Northwest Atlantic Fisheries Organization

Serial No. N5026 **NAFO SCR Doc. 04/65**

SCIENTIFIC COUNCIL MEETING – SEPTEMBER 2004

Divisions 3LNO Northern shrimp (*Pandalus borealis*) – Interim Monitoring Update

By

D.C. Orr, P.J. Veitch and D.J. Sullivan

Abstract

This document updates some of the indices for northern shrimp (*Pandalus borealis*) harvested within NAFO Divisions 3LNO. A full assessment for this resource was completed, within Scientific Council during November 2003, and management advice was provided for the years 2004 and 2005. The catch table and biomass estimates are updated within this report. Preliminary data indicate that 11,791 and 11,907 tons of shrimp were taken against annual TACs of 13,000 tons in 2003 and 2004 respectively. The autumn 2003 biomass index was 224,000 tons while the spring 2004 biomass index was 111,000 tons. The autumn biomass index is characterized by tight confidence limits (95% C.I. = ±117,000 tons) relative to those determined from spring 2004 survey data (95% C.I. = ±641,000 tons). Lower 95% confidence limits determined for the spring 2004 biomass and abundance indices were negative; therefore, the spring 2004 research survey results were considered imprecise. The 95% confidence intervals around the autumn indices overlapped the 95% confidence intervals for the respective indices since spring 2000 indicating that research survey indices have not changed significantly since spring 2000.

Fishery and Management

TAC regulation

During November 2002, Scientific Council (SC) noted that there had been a significant increase in biomass and recruitment in Div. 3LNO shrimp since 1999. Applying a 15% exploitation rate to the lower 95% confidence interval of biomass estimates, averaged over the autumn 2000-2001 and spring 2001-2002 surveys, resulted in a catch of approximately 13,000 tons. Accordingly, SC recommended that the TAC for shrimp in Divs. 3LNO in 2003 and 2004 should not exceed 13,000 tons. At that time, SC reiterated its recommendation that the fishery be restricted to Div. 3L and that the use of a sorting grate with a maximum bar spacing of 22 mm be mandatory for all vessels in the fishery (NAFO, 2003). During the November 2003 shrimp assessment, SC decided that this advice should extend through 2005, and that the advice would be reviewed in September 2004.

Catch trends

Catches increased dramatically since 1999, with the beginning of a regulated fishery. Since then, sixteen contracting nations have exercised their privileges to fish shrimp in Div. 3L (Table 1). Over the period 2000-2004, catches were 4,920, 10,566, 6 977, 11,791 and 11,907 tons, respectively. As per NAFO agreements, Canadian vessels took most of the catch during each year. Canadian catches increased from 4,301 tons in 2000 to 10,178 tons in 2004. Fishing vessels from contracting nations took 619, 5 437, 1 563, 1 783 and 1 729 tons of shrimp in each respective year. Table 1 provides a break down of catches by nation and year. Figure 1 indicates catches and TAC since 1992.

Canadian Multi-species Bottom Trawl Research Survey Trends

Spring and autumn multi-species surveys, using a Campelen 1800 shrimp trawl, have been conducted onboard the Canadian Coast Guard vessels *Wilfred Templeman, Teleost* and *Alfred Needler* since 1995. Details of the survey design and fishing protocols are outlined in (Brodie, 1996; McCallum and Walsh, 1996). Prior to autumn 2003, shrimp were frozen and returned to the Northwest Atlantic Fisheries Centre where species identifications were made, and number and weight per set were calculated. Beginning with the autumn 2003 survey, most of the shrimp samples have been processed at sea. Samples that could not be processed at sea were frozen and processed in the Northwest Atlantic Fisheries Centre upon return. Stratified abundance and biomass indices were estimated via areal expansion using programs based upon Cochran (1997) and written in SAS (D.C. Orr, unpublished).

Analyses from the autumn 2003 survey indicated that the Div. 3LNO trawlable biomass remained stable at 224,000 tons (47 billion animals) (Table 2, Fig. 2).

Analyses from the spring 2004 survey indicated that the Div. 3LNO trawlable biomass was 111,000 tons (22 billion animals), half that derived from the previous autumn survey (Tables 2 and 3, Fig. 2 and 3). As was the case in 2000, the spring 2004 biomass and abundance indices are thought to be imprecise, because the 95% confidence intervals were broad with negative lower confidence interval values. The spring 2000 results were heavily influenced by two anomalously high catches (500 and 511 kg) while the spring 2004 results were heavily influence by one anomalously high catch (1060 kg).

The 95% confidence intervals around the autumn 2003 indices overlap the 95% confidence intervals for the respective indices since spring 2000; therefore, biomass and abundance indices have not changed significantly since spring 2000.

The NRA accounted for between 12 and 32% of the total Div. 3LNO biomass as determined from each survey since 1995. More than 90% of the biomass was found within Div. 3L, mostly within depths from 185 to 550 m. Div. 3N accounted for less than 10% of the total Div. 3LNO biomass while Div. 3O accounted for less than 1% of the Div. 3LNO biomass (Tables 4-6). Figure 4 demonstrates that there has been no change in distribution of Canadian multi-species survey catches since autumn 2002.

Conclusions

Autumn 2003 research survey data indicate that the status of the 3LNO northern shrimp stock had not changed since it was last assessed in November 2003. The spring 2004 research survey indices are thought to be imprecise because 95 % confidence limits are very broad with negative lower limits.

References

Brodie, W. 1996. A description of the 1995 fall groundfish survey in Division 2J3KLMNO. NAFO SCR. Doc. 96/27, Serial No. N2700. 7p.

Cochran, W. G. 1997. Sampling Techniques. Third Edition. John Wiley & Sons. Toronto. 428 p.

McCallum, B.R. and S.J. Walsh. 1996. Groundfish survey trawls used at the Northwest Atlantic Fisheries Centre, 1971 – present. NAFO SCR Doc. 96/50, Serial No. N2726, 18 p.

NAFO, 1999. Scientific Council Reports . p 207-215.

NAFO 2003. Scientific Council Meeting, 5-11, November 2003. Appendix III. Management advice and responses to special requests.

Table 1 Nominal catches (tons) by country of northern shrimp (*Pandalus borealis*) caught in NAFO Div. 3L.

Country	2000	2001	2002	2003	2004	2005
Canada – Nfld.	3,843[1]	4,708[2]	4847[2]	9,296[2]	9461[2]	
Canada – Mar.	458[1]	421[2]	567[2]	712[2]	717[2]	
Cuba			70[3]	146[3]	145[4]	
Estonia	64[1]	2,264[7]	450 [4]	152[3]	58[4]	
Faroe Islands	42[2]	2,052[7]	620[4]		650[4]	
France (SPM)	67[1]		36[3]	110[4]		
Greenland	34[2]			472[4]	300[4]	
Iceland	97[2]	55[6]	55[6]	102[3]	1[6]	
Latvia	64[1]	53[3]	59[3]	144[3]	62[4]	
Lithuania	67[1]	51[3]	67[3]	142[3]	62[4]	
Norway	77[1]	78[5]	70[5]	145[3]	148[4]	
Poland	40[1]				144[4]	
Portugal		61[4]				
Russia	67[1]	67[3]	67[3]			
Spain		699[4]		117[4]	159[4]	
Ukraine		57[1]		144[3]		
USA			69[3]	144[3]		
GRAND TOTAL	4,920	10,566	6,977	11,791	11,907	
TAC (tons)	6,000	6,000	6,000	13,000	13,000	13,000

Sources:

1 NAFO STATLANT 21A
2 Canadian Quota Report, or other preliminary sources
3 NAFO monthly records of provisional catches
4 Canadian surveillance reports
5 Observer datasets
6 Icelandic logbook dataset.
7 Estonian logbook dataset
8 Greenland logbook dataset

Table 2 Northern shrimp stock size estimates in NAFO divisions 3LNO from annual autumn Canadian multi-species bottom surveys, 1995 - 2003. Offshore strata only. (standard 15 min. tows)

	Biomass (tons)			Abundance (numbers x 10^{-6})			Survey
Year	Lower C.I.	Estimate	Upper C.I.	Lower C.I.	Estimate	Upper C.I.	Sets
1995	3,639	5,921	8,202	659	2,054	3,449	337
1996	10,230	20,088	29,948	1,985	5,867	9,748	304
1997	25,530	46,202	66,875	6,280	10,523	14,766	318
1998	40,011	59,914	79,816	10,787	15,326	19,866	347
1999	36,202	53,144	70,086	9,588	13,060	16,533	313
2000	93,132	118,180	143,227	25,840	32,066	38,292	337
2001	77,563	223,995	370,427	20,177	54,077	87,978	362
2002	126,180	215,008	303,837	30,469	50,257	70,044	365
2003	106,338	223,568	340,798	29,708	47,281	64,853	316

Table 3 Northern shrimp stock size estimates in NAFO divisions 3LNO from annual spring Canadian multi-species bottom surveys, 1999 - 2004. Offshore strata only. (standard 15 min. tows)

	Biomass (tons)			Abundance (numbers x 10^{-6})			Survey
Year	Lower C.I.	Estimate	Upper C.I.	Lower C.I.	Estimate	Upper C.I.	Sets
1999	12,564	55,317	98,069	3,178	12,702	22,227	313
2000	-15,869	121,815	259,498	-54,743	25,012	104,768	298
2001	62,359	102,566	142,773	13,417	24,845	36,272	300
2002	121,067	159,491	197,916	28,311	37,512	46,714	300
2003	112,299	193,766	275,233	21,857	46,295	70,732	300
2004	-529,764	110,827	751,418	-97,747	21,696	141,395	296

Table 4 NAFO divisions 3LNO *Pandalus borealis* biomass estimates for entire divisions. (Shrimp were collected during the Canadian spring and autumn multi-species surveys using a Campelen 1800 shrimp trawl. (standard 15 min. tows).

Season	Year	Division	Entire Division Biomass estimate (Kg x 1000)	Percent by division
Autumn	1995	3L	5,357	90.48
Autumn	1996	3L	18,566	92.42
Autumn	1997	3L	45,758	99.04
Autumn	1998	3L	56,485	94.28
Autumn	1999	3L	52,863	99.47
Autumn	2000	3L	117,902	99.77
Autumn	2001	3L	223,149	99.62
Autumn	2002	3L	210,451	97.88
Autumn	2003	3L	220,711	98.72
Autumn	1995	3N	533	9.00
Autumn	1996	3N	1,514	7.54
Autumn	1997	3N	427	0.92
Autumn	1998	3N	3,360	5.61
Autumn	1999	3N	272	0.51
Autumn	2000	3N	270	0.23
Autumn	2001	3N	836	0.37
Autumn	2002	3N	4,444	2.07
Autumn	2003	3N	2,785	1.25
Autumn	1995	3O	31	0.52
Autumn	1996	3O	9	0.04
Autumn	1997	3O	17	0.04
Autumn	1998	3O	69	0.12
Autumn	1999	3O	9	0.02
Autumn	2000	3O	8	0.01
Autumn	2001	3O	10	0.00
Autumn	2002	3O	113	0.05
Autumn	2003	3O	72	0.03
	all divisions			
Autumn	1995		5,921	
Autumn	1996		20,089	
Autumn	1997		46,202	
Autumn	1998		59,914	
Autumn	1999		53,144	
Autumn	2000		118,180	
Autumn	2001		223,995	
Autumn	2002		215,008	
Autumn	2003		223,568	

Season	Year	Division	Entire Division Biomass estimate (Kg x 1000)	Percent by division
Spring	1999	3L	53,934	97.50
Spring	2000	3L	119,521	98.12
Spring	2001	3L	102,493	99.93
Spring	2002	3L	155,061	97.22
Spring	2003	3L	195,121	98.46
Spring	2004	3L	109,590	98.88
Spring	1999	3N	1,349	2.44
Spring	2000	3N	2,248	1.85
Spring	2001	3N	53	0.05
Spring	2002	3N	4,395	2.76
Spring	2003	3N	2,852	1.44
Spring	2004	3N	1,099	0.99
Spring	1999	3O	34	0.06
Spring	2000	3O	46	0.04
Spring	2001	3O	20	0.02
Spring	2002	3O	35	0.02
Spring	2003	3O	196	0.10
Spring	2004	3O	138	0.12
	all divisions			
Spring	1999		55,317	
Spring	2000		121,815	
Spring	2001		102,566	
Spring	2002		159,491	
Spring	2003		198,169	
Spring	2004		110,827	

Table 5 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. (standard 15 min. tows).

Season	Year	Division	Entire Division Biomass estimate (Kg x 1000)	Percent by division	Outside 200 Nmi limit Biomass estimate (Kg x 1000)	Percent biomass by division		percent biomass in NRA	3 year running average percent biomass in NRA
Autumn	1995	3L	5,357	90.48	1,039	67.63		19.40	19.40
Autumn	1996	3L	18,566	92.42	4,506	76.86		24.27	21.84
Autumn	1997	3L	45,758	99.04	5,115	92.83		11.18	18.28
Autumn	1998	3L	56,485	94.28	8,707	75.66		15.42	16.95
Autumn	1999	3L	52,863	99.47	8,734	97.38		16.52	14.37
Autumn	2000	3L	117,902	99.77	28,447	99.16		24.13	18.69
Autumn	2001	3L	223,149	99.62	52,292	98.47		23.43	21.36
Autumn	2002	3L	210,451	97.88	35,702	91.48		16.96	21.51
Autumn	2003	3L	220,711	98.72	43,986	94.76		19.93	20.11
			Overall average	**96.85**			Overall average	**19.03**	
Autumn	1995	3N	533	9.00	497	32.34		93.29	93.29
Autumn	1996	3N	1,514	7.54	1,356	23.12		89.52	91.40
Autumn	1997	3N	427	0.92	391	7.09		91.52	91.44
Autumn	1998	3N	3,360	5.61	2,786	24.21		82.91	87.98
Autumn	1999	3N	272	0.51	232	2.59		85.57	86.67
Autumn	2000	3N	270	0.23	240	0.84		88.80	85.76
Autumn	2001	3N	836	0.37	809	1.52		96.77	90.38
Autumn	2002	3N	4,444	2.07	3,295	8.44		74.14	86.57
Autumn	2003	3N	2,785	1.25	2,421	5.22		86.93	85.95
			Overall average	**3.06**			Overall average	**87.72**	
Autumn	1995	3O	31	0.52	1	0.04		1.82	1.82
Autumn	1996	3O	9	0.04	1	0.02		12.50	7.16
Autumn	1997	3O	17	0.04	4	0.07		23.79	12.70
Autumn	1998	3O	69	0.12	15	0.13		21.23	19.17
Autumn	1999	3O	9	0.02	3	0.03		33.59	26.21
Autumn	2000	3O	8	0.01	1	0.00		8.02	20.95
Autumn	2001	3O	10	0.00	3	0.01		30.00	23.87
Autumn	2002	3O	113	0.05	32	0.08		28.32	22.11
Autumn	2003	3O	72	0.03	8	0.02		11.11	23.14
			Overall average	**0.09**			Overall average	**18.93**	
	all divisions								
Autumn	1995		5,921		1,537			25.96	25.96
Autumn	1996		20,088		5,862			29.18	27.57
Autumn	1997		46,202		5,509			11.92	22.36
Autumn	1998		59,914		11,508			19.21	20.11
Autumn	1999		53,144		8,969			16.88	16.00
Autumn	2000		118,180		28,687			24.27	20.12
Autumn	2001		223,995		53,104			23.71	21.62
Autumn	2002		215,008		39,029			18.15	22.04
Autumn	2003		223,568		46,416			20.76	20.87
							Overall average	**21.12**	

Table 6 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. (standard 15 min. tows)

Season	Year	Division	Entire Biomass estimate (Kg x 1000)	Percent by division	Outside 200 Nmi limit Biomass estimate (Kg x 1000)	Percent biomass by division		percent biomass in NRA	3 year running average percent biomass in NRA
Spring	1999	3L	53,934	97.50	14,731	91.74		27.31	27.31
Spring	2000	3L	119,521	98.12	36,127	94.30		30.23	28.77
Spring	2001	3L	102,493	99.93	18,397	99.75		17.95	25.16
Spring	2002	3L	155,061	97.22	47,288	92.79		30.50	26.22
Spring	2003	3L	190,718	98.43	38,473	93.13		20.17	22.87
Spring	2004	3L	109,590	98.88	27,262	96.37		24.88	25.18
			Overall average	**98.35**			Overall average	**25.17**	
Spring	1999	3N	1,349	2.44	1,327	8.26		98.37	98.37
Spring	2000	3N	2,248	1.85	2,178	5.69		96.89	97.63
Spring	2001	3N	53	0.05	45	0.24		84.91	93.39
Spring	2002	3N	4,395	2.76	3,670	7.20		83.50	88.43
Spring	2003	3N	2,853	1.47	2,834	6.86		99.33	89.25
Spring	2004	3N	1,099	0.99	1,019	3.60		92.72	91.85
			Overall average	**1.59**			Overall average	**92.62**	
Spring	1999	3O	34	0.06	0	0.00		0.00	0.00
Spring	2000	3O	46	0.04	6	0.02		13.04	6.52
Spring	2001	3O	20	0.02	2	0.01		10.00	7.68
Spring	2002	3O	35	0.02	4	0.01		11.43	11.49
Spring	2003	3O	196	0.10	2	0.01		1.02	7.48
Spring	2004	3O	138	0.12	8	0.02		5.80	6.08
			Overall average	**0.06**			Overall average	**6.88**	
	all divisions								
Spring	1999		55,317		16,057			29.03	29.03
Spring	2000		121,815		38,310			31.45	30.24
Spring	2001		102,566		18,444			17.98	26.15
Spring	2002		159,491		50,962			31.95	27.13
Spring	2003		193,766		41,310			21.32	34.23
Spring	2004		110,827		28,289			25.53	32.26
							Overall average	**26.21**	

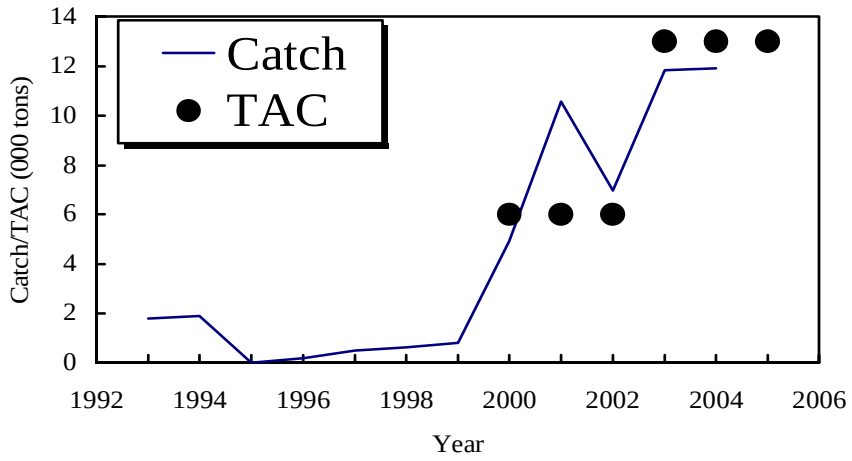

Fig. 1. Trends in NAFO Div. 3LNO northern shrimp (*Pandalus* borealis) catch and TAC over the period 1993-2003.

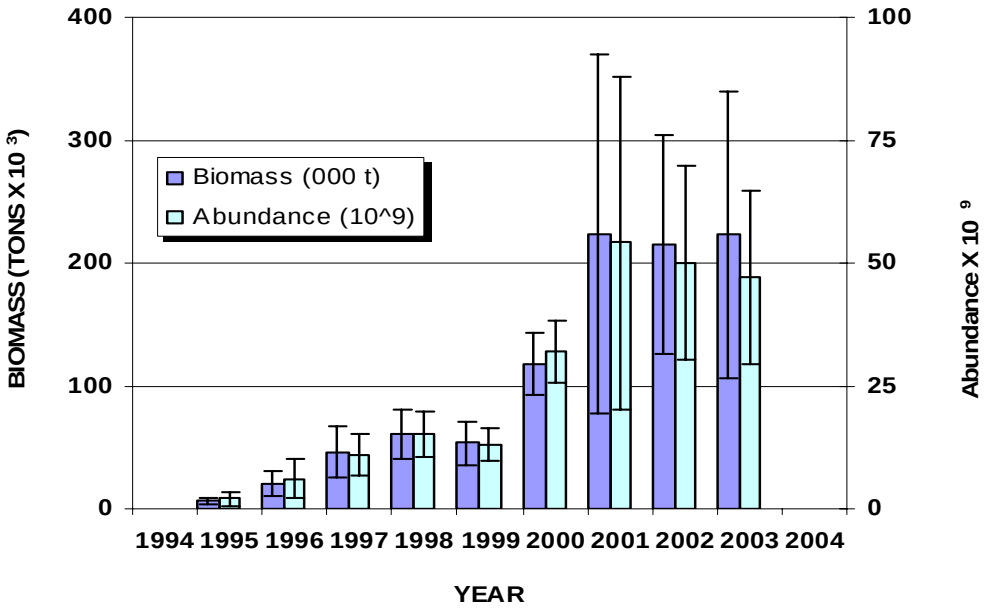

Fig. 2. Autumn northern shrimp (*Pandalus borealis*) abundance and biomass estimates within NAFO Div. 3LNO. Data were from Canadian multi-species bottom trawl surveys using a Campelen 1800 trawl. (standard 15 min. tows).

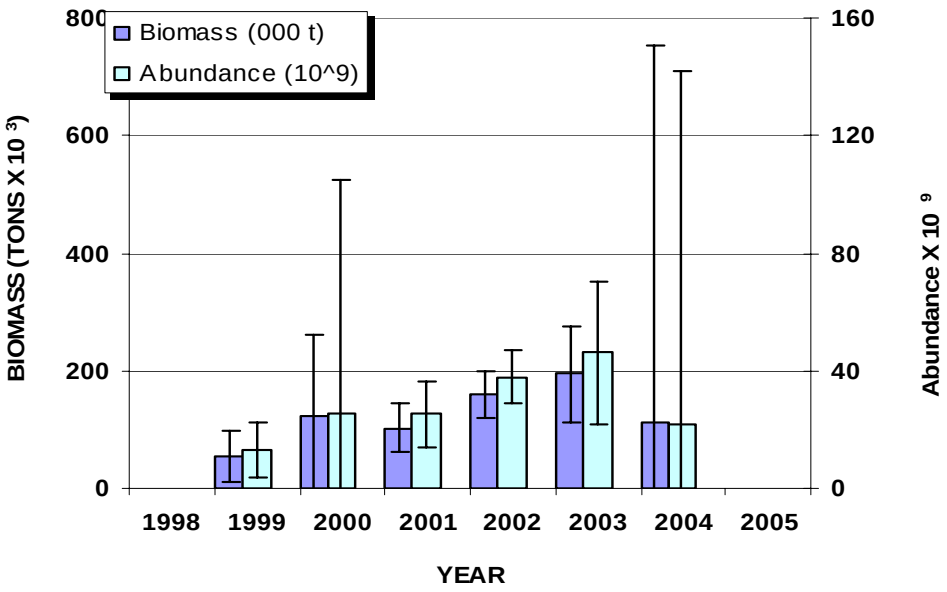

Fig. 3. Spring northern shrimp (*Pandalus borealis*) abundance and biomass estimates within NAFO Div. 3LNO. Data were from Canadian multi-species bottom trawl surveys using a Campelen 1800 trawl. (standard 15 min. tows).

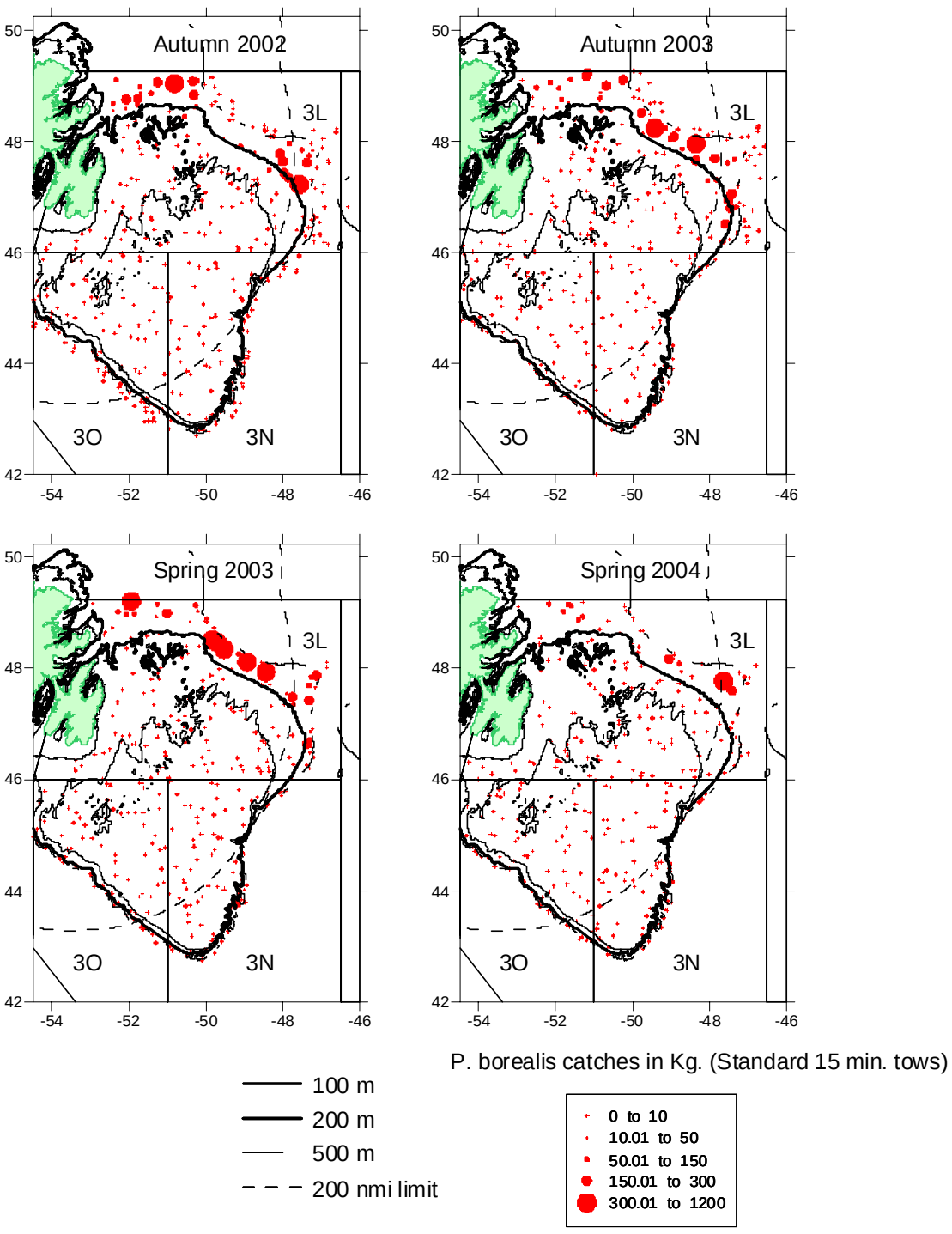

Fig. 4. Distribution of NAFO Div. 3LNO northern shrimp (*Pandalus borealis*) catches (kg/tow) from as determined from spring and autumn Canadian stratified random surveys conducted over the period 2002-2004 using a Campelen 1800 shrimp trawl.