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An Update of Information Pertaining to Northern Shrimp (*Pandalus borealis*) and Groundfish in NAFO Divisions 3LNO

by

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Abstract

This document describes the status of the Div. 3L northern shrimp (*Pandalus borealis*) stock, as well as, the 2000 shrimp fishery upon it. The description of the fishery includes preliminary catch-per-unit-effort (CPUE) and fishing mortality (catch/biomass) estimates. An overview of by-catch of various groundfish in the shrimp fishery is also provided.

Introduction

The 3LNO northern shrimp (*Pandalus borealis*) stock extends beyond Canada's 200 Nmi limit (EEZ), therefore, it is a NAFO regulated stock. The Faroese began fishing shrimp in the NAFO Regulatory Area (NRA) during 1993. Canadian vessels made exploratory fishing trips into Div. 3LNO during 1999. Later during 1999, a 6,000 ton quota was established for 2000 and 2001. Fishing was restricted to Div. 3L, at depths greater than 200 m. Canadian vessels were allowed to catch 5,000 tons inside the EEZ, while a foreign 1,000 ton quota was established in the NRA. The fishery is not only important from an economic standpoint but also because the fishery overlaps the distribution of several groundfish stocks that are presently under moratoria. In order to minimize by-catch, all vessels fishing this stock must utilize a 22 mm Nordmore Grate. Therefore, this paper assesses the status of the stock, as well as the by-catch of groundfish co-inhabiting the area. This work was requested in Annex 1 of the NAFO Scientific Council Document SC-00/26.

Methods and Materials

Data were collected from the following sources:

1) Canadian autumn and spring multi-species research surveys;
2) Observer databases;
3) Logbook databases, and
4) International catch and effort information.

1) Canadian spring and autumn multi-species research surveys:

Shrimp abundance, biomass, maturity and carapace length data have been collected since autumn 1995, as part of the Canadian multi-species surveys conducted using the Canadian Coast Guard vessels Wilfred Templeman, Alfred Needler and Teleost. Fishing sets of 15 minute duration and a towing speed of 3 knots were randomly

allocated to strata covering the Grand Banks and slope waters to a depth of 1 500 m (Fig. 1). All vessels used a Campelen 1800 trawl with a codend mesh size of 44 mm and a 12.7 mm liner. SCANMAR sensors estimated that the mean wingspread was 16.8 m. Details of the survey design and fishing protocols are outlined in Brodie (1996).

Since the spring of 2000, a juvenile shrimp net (Fig. 2) has been sewn into the belly of the Campelen approximately 1 m ahead of the codend. The net was developed by Nilssen *et al*. (1986) but modified to account for the 12.7mm liner material rather than 20mm material. It is hoped that it will provide a recruitment index of 1-group northern shrimp that escape through the mesh ahead of the codend.

Shrimp were frozen and returned to the Northwest Atlantic Fisheries Centre where identification to species and maturity stage (McCrary, 1971) was made, oblique carapace lengths (0.1 mm) were taken, and number and weight per set were estimated. Stratified abundance and biomass indices were estimated *via* areal expansion using programs based upon Cochran (1997) and written in SAS (D. Orr unpublished). Inshore strata were not sampled during 1999 and the waters deeper than 700 m were not consistently sampled throughout the history of this survey. Therefore, the analysis was restricted to data collected from strata <784 and depths shallower than 700 m.

Both annual (A) and instantaneous total mortality (Z) rates were determined using abundance at maturity stage data. The life cycle of the shrimp was defined by three stages:

males;
transitionals which includes transitionals and primiparous individuals;
and multiparous females.

For the purposes of this study, annual mortality was defined as the difference in abundance between the total number of transitional and multiparous individuals in one year and the number of multiparous individuals in the succeeding year. Multiparous females are most easily distinguished from primiparous females during the spring, therefore, mortality rate was only determined for the period between spring 1999 and spring 2000.

The following female shrimp length weight relationships were used in determining the spawning stock biomass:

Fall	$Wt. = 0.000838Lt^{2.929}$	
Spring	$Wt. = 0.001245Lt^{2.778}$	(Skúladóttir, 1997)

Mix version 3.1A (MacDonald and Green, 1988) was used in determining the proportions at age. Proportions at age were used in conjunction with catch at age to determine age specific exploitation rates.

The distributions of adult and juvenile Atlantic cod (*Gadus morhua*), American plaice (*Hippoglossoides platessoides*), Greenland halibut (*Rheinhardtius hippoglossoides*) and redfish (*Sebastes mentella*) were plotted to learn the degree of overlap with the fishery. The term juvenile refers to the modal length of a species (LC_{50}) passing through a 22 mm Nordmore Grate. The modal lengths were determined from the Observer database (Fig. 3.) as well as from the literature. The respective LC_{50} values for Atlantic cod, Greenland halibut, redfish and American plaice were: 19 cm (this study and Hickey *et al* 1993), 24 cm (Nicolajsen, 1997), 14-18 cm (Hickey *et al*.1993, Kulka and Power, 1996, Kulka, 1998, Nicolajsen, 1997 and Skúladóttir, 1997) and 23 cm (this study).

The various distributions were compared with shrimp distributions to determine degrees of overlap.

2) Observer database:

Approximately 12 large (>500 ton) vessels fish shrimp within Davis Strait, along the coast of Labrador and off the east coast of Newfoundland. About 300 smaller vessels (™ 500 t; ™ 65 ft) fish off southern Labrador and the east coast of Newfoundland. There is 100% mandatory Observer coverage of the offshore fleet, but only 10% coverage of the inshore fleet.

Observers working on large vessels collect detailed maturity stage (McCrary, 1971) length frequency information from at least one set for each fishing day. Those working on smaller vessels collect ovigerous/non-ovigerous length frequencies from at least one set for each fishing day and only one detailed maturity stage length

frequency per trip. Observers on both types of vessels record: shrimp catches, effort, amount of discarding, approximate amounts of by-catch on a species by species basis and randomly collect length frequencies of by-caught species. Length frequencies are collected for all by-caught Atlantic cod.

At the time of writing this report, Observer data were only available from large vessels reporting to Newfoundland, Gulf and Laurentian Regions and a small number of smaller vessels.

The Observer database was used to determine the catch per unit effort (CPUE) of the large boat fleet, catch at size and maturity, the LC_{50} values for various groundfish and the by-catch of various groundfish species.

3) Logbook database:

Captains of all shrimp fishing vessels must record fishing location, date, catch, amounts of discarding, hours fished and species specific amounts of by-catch.

When this report was being written, only the logbooks for the Div. 3L small shrimp fishing vessels had been completely keypunched and were ready for analysis.

This data source provided information used to determine the CPUE of the small boat fleet. There were varying levels of experience among the small boat fleet therefore the CPUE was developed for an index group of fishermen. The index group were those that had been fishing shrimp during each of the past 3 years.

Both the observer and logbook data sets complement the research trawl survey data sets. Research data are collected during the spring and autumn using stratified random set allocations that cover the Labrador Shelf and offshore areas of the Grand Banks. Conversely, the observer and logbook data sets are representative of the commercial fishery. They focus upon fishing areas and cover a much broader seasonal scale than the research data. All three were used in determining the relative exploitation level (catch/biomass), which is a proxy for fishing mortality, and the impact of shrimp fishing upon groundfish.

4) International catch and effort information:

These data were made available by Contracting Parties that fish the 3L shrimp stock, and provide estimates of shrimp removal. Where possible they also provide CPUEs that may be compared with Canadian estimates.

Results and Discussion

The Fishery

Population at length estimates by maturity stage are presented in Tables 1-3 and Fig 4. Between 4 and 6 cohorts can be identified from samples collected in each survey. The first cohort was always 1year old at the time of sampling. The last cohort was always a + group.

Figure 5 is a comparison between the raw research trawl length frequencies and length frequencies from the juvenile shrimp net. This figure indicates that during spring, the research trawl provided a representative sample of shrimp size frequencies, but the fact that small shrimp were found in the juvenile net means that there was escapement. The juvenile net length frequencies correspond to sizes from the first three cohorts. Thus abundances of the first three cohorts are underestimated. The young of the year had not settled and therefore were not available to either the Campelen or the juvenile net. This figure also indicates that there is probably very little escapement of shrimp with carapace lengths > 18.0 mm.

The annual and instantaneous total mortality was determined as follows:

N_0 = Abundance of transitionals + multiparous females during the 1999 spring survey
= 2,339,315,000 + 641,798,000
= 2,981,113,000

N_1 = Abundance of multiparous females surviving until the 2000 spring survey
= 2,654,824,000

S = survival rate

$S = N_1/N_0$

S = 2,654,824,000/2,981,113,000
= 0.891

A = annual mortality
= 1-S
= 0.109

Z = instantaneous mortality rate
$Z = -\log_e(S)$

Z = .115

It is difficult to interpret these values because they were derived over just one year. More meaningful values will be obtained in the future as averages of values over several years. Through cohort analysis, Rätz and Skúladóttir (2000) estimated that shrimp within NAFO Div. 3M had an instantaneous mortality of 0.55.

As indicated in the following table, the fishery is exploited between the spring and early fall.

Country	Year	Month	Catch (tons)	Effort (hrs.)	CPUE (kg/hr)	Comments (Source)
Faroe Island	1993		1789			(Nicolajsen, 1999a)
	1994	-	356	-	-	(Nicolajsen, 1999a)
	1995	-	0	-	-	(Nicolajsen, 1999a)
	1996	-	79	-	-	(Nicolajsen, 1999a)
	1997	-	485	-	-	(Nicolajsen, 1999a)
	1998	-	515	-	-	(Nicolajsen, 1999a)
	1999	-	700	-	-	(Nicolajsen, 1999a), twin trawl
	2000	-	39	-	-	(Nicolajsen, 1999a)
Canada	1999	July	9.0	-	-	2 small vessels (Dept. Fish. & Agricult.,Nfld.)
	1999	Aug.	33.0	173	191	2 trips on a large vessel (DFO)
Spain	1999		85.0	-	-	Junquera (pers. comm.)
Canada	2000	April – June	246.6	334.3	737.85	Large vessels, single trawl (DFO)
	2000	April – June	270.4	236.4	1,143.8	Large vessels, double trawl (DFO)
	2000	-	58.0	-	-	Large vessels from Gulf Region (DFO-Canada Atlantic Quota Report)
	2000	-	349.0	-	-	Large vessels from Scotia Fundy Region (DFO – Canada Atlantic Quota Report)
	2000	April – Aug.	1,679.0	4,825.7	347.37	Index small vessel (DFO)
	2000	April – Aug.	3030.0	8,494.6	356.76	All small vessel (DFO)
	2000	-	29.0	-	-	DFO – Canada Atlantic Quota Report
Greenland	2000	April	6.0	3.0	2000	Siegstad (2000), twin trawl
	2000	July	28.0	27.0	1037	Siegstad (2000), twin trawl
Iceland	2000	April	6.7	15.0	460.4	Skúladóttir (pers. comm.)
	2000	Sept.	22.2	19	1184.7	Skúladóttir (pers. comm.)
Russia	2000	July	67.0	-	-	Bereboim (pers. comm.)

* The 2000 index inshore vessel statistics are a subset of the all inshore vessel statistics.

Ratios of 1996 – 1999 Faroese catches/autumn Canadian research survey biomass estimates are 0.004, 0.01, 0.01 and 0.01 respectively. The ratios of 1999-2000 catches / spring Canadian research survey biomass estimates are 0.001 and 0.033 respectively. These ratios of catch to survey biomass estimates indicate that exploitation has been low.

During 2000, catch rates for both index and all small vessel shrimp fisherpersons were similar. Fig. 6, indicates that the inshore fleet worked along the edge of 3L but concentrated much of its fishing effort just inside the NRA.

The large vessel foreign and Canadian fleets experienced catch rates that varied between 460.4 and 2000 kg/hr. As indicated in Fig 7 the Canadian large boat fleet expended much of its effort in the north of the Grand Banks and to a lesser spur of the Grand Banks.

Figure 8 indicates length frequencies obtained from the commercial catch. The top panel was produced from small vessel data. Only 2 length frequencies were obtained from this fishery. The second panel was created using 90 length frequencies from the large vessels. The length frequencies within each panel were increased to their respective landings. The third is a composite created by combining frequencies from the 2 fleets. As indicated by the lower panel, 6 cohorts could easily be identified.

Table 5 indicates the demographic breakdown of the shrimp that were removed by the Canadian fishing fleets. The autumn 1999 abundances by cohort as indicated in Table 4 were used as the pre-fishing cohort sizes. By dividing the commercial removals by the research abundance estimates it was possible to determine the following exploitation rates:

Cohort	Autumn 1999 Demographics	2000 commercial removals	exploitation rate
males			
1998	462,706,000	31,441,191	0.068
1997	6,004,030,000	60,095,861	0.010
1996	403,500,000	123,916,252	0.307
1995	3,553,427,00059,622,730	0.168	
transitionals	1,608,499,000	147,649,960	0.092
multiparous females	1,031,070,000	150,399,726	0.146
total	13,063,233,000	573,125,720	0.044

Since the juvenile shrimp net indicated that there is escapement from the Campelen, the above exploitation rates are maximum theoretical values. Multiparous females were exploited at a rate of 14.6%. Transitionals were fished at a rate below 10% as were the 1997 and 1998 male cohorts. The 1996 cohort of males was fished at a rate just below 31% while the 1996 cohort was fished at a rate of 17%.

Data were not available to determine non-Canadian age specific exploitation rates.

Distribution of Shrimp

Tables 699, Fig. 9 and 10 indicate abundances and biomasses of shrimp as determined from autumn and spring collections that taken between autumn 1995 and spring 2000. The autumn 1995 – spring 2000 Canadian research shrimp biomass estimates were 5 921, 20 089, 46 202, 59 913, 55 317, 53 144 and 121 815 tons, respectively (Table 6, Fig. 10). These biomass estimates are lower than those tabled in NAFO SCR Doc. 99/102 because that paper made use of all of the data, whereas, estimates within this paper do not include data from the inshore, or the strata deeper than 700 m, as indicated in the methods. The biomass increased dramatically between 1995 and 1998 then remained stable until spring 2000, at which time, the abundance and biomass of northern shrimp more than doubled. However, these increases were due to 2 >500 kg./15 min tow outliers in the spring survey. This was the only instance in which there were negative lower confidence limits around the Div. 3L abundance and biomass estimates confirming that one should have very little confidence in the spring 2000 estimates.

At least 90% of the biomass was found within Div. 3L. Between 11 and 30% of the Div. 3L biomass was in the NRA. Division 3N accounted for less than 10% of the biomass. More than 82% of the Div. 3N biomass was in the NRA. Division 3O accounted for less than 1% of the 3LNO biomass. The NRA contributed between 2-33 % to the Div. 3O biomass (Table 6, Fig 10).

In all years more than 95% of the Div. 3L biomass occurred within the 184-549 m depth range.

The trends are not clear within Div. 3N and 3O (Tables 8 and 9). In both Div. 3N and 3O the confidence intervals are broad reflecting high variances. This is confirmed by Fig. 9 which indicates that a few large and several small catches were taken within Div. 3N and 3O. In both cases, the large catches occurred along the edge of the Grand Banks. In Division 3N, over 80% of the abundance and 60% of the biomass occurred within the 184-549 m depth range. In Division 3O waters shallower than 184 m were often more productive than the 184-549 m depth range.

There are only two spring surveys, therefore there is not enough information to allow a discussion of seasonal distribution patterns.

Northern shrimp recruitment and spawning stock biomasses

Two year old and 3 year old male abundances were plotted in a time series (Fig. 11). As one would expect, the general trends followed in the 2 year old abundances are followed by the 3 year old shrimp with a one year lag. Therefore, it may be possible to use this internal consistency to predict peaks and troughs in older age groups.

The 2 year old, 3 year old male abundance and spawning stock biomass indices were low in 1995. The 1994 year-class was recruited to the research trawl, during 1996, as 2-year-old shrimp. The index of 3-year-old males abundance and spawning stock biomass indices peaked during 1998. The 1996 year-class was weak resulting in the low abundance of 2 year olds during 1998. This trough was followed during spring and autumn of 1999 by troughs in the 3 year old and spawning stock biomasses. The 1997 year-class was strong resulting in a peak among 2 year olds during 1999. The 1997 year-class was the driving force creating peaks within the 3 year old and female shrimp during the spring of 2000. Nicolajsen (1999b) indicates that there are peaks in Div. 3M spawning stock biomass during 1997 and later during 2000.

A longer time series is necessary to determine the utility of the 2-year-old abundance index as a recruitment index.

By-catch

Unfortunately, no information pertaining to by-catch was available from the international fleets, therefore, the following information was compiled using Canadian research and Observer database information.

Based upon a sample of 62 tons of shrimp the following table indicates the portion of by-catch per ton of shrimp.

Species	By-catch (kg/ton)
Atlantic cod	0.6
American plaice	3.9
Redfish	3.0
Greenland halibut	7.6

Atlantic cod

Relatively few juvenile cod (<19 cm total length) have been caught throughout the mid-1990s to spring 2000, although, cod were consistently found in the lower half of Div. 3L and throughout Div. 3N and 3O (Fig. 12 and Orr *et al*., 1999). It is noteworthy that figure 12 indicates an overlap in the distribution between cod and a part of the northern shrimp stock that is being exploited by the Canadian shrimp fishing fleet (figures 6 and 7). Seventy-eight Atlantic cod, weighing a total of 40 kg were taken as by-catch according to the Observer database. Figure 3 indicates the length frequencies of these fish.

American plaice

Figure 13 indicates that juvenile American plaice (<=23 cm) are dispersed over the Grand Banks but don't consistently overlap with northern shrimp distributions along the edge of Div. 3L. Two hundred and forty five kg.

of American plaice were recorded in the Observer database. An American plaice length frequency compiled from two offshore trawler sets is provided in Fig. 3.

Redfish

Figure 14 illustrates that juvenile redfish (<=16 cm) and shrimp share similar habitats. Both are commonly found along the edge of the Grand Banks in water between 200 and 500 m. The largest abundances of juvenile redfish were found in Div. 3O. However, the most important feature of this figure is that it indicates a general decline in abundances of juvenile redfish throughout the entire study area. Power and Maddock Parsons (1999) confirms that there has been a general decline in redfish population densities over the last 20 years. They indicate that a recovery of the resource is not anticipated in the near future.

A total of 189 kg. of redfish was captured by the Canadian shrimp fishing fleets.

Greenland halibut

Figure 15 indicates that large concentrations of juvenile Greenland halibut (<24 cm) are sympatric with large concentrations of shrimp. Four hundred and seventy kg. of Greenland halibut were taken by the Canadian shrimp fishery. The Observer database indicated that the inshore fleets had a by-catch of 57 kg. No measurements were taken of the inshore by-catch. There is 10% coverage of the inshore fleet therefore, one may assume that the inshore fleet had a Greenland halibut by-catch of 570 kg. The Canadian offshore shrimp fishing fleet took 413 kg of Greenland halibut.

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Table 1. Abundance (000's) of male northern shrimp (*Pandalus borealis*) collected in NAFO Div. 3LNO during autumn and spring Canadian Research surveys throughout 1995 - 2000. The data were taken from strata <784 and depths <700 m so that all years would be Comparable.

Length in mm	Autumn 1995 WT 176 - 179, WT 181, Tel 22 & Tel 23	Autumn 1996 WT 196 - 198, WT 200, AN 253, Tel 41 & 42	Autumn 1997 WT 212 - 217, Tel 57 7 58	Autumn 1998 WT 229 - 233, Tel 75 7 76	Spring 1999 WT 238 - 241	Autumn 1999 WT 244 - 248	Spring 2000 WT 315 - 318
5.5	0	0	855	0	0	0	0
6.0	0	0	0	0	0	0	0
6.5	0	111	0	0	703	0	0
7.0	382	55	0	47	11,099	1,276	14,387
7.5	4,492	548	3,341	71	4,728	4,290	46,869
8.0	270	2,178	1,542	804	22,011	5,582	95,301
8.5	4,848	6,509	6,875	60,601	26,890	20,487	135,840
9.0	27,395	9,910	21,185	162,470	15,859	15,644	74,180
9.5	62,014	31,303	62,256	329,427	28,213	30,214	39,831
10.0	134,066	36,438	68,030	640,705	14,552	65,922	34,300
10.5	165,074	27,124	104,909	803,347	15,717	78,823	60,587
11.0	204,882	28,566	97,314	688,029	25,250	76,732	50,993
11.5	125,333	47,621	71,023	467,599	30,249	75,651	169,630
12.0	75,757	76,101	40,746	172,256	49,764	34,346	274,247
12.5	33,682	86,904	34,673	121,814	136,117	48,364	455,568
13.0	22,484	99,708	27,764	63,981	268,223	71,854	891,854
13.5	24,914	127,367	38,460	92,604	705,115	134,311	994,659
14.0	20,856	235,167	77,113	135,430	804,177	242,200	1,028,440
14.5	16,247	368,703	191,153	270,428	841,026	396,076	716,927
15.0	23,272	619,513	403,670	443,520	741,576	780,197	742,644
15.5	32,890	727,877	633,475	471,543	435,282	1,222,507	614,294
16.0	44,575	652,349	743,964	459,915	193,005	1,326,686	613,210
16.5	38,401	445,760	496,225	415,527	121,782	966,914	771,835
17.0	41,682	280,750	472,840	436,950	283,637	492,181	1,358,786
17.5	29,305	184,004	476,973	579,364	339,923	306,399	1,647,536
18.0	16,164	210,944	576,167	842,287	518,383	346,026	1,633,388
18.5	12,839	212,870	790,144	997,213	479,339	468,133	1,241,221
19.0	21,104	256,541	720,103	1,060,990	490,357	485,986	617,208
19.5	16,056	251,255	656,060	975,338	593,725	490,523	687,161
20.0	16,756	150,181	380,955	875,327	742,174	519,131	435,102
20.5	13,294	80,541	255,787	733,205	690,630	512,787	547,918
21.0	10,476	77,822	116,219	500,967	484,495	493,872	409,895
21.5	8,238	38,332	62,912	345,670	413,102	331,419	247,461
22.0	4,862	33,114	15,121	130,505	115,645	193,324	179,686
22.5	2,547	26,946	8,466	27,672	54,782	120,117	116,076
23.0	1,248	17,019	576	15,252	23,786	34,878	13,182
23.5	248	10,842	416	1,236	6,794	25,468	8,366
24.0	104	3,428	69	23	1,089	3,528	189
24.5	54	1,427	0	0	0	1,820	0
25.0	54	0	0	0	0	0	0
Total (000's)	1,256,864	5,465,828	7,657,380	13,322,117	9,729,198	10,423,664	16,968,771
upper 95% limit	2,386,779	9,122,011	10,393,895	17,507,281	18,085,244	13,237,807	36,240,923
lower 95% limit	126,949	1,809,644	4,920,865	9,136,953	1,373,152	7,609,522	-2,303,381

Table 2. Abundance (000's) of transitional northern shrimp (*Pandalus borealis*) collected in NAFO Div. 3LNO during autumn and spring Canadian research surveys throughout 1995 - 2000. The data were taken from strata <784 and depths <700 m so that All years would be compatible.

Length in mm	Autumn 1995 WT 176 - 179, WT 181, Tel 22 & Tel 23	Autumn 1996 WT 196 - 198, WT 200, AN 253, Tel 41 & 42	Autumn 1997 WT 212 - 217, Tel 57 7 58	Autumn 1998 WT 229 - 233, Tel 75 7 76	Spring 1999 WT 238 - 241	Autumn 1999 WT 244 - 248	Spring 2000 WT 315 - 318
12.5	959	0	0	0	0	638	0
13	0	0	0	0	0	0	0
13.5	3,989	0	0	0	0	0	0
14	15,348	0	0	0	0	0	0
14.5	9,708	0	0	0	0	0	0
15	48,864	0	0	0	0	0	0
15.5	126,767	0	0	0	0	0	0
16	116,811	0	245	0	0	0	0
16.5	92,772	2,574	71	0	0	0	0
17	63,648	58	4,611	0	0	0	0
17.5	43,865	5,883	593	47	156	0	3,153
18	16,738	3,738	13,738	0	2,752	0	5,615
18.5	13,954	7,247	32,009	9,680	4	184	13,755
19	16,792	13,926	68,940	9,390	6,041	3,945	11
19.5	18,622	22,211	193,204	47,758	2,314	16,718	15,948
20	19,354	30,842	221,376	55,099	21,171	35,375	60,712
20.5	17,089	26,876	382,406	86,637	13,436	70,631	117,600
21	16,499	9,931	407,291	104,502	48,071	139,780	254,028
21.5	20,577	19,652	360,757	79,428	96,358	267,540	328,120
22	22,242	6,808	201,701	45,695	182,755	374,626	601,082
22.5	17,315	8,842	107,364	20,662	390,113	317,088	636,319
23	13,263	430	55,497	4,126	498,405	211,040	811,106
23.5	8,503	41	25,610	0	403,950	87,859	861,544
24	2,988	42	6,821	0	349,581	46,931	843,773
24.5	3,041	16	4,102	11	186,312	44,066	376,890
25	432	7	40	0	89,024	3,151	246,273
25.5	129	0	23	0	39,463	0	147,609
26	10	0	0	0	7,782	0	44,764
26.5	0	0	0	0	1,582	0	19,820
27	10	0	0	0	46	0	1,121
27.5	60	0	0	0	0	0	230
Total (000's)	730,345	159,123	2,086,397	463,035	2,339,315	1,619,572	5,389,472
upper 95% limit	1,088,041	434,880	3,539,696	651,862	4,226,487	2,170,017	11,814,756
lower 95% limit	372,650	-116,634	633,098	274,208	452,142	1,069,127	-1,035,812

Table 3. Aundance (000's) at length of female northern shrimp (*Pandalus borealis*) collected in NAFO Div. 3LNO during Autumn and spring Canadian research surveys throughout 1995 - 2000. The data were taken from strata <784 and Depths <700 m so that all years would be compatible.

Length in mm	Autumn 1995 WT 176 - 179, WT 181, Tel 22 & Tel 23	Autumn 1996 WT 196 - 198, WT 200, AN 253, Tel 41 & 42	Autumn 1997 WT 212 - 217, Tel 57 7 58	Autumn 1998 WT 229 - 233, Tel 75 7 76	Spring 1999 WT 238 - 241	Autumn 1999 WT 244 - 248	Spring 2000 WT 315 - 318
11.5	0	58	0	0	0	0	0
12	0	0	0	0	0	0	0
12.5	0	58	0	0	0	0	0
13	0	0	0	0	0	0	0
13.5	0	0	0	0	0	1,792	0
14	0	0	523	0	0	0	0
14.5	0	289	0	0	0	0	0
15	755	457	0	0	0	0	3,153
15.5	0	58	0	406	0	0	0
16	0	231	3,135	4,834	0	0	0
16.5	0	231	1,305	4,760	0	3,918	0
17	0	0	1,317	7,548	257	8,841	0
17.5	0	1,662	2,673	6,860	4,309	7,583	22
18	298	284	1,370	9,586	6,357	7,744	24,194
18.5	0	1,023	3,401	1,833	6,452	6,374	19,307
19	724	6,087	3,195	1,069	10,509	14,008	18,883
19.5	506	6	4,004	5,013	2,204	4,277	14,316
20	438	391	7,986	9,164	2,723	10,157	22,939
20.5	60	847	8,832	24,229	2,296	7,455	36,349
21	746	1,190	21,861	55,240	10,165	17,745	36,223
21.5	2,290	4,362	48,246	115,863	6,067	39,186	152,084
22	2,766	4,119	66,829	186,364	33,072	79,099	217,812
22.5	4,067	14,577	83,857	251,298	42,180	103,443	288,943
23	6,211	24,802	95,612	248,676	61,102	150,063	315,931
23.5	6,281	25,728	99,927	188,663	87,701	149,734	384,238
24	8,159	20,280	78,877	161,696	110,767	153,122	407,007
24.5	12,241	30,367	82,838	98,121	78,498	84,113	317,258
25	8,434	30,943	72,359	66,753	60,844	75,424	160,754
25.5	9,094	23,848	40,667	42,105	60,492	43,163	94,156
26	7,674	17,710	23,790	20,125	23,344	23,975	58,375
26.5	6,583	11,484	5,331	10,911	11,183	11,335	48,109
27	4,562	6,745	5,903	10,571	4,979	7,471	19,528
27.5	2,347	3,847	10,963	3,796	8,045	4,668	5,589
28	2,569	2,376	2,270	5,916	2,968	3,070	3,358
28.5	827	2,815	1,759	1,823	3,230	674	3,077
29	374	2,198	1,650	309	1,148	1,300	2,604
29.5	670	1,635	356	0	581	197	254
30	79	1,227	238	17	327	67	363
30.5	0	0	0	0	0	0	0
Total (000's)	88,755	241,932	781,071	1,543,546	641,799	1,019,997	2,654,824
upper 95% limit	437,927	537,812	1,558,170	2,196,343	894,596	1,526,037	9,122,462
lower 95% limit	-260,416	-53,948	3,971	890,750	389,001	513,957	-3,812,814

Table 4. Portion by which each northern shrimp (*Pandalus borealis*) cohort contributed to the overall abundance estimates within each 3LNO Canadian research survey between autumn 1995 and spring 2000.

Cohort	Autumn 1995 WT 176 - 179, WT 181, Tel 22 & Tel 23	Autumn 1996 WT 196 - 198, WT 200, AN 253, Tel 41 & 42	Autumn 1997 WT 212 - 217, Tel 57 7 58	Autumn 1998 WT 229 - 233, Tel 75 7 76	Spring 1999 WT 238 - 241	Autumn 1999 WT 244 - 248	Spring 2000 WT 315 - 318
	Proportions estimated by Mix 3a						
1999							0.0296
1998					0.01969	0.04439	0.3427
1997				0.25659	0.44761	0.576	0.50239
1996			0.06498	0.169	0.18941	0.03871	0.003032
1995		0.04906	0.37811	0.57441	0.34329	0.3409	0.12216
1994	0.68297	0.68115	0.55691				
1993	0.21037	0.26979					
1992	0.10666						
	Male abundance estimates						
Total (000's)	1,256,864	5,465,828	7,657,380	13,322,117	9,729,198	10,423,664	16,968,771
	Each cohort's contribution to the male abundance estimate						
1999							502,276
1998					191,568	462,706	5,815,198
1997				3,418,322	4,354,886	6,004,030	8,524,941
1996			497,577	2,251,438	1,842,807	403,500	51,449
1995		268,154	2,895,332	7,652,357	3,339,936	3,553,427	2,072,905
1994	858,400	3,723,049	4,264,471				
1993	264,406	1,474,626					
1992	134,057						
	Transitional cohort abundances						
1996							
1995						1,619,572	5,389,472
1994				463,035	2,339,315		
1993			2,086,397				
1992	730,345	159,123					
	Female cohort abundances						
1994						1,019,997	2,654,824
1993				1,543,546	641,798		
1992		241,932	781,071				
1991	88,755						

Table 5. Estimation of cohort specific removals by the Canadian inshore and offshore shrimp fishing fleets.

	Male cohorts	
	Proportions were estimated by Mix 31A	
1998	0.11430	
1997	0.21847	
1996	0.45048	
1995	0.21675	
	Estimated male removals =	275,076,034
	Estimated cohort specific removals	
1998	31,441,191	
1997	60,095,861	
1996	123,916,252	
1995	59,622,730	
	Estimated transitional removals =	147,649,960
	Transitional cohorts	
	Proportions estimated by Mix 31A	
1998	.13754	
1997	.84590	
1996	.01656	
	Estimated cohort specific removals	
1998	20,307,775	
1997	124,897,101	
1996	2,445,083	
	Estimated female removals =	150,399,726
	Proportions estimated by Mix 31A	
1994	.86339	
1993	.13661	
	Estimated cohort specific removals	
1994	129,853,619	
1993	20,546,107	

Table 6. NAFO Div. 3LNO *Pandalus borealis* biomass estimates for entire divisions and outside the 200 Nmi Limit.

	Entire Divisions		Outside 200 Nmi Limit				
Season	Year	Division	Biomass estimate (kg x 1000)	Percent biomass by division	Biomass estimate (kg x 1000)	Percent biomass by division	Percent of biomass
Fall	1995	3L	5,357	90.47	1,039	67.60	19.40
Fall	1996	3L	18,565	92.41	4,506	76.87	24.27
Fall	1997	3L	45,758	99.04	5,114	92.83	11.18
Fall	1998	3L	56,485	94.28	8,707	75.66	15.41
Spring	1999	3L	53,934	97.50	14,731	91.74	27.31
Fall	1999	3L	52,863	99.47	8,734	97.38	16.52
Spring	2000	3L	119,521	98.12	36,128	94.30	30.23
Fall	1995	3N	533	9.00	497	32.34	93.25
Fall	1996	3N	1,514	7.54	1,356	23.13	89.56
Fall	1997	3N	427	0.92	391	7.10	91.57
Fall	1998	3N	3,360	5.61	2,786	24.21	82.92
Spring	1999	3N	1,349	2.44	1,326	8.26	98.30
Fall	1999	3N	272	0.51	232	2.59	85.29
Spring	2000	3N	2,248	1.85	2,178	5.69	96.89
Fall	1995	3O	30	0.51	0.56	0.04	1.87
Fall	1996	3O	9	0.04	1.1	0.02	12.22
Fall	1997	3O	17	0.04	4.02	0.07	23.65
Fall	1998	3O	69	0.12	14.7	0.13	21.30
Spring	1999	3O	34	0.06	0.0	0.0	0.0
Fal	1999	3O	9	0.02	3.0	0.03	33.33
Spring	2000	3O	46	0.04	6.0	0.02	13.04
		All divisions					
Fall	1995		5,921	99.98	1,537	99.97	25.96
Fall	1996		20,089	100.0	5,862	100.0	29.18
Fall	1997		46,202	100.0	5,509	100.0	11.92
Fall	1997		59,913	100.0	11,508	100.0	19.21
Spring	1999		55,317	100.0	16,057	100.0	29.03
Fall	1999		53,144	100.0	8,969	100.0	16.88
Spring	2000		121,815	100.0	38,310	100.0	31.45

Table 7. Abundance (000's) and biomass (Kg 000's) of northern shrimp (*Pandalus borealis*) collected in NAFO Div. 3L during autumn and spring Canadian research surveys throughout 1995 – 2000. The data were taken from strata <784 and in depths <700 so that all years would be comparable.

Depth	Area	Autumn 95		Autumn 96		Autumn 97		Autumn 98		Spring 99		Autumn 99		Spring 2000	
Range in m	in Nmi2	WT 176, 178 179, 181 & Tel 23		WT 196 - 198 Tel 41		WT 213-217 Tel 57 & 58		WT 230 - 233 Tel 75 & 76		WT 240 & 241		WT 246 - 248		WT 317 & 318	
		Abundance (x 1000)	biomass (Kg X 1000)	abundance (x 1000)	biomass (Kg X 1000)	abundance (x 1000)	biomass (Kg X 1000)	abundance (x 1000)	biomass (Kg X 1000)	abundance (x 1000)	biomass (Kg X 1000)	abundance (x 1000)	biomass (Kg X 1000)	abundance (x 1000)	biomass (Kg X 1000)
57 - 92	8,552	0	0	1,591	6	3,558	16	3,273	13	123	1	1,532	5	40	0
93 - 183	17,452	26,803	41	66,329	176	448,482	1,849	485,811	1,237	6,004	29	597,044	1,855	25,633	54
184 - 274	7,006	254,635	787	989,385	3,518	5,284,488	25,015	8,806,344	32,516	3,197,714	13,247	9,312,284	36,423	14,036,717	63,616
275 - 366	3,855	1,659,530	4,374	4,271,393	14,647	4,624,501	18,515	5,186,605	22,691	9,158,773	40,320	3,056,209	14,390	10,359,484	54,779
367 - 549	1,192	12,073	142	80,063	218	50,610	353	5,649	25	27,134	248	32,400	187	110,186	1,023
550 - 731	929	2,577	14	197	1	3,754	16	1,249	5	16,405	91	992	5	5,940	53
Total (X 1000)		1,957,945	5,358	5,346,525	18,565	10,419,693	45,757	14,471,170	56,485	12,405,970	53,934	13,013,407	52,863	24,535,332	119,521
Upper 95% (X1000)		3,335,665	7,397	9,051,655	28,893	14,661,061	66,425	18,820,956	76,064	21,924,774	96,644	16,485,962	69,804	104,192,465	257,005
Lower 95%(X1000)		580,224	3,318	1,641,394	8,238	6,178,325	25,089	10,121,384	36,905	2,887,166	11,223	9,540,852	35,923	-55,121,800	-17,963
%<184m		1	1	1	1	4	4	3	2	0	0	5	4	0	0
%184 - 549 m		98	96	98	98	95	95	97	98	100	99	95	96	99	99
%>549 m		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Outside 200 Nmi Limit															
93 - 183	933	24	0	110	0	18,480	79	6,906	14	491	1	20,967	70	279	1
184 - 274	791	8,806	26	429,678	1,635	290,656	1,246	1,005,018	4,454	1,160,062	6,284	1,346,964	6,486	3,980,018	21,186
275 - 366	758	162,699	997	433,908	2,759	643,252	3,685	558,307	4,222	1,588,698	8,192	306,325	2,079	2,424,460	14,212
367 - 549	636	275	4	7,328	110	11,499	102	3,954	17	19,408	170	13,288	98	73,282	681
550 - 731	629	1,935	12	196.93	1	186	1	10	0	15,374	83	90	1	5,137	48
Total (X 1000)		173,738	1,039	871,221	4,505	964,047	5,114	1,574,195	8,707	2,780,533	14,731	1,691,507	8,734	6,488,871	36,127
Upper 95% (X1000)		440,468	4,853	2,035,525	25,676	2,533,343	13,242	4,705,882	25,437	7,145,264	37,178	3,907,713	19,432	57,253,651	301,999
Lower 95%(X1000)		-92,992	-2,774	-293,012	-1,664	-605,248	-3,013	-1,557,492	-8,022	-1,584,198	-7,717	-524,699	-1,964	-44,275,909	-229,745
%<184m		0	0	0	0	2	2	0	0	0	0	1	1	0	0
%184 - 549 m		99	99	100	100	98	98	100	100	99	99	99	99	100	100
%>549 m		1	1	0	0	0	0	0	0	1	1	0	0	0	0

Table 8. Total abundance (X 1000), biomass (Kg. X1000) of northern shrimp (*Pandalus borealis*) collected during the spring and autumn 1995 - 2000 Canadian Multi-species research surveys into NAFO Div. 3N. (All tows were standardized to 15 minutes . Means depth ranges not sampled). Please note that these estimates were taken from strata numbers >784 and depths <700m so that estimates from all years would be comparable.

Depth	Area	Autumn 95		Autumn 96		Autumn 97		Autumn 98		Spring 99		Autumn 99		Spring 2000	
Range in m	in Nmi2	WT 176, 177		Tel 41, 42 & AN 253		WT 212-214		WT 229, 230, WT 233,, Tel 76		WT 238 - 240		WT 245 - 247		WT 316 & 317	
		abundance (x 1000)	biomass (Kg X 1000)	abundance (x 1000)	biomass (Kg X 1000)	abundance (x 1000)	biomass (Kg X 1000)	abundance (x 1000)	biomass (Kg X 1000)	abundance (x 1000)	biomass (Kg X 1000)	abundance (x 1000)	biomass (Kg X 1000)	abundance (x 1000)	biomass (Kg X 1000)
<=56	3,092	0	0	0	0	63	1	0	0	0	0	175	1	0	0
57 - 92	11,490	7,903	36	3,507	13	1,661	6	2,042	13	804	3	1,291	4	45	0
93 – 183	1,168	0	0	1,107	2	17,302	44	43,866	119	87,864	101	55	1	142	1
184 – 274	546	18,053	45	377,532	776	73,069	318	769,586	3,023	61,322	223	22,871	104	158,291	319
275 – 366	386	191	2	46,636	144	3,689	40	8,846	82	117,656	940	11,758	90	305,982	1,886
367 – 549	420	65,926	450	89,437	578	1,620	17	3,286	25	10,200	74	6,638	61	4,678	40
550 – 731	352	0	0	139	1	172	1	10,473	97	47	0	1,241	12	114	1
Total (X 1000)		92,073	533	518,357	1,514	97,577	427	838,098	3,360	277,892	1,341	44,029	271	469,254	2,248
Upper 95% (X1000)		952,009	6,272	5,139,701	13,314	692,819	2,694	9,394,044	36,474	856,118	11,201	108,302	731	4,430,958	24,096
Lower 95%(X1000)		-767,863	-5,206	-4,102,985	-10,285	-497,665	-1,840	-7,717,847	-29,754	-300,335	-8,518	-20,243	-188	-3,492,449	-19,600
%<184m		9	7	1	1	19	12	5	4	32	8	3	2	0	0
%184 - 549 m		91	93	99	99	80	88	93	93	68	92	94	94	100	100
%>549 m		0	0	0	0	0	0	1	3	0	0	3	4	0	0
							Outside 200 Nmi Limit								
<=56	1,605	0	0	0	0	11	0	0	0	0	0	30	0	0	0
57 - 92	2,996	1,732	7	3,029	11	658	2	20	0	10	0	51	1	0	0
93 – 183	864	0	0	1,107	2	17,235	44	43,866	119	87,864	101	33	0	75	1
184 - 274	508	15,225	38	304,211	626	68,154	292	629,225	2,474	57,859	212	18,870	84	128,087	260
275 - 366	366	191	2	44,894	138	3,143	34	7,560	70	116,431	932	9,764	74	303,944	1,876
367 - 549	420	65,926	450	89,437	578	1,620	17	3,286	25	10,200	74	6,638	61	4,678	40
550 - 731	352	0	0	139	1	172	1	10,473	97	47	0	1,241	12	114	1
Total (X 1000)		83,073	497	442,817	1,356	90,994	391	694,430	2,786	272,410	1,319	36,627	232	436,899	2,178
Upper 95% (X1000)		931,482	6,216	4,176,800	4,875	685,498	2,645	7,507,801	29,156	849,415	11,168	90,987	629	4,236,408	23,915
Lower 95%(X1000)		-765,336	-5,222	-3,291,166	-2,164	-503,510	-1,863	-6,118,942	23,585	-304,594	-8,531	-17,732	-164	-3,362,610	-19,559
%<184m		2	2	1	1	20	12	6	4	32	8	0	0	0	0
%184 - 549 m		98	98	99	99	80	88	92	92	68	92	96	95	100	100
%>549 m		0	0	0	0	0	0	2	3	0	0	3	5	0	0

Table 9. Abundance (000's) and biomass (Kg 000's) of northern shrimp (*Pandalus borealis*) collected in NAFO Div. 3O during autumn and spring Canadian research surveys throughout 1995 – 2000. The data were taken from strata <784 and in depths <700 so that all years would be comparable.

Depth	Area	Autumn 95		Autumn 96		Autumn 97		Autumn 98		Spring 99		Autumn 99		Spring 2000	
Range in m	in Nmi2	WT 176, 177		WT 200, AN 253 & Tel 42		WT 212, 213		WT 229, 230, 233 & Tel 76		WT 238 & 239		WT 244 - 246		WT 315 - 317	
		Abundance (x 1000)	biomass (Kg X 1000)	abundance (x 1000)	biomass (Kg X 1000)	abundance (x 1000)	biomass (Kg X 1000)	abundance (x 1000)	biomass (Kg X 1000)	abundance (x 1000)	biomass (Kg X 1000)	Abundance (x 1000)	Biomass (Kg X 1000)	abundance (x 1000)	biomass (Kg X 1000)
57 - 92	12,541	0	0	675	6	727	4	6,847	19	126	0	1,083	3	0	0
93 - 183	4,775	2,488	10	1,129	2	4,305	9	5,586	14	8,592	12	1,359	3	508	1
184 - 274	371	1,875	20	81	1	705	4	4,626	36	2,528	11	143	1	2,269	7
275 - 366	215	0	0	0	0	27	0	46	1	1,097	8	24	0	3,983	29
367 - 549	318	0	0	16	0	12	0	23	0	298	3	44	1	264	2
550 - 731	332	7	0	6	0	12	0	9	0	0	0	184	2	797	7
Total (X 1000)		4,369	30	1,906	9	5,789	17	17,138	69	12,641	34	2,837	9	7,823	46
Upper 95% (X1000)		28,725	280	14,756	15	38,940	85	26,756	301	35,594	63	5,351	17	61,843	399
Lower 95%(X1000)		-19,986	-219	-10,943	2	-27,362	-52	7,520	-163	-10,311	5	324	1	-46,198	-307
%<184m		57	35	95	89	87	75	73	47	69	37	86	62	6	3
%184 - 549 m		43	67	5	11	13	24	27	52	31	63	7	19	83	83
%>549 m		0	0	0	1	0	1	0	0	0	0	6	20	10	14
							Outside 200 Nmi Limit								
57 - 92	269	0	0	20	0	20	0	458	1	0	0	37	0	0	0
93 - 183	246	34	0	506	1	1,318	3	680	2	0	0	235	1	0	0
184 - 274	74	34	0	10	0	342	1	1,659	11	0	0	81	1	29	0
275 - 366	47	0	0	0	0	0	0	0	0	0	0	18	0	0	0
367 - 549	58	0	0	12	0	0	0	8	0	0	0	18	0	133	1
550 - 731	71	5	0	0	0	9	0	0	0	0	0	141	1	603	5
Total (X 1000)		73	1	548	1	1,688	4	2,806	15	0	0	530	3	764	6
Upper 95% (X1000)		279	5	6,987	11	18,447	36	25,253	162	0	0	4,137	23	8,498	69
Lower 95%(X1000)		-134	-4	-5,891	-8	-15,071	-28	-19,642	-132	0	0	-3,077	-17	-6,970	-58
%<184m		47	30	96	81	79	65	41	22	0	0	51	27	0	0
%184 - 549 m		46	61	4	19	20	32	59	78	0	0	22	29	21	15
%>549 m		7	9	0	0	1	2	0	0	0	0	27	44	79	85

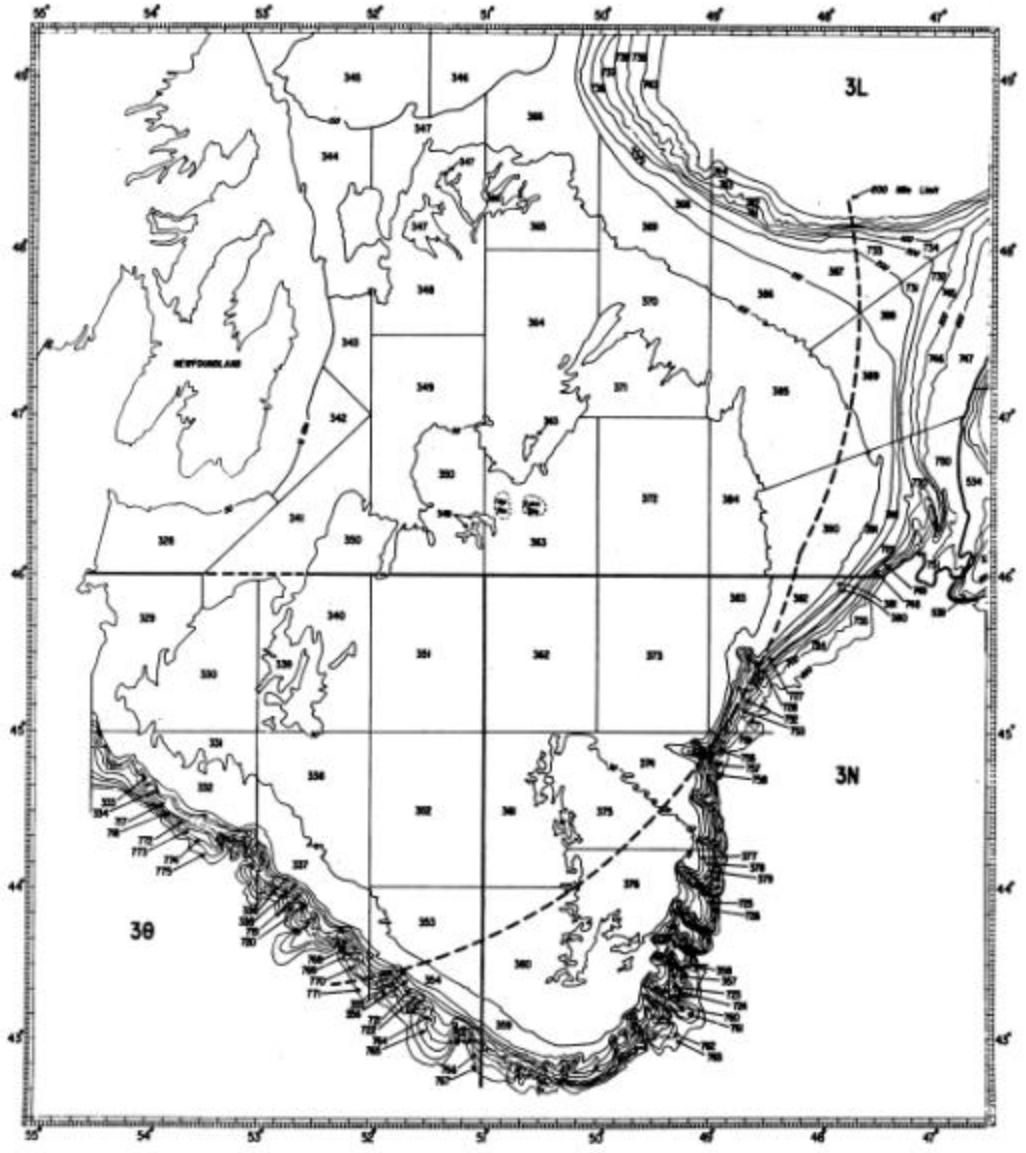
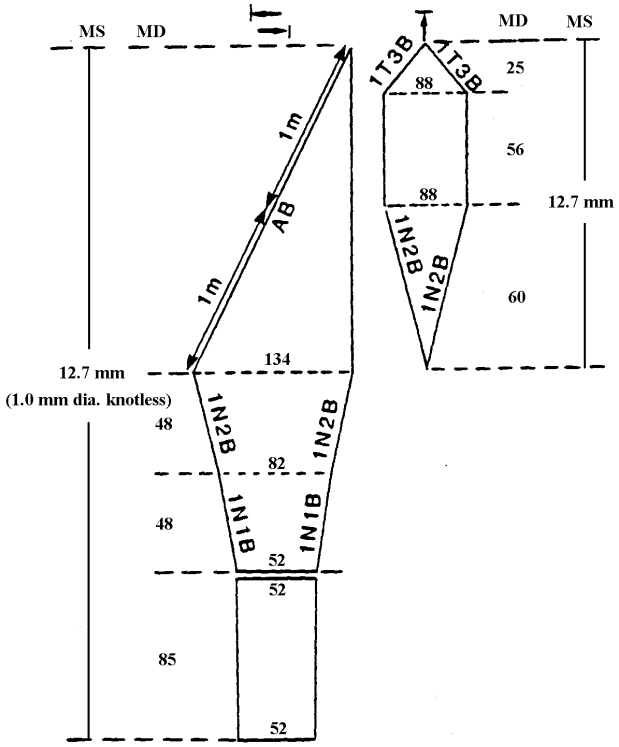
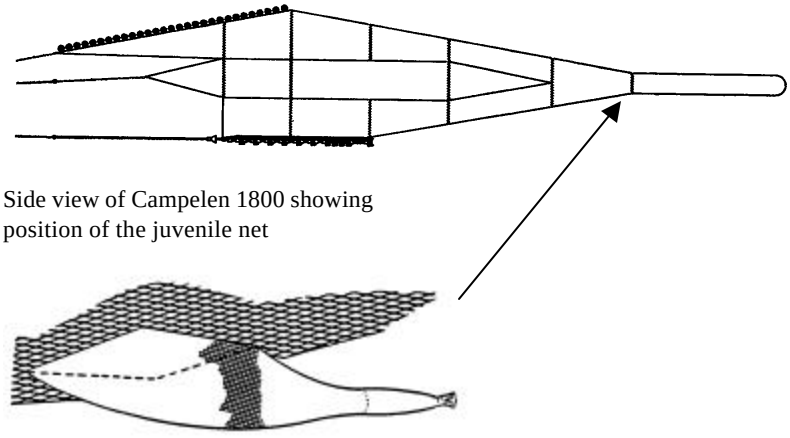


Figure 1. Stratified area for Canadian research trawl surveys in NAFO Div. 3LNO.



juvenile net plan



Side view of Campelen 1800 showing position of the juvenile net

Figure 2. The juvenile shrimp net (modified from Nilssen *et al*. 1986) and it's position approximately 1 m ahead of the Campelen 1800's codend.

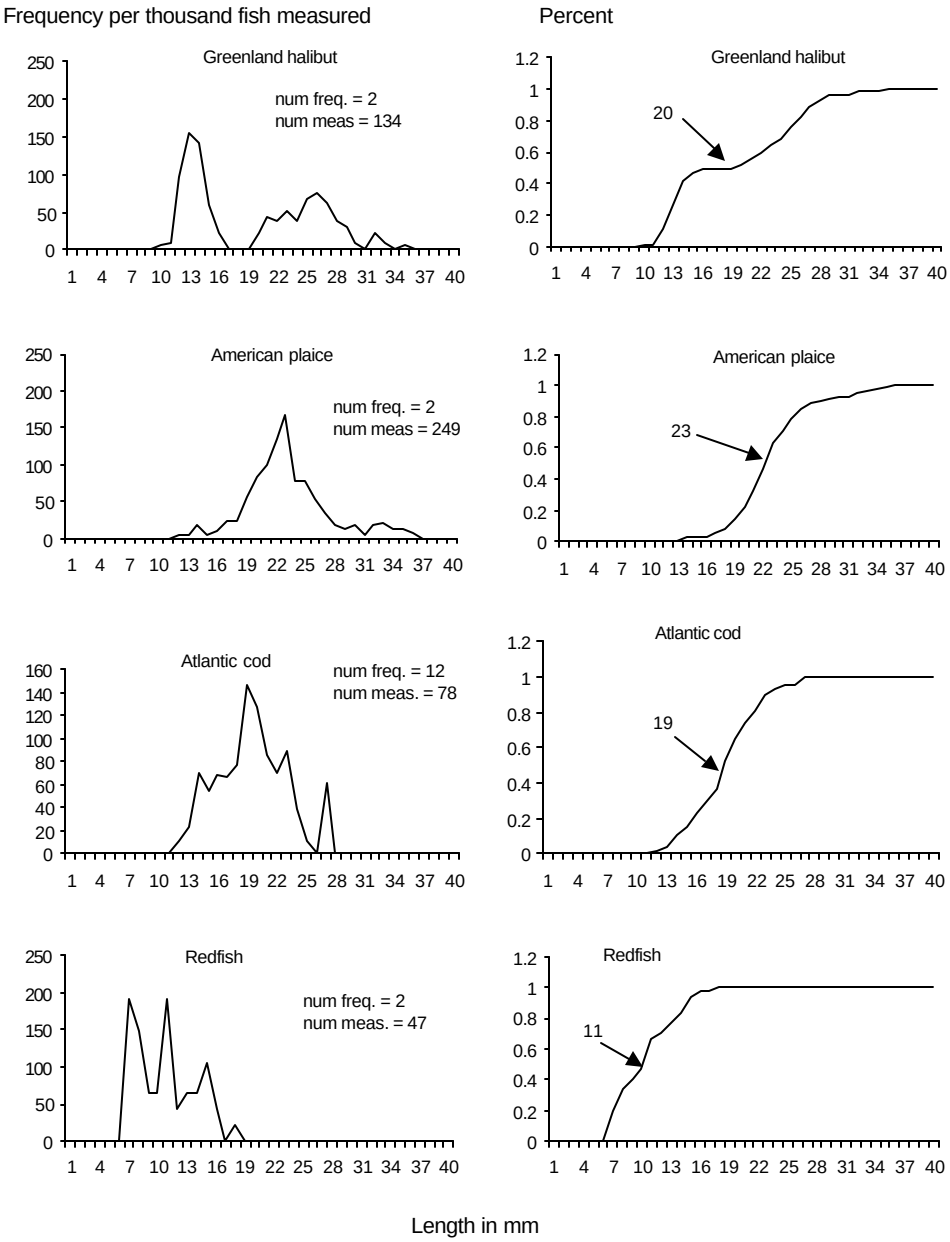


Figure 3. Length frequencies and respective selectivity ogives for various groundfish species that passed through 22 mm Nordmore grates utilized by Offshore vessels fishing shrimp in NAFO Div. 3L during 2000.

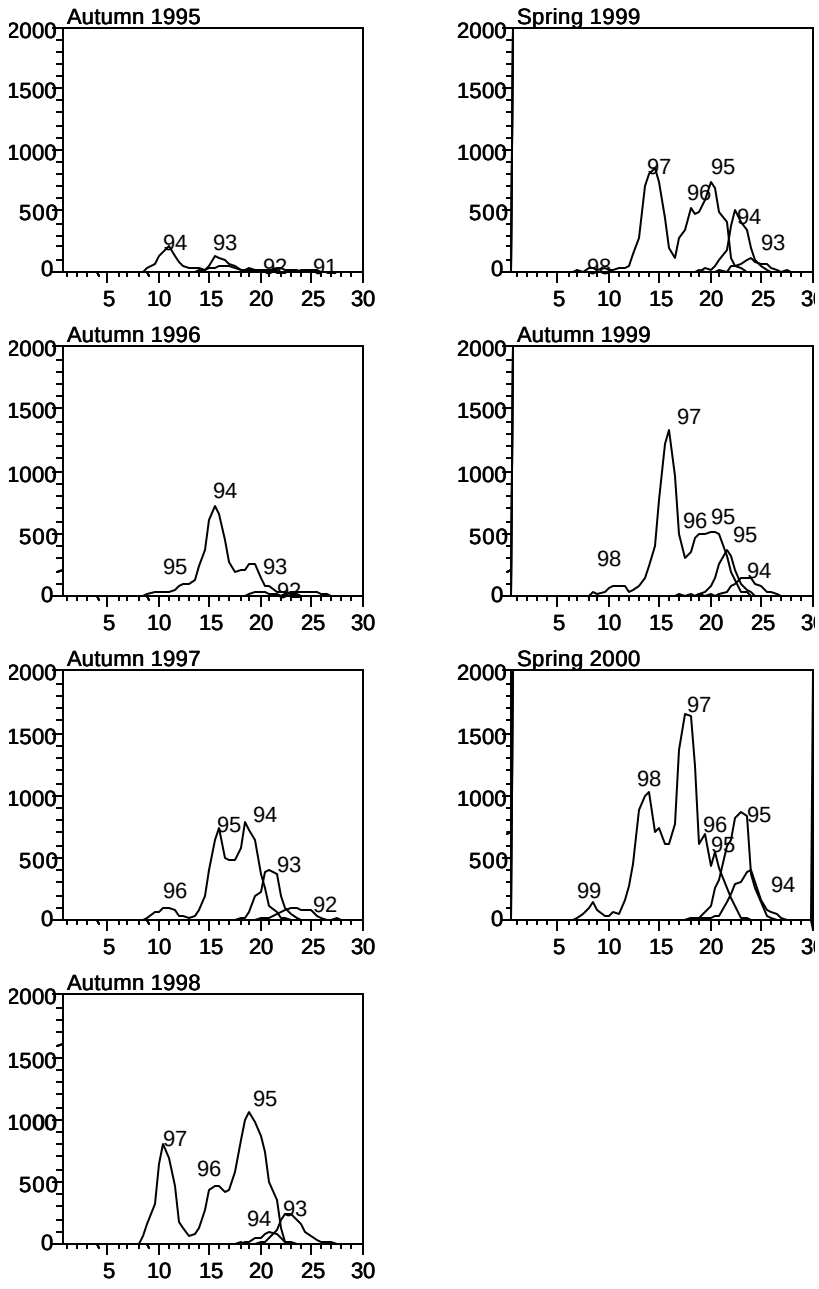


Figure 4. Population estimates (millions) at length of *P. borealis* collected in autumn 1995 to spring 2000 multi-species surveys. (Tows standardized to 15 min.)

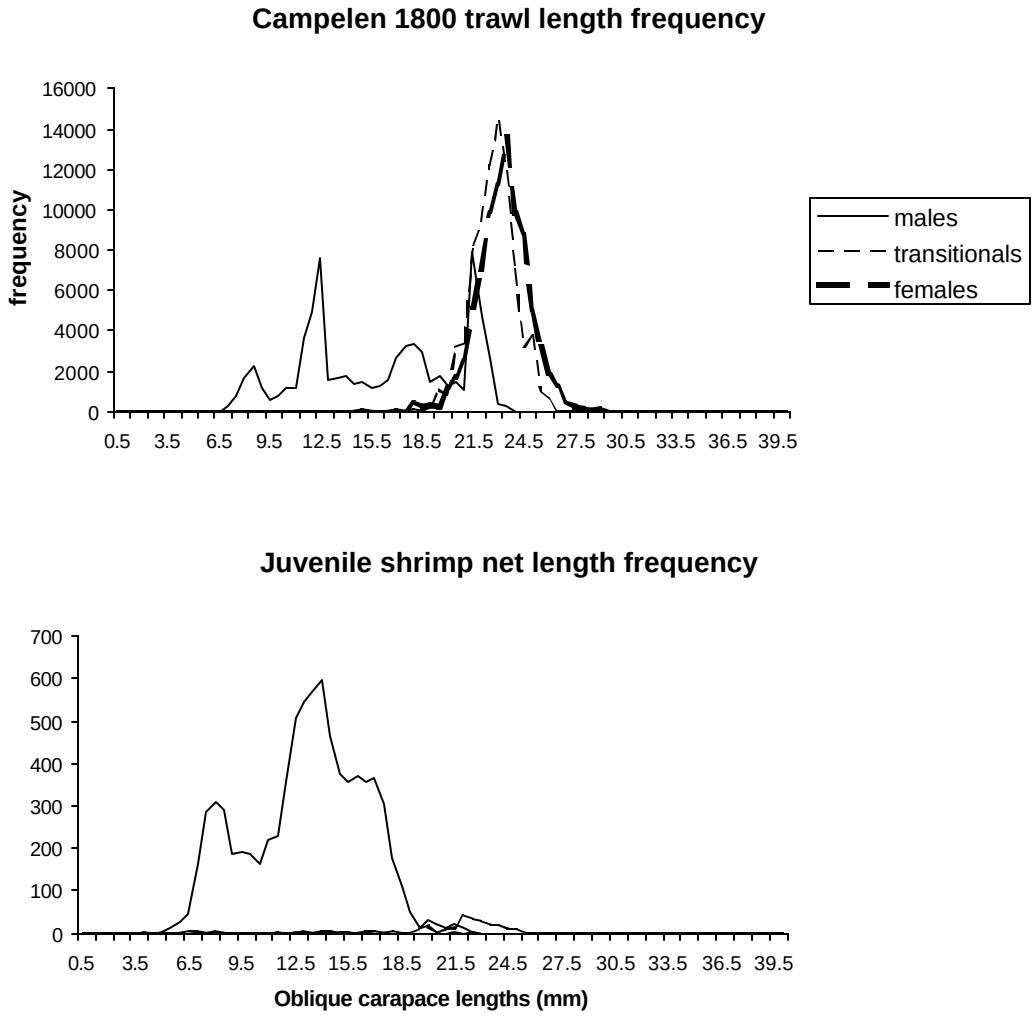


Figure 5. A comparison between length frequencies of spring 2000 3LNO shrimp obtained by the Campelen 1800 shrimp trawl and the juvenile shrimp net.

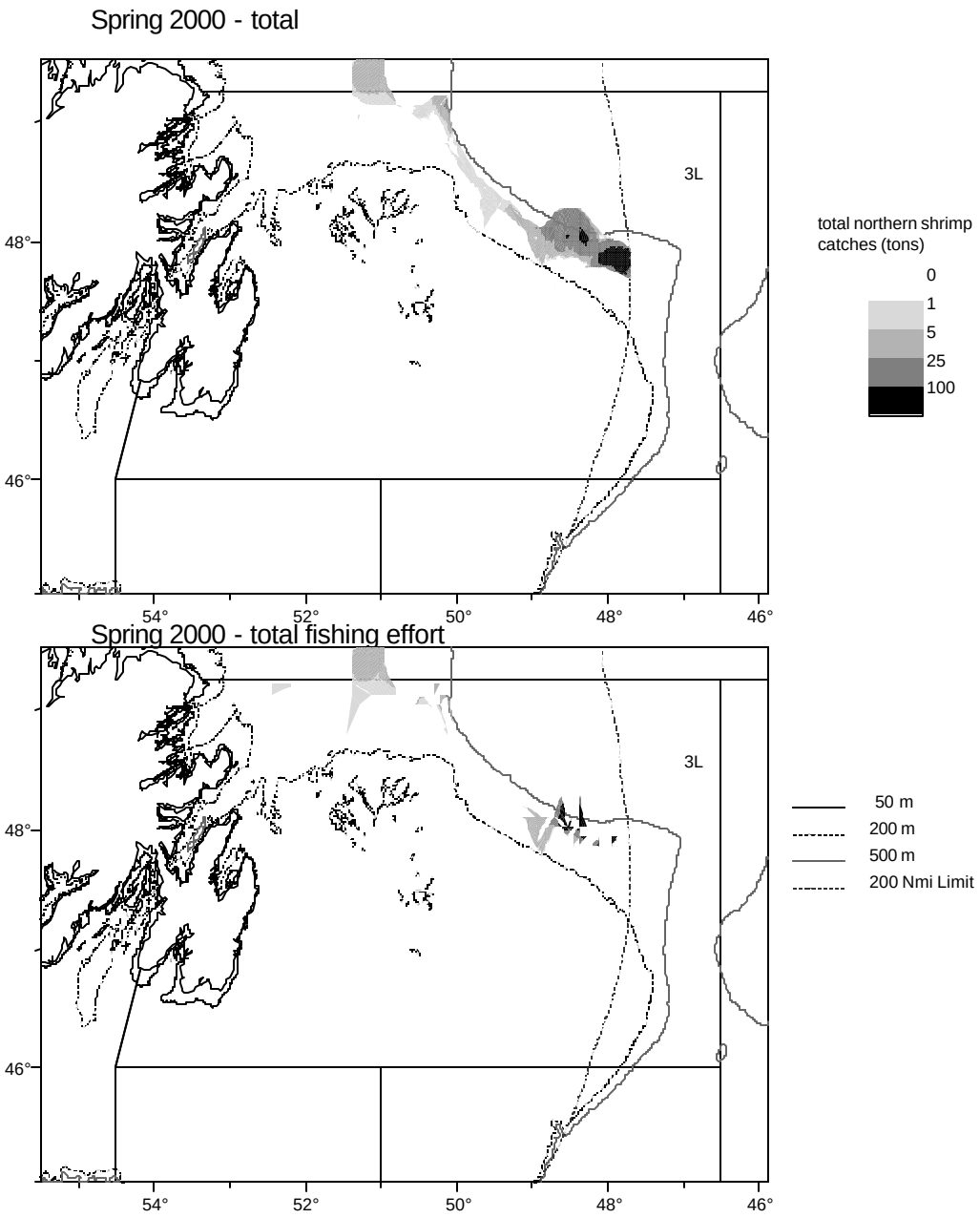


Figure 6. Distribution of inshore shrimp fishing fleet catches and effort expended during the spring 2000 shrimp fishery in NAFO Div. 3L (catches are in tons, effort in hours).

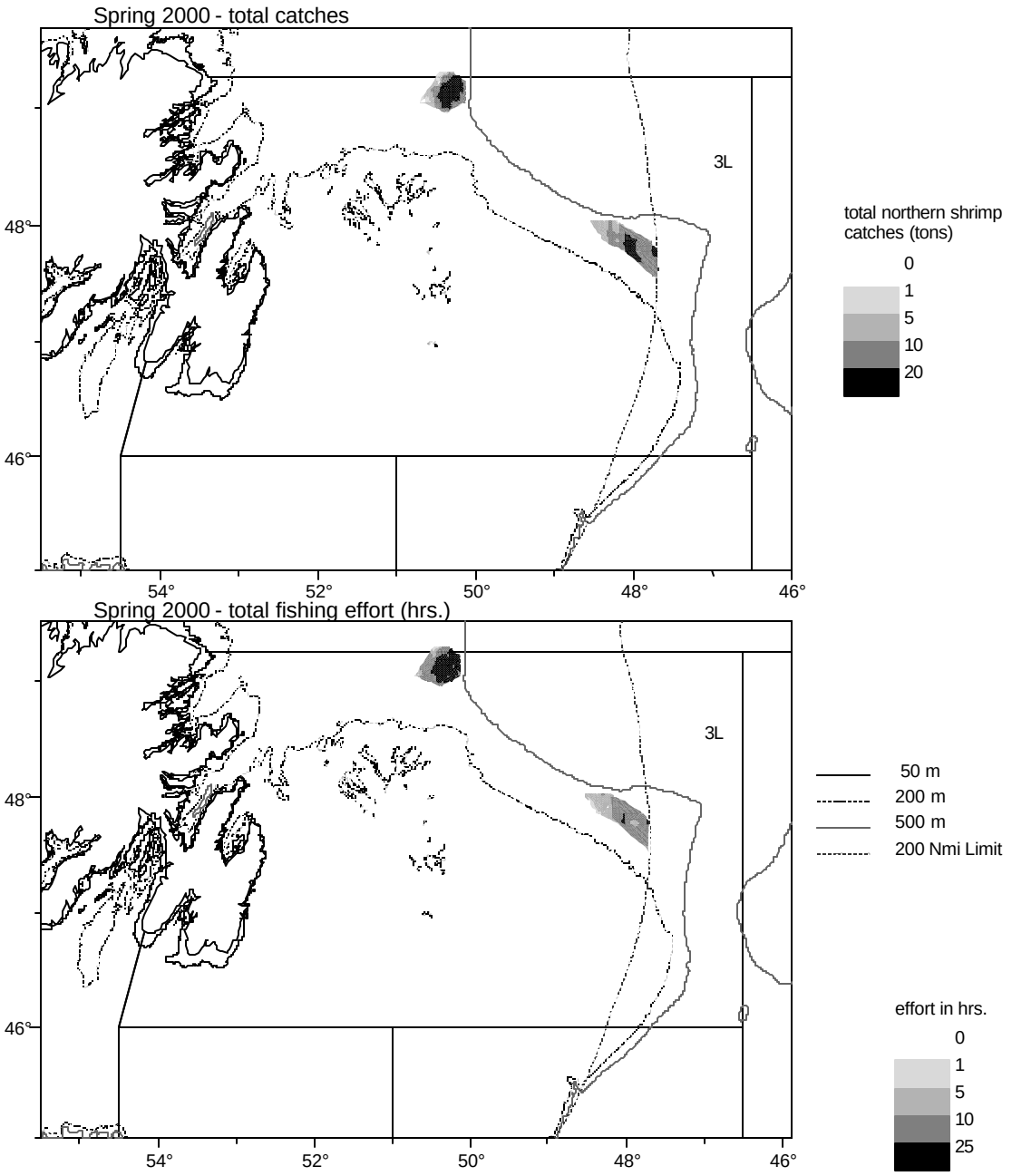


Figure 7. Distribution of large vessel shrimp catches and effort expended during the spring 2000 shrimp fishery in NAFO Div. 3L (catches are in tons, effort is in hours, data source Nfld. Gulf and Quebec offshore Observer data only, Nova Scotian Region Observer data were not available).

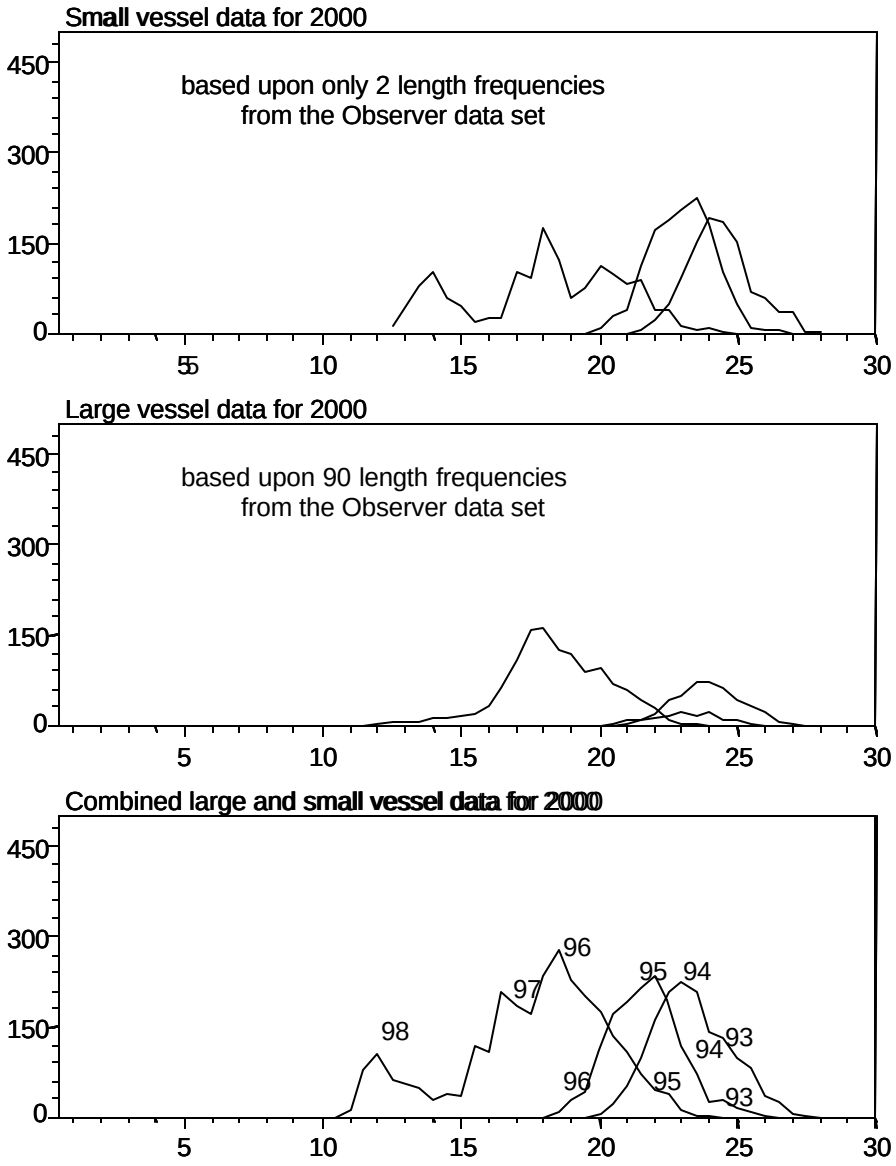


Figure 8. Demographics (x 100,000) of 3L shrimp taken by Canadian shrimp fishing vessels.

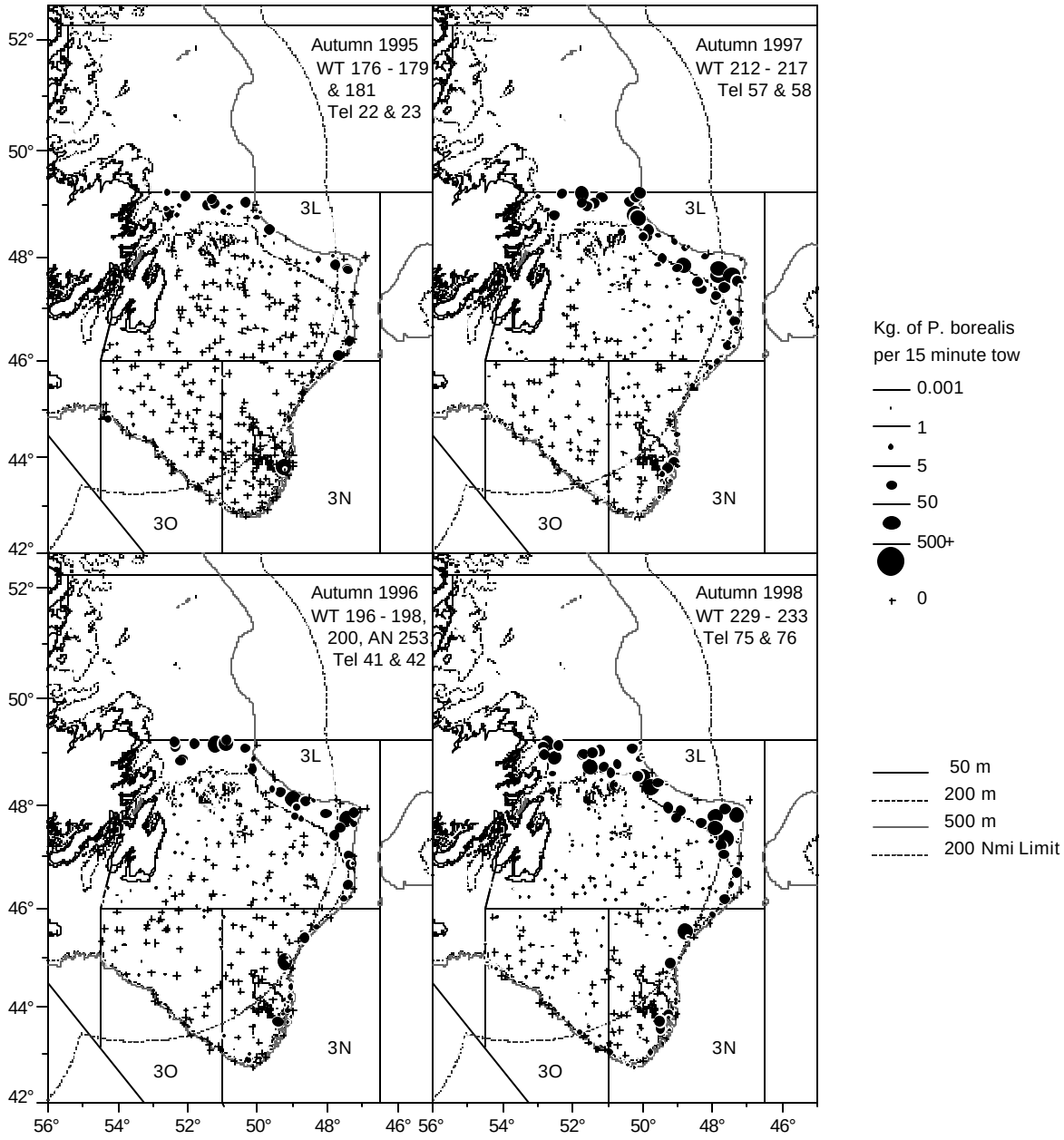


Figure 9. Distribution of *Pandalus borealis* collected during Canadian 1995-98 autumn multi-species research surveys. (Catches were made with a Campelen 1800 shrimp trawl).

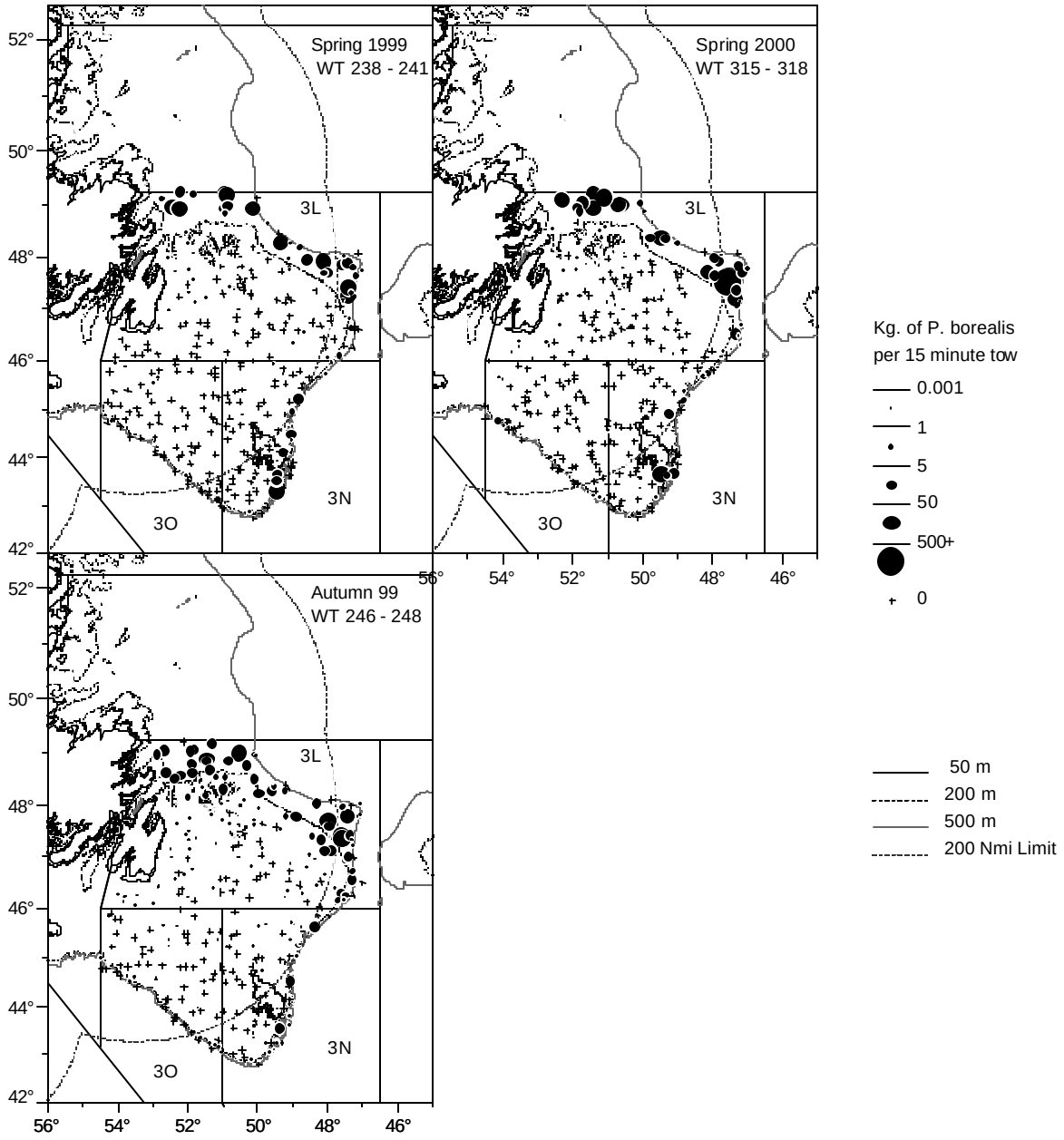


Figure 9. (continued) Distribution of *Pandalus borealis* collected during Canadian 1999-2000 autumn and spring multi-species research surveys. (Catches were made with a Campelen 1800 shrimp trawl).

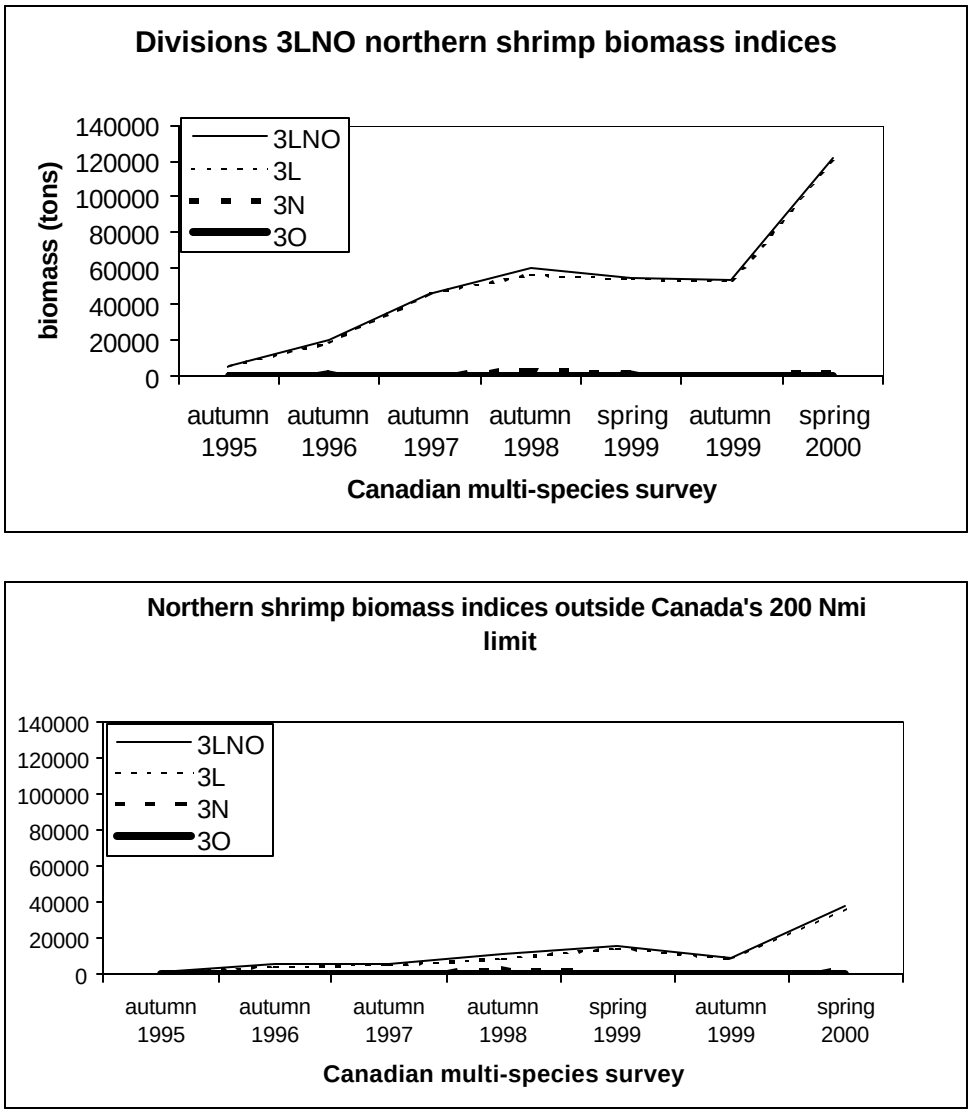


Figure 10. Divisions 3LNO northern shrimp biomass indices estimated from collections taken during the autumn 1995 to spring 2000 Canadian multi-species surveys.

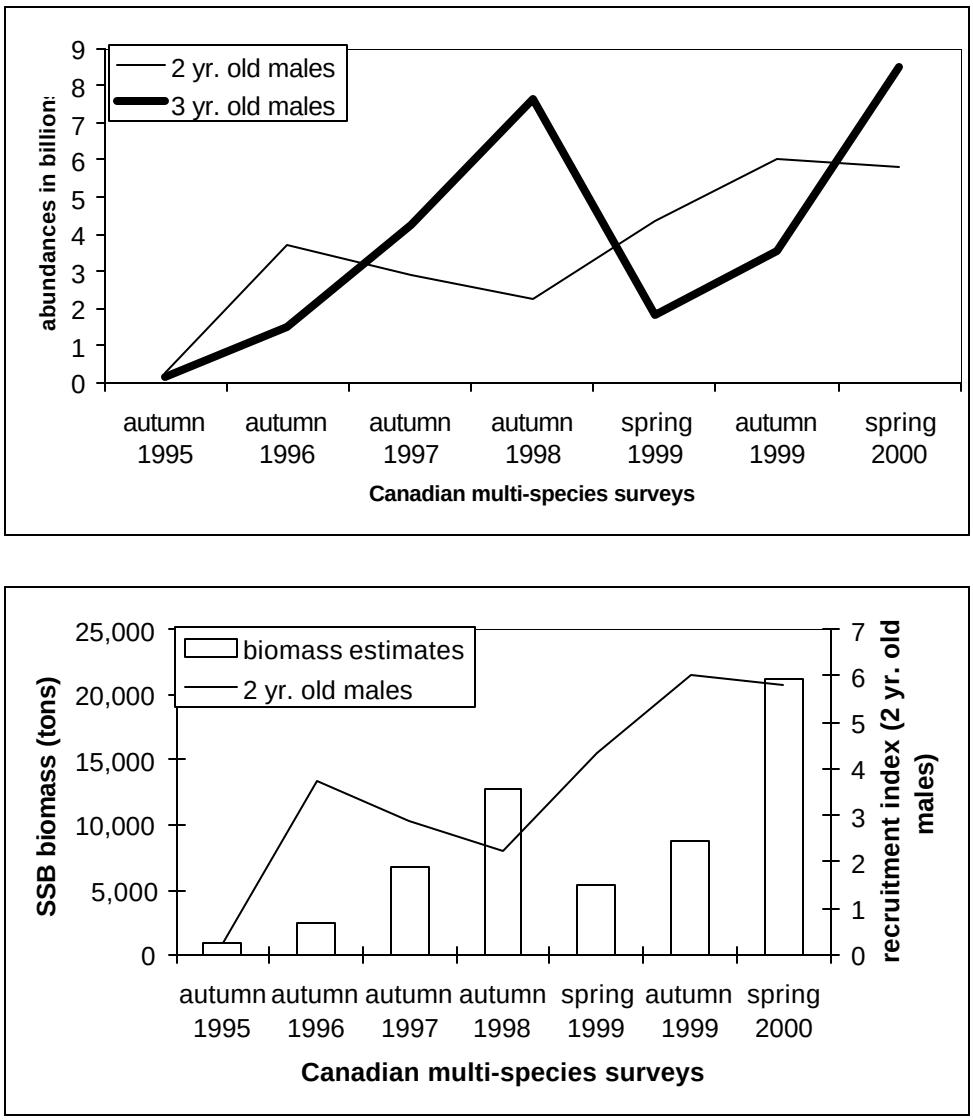


Figure 11. Use of 2-year-old male abundance as a recruitment index to predict 3-year-old abundance and spawning stock biomass.

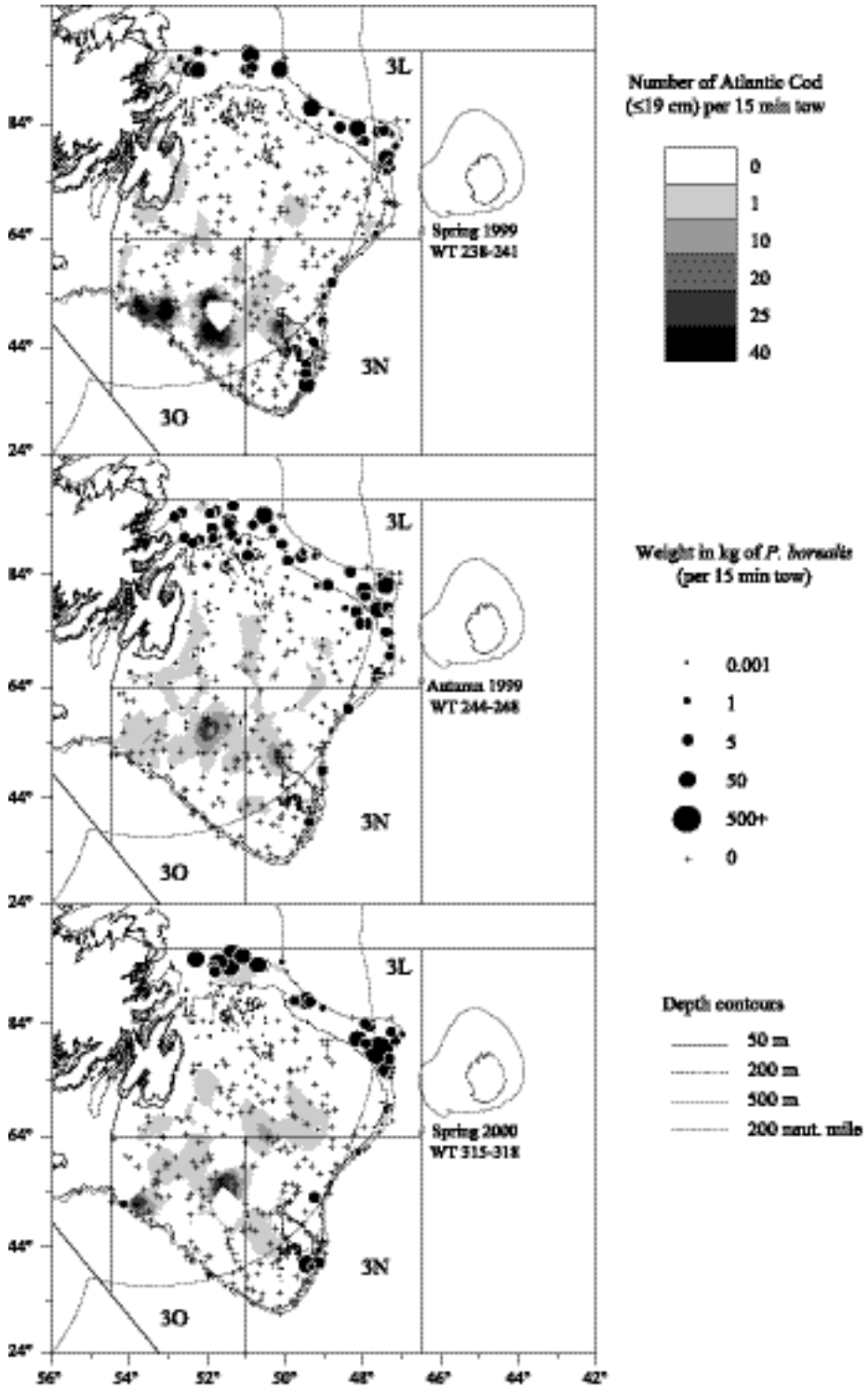


Fig. 12. Shrimp in Div. 3LNO: distribution of northern shrimp in relation to Atlantic cod with lengths ≤19 cm, collected during Canadian 1999-2000 autumn and spring multi-species research surveys (with a Campelen 1800 shrimp trawl, tows were standardized to 15 min.).

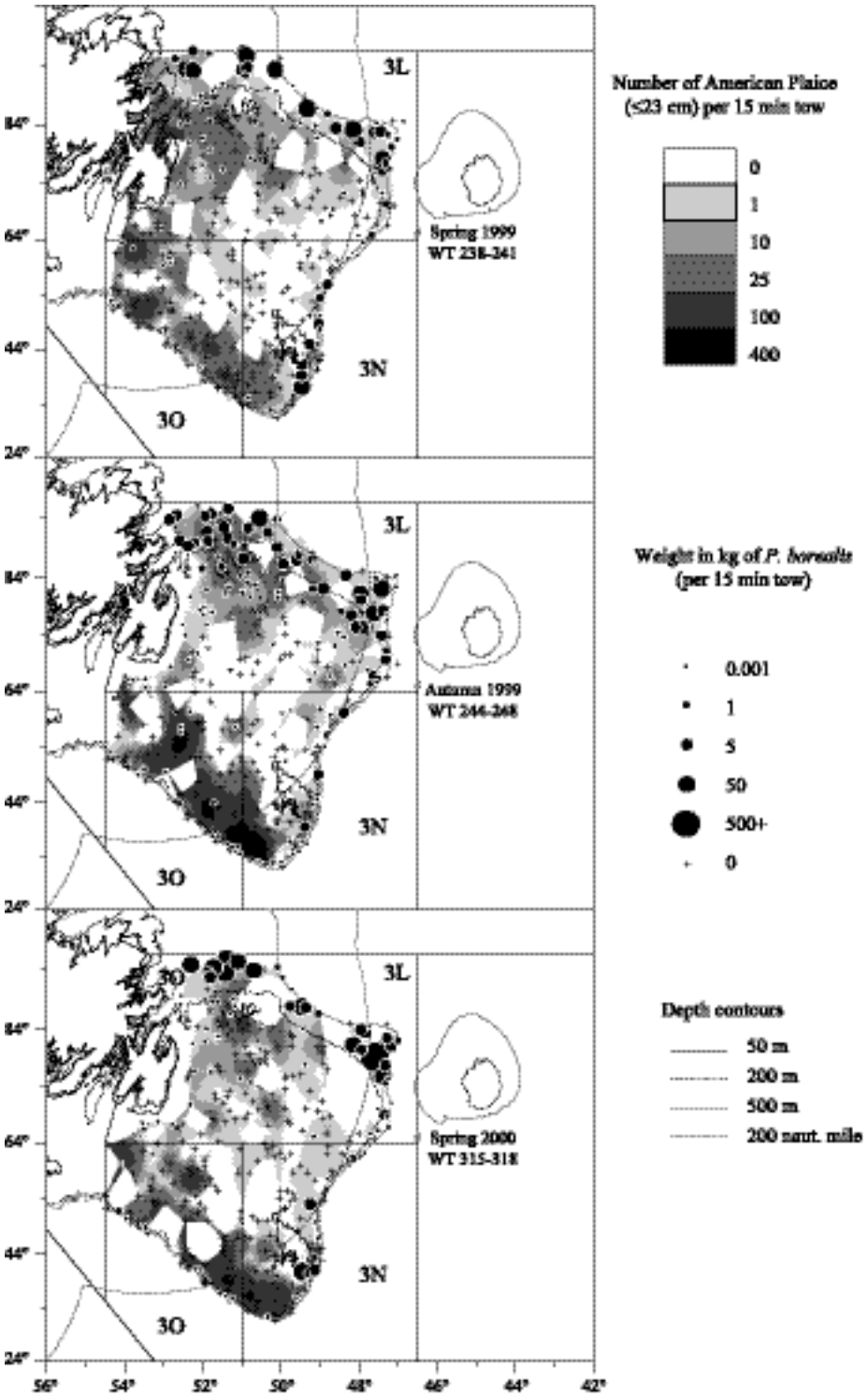


Fig. 13. Shrimp in Div. 3LNO: distribution of northern shrimp in relation to American plaice with lengths ≤23 cm, collected during Canadian 1999-2000 autumn and spring multi-species research surveys (with a Campelen 1800 shrimp trawl, tows were standardized to 15 min.).

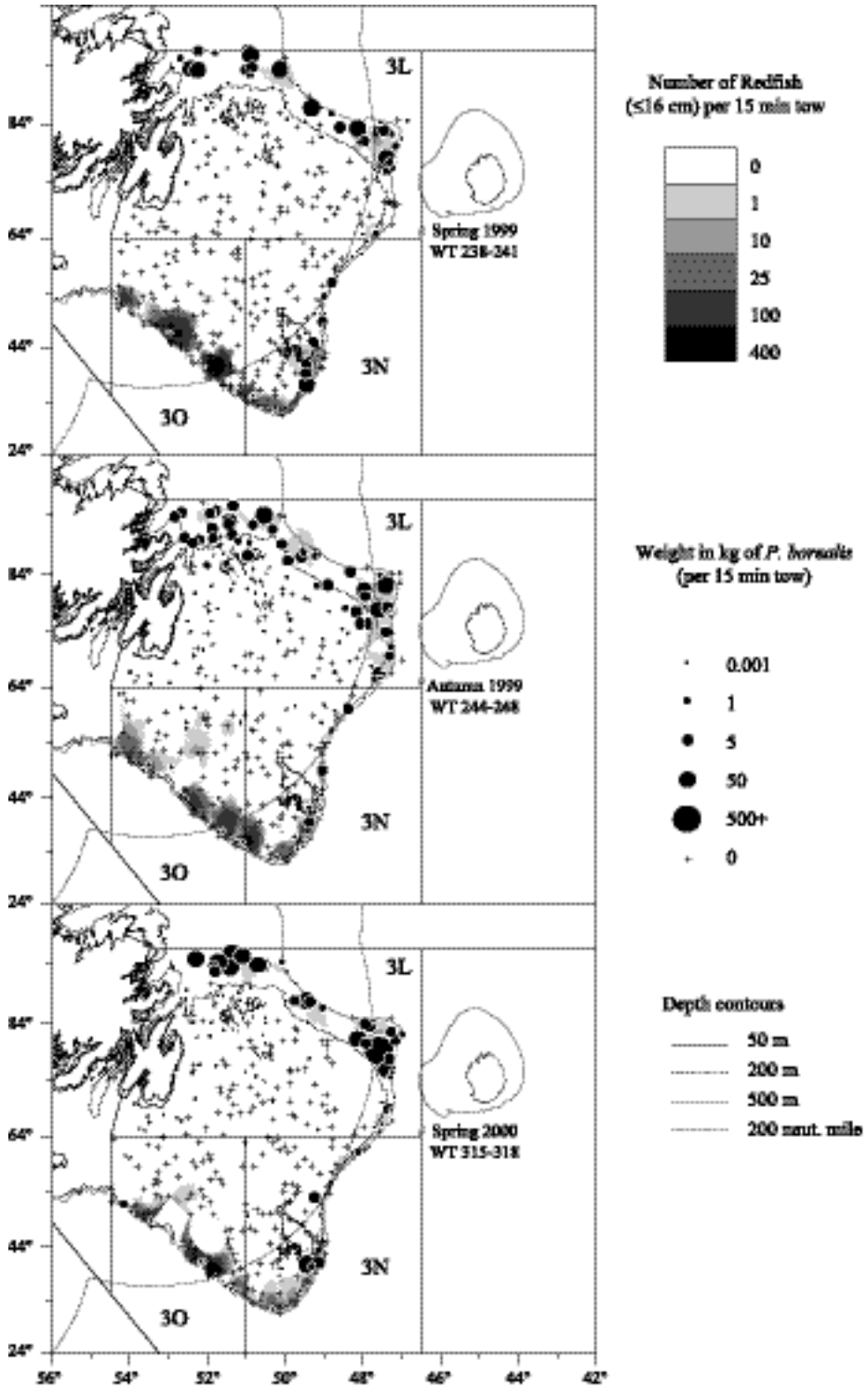


Fig. 14. Shrimp in Div. 3LNO: distribution of northern shrimp in relation to redfish with lengths ≤16 cm, collected during Canadian 1999-2000 autumn and spring multi-species research surveys (with a Campelen 1800 shrimp trawl, tows were standardized to 15 min.).

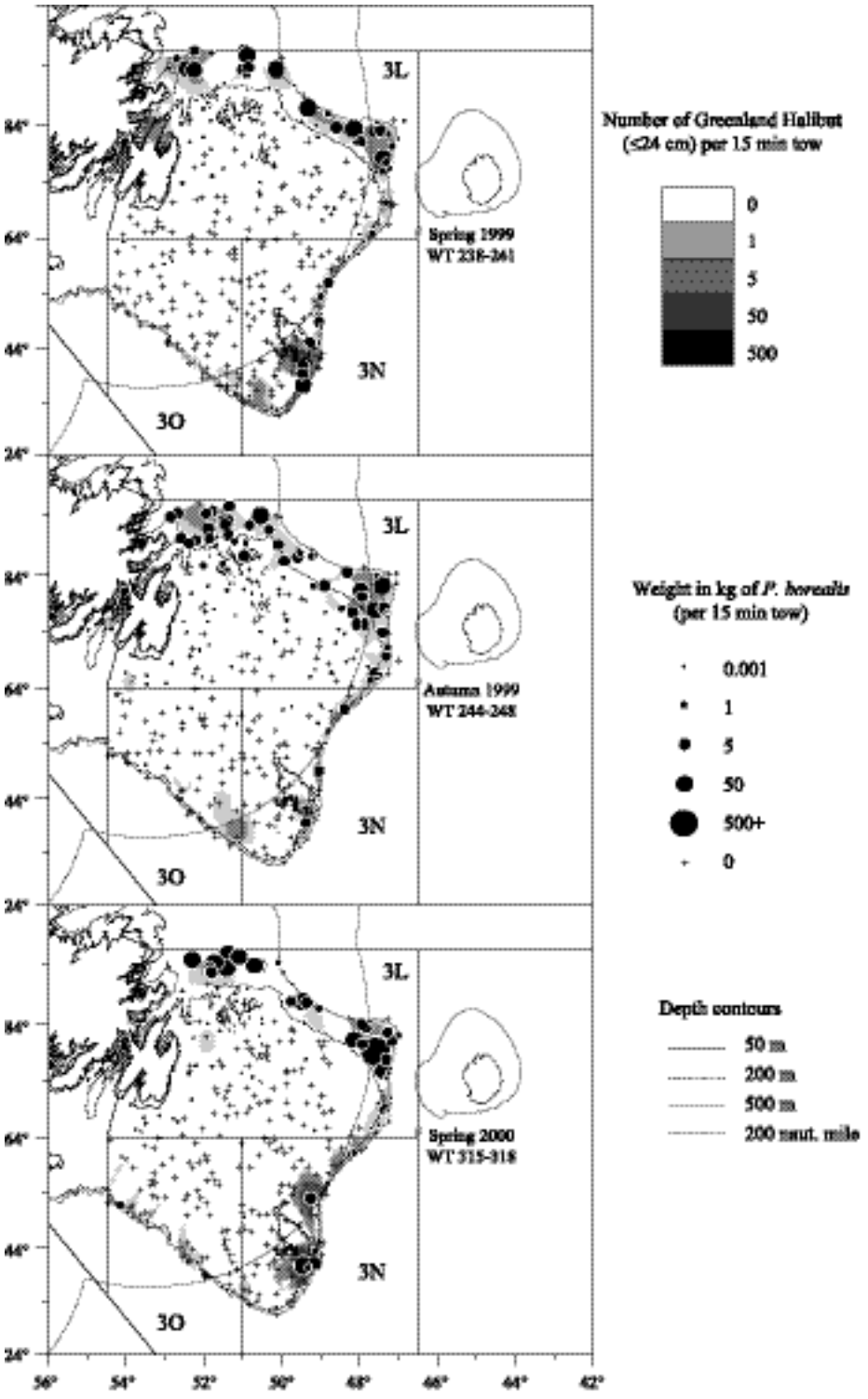


Fig. 15. Shrimp in Div. 3LNO: distribution of northern shrimp in relation to Greenland halibut with lengths ≤24 cm, collected during Canadian 1999-2000 autumn and spring multi-species research surveys (with a Campelen 1800 shrimp trawl, tows were standardized to 15 min.).