the longest distances are covered usually by fish of 60 cm long and more (Nizovtsev, 1989; Smirnov, in prep.).

From the above it is seen that Greenland halibut is distributed over a vast area of the Barents Sea and adjacent waters, however, by the main role of different areas played in maintaining vitality of the population they can be differentiated as follows. The Norwegian Sea (Subarea IIa) is the main area of spawning and feeding of individuals from older age groups. The Bear Island – Spitbergen area (Subarea IIb) is the main area for feeding of juveniles and spawning of the first maturing individuals. The Barents Sea (Subarea I) is the feeding area for both juveniles (northern and central parts) and adults (central and southern parts).

Food composition of Greenland halibut in the Barents Sea comprises more than 40 prey species, however the diet is dominated by fish (mostly capelin and polar cod) as well as cephalopods, northern shrimp and (since 1990’s) wastes from fishery (Dolgov, 2005a). With growth, a decrease of percentage of small food items (shrimp, capelin) and increase of large fish (cod, haddock) and waste proportion in the diet is observed.

A comparison of food composition showed a considerable intra-species similarity of the Greenland halibut diet both between separate size groups and between sexes. The degree of similarity of Greenland halibut diet with other fish species was the highest with thorny skate and cod, which however usually dwelled in the areas where Greenland halibut occurred in minor amount (Dolgov and Smirnov, in prep).

At the average level of the Greenland halibut stock of nearly 120 thousand tonnes (AFWG 2005), total consumption of food by its population make up about 174 thousand tonnes (Dolgov, 2005a). The consumed biomass of commercial species (cod, haddock, redfish, herring, shrimp, long rough dab and polar cod) is totally estimated to be about 38%.

The Greenland halibut is weakly susceptible to the press of predation (Dolgov and Smirnov, in prep.). Its juveniles were found in the stomachs of only three species – Greenland shark, cod and Greenland halibut itself. Potentially it can be consumed by grey seal, narwhal and killer whale. Cod annually consume from 0.1 to 5.5 thousand tones (1.0 thousand tones on the average) of juvenile Greenland halibut (Dolgov, 2005b), while Greenland halibut itself consume from 90 to 750 tonnes (280 tonnes on the average).

Thus, peculiarities of Greenland halibut distribution and feeding at different stages of the life cycle allow to infer that the Greenland halibut is a species that has an insignificant effect on other commercial species in the Barents Sea. At the same time, the effect of predation on the recruitment to the fishable stock of Greenland halibut is also negligible.

2. Accuracy of age reading and its effect on the Greenland halibut stock assessment

Thorough examinations of the current ageing method routinely used by Norwegian age-readers, showed that the age estimates were seriously biased (Albert *et al*., 2005). It was concluded that the production ageing method is not a scientifically sound method and that it results in underestimation of true age for older individuals. A refined ageing method has been developed and partly verified. Figure 3 shows the difference between the two ageing methods. The refined method produces growth estimates that are in accordance with data from tag-recaptures and modal progression analyses, and is also in accordance with recent radiocarbon analyses of Greenland halibut otoliths from Canadian waters (Treble *et al*, 2005).

A rough comparison of the two methods was made for the Norwegian Greenland halibut survey in 2003. For females the estimated mean age was 6.7 and 11.6 years for the production ageing and the refined ageing method respectively. For males the corresponding figures were 4.7 and 8.3 years. If these results are correct, this means that the age-structured assessments are based on erroneous data. The effect of underestimation of age for older individuals is overestimation of growth and increase of uncertainty in fishing mortality estimates.

The Russian scientists, based on the historical experience, literature data as well as on current experiments on joint (together with IMR specialists) age reading (Figure 4) and comparison of results of age reading done by Russian scientists by scales and otoliths, believes that situation with reliability of age determination results is not so dramatic as the Norwegian colleagues argued.

3. Catchability of scientific trawl and comparative selectivity of trawl and longline

In order to estimate Greenland halibut stock size from bottom trawl surveys, it is necessary to know how the number of specimens caught relates to the number that is present above the area swept by the trawl. The catchability, the fraction of individuals caught to those present, depends on behavioral processes like herding, escapement, and vertical distribution, and varies generally with fish length. For Greenland halibut specimens occurring close to the seabed, catchability of the survey trawl was studied by video recordings and by use of auxiliary bags beneath the trawl. In addition, the vertical distribution of Greenland halibut was studied by use of vertical longlines.

a) Video

At the first stage of works on the estimation of catchability, the Greenland halibut behaviour in the vicinity of the bottom trawl was investigated. Totally 31 video recordings of overall duration of 28.9 hours were used that gave images of 2216 individuals of Greenland halibut.

Elements of the Greenland halibut behaviour during fishing (speed, orientation, percentage of individuals swimming, lying on the ground and escaping under the groundrope in different parts of the fished area) were estimated. These data were used to simulate the Greenland halibut behaviour when fishing and a factor of concentration was calculated (FC is a factor by which density in the trawl mouth is higher than the natural density): FC=3.2.

In the result of the investigations with the use of video equipment a catchability coefficient of bottom trawl was determined to be q=0.3. It was found that artificial light of the video system reduces catches by approximately 19%. Taking this into account, the catchability coefficient can be considered to be q=0.35.

Video recordings of Greenland halibut were also made on eight trawl stations in the Spitsbergen archipelago waters in August 2002 (Albert *et al*, 2003). The recordings were made down to 600 m depth using artificial light. A method for calculating actual fish length from the video image was established and the recordings were analysed with respect to length dependent behaviour, escapement and spatial pattern. From all eight videos, 127 Greenland halibut were recorded as either caught or lost under the ground-gear. The percentage of fish denoted as caught was 72. For 30 cm and larger individuals the proportion caught (catchability) was 70% and independent of length (Figure 5). For smaller individuals catchability was significantly lower (χ^2, df=1, $p<0.05$), estimated to 40%. Studies on the effect of artificial light shows that this may severely influence the catchability estimate (Albert *et al*, in prep.) and further studies were therefore made with auxiliary bags instead of video recordings.

b) Auxiliary bags

In August 2005 a series of experiments were made with auxiliary bags mounted beneath the trawl to catch individuals that otherwise would have escaped under the groundgear or between the groundgear and the groundrope. The auxiliary bags covered the whole area behind the rockhopper groundgear and were equipped with a separate groundgear. Figure 6 shows that approximately 12% of the total catch with Alfredo 5 trawl were taken with the auxiliary bags. For Campelen trawl, the corresponding figure was 4%, but this was based on only four successful hauls. Percentage of catch that were taken with the auxiliary bags was the highest for intermediate sized fish (40-60 cm) (Karlsen and Albert, 2005).

c) Vertical longlines

In stock assessment perspectives, the Greenland halibut is considered to be a demersal species. However, recent results from experiments with vertical longlines at the Continental Slope show that individuals occur frequently in large parts of the water column (Vollen and Albert, in prep.).

Greenland halibut were found in the water column through the year, and over all bottom depths investigated (450-900 m). Individuals were also found over larger depths were the species is not numerous at the bottom (Figure 7).

Greenland halibut were caught in all depths, up to an upper depth limit. This limit was independent of bottom depth and varied between seasons (400-500 m depth in March and August, to approximately 250 m in November). Individuals were caught as high as 600 m off bottom or at 200 m depth.

The sex composition differed between vertical and bottom longline catches. Males were predominant in the pelagic, whereas females were predominant on the bottom. In November, during or close to the spawning period, only males were caught pelagically. When accounting for differences in sex composition, the length frequency distribution of pelagic catches differed only slightly from bottom longline catches, pelagic individuals being somewhat smaller.

The pelagic behaviour of Greenland halibut may influence the annual bottom trawl surveys, as parts of the population is out of the gear's range. To achieve a better understanding of this problem, the pelagic occurrence of the Greenland halibut need to be quantified.

d) Comparative fishing trawl-longline

The investigations showed that catch rate (by weight) by longline at depths down to 550 m was 2.0-2.5 times lower compared to those taken by trawl at the same fishing depths. At depths more than 600 m catch rate by trawl and longline did not differ (Lisovsky et al., in prep.).

Catches by longline were dominated by females. Catches of females by longline exceeded those by trawl 3.7-1.2 times, and the mean ratio constituted 2.5 (Figure 8).

Therefore, judging by the provisional results, the catchability coefficient of trawl in relation to females cannot be higher than 0.4.

Mean length of males and females in catches by both gears did not differ.

Because of the limited scope of investigations, comparative data on fishing «trawl-longline» were obtained only for autumn.

Thus, for the reported period, materials were collected to develop a method of longline-trawl survey for Greenland halibut allowing to improve the stock estimate.

4. Greenland halibut distribution and stock dynamics from survey data

Our results clearly show that the vast majority of adult Northeast Arctic Greenland halibut throughout the year are distributed along the continental slope between the Norwegian mainland and the Spitsbergen archipelago, while further eastwards in the Barents Sea its distribution remains severely limited. Juveniles were mainly found north and east of the Spitsbergen archipelago to White Island and Franz Josef's Land, thus firmly establishing these areas as nursery grounds for the species. Spawning grounds were confirmed located largely on the upper slope areas north and south of Bear Island.

Data from Russian and Norwegian surveys in the northern Barents Sea (north and east of the Spitsbergen archipelago and in the area of the Franz Josef Land), which have become joint surveys since 2000, showed that a considerable proportion of juveniles (28-56%) settled in the area of the EEZ RF (Table 3).

Russian stratified surveys for Greenland halibut having been conducted since 1984 cover the area of about 140 thousand square miles from the Novaya Zemlya in the east to the continental slope (depth of 900 m) in the west. Despite the fact that these surveys are carried out during pre-spawning and spawning period (October-December) when Greenland halibut migrate to the west and concentrate on the continental slope, from 11 to 43% (about 20% on the average) of the Greenland halibut fishable stock (fish longer 30 cm) abundance were distributed in the ICES Subarea I (east of 30°E) (Figure 9) (Smirnov, 2002).

In August-September 2004 and 2005 Russian and Norwegian reseach vessels covered most of the Barents Sea and Spitsbergen area by Campelen-1800 trawl, and in the same period Norwegian vessels covered the deeper areas from 62 – 80 N by Alfredo-5 trawl. In total this was a coverage, which included most of the distribution area of the Northeast Arctic Greenland halibut stock (Fig. 10). In 2005 also a coverage using the Alfredo-5 trawl in the whole Barent Sea, also included the deeper slope area and the EEZ RF, was conducted by Norwegian vessels. Patterns of distribution and abundance from these coverages are given in Thangstad *et al.* (in prep). The swept area estimates from all these surveys shows that approx. 89 –94 % of the biomass is found in the NEEZ and the fishery protected zone around the Spitsbergen archipelago (Table 4). In terms of numbers the percentage in these zones was 62-82.

Commenting on distribution of Greenland halibut in EEZs it should be emphasized that estimated proportions are imprecise because they are based on the survey data, which always have some uncertainty, and that they will also vary in dependence on environmental conditions and stock dynamics.

Most of the surveys (Figure 11) indicated an increase or at the least stabilization of the Greenland halibut abundance in the area of investigations during recent years.

Thus, due to peculiarities of distribution, drift of eggs and larvae as well as active migration, the Greenland halibut at different stages of its life and annual cycles forms concentrations in all economic zones of the Barents Sea (Nedreaas, Smirnov, 2004), that indicates the Greenland halibut to be a transboundary stock.

5. Preparation of a new joint scientific program on improving of stock assessment methods and evaluation of optimal long-term harvest strategy for North-East Arctic Greenland halibut.

During implementation of the 3-year Program of joint Russian-Norwegian research a large body of biological information on Greenland halibut was analyzed with the use of both traditional and advanced methods (underwater video filming, DST-tags, genetic studies etc.)

The results obtained permitted to extend and deepen the knowledge on distribution, biology, behaviour of Greenland halibut at different stages of its life cycle as well as on its stock dynamics.

At the same time, during the research new problems are revealed, which have not been solved until the present. They include, in particular, age reading, pelagic distribution and biological differences between males and females, which are all crucial problems for the quality of the stock assessment by traditional methods applied by ICES and the use of it for management purposes.

To decrease the uncertainty and to get stock estimates that adequately reflect its state with the aim of rational fishery it is necessary to pursue the joint research and to develop a new Program.

Proposals on the program structure:

- Improvement of a method of age reading
- Improvement of survey methodology and methods of combination of data from different surveys
- Quantification of pelagically occurring Greenland halibut
- Studying of sexual dimorphism and influence of fishery on the population structure
- Improvement of stock assessment methods
- Evaluation of optimal long-term harvest strategy.

Scientists of both countries believe that in order to initiate a new program it should be approved by the Mixed Russian-Norwegian Commission.

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Appendix 1

Meetings of scientists held in the framework of 3-year (2002-2004) research programme on Greenland halibut

1. 13 – 15 of March 2002 (Svanhovd)
   discussion of the programme content.

2. 4 – 5 of June 2002 (Tromsø)
   schedule of work and distribution of responsibility for realisation of components of the programme.

3. 18 – 20 of March 2003 (Murmansk)
   - amount of available data;
   - underwater observations;
   - diet;
   - applying of GIS for research of distribution.

4. 16 – 19 of June 2003 (Copenhagen)
   - migration of G. halibut.

5. 25 – 27 of May 2004 (Murmansk)
   - distribution of G. halibut during its life cycle;
   - seasonal variations in distribution;
   - occurrence of G. halibut in pelagial;
   - G. halibut behaviour in front of the trawl;
   - new approaches for improvement of accuracy in ageing;
   - genetic investigations.

6. 15-17 of March 2005 (Arkhangelsk)
   - last investigations results;
   - report structure discussion.

7. 03-07 October 2005 (Murmansk)
   - report preparation.

Some of the results from joint research programme were presented at:

- International Flatfish Symposium (Isle of Man, December 2002);

- 10th Russian-Norwegian Symposium (Bergen, 2003);

- Symposium on deep-water fish (New Zealand, 2003);

- 3rd international symposium on otolith studies (Australia, 2004)

- ICES ASC, 2004

- 6th International Symposium on Flatfish Ecology (Kyoto, Japan, 2005)

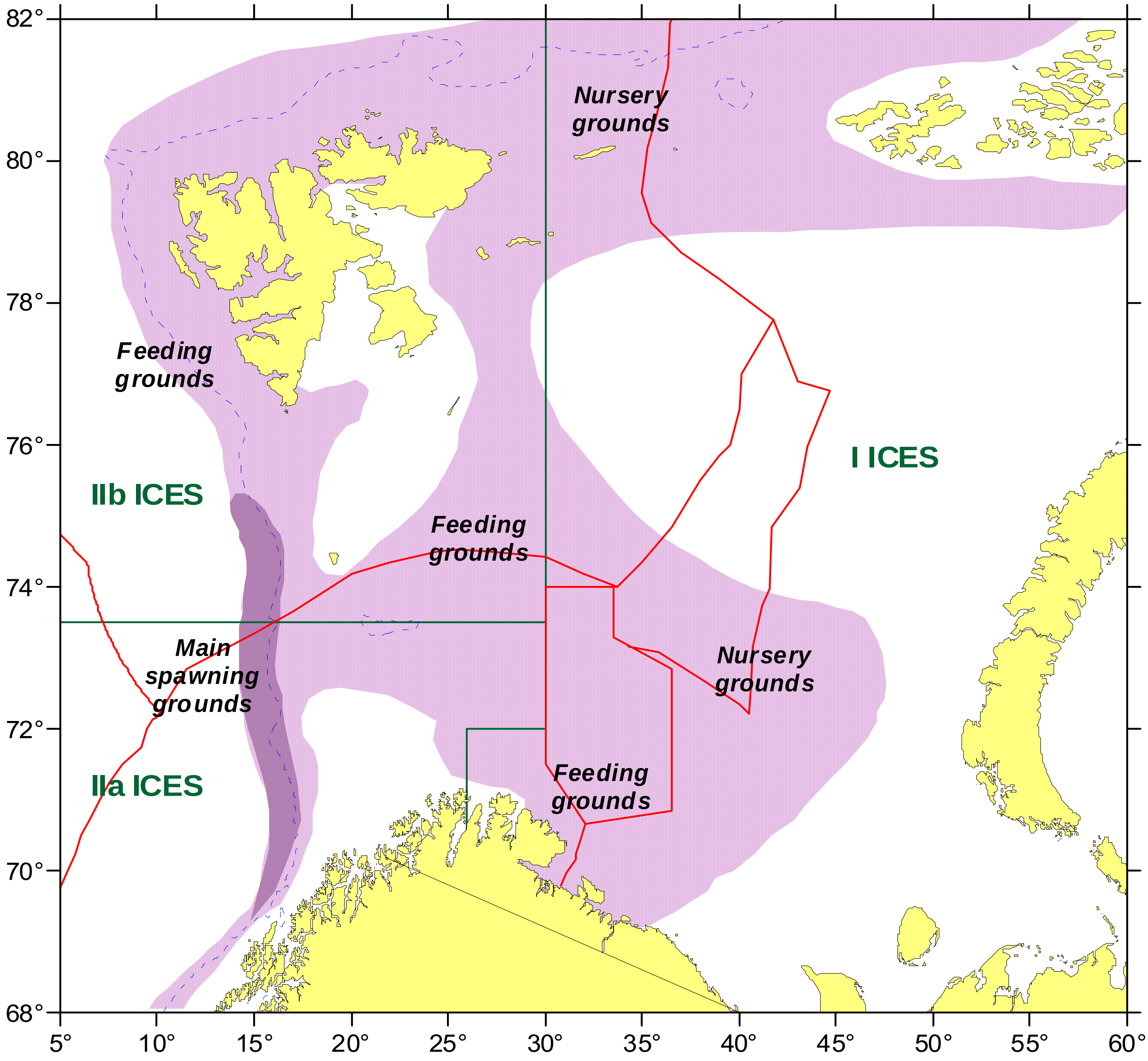


Figure 1. Map of Greenland halibut distribution in the Barents Sea
(after Nedreaas & Smirnov 2004)

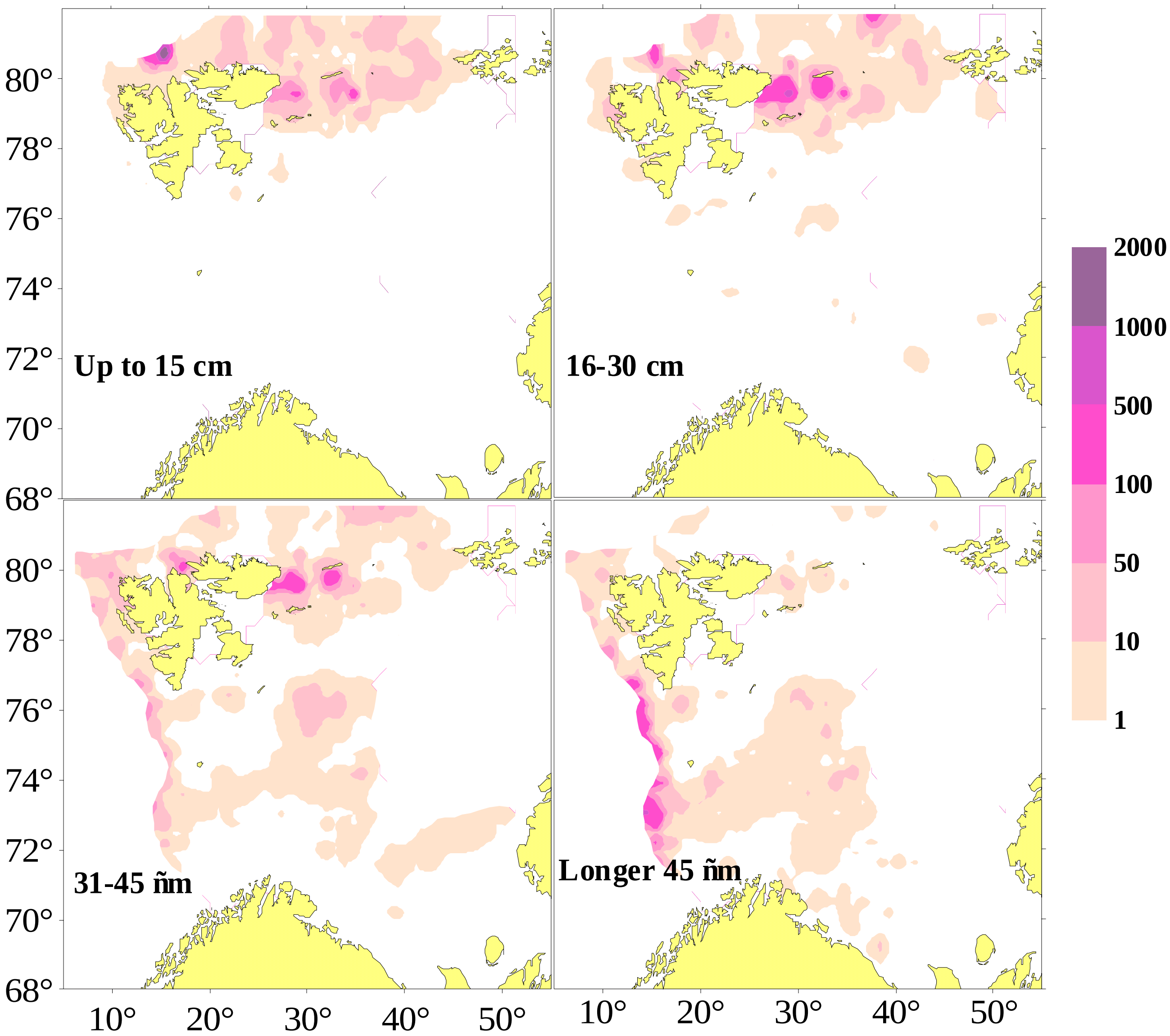


Figure 2. Distribution of catches of Greenland halibut by length in September-December from Russian trawl surveys, individuals/1-hour tow (data combined for 1999-2004)

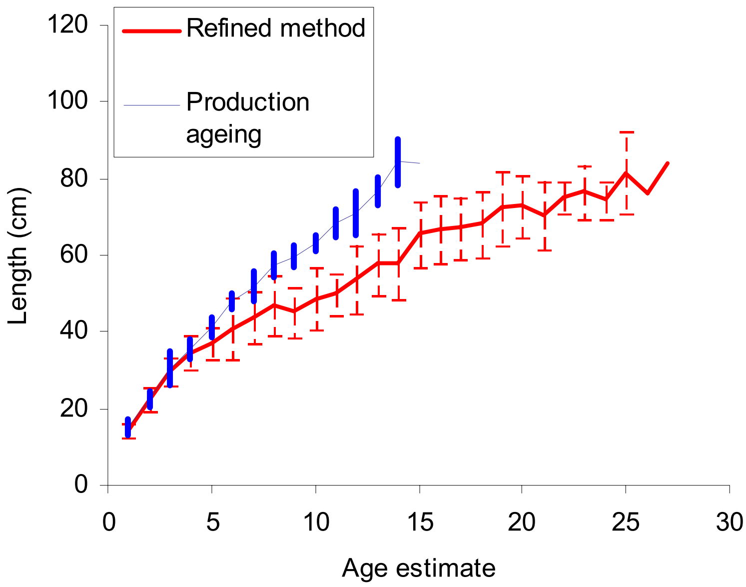


Fig. 3. Mean length at age (± SD) based on the production ageing method (blue) and the refined method (red) respectively.

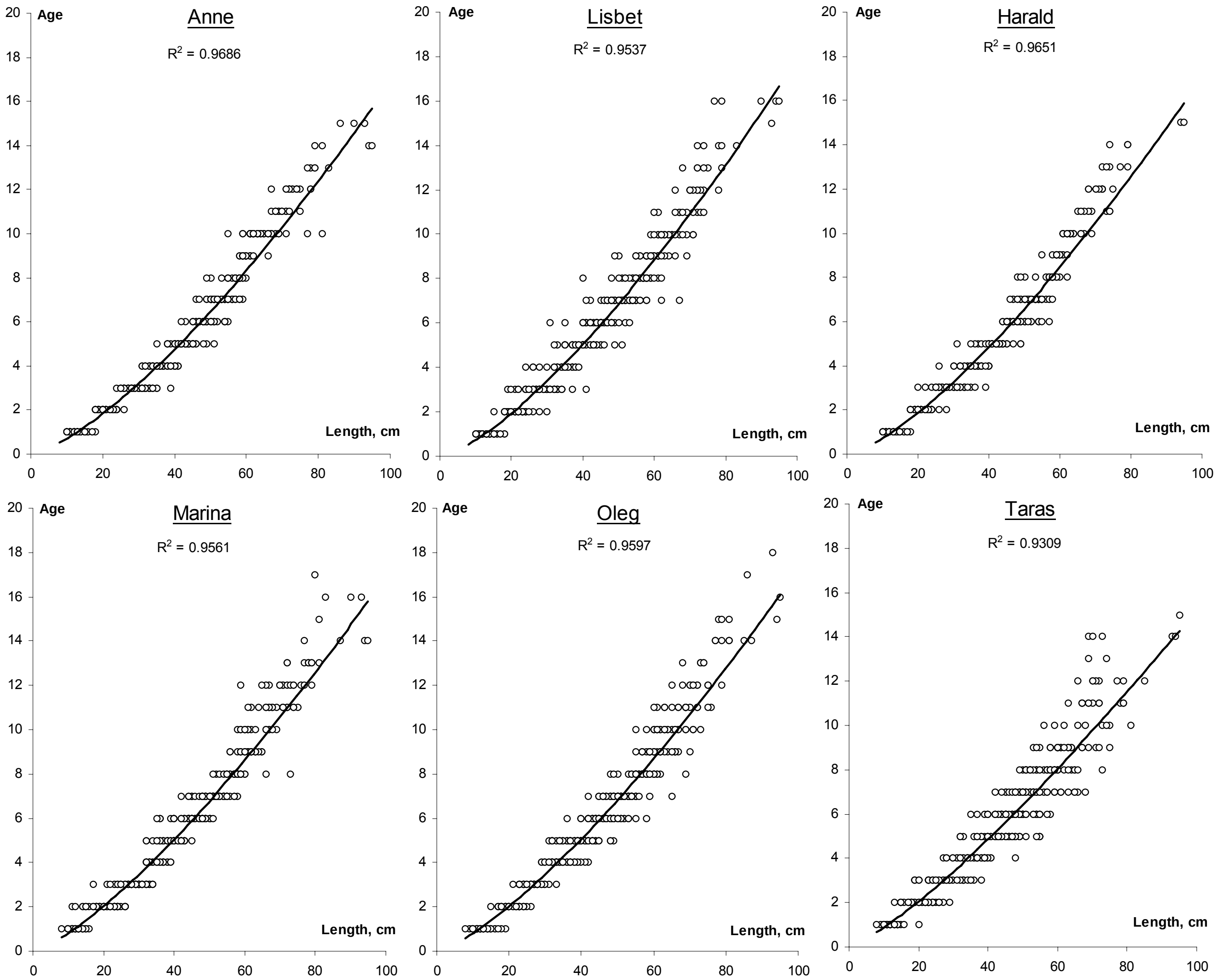


Fig. 4. Length-age curves based on results of different age readers

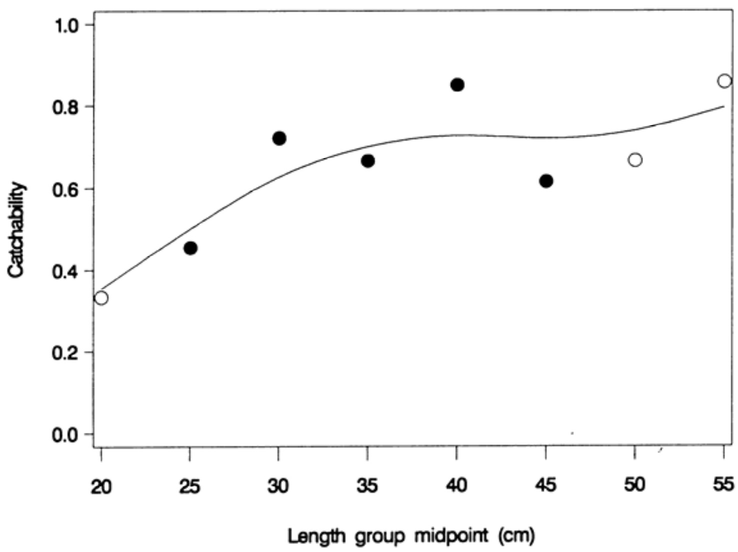


Figure 5. Catchability by size of Greenland halibut in trawl estimated from video recordings. Symbol size indicates number of observations; the leftmost and the two rightmost values were based on less than ten observations. The first and last groups are plusgroups and the line is fitted using a cubic function.

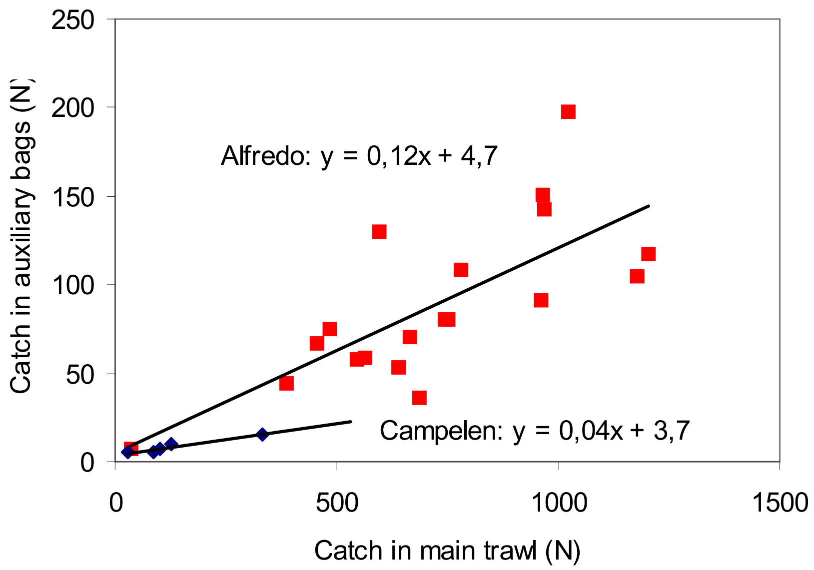


Figure 6. Results from experiments with auxiliary bags beneath the sampling trawl.

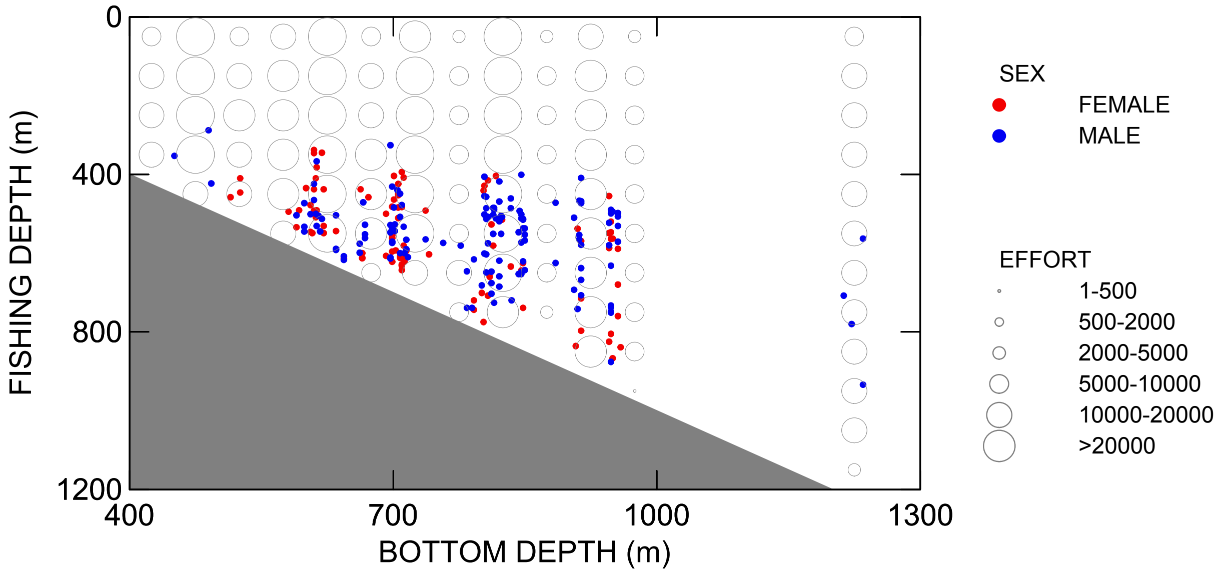
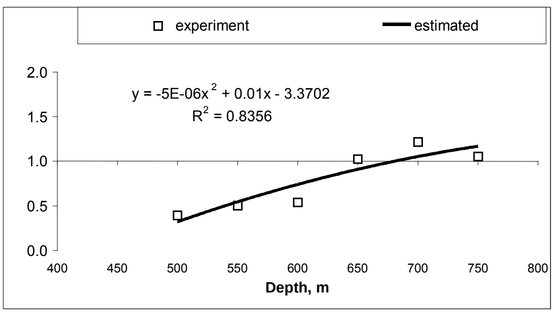


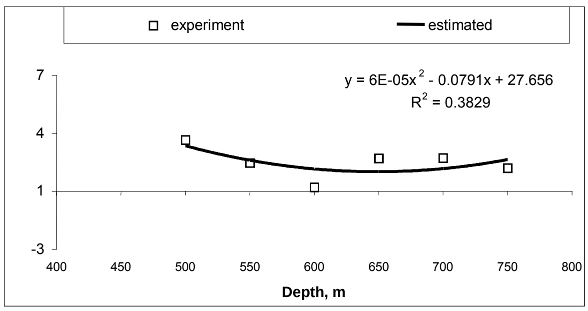
Figure 7. Individual catches from August 2003-2005 by fishing depth and bottom depth, together with overall Effort in every 100 m fishing depth interval and 50 m bottom depth interval; Effort = # 100 hooks * setting time (hours) until saturation (15 hours).

1



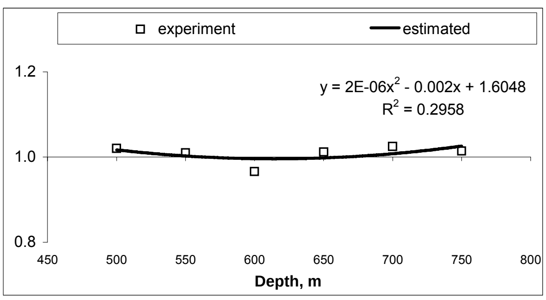
Relative catch by longline and trawl

2



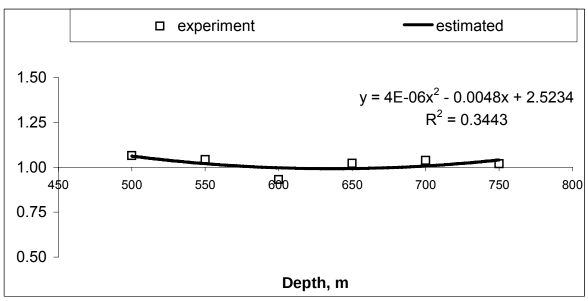
Female ratio in catches by longline and trawl

3



Ratio of mean length of males in catches by longline and trawl

4



Ratio of mean length of females in catches by longline and trawl

Fig. 8. Dependence of ratio of catches (1), percentage of females (2), mean length of males (3) and females (4) in catches by longline/trawl on fishing depth.

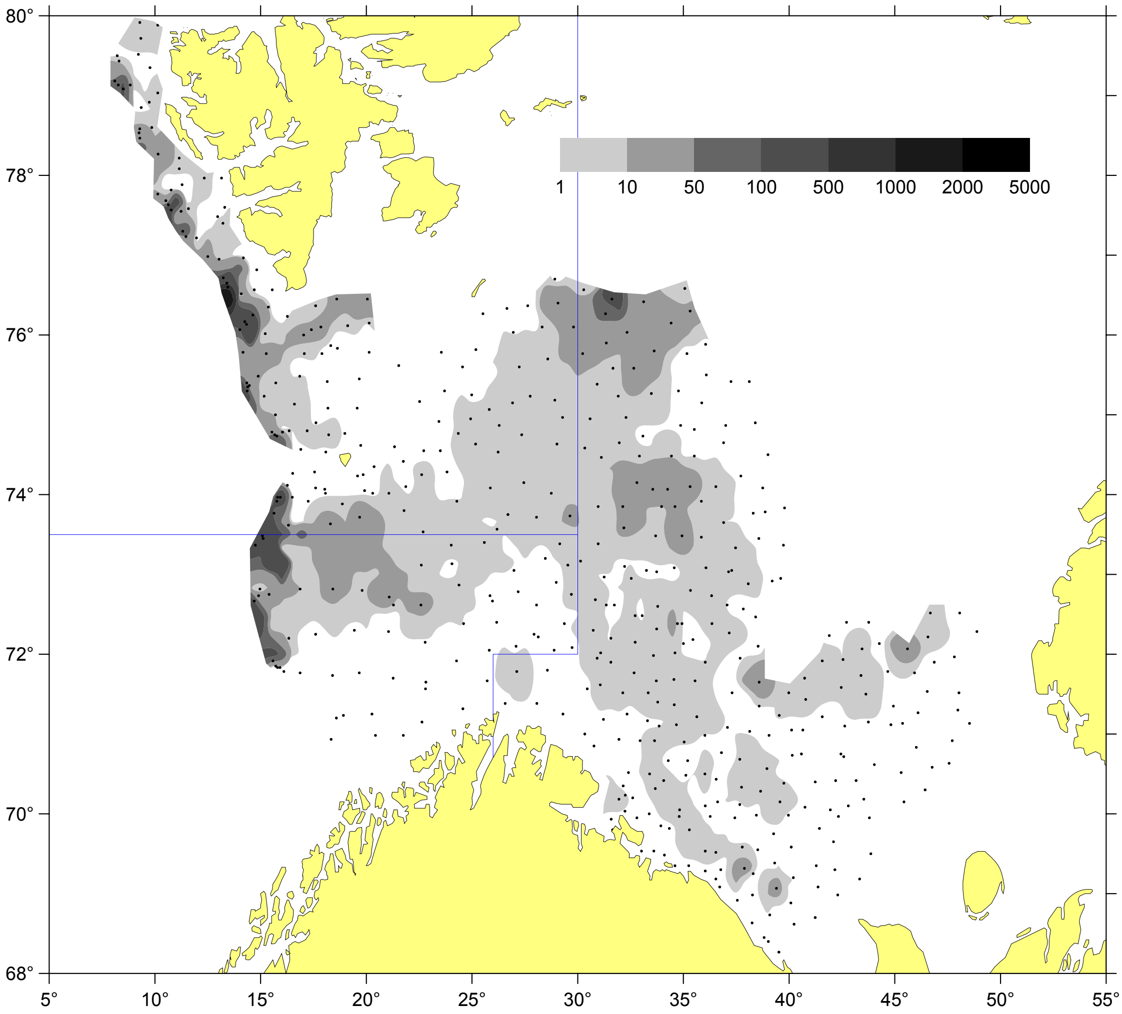


Fig. 9. Distribution of Greenland halibut in October-December from the data of Russian survey 2003, spec./1 hour trawling

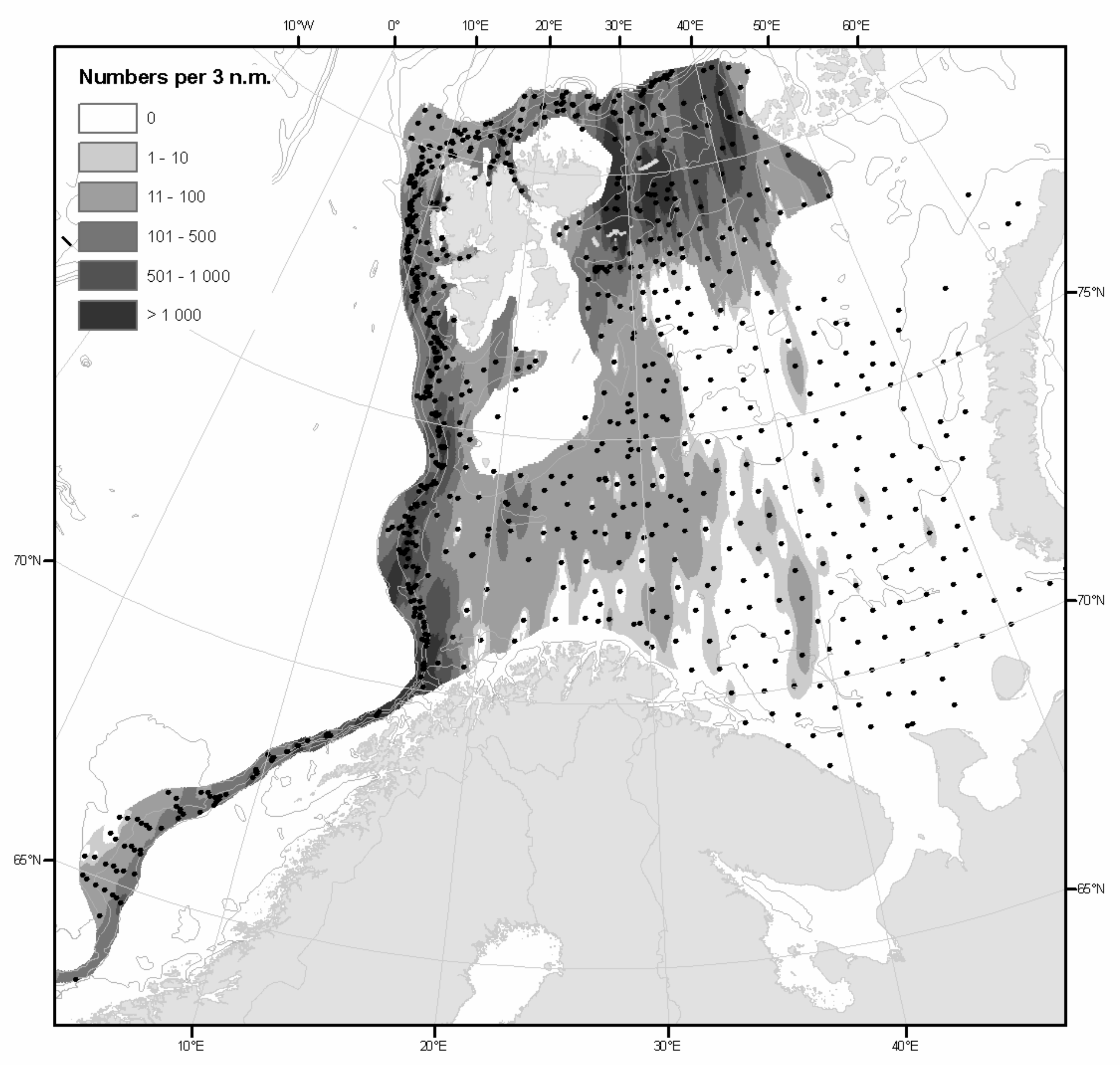


Fig. 10. Total density distribution of Greenland halibut from Russian-Norwegian bottom trawl surveys, August-October 2004. Dots denote sampling stations.

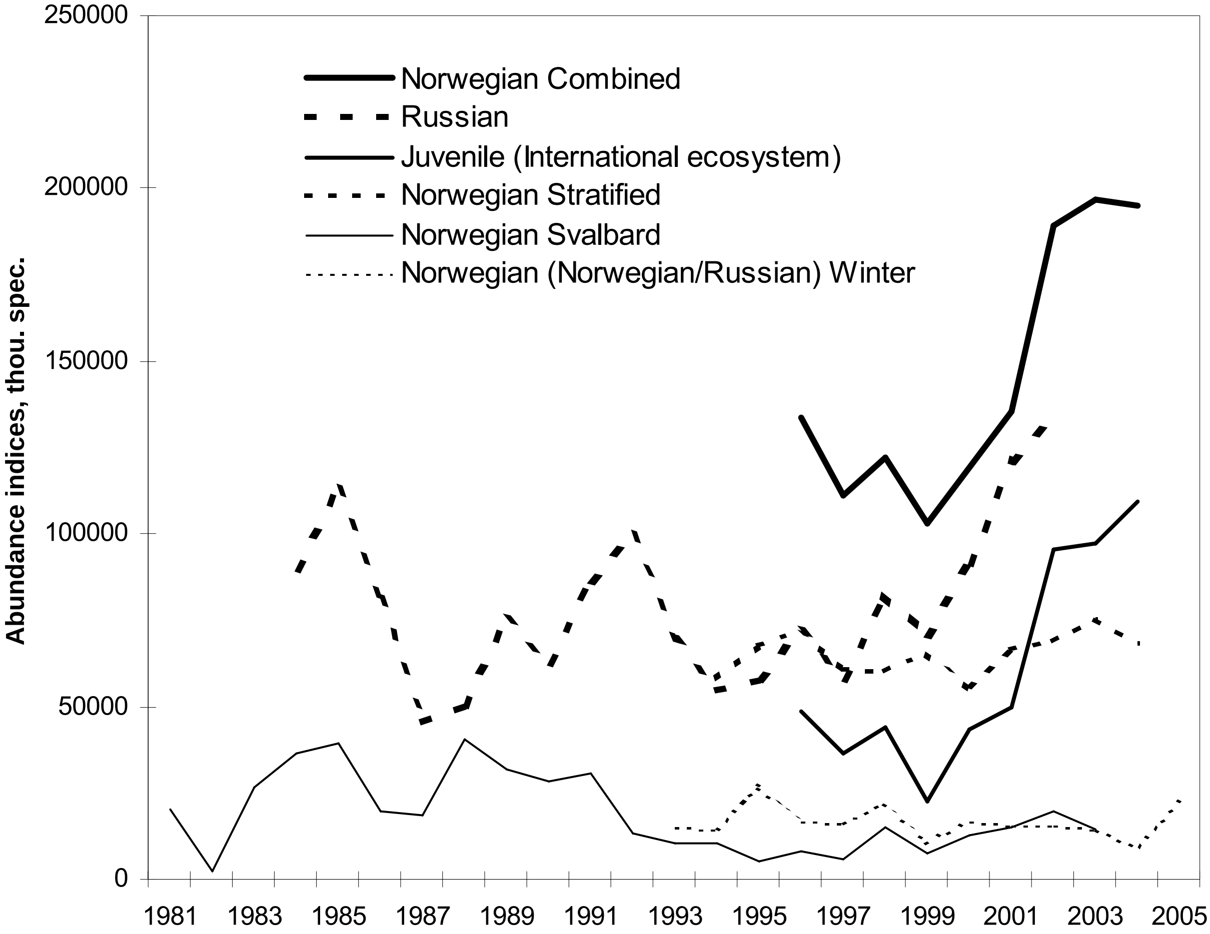


Fig. 11. Abundance indices of Greenland halibut based on results of different surveys

Table 1. Biological materials on Greenland halibut collected by PINRO in 2002-2004

2002

Kind of data	Area			
	I	IIa	IIb	Total
Length (with sex determination)	19864	19485	94830	134179
Age samples	406	371	1644	2421
Stomach contents	539	300	1096	1935
Maturation	5055	2948	16250	24253
Tagging	181	566	142	889

2003

Kind of data	Area			
	I	IIa	IIb	Total
Length (with sex determination)	6765	75269	63799	145833
Age samples	276	628	712	1616
Stomach contents	396	316	570	1282
Maturation	1236	4791	10283	16310
Tagging	78	41	579	698

2004

Kind of data	Area			
	I	IIa	IIb	Total
Length (with sex determination)	7445	23258	93201	123904
Age samples	785	592	2550	3927
Stomach contents	782	435	2177	3394
Maturation	1093	2324	13194	16611
Tagging	-	20	915	935 (415*)

2002-2004

Kind of data	Area			
	I	IIa	IIb	Total
Length (with sex determination)	34074	118012	251830	403916
Age samples	1467	1591	4906	7964
Stomach contents	1717	1051	3843	6611
Maturation	7384	10063	39727	57174
Tagging	259	627	1636	2522 (415*)

* With collecting scale for age reading

Table 2. Biological materials on Greenland halibut collected by IMR in 2002-2005

Year	Period	Samples from trawl			Tagging	
		Length *	Individ	Stomachs	Conventional tags	Data storage tags
2002	November				2383	227
2003	August	44061	3261		3366	40
2003	November	27320	1022	47	2274	
2004	March	27498	1697	1469	1597	
2004	August	46046	3092	1852	1090	
2004	November	34671	1311	1063	1034	
2005	March	27232	1077	1077	1609	
2005	August	70945	3748	295		97
Total		277773	15208	5803	13353	364

* with sex determination

Table 3. Abundance indices of young Greenland halibut based on the data of trawl surveys northeast of Spitsbergen and in the Franz Josef Land area, thousands specimens

A. Norwegian data (source – AFWG report 2005)

Year	Total	REEZ	% REEZ
1998	64279	20357	32
1999	38140	15651	41
2000*			
2001	92475	42955	46
2002	193641	98211	51
2003*			
2004	166989	57593	34

B. Russian data

Year	Total	REEZ	% REEZ
1999	19316	7105	37
2000*			
2001	45470	25396	56
2002*			
2003*			
2004	129761	66957	52

C. Joint Russian-Norwegian data
(source - IMR/PINRO Joint Report Series)

Year	Total	REEZ	% REEZ
2001	55072	21097	38
2002	108905	29975	28
2003*			
2004	138695	76273	55

* limited area coverage due to hard ice condition

Table 4. Swept area estimates from three surveys covering the total distribution area of the Northeast Arctic Greenland halibut stock.

Biomass

	August 2004 Alfredo & Campelen						August 2005 Alfredo						August 2005 Alfredo & Campelen					
Length	NEZ	SVAL	REZ	INTER	GREY	TOTAL	NEZ	SVAL	REZ	INTER	GREY	TOTAL	NEZ	SVAL	REZ	INTER	GREY	TOTAL
< 10	0	11	0	0	0	12	0	0	0	0	0	0	0	8	1	0	0	8
10-15	0	34	72	0	0	106	0	0	0	0	0	0	0	519	764	0	0	1 283
15-20	0	188	384	0	0	571	0	0	0	0	0	0	1	743	557	0	0	1 300
20-25	0	939	1 880	0	0	2 819	0	199	168	0	0	367	0	403	429	0	0	832
25-30	8	1 436	2 266	0	5	3 715	1	733	1 202	0	0	1 937	9	1 274	2 154	0	0	3 437
30-35	151	1 623	1 141	0	0	2 915	143	2 921	2 518	0	0	5 583	200	5 124	3 885	0	0	9 209
35-40	1 633	4 403	390	281	204	6 910	1 606	7 087	1 270	0	95	10 057	1 457	10 045	1 908	0	104	13 514
40-45	4 140	5 897	408	408	611	11 464	4 260	10 304	529	327	653	16 072	3 934	15 290	1 338	679	856	22 097
45-50	13 643	7 904	726	0	710	22 983	10 402	13 076	476	0	735	24 689	9 630	15 647	1 206	1 013	1 199	28 694
50-55	34 036	6 297	229	0	917	41 479	24 901	8 327	652	67	585	34 532	24 375	10 820	0	1 450	899	37 545
55-60	30 058	3 784	1 566	0	275	35 683	25 242	4 996	244	0	488	30 969	23 970	5 725	0	0	2 142	31 836
60-65	17 939	3 148	465	0	213	21 766	19 343	4 274	87	0	529	24 233	18 966	4 240	0	1 355	389	24 950
65-70	11 231	2 404	0	0	212	13 846	14 580	3 025	98	0	0	17 703	15 028	3 158	0	0	950	19 135
70-75	5 781	919	0	0	20	6 720	8 191	1 199	71	0	0	9 461	8 191	1 334	0	0	0	9 525
75-80	2 675	324	0	0	34	3 033	3 863	480	0	0	0	4 343	3 863	480	0	0	0	4 343
80-85	1 252	169	0	0	0	1 421	2 277	235	0	0	0	2 512	2 277	235	0	0	0	2 512
85-90	249	34	0	0	0	284	796	93	0	0	0	889	796	93	0	0	0	889
> 90						0						0						0
Total (tons)	122 796	39 513	9 527	688	3 202	175 726	115 606	56 948	7 315	394	3 085	183 347	112 695	75 136	12 242	4 497	6 538	211 108
Percentage	69.9	22.5	5.4	0.4	1.8	100.0	63.1	31.1	4.0	0.2	1.7	100.0	53.4	35.6	5.8	2.1	3.1	100.0

Abundance

	August 2004 Alfredo & Campelen						August 2005 Alfredo						August 2005 Alfredo & Campelen					
Length	NEZ	SVAL	REZ	INTER	GREY	TOTAL	NEZ	SVAL	REZ	INTER	GREY	TOTAL	NEZ	SVAL	REZ	INTER	GREY	TOTAL
< 10	0	10161.7	432.8	0	0	10 595	0	0	0	0	0	0	0	6862.5	540.3	0	0	7 403
10-15	0	4 790	10 054	0	0	14 844	0	0	0	0	0	0	0	72 861	107 359	0	0	180 219
15-20	0	7 880	16 134	0	0	24 014	0	0	0	0	0	0	31	31 213	23 389	0	0	54 633
20-25	0	16 012	32 067	0	0	48 079	0	3 397	2 867	0	0	6 264	0	6 874	7 310	0	0	14 184
25-30	70	11 923	18 813	0	40	30 847	9	6 087	9 984	0	0	16 081	77	10 577	17 884	0	0	28 539
30-35	689	7 402	5 202	0	0	13 294	654	13 320	11 484	0	0	25 458	910	23 364	17 718	0	0	41 993
35-40	4 456	12 015	1 063	766	557	18 859	4 383	19 340	3 466	0	258	27 448	3 976	27 414	5 208	0	283	36 880
40-45	7 211	10 271	711	710	1 064	19 968	7 420	17 948	921	569	1 137	27 995	6 852	26 632	2 331	1 183	1 490	38 488
45-50	15 945	9 237	849	0	829	26 860	12 157	15 282	556	0	859	28 855	11 254	18 286	1 410	1 183	1 402	33 535
50-55	27 779	5 139	187	0	749	33 853	20 323	6 796	532	55	478	28 184	19 894	8 831	0	1 183	734	30 642
55-60	17 700	2 228	922	0	162	21 013	14 865	2 942	143	0	287	18 237	14 115	3 371	0	0	1 261	18 748
60-65	7 833	1 375	203	0	93	9 504	8 446	1 866	38	0	231	10 581	8 281	1 851	0	592	170	10 894
65-70	3 721	796	0	0	70	4 587	4 830	1 002	32	0	0	5 865	4 979	1 046	0	0	315	6 339
70-75	1 482	236	0	0	5	1 723	2 100	307	18	0	0	2 426	2 100	342	0	0	0	2 442
75-80	540	65	0	0	7	612	780	97	0	0	0	876	780	97	0	0	0	876
80-85	202	27	0	0	0	229	367	38	0	0	0	405	367	38	0	0	0	405
85-90	33	4	0	0	0	37	104	12	0	0	0	116	104	12	0	0	0	116
> 90	0	0	0	0	0	0	30	9	0	0	0	39	30	9	0	0	0	39
Total	87 660	99 564	86 639	1 476	3 577	278 916	76 468	88 443	30 043	624	3 250	198 828	73 750	239 683	183 148	4 142	5 654	506 377
Percentage	31.4	35.7	31.1	0.5	1.3	100.0	38.5	44.5	15.1	0.3	1.6	100.0	14.6	47.3	36.2	0.8	1.1	100.0