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Information pertaining to northern Shrimp (*Pandalus borealis)* and groundfish in NAFO Divisions 3LNO

by

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Introduction

Data on northern shrimp (*Pandalus borealis*) in Division 3LNO have been collected each autumn since 1995, as part of the Canadian multi-species research surveys. Biomass and abundance indices resulting from these surveys indicate that the resource has been increasing. The stock, which extends beyond Canada's 200 Nmi limit, overlaps several groundfish species presently under moratoria. Therefore this paper provides biomass and abundances indices for the entire 3LNO, as well as, that area outside Canada's 200 Nmi limit and describes 3LNO shrimp distributions relative to distributions of various groundfish distributions, as requested by the Fisheries Commission of NAFO in 1998 (FC Doc 98/29 Serial No. N3016).

Materials and Methods

The autumn multi-species surveys were conducted onboard the Canadian research vessels **Wilfred Templeman** 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 1500m (Fig. 1). Additional inshore strata (not shown on Fig. 1) were included in the survey design after 1995. Both vessels used a Campelen 1800 trawl with a codend mesh size of 40 mm and a 12.7mm liner. SCANMAR sensors estimated that the mean wingspread was 16.8m. Details of the survey design and fishing protocols are provided by Brodie (1996).

Shrimp were frozen and returned to the Northwest Atlantic Fisheries Centre where identifications were made, and number and weight per set were estimated. Stratified abundance and biomass indices were estimated via areal expansion using programs based upon Cochran (1977) and written in SAS (D.Orr unpublished).

Juvenile groundfish distributions were inferred using data from the groundfish (**AT Cameron** 1971 – 1982), juvenile flatfish (**Wilfred Templeman** 1989 – 1994), multi-species (**Wilfred Templeman** and **Teleost** 1995 – 1998) surveys . 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 (*Gadus morhua*), Greenland halibut (*Rienhardtius hippoglossoides*), redfish (*Sebastes mentella*), and American Plaice (*Hippoglossoides platessoides*) were: 19 cm (Hickey *et al.* 1993), 24 cm (Nicolajen, 1997), 14 – 18 cm (Hickey *et al.*, 1993, Kulka and Power, 1996, Kulka, 1998, Nicolajsen, 1997 and Skuladottir, 1997), and 16 cm (Hickey *et al.* 1993). In the absence of data, the LC_{50} value for Witch flounder (*Glytocephalus cynoglossus*) was assumed to be similar to that for American plaice.

The **AT Cameron** made use of a Yankee 41.5 otter trawl constructed of polyethylene twine with mesh sizes of 130 mm in the wings tapering to 92 mm in the codend. The wing spread was 13.7 m. The trawl was towed at 3.5 knots for a duration of 30 minutes. Between 1971 and 1976 fishing stations were selected along transects. After 1976, stations were selected by random stratified design. The juvenile surveys conducted by the **Wilfred Templeman** made use of a Yankee 41 shrimp trawl that had 40mm mesh throughout, a 12.7mm codend liner and a

wing spread of 13.4 m. It was towed at 2.5 knots for 30 minutes on stations allocated by random stratified sampling design (McCallum and Walsh, 1996).

Density contour plots were made using **AT Cameron** and juvenile groundfish data to allow retrospective inferences while 1995 – 1998 autumn multi-species survey contours provide an indication of present usage. Relationships between shrimp and groundfish distributions were made by overlaying shrimp catch weights (expanding symbols) upon 1995 – 1998 groundfish contour plots.

Results and Discussion

The Fishery

No estimates of fishing mortality (F) are available for shrimp in Divisions 3LNO.

The Faroese have been fishing shrimp within 3LNO since 1994. Their efforts have been restricted to 3L outside Canada's 200 Nmi limit. Reported catches were 355, 0 85, 501, 500 and 428 tons from 1994 to 1999 respectively (Nicolajsen, 1999a).

During the summer of 1999, the Fisheries and Aquaculture Department of the province of Newfoundland and Labrador chartered two inshore boats (<65') to conduct a 3L exploratory fishery. During the period July 17 – 29, 1999, they made 68 tows from which preliminary information indicate that 9 tons were caught.

During August 1999, an offshore commercial fishing ship made two trips into 3L as an exploratory fishery undertaken by the Canadian Association of Prawn Producers. The ship made 51, 2 – 4 hour tows and caught 33 tons of shrimp.

Ratios of 1995 – 1998 Faroese catches / Canadian research biomass estimates are 0, 0.004, 0.01 and 0.01 respectively. The ratio of the 1999 Canadian catch/fall 1998 Canadian research biomass is 0.001. These ratios of catch to RV biomass indicate that exploitation has been low.

By-catch from the Canadian exploratory fisheries in 1999 was reported to be low. Selection experiments conducted by the Faroese indicate that a 22 mm Nordmore Grate was effective in reducing by-catches of cod and American plaice. They also indicated that a 22 mm grate was effective in eliminating Greenland halibut or redfish greater than 20 cm and 15 cm respectively (Nicolajsen, 1999b).

Distribution of Shrimp in Relation to Various Groundfish Species

Canadian autumn multi-species research data indicate that the shrimp biomass within 3LNO was 6325, 20832, 47221 and 61655 for the years 1995 – 1998 respectively. At least 90% of the shrimp biomass was within 3L and at depths of 200 – 500 m. Less than 10% of the shrimp biomass was found inshore within Conception, Trinity and Bonavista Bays . Shrimp distributions overlap several groundfish (Atlantic cod, American plaice, redfish, Greenland halibut and Witch flounder) habitats (Figures 2 – 12) as follows:

Atlantic cod

Relatively few juvenile cod (<19 cm total length) have been caught during 1995 – 1998, although, cod were consistently found within Conception, Trinity and Bonavista Bays where their distribution overlapped with shrimp. Concentrations appeared within divisions 3NO and the southern portion of 3L. Few shrimp were found in these areas (Fig. 2).

Figure 3 illustrates that prior to the moratorium, juvenile cod were found throughout the Grand Banks. This figure was created from juvenile flatfish survey data. Unfortunately, these surveys rarely ventured into depths greater than 300 m. Therefore, one should not assume that the figures show the extent of juvenile habitats. Data from the **AT Cameron** surveys covering the period 1971 – 1982 concur that juvenile cod historically made use of the entire Grand Banks including the edge areas where large concentrations of shrimp are presently found.

Figure 4 indicates that relatively few cod have been collected during recent autumn surveys and that cod were widely dispersed. This may explain the low numbers of juvenile cod captured during recent autumn multi-species surveys. It should be noted that large cod were found in the 200 – 500 m depth ranges along the northern edge of the Grand Banks. The latter is an area of high shrimp abundance.

Concentrations of cod may be seen on the Southeast Shoal in all three figures.

American Plaice

Figure 5 illustrates that juvenile American plaice (<16 cm total length) are dispersed throughout the Grand Banks and that there is overlap between American plaice and large shrimp catches; however, relatively few American plaice were found in 200 – 500 m depths. Data from the juvenile flatfish (Fig. 6) and **AT Cameron** surveys indicate similar distributions of plaice.

Figure 5 indicates a general decline in juvenile American plaice abundances from 1995 – 1998.
This observation was confirmed by M. J..Morgan (pers. com.).

Figure 7 illustrates that American plaice of all sizes were common throughout the Grand Banks during the autumn surveys.

Redfish

Figures 8 and 9 illustrate that redfish and shrimp share similar habitats. Both are commonly found along the edge of the Grand Banks in water between 200 and 500 m. Areas of overlap occur where juvenile redfish have traditionally been found, particularly in the Sackville Spur and on the nose of the Grand Banks. These are the areas of highest shrimp concentration. However, the largest concentrations of redfish are found along the southern edge of divisions 3NO.

Greenland halibut

Figure 10 indicates that large concentrations of juvenile Greenland halibut (<24 cm total length) are sympatric with large concentrations of shrimp.

Witch flounder

Figures 11 and 12 indicate that relatively low numbers of witch flounder have been caught during autumn surveys. Witch flounder commonly occur with shrimp, however, the largest concentrations of witch flounder are found along the southern edge of Division 3O, where shrimp are scarce.

Spring data indicate similar trends for all of these groundfish species.

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

The autumn 1995 – 1998 Canadian research shrimp biomass estimates were 6325, 20832, 47221 and 61655 tons respectively (Table 1). The area outside 200 Nmi accounted for 27, 28, 12 and 19% of the Divisions 3LNO biomass estimates for the years 1995 –1998 respectively.

At least 86% of the biomass was found within NAFO Division 3L. Between 11 and 23 % of the 3L shrimp biomass was outside 200 Nmi. Division 3N accounted for less than 14% of the biomass. Approximately 68, 90, 92 and 83% of the 3N biomass was outside of Canada's 200 Nmi limit. Division 3O accounted for less than 1% of the biomass. The area outside contributed between 2 and 24 % to the 3O biomass estimate.

Biomass and abundance of shrimp has been increasing within 3L (Table 2, Fig. 13). In all years, more than 94% of the abundance and 95% of the biomass occurred within the 184 – 549 m depth range. Sampling within St. Mary's , Conception, Trinity and Bonavista Bays began during the 1996 autumn survey. Several 1 – 50 kg shrimp

catches were made within Trinity and Bonavista Bays. Smaller catches were made in St. Mary's and Conception Bays. However, the bays contributed less than 9% to the overall biomass estimates.

The trends are not clear within 3N and 3O (Tables 3 and 4). In both 3N and 3O the confidence intervals are broad reflecting high variances. This is confirmed by Figure 13 which indicates that a few large and several small catches were taken within 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.

Tables 5 – 7 provide the abundance/ biomass estimates for the areas outside Canada's 200 Nmi limit. The trends within these tables parallel the overall trends indicated by Tables 2 – 4. The biomass estimates within this portion of Division 3L increased from 1112 to 8707 tons and the 184 – 549 m depth range contributed approximately 99% of the biomass. The trends within 3N and 3O, outside 200 Nmi, are not so clear and the confidence limits are broader than in 3L. Within 3O, waters shallower than 184 m were often more productive than the 184 – 549 m depth range (Table 7).

The identification of a shrimp inclusion zone area that would lessen the impact of fishing upon species presently under moratoria

The present information illustrate that there is only limited overlap between distributions of juvenile Atlantic cod (Fig. 2), juvenile American plaice (Fig. 5) and areas of high shrimp biomass. Juvenile Atlantic cod and American plaice are present in shallower water. Restriction of fishing to areas of 3L with depths greater than 200 m would prevent overlap in distribution of effort and these juveniles. Shrimp distributions overlap considerably with juvenile redfish and Greenland halibut distributions, making it impractical to create exclusion zones to protect these species. The use of toggle chains may allow greater separation between foot gear and the trawl allowing small fish to pass over the foot gear but escape under the net (Walsh , 1997).

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Table 1. NAFO divisions 3LNO *Pandalus borealis* biomass estimates for entire divisions and outside the 200 Nmi limit.

		Entire Divisions		Outside 200 Nmi Limit		
Year	Division	Biomass estimate (Kg X1000)	Percent biomass by division	Biomass estimate (Kg X 1000)	Percent biomass by division	Percent of biomass
1995	3L	5,470	86.48	1,112	66.33	20.33
1996	3L	19,309	92.69	4,505	76.85	23.33
1997	3L	46,777	99.06	5,114	92.83	10.93
1998	3L	58,226	94.44	8,707	75.66	14.95
1995	3N	825	13.04	564	33.64	68.36
1996	3N	1,514	7.27	1,356	23.13	89.56
1997	3N	427	0.90	391	7.10	91.57
1998	3N	3,360	5.45	2,786	24.21	82.92
1995	3O	30	0.47	0.55	0.03	1.83
1996	3O	9	0.04	1.1	0.02	12.22
1997	3O	17	0.04	4.02	0.07	23.65
1998	3O	69	0.11	14.6	0.13	21.16
	All divisions					
1995		6,325	99.99	1,676.55	100.00	26.51
1996		20,832	100.00	5,862.1	100.00	28.14
1997		47,221	100.00	5,509.02	100.00	11.67
1998		61,655	100.00	11,507.6	100.00	18.66

Table 2. Total abundance (x 1000)/ biomass (Kg x 1000) of northern shrimp (*Pandalus borealis*) collected during fall 1995 - 1998 Canadian multi - species research surveys into NAFO Div 3L. (All tows were standardized to 15 minutes . means depth ranges not sampled).

Depth	Area	95		96		97		98	
Range in m	in Nmi2	/T 176, 178, 179 Tel 23		WT 196 - 198, Tel 41		WT 213 - 217 Tel 57 & 58		WT 230 - 233 Tel 75 & 76	
		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)
30 - 56	268	.	.	0	0	0	0	97.08	0.38
57 - 92	9,017.00	0	0	2,205.13	8.51	3,557.57	15.94	3,497.30	13.52
93 - 183	18,957.00	26,802.81	41.15	101,099.91	267.36	489,067.15	1,979.35	570,638.81	1,499.42
184 - 274	7,170.00	305,062.60	922.76	990,290.72	3,520.71	5287008.7	25,019.81	8,863,192.00	32,729.56
184 - 366	399.00	.	.	57,640.60	199.36	58,934.20	154.68	258,944.44	578.54
275 - 366	4,111.00	1,659,729.00	4,350.71	4,063,574.00	14,673.65	4,746,530.70	18,992.45	5,388,870.00	23,220.89
367 - 549	1,192.00	12,073.36	141.66	80,062.60	638.58	93,081.84	605.08	30,564.45	181.64
550 - 731	804.00	2,255.78	13.39	0	0	1,956.82	9.17	631.95	2.42
732 - 914	957.00	.	.	0	0	86.06	0.61	12.50	0.12
915 -1097	945.00	.	.	0	0	0	0	0	0
1098 -1280	1,745.00	.	.	35.41	0.35	0	0	0	0
1281 -1463	773.00	.	.	0	0	0	0	0	0
Total (X1000)		2,005,923	5,470	5,518,105	19,309	10,685,503	46,777	15,099,564	58,226
Upper 95% C.I. (X1000)		3,389,981	7,511	9,225,802	29,679	14,928,588	67,456	19,489,962	77,852
Lower 95% C.I.(X1000)		621,866	3,428	1,810,407	8,940	6,442,417	26,099	10,709,167	38,601
%<184 m		1.3	0.8	1.9	1.4	4.6	4.3	3.8	2.6
184 - 549 m		98.6	99.0	94.1	98.6	95.3	95.7	96.3	97.4
%>549 m		0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0

Table 3. Total abundance (x1000)/ biomass (Kg x 1000) of northern shrimp (*Pandalus borealis*) collected during fall 1995 - 1998 Canadian multi - species research surveys into NAFO Div 3N. (All tows were standardized to 15 minutes . means depth ranges not sampled).

Depth	Area	1995		1996		1997		1998	
Range in m	in Nmi^2	WT 176 & 177		AN 253 Tel 41 & 42		WT 212 - 214		WT 229, 230, 233, Tel 76	
		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	3092	0	0	0	0	62.61	0.63	0	0
57 - 92	11490	7,903	329	3,507	13	1,661	6	2,042	13
93 - 183	1168	-	-	1,107	2	17,302	44	43,866	119
184 - 274	546	18,053	45	377,532	776	73,069	318	769,586	3,023
275 - 366	386	66,116	2	46,636	144	3,689	40	8,846	82
367 - 549	420	-	450	89,437	578	1,620	17	3,286	25
550 - 731	352	-	-	139	1	183	1	10,473	97
732 - 914	394	.	.	.	.	.	.	-	-
915 -1097	411	.	.	.	.	.	.	-	-
1098 -1280	491	.	.	.	.	.	.	-	-
1281 -1463	773	.	.	.	.	.	.	-	-
Total (X1000)		92,073	825	518,358	1,514	97,588	427	838,098	3,360
Upper 95% C.I. (X1000)		952,009	7,887	5,139,701	13,314	692,829	2,694	9,394,044	36,474
Lower 95% C.I.(X1000)		-767,864	-6,236	-4,102,986	-10,285	-497,654	-1,840	497,654	-29,754
%<184 m		8.6	39.9	0.9	1.0	19.5	12.1	5.5	3.9
184 - 549 m		91.4	60.2	99.1	99.0	80.3	87.6	93.3	93.2
%>549 m		0.0	0.0	0.0	0.0	0.2	0.3	1.2	2.9

Table 4. Total abundance (x1000)/ biomass (Kg x 1000) of northern shrimp (*Pandalus borealis*) collected during fall 1995 - 1998 Canadian multi - species research surveys into NAFO Div 3O. (All tows were standardized to 15 minutes . means depth ranges not sampled).

Depth	Area	1995		1996		1997		1998	
Range in m	in Nmi2	WT 176 & 177		WT 200 AN 253 Tel 42		WT 212 & 213		WT 229, 230, 233	
		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
93 - 183	4775	2488.01	10.44	1128.85	2.13	4305.34	9.05	5586.12	14.19
184 - 274	371	17841.67	19.48	80.75	0.74	705.04	3.68	4626.47	35.5
275 - 366	215	0	0	0	0	27.29	0.27	46.22	0.53
367 - 549	318	0	0	15.68	0.21	12.18	0.12	22.63	0.17
550 - 731	332	6.82	0.07	6.42	0.06	11.71	0.12	9.22	0.09
732 - 914	339	.	.	.	.	.	.	7.22	0.07
915 -1097	390	.	.		.	.	.	0	0
1098 -1280	407	.	.	.	.	.	.	.	.
1281 -1463	488	.	.	.	.	.	.	.	.
Total (X1000)		20,366.00	30	1,906	9	5789	17	17145	69
Upper 95% C.I. (X1000)		246,547.00	273	14,756	15	38940	86	26763	301
Lower 95% C.I.(X1000)		-205,874	-213	-10,943	3	-27362	-51	7527	-163
%<184 m		12.2	34.8	94.6	87.8	86.9	74.7	72.5	47.4
184 - 549 m		87.6	64.9	5.1	10.6	12.9	23.9	27.4	52.5
%>549 m		0.0	0.2	0.3	0.7	0.2	0.7	0.1	0.2

Table 5. Total abundance (X1000)/ biomass (Kg X1000) of northern shrimp (Pandalus borealis) collected in NAFO Div. 3L, outside the 200 Nmi limit during the fall Canadian multi-species research surveys (all tows were standardized to 15 minutes).

Depth Range in m	Area (Nmi2) outside 200 Nmi	95 WT 176, 178, WT 179, Tel 23		96 WT 196 - 198, Tel 41		97 WT 213 - 217 Tel 57 & 58		98 WT 230 - 233 Tel 75 & 76	
		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)
93 - 183	933	24	0	110	0	18,480	79	6,906	14
184 - 274	791	39,917	99	429,678	1,635	290,656	1,246	1,005,018	4,454
275 - 366	758	162,699	997	433,908	2,759	643,252	3,685	558,307	4,222
367 - 549	636	275	4	7,328	110	11,499	102	3,954	17
550 - 731	554	1,935	12	197	1	186	1	10	0
Total (X1000)		204,850	1,112	871,221	4,505	964,072	5,114	1,574,195	8,707
Upper 95% C.I. (X1000)		419,165	4,997	2,035,489	25,675	2,533,368	13,241	4,705,882	25,437
Lower 95% C.I.(X1000)		-9,456	-2,772	-293,048	-16,665	-605,223	-3,014	-1,557,492	-8,022
%<184 m		0	0	0	0	2	2	0	0
184 - 549 m		99	99	100	100	98	98	100	100
%>549 m		1	1	0	0	0	0	0	0

Table 6. Total abundance (X1000)/ biomass (Kg X1000) of northern shrimp (Pandalus borealis) collected in NAFO Div. 3N, outside the 200 Nmi limit during the fall Canadian multi-species research surveys (all tows were standardized to 15 minutes).

Depth Range in m	Area (Nmi2) outside 200 Nmi	95 WT 176 & 177		96 AN 253 Tel 42		97 WT 213 & 214		98 Wt 229 & 230	
		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	1,605	-	-	-	-	11	0	-	-
57 - 92	2,996	1,732	75	3,029	11	658	2	20	0
93 - 183	864	-	-	1,107	2	17,235	44	43,866	119
184 - 274	508	15,225	38	304,211	626	68,154	292	629,225	2,474
275 - 366	366	191	2	44,894	138	3,143	34	7,560	70
367 - 549	420	65,926	450	89,437	578	1,620	17	3,286	25
550 - 731	352	-	-	139	1	183	1	10,473	97
Total (X1000)		83,073	564	442,817	1,356	91,005	391	694,430	2,786
Upper 95% C.I. (X1000)		931,482	6,361	4,176,800	4,875	685,509	2,645	7,507,801	29,156
Lower 95% C.I.(X1000)		-765,336	-5,232	-3,291,167	-2,164	-503,500	-1,863	-6,118,942	-23,585
%<184 m		2	13	1	1	20	12	6	4
184 - 549 m		98	87	99	99	80	88	92	92
%>549 m		-	-	0	0	0	0	2	3

Table 7. Total abundance (X1000)/ biomass (Kg X1000) of northern shrimp (Pandalus borealis) collected in NAFO Div. 30, outside the 200 Nmi limit during the fall Canadian multi-species research surveys (all tows were standardized to 15 minutes).

Depth Range in m	Area (Nmi2) outside 200 Nmi	95 WT 178 & 179		96 AN 253 Tel 42		97 WT 212 & 213		98 WT 229	
		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	269	-	-	20	0	20	0	458	1
93 - 183	246	34	0	506	1	1,318	3	680	2
184 - 274	74	34	0	10	0	342	1	1,659	11
275 - 366	47	-	-	-	-	-	-	-	-
367 - 549	58	-	-	12	0	-	-	8	0
550 - 731	71	5	0	-	-	9	0	-	-
Total (X1000)		73	1	548	1	1,688	4	2,806	15
Upper 95% C.I. (X1000)		279	5	6,987	11	18,447	36	25,253	162
Lower 95% C.I.(X1000)		-134	-4	-5,891	-8	-15,071	-28	-19,642	-133
%<184 m		46	31	96	83	79	65	41	22
184 - 549 m		46	62	4	19	20	32	59	78
%>549 m		7	9	-	-	1	2	-	-

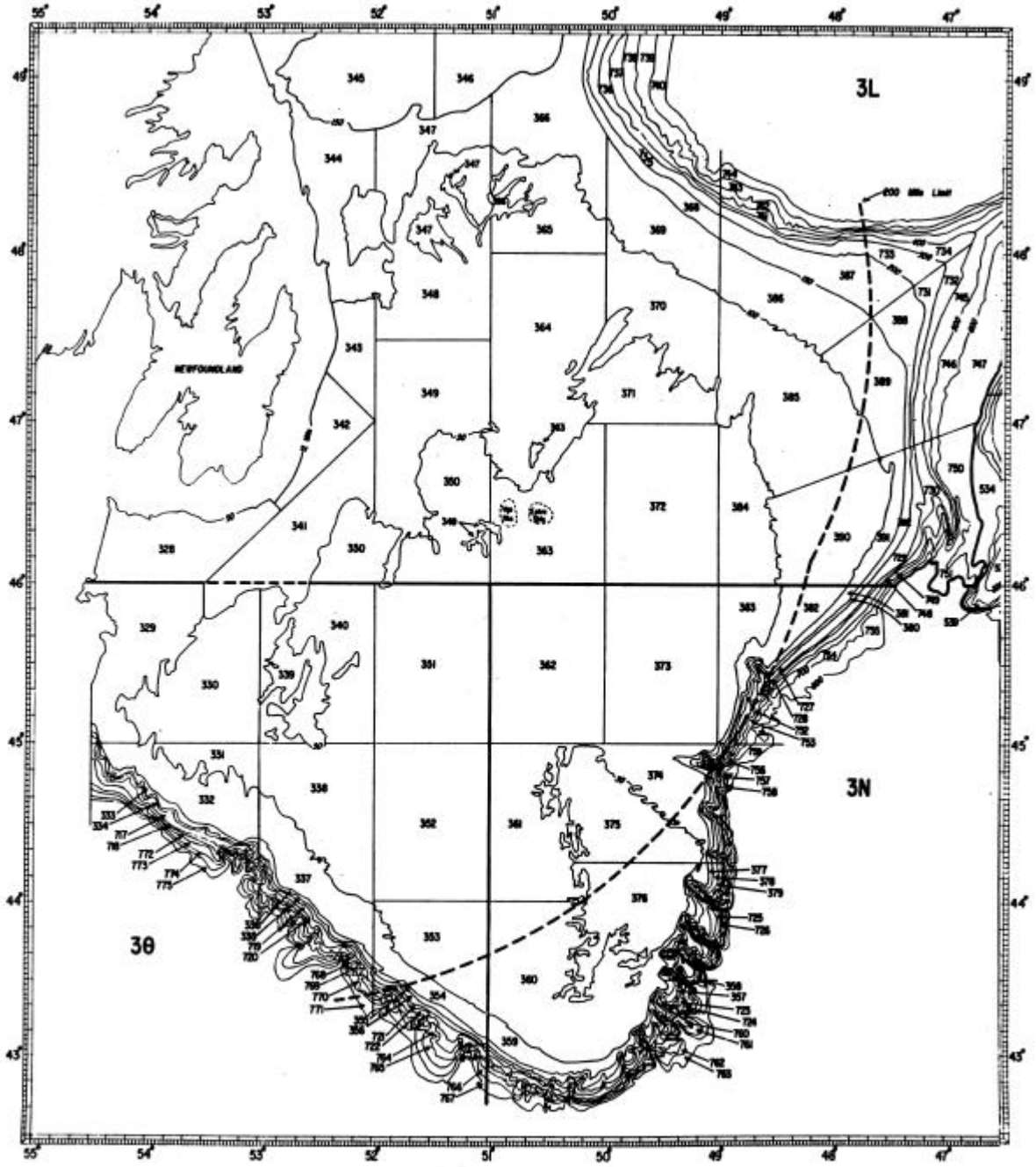

Figure 1. Stratified area for Canadian research trawl surveys in NAFO Div. 3LNO.

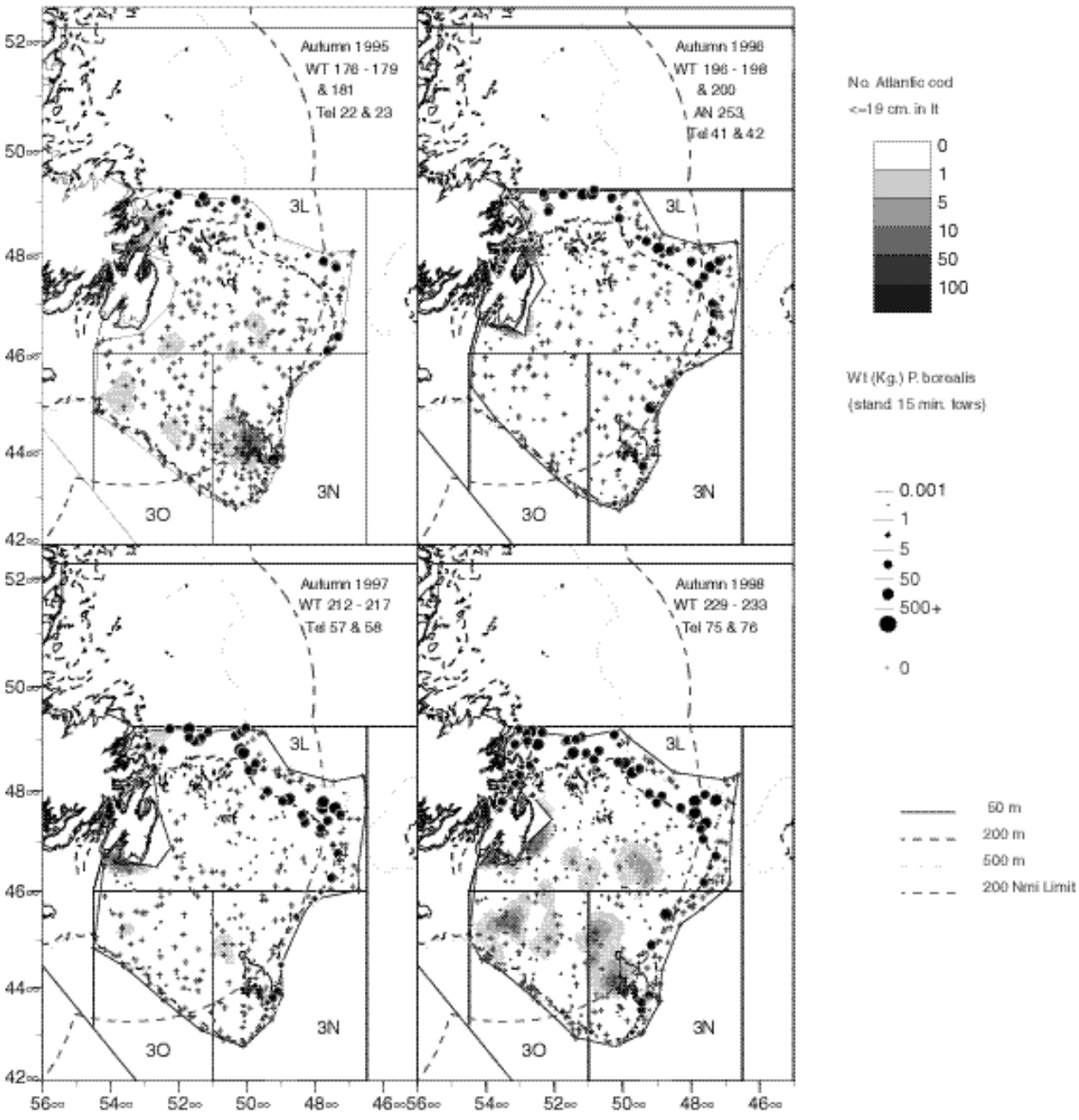

Fig. 2 Distribution of juvenile Atlantic cod (total lt <=19 cm) in relation to catches of Pandalus borealis.
(Catches were collected during the annual Canadian multi-species autumn research surveys with a Campelen 1800 shrimp trawl.)

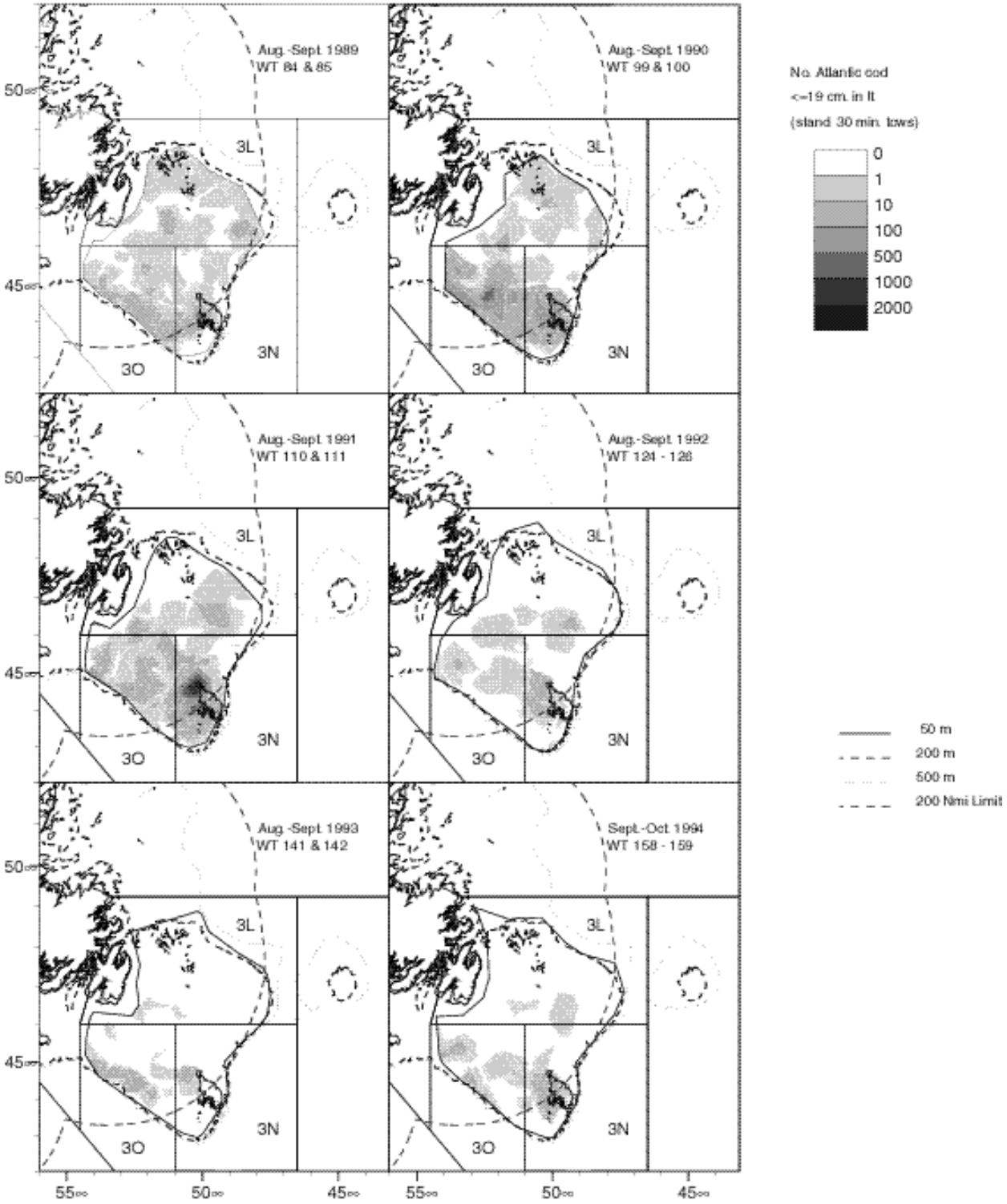

Fig. 3 Distribution of juvenile Atlantic cod (total lt <=19 cm). Collections were made during Canadian juvenile flatfish research surveys using a Yankee 41 shrimp trawl.

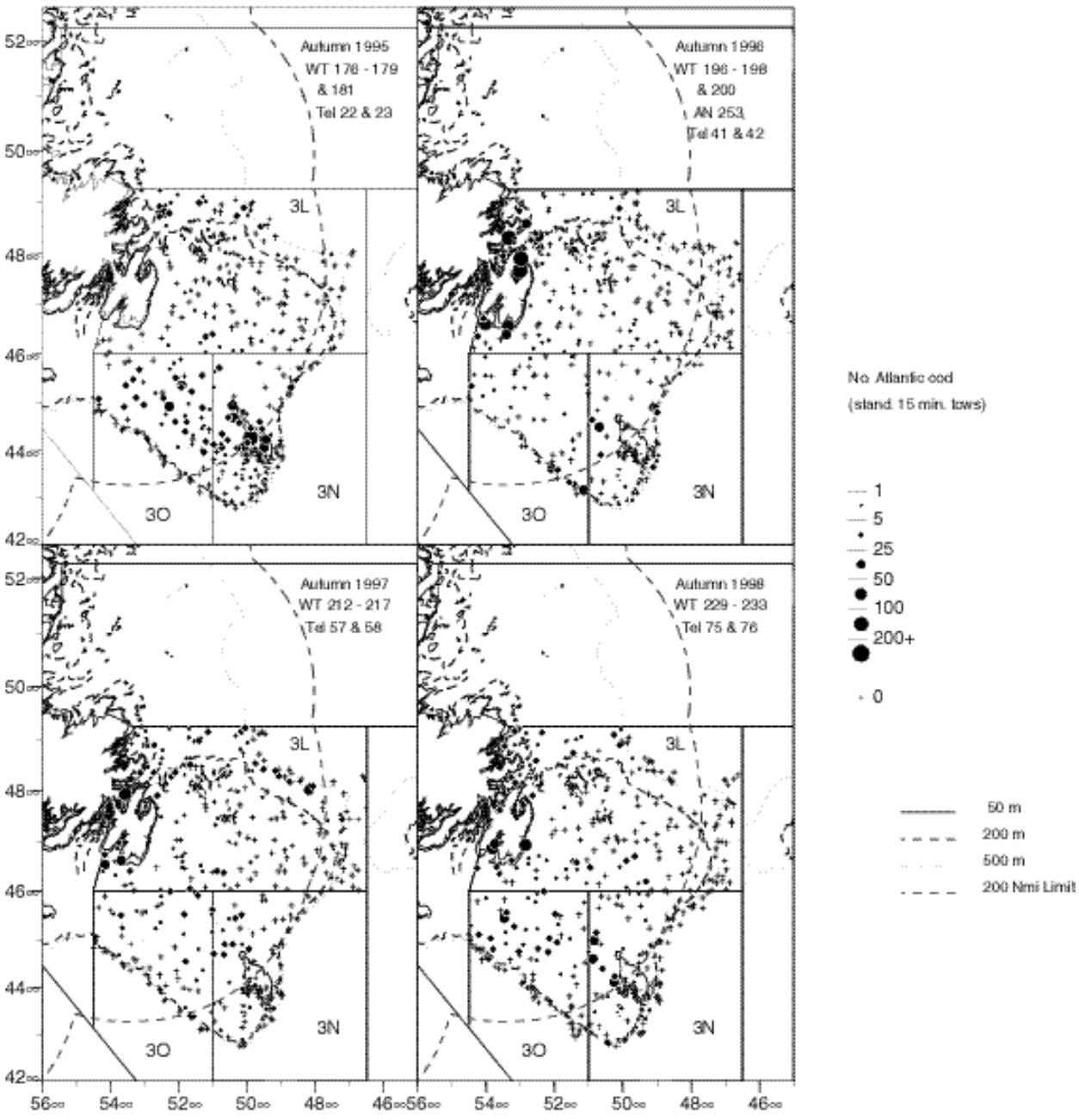

Fig. 4 Distribution of Atlantic cod collected during Canadian 1995 - 98 autumn multi-species research surveys. (Catches were made with a Campelen 1800 shrimp trawl).

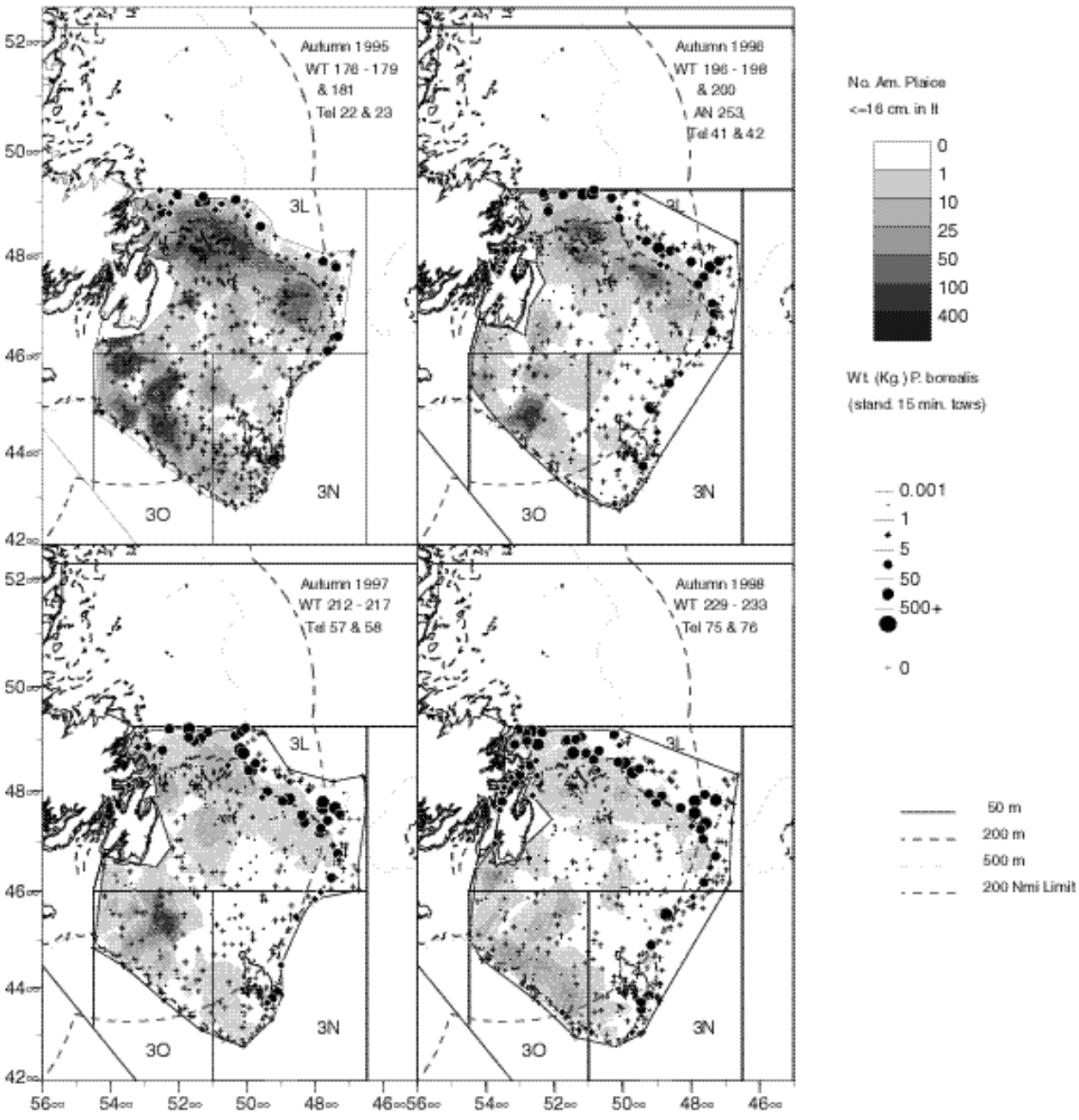

Fig. 5 Distribution of juvenile American Plaice (total lt <=16 cm) in relation to catches of Pandalus borealis.
(Catches were collected during the annual Canadian multi-species autumn research surveys with a Campelen 1800 shrimp trawl).

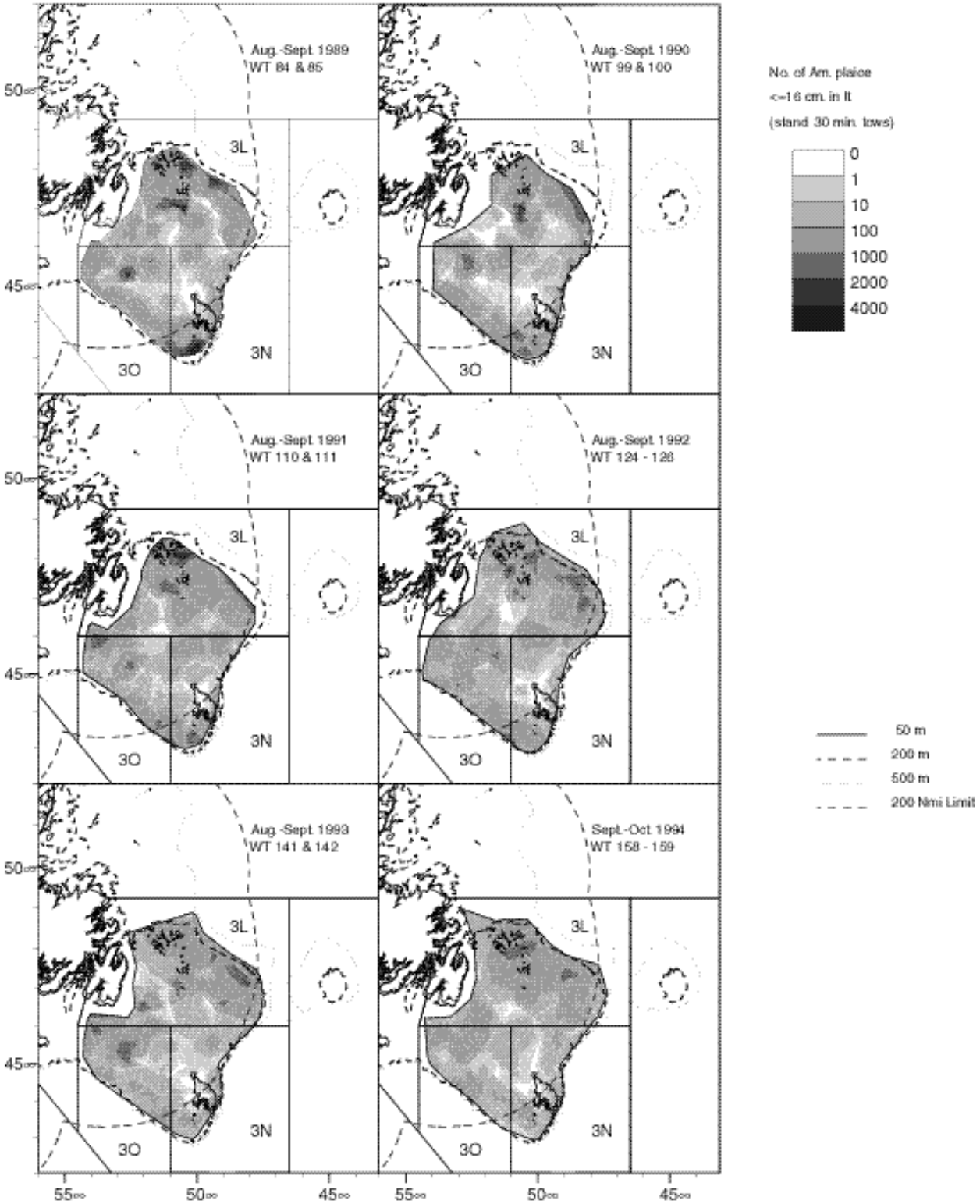

Fig. 6 Distribution of juvenile American plaice (total lt <=16 cm). Collections were made during Canadian juvenile flatfish research surveys using a Yankee 41 shrimp trawl.

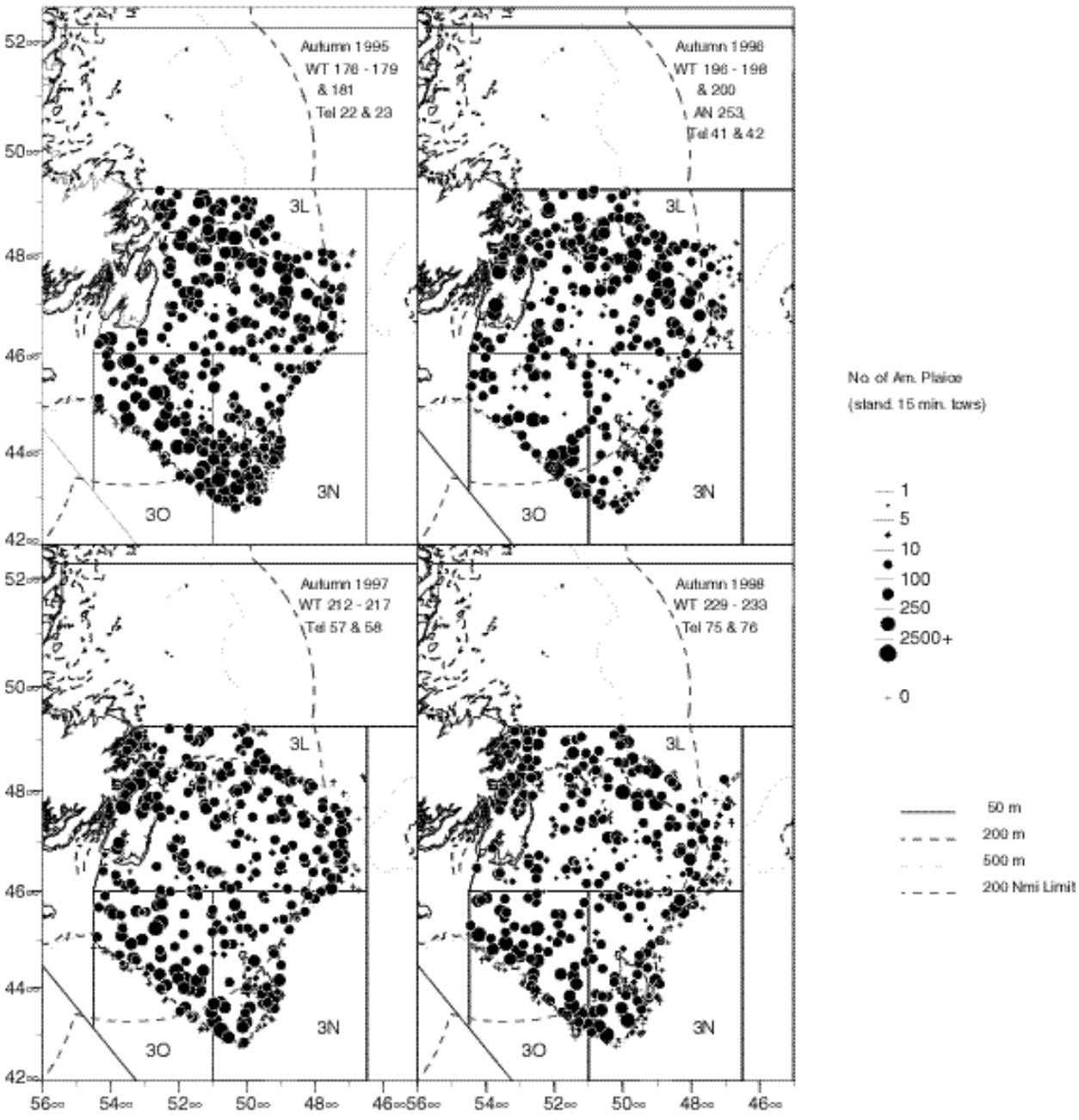

Fig. 7 Distribution of American Plaice collected during Canadian 1995 - 98 autumn multi-species research surveys. (Catches were made with a Campelen 1800 shrimp trawl).

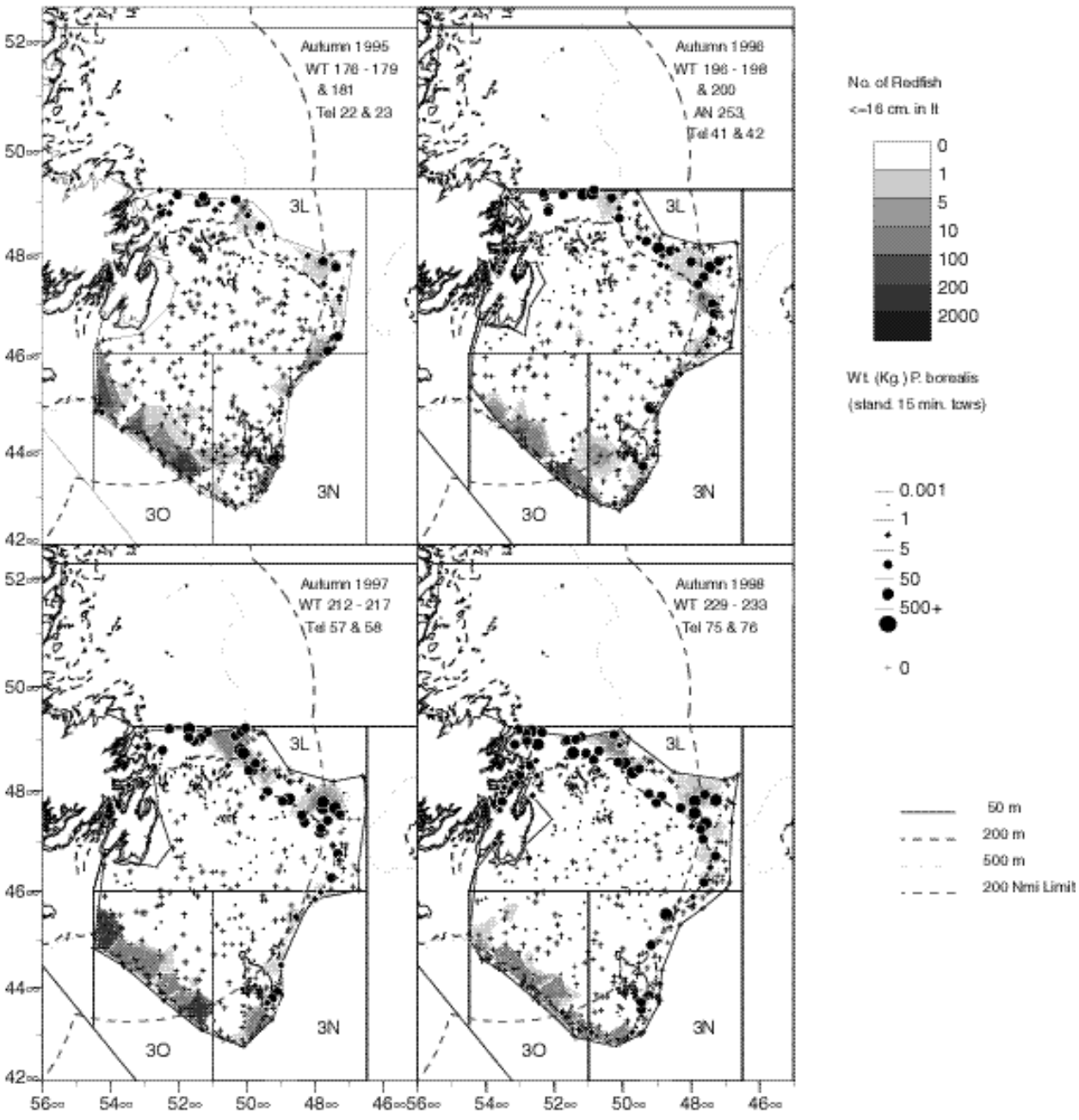

Fig. 8 Distribution of juvenile Redfish (total lt <=16 cm) in relation to catches of Pandalus borealis.
(Catches were collected during the annual Canadian multi-species autumn research surveys with a Campelen 1800 shrimp trawl).

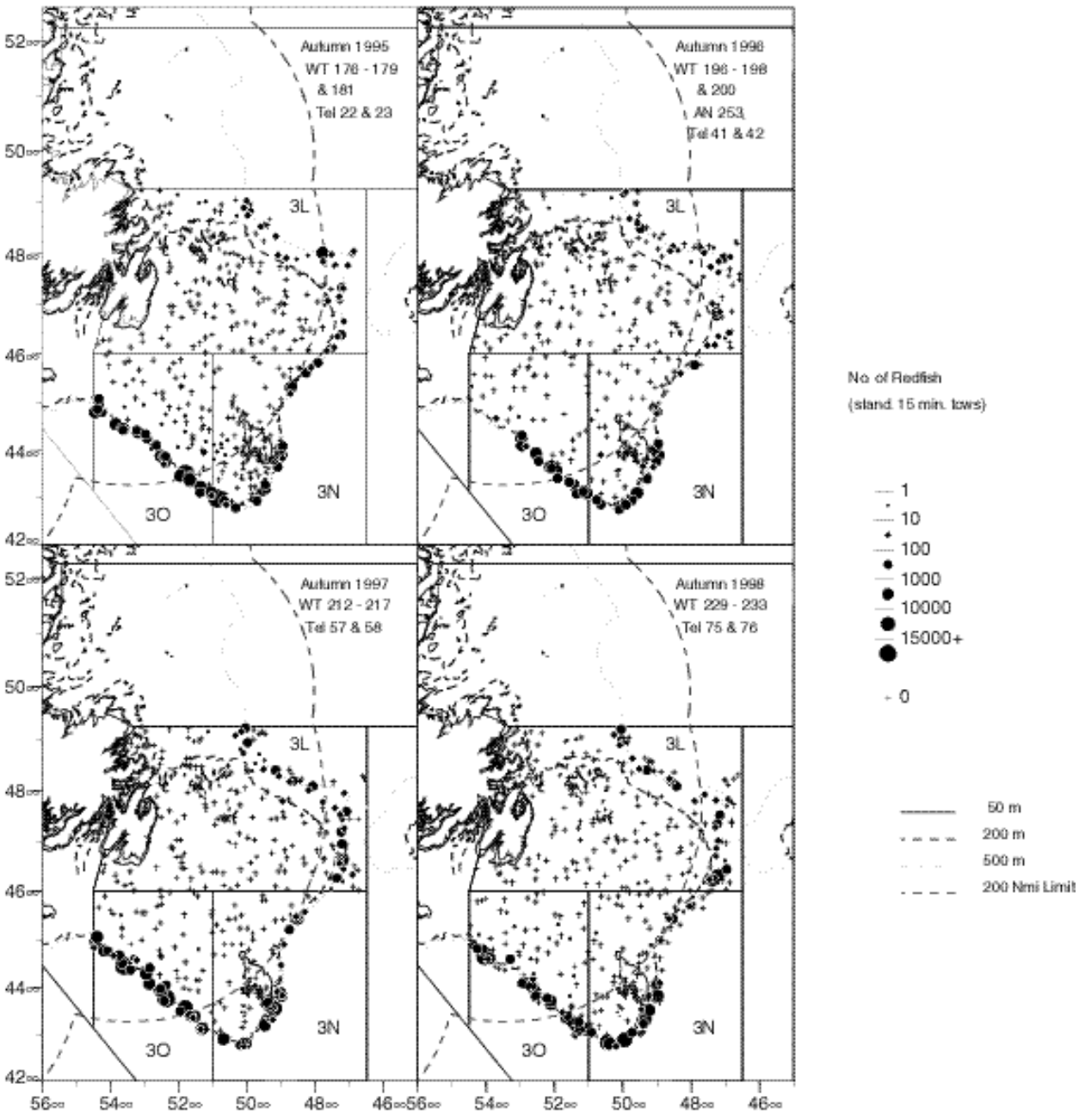

Fig. 9 Distribution of Redfish collected during Canadian 1995 - 98 autumn multi-species research surveys. (Catches were made with a Campelen 1800 shrimp trawl).

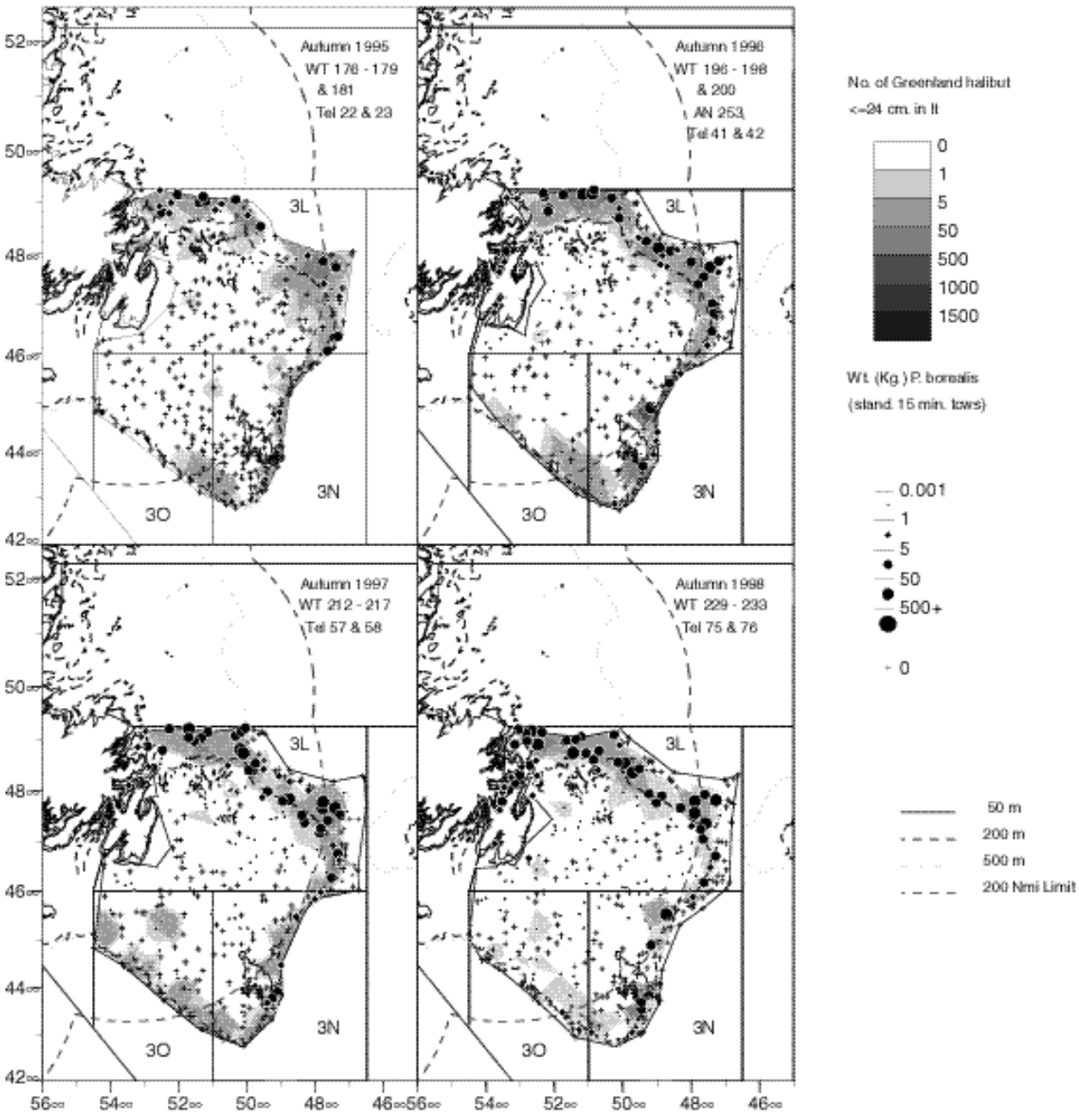

Fig. 10 Distribution of juvenile Greenland halibut (total lt <=24 cm) in relation to catches of Pandalus borealis.
(Catches were collected during the annual Canadian multi-species autumn research surveys with a Campelen 1800 shrimp trawl).

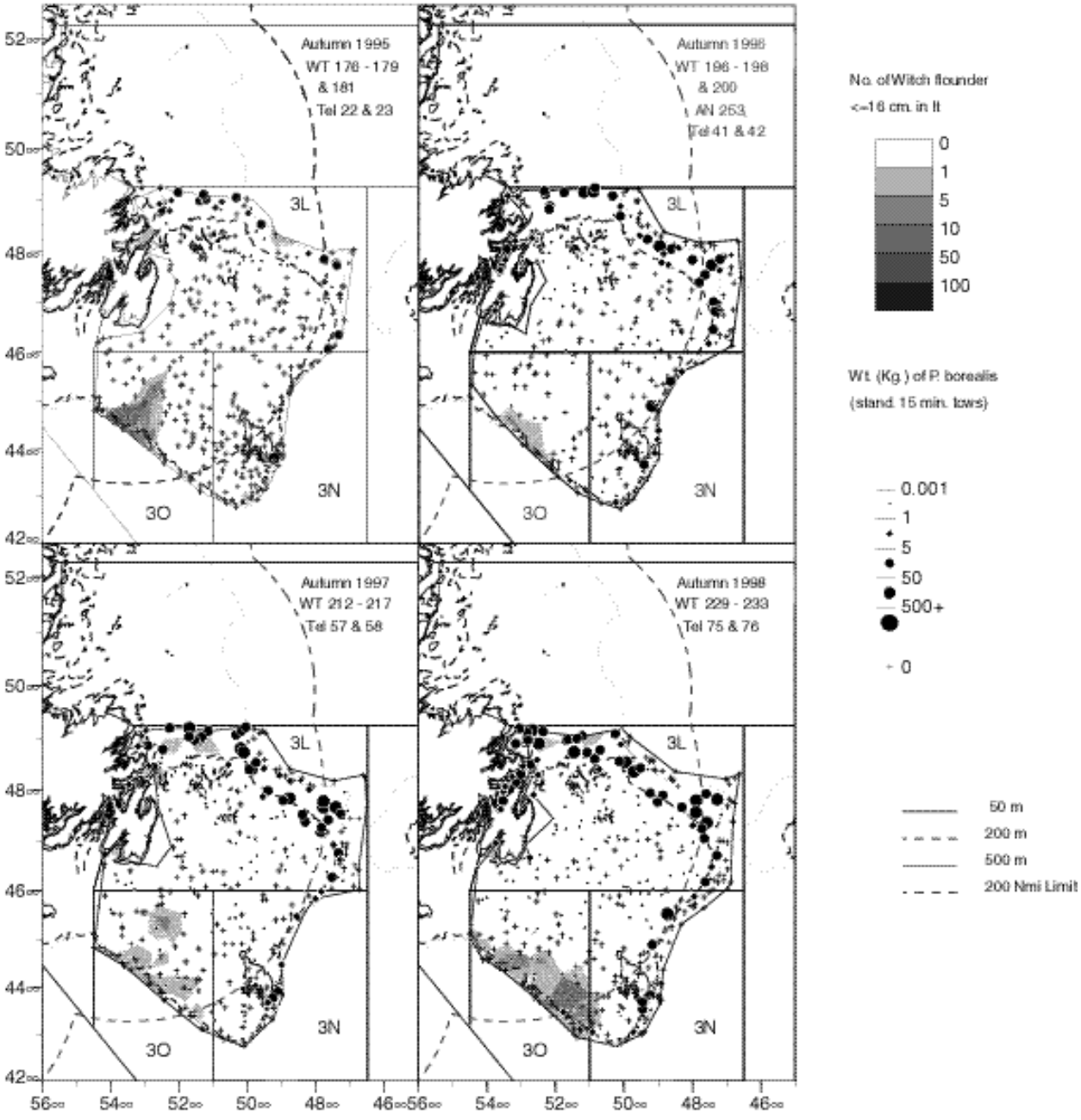

Fig. 11 Distribution of juvenile Witch flounder (total lt <=16 cm) in relation to catches of Pandalus borealis.
(Catches were collected during the annual Canadian multi-species autumn research surveys with a Campelen 1800 shrimp trawl).

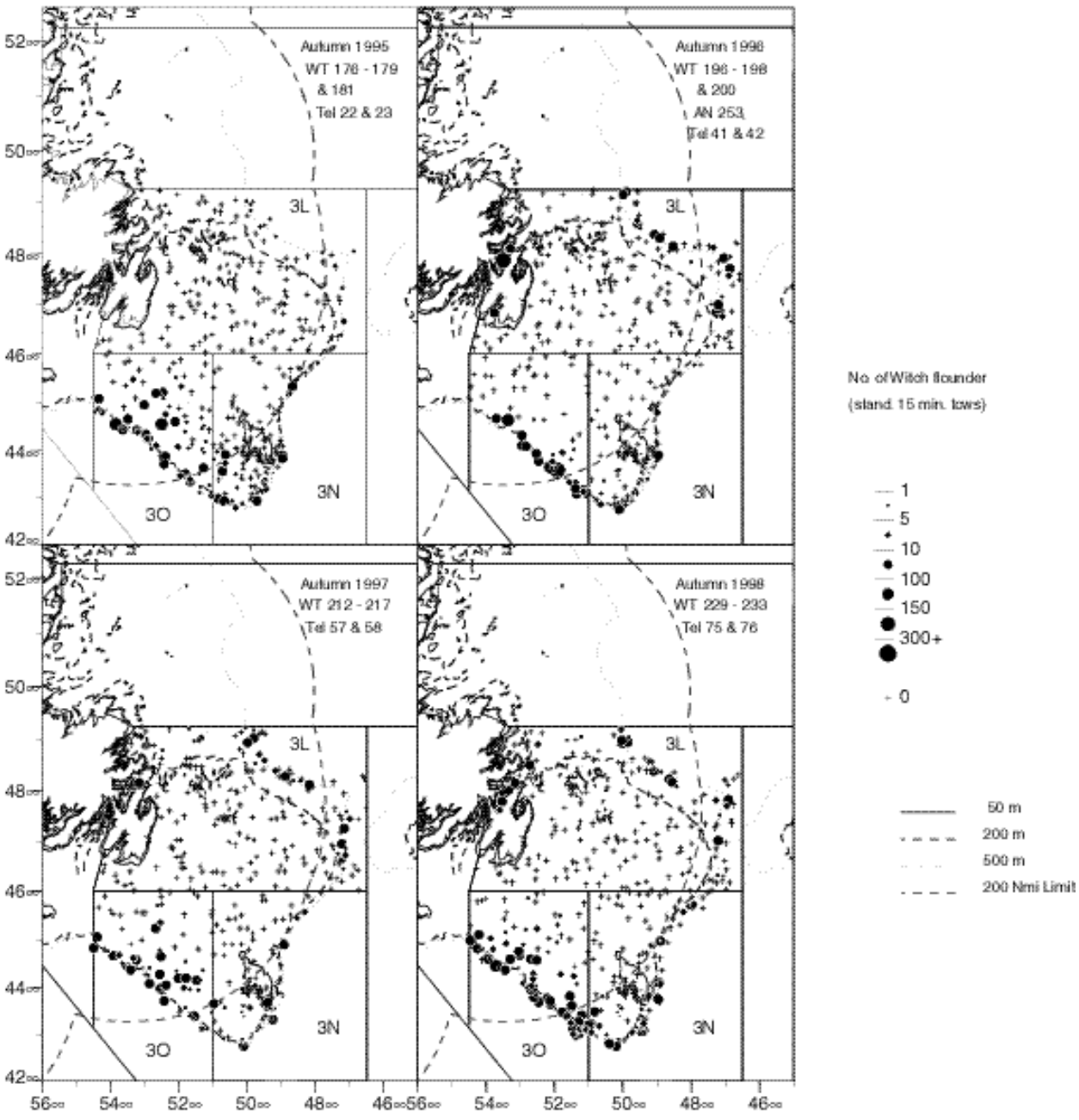

Fig. 12 Distribution of Witch flounder collected during Canadian 1995 - 98 autumn multi-species research surveys. (Catches were made with a Campelen 1800 shrimp trawl).

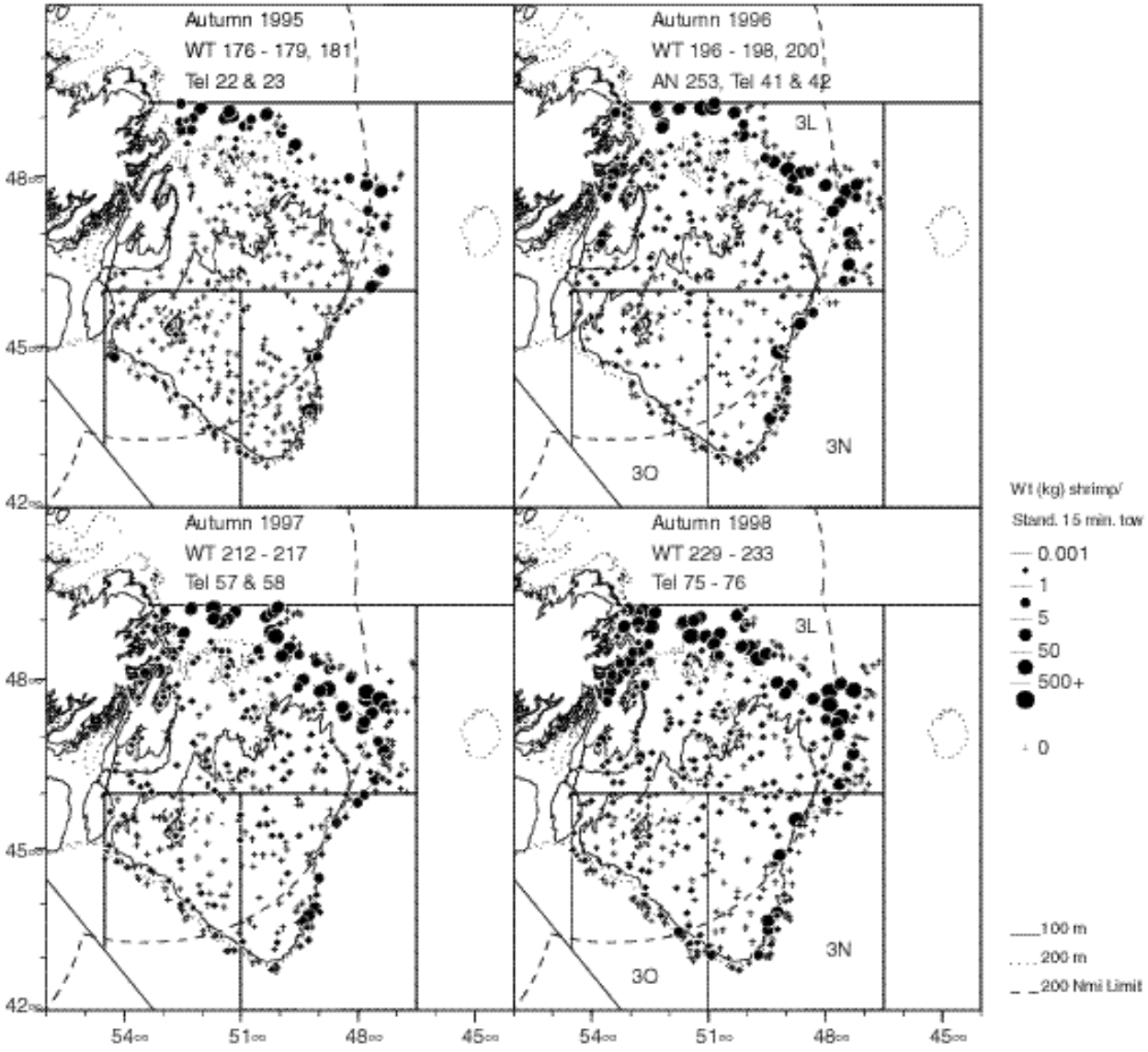

Fig. 13 Distribution of Pandalus borealis within NAFO div. 3LNO during autumn 1995 - 1998 Canadian multi-species research surveys using a Campelen 1800 trawl. (Data were standardized to 15 minute tows.)