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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

Since 1995, Canadian multi-species stratified random surveys have been used to estimate northern shrimp (*Pandalus borealis*, Krøyer) biomass and abundances in Division 3LNO. Biomass increased from 5,921 tons in 1995 to 121,815 tons during spring 2000, and then decreased to the estimated 103,451 tons in spring 2001. Data from these surveys were used in age, relative year-class strength and year-class progression determinations. Preliminary total instantaneous mortality rates are estimated. Fisheries data were used in determining Catch-Per-Unit-Effort (CPUE) and exploitation levels. Additionally, both multi-species survey and observer data sets were used in quantifying the impact of the shrimp fishery upon various groundfish.

Introduction

The northern shrimp (*Pandalus borealis*) stock, in Div. 3LNO, extends beyond Canada's 200 N mi limit, therefore, it is a NAFO regulated stock. The Faroese began fishing shrimp in the NAFO Regulatory Area (NRA) during 1993. Then in 1999, a 6,000-ton quota was established for 2000 and 2001, and fishing was restricted to Div. 3L, at depths greater than 200 m. Canadian vessels may catch 5,000 tons inside the Exclusive Economic Zone (EEZ), while a 1,000-ton quota is set for the NRA. In order to decrease by-catch, all vessels fishing this stock must utilize sorting grates with a maximum bar spacing of 22 mm. The fishery is also important because the distribution of shrimp overlaps the distribution of several groundfish stocks that are presently under moratoria. Therefore, this paper assesses the status of the stock, as well as, the impact that the fishery has upon groundfish co-inhabiting in the area.

Materials and Methods

Data were collected from the following sources:

1. Canadian spring and autumn 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 CCG Wilfred Templeman, CCG Alfred Needler and

CCG 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 1500 m (Fig. 1). All vessels used a Campelen 1800 trawl with a codend mesh size of 40 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; McCallum and Walsh, 1996).

Modal analysis using Mix 3.1A (MacDonald and Pitcher, 1979) was conducted on research length frequencies. Abundances of age 2 males were plotted against spawning biomass to determine whether a recruitment – stock relationship exists. Such a relationship could be used to predict stock prospects.

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 12.7 mm liner material rather than 20 mm material. It is being used to provide an indication of escapement through the 44 mm mesh ahead of the codend.

Shrimp were frozen and returned to the Northwest Atlantic Fisheries Centre where identification to species and maturity stage was made. The maturity of the shrimp was defined by four stages:

males;
transitionals;
primiparous females;
and multiparous females

as defined by Ramussen (1953), Allen (1959) and McCrary (1971).

Oblique carapace lengths (0.1 mm) were recorded, while 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, therefore, the analysis was restricted to data collected from offshore strata only (Fig. 1).

Instantaneous total mortality (Z) rates were determined for:

a) the change in abundance between age 4 + (males, transitionals and females) in one autumn survey $_{(t1)}$ and the abundance of age 5+ females in the next $_{(t2)}$;
b) the change in abundance between multiparous and ovigerous females from the autumn survey data one year $_{(t1)}$ and spring survey data during the next $_{(t2)}$; and finally
c) the change in abundance between total females (transitionals, primiparous, multiparous and ovigerous) during one spring survey $_{(t1)}$ and the abundance of multiparous females during the succeeding spring $_{(t2)}$.

Mortalities were determined using the following formula:

$$Z = -\log_e (N_{t2}/N_{t1}) \text{ (Ricker, 1975).}$$

Exploitation indices were developed by dividing total catch by each of the following parameters: biomass, spawning stock biomass (SSB), and fishable biomass. The fishable component of the population was defined as being all animals greater than 17 mm CL. Male biomass was determined by converting to biomass using the autumn length weight regression:

$$Wt. = 0.000838 Lt^{2.929} \text{ (Skúládottir, 1997).}$$

Female biomass was determined by areal expansion. Female and male biomass were added together to obtain total fishable biomass.

Distribution maps of adult and juvenile Atlantic cod (*Gadus morhua*), American plaice (*Hippoglossoides platessoides*), Greenland halibut (R*einhardtius hippoglossoides*) and redfish (*Sebastes mentella*) were overlain with plots of survey shrimp catches to determine the degree of overlap. The term juvenile refers to the modal length of a

species (LC_{50}) passing through a 22 mm Nordmore Grate. The respective LC_{50} values for Atlantic cod, Greenland halibut, redfish and American plaice were: 19 cm (Orr *et* al., 2000 and Hickey *et al.*, 1993), 24 cm (Nicolajsen, 1997), 14-18 cm (Hickey *et al.*, 1993; Kulka and Power, 1996; Kulka, 1998; Nicolajsen, 1997; Skúládottir, 1997) and 23 cm (Orr *et al.*, 2000). Amounts of by-catch were assessed in relation to total shrimp catch.

2. Observer database

Approximately 12 large (=>500 ton) fishing vessels and more than 300 smaller (<500 ton; <100') vessels fish shrimp within Davis Strait, along the coast of Labrador and off the east coast of Newfoundland. There is 100% mandatory observer coverage of the large vessels, but only 10% coverage of the small vessels.

Observers working on large vessels collect detailed maturity stage length frequency information from random sets. Those working on small vessels collected ovigerous/non-ovigerous length frequencies from random sets and 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.

The Observer database was used to determine the catch per unit effort (CPUE) of the large vessel fleet, catch at size and maturity, as well as, the impact of shrimp fishing upon groundfish species.

3. Logbook database

The landings by small and large vessels allowed a comparison with the total observed catches. This comparison provided an indication of percent of total catch that was observed. This percentage was used in estimating the number of shrimp -at-length caught and the total groundfish by-catch on a species by species basis.

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 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 an exploitation rate (catch/biomass), which is a proxy for fishing mortality, and provide insight into the impact of shrimp fishing upon groundfish.

4. International catch and effort information

These data were made available by Contracting Parties that fish for shrimp in Div. 3L. They were added to the Canadian catches when determining a total catch. Where no information was provided by a Contracting Party, information was augmented through the use of Canadian aerial surveillance data.

Results and Discussion

FISHERY DATA

In 1993, Faroese fishermen began an exploratory fishery for Div. 3LNO shrimp within the NRA. The exploratory fishery lasted until 1999. Over this 7 year period, the Faroese catches were 1789, 356, 0, 79, 485, 515 and 700 tons, respectively.

During autumn 1995, the Canadian multi-species surveys began to use a Campelen 1800 shrimp trawl. It was at this time that shrimp were included in the multi-species survey data collections. As a result of Faroese and Canadian multi-species survey efforts, various nations became interested in exploiting shrimp in Div. 3LNO. During 1999, one Spanish and four Canadian exploratory fishing trips were made in Div. 3LNO. The combined catch was 127 tons. That year, the Fisheries Commission within NAFO set a Total Allowable Catch (TAC) of 5,000 tons for Canada and a total of 1,000 tons for all of the remaining convention member states. This level of removal was set for both 2000 and 2001. The following table provides catches by nation:

Country	2000	2001
Canada – Nfld.	3,826[1]	4,774[2]
Canada – Mar.	458[1]	399[2]
Estonia	64[1]	24[3]
Faroe Islands	40[2]	55[2]
Greenland	34[2]	
Iceland	29[2]	10[3]
Latvia	64[1]	53[3]
Lithuania	67[1]	51[3]
Norway	77[1]	31[3]
Portugal		61[4]
Russia	67[1]	67[3]
Spain		699[4]
GRAND TOTAL	4,726	6,224

Sources:

1 NAFO STATLANT 21A
2 Canadian Quota Report, or other sources
3 NAFO monthly records of provisional catches
4 Canadian surveillance reports

Catch Per Unit Effort (CPUE)

During 2000, the Canadian small vessel fleet caught 3,217 tons while the large vessel fleet caught 1,029 (Canadian Quota Report, 2000). To date (Oct. 31/01), quota reports indicate that during 2001, the small and large vessel fleets caught 2,797 and 2,376 tons of shrimp, respectively. Logbook and observer datasets indicate that the CPUE for small vessels in 2000 was approximately 356 kg/hr. A small sample of observer data (~2% fleet coverage) indicated a 2001 CPUE of 410 kg/hr. The large vessel single trawl CPUE's were 343 and 619 kg/hr, respectively, for the two years, while twin trawl CPUE's for the same period were 579 and 350 kg/hr.

Small vessel effort (catch/CPUE) was 9,036 and 6,822 hrs for 2000 and 2001. Single trawl large vessel effort was 1,875 and 1,182 hrs, respectively, for the same period. The 2000 and 2001 twin trawl effort was 671 hrs in 2000 and 4,692 hrs in 2001.

Both Canadian fleets fished along the edge of Div. 3L during the early spring to early fall (Fig. 3-6).

Size/Age Composition

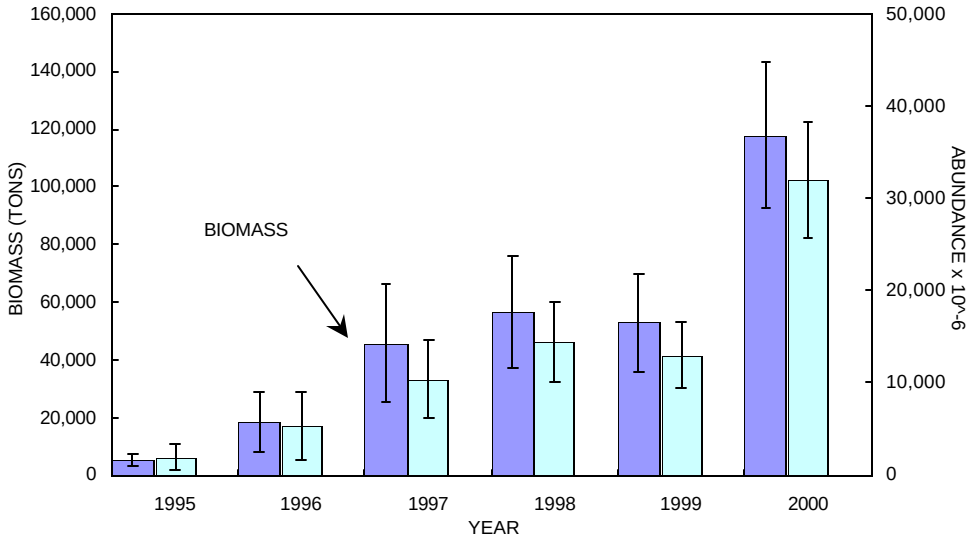
Length frequencies, produced from small vessel observer coverage indicate that at least 5 cohorts were taken in the fishery (Fig. 7). The 2000 samples were dominated by 22-26 mm carapace length (CL) shrimp believed to be age 5 and older. The 2001 plot was dominated by males 18.5-21 mm CL from what is assumed to be the 1997 year-class.

In both years, the large vessel catches were dominated by the 1997 year-class (Fig. 8).

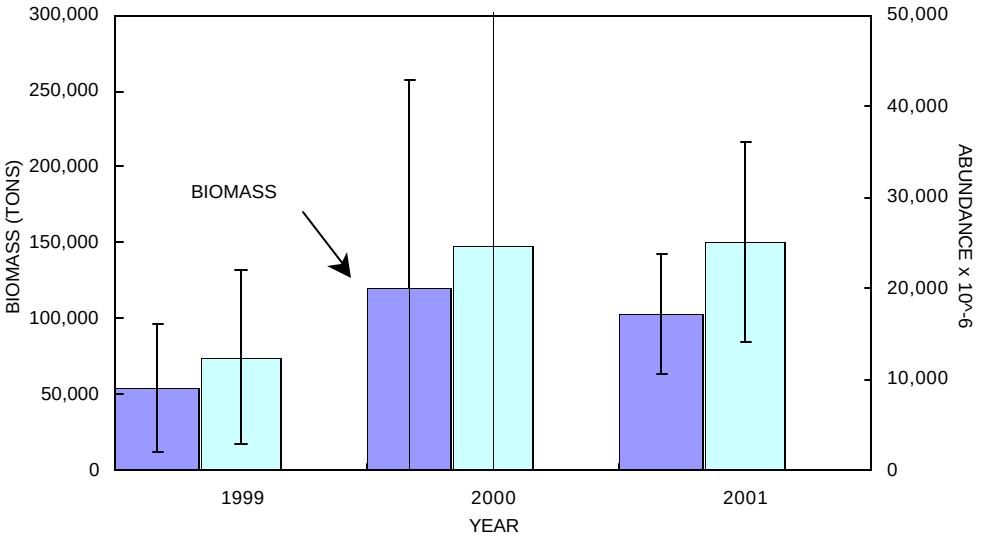
In all cases, the female distributions are broad indicating the likely presence of more than one year-class. Additionally, the data indicates that the 1996 year-class was weaker than the 1997 year-class. The impacts of this weaker year-class will probably be moderated by the 1997 year-class and residual female biomass. The 1998 year-class was well represented in all plots.

RESEARCH SURVEY DATA

Results of the autumn 1995-spring 2001 Canadian multi-species surveys (Fig. 9-11; Tables 1-8) indicate that shrimp have been widely distributed along the edge of Div. 3L. The biomass index increased from 5,921 tons in autumn of 1995 to 59,914 tons during autumn of 1998, remained stable until spring of 2000, at which time it increased to 121,815 tons. The index then decreased to 103,451 tons during spring 2001.



Autumn multispecies survey biomass and abundances of 3LNO *P. borealis*



Spring multispecies survey biomass and abundances of 3LNO *P. borealis*

These charts indicate that the biomass and abundance estimates for the autumn surveys have tight confidence limits relative to spring survey results. The lower confidence limits for the spring of 2000 are negative. The differences between spring and autumn confidence limits indicate that there may be a seasonal influence upon shrimp catchability. For this reason, data from the autumn surveys are treated separately from the spring survey data.

Within the autumn estimates, ratio of confidence limit width to point estimate appears inversely proportional to the point estimate. This indicates that catches (weight and count) are less variable when population size is high.

Distribution of shrimp in Divisions 3L, 3N and 3O

Over the study period, the area outside 200 Nmi accounted for between 12 and 31% of the Div. 3LNO biomass estimates (Tables 7 and 8; Fig. 9-11).

More than 90% of the biomass was found within Div. 3L, mostly within depths from 185 to 550 m. Over the six autumn surveys, the biomass within the NRA ranged between 11 and 24%, averaging 15.8%. In the spring, the percent biomass within the NRA ranged between 18 and 30% while the average was 26.2%. However, one must use caution when interpreting the latter range, because as mentioned above, confidence limits for the spring are broad. The percent biomass outside the 200 Nmi limit peaks (30.23%) during spring 2000 when the lower confidence limits for the entire spring survey extend into negative values.

Division 3N accounted for less than 10% of the biomass. More than 80% of the Div. 3N biomass was found outside the 200 Nmi limit. Division 3O accounted for less than 1% of the Div. 3LNO biomass. The area outside the 200 Nmi limit contributed between 0-34% of the Div. 3O biomass (Tables 7 and 8; Fig. 9-11).

Stock composition

Length distributions representing abundance-at-length from the autumn 1995 to spring 2001 surveys are compared in Fig. 12 and 13. Tables 9-16 provide the detailed length frequency data obtained from each survey.

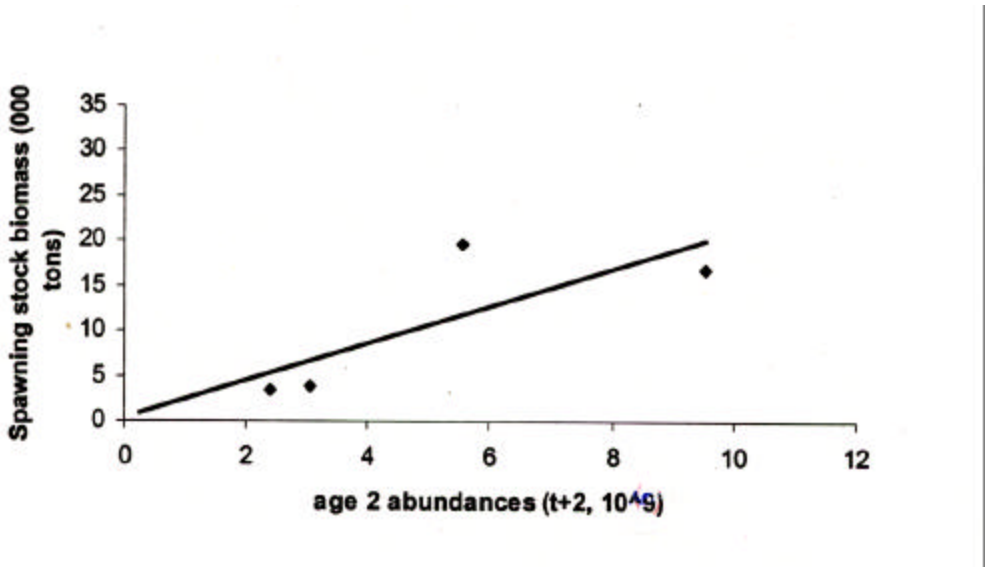
Abundances within the autumn 2000 survey data were dominated by males with a modal length of 17.5 mm CL, believed to have been the 1997 year-class (age 3). The 1998 year-class was evident near 15 mm while the 1999 year-class had a mode between 9 and 11.5 mm. The largest males (>19 mm) and smallest females (<22 mm) are thought to belong to the 1996 year-class. The weaker 1996 year-class appears to be followed by relatively strong 1997 and 1998 year-classes. The broad female distribution suggests that it consists of several year-classes.

It is predicted that the affects of the weaker 1996 year-class will be moderated by the residual female biomass as well as the stronger 1997 and 1998 year-classes.

Recruitment indices

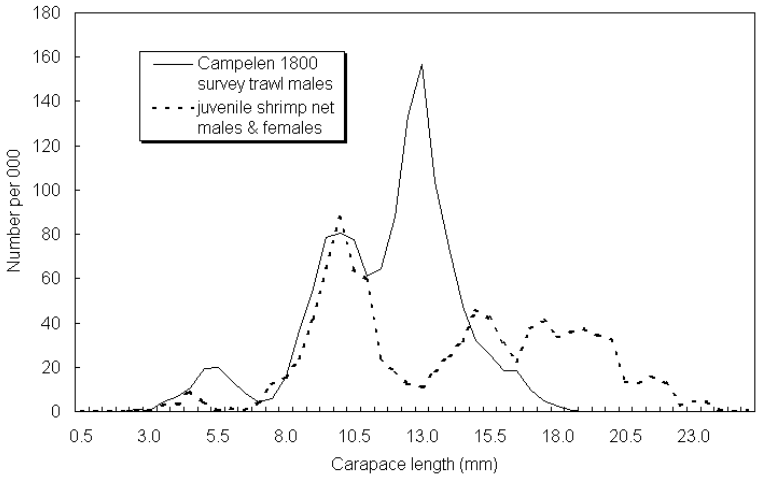
Campelen shrimp trawl

The following is a plot of spawning stock biomass and a recruitment index (age 2 shrimp). The recruitment index was advanced by 2 years (to be consistent with the fact that many of these animals change sex at fours years of age). Spawning stock biomass appears to be positively related to recruitment ($_{t+2}$), and therefore may have predictive value, however, the time series is too short to be conclusive.



Juvenile net index

Since spring 2000, a juvenile shrimp net has been used to collect shrimp and fish that escape through the 44 mm mesh ahead of the research trawl's codend. The following length frequencies illustrate that in situations of high shrimp abundance, one may use the Campelen shrimp trawl to obtain representative samples of age 1 and 2 shrimp. Similar findings were noted during the spring of 2000 (Orr *et al*., 2000). This is in agreement with Diaz (2001) who made comparisons between a Campelen shrimp trawl and a juvenile net.



Exploitation Rates

Ratios of catch to the previous autumn biomass indices will be used to provide an exploitation rate index.

Year	Catch	Total biomass	SSB	Fishable biomass
1995		5,358	3,766	4,843
1996	79	18,566	3,513	6,378
1997	485	45,758	19,565	27,694
1998	515	56,485	16,793	31,907
1999	827	52,863	18,527	28,941
2000	4,726	117,902	32,517	58,063
2001	6,224			

Year	Catch/total biomass	Catch/ SSB	Catch/fishable biomass
1996	0.015	0.021	0.016
1997	0.026	0.138	0.076
1998	0.011	0.026	0.019
1999	0.015	0.049	0.026
2000	0.089	0.255	0.163
2001	0.053	0.191	0.107

Exploitation levels using ratios of catch/biomass, catch/SSB and catch/fishable biomass track the same trend. Overall, exploitation was low, with increased values in 2000 and 2001 reflecting the start of the fishery under TAC regulation.

Mortality rates

Mortality estimates varied from –1.02 to 1.11 (Table 17). The only realistic values were derived by determining the number of age 4+ males that survive until the next year's autumn survey as females (these values ranged between 0.62 and 0.75). By continuing this work and averaging over several years, it may be possible to estimate reliable mortality rates.

DISTRIBUTION OF SHRIMP IN RELATION TO VARIOUS GROUNDFISH SPECIES

By-catch

A review of recent distributions of shrimp from research survey data compared with those of various juvenile groundfish species indicates some overlap with cod in Div. 3L (Fig. 14) and American plaice (Fig. 17). There is considerable overlap in areas where juvenile redfish (Fig. 19) have traditionally been found, particularly in the Sackville Spur and 'nose' areas of Div. 3L. These are the same areas where the highest concentrations of shrimp occur. In addition, there is considerable overlap in the distribution of shrimp and juvenile Greenland halibut (Fig. 21).

No by-catch information was provided by the international fleets fishing in the NRA, therefore, the by-catch discussed below pertains only to the Canadian fishing fleets. Based on catches observed in the Canadian fishery in 2001, the following estimated total groundfish removals in the Canadian fishery were obtained.

	Small vessels (<500 t)		Large vessels (=>500 t)	
Species	Est. catch (kg)	Kg/tons of shrimp	Est. catch (kg)	Kg/ton of shrimp
Atlantic cod	265	0.10	232	0.10
American plaice	1216	0.44	1166	0.49
Redfish	1163	0.42	1015	0.43
Greenland halibut	1851	0.66	5877	2.47

By-catch in 2000 was similar to that in 2001. The detailed by-catch is as follows:

Atlantic cod

Atlantic cod by-catch was taken near Tobin's point and near the 200 Nmi limit (Fig. 15). As indicated in the above table, by-catch levels were relatively low, however, this was at a time of low cod abundance.

Figure 16 provides the length frequencies of Atlantic cod that were taken by the offshore fleet. The 2000 modal length was 19 cm, which is consistent with previous studies (Orr *et al*., 2000 and Hickey *et al*., 1993). The 2001 mode is shifted to the right but with low sample size, the significance of this difference is uncertain.

American plaice

Relatively low abundances of juvenile American place were along the edge of Div. 3L (Fig. 17), consistent with low levels of American plaice by-catch were taken in the Div. 3L shrimp fishery (Fig. 18).

Redfish

For similar reasons, low by-catch levels of redfish were taken in the Div. 3L fishing area (Fig. 19 and 20).

Greenland halibut

Juvenile Greenland halibut are abundant along the edge of Div. 3LNO, therefore, it is not surprising that this species was consistently taken as by-catch throughout the shrimp fishing area (Fig. 21, 22 and the above table). Each of the plots in Fig. 23 and 24 indicate two distinct modes, one at 14 cm while the other is at 22-25 mm irrespective of bar spacing.

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Table 1 Total abundance (X 1000), biomass (Kg. X1000) of northern shrimp (*Pandalus borealis*) collected during the autumn 1995 - 2000 Canadian multi-species research surveys into NAFO Div. 3L. (All tows were standardized to 15 minutes; . means not sampled.).

Please note that these estimates were taken from strata numbers <784 so that estimates from all years would be comparable.

Depth	Area	Autumn 95		Autumn 96		Autumn 97		Autumn 98		Autumn 99		Autumn 2000	
Range in m	in Nmi2	WT 176 - 179		WT 196 - 198,		WT 213-217		WT 230 - 233		WT 246 - 248		WT 321 - 323	
		WT 181, Tel 22		WT 200 &		Tel 57 & 58		Tel 75 & 76				Tel 339, 342	
		& Tel 23		Tel 41								& 343	
		abundance	biomass	abundance	biomass	abundance	biomass	abundance	biomass	abundance	biomass	abundance	biomass
		(x 1000)	(Kg X 1000)	(x 1000)	(Kg X 1000)	(x 1000)	(Kg X 1000)	(x 1000)	(Kg X 1000)	(x 1000)	(Kg X 1000)	(x 1000)	(Kg X 1000)
30 - 56	9285	.	.	0	0	0	0	97	0	.	.	393	0
57 - 92	18957	0	0	1,591	6	3,558	16	3,273	13	1,532	5	7,880	34
93 - 183	7170	26,803	41	66,329	176	448,482	1,849	485,811	1,237	597,044	1,855	962,240	3,313
184 - 274	399	254,635	787	989,385	3,518	5,284,488	25,015	8,806,344	32,516	9,312,284	36,423	22,399,779	73,001
275 - 366	4030	1,659,530	4,374	4,271,393	14,647	4,624,501	18,515	5,186,605	22,691	3,056,209	14,390	8,585,977	41,292
367 - 549	1192	12,073	142	15,004	218	50,610	353	5,649	25	32,400	187	45,685	232
550 - 731	804	2,256	13	197	1	1,982	9	632	2	547	3	7,494	27
732 - 914	957	0	0	0	0	86	1	13	0	0	0	265	2
915 -1097	945	0	0	0	0	0	0	0	0	0	0	79	1
1098 -1280	1745	.	0	35	0	0	0	0	0	0	0	0	0
1281 -1463	773	.	0	0	0	0	0	0	0	0	0	0	0
Total (000's)		1,957,945	5,358	5,346,560	18,566	10,419,805	45,758	14,471,183	56,485	13,013,407	52,863	32,019,951	117,902
Upper 95% limit		3,335,665	7,397	9,051,691	28,893	14,661,173	66,426	18,820,969	76,064	16,485,962	69,804	38,245,868	142,949
Lower 95% limit		580,225	3,318	1,641,430	8,238	6,178,437	25,090	10,121,396	36,905	9,540,852	35,923	25,794,034	92,855
%<184m		1	1	1	1	4	4	3	2	5	4	3	3
%184 - 549 m		98	99	99	99	96	96	97	98	95	96	97	97
%>549 m		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	20,967	70	48,171	187
184 - 274	791	8,806	26	429,678	1,635	290,656	1,246	1,005,018	4,454	1,346,964	6,486	4,405,969	19,197
275 - 366	758	162,699	997	433,908	2,759	643,252	3,685	558,307	4,222	306,325	2,079	1,519,770	8,949
367 - 549	636	275	4	7,328	110	11,499	102	3,954	17	13,288	98	18,808	113
550 - 731	554	1,935	12	197	1	186	1	10	0	90	1	0	0
732 - 914	607	0	.	0	0	86	1	13	0	0	0	119	1
915 -1097	582	.	.	0	0	0	0	0	0	0	0	46	0
1098 -1280	1,331	.	.	35	0	0	0	0	0	0	0	0	0
1281 -1463	295	.	.	0	0	0	0	0	0	.	.	0	0
Total (000's)		173,738	1,039	871,256	4,506	964,158	5,115	1,574,208	8,707	1,691,507	8,734	5,990,885	28,447
Upper 95% limit		440,468	4,853	2,035,525	25,676	2,533,454	13,242	4,705,895	25,437	3,907,713	19,432	10,973,587	49,256
Lower 95% limit		-92,992	-2,774	-293,013	-16,664	-605,137	-3,013	-1,557,479	-8,022	-524,699	-1,964	1,008,184	7,638
%<184m		0	0	0	0	2	2	0	0	1	1	1	1
%184 - 549 m		99	99	100	100	98	98	100	100	99	99	99	99
%>549 m		1	1	0	0	0	0	0	0	0	0	0	0

Table 2 Total abundance (X 1000), biomass (Kg. X1000) of northern shrimp (*Pandalus borealis*) collected during the autumn 1995 - 2000 Canadian multi-species research surveys into NAFO Div. 3N. (All tows were standardized to 15 minutes; . means not sampled.).
Please note that these estimates were taken from strata numbers <784 so that estimates from all years would be comparable.

Depth	Area	Autumn 95		Autumn 96		Autumn 97		Autumn 98		Autumn 99		Autumn 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 245 - 247		WT 320, 322 WT 323, Tel 338 & Tel 339	
		abundance	biomass	abundance	biomass	abundance	biomass	abundance	biomass	abundance	biomass	abundance	biomass
		(x 1000)	(Kg X 1000)	(x 1000)	(Kg X 1000)	(x 1000)	(Kg X 1000)	(x 1000)	(Kg X 1000)	(x 1000)	(Kg X 1000)	(x 1000)	(Kg X 1000)
<=56	3,092	0	0	0	0	63	1	0	0	175	1	0	0
57 - 92	11,490	7,903	36	3,507	13	1,661	6	2,042	13	1,291	4	3,664	14
93 - 183	1,168	0	0	1,107	2	17,302	44	43,866	119	55	1	2,368	10
184 - 274	546	18,053	45	377,532	776	73,069	318	769,586	3,023	22,871	104	13,223	65
275 - 366	386	191	2	46,636	144	3,689	40	8,846	82	11,758	90	9,806	57
367 - 549	420	65,926	450	89,437	578	1,620	17	3,286	25	6,638	61	11,859	88
550 - 731	352	0	0	139	1	183	1	10,473	97	1,241	12	1,971	17
732 - 914	394	.	.	.	.	.	.	0	0	.	.	1,834	17
915 -1097	411	.	.	.	.	.	.	0	0	.	.	102	1
1098 -1280	491	.	.	.	.	.	.	0	0	.	.	7	0
1281 -1463	773	.	.	.	.	.	.	0	0	.	.	13	0
Total (000's)		92,073	533	518,358	1,514	97,588	427	838,098	3,360	44,030	272	44,847	270
Upper 95% limit		952,009	6,272	5,139,701	13,314	692,829	2,694	9,394,044	36,474	108,302	731	90,560	1,175
Lower 95% limit		-767,863	-5,206	-4,102,986	-10,285	-497,654	-1,840	-7,717,847	-29,754	-20,243	-188	-865	-635
%<184m		9	7	1	1	19	12	5	4	3	2	13	9
%184 - 549 m		91	93	99	99	80	88	93	93	94	94	78	78
%>549 m		0	0	0	0	0	0	1	3	3	4	9	13
						Outside 200 Nmi limit							
<=56	1,605	0	0	0	0	11	0	0	0	30	0	0	0
57 - 92	2,996	1,732	7	3,029	11	658	2	20	0	51	1	48	0
93 - 183	864	0	0	1,107	2	17,235	44	43,866	119	33	0	1,887	8
184 - 274	508	15,225	38	304,211	626	68,154	292	629,225	2,474	18,870	84	11,846	56
275 - 366	366	191	2	44,894	138	3,143	34	7,560	70	9,764	74	8,694	51
367 - 549	420	65,926	450	89,437	578	1,620	17	3,286	25	6,638	61	11,859	88
550 - 731	352	0	0	139	1	183	1	10,473	97	1,241	12	1,971	17
732 - 914	394	.	.	.	.	.	.	0	0	.	.	1,834	17
915 -1097	411	.	.	.	.	.	.	0	0	.	.	102	1
1098 -1280	491	.	.	.	.	.	.	0	0	.	.	7	0
1281 -1463	773	.	.	.	.	.	.	0	0	.	.	13	0
Total (000's)		83,073	497	442,817	1,356	91,005	391	694,430	2,786	36,627	232	38,262	240
Upper 95% limit		931,482	6,216	4,176,800	4,875	685,509	2,645	7,507,801	29,156	90,987	629	82,410	1,118
Lower 95% limit		-765,336	-5,222	-3,291,167	-2,164	-503,500	-1,863	-6,118,942	-23,585	-17,732	-164	-5,886	-638
%<184m		2	2	1	1	20	12	6	4	0	0	5	3
%184 - 549 m		98	98	99	99	80	88	92	92	96	95	85	82
%>549 m		0	0	0	0	0	0	2	3	3	5	10	15

Table 3 Total abundance (X 1000), biomass (Kg. X1000) of northern shrimp (*Pandalus borealis*) collected during the autumn 1995 - 2000 Canadian multi-species research surveys into NAFO Div. 3O. (All tows were standardized to 15 minutes; . means not sampled.).
Please note that these estimates were taken from strata numbers <784 so that estimates from all years would be comparable.

Depth	Area	Autumn 95		Autumn 96		Autumn 97		Autumn 98		Autumn 99		Autumn 2000	
Range in m	in Nmi2	WT 176, 177		Tel 41, 42 & AN 253		WT 212 & 213		WT 229, 230, WT 233, Tel 76		WT 244 - 246		WT 319, 320 WT 322 & Tel 338	
		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	12541	0	0	674.76	5.77	727.19	3.65	6847.29	18.52	1083.42	2.73	643.79	3.47
93 - 183	4775	2488.01	10.44	1128.85	2.13	4305.34	9.05	5586.12	14.19	1358.62	2.87	0	0
184 - 274	371	1874.57	20	80.75	0.74	705.04	3.68	4626.47	35.5	143.13	1.08	459.78	3.63
275 - 366	215	0	0	0	0	27.29	0.27	46.22	0.53	23.69	0.12	0	0
367 - 549	318	0	0	15.68	0.21	12.18	0.12	22.63	0.17	44.2	0.5	28.43	0.1
550 - 731	332	6.82	0.07	6.42	0.06	11.71	0.12	9.22	0.09	184.22	1.77	34.12	0.41
732 - 914	339	.	.	.	.	.	.	7.22	0.07	.	.	15.41	0.08
915 -1097	390	.	.	.	.	.	.	0	0	.	.	0	0
1098 -1280	407	.	.	.	.	.	.	.	.	.	.	0	0
1281 -1463	488	.	.	.	.	.	.	.	.	.	.	0	0
Total (000's)		4,369	31	1,906	9	5,789	17	17,145	69	2,837	9	1,182	8
Upper 95% limit		28,725	280	14,756	15	38,940	86	26,763	301	5,351	17	3,239	51
Lower 95% limit		-19,986	-219	-10,943	3	-27,362	-52	7,527	-163	325	1	-876	-36
%<184m		57	34	95	89	87	75	73	47	86	62	54	45
%184 - 549 m		43	66	5	11	13	24	27	52	7	19	41	49
%>549 m		0	0	0	1	0	1	0	0	6	20	4	6
						Outside 200 Nmi limit							
57 - 92	269	0	0	20	0	20	0	458	1	37	0	0	0
93 - 183	246	34	0	506	1	1,318	3	680	2	235	1	0	0
184 - 274	74	34	0	10	0	342	1	1,659	11	81	1	56	0
275 - 366	47	0	0	0	0	0	0	0	0	18	0	0	0
367 - 549	58	0	0	12	0	0	0	8	0	18	0	22	0
550 - 731	71	5	0	0	0	9	0	0	0	141	1	26	0
732 - 914	105	.	.	.	.	.	.	7	0	.	.	15	0
915 -1097	126	.	.	.	.	.	.	0	0	.	.	0	0
1098 -1280	147	.	.	.	.	.	.	.	.	.	.	0	0
1281 -1463	180	.	.	.	.	.	.	.	.	.	.	0	0
Total (000's)		73	1	548	1	1,688	4	2,813	15	530	3	119	1
Upper 95% limit		279	5	6,987	11	18,447	36	25,261	162	4,137	23	292	5
Lower 95% limit		-134	-4	-5,891	-8	-15,071	-28	-19,635	-133	-3,077	-17	-53	-4
%<184m		47	31	96	82	79	65	40	22	51	27	0	0
%184 - 549 m		46	61	4	19	20	32	59	78	22	29	65	36
%>549 m		7	9	0	0	1	2	0	0	27	44	35	63

Table 4 Total abundance (X 1000), biomass (Kg. X1000) of northern shrimp (*Pandalus borealis*) collected during the spring 1999 - 2001 Canadian multi-species research surveys into NAFO Div. 3L. (All tows were standardized to 15 minutes; . means not sampled.).
Please note that these estimates were taken from strata numbers <784 so that estimates from all years would be comparable.

Depth	Area	Spring 99		Spring 2000		Spring 2001	
Range in m	in Nmi2	WT 240 & 241		WT 317 & 318		WT 365 & WT 367 - 370	
		abundance	biomass	abundance	biomass	abundance	biomass
		(x 1000)	(Kg X 1000)	(x 1000)	(Kg X 1000)	(x 1000)	(Kg X 1000)
30 - 56	9285	0	0	.	.	0	0
57 - 92	18957	123	1	40	0	45	0
93 - 183	7170	6,004	29	25,633	54	10,726	41
184 - 274	399	3,197,714	13,247	14,036,717	63,616	3,489,745	16,314
275 - 366	4030	9,158,773	40,320	10,359,484	54,779	21,356,705	86,018
367 - 549	1192	27,134	248	110,186	1,023	102,197	906
550 - 731	804	15,963	88	5,539	50	12,716	98
732 - 914	957	.	.	.	.	.	.
915 -1097	945	.	.	.	.	.	.
1098 -1280	1745	.	.	.	.	.	.
1281 -1463	773	.	.	.	.	.	.
Total (000's)		12,405,970	53,934	24,535,333	119,521	24,975,809	103,378
Upper 95% limit		21,924,774	96,644	104,192,465	257,005	35,965,001	142,843
Lower 95% limit		2,887,166	11,223	-55,121,800	-17,963	13,986,617	63,913
%<184m		0	0	0	0	0	0
%184 - 549 m		100	100	100	100	100	100
%>549 m		0	0	0	0	0	0
				Outside 200 Nmi limit			
93 - 183	933	491	1	279	1	155	1
184 - 274	791	1,160,062	6,284	3,980,018	21,186	133,867	722
275 - 366	758	1,588,698	8,192	2,424,460	14,212	3,895,114	17,131
367 - 549	636	19,408	170	73,282	681	90,285	796
550 - 731	554	15,374	83	5,137	48	8,465	65
732 - 914	607	.	.	.	.	.	.
915 -1097	582	.	.	.	.	.	.
1098 -1280	1331	.	.	.	.	.	.
1281 -1463	295	.	.	.	.	.	.
Total (000's)		2,780,533	14,731	6,488,871	36,127	4,123,688	18,714
Upper 95% limit		7,145,264	37,178	57,253,651	301,999	31,466,669	125,743
Lower 95% limit		-1,584,198	-7,717	-44,275,909	-229,746	-23,219,293	-88,315
%<184m		0	0	0	0	0	0
%184 - 549 m		100	99	100	100	100	100
%>549 m		1	1	0	0	0	0

Table 5 Total abundance (X 1000), biomass (Kg. X1000) of northern shrimp (*Pandalus borealis*) collected during the spring 1999 - 2001 Canadian multi-species research surveys into NAFO Div. 3N. (All tows were standardized to 15 minutes; . means not sampled.).

Please note that these estimates were taken from strata numbers <784 so that estimates from all years would be comparable.

Depth	Area	Spring 99		Spring 2000		Spring 2001	
Range in m	in Nmi2	WT 238 - 240		WT 316 & 317		WT 367 - 369	
		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	0	0
57 - 92	11,490	804	3	45	0	176	2
93 - 183	1,168	87,864	101	142	1	347	1
184 - 274	546	67,373	231	158,291	319	2,341	5
275 - 366	386	117,656	940	305,982	1,886	7,742	43
367 - 549	420	10,200	74	4,678	40	474	3
550 - 731	352	47	0	114	1	0	0
732 - 914	394	.	.	.	.	.	
915 -1097	411	.	.	.	.	.	
1098 -1280	491	.	.	.	.	.	
1281 -1463	773	.	.	.	.	.	
Total (000's)		283,943	1,349	469,254	2,248	11,081	53
Upper 95% limit		862,737	11,209	4,430,958	24,096	47,633	278
Lower 95% limit		-294,852	-8,511	-3,492,450	-19,601	-25,471	-171
%<184m		31	8	0	0	5	4
%184 - 549 m		69	92	100	100	95	96
%>549 m		0	0	0	0	0	0
				Outside 200 Nmi limit			
<=56	1605	0	0	0	0	0	0
57 - 92	2996	10	0	0	0	0	0
93 - 183	864	87,864	101	75	1	347	1
184 - 274	508	63,910	220	128,087	260	1,981	4
275 - 366	366	116,431	932	303,944	1,876	6,545	37
367 - 549	420	10,200	74	4,678	40	474	3
550 - 731	352	47	.	114	1	0	0
732 - 914	394	.		0	0	0	0
915 -1097	411	.		0	0	0	0
1098 -1280	491	.		0	0	0	0
1281 -1463	773	.		0	0	0	0
Total (000's)		278,461	1,327	436,899	2,178	9,347	45
Upper 95% limit		856,035	11,176	4,236,408	23,915	39,743	232
Lower 95% limit		-299,112	-8,523	-3,362,610	-19,559	-21,049	-143
%<184m		32	8	0	0	4	1
%184 - 549 m		68	92	100	100	96	99
%>549 m		0	0	0	0	0	0

Table 6 Total abundance (X 1000), biomass (Kg. X1000) of northern shrimp (*Pandalus borealis*) collected during the spring 1999 - 2001 Canadian multi-species research surveys into NAFO Div. 3O. (All tows were standardized to 15 minutes; . means not sampled.).
Please note that these estimates were taken from strata numbers <784 so that estimates from all years would be comparable.

Depth	Area	Spring 99		Spring 2000		Spring 2001	
Range in m	in Nmi2	WT 238 & 239		WT 316 - 317		WT 365, 367 & WT 368	
		abundance (x 1000)	biomass (Kg X 1000)	abundance (x 1000)	biomass (Kg X 1000)	abundance (x 1000)	biomass (Kg X 1000)
57 - 92	12541	126	0	0	0	1,037	3
93 - 183	4775	8,592	12	508	1	3,540	13
184 - 274	371	2,528	11	2,269	7	486	2
275 - 366	215	1,097	8	3,983	29	7	0
367 - 549	318	298	3	264	2	263	2
550 - 731	332	0	0	797	7	0	0
732 - 914	339	.	.	.	.	.	.
915 -1097	390	.	.	.	.	.	.
1098 -1280	407	.	.	.	.	.	.
1281 -1463	488	.	.	.	.	.	.
Total (000's)		12,642	34	7,823	46	5,332	20
Upper 95% limit		35,594	63	61,843	399	27,536	99
Lower 95% limit		-10,311	5	-46,198	-307	-16,872	-60
%<184m		69	37	6	3	86	81
%184 - 549 m		31	63	83	83	14	19
%>549 m		0	0	10	14	0	0
				Outside 200 Nmi limit			
57 - 92	269	0	0	0	0	0	0
93 - 183	246	0	0	0	0	0	0
184 - 274	74	0	0	29	0	54	0
275 - 366	47	0	0	0	0	0	0
367 - 549	58	0	0	133	1	201	1
550 - 731	71	0	0	603	5	0	0
732 - 914	105	.	.	.	.	.	.
915 -1097	124	.	.	.	.	.	.
1098 -1280	147	.	.	.	.	.	.
1281 -1463	180	.	.	.	.	.	.
Total (000's)		0	0	764	6	255	2
Upper 95% limit		0	0	8,498	69	2,582	17
Lower 95% limit		0	0	-6,970	-58	-2,073	-14
%<184m		0	0	0	0	0	0
%184 - 549 m		0	0	21	15	100	100
%>549 m		0	0	79	85	0	0

Table 7 NAFO divisions 3LNO *Pandalus borealis* biomass estimates for entire divisions and outside the 200 Nmi limit. Shrimp were collected during the autumn Canadian multi-species surveys using a Campelen 1800 shrimp trawl. (15 minute standard tows.)

					Outside 200 Nmi limit		
Season	Year	Division	Entire Division biomass estimate (Kg x 1000)	Percent by division	Biomass estimate (Kg x 1000)	Percent biomass by division	Percent of biomass
fall	1995	3L	5,358	90.49	1,039	67.63	19.40
fall	1996	3L	18,566	92.42	4,506	76.86	24.27
fall	1997	3L	45,758	99.04	5,115	92.83	11.18
fall	1998	3L	56,485	94.28	8,707	75.66	15.42
fall	1999	3L	52,863	99.47	8,734	97.38	16.52
fall	2000	3L	117,902	99.77	28,447	99.16	24.13
fall	1995	3N	533	9.00	497	32.34	93.29
fall	1996	3N	1,514	7.54	1,356	23.12	89.52
fall	1997	3N	427	0.92	391	7.09	91.52
fall	1998	3N	3,360	5.61	2,786	24.21	82.91
fall	1999	3N	272	0.51	232	2.59	85.57
fall	2000	3N	270	0.23	240	0.84	88.80
fall	1995	3O	31	0.52	1	0.04	1.82
fall	1996	3O	9	0.04	1	0.02	12.50
fall	1997	3O	17	0.04	4	0.07	23.79
fall	1998	3O	69	0.12	15	0.13	21.23
fall	1999	3O	9	0.02	3	0.03	33.59
fall	2000	3O	8	0.01	1	0.00	8.02
	all divisions						
fall	1995		5,921		1,537		25.96
fall	1996		20,089		5,862		29.18
fall	1997		46,202		5,509		11.92
fall	1998		59,914		11,508		19.21
fall	1999		53,144		8,969		16.88
fall	2000		118,180		28,687		24.27

Table 8 NAFO divisions 3LNO *Pandalus borealis* biomass estimates for entire divisions and outside the 200 Nmi limit. Shrimp were collected during the spring Canadian multi-species surveys using a Campelen 1800 shrimp trawl. (15 minute standard tows.)

					Outside 200 Nmi limit		
Season	Year	Division	Entire Division biomass estimate (Kg x 1000)	Percent by division	Biomass estimate (Kg x 1000)	Percent biomass by division	Percent of biomass
spring	1999	3L	53,934	97.50	14,731	91.74	27.31
spring	2000	3L	119,521	98.12	36,127	94.30	30.23
spring	2001	3L	103,378	99.93	18,714	99.75	18.10
spring	1999	3N	1,349	2.44	1,327	8.26	98.34
spring	2000	3N	2,248	1.85	2,178	5.68	96.88
spring	2001	3N	53	0.05	45	0.24	83.89
spring	1999	3O	34	0.06	0	0.00	0.00
spring	2000	3O	46	0.04	6	0.02	12.77
spring	2001	3O	20	0.02	2	0.01	7.84
	all divisions						
spring	1999		55,317		16,057		29.03
spring	2000		121,815		38,310		31.45
spring	2001		103,451		18,761		18.13

Table 9 Abundance (000's) of male northern shrimp (*Pandalus borealis)*collected in NAFO Div. 3LNO during autumn Canadian research surveys during 1995 - 2000. The data were taken from strata <784 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 & 58	Autumn 1998 WT 229 - 233 Tel 75 & 76	Autumn 1999 WT 244 - 248	Autumn 2000 WT 319 - 323, Tel 338, 339, 342 & Tel 343
5.5	0	0	855	0	0	0
6.0	0	0	0	0	0	0
6.5	0	111	0	0	0	0
7.0	382	55	0	47	1,276	0
7.5	4,492	548	3,341	71	4,290	18,215
8.0	270	2,178	1,542	804	5,582	5,696
8.5	4,848	6,509	6,875	60,601	20,487	91,357
9.0	27,395	9,910	21,185	162,470	15,644	150,098
9.5	62,014	31,303	62,256	329,427	30,214	229,876
10.0	134,066	36,438	68,030	640,705	65,922	421,556
10.5	165,074	27,124	104,909	803,347	78,823	432,442
11.0	204,882	28,566	97,314	688,029	76,732	304,061
11.5	125,333	47,621	71,023	467,599	75,651	176,027
12.0	75,757	76,101	40,746	172,256	34,346	93,780
12.5	33,682	86,904	34,673	121,814	48,364	128,345
13.0	22,484	99,708	27,764	63,981	71,854	343,253
13.5	24,914	127,367	38,460	92,604	134,311	788,552
14.0	20,856	235,167	77,113	135,430	242,200	1,201,742
14.5	16,247	368,703	191,153	270,428	396,076	1,705,726
15.0	23,272	619,513	403,670	443,520	780,197	1,754,548
15.5	32,890	727,877	633,475	471,543	1,222,507	1,688,485
16.0	44,575	652,349	743,964	459,915	1,326,686	1,327,051
16.5	38,401	445,760	496,225	415,527	966,914	1,398,609
17.0	41,682	280,750	472,840	436,950	492,181	1,908,443
17.5	29,305	184,004	476,973	579,364	306,399	2,901,654
18.0	16,164	210,944	576,167	842,287	346,026	3,400,956
18.5	12,839	212,870	790,144	997,213	468,133	2,259,814
19.0	21,104	256,541	720,103	1,061,021	485,986	1,617,071
19.5	16,056	251,255	656,060	975,338	490,523	1,031,449
20.0	16,756	150,181	380,955	875,327	519,131	694,549
20.5	13,294	80,541	255,787	733,217	512,787	555,935
21.0	10,476	77,822	116,219	500,967	493,872	398,602
21.5	8,238	38,332	62,912	345,670	331,419	404,183
22.0	4,862	33,114	15,121	130,505	193,324	211,379
22.5	2,547	26,946	8,466	27,672	120,117	101,683
23.0	1,248	17,019	592	15,252	34,878	56,800
23.5	248	10,842	416	1,236	25,468	12,853
24.0	104	3,428	69	23	3,528	4,857
24.5	54	1,427	0	0	1,820	20
25.0	54	0	0	0	0	0
25.5	0	0	0	0	0	0
26.0	0	0	0	0	0	0
26.5	0	0	0	0	0	0
27.0	0	0	0	0	0	0
27.5	0	0	0	0	0	0
28.0	0	0	0	0	0	0
28.5	0	0	0	0	0	0
29.0	0	0	0	0	0	0
29.5	0	0	0	0	0	0
30.0	0	0	0	0	0	0
30.5	0	0	0	0	0	0
31.0	0	0	0	0	0	0
31.5	0	0	0	0	0	0
32.0	0	0	0	0	0	0
Total (000's)	1,256,864	5,465,828	7,657,395	13,322,160	10,423,664	27,819,667
Upper 95% limit	2,386,779	9,122,011	10,393,910	17,507,324	13,237,807	33,599,699
Lower 95% limit	126,949	1,809,644	4,920,880	9,136,997	7,609,522	22,039,635

Table 10 Abundance (000's) of transitional northern shrimp *(Pandalus borealis)* collected in NAFO Div. 3LNO during autumn Canadian research surveys during 1995 - 2000. The data were taken from strata <784 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 & 58	Autumn 1998 WT 229 - 233 Tel 75 & 76	Autumn 1999 WT 244 - 248	Autumn 2000 WT 319 - 323, Tel 338, 339, 342 & Tel 343
5.5	0	0	0	0	0	0
6.0	0	0	0	0	0	0
6.5	0	0	0	0	0	0
7.0	0	0	0	0	0	0
7.5	0	0	0	0	0	0
8.0	0	0	0	0	0	0
8.5	0	0	0	0	0	0
9.0	0	0	0	0	0	0
9.5	0	0	0	0	0	0
10.0	0	0	0	0	0	0
10.5	0	0	0	0	0	0
11.0	0	0	0	0	0	0
11.5	0	0	0	0	0	0
12.0	0	0	0	0	638	0
12.5	959	0	0	0	0	0
13.0	0	0	0	0	0	0
13.5	3,989	0	0	0	0	0
14.0	15,348	0	0	0	0	0
14.5	9,708	0	0	0	0	0
15.0	48,864	0	0	0	0	0
15.5	126,767	0	0	0	0	0
16.0	116,811	0	245	0	0	0
16.5	92,772	2,574	71	0	0	0
17.0	63,648	58	4,611	0	0	0
17.5	43,865	5,883	593	47	0	26
18.0	16,738	3,738	13,738	0	184	35,572
18.5	13,954	7,247	32,009	9,680	3,604	62,928
19.0	16,792	13,926	68,940	9,390	16,718	96,459
19.5	18,622	22,211	193,204	47,758	34,970	94,795
20.0	19,354	30,842	221,376	55,099	70,631	248,462
20.5	17,089	26,876	382,346	86,637	139,780	220,411
21.0	16,470	9,931	407,291	104,444	262,568	325,999
21.5	20,577	19,652	360,800	79,428	370,442	275,864
22.0	22,242	6,808	201,701	45,637	317,057	171,962
22.5	17,315	8,842	107,364	20,662	210,582	178,600
23.0	13,263	430	55,497	4,119	87,859	111,344
23.5	8,503	41	25,610	0	46,917	26,702
24.0	2,988	42	6,821	0	44,066	9,966
24.5	3,020	16	4,102	0	2,481	6,210
25.0	402	7	40	0	0	0
25.5	119	0	23	0	0	0
26.0	0	0	0	0	0	0
26.5	0	0	0	0	0	0
27.0	0	0	0	0	0	0
27.5	0	0	0	0	0	0
28.0	0	0	0	0	0	0
28.5	0	0	0	0	0	0
29.0	0	0	0	0	0	0
29.5	0	0	0	0	0	0
30.0	0	0	0	0	0	0
30.5	0	0	0	0	0	0
31.0	0	0	0	0	0	0
31.5	0	0	0	0	0	0
32.0	0	0	0	0	0	0
Total (000's)	730,177	159,123	2,086,380	462,900	1,608,499	1,865,301
Upper 95% limit	1,087,878	434,880	3,539,679	651,727	2,142,187	3,037,345
Lower 95% limit	372,475	-116,634	633,081	274,074	1,074,811	693,257

Table 11 Abundance (000's) of primiparous northern shrimp (*Pandalus borealis)* collected in NAFO Div. 3LNO during autumn Canadian research surveys during 1995 - 2000. The data were taken from strata <784 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 & 58	Autumn 1998 WT 229 - 233 Tel 75 & 76	Autumn 1999 WT 244 - 248	Autumn 2000 WT 319 - 323, Tel 338, 339, 342 & Tel 343
5.5	0	0	0	0	0	0
6.0	0	0	0	0	0	0
6.5	0	0	0	0	0	0
7.0	0	0	0	0	0	0
7.5	0	0	0	0	0	0
8.0	0	0	0	0	0	0
8.5	0	0	0	0	0	0
9.0	0	0	0	0	0	0
9.5	0	0	0	0	0	0
10.0	0	0	0	0	0	0
10.5	0	0	0	0	0	0
11.0	0	0	0	0	0	0
11.5	0	0	0	0	0	0
12.0	0	0	0	0	0	0
12.5	0	0	0	0	0	0
13.0	0	0	0	0	0	0
13.5	0	0	0	0	0	0
14.0	0	0	0	0	0	0
14.5	0	0	0	0	0	0
15.0	0	0	0	0	0	0
15.5	0	0	0	0	0	0
16.0	0	0	0	0	0	0
16.5	0	0	0	0	0	0
17.0	0	0	0	0	0	0
17.5	0	0	0	0	0	0
18.0	0	0	0	0	0	0
18.5	0	0	0	0	341	0
19.0	0	0	0	0	0	0
19.5	0	0	0	0	404	0
20.0	0	0	0	0	0	0
20.5	0	0	60	0	0	0
21.0	28	0	0	58	4,972	133
21.5	0	0	0	0	4,184	44
22.0	0	0	0	58	32	44
22.5	0	0	0	0	457	0
23.0	0	0	0	8	0	33
23.5	0	0	0	0	13	0
24.0	0	0	0	0	0	22
24.5	20	0	0	11	669	11
25.0	30	0	0	0	0	1,707
25.5	10	0	0	0	0	0
26.0	10	0	0	0	0	0
26.5	0	0	0	0	0	0
27.0	10	0	0	0	0	0
27.5	60	0	0	0	0	0
28.0	0	0	0	0	0	0
28.5	0	0	0	0	0	0
29.0	0	0	0	0	0	0
29.5	0	0	0	0	0	0
30.0	0	0	0	0	0	0
30.5	0	0	0	0	0	0
31.0	0	0	0	0	0	0
31.5	0	0	0	0	0	0
32.0	0	0	0	0	0	0
Total (000's)	169	0	60	135	11,073	1,995
Upper 95% limit	1,533	0	319	437	34,584	9,376
Lower 95% limit	-1,196	0	-198	-167	-12,438	-5,387

Table 12 Abundance (000's) of multiparous + ovigerous northern shrimp (*Pandalus borealis)* collected in NAFO Div. 3LNO during autumn Canadian research surveys during 1995 - 2000. The data were taken from strata <784 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 & 58	Autumn 1998 WT 229 - 233 Tel 75 & 76	Autumn 1999 WT 244 - 248	Autumn 2000 WT 319 - 323, Tel 338, 339, 342 & Tel 343
10.0	0	0	0	0	0	0
10.5	0	0	0	0	0	0
11.0	0	0	0	0	0	0
11.5	0	58	0	0	0	0
12.0	0	0	0	0	0	0
12.5	0	58	0	0	0	0
13.0	0	0	0	0	0	0
13.5	0	0	0	0	1,792	0
14.0	0	0	523	0	0	0
14.5	0	289	0	0	0	0
15.0	755	457	0	0	0	0
15.5	0	58	0	406	0	0
16.0	0	231	3,135	4,834	0	0
16.5	0	231	1,305	4,760	3,918	9,912
17.0	0	0	1,317	7,548	8,841	56
17.5	0	1,662	2,673	6,860	7,583	3,125
18.0	298	284	1,370	9,586	7,744	17,122
18.5	0	1,023	3,401	1,833	6,374	7,538
19.0	724	6,087	3,195	1,069	14,008	9,610
19.5	506	6	4,004	5,013	4,277	11,738
20.0	438	391	7,986	9,164	10,157	5,495
20.5	60	847	8,832	24,229	7,455	27,118
21.0	746	1,190	21,861	55,240	17,745	58,720
21.5	2,290	4,362	48,246	115,863	39,186	118,559
22.0	2,766	4,119	66,829	186,364	79,099	153,368
22.5	4,067	14,577	83,857	251,298	103,443	293,286
23.0	6,211	24,802	95,627	248,676	150,063	290,711
23.5	6,281	25,728	99,927	188,663	149,734	395,290
24.0	8,159	20,280	78,887	161,696	153,122	406,877
24.5	12,241	30,367	82,838	98,121	84,113	285,001
25.0	8,434	30,943	72,359	66,753	75,424	186,106
25.5	9,094	23,848	40,667	42,105	43,163	91,892
26.0	7,674	17,710	23,821	20,125	23,975	41,133
26.5	6,583	11,484	5,331	10,911	11,335	37,121
27.0	4,562	6,745	5,910	10,571	7,471	5,231
27.5	2,347	3,847	10,963	3,796	4,668	5,885
28.0	2,569	2,376	2,270	5,916	3,070	1,994
28.5	827	2,815	1,759	1,823	674	226
29.0	374	2,198	1,650	309	1,300	79
29.5	670	1,635	356	0	197	2,262
30.0	79	1,227	238	17	67	0
30.5	50	1,138	110	20	79	0
31.0	0	110	106	0	0	869
31.5	0	135	0	20	14	0
32.0	0	0	0	0	0	0
Total (000's)	88,805	243,314	781,349	1,543,586	1,020,090	2,466,323
Upper 95% limit	437,945	538,855	1,558,469	2,196,382	1,526,132	3,772,757
Lower 95% limit	-260,335	-52,227	4,230	890,789	514,049	1,159,889

Table 13. Abundance (000's) of male northern shrimp (*Pandalus borealis)* collected in NAFO Div. 3LNO during spring Canadian research surveys during 1999 - 2001. The data were taken from strata <784 so that all years would be comparable.

Length in mm	Spring 1999 WT 238 - 241	Spring 2000 WT 315 - 318	Spring 2001 WT 365 & WT 367-370
5.5	0	0	0
6.0	0	0	0
6.5	629	0	2,909
7.0	10,950	14,387	7,218
7.5	4,505	46,869	36,791
8.0	21,825	95,301	36,831
8.5	26,815	135,840	11,852
9.0	15,785	74,180	137
9.5	28,176	39,831	9,711
10.0	14,367	34,300	20,829
10.5	15,123	60,587	36,128
11.0	24,841	50,993	184,768
11.5	29,581	169,630	201,256
12.0	49,207	274,247	312,797
12.5	135,597	455,568	614,303
13.0	267,629	891,854	689,600
13.5	704,706	994,659	744,365
14.0	804,028	1,028,440	681,115
14.5	840,930	716,927	508,677
15.0	741,258	742,644	484,172
15.5	435,207	614,294	794,879
16.0	192,745	613,210	879,409
16.5	121,670	771,835	1,351,104
17.0	283,562	1,358,786	1,288,236
17.5	339,923	1,647,536	1,540,598
18.0	518,383	1,633,388	1,574,906
18.5	479,302	1,241,221	1,787,021
19.0	490,357	617,208	1,901,451
19.5	593,703	687,161	1,646,935
20.0	742,174	435,102	1,007,415
20.5	690,630	547,918	451,971
21.0	484,495	409,895	232,618
21.5	413,102	247,461	87,859
22.0	115,645	179,686	52,072
22.5	54,782	116,076	13,830
23.0	23,786	13,182	8,716
23.5	6,794	8,366	15,237
24.0	1,089	189	20
24.5	0	0	0
25.0	0	0	0
25.5	0	0	4,183
26.0	0	0	0
26.5	0	0	0
27.0	0	0	0
27.5	0	0	0
28.0	0	0	0
28.5	0	0	0
29.0	0	0	0
29.5	0	0	0
30.0	0	0	0
30.5	0	0	0
31.0	0	0	0
31.5	0	0	0
32.0	0	0	0
Total (000's)	9,723,302	16,968,771	19,221,917
Upper 95% limi	18,079,360	36,240,923	29,372,120
Lower 95% limit	1,367,243	-2,303,381	9,071,713

Table 14. Abundance (000's) of transitional + primiparous northern shrimp (*Pandalus borealis)* collected in NAFO Div. 3LNO during spring Canadian research surveys during 1999 - 2001. The data were taken from strata <784 so that all years would be comparable.

Length in mm	Spring 1999 WT 238 - 241	Spring 2000 WT 315 - 318	Spring 2001 WT 365 & WT 367-370
15.0	0	0	24
15.5	0	0	48
16.0	0	0	18,876
16.5	0	0	72
17.0	156	3,153	11,856
17.5	2,752	5,615	7,865
18.0	4	13,755	72
18.5	6,041	11	9,508
19.0	2,314	15,948	27,507
19.5	21,171	60,712	127,445
20.0	13,436	117,600	240,083
20.5	48,071	254,028	430,118
21.0	96,358	328,120	440,725
21.5	182,755	601,082	428,266
22.0	390,113	636,319	376,954
22.5	498,405	811,106	353,168
23.0	403,913	861,544	300,253
23.5	349,581	843,773	136,783
24.0	186,312	376,890	106,135
24.5	89,024	246,273	42,695
25.0	39,463	147,609	34,765
25.5	7,782	44,764	1,090
26.0	1,582	19,820	855
26.5	46	1,121	233
27.0	0	230	166
27.5	0	0	0
28.0	0	0	0
28.5	0	0	0
29.0	0	0	0
29.5	0	0	0
30.0	0	0	0
30.5	0	0	0
31.0	0	0	0
31.5	0	0	0
32.0	0	0	0
Total (000's)	2,339,278	5,389,472	3,095,561
Upper 95% limit	4,226,450	11,814,756	4,679,186
Lower 95% limit	452,105	-1,035,812	1,511,936

Table 15. Abundance (000's) of multiparous female northern shrimp (*Pandalus borealis)* collected in NAFO Div. 3LNO collected during spring Canadian research surveys during 1999 - 2001. The data were taken from strata <784 so that all years would be comparable.

Length in mm	Spring 1999 WT 238 - 241	Spring 2000 WT 315 - 318	Spring 2001 WT 365 & WT 367-370
13.5	0	0	7,841
14.0	0	0	0
14.5	0	0	0
15.0	0	3,153	0
15.5	0	0	0
16.0	0	0	0
16.5	0	0	2,651
17.0	257	0	14,678
17.5	4,309	22	12,677
18.0	6,357	24,194	2,789
18.5	6,452	19,307	4,349
19.0	10,509	18,883	18,738
19.5	2,204	14,316	24,397
20.0	2,723	22,939	36,402
20.5	2,296	36,349	13,971
21.0	10,165	36,223	33,853
21.5	3,274	152,084	76,698
22.0	30,850	217,812	198,811
22.5	42,180	288,943	208,581
23.0	61,102	313,496	355,800
23.5	87,701	384,192	394,153
24.0	110,767	406,985	385,222
24.5	78,498	315,907	317,600
25.0	60,813	160,699	205,871
25.5	60,492	94,144	155,861
26.0	23,344	58,375	91,204
26.5	11,183	48,109	57,053
27.0	4,979	19,528	21,661
27.5	8,045	5,589	4,161
28.0	2,968	3,358	13,606
28.5	3,230	3,077	1,304
29.0	1,148	2,604	1,022
29.5	581	254	437
30.0	327	363	0
30.5	52	36	0
31.0	212	57	0
31.5	0	62	0
32.0	0	36	0
Total (000's)	637,017	2,651,092	2,661,392
Upper 95% limit	889,555	9,114,943	3,504,433
Lower 95% limit	384,478	-3,812,759	1,818,350

Table 16. Abundance (000's) of ovigerous female northern shrimp (*Pandalus borealis)* collected in NAFO Div. 3LNO collected during spring Canadian research surveys during 1999 - 2001. The data were taken from strata <784 so that all years would be comparable.

Length in	Spring 1999	Spring 2000	Spring 2001
mm	WT 238 - 241	WT 315 - 318	WT 365 &
18.5	0	0	11,034
19.0	0	0	0
19.5	0	0	0
20.0	0	0	0
20.5	0	0	0
21.0	0	0	0
21.5	2,792	0	0
22.0	2,222	0	0
22.5	0	0	106
23.0	0	2,435	0
23.5	0	46	0
24.0	0	23	0
24.5	0	1,351	0
25.0	32	56	0
25.5	0	11	0
26.0	0	0	51
26.5	0	0	0
27.0	0	0	0
27.5	0	0	0
28.0	0	0	0
28.5	0	0	0
29.0	0	0	0
29.5	0	0	0
30.0	0	0	0
30.5	0	0	0
31.0	0	0	0
31.5	0	0	0
32.0	0	0	0
Total (000's)	5,046	3,921	11,191
Upper 95% limi	17,120	12,743	151,399
Lower 95% limit	-7,028	-4,901	-129,016

Table 17 Estimated shrimp mortalities in NAFO divisions 3LNO based upon Canadian multi-species survey data

	Time (t1)					Time (t2)	Z
Year		Age 4			Age 5	Total	
	males	transitionals		primiparous	multiparous		
1995		118,259		169	88,805		
1996		38,024		0	243,314	207,233	-0.16
1997		2,086,380		60	781,349	281,338	-1.02
1998		462,900		135	1,543,586	2,867,789	0.62
1999	2,566,931	1,608,499		11,073	1,020,090	2,006,621	0.68
2000	3,266,029	496,170	1,182,601	1,995	2,466,323	5,206,593	0.75

Estimated shrimp mortalities in NAFO divisions 3LNO based upon autumn and spring Canadian multi-species survey data

Year	Time (t1) multiparous & ovigerous	Time (t2)	Z
1998	1,543,586		
1999	1,020,090	637,017	0.89
2000	2,466,323	2,651,092	-0.96
2001		2,661,392	-0.08

Estimated shrimp mortalities in NAFO divisions 3LNO based upon data from consecutive spring Canadian multi-species survey data.

Year	Time (t1) transitionals, primiparous multiparous ovigerous	Time (t2) multiparous	Z
1999	2,981,341		
2000	8,044,485	2,651,092	0.12
2001		2,661,392	1.11

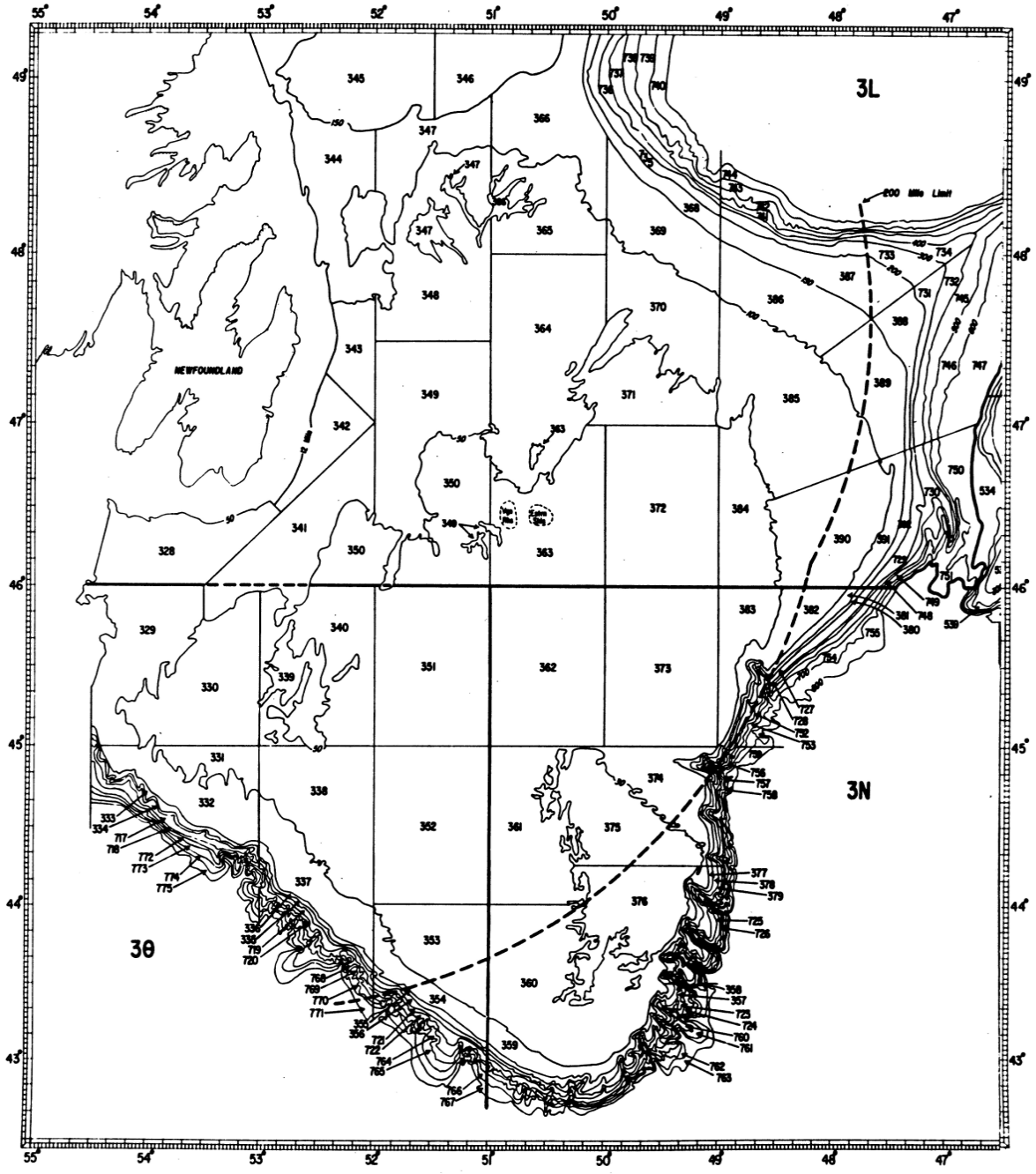

Fig. 1. Stratified area for Canadian research trawl surveys in NAFO Div. 3LNO.

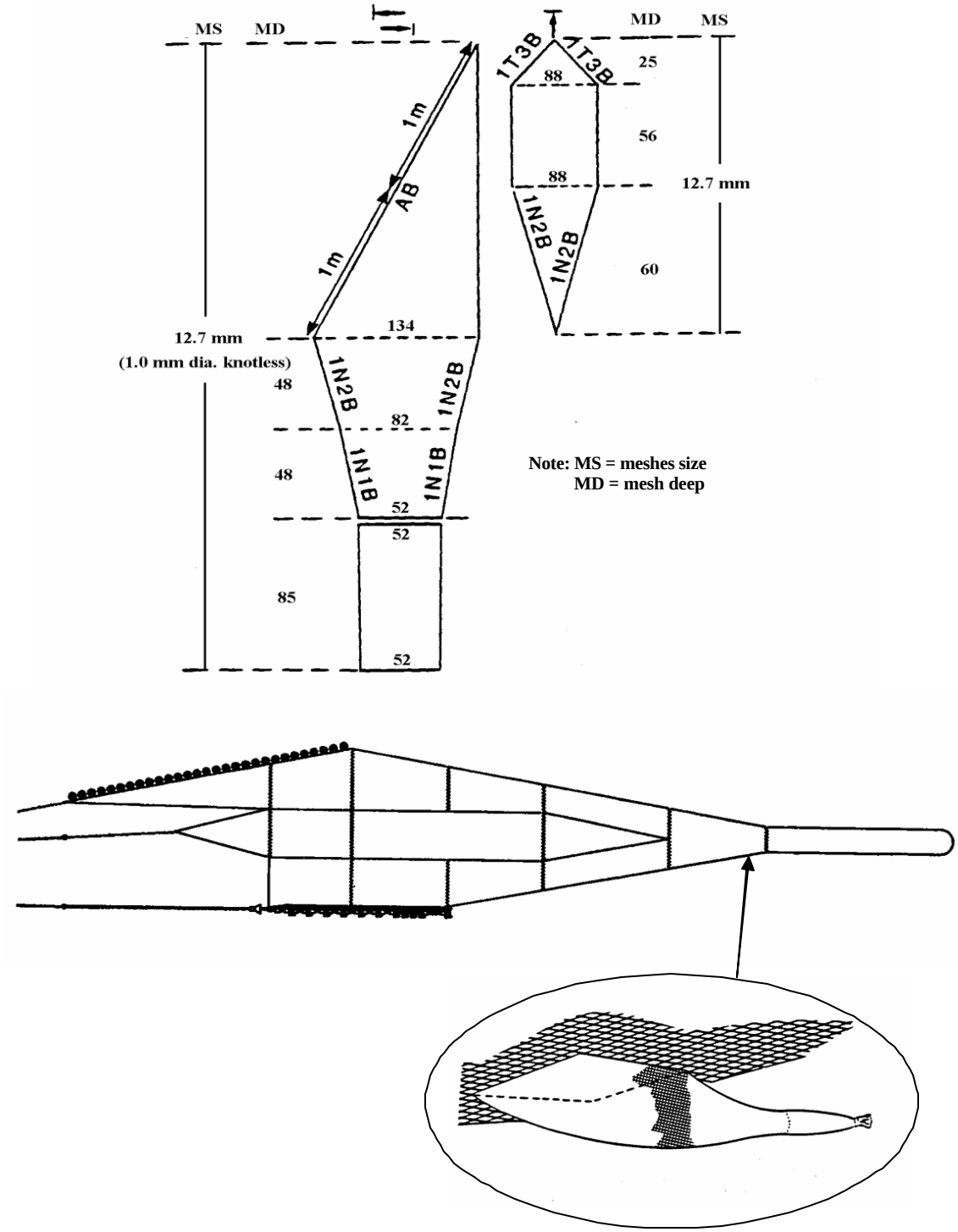

Fig. 2. Campelen 1800 trawl fitted with a juvenile shrimp net 1.0 m forward of the join between the codend and the extension (modified from Nilssen *et al.*, 1986).

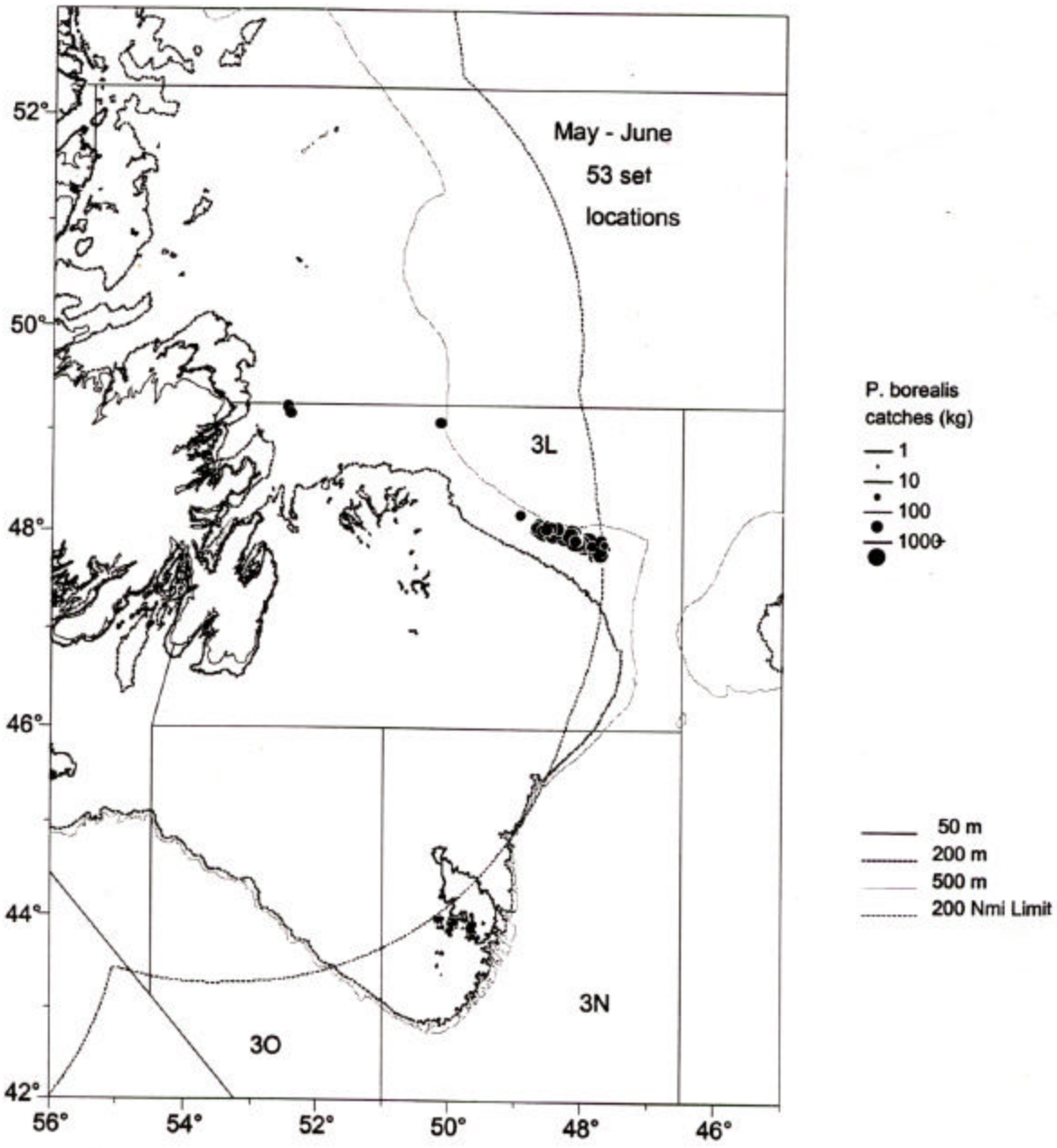

Fig. 3. Distribution of inshore commercial shrimp vessel catches during 2000. (Note this represents 2.19% observer coverage of the inshore shrimp fishing activities within Div. 3L.)

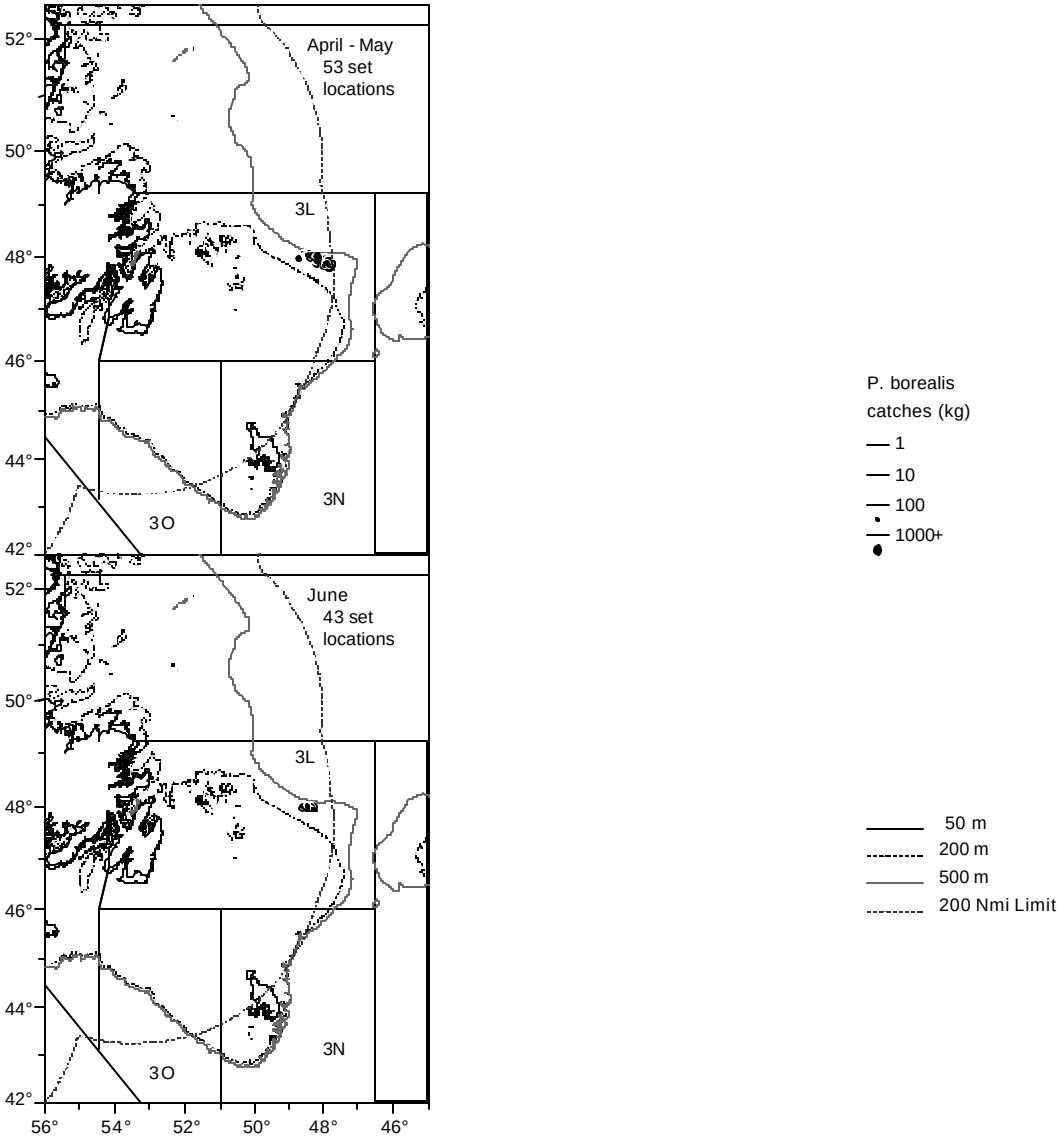

Fig. 4. Distribution of inshore commercial shrimp vessel catches during 2001. (Note this represents 1.89% observer coverage of the inshore shrimp fishing activities in Div. 3L.)

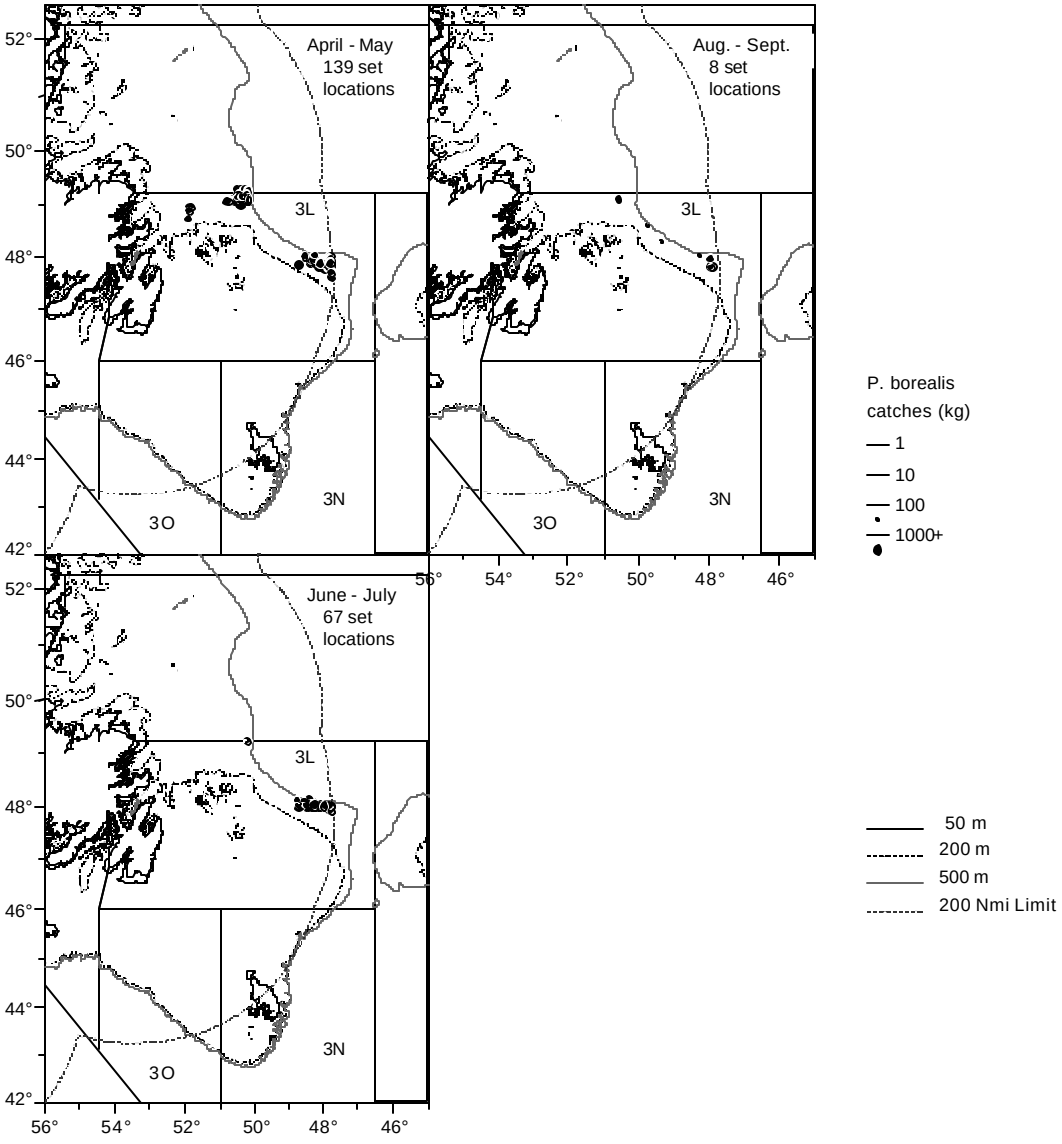

Fig. 5. Distribution of offshore commercial shrimp vessel catches during 2000. (Note this represents 84.65% observer coverage of the offshore shrimp fishing activities in Div. 3L.)

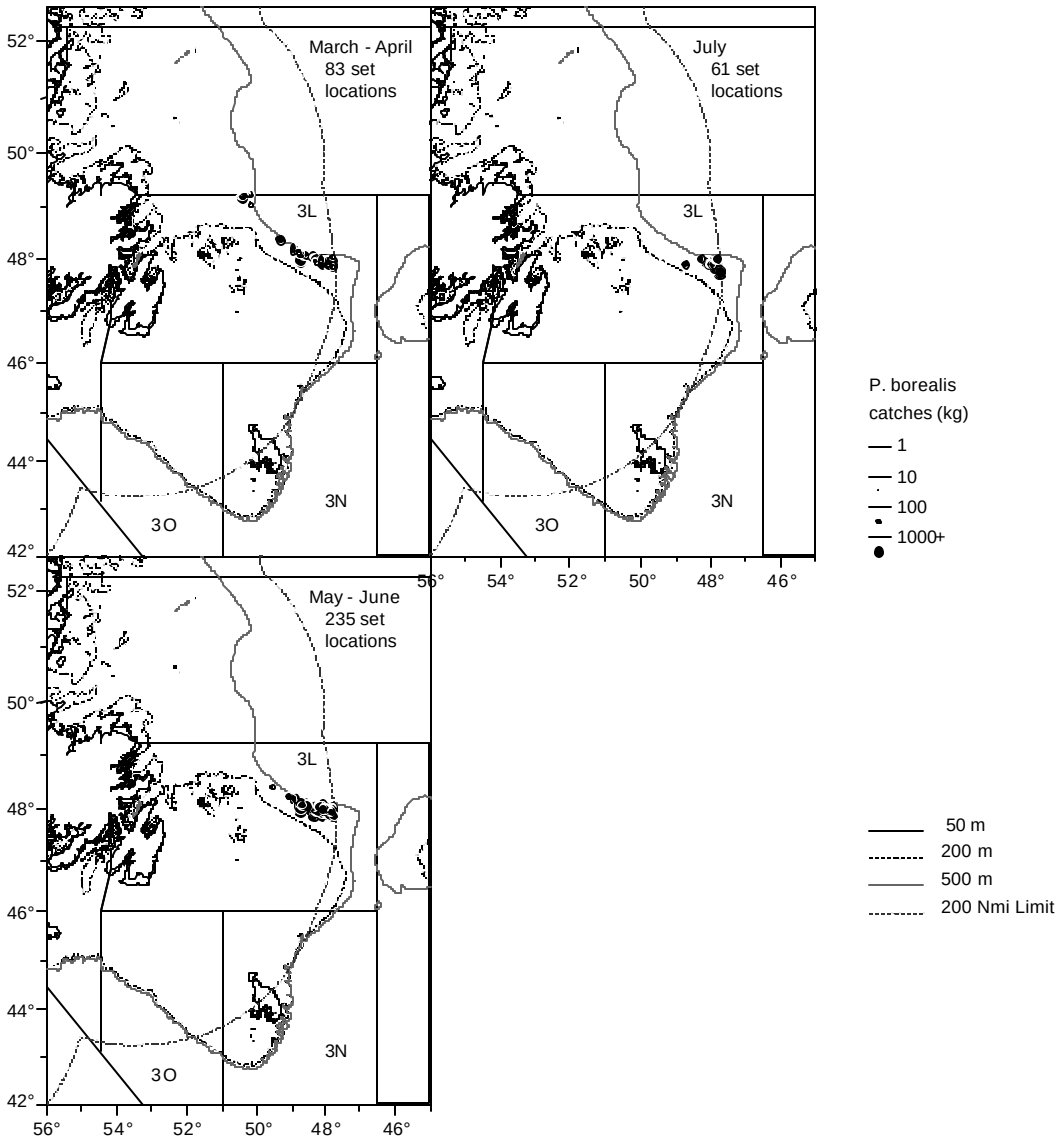

Fig. 6. Distribution of offshore commercial shrimp vessel catches during 2001. (Note this represents 93.2% observer coverage of the offshore shrimp fishing activities in Div. 3L.)

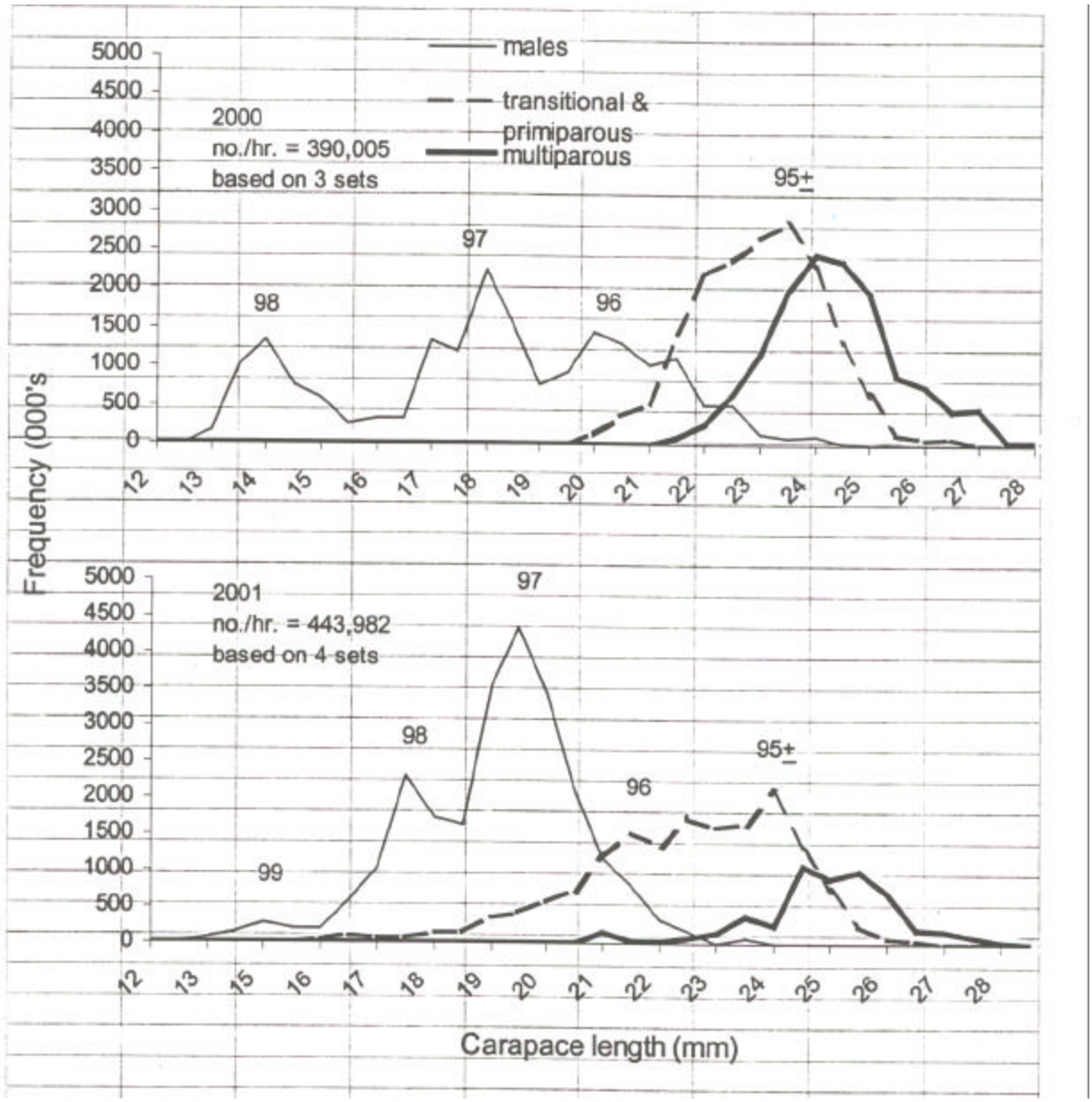

Fig. 7. Canadian small vessel (<500 ton; <100') catches in numbers per hour (000's) taken from NAFO Div. 3L during May-Jun 2000 and 2001.

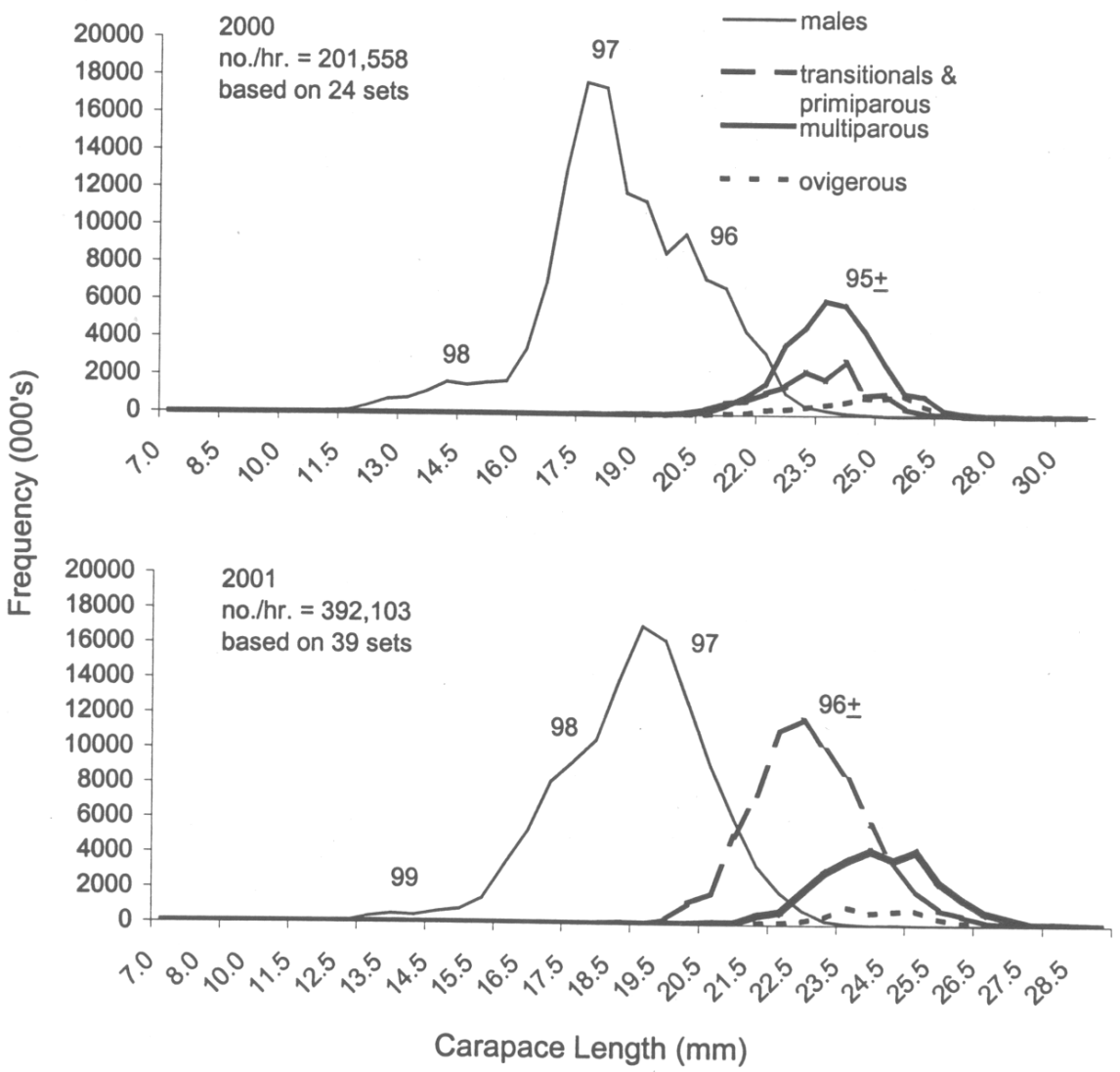

Fig. 8. Canadian large vessel (=>500 ton) catches in numbers per hour (000's) taken from NAFO Div. 3L during Mar-Sep 2000 and 2001.

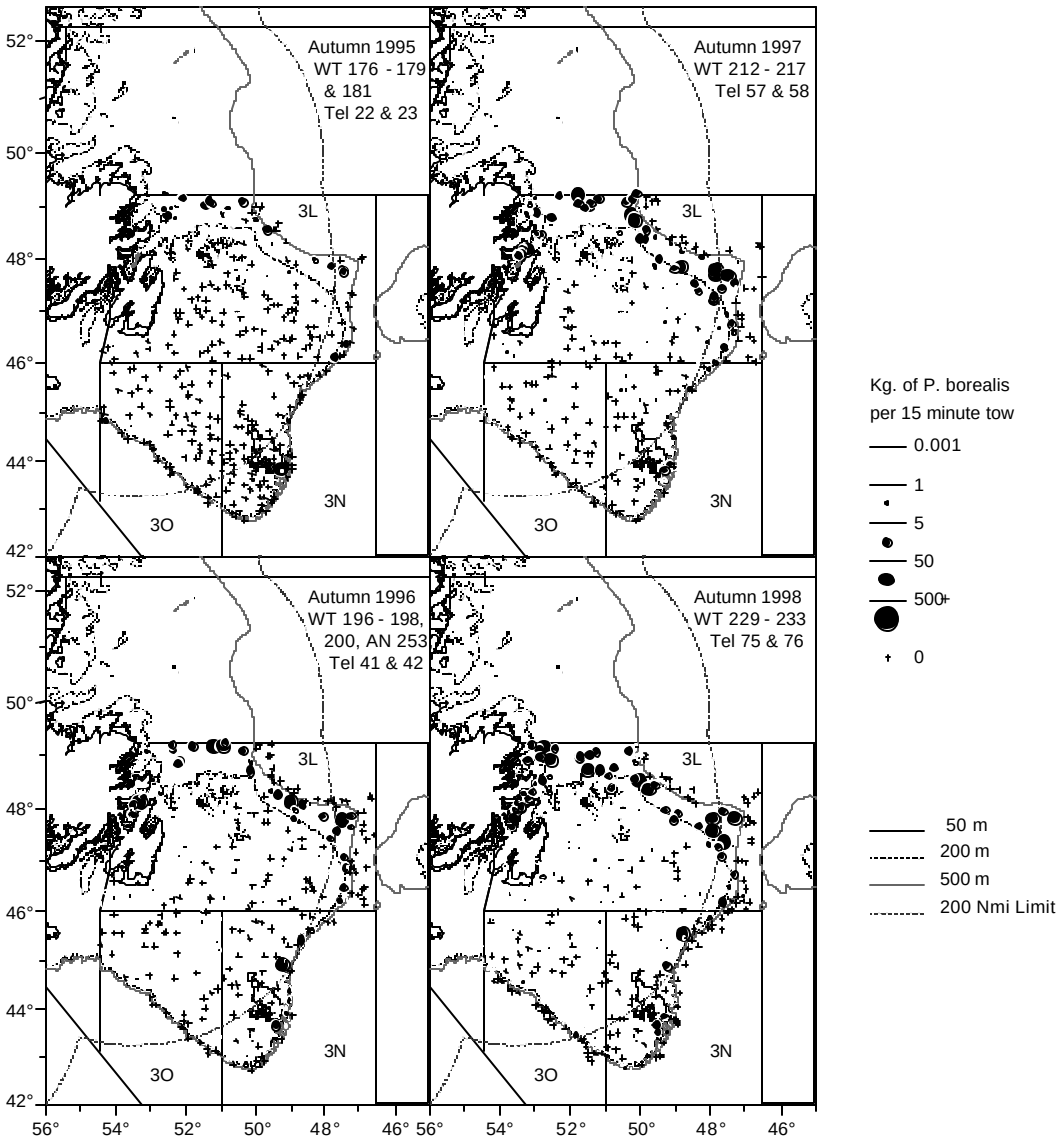

Fig. 9. Distribution of *Pandalus borealis* collected during Canadian 1995-98 autumn multi-species research surveys. (Catches were made with a Campelen 1800 shrimp trawl.)

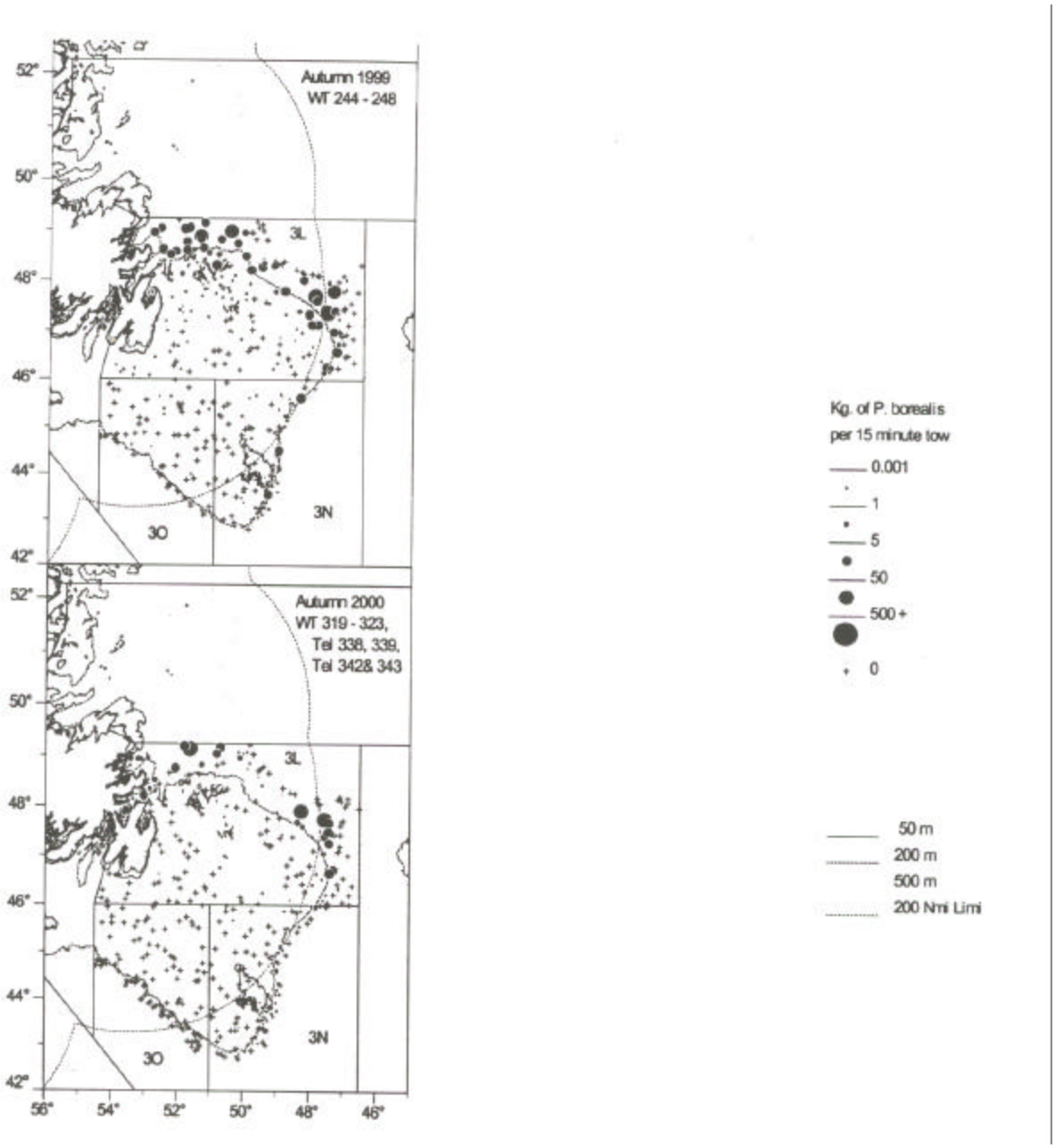

Fig. 10. Distribution of *Pandalus borealis* collected during Canadian 1999-00 autumn multi-species research surveys. (Catches were made with a Campelen 1800 shrimp trawl.)

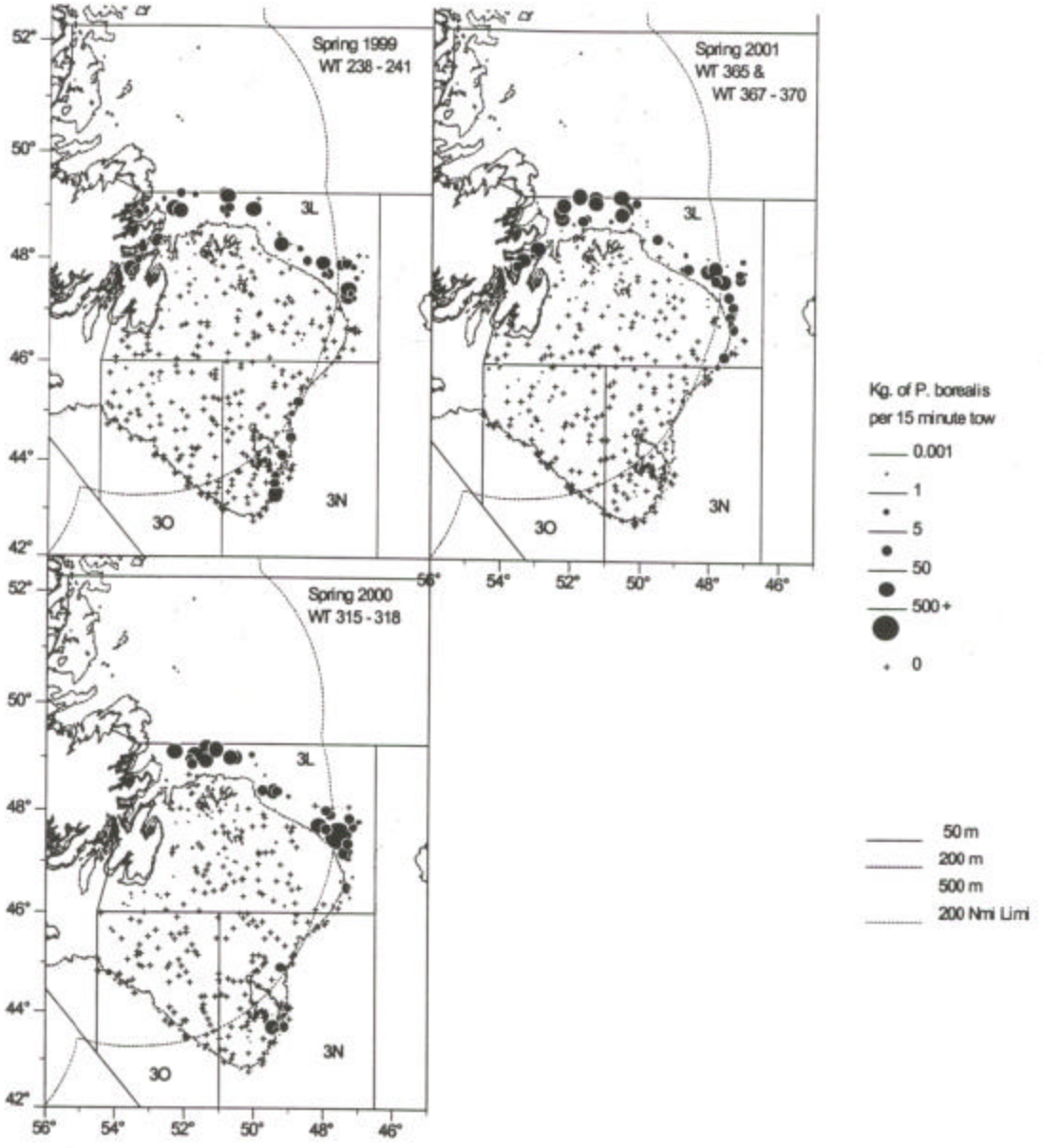

Fig. 11. Distribution of *Pandalus borealis* collected during Canadian 1999-01 spring multi-species research surveys. (Catches were made with a Campelen 1800 shrimp trawl.)

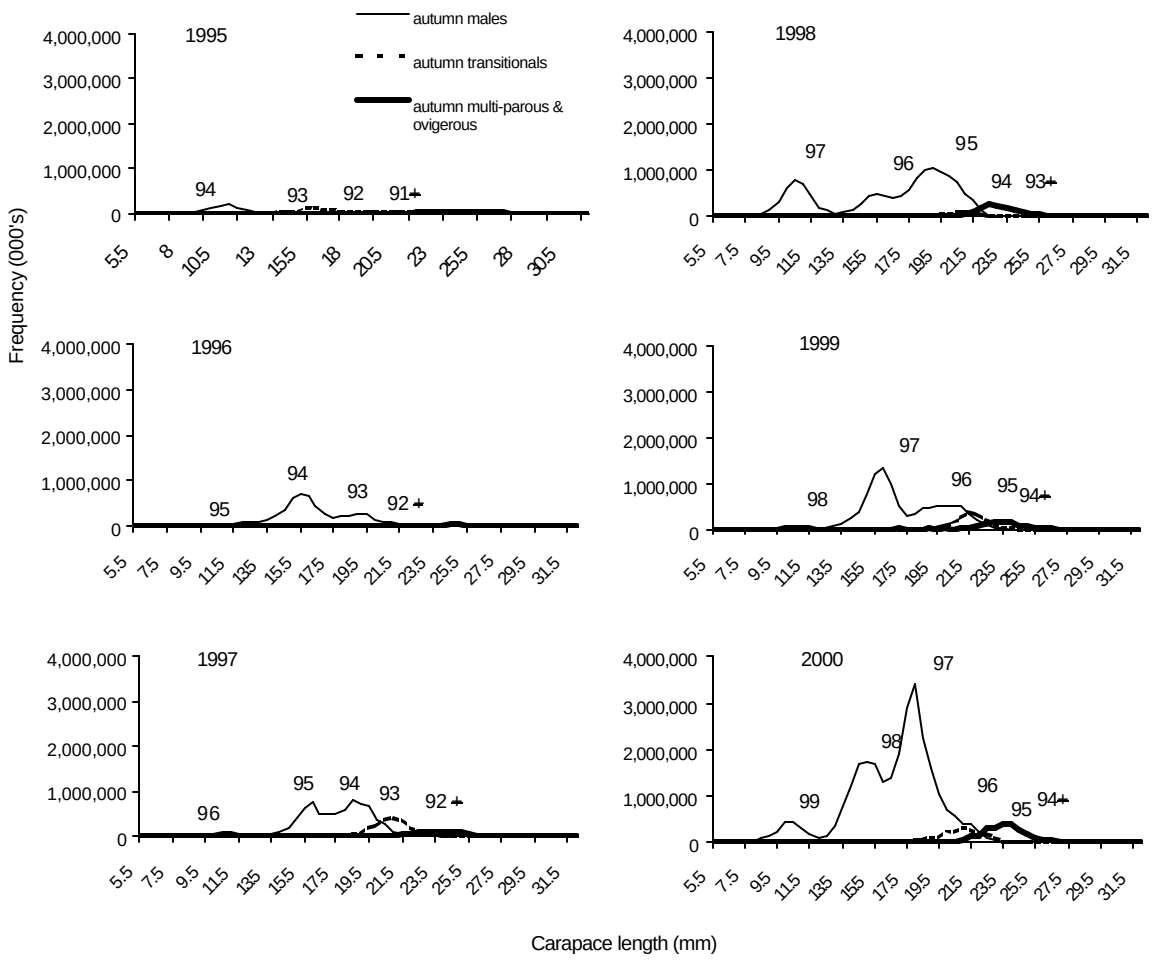

Fig. 12. Population estimates (000's) at length of *Pandalus borealis* collected in Div. 3LNO during Canadian autumn multi-species surveys. (Tows standardized to 15 min.)

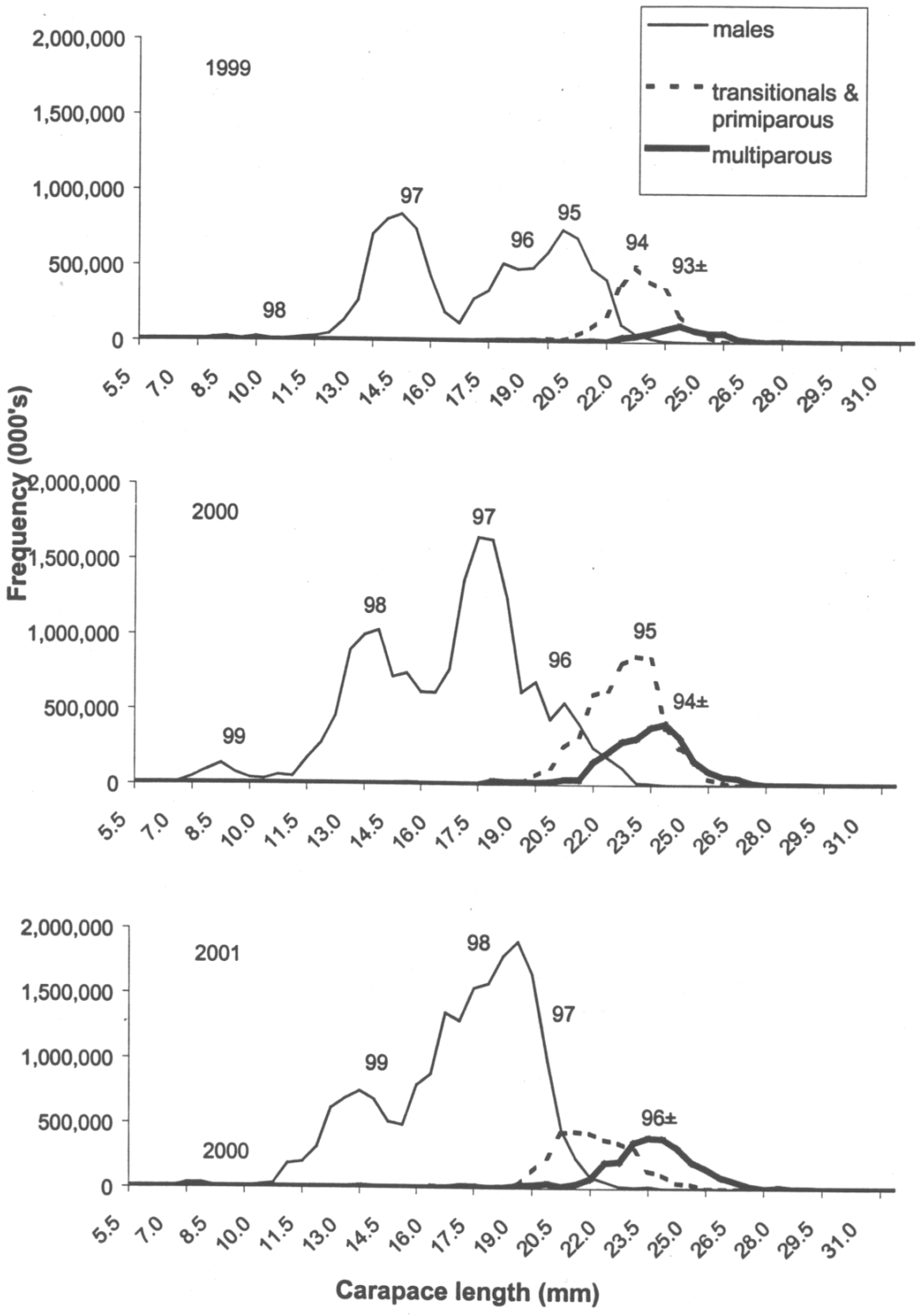

Fig. 13. Population estimates (000's) at length of *P. borealis* collected in Div. 3LNO during spring 1999-2001 multi-species surveys using a Campelen 1800 shirmp trawl. (Tows standardized to 15 min.)

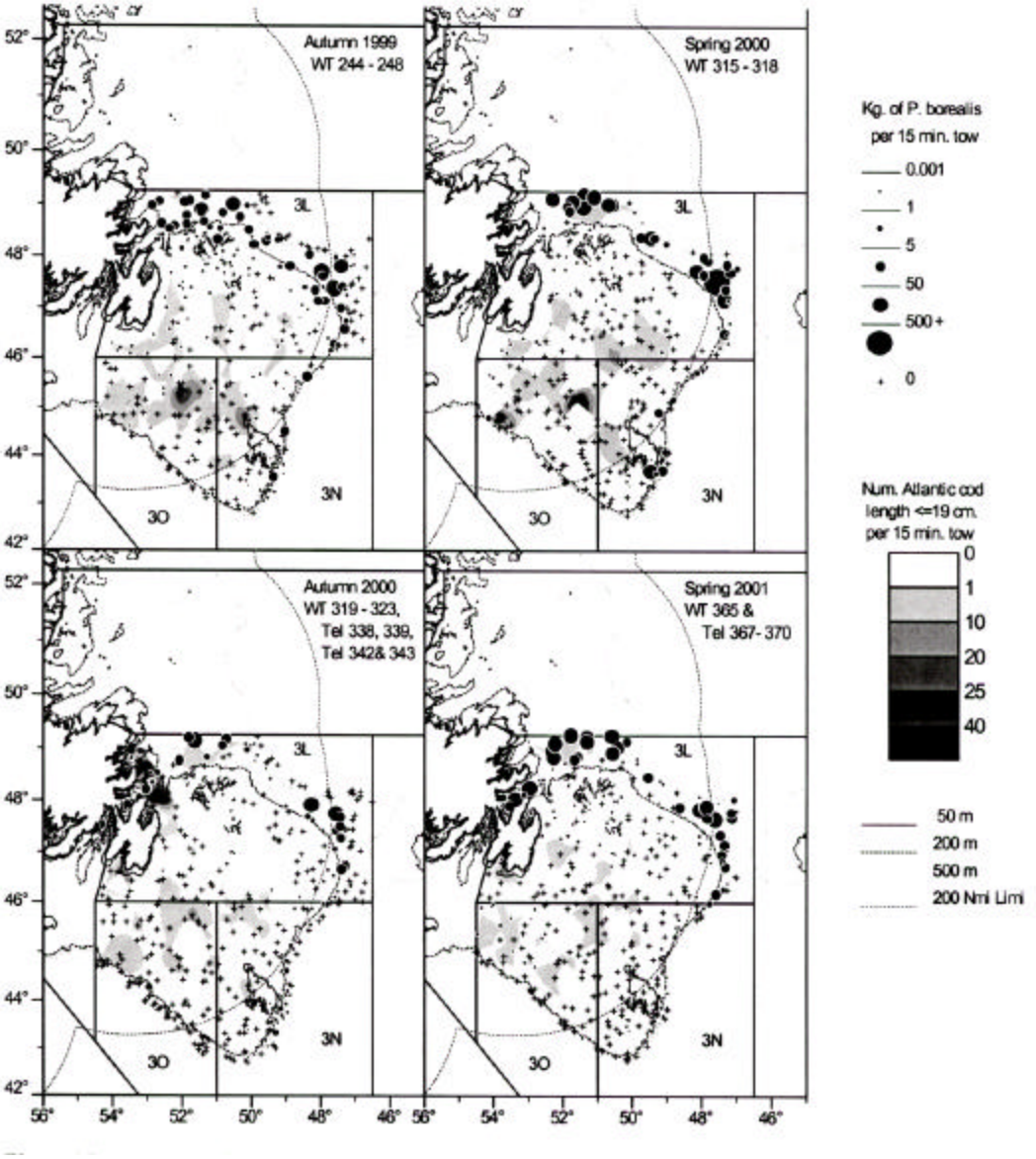

Fig.14. Distribution of northern shrimp in relation to Atlantic cod with lengths <=19 cm, collected during Canadian autumn 1999-spring 2001 multi-species research surveys. (Catches were made with a Campelen 1800 shrimp trawl, tows were standardized to 15 min.)

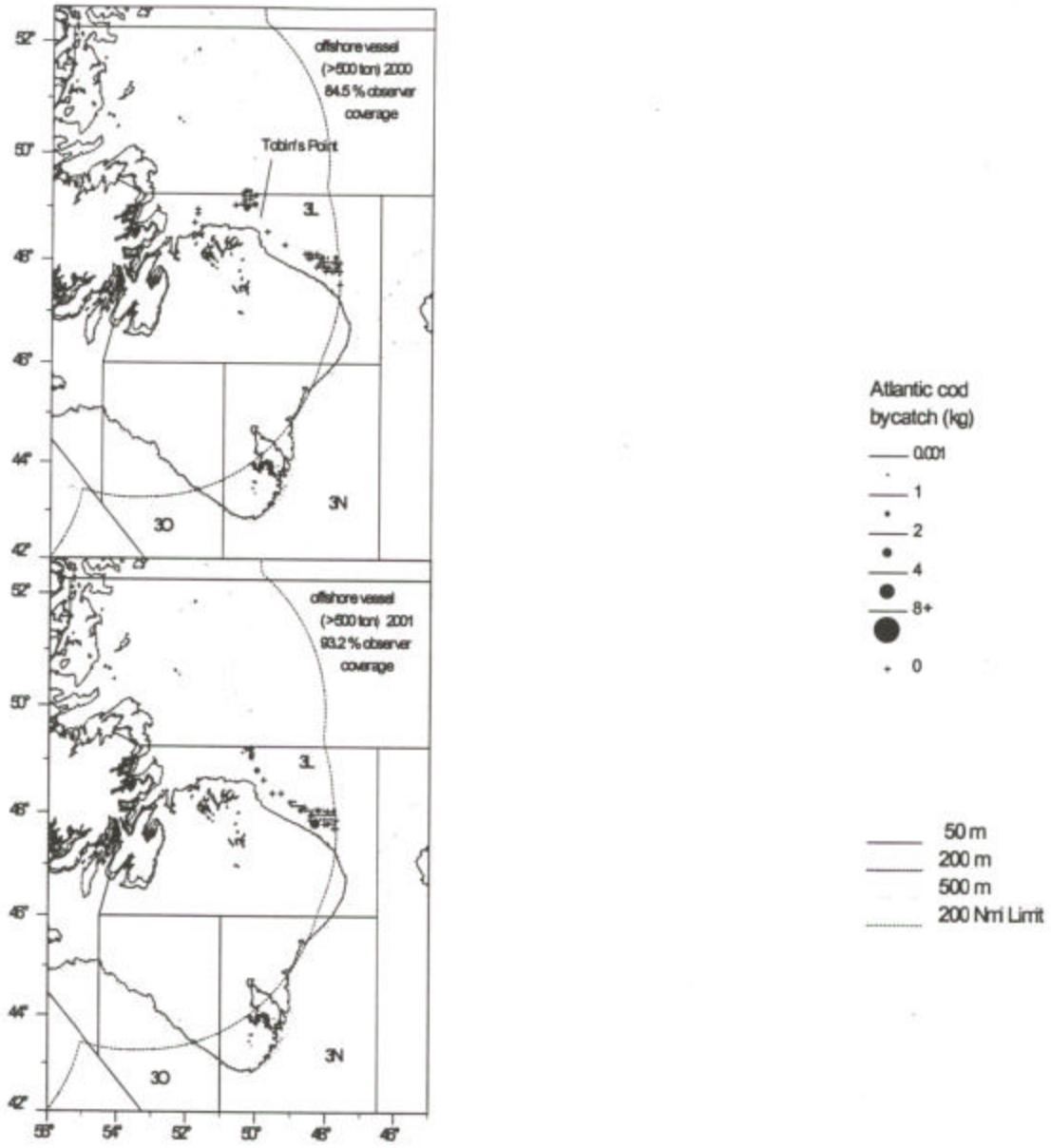

Fig. 15. Distribution of Atlantic cod by-catch removed by the Canadian offshore vessel (=>500 ton) shrimp fishing fleet during spring-autumn 2000 and 2001.

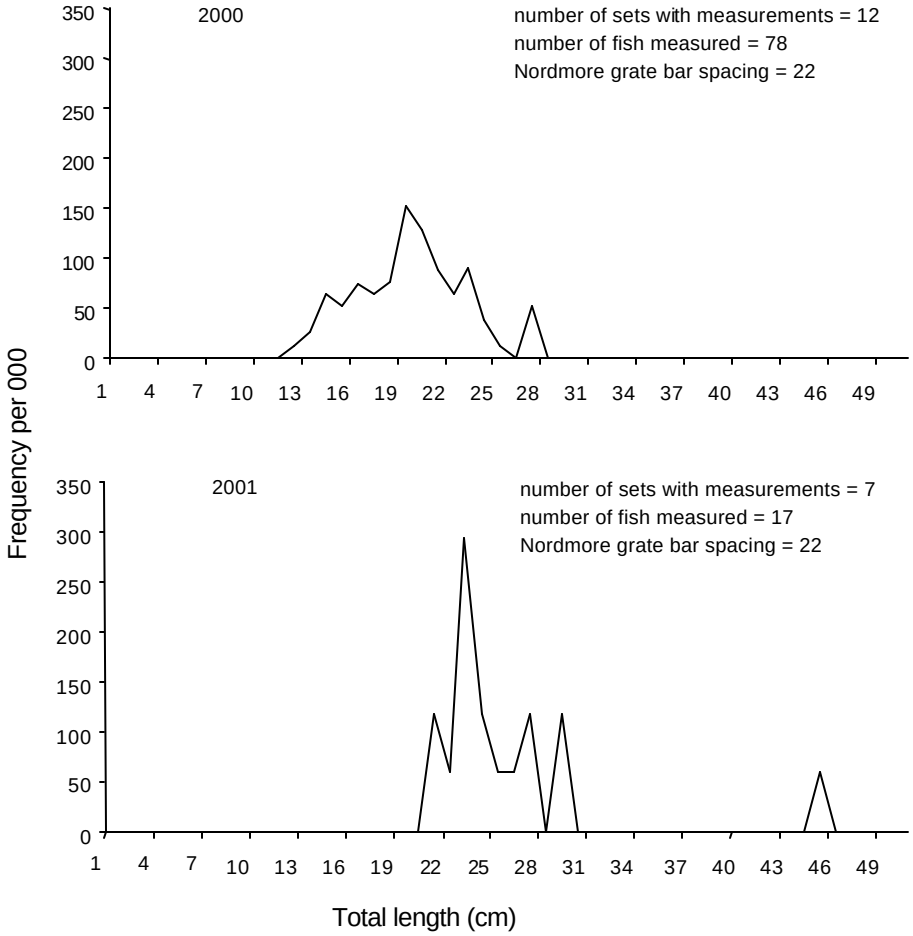

Fig. 16. Size frequency per thousand Atlantic cod caught in the Div. 3L offshore vessel (>500 ton) shrimp fishery during 2000 and 2001. (No measurements were recorded for fish taken using a 28 mm Nordmore grate.)

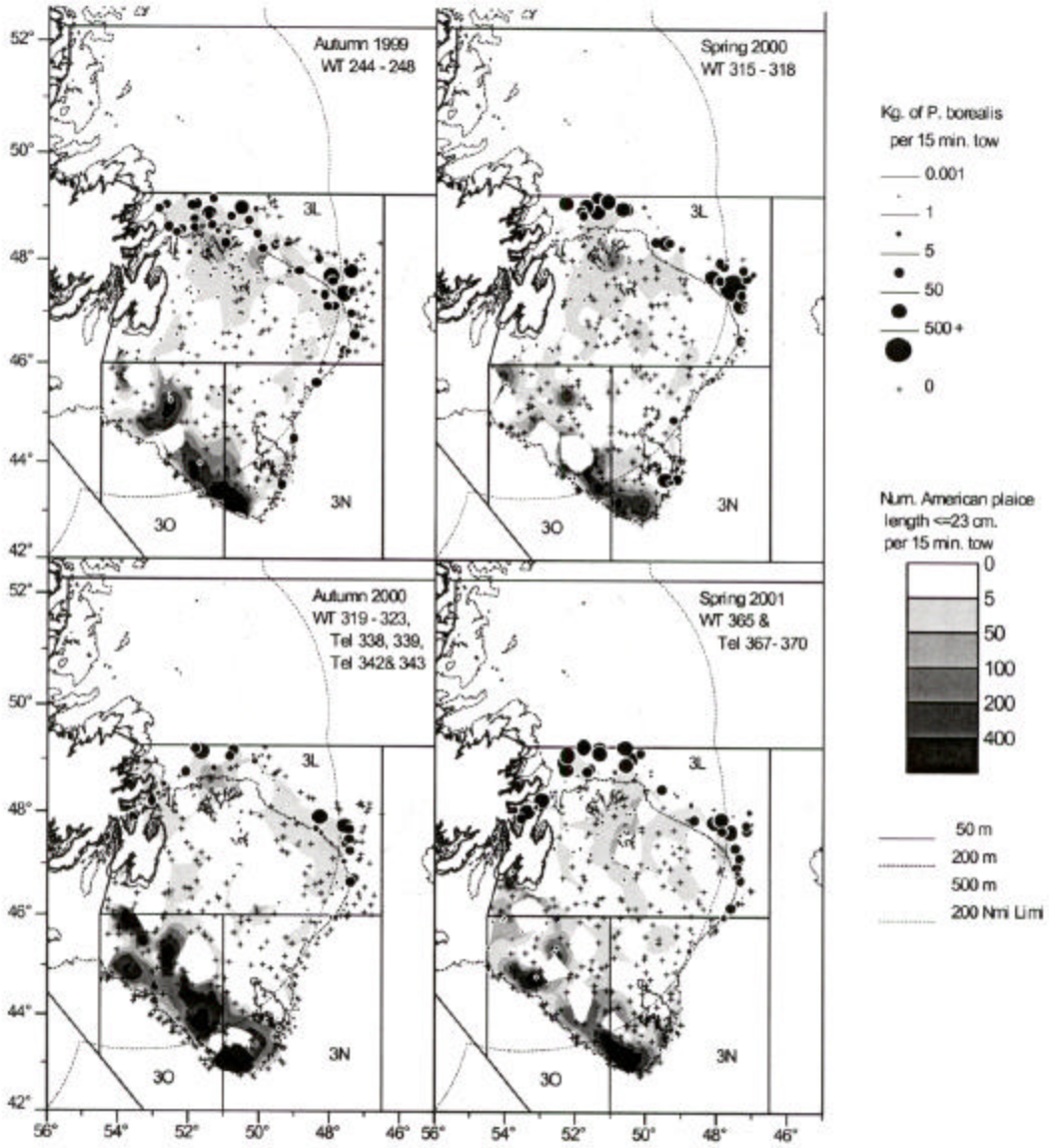

Fig. 17. Distribution of northern shrimp in relation to American plaice with lengths <=23cm, collected during Canadian autumn 1999-spring 2001 multi-species research surveys. (Catches were made with a Campelen 1800 shrimp trawl, tows were standardized to 15 min.)

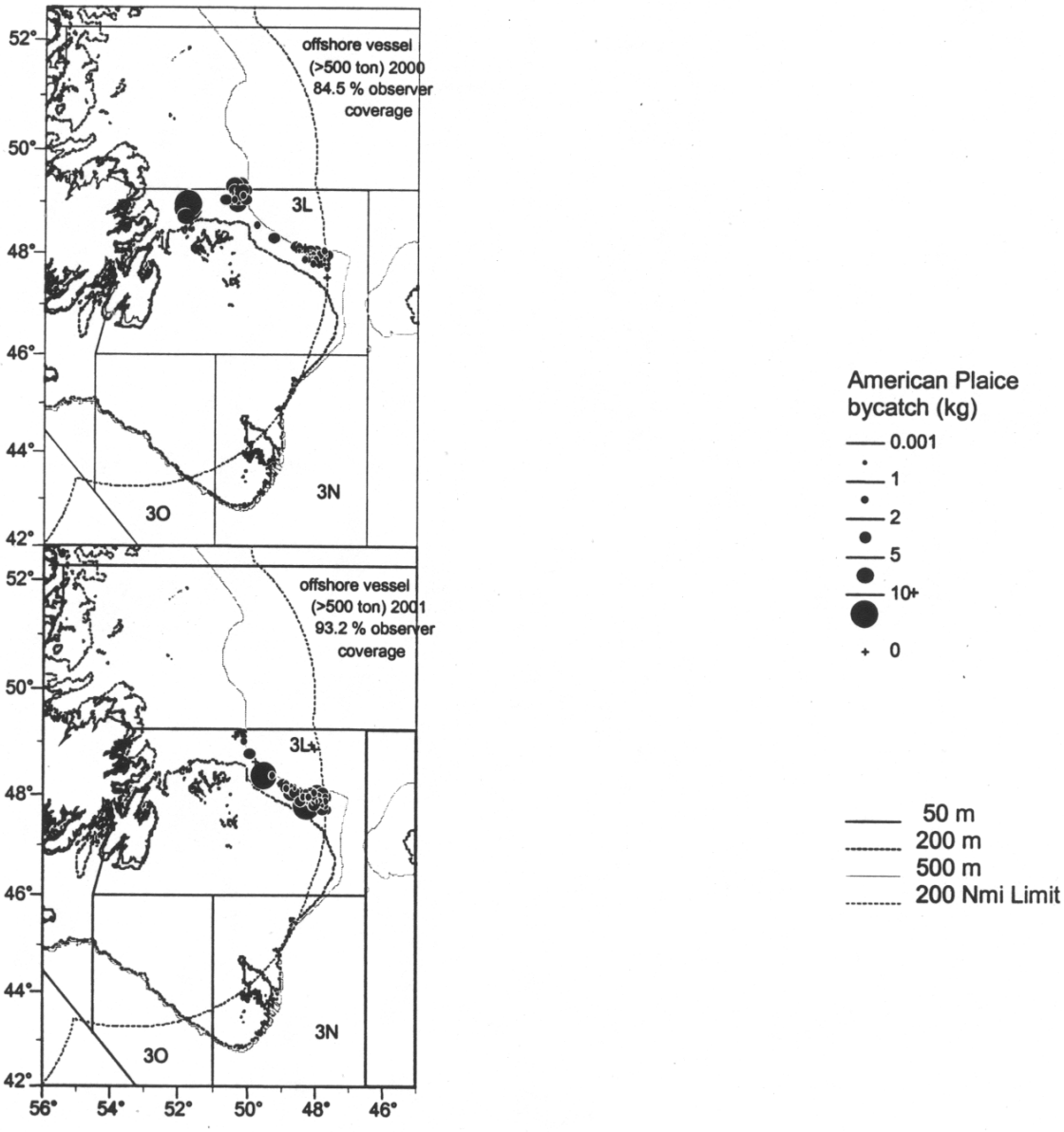

Fig. 18. Distribution of American plaice by-catch removed by the Canadian offshore vessel (=>500 ton) shrimp fishing fleet during spring-autumn 2000 and 2001.

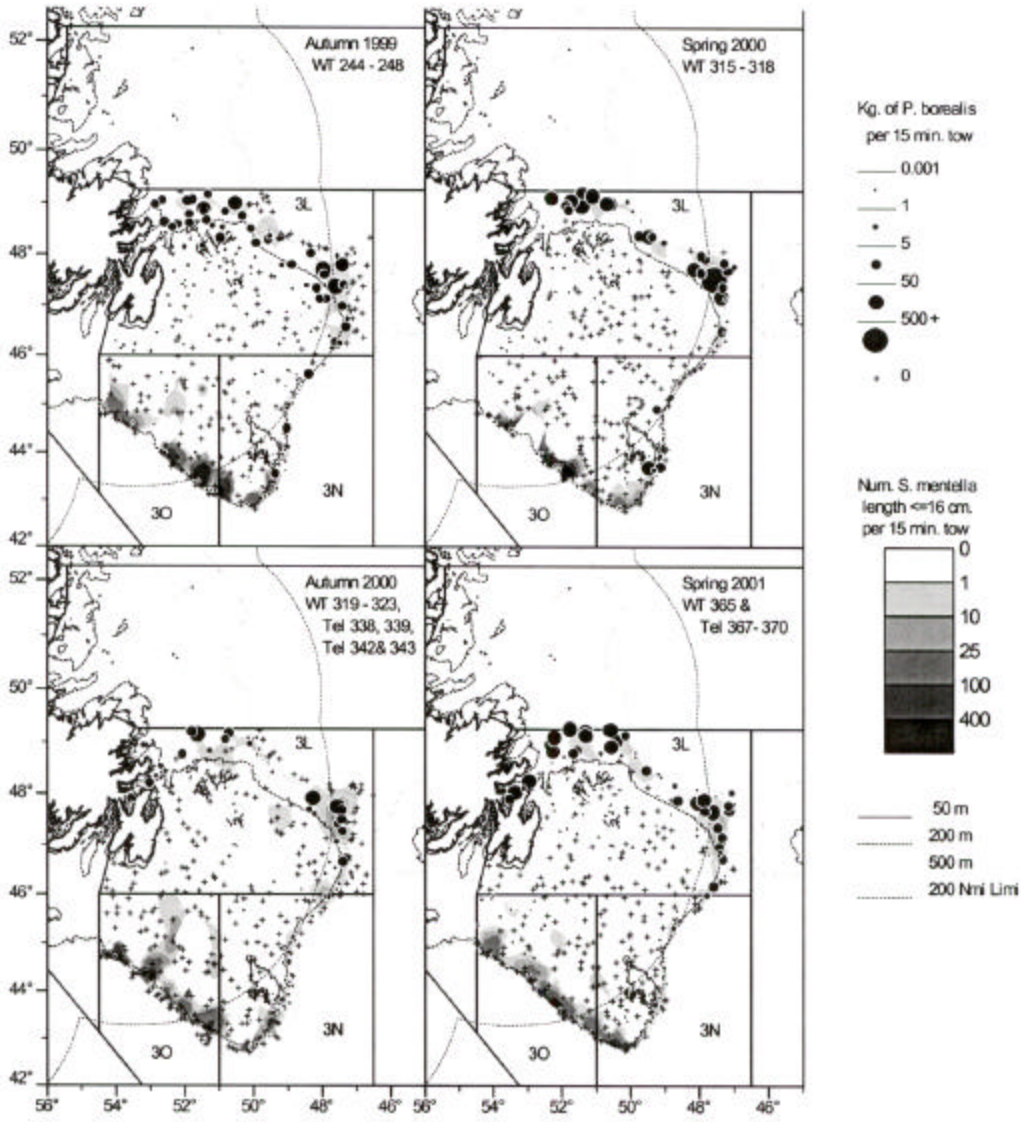

Fig. 19. Distribution of northern shrimp in relation to redfish with lengths <=16cm, collected during Canadian autumn 1999-spring 2001 multi-species research surveys. (Catches were made with a Campelen 1800 shrimp trawl, tows were standardized to 15 min.)

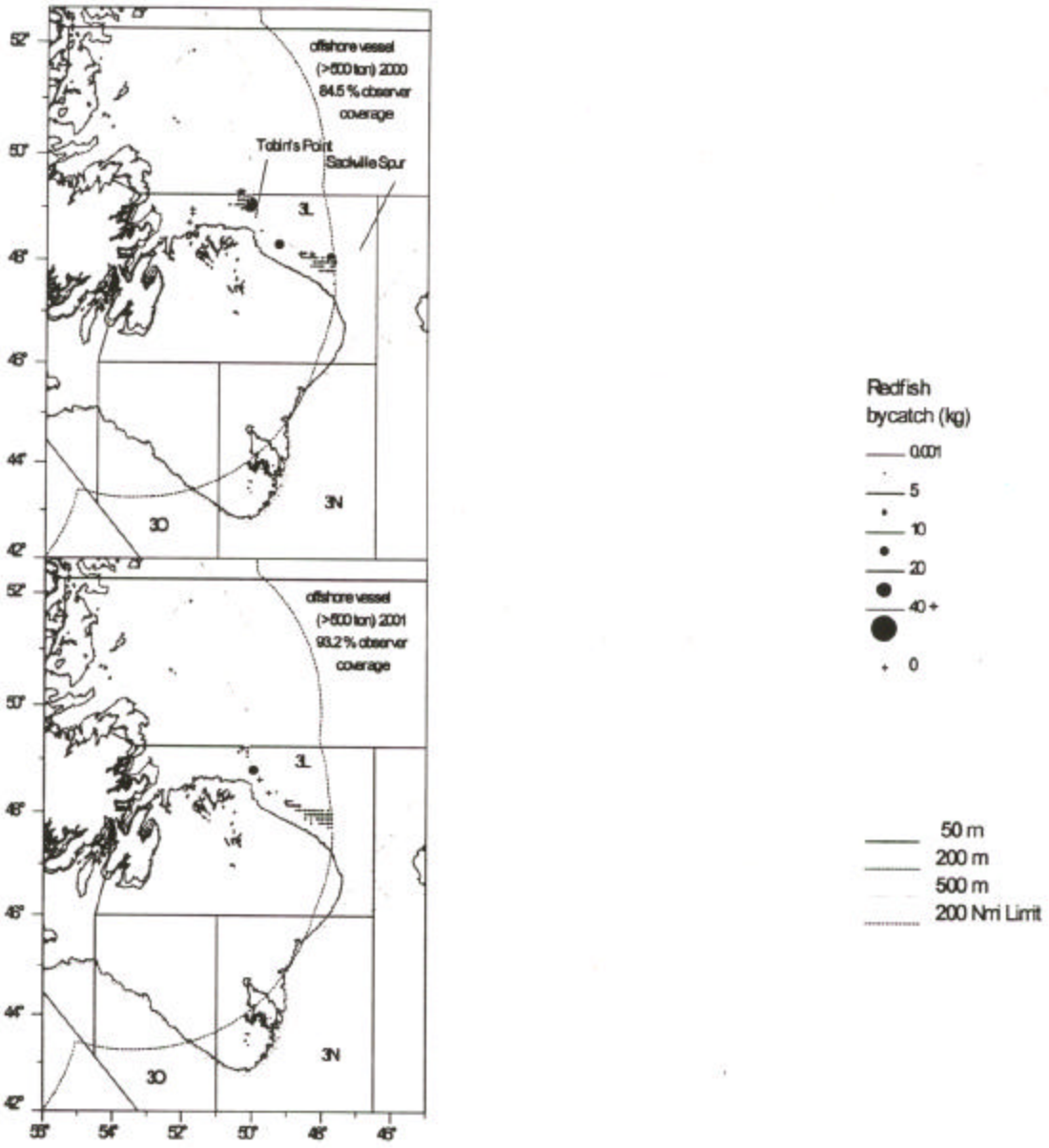

Fig. 20. Distribution of redfish by-catch removed by the Canadian offshore vessel (=>500 ton) shrimp fishing fleet during spring-autumn 2000 and 2001.

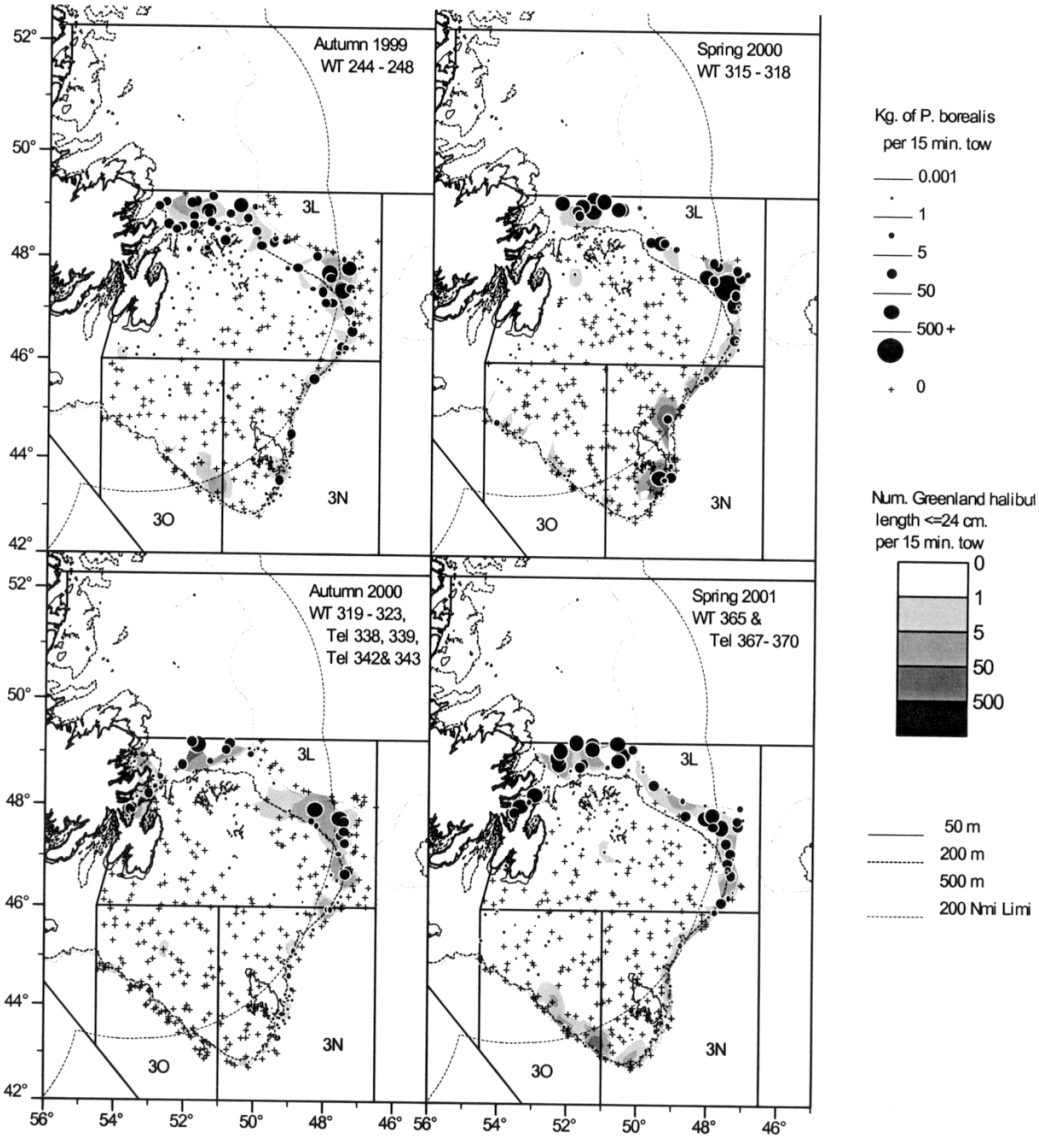

Fig. 21. Distribution of northern shrimp in relation to Greenland halibut with lengths <=24cm, collected during Canadian autumn 1999-spring 2001 multi-species research surveys. (Catches were made with a Campelen 1800 shrimp trawl, tows were standardized to 15 min.)

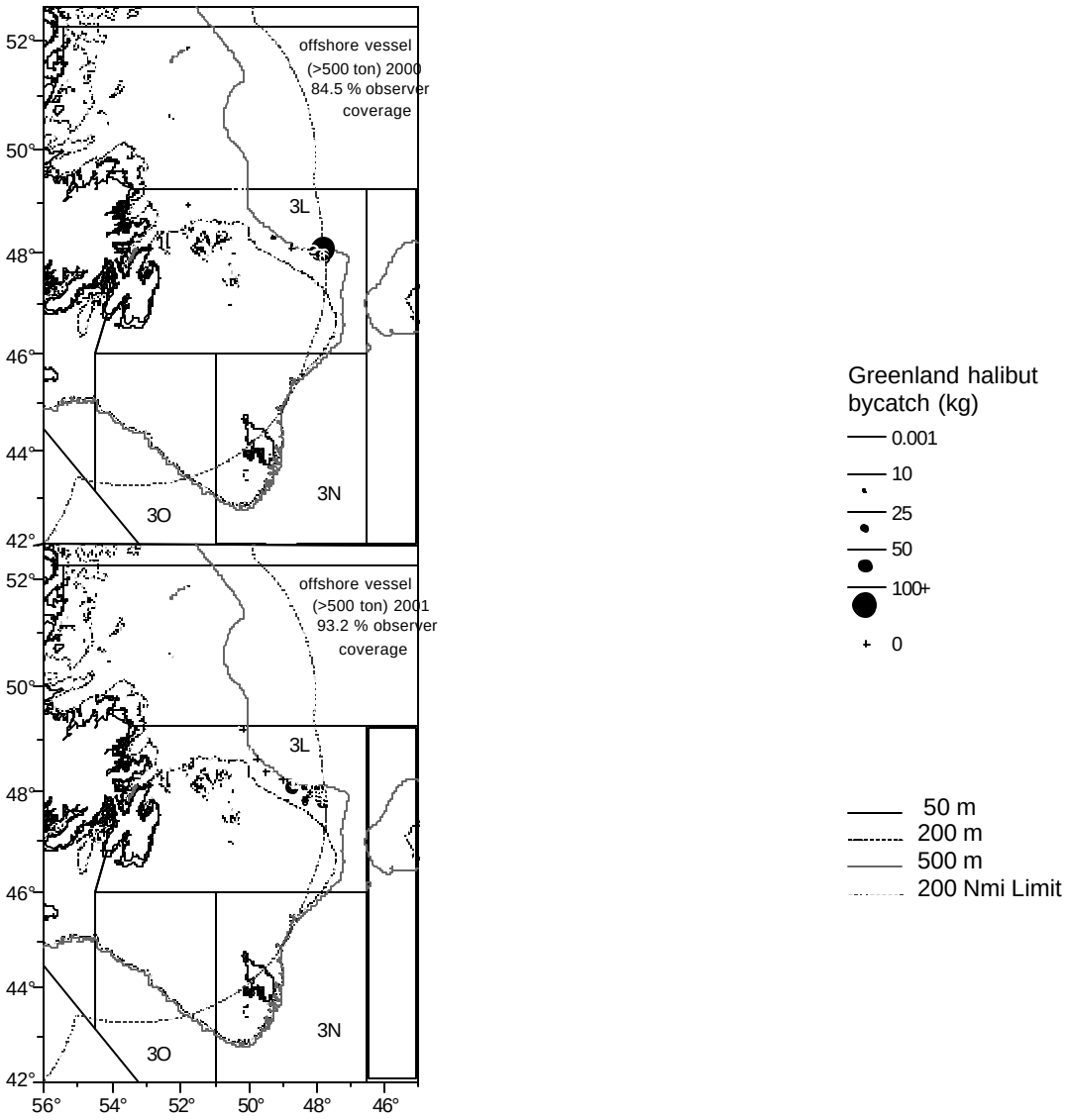

Fig. 22. Distribution of Greenland halibut by-catch removed by the Canadian offshore vessel(=>500 ton) shrimp fishing fleet during spring – autumn 2000 and 2001.

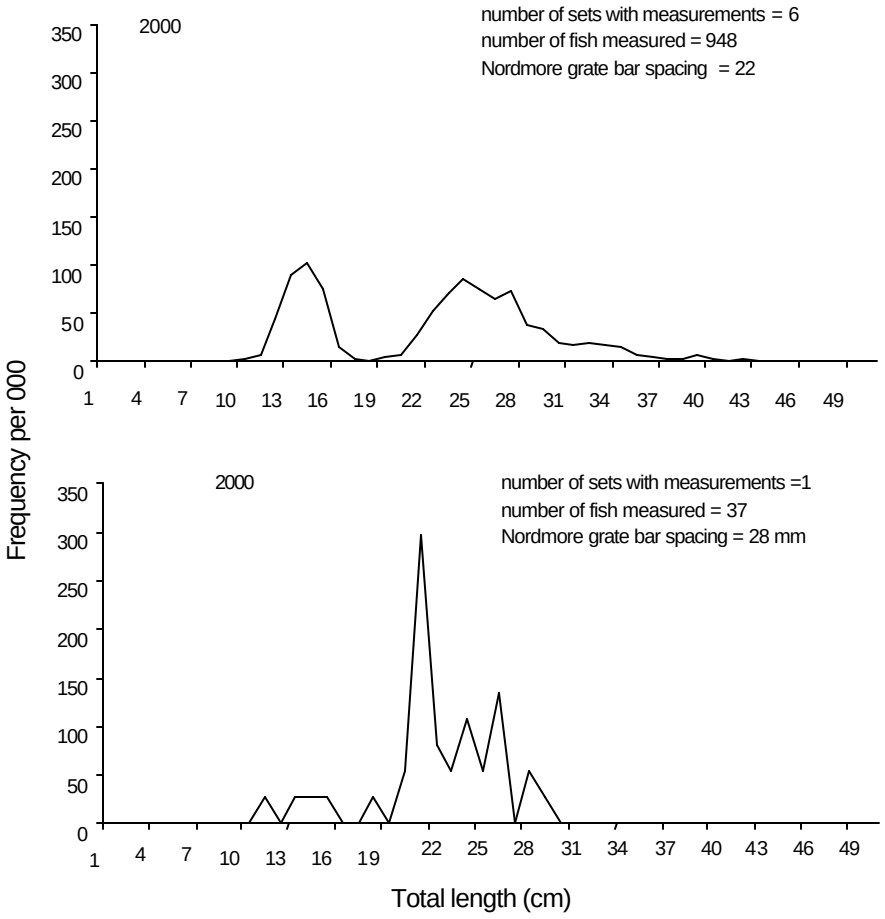

Fig. 23. Size frequency per thousand Greenland halibut caught in the Div. 3L offshore vessel (>500 ton) shrimp fishery during 2000.

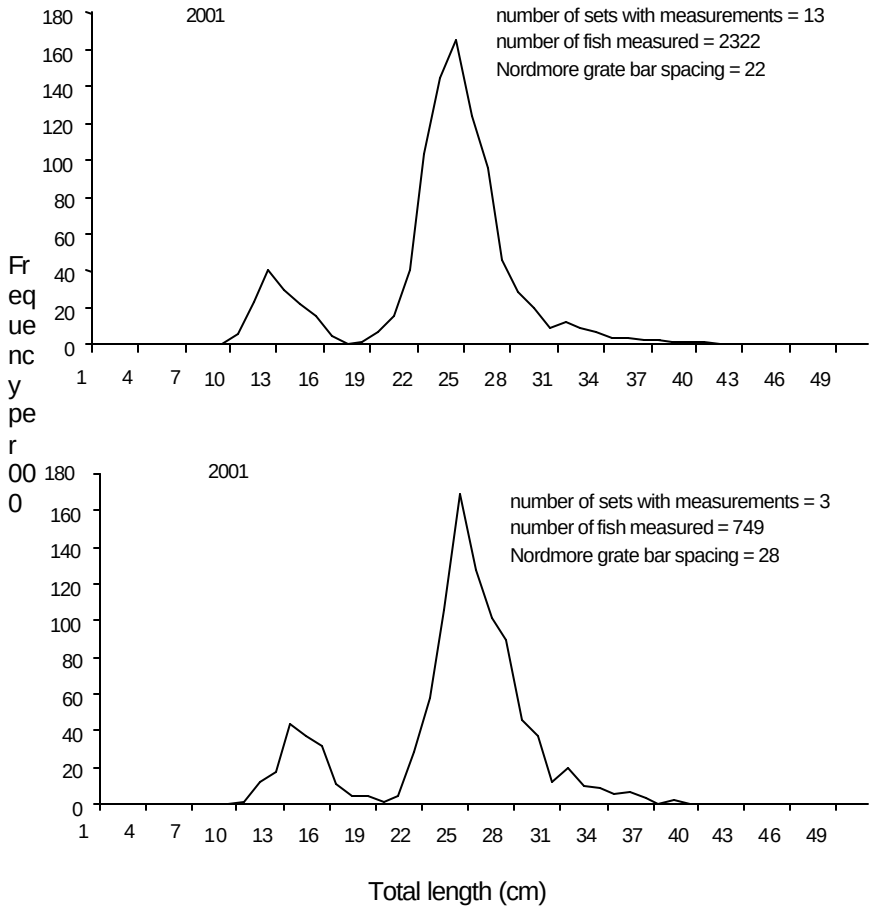

Fig. 24. Size frequency per thousand Greenland halibut caught in the Div. 3L offshore vessel (>500 ton) shrimp fishery during 2001.