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An Assessment of Redfish in NAFO Divisions 3LN

by

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Introduction

From 1959 to 1985 the average nominal catch for Div. 3LN was about 21,000 t ranging from 8,000 t to 45,000 t (Table 1, Fig. 1). From 1980 to 1985 between 60%-80% of the total was taken in Div. 3N. Over this period catches averaged 19,000 t and Russia was the dominant fleet (Table 2). In 1986, catches doubled to 43,000 t due to the greater participation of EEC-Portugal in both Div. 3L (13,000 t) and Div. 3N (8,000 t). Russia, which had taken the majority of its catch from Div. 3N since 1980, also diverted the major portion of its fishery to Div. 3L in 1986. In 1987 catches increased again to the highest historically at 78,000 t due primarily to substantial catches by South Korea (about 16,000 t), EEC-Portugal (6,000 t more than 1986) and Russia (8,000 t more). Since 1987 catches have declined in each year to the preliminary estimate of 25,000 t in 1991.

From 1980 to 1990 the TAC each year for this stock has been 25,000 t. The TAC was reduced to 14,000 for 1991 and maintained at that level for 1992. Since 1986 the TAC has been exceeded each year, and in some years catches have been double (1988) and even triple (1987).

The monthly pattern of the catches in recent years (Table 3) reveals the fishery is prosecuted throughout the year in Div. 3L but more active in the second half of the year in Div. 3N. A tabulation of the of the catches for each division by gear type since 1980 (Table 4) shows the bottom trawl is the predominant method of capture. Since 1986 the shifts in the proportion of midwater trawls in Div. 3L is probably reflective of movements of the Russian fleet as it accounts for most of the catches by this gear.

Commercial Fishery Data

Catch and Effort

Catch and effort data were obtained from 1959 to 1988 from ICNAF/NAFO Statistical Bulletins and were combined with provisional 1989-1990 NAFO data and preliminary Canadian data for 1991. In addition, data available in Portuguese research reports from NAFO SCS Document series for 1989-1991 from the annual Portuguese sampling program were also incorporated into this database. Only those data where redfish comprised more than 50% of the total catch were selected for further analysis except those data that met this criteria for Portugal prior to 1989 because they were considered confounded with cod directed effort.

The catch/effort data were analyzed with a multiplicative model (Gavaris 1980) to derive a standardized catch rate series in tons per hour and an additional series utilizing effort in days fished. Effects included in the model were a combination country-gear-tonnage class category type (CGT), NAFO division, month, and a category type representing the amount of bycatch associated with each observation, consistent with last years assessment (eg. see Power and Atkinson, MS 1989).

In the usual practise, catch or effort data of less than 10 units were eliminated prior to analysis as were most category types where there was less than five samples in the database except the year category type. However, for the analysis utilizing the effort in terms of days fished catch less than 10 tons or effort less than an arbitrarily chosen 5 days were eliminated prior to analysis. For all analyses an unweighted regression was run because of unknown percentages of prorating prior to 1984. The data were analyzed for each division separately because of different trends in the catch rate series in recent years, which violates a basic assumption of the model if the data are combined.

Preliminary analyses were conducted on data with effort in units of hours fished to investigate the use of alternate cutoffs for including observations in the analysis. This was done to assess the impact on the variability of the resulting index. Initially, indices were to be compared under four scenarios of

data deletion: (1) the usual less than 10 units, (2) less than 20 units, (3) less than 50 units and (4) less than 100 units. When the analyses were conducted for Div. 3L and 3N separately only those for the first two scenarios for Div. 3L and the first three scenarios for Div. 3N ran to completion and provided parameter estimates from the APL software version of the model. It is suspected that after sufficient deletion of data there were some categories for which the model could not provide parameter estimates because there was no overlap with other category combinations.

The results for Div. 3L (Fig. 2a and 2b) show that eliminating less than 20 observations generally reduces the variability. However, it is also clear that trends between some years changed, for example between 1968 and 1972. The results for Div. 3N (Fig. 3a, 3b, 3c) were quite opposite. The general effect of increasing the selection criteria was to increase the variability around the predicted mean. There was also a corresponding scaling up of the index as the selection criteria was increased.

The regression for Div. 3L using effort in hours under scenario (2) was significant ($p < .05$), explaining 63% of the variation in catch rates (Table 5). All category types were significant. For the year category type, only five of the estimated coefficients are different from 1959 (within 2 s.e.). The standardized catch rate series (Table 9, Fig. 2b) shows much within year variability and prior to 1974. There is a slight trend of increase to 1986 followed by a decline to 1991 except for an intermittent increase in 1989. The 1991 rate based on provisional data is about the lowest rate in the time series.

The regression for Div. 3N using effort in hours under scenario (2) was significant ($p < .05$), explaining 66% of the variability in the CPUE data (Table 6). All category types were significant, the month category only marginally significant. For the year category type only three of the estimated coefficients are significantly different from 1959 (within 2 s.e.). The standardized catch rate series (Table 10, Fig. 3b) shows much within year variability over time, especially for the period prior to 1976. There is a general trend of increase to about the highest rate in the series in 1980 followed by a decline to 1985. Except for the relatively large increase that occurred in 1987 this decline continued to 1991. The 1991 rate based on provisional data is about the lowest rate in the time series.

Analyses incorporating effort measured in days fished were conducted on the premise that such a unit of effort would reflect time searching for concentrations of redfish.

The regression for Div. 3L was significant ($p < .05$), explaining 64% of the variation in the CPUE data (Table 7). All category types were significant. For the year category type only four of the estimated coefficients are significantly different from 1959 (within 2 s.e.). The standardized catch rate series (Table 11, Fig. 4) shows much interannual variability throughout the series especially prior to 1978. There is a trend of successive increases from 1978 to 1983 followed by a decrease to 1985. Catch rate increased again in 1986 to the level of the 1983 rate and except for an intermittent large increase in 1989 have decreased systematically to 1991. The 1991 rate based on provisional data is about the lowest rate over the time series.

The regression utilizing effort as days fished for Div. 3N was significant ($p < .05$), explaining 70% of the variability in CPUE (Table 8). Only the month category type was not significant. Only three years had significantly different coefficients than 1959 (within 2 s.e.). Again the catch rate series has much interannual variability associated with the mean (Table 12, Fig. 5) particularly prior to 1980 but there is an indication of stability. From 1980 to 1985 there is a trend of decline followed by successive increases to 1987. Since then the series shows a continuous decline to 1991. The 1991 rate based on provisional data is about the lowest in the time series.

Since the multiplicative analyses on Div. 3L and Div. 3N CPUE data indicated there was generally no contrast in the estimated catch rate series over time, general production analyses were not considered appropriate. The results of previous attempts for Div. 3L (NAFO Sci. Coun. Rep., 1987) and for Div. 3N (NAFO Sci. Coun. Rep., 1988) have been viewed with little confidence.

Commercial fishery sampling

Length compositions from the Portuguese fishery in Div. 3L (Alpoim et al., MS 1992) indicate the dominant size in the catch was between 24-32 cm for males and 22-30 cm for females. Sampling in Div. 3N suggest the dominant size range was 19-28 for males and 19-32 cm for females. Length frequencies available from limited Canadian sampling from Div. 3L indicate the majority of the catch was composed of 26-37 cm for males and 26-45 cm for females (Fig. 6).

Research Survey Data

A number of stratified-random surveys have been conducted by Canada in Div. 3L in various years and seasons from 1978 to 1991 in which strata up to a maximum of 732 m (400 fathoms) were sampled. Although these surveys were conducted at various times of the year throughout the period, they provide an indication of relative abundance and dynamics of the population. The design of the surveys was based on the stratification scheme down to 400 fathoms for Div. 3LN (Fig. 7).

A number of points can be drawn from the information in terms of mean number and mean weight per tow (Table 13-14, Fig. 8). Firstly, there is a seasonal component to the distribution, as reflected in an increase from winter through summer and a subsequent decrease in the fall to a level comparable to the winter density. This was apparent in the 1985 seasonal surveys and confirmed in 1990 and 1991 when three of the four seasons were covered. It is unclear whether this may related to migration or availability to the trawl. Second, there are sometimes rather large changes in stratum by stratum density estimates in adjacent years where seasons can be compared. This demonstrates the inherent variability in tow by tow estimates within a stratum and reflected in high variance estimates about the overall mean. In spite of these caveats it appears that the abundance is at its lowest level in 1991 relative to the whole time period.

Stratified-random surveys conducted by Canada in Div 3N have been of little value because they have traditionally only covered strata less than 367 m (200 fathoms). However, in 1991 spring and fall surveys covered down to 732 m (400 fathoms) and are included for comparisons to Div. 3L. In addition a redfish directed survey was conducted in the summer. Estimates of density in terms of mean number and weight per standard tow (Table 15-16) are considerably higher than in Div 3L but it is evident that there is much more variability in these estimates as well.

Russian stratified-random bottom trawl surveys in Div. 3L (Power and Vaskov, MS 1992) indicate that from 1984 to 1990 there has been a steady decline in density in terms of mean number and mean weight per standard tow. The 1991 estimates indicate a three fold increase but still substantially lower than the level of the mid 1980s (Fig. 9). In Div. 3N, although there are still some rather dynamic changes over this period, there is also an indication of a decline. This is evident in both the mean number and weight per standard tow (Fig. 10). A comparison of Canadian and Russian bottom trawl surveys in Div. 3L indicate a decline in density estimates in terms of stratified mean weight (Fig. 11) from 1984 to 1990. The Canadian survey indicates a further decline in the density in 1991 evident in both the summer and fall surveys while the Russian survey indicates a three fold increase.

Russia has conducted an acoustic survey in Div. 3LN concurrent with the bottom trawl survey since 1987. Estimates of total abundance and biomass from the trawl-acoustic surveys are as follows (from Vaskov and Oganin, MS 1992, Table 5):

Year	Abundance ($x10^{-6}$)	Biomass ('000 t)
1987*	510.8	135.0
1988	822.2	158.1
1989	145.2	29.2
1990	139.3	39.6
1991	372.5	190.9

* based assuming that 50% of the resource is in Div. 3LN (see NAFO Sci. Counc. Rep., 1990, Pg. 66)

From 1988 to 1989 these represent a very large reduction in population size over a very short period of time. Coincident with these observations are large changes in total biomass estimates from a trawl-acoustic survey in adjacent Div. 3O between 1989 and 1990 but in the opposite direction (NAFO Sci. Counc. Rep., 1991, Pg. 63). To address this issue redfish catches from Russian and Canadian summer bottom trawl surveys were plotted to see if their distribution may explain these occurrences (Fig. 12). It is unclear from the distribution of the catches whether or not the dynamics in Div 3LN relative to Div. 3O are caused by migrations. For the timeframe in question, between 1988 and 1990 the Russian bottom trawl surveys do not show a major shift to account for the magnitude of the difference. It is quite clear that trawlable biomass has systematically declined from 1987 to 1991. The 1991 Canadian survey indicates a break in the distribution on the very tail of the slopes of the Grand Bank, but no sets were conducted here simply because no fishing units were selected during the random selection process for determining fishing sets.

Length frequencies and corresponding age distributions from Canadian surveys in Div. 3L expressed as number per thousand indicate there has been relatively poor recruitment observed over the time period covered by the surveys (Figs. 13-16). For the 1991 spring and fall surveys the research survey catch was dominated by 21-26 cm fish in the spring and 24-30 cm in the fall corresponding to the year classes of the early 1980s. The distribution is different in the summer, dominated by a much broader base of 23-35 cm fish demonstrating a fairly uniform distribution. The changes in the overall distribution in the summer is coincident with movement of fish into shallower water in summer. Length frequencies and ages from Div. 3N from 1991 surveys (Fig 17) show different distributions from Div. 3L for each corresponding seasonal survey, consistently being composed of size groups that are much smaller. There was a relatively good pulse of recruitment picked up in the fall survey in the range of 12-14 cm. There was evidence from the spring and summer surveys of these small fish but their numbers were relatively insignificant.

Length compositions from the Russian bottom trawl surveys in Div. 3LN from 1986 to 1991 indicate quite different size distributions in both divisions (Vaskov and Oganin, MS 1992, Fig. 4-5). The data for Div. 3N suggests the size range sampled over the time period is generally between 18 and 29 cm while in Div. 3L there tends to be a considerable proportion greater than 29 cm. These surveys also indicate a relatively strong pulse of recruitment in Div. 3N in 1989 at 14-16 cm. This was not observed in Div. 3L. In 1990 the size of this year class was substantially smaller but in 1991 was the dominant mode in the research catch.

Prognosis

The catch rate indices derived for Div. 3L and Div. 3N show much within year variability, particularly prior to 1975. Although some of the changes in mean catch rate between some years are too dramatic to be solely the result changes in population abundance, there are indications of decline since the mid 1980s in all the derived indices. This corresponds to a period when some of the largest catches historically have been taken.

Russian bottom trawl surveys indicate a decline in density to historically low values in recent years for Div. 3L and Div. 3N. The situation in Div. 3L is confirmed in the surveys conducted by Canada that cover the deep water sufficiently. One should be cautious in drawing conclusions about stock status given the inherent variability in bottom trawl surveys but the signals from the two survey series suggest the densities are at an all time low over the time period.

Russian trawl-acoustic estimates of total abundance suggest a rather dynamic reduction in abundance from an average of 140,000 t in 1987-88 to about 34,000 in 1989-1990. Indications from the 1991 survey suggest a five fold increase in total biomass to 190,000 t. The dramatic increase is not consistent with the population dynamics of such a long-lived species as redfish. To put these observations in perspective, the illustrative sequential population analyses conducted in last years assessment suggested the very high catches of 1987 and 1988 have generated fishing mortalities, so the reduction in total biomass to about 34,000 may have been generated by such high fishing mortalities. Assuming the 190,000 t is a true change in abundance, then the majority of this biomass must be recruitment. Relative size distributions from the bottom trawl surveys would tend to refute this situation. There is no information adequate to determine a reference catch for this stock.

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Table 1. Summary of nominal catches (t) of redfish in Divisions 3LN.

Year	3L	3N	Total	TAC
1959	34,107	10,478	44,585	
1960	11,463	16,547	28,010	
1961	8,349	14,826	23,175	
1962	3,425	18,009	21,434	
1963	8,191	12,906	21,097	
1964	3,898	4,206	8,104	
1965	9,451	4,042	13,493	
1966	6,927	10,047	16,974	
1967	7,684	19,504	27,188	
1968	2,348	15,265	17,613	
1969	927	22,142	23,069	
1970	1,029	13,359	14,388	
1971	10,043	24,310	34,353	
1972	3,095	25,838	28,933	
1973	4,709	28,588	33,297	
1974	11,419	10,867	22,286	28,000
1975	3,838	14,033	17,871	20,000
1976	15,971	4,541	20,512	20,000
1977	13,452	3,064	16,516	16,000
1978	6,318	5,725	12,043	16,000
1979	5,584	8,483	14,067	18,000
1980	4,367	11,663	16,030	25,000
1981	9,407	14,873	24,280	25,000
1982	7,870	13,677	21,547	25,000
1983	8,657	11,090	19,747	25,000
1984	2,696	12,065	14,761	25,000
1985	3,677	16,880	20,557	25,000
1986	27,833	14,972	42,805	25,000
1987	30,342	40,949	78,441[b]	25,000
1988	22,317	23,049	53,266[b]	25,000
1989[a]	18,947	12,902	33,648[b]	25,000
1990[a]	15,538	9,217	29,086[b]	25,000
1991[a]	7,547	9,496	25,233[b,c]	14,000
1992				14,000

[a]Provisional.

[b]Includes unreported catch estimated by the NAFO Standing Committee on Fishery Science (STACFIS).

[c]Includes 1290 t of EEC catch that could not be disaggregated by division.

Table 2a. Nominal catches (t) of redfish in Div. 3L by country and year.

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989[a]	1990[a]	1991[a]
Canada (M)	554	1,696	1,003	2,633	52	342	2,597	2,352	5,042	1,095	73	45
Canada (N)	2,412	5,925	5,910	3,800	1,229	1,716	2,235	2,159	1,444	489	947	364
France (M)	3	-	-	-	-	-	-	5	-	1	-	-
France (SP)	11	-	-	-	-	-	-	-	-	-	-	-
EEC/Deu	-	-	-	-	89	309	54	-	33	3	3	-
DDR	375	509	12	586	849	672	486	696	661	739	643	-
Germany	-	-	-	-	-	-	-	-	-	-	-	898
Japan	26	128	159	-	105	129	135	114	152	114	151	83
Poland	2	-	-	2	1	4	-	-	-	-	-	-
EEC/Portugal	639	275	125	91	48	4	13,469	19,858	9,867	5,408	4,820	5,099
EEC/Spain	-	137	25	347	91	192	199	335	94	109	837	-
EEC/UK	-	-	-	-	-	-	-	-	-	-	-	26
Russia	345	737	607	1,168	232	309	8,658	4,459	5,004	10,037	7,003	1,032
Kor-S	-	-	29	-	-	-	-	364	20	952	1,061	-
Total	4,367	9,407	7,870	8,657	2,696	3,677	27,833	30,342	22,317	18,947	15,538	7,547

[a]Provisional

Table 2a. Nominal catches (t) of redfish in Div. 3N by country and year.

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989[a]	1990[a]	1991[a]
Canada (M)	683	442	-	-	13	311	-	-	1	22	-	9
Canada (N)	367	63	337	1	2	82	17	21	4	4	11	-
France (M)	-	-	-	-	-	-	-	8	-	-	-	-
DDR	-	58	-	-	-	-	-	-	-	-	96	-
Germany	-	-	-	-	-	-	-	-	-	-	-	12
Japan	-	-	-	-	81	-	12	51	-	39	4	3
EEC/Portugal	-	-	1	-	365	890	8,273	7,854	2,147	600	1,235	3,273
EEC/Spain	14	239	278	875	239	2,881	1,393	132	581	224	416	-
Russia	8,944	12,762	10,414	7,844	9,045	10,576	2,227	14,397	6,735	941	359	4,821
Cuba	1,644	1,309	2,621	2,370	2,320	2,055	2,429	2,433	2,483	2,869	2,456	1,378
USA	11	-	-	-	-	85	4	-	-	-	-	-
Kor-S	-	-	26	-	-	-	617	16,053	11,098	8,203	4,640	-
Total	11,663	14,873	13,677	11,090	12,065	16,880	14,972	40,949	23,049	12,902	9,217	9,496

[a]Provisional

Table 3a. Nominal catches (t) of redfish in Division 3L by month and year.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1980	271	112	396	119	373	261	80	10	718	311	22	1,694	4,367
1981	280	61	137	1,120	2,286	532	73	90	404	161	1,980	2,283	9,407
1982	1,126	672	1,232	1,225	295	289	459	37	643	1,367	173	352	7,870
1983	1,304	496	672	1,080	934	708	274	642	562	1,070	799	116	8,657
1984	243	135	168	360	76	161	49	57	1,002	318	46	81	2,696
1985	481	120	177	331	215	165	41	78	354	866	441	408	3,677
1986	423	845	3,470	7,266	3,662	503	975	2,196	544	3,964	2,166	1,819	27,833
1987	2,439	1,631	5,306	1,423	1,765	75	1,233	3,877	3,285	4,215	3,712	1,381	30,342
1988	2,856	1,623	865	1,466	471	1,213	2,776	4,800	1,628	1,869	682	2,068	22,317
1989[a]	786	4,497	4,301	1,140	1,628	501	1,730	1,311	832	1,151	1,002	68	18,947
1990[a]	153	296	294	831	586	1,714	3,062	3,679	1,909	1,611	1,056	193	15,384[b]

[a]Provisional.
[b]Does not include 154 t that could not be disaggregated by month.

Table 3b. Nominal catches (t) of redfish in Division 3N by month and year.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1980	3,561	2,798	2,269	121	368	833	81	422	1,085	122	2	1	11,663
1981	6,293	3,657	877	78	77	145	1,035	1,577	413	273	208	240	14,873
1982	3,042	1,970	2,929	1,141	243	100	581	3,156	485	21	12	7	13,677
1983	869	609	2,029	2,186	1,226	675	1,121	1,266	303	376	208	222	11,090
1984	4,562	1,763	1,821	676	67	74	1,694	1,014	156	93	131	14	12,065
1985	1,110	2,169	2,181	4,213	1,668	420	1,665	676	784	541	230	1,223	16,880
1986	392	665	406	534	454	915	4,392	81	1,196	110	4,131	1,696	14,972
1987	3,787	3,118	1,885	2,203	2,698	2,383	4,339	6,280	7,287	2,431	1,004	3,534	40,949
1988	662	648	815	841	952	1,295	2,327	4,505	3,390	1,419	3,453	2,742	23,049
1989[a]	576	151	274	380	278	1,183	928	4,109	2,085	1,515	1,164	259	12,902[b]
1990[a]	220	366	537	9	1,003	1,675	1,236	1,716	619	754	858	220	9,213

[a]Provisional.
[b]Does not include 4 t that could not be disaggregated by month.

Table 4. Nominal catches by gear type for redfish in Divisions 3L and 3N.

	3L					3N				
Year	Bottom trawl	MW trawl	Gillnets	Misc.	Total	Bottom trawl	MW trawl	Gillnets	Misc.	Total
1980	3,920	314	133	-	4,367	9,197	2,463	-	3	11,663
1981	8,397	650	223	137	9,407	8,858	5,774	2	239	14,873
1982	7,234	466	145	25	7,870	7,400	6,001	1	275	13,677
1983	7,760	308	238	351	8,657	7,050	3,165	-	875	11,090
1984	2,151	237	218	90	2,696	3,287	8,767	-	11	12,065
1985	3,092	307	128	150	3,677	10,232	6,453	-	195	16,880
1986	18,964	8,624	122	123	27,833	10,423	3,405	-	1,144	14,972
1987	25,294	4,441	276	331	30,342	32,391	8,527	-	31	40,949
1988	15,435	6,722	105	55	22,317	16,740	6,269	17	23	23,049
1989[a]	7,542	10,922	449	34	18,947[b]	9,131	3,746	-	25	12,902[c]
1990[a]	7,705	7,537	128	14	15,384[b]	6,507	2,675	10	21	9,213[c]

[a]Provisional.
[b]Does not include 154 t that could not be disaggregated by gear.
[c]Does not include 4 t that could not be disaggregated by gear.

Table 5. Anova results and regression coefficients from a multiplicative model to derive a standardized catch rate series for redfish in NAFO Div. 3L. Effort is measured in hours fished. (1989-91 based on preliminary data)

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.794
MULTIPLE R SQUARED..... 0.630

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	3.334E1	3.334E1	
REGRESSION	76	1.059E2	1.394E0	8.682
Country¦Gear¦TC (1)	29	3.963E1	1.367E0	8.514
Month (2)	11	7.914E0	7.195E-1	4.482
Bycatch pct (3)	4	1.236E1	3.090E0	19.253
Year (4)	32	9.697E0	3.030E-1	1.888
RESIDUALS	388	6.228E1	1.605E-1	
TOTAL	465	2.015E2		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	3125	INTERCEPT	0.039	0.157	465
2	6				
3	95				
4	59				
1	2114	1	-0.515	0.184	8
	2125	2	-0.193	0.176	7
	2155	3	-0.110	0.202	5
	3114	4	-0.443	0.176	13
	3124	5	0.047	0.154	8
	3154	6	-0.333	0.229	4
	3155	7	0.113	0.114	23
	10127	8	-0.524	0.259	3
	11115	9	-0.445	0.194	9
	11116	10	-0.285	0.216	6
	11125	11	-0.040	0.107	19
	11126	12	-0.079	0.196	10
	11127	13	-0.012	0.131	17
	11155	14	-0.606	0.194	5
	14126	15	-0.438	0.158	8
	14127	16	0.677	0.236	9
	16127	17	-0.096	0.162	26
	17116	18	-0.221	0.209	5
	17126	19	-0.414	0.196	6
	20114	20	-1.233	0.196	8
	20116	21	-0.106	0.198	9
	20127	22	0.342	0.088	53
	20145	23	1.204	0.363	12
	20157	24	0.388	0.082	44
	25126	25	-0.189	0.198	5
	25127	26	0.247	0.200	5
	27125	27	0.100	0.083	35
	27126	28	0.203	0.193	5
	27157	29	0.621	0.187	6
2	1	30	0.152	0.105	31
	2	31	0.181	0.106	28
	3	32	0.337	0.093	41
	4	33	0.497	0.091	45
	5	34	0.231	0.100	29
	7	35	0.138	0.085	52
	8	36	0.033	0.088	47
	9	37	0.138	0.090	43
	10	38	0.006	0.090	46
	11	39	0.071	0.095	36
	12	40	0.159	0.117	19
3	55	41	-0.566	0.102	23
	65	42	-0.530	0.081	38
	75	43	-0.395	0.069	58
	85	44	-0.084	0.056	94
4	60	45	0.133	0.179	11
	61	46	0.491	0.230	7
	62	47	0.162	0.210	10
	63	48	0.393	0.219	9
	64	49	0.634	0.292	3
	65	50	0.034	0.263	4
	66	51	0.070	0.204	12
	67	52	0.486	0.203	16
	68	53	0.364	0.233	6
	69	54	0.208	0.206	7
	70	55	0.168	0.244	6
	71	56	0.226	0.238	11
	72	57	0.323	0.271	3
	73	58	0.478	0.276	3
	74	59	-0.299	0.351	14
	75	60	-0.124	0.279	3
	76	61	0.137	0.151	26
	77	62	0.070	0.156	29
	78	63	-0.123	0.161	21
	79	64	0.048	0.183	15
	80	65	0.272	0.187	11
	81	66	0.240	0.173	16
	82	67	0.275	0.167	21
	83	68	0.289	0.166	18
	84	69	0.158	0.188	12
	85	70	0.259	0.174	17
	86	71	0.388	0.161	30
	87	72	0.162	0.171	19
	88	73	0.150	0.161	30
	89	74	0.370	0.176	19
	90	75	-0.096	0.164	31
	91	76	-0.288	0.266	4

Table 6. Anova results and regression coefficients from a multiplicative model to derive a standardized catch rate series for redfish in NAFO Div. 3N. Effort is measured in hours fished. (1989-91 based on preliminary data)

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.811
MULTIPLE R SQUARED..... 0.658

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	4.143E1	4.143E1	
REGRESSION	64	9.194E1	1.437E0	9.060
Country¦Gear¦TC (1)	17	1.704E1	1.003E0	6.324
Month (2)	11	3.565E0	3.241E-1	2.044
Bycatch pct (3)	4	1.502E1	3.756E0	23.689
Year (4)	32	1.684E1	5.262E-1	3.319
RESIDUALS	302	4.788E1	1.586E-1	
TOTAL	367	1.813E2		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	3125	INTERCEPT	0.420	0.175	367
2	6				
3	95				
4	59				
1	2114	1	-0.445	0.167	15
	3114	2	-0.151	0.138	54
	3124	3	-0.033	0.197	6
	4127	4	0.215	0.156	17
	4157	5	0.550	0.150	24
	11115	6	-0.224	0.277	4
	14127	7	0.262	0.237	5
	16127	8	0.095	0.239	4
	17116	9	-0.015	0.337	3
	17126	10	-0.114	0.231	7
	20114	11	-1.022	0.210	7
	20116	12	-0.122	0.231	5
	20127	13	0.455	0.122	79
	20157	14	0.504	0.130	58
	25126	15	0.152	0.177	16
	25127	16	0.540	0.152	36
	27125	17	0.207	0.211	6
2	1	18	-0.182	0.119	26
	2	19	-0.168	0.119	25
	3	20	-0.186	0.121	26
	4	21	0.091	0.127	20
	5	22	-0.051	0.119	22
	7	23	0.016	0.100	45
	8	24	-0.068	0.098	51
	9	25	-0.116	0.100	49
	10	26	-0.236	0.114	27
	11	27	-0.135	0.118	25
	12	28	-0.374	0.122	22
3	55	29	-0.613	0.089	39
	65	30	-0.692	0.082	41
	75	31	-0.350	0.077	47
	85	32	-0.317	0.070	57
4	60	33	0.108	0.226	5
	61	34	0.111	0.190	10
	62	35	0.067	0.170	15
	63	36	0.054	0.207	7
	64	37	0.073	0.209	8
	65	38	0.291	0.216	7
	66	39	0.272	0.177	13
	67	40	0.102	0.256	6
	68	41	-0.273	0.282	3
	69	42	-0.006	0.204	8
	70	43	-0.037	0.201	8
	71	44	-0.135	0.271	3
	72	45	-0.001	0.190	10
	73	46	0.285	0.225	8
	74	47	0.354	0.238	5
	75	48	0.364	0.236	5
	76	49	-0.355	0.198	8
	77	50	-0.125	0.225	6
	78	51	-0.114	0.214	7
	79	52	0.020	0.175	15
	80	53	0.349	0.180	14
	81	54	0.271	0.187	15
	82	55	0.272	0.174	17
	83	56	0.103	0.180	15
	84	57	0.074	0.202	9
	85	58	-0.242	0.187	15
	86	59	-0.134	0.196	11
	87	60	0.277	0.165	37
	88	61	-0.086	0.177	23
	89	62	-0.200	0.180	24
	90	63	-0.706	0.190	12
	91	64	-0.636	0.327	4

Table 7. Anova results and regression coefficients from a multiplicative model to derive a standardized catch rate series for redfish in NAFO Div. 3L. Effort is measured in days fished. (1989-91 based on preliminary data)

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.799
MULTIPLE R SQUARED..... 0.639

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	2.630E3	2.630E3	
REGRESSION	73	8.418E1	1.153E0	7.571
Country*Gear*TC (1)	26	4.078E1	1.568E0	10.297
Month (2)	11	3.666E0	3.333E-1	2.188
Bycatch pct (3)	4	8.040E0	2.010E0	13.197
Year (4)	32	1.029E1	3.214E-1	2.110
RESIDUALS	312	4.752E1	1.523E-1	
TOTAL	386	2.762E3		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	3125	INTERCEPT	2.777	0.167	386
2	6				
3	95				
4	59				
1	2114	1	-0.607	0.197	7
	2125	2	-0.255	0.178	7
	2155	3	-0.243	0.202	5
	3114	4	-0.528	0.182	11
	3124	5	0.310	0.162	7
	3155	6	0.252	0.120	23
	10105	7	0.149	0.195	8
	10106	8	0.208	0.211	9
	11115	9	-0.562	0.199	9
	11125	10	-0.199	0.110	18
	11126	11	-0.227	0.225	10
	11127	12	-0.374	0.135	15
	11155	13	-0.959	0.193	5
	14126	14	-0.522	0.169	7
	16127	15	-0.104	0.162	24
	17116	16	-0.169	0.232	4
	17126	17	-0.123	0.205	5
	20114	18	-1.225	0.237	6
	20116	19	-0.870	0.207	8
	20127	20	0.303	0.112	39
	20145	21	0.539	0.468	11
	20157	22	0.563	0.097	32
	25126	23	-0.297	0.251	3
	25127	24	0.370	0.222	4
	27125	25	0.130	0.093	27
	27157	26	0.468	0.202	5
2	1	27	-0.080	0.118	25
	2	28	-0.005	0.120	20
	3	29	0.208	0.104	35
	4	30	0.232	0.105	33
	5	31	0.219	0.120	19
	7	32	0.243	0.094	44
	8	33	0.181	0.098	41
	9	34	0.181	0.099	38
	10	35	0.116	0.098	44
	11	36	-0.022	0.108	28
	12	37	0.074	0.117	22
3	55	38	-0.581	0.111	18
	65	39	-0.474	0.090	34
	75	40	-0.342	0.073	56
	85	41	-0.106	0.062	82
4	60	42	-0.033	0.174	13
	61	43	-0.047	0.188	15
	62	44	-0.051	0.197	10
	63	45	0.156	0.230	6
	64	46	0.299	0.287	3
	65	47	-0.125	0.258	4
	66	48	-0.217	0.203	11
	67	49	0.144	0.219	12
	68	50	-0.060	0.233	6
	69	51	-0.163	0.227	5
	70	52	-0.921	0.293	3
	71	53	0.150	0.336	3
	72	54	-0.406	0.265	3
	73	55	-0.055	0.303	2
	74	56	-0.703	0.450	12
	75	57	-0.340	0.275	3
	76	58	-0.100	0.150	24
	77	59	-0.156	0.155	27
	78	60	-0.458	0.164	16
	79	61	-0.243	0.192	11
	80	62	-0.077	0.205	8
	81	63	-0.021	0.189	13
	82	64	0.082	0.183	15
	83	65	0.078	0.180	13
	84	66	-0.212	0.212	8
	85	67	-0.257	0.191	12
	86	68	0.015	0.176	22
	87	69	-0.123	0.180	18
	88	70	-0.226	0.174	24
	89	71	0.020	0.195	14
	90	72	-0.424	0.185	25
	91	73	-0.803	0.285	3

Table 8. Anova results and regression coefficients from a multiplicative model to derive a standardized catch rate series for redfish in NAFO Div. 3N. Effort is measured in days fished. (1989-91 based on preliminary data)

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.840
MULTIPLE R SQUARED..... 0.706

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	2.695E3	2.695E3	
REGRESSION	57	9.727E1	1.706E0	11.651
Country|Gear|TC (1)	11	4.745E1	4.313E0	29.449
Month (2)	11	1.676E0	1.523E-1	1.040
Bycatch pct (3)	4	6.571E0	1.643E0	11.216
Year (4)	31	1.689E1	5.449E-1	3.720
RESIDUALS	276	4.043E1	1.465E-1	
TOTAL	334	2.833E3		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	3125	INTERCEPT	2.523	0.215	334
2	6				
3	95				
4	59				
1	2114	1	-0.350	0.194	13
	3114	2	-0.153	0.171	46
	4127	3	0.108	0.196	15
	4157	4	0.566	0.196	22
	17126	5	0.493	0.355	4
	20114	6	-1.353	0.273	5
	20127	7	0.615	0.169	71
	20157	8	0.780	0.178	49
	22114	9	1.006	0.185	50
	25126	10	0.196	0.212	16
	25127	11	0.707	0.194	33
2	1	12	-0.107	0.122	27
	2	13	-0.079	0.118	27
	3	14	-0.071	0.121	27
	4	15	0.009	0.126	21
	5	16	-0.174	0.125	20
	7	17	0.115	0.107	36
	8	18	-0.029	0.104	44
	9	19	-0.046	0.109	39
	10	20	-0.026	0.120	26
	11	21	-0.043	0.122	23
	12	22	-0.188	0.125	21
3	55	23	-0.495	0.094	34
	65	24	-0.513	0.093	30
	75	25	-0.200	0.082	39
	85	26	-0.153	0.077	40
4	60	27	0.783	0.148	12
	61	28	0.138	0.130	21
	62	29	0.139	0.164	12
	63	30	-0.048	0.131	19
	64	31	0.020	0.150	12
	65	32	0.141	0.209	5
	66	33	0.234	0.198	6
	68	34	0.107	0.277	3
	69	35	0.166	0.216	7
	70	36	0.195	0.219	7
	71	37	0.123	0.260	3
	72	38	0.208	0.191	9
	73	39	0.001	0.317	2
	74	40	-1.775	0.423	1
	75	41	0.384	0.235	5
	76	42	-0.182	0.191	7
	77	43	0.126	0.258	4
	78	44	-0.141	0.238	5
	79	45	0.252	0.191	9
	80	46	0.300	0.191	10
	81	47	0.093	0.196	11
	82	48	0.075	0.182	15
	83	49	0.024	0.189	13
	84	50	-0.100	0.210	8
	85	51	-0.335	0.188	13
	86	52	-0.110	0.203	10
	87	53	0.115	0.172	36
	88	54	-0.136	0.181	23
	89	55	-0.163	0.192	17
	90	56	-0.666	0.210	10
	91	57	-0.880	0.446	2

Table 9. Standardized catch rate series for Div 3L utilizing hours fished as a measure of effort.

STANDARDIZED TO Can(N) OTB 5 JUNE 95%

PREDICTED CATCH RATE

YEAR	LN TRANSFORM MEAN	LN TRANSFORM S.E.	RETRANSFORMED MEAN	RETRANSFORMED S.E.	CATCH	EFFORT
1959	0.0388	0.0245	1.113	0.173	34107	30648
1960	0.1718	0.0296	1.268	0.217	11463	9040
1961	0.5300	0.0512	1.795	0.401	8349	4652
1962	0.2012	0.0412	1.298	0.261	3425	2638
1963	0.4313	0.0458	1.630	0.346	8191	5024
1964	0.6724	0.0808	2.039	0.569	3898	1912
1965	0.0732	0.0663	1.128	0.286	9451	8379
1966	0.1088	0.0345	1.188	0.219	6927	5833
1967	0.5251	0.0338	1.801	0.329	7684	4265
1968	0.4030	0.0433	1.587	0.327	2348	1480
1969	0.2465	0.0338	1.363	0.249	927	680
1970	0.2071	0.0565	1.296	0.304	1029	794
1971	0.2644	0.0501	1.377	0.305	10043	7294
1972	0.3618	0.0689	1.503	0.388	3095	2059
1973	0.5167	0.0697	1.755	0.456	4709	2684
1974	-0.2598	0.1191	0.787	0.264	11419	14503
1975	-0.0855	0.0654	0.963	0.243	3838	3986
1976	0.1756	0.0138	1.283	0.151	15971	12450
1977	0.1092	0.0139	1.201	0.141	13452	11205
1978	-0.0839	0.0145	0.989	0.119	6318	6386
1979	0.0868	0.0216	1.169	0.171	5584	4775
1980	0.3105	0.0202	1.463	0.207	4367	2984
1981	0.2786	0.0160	1.421	0.179	9407	6622
1982	0.3138	0.0124	1.474	0.164	7870	5339
1983	0.3282	0.0142	1.494	0.178	8657	5794
1984	0.1966	0.0194	1.307	0.181	2696	2063
1985	0.2978	0.0155	1.448	0.180	3677	2539
1986	0.4269	0.0117	1.651	0.178	27833	16856
1987	0.2008	0.0154	1.315	0.163	33917	25799
1988	0.1887	0.0134	1.300	0.150	26267	20205
1989	0.4088	0.0162	1.618	0.205	19847	12267
1990	-0.0570	0.0132	1.017	0.116	17704	17409
1991	-0.2496	0.0547	0.822	0.190	11642	14171

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.179

Table 10. Standardized catch rate series for Div 3N utilizing hours fished as a measure of effort.

STANDARDIZED TO Can(N) OTB 5 JUNE 95%

PREDICTED CATCH RATE

YEAR	LN TRANSFORM MEAN	LN TRANSFORM S.E.	RETRANSFORMED MEAN	RETRANSFORMED S.E.	CATCH	EFFORT
1959	0.4201	0.0305	1.623	0.282	10478	6456
1960	0.5285	0.0553	1.786	0.415	16547	9262
1961	0.5311	0.0405	1.804	0.360	14826	8216
1962	0.4874	0.0324	1.734	0.310	18009	10383
1963	0.4743	0.0494	1.697	0.373	12906	7603
1964	0.4926	0.0499	1.728	0.382	4206	2434
1965	0.7109	0.0528	2.147	0.488	4042	1883
1966	0.6916	0.0250	2.135	0.336	10047	4705
1967	0.5218	0.0605	1.770	0.430	19504	11019
1968	0.1469	0.0673	1.212	0.310	15265	12590
1969	0.4145	0.0374	1.608	0.309	22142	13767
1970	0.3834	0.0393	1.558	0.306	13359	8576
1971	0.2849	0.0766	1.385	0.377	24310	17547
1972	0.4187	0.0331	1.619	0.293	25838	15962
1973	0.7049	0.0450	2.142	0.450	28588	13344
1974	0.7746	0.0553	2.285	0.531	10867	4756
1975	0.7836	0.0558	2.305	0.538	14033	6087
1976	0.0651	0.0402	1.133	0.225	4541	4009
1977	0.2951	0.0450	1.422	0.299	3064	2155
1978	0.3057	0.0407	1.440	0.288	5725	3975
1979	0.4398	0.0241	1.661	0.257	8483	5108
1980	0.7689	0.0287	2.302	0.388	11663	5065
1981	0.6910	0.0321	2.126	0.379	14873	6994
1982	0.6918	0.0246	2.136	0.333	13677	6402
1983	0.5229	0.0290	1.800	0.305	11090	6160
1984	0.4939	0.0380	1.741	0.337	12065	6930
1985	0.1782	0.0315	1.274	0.225	16880	13253
1986	0.2860	0.0354	1.416	0.264	14972	10574
1987	0.6968	0.0248	2.147	0.336	44524	20741
1988	0.3336	0.0296	1.489	0.255	26999	18129
1989	0.2204	0.0290	1.330	0.225	13801	10374
1990	-0.2858	0.0341	0.800	0.147	11382	14231
1991	-0.2159	0.1061	0.827	0.263	13591	16428

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.200

Table 11. Standardized catch rate series for Div. 3L utilizing days fished as a measure of effort.

STANDARDIZED TO Can(N) OTB 5 JUNE 95%

PREDICTED CATCH RATE

YEAR	LN TRANSFORM MEAN	LN TRANSFORM S.E.	RETRANSFORMED MEAN	RETRANSFORMED S.E.	CATCH	EFFORT
1959	2.7774	0.0278	17.113	2.836	34107	1993
1960	2.7447	0.0357	16.498	3.093	11463	695
1961	2.7304	0.0405	16.224	3.238	8349	515
1962	2.7264	0.0413	16.152	3.255	3425	212
1963	2.9330	0.0547	19.727	4.558	8191	415
1964	3.0763	0.0808	22.471	6.269	3898	173
1965	2.6525	0.0673	14.807	3.783	9451	638
1966	2.5607	0.0365	13.719	2.603	6927	505
1967	2.9211	0.0428	19.609	4.022	7684	392
1968	2.7171	0.0441	15.980	3.325	2348	147
1969	2.6147	0.0434	14.430	2.977	927	64
1970	1.8560	0.0868	6.612	1.909	1029	156
1971	2.9269	0.1081	19.088	6.119	10043	526
1972	2.3715	0.0723	11.153	2.949	3095	278
1973	2.7225	0.0963	15.652	4.751	4709	301
1974	2.0742	0.1990	7.774	3.307	11419	1469
1975	2.4378	0.0645	11.964	2.995	3838	321
1976	2.6770	0.0171	15.563	2.027	15971	1026
1977	2.6215	0.0166	14.725	1.891	13452	914
1978	2.3198	0.0192	10.876	1.501	6318	581
1979	2.5345	0.0255	13.438	2.135	5584	416
1980	2.7001	0.0273	15.844	2.602	4367	276
1981	2.7568	0.0186	16.841	2.290	9407	559
1982	2.8593	0.0161	18.684	2.363	7870	421
1983	2.8549	0.0173	18.591	2.436	8657	466
1984	2.5658	0.0283	13.847	2.315	2696	195
1985	2.5205	0.0193	13.292	1.841	3677	277
1986	2.7927	0.0146	17.492	2.112	27833	1591
1987	2.6540	0.0170	15.209	1.977	33917	2230
1988	2.5514	0.0166	13.728	1.763	26267	1913
1989	2.7976	0.0223	17.511	2.606	19847	1133
1990	2.3530	0.0172	11.255	1.471	17704	1573
1991	1.9744	0.0631	7.532	1.866	11642	1546

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.197

Table 12. Standardized catch rate series for Div. 3N utilizing days fished as a measure of effort.

STANDARDIZED TO Can(N) OTB 5 JUNE 95%

PREDICTED CATCH RATE

YEAR	LN TRANSFORM MEAN	LN TRANSFORM S.E.	RETRANSFORMED MEAN	RETRANSFORMED S.E.	CATCH	EFFORT
1959	2.5233	0.0462	13.114	2.790	10478	799
1960	3.3065	0.0508	28.630	6.386	16547	578
1961	2.6617	0.0453	15.066	3.176	14826	984
1962	2.6619	0.0491	15.040	3.299	18009	1197
1963	2.4754	0.0470	12.495	2.682	12906	1033
1964	2.5434	0.0536	13.330	3.051	4206	316
1965	2.6648	0.0740	14.897	3.987	4042	271
1966	2.7570	0.0422	16.599	3.380	10047	605
1968	2.6300	0.0674	14.435	3.693	15265	1058
1969	2.6898	0.0618	15.368	3.769	22142	1441
1970	2.7180	0.0650	15.781	3.967	13359	846
1971	2.6462	0.0886	14.515	4.234	24310	1675
1972	2.7316	0.0466	16.147	3.450	25838	1600
1973	2.5245	0.1137	12.691	4.168	28588	2253
1974	0.7485	0.1891	2.069	0.860	10867	5252
1975	2.9076	0.0713	19.016	4.998	14033	738
1976	2.3418	0.0521	10.904	2.461	4541	416
1977	2.6493	0.0755	14.656	3.959	3064	209
1978	2.3824	0.0638	11.290	2.812	5725	507
1979	2.7752	0.0365	16.952	3.217	8483	500
1980	2.8231	0.0472	17.688	3.806	11663	659
1981	2.6165	0.0510	14.360	3.207	14873	1036
1982	2.5988	0.0430	14.164	2.912	13677	966
1983	2.5475	0.0457	13.438	2.845	11090	825
1984	2.4233	0.0572	11.800	2.788	12065	1022
1985	2.1879	0.0490	9.364	2.051	16880	1803
1986	2.4136	0.0538	11.706	2.683	14972	1279
1987	2.6382	0.0413	14.746	2.970	44524	3019
1988	2.3877	0.0463	11.449	2.439	26999	2358
1989	2.3606	0.0471	11.139	2.394	13801	1239
1990	1.8574	0.0554	6.706	1.559	11382	1697
1991	1.6436	0.2107	5.010	2.187	13591	2713

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.244

Table 13. Mean number per standard tow from various Canadian surveys in Div. 3L where strata greater than 366 m (200 fathoms) were sampled. Dashes (-) represent unsampled strata. Number of successful sets in brackets. G.A. = GADUS ATLANTICA, W.T. = WILFRED TEMPLEMAN, A.N. = ALFRED NEEDLER.

Stratum	Depth range (m)	Area (sq. n. mi)	Aug 16–Aug 29 1978 (G.A. 12)	Sep 4–Sep 10 1979 (G.A. 25)	May 8–May 13 1980 (G.A. 36)	Sep 18–Sep 26 1981 (G.A. 55)	Jul 26–Sep 3 1984 (W.T. 16–18)	Jan 10–Feb 11 1985–1 (W.T. 22–24)	Apr 17–May 26 1985–2 (W.T. 28–30)	Jul 27–Aug 25 1985–3 (W.T. 32–34)	Oct 9–Nov 18 1985–4 (W.T. 37–39)
345	275–366	1432	68.50(2)	96.75(4)	12.00(4)	46.60(5)	37.80(7)	3.33(3)	3.20(5)	62.29(7)	5.11(9)
346	275–366	865	206.00(2)	126.75(4)	27.00(2)	70.33(3)	263.33(6)	10.00(4)	20.00(2)	91.33(3)	84.40(5)
347	184–274	983	131.67(3)	0.00(2)	0.00(4)	3.96(4)	0.00(6)	0.00(5)	0.40(5)	0.00(3)	0.00(5)
366	184–274	1394	197.00(3)	13.50(2)	9.83(6)	47.67(6)	13.91(11)	0.00(5)	1.33(6)	17.40(5)	17.22(9)
368	275–366	334	2709.00(2)	140.00(3)	24.00(2)	526.50(2)	4379.50(2)	4.50(2)	14.50(2)	320.50(2)	351.50(2)
369	184–274	961	0.00(3)	1.00(2)	0.25(4)	13.75(4)	0.43(7)	0.00(5)	0.20(5)	0.17(6)	0.00(6)
386	184–274	983	115.67(3)	11.50(2)	2.00(4)	11.00(4)	23.13(8)	0.00(5)	0.40(5)	19.60(5)	0.60(5)
387	275–366	718	532.00(2)	595.40(5)	23.67(3)	1748.67(3)	4678.00(3)	102.00(4)	11.33(6)	1807.33(3)	628.00(4)
388	275–366	361	1240.50(2)	2326.33(3)	4.50(2)	464.50(2)	195.00(2)	16.00(3)	20.00(2)	397.00(2)	78.00(2)
389	184–274	821	0.33(3)	0.00(1)	29.50(2)	4.00(3)	21.67(6)	4.00(4)	0.20(5)	1.75(4)	7.40(5)
391	184–274	282	0.00(2)	19.00(2)	4.00(2)	1.50(2)	0.50(2)	0.00(2)	0.00(2)	0.00(2)	12.50(2)
392	275–366	145	-	818.00(3)	27.33(3)	536.50(2)	2811.00(2)	4.00(2)	10.00(2)	131.50(2)	1398.50(2)
729	367–549	186	-	488.00(3)	77.00(1)	1050.00(2)	448.00(2)	3406.00(2)	24.50(2)	1231.00(2)	2720.50(2)
730	550–731	170	1135.00(2)	399.33(3)	295.00(2)	496.50(2)	100.50(2)	816.00(2)	8926.00(2)	347.00(2)	37.50(2)
731	367–549	216	486.00(2)	457.00(3)	325.50(2)	176.00(2)	257.00(2)	80.67(3)	63.00(2)	257.00(2)	502.00(2)
732	550–731	231	85.50(2)	54.00(2)	104.00(2)	53.00(2)	90.00(2)	416.00(2)	141.50(2)	48.00(2)	39.00(2)
733	367–549	468	817.00(2)	1300.67(3)	43.67(3)	1420.50(2)	480.00(4)	1921.67(3)	1147.53(3)	1699.50(2)	727.00(3)
734	550–731	228	1435.50(2)	535.67(3)	1756.00(2)	760.50(2)	557.00(3)	195.50(2)	366.00(2)	912.00(2)	540.00(2)
735	367–549	272	810.50(2)	452.67(3)	39.00(2)	768.00(2)	723.33(3)	10.50(2)	52.50(2)	282.00(2)	232.00(2)
736	550–731	175	163.50(2)	270.33(3)	119.00(1)	84.00(2)	17.00(1)	-	532.50(2)	26.50(2)	222.00(2)
Upper (95% CI)[a]			653.4	544.2	266.4	680.1	1078.5	302.2	1909.1	465.2	290.3
Weighted mean (by area) (incl. strata with 1 set)			349.3	257.3	64.5	293.5	567.5	174.7	208.7	286.8	187.9
Lower (95% CI)[a]			45.2	11.03	-139.6	-93.2	73.94	47.2	-1491.7	108.5	85.5
Abundance of surveyed area ($\times 10^{-6}$)			285.6	216.8	54.3	247.3	478.2	144.9	175.9	241.7	158.3

[a]Confidence interval of mean for those strata with at least two sets.

Table 13. (Cont'd.)

Stratum	Depth range (m)	Area (sq. n. mi)	Jan 22–Feb 27 1986–1 (W.T. 42–44)	Nov 13–Nov 30 1986–4 (A.N. 72)	Jan 17–Jan 25 1990–1 (W.T. 90)	Aug 7–Aug 19 1990–3 (W.T. 98)	Oct 18–Nov 18 1990–4 (W.T. 101)	May 11–May 29 1991–2 (W.T. 106–7)	Aug 4–Aug 11 1991–3 (W.T. 109)	Nov 10–Dec 2 1991–4 (W.T. 114–115)
345	275–366	1432	1.33(3)	6.68(4)	0.40(5)	16.33(6)	1.00(5)	0.67(3)	4.50(4)	0.25(4)
346	275–366	865	4.25(4)	22.13(3)	14.67(3)	247.66(7)	67.00(3)	–	30.00(4)	6.80(15)
347	184–274	983	1.50(4)	0.00(4)	0.50(4)	1.93(4)	0.00(2)	0.25(2)	0.00(3)	0.00(4)
366	184–274	1394	1.50(2)	5.50(4)	1.00(5)	9.00(4)	0.00(6)	–	0.33(3)	0.19(21)
368	275–366	334	7.00(1)	24.90(2)	21.00(2)	1728.57(7)	57.50(2)	–	409.75(4)	31.17(6)
369	184–274	961	0.00(3)	4.24(3)	0.00(4)	2.50(4)	0.00(4)	0.00(2)	6.50(4)	0.56(9)
386	184–274	983	0.86(7)	4.10(4)	5.50(4)	1.29(7)	2.00(4)	0.67(3)	1.00(3)	0.00(3)
387	275–366	718	12.00(4)	6.00(2)	135.00(3)	297.70(10)	89.67(3)	45.00(3)	189.40(5)	13.00(5)
388	275–366	361	15.67(3)	–	13.00(2)	183.86(7)	16.00(2)	13.53(3)	50.33(3)	12.33(3)
389	184–274	821	1.50(4)	2.25(4)	0.00(3)	5.33(3)	1.00(3)	1.67(3)	0.33(3)	0.00(3)
391	184–274	282	0.00(3)	18.00(2)	0.50(2)	1.00(5)	0.00(2)	0.00(3)	5.67(3)	0.00(3)
392	275–366	145	9.67(3)	359.50(2)	4.00(2)	146.56(9)	9.00(2)	2.50(2)	350.67(3)	4.67(3)
729	367–549	186	2690.00(2)	1491.22(2)	206.50(2)	328.43(7)	206.50(2)	19.00(2)	190.00(2)	142.00(3)
730	550–731	170	1822.50(1)	–	109.50(2)	183.52(4)	42.00(1)	178.00(2)	222.33(3)	348.50(2)
731	367–549	216	153.00(1)	220.80(1)	68.00(2)	166.83(6)	275.50(2)	27.50(2)	244.00(3)	41.00(3)
732	550–731	231	1694.00(1)	–	68.00(2)	59.44(9)	193.00(2)	300.00(2)	96.67(3)	39.00(2)
733	367–549	468	452.07(2)	–	72.00(2)	490.87(9)	216.00(2)	16.00(2)	611.00(4)	340.00(3)
734	550–731	228	451.00(2)	–	142.93(2)	271.60(5)	42.00(2)	231.60(2)	59.67(3)	16.00(2)
735	367–549	272	–	153.50(2)	223.00(2)	603.51(6)	195.00(1)	–	106.82(3)	125.67(3)
736	550–731	175	–	24.74(2)	208.50(2)	93.50(6)	281.00(2)	–	12.67(3)	51.00(2)
Upper (95% CI)[a]			466.0	66.3	62.5	263.8	63.1	123.2	94.9	58.3
Weighted mean (by area) (incl. strata with 1 set)			146.4	49.9	33.9	156.2	45.9	25.7	76.9	30.4
Lower (95% CI)[a]			-294.7	25.8	5.3	48.6	21.3	-71.9	58.8	2.5
Abundance of surveyed area ($\times 10^{-6}$)			118.5	36.6	28.6	131.6	38.7	15.8	64.8	25.6

[a]Confidence interval of mean for those strata with at least two sets.

Table 14. Mean weight (kg) per standard tow from various Canadian surveys in Div. 3L where strata greater than 366 m (200 fathoms) were sampled. Dashes (–) represent unsampled strata. Number of successful sets in brackets. G.A. = GADUS ATLANTICA, W.T. = WILFRED TEMPLEMAN, A.N. = ALFRED NEEDLER.

Stratum	Depth range (m)	Area (sq. n. mi)	Aug 16–Aug 29 1978 (G.A. 12)	Sep 4–Sep 10 1979 (G.A. 25)	May 8–May 13 1980 (G.A. 36)	Sep 18–Sep 26 1981 (G.A. 55)	Jul 26–Sep 3 1984 (W.T. 16–18)	Jan 10–Feb 11 1985–1 (W.T. 22–24)	Apr 17–May 26 1985–2 (W.T. 28–30)	Jul 27–Aug 25 1985–3 (W.T. 32–34)	Oct 9–Nov 18 1985–4 (W.T. 37–39)
345	275–366	1432	51.08(2)	78.92(4)	8.50(4)	35.80(5)	31.10(7)	0.83(3)	3.14(5)	44.41(7)	3.32(9)
346	275–366	865	151.18(2)	80.88(4)	14.75(2)	64.83(3)	163.33(6)	5.80(4)	18.25(2)	67.50(3)	61.50(5)
347	184–274	983	42.52(3)	0.00(2)	0.00(4)	1.32(4)	0.00(6)	0.00(5)	0.00(5)	0.00(3)	0.00(5)
366	184–274	1394	35.42(3)	1.82(2)	2.00(6)	25.01(6)	1.14(11)	0.00(5)	0.05(6)	4.00(5)	5.33(9)
368	275–366	334	1154.53(2)	61.72(3)	7.25(2)	176.75(2)	1915.75(2)	2.00(2)	5.35(2)	181.75(2)	151.50(2)
369	184–274	961	0.00(3)	0.80(2)	0.25(4)	2.40(4)	0.00(7)	0.00(5)	0.20(5)	0.17(6)	0.00(6)
386	184–274	983	62.99(3)	11.34(2)	1.25(4)	8.50(4)	14.18(8)	0.00(5)	0.21(5)	15.30(5)	0.44(5)
387	275–366	718	203.16(2)	286.77(5)	6.83(3)	572.00(3)	1972.33(3)	71.50(4)	4.68(6)	633.03(3)	279.17(4)
388	275–366	361	262.18(2)	562.10(3)	1.10(2)	145.50(2)	63.00(2)	14.17(3)	7.65(2)	130.50(2)	30.75(2)
389	184–274	821	0.03(3)	0.00(1)	9.25(2)	2.33(3)	8.83(6)	0.50(4)	0.01(5)	0.63(4)	1.46(5)
391	184–274	282	0.00(2)	6.39(2)	0.75(2)	0.08(2)	0.03(2)	0.00(2)	0.00(2)	0.00(2)	4.00(2)
392	275–366	145	–	304.24(3)	7.50(3)	146.75(2)	1118.44(2)	1.40(2)	1.50(2)	45.75(2)	451.50(2)
729	367–549	186	–	199.53(3)	24.00(1)	413.50(2)	203.43(2)	1249.00(2)	7.25(2)	560.00(2)	1213.50(2)
730	550–731	170	509.74(2)	238.85(3)	96.75(2)	263.25(2)	57.25(2)	408.00(2)	4710.00(2)	195.50(2)	19.75(2)
731	367–549	216	289.42(2)	255.57(3)	112.25(2)	69.00(2)	120.00(2)	29.17(3)	16.00(2)	121.50(2)	275.50(2)
732	550–731	231	47.44(2)	29.94(2)	30.25(2)	30.50(2)	49.25(2)	217.50(2)	56.00(2)	33.00(2)	22.00(2)
733	367–549	468	460.96(2)	647.34(3)	18.83(3)	754.00(2)	280.63(4)	895.28(3)	623.43(3)	1023.50(2)	353.76(3)
734	550–731	228	1084.93(2)	357.43(3)	1187.45(2)	430.64(2)	350.00(3)	119.75(2)	146.75(2)	598.50(2)	387.13(2)
735	367–549	272	603.98(2)	252.05(3)	14.50(2)	348.00(2)	442.00(3)	4.50(2)	20.50(2)	186.00(2)	127.75(2)
736	550–731	175	61.59(2)	116.73(3)	28.00(1)	42.25(2)	11.00(1)	–	152.00(2)	17.25(2)	107.75(2)
Upper (95% CI)[a]			252.9	164.5	185.3	245.6	536.8	111.3	1008.1	264.9	278.7
Weighted mean (by area) (incl. strata with 1 set)			163.5	114.6	34.4	124.4	255.5	78.7	107.3	138.3	88.8
Lower (95% CI)[a]			74.13	82.8	–115.9	3.2	–18.1	46.1	–793.4	11.7	–101.1
Trawlable biomass (t) of surveyed area			133724	96536	29001	104817	215259	65282	90432	116543	74828

[a]Confidence interval of mean for those strata with at least two sets.

Table 14. (Cont'd.)

Stratum	Depth range (m)	Area (sq. n. mi)	Jan 22–Feb 27 1986–1 (W.T. 42–44)	Nov 13–Nov 30 1986–4 (A.N. 72)	Jan 17–Jan 25 1990–1 (W.T. 90)	Aug 7–Aug 19 1990–3 (W.T. 98)	Oct 18–Nov 18 1990–4 (W.T. 101)	May 11–May 29 1991–2 (W.T. 106–7)	Aug 4–Aug 11 1991–3 (W.T. 109)	Nov 10–Dec 2 1991–4 (W.T. 114–115)
345	275–366	1432	0.04(3)	5.21(4)	0.02(5)	8.66(6)	0.53(5)	0.07(3)	2.13(4)	0.12(4)
346	275–366	865	1.08(4)	16.80(3)	3.22(3)	172.19(7)	38.98(3)	–	11.46(4)	2.59(15)
347	184–274	983	0.08(4)	0.00(4)	0.06(4)	0.63(4)	0.00(2)	0.00(4)	0.00(3)	0.00(4)
366	184–274	1394	0.01(2)	2.13(4)	0.04(5)	2.56(4)	0.00(6)	–	0.10(3)	0.03(21)
368	275–366	334	1.70(1)	7.25(2)	5.10(2)	737.95(7)	14.25(2)	–	153.78(4)	6.80(6)
369	184–274	961	0.00(3)	0.71(3)	0.00(4)	0.79(4)	0.00(4)	0.00(2)	3.27(4)	0.12(9)
386	184–274	983	0.45(7)	0.34(4)	3.21(4)	0.09(7)	0.05(4)	0.02(3)	0.20(3)	0.00(3)
387	275–366	718	8.00(4)	3.10(2)	75.92(3)	115.68(10)	35.05(3)	12.73(3)	61.37(5)	6.08(5)
388	275–366	361	5.33(3)	–	2.85(2)	47.46(7)	3.30(2)	1.56(3)	8.13(3)	1.67(3)
389	184–274	821	0.15(4)	0.84(4)	0.00(3)	0.85(3)	0.54(3)	0.07(3)	0.22(3)	0.00(3)
391	184–274	282	0.00(3)	3.50(2)	0.01(2)	0.26(5)	0.00(2)	0.00(2)	1.40(3)	0.00(3)
392	275–366	145	4.10(3)	113.25(2)	2.08(2)	35.49(9)	2.32(2)	0.48(2)	133.63(3)	0.56(3)
729	367–549	186	1118.30(2)	480.88(2)	121.20(2)	175.09(7)	94.00(2)	4.45(2)	86.38(2)	40.88(3)
730	550–731	170	767.81(1)	–	59.68(2)	107.15(4)	25.90(1)	45.30(2)	120.32(3)	247.68(2)
731	367–549	216	69.00(1)	105.60(1)	18.38(2)	66.18(6)	116.86(2)	5.47(2)	78.32(3)	9.65(3)
732	550–731	231	850.50(1)	–	37.75(2)	31.32(9)	118.85(2)	56.35(2)	44.95(3)	19.08(2)
733	367–549	468	238.22(2)	–	30.00(2)	314.42(9)	59.60(2)	5.83(2)	282.51(5)	100.25(3)
734	550–731	228	296.90(2)	–	80.68(2)	164.97(5)	23.00(2)	43.29(2)	37.08(3)	11.00(2)
735	367–549	272	–	63.50(2)	51.22(2)	417.61(6)	70.45(1)	–	47.01(3)	30.17(3)
736	550–731	175	–	14.38(2)	65.63(2)	51.32(6)	156.25(2)	–	6.43(3)	22.02(2)
Upper (95% CI)[a]			202.7	24.8	31.9	130.0	29.9	11.7	40.8	19.8
Weighted mean (by area) (incl. strata with 1 set)			68.6	18.5	14.9	80.1	19.7	5.53	31.5	11.4
Lower (95% CI)[a]			-121.9	8.3	-2.1	30.1	6.6	-0.6	22.1	2.9
Trawlable biomass (t) of surveyed area			55514	13568	12525	67453	16563	3399	26510	9576

[a]Confidence interval of mean for those strata with at least two sets.

Table 15. Mean number per standard tow from various Canadian surveys in Div. 3N where strata greater than 366 m (200 fathoms) were sampled. Dashes (-) represent unsampled strata. Number of successful sets in brackets. W.T. = Wilfred Templeman.

Stratum	Depth range (m)	Area (sq. n. mi.)	May 3-11 1991-Q1 (W.T.106)	Aug 11-18 1991-Q3 (W.T.109)	Oct 27-Nov 10 1991-Q4 (W.T.113-114)
357	275-366	164	101.50(2)	2649.00(2)	2380.00(2)
358	185-274	225	9.00(2)	677.00(3)	1867.50(2)
359	93-183	421	0.50(2)	26.25(4)	0.00(2)
377	93-183	100	0.00(2)	0.00(2)	0.00(1)
378	185-274	139	5.33(3)	13.00(3)	177.00(2)
379	275-366	106	30.00(2)	6305.20(2)	57.00(1)
380	275-366	116	1.00(2)	3856.00(2)	197.00(2)
381	185-274	182	0.50(2)	5.00(3)	1.00(2)
382	93-183	647	0.50(2)	0.00(3)	0.00(3)
723	367-549	155	158.00(2)	328.00(1)	170.00(2)
724	550-731	124	446.85(2)	61.00(1)	34.76(2)
725	367-549	105	148.00(2)	502.67(3)	378.33(1)
726	550-731	72	402.00(2)	91.00(2)	74.00(1)
727	367-549	160	15.50(2)	121.44(4)	-
728	550-731	156	72.50(2)	66.50(4)	-
Upper (95% CI)[a]			134.6	2964.8	850.2
Weighted mean (by area) (Incl. strata with 1 set)			56.2	648.9	367.7
Lower (95% CI)[a]			-22.2	-1572.3	-32.2
Abundance of surveyed area ($\times 10^{-6}$)			12.1	139.9	70.6

[a]Confidence interval of mean for those strata with at least 2 sets.

Table 16. Mean weight (kg) per standard tow from various Canadian surveys in Div. 3N where strata greater than 366 m (200 fathoms) were sampled. Dashes (-) represent unsampled strata. Number of successful sets in brackets. W.T. = Wilfred Templeman.

Stratum	Depth range (m)	Area (sq. n. mi.)	May 3-11 1991-Q2 (W.T.106)	Aug 11-18 1991-Q3 (W.T.109)	Oct 27-Nov 10 1991-Q4 (W.T.113-114)
357	275-366	164	11.13(2)	576.92(2)	324.18(2)
358	185-274	225	0.18(2)	106.19(3)	132.02(2)
359	93-183	421	0.00(2)	0.60(4)	0.00(2)
377	93-183	100	0.00(2)	0.00(2)	0.00(1)
378	185-274	139	0.88(3)	3.68(3)	57.39(2)
379	275-366	106	3.14(2)	949.58(2)	7.25(1)
380	275-366	116	0.03(2)	1041.38(2)	53.54(2)
381	185-274	182	0.13(2)	0.97(3)	0.09(2)
382	93-183	647	0.16(2)	0.00(3)	0.00(3)
723	367-549	155	19.05(2)	188.85(1)	46.42(2)
724	550-731	124	76.18(2)	36.10(1)	26.17(2)
725	367-549	105	18.78(2)	177.22(3)	127.50(1)
726	550-731	72	97.75(2)	41.17(2)	40.05(1)
727	367-549	160	2.85(2)	40.73(4)	-
728	550-731	156	22.20(2)	30.75(4)	-
Upper (95% CI)			24.4	729.9	160.7
Weighted mean (by area)			9.7	141.7	48.7
Lower (95% CI)			-5.1	-442.0	-61.7
Trawlable biomass (t) of surveyed area			2085	30552	9350

[a]Confidence interval of mean for those strata with at least 2 sets.

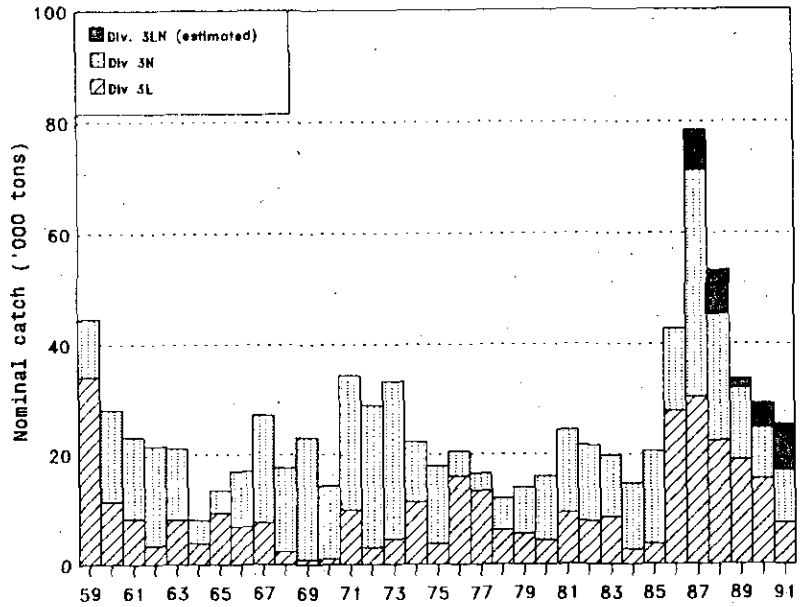

Fig. 1. Nominal catches and TACs of redfish in Div. 3LN (1989-91 are provisional).

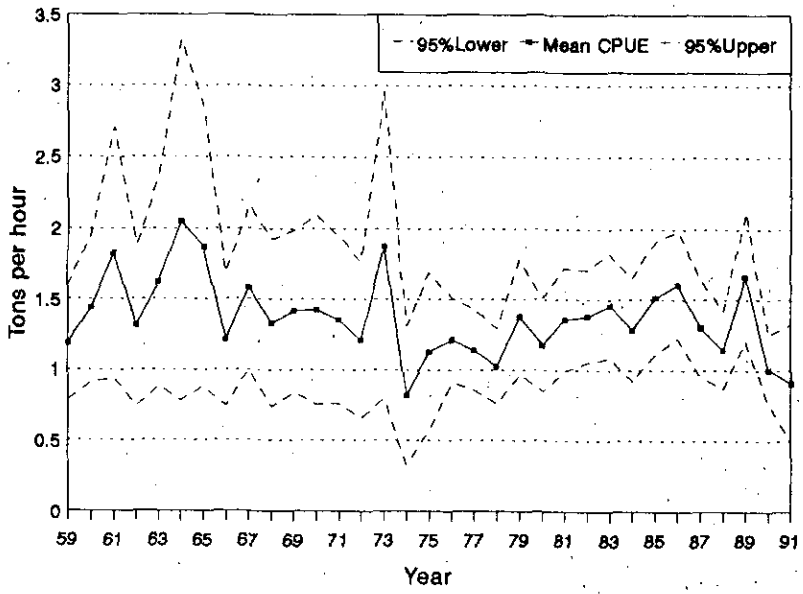

Fig. 2a. Standardized CPUE and 95% confidence intervals about the mean derived from a multiplicative model for Div. 3L catch and effort data eliminating observations of less than 10 units.

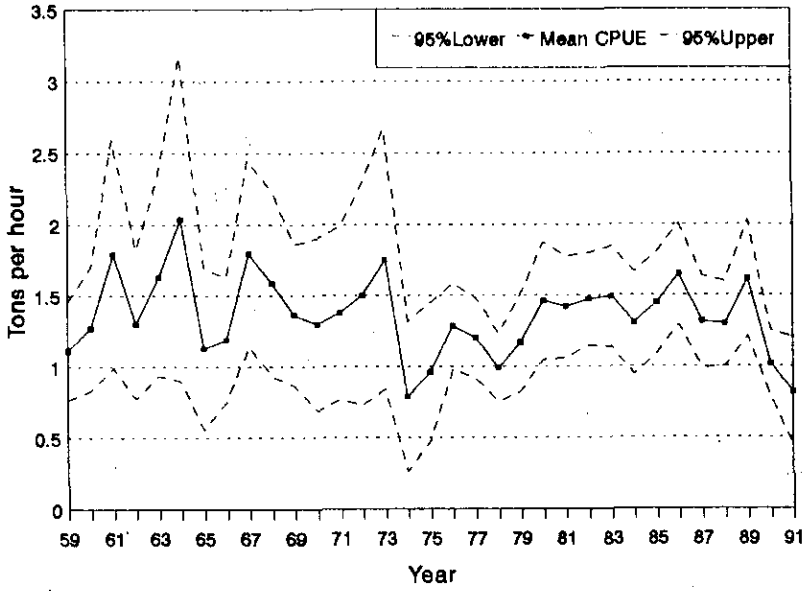

Fig. 2b. Standardized CPUE and 95% confidence intervals about the mean derived from a multiplicative model for Div. 3L catch and effort data eliminating observations of less than 20 units.

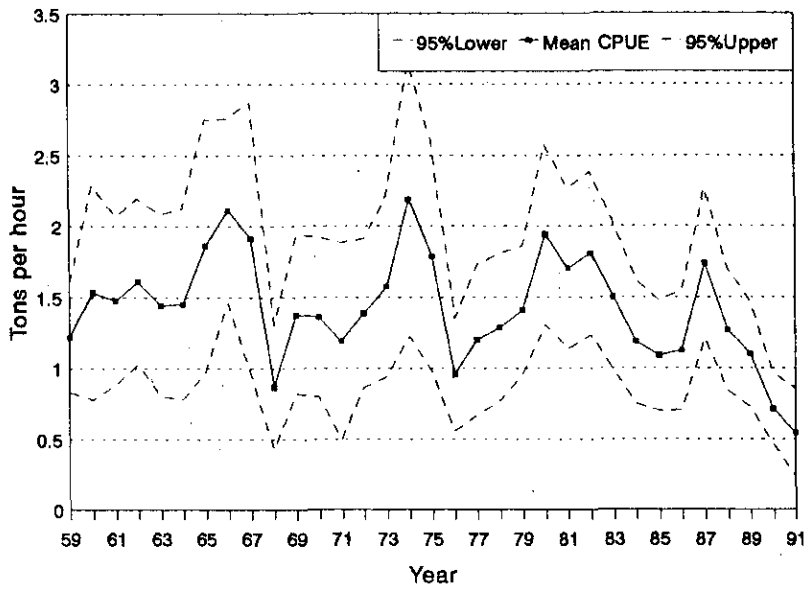

Fig. 3a. Standardized CPUE and 95% confidence intervals about the mean derived from a multiplicative model for Div. 3N catch and effort data eliminating observations of less than 10 units.

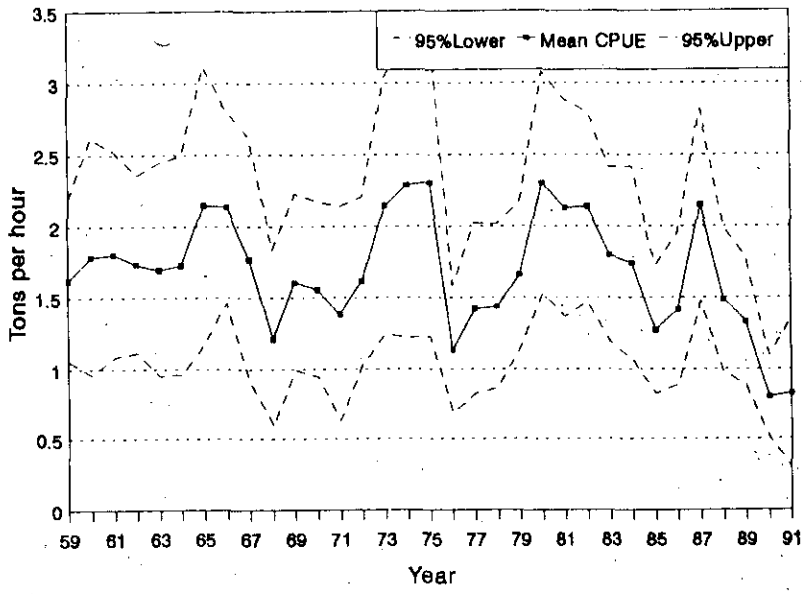

Fig. 3b. Standardized CPUE and 95% confidence intervals about the mean derived from a multiplicative model for Div. 3N catch and effort data eliminating observations of less than 20 units.

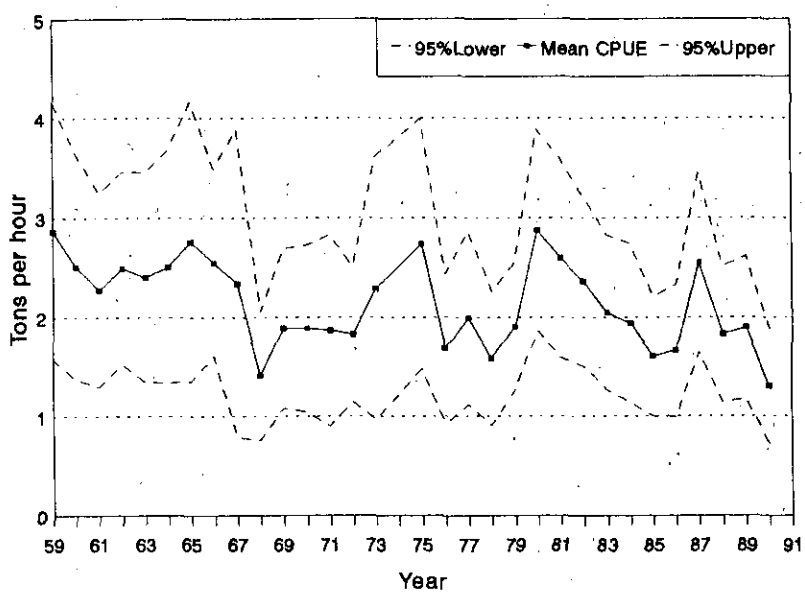

Fig. 3c. Standardized CPUE and 95% confidence intervals about the mean derived from a multiplicative model for Div. 3N catch and effort data eliminating observations of less than 50 units.

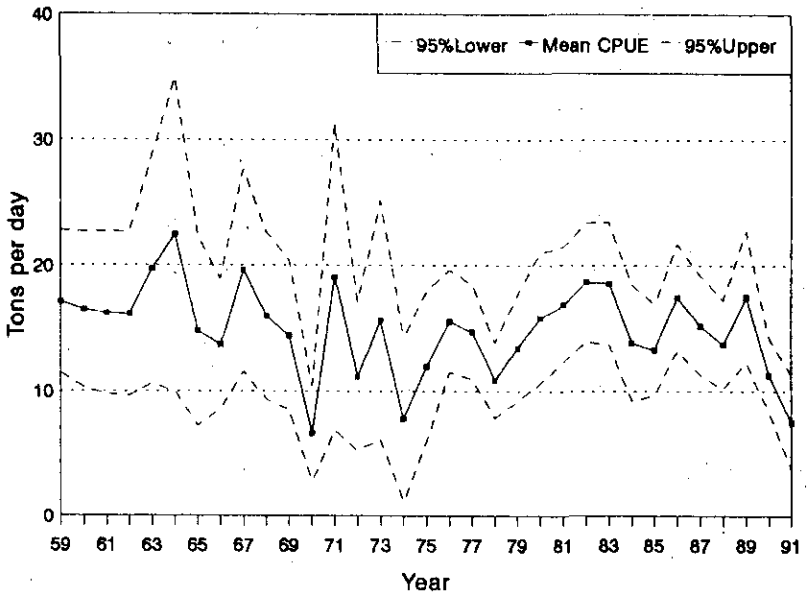

Fig. 4. Standardized CPUE and 95% confidence intervals about the mean derived from a multiplicative model for Div. 3L catch and effort data utilizing days fished as a measure of effort.

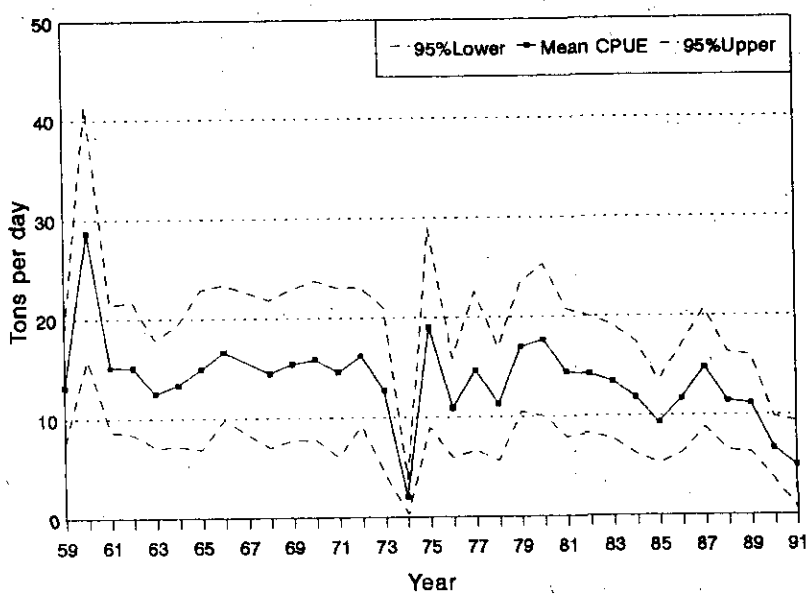

Fig. 5. Standardized CPUE and 95% confidence intervals about the mean derived from a multiplicative model for Div. 3N catch and effort data utilizing days fished as a measure of effort.

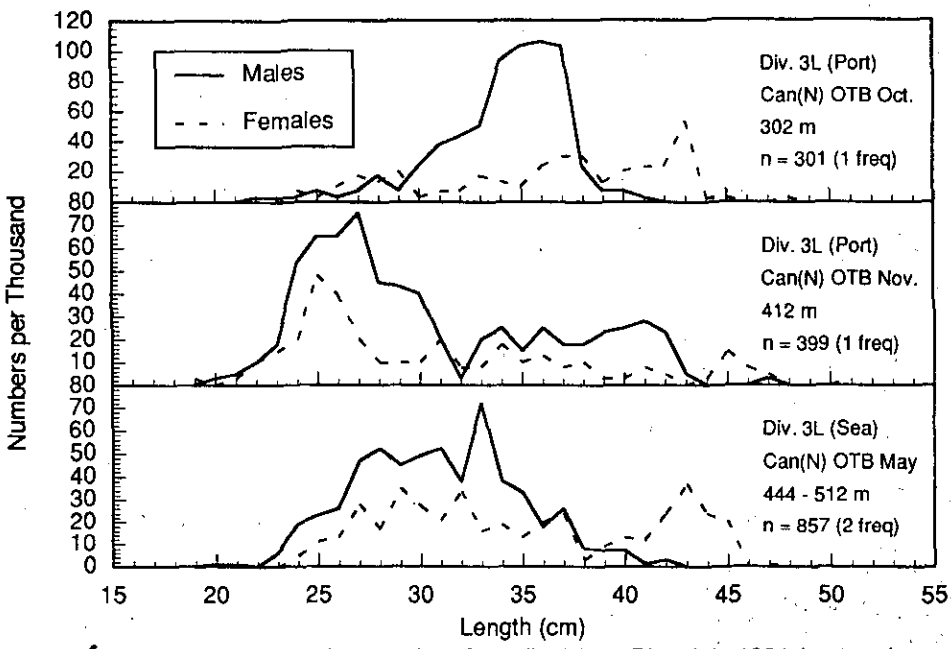

Figure 6: Commercial length frequencies (Canadian) from Div. 3L in 1991 (port and observer sampling).

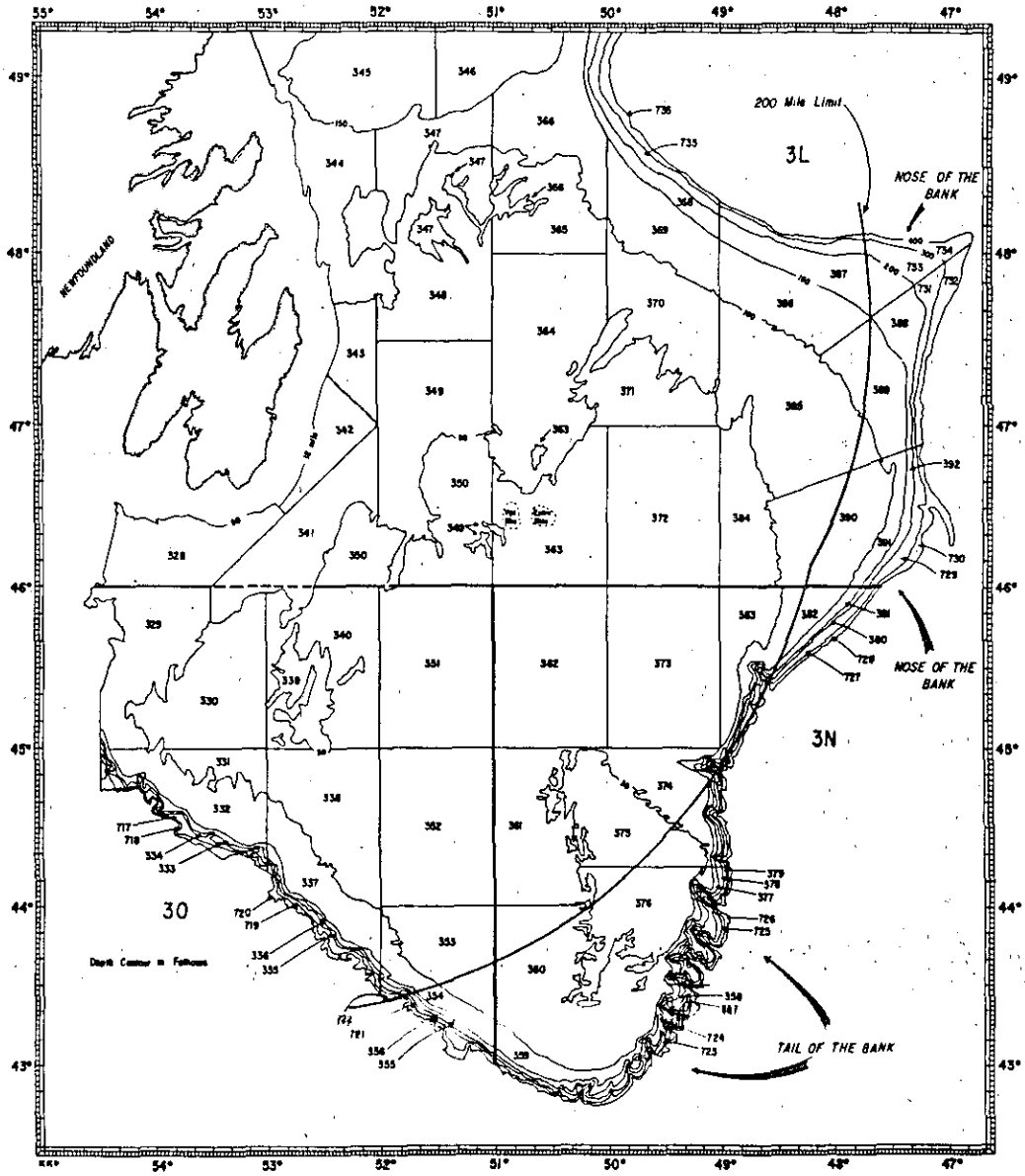

Figure 7. Stratification scheme for NAFO Divisions 3LNO showing the Canadian 200-mile limit.

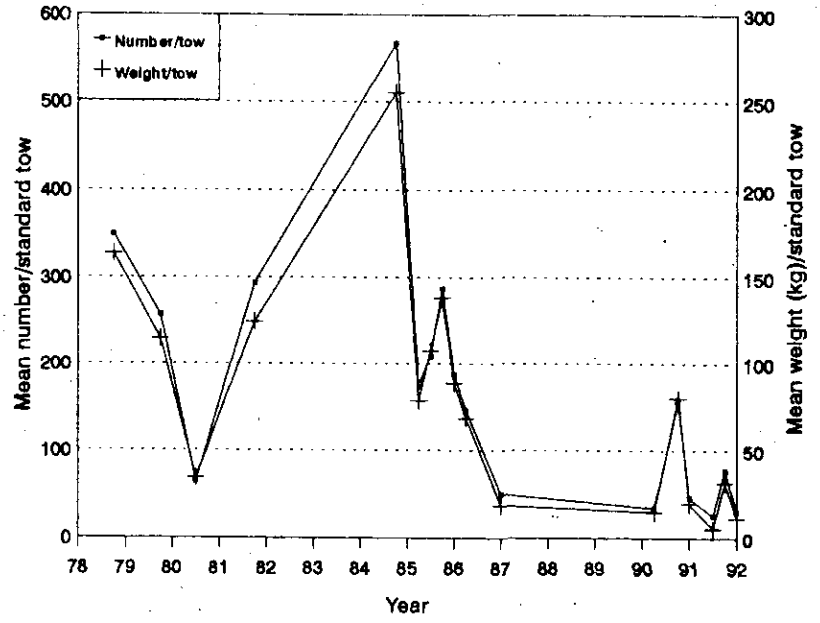

Fig 8. Stratified mean number and weight per standard tow in Div. 3L from various Canadian surveys where strata greater than 366 m were surveyed.

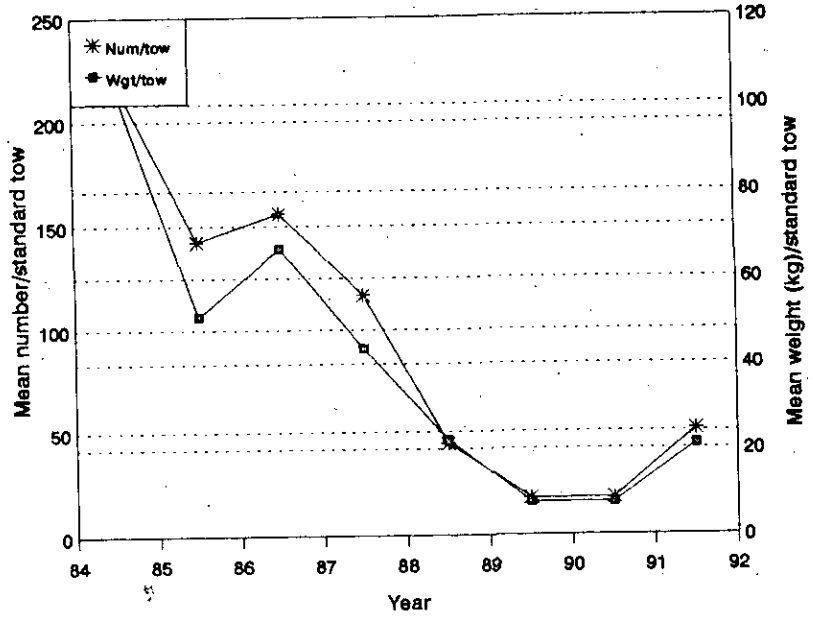

Fig 9. Stratified mean number and weight per standard tow from Russian surveys in Div. 3L.

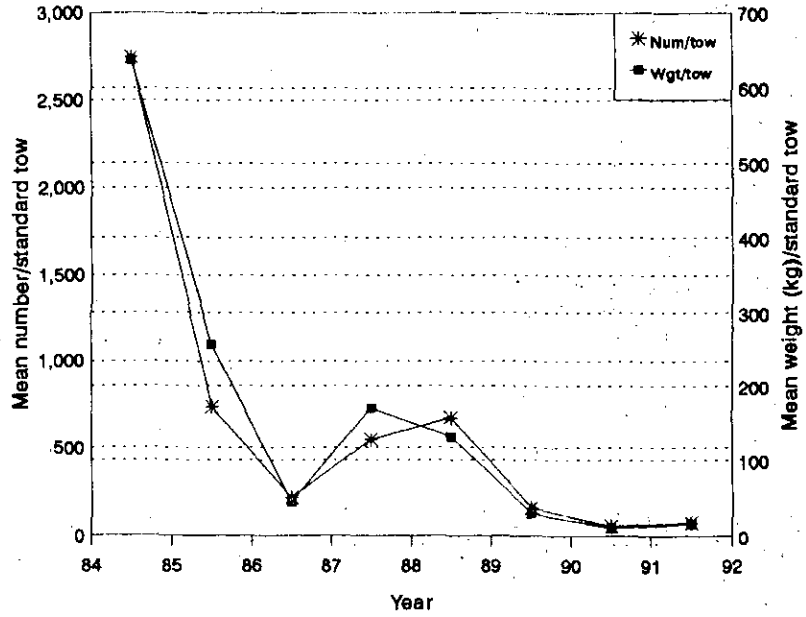

Fig 10. Stratified mean number and weight per standard tow from Russian surveys in Div. 3N.

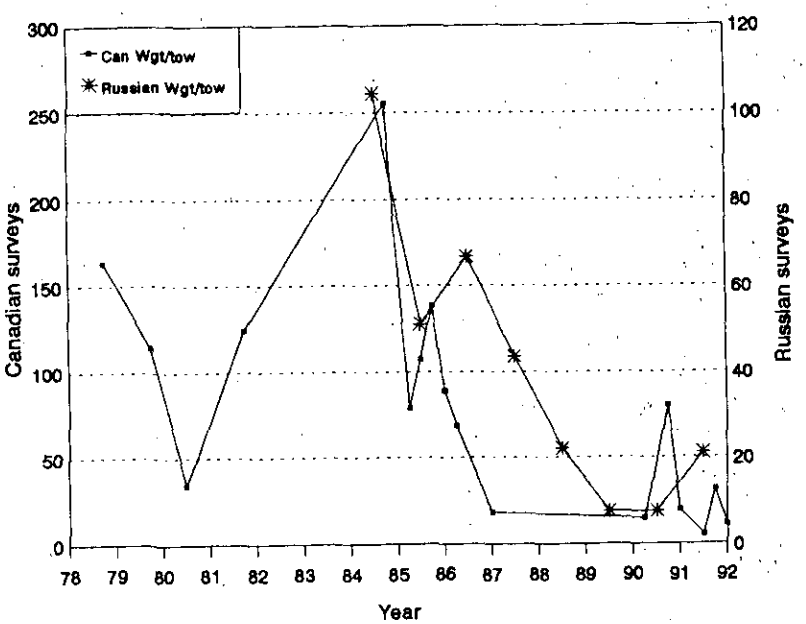

Fig 11. Stratified mean weight (kg) per standard tow in Div. 3L from Canadian and Russian surveys where strata greater than 366 m were surveyed.

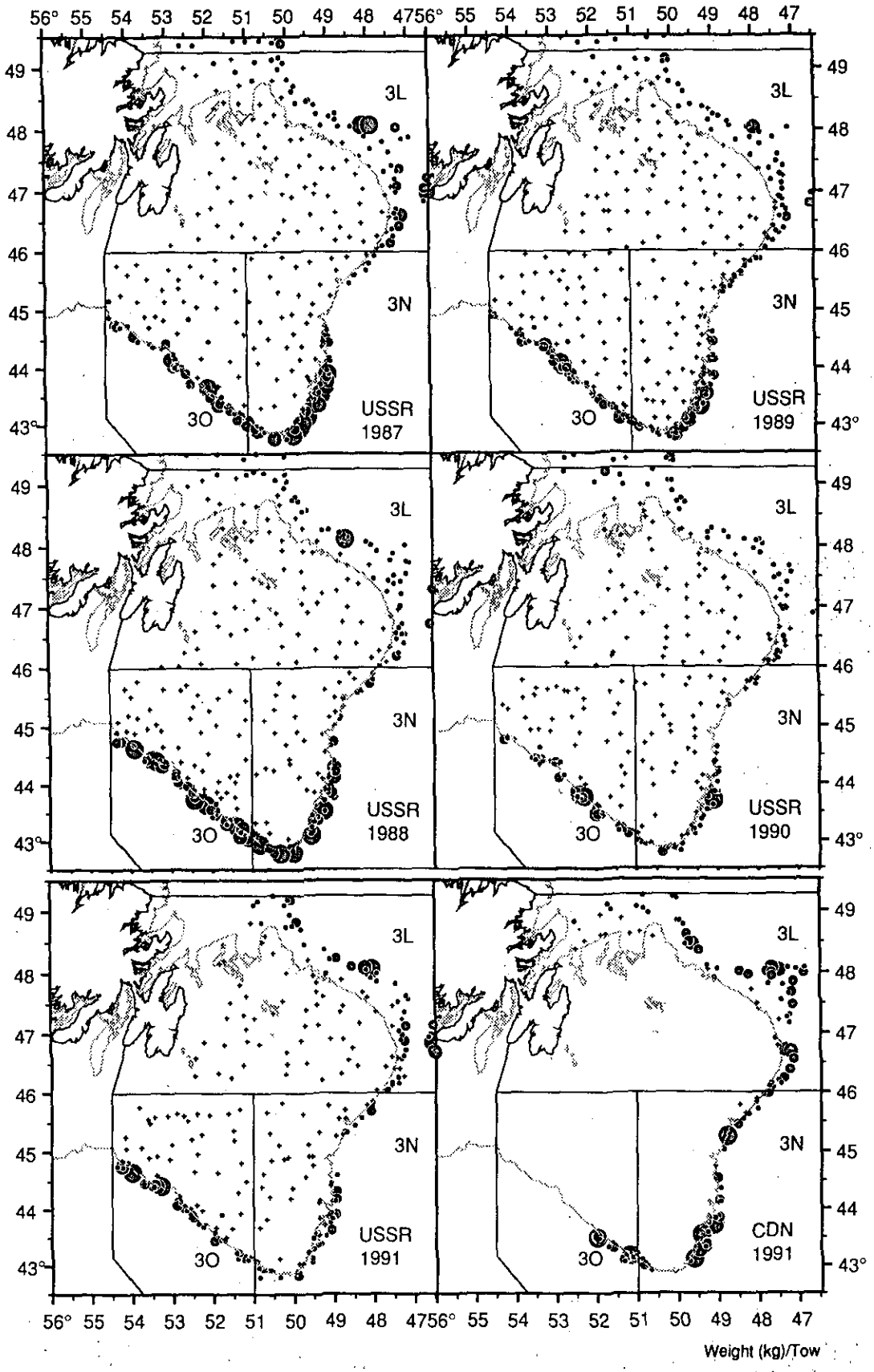

Figure 12. Distribution of redfish catches in Div. 3LNO from USSR and Canadian trawl surveys.

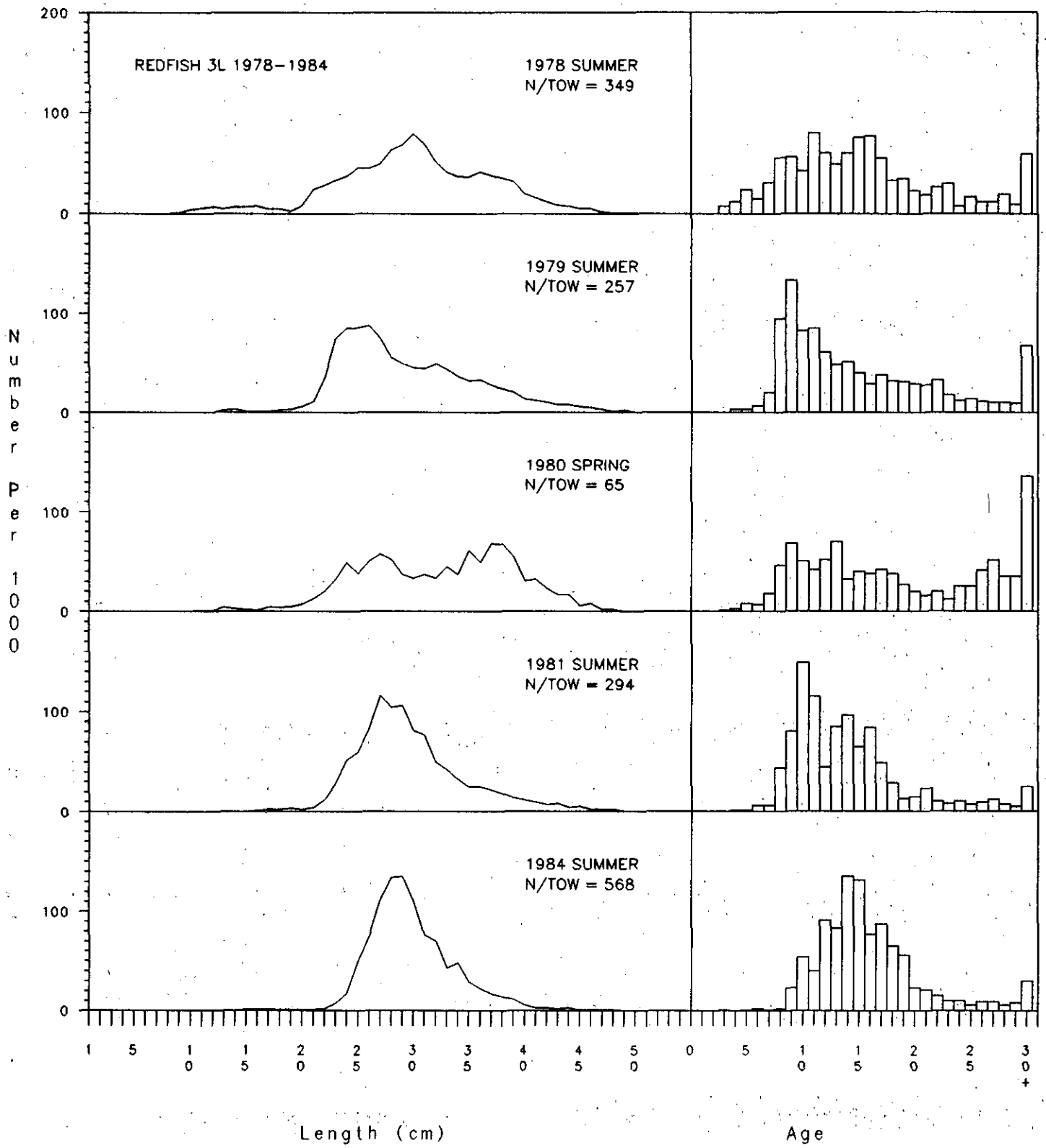

Figure 13. Length frequencies and corresponding age distribution from various stratified random research surveys where strata greater than 366 m (200 fathoms) were sampled in Div. 3L from 1978–1984.

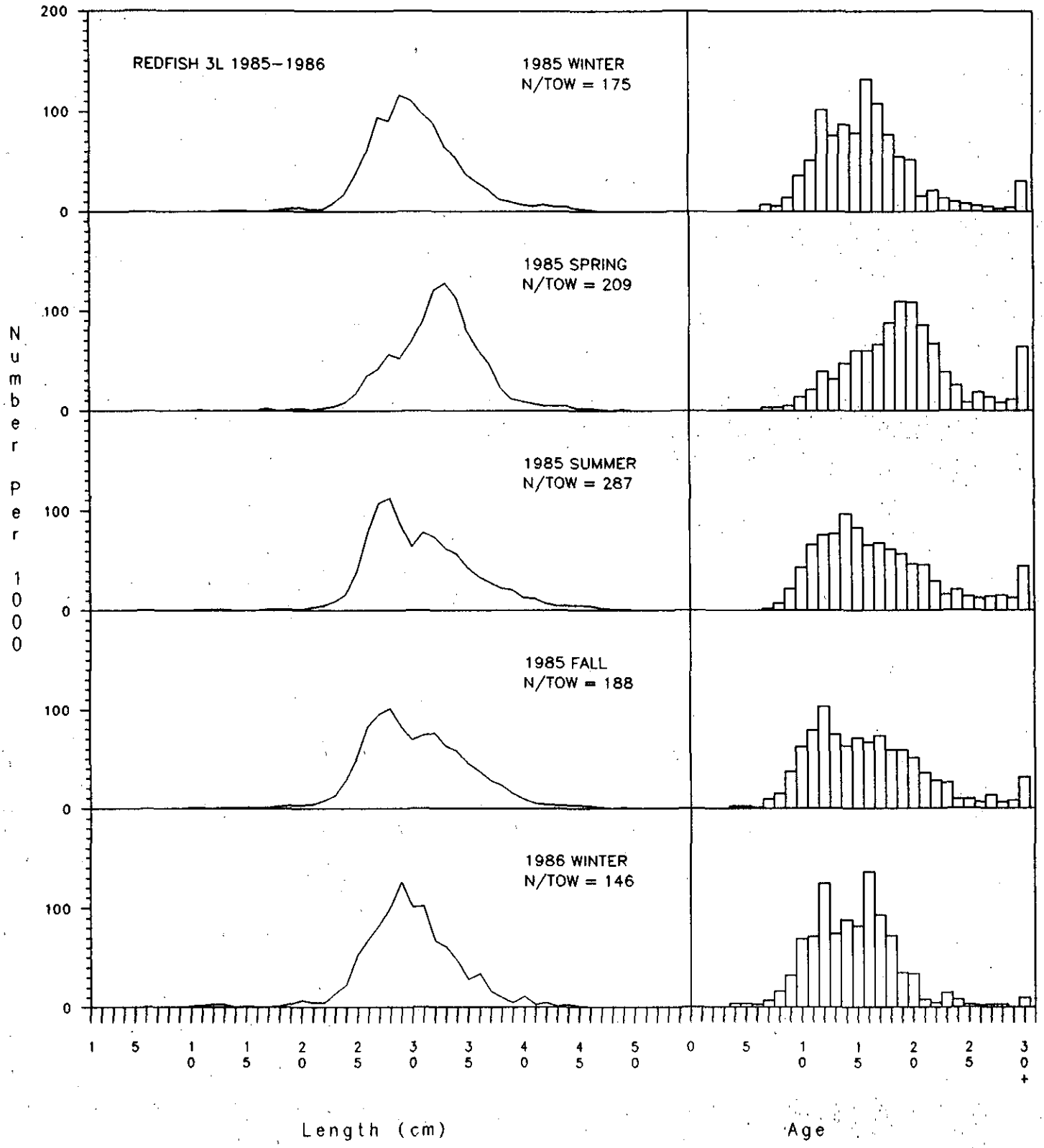

Figure 14. Length frequencies and corresponding age distribution from various stratified random research surveys where strata greater than 366 m (200 fathoms) were sampled in Div. 3L from 1985–1986.

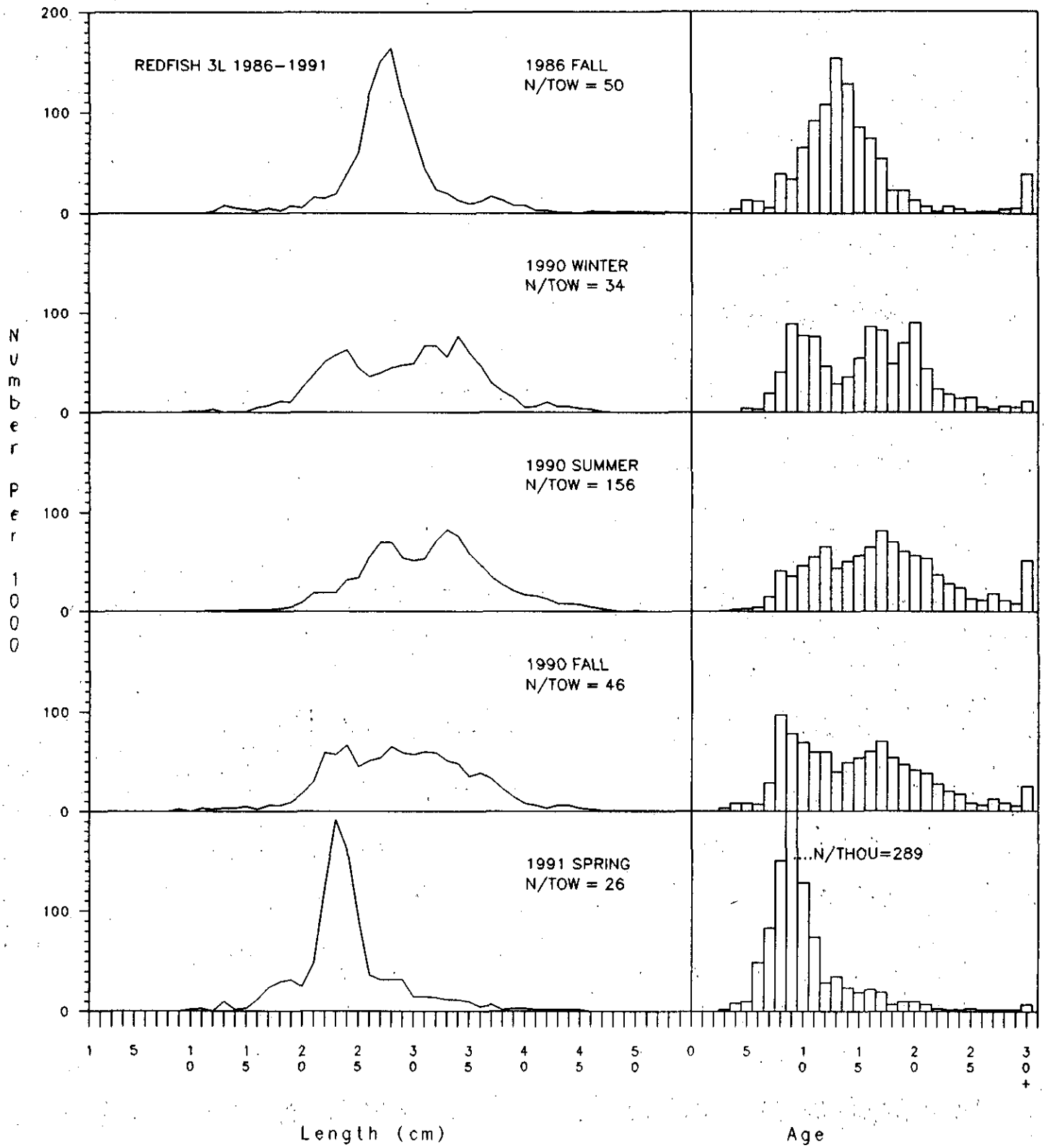

Figure 15. Length frequencies and corresponding age distribution from various stratified random research surveys where strata greater than 366 m (200 fathoms) were sampled in Div. 3L from 1986-1991.

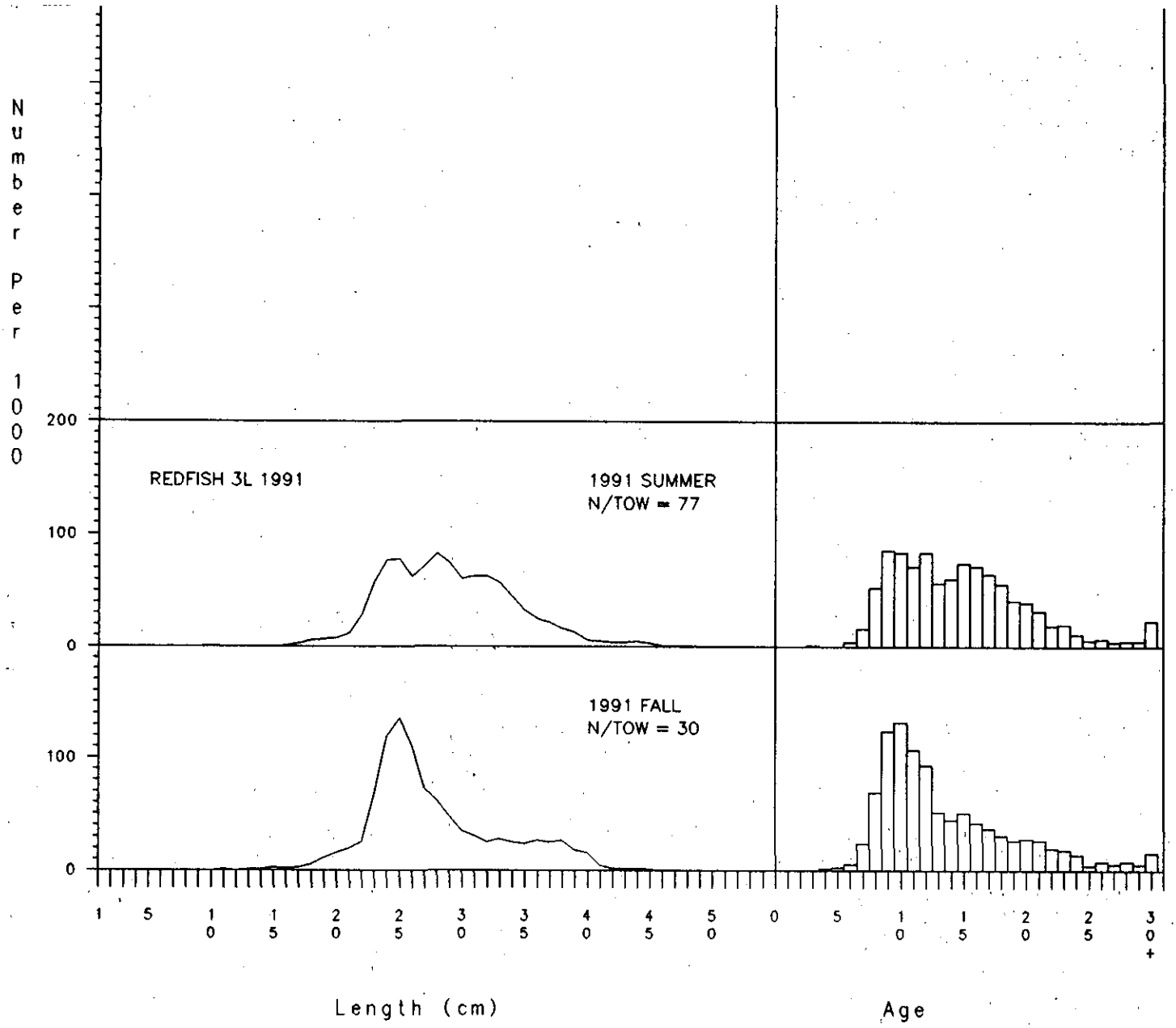

Figure 16. Length frequencies and corresponding age distribution from various stratified random research surveys where strata greater than 366 m (200 fathoms) were sampled in Div. 3L in 1991.

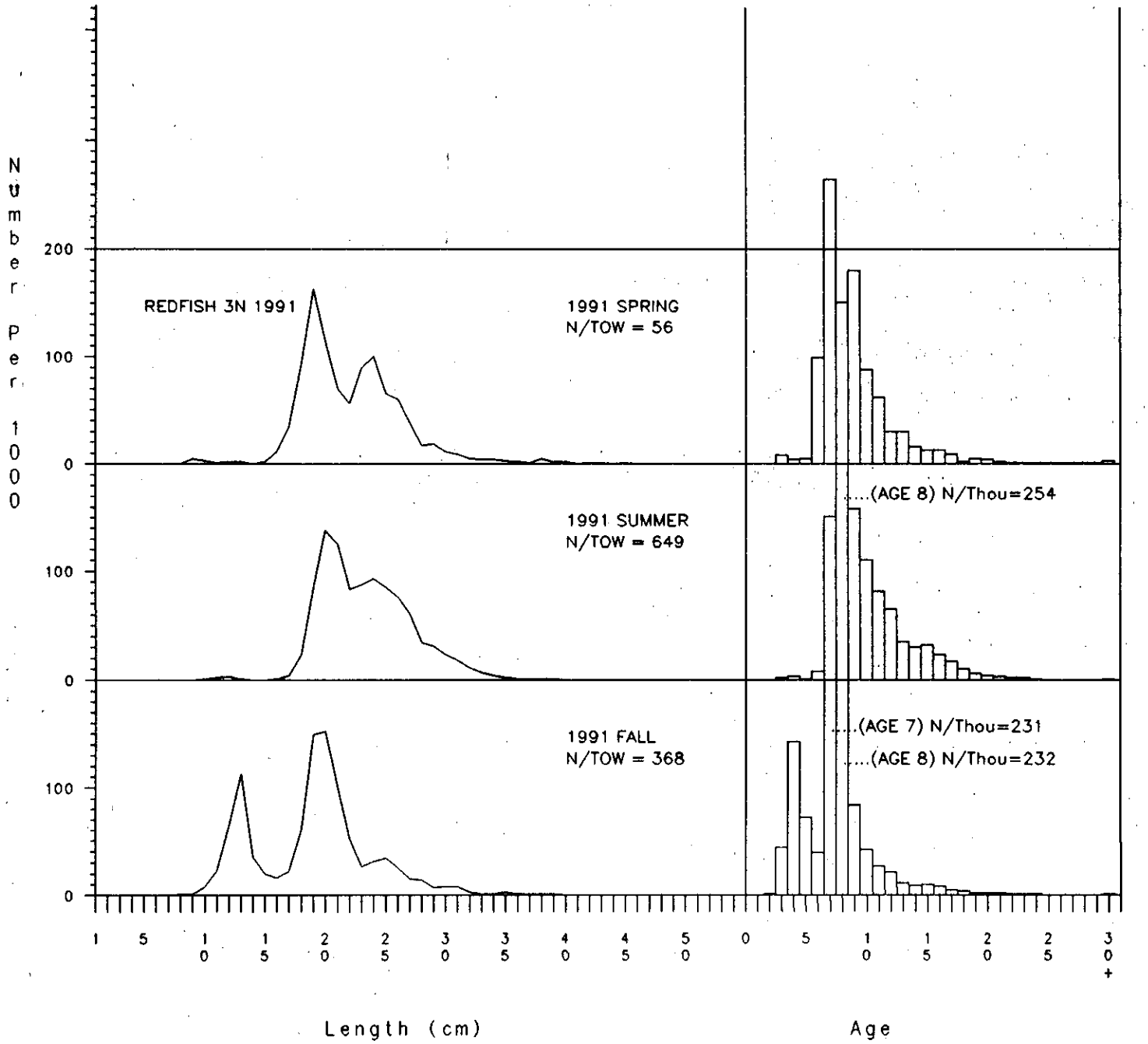

Figure 17. Length frequencies and corresponding age distribution from various stratified random research surveys where strata greater than 366 m (200 fathoms) were sampled in Div. 3N in 1991.