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Distribution and Biomass of Selected Unregulated Species Occurring in the NAFO Regulatory Area and Adjacent Areas

by

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Abstract

The Scientific Council was requested to review all available information from both research vessel surveys and commercial catches on the relative biomass and geographic distribution of selected unregulated species. This paper examines the distribution and biomass trends for monkfish, striped, spotted and northern wolffishes, thorny skate, black dogfish, eelpouts (12 species) and longfin hake using Canadian spring and fall survey information. Distribution and biomass is examined over the entire range of the surveys including areas outside of the NAFO Regulatory Area. Results show that the species examine in this paper can be placed into two general categories: those that have a more widespread distribution on the banks within the area surveyed and those restricted to warmer slope waters. The more widespread species namely the eelpouts, thorny skate and the wolfishes underwent a decline in abundance during the late 1980's (or earlier) and early 1990's. The other group, longfin hake, monkfish and black dogfish were distributed along the slope where bottom temperatures were warmest. A decline in abundance was not observed for these species. For eelpouts, out of the 12 species taken in the surveys, catches are dominated by Arctic and Vahl's eelpout.

Introduction

The Scientific Council was requested to review all available information from both research vessel surveys and commercial catches on the relative biomass and geographic distribution of the following unregulated species/stocks occurring within the NAFO Regulatory Area: monkfish *(Lophius americanu*s), wolffishes *(Anarhichas lupus, A. minor, A. denticulatu*s), thorny skate *(Amblyraja radiat*a), black dogfish *(Centroscyllium fabrici*i), eelpouts *(Lycodes spp*.), longfin hake *(Urophycis chester*i), and orange roughy *(Hoplosthethus atlanticu*s) (Anon 2001). The purpose of this paper is to address this request for species that have not been presented elsewhere. Information on orange roughy is presented separately in Kulka et al. (2001), the status of monkfish and thorny skate is presented by Kulka and Miri (2001) and Kulka and Mowbray (1998) respectively. For the remaining species, this paper examines distribution and trends in biomass using Canadian spring and fall survey information. It also includes updates for monkfish and skate to bring that information up to date In particular for black dogfish, eelpouts and longfin hake, there is very little in the way of published studies and this paper is essentially a first look at their distribution and biomass in waters of Canada. The species are examined over the entire range of the surveys including areas outside of the NAFO Regulatory Area. Information on catches is presented for thorny skate, an important fishery in the NAFO Regulatory area. The other species are bycatch only usually captured in small amounts.

Methods

Data from 1986-2000 from the Canadian spring and fall stratified research vessel survey were examined for NAFO Divisions 3LNO (fall) and 3LNOPs (spring). The survey stratification scheme is based on depth (Doubleday 1981).

For every trawl set, species are separated, counted and weighed. The number and weight of each catch was standardized to the distance towed (which varied between gear types). Prior to spring 1996 and fall 1995 an Engel 145 Hi-Lift otter trawl (1.8nm at 3.5k) was deployed from the *Wilfred Templeman* (WT). Occasionally the *Alfred Needler* (AN), sister ship to the *W. Templeman*, was used in the surveys. In 1995, the Engel otter trawl was replaced by the Campelen 1800 shrimp trawl (0.8nm at 3.0k). As well, during the 1995 fall surveys and onward the *Templeman* was augmented by the *Teleost* (TEL) deploying a similar trawl. Comparative analyses of the catchability of Engels versus Campelen gear were not done for the species examined in this paper. Thus, the abundance and biomass series are broken in the fall of 1995. For all of theses species, given the large jump in apparent biomass and abundance, a much higher catchability is observed with the Campelen trawl.

With the exception of the Zoarcidae (Eelpouts), which were analyzed as a group, for each species we examined the annual variation in abundance, biomass and geographic distribution. Geographic distribution of catches, for each species, was examined using point pattern/expanding symbol plots of standardized number per tow for all successful trawls using ACON (Black 2001). Each successful trawl is represented as an expanding point, with zero catches indicated by a plus sign. Annual estimates of species abundance and biomass, by Division for each species from 1986-2000, were generated using a computer program, STRAP - Stratified Analysis Programs of Smith and Somerton (1981).

Results and Discussion

Eelpouts:

Information on relative biomass and distribution for eelpouts is presented in Fig. 2 for all species combined. Tables 1a (spring) and 1b (fall) show that Arctic and Vahl's eelpout dominated the survey catches (the two species comprised about 85% of the catch of eelpouts) in all years. Fig. 2 shows that eelpouts, as a group, are found over the entire extent of the bank in Division 3L, mainly in slope waters in the other divisions. Thus they commonly occur in the NRA. This is particularly apparent prior to the change to Campelen gear in 1995. In both the spring and fall surveys, a decline in abundance and biomass is apparent from the late 1980's to 1994 (Table 2 and 3). Following the change to the Campelen trawl, abundance and biomass were relatively stable from 1995-2000 in both the spring and fall surveys. Catches of Eelpouts were distributed throughout NAFO Divisions 3LNO in fall and NAFO Divisions 3LNOPs in spring. In both the spring and fall surveys, catches of Eelpouts in NAFO Division 3NO appear to be concentrated in deeper water along the edge of the bank. Within years, catches of Zoarcidae were dominated by mainly Arctic Eelpouts, and to a lesser extent Vahl's and Esmark's eelpouts. However in more recent years, and consistent with the switch to the Campelen trawl, lesser species of Zoarcidae are more highly represented in the catches.

Longfin Hake:

Longfin hake are concentrated mainly along the Laurentian Channel slope and the southwest slope of the Grand Banks, in NAFO Division 3O in the fall surveys and to a lesser extent in NAFO Divisions 3LN (Fig. 4). Similarly, in the spring surveys, longfin hake are concentrated in NAFO Division 3OPs. Prior to the switch to the Campelen trawl, abundance and biomass estimates were very low in all Divisions (Fig. 3, Table 3). After the change, the fall research vessel surveys show a steady increase in biomass and abundance from 1996 to present in particularly NAFO Division 3O. In NAFO Divisions 3LN, the abundance of longfin hake in the fall appears to be variable. While the abundance and biomass estimates from the spring research vessel surveys in NAFO Divisions 3OPs are greater than those observed in the fall surveys, the general increase in abundance in 3O is not apparent. Geographically, catches of longfin hake are distributed mainly in NAFO Division 3O during the fall surveys in deep water along the edge of the Grand Bank. Where they do occur in NAFO Divisions 3LN in the fall surveys, catches of longfin hake are also found along the edge of the bank. Similarly, during the spring survey, catches of longfin hake are generally found in 3Ps in the deep waters of the Laurentian and Hermitage channels and in 3LNO along the edge of the Grand Bank. longfin hake were found almost exclusively where bottom temperature exceed 3^0 C.

Thorny Skate:

Similar to many other species examined thorny skate abundance and biomass underwent a decline during the late 1980's and early 1990's (Fig. 5, Table 4). In NAFO Division 3L, Thorny skate biomass declined from an estimated

44,555 (t) in 1986 to 6,379(t) in 1994 in the fall surveys. A similar decline in biomass was observed in NAFO Divisions 3LN from the spring research vessel surveys from 1986-1995. Since the change to the Campelen trawl, thorny skate numbers from the fall and spring surveys have been variable. Geographically, thorny skate are widely distributed throughout the survey area in both the fall and spring surveys (Fig. 6). In more recent spring/fall surveys, few catches of thorny skate occurred in the western portion of NAFO 3L in the vicinity of Woolfall Bank and the Avalon channel in NAFO 3L. In recent spring survey's catches of thorny skate appear to be concentrated in 3NO and 3Ps. While distributed throughout the area, Thorny Skate appear to be concentrated more along the southwest slope and edge of the Grand Bank in recent spring surveys. Fig. 7 and Table 5 illustrate commercial catches 1985-2000. The majority of the catch continues to be non-Canadian from the NRA. A more thorough description of thorny skate distribution, biomass and abundance trends and commercial catches can be found in Kulka and Mowbray (1998). That paper showed than skate undergoes a limited on (fall/winter)/off (spring/summer) bank migration.

Spotted Wolffish:

Spotted wolffish biomass and abundance in the fall and spring surveys are concentrated in NAFO Division 3L (Fig. 8, Table 6). In both spring and fall surveys, spotted wolffish abundance and biomass underwent a decline from the late 1980's through the early 1990's. In recent spring surveys, since the gear change, there has been an apparent increase in abundance and biomass from 1997 to present. During the same time period, there has been a less apparent increase in abundance in the fall surveys. Geographically, spotted wolffish are concentrated mainly on the north and east edges of the Grand Bank in NAFO Division 3L (Fig. 9). In NAFO Division 3Ps, large catches occurred mainly in the vicinity of the Hermitage channel in the recent spring survey. History of distribution and biomass trends of the wolffish species are elaborated in Kulka and Deblois (1996).

Striped Wolffish:

Striped wolffish abundance declined from the late 1980's to 1994 in both the fall and spring surveys (Fig. 10, Table 7). Since 1996, there has been a marginal increase in abundance in the fall surveys. However, the abundance estimated from the spring surveys is variable over the same period of time. In the fall surveys, striped wolffish appear to be concentrated along the edge of the Grand Bank and on the southwest slope of the Grand Bank in NAFO Division 3NO (Fig. 11). In the spring surveys a similar pattern emerges with striped wolffish concentrated along the northern edge of the Grand Bank in NAFO Division 3L and on the southwest slope of NAFO Division 3NO. In NAFO Division 3Ps, striped wolffish appear to be concentrated on the north slope of the Laurentian channel and along the slopes of Hermitage channel.

Broadhead Wolffish:

Similar to the other species of wolffish examined, Broadhead wolfish (also referred to as northern wolffish) abundance declined from the late 1980's to early 1990's (Fig. 12 Table 8). Prior to 1994, Broadhead wolffish were most abundant in NAFO Division 3L, and present at low levels in NAFO Divisions 3NO in the fall surveys. In recent years, the abundance and biomass of Broadhead wolffish has been variable in the fall surveys in NAFO Divisions 3LNO, with a slight increasing trend. However, the abundance and biomass estimates from the fall 2000 survey show a decline in NAFO Division 3L. Geographically, the fall and spring surveys show catches of Broadhead wolffish are concentrated along the edge of the Grand Bank in NAFO Divisions 3LNO (Fig. 13). During the spring surveys, catches also occur in the Laurentian channel in NAFO Division 3Ps.

Monkfish:

Monkfish, as indicated by the fall and spring surveys, are concentrated mainly in NAFO Divisions 3O and 3Ps. Prior to the gear change in 1995, Monkfish abundance and biomass estimates in NAFO Division 3O, from the fall surveys, are variable at very low levels (Fig. 14 Table 9). . Over the same time period, biomass estimates from the spring survey show a decline from the late 1980's to early 1990's in both NAFO Divisions 3Ps and 3O. In recent years, there is a slight indication of an increase in abundance and biomass of Monkfish in NAFO Divisions 3O and 3Ps in the spring surveys. However, biomass and abundance estimates derived from the fall survey's indicate a continued decline in biomass and abundance through to 1998 in NAFO Division 3O (Note: the gear change occurred in 1995). Geographically, the fall distribution of Monkfish catches is concentrated mainly on the southwest slope

and edge of the Grand Bank in NAFO Division 3O (Fig. 15). Spring surveys, show a similar distribution in NAFO Division 3O, plus a concentration of Monkfish catches along the slopes of the Laurentian and Hermitage channels in NAFO Division 3Ps.

Black Dogfish:

Prior to the gear change, black dogfish were detected at very low levels in the fall survey cruises. In NAFO Divisions 3LNO, black dogfish estimates of abundance and biomass are quite variable since 1995 (Fig. 16, Table 10). However, the estimates of biomass and abundance from the spring surveys show a relatively stable level of abundance and biomass during the late 1980's and early 1990's in NAFO Division 3Ps. In recent spring surveys, abundance and biomass levels are lower than that observed immediately after the gear change in 1996. During the fall surveys, catches of black dogfish generally are found to occur in deeper waters along the edge of the Grand Bank in NAFO 3LNO (Fig. 17). In spring surveys, black dogfish are mainly concentrated in the deep waters of the Laurentian channel, to a lesser degree in the Hermitage channel. In NAFO Division 3O, Black dogfish are also found along the southwest slope of the Grand Bank at the greatest depths sampled. Commercial catches at depths exceeding 1000 m commonly take this species alnong the entire slope.

Conclusions

The species examine in this paper can be placed into two general categories: those that have a more widespread distribution on the banks within the area surveyed and those restricted to warmer slope waters. The more widespread species namely the eelpouts, thorny skate and the wolfishes underwent a decline in abundance during the late 1980's (or earlier) and early 1990's. The other group, longfin hake, monkfish and black dogfish were distributed along the slope, particularly in the Laurentian Channel and the southeset slope of the Grand Bank where bottom temperatures were warmest. A decline in abundance was not observed for these species.

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Table 1a. Percent composition of Eelpout catch by species in spring surveys from 1986-2000.

Common Name	Scientific Name	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	All
Newfoundland Eelpout	Lycodes terraenovae																
	Lycodes agnostus																
Laval's Eelpout	Lycodes lavalaei		0.11														0.11
Eelpout(NS)	Lycodes sp.												0.37	0.40	0.00		0.26
Common Ocean Pout	Macrozoarces americanus	0.12	0.32	0.19	0.28	0.83	0.27			1.05		0.78	0.10	0.05	0.28	0.39	0.39
Esmark's Eelpout	Lycodes esmarki	0.35	0.32		0.28	0.42	3.29	3.86	2.24	0.52	3.47	0.92	1.00	1.00	0.93	1.73	1.45
Polar Eelpout	Lycodes turneri											5.21	1.47				3.34
Green Ocean Pout	Gymnelis viridis	0.24		0.78						0.52		6.48	4.83	3.71	6.17	7.86	3.82
Soft Eelpout	Melanostigma atlanticum						4.11	17.39	16.35	2.62	17.36	0.70	1.73	1.70	0.59	2.33	6.49
Eelpouts(NS)	Zoarcidae		0.11				0.27		0.64			0.70	18.64	33.12	37.28	40.34	16.39
Vahl's Eelpout	**Lycodes vahlii**	8.13	14.39	3.88	8.16	9.15	15.34	35.75	31.09	21.99	26.39	31.26	33.18	27.56	18.67	28.42	20.89
Arctic Eelpout	**Lycodes reticulatus**	91.17	84.76	95.16	91.29	89.60	76.71	43.00	49.68	73.30	52.78	53.95	38.69	32.46	36.07	18.94	61.84

Table 1b. Percent composition of Eelpout catch by species in fall surveys from 1986-2000.

Common Name	Scientific Name	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	All
	Lycodes agnostus													0.05			0.05
Newfoundland Eelpout	Lycodes terraenovae										0.11						0.11
Soft Eelpout	Melanostigma atlanticum						0.72		0.19		0.73	0.12	0.02	0.53	0.03	0.67	0.38
Laval's Eelpout	Lycodes lavalaei				0.21			0.24						0.26	1.16		0.47
Common Ocean Pout	Macrozoarces americanus					0.62	0.60	0.71	0.38	0.91	1.51		0.79	0.10	0.03	0.23	0.59
Polar Eelpout	Lycodes turneri										2.30		0.05		0.45		0.93
Esmark's Eelpout	Lycodes esmarki	1.82	0.66	0.34	0.62	0.78	3.32	1.47	5.75	5.01	1.73	1.28	0.88	1.73	1.64	0.44	1.83
Eelpout(NS)	Lycodes sp.										0.53	0.04	0.05		5.69	3.83	2.03
Green Ocean Pout	Gymnelis viridis										4.44	2.11	3.16	4.03	3.33	0.94	3.00
Eelpouts(NS)	Zoarcidae										1.34	16.03	32.87	29.34	10.68	44.42	22.45
Vahl's Eelpout	**Lycodes vahlii**	17.89	16.81	9.71	16.44	11.27	34.04	32.69	31.67	39.86	34.08	34.82	34.80	31.01	48.19	33.40	28.44
Arctic Eelpout	**Lycodes reticulatus**	80.30	82.54	89.94	82.73	87.32	61.33	64.90	62.02	54.22	53.23	45.60	27.39	32.96	28.80	16.07	57.96

Table 2: Survey Biomass and abundance of Eelpouts in Fall/spring DFO RV Surveys, 1986-2000

Biomass (t)

	FALL				SPRING			
Year	3L	3N	3O	Year	3L	3N	3O	3Ps
1986	6,007	0	0	1986	8,260	688	32	389
1987	9,251	0	0	1987	8,123	701	260	647
1988	8,750	0	0	1988	6,732	228	117	174
1989	4,674	0	0	1989	6,907	287	166	208
1990	6,975	391	394	1990	3,595	570	415	277
1991	1,853	265	317	1991	1,917	221	211	310
1992	1,847	278	269	1992	474	183	53	81
1993	2,987	501	317	1993	1,056	238	192	39
1994	1,074	353	190	1994	750	67	165	119
				1995	326	44	115	99
1995	6,453	1,738	2,401					
1996	10,558	234	579	1996	3,744	1,169	1,291	696
1997	6,887	2,697	2,418	1997	1,580	453	782	352
1998	6,809	3,147	1,080	1998	2,123	888	435	725
1999	8,641	2,281	1,413	1999	5,304	1,171	1,512	1,113
2000	6,952	3,155	1,382	2000	2,423	1,189	1,178	846

Abundance (thousands)

	FALL				SPRING			
Year	3L	3N	3O	Year	3L	3N	3O	3Ps
1986	7,937	0	0	1986	9,126	528	51	335
1987	11,186	0	0	1987	10,402	746	534	794
1988	10,867	0	0	1988	7,614	306	179	139
1989	6,433	0	0	1989	8,115	286	230	252
1990	9,386	321	485	1990	5,021	591	669	431
1991	2,498	340	460	1991	3,283	380	418	725
1992	3,457	321	439	1992	1,174	267	123	446
1993	6,357	680	404	1993	2,138	476	244	725
1994	1,734	379	311	1994	1,958	162	283	177
				1995	821	116	152	357
1995	62,028	8,322	9,956					
1996	90,598	2,321	2,336	1996	41,939	7,018	5,935	9,542
1997	55,073	11,690	10,287	1997	14,762	4,146	5,760	4,467
1998	50,432	12,704	3,931	1998	15,731	6,034	2,022	7,247
1999	57,207	11,842	5,222	1999	34,349	5,136	4,810	8,157
2000	63,473	16,643	3,705	2000	23,760	7,636	4,776	13,409

Table 3: Survey Biomass and abundance of Longfin Hake in Fall/spring DFO RV Surveys, 1986-2000

Biomass (t)

	FALL				SPRING			
Year	3L	3N	3O	Year	3L	3N	3O	3Ps
1986	0	0	0	1986	0	0	15	773
1987	0	0	0	1987	0	0	34	664
1988	0	0	0	1988	0	0	24	677
1989	0	0	0	1989	0	0	14	820
1990	0	0	100	1990	0	0	2	548
1991	2	4	49	1991	2	0	99	1,003
1992	1	0	46	1992	2	1	40	287
1993	0	0	94	1993	1	4	175	209
1994	1	3	83	1994	2	5	126	493
				1995	2	2	60	392
1995	20	89	1,831					
1996	15	63	684	1996	29	22	4,625	5,572
1997	48	25	1,930	1997	12	26	1,519	5,319
1998	29	74	2,505	1998	104	27	1,519	4,215
1999	66	74	2,749	1999	31	71	10,146	3,823
2000	169	144	4,033	2000	37	99	6,123	7,088

Abundance (thousands)

	FALL				SPRING			
Year	3L	3N	3O	Year	3L	3N	3O	3Ps
1986	0	0	0	1986	0	0	113	4,301
1987	0	0	0	1987	0	0	326	4,011
1988	0	0	0	1988	0	0	225	4,807
1989	0	0	0	1989	0	0	196	5,714
1990	0	0	605	1990	0	0	65	5,536
1991	9	0	555	1991	6	0	903	8,593
1992	5	0	365	1992	9	20	378	2,288
1993	0	5	707	1993	19	43	1,381	1,931
1994	21	27	737	1994	23	38	1,243	4,451
				1995	16	20	499	4,507
1995	177	846	23,097					
1996	741	964	10,270	1996	427	547	58,051	81,606
1997	1,146	521	29,420	1997	189	1,411	23,500	91,666
1998	614	1,882	29,947	1998	992	828	18,938	70,777
1999	1,206	1,277	35,983	1999	468	1,233	148,750	51,553
2000	2,570	1,755	53,323	2000	442	1,809	67,503	99,802

Table 4: Survey Biomass and abundance of Thorny Skate in Fall/spring DFO RV Surveys, 1986-2000

Biomass (t)

	FALL				SPRING			
Year	3L	3N	3O	Year	3L	3N	3O	3Ps
1986	44,555	0	0	1986	27,506	43,435	18,360	18,790
1987	34,584	0	0	1987	32,298	23,833	20,081	16,022
1988	42,484	0	0	1988	27,616	19,561	34,399	11,808
1989	26,723	0	0	1989	28,855	19,347	15,816	17,430
1990	37,632	26,559	38,384	1990	17,839	18,693	24,388	9,553
1991	20,730	40,929	29,735	1991	8,739	11,388	38,978	24,226
1992	15,862	20,858	16,686	1992	4,703	9,074	22,807	15,251
1993	9,487	13,987	25,313	1993	3,365	7,303	13,824	6,400
1994	6,379	20,059	12,531	1994	1,543	4,013	11,361	6,511
				1995	1,102	1,112	12,726	9,812
1995	11,306	40,775	44,587					
1996	14,459	28,629	36,969	1996	4,993	11,010	35,529	21,851
1997	7,534	43,075	58,160	1997	3,969	9,703	28,293	20,705
1998	9,205	34,279	39,280	1998	5,807	13,186	42,351	28,629
1999	13,614	32,609	42,608	1999	7,278	26,254	54,045	32,062
2000	17,722	61,202	40,861	2000	14,011	27,861	40,917	22,528

Abundance (thousands)

	FALL				SPRING			
Year	3L	3N	3O	Year	3L	3N	3O	3Ps
1986	31,167	0	0	1986	21,170	22,063	8,733	14,939
1987	33,421	0	0	1987	16,178	13,859	14,066	11,617
1988	35,799	0	0	1988	14,475	10,940	17,765	7,869
1989	31,733	0	0	1989	16,673	12,409	7,305	10,687
1990	48,247	18,122	21,980	1990	18,156	29,610	16,578	8,820
1991	30,403	25,260	12,264	1991	14,372	18,408	14,543	20,766
1992	38,867	13,989	10,196	1992	15,486	8,531	14,697	8,889
1993	25,414	12,840	17,100	1993	11,473	7,053	6,208	8,917
1994	18,263	20,720	12,697	1994	6,611	7,258	7,887	7,943
				1995	3,851	2,900	11,067	8,055
1995	23,299	37,322	30,573					
1996	23,483	16,614	45,145	1996	10,418	10,636	22,731	25,591
1997	13,443	30,540	50,047	1997	6,804	13,554	25,635	18,379
1998	8,917	21,132	29,785	1998	7,764	10,140	34,130	22,781
1999	10,448	25,116	31,847	1999	8,273	15,967	36,042	20,212
2000	12,536	31,419	39,918	2000	12,512	16,027	28,525	18,574

Table 5. Landings of skate in Canadian and non-Canadian waters of NAFO Divisions 3LNOPs, 1985-2000. Catches inside 200 miles were calculated from ZIF files (landings) and Observer data (Canadian discards and non-Canadian catches). Catches in non-Canadian waters were estimated from Canadian Conservation & Protection boardings.

	3L		3N		3O		3Ps	**Canadian & Non-Canadian**				
Year	Canadian	Non-Can.	Canadian	Non-Can.	Canadian	Non-Can.	Canadian	3L	3N	3O	3PS	**Total**
1985	1,676	1,850	870	13,000	1,126	900	1,299	3,526	13,870	2,026	1,299	20,722
1986	1,830	1,500	1,314	10,500	1,596	700	1,105	3,330	11,814	2,296	1,105	18,546
1987	2,307	1,200	1,708	8,500	935	600	4,999	3,507	10,208	1,535	4,999	20,249
1988	9,785	950	1,431	6,500	1,567	400	2,006	10,735	7,931	1,967	2,006	22,639
1989	1,367	1,000	1,910	7,400	1,324	500	2,424	2,367	9,310	1,824	2,424	15,925
1990	2,033	1,800	485	12,400	953	900	3,396	3,833	12,885	1,853	3,396	21,966
1991	1,710	1,550	549	10,500	771	700	4,023	3,260	11,049	1,471	4,023	19,803
1992	436	600	343	5,800	1,953	200	2,385	1,036	6,143	2,153	2,385	11,717
1993	303	1,100	853	4,600	3,417	150	711	1,403	5,453	3,567	711	11,135
1994	269	650	63	6,700	1,219	150	1,238	919	6,763	1,369	1,238	10,290
1995	182	250	3	2,600	2,603	50	1,959	432	2,603	2,653	1,959	7,647
1996	58	1,200	6	3,000	1,218	200	645	1,258	3,006	1,418	645	6,328
1997	26	650	81	7,950	2,086	275	860	676	8,031	2,361	860	11,928
1998	**63**	**250**	**49**	**7,200**	**1,043**	**300**	**1,469**	**313**	**7,249**	**1,343**	**1,469**	**10,374**
1999	**63**	**1,100**	**49**	**5,200**	**1,043**	**500**	**1,469**	**1,163**	**5,249**	**1,543**	**1,469**	**9,424**
2000	**287**	**850**	**87**	**8,200**	**372**	**300**	**1,570**	**1,137**	**8,287**	**672**	**1,570**	**11,666**

Table 6:Survey Biomass and abundance of Spotted Wolffish in Fall/spring DFO Surveys, 1986-2000

Biomass (t)

	FALL				SPRING			
Year	3L	3N	3O	Year	3L	3N	3O	3Ps
1986	4,687	0	0	1986	2,117	26	0	0
1987	8,583	0	0	1987	2,646	4	0	0
1988	5,419	0	0	1988	3,402	24	64	216
1989	3,701	0	0	1989	2,821	0	0	0
1990	3,294	3	0	1990	1,912	25	48	157
1991	1,330	168	7	1991	207	51	160	0
1992	1,221	154	31	1992	431	69	5	0
1993	782	137	6	1993	192	135	0	0
1994	600	190	2	1994	145	6	6	0
				1995	422	149	10	17
1995	1,533	244	7					
1996	52	10	0	1996	978	80	0	0
1997	2,251	528	1	1997	675	73	5	0
1998	2,028	129	26	1998	1,961	359	0	0
1999	1,261	467	176	1999	1,781	271	275	2
2000	1,300	782	0	2000	3,056	182	31	86

Abundance (thousands)

	FALL				SPRING			
Year	3L	3N	3O	Year	3L	3N	3O	3Ps
1986	802	0	0	1986	411	18	0	0
1987	1,426	0	0	1987	709	4	0	0
1988	1,149	0	0	1988	802	8	5	15
1989	915	0	0	1989	650	0	0	0
1990	882	5	0	1990	570	17	7	11
1991	364	54	2	1991	103	35	14	0
1992	257	48	2	1992	136	41	3	0
1993	228	46	2	1993	117	48	0	0
1994	88	71	2	1994	91	8	6	0
				1995	68	57	4	5
1995	503	236	17					
1996	182	11	0	1996	536	74	0	0
1997	513	263	12	1997	327	85	9	13
1998	547	100	18	1998	539	143	0	0
1999	721	177	31	1999	605	90	47	18
2000	1,032	170	0	2000	1,053	57	4	52

Table 7:Survey Biomass and abundance of Striped Wolffish in Fall/spring DFO Surveys, 1986-2000

Biomass (t)

	FALL				SPRING			
Year	3L	3N	3O	Year	3L	3N	3O	3Ps
1986	1,618	0	0	1986	2,557	15,158	1,750	1,927
1987	2,924	0	0	1987	3,302	9,443	4,540	540
1988	3,359	0	0	1988	2,378	7,851	4,234	312
1989	1,186	0	0	1989	1,942	7,508	3,160	224
1990	2,102	3,060	1,659	1990	1,792	11,102	2,353	515
1991	818	1,446	1,260	1991	396	6,200	2,258	306
1992	556	8,577	1,257	1992	417	6,339	1,749	43
1993	599	2,014	1,324	1993	517	5,125	2,507	253
1994	411	1,417	498	1994	553	12,111	2,600	208
				1995	129	3,213	598	346
1995	1,110	1,390	1,283					
1996	785	1,618	1,317	1996	1,135	3,187	1,350	1,230
1997	559	2,159	1,724	1997	1,067	5,252	772	184
1998	1,373	3,217	1,960	1998	1,110	3,386	2,883	630
1999	1,679	1,387	1,122	1999	1,953	4,419	3,629	4,573
2000	2,131	1,700	4,186	2000	2,213	4,265	3,206	1,534

Abundance (thousands)

	FALL				SPRING			
Year	3L	3N	3O	Year	3L	3N	3O	3Ps
1986	1,362	0	0	1986	1,567	1,378	311	619
1987	3,590	0	0	1987	3,107	887	812	370
1988	3,373	0	0	1988	2,023	786	1,231	258
1989	1,360	0	0	1989	2,294	672	919	111
1990	2,319	503	559	1990	2,139	1,347	662	154
1991	805	549	451	1991	281	822	1,001	182
1992	714	1,262	310	1992	578	700	360	101
1993	687	412	448	1993	628	871	446	126
1994	351	382	233	1994	840	1,483	472	127
				1995	200	388	200	183
1995	3,735	3,579	1,346					
1996	3,313	1,360	808	1996	3,323	2,030	1,269	4,443
1997	2,183	2,578	1,797	1997	3,319	2,053	2,444	1,054
1998	3,913	1,838	2,069	1998	1,878	1,491	1,728	892
1999	6,160	1,816	1,926	1999	3,988	1,367	3,154	5,945
2000	4878	1359	3770	2000	8282	1657	1834	2170

Table 8:Survey Biomass and abundance of Broadhead Wolffish in Fall/spring DFO Surveys, 1986-2000

Biomass (t)

	FALL				SPRING			
Year	3L	3N	3O	Year	3L	3N	3O	3Ps
1986	7,172	0	0	1986	175	0	213	240
1987	3,592	0	0	1987	3,862	4	18	362
1988	10,653	0	0	1988	9,700	0	0	69
1989	5,741	0	0	1989	4,404	0	8	471
1990	3,861	0	0	1990	1,217	0	0	123
1991	2,046	282	9	1991	20	29	0	134
1992	1,208	228	0	1992	281	75	482	44
1993	334	273	793	1993	33	563	125	140
1994	560	490	118	1994	736	5	98	50
				1995	352	23	33	204
1995	593	973	494					
1996	2,534	138	101	1996	210	153	1,073	303
1997	2,234	1,001	63	1997	734	2,066	0	0
1998	2,440	1,702	576	1998	1,491	325	285	262
1999	3,083	1,153	110	1999	1,050	467	157	214
2000	1,044	821	455	2000	1,543	406	928	0

Abundance (thousands)

	FALL				SPRING			
Year	3L	3N	3O	Year	3L	3N	3O	3Ps
1986	901	0	0	1986	25	0	14	22
1987	384	0	0	1987	471	4	2	58
1988	1,003	0	0	1988	884	0	0	31
1989	480	0	0	1989	415	0	2	73
1990	340	0	0	1990	96	0	0	55
1991	238	44	2	1991	10	5	0	19
1992	158	36	0	1992	92	17	51	29
1993	59	57	55	1993	13	47	36	34
1994	99	104	22	1994	127	4	25	25
				1995	88	5	13	71
1995	101	209	131					
1996	553	66	18	1996	86	51	93	133
1997	354	280	39	1997	132	194	0	0
1998	392	317	124	1998	412	123	100	65
1999	476	191	27	1999	210	169	38	103
2000	275	177	30	2000	434	110	98	0

Table 9: Survey Biomass and abundance of Monkfish in Fall/Spring DFO RV Surveys, 1986-2000

Biomass (t)

FALL

Year	3L	3N	3O
1986			0
1987			0
1988			0
1989			0
1990			292
1991			515
1992			75
1993			610
1994			536
1995			846
1996		0	1,166
1997		0	585
1998	0	112	154
1999	0	1	256
2000	0	0	1,194

Biomass (t)

SPRING

Year	3L	3N	3O	3Ps
1986	0	0	535	2,580
1987	0	0	916	2,843
1988	0	179	2,191	1,430
1989	0	0	359	1,445
1990	0	0	452	2,220
1991	0	0	909	2,187
1992	0	0	93	710
1993	0	0	185	474
1994	0	1	1,224	1,218
1995	0	0	232	1,098
1996	0	0	590	1,136
1997	0	0	1,515	2,881
1998	0	0	274	1,187
1999	0	0	1,165	640
2000	0	0	1,266	1,324

Abundance (thousands)

FALL

Year	3L	3N	3O
1986			0
1987			0
1988			0
1989			0
1990			59
1991			178
1992			58
1993			123
1994			123
1995			300
1996		0	302
1997		0	220
1998	0	21	50
1999	0	7	431
2000	0	0	584

Abundance (thousands)

SPRING

Year	3L	3N	3O	3Ps
1986	0	0	64	419
1987	0	0	157	412
1988	0	20	186	360
1989	0	0	44	235
1990	0	0	34	341
1991	0	0	196	425
1992	0	0	34	187
1993	0	0	29	107
1994	0	4	426	143
1995	0	0	38	167
1996	0	0	92	296
1997	0	0	461	778
1998	0	0	51	452
1999	0	0	509	370
2000	0	0	883	596

Table 10: Survey Biomass and abundance of Black Dogfish in Fall/spring DFO RV Surveys, 1986-200

Biomass (t)

FALL				SPRING				
Year	3L	3N	3O	Year	3L	3N	3O	3Ps
1986	286	0	0	1986	0	0	0	11,665
1987	0	0	0	1987	0	0	0	15,449
1988	0	0	0	1988	0	0	0	15,719
1989	0	0	0	1989	0	0	0	17,023
1990	41	0	0	1990	0	0	0	18,181
1991	497	0	0	1991	9	0	2	20,730
1992	8	0	0	1992	0	0	1	16,969
1993	34	54	7	1993	33	0	0	20,431
1994	0	1	14	1994	0	0	3	25,045
				1995	0	0	0	11,940
1995	34	48	27					
1996	1,986	0	10	1996	0	0	41	18,781
1997	724	177	28	1997	0	0	0	22,142
1998	1,772	897	2,404	1998	0	0	11	9,636
1999	2,796	24	1	1999	0	0	168	9,469
2000	744	1,203	2,806	2000	13	0	466	13,165

Abundance (thousands)

FALL				SPRING				
Year	3L	3N	3O	Year	3L	3N	3O	3Ps
1986	223	0	0	1986	0	0	0	29,763
1987	0	0	0	1987	0	0	0	37,239
1988	0	0	0	1988	0	0	0	39,923
1989	0	0	0	1989	0	0	0	45,854
1990	32	0	0	1990	0	0	0	37,831
1991	362	0	0	1991	6	0	13	42,260
1992	6	0	0	1992	0	0	12	34,608
1993	30	28	35	1993	20	0	12	43,478
1994	0	5	37	1994	0	0	30	61,717
				1995	0	0	5	36,309
1995	15	49	166					
1996	1,675	0	22	1996	0	0	220	114,253
1997	530	114	387	1997	0	0	0	117,390
1998	1,482	921	2,455	1998	0	0	56	70,261
1999	2,387	17	46	1999	0	0	653	56,404
2000	830	1,075	3,172	2000	16	8	1,523	69,182

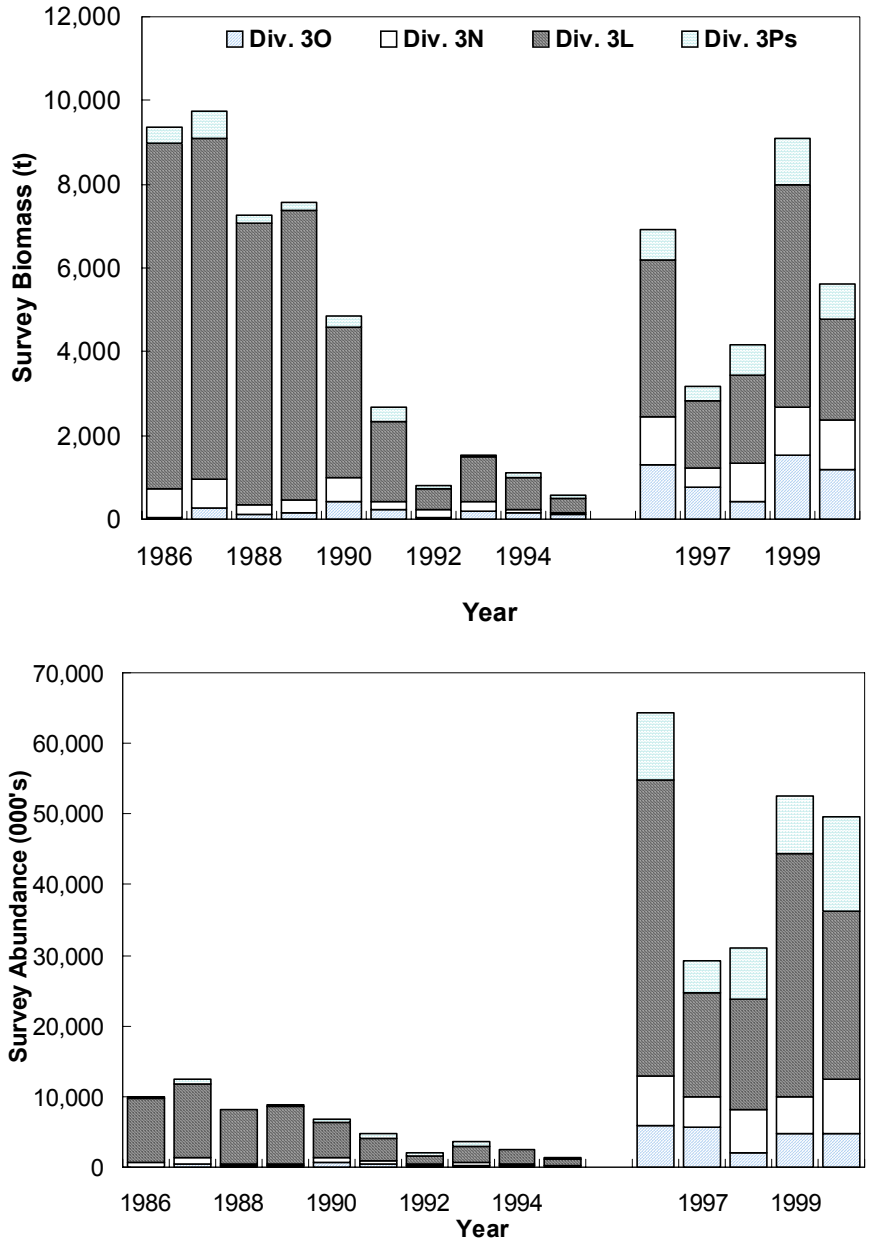


Figure 1a. Biomass and abundance estimates of eelpouts based on Canadian spring surveys, 1986-2000.

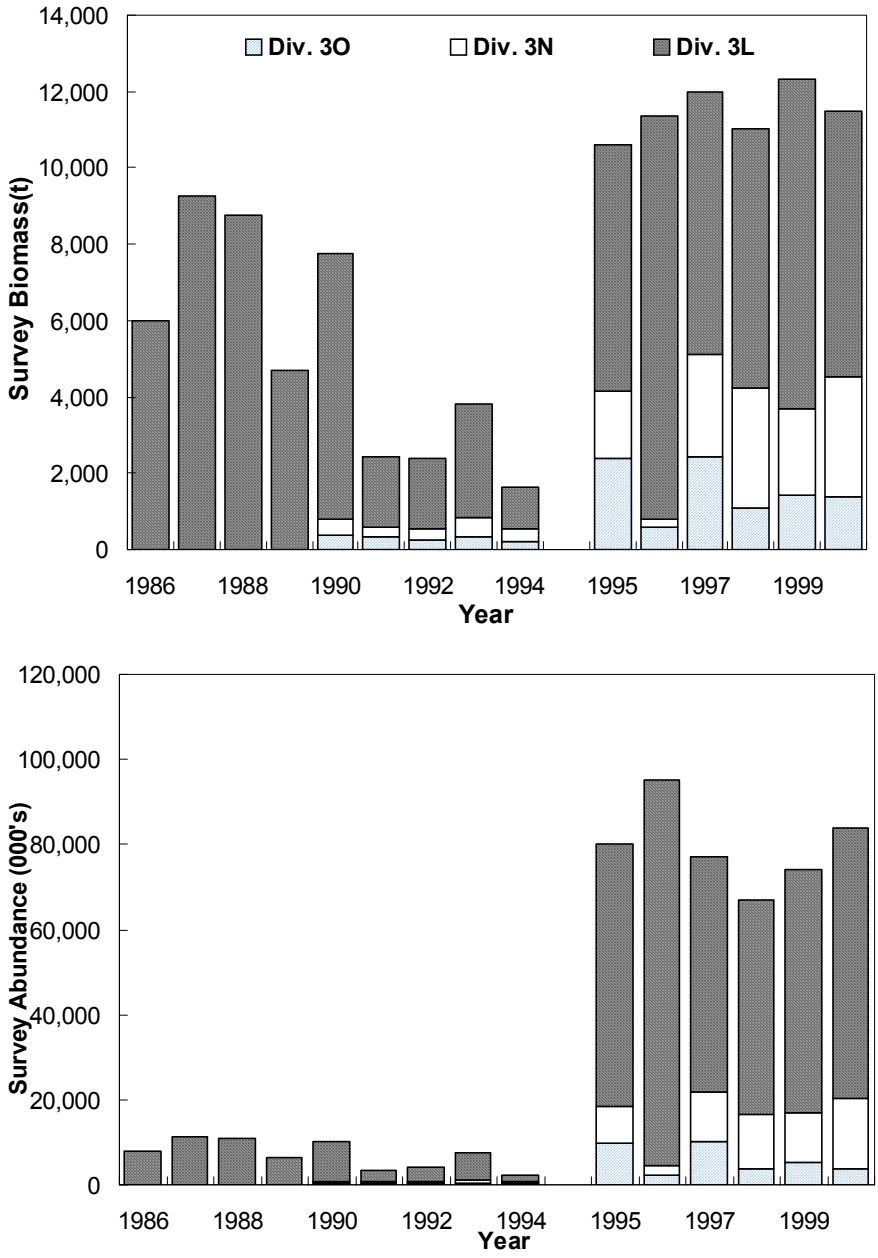


Figure 1b. Biomass and abundance estimates of eelpouts based on Canadian fall surveys, 1986-2000.

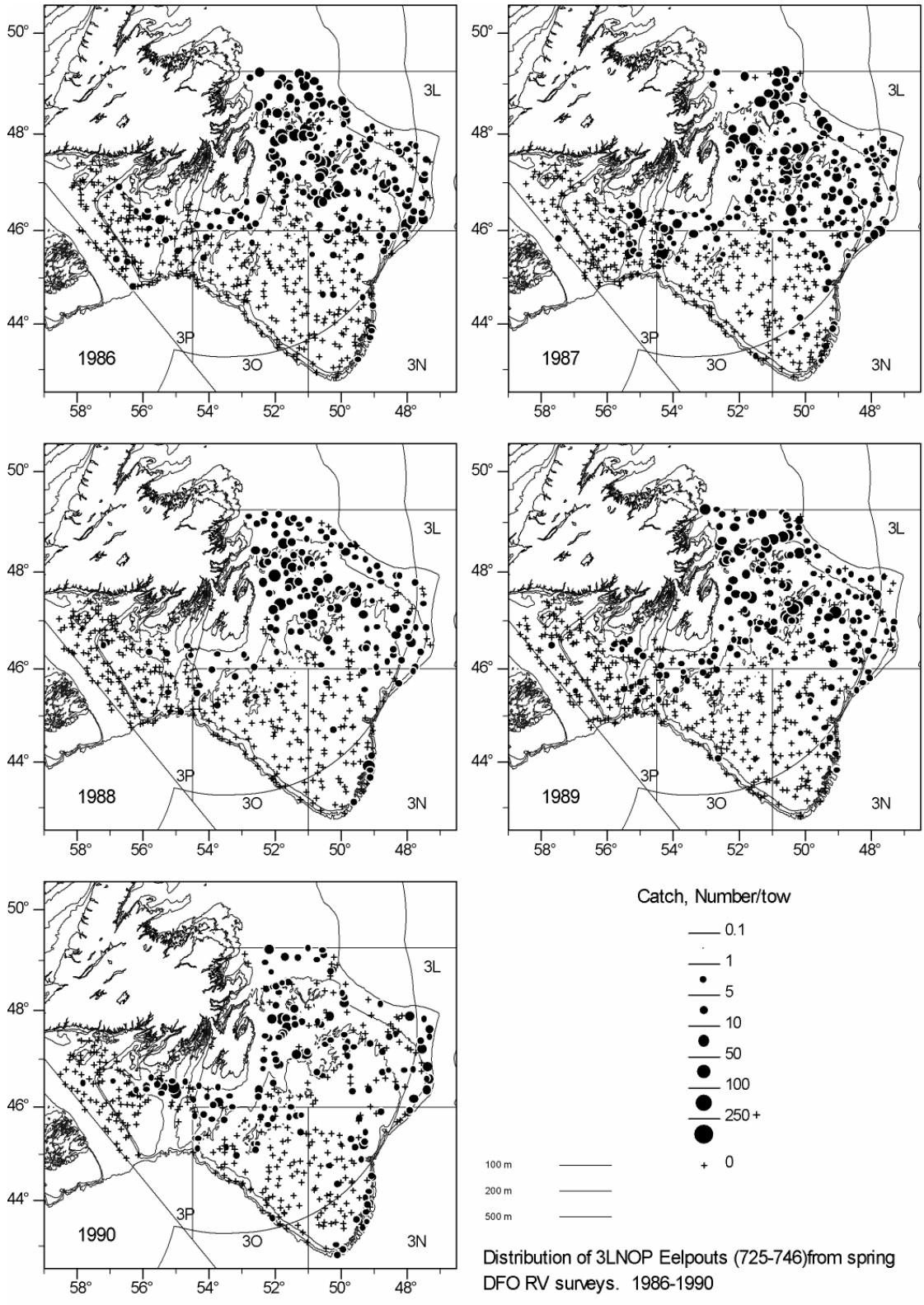


Figure 2a. Distribution of eelpouts based on Canadian spring surveys, 1986-1990.

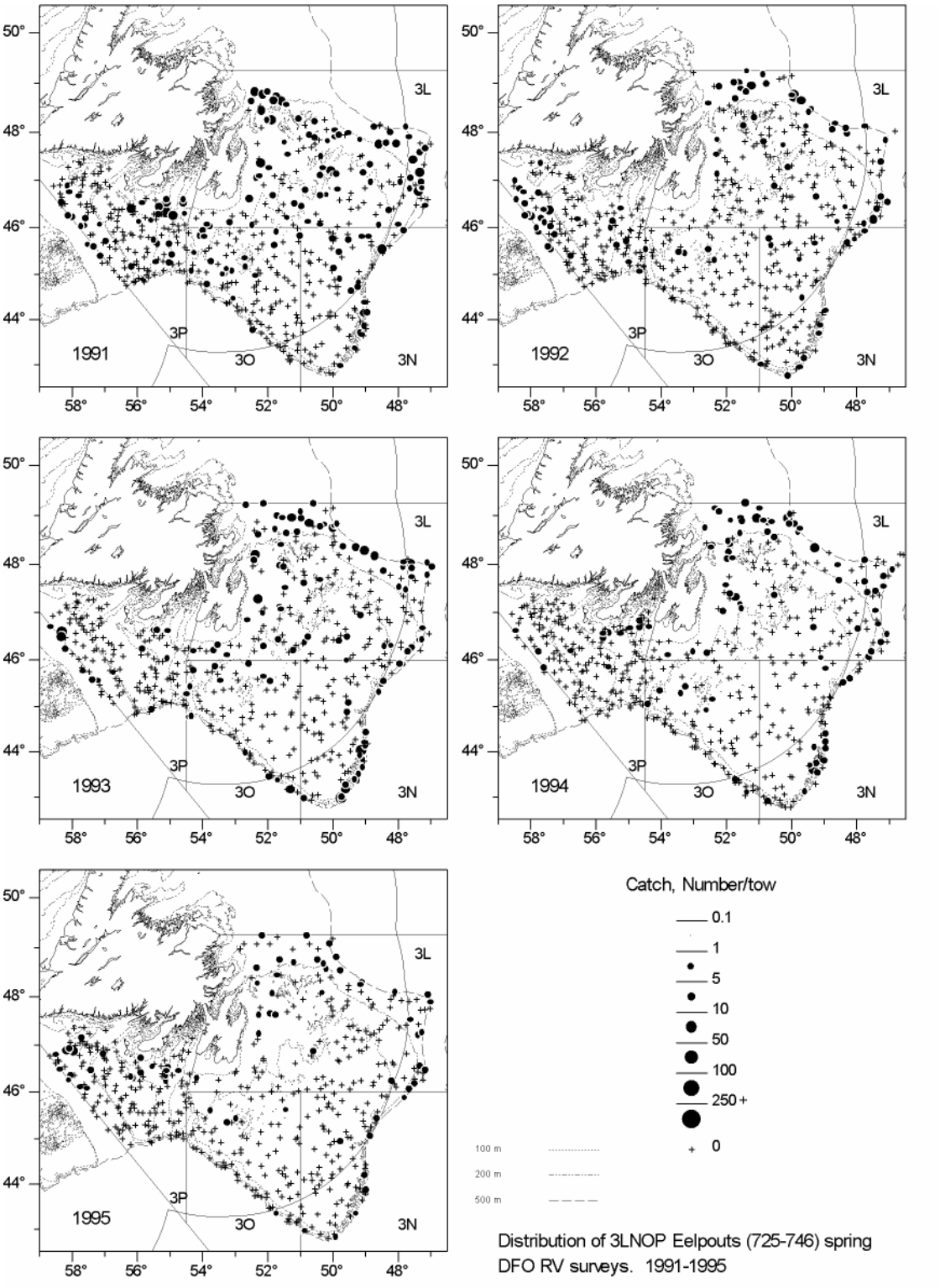


Figure 2b. Distribution of eelpouts based on Canadian spring surveys, 1991-1995.

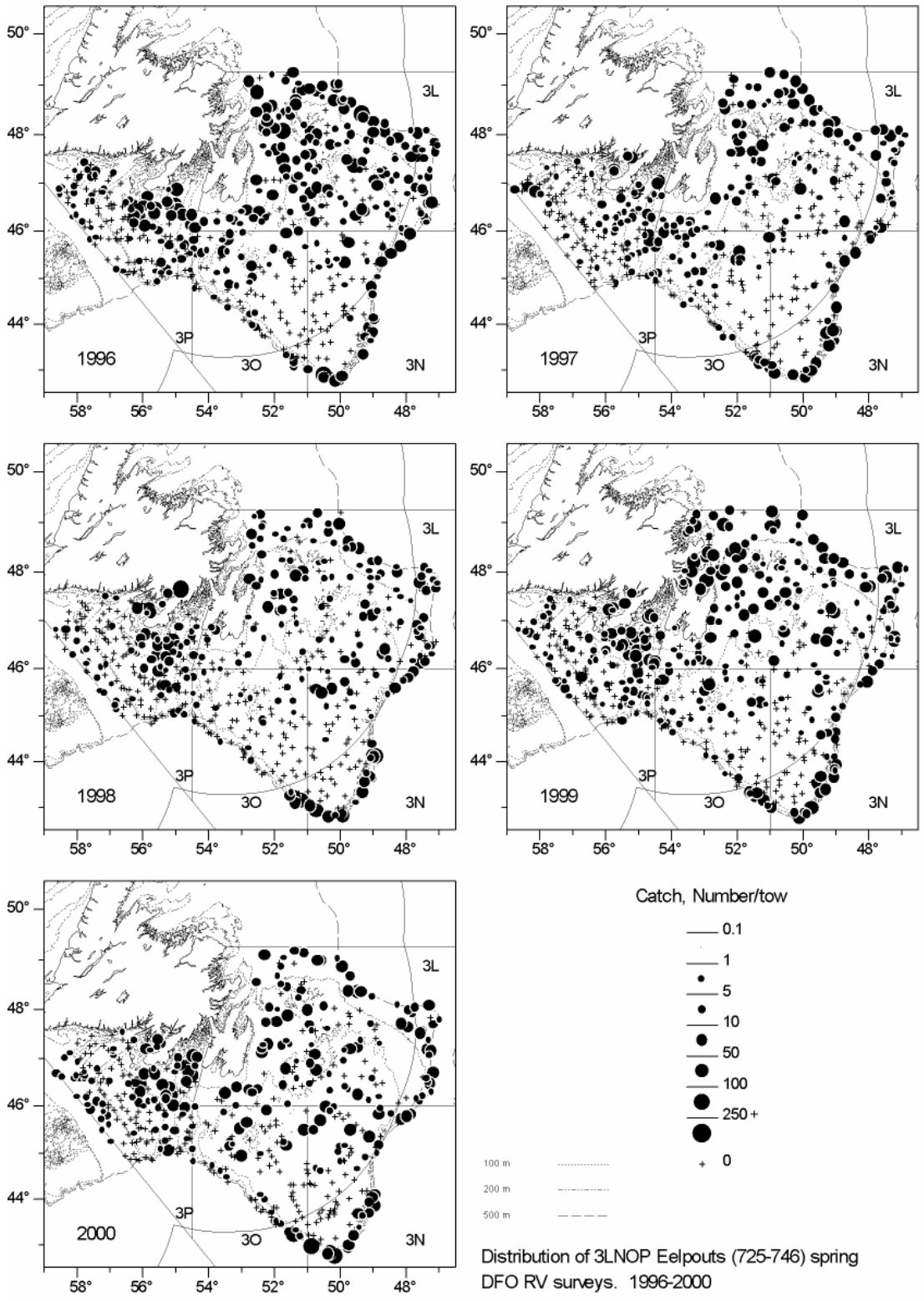


Figure 2c. Distribution of eelpouts based on Canadian spring surveys, 1996-2000.

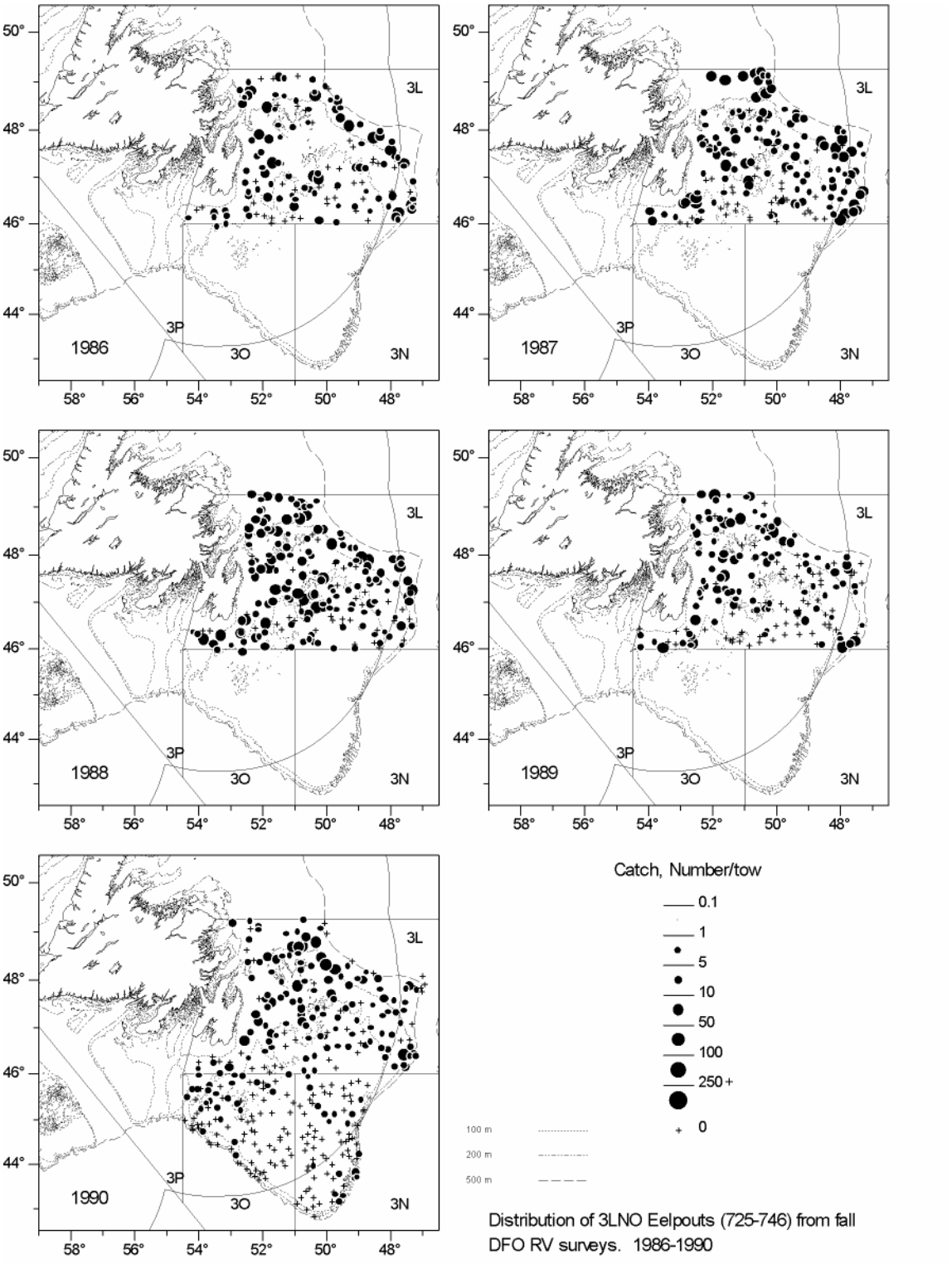


Figure 2d. Distribution of eelpouts based on Canadian fall surveys, 1986-1990.

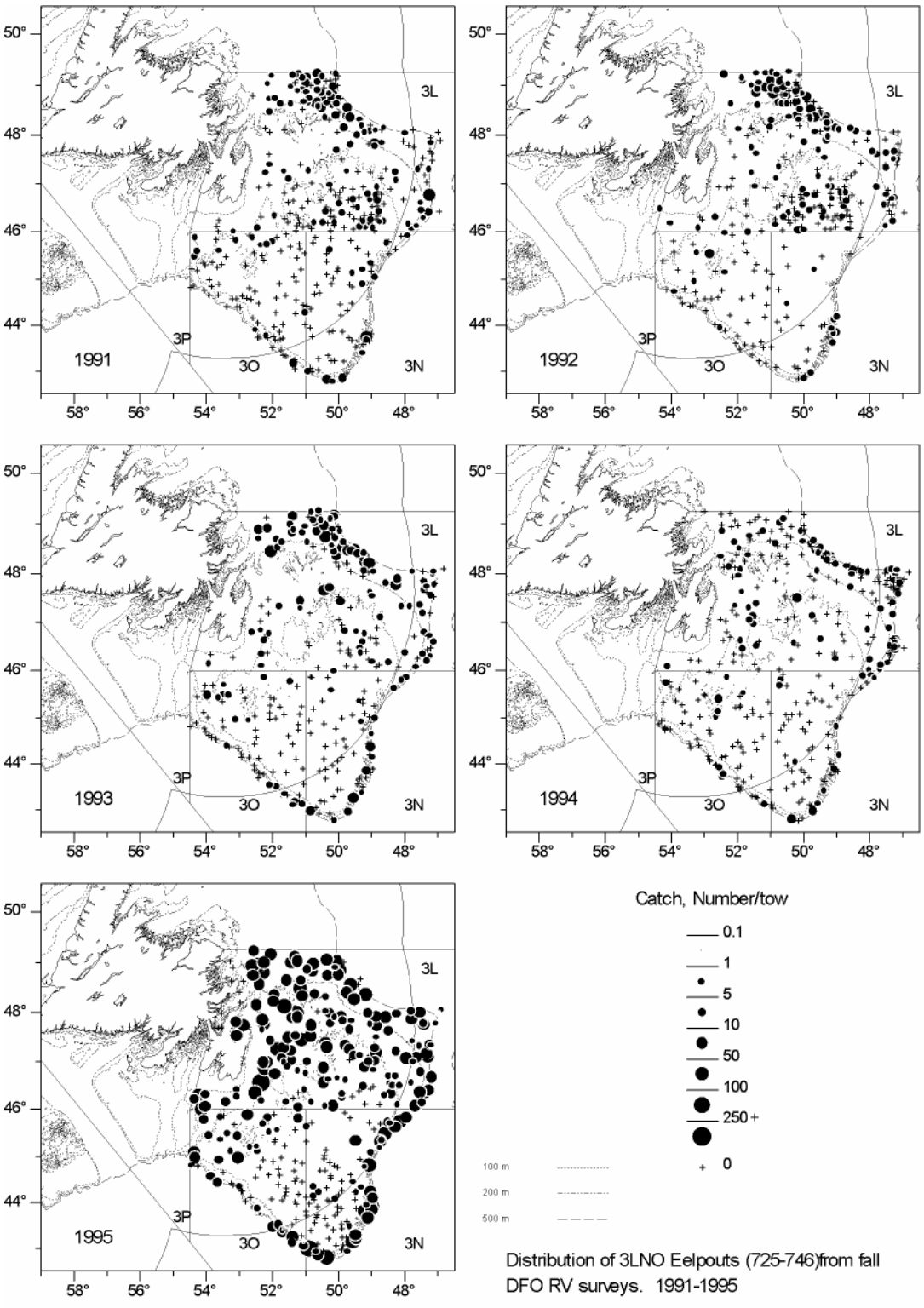


Figure 2e. Distribution of eelpouts based on Canadian fall surveys, 1991-1995.

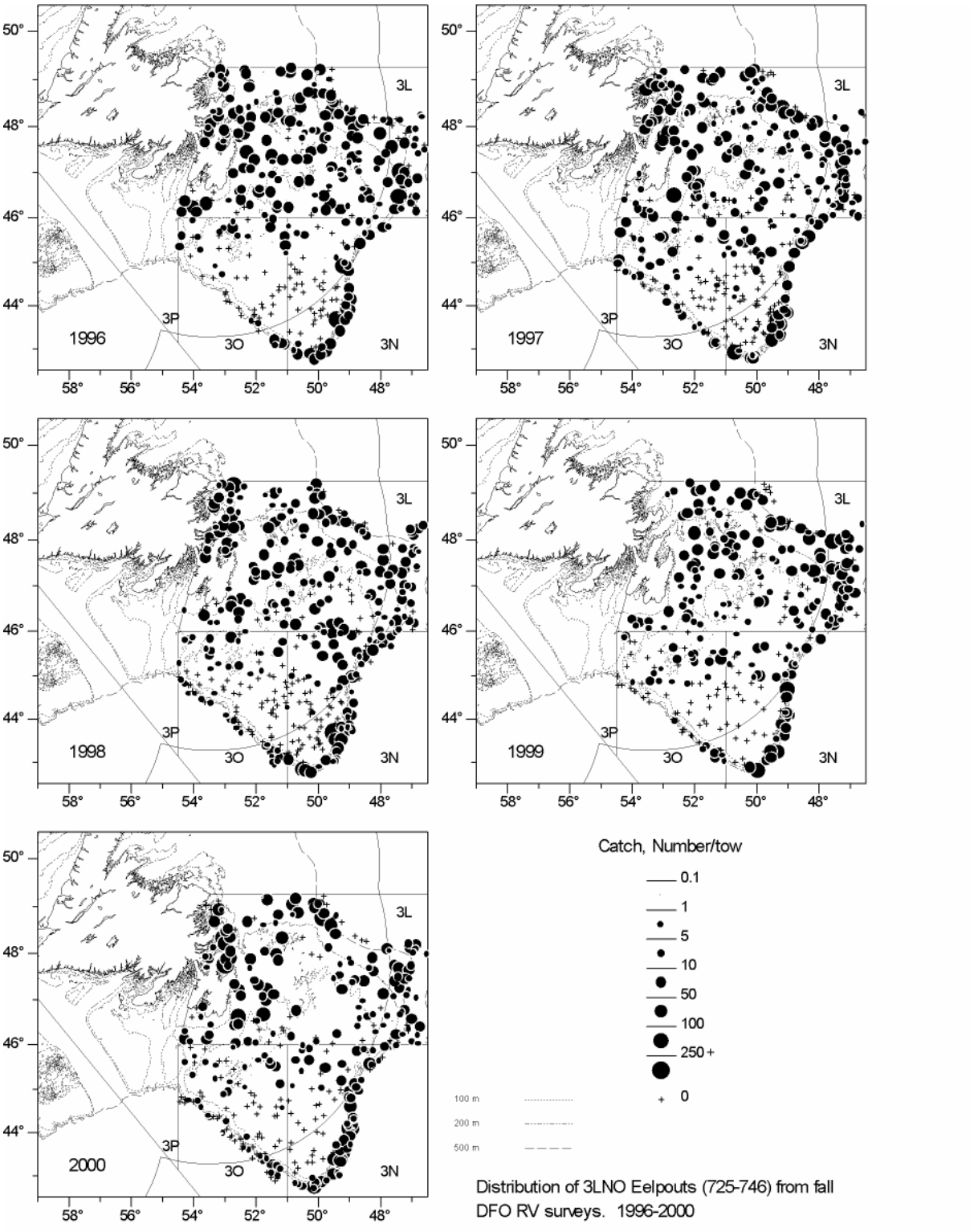


Figure 2f. Distribution of eelpouts based on Canadian fall surveys, 1996-2000.

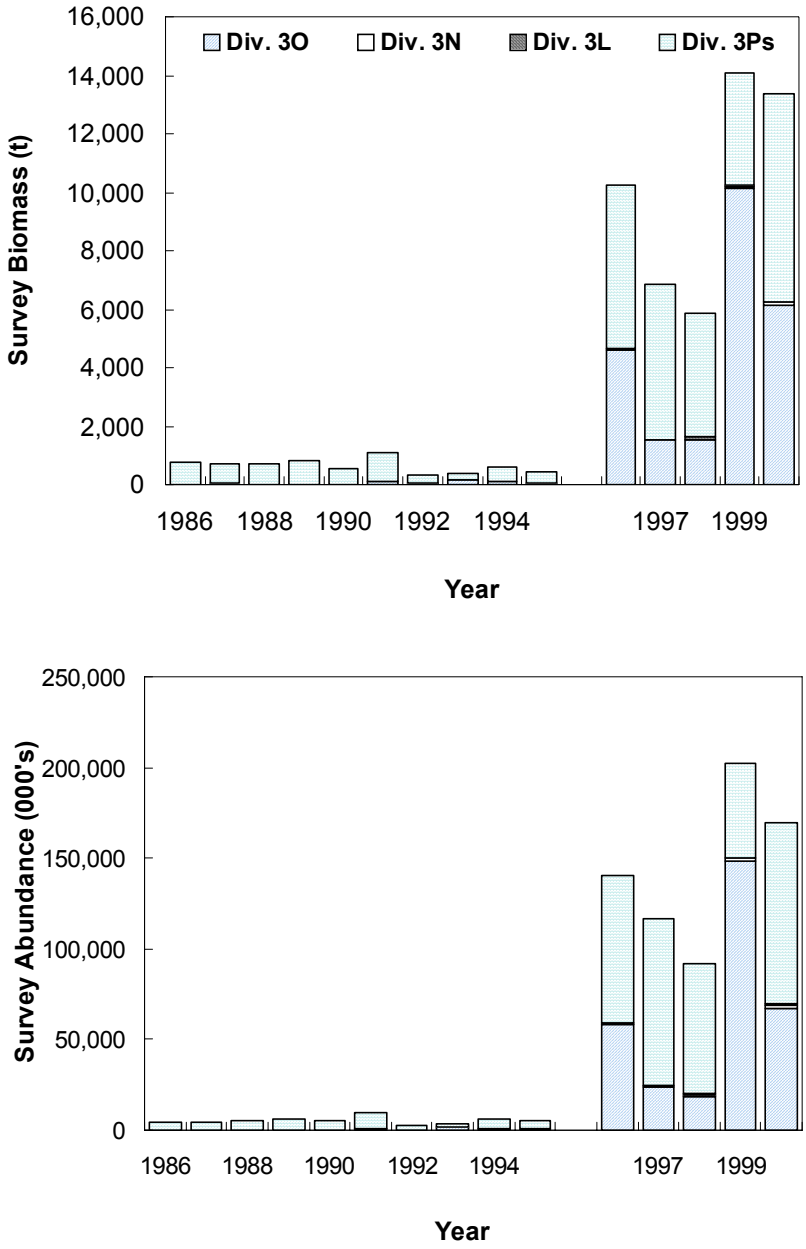


Figure 3a. Biomass and abundance estimates of longfin hake based on Canadian spring surveys, 1986-2000.

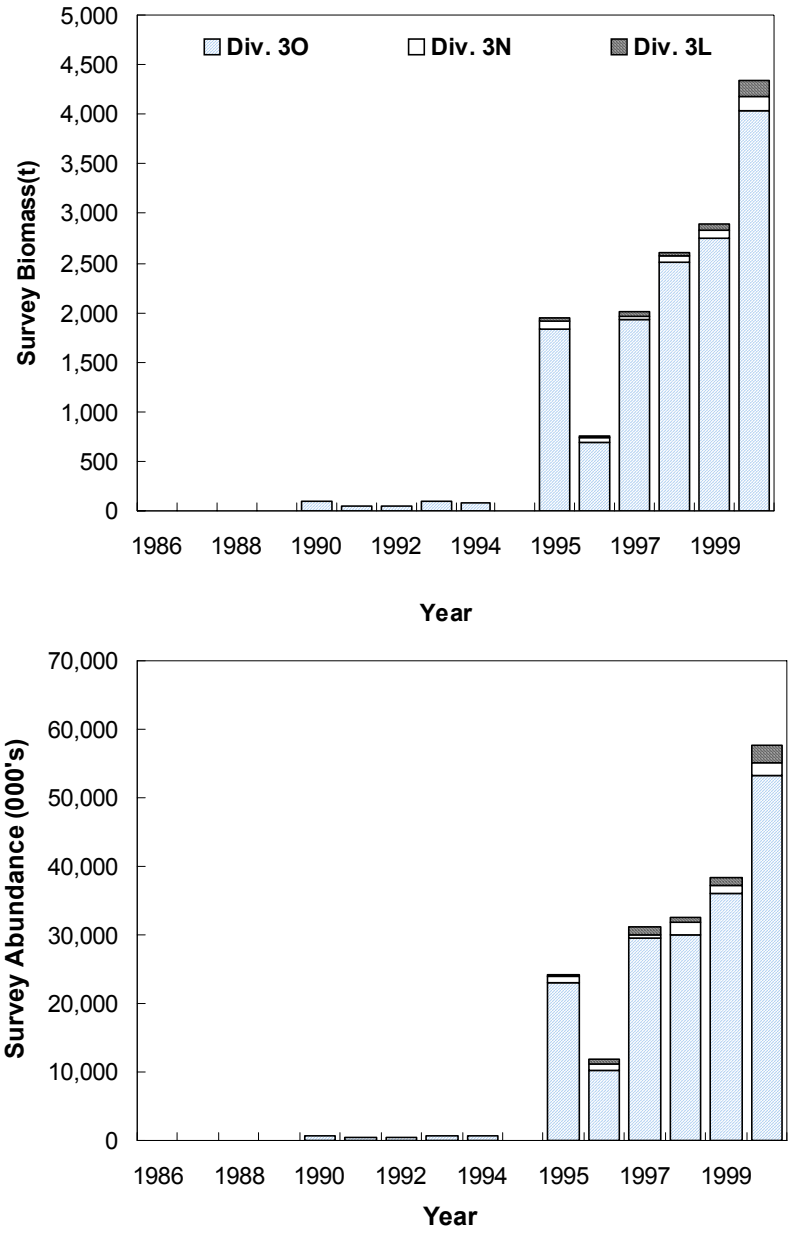


Figure 3b. Biomass and abundance estimates of longfin hake based on Canadian fall surveys, 1986-2000.

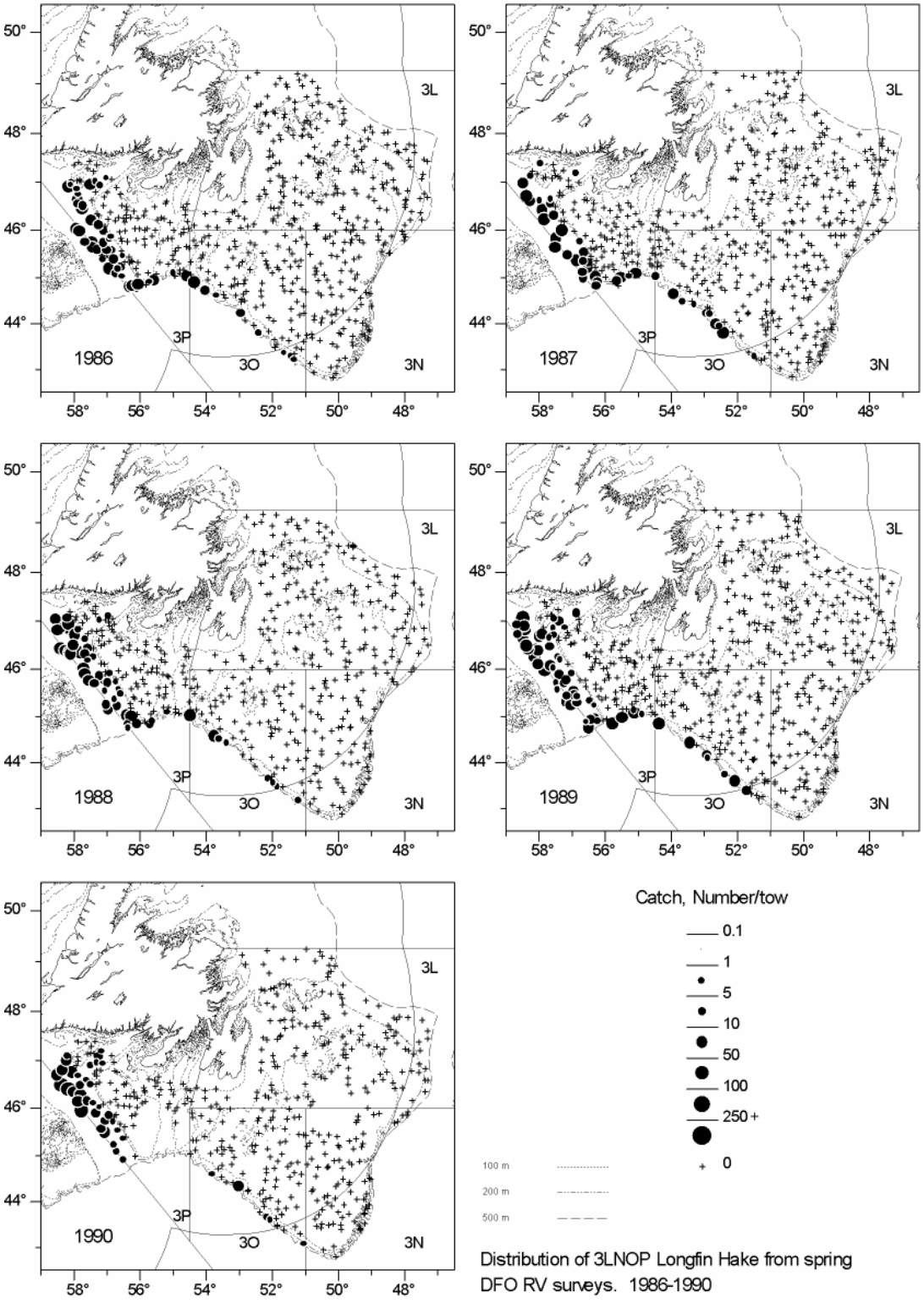


Figure 4a. Distribution of longfin hake based on Canadian spring surveys, 1986-1990.

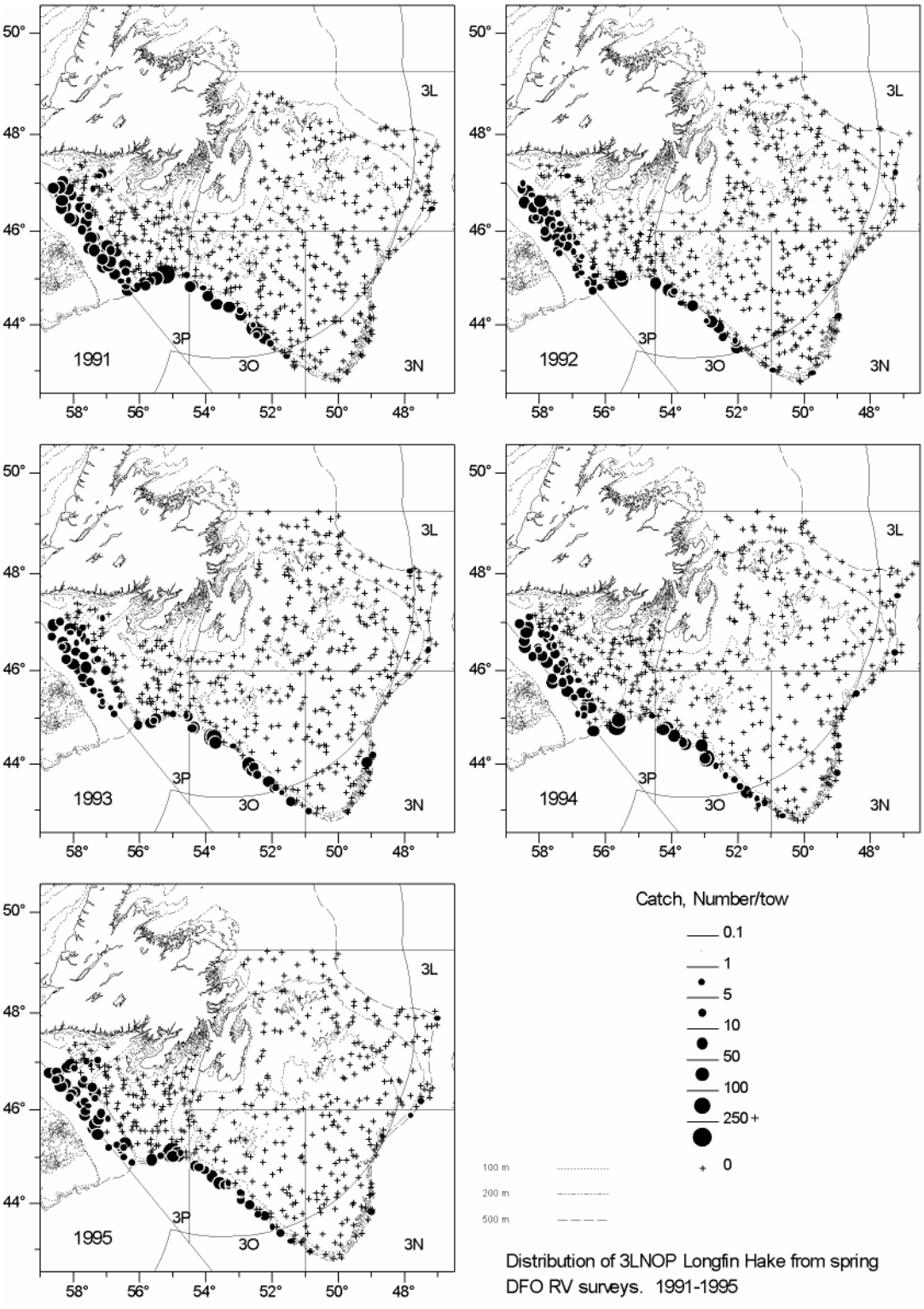


Figure 4b. Distribution of longfin hake based on Canadian spring surveys, 1991-1995.

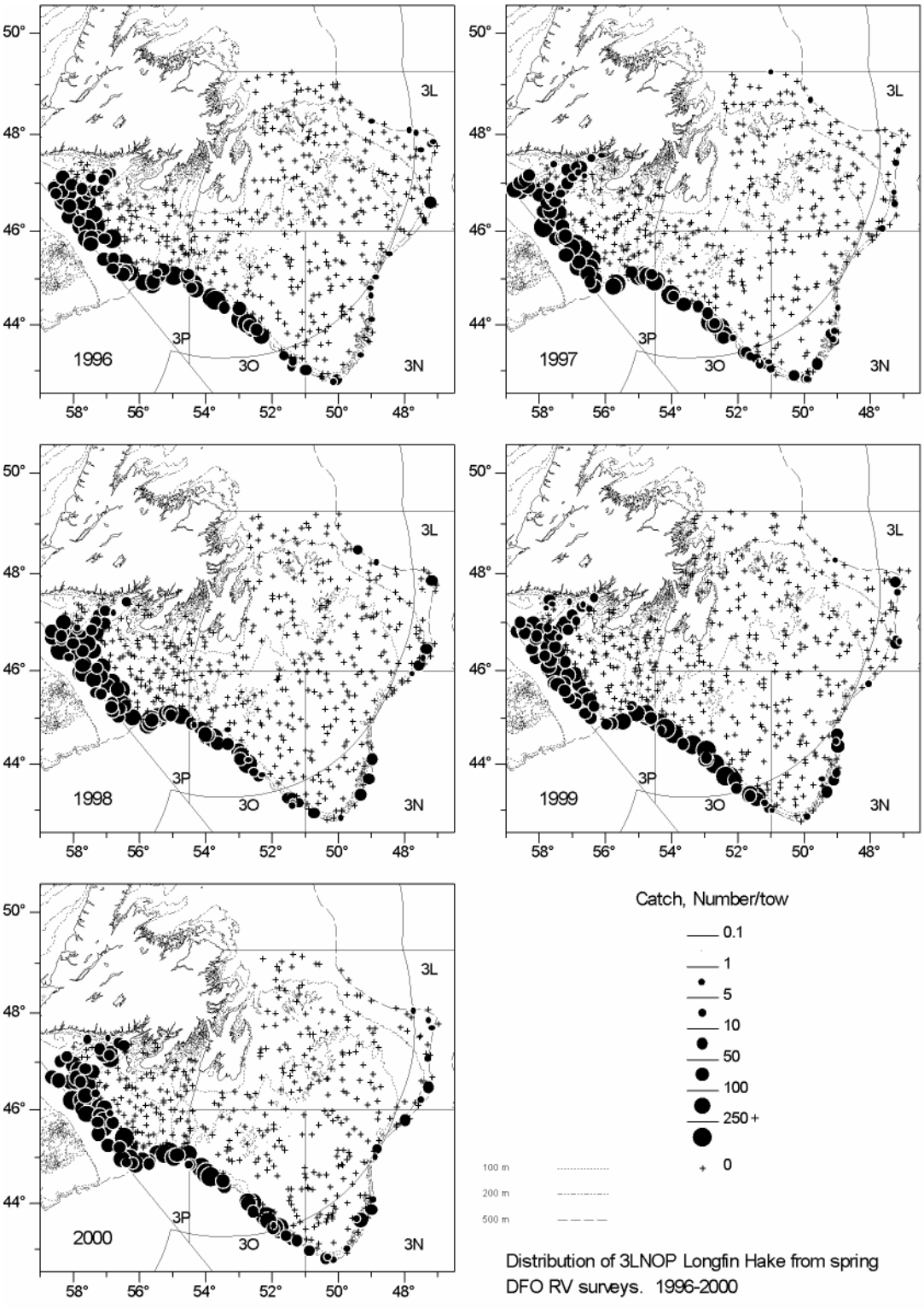


Figure 4c. Distribution of longfin hake based on Canadian spring surveys, 1996-2000.

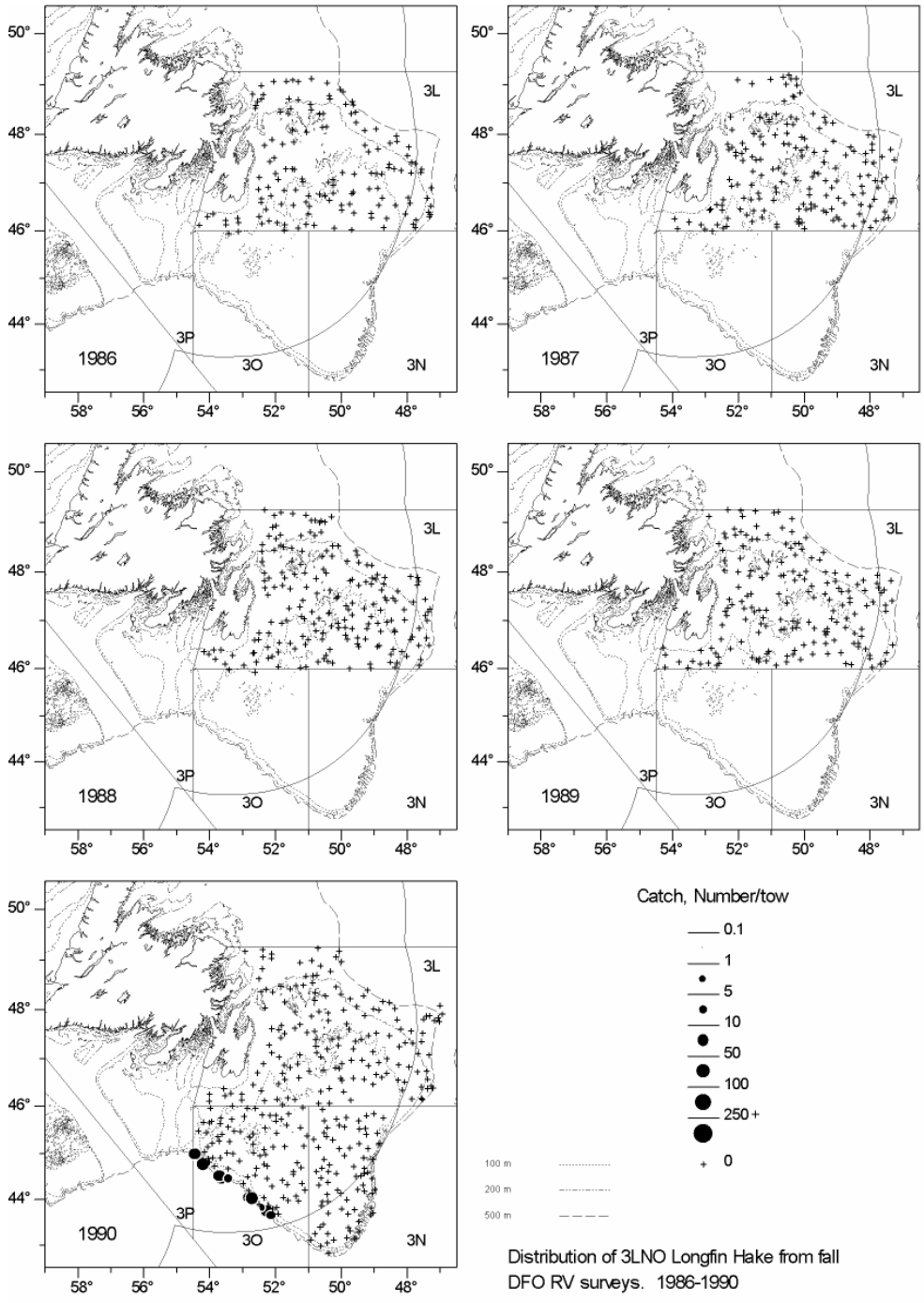


Figure 4d. Distribution of longfin hake based on Canadian fall surveys, 1986-1990.

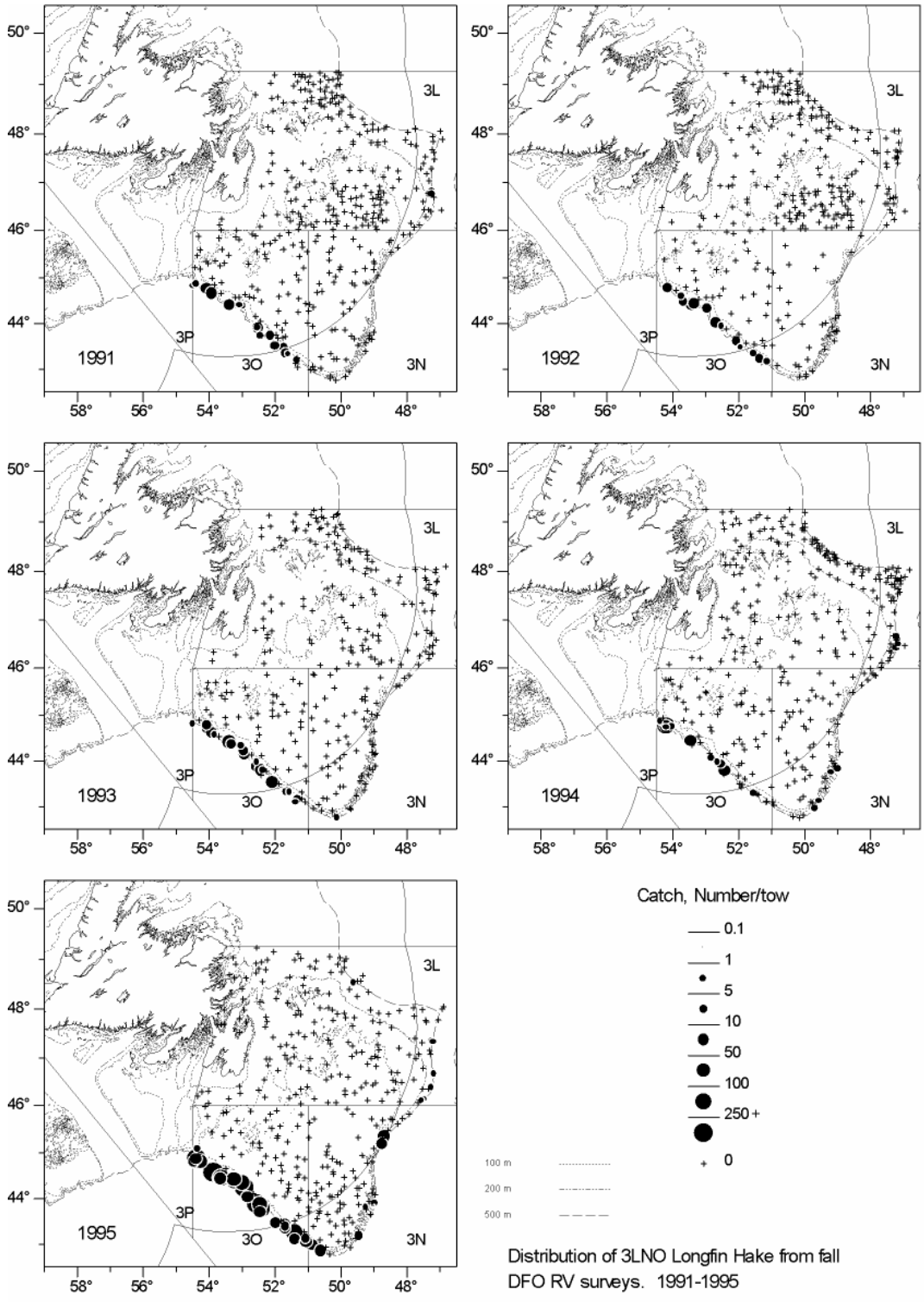


Figure 4e. Distribution of longfin hake based on Canadian fall surveys, 1991-1995.

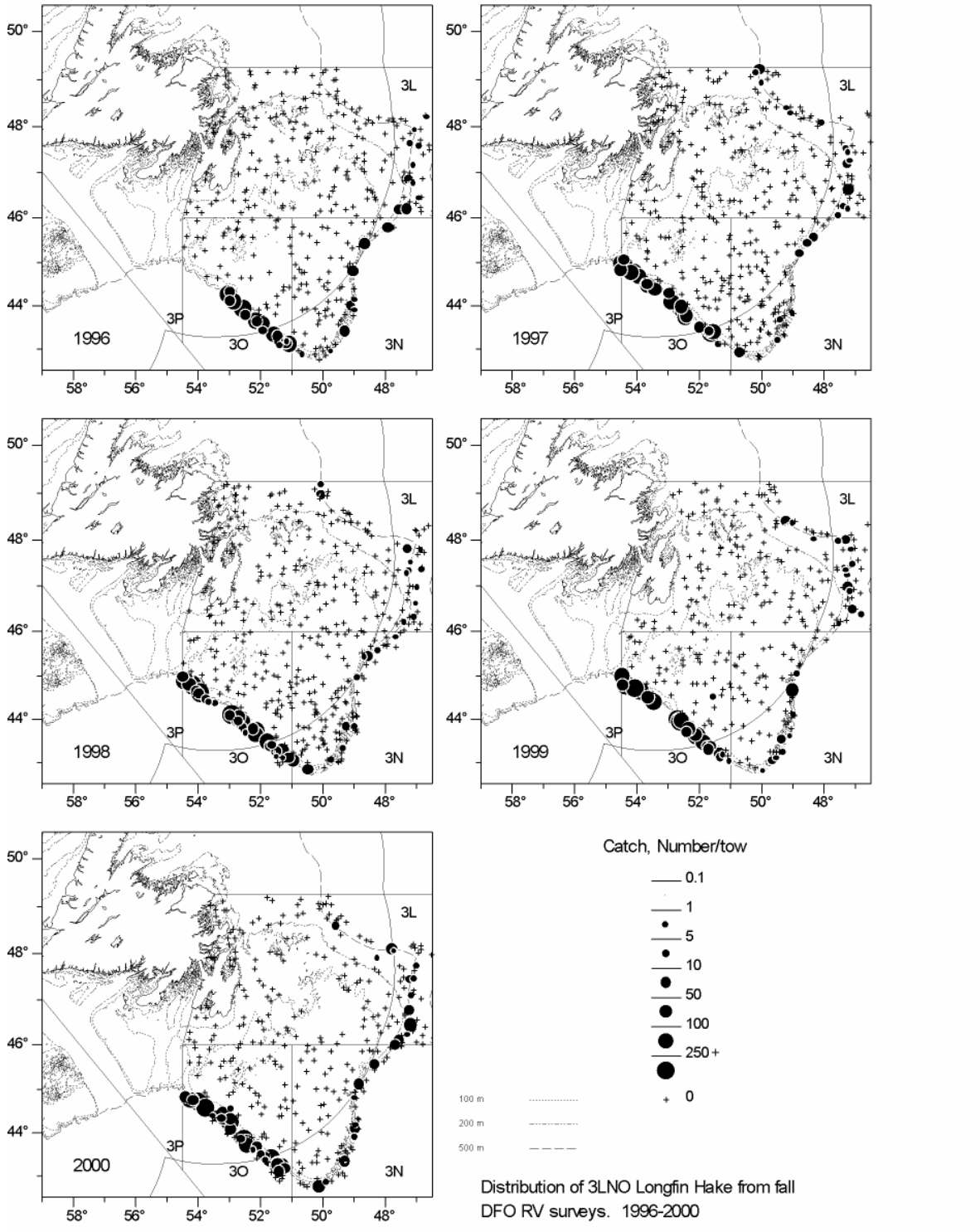


Figure 4f. Distribution of longfin hake based on Canadian fall surveys, 1996-2000.

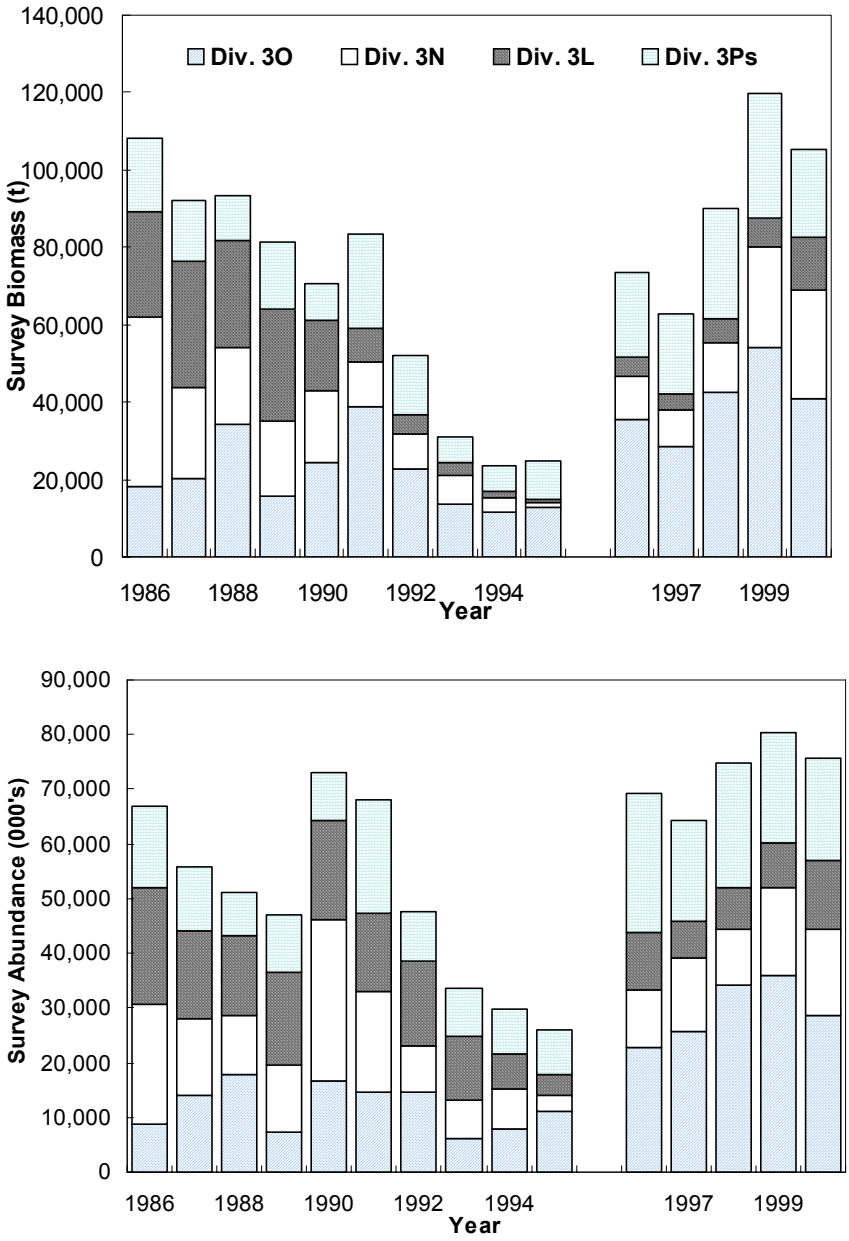


Figure 5a. Biomass and abundance estimates of thorny skate based on Canadian spring surveys, 1986-2000.

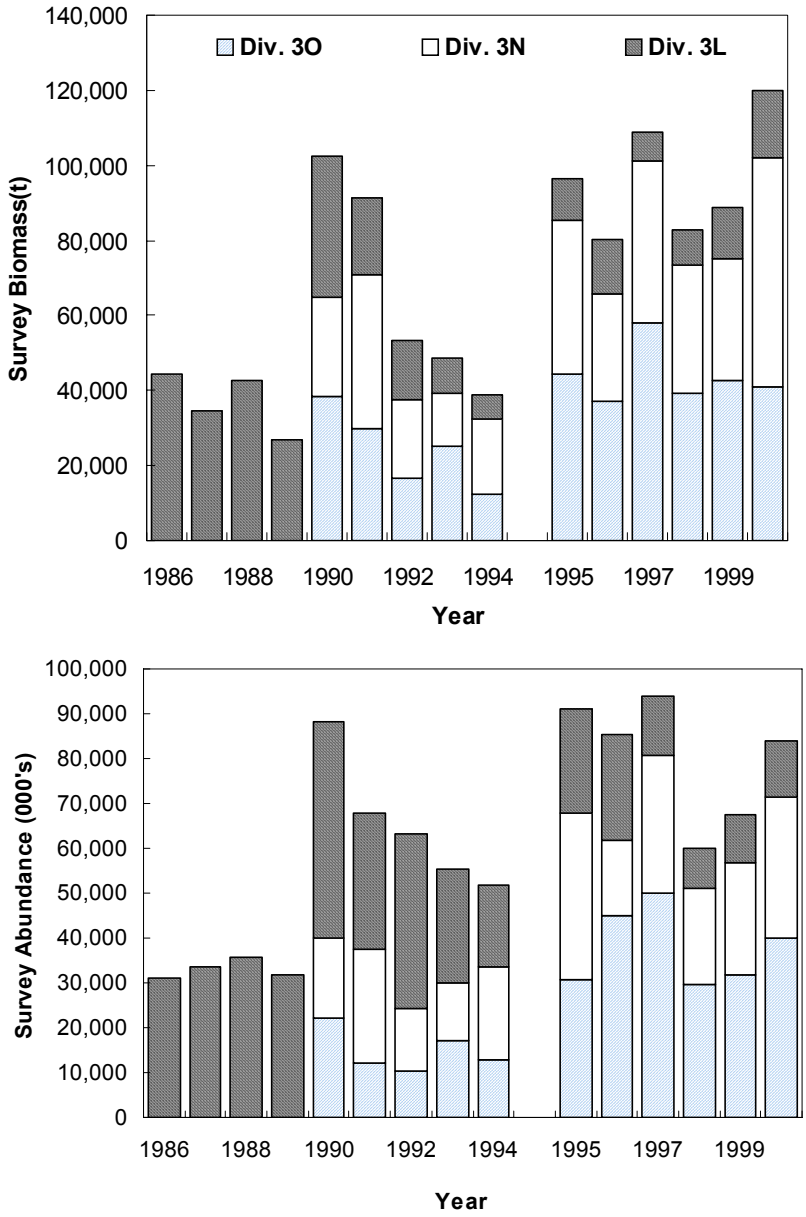


Figure 5b. Biomass and abundance estimates of thorny skate based on Canadian fall surveys, 1986-2000.

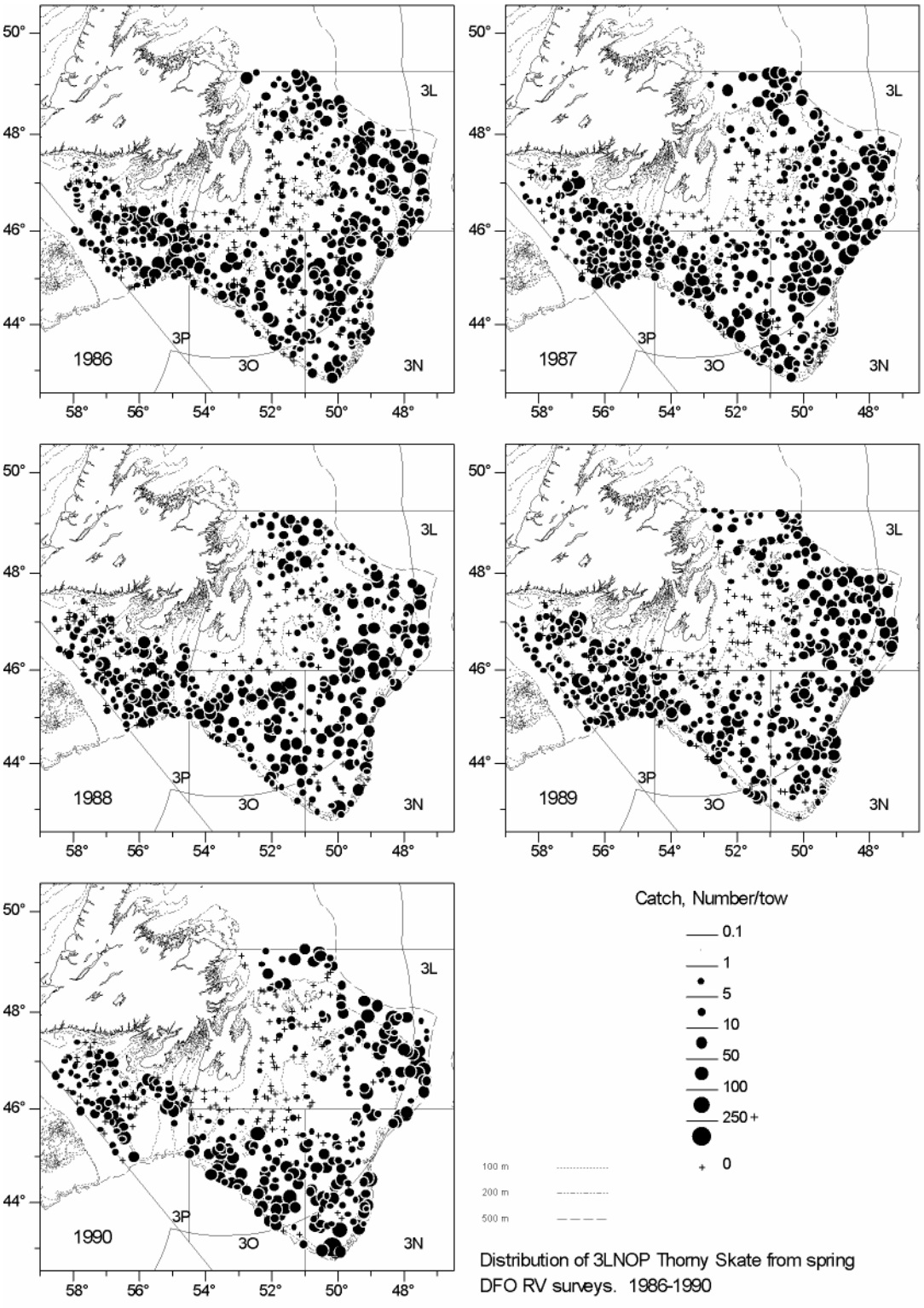


Figure 6a. Distribution of thorny skate based on Canadian spring surveys, 1986-1990.

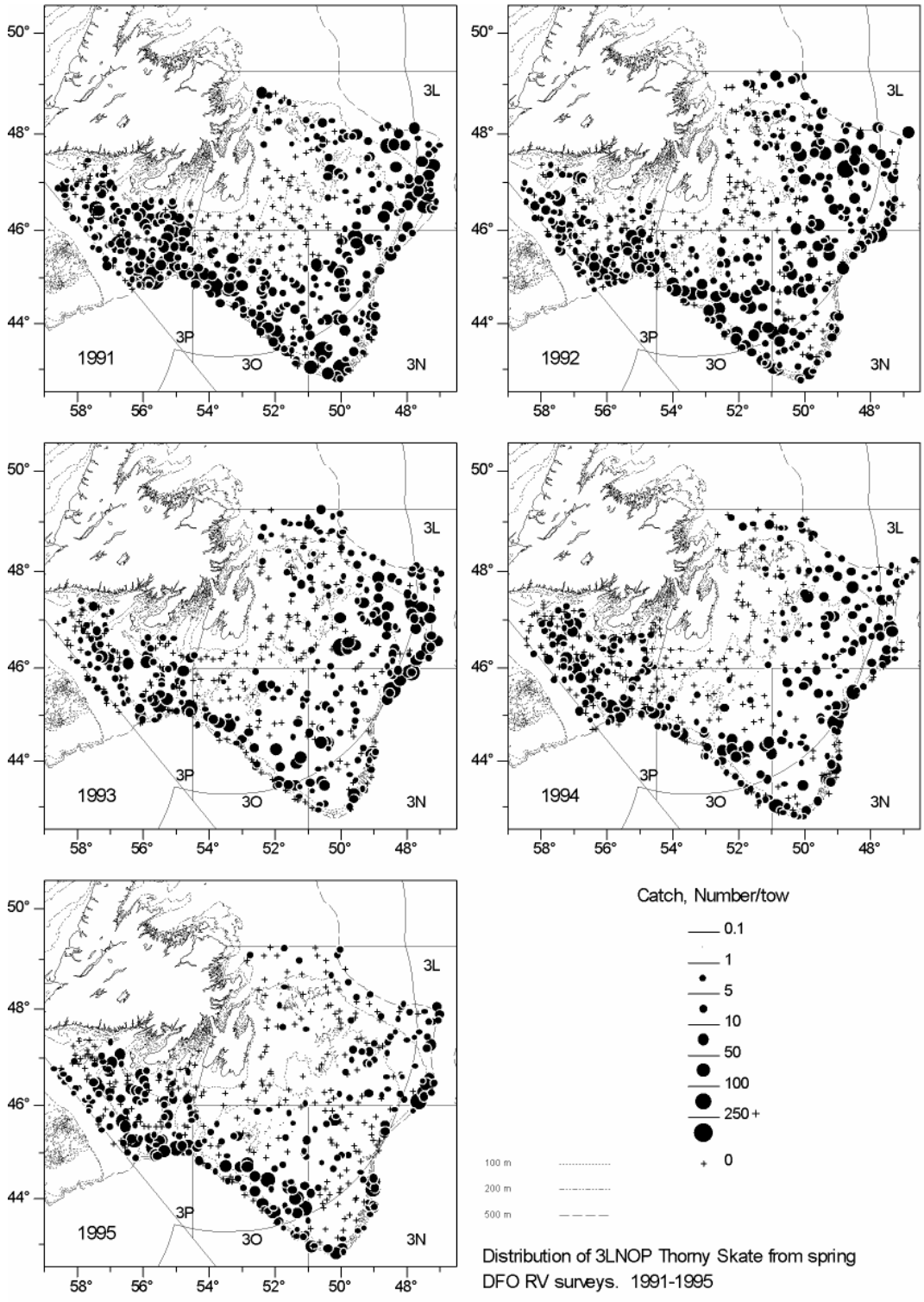


Figure 6b. Distribution of thorny skate based on Canadian spring surveys, 1991-1995.

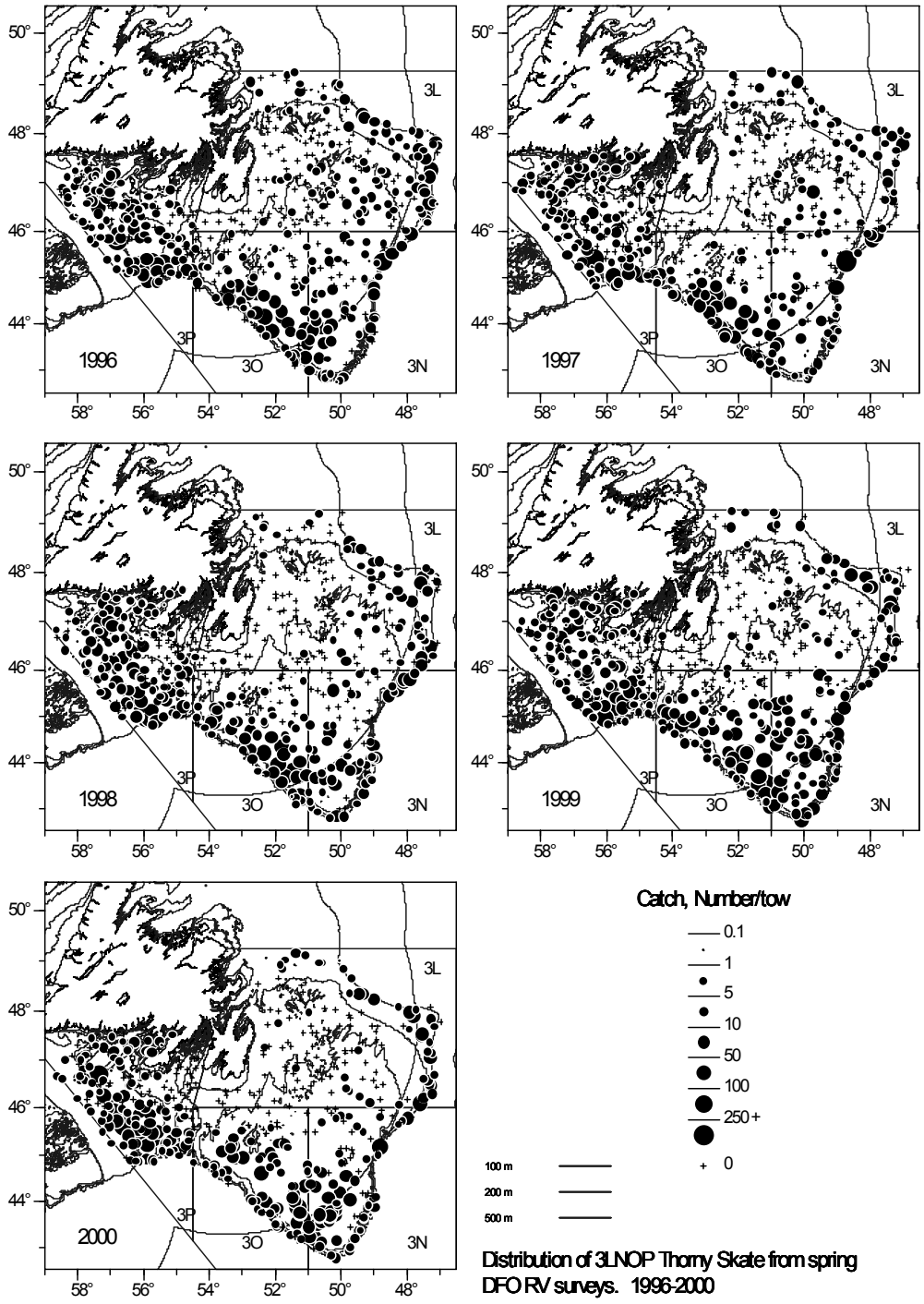


Figure 6c. Distribution of thorny skate based on Canadian spring surveys, 1996-2000.

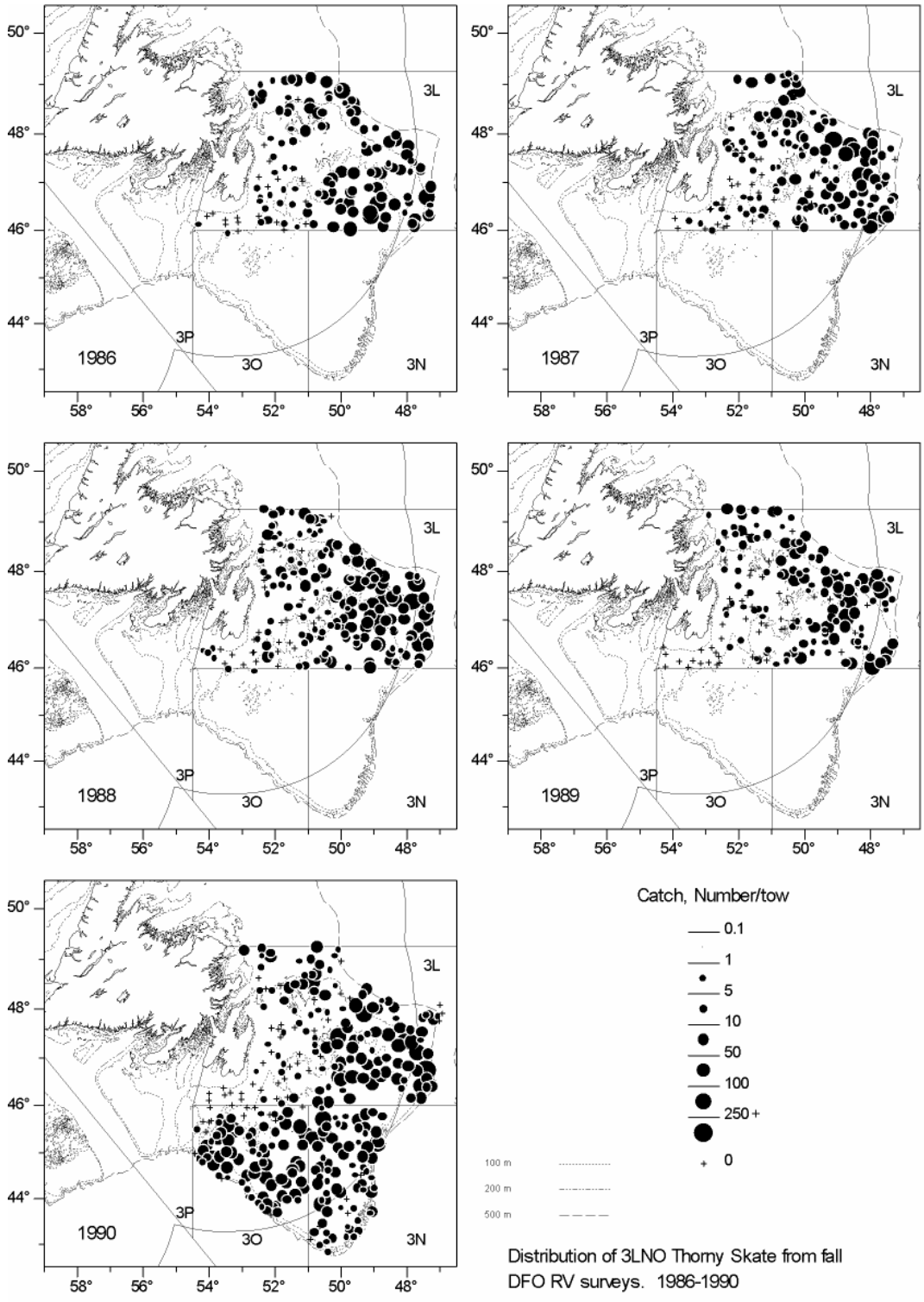


Figure 6d. Distribution of thorny skate based on Canadian fall surveys, 1986-1990.

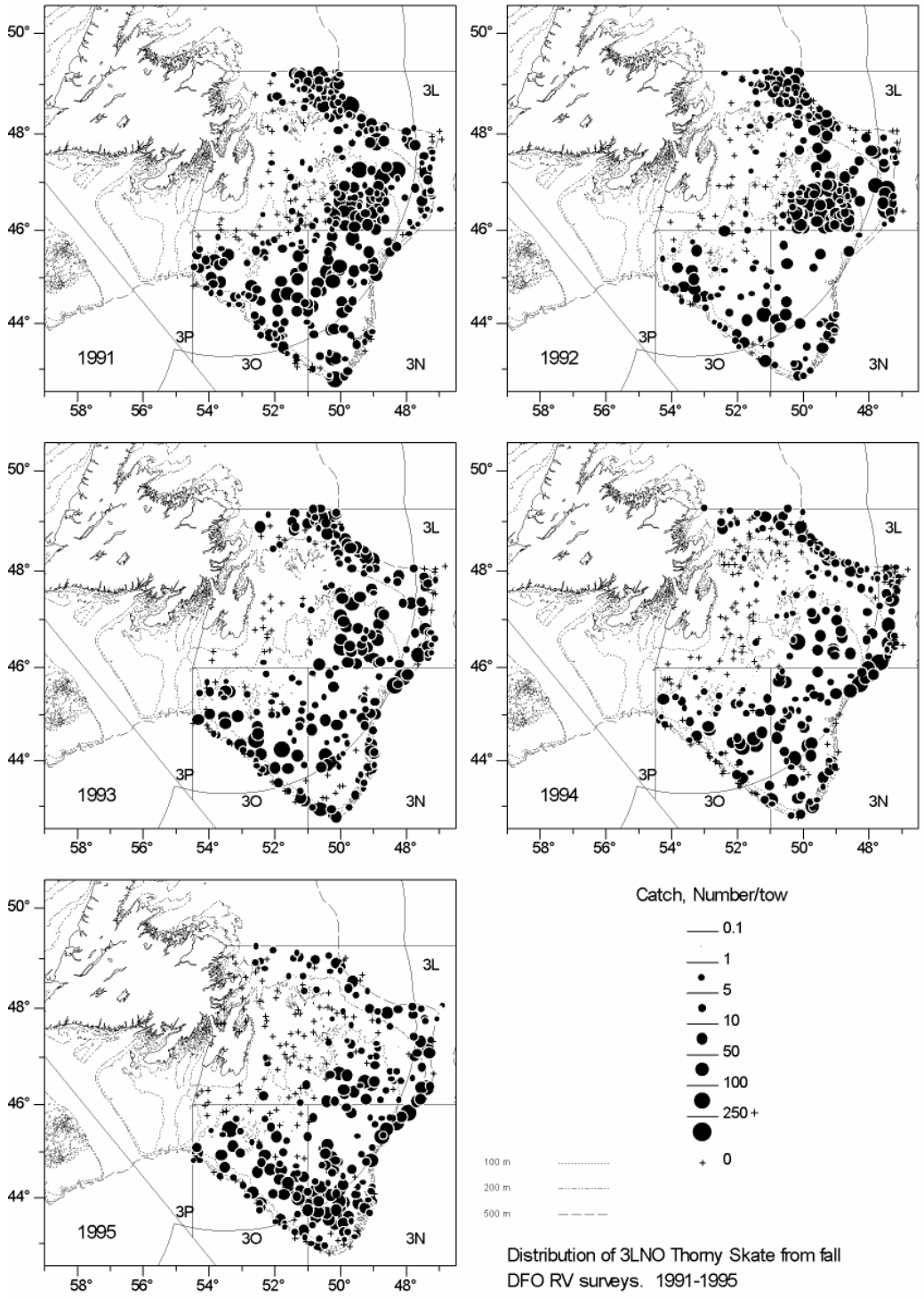


Figure 6e. Distribution of thorny skate based on Canadian fall surveys, 1991-1995.

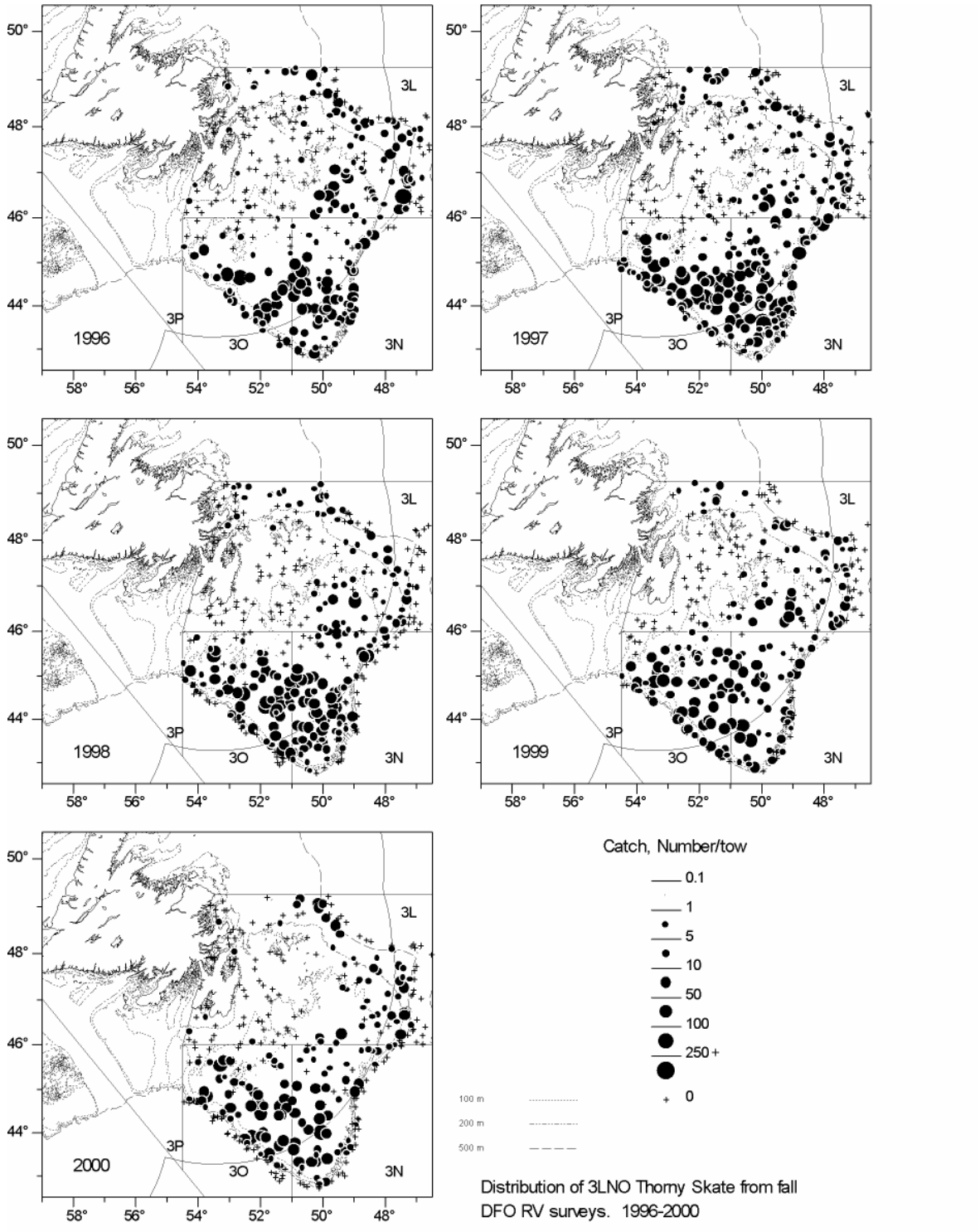
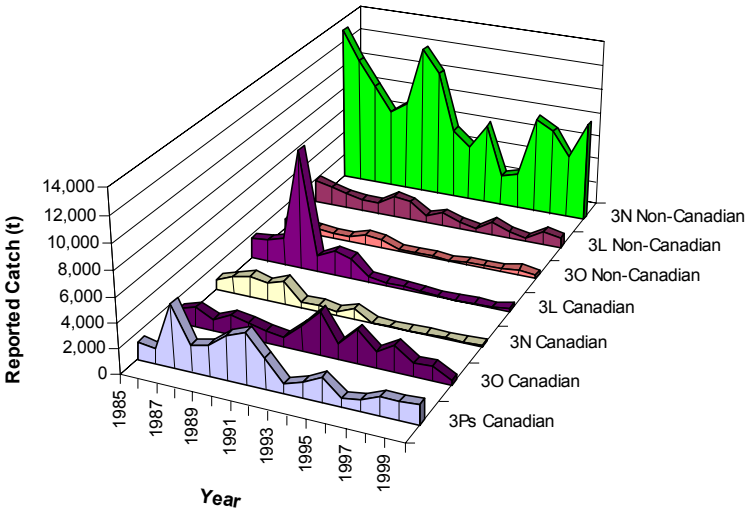


Figure 6f. Distribution of thorny skate based on Canadian fall surveys, 1996-2000.



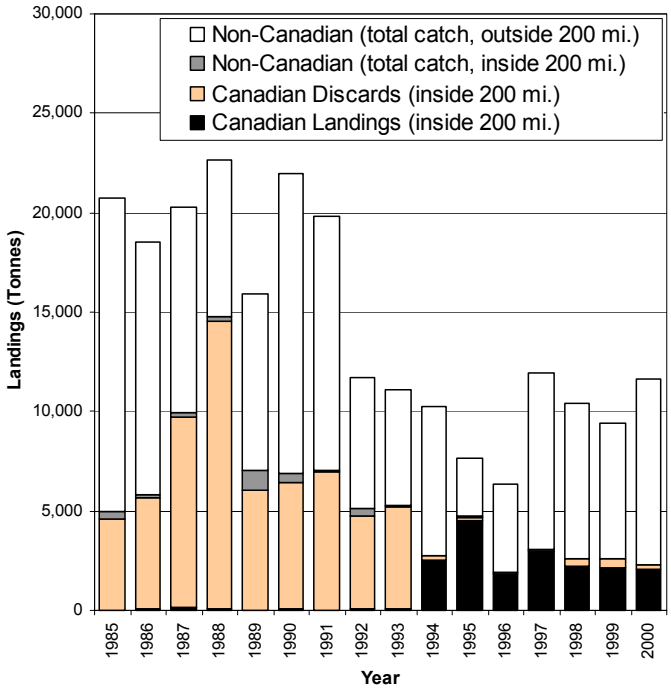


Figure 7. Landings of skate in Canadian and non-Canadian waters of NAFO Divisions 3LNOPs, 1985-2000. Catches inside 200 miles were calculated from ZIF files (landings) and Observer data (Canadian discards and non-Canadian catches). Catches in non-Canadian waters were estimated from Canadian Conservation & Protection boardings.

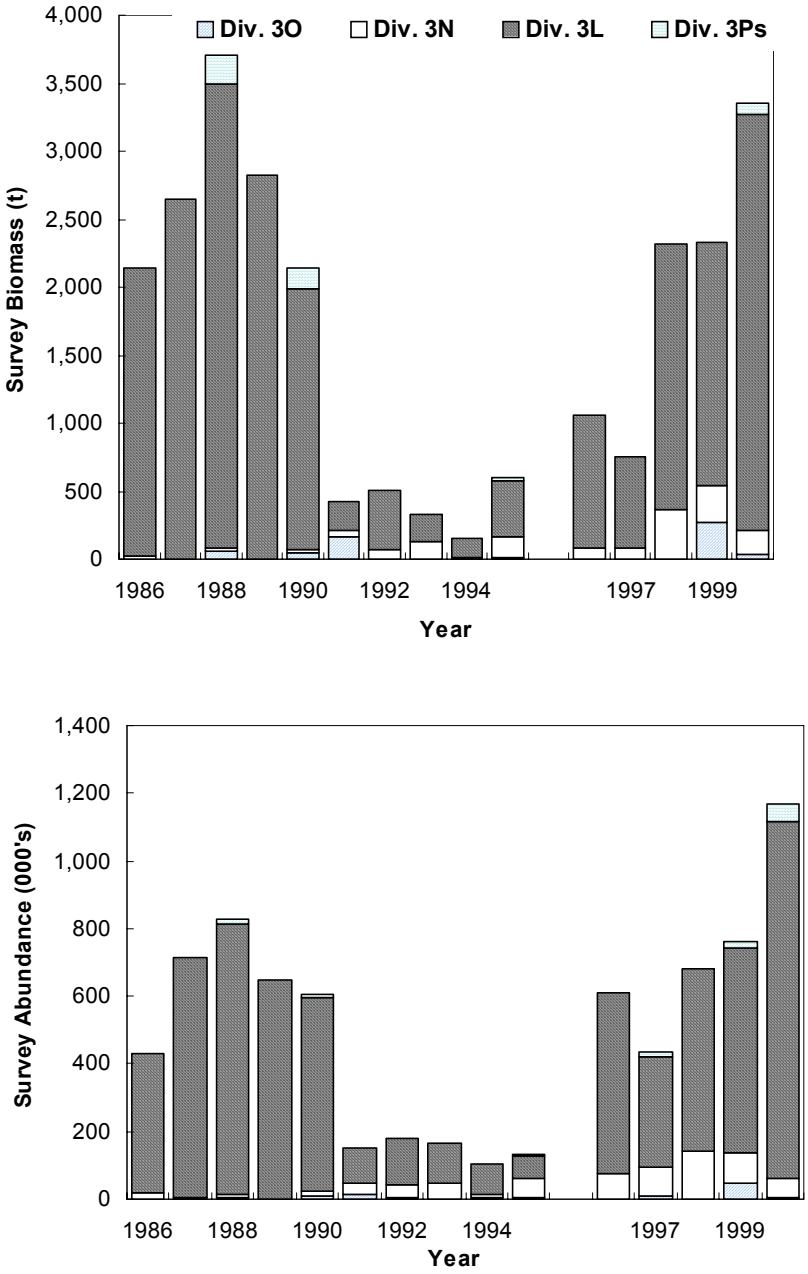


Figure 8a. Biomass and abundance estimates of spotted wolffish based on Canadian spring surveys, 1986-2000.

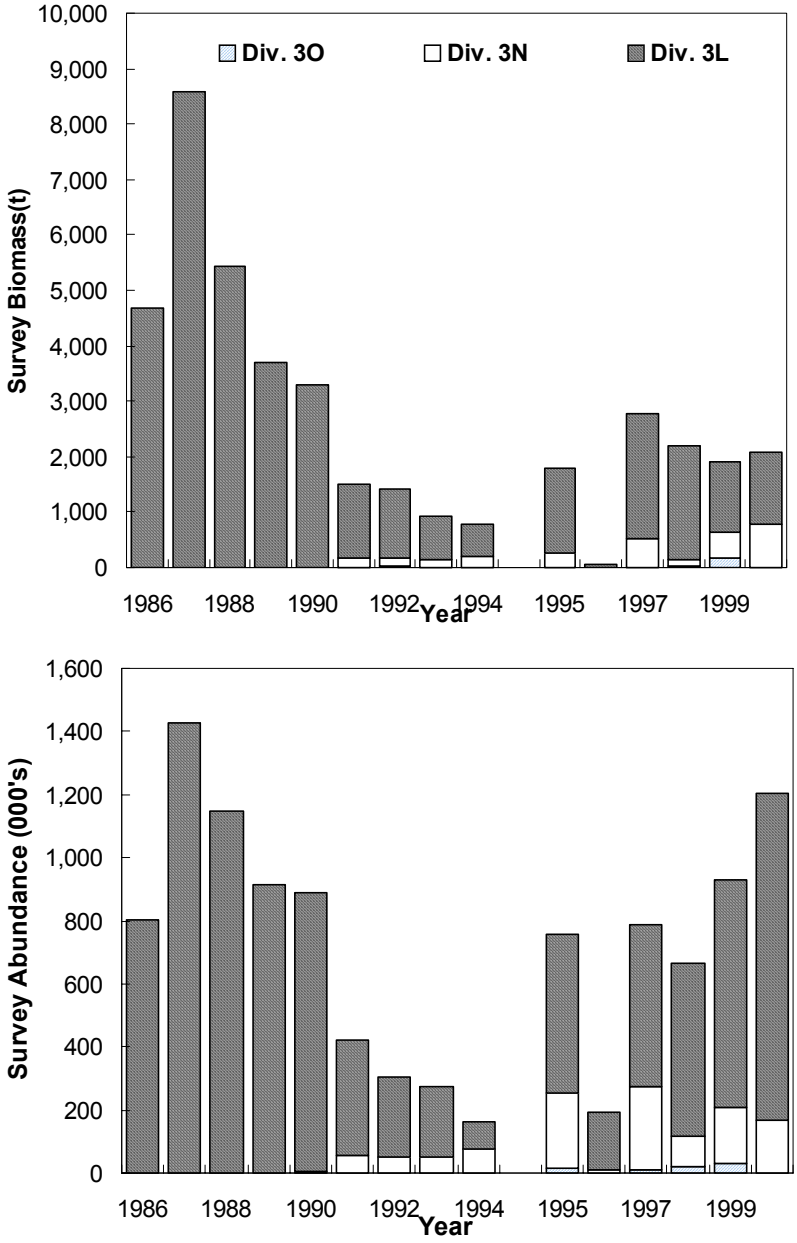


Figure 8b. Biomass and abundance estimates of spotted wolffish based on Canadian fall surveys, 1986-2000.

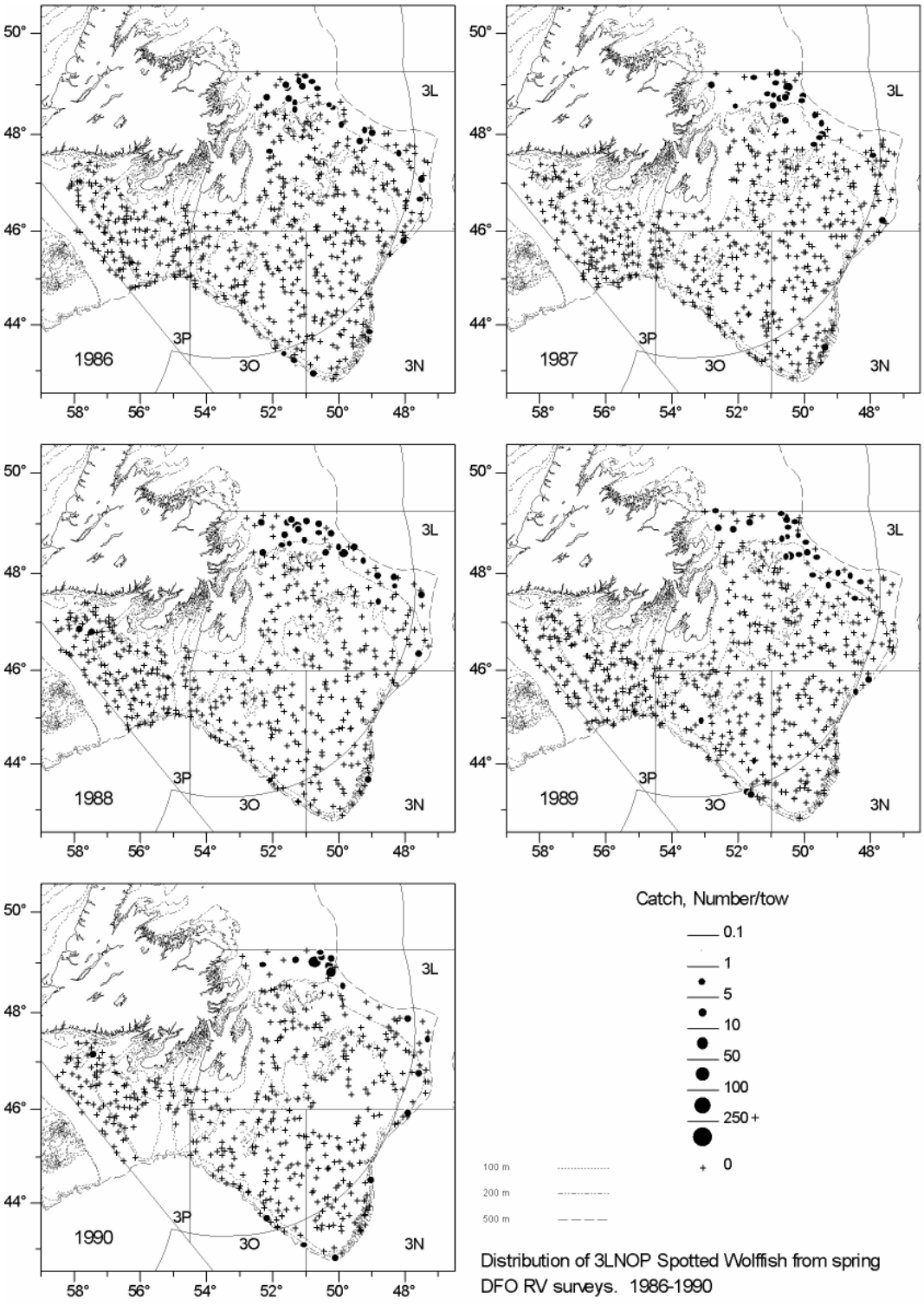


Figure 9a. Distribution of spotted wolffish based on Canadian spring surveys, 1986-1990.

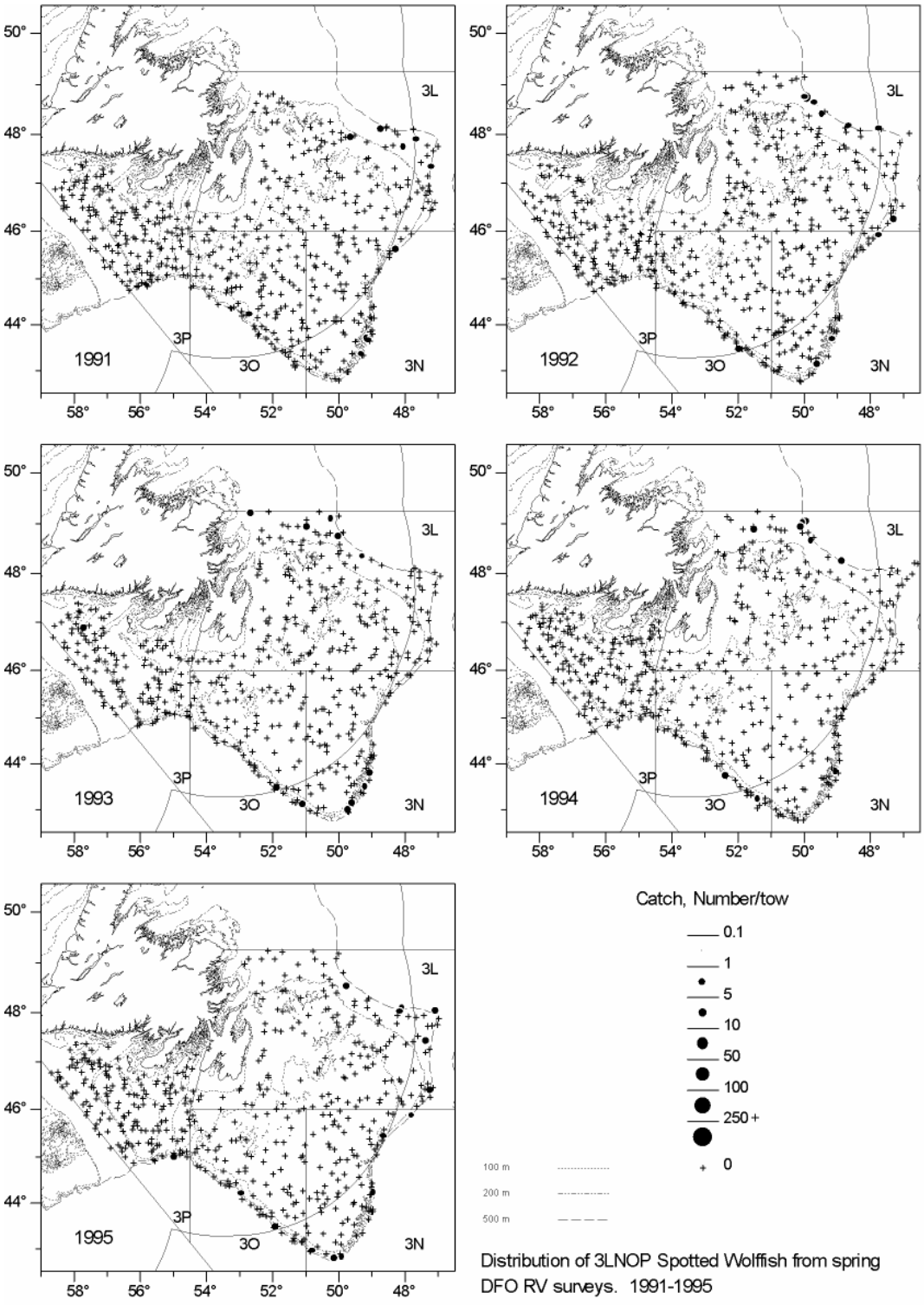


Figure 9b. Distribution of spotted wolffish based on Canadian spring surveys, 1991-1995.

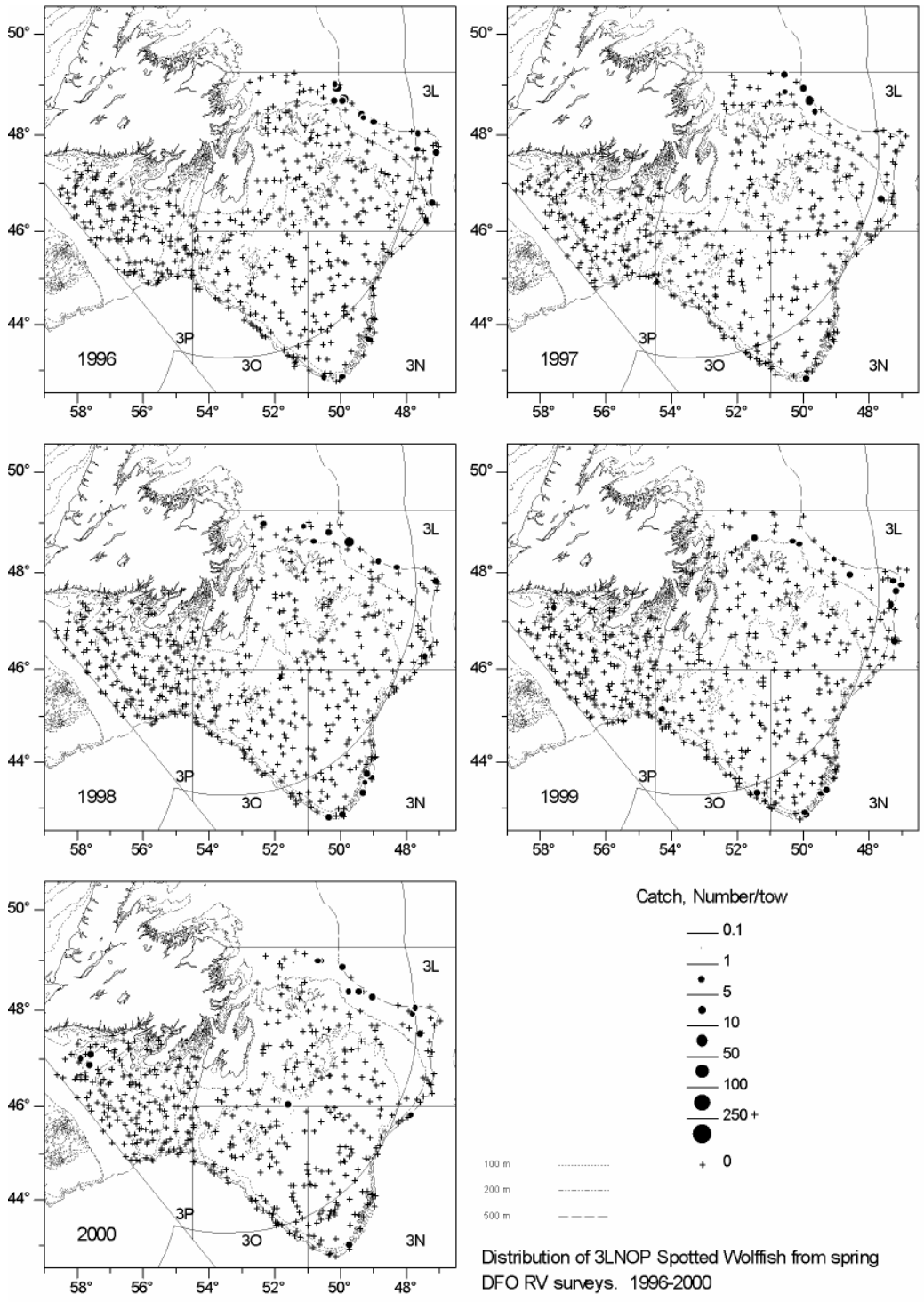


Figure 9c. Distribution of spotted wolffish based on Canadian spring surveys, 1996-2000.

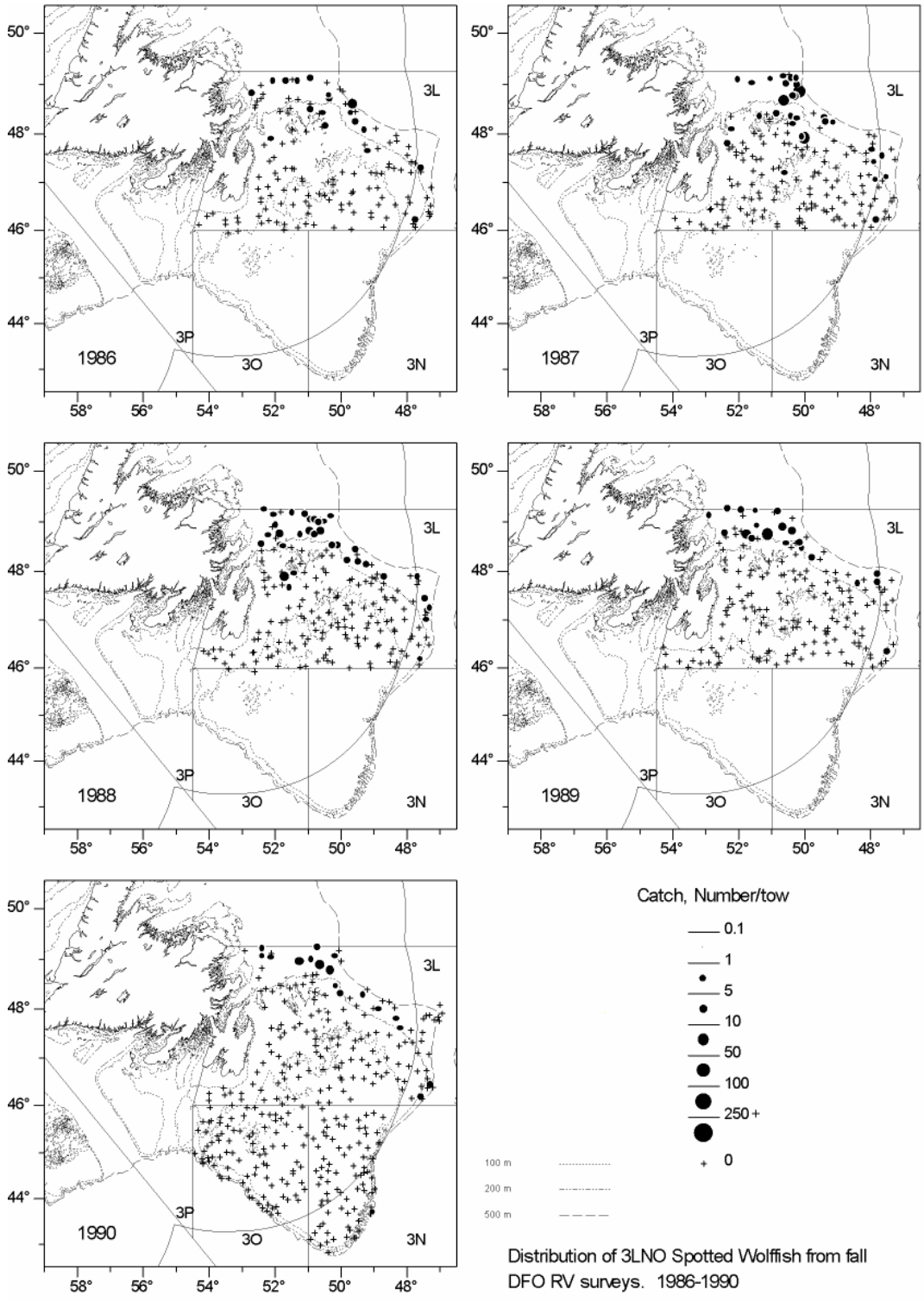


Figure 9d. Distribution of spotted wolffish based on Canadian fall surveys, 1986-1990.

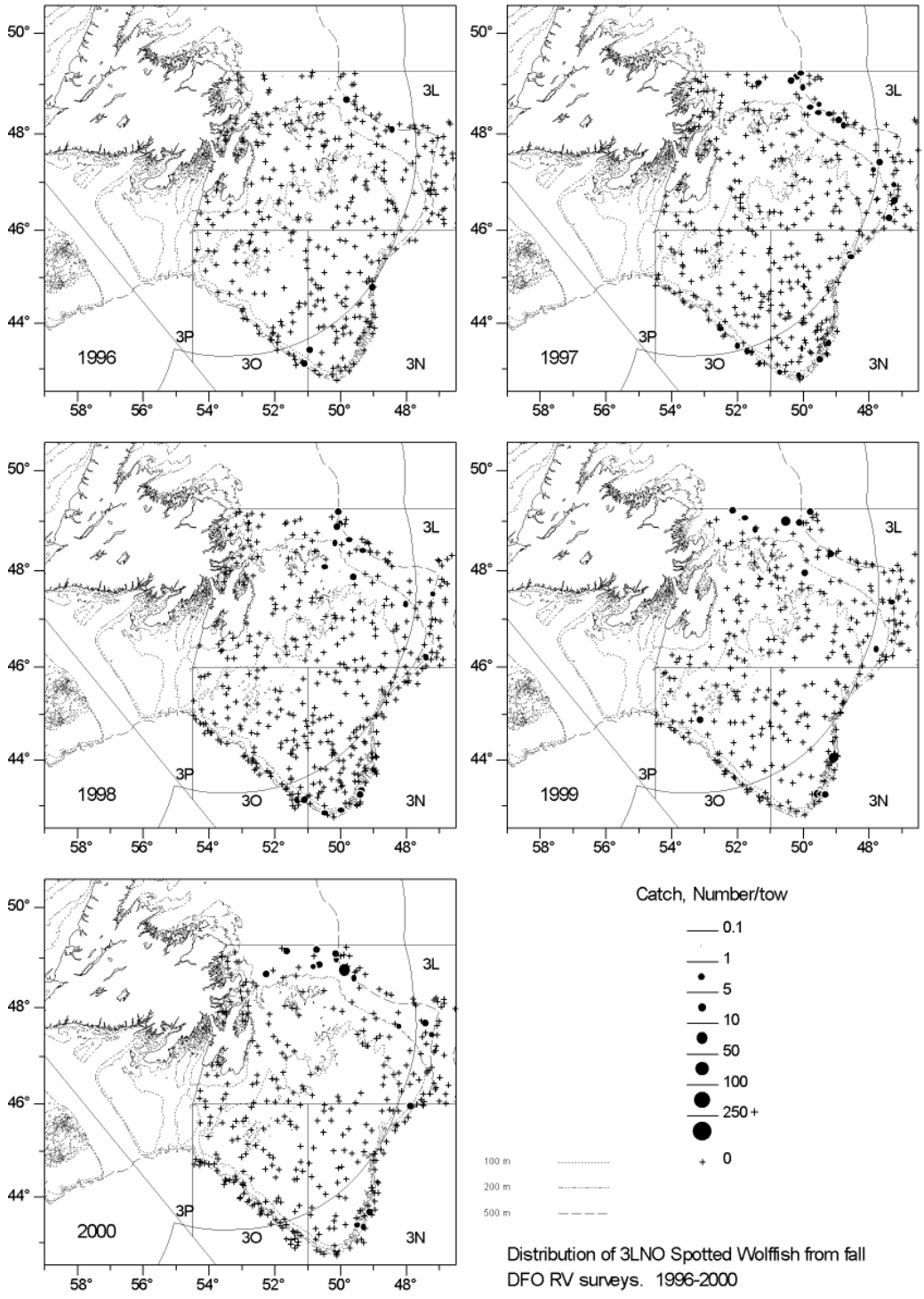


Figure 9e. Distribution of spotted wolffish based on Canadian fall surveys, 1991-1995.

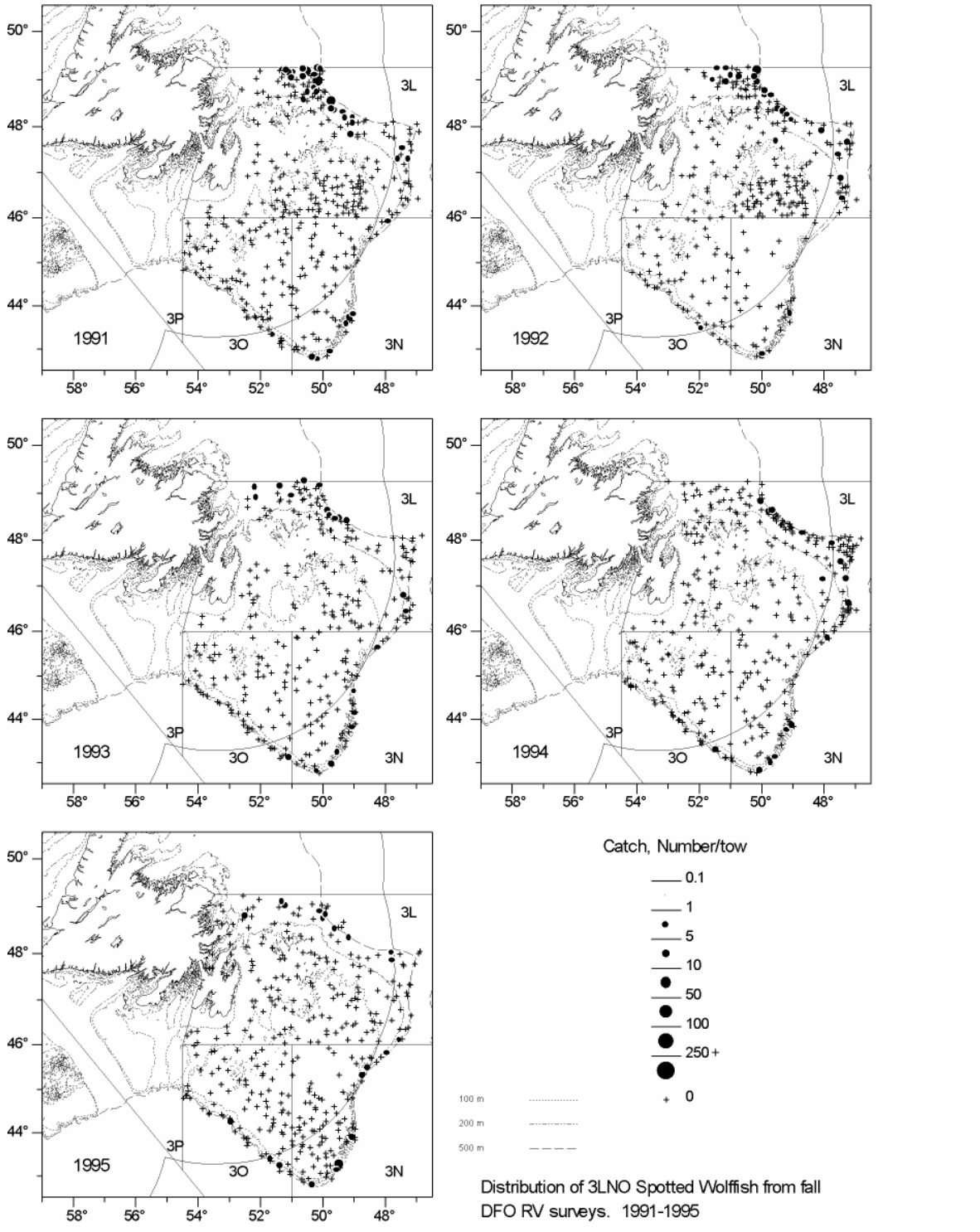


Figure 9f. Distribution of spotted wolffish based on Canadian fall surveys, 1996-2000.

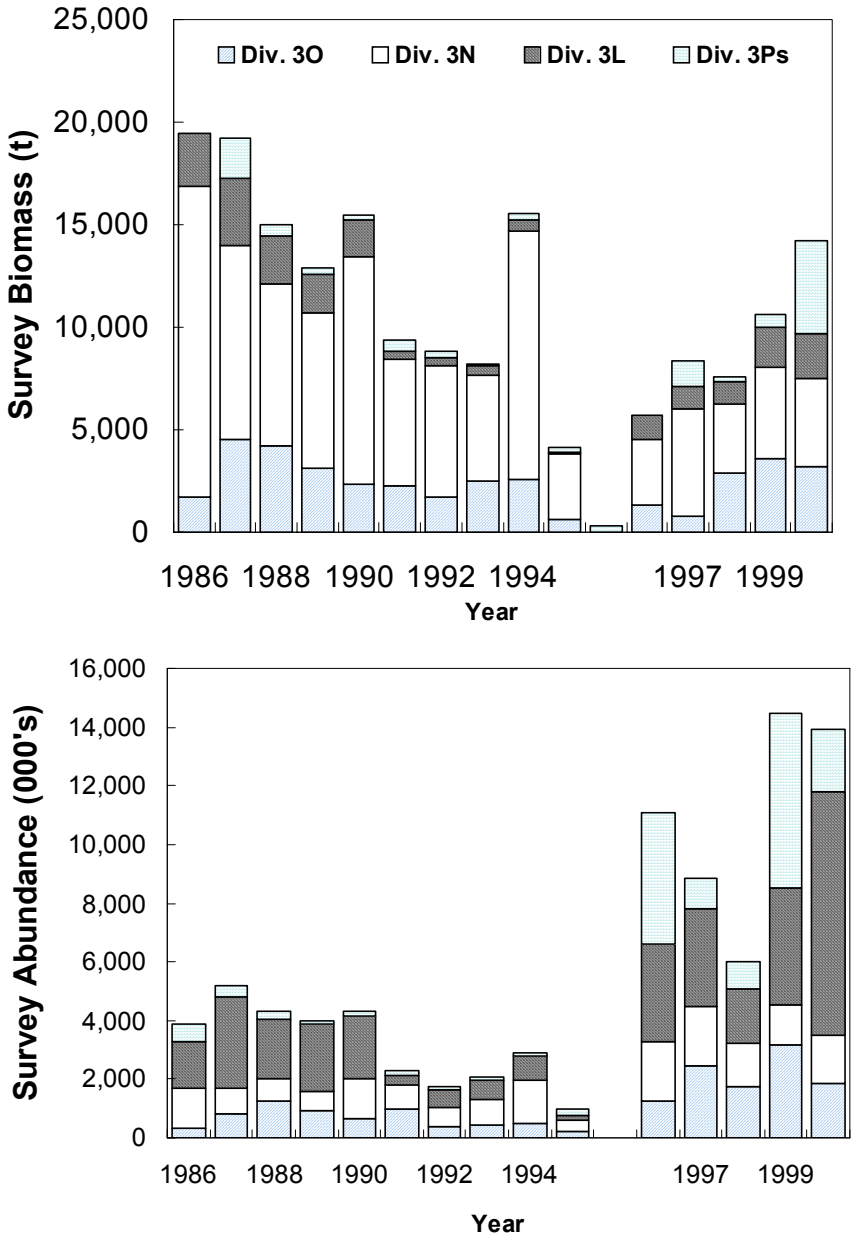


Figure 10a. Biomass and abundance estimates of striped wolffish based on Canadian spring surveys, 1986-2000.

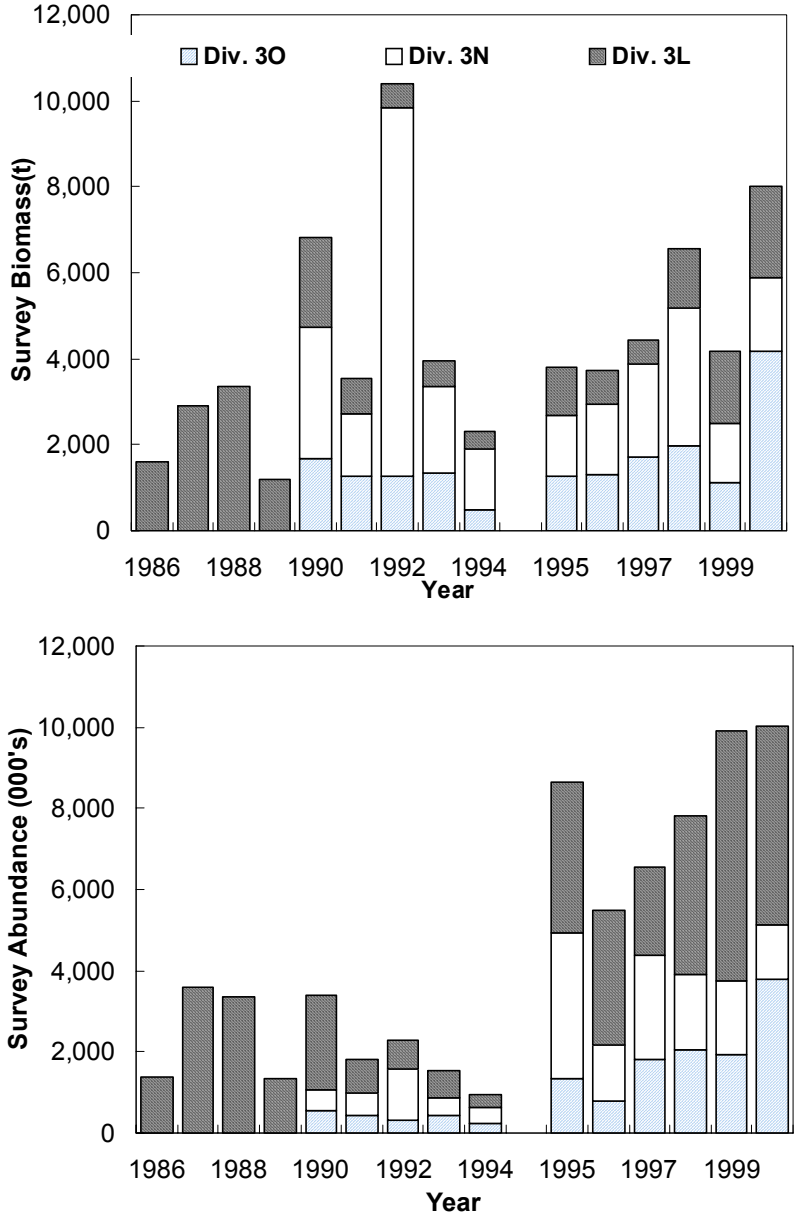


Figure 10b. Biomass and abundance estimates of striped wolffish based on Canadian fall surveys, 1986-2000.

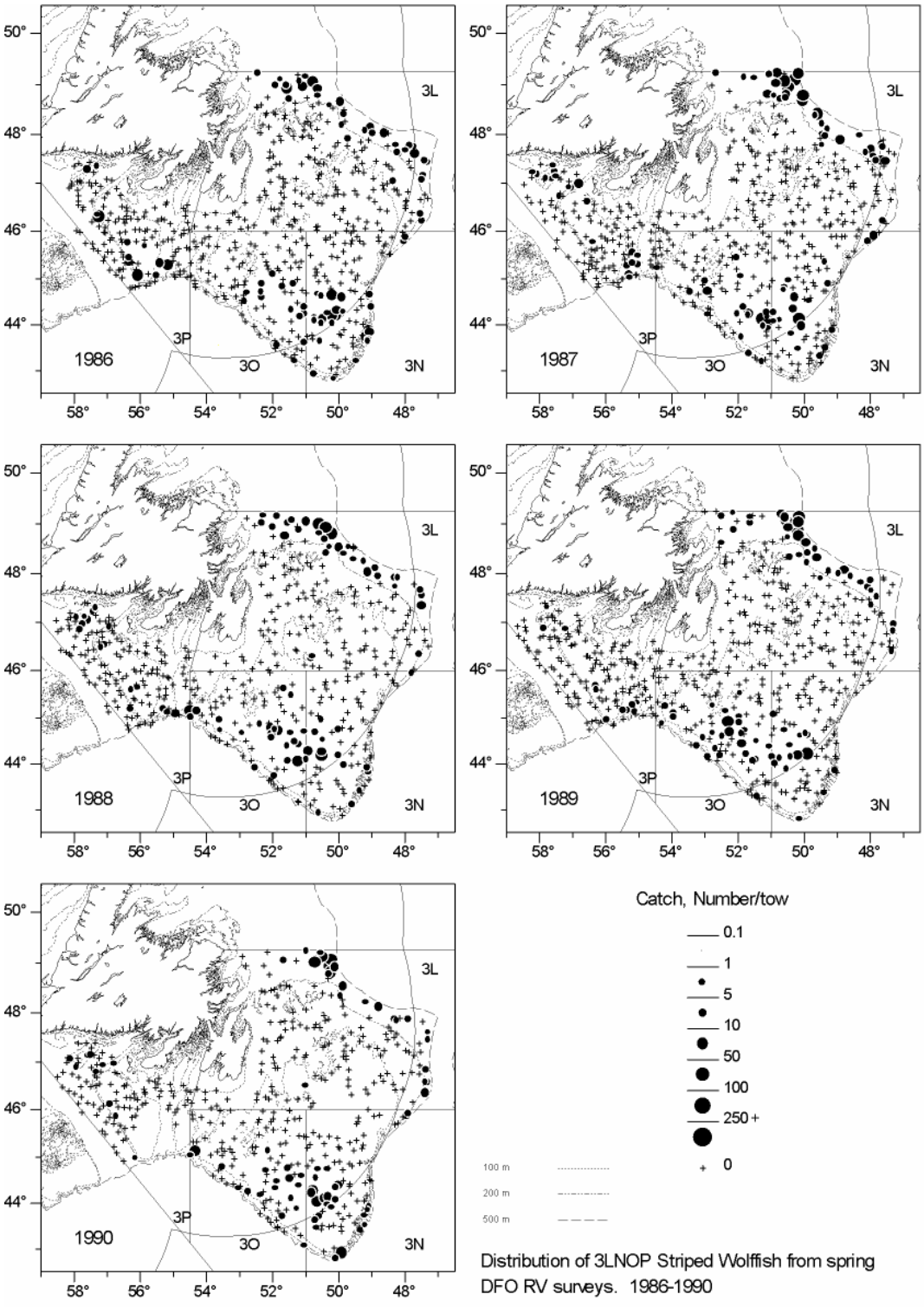


Figure 11a. Distribution of striped wolffish based on Canadian spring surveys, 1986-1990.

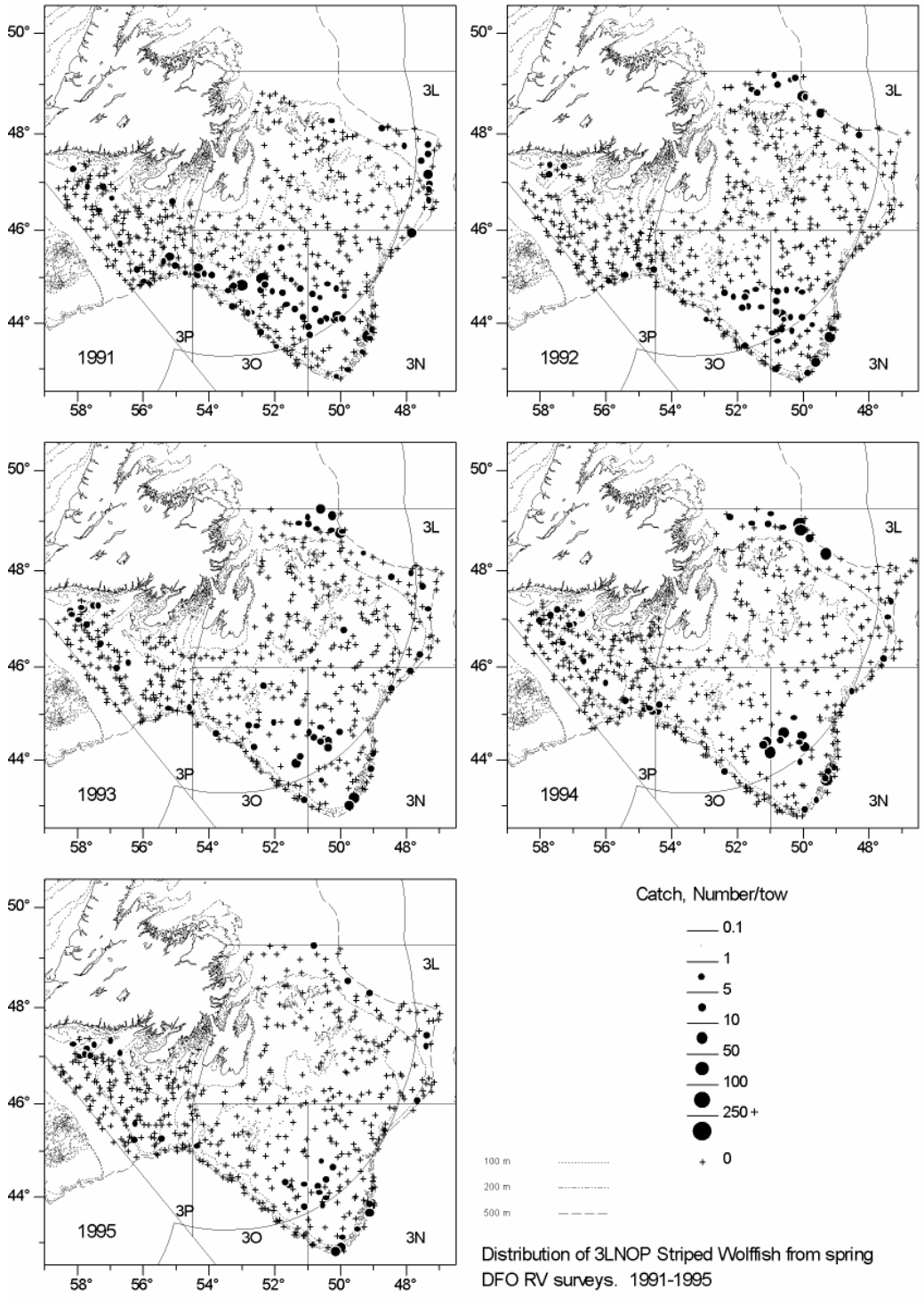


Figure 11b. Distribution of striped wolffish based on Canadian spring surveys, 1991-1995.

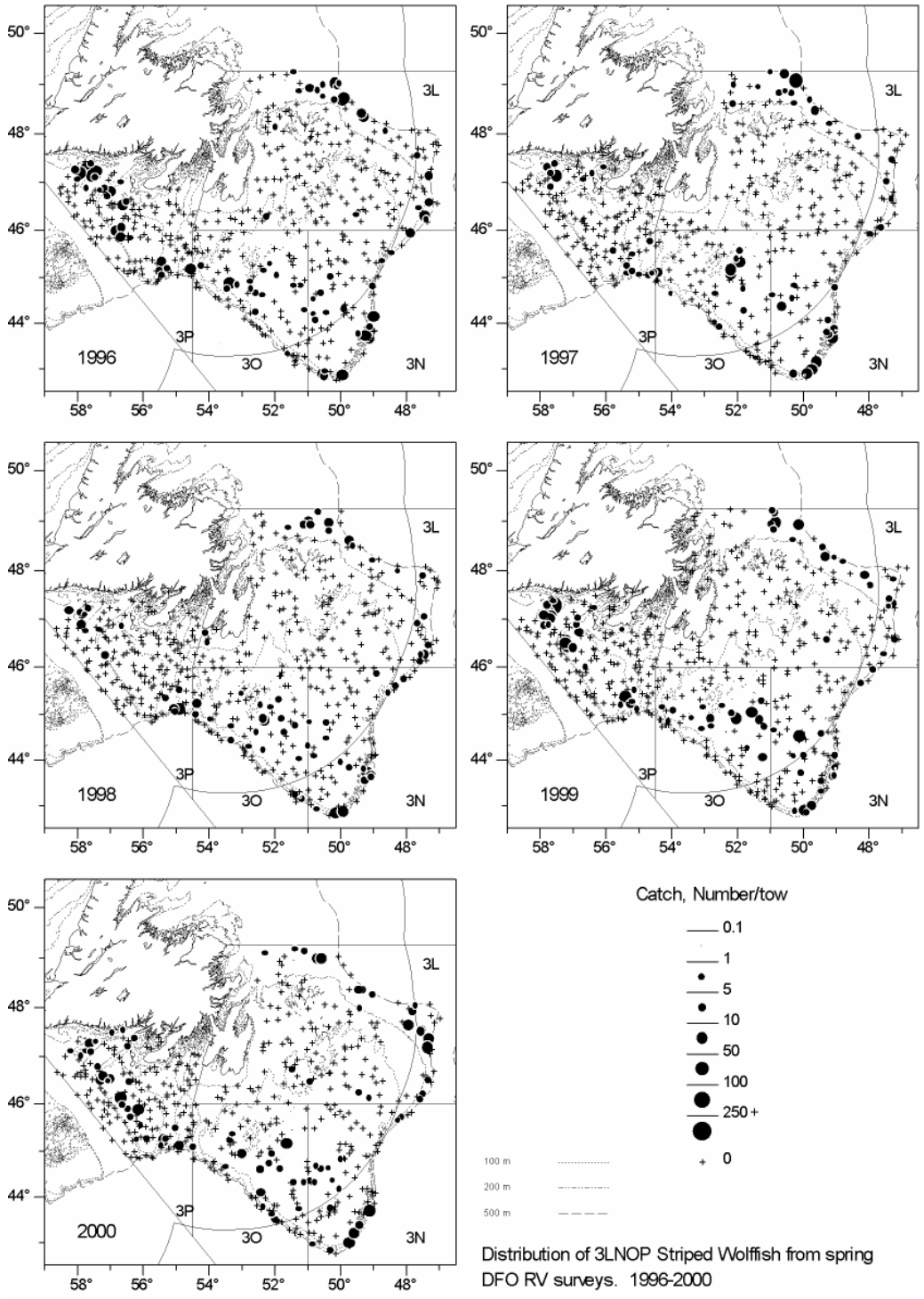


Figure 11c. Distribution of striped wolffish based on Canadian spring surveys, 1996-2000.

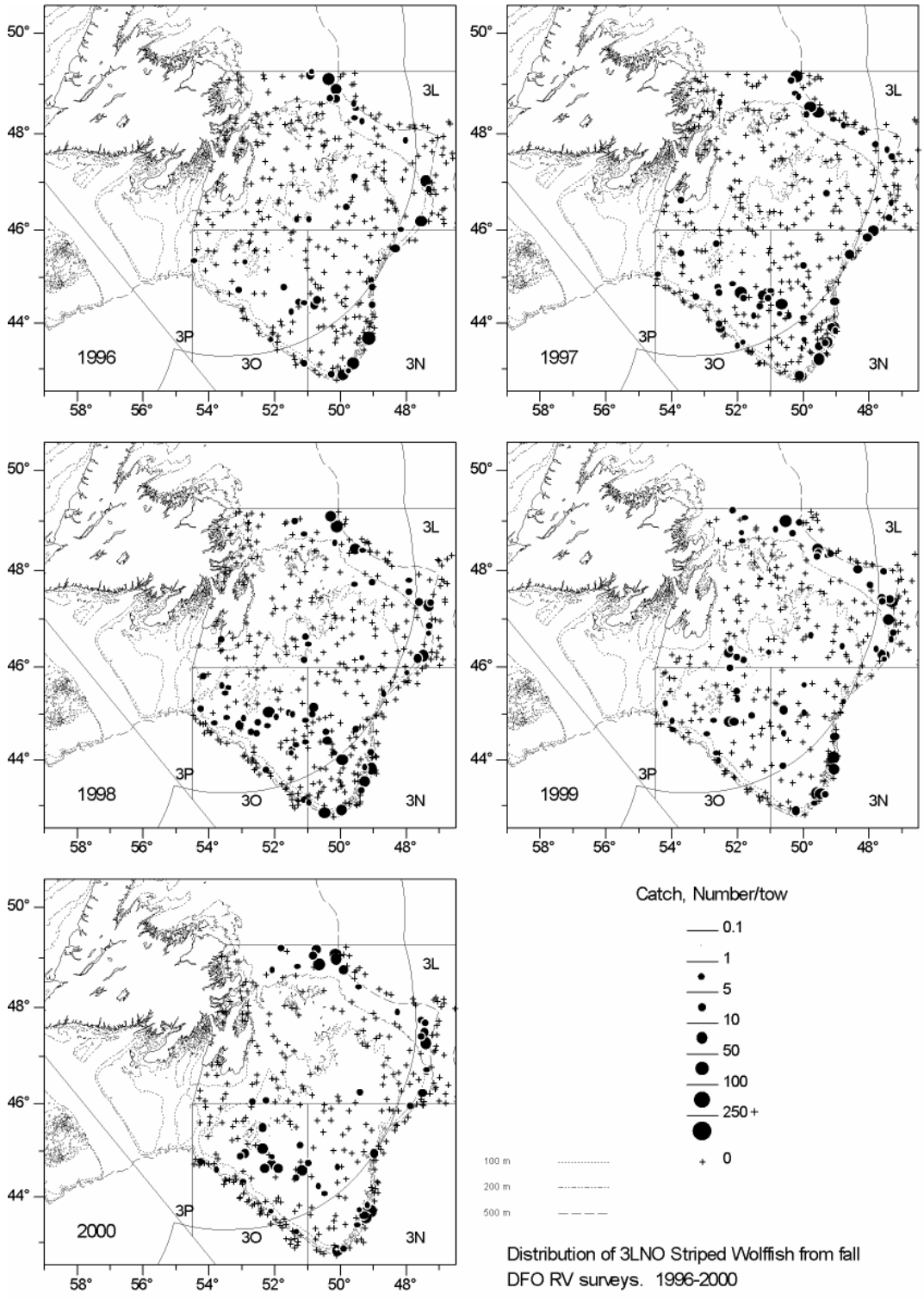


Figure 11d. Distribution of striped wolffish based on Canadian fall surveys, 1986-1990.

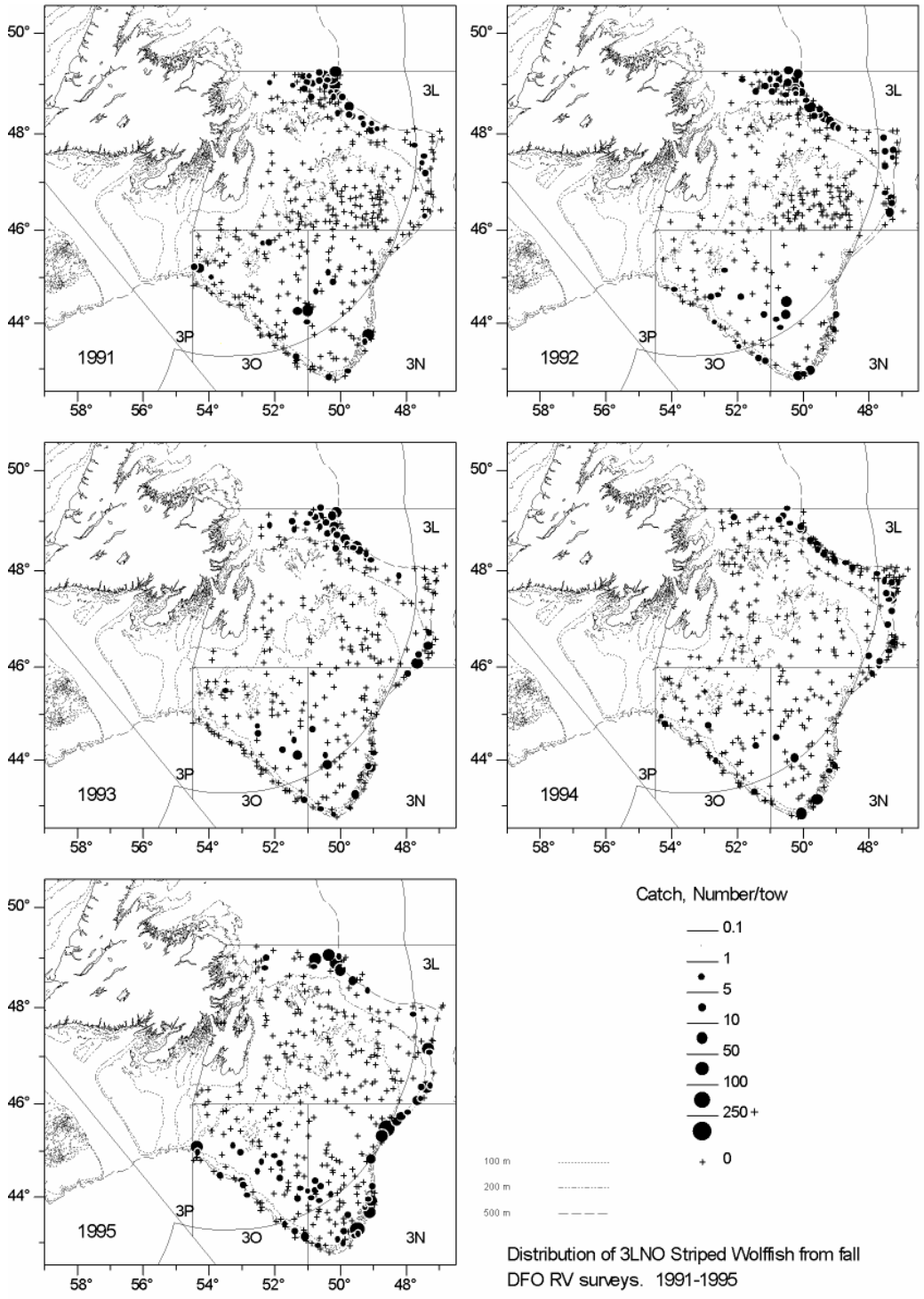


Figure 11e. Distribution of striped wolffish based on Canadian fall surveys, 1991-1995.

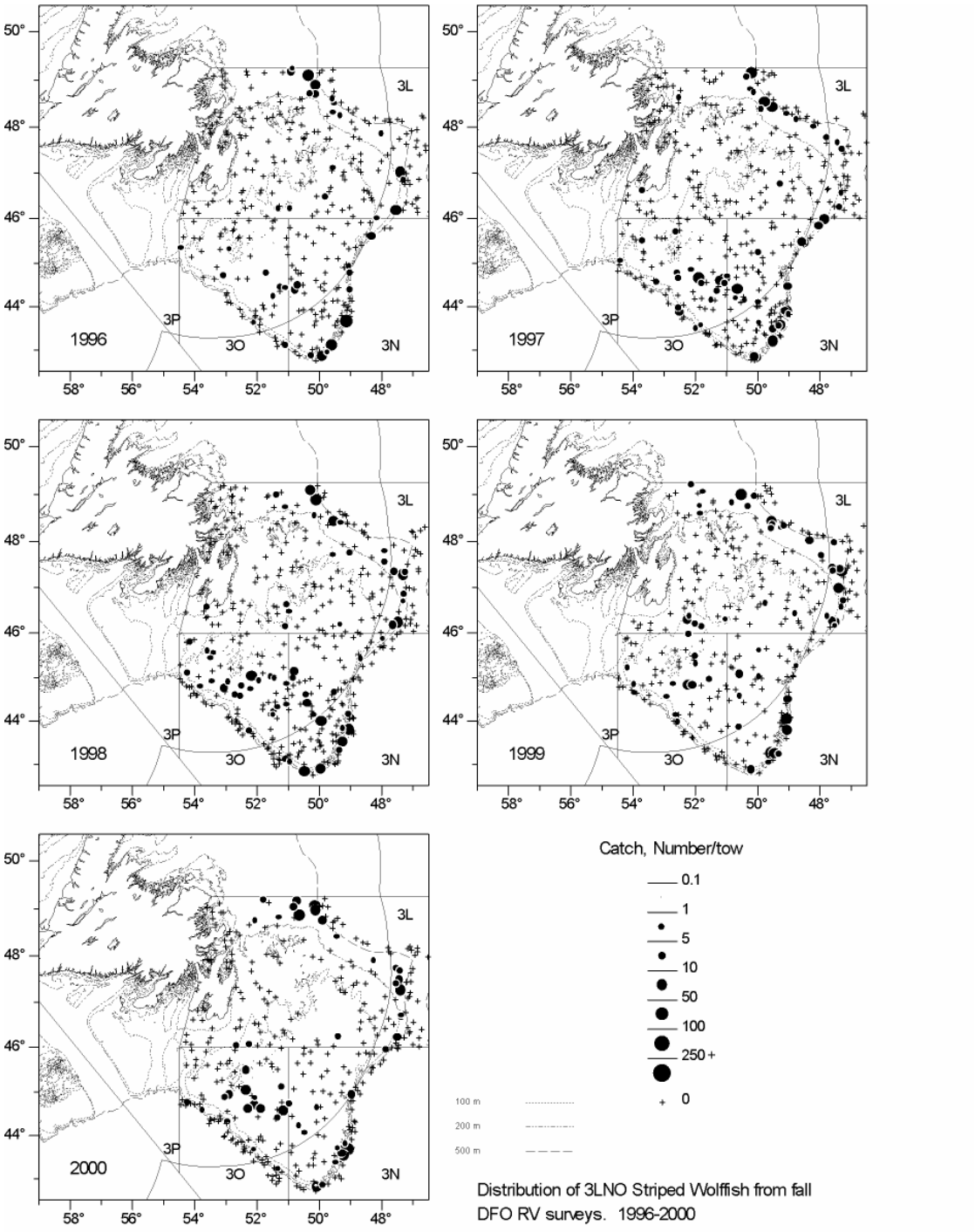


Figure 11f. Distribution of striped wolffish based on Canadian fall surveys, 1996-2000.

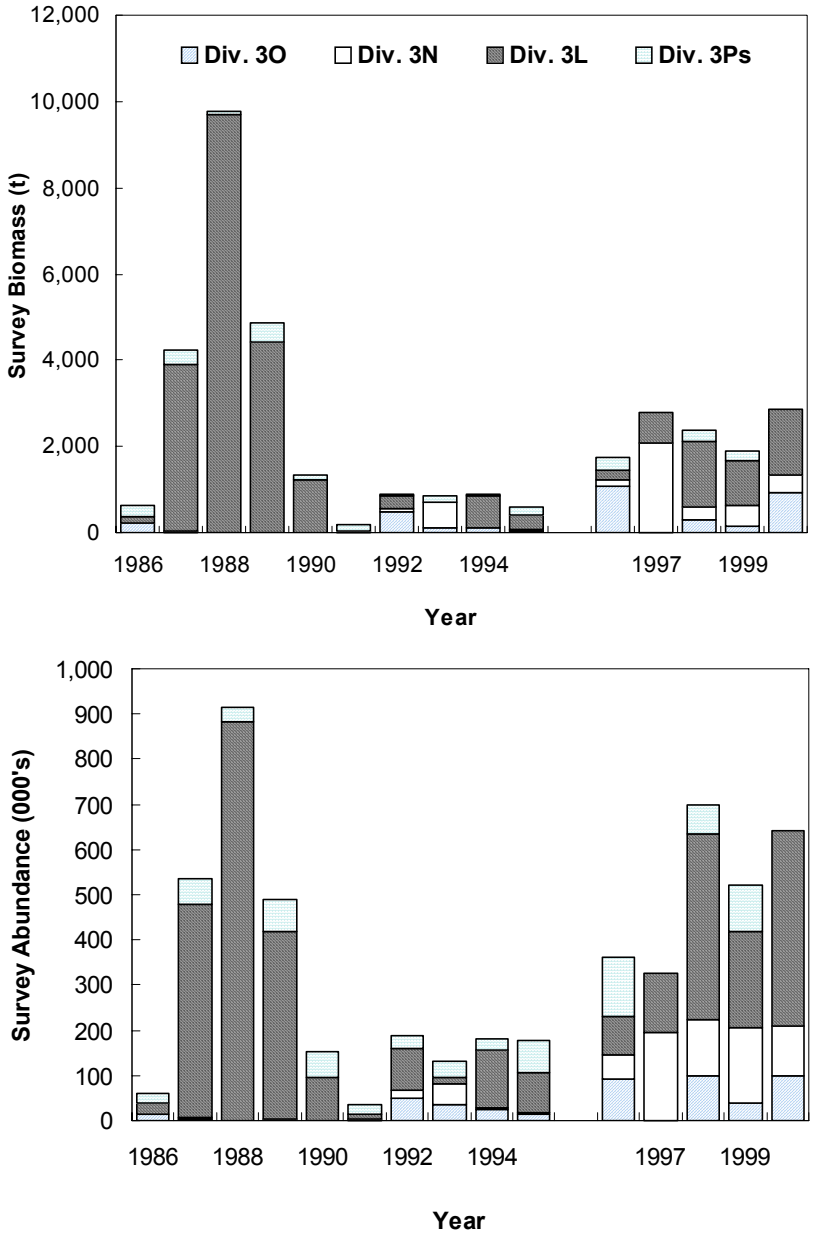


Figure 12a. Biomass and abundance estimates of broadhead wolffish based on Canadian spring surveys, 1986-2000.

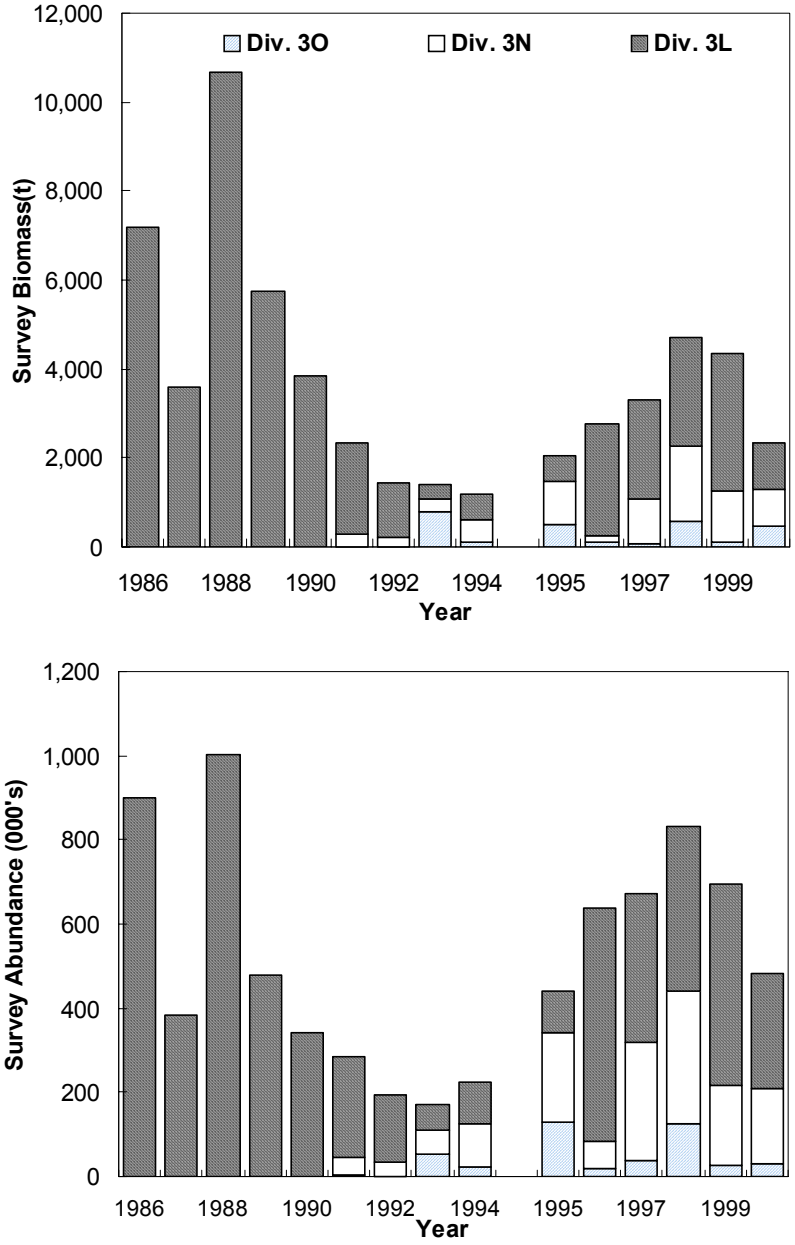


Figure 12b. Biomass and abundance estimates of broadhead wolffish based on Canadian fall surveys, 1986-2000.

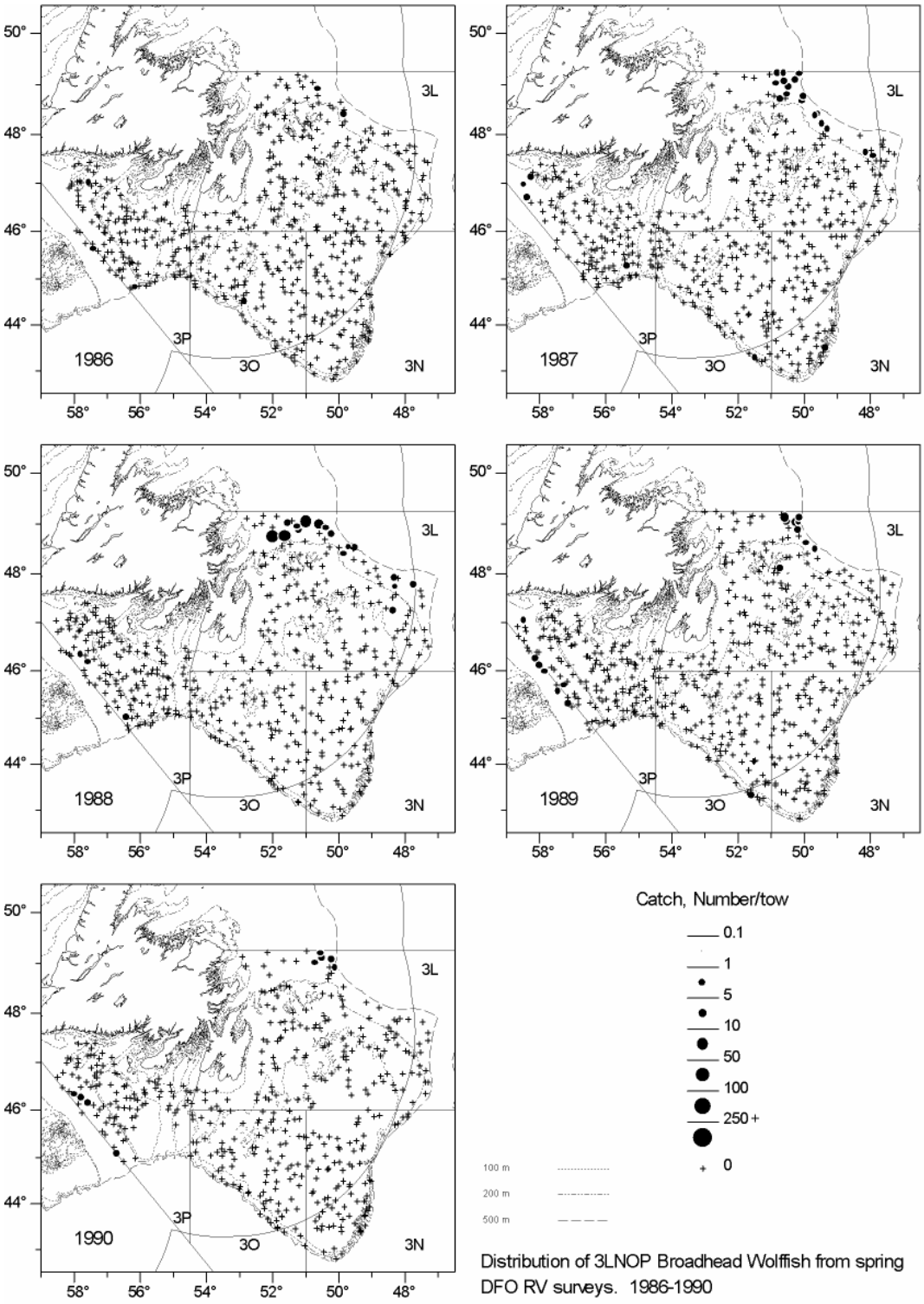


Figure 13a. Distribution of broadhead wolffish based on Canadian spring surveys, 1986-1990.

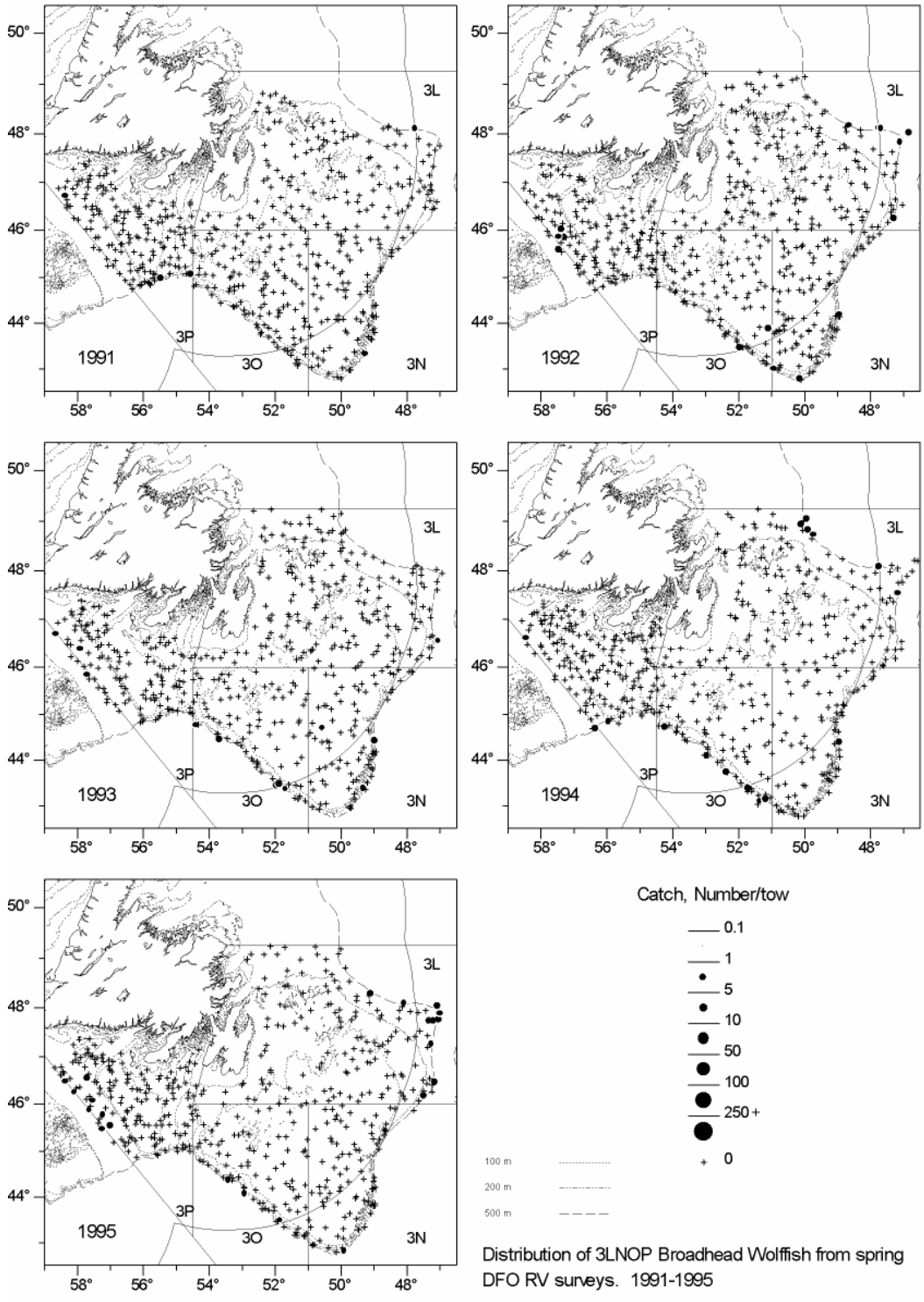


Figure 13b. Distribution of broadhead wolffish based on Canadian spring surveys, 1991-1995.

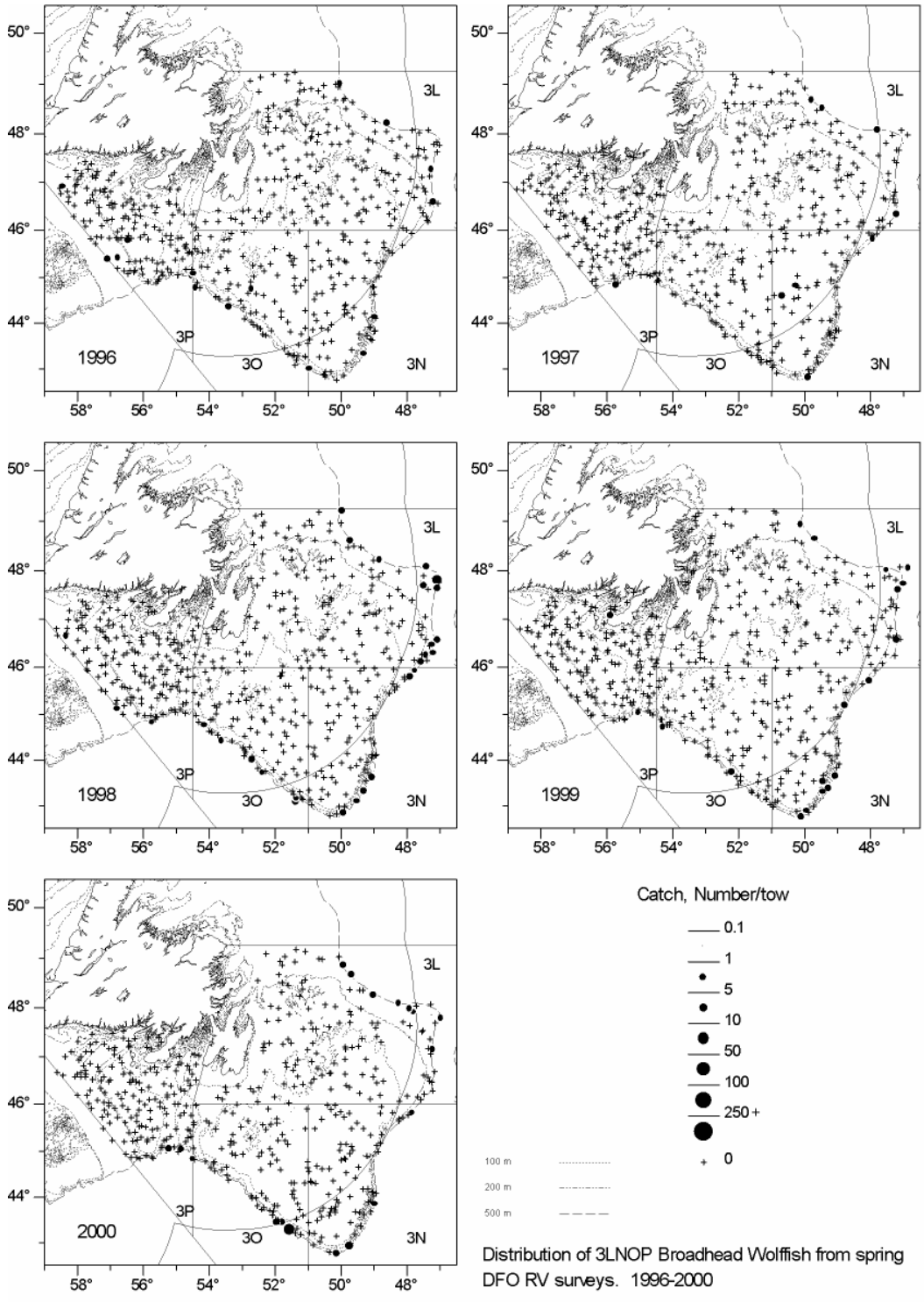


Figure 13c. Distribution of broadhead wolffish based on Canadian spring surveys, 1996-2000.

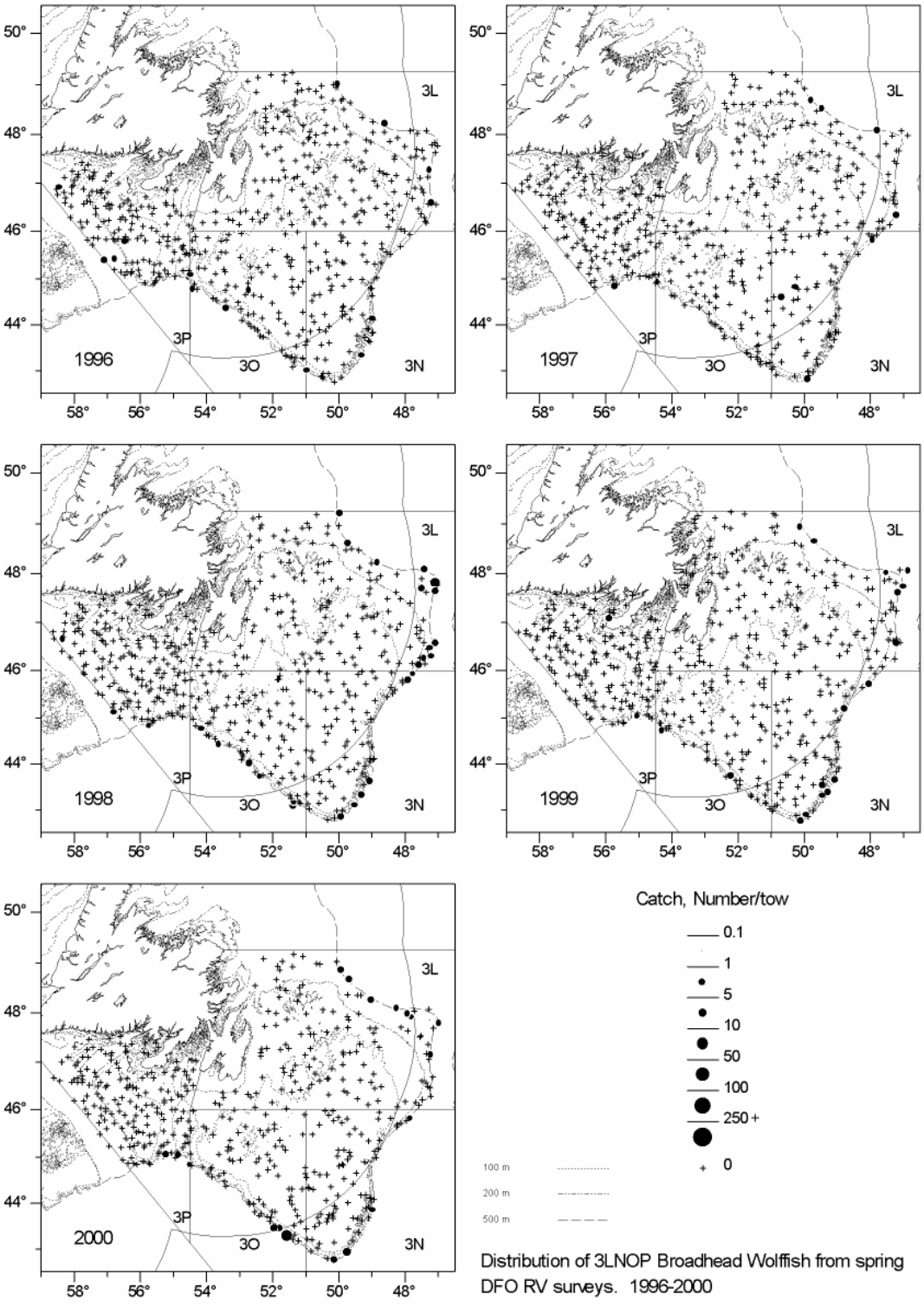


Figure 13d. Distribution of broadhead wolffish based on Canadian fall surveys, 1986-1990.

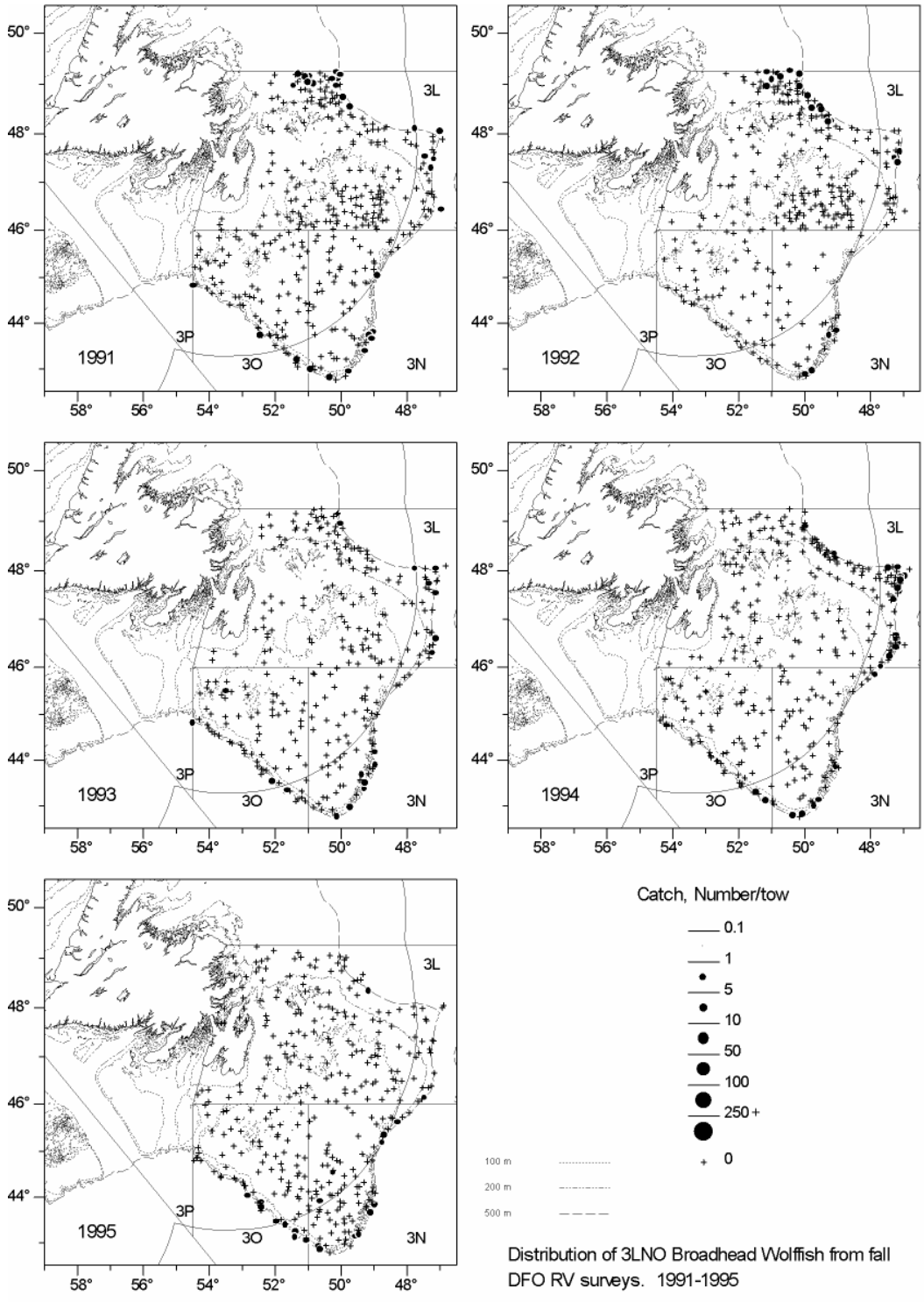


Figure 13e. Distribution of broadhead wolffish based on Canadian fall surveys, 1991-1995.

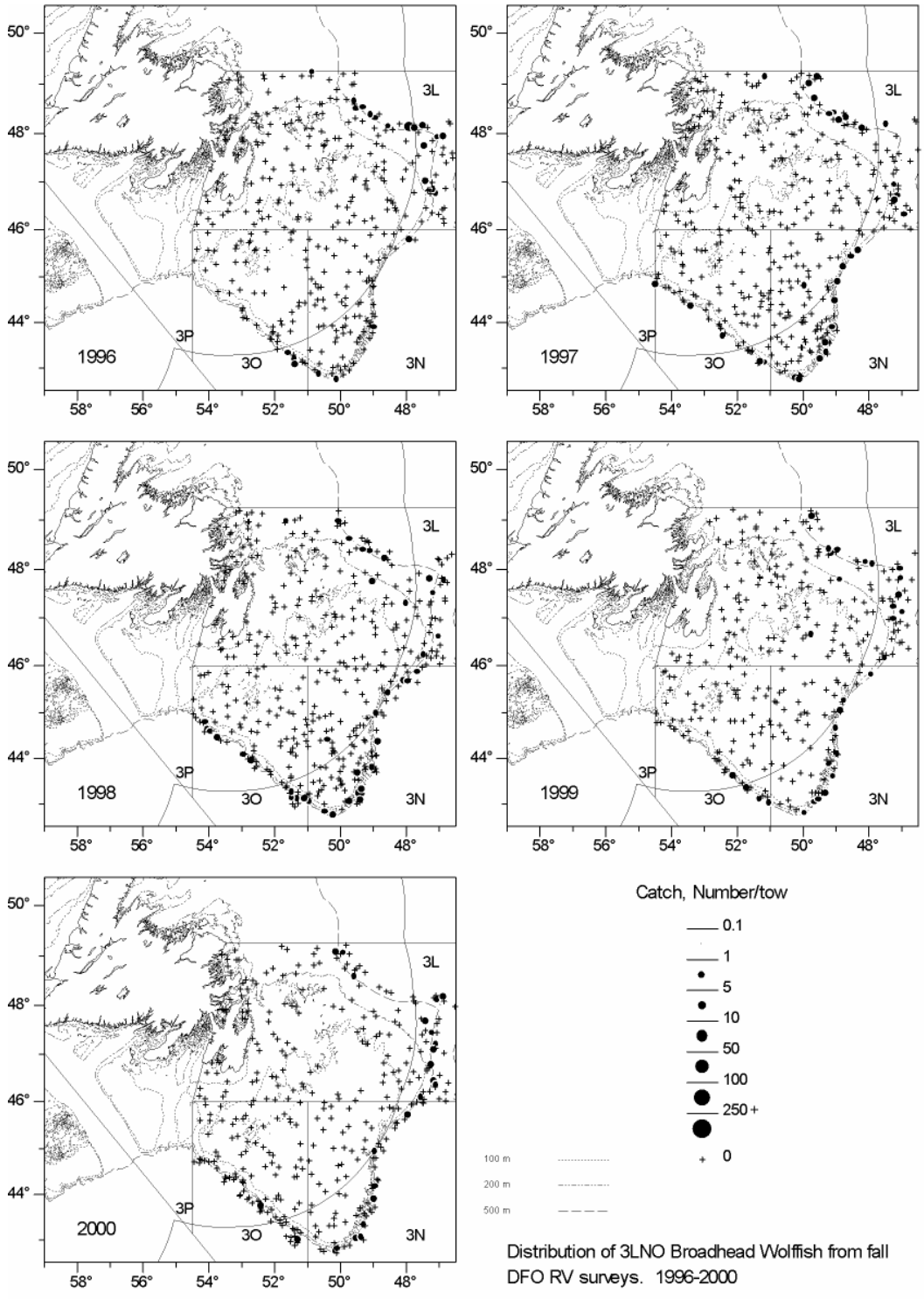


Figure 13f. Distribution of broadhead wolffish based on Canadian fall surveys, 1996-2000.

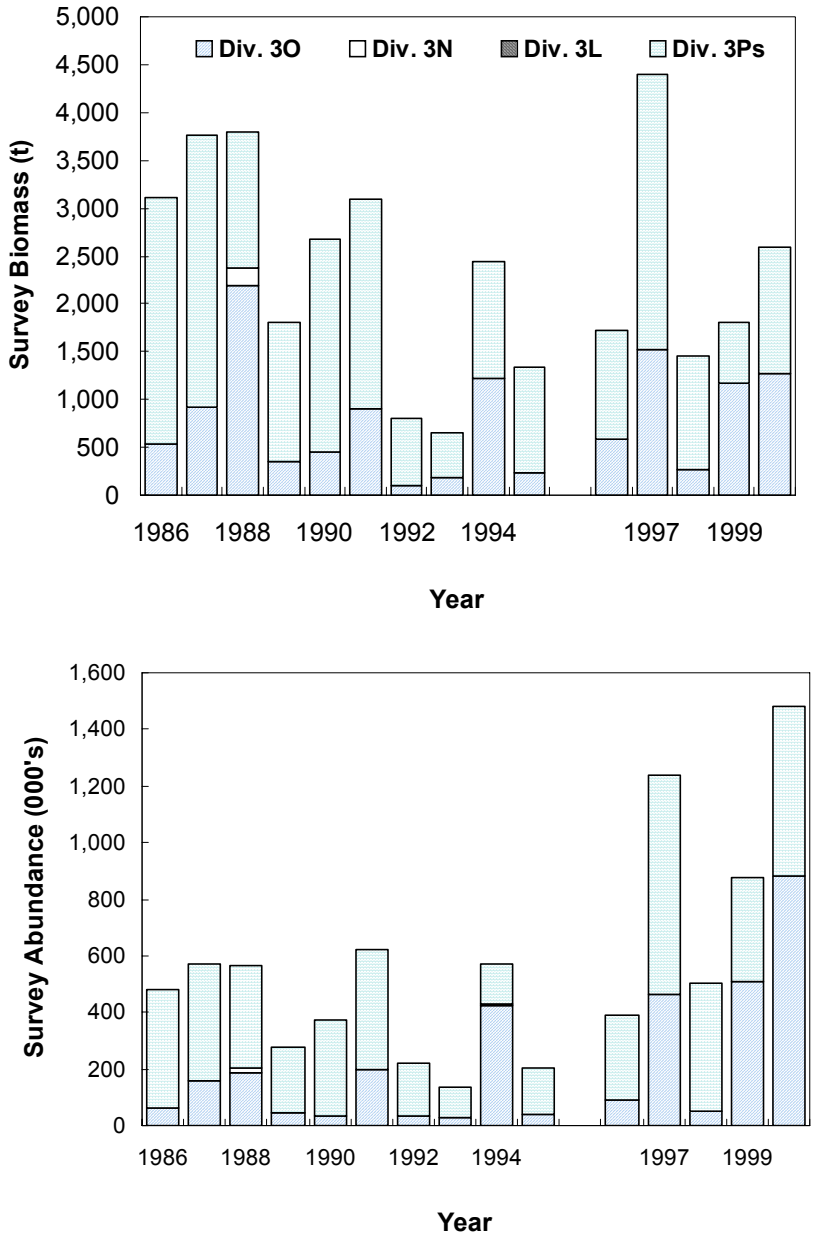


Figure 14a. Biomass and abundance estimates of monkfish based on Canadian spring surveys, 1986-2000.

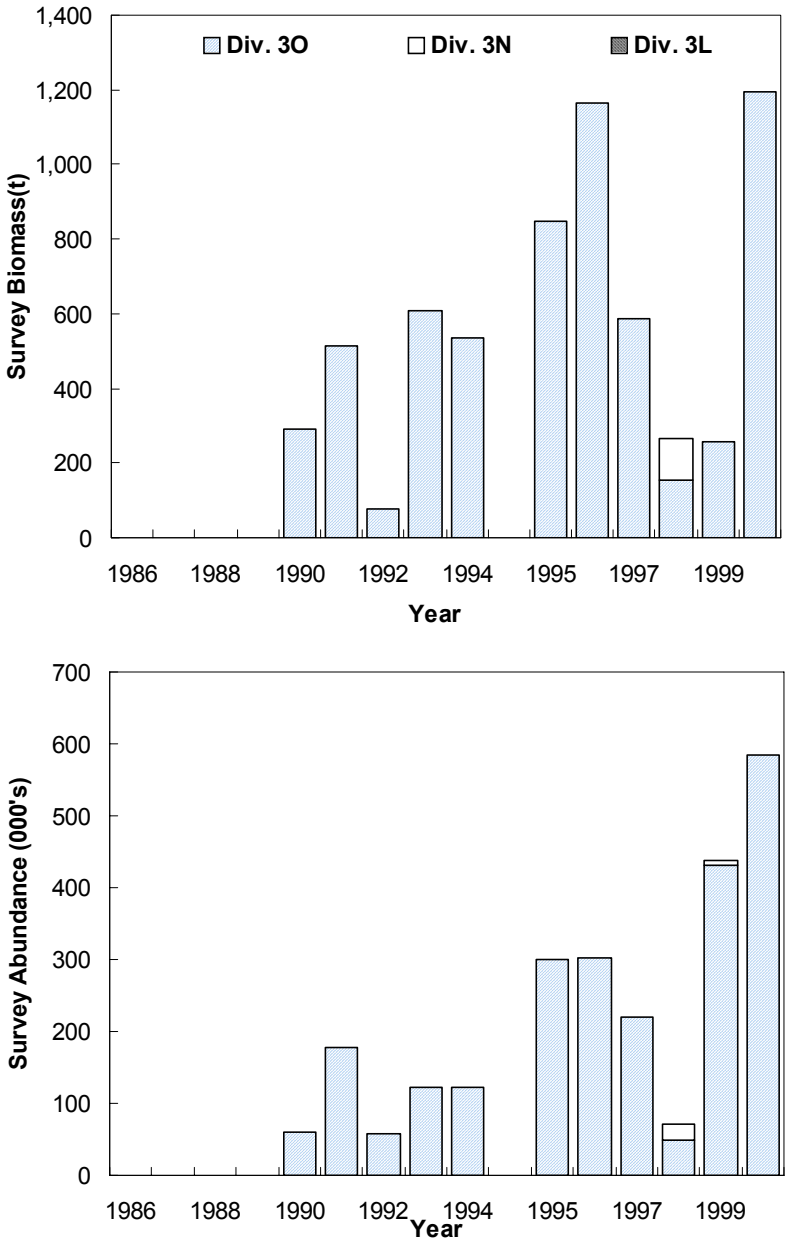


Figure 14b. Biomass and abundance estimates of monkfish based on Canadian fall surveys, 1986-2000.

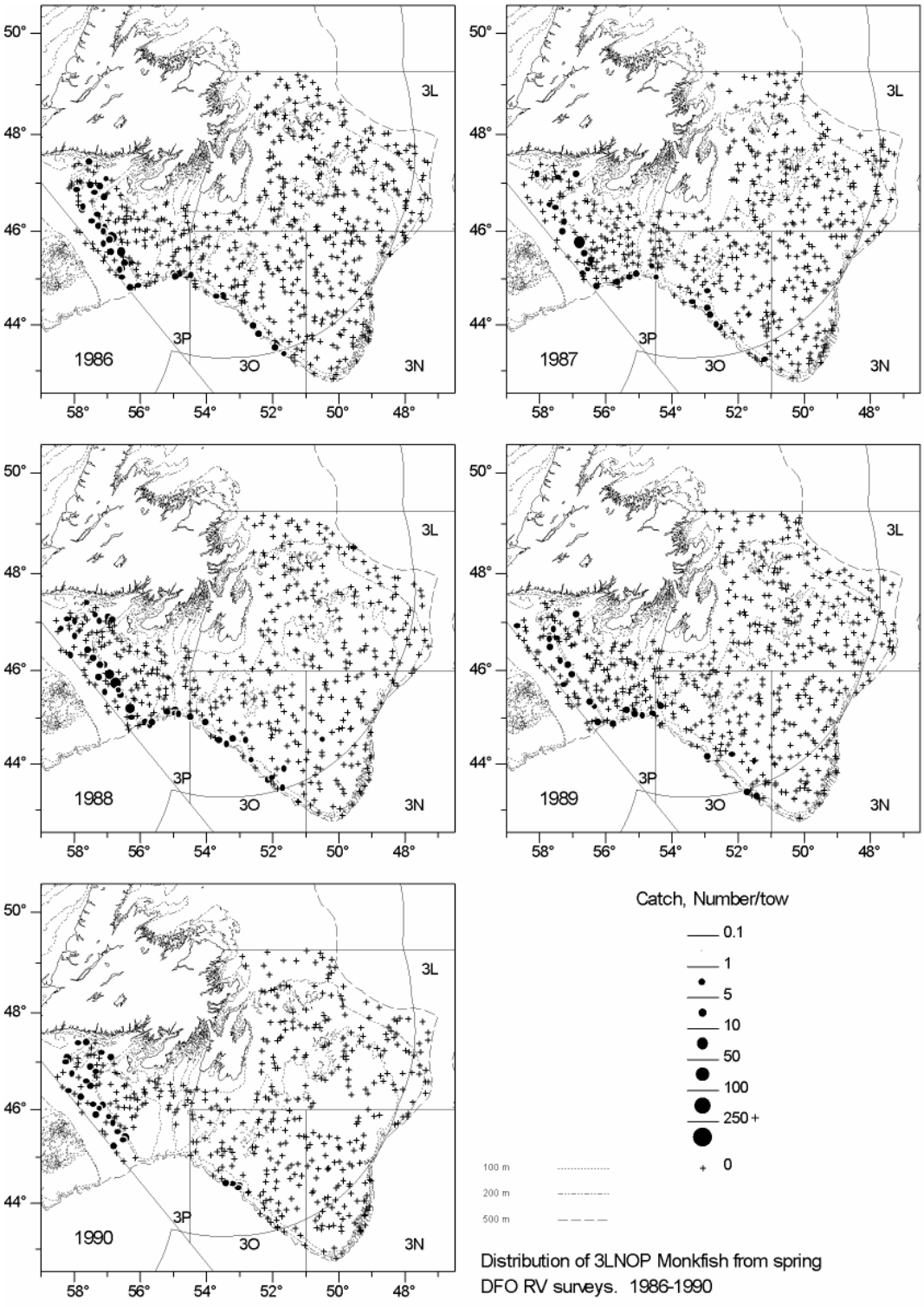


Figure 15a. Distribution of monkfish based on Canadian spring surveys, 1986-1990.

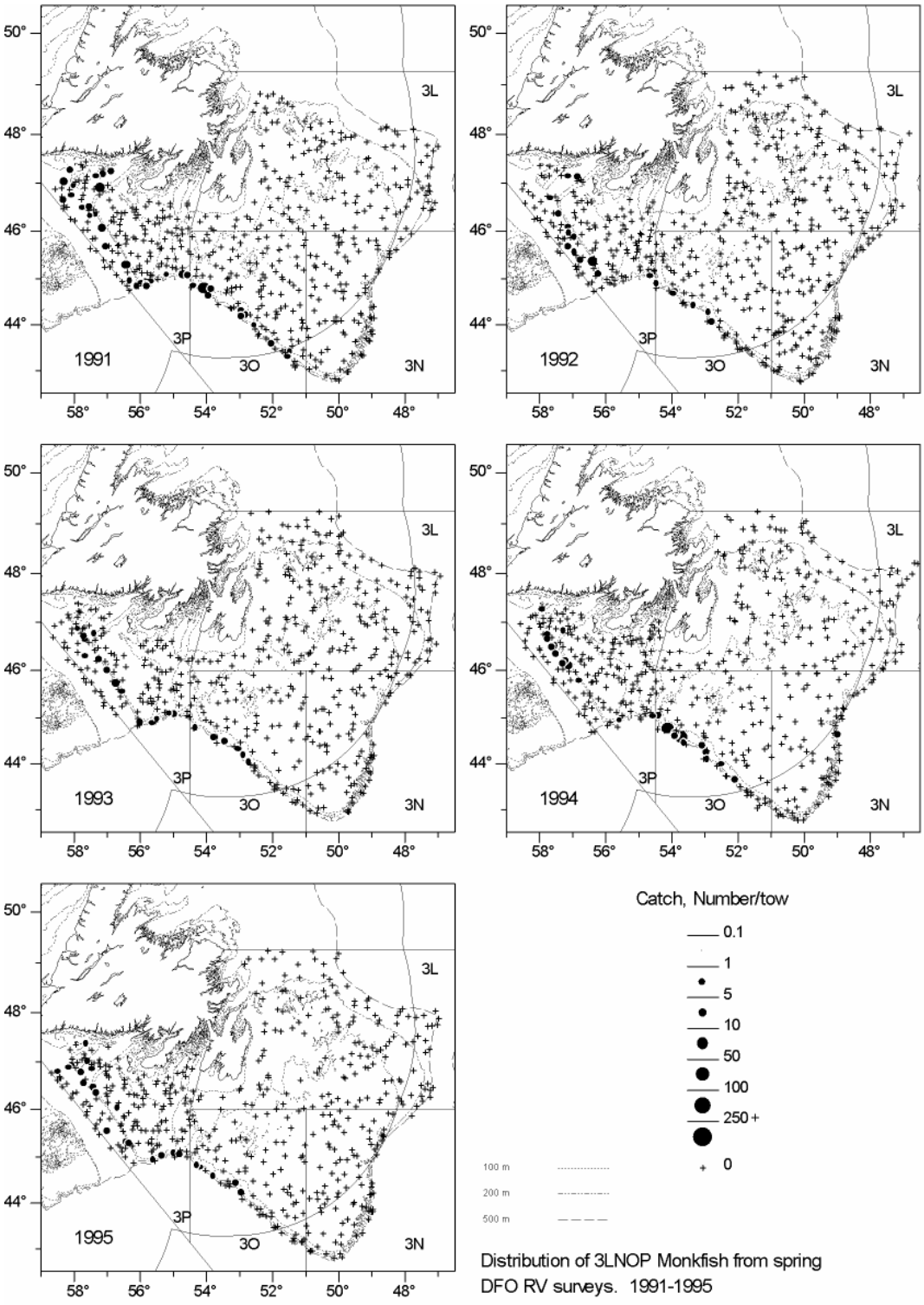


Figure 15b. Distribution of monkfish based on Canadian spring surveys, 1991-1995.

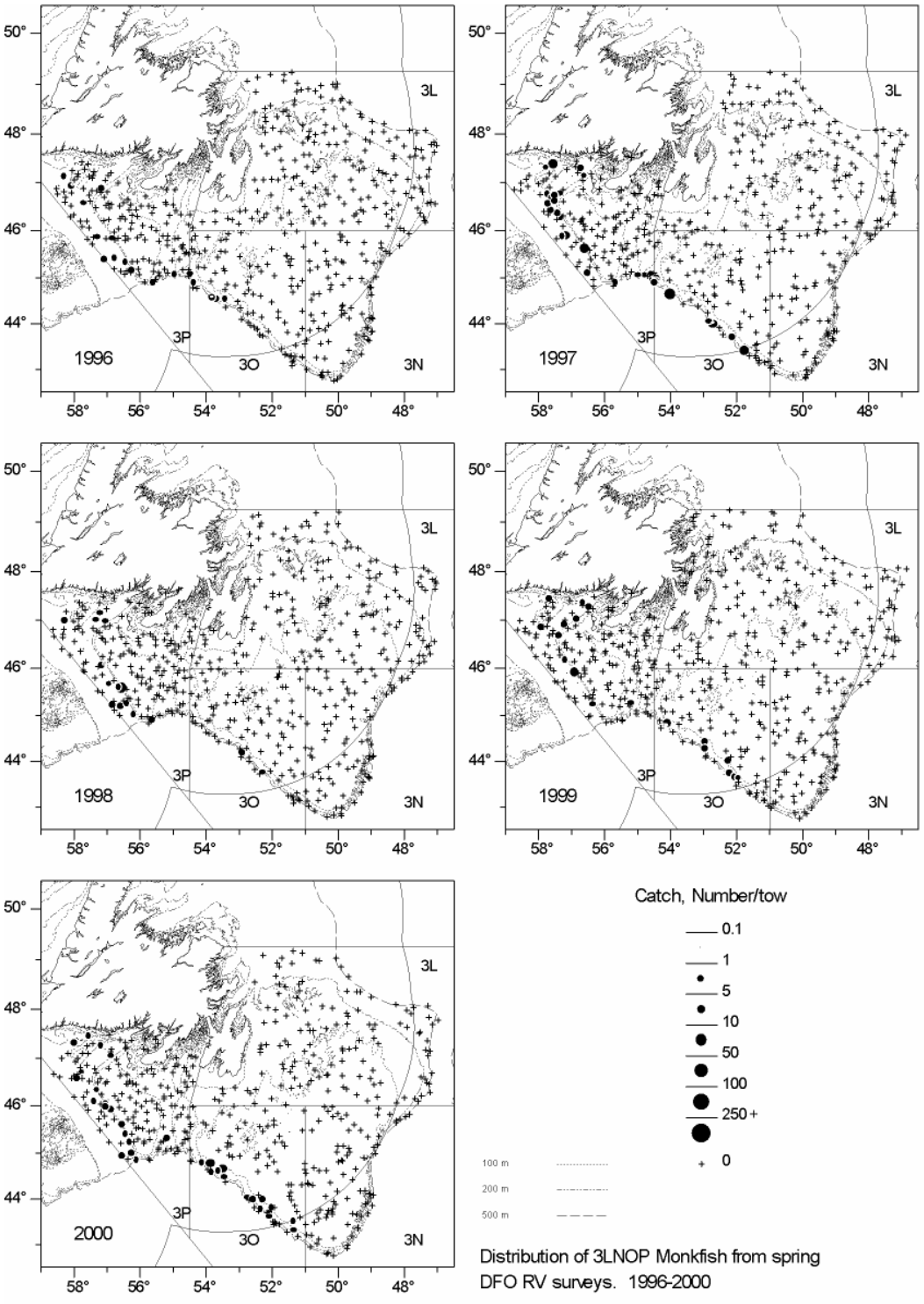


Figure 15c. Distribution of monkfish based on Canadian spring surveys, 1996-2000.

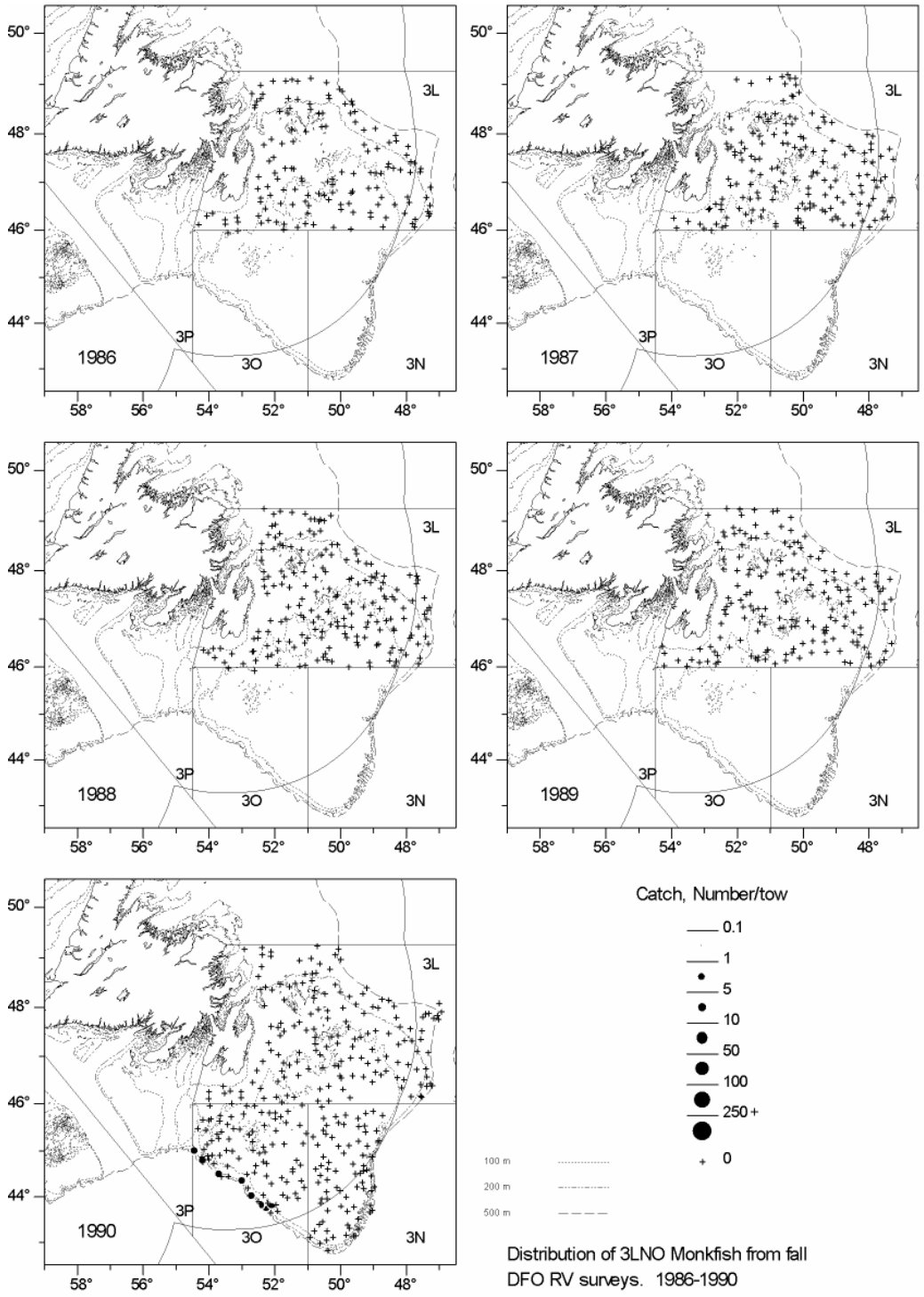


Figure 15d. Distribution of monkfish based on Canadian fall surveys, 1986-1990.

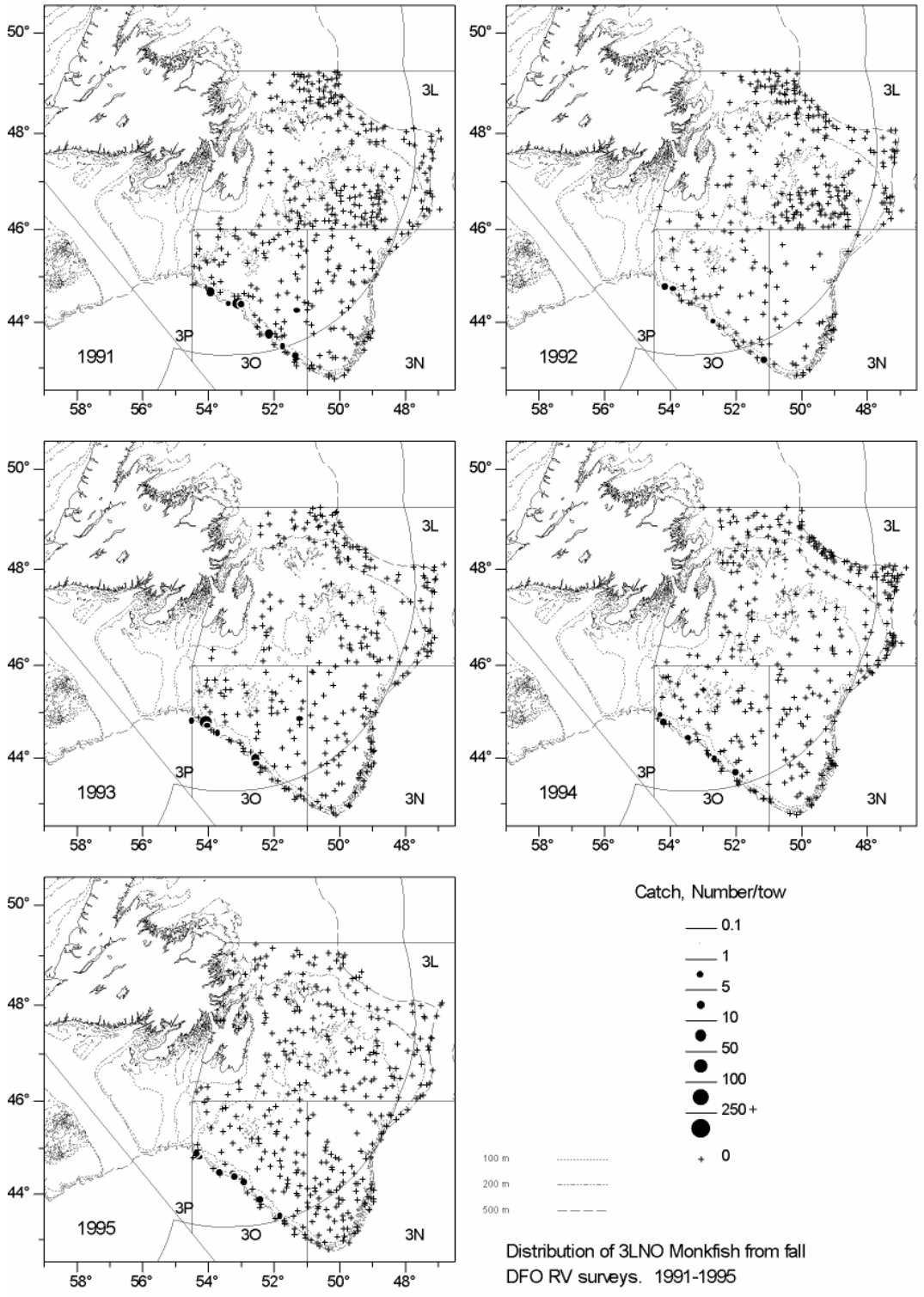


Figure 15e. Distribution of monkfish based on Canadian fall surveys, 1991-1995.

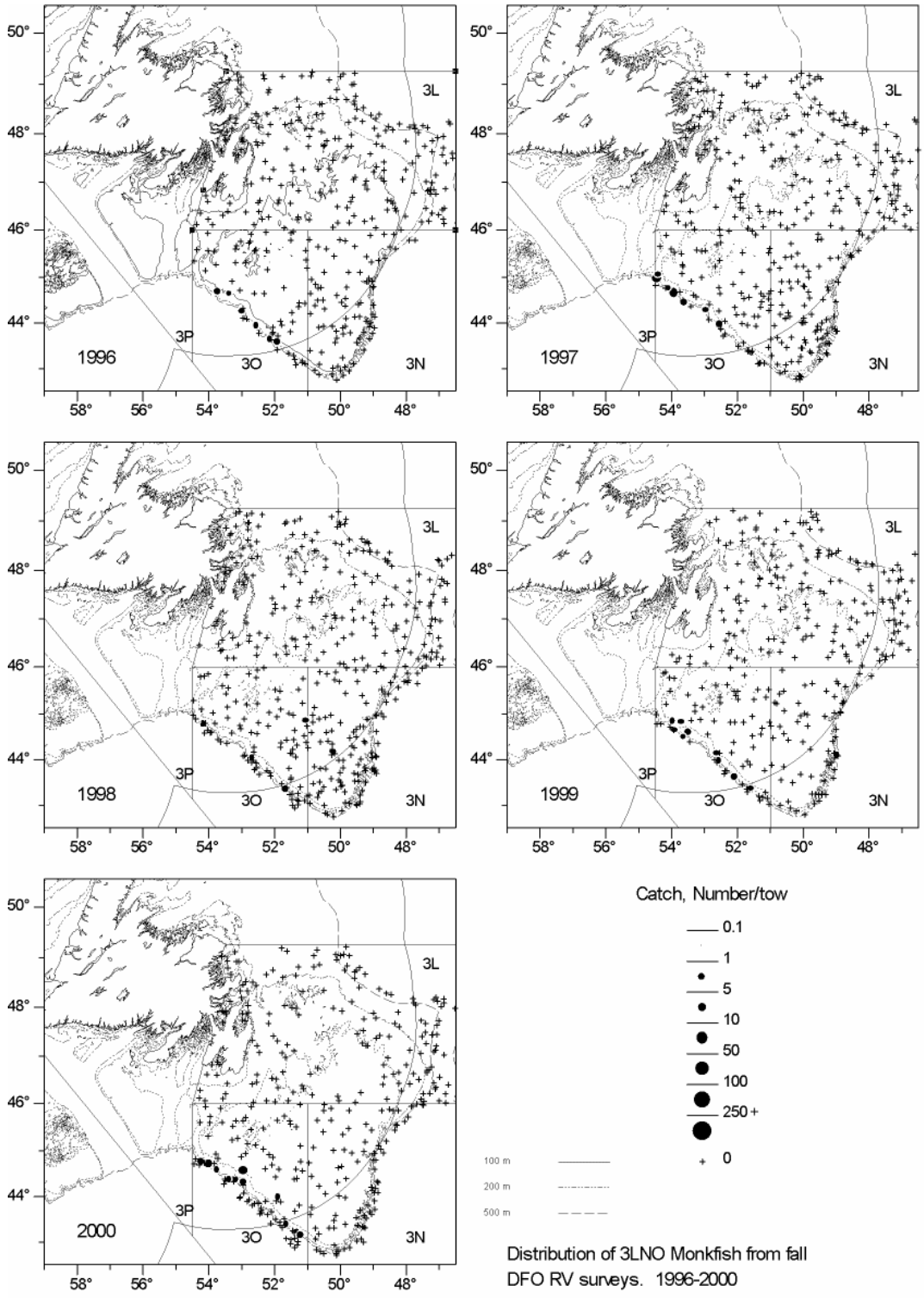


Figure 15f. Distribution of monkfish based on Canadian fall surveys, 1996-2000.

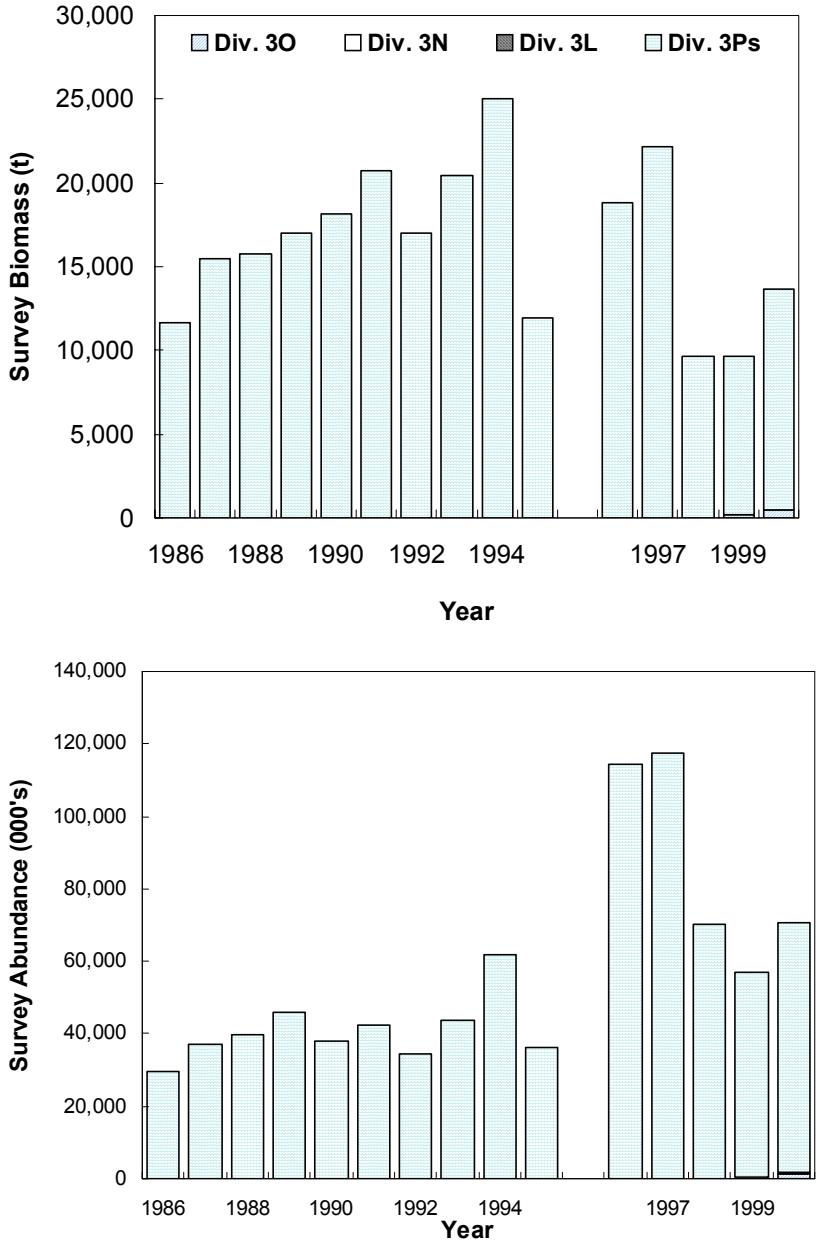


Figure 16a. Biomass and abundance estimates of black dogfish based on Canadian spring surveys, 1986-2000.

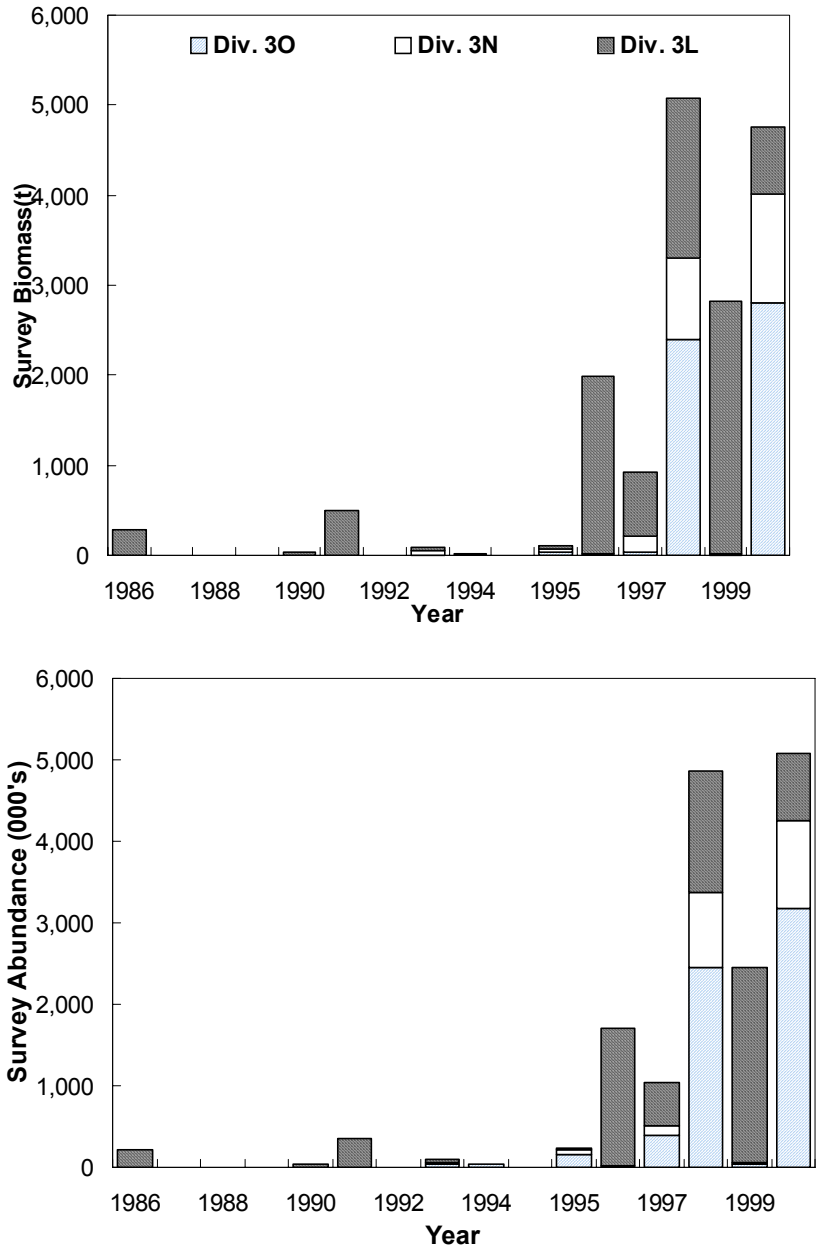


Figure 16b. Biomass and abundance estimates of black dogfish based on Canadian fall surveys, 1986-2000.

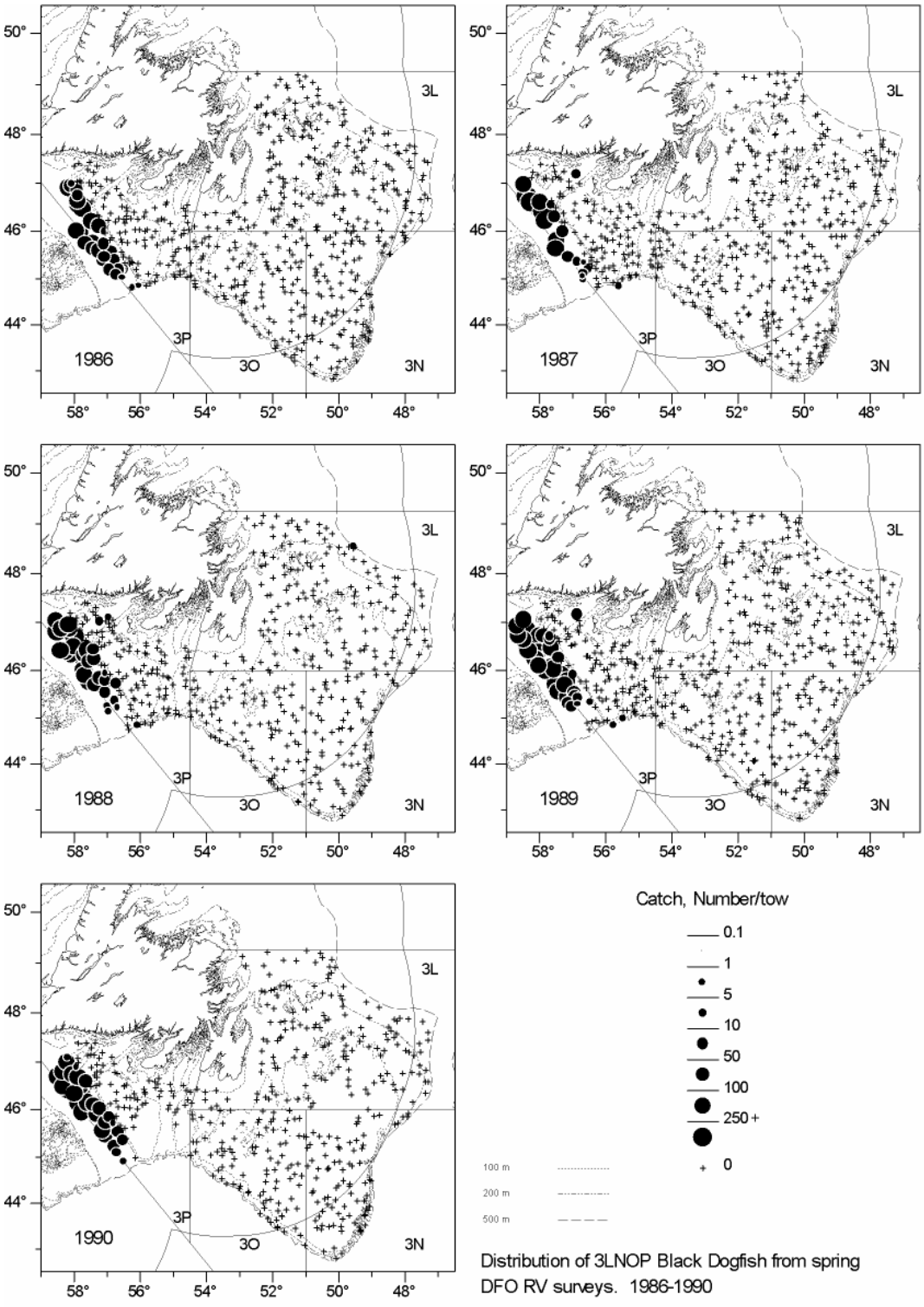


Figure 17a. Distribution of black dogfish based on Canadian spring surveys, 1986-1990.

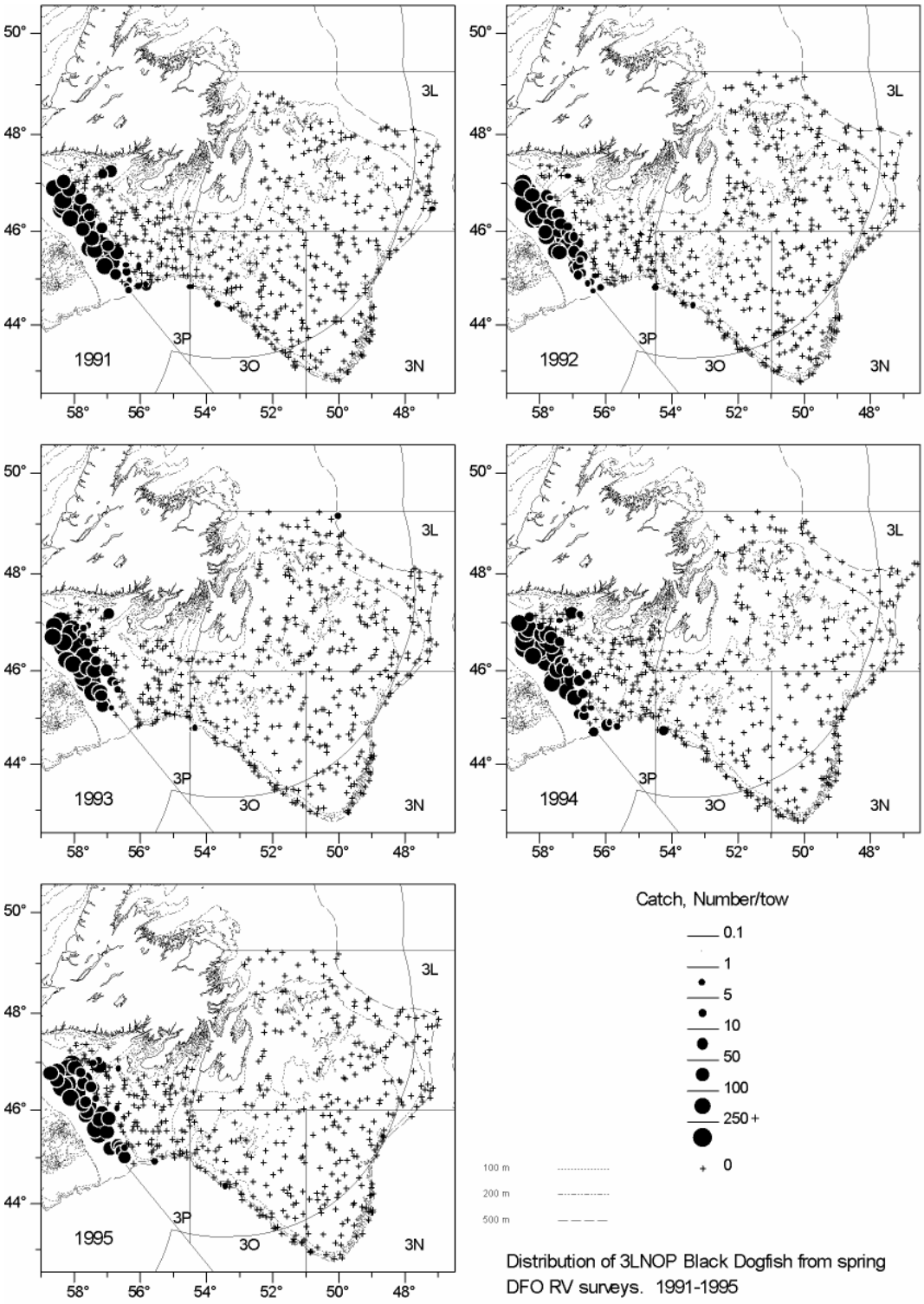


Figure 17b. Distribution of black dogfish based on Canadian spring surveys, 1991-1995.

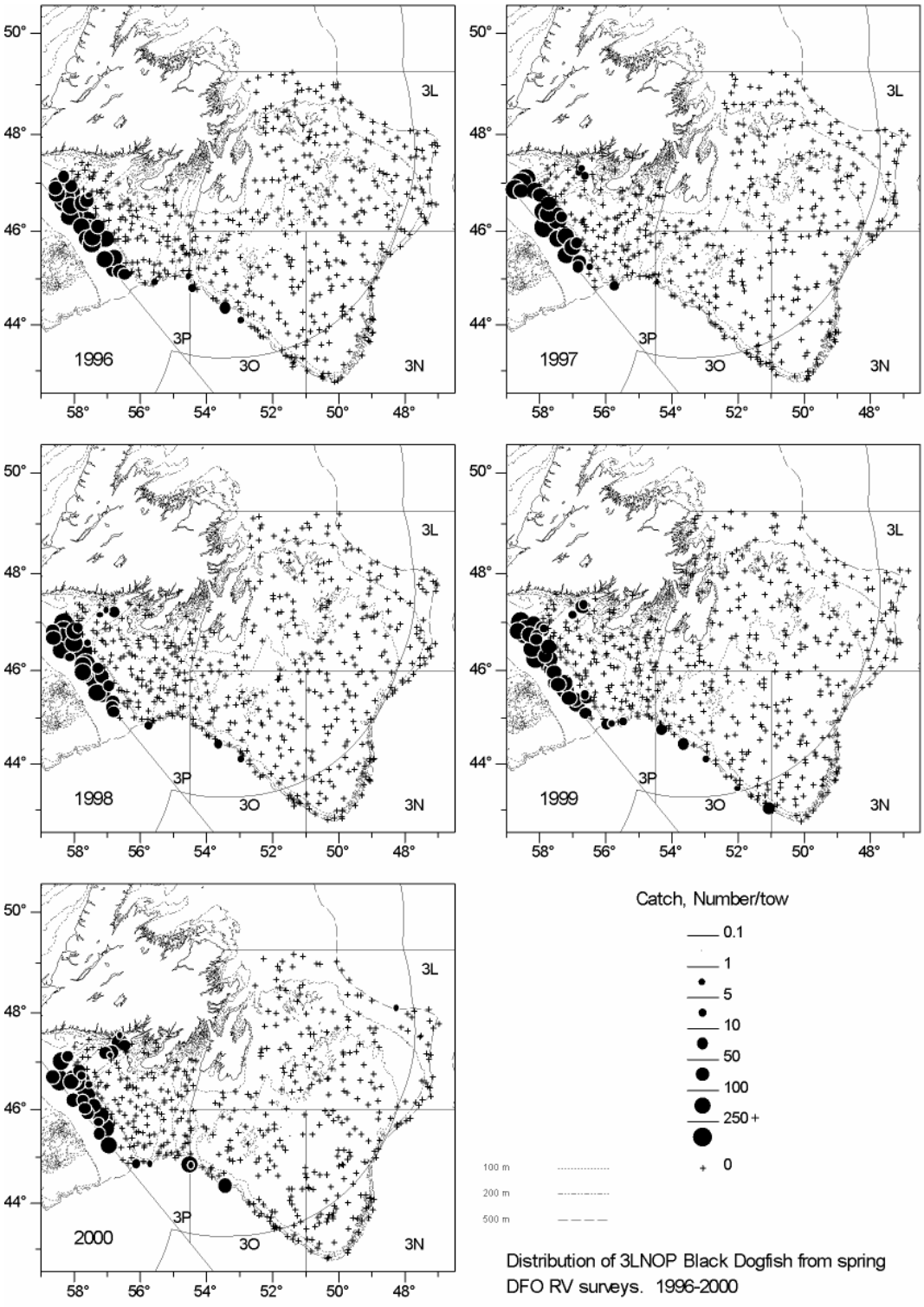


Figure 17c. Distribution of black dogfish based on Canadian spring surveys, 1996-2000.

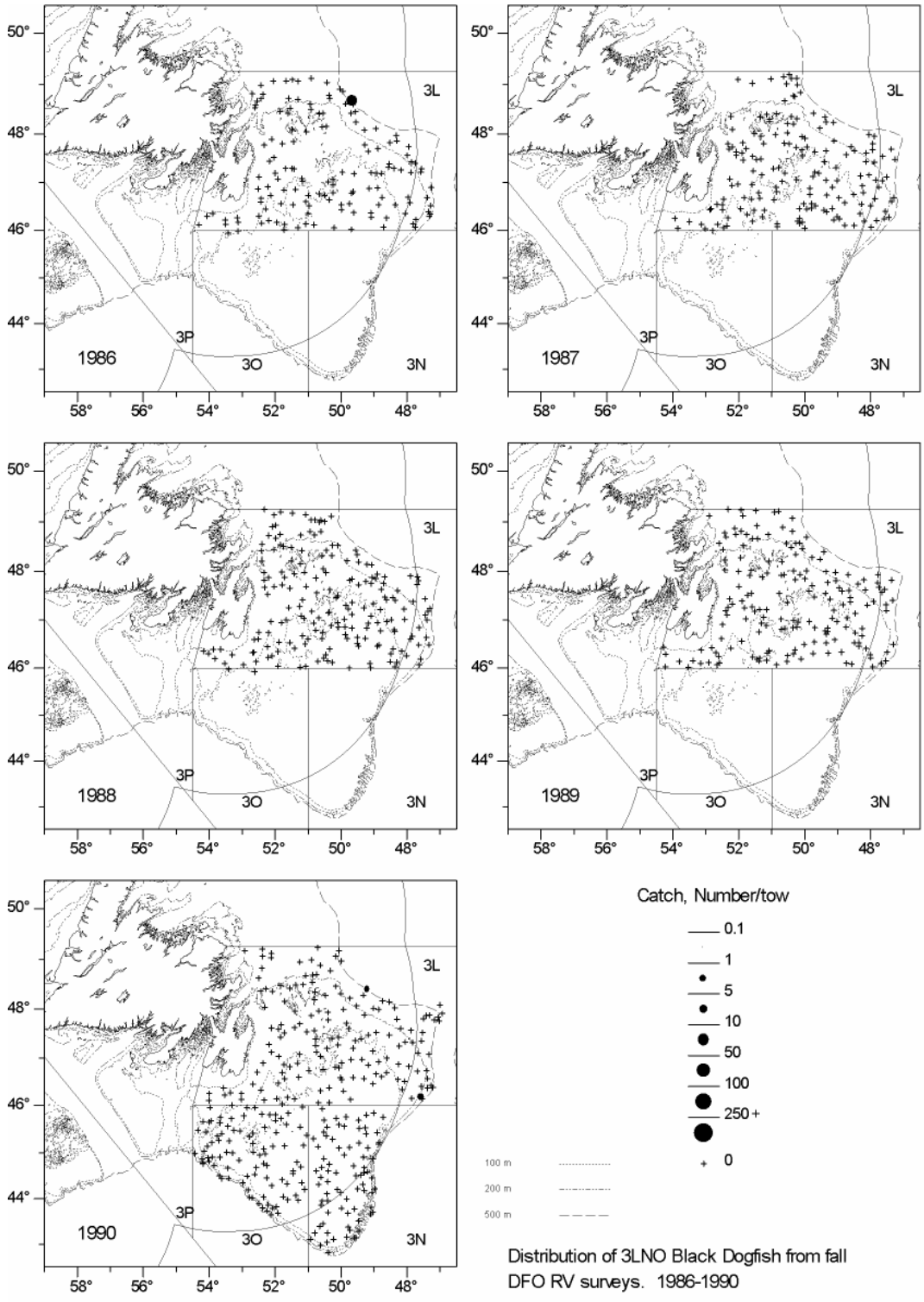


Figure 17d. Distribution of black dogfish based on Canadian fall surveys, 1986-1990.

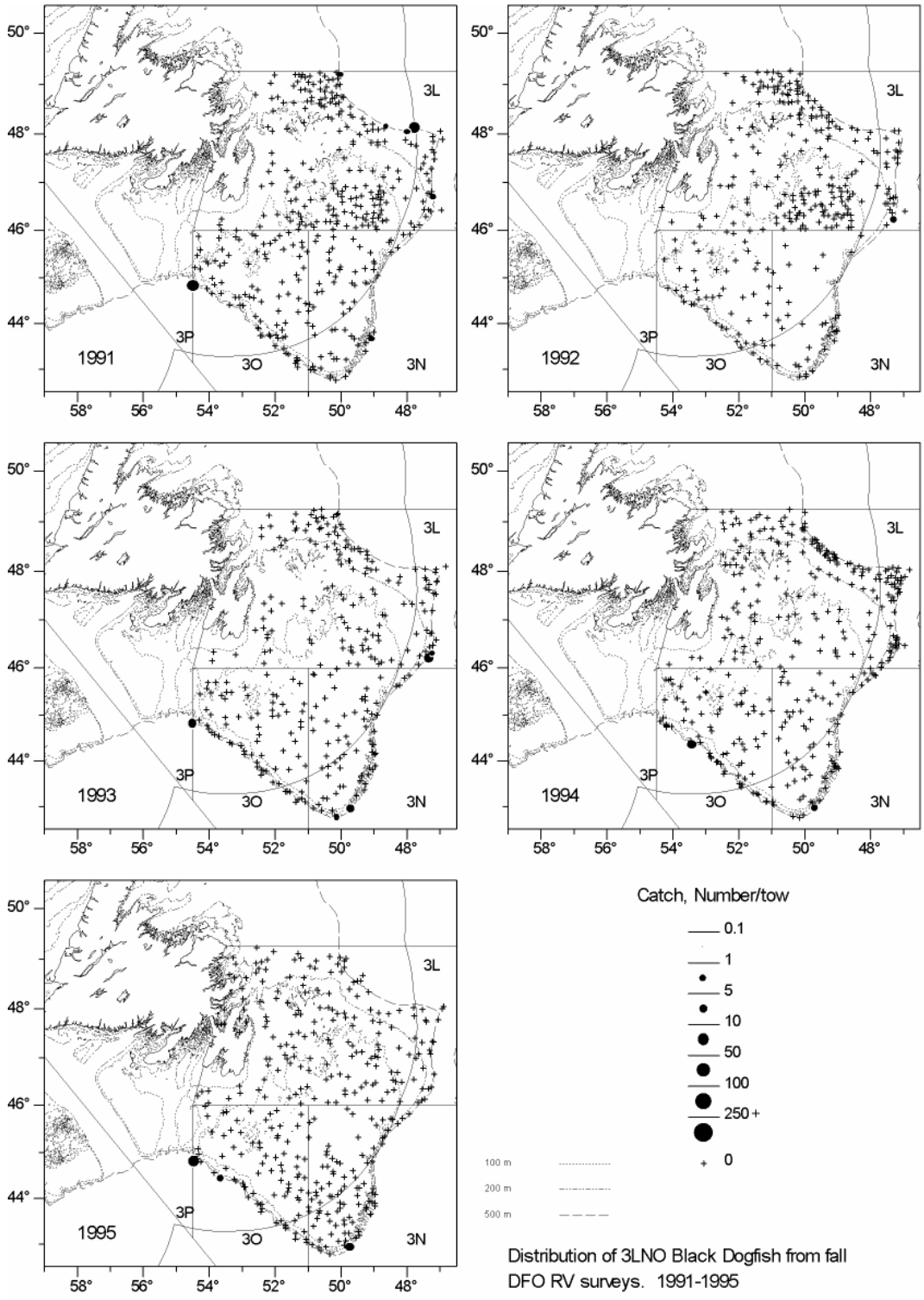


Figure 17e. Distribution of black dogfish based on Canadian fall surveys, 1991-1995.

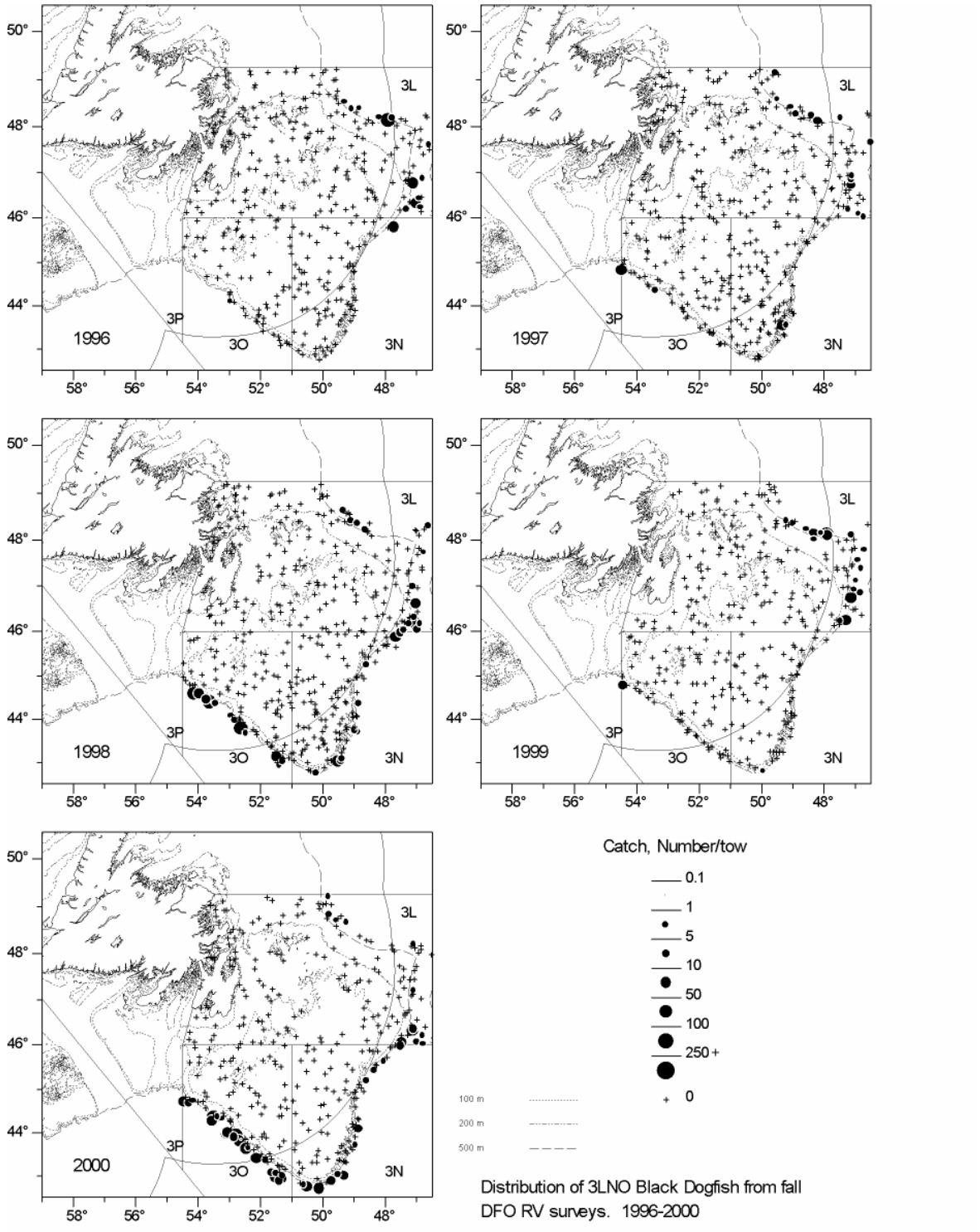


Figure 17f. Distribution of black dogfish based on Canadian fall surveys, 1996-2000.