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Distribution of Redfish in Division 3O Based on Data from Russian Trawl Surveys in 1983-1993

by

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Abstract

The present paper gives estimates of total abundance and biomass of beaked redfish *S. mentella* and *S. fasciatus* resulted from research trawl surveys in 1983-93 in Div 3O. Stock estimates and distribution of the redfish in the NAFO Regulatory Area outside the 200-mile Fishing Zone of Canada are presented.

During the survey period the stock estimated for the entire Div. 3O showed considerable fluctuations. Abundance varied from 93.7 to 2 661 million individuals and biomass ranged within 13.5-212.6 thousand tons. The redfish stock in Div. 3O within the NAFO Regulatory Area varied within 3.5-290.4 million fish in abundance and from 0.6 to 46.7 thousand tons in biomass.

On the whole for the study period the proportion of the redfish stock in the NAFO Regulatory Area made up 2.1-59.4% in abundance and 1.9-62.2% in biomass of the total in the Div. 3O.

From 1983 to 1993 in Div. 3O abundant year-classes were found during the surveys in 1983, 1988 and 1991. The strongest year-classes were observed in the 1983 survey when young redfish of 14-18 cm in length at age 3-4 constituted 35.4% of the redfish total abundance.

Introduction

Division 3O is of historic importance for Russian fishery of redfish. Prior to 1994, Russian catch of redfish made up 40-80% of the international one. Since 1994 both Russian and international catch reduced sharply and in 1995 was as low as 2.8 thousand tons (Table 1). Later on, the fishery has livened up mostly due to Canadian, Portuguese and Spanish vessels. Since 2000 the Russian fleet has resumed the fishery for redfish in the Div. 3O having reached annual catch of about 11 thousand tons in 2001-2002.

At present redfish fishery outside the 200-mile Fishing Zone of Canada in Div. 3O is not regulated. For the possible management purposes the Scientific Council was requested by the Fisheries Commission to review all available information on the redfish biology and fishery and make appropriate recommendations. In the present paper the redfish distribution in both Div. 3O on the whole and its areas within the NAFO Regulatory Area using data from Russian research surveys is analyzed.

Materials and Methods

In Div. 3O concentrations of redfish mostly comprises two species of redfish from the *Sebastes* genus: *S. mentella* and *S. fasciatus*. Just single individuals of S. *marinus* occur in this area. Redfish stock estimates are given for mixed concentrations of *S. mentella* and *S. fasciatus*.

In 1983-1993 trawl surveys were conducted using stratified-random method (Doubleday, MS 1981; Bulatova and Chumakov, MS 1986). These observations were made down to 730 m depth according to the area stratification suggested by Bishop (Bishop, MS 1994). Area estimates by strata within the NAFO Regulatory Area (Fig. 1) were borrowed from Canadian researchers Power and Orr (Power and Orr, MS 2002).

Tows were done on a twenty-four hour basis. There was a small-mesh insertion with a mesh size of 10-12 mm in the codend of a standard research trawl (drawing 1625A). The survey covered the area of 18 552 mile^2.

Because of the identification complexity *S. mentella* and *S. fasciatus* were not identified to species. Biological materials were sampled and processed using PINRO and NAFO's methods.

Data on Russian surveys on the Flemish Cap in 1983-1993 are given in Table 2.

Results and Discussion

During the surveys redfish were mostly distributed throughout the whole area at depths below 93 m (Tables 3 and 4). In shallower strata redfish occurred only in 1983, 1988 and 1989. In strata embracing the depth range from 93 m to 274 m, which were nursery areas within the Div. 3O, catches were dominated by young redfish 15 cm in length. Main redfish concentrations during the surveys in 1983-1993 occupied the depth range from 275 m to 550 m in the areas adjacent to the bank slopes.

As is seen from estimations during the study period abundance and biomass experienced significant fluctuations. Abundance varied from 93.7 to 2 661 million individuals and biomass from 13.5 to 212.6 thousand tons (Tables 5-14). In our opinion the main factor influencing the variation in the above estimates was availability of the redfish concentrations to sampling gear that in its turn was related to daily migration and vertical distribution of the redfish. Variability in abundance was also affected by the appearance of strong year-classes of redfish. Data from Canadian surveys (Power and Orr, MS 2002) showed that estimates of the redfish stock varied greatly not only from year to year but also from season to season.

Russian surveys in 1983-1993 in Div. 3O of the NAFO Regulatory Area covered the area of 496 mile^2. During the study period the redfish were found in catches from all strata except for 1990-91 when no redfish was observed in stratum 354 (Tables 15 and 16). It is worth noting that in some years (1984-85, 1987-88) the main proportion of estimated abundance and biomass of the redfish fell on this stratum. The stock estimates for Div. 3O in the NAFO Regulatory Area also showed considerable interannual fluctuations. Abundance ranged from 3.5 to 290.4 million redfish and biomass varied between 0.6 to 46.7 thousand tons.

On the whole for the study period proportion of the redfish in the NAFO Regulatory Area accounted for 2.1-59.4% in abundance and 1.9-62.2% in biomass of the total in the Div. 3O (Table 17).

The redfish (*S. mentella and S. fasciatus*) were represented in catches by individuals from 6 to 50 cm in length (Fig. 2). Redfish of 22-26 cm long dominated the catches during the surveys period. The sex ratio was 1.2:1, in which females predominated.

From 1983 to 1993 in Div. 3O strong year-classes were observed during the surveys in 1983, 1988 and 1991. The most abundant year-classes were found during the 1983 survey when young redfish 14-18 cm long at age 3 and 4 accounted for 35.4% of the total redfish abundance.

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Table 1**.** Nominal catches by country (tons) of redfish in Div. 3O, 1991-2001. STATLANT 21A.

Country	**Year**										
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Canada	28	1219	698	1624	177	7255	2554	8972	2344	2206	4869
Cuba	2748	2776	665	0	0	0	0	0	0	0	0
France (SP)	0	0	0	0	0	0	134	266	0	0	0
Japan	226	125	159	0	264	417	285	355	0	0	0
Portugal	3	1468	4794	2918	1935	1635	894	1875	5469	4555	3535
Spain	0	0	0	26	22	338	1245	1884	4549	3838	2314
Russia	4427	5845	6887	60	416	0	0	0	231	2233	11343
S. Korea	129	1935	17	0	0	0	0	0	0	0	0
Estonia	0	0	0	0	0	0	0	0	0	49	0
Total	**7561**	**13368**	**13220**	**4628**	**2814**	**9645**	**5112**	**13352**	**12593**	**12881**	**22061**

Table 2. A list of Russian trawl surveys in Div. 3O, 1983-93*.

Year	Vessel	Valid tows	Area, mile^2	Dates
1983	MB-2645 *"Suloy"*	74	18552	12.06 - 30.06
1984	MB-2645 *"Suloy"*	84	18552	17.05 - 05.06
1985	MG-1363 *"Genichesk"*	80	18552	29.04 - 18.05
1986	MB- 0422 *"N.Kononov"*	80	18552	16.04 - 22.05
1987	MB - 1202 *"Persey – III"*	81	18552	11.03 - 18.04
1988	MB - 1202 *"Persey – III"*	90	18552	23.03 - 03.04
1989	MB - 1202 *"Persey – III"*	98	18552	04.04 - 27.04
1990	MB - 1202 *"Persey – III"*	81	18552	04.04 - 07.05
1991	MG - 1362 *"Vilnus"*	77	18552	21.03 - 26.05
1993	MG - 1362 *"Vilnus"*	78	18552	04.04 - 26.05

* No investigations were carried out in 1992.

Table 3. Average catches (fish) per one valid tow from the Russian trawl survey for Redfish in Div. 3O by stratum in 1983-93.

Stratum	Depth, m	Year									
		1983	1984	1985	1986	1987	1988	1989	1990	1991	1993
330	57-91	5.3	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0
331	57-91	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0
338	57-91	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
340	57-91	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
351	57-91	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
352	57-91	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
353	57-91	0.0	0.0	0.0	0.0	0.0	1519.8	0.0	0.0	0.0	0.0
329	93-183	0.0	106.3	0.0	0.0	18.8	0.0	0.0	0.0	0.0	8.0
332	93-183	3448.3	1140.0	3970.6	1483.5	164.8	9.0	567.0	0.5	0.0	2356.8
337	93-183	19891.3	0.0	6762.0	316.3	84.3	0.0	1035.0	6088.0	0.0	1832.7
339	93-183	0.0	0.67	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
354	93-183	749.0	10971.7	6763.7	64.3	1326.0	5544.0	12.0	0.0	0.0	444.7
333	185-274	16740.3	1370.7	1683.0	1270.7	225.7	1862.0	21.3	120.7	5277.7	10424.0
336	185-274	4163.0	5373.3	15408.3	860.0	1115.7	48.0	4227.3	9775.0	379.3	11635.7
355	185-274	359.0	13928.0	486.8	6645.3	188.0	4886.5	132.5	842.8	107.0	2182.0
334	275-366	6849.3	3830.7	744.5	1191.3	97.0	6013.3	186.5	284.0	3168.7	28981.3
335	275-366	9736.8	2254.5	4913.0	1087.3	589.7	6582.7	130.5	234.0	660.0	2250.0
356	275-366	35684.0	1343.3	1627.3	638.3	807.7	554.3	262.7	358.0	446.7	930.7
717	367-549	22119.9	5130.7	6266.7	758.0	159.8	272.0	130.3	314.0	177.0	206.3
719	367-549	16627.0	1783.0	1002.7	365.3	281.3	495.3	312.0	121.3	249.3	619.3
721	367-549	6630.7	1749.3	268.3	721.3	531.3	1517.3	355.8	165.0	27.3	939.3
718	550-731	7429.5	186.3	75.3	955.0	26.3	105.7	4.0	16.0	12.7	52.0
720	550-731	100.0	670.3	416.3	112.3	11.5	526.7	76.3	88.3	30.3	79.3
722	550-731	2741.7	272.3	58.7	311.0	699.7	246.0	140.3	338.0	80.7	204.0

Table 4. Average catches (kg) per one valid tow from the Russian trawl survey for Redfish in Div. 3O by stratum in 1983-993.

Stratum	Depth, m	Year									
		1983	1984	1985	1986	1987	1988	1989	1990	1991	1993
330	57-91	0.1	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0
331	57-91	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0
338	57-91	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
340	57-91	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
351	57-91	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
352	57-91	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
353	57-91	0.0	0.0	0.0	0.0	0.0	243.8	0.0	0.0	0.0	0.0
329	93-183	0.0	5.3	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.1
332	93-183	73.3	133.2	478.1	1149.7	27.0	0.5	84.3	0.1	0.0	685.4
337	93-183	578.0	0.0	608.3	57.6	14.8	0.0	174.0	1098.8	0.0	545.2
339	93-183	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
354	93-183	31.1	680.2	763.8	6.6	256.6	1058.4	0.6	0.0	0.0	58.5
333	185-274	768.1	149.3	325.5	229.3	39.8	293.4	3.1	23.4	705.2	1751.5
336	185-274	149.6	963.0	1782.5	195.4	189.8	75.9	685.2	1867.6	23.5	2152.4
355	185-274	27.8	1408.8	97.1	1258.8	29.9	760.7	7.6	88.9	2.9	349.1
334	275-366	1035.3	345.9	155.9	280.8	26.1	1069.0	36.8	53.0	465.4	5952.0
335	275-366	1095.4	482.8	1062.5	250.3	146.1	1104.6	24.5	47.6	94.8	488.5
356	275-366	3852.8	277.6	455.7	181.6	148.4	120.9	18.5	67.3	55.3	178.1
717	367-549	4279.9	1050.5	1489.9	255.4	52.9	88.8	33.7	104.6	64.1	99.7
719	367-549	2204.7	314.4	242.3	147.4	129.3	129.0	93.3	34.8	49.3	214.4
721	367-549	5260.7	522.8	87.2	248.8	161.9	371.0	61.5	26.3	7.7	376.2
718	550-731	2622.6	79.2	42.8	484.7	9.0	48.8	1.8	9.6	8.1	28.4
720	550-731	60.3	391.8	242.4	35.1	4.1	259.8	41.4	54.4	11.8	38.2
722	550-731	681.3	136.0	33.1	69.9	284.5	165.2	43.3	114.5	48.6	80.3

Table 5. Results from the trawl survey for Redfish in Div. 3O in 1983.

Stratum	Depth, m	Area, mile^2	Nos of tows	Mean catch / 1 valid tow		Abundance, '000 fish	Biomass, tons
				fish	kg		
330	57-91	2089	3	5.3	0.1	825.3	13.9
331	57-91	456	3	0.0	0.0	0.0	0.0
338	57-91	1898	3	0.0	0.0	0.0	0.0
340	57-91	1716	2	0.0	0.0	0.0	0.0
351	57-91	2520	3	0.0	0.0	0.0	0.0
352	57-91	2580	5	0.0	0.0	0.0	0.0
353	57-91	1282	3	0.0	0.0	0.0	0.0
329	93-183	1721	3	0.0	0.0	0.0	0.0
332	93-183	1047	4	3448.3	73.3	267430.9	5681.6
337	93-183	948	3	19891.3	578.0	1396813.6	40586.5
339	93-183	585	2	0.0	0.0	0.0	0.0
354	93-183	474	4	749.0	31.1	26298.2	1092.1
333	185-274	147	3	16740.3	768.1	182283.6	8363.7
336	185-274	121	1	4163.0	149.6	37312.8	1341.0
355	185-274	103	1	359.0	27.8	2739.0	211.7
334	275-366	96	3	6849.3	1035.3	48706.4	7362.2
335	275-366	58	5	9736.8	1095.4	41832.2	4706.3
356	275-366	61	4	35684.0	3852.8	161238.8	17409.1
717	367-549	166	7	22119.9	4279.9	271992.3	52627.2
719	367-549	76	3	16627.0	2204.7	93603.9	12411.7
721	367-549	76	3	6630.7	5260.7	37328.2	29615.7
718	550-731	134	2	7429.5	2622.6	73744.7	26031.7
720	550-731	105	1	100.0	60.3	777.8	468.9
722	550-731	93	3	2741.7	681.3	18928.4	4693.3
Total		**18552**	**74**			**2661856.1**	**212616.6**

Table 6. Results from the trawl survey for Redfish in Div. 3O in 1984.

Stratum	Depth, m	Area, mile^2	Nos of tows	Mean catch / 1 valid tow		Abundance, '000 fish	Biomass, tons
				fish	kg		
330	57-91	2089	4	0.0	0.0	0.0	0.0
331	57-91	456	3	0.0	0.0	0.0	0.0
338	57-91	1898	3	0.0	0.0	0.0	0.0
340	57-91	1716	3	0.0	0.0	0.0	0.0
351	57-91	2520	6	0.0	0.0	0.0	0.0
352	57-91	2580	5	0.0	0.0	0.0	0.0
353	57-91	1282	5	0.0	0.0	0.0	0.0
329	93-183	1721	3	106.3	5.3	13555.5	680.7
332	93-183	1047	4	1140.0	133.2	88413.3	10326.7
337	93-183	948	5	0.0	0.0	0.0	0.0
339	93-183	585	3	0.67	0.3	28.9	12.5
354	93-183	474	3	10971.7	680.2	385227.4	23884.1
333	185-274	147	3	1370.7	149.3	14925.0	1625.8
336	185-274	121	4	5373.3	963.0	48160.2	8631.0
355	185-274	103	3	13928.0	1408.8	106265.5	10748.2
334	275-366	96	3	3830.7	345.9	27240.3	2459.9
335	275-366	58	4	2254.5	482.8	9686.0	2074.1
356	275-366	61	3	1343.3	277.6	6069.9	1254.5
717	367-549	166	3	5130.7	1050.5	63088.2	12917.1
719	367-549	76	4	1783.0	314.4	10037.6	1769.9
721	367-549	76	3	1749.3	522.8	9848.1	2943.1
718	550-731	134	3	186.3	79.2	1849.5	785.7
720	550-731	105	3	670.3	391.8	5213.7	3047.6
722	550-731	93	3	272.3	136.0	1876.1	936.7
Total		**18552**	**86**			**791485.2**	**84097.6**

Table 7. Results from the trawl survey for Redfish in Div. 3O in 1985.

Stratum	Depth, m	Area, mile^2	Nos of tows	Mean catch / 1 valid tow		Abundance, '000 fish	Biomass, tons
				fish	kg		
330	57-91	2089	3	0.0	0.0	0.0	0.0
331	57-91	456	3	0.0	0.0	0.0	0.0
338	57-91	1898	3	0.0	0.0	0.0	0.0
340	57-91	1716	3	0.0	0.0	0.0	0.0
351	57-91	2520	5	0.0	0.0	0.0	0.0
352	57-91	2580	4	0.0	0.0	0.0	0.0
353	57-91	1282	4	0.0	0.0	0.0	0.0
329	93-183	1721	3	0.0	0.0	0.0	0.0
332	93-183	1047	5	3970.6	478.1	307942.1	37079.2
337	93-183	948	3	6762.0	608.3	474842.7	42712.6
339	93-183	585	3	0.0	0.0	0.0	0.0
354	93-183	474	3	6763.7	763.8	237479.8	26818.3
333	185-274	147	3	1683.0	325.5	18326.0	3544.4
336	185-274	121	3	15408.3	1782.5	138104.3	15976.5
355	185-274	103	4	486.8	97.1	3713.7	741.1
334	275-366	96	4	744.5	155.9	5294.2	1108.4
335	275-366	58	3	4913.0	1062.5	21107.7	4564.7
356	275-366	61	3	1627.3	455.7	7353.1	2058.9
717	367-549	166	3	6266.7	1489.9	77056.8	18321.2
719	367-549	76	3	1002.7	242.3	5644.6	1363.8
721	367-549	76	3	268.3	87.2	1510.6	490.6
718	550-731	134	3	75.3	42.8	747.8	425.0
720	550-731	105	3	416.3	242.4	3238.2	1885.4
722	550-731	93	3	58.7	33.1	404.2	228.1
Total		**18552**	**80**			**1302765.8**	**157318.2**

Table 8. Results from the trawl survey for Redfish in Div. 3O in 1986.

Stratum	Depth, m	Area, mile^2	Nos of tows	Mean catch / 1 valid tow		Abundance, '000 fish	Biomass, tons
				fish	kg		
330	57-91	2089	5	0.0	0.0	0.0	0.0
331	57-91	456	3	0.0	0.0	0.0	0.0
338	57-91	1898	4	0.0	0.0	0.0	0.0
340	57-91	1716	4	0.0	0.0	0.0	0.0
351	57-91	2520	4	0.0	0.0	0.0	0.0
352	57-91	2580	4	0.0	0.0	0.0	0.0
353	57-91	1282	3	0.0	0.0	0.0	0.0
329	93-183	1721	4	0.0	0.0	0.0	0.0
332	93-183	1047	4	1483.5	1149.7	115053.7	89166.9
337	93-183	948	3	316.3	57.6	22213.6	4047.4
339	93-183	585	3	0.0	0.0	0.0	0.0
354	93-183	474	3	64.3	6.6	2258.8	232.7
333	185-274	147	3	1270.7	229.3	13836.2	2497.2
336	185-274	121	3	860.0	195.4	7708.2	1751.5
355	185-274	103	3	6645.3	1258.8	50701.4	9604.0
334	275-366	96	3	1191.3	280.8	8471.7	1996.5
335	275-366	58	3	1087.3	250.3	4671.5	1075.2
356	275-366	61	3	638.3	181.6	2884.3	820.8
717	367-549	166	3	758.0	255.4	9320.6	3140.6
719	367-549	76	3	365.3	147.4	2056.7	829.9
721	367-549	76	3	721.3	248.8	4060.8	1400.5
718	550-731	134	3	955.0	484.7	9479.3	4810.8
720	550-731	105	3	112.3	35.1	873.7	273.0
722	550-731	93	3	311.0	69.9	2142.4	481.4
Total		**18552**	**80**			**255732.9**	**122128.4**

Table 9. Results from the trawl survey for Redfish in Div. 3O in 1987.

Stratum	Depth, m	Area, mile^2	Nos of tows	Mean catch / 1 valid tow		Abundance, '000 fish	Biomass, tons
				fish	kg		
330	57-91	2089	6	0.0	0.0	0.0	0.0
331	57-91	456	3	0.0	0.0	0.0	0.0
338	57-91	1898	3	0.0	0.0	0.0	0.0
340	57-91	1716	4	0.0	0.0	0.0	0.0
351	57-91	2520	5	0.0	0.0	0.0	0.0
352	57-91	2580	4	0.0	0.0	0.0	0.0
353	57-91	1282	3	0.0	0.0	0.0	0.0
329	93-183	1721	4	18.8	1.3	2390.3	171.1
332	93-183	1047	4	164.8	27.0	12777.3	2091.3
337	93-183	948	3	84.3	14.8	5922.1	1041.3
339	93-183	585	3	0.0	0.0	0.0	0.0
354	93-183	474	3	1326.0	256.6	46557.3	9009.6
333	185-274	147	3	225.7	39.8	2457.3	433.5
336	185-274	121	3	1115.7	189.8	9999.7	1700.7
355	185-274	103	3	188.0	29.9	1434.4	228.5
334	275-366	96	3	97.0	26.1	689.8	185.8
335	275-366	58	3	589.7	146.1	2533.4	627.8
356	275-366	61	3	807.7	148.4	3649.5	670.4
717	367-549	166	4	159.8	52.9	1964.3	650.2
719	367-549	76	3	281.3	129.3	1583.8	728.0
721	367-549	76	3	531.3	161.9	2991.2	911.6
718	550-731	134	3	26.3	9.0	261.4	89.1
720	550-731	105	2	11.5	4.1	89.4	31.6
722	550-731	93	3	699.7	284.5	4819.9	1959.8
Total		**18552**	**81**			**100121.1**	**20530.3**

Table 10. Results from the trawl survey for Redfish in Div. 3O in 1988.

Stratum	Depth, m	Area, mile^2	Nos of tows	Mean catch / 1 valid tow		Abundance, '000 fish	Biomass, tons
				fish	kg		
330	57-91	2089	5	0.0	0.0	0.0	0.0
331	57-91	456	5	0.0	0.0	0.0	0.0
338	57-91	1898	5	0.0	0.0	0.0	0.0
340	57-91	1716	3	0.0	0.0	0.0	0.0
351	57-91	2520	5	0.0	0.0	0.0	0.0
352	57-91	2580	6	0.0	0.0	0.0	0.0
353	57-91	1282	6	1519.8	243.8	144327.9	23156.2
329	93-183	1721	4	0.0	0.0	0.0	0.0
332	93-183	1047	4	9.0	0.5	698.0	35.4
337	93-183	948	3	0.0	0.0	0.0	0.0
339	93-183	585	3	0.0	0.0	0.0	0.0
354	93-183	474	3	5544.0	1058.4	194656.0	37161.3
333	185-274	147	3	1862.0	293.4	20275.1	3194.8
336	185-274	121	4	48.0	75.9	4302.2	680.7
355	185-274	103	4	4886.5	760.7	37282.2	5803.7
334	275-366	96	3	6013.3	1069.0	42761.5	7601.6
335	275-366	58	3	6582.7	1104.6	28281.1	4745.8
356	275-366	61	3	554.3	120.9	2504.8	546.5
717	367-549	166	3	272.0	88.8	3344.6	1091.4
719	367-549	76	3	495.3	129.0	2788.5	726.4
721	367-549	76	3	1517.3	371.0	8542.0	2088.5
718	550-731	134	3	105.7	48.8	1048.8	484.1
720	550-731	105	3	526.7	259.8	4096.3	2020.5
722	550-731	93	3	246.0	165.2	1694.7	1138.1
Total		**18552**	**90**			**496603.7**	**90475.0**

Table 11. Results from the trawl survey for Redfish in Div. 3O in 1989.

Stratum	Depth, m	Area, mile^2	Nos of tows	Mean catch / 1 valid tow		Abundance, '000 fish	Biomass, tons
				fish	kg		
330	57-91	2089	5	1.4	1.0	216.6	153.5
331	57-91	456	3	6.0	3.0	202.7	100.1
338	57-91	1898	5	0.0	0.0	0.0	0.0
340	57-91	1716	7	0.0	0.0	0.0	0.0
351	57-91	2520	5	0.0	0.0	0.0	0.0
352	57-91	2580	6	0.0	0.0	0.0	0.0
353	57-91	1282	4	0.0	0.0	0.0	0.0
329	93-183	1721	4	0.0	0.0	0.0	0.0
332	93-183	1047	4	567.0	84.3	43974.0	6539.4
337	93-183	948	4	1035.0	174.0	72680.0	12219.1
339	93-183	585	3	0.0	0.0	0.0	0.0
354	93-183	474	4	12.0	0.6	421.3	19.3
333	185-274	147	4	21.3	3.1	231.4	34.1
336	185-274	121	6	4227.3	685.2	37889.4	6141.6
355	185-274	103	4	132.5	7.6	1010.9	58.3
334	275-366	96	4	186.5	36.8	1326.2	261.6
335	275-366	58	4	130.5	24.5	560.7	105.1
356	275-366	61	3	262.7	18.5	1186.9	83.5
717	367-549	166	3	130.3	33.7	1602.6	414.4
719	367-549	76	3	312.0	93.3	1756.4	525.5
721	367-549	76	4	355.8	61.5	2002.7	346.4
718	550-731	134	3	4.0	1.8	39.7	17.8
720	550-731	105	3	76.3	41.4	593.7	322.0
722	550-731	93	3	140.3	43.3	966.7	298.6
Total		**18552**	**98**			**166661.9**	**27640.3**

Table 12. Results from the trawl survey for Redfish in Div. 3O in 1990.

Stratum	Depth, m	Area, mile^2	Nos of tows	Mean catch / 1 valid tow		Abundance, '000 fish	Biomass, tons
				fish	kg		
330	57-91	2089	5	0.0	0.0	0.0	0.0
331	57-91	456	3	0.0	0.0	0.0	0.0
338	57-91	1898	3	0.0	0.0	0.0	0.0
340	57-91	1716	4	0.0	0.0	0.0	0.0
351	57-91	2520	4	0.0	0.0	0.0	0.0
352	57-91	2580	5	0.0	0.0	0.0	0.0
353	57-91	1282	3	0.0	0.0	0.0	0.0
329	93-183	1721	3	0.0	0.0	0.0	0.0
332	93-183	1047	4	0.5	0.1	38.8	6.4
337	93-183	948	4	6088.0	1098.8	427512.9	77159.8
339	93-183	585	3	0.0	0.0	0.0	0.0
354	93-183	474	2	0.0	0.0	0.0	0.0
333	185-274	147	3	120.7	23.4	1313.9	255.1
336	185-274	121	3	9775.0	1867.6	87613.0	16739.6
355	185-274	103	4	842.8	88.9	6429.9	678.6
334	275-366	96	3	284.0	53.0	2019.6	376.7
335	275-366	58	4	234.0	47.6	1005.3	204.3
356	275-366	61	3	358.0	67.3	1617.6	303.9
717	367-549	166	3	314.0	104.6	3861.0	1285.9
719	367-549	76	3	121.3	34.8	683.1	196.0
721	367-549	76	3	165.0	26.3	928.9	148.3
718	550-731	134	3	16.0	9.6	158.8	95.0
720	550-731	105	3	88.3	54.4	687.0	423.2
722	550-731	93	3	338.0	114.5	2328.4	788.4
Total		**18552**	**81**			**536198.2**	**98661.2**

Table 13. Results from the trawl survey for Redfish in Div. 3O in 1991.

Stratum	Depth, m	Area, mile^2	Nos of tows	Mean catch / 1 valid tow		Abundance, '000 fish	Biomass, tons
				fish	kg		
330	57-91	2089	5	0.0	0.0	0.0	0.0
331	57-91	456	3	0.0	0.0	0.0	0.0
338	57-91	1898	3	0.0	0.0	0.0	0.0
340	57-91	1716	3	0.0	0.0	0.0	0.0
351	57-91	2520	4	0.0	0.0	0.0	0.0
352	57-91	2580	4	0.0	0.0	0.0	0.0
353	57-91	1282	3	0.0	0.0	0.0	0.0
329	93-183	1721	3	0.0	0.0	0.0	0.0
332	93-183	1047	4	0.0	0.0	0.0	0.0
337	93-183	948	3	0.0	0.0	0.0	0.0
339	93-183	585	3	0.0	0.0	0.0	0.0
354	93-183	474	3	0.0	0.0	0.0	0.0
333	185-274	147	3	5277.7	705.2	57467.9	7678.8
336	185-274	121	3	379.3	23.5	3399.9	211.0
355	185-274	103	3	107.0	2.9	816.4	22.1
334	275-366	96	3	3168.7	465.4	22532.7	3309.7
335	275-366	58	3	660.0	94.8	2835.6	407.1
356	275-366	61	3	446.7	55.3	2018.3	249.7
717	367-549	166	3	177.0	64.1	2176.4	787.5
719	367-549	76	3	249.3	49.3	1403.7	277.7
721	367-549	76	3	27.3	7.7	153.9	43.4
718	550-731	134	3	12.7	8.1	125.7	80.5
720	550-731	105	3	30.3	11.8	235.9	91.8
722	550-731	93	3	80.7	48.6	555.7	334.5
Total		**18552**	**77**			**93722.1**	**13493.8**

Table 14. Results from the trawl survey for Redfish in Div. 3O in1993.

Stratum	Depth, m	Area, mile^2	Nos of tows	Mean catch / 1 valid tow		Abundance, '000 fish	Biomass, tons
				fish	kg		
330	57-91	2089	5	0.0	0.0	0.0	0.0
331	57-91	456	3	0.0	0.0	0.0	0.0
338	57-91	1898	3	0.0	0.0	0.0	0.0
340	57-91	1716	4	0.0	0.0	0.0	0.0
351	57-91	2520	4	0.0	0.0	0.0	0.0
352	57-91	2580	4	0.0	0.0	0.0	0.0
353	57-91	1282	3	0.0	0.0	0.0	0.0
329	93-183	1721	3	8.0	0.1	1019.9	13.5
332	93-183	1047	4	2356.8	685.4	182779.1	53153.6
337	93-183	948	3	1832.7	545.2	128693.9	38287.8
339	93-183	585	3	0.0	0.0	0.0	0.0
354	93-183	474	3	444.7	58.5	15612.7	2054.5
333	185-274	147	3	10424.0	1751.5	113505.8	19071.6
336	185-274	121	3	11635.7	2152.4	104290.1	19292.2
355	185-274	103	3	2182.0	349.1	16647.9	2663.2
334	275-366	96	3	28981.3	5952.0	206089.5	42325.4
335	275-366	58	3	2250.0	488.5	9666.7	2098.5
356	275-366	61	3	930.7	178.1	4205.2	804.9
717	367-549	166	3	206.3	99.7	2537.1	1225.5
719	367-549	76	3	619.3	214.4	3486.6	1206.7
721	367-549	76	3	939.3	376.2	5288.1	2117.9
718	550-731	134	3	52.0	28.4	516.2	282.3
720	550-731	105	3	79.3	38.2	617.0	297.3
722	550-731	93	3	204.0	80.3	1405.3	553.4
Total		**18552**	**78**			**796361.1**	**185448.3**

Table 15. Abundance ('000 fish) from the trawl survey for Redfish in Div. 3O within NRA, 1983-93.

Stratum	Area within NRA, mile^2	Area within NRA, %	Year									
			1983	1984	1985	1986	1987	1988	1989	1990	1991	1993
354	246	0.52	13675.1	200318.2	237479.8	2258.8	46557.3	194656.0	421.3	0.0	0.0	15612.7
355	74	0.72	1972.1	76511.2	3713.7	50701.4	1434.4	37282.2	1010.9	6429.9	816.4	16647.9
356	47	0.77	124153.9	4673.8	7353.1	2884.3	3649.5	2504.8	1186.9	1617.6	2018.3	4205.2
721	58	0.76	28369.4	7484.6	1510.6	4060.8	2991.2	8542.0	2002.7	928.9	153.9	5288.1
722	71	0.76	14385.6	1425.8	404.2	2142.4	4819.9	1694.7	966.7	2328.4	555.7	1405.3
Total	**496**		**182556.1**	**290413.6**	**250461.4**	**62047.7**	**59452.3**	**244679.7**	**5588.5**	**11304.8**	**3544.3**	**43159.2**

Table 16. Biomass (tons) from the trawl survey for Redfish in Div. 3O within NRA, 1983-93.

Stratum	Area within NRA, mile^2	Area within NRA, %	Year									
			1983	1984	1985	1986	1987	1988	1989	1990	1991	1993
354	246	0.52	567.9	12419.7	26818.3	232.7	9009.6	37161.3	19.3	0.0	0.0	2054.5
355	74	0.72	152.4	7738.7	741.1	9604.0	228.5	5803.7	58.3	678.6	22.1	2663.2
356	47	0.77	13405.0	965.9	2058.9	820.8	670.4	546.5	83.5	303.9	249.7	804.9
721	58	0.76	22507.9	2236.8	490.6	1400.5	911.6	2088.5	346.4	148.3	43.4	2117.9
722	71	0.76	3566.9	711.9	228.1	481.4	1959.8	1138.1	298.6	788.4	334.5	553.4
Total	**496**		**40200.1**	**24073.0**	**30337.0**	**12539.4**	**12779.9**	**46738.1**	**806.1**	**1919.2**	**649.7**	**8193.9**

Table 17. Estimates provided by the trawl survey for Redfish in Div. 3O for 1983-93*.

Year	Abundance			Biomass		
	Total, fish x 10^6	NRA, fish x 10^6	NRA, %	Total, '000 tons	NRA, '000 tons	NRA, %
1983	2661.9	182.6	6.9	212.6	40.2	18.9
1984	791.5	290.4	36.7	84.1	24.1	28.6
1985	1302.8	250.5	19.2	157.3	30.3	19.3
1986	255.7	62.0	24.3	122.1	12.5	10.3
1987	100.1	59.4	59.4	20.5	12.8	62.2
1988	496.6	244.7	49.3	90.5	46.7	51.7
1989	166.7	5.6	3.3	27.6	0.8	2.9
1990	536.2	11.3	2.1	98.7	1.9	1.9
1991	93.7	3.5	3.8	13.5	0.6	4.8
1993	796.4	43.2	5.4	185.4	8.2	4.4

* No investigations were carried out in 1992.

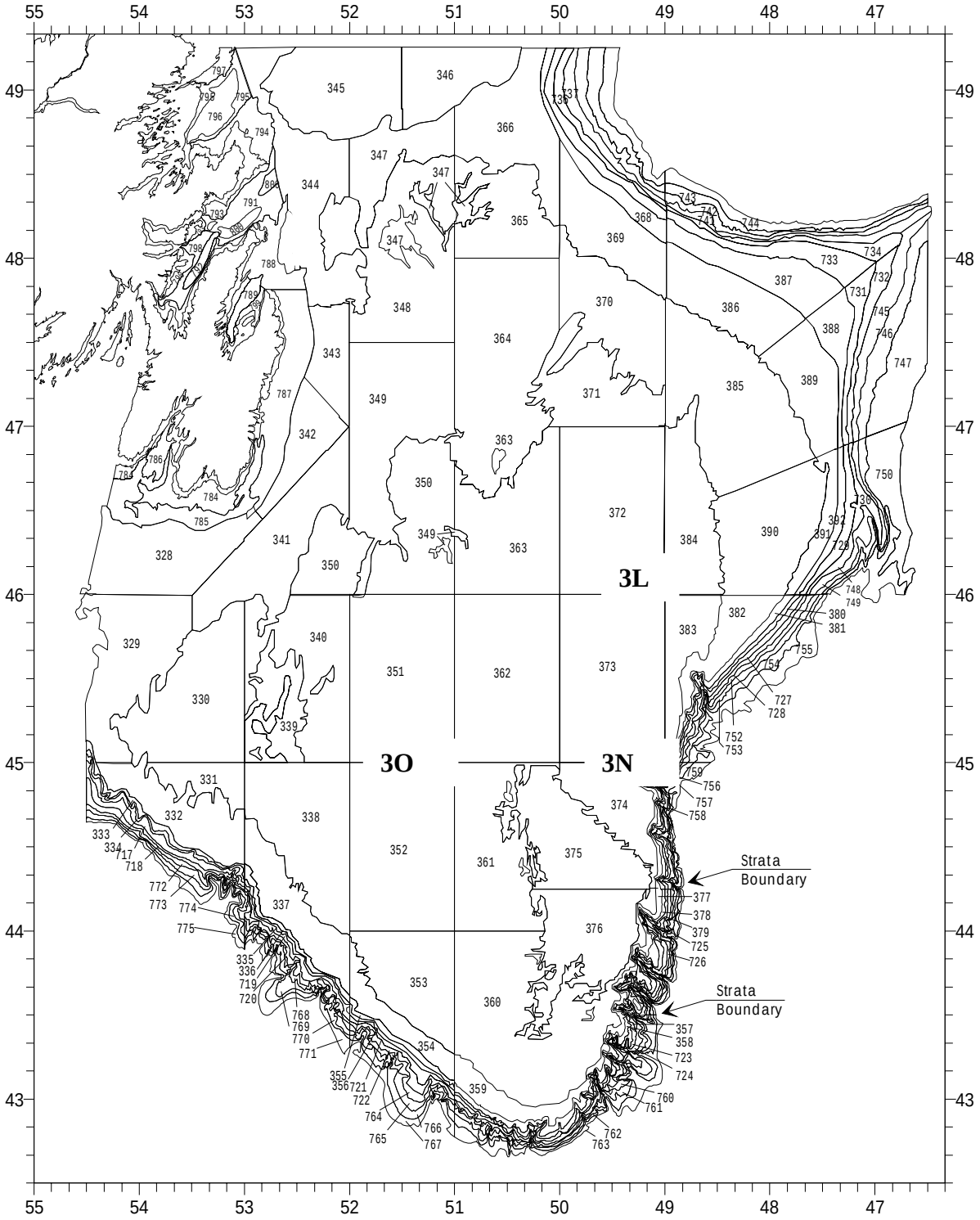

Fig. 1. Stratification chart for Div. 3LNO (Power and Orr, 2002).

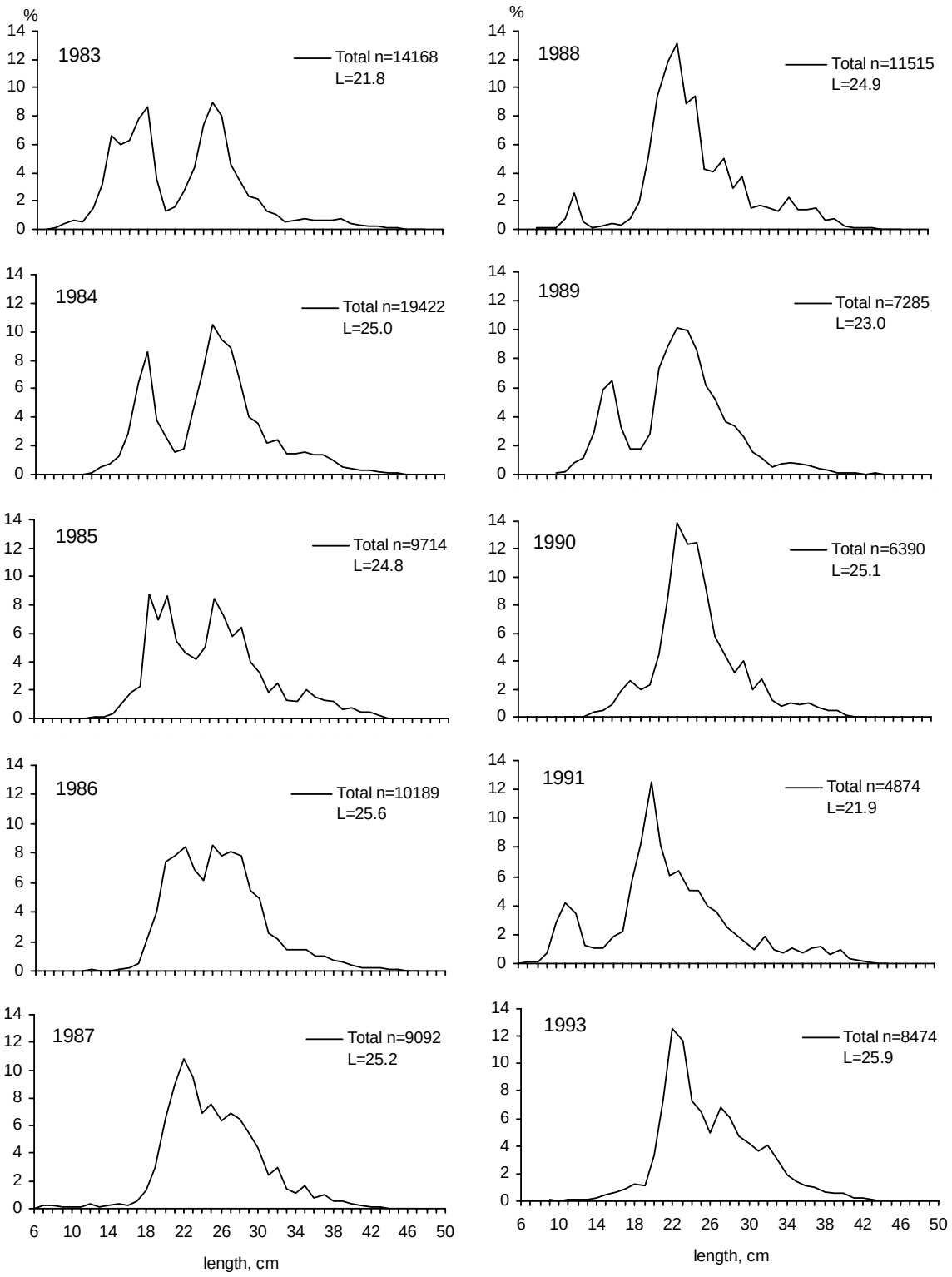

Fig. 2. Length composition of Beaked Redfish in Div. 3O based on data from Russian surveys in 1983-1993.