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RUSSIAN RESEARCH ON GREENLAND HALIBUT (*REINHARDTIUS HIPPOGLOSSOIDES)* IN THE WEST GREENLAND AREA IN 2001-2013

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Summary

Information presented in the document concerns the Russian studies of Greenland halibut collected by observers aboard the commercial fishing vessels within the West Greenland area. Results include the halibut size variability and length-weight distribution, CPUE dynamics, maturity and feeding statistics.

Introduction

In 2001-2013, Russian scientific observers conducted researches on Greenland halibut aboard fishing vessels in the area of West Greenland. A significant amount of data on the fish biology and fishery was collected in the course of those investigations.

The purpose of this paper is to submit the data, which might be useful for estimation of the fish stock status in the West Greenland, to the Scientific Council of NAFO.

Material and methods

The materials on Greenland halibut biology collected by scientists from PINRO during the cruises of Russian fishing vessels engaged in fishing in 2001-2013 were used as the input data. In Divs. 1AB, scientific observers carried out researches in 2002-2003, 2006-2011 and 2013, and in Divs. 1CD – in 2001-2013.

Maturity was estimated using the following scale: II – immature, III – maturing, IV –pre-spawning, V – spawning, VI – post-spawning, VI-III – post-spawning recovery.

To study feeding intensity the following scale of stomach fullness was used:

0 – no food in stomach;
1 – very little food, food traces in stomach;
2 – little food, food does not fill the entire volume of the stomach;
3 – much food, stomach filled with food; folds on the walls;
4 – a lot of food, food stretches the stomach walls, no folds;
5 – stomach is inverted.

Mean Index of Stomach Fullness (MISF) was used as an indicator of feeding intensity.
To analyze the year-to-year dynamics of fishing efficiency a catch (t) per effort (1 hauling hour) of vessels of Tonnage Class 6 in accordance with NAFO classification was used. The catches were taken by bottom trawls with the mesh size of no less than 140 mm.

Results

Dynamics of fishing efficiency

The duration and period of Greenland halibut fishery by Russian vessels in the East Greenland significantly varied from year to year. Primarily, the trawlers of Tonnage Class 5, 6 and 7 in accordance with the classification adopted in NAFO participated in the fishery. However, the only available continuous data series are from vessels of Tonnage Class 6 working in Divs. 1AB, in September-October 2003-2013 and Divs. 1CD, in August-October 2001-2013 (Fig. 1).

In Divs. 1AB, the increase in fishing efficiency had been registered since 2006, and it has reached its maximum in 2011 (Fig.1). The catch per fishing effort unit rose from 0.36 t per hauling hour in 2006 to 0.55 t per hauling hour in 2013. The catch rate in 2013 (0.55 t per hauling hour) almost have not changed compared to the 2012 (0.56 t per hauling hour) (Fig. 1).

In Divs. 1CD, the catch rates fluctuated around the mean value in August-October 2001-2010. However, in 2011-2013, the catch per fishing effort unit increased, and now it is higher than the average value calculated for the whole observation period (2001-2013). In 2013, the fishing efficiency (0.64 t per hauling hour) somewhat grew as compared to that one in 2012 (0.62 t per hauling hour), and, at present, it is at the highest level for the whole period of researches (Fig. 1).

Biological parameters of Greenland halibut

Length-weight composition

In Divs. 1AB, in 2002-2013, the catches by Russian vessels contained the halibut between 15-114 cm (primarily, 43-55 cm). During the whole research period, the mean length of halibut was 49.5 cm, from year to year it varied from 44.9 cm in July 2006 to 51.1 cm in August 2009 (Fig. 2). In 2013, Greenland halibut with the length of 33-82 cm were caught. Specimen of 45-53 cm prevailed, and the mean length equaled to 48.8 cm.

In the catches the percentage of halibut with length under 35 cm rose in 2002-2003 (4.6-5.9 %) and in 2010-2011 (0.8-1.1 %) (Fig. 2), perhaps due to the coming of relatively abundant previous years' year-classes into commercial size.

Over the entire period of study, in Divs. 1AB, in the catches, the weight of a single fish varied from 0.02 kg to 11.8 kg. Specimens weighting 0.6-1.6 kg (1.2 kg, on the average) were predominating. The length-weight ratio is shown in Fig.4.

In Divs.1CD, in 2001-2013, the size of halibut was greater than in Divs. 1AB. The length of fish in catches ranged from 26 cm to 113 cm. The fish with length of 46-57 cm predominated. In the period of study, the halibut average length amounted to 53.1 cm. At that, it varied from 50.7 cm (July-October 2013) to 57.2 cm (July 2001) (Fig.3). In 2013, the fish sized from 32 to 103 cm were found with the prevalence of the individuals of 45-54 cm in length and with the average length of 50.7 cm.

In Divs. 1CD, the weight of a single fish in the catches ranged from 0.11kg to 12.1 kg. Halibut weighting from 0.8 kg to 1.6 kg and with the average length of 1.4 kg predominated (Fig. 4).

Maturity and sex ratio

In Divs. 1AB, in the course of observations, immature fish prevailed in catches. However, their percentage varied by years from 3 % (in November 2003) to 87 % (in November 2007). The percentage of halibut with maturing gonads, mainly, equaled to 8-11 %, except for September-November 2003, when it increased to 61-77 % (Fig.5 - Fig.7). Pre-spawning fish were found in September-November, but their percentage did not exceed 10 % from the halibut abundance in catch.

In Divs. 1CD, in catches, mature fish prevailed, as a rule (50-81 %). The percentage of immature halibut ranged from 19 % (October 2001) to 50 % (September 2005). Among immature fish, females were prevailing (Figs. 8 - 12). In July-September, males had maturing gonads. In October-December, there was an increase in abundance of the pre-spawning fish, the percentage of which, reaching 44 % from the total abundance and 73 % from the total abundance of males, was maximal in October 2005 (Figs. 8 - 12). Spawning individuals were usually registered in October-November (Figs. 8 - 9, Fig. 11).

Feeding

In Divs. 1AB, in the period of study, over 19 food items were found in halibut stomachs. The majority of stomach contents consisted of various fish species, varying from 7,6 % in 2006 to 85,1 % in 2007 (from the amount of stomachs with food). The percentage of highly digested fish was significant (6.7-81.4 %). The second important food item was shrimp predominating in halibut stomachs in 2006 (Table 1).

In the period of study, the fish feeding intensity was moderate. MISF was 0.8-1.4, and only, in 2002, it was lower and amounted to 0.4. More than a half of the stomachs (from 40 to 82 %) were empty (Table 1).

In Divs. 1CD, 31 food items were found in the halibut stomachs. Squids (from 25 to 71 %), fish (from 14 to 47 %) and shrimp (from 2 to 48 %) predominated (Table 2). The feeding intensity was low, MISF was 0.2-0.5. Most stomachs (from 80 to 92 %) were empty (Table 2).

Conclusions

Since 2006, there was a noticed trend towards the increase in the efficiency of Greenland halibut fishing by Russian trawlers operating near West Greenland in Divs. 1AB, and it was maximal in 2011. In 2013, the catch rate was practically unchanged there as compared to 2012, and it was higher the average level calculated for 2003-2013.

In 2011-2013, in Divs. 1CD, the catch per fishing unit of effort rose, and now it is among the highest ones during the period of investigations.

In Divs. 1CD larger fish comparing with those ones from Divs. 1AB are distributed. The relative amount of mature fish is higher there.

The increase in the amount of undersized halibut in catches taken in Divs. 1AB in 2002-2003 and 2010-2011 is possibly a consequence of abundant year-classes to reach commercial size.

In the research period, the feeding intensity of Greenland halibut in Divs. 1CD was lower than in Div. 1AB. In Divs. 1AB, fish and shrimp predominated among the food items while, in Divs. 1CD, feeding was based on squids and fish.

Table 1. Stomach content (food item frequency of occurrence in stomachs, %) of Greenland halibut in Divs. 1AB of the West Greenland in 2002-2003, 2006-2011 and 2013

Food items	2002	2003	2006	2007	2008	2009	2010	2011	2013
Smelt					4.36		0.2		
Amphipods			1.69						0.11
Gobies		0.12	0.95						
Gammarids			1.9		2.11		0.2		
Ctenophora						4.24			
Squids	8.33	6.91	0.95	3.38	5.86	0.85	1.99	0.29	1.23
Shrimps	22.22	31.15	86.67	4.79	20.3	7.63	6.22	42	0.45
Eelpout		0.12			1.05				
Jellyfish				0.28			0.36	0.57	
Mysids					1.95		43.4		
Red hake	2.78			1.41	1.65	0.85	0.05		1.01
Octopuses	2.78	0.7		1.97	2.71		1.43	3.71	0.22
Fishing waste				0.28	1.35		0.66	1.71	0.11
Greenland halibut	8.33	0.82			0.3			0.29	
Digested food	2.78	0.7			0.9			1.71	0.22
Digested fish	13.89	56.91	6.67	81.41	45.56	16.1	14.64	40.86	35.5
Pycnogonids							24.48		
Other fish	30.56	0.24		2.25	2.41		0.66	0.57	23.85
Euphausiids	5.56	0.35	1.9	2.54	9.47	70.34	5.2	8.29	36.84
Others	2.78	1.99	0.95				0.5		0.44
MISF*	0.4	1.1	1.0	0.8	1.0	1.2	1.4	0.8	1.4
Number of examined stomachs	204	1792	177	1062	1509	191	3013	876	1296
Number of stomachs with food	36	814	102	337	647	114	1758	339	695

*Mean index of stomach fullness

Table 2. Stomach content (food item frequency of occurrence in stomachs, %) of Greenland halibut in Divs. 1CD of the West Greenland in 2001-2013

Food items	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Antimora	1.32		0.55	0.85	0.28	0.32		0.73		0.16	1.28		0.58
Smelt						1.58		0.49	0.28	1.81			
Gobies			0.18		0.28								
Stickheads						0.32	0.59						
Ctenophora				0.85			0.29	0.49	0.28	0.16			
Detritus				0.85		4.42							
Squids	32.16	29.91	62.84	24.79	65.92	41.32	58.7	46.83	18.13	40.03	38.14	43.33	23.12
Squid beaks	2.64	0.93	3.1		4.75	0.32		0.24	0.28	0.33		10	2.02
Shrimps	1.76	14.02	9.29	6.84	3.91	15.77	4.13	12.2	48.16	19.11	7.05	3.33	20.81
Grenadier sp.	0.88					0.95	1.47				0.64		
Shortbeard grenadier	1.32								0.28				
Roughhead grenadier	8.81	3.74	2	15.38	0.56	2.52	3.83	0.98	0.28	0.99	0.32		0.87
Roundnose grenadier		0.93		0.85		1.26	0.29	1.71		0.16	0.32		0.58
Jellyfish	0.44	0.93	0.91							1.32	0.96		0.29
Mysids									0.28	0.99			
Myctophids		0.93	2	1.71		0.32		0.73	0.28	0.16		10	3.18
White hake					0.28	0.32				0.33			0.58
Red hake	0.88	2.8	0.36	5.13		1.26	0.29	0.24		0.66			
Marlin-spike grenadier			0.18		0.56	0.32	0.29						
Redfish spp.									0.28				0.29
Octopuses	3.52		0.73		1.96		1.47	2.68		0.49	4.49		6.07
Fishing waste					0.56		1.77	0.49	0.28	3.95	0.32		
Greenland halibut	1.32	3.74	1.64	3.42	0.28		1.77	0.24	0.85	0.33	0.64		0.29
Digested food	9.25	1.87	2.19	1.71	0.28		1.77	0.49		0.99	2.24	6.67	0.29
Digested fish	21.59	20.56	8.38	15.38	10.61	25.87	19.47	30.73	25.78	19.77	42.95	23.33	34.1
Other fish	0.44	1.87			0.56	0.64	0.29	0.24		6.25	0.32		0.29
Eels			0.54		0.56		0.29			0.65			
Worms				0.85				0.24					
Euphausiids	0.88								0.28	0.33	0.32		1.45
Others	12.78	17.75	5.1	21.36	8.66	2.52	3.23	0.24	4.25	0.98		3.33	5.2
MISF*	0.2	0.4	0.6	0.5	0.5	0.4	0.3	0.4	0.3	0.2	0.3	0.2	0.2
Number of examined stomachs	2440	781	2624	590	2274	1939	2646	2470	2158	7207	3010	350	4305
Number of stomachs with food	219	106	535	107	352	310	336	408	349	597	306	30	339

*Mean index of stomach fullness

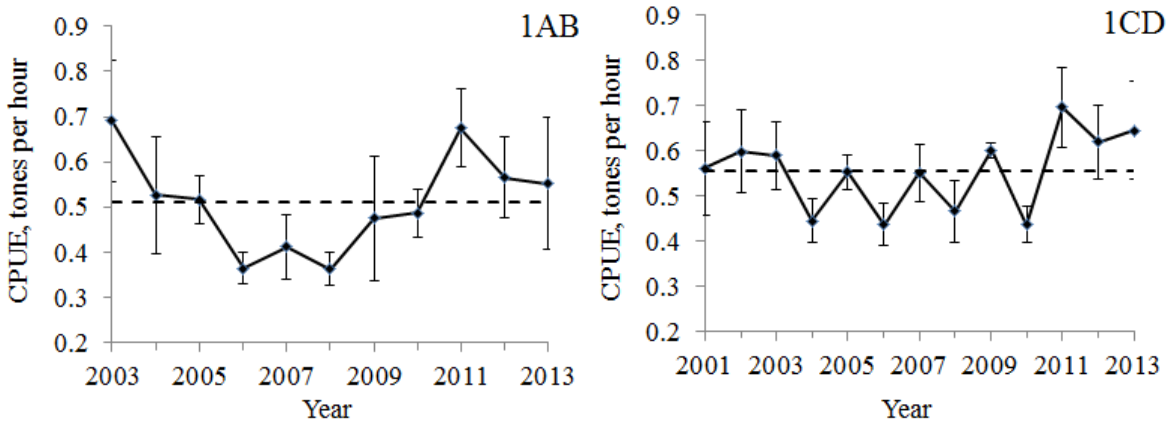

Fig. 1. Dynamics of catch per unit of effort (CPUE) of Russian Tonnage Class 6 vessels in the fishery of Greenland halibut in Divs. 1AB of West Greenland in September-October 2003-2013 and in Divs. 1CD in August-October 2001-2013 (mean CPUE is shown by dashed line).

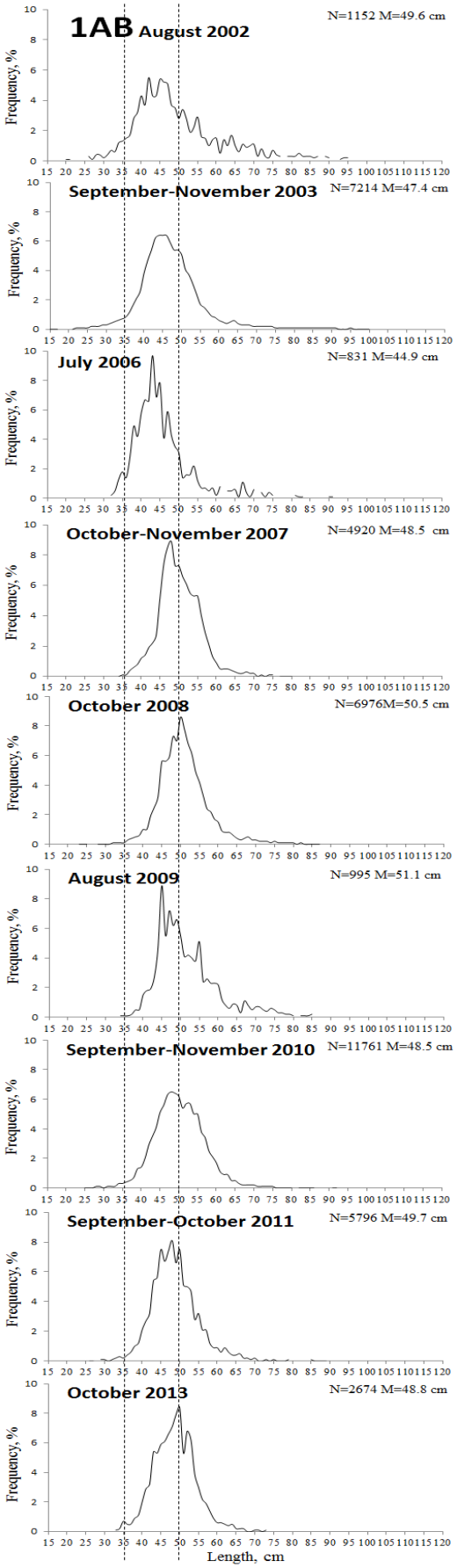

Fig. 2. Length composition of Greenland halibut trawl catches in Divs. 1AB of West Greenland in 2002-2003, 2006-2011 and 2013 by the data from observers aboard Russian fishery vessels.

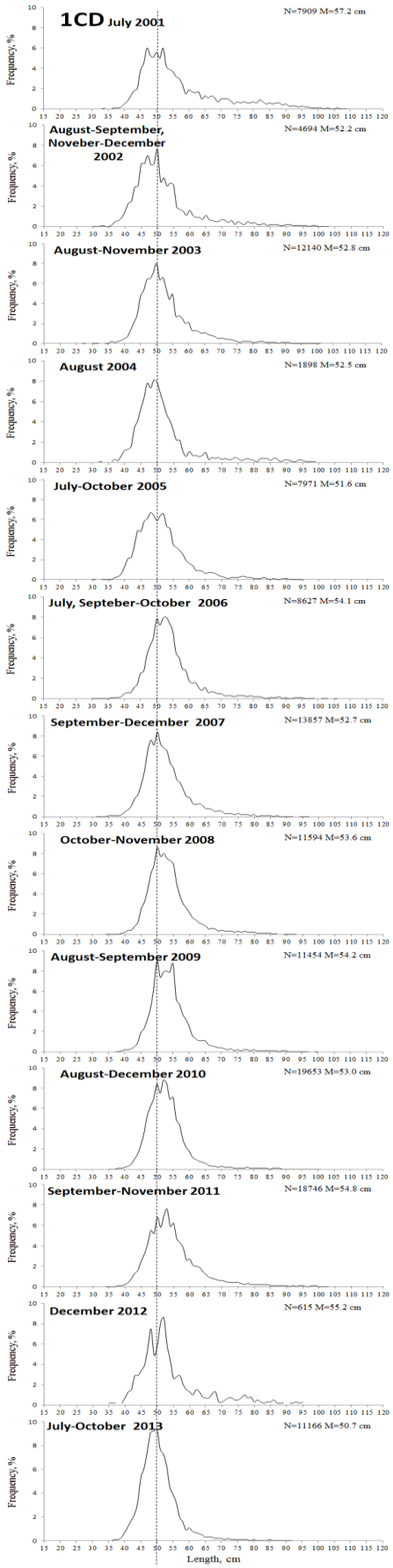

Fig. 3. Length composition of Greenland halibut trawl catches in Divs. 1CD of West Greenland in 2001-2013 by the data from observers aboard Russian fishing vessels.

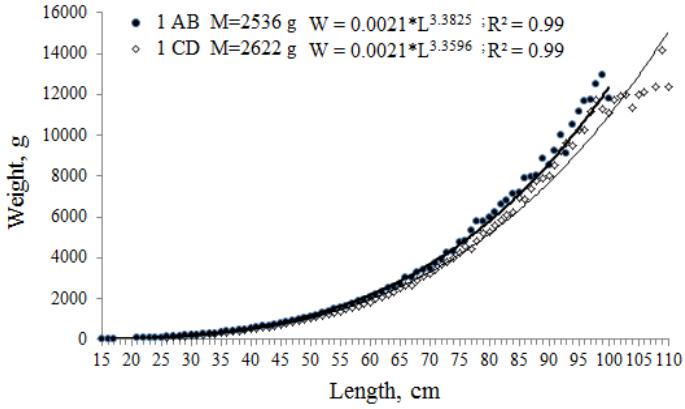

Fig. 4. Relationship between weight and length of Greenland halibut in West Greenland (Divs. 1AB and 1CD) by the data from observers aboard Russian fishing vessels in 2001- 2013.

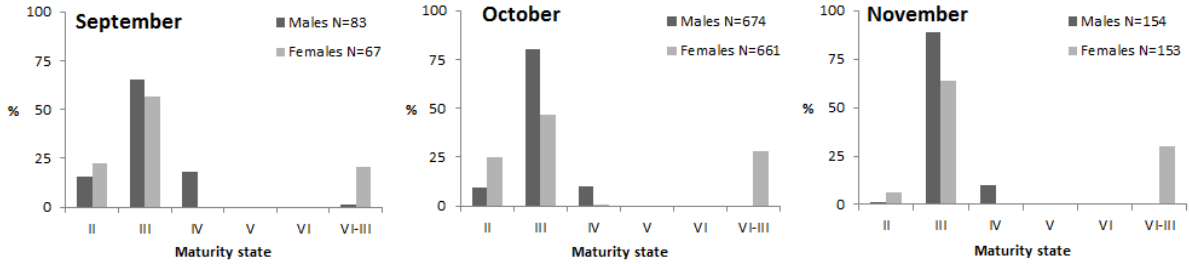

Fig. 5. Maturity of Greenland halibut in Divs. 1AB of West Greenland in September-November 2003 by the data from observers aboard Russian fishing vessels.

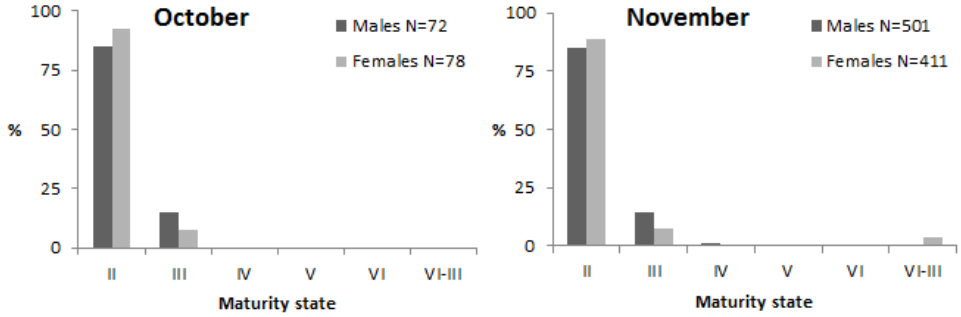

Fig. 6. Maturity of Greenland halibut in Divs. 1AB of West Greenland in October-November 2007 by the data from observers aboard Russian fishing vessels.

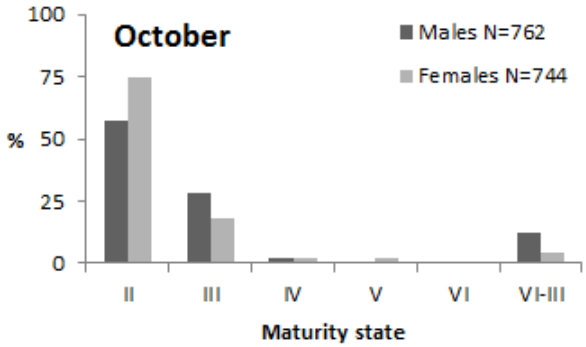

Fig. 7. Maturity of Greenland halibut in Divs. 1AB of West Greenland in October 2008 by the data from observers aboard Russian fishing vessels.

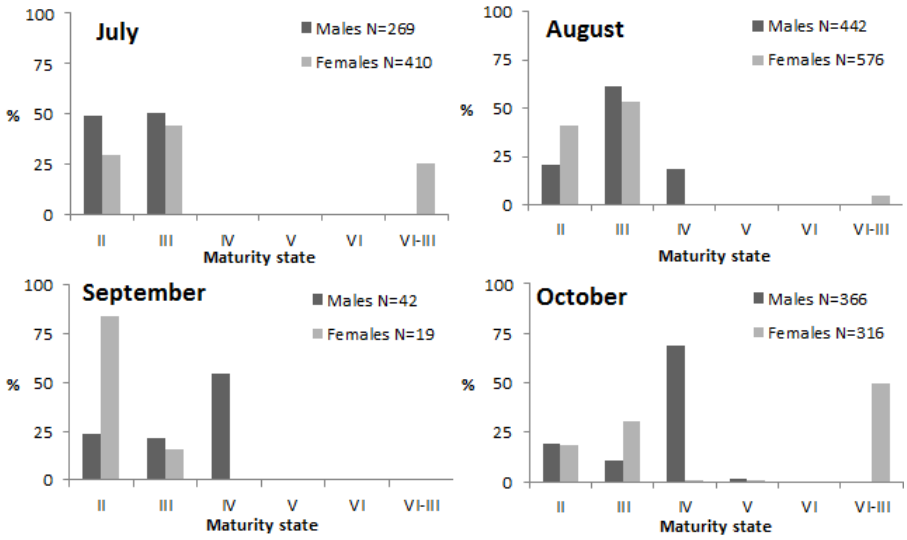

Fig. 8. Maturity of Greenland halibut in Divs. 1CD of West Greenland in July-October 2001 by the data from observers aboard Russian fishing vessels.

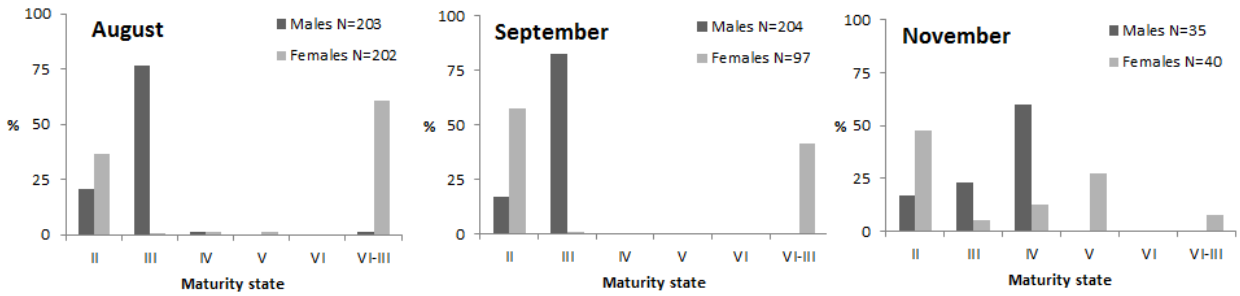

Fig. 9. Maturity of Greenland halibut in Divs. 1CD of West Greenland in August-September and November 2002 by the data from observers aboard Russian fishing vessels.

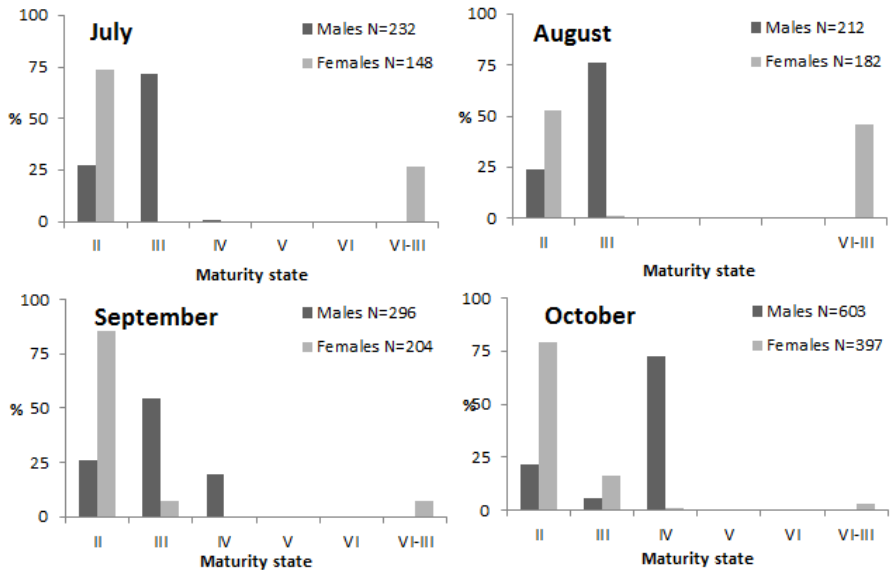

Fig. 10. Maturity of Greenland halibut in Divs. 1CD of West Greenland in July-October 2005 by the data from observers aboard Russian fishing vessels.

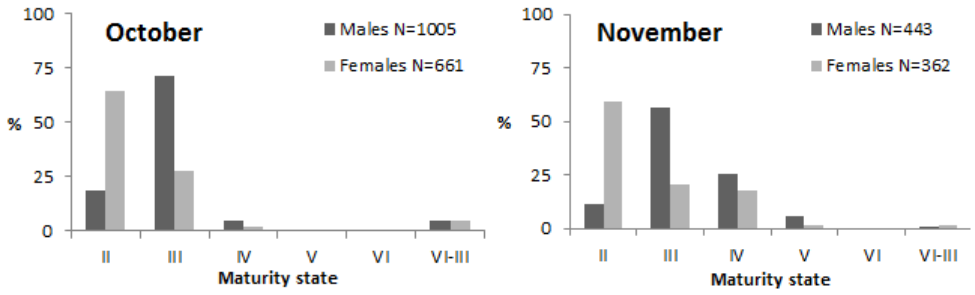

Fig. 11. Maturity of Greenland halibut in Divs. 1CD of West Greenland in October-November 2008 by the data from observers aboard Russian fishing vessels.

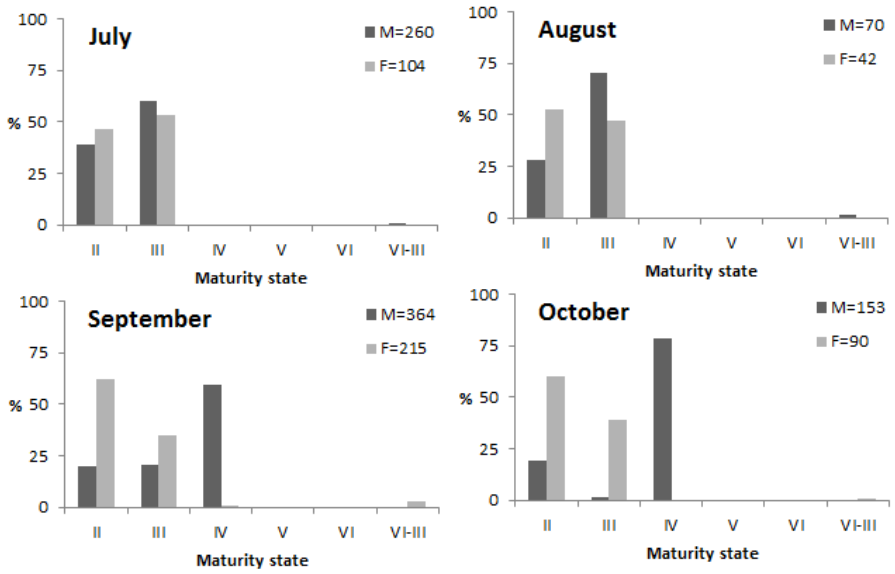

Fig. 12. Maturity of Greenland halibut in the West Greenland area in July-August and July-October 2013 by the data from observers aboard Russian fishing vessels.