Northwest Atlantic Fisheries Organization

Serial No. N5749 **NAFO SCR Doc. 10/3**

SCIENTIFIC COUNCIL MEETING – JUNE 2010

Pigmented patches of beaked redfish *Sebastes mentella* in the different regions of fishing in the opened part of North Atlantic.

By
Valery V. Paramonov
Southern Scientific Research Institute of Marine Fishery and Oceanography (YUGNIRO),
2, Sverdlov St., Kerch, Crimea, 98300 Ukraine; e-mail: VPARAMONOV@LIST.RU

Abstract

Beaked redfish, dwelling in the opened waters of North Atlantic often has pigmented patches (spots) of different types and colors. Researches routine that certain distinctions of pigmented fish depend from a sex, size, region and season of works. It is possible to use repetition of the pigmented fish as additional factor for differentiation of accumulations of redfish.

Inroduction

Beaked redfish (*Sebastes mentella*) is one of major commercial fish, dwellings both in Northeastern (NEA) and in Northwestern (NWA) Atlantic. Redfish fishery is conducted practically from the beginning of XX century, and almost always basic commercial type of redfish was beaked redfish. At the beginning of 80th of the last century commercial redfish fishery began outside EEZ in the Irminger Sea (NEA), at the end of 90th – in the Labrador Sea (NWA), from 2005 in the Norwegian Sea (NEA). For the last 30 years of XX century the total catch of redfish in NWA was about 2.5 million т (Chepel, 2001). Presently fishery in all regions is regulated.

Presence of pigmented patches is a substantial factor, which is useful for differentiation of separated concentrations of redfish. Occurrence of pigmented patches is one of criteria for differentiation “oceanic” and “pelagic deep-sea” redfish (Magnusson at al, 1995). Pigmented patches can be indicator of intraspecific structure of beaked redfish (Bakay, 2000).

In this work information about pigmented redfish from the different regions of North Atlantic for the last 2 years was generalized.

Material and Methods

In basis of work materials are fixed collected an author aboard the Latvian f/v “Dorado”, where he worked as a scientific observer NAFO and NEAFC in North Atlantic last 2 years (2008-2009). Aboard a ship mass measurements and biological analyses of redfish was executed in obedience to methods accepted in YUGNIRO.

Total length (TL) of fish was measured by a tapeline within 1 cm. Length distribution was summarized with an interval in 1 cm. Weight of fish was measured by electronic scales within 5 g. All measurements were made separately for females and males.

22700 measurements were executed in all, including: Irminger Sea - 17300, Labrador Sea - 2900, Norwegian Sea - 2500.

In 2008-2009 during each measured of redfish presence of pigmented patches was fixed. Only black pigmented patches (melanomas) were fixed. Mostly they were localized on gill covers, also on caudal fins and lateral sides (last ones usually were observed seldom and were largest by size).

Data of last year (2009) was used for determination of prevalence of pigmented fish by size separately for males and females.

The order of consideration of regions corresponds fishery motion – at first the Irminger Sea, after the Labrador Sea and last the Norwegian Sea (Fig.1, and Fig.2).

Results

Irminger Sea.. This is the basic region of redfish fishery. Most statistical material is collected exactly on this region. It is characterized most seasonal scope – a period from March to September is observed. Spatial scope, not very big - almost all individuals belonged to the division XIVb, and only small part - to the division XII (in May).

Labrador Sea. Here both general volume of information and temporal scope (June-September) is less. Also we have here only 1 division (1F).

Norwegian Sea. In this region the least amount of information is collected. Direct redfish fishery began in the opened waters from 2005; however information on pigmented redfish were collected only in 2008-2009.

Spatial changeability. (Table 1-3). The least quantity of fish with pigmented patches was registered in Irminger Sea. The redfish from NAFO was more pigmented. The most pigmented redfish was from the Norwegian Sea, where .every second redfish had pigmented patches. Within the limits of one region distinctions are small. So, in Irminger Sea the average prevalence of redfish with pigmented patches was 10,7% in division XIVb, and 9,1% in division XII.

Seasonal changeability.(table 4-9). In Irminger Sea, division XIVb, on the whole there was increasing of prevalence of fish with pigmented patches from 7,0 % in April to 21,0 % in September. We can see it better for males. Females had also additional maximum in May. Infestation in March also was below, than in April. Approximately the same situation was in division XII in Irminger Sea.

In division 1F NAFO was observed approximately analogical situation with increasing of prevalence of fish with pigmented patches from July to August. Seasonal changeability in division IIa NEAFC (Norwegian Sea) was not possible to analyze because there was information only for one month.

Interannual changeability. We have datum only for 2 years, so it is not very representative. In all divisions and regions (NEAFC XIVb and IIa, NAFO 1F) we can see significant increasing of prevalence of fish with pigmented patches for last 2 years.

Changeability by sex. In 2009 data was generalized separately by sex and by size (table 10-45). In all region for all period quantity of females with pigmented patches was more, than males. Ratio prevalence of females with pigmented patches/prevalence of males with pigmented patches is shown in table 46. In XIVb division we can see diminishing this ratio from April to July and increasing later till September. Ratio is maximal in Irminger Sea (division XIVb NEAFC) and minimal in Labrador Sea (division 1F NAFO).

Changeability by size. In connection with large variation of data it is better to look at tables 43-45, where data for division XIVb is generalized. Both for females and for males we can see increasing of prevalence of individuals with pigmented patches with the increasing of size to the size groups 26-30 cm, where a maximum was observed, and decreasing for more large fish.

In other divisions we can see situation. In division XII NEAFC most pigmented fish had size 31-35 cm (females 31-40 cm and males 31-35 cm). In division IIa NEAFC in Norwegian Sea most prevalence of fish with pigmented patches had size 36-40 cm (both females and males). In division 1F NAFO most pigmented fish had size

31-40 cm (females 36-40 cm, males 31-35 cm). It is interested to note, that in 2 last divisions (IIa and 1F) there was no fish with pigmented patches with size more 41 cm and less 30 cm at all.

Discussion and Conclusions

Redfish with pigmented patches had size 21- 45 cm. Fish larger 45 cm was not pigmented at all, and so results Bakay and Mel'nikov (2008) also had.

Most pigmented fish had size 31-40 cm (Mel'nikov and .Bakay, 2009 – 35-40cm). Only in XIVb NEAFC (both inside and outside Greenland EEZ) this fish had size 26-30 cm. So it is possible to suppose that the fish with enough big prevalence of individuals with pigmented patches for size 26-30 cm is an origin from waters of Greenland (at least, in 2009).

Prevalence of individuals with pigmented patches in Norwegian Sea is more than in other divisions of North Atlantic. Taking into account that infestation of redfish in Norwegian Sea also is very Unfortunately it is not possible to determine dependence prevalence of individuals with pigmented patches from depth, so f/v "Dorado" have caught redfish all time at depth more that 500 m (in Irminger Sea).

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Table 1. Prevalence of females with pigmented patches, 2009, by regions

Size	Prevalence, %				
	NEAFC, XIVb	NEAFC, XII	NEAFC, XIVb, Greenland EEZ	NEAFC, IIa	NAFO, 1F
21-25	12,5	0	-	-	0
26-30	22,7	7,1	20,0	-	0
31-35	13,8	9,7	19,4	64,3	14,6
36-40	11,0	10,3	16,5	68,4	30,4
41-45	5,9	5,1	2,6	0	-
46-50	0	0	-	-	-
Total	10,7	9,1	15,6	64,7	22,2

Table 2. Prevalence of males with pigmented patches, 2009, by regions

Size	Prevalence, %				
	NEAFC, XIVb	NEAFC, XII	NEAFC, XIVb, Greenland EEZ	NEAFC, IIa	NAFO, 1F
21-25	0	-	50,0	-	-
26-30	20,6	0	30,0	-	0
31-35	13,2	9,5	25,4	32,4	19,4
36-40	7,2	4,5	10,1	56,3	12,9
41-45	1,9	5,3	2,5	-	-
46-50	0	-	0	-	-
Total	7,3	5,9	13,4	43,9	17,2

Table 3. Total prevalence of redfish with pigmented patches, 2009, by regions

Size	Prevalence, %				
	NEAFC, XIVb	NEAFC, XII	NEAFC, XIVb, Greenland EEZ	NEAFC, IIa	NAFO, 1F
21-25	8,3	0	50,0	-	0
26-30	21,4	3,8	26,2	-	0
31-35	13,5	9,6	23,2	41,7	18,1
36-40	8,8	8,0	12,1	60,8	21,2
41-45	3,6	5,2	2,5	0	-
46-50	0	0	0	-	-
Total	8,8	7,9	14,1	51,0	19,0

Table 4. Prevalence of females with pigmented patches, NEAFC, XIVb, by months

Size	Prevalence, %					
	April	May	June	July	August	September
21-25	-	-	-	0	16,7	-
26-30	0	22,2	14,3	42,9	18,2	40,0
31-35	6,7	14,7	12,9	15,4	26,7	25,0
36-40	12,3	12,6	7,9	9,2	11,6	41,0
41-45	2,0	8,5	6,3	5,9	3,3	7,1
46-50	-	-	0	0	-	0
Total	8,7	12,0	8,5	9,7	12,7	29,9

Table 5. Prevalence of males with pigmented patches, NEAFC, XIVb, by months

Size	Prevalence, %					
	April	May	June	July	August	September
21-25	-	-	-	-	0	-
26-30	8,3	11,1	7,1	40,7	18,9	50,0
31-35	3,7	8,6	11,4	15,8	17,9	32,8
36-40	3,6	6,1	5,7	7,3	8,4	15,3
41-45	3,8	1,0	2,0	2,2	2,1	0
46-50	0	0	0	-	0	-
Total	4,0	5,4	5,8	7,8	8,6	17,4

Table 6. Total prevalence of redfish with pigmented patches, NEAFC, XIVb, by months

Size	Prevalence, %					
	April	May	June	July	August	September
21-25	-	-	-	0	10,0	-
26-30	6,5	16,7	9,5	41,5	18,6	44,4
31-35	5,7	11,6	12,1	15,6	21,4	30,3
36-40	9,6	9,2	6,6	8,0	9,5	22,6
41-45	3,0	4,9	3,7	3,7	2,5	1,6
46-50	0	0	0	0	0	0
Total	7,0	8,7	6,9	8,6	10,1	21,0

Table 7. Prevalence of redfish with pigmented patches, NEAFC, XIVb, %

Month	Year		
	2008	2009	Average
April	-	7,0	7,0
May	1,3	8,7	5,0
June	4,2	6,9	5,6
July	3,4	8,6	6,0
August	-	10,1	10,1
September	-	21,0	21,0
Average	3,0	10,4	9,1

Table 8. . Prevalence of redfish with pigmented patches, NAFO, 1F, %

Month	Year		
	2008	2009	Average
July	9,8	-	9,8
August	10,1	19,0	14,6
Average	10,0	19,0	12,2

Table 9. . Prevalence of redfish with pigmented patches, NEAFC, IIa, %

Month	Year		
	2008	2009	Average
September	6,0	51,0	28,5

Table 10. Prevalence of females with pigmented patches, NEAFC, XIVb, April, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
26-30	0	7	0
31-35	23	341	6,7
36-40	37	301	12,3
41-45	1	49	2,0
Total	61	698	8,7

Table 11. Prevalence of males with pigmented patches, NEAFC, XIVb, April, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
26-30	2	24	8,3
31-35	7	188	3,7
36-40	5	137	3,6
41-45	2	52	3,8
46-50	0	1	0
TOTAL	16	402	4,0

Table 12. Total prevalence of redfish with pigmented patches, NEAFC, XIVb, April, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
26-30	2	31	6,5
31-35	30	529	5,7
36-40	42	438	9,6
41-45	3	101	3,0
46-50	0	1	0
TOTAL	77	1100	7,0

Table 13. Prevalence of females with pigmented patches, NEAFC, XII, May, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
21-25	0	1	0
26-30	1	14	7,1
31-35	30	309	9,7
36-40	45	439	10,3
41-45	8	157	5,1
46-50	0	1	0
TOTAL	84	921	9,1

Table 14. Prevalence of males with pigmented patches, NEAFC, XII, May, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
26-30	0	12	0
31-35	14	148	9,5
36-40	13	286	4,5
41-45	7	133	5,3
TOTAL	34	579	5,9

Table 15. Total prevalence of redfish with pigmented patches, NEAFC, XII, May, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
21-25	0	1	0
26-30	1	26	3,8
31-35	44	457	9,6
36-40	58	725	8,0
41-45	15	290	5,2
46-50	0	1	0
TOTAL	118	1500	7,9

Table 16. Prevalence of females with pigmented patches, NEAFC, XIVb, May, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
26-30	2	9	22,2
31-35	25	170	14,7
36-40	60	478	12,6
41-45	19	223	8,5
TOTAL	106	880	12,0

Table 17. Prevalence of males with pigmented patches, NEAFC, XIVb, May, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
26-30	1	9	11,1
31-35	15	175	8,6
36-40	32	525	6,1
41-45	2	209	1,0
46-50	0	2	0
TOTAL	50	920	5,4

Table 18. Total prevalence of redfish with pigmented patches, NEAFC, XIVb, May, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
26-30	3	18	16,7
31-35	40	345	11,6
36-40	92	1003	9,2
41-45	21	432	4,9
46-50	0	2	0
TOTAL	156	1800	8,7

Table 19. Prevalence of females with pigmented patches, NEAFC, XII+XIVb, May, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
21-25	0	1	0
26-30	3	23	13,0
31-35	55	479	11,5
36-40	105	917	11,5
41-45	27	380	7,1
46-50	0	1	0
TOTAL	190	1801	10,5

Table 20. Prevalence of males with pigmented patches, NEAFC, XII+XIVb, May, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
26-30	1	21	4,8
31-35	29	323	9,0
36-40	45	811	5,5
41-45	9	342	2,6
46-50	0	2	0
TOTAL	84	1499	5,6

Table 21. Total prevalence of redfish with pigmented patches, NEAFC, XII+XIVb, May, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
21-25	0	1	0
26-30	4	44	9,1
31-35	84	802	10,5
36-40	150	1728	8,7
41-45	36	722	5,0
46-50	0	3	0
TOTAL	274	3300	8,3

Table 22. Prevalence of females with pigmented patches, NEAFC, XIVb, June, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
26-30	1	7	14,3
31-35	21	163	12,9
36-40	32	404	7,9
41-45	13	208	6,3
46-50	0	2	0
TOTAL	67	784	8,5

Table 23. Prevalence of males with pigmented patches, NEAFC, XIVb, June, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
26-30	1	14	7,1
31-35	24	210	11,4
36-40	34	592	5,7
41-45	6	299	2,0
46-50	0	1	0
TOTAL	65	1116	5,8

Table 24. Total prevalence of redfish with pigmented patches, NEAFC, XIVb, June, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
26-30	2	21	9,5
31-35	45	373	12,1
36-40	66	996	6,6
41-45	19	507	3,7
46-50	0	3	0
TOTAL	132	1900	6,9

Table 25. Prevalence of females with pigmented patches, NEAFC, XIVb, July, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
21-25	0	2	0
26-30	6	14	42,9
31-35	33	214	15,4
36-40	61	665	9,2
41-45	19	324	5,9
46-50	0	2	0
TOTAL	119	1221	9,7

Table 26. Prevalence of males with pigmented patches, NEAFC, XIVb, July, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
26-30	11	27	40,7
31-35	48	304	15,8
36-40	77	1053	7,3
41-45	11	495	2,2
TOTAL	147	1879	7,8

Table 27. Total prevalence of redfish with pigmented patches, NEAFC, XIVb, July, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
21-25	0	2	0
26-30	17	41	41,5
31-35	81	518	15,6
36-40	138	1718	8,0
41-45	30	819	3,7
46-50	0	2	0
TOTAL	266	3100	8,6

Table 28. Prevalence of females with pigmented patches, NEAFC, XIVb, August, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
21-25	1	6	16,7
26-30	6	33	18,2
31-35	37	139	26,7
36-40	45	387	11,6
41-45	6	181	3,3
TOTAL	95	746	12,7

Table 29. Prevalence of males with pigmented patches, NEAFC, XIVb, August, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
21-25	0	4	0
26-30	10	53	18,9
31-35	37	207	17,9
36-40	63	752	8,4
41-45	7	337	2,1
46-50	0	1	0
TOTAL	117	1354	8,6

Table 30. Total prevalence of redfish with pigmented patches, NEAFC, XIVb, August, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
21-25	1	10	10,0
26-30	16	86	18,6
31-35	74	346	21,4
36-40	108	1139	9,5
41-45	13	518	2,5
46-50	0	1	0
TOTAL	212	2100	10,1

Table 31. Prevalence of females with pigmented patches, NAFO, 1F, August, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
21-25	0	1	0
26-30	0	3	0
31-35	7	48	14,6
36-40	17	56	30,4
TOTAL	24	108	22,2

Table 32. Prevalence of males with pigmented patches, NAFO, 1F, August, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
26-30	0	1	0
31-35	25	129	19,4
36-40	8	62	12,9
TOTAL	33	192	17,2

Table 33. Total prevalence of redfish with pigmented patches, NAFO, 1F, August, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
21-25	0	1	0
26-30	0	4	0
31-35	32	177	18,1
36-40	25	118	21,2
TOTAL	57	300	19,0

Table 34. Prevalence of females with pigmented patches, NEAFC, XIVb, September, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
26-30	2	5	40,0
31-35	7	28	25,0
36-40	16	39	41,0
41-45	1	14	7,1
46-50	0	1	0
TOTAL	26	87	29,9

Table 35. Prevalence of males with pigmented patches, NEAFC, XIVb, September, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
26-30	2	4	50,0
31-35	20	61	32,8
36-40	15	98	15,3
41-45	0	50	0
TOTAL	37	213	17,4

Table 36. Total prevalence of redfish with pigmented patches, NEAFC, XIVb, September, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
26-30	4	9	44,4
31-35	27	89	30,3
36-40	31	137	22,6
41-45	1	64	1,6
46-50	0	1	0
TOTAL	63	300	21,0

Table 37. Prevalence of females with pigmented patches, NEAFC, IIa, September, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
31-35	9	14	64,3
36-40	13	19	68,4
41-45	0	1	0
TOTAL	22	34	64,7

Table 38. Prevalence of males with pigmented patches, NEAFC, IIa, September, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
31-35	11	34	32,4
36-40	18	32	56,3
TOTAL	29	66	43,9

Table 39. Total prevalence of redfish with pigmented patches, NEAFC, IIa, September, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
31-35	20	48	41,7
36-40	31	51	60,8
41-45	0	1	0
TOTAL	51	100	51,0

Table 40. Prevalence of females with pigmented patches, NEAFC, XIVb, Greenland EEZ, September, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
26-30	5	25	20,0
31-35	14	72	19,4
36-40	20	121	16,5
41-45	1	39	2,6
TOTAL	40	257	15,6

Table 41. Prevalence of males with pigmented patches, NEAFC, XIVb, Greenland EEZ, September, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
21-25	1	2	50
26-30	12	40	30
31-35	31	122	25,4
36-40	26	258	10,1
41-45	3	120	2,5
46-50	0	1	0
TOTAL	73	543	13,4

Table 42. Total prevalence of redfish with pigmented patches, NEAFC, XIVb, Greenland EEZ, September, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
21-25	1	2	50
26-30	17	65	26,2
31-35	45	194	23,2
36-40	46	379	12,1
41-45	4	159	2,5
46-50	0	1	0
TOTAL	113	800	14,1

Table 43. Prevalence of females with pigmented patches, NEAFC, XIVb, April - September, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
21-25	1	8	12,5
26-30	17	75	22,7
31-35	146	1055	13,8
36-40	251	2274	11,0
41-45	59	999	5,9
46-50	0	5	0
Всего	474	4416	10,7

Table 44. Prevalence of males with pigmented patches, NEAFC, XIVb, April – September, 2009

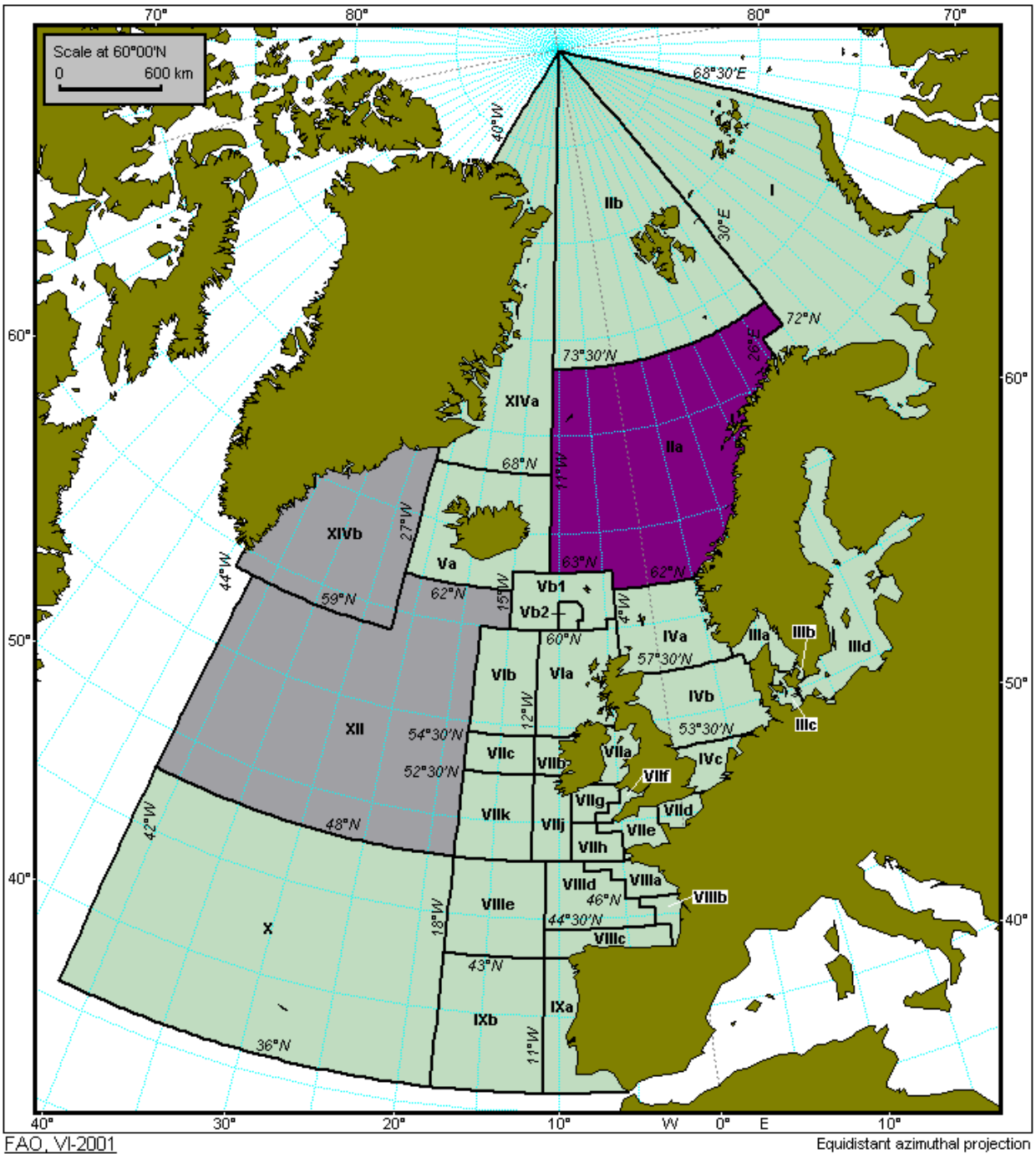
Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
21-25	0	4	0
26-30	27	131	20,6
31-35	151	1145	13,2
36-40	226	3157	7,2
41-45	28	1442	1,9
46-50	0	5	0
TOTAL	432	5884	7,3

Table 45. Total prevalence of redfish with pigmented patches, NEAFC, XIVb, April-September, 2009

Size	Amount of individuals with pigmented patches	Total quantity of individuals	Prevalence, %
21-25	1	12	8,3
26-30	44	206	21,4
31-35	297	2200	13,5
36-40	477	5431	8,8
41-45	87	2441	3,6
46-50	0	10	0
TOTAL	906	10300	8,8

Table 46. Prevalence of females with pigmented patches/prevalence of males with pigmented patches ratio in 2009.

Region and division	Month	Prevalence of females with pigmented patches/prevalence of males with pigmented patches
NEAFC, XIVb	April	2,18
	May	2,22
	June	1,47
	July	1,24
	August	1,48
	September	1,72
NEAFC, XII	May	1,54
NAFO, 1F	August	1,28
NEAFC, IIa	September	1,47



FAO, VI-2001

Equidistant azimuthal projection

Fig 1.Divisions of redfish fishery in NEAFC region

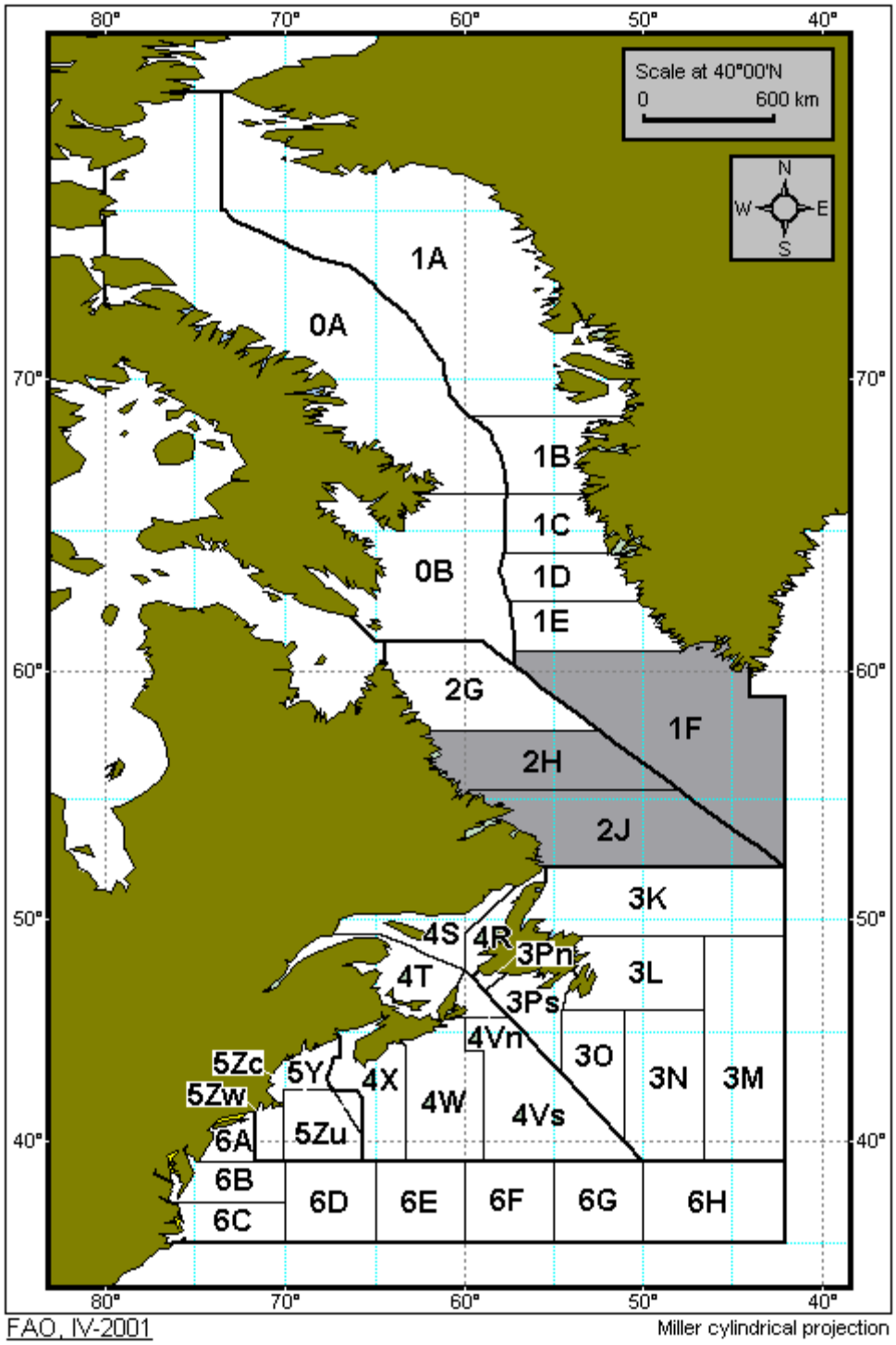


Fig 2.Divisions of redfish fishery in NAFO region