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Length-age composition of Greenland halibut *Reinhardtius hippoglossoides* (Walbaum) from Russian commercial catches in the area of the Flemish Cap and Grand Newfoundland Banks (Divs. 3LMNO) in 2007

by

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Abstract

This paper presents the data on the length-age composition of the commercial catches of Greenland halibut *Reinhardtius hippoglossoides* from the Grand Newfoundland and Flemish Cap Banks in 2007 and given is the comparison of them with the data from the Russian fishery for 2004-2006.

The data were collected by the observers aboard Russian fishing vessels in January-June 2007. Halibut was fished in 570-1,300 m layer. The used fishing gears were bottom trawls with 130 mm mesh size.

As in 2004-2006, in 2007, in the catches of halibut, females predominated with 2:1 ratio.

In the catches, males were represented by individuals 30-72 cm in length. The length of females varied from 28 to 100 cm. The common trend of halibut size increase, which had been observed before, with the rise in fishing depth in 2007, was only recorded more or less distinctly in Div.3L.

A comparative analysis of Russian catches in 2004-2007 showed that, in 2007, as opposed to three previous years, the length composition of halibut had changed and larger fish prevailed in the catches. The absence of fish with the length under 28 cm in the catches may be the indication of poor recruitment of the commercial stock by individuals from younger age groups.

Introduction

Greenland halibut is an important object of Russian fishery in the Northwest Atlantic (NWA). The concentrations of Greenland halibut on the slopes of the Ground Newfoundland and Flemish Cap Banks are of special interest for fishery and researches in the open part of the Northwest Atlantic (NWA). This valuable fish has been actively harvested by trawlers of European countries here since the late 1980s. Before 1990, halibut was mainly fished in 200-mile zone of Canada. Since 1990, with the development of fishery in NAFO Regulation Area, the total catch of halibut abruptly increased. Before 1995, halibut catches were not limited in the Regulatory Area. Russian fleet started fishing in NAFO Regulatory Area in 1998.

In recent years, the decrease in halibut stock from Divs.3LMNO has been noticed (Anon., 2007; Anon., 2008). Due to the reduction in halibut commercial stock and total allowable catch (TAC), the quota allocated to Russia and the Russian catch in recent years gradually reduced from 3,773 t in 2001 to 1,507 t in 2007 (Table 1). In 1998-2007, Russian catch accounted for 12-14% from the total catch. Russia takes one of the leading places together with Spain and Portugal in the total halibut catch in this area.

Russian data on the length-age composition of halibut catches, alongside with those ones from the other countries exploited the stock, are used for analytical estimation of Greenland halibut stock state and TAC calculation for the following years. Therefore this paper is aimed at analyzing the length-age composition of Russian catches of Greenland halibut for 2007 by fishing areas and depths and at comparing with the data on fishery in 2004-2006.

Material and methods

The paper is based on the data collected by Russain observers in January-June 2007, during the target fishery of Greenland halibut. The length-age and sex composition of fished concentrations was analysed. In this period, 1,082 individuals (694 females and 388 males) were aged, 35,937 individuals were measured. The hauls were made by bottom trawls with the mesh of not less than 130 mm.

The length composition was obtained during the mass measurements. The measurements were made with the accuracy of to 1 cm.

The material to age was taken at 10-15 specimens per each 2 cm length group.

The age was mainly read using scale, with the aid of microprojector (Anon., 2004). When the scale was unsuitable the age was read by otoliths, in the reflected light, under the binocular microscope. The large otoliths were polished beforehand and wetted by mixture of glycerine and alcohol. The age data were recalculated for whole length distribution.

Statistical data on the international catch of Greenland halibut on the Grand Newfoundland and Flemish Cap Banks were taken from STATLANT 21A database, on the NAFO site, www.nafo.int.

Results

In 2007, four Russian trawlers including 1 large-capacity (of the BMRTPT-type) vessel and the 2-3 middle-tonnage (of the STM-type) ones conducted target fishery of halibut. The main fishing area was the northeastern slope of the Grand Newfoundland Bank and the adjacent area of the Flemish Cap Bank (Divs.3LMN), between 42°-48°N and 44°-49°W, at 570-1,300 m (Fig.1). In the trawl catches, halibut portion was 98%. The main bycatch constituents were deepwater redfish, skates and roughhead grenadier. Russian catch of halibut was 1,507 t, of which 86% were taken in Divs.3L and 3N and the rest part – in Div.3M (Table 2).
Halibut concentrations were fished at 570-1,300 m depths (Table 3). The fishery was mainly undertaken at 570-1,300 m depths. Within that range, 90% of fishing efforts were spent and about 90% of total catch were taken. At those depths, the mean catch per a hauling hour was approximately the same, 0.48-0.49 t/h. The efficiency was the greatest (0.73 t/h) at 600-699 m depths but only a single haul was performed there. At 1,200-1,299 depths, the efficiency reduced to 0.36 t/h, at that, the number of hauls (21) and of the haul hours (219) was quite great.

In 2007, in the halibut catches, fish as long as 28-100 cm occurred. Immature and first maturing fish prevailed in catches (about 80%). This corroborates the concept of the Flemish Pass Deep area, as a feeding area of Greenland halibut in the Northwest Atlantic (NWA) (Igashov, 1998). In the south of the area, in the Newfoundland Shallows, occurring are young fish, in the Labrador area – old specimens, on the continental slope of the North Labrador – the oldest fish (Chumakov, 1982).

The analysis of Russian catches showed that, in 2004-2006, length frequencies of Greenland halibut had the similar character of occurrence frequency distribution. The portion of individuals in the main size groups was approximately the same and comparatively small (to 5% males and to 10% females). The average length insignificantly differed and was 40.7 cm-42.0 cm in males and 44.0 cm-45.7 cm in females (Fig.2).

In 2007, the average length of both males (45.7 cm) and females (47.2 cm) in catches was greater than in 2004-2006. The percentage of modal length group was: to 5% for males and to 10% for females. The length of fish in catches varied from 28 to 100 cm. There were no specimens with the length under 28 cm that, probably, indicates poor recruitment of commercial stock by younger fish.

During the studied period (2004-2007), females predominated in catches. The sex ratio was approximately 2:1 (minimal – 1.7:1 in 2005, maximal – 2.3:1 in 2007) (Fig.2). Probably, the dynamics of halibut sex structure in Divs.3LMNO has been being constant, without significant changes.

The data analysis by divisions and depths showed that, in Div.3M, there was no well-pronounced shift of modal length in catches (Fig.3). In 700-799 m layer, in the catches, males as long as 40-45 cm prevailed and accounted for 70-73% in abundance. Females were distributed in the wider size range, from 38 cm to 56 cm (70% of abundance), and the curve of occurrence frequency distribution of different size groups was more faired for them. With the increase in fishing depth, the average length of females insignificantly increased from 45.9 cm to 48.2 cm. The mean length of males in catches practically did not vary and was about 44.5 cm.

In Div.3L and, to a less extent, Div.3N, unlike Div.3M, at 700-1,100 m depths, the average length of halibut increased with depth quite regularly: in Div.3L, within 37.6-44.0 cm for males and 39.0-47.7 cm for females; in Div.3N, 40.4-44.1 cm for males and 46.1-48.0 cm for females (Figs.4,5). The regularity was disrupted at the depths of more than 1,100 m.

In Div.3O, halibut fishery was only executed at 1,100-1,200 m depths where the average length of males was 46.0 cm, and of females – 48.7 cm (Fig.6).

The research showed that, in 2007, in Divs.3LMNO, Russian halibut catches consisted of males aged 3-12 and females at the age of 3-19.

Based on collected primary biological material, to convert length distribution into the data on age composition, halibut length-age keys were derived as separately (for males and females), as well as being combined (Tables 4, 5, 6). The calculations showed that fish aged 6-7 prevailed in Russian catches everywhere (Table 7).

The derived keys will be given to use them in the process of analytical estimation of the stock status and when forecasting its dynamics.

Conclusion

Larger fish predominated in catches as compared to 2004-2006. At the same time, there were no small individuals with length of less than 28 cm that may be indicative of the poor recruitment of the commercial stock by younger fish. Halibut aged 6-7 prevailed in the catches. The common trend of halibut size rise with fishing depth increase, which had been observed before, was more or less pronounced only in Div.3L. The sex structure dynamics has not changed significantly.

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Table 1. Nominal catches (tons) of Greenland halibut from Div**.** 3LMNO by Russia**,** 1998-2007 STATLANT 21A

Country	**Year**									
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005***	**2006***	**2007***
Russia	1890	3117	3335	3773	3278	3005	1680	1590	1531	1507
Total	**16028**	**20963**	**25486**	**28256**	**25985**	**25230**	**12077**	**12637**	**12481**	**10711**
доля в%	11.8	14.9	13.1	13.4	12.6	11.9	13.9	12.6	12.3	14.1

**preliminary data*

Table 2. Distribution of Russian catch and a catch per effort of the Greenland halibut by fishing areas

Local area	**Total catch (t)**	**Halibut catch**	**Haul hours**	**Catch per an effort (t/h)**
3 L	828	786	1531.2	0.51
3 M	141	116	385.2	0.31
3 N	771	603	1355.5	0.44
Total	1740	1507	3255.8	0.46

Table 3. Fishing efforts, catch and catches per an effort of Greenland halibut by Russian vessels at different depths in Divs.3LMNO in 2007.

Depth range,	Number of		Catch	
	hauls	hours	t	t/h trawl
500-599	1	4.0	0.1	0.04
600-699	1	7.5	5.5	0.73
700-799	14	117.9	55.5	0.47
800-899	50	382.8	182.0	0.48
900-999	134	1021.1	489.2	0.48
1000-1099	105	865.6	380.8	0.44
1100-1199	79	630.3	310.4	0.49
1200-1299	21	219.0	79.4	0.36
1300-1399	1	7.5	4.1	0.55
Total	406	3255.8	1507	0.45

Table 4. Length-age key for Greenland halibut males from Div. 3LMNO, 2007

Length, cm	Age										No	Average weight, g
cm	3	4	5	6	7	8	9	10	11	12		
30	4	1									5	224
32	9	5	2								16	300
34	1	13	2	1							17	329.7
36	1	8	9	2							20	392
38		7	14	1							22	450
40		3	21	9	1						34	530.7
42			16	16	2						34	614.3
44			17	15	5						37	723.6
46			2	26	8	1					37	828.9
48			1	12	16	3					32	954.5
50				10	21	3	1				35	1060.9
52				2	17	5	1				25	1201.6
54				1	7	17	2				27	1331.5
56				1	1	12	3				17	1495
58					2	2	3	2			9	1677.8
60				1			4	5	1		11	1911.8
62							5			2	7	2097.1
64							1		1		2	2290
66												
68												
70												
72									1		1	3810
No	15	37	84	97	80	43	20	7	3	2	388	
Average weight,g	268.7	381.6	555.5	798.2	1052.8	1334.7	1756.3	1850	2593.3	2105		886.4
Average length,cm	32.3	35.8	40.8	45.6	50.1	54.2	58.8	59.6	66	62.5		46.2

Table 5. Length-age key for Greenland halibut females from Div. 3LMNO, 2007

Length, cm	Age																	No	Average weight, g
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19		
28	3																	3	180
30	1																	1	240
32	2	4	1															7	270
34	2	6	2															10	342.5
36		10	10															20	390
38		8	9	2														19	468.9
40		2	17	10	3													32	541.7
42			10	18	4													32	614.7
44			15	12	4													31	722.4
46			5	27	8													40	835
48			6	15	22													43	955.2
50				5	26	4												35	1097.6
52				5	26	9	1											41	1216.8
54					15	22	2											39	1346.7
56					6	22	9	1										38	1561.6
58						16	19	4	2									41	1731.2
60					1	7	18	10	1	1								38	2358.7
62							20	14	2	1	1							38	2156.8
64						1	8	13	5	2								29	2435.9
66							2	10	13	2								27	2825.7
68							2	5	7	5	2	1						22	3010.9
70								3	7	9	1	1						21	3512.6
72									3	3	6	3						15	3686.7
74									1	9	4							14	4235
76										2	5	6						13	4679.2
78									1	1	5	4						11	5043.6
80											5	2	5	1				13	5873.1
82												4	1					5	6252
84													1					1	8080
86												3		1				4	7970
88												1	1					2	7710
90												1	1	2	1			5	8370
92														1				1	9990
94													1					1	11270
96																			
98															1			1	12020
100																	1	1	13040
No	8	30	75	94	115	81	81	60	42	35	29	26	10	5	2		1	694	
Average weight,g	252.5	390	602.1	781.6	1240.9	1507.8	1993.4	2414.4	2913.2	3550.6	4466.9	5486.7	7059	8404	10220		13040		1971.8
Average length,cm	31.5	36.2	41.6	45.5	50.5	56.1	60.6	63.8	67.5	70.8	75.2	79.2	84.4	88	94		100		56.1

Table 6. Length-age key of Greenland halibut males and females from Div. 3LMNO, 2007

Length, cm	Age																	No	Average weight, g
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19		
28	3																	3	180.0
30	5	1																6	226.7
32	11	9	3															23	290.9
34	3	19	4	1														27	334.4
36	1	18	19	2														40	391.0
38		15	23	3														41	458.8
40		5	38	19	4													66	536.1
42			26	34	6													66	614.5
44			32	27	9													68	723.1
46			7	53	16	1												77	832.1
48			7	27	37	3												75	954.9
50				15	47	7	1											70	1079.2
52				7	43	14	2											66	1211.1
54				1	22	39	4											66	1340.5
56				1	7	34	12	1										55	1541.0
58					2	18	22	6	2									50	1721.6
60				1	1	7	22	15	2	1								49	2258.4
62							25	14	2	3	1							45	2147.6
64						1	9	13	6	2								31	2426.5
66							2	10	13	2								27	2825.7
68							2	5	7	5	2	1						22	3010.9
70								3	7	9	1	1						21	3512.6
72									4	3	6	3						16	3694.4
74									1	9	4							14	4235.0
76										2	5	6						13	4679.2
78									1	1	5	4						11	5043.6
80											5	2	5	1				13	5873.1
82												4	1					5	6252.0
84													1					1	8080.0
86												3		1				4	7970.0
88												1	1					2	7710.0
90												1	1	2	1			5	8370.0
92														1				1	9990.0
94													1					1	11270
96																			0
98															1			1	12020
100																	1	1	13040.0
No	23	67	159	191	195	124	101	67	45	37	29	26	10	5	2		1	1082	
Average weight,g	263.0	385.4	577.5	790.0	1163.7	1447.8	1946.4	2355.4	2891.9	3472.4	4466.9	5486.7	7059.0	8404.0	10220.0		13040.0		1582.6
Average length,cm	32.0	36.0	41.2	45.6	50.3	55.4	60.3	63.3	67.4	70.4	75.2	79.2	84.4	88.0	94.0		100.0		52.6

Table 7. Greenland halibut age composition of the Russian commercial trawler catches in NAFO Divs. 3LMNO in 2007

Age.	3 L		3 M		3 N		3O		3 LMNO	
years	n	%	n	%	n	%	n	%	n	%
3	19	0.2	3	0.1	23	0.2			**45**	**0.1**
4	319	2.5	42	0.9	353	1.9	1	0.3	**715**	**2**
5	2230	17.6	627	13.5	2943	15.9	13	7.3	**5813**	**16.2**
6	3867	30.6	1408	30.2	5480	29.7	44	24.8	**10799**	**30**
7	3691	29.2	1478	31.7	5522	29.9	71	40.4	**10762**	**29.9**
8	1423	11.2	612	13.1	2097	11.4	27	15.2	**4159**	**11.6**
9	594	4.7	276	5.9	928	5	12	6.6	**1810**	**5**
10	245	1.9	115	2.5	468	2.5	4	2.5	**832**	**2.3**
11	113	0.9	47	1.0	265	1.4	2	1.4	**427**	**1.2**
12	71	0.6	26	0.6	166	0.9	2	0.9	**265**	**0.8**
13	38	0.3	12	0.3	95	0.5	1	0.5	**146**	**0.4**
14	28	0.2	9	0.2	75	0.4		0.1	**112**	**0.3**
15	8	0.1	2		26	0.2			**36**	**0.1**
16	3	0.0			10	0.1			**13**	**0.1**
17					2	0.0			**2**	**0.0**
18										
19					1	0.0			**1**	**0.0**
Total	**12649**	**100**	**4657**	**100**	**18454**	**100**	**177**	**100**	**35937**	**100**

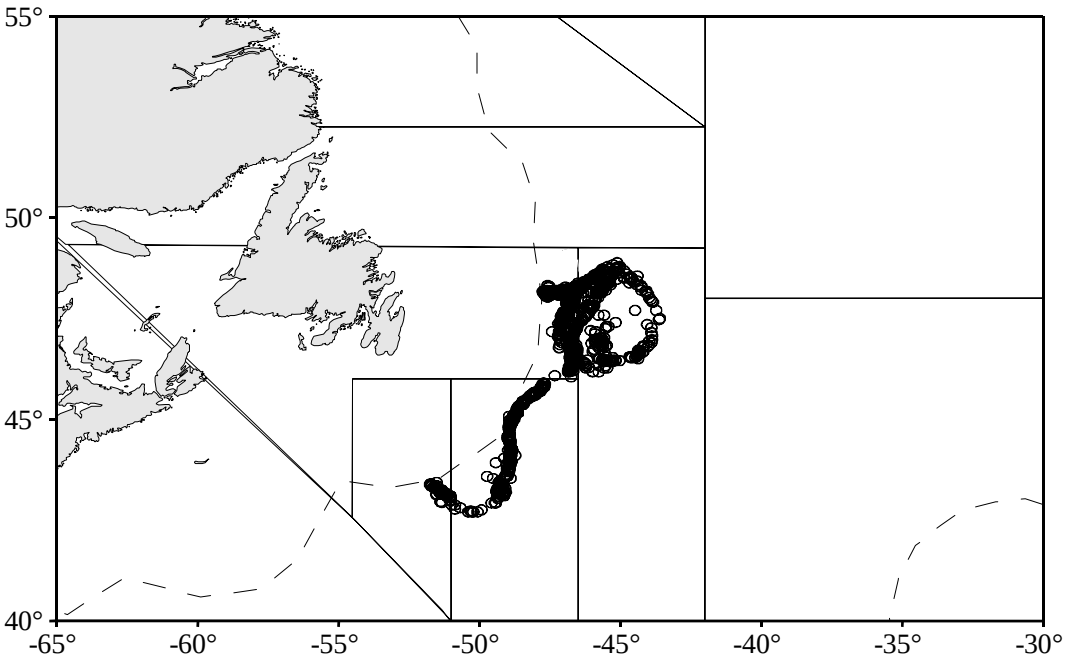

Fig.1. Location of Russian fleet during the target Greenland halibut fishery in Divs. 3LMNO in 2007

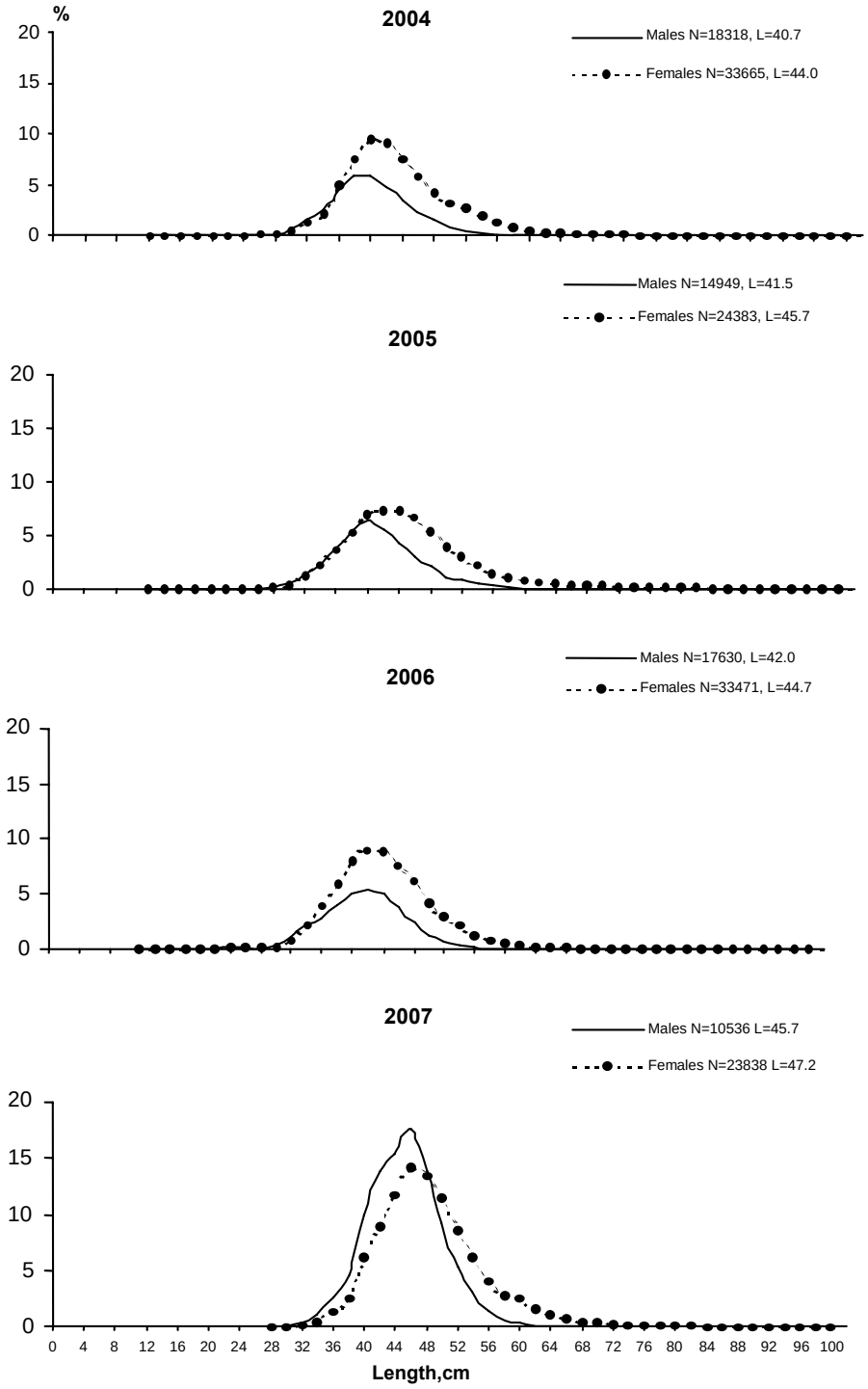

Fig.2. Length distribution of Greenland halibut in Divs. 3LMNO in 2004-2007

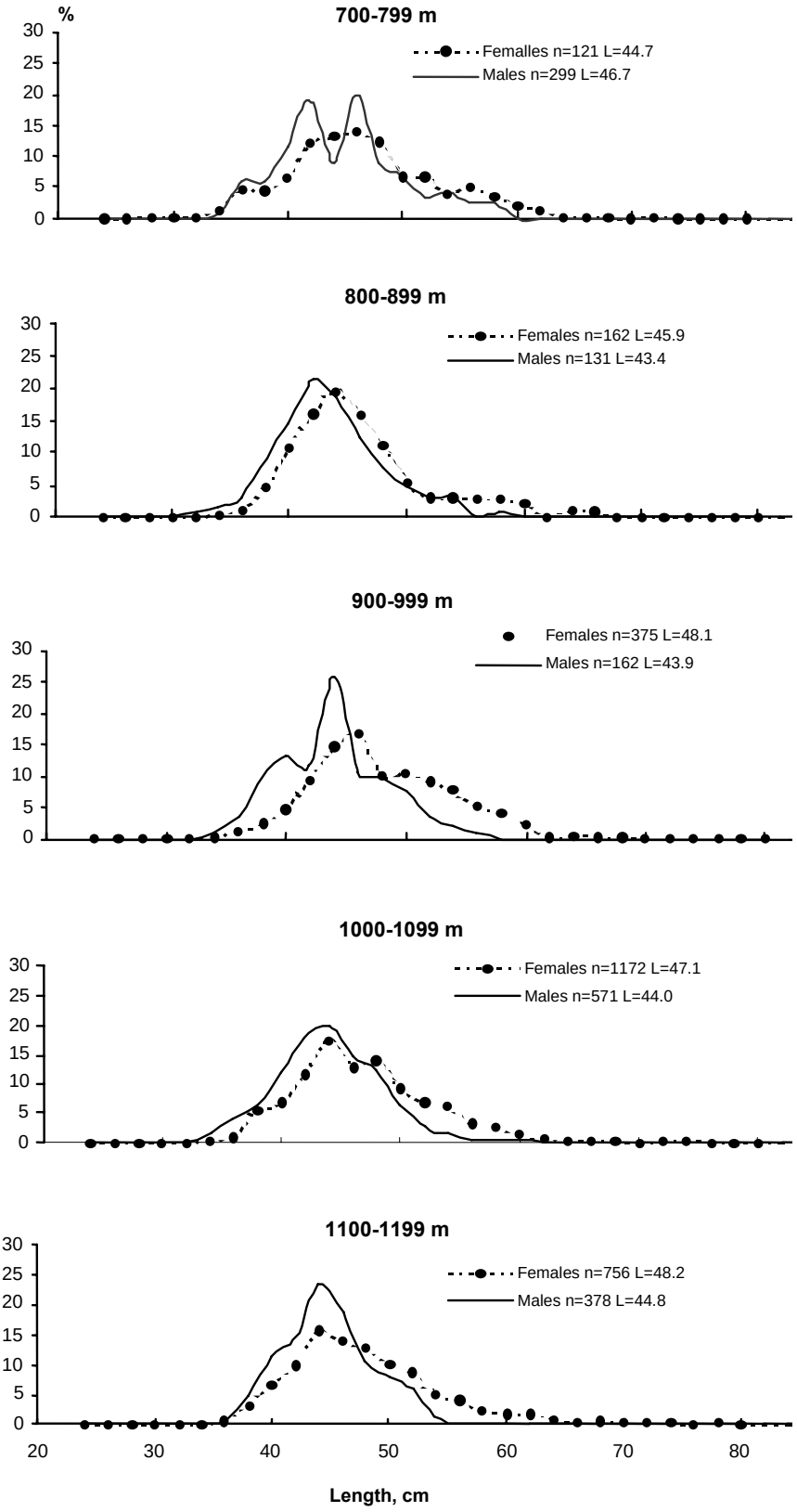

Fig. 3. Length distribution of Greenland halibut in Div.3M by depths in 2007

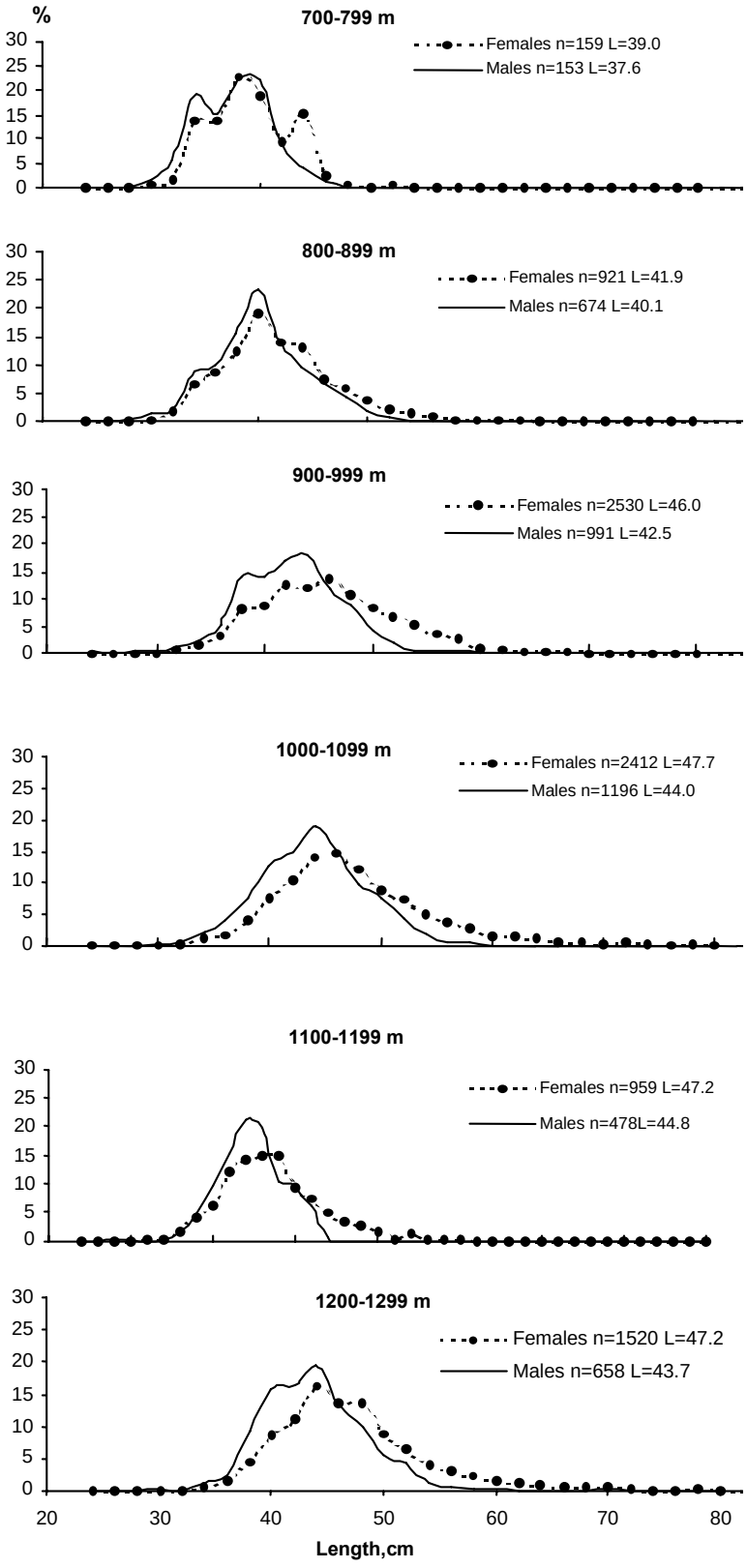

Fig. 4. Length distribution of Greenland halibut in Div.3L by depths in 2007

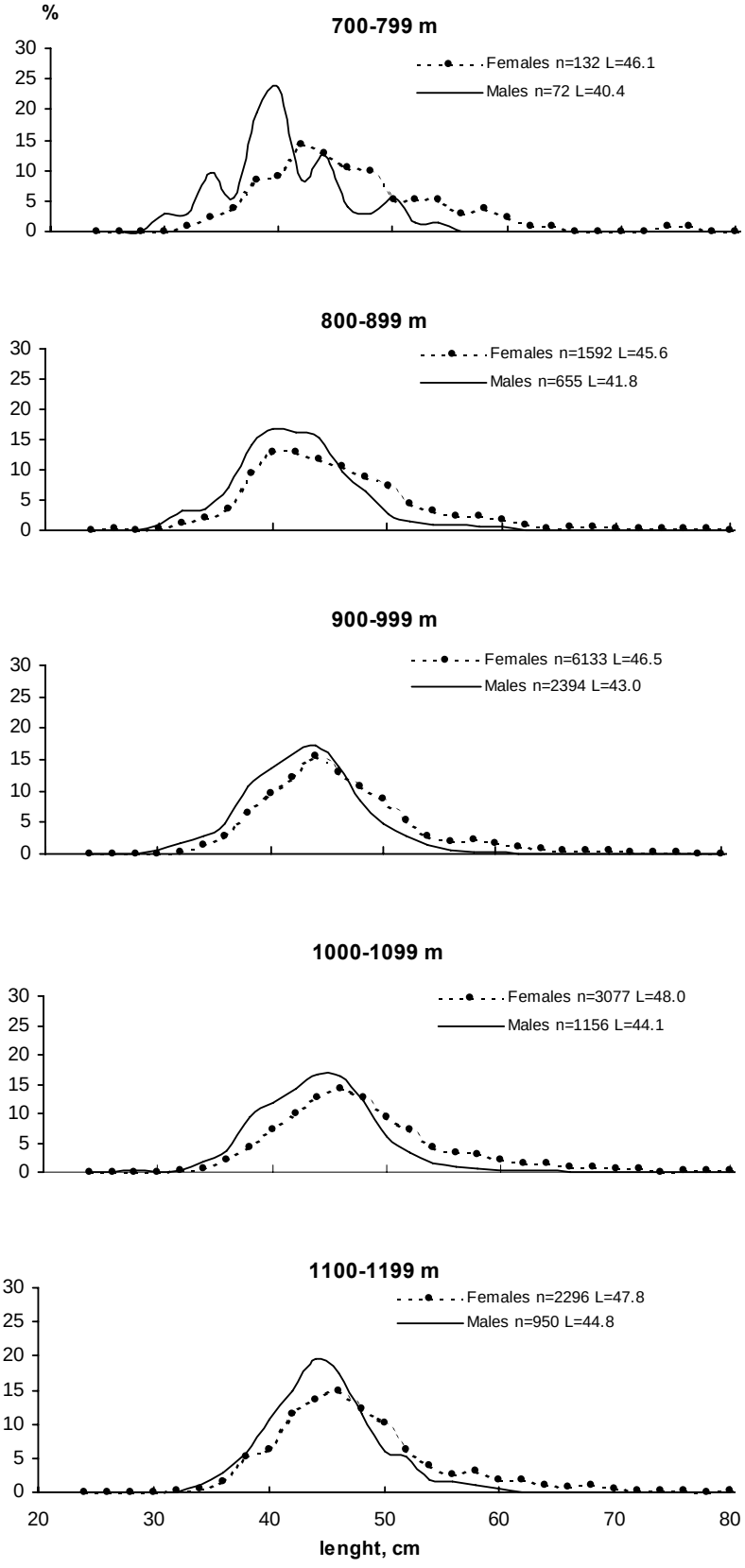

Fig. 5. Length distribution of Greenland halibut in Div.3N by depths in 2007

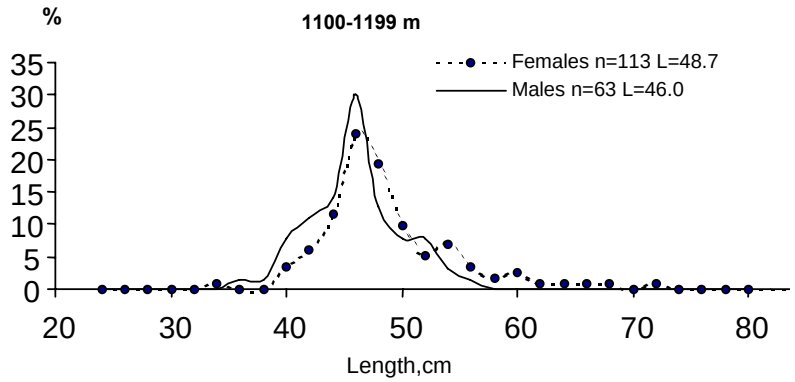

Fig. 6. Length distribution of Greenland halibut in Div. 3O by depths in 2007