Northwest Atlantic Fisheries Organization

Serial No. N5000 **NAFO SCR Doc. 04/47**

SCIENTIFIC COUNCIL MEETING – JUNE 2004

A Stock Status Update of American Plaice in NAFO Divisions 3LNO

by

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Abstract

Catches from this stock were generally in the range of 40,000 to 50,000 tons per year throughout the 1970's and 1980's, before declining to low levels in the early-1990's. There has been no directed fishing on this stock since 1993. The TACs in 1995 to 2004 have been set at 0. In 2003, catch estimates ranged from 6,855-10,599 tons (with a mean of 8,727 tons). As in recent years, catches in 2003 were mainly in the NAFO Regulatory Area (NRA) and as bycatch in the Canadian yellowtail flounder fishery. The Canadian spring surveys show a large decline in abundance and biomass from the mid to late-1980's with current biomass being only 22% of that of the mid-1980's. The fall survey has also shown large declines and the biomass is only 32% of that of 1990.

TAC regulation

This stock has been under TAC regulation since 1973 when a TAC of 60,000 tons was established. From 1973-87, the TAC varied from 47,000 tons to 60,000 tons (Table 1) but was lowered to 33,585 tons in 1988. Further reductions followed, bringing the TAC to 10,500 tons in 1993. In 1994, a TAC of 4,800 tons was implemented, but the Fisheries Commission of NAFO stated that no directed fisheries were to take place on this stock. The TAC has been set at 0 since then.

Catch trends

Catches increased from about 20,000 tons in the early-1960s to a peak of 94,000 tons in 1967, were relatively stable around 45,000-50,000 tons in 1973-82, then declined to 39,000 tons in 1984-85 (Table 1). Catches increased to 65,000 tons in 1986 and then declined rapidly thereafter, to about 7,400 tons in 1994. The catch declined following the moratorium in 1995, but has been steadily increasing 1997. Most of these catches occurred as by catch in the skate and Greenland halibut fisheries in the NRA. In 2003, the Canadian catch totalled about 1,607 t, most of which was taken as by catch in the yellowtail flounder fishery.

From 1977 to 1982, the catch was taken almost exclusively by Canadian vessels, but the catch by other nations increased rapidly from less than 2,000 tons in 1981-82 to over 30,000 tons in 1986 as new fisheries were developed in the Regulatory Area (Table 1 and Fig. 1). Considerable doubts have arisen about some nominal catches in the 1985 to 1994 period, resulting in various catch estimates being used. These include surveillance estimates, breakdowns of unspecified flounder catches by S. Korea prior to 1991 based on reported flounder catches, and any other estimates deemed by Scientific Council to be reliable. There is also some uncertainty regarding catches prior to 1973, when large amounts of unspecified flounder catches from some nations were broken down by species based on estimates of species composition. As well, estimates of discards are not available, and are believed to be substantial during some periods. In

2003, there was difficulty in determining catches: estimates ranged from 6,855-10,599 tons (with a mean of 8,727 tons) (Table 1).

Canadian Research Vessel Surveys

Spring

Stratified-random surveys have been carried out on the Grand Bank by Canadian research vessels in the spring (April to June period) of each year from 1971 to 2003, with the exception of 1983. The stratification scheme used is shown in Morgan *et al*. 2003. The data can be split into 3 time periods, based on the trawl used in each period: 1971-82 was Yankee 36, 1983-95 was Engel 145, and 1996-2002 was Campelen 1800 (see McCallum and Walsh (1996) for a description of the various trawls). Conversions exist for the first to second series (Gavaris and Brodie, 1984), and from the second to the third (Morgan *et al.*, 1998). However, data from the first series have not been converted to be comparable with the third series. Thus comparable data exist for 1971-95, and for 1984 to 2003. A full comparison between the Engel and Campelen data series is given in Brodie *et al.* (1998).

Abundance in the spring survey in Div. 3LNO combined decreased steadily from 1987 to 1992 and has fluctuated since 1996 with perhaps a slight increase over the period (Fig. 2). The spring survey abundance index in 2003 was 24% of the average level in the mid-1980's, about the same as in 2002.

Biomass for Div. 3LNO combined from the spring survey has shown the same trend as abundance (Fig. 3). Biomass in Div. 3LNO combined has increased somewhat since 1996 but is only 22% of that of the mid-1980's (Fig. 3). Biomass estimates for each Division by stratum and depth for 1996 to 2003 are given in Tables 3-5. In the spring survey in 2003 the biomass estimates for 3L, 3N and 3O were 26 000, 73 000 and 61 000 tons, respectively. From 1996 to 1998 the estimate for Div. 3N biomass was approximately half of the estimate for Div. 3O while from 1999 to 2003 the estimates in the two divisions are similar.

In Figures 4 and 5 the biomass index is shown as mean weight per tow. In Fig. 4 the index is presented for Div 3LNO combined and in Fig. 4 by Division. Overall the combined index shows the same trend as the swept area estimate of biomass with a large decline followed by a slight increase since 1996. As with the swept area estimate the average mean weight per tow in the last 3 years is 22% of the average of the mid-1980's. The decrease in mean weight per tow has been greatest in Div. 3L and this Division shows no signs of recovery (Fig. 5).

Mean number per tow for Div. 3LNO combined in spring surveys shows the same trend as mean weight per tow (Fig. 6). As with the biomass estimate, mean number per tow has shown the greatest decline in Div. 3L (Fig. 7).

Plots of distribution by weight for the spring surveys (Fig. 8 and 9) in 1995 to 2003 show that A. plaice are distributed throughout the Div. 3LNO area. The area of highest concentration is southern 3NO, particularly the southwest edge. Since 1999, the distribution of fish in Div. 3NO has been equally divided, and in some years there are large concentrations of American plaice on the tail of the Grand Bank (Fig. 8 and 9).

Fall

Stratified-random surveys have been conducted in Div. 3L in the fall from 1981 to 2003, usually in October-November. From 1990 to 2003, fall surveys were also carried out in Div. 3NO (though not in deep water in 2003). Surveys from 1983 to 1994 were done with the Engel trawl and starting in fall 1995, a Campelen 1800 trawl was used.

Abundance in the fall survey decreased steadily from 1990 to 1998 followed by a slight increase in 1999 and has remained stable since that time (Fig. 2). Biomass in the fall survey decreased from 1990 to 1995; however since 2000, biomass has been declining (Fig. 3). The fall survey abundance index in 2003 was 38% of the average level of 1990 and 1991 and the biomass index was 30% of that level.

The overall biomass for Div. 3LNO in the fall has shown a slight increasing trend since 1995 (Fig. 3). The biomass index remains well below that of 1990 with the average of the 2000 to 2003 indices representing only 32% of that of 1990. Biomass estimates by stratum and depth are given for each Division in Tables 6-8. Biomass estimates from the fall survey in 2003 were 27 000, 127 000 and 68 000 tons for Div. 3L, 3N and 3O respectively. The large

biomass estimates in Div. 3N in 2000 and 2003 are heavily influenced by a single large set in stratum 360. Biomass in Div. 3L has been fairly stable since 1995, but declined in 2000, and again in 2003. During 1995 to 1997, Div. 3N constituted on average 40% of the Div. 3NO total while from 2000 to 2003 it averaged about 70% of the Div. 3NO total.

The biomass index expressed as mean weight per tow for Div. 3LNO combined (Fig. 4) shows the same overall trend as swept area estimates of biomass. Mean weight per tow has shown the largest decline in Div. 3L and has been increasing since 1997 in Div. 3N (Fig. 10).

Mean numbers per tow show the same patterns (Fig. 6 and 11). The largest decline was once again in Div. 3L (Fig. 11).

Plots of distribution by weight (Fig. 12 and 13) for the fall surveys in 1995 to 2003 show that A. plaice are distributed throughout the Div. 3LNO area. However the area of highest concentration is southern 3NO, particularly the southern edge of Div. 3O and on the tail of the bank in 3N; the fall survey is similar to the spring survey in recent years.

Comparison of Spring and Fall Surveys

Both spring and fall surveys have shown similar trends in biomass and abundance over the 1990 to 2003 period (Fig. 2 and 3) as well as mean weight (Figs. 4, 5 and 10) and mean number per tow (Fig. 6, 7 and 11). Both surveys have shown the largest decline in Div. 3L. Distribution is also similar between the two surveys, with the majority of the fish being distributed in southern Div. 3NO.

EU-Spain Research Surveys

Surveys have been conducted annually from 1995 to 2003 by EU-Spain in the Regulatory Area in Div. 3NO to a maximum depth of 1,462 m (since 1998). Both the biomass and abundance indices from this survey peaked in 2000 and fluctuated since then, decreasing slightly (González Troncoso *et al*. 2004).

Projections

A deterministic projection was carried out, using the estimate of catch for 2003 (8,727 tons) and the same projection inputs of M, weights at age and PR from the 2003 assessment (Morgan *et al.*, 2003), along with population numbers estimated at the beginning of 2003. These are used to determine the effect of the 2003 catch on F and SSB during the year.

The F used in the 2003 assessment was 0.26, an average of the previous 3 years on age 13. At this level of F, the stock was projected not to recover to a B_{lim} of 50,000 tons. In this projection, F is estimated at 0.531, more than double the previous value. In addition, the SSB is projected to decrease from 20,000 tons-15,000 tons in one year.

Stock Status

There has been little change in the abundance or biomass of the stock from 2002 to 2003. Both spring and fall survey indices are only a fraction of their level at the beginning of the time series. The stock remains at a low level compared to historic values. The substantial increase in catch in 2003 is cause for concern and the stock will not recover at the projected level of F.

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Table 1. Nominal catches (t) of American plaice for NAFO Divisions 3LNO, 1960-2003 and TACs from 1973 to 2003.

	Country							
Year	Canada	USSR/Russia	EU-Spain	EU-Portugal	Other	Total	STACFIS[a]	TAC
1960	21,353	-	-	-	20	21,373		-
1961	14,897	-	-	-	1,476	16,373		-
1962	15,210	-	-	-	982	16,192		-
1963	24,591	466	-	-	662	25,719		-
1964	35,474	680	-	-	2,413	38,567		-
1965	45,365	4,544	-	-	3,352	53,261		-
1966	51,225	11,484	-	-	2,302	65,011		-
1967	54,190	35,139	-	-	5,084	94,413		-
1968	48,674	23,751	-	-	742	73,167		-
1969	64,815	14,493	-	-	129	79,437		-
1970	54,929	10,232	-	-	1,492	66,653		-
1971	49,394	17,173	438	-	883	67,888		-
1972	41,605	14,164	5	250	3,337	59,361		-
1973	38,586	12,516	-	-	1,741	52,843		60,000
1974	35,101	10,074	-	-	1,122	46,297		60,000
1975	34,015	7,682	-	429	1,095	43,221		60,000
1976	47,806	3,280	38	390	310	51,824		47,000
1977	42,579	1,023	234	41	104	43,981		47,000
1978	48,634	1,048	56	-	283	50,021		47,000
1979	47,131	1,190	92	33	122	48,568		47,000
1980	48,296	336	249	16	189	49,086		47,000
1981	48,177	847	861	34	239	50,158		55,000
1982	49,620	67	422	47	181	50,337		55,000
1983	35,907	170	1,599	-	44	37,720		55,000
1984	33,756	360	1,697	34	181	36,028		55,000
1985	40,024	81	5,498	27	2,388	48,018	54,212	49,000
1986	33,409	188	11,882	9,240	2,730	57,449	64,570	55,000
1987	33,967	47	14,476	2,516	2,451	53,457	55,012	48,000
1988	26,832	159	8,956	872	2,106	38,925	40,835	33,585[c]
1989	27,901	6	10,909	583	1,807	41,206	43,369	30,300
1990	22,600	17	294	356	739	24,006	32,501	24,900
1991	22,510	60	786	187	1,960	25,503	34,681	25,800
1992	9,663	50	412	139	606	10,870	13,350	25,800
1993[b]	7,454	8	199	92	163	7,916	17,122	10,500
1994	73	-	391	95	1	560	7,378	4,800[d]
1995	67	-	429	52	0	548	637	0
1996	49	-	555	260	11	875	913	0
1997	75	-	946	337	7	1,365	1,401	0
1998	227	-	993	314	26	1,560	1,618	0
1999	323	147	1,243	700	23	2,436	2,565	0
2000[e]	623	311	1,271	373	22	2,600	5,176	0
2001	1,618	243	659	471	7	2,998	5,739	0
2002	1,343	414	705	559	96	3,117	4,870	0
2003[e]	1,607	346	850	873	146	3,822	8,727	0

Values for countries back to 2000 are provisional.

[a] May include some catch estimated from surveillance reports or miscellaneous information. See text for details.

[b] Catch may have been as high as 19,400.

[c] Effective TAC.

d No directed fishing.

[e] STACFIS unable to determine precise estimates because of discrepancies between various sources. See text for range of values for 2003.

Table 2. Biomass estimates ('000t) of A.plaice, by stratum and depth zone (m), from Canadian spring surveys in Div. 3L in 1996-2003 (Campelen). (+) indicates biomass <50 t, (-) means stratum not surveyed.

		Biomass							
Depth	Stratum	1996	1997	1998	1999	2000	2001	2002	2003
30-56	784	-	-	0.2	+	-	+	0.0	-
	Total	-	-	0.2	+	-	+	0.0	-
57-92	350	0.6	0.3	0.3	6.1	1.8	0.4	0.2	0.7
	363	2.3	0.8	0.0	3.2	6.2	0.6	0.1	3.4
	371	0.9	0.2	0.1	2.4	0.9	0.1	+	0.2
	372	1.4	0.8	1.3	2.7	3.7	1.2	0.3	2.2
	384	0.7	0.9	0.2	0.8	1.2	0.3	0.4	0.3
	785	-	-	0.2	0.5	-	0.7	+	-
	Total	5.9	3.0	2.1	15.7	13.8	3.3	1.0	6.9
93-183	328	0.5	0.5	0.1	2.4	0.9	1.3	0.5	0.2
	341	1.8	0.5	0.7	4.5	0.8	1.5	0.2	0.6
	342	0.1	0.1	0.4	0.4	0.2	0.1	+	0.1
	343	0.3	0.0	+	0.6	0.2	+	+	0.1
	348	1.4	0.8	1.2	2.8	1.5	0.4	0.3	0.4
	349	0.8	0.3	0.2	4.4	1.3	0.5	0.3	0.6
	364	2	1.0	0.9	5.6	1.3	1.5	1.2	0.7
	365	1.1	0.5	0.9	1.4	1.2	0.3	0.6	0.6
	370	1.3	0.6	1.6	2.4	1.9	0.9	0.6	0.5
	385	5.6	0.9	0.5	2.5	1.9	1.4	0.7	0.4
	390	0.6	0.4	0.5	0.3	0.3	0.4	1.0	0.3
	786	-	-	0.3	0.5	-	0.4	-	-
	787	-	-	0.5	0.8	-	0.1	-	-
	788	-	-	-	0.3	-	-	-	-
	790	-	-	-	+	-	-	-	-
	793	-	-	-	+	-	-	-	-
	794	-	-	-	+	-	-	-	+
	797	-	-	-	+	-	-	-	+
	799	-	-	-	-	-	-	-	-
	Total	15.5	5.5	7.8	28.9	11.5	8.8	5.4	4.5
184-274	344	1	0.3	0.8	1.8	0.5	0.3	0.2	0.3
	347	0.6	0.2	0.6	0.6	0.2	0.4	0.1	0.5
	366	0.4	0.3	0.3	0.5	0.7	0.7	0.9	0.6
	369	0.3	0.2	0.2	1.2	0.7	0.9	0.8	0.4
	386	0.5	0.2	0.4	1.4	1.7	0.4	0.5	0.4
	389	0.4	0.2	0.4	0.6	0.8	0.8	0.3	0.4
	391	0.3	0.1	0.2	0.1	+	0.2	0.2	0.2
	789	-	-	-	0.5	-	-	-	+
	791*	-	-	-	0.3	-	-	-	-
	795	-	-	-	0.1	-	-	-	-
	798	-	-	-	0.1	-	-	-	+
	Total	3.5	1.5	2.9	7.2	4.6	3.7	3.0	2.8
275-366	345	0.5	0.2	0.3	1.5	0.5	0.7	0.7	0.2
	346	0.4	0.3	0.2	0.2	0.5	0.1	0.8	0.8
	368	0.3	0.0	0.1	0.3	0.4	0.2	0.2	0.2
	387	0.6	0.6	0.8	0.4	1.6	0.8	0.1	0.4
	388	0.6	0.2	0.2	0.8	0.3	0.4	0.1	0.1
	392	0.5	0.1	0.4	0.2	0.1	0.1	0.3	0.1
	792	-	-	-	+	-	0.1	-	0.1
	796	-	-	-	0.1	-	-	-	0.1
	800	-	-	-	0.2	-	-	-	-
	Total	2.9	1.4	2.0	3.7	3.4	2.4	2.2	1.8
367-549	729	0.2	0.6	2.2	0.1	1.3	1.1	1.3	1.2
	731	0.5	0.1	+	0.1	1.2	0.3	0.2	0.1
	733	0.7	0.0	0.3	1	0.1	2.3	0.5	2.1
	735	1.4	1.6	1.2	0.6	1.2	2.1	1.2	4.9
	Total	2.8	2.4	3.7	1.8	3.8	5.8	3.2	8.3
550-731	730	+	0.0	0.2	+	0.1	0.1	0.3	+
	732	+	0.0	0.0	+	0.3	3.4	0.6	0.6
	734	+	0.0	0.1	0	0	0.1	0.9	0.5
	736	+	0.1	0.0	+	+	+	0.5	0.1
	Total	0.1	0.1	0.3	+	0.4	3.6	2.3	1.2
732-914	737	-	-	-	-	-	-	-	-
	741	-	-	-	-	-	-	-	-
	745	-	-	-	-	-	-	-	-
	748	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-
915-1097	738	-	-	-	-	-	-	-	-
	742	-	-	-	-	-	-	-	-
	746	-	-	-	-	-	-	-	-
	749	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-
1098-1280	739	-	-	-	-	-	-	-	-
	743	-	-	-	-	-	-	-	-
	747	-	-	-	-	-	-	-	-
	750	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-
1281-1463	740	-	-	-	-	-	-	-	-
	744	-	-	-	-	-	-	-	-
	751	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-
Grand Total		30.7	13.8	19.0	57.3	37.5	27.6	17.1	25.4

* in 1996 had a depth range of 184-366

Table 3. Biomass estimates ('000t) of A.plaice, by stratum and depth zone (m), from Canadian spring surveys in Div. 3N in 1996-2003 (Campelen). (+) indicates biomass <50 t, (-) means stratum not

Biomass

Depth	Stratum	1996	1997	1998	1999	2000	2001	2002	2003
≤ 56	375	2.9	2.2	1.1	1.8	5.1	2.1	3.9	2.1
	376	0.8	1.8	2.0	3.2	5.1	9.3	8.6	9.6
	Total	3.7	4.0	3.1	5.0	10.2	11.4	12.5	11.8
57-92	360	8.8	8.6	7.9	27.4	22.8	50.3	28.0	29.6
	361	3.8	1.9	2.0	5.5	4.2	9.0	6.0	9.3
	362	2.8	5.5	4.0	4.6	6.6	7.0	2.7	4.7
	373	1.6	0.5	0.9	8.3	3.2	2.5	0.4	2.7
	374	1.1	0.4	0.3	1.7	0.9	1.0	0.6	3.2
	383	0.5	0.1	+	1.0	0.2	0.1	+	0.3
	Total	18.6	17.0	15.1	48.5	37.9	69.9	37.7	49.7
93-183	359	1.1	1.1	1.6	3.3	5.1	5.1	0.6	7.0
	377	0.2	0.1	+	0.2	+	0.9	0.1	0.2
	382	0.1	0.1	0.7	0.2	0.4	0.1	0.1	0.1
	Total	1.4	1.3	2.3	3.7	5.5	6.1	0.8	7.3
184-274	358	0.1	0.1	1.4	0.3	0.6	0.5	0.1	0.3
	378	0.1	0.2	0.2	0.9	+	0.1	0.1	0.5
	381	0.3	0.1	0.1	0.2	0.1	0.1	0.1	0.2
	Total	0.5	0.4	1.7	1.4	0.7	0.7	0.3	1.0
275-366	357	0.1	0.1	0.1	+	0.1	0.1	0.1	0.1
	379	+	0.1	0.1	0.1	0.1	0.1	0.1	0.3
	380	0.2	0.8	0.1	0.2	+	0.1	+	0.4
	Total	0.3	1.0	0.3	0.3	0.2	0.3	0.2	0.9
367-549	723	0.2	0.4	0.3	+	0.0	0.1	0.3	1.1
	725	0.1	0.5	0.2	+	0.4	0.1	+	0.3
	727	0.5	2.2	2.0	0.4	1.2	2.5	0.1	0.5
	Total	0.8	3.1	2.5	0.4	1.6	2.7	0.4	1.8
550-731	724	0.2	0.5	0.2	+	0.1	0.1	0.5	0.1
	726	+	0.1	+	+	0.1	+	+	+
	728	0.5	-	0.3	0.2	0.5	1.0	0.4	0.1
	Total	0.7	0.5	0.5	0.2	0.7	1.1	0.9	0.3
732-914	752	-	-	-	-	-	-	-	-
	756	-	-	-	-	-	-	-	-
	760	-	-	-	-	-	-	-	-
	Total			-	-	-	-	-	-
915-1097	753	-	-	-	-	-	-	-	-
	757	-	-	-	-	-	-	-	-
	761	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-
1098-1280	754	-	-	-	-	-	-	-	-
	758	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-
1281-1463	755	-	-	-	-	-	-	-	-
	759	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-
Grand Total		26.0	27.4	25.5	59.5	56.8	92.1	52.8	72.7

Table 4. Biomass estimates ('000t) of A.plaice, by stratum and depth zone (m), from Canadian spring surveys in Div. 3O in 1996-2003 (Campelen). (+) indicates biomass <50 t, (-) means stratum

		Biomass							
Depth	Stratum	1996	1997	1998	1999	2000	2001	2002	2003
57-92	330	3.8	0.8	6.9	3.5	5.9	4.2	2.1	1.3
	331	1.4	0.3	0.3	2.7	2.3	2.6	2.2	2.6
	338	6.0	5.7	6.0	4.0	2.3	6.0	3.1	5.0
	340	2.2	1.7	1.8	2.9	1.9	1.7	0.5	1.5
	351	2.9	4.4	3.8	4.6	3.4	6.5	3.2	2.4
	352	9.1	13.8	10.6	14.2	13.4	17.5	18.6	10.1
	353	7.8	8.3	10.9	21.5	21.1	20.6	14.8	25.2
	Total	33.2	34.9	40.3	53.4	50.3	59.1	44.5	48.0
93-183	329	1.6	1.4	4.4	4.7	3.9	1.9	1.4	1.8
	332	3.9	2.5	3.8	2.2	0.9	2.2	3.1	1.4
	337	4.6	1.9	3.2	2.7	1.5	1.2	1.4	1.4
	339	1.4	0.8	0.8	2.1	2.1	2.6	0.9	0.9
	354	1.6	1.1	5.0	9.0	1.3	1.6	6.4	5.3
	Total	13.1	7.8	17.2	20.7	9.7	9.5	13.2	10.9
184-274	333	+	0.3	0.1	0.1	+	+	0.3	+
	336	0.2	0.3	+	0.2	+	0.1	+	+
	355	0.5	0.3	0.1	0.1	0.1	0.4	0.4	0.6
	Total	0.7	0.9	0.2	0.4	0.1	0.5	0.7	0.6
275-366	334	0.2	0.8	0.0	0.1	+	+	0.2	0.2
	335	0.2	0.2	0.0	+	+	+	+	+
	356	0.1	+	+	0.1	+	+	+	0.4
	Total	0.5	1.0	+	0.2	+	+	0.2	0.5
367-549	717	0.2	1.7	+	0.1	0.0	+	0.4	0.2
	719	0.1	0.5	+	+	0.0	+	+	+
	721	0.2	0.1	+	0.1	+	0.2	+	0.1
	Total	0.5	2.2	+	0.2	+	0.2	0.4	0.3
550-731	718	+	0.1	+	+	0.0	+	+	0.3
	720	+	0.1	+	+	0.0	0.1	0.0	+
	722	1.0	4.2	0.0	0.2	0.1	0.2	0.1	0.2
	Total	1.0	4.4	+	0.2	0.1	0.2	0.1	0.2
732-914	764	-	-	-	-	-	-	-	-
	768	-	-	-	-	-	-	-	-
	772	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-
915-1097	765	-	-	-	-	-	-	-	-
	769	-	-	-	-	-	-	-	-
	773	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-
Grand Total		49.0	51.2	57.7	75.1	60.2	69.5	59.1	60.5

Table 5. Biomass estimates ('000t) of A.plaice, by stratum and depth zone (m), from Canadian fall surveys in Div. 3L in 1995-2003 (Campelen). (+) indicates biomass <50 t, (-) means stratum not surveyed.

		Biomass								
Depth	Stratum	1995	1996	1997	1998	1999	2000	2001	2002	2003
30-56	784	-	+	+	0.0	-	+	+	+	+
	Total	-	+	+	0.0	-	+	+	+	+
57-92	350	0.8	0.9	0.5	1.1	1.0	0.5	7.7	0.5	0.2
	363	3.1	2.0	1.4	2.1	1.9	2.3	3.7	0.7	0.3
	371	1.2	1.1	0.2	0.5	0.4	0.8	0.8	1.8	0.3
	372	1.4	1.6	1.5	0.3	1.7	0.6	2.5	0.9	1.1
	384	1.6	1.6	0.5	0.2	1.5	0.1	1.3	2.2	0.1
	785	-	+	+	+	-	+	0.1	0.1	0.1
	Total	8.1	7.2	4.0	4.2	6.5	4.3	16.1	6.2	2.2
93-183	328	3.0	1.6	0.9	0.5	2.0	0.8	1.6	7.3	0.7
	341	1.6	2.8	0.8	2.1	0.6	0.7	0.9	0.8	0.4
	342	0.6	+	0.4	0.2	-	0.2	0.1	0.1	0.2
	343	0.7	0.1	0.0	0.1	-	+	0.1	0.1	0.1
	348	3.1	1.8	1.3	1.5	1.4	0.4	0.6	1.0	0.6
	349	3.4	1.4	1.5	0.8	0.4	0.3	0.6	0.1	0.7
	364	2.8	3.6	2.8	5.2	1.2	1.8	2.9	2.1	1.0
	365	1.7	1.1	1.0	1.4	1.0	-	0.4	0.6	0.5
	370	2.0	6.3	1.3	4.6	3.9	1.1	2.2	3.7	0.8
	385	3.9	7.6	1.9	4.0	2.9	0.8	3.5	5.4	3.3
	390	1.7	1.6	2.2	3.3	2.1	0.7	3.1	1.0	0.5
	786	-	0.3	0.1	0.1	-	0.1	0.2	0.1	0.1
	787	-	0.4	0.5	0.1	-	0.1	0.1	0.1	0.1
	788	-	0.3	0.3	0.1	-	0.1	+	0.3	+
	790	-	0.2	0.2	+	-	+	+	+	+
	793	-	0.1	0.1	0.1	-	+	0.1	+	+
	794	-	+	0.1	+	-	-	+	+	+
	797	-	0.1	0.1	+	-	+	+	0.1	+
	799	-	0.1	0.1	+	-	+	+	0.4	+
	Total	24.5	29.4	15.6	24.1	15.5	7.1	16.4	23.2	9.1
184-274	344	1.0	1.1	0.1	0.5	0.5	0.4	0.6	0.7	0.3
	347	1.8	0.7	0.3	0.8	0.5	0.4	0.4	0.7	0.2
	366	1.6	1.2	0.5	0.8	1.7	0.5	0.3	0.4	0.7
	369	1.0	1.6	0.5	1.8	1.6	0.8	2.7	1.1	0.3
	386	1.8	2.6	1.0	0.9	1.2	0.4	1.3	2.3	0.9
	389	0.6	0.6	0.6	0.7	0.6	0.4	1.4	0.4	0.6
	391	0.4	0.2	0.2	0.2	0.3	+	0.1	0.1	0.4
	789	-	0.2	0.2	0.1	-	0.1	0.2	0.1	+
	791*	-	0.5	0.4	0.1	-	0.3	0.3	0.7	+
	795	-	+	0.2	0.4	-	+	+	0.1	0.2
	798	-	0.2	0.7	0.3	-	+	0.2	+	+
	Total	8.2	8.9	4.6	6.6	6.4	3.3	7.5	6.6	3.6
275-366	345	4.1	2.4	0.8	2.5	1.3	0.6	0.8	1.3	0.6
	346	2.8	1.1	2.2	1.7	1.7	0.4	0.9	0.8	0.5
	368	0.2	0.3	0.2	0.4	0.7	0.6	0.3	0.5	0.1
	387	0.4	0.7	0.7	0.2	1.8	1.0	0.4	0.2	0.5
	388	0.3	0.1	0.4	+	0.9	0.4	0.1	0.1	0.1
	392	+	+	0.2	0.1	0.5	0.2	0.1	0.1	0.1
	796	-	0.6	0.9	0.4	-	-	0.2	0.1	0.1
	800	-	-	-	0.2	-	0.2	0.3	0.3	0.2
	Total	7.8	5.2	5.5	5.5	6.9	3.4	3.1	3.4	2.2
367-549	729	+	+	0.2	0.1	0.7	1.6	0.4	+	0.1
	731	0.2	-	0.6	0.1	1.0	1.1	0.1	+	0.1
	733	0.2	0.2	0.5	0.6	0.3	1.0	0.6	0.3	0.4
	735	0.7	0.7	0.3	0.8	1.9	2.1	1.6	1.1	0.1
	792	-	0.2	1.9	0.3	-	0.2	0.6	0.1	0.2
	Total	1.1	1.1	3.6	1.9	3.9	6.0	3.3	1.5	0.9
550-731	730	+	0.0	0.5	0.1	0.2	0.4	0.9	0.1	+
	732	+	+	1.3	0.2	1.9	0.7	1.3	+	+
	734	0.0	0.2	0.3	0.1	0.1	0.1	+	+	0.0
	736	0.2	0.5	0.8	0.6	0.6	1.5	1.3	1.7	0.3
	Total	0.2	0.7	2.8	1.0	2.8	2.7	3.5	1.8	0.3
732-914	737	0.4	1.5	1.8	3.3	0.8	0.7	1.4	1.0	1.1
	741	-	1.0	2.3	1.7	0.1	0.0	0.0	0.6	0.1
	745	-	0.1	2.2	0.1	0.7	0.0	0.0	0.0	0.3
	748	-	1.4	0.7	0.0	1.1	0.0	0.0	+	1.1
	Total	0.4	4.0	7.0	5.1	2.7	0.7	1.4	1.6	2.6
915-1097	738	0.6	0.2	0.0	0.0	0.0	0.0	+	+	2.2
	742	-	0.1	0.0	0.0	+	0.0	0.0	0.0	3.5
	746	-	0.1	0.0	+	0.0	0.0	0.0	0.0	0.0
	749	-	+	0.2	0.0	-	0.0	0.0	0.0	+
	Total	0.6	0.4	0.2	+	+	0.0	+	+	5.7
1098-1280	739	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	743	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	747	-	0.0	0.0	0.1	+	0.0	0.0	0.0	0.0
	750	-	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	-	0.1	0.0	0.1	+	0.0	0.0	0.0	0.0
1281-1463	740	-	0.0	0.0	0.0	0.1	0.0	0.0	0.0	+
	744	-	0.5	0.0	0.1	-	0.0	0.0	0.0	0.0
	751	-	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0
	Total	-	0.5	0.0	0.1	0.1	0.0	0.0	0.0	+
Grand Total		50.9	57.5	43.3	48.6	44.8	27.5	51.3	44.3	26.4

* in 1996 stratum 791 covered a depth range of 184-366 m

Table 6. Biomass estimates ('000t) of A.plaice, by stratum and depth zone (m), from Canadian fall surveys in Div. 3N in 1995-2003 (Campelen). (+) indicates biomass <50 t, (-) means stratum not surveyed.

		Biomass								
Depth	Stratum	1995	1996	1997	1998	1999	2000	2001	2002	2003
< 56	375	1.9	1.1	3.9	5.2	0.6	1.7	0.6	9.8	2.3
	376	4.7	2.4	7.7	4.4	4.3	35.8	15.4	34.1	6.4
	Total	6.6	3.5	11.6	9.6	4.9	37.5	16.0	43.9	8.7
57-92	360	22.3	7.4	28.4	39.2	43.4	96.4	46.0	67.4	99.9
	361	3.5	4.1	3.3	2.1	1.8	3.9	2.3	9.2	3.1
	362	5.0	1.1	5.1	2.9	2.9	2.6	5.3	6.1	2.6
	373	1.8	0.2	2.3	1.7	4.2	1.7	6.9	2.9	1.9
	374	2.4	0.4	1.8	1.3	2.7	1.7	3.7	0.5	0.6
	383	-	0.3	0.5	0.8	0.8	+	0.5	0.5	0.1
	Total	35.0	13.5	41.4	48.0	55.8	106.3	64.7	86.6	108.2
93-183	359	2.2	0.3	3.8	11.6	9.8	32.2	4.0	17.5	7.1
	377	0.5	0.4	2.3	1.1	0.9	0.7	3.0	6.1	1.9
	382	0.3	0.3	0.8	6.1	2.7	1.0	3.5	2.2	0.0
	Total	3.0	1.0	6.9	18.8	13.4	33.9	10.5	25.8	9.0
184-274	358	0.8	0.2	0.4	0.3	0.3	0.6	1.0	0.2	0.0
	378	0.1	0.2	0.1	0.1	0.4	0.2	0.1	0.4	0.5
	381	0.1	0.4	0.2	0.1	0.3	0.3	0.3	0.1	0.5
	Total	1.0	0.8	0.7	0.5	1.0	1.1	1.4	0.7	1.0
275-366	357	0.1	0.1	0.0	+	-	+	+	+	0.0
	379	+	0.2	0.1	+	0.3	+	0.1	+	0.0
	380	0.1	0.2	0.1	0.1	0.7	0.3	0.1	+	0.1
	Total	0.2	0.5	0.2	0.1	1.0	0.3	0.2	+	0.1
367-549	723	+	+	0.0	0.1	+	+	+	0.0	0.0
	725	0.1	0.1	0.0	+	0.1	0.2	+	0.0	0.0
	727	+	0.1	0.1	0.1	1.5	0.4	0.1	0.3	0.3
	Total	0.1	0.2	0.2	0.2	1.6	0.6	0.1	0.3	0.3
550-731	724	0.1	0.3	0.0	0.0	0.1	0.0	0.0	0.0	-
	726	+	0.3	0.1	+	+	+	+	0.0	0.0
	728	+	0.8	0.1	0.1	0.3	0.6	+	0.1	0.0
	Total	0.1	1.4	0.2	0.1	0.4	0.6	+	0.1	0.0
732-914	752	-	-	-	1.5	-	0.0	0.0	0.0	-
	756	-	-	-	0.1	-	-	0.0	0.0	-
	760	-	-	-	0.0	-	-	0.0	0.0	-
	Total				0.0	-	0.0	0.0	0.0	-
915-1097	753	-	-	-	+	-	0.0	0.0	0.0	-
	757	-	-	-	0.0	-	-	0.0	0.0	-
	761	-	-	-	0.0	-	-	0.0	0.0	-
	Total	-	-	-	+	-	0.0	0.0	0.0	-
1098-1280	754	-	-	-	0.0	-	0.0	0.0	0.0	-
	758	-	-	-	0.0	-	0.0	0.0	0.0	-
	762	-	-	-	-	-	-	0.0	0.0	-
	Total	-	-	-	0.0	-	0.0	0.0	0.0	-
1281-1463	755	-	-	-	0.0	-	0.0	0.0	0.0	-
	759	-	-	-	0.0	-	-	0.0	0.0	-
	763	-	-	-	-	-	-	0.0	0.0	-
	Total	-	-	-	0.0	-	0.0	0.0	0.0	-
Grand Total		46.0	20.9	61.0	77.3	78.1	180.3	92.9	157.4	127.4

Table 7. Biomass estimates ('000t) of A.plaice, by stratum and depth zone (m), from Canadian fall surveys in Div. 3O in 1995-2003 (Campelen). (+) indicates biomass <50 t, (-) means stratum not surveyed.

Biomass

Depth	Stratum	1995	1996	1997	1998	1999	2000	2001	2002	2003
57-92	330	7.7	0.8	5.5	5.9	5.4	5.3	5.9	4.5	4.0
	331	1.2	0.3	0.9	1.8	1.0	1.0	1.1	1.2	1.5
	338	6.6	3.3	6.4	3.4	3.8	2.1	4.4		6.7
	340	7.2	0.4	3.2	1.1	2.8	2.2	1.7	3.7	0.9
	351	1.7	0.9	5.2	3.3	2.9	6.4	4.3	2.9	3.7
	352	4.6	9.1	6.9	8.4	3.2	8.4	8.0	6.7	7.7
	353	5.6	14.4	14.8	19.3	10.3	14.5	13.9	11.2	14.4
	Total	34.6	29.2	42.9	43.2	29.4	39.9	39.3	30.2	38.8
93-183	329	3.2	1.5	2.7	5.0	6.6	8.0	7.6	3.7	1.6
	332	3.5	3.9	1.6	3.9	1.9	2.8	1.3	2.5	3.0
	337	2.4	25.3	2.5	1.5	1.4	1.8	0.5	1.3	0.6
	339	6.5	0.9	5.1	1.4	-	3.8	2.4	3.2	3.3
	354	4.5	8.0	2.4	3.7	27.0	3.8	2.7	3.0	21.1
	Total	20.1	39.6	14.4	15.5	36.9	20.2	14.5	13.7	29.6
184-274	333	+	-	+	+	0.1	+	0.0	0.1	+
	336	+	0.1	0.1	+	0.1	0.1	+	0.1	+
	355	0.2	5.4	0.1	+	0.3	+	0.1	0.1	+
	Total	0.2	5.5	0.2	+	0.5	0.1	0.1	0.3	0.0
275-366	334	0.0	-	+	+	+	0.0	0.0	0.0	0.0
	335	+	+	+	+	+	+	+	+	+
	356	0.0	0.1	+	+	+	+	0.0	0.0	+
	Total	+	0.1	0.1	+	0.1	0.0	0.0	0.0	0.0
367-549	717	0.0	-	+	0.0	+	+	+	0.0	0.0
	719	+	0.2	0.0	+	+	+	0.0	0.0	+
	721	+	0.6	0.0	0.0	+	+	0.0	0.0	0.0
	Total	+	0.8	+	+	+	+	0.0	0.0	0.0
550-731	718	0.0	-	0.0	+	0.0	0.0	0.0	0.0	0.0
	720	0.0	+	-	+	+	+	0.0	0.0	0.0
	722	0.0	+	0.0	0.0	+	0.0	0.0	0.0	0.0
	Total	0.0	+	0.0	+	+	+	0.0	0.0	0.0
732-914	764	-	-	-	0.0	-	-	0.0	0.0	-
	768	-	-	-	0.0	-	-	0.0	0.0	-
	772	-	-	-	0.0	-	-	-	0.0	0.0
	Total	-	-	-	0.0	-	-	0.0	0.0	0.0
915-1097	765	-	-	-	0.0	-	-	0.0	0.0	-
	769	-	-	-	0.0	-	-	0.0	0.0	-
	773	-	-	-	0.0	-	-	0.0	0.0	0.0
	Total	-	-	-	0.0	-	-	0.0	0.0	0.0
1098-1280	766	-	-	-	-	-	0.0	0.0	0.0	-
	770	-	-	-	-	-	0.0	0.0	0.0	-
	774	-	-	-	-	-	0.0	0.0	0.0	0.0
	Total	-	-	-	-	-	0.0	0.0	0.0	0.0
1281-1463	767	-	-	-	-	-	0.0	0.0	0.0	-
	771	-	-	-	-	-	0.0	0.0	0.0	-
	775	-	-	-	-	-	0.0	0.0	0.0	0.0
	Total	-	-	-	-	-	0.0	0.0	0.0	0.0
Grand Total		54.9	75.2	57.5	58.7	66.9	60.2	53.9	44.2	68.4

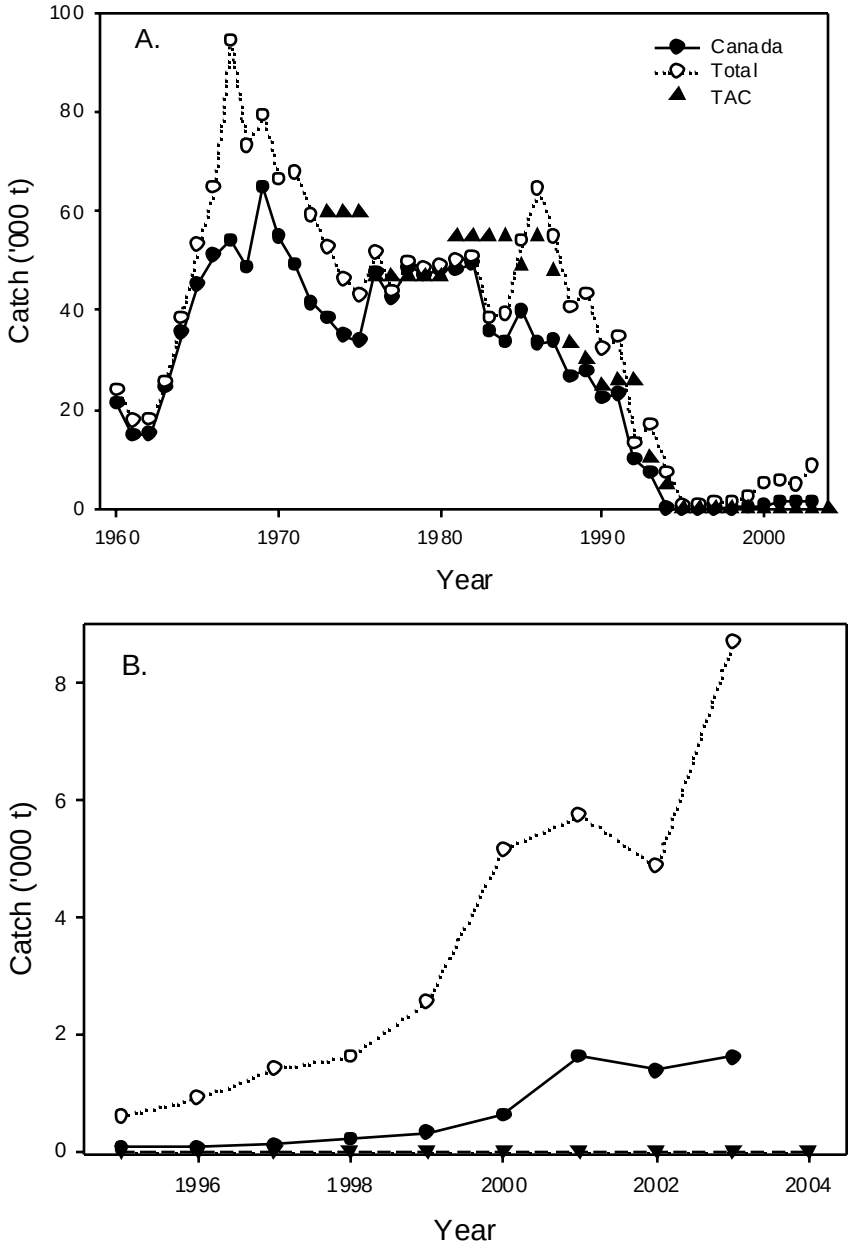


Fig. 1. American plaice catches ('000 tons) from 1960-2003 (A) and since the moratorium (1995-2003) (B).

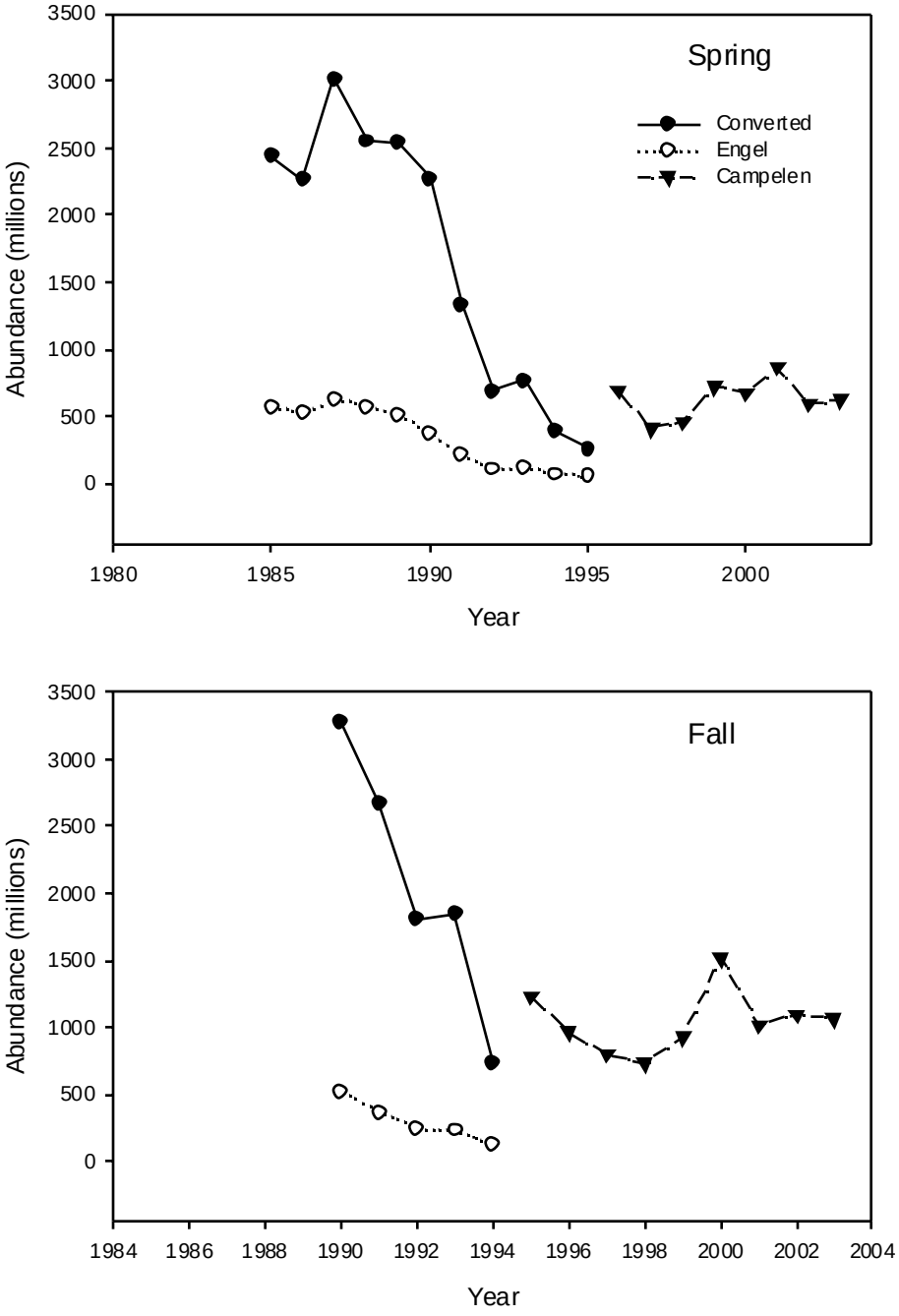


Figure 2. Abundance (millions) of American plaice from spring and fall Canadian surveys in Div. 3LNO combined.

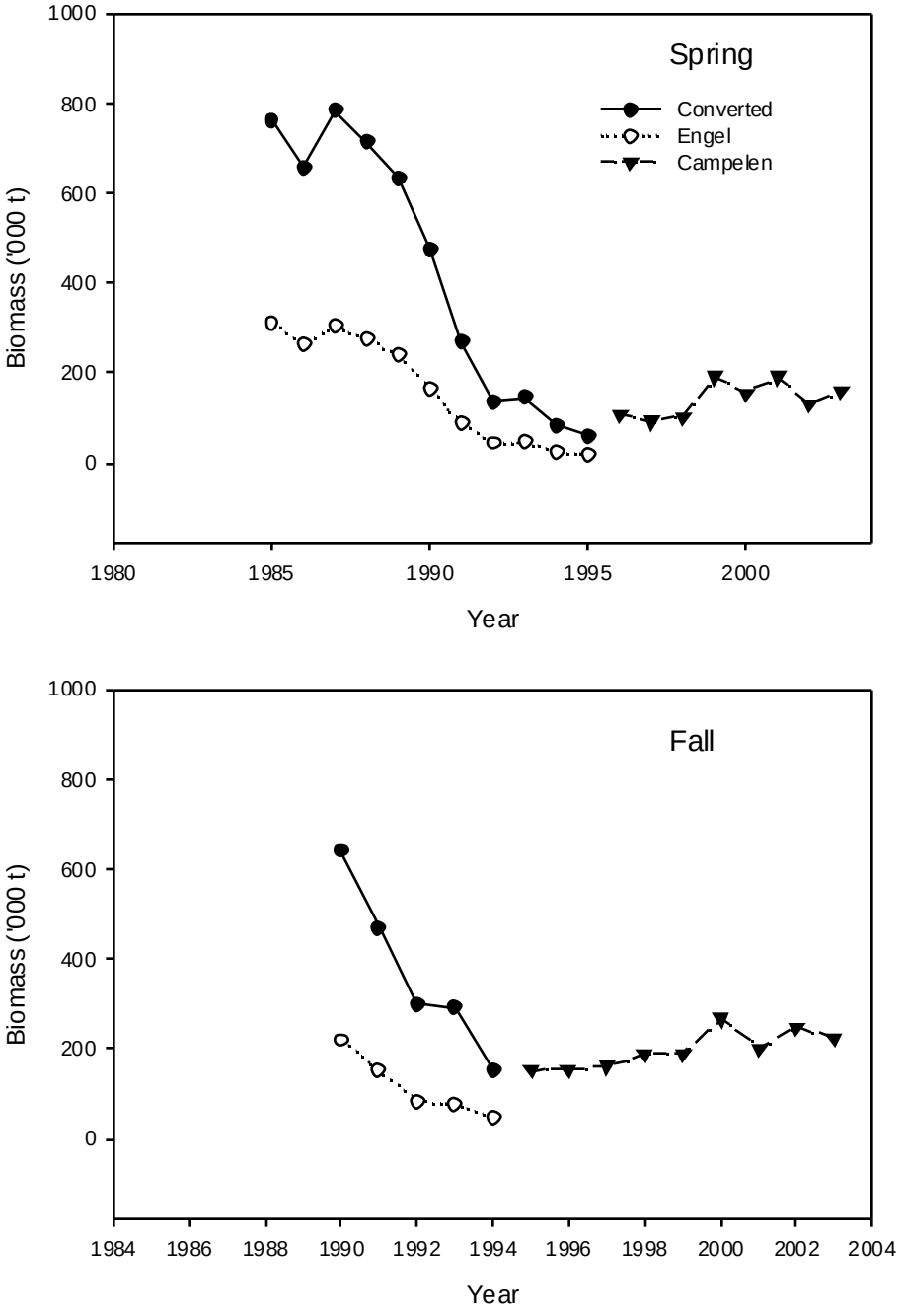
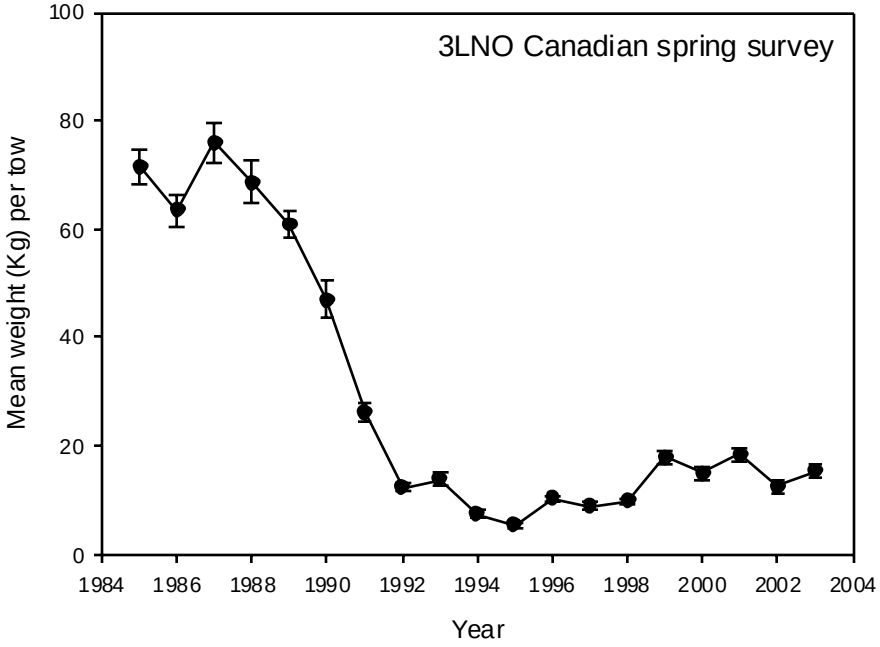


Figure 3. Biomass ('000 tons) of American plaice from spring and fall Canadian surveys in Div. 3LNO combined.



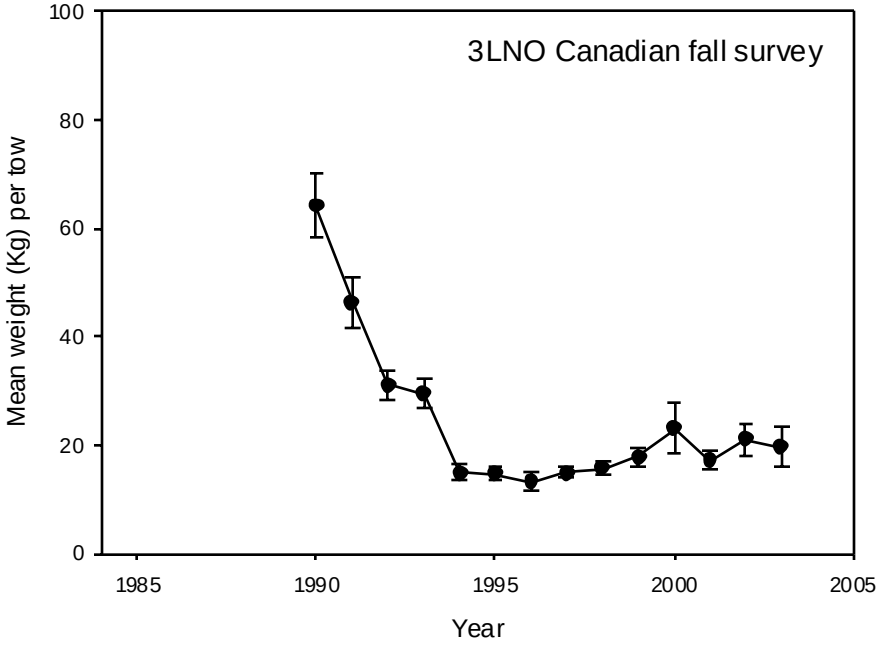


Figure 4. Mean weight per tow (± 1 Std. dev.) of American plaice from Canadian spring and fall surveys of Div. 3LNO combined.

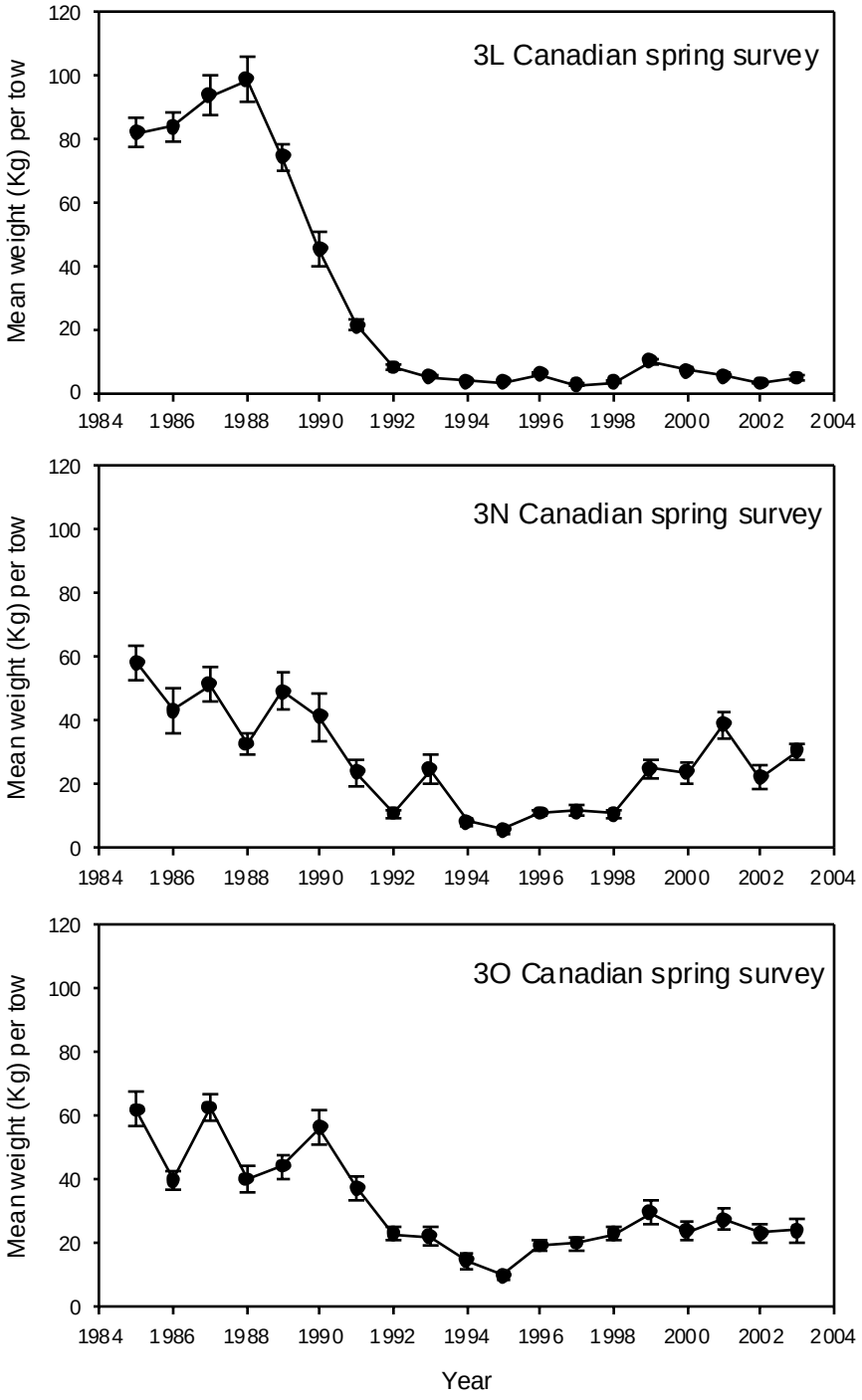
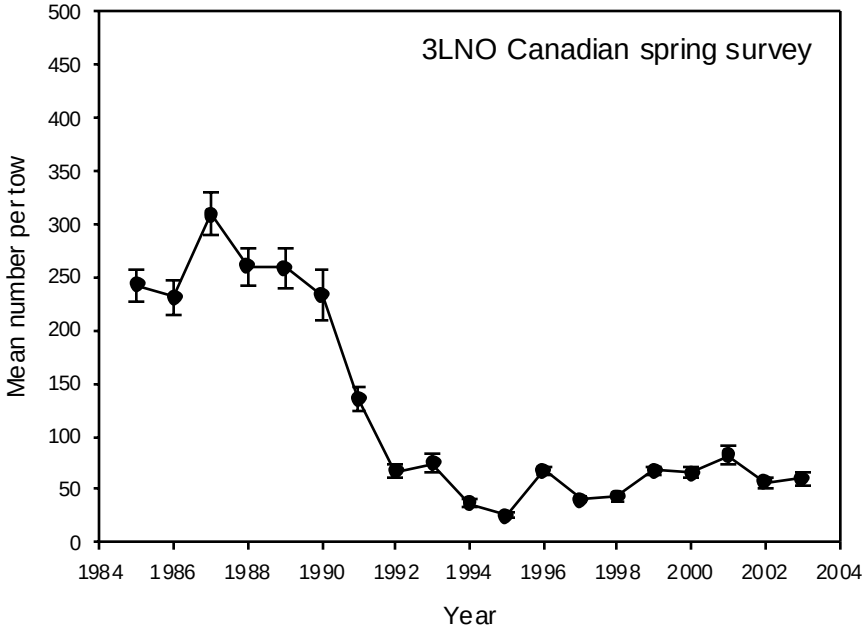


Figure 5. Mean (± 1 Std. dev.) weight per tow (Kg) of American plaice from Canadian spring surveys inDiv. 3L, 3N and 3O.



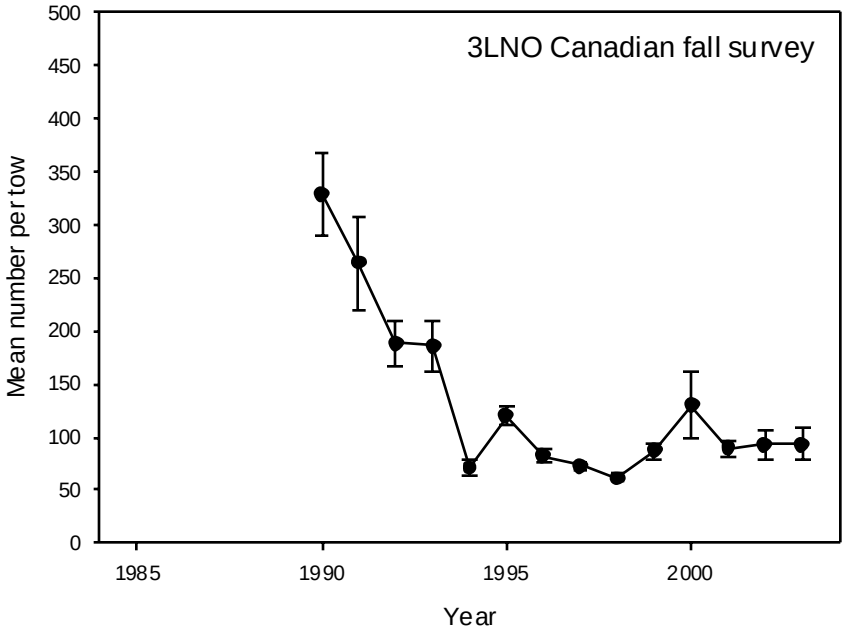


Figure 6. Mean (± 1 Std. Dev.) number per tow of American plaice from Canadian spring and fall surveys of Div. 3LNO combined.

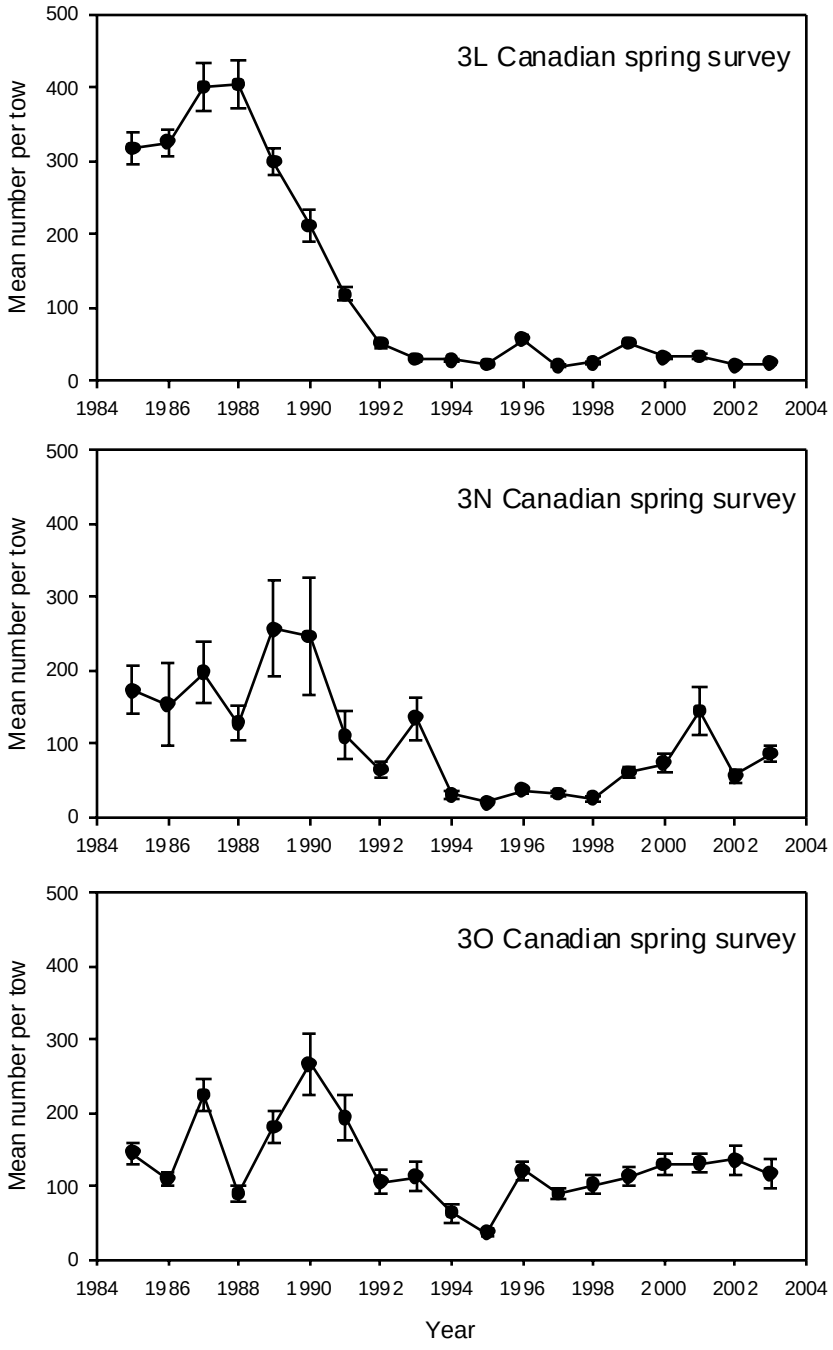


Figure 7. Mean (± 1 Std. Dev.) number per tow of American plaice from Canadian spring surveys of Div. 3L, 3N and 3O.

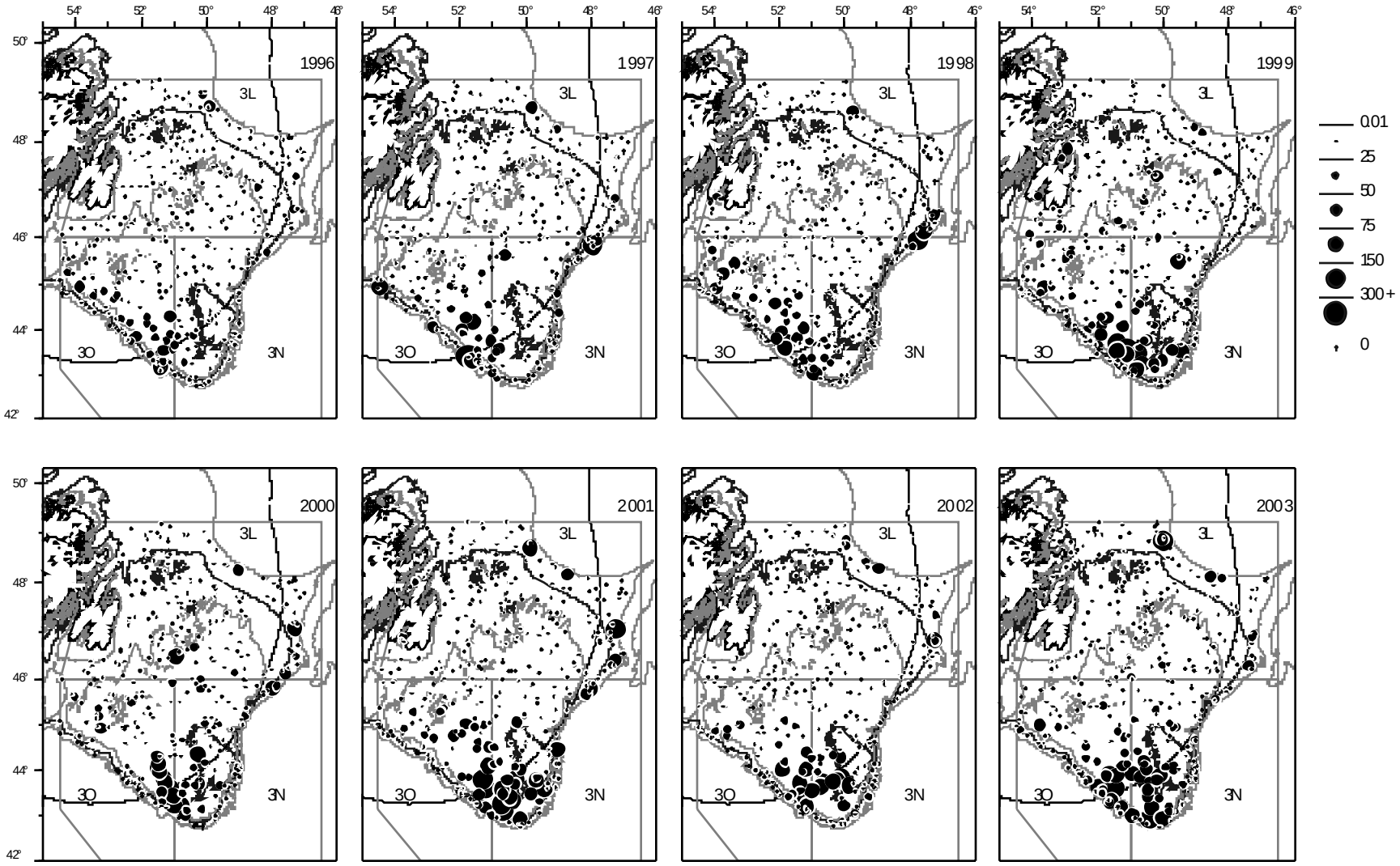


Fig. 8. Catch per tow (kg) of American plaice in spring surveys from 1996-2003.

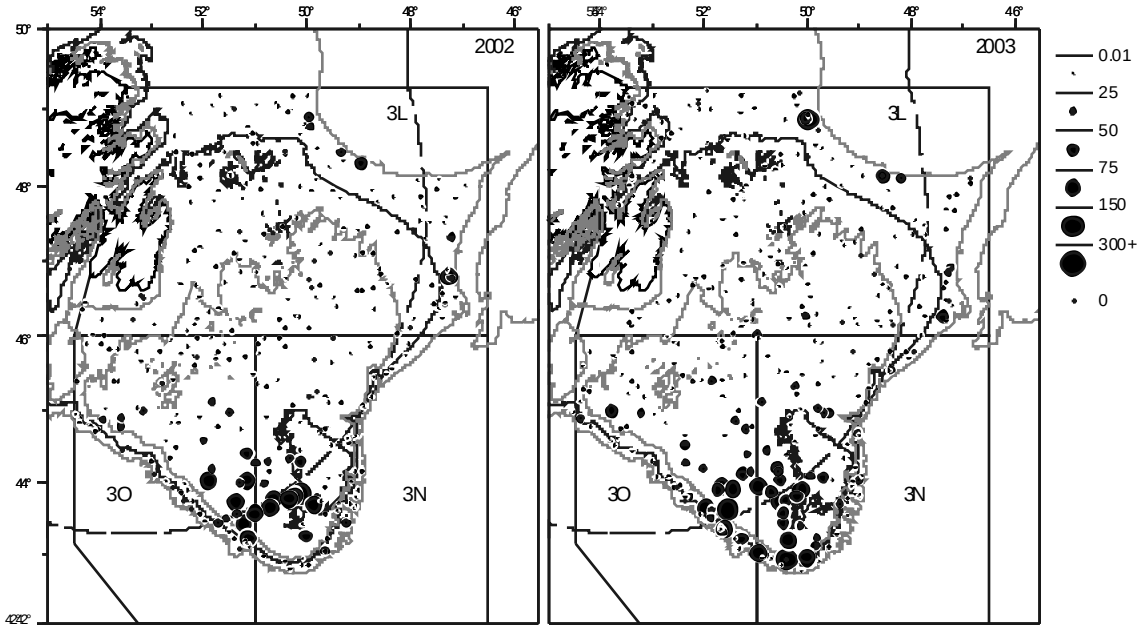


Fig. 9. Comparison of catch per tow (kg) for American plaice for 2002 and 2003 spring surveys.

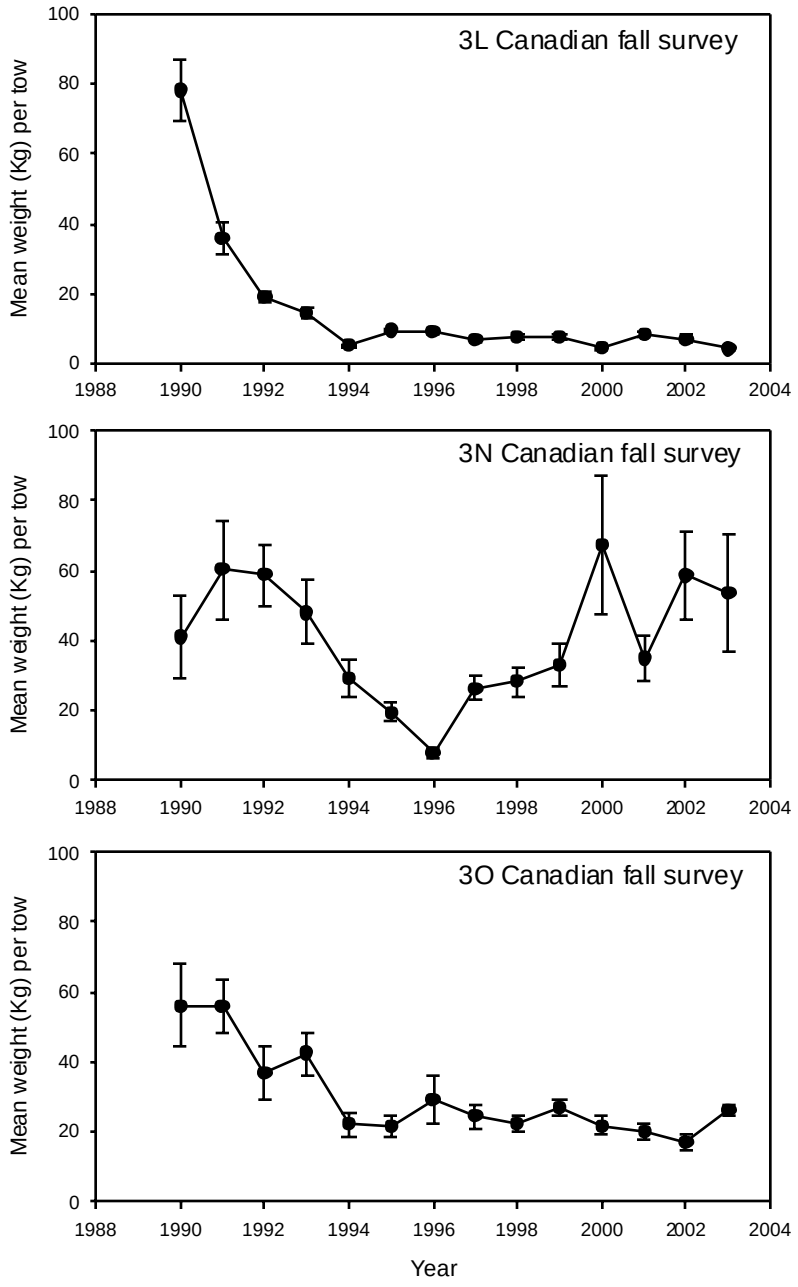


Figure 10. Mean (± 1 Std. Dev.) weight (Kg) per tow of American plaice from Canadian fal surveys in Div. 3L, 3N and 3O.

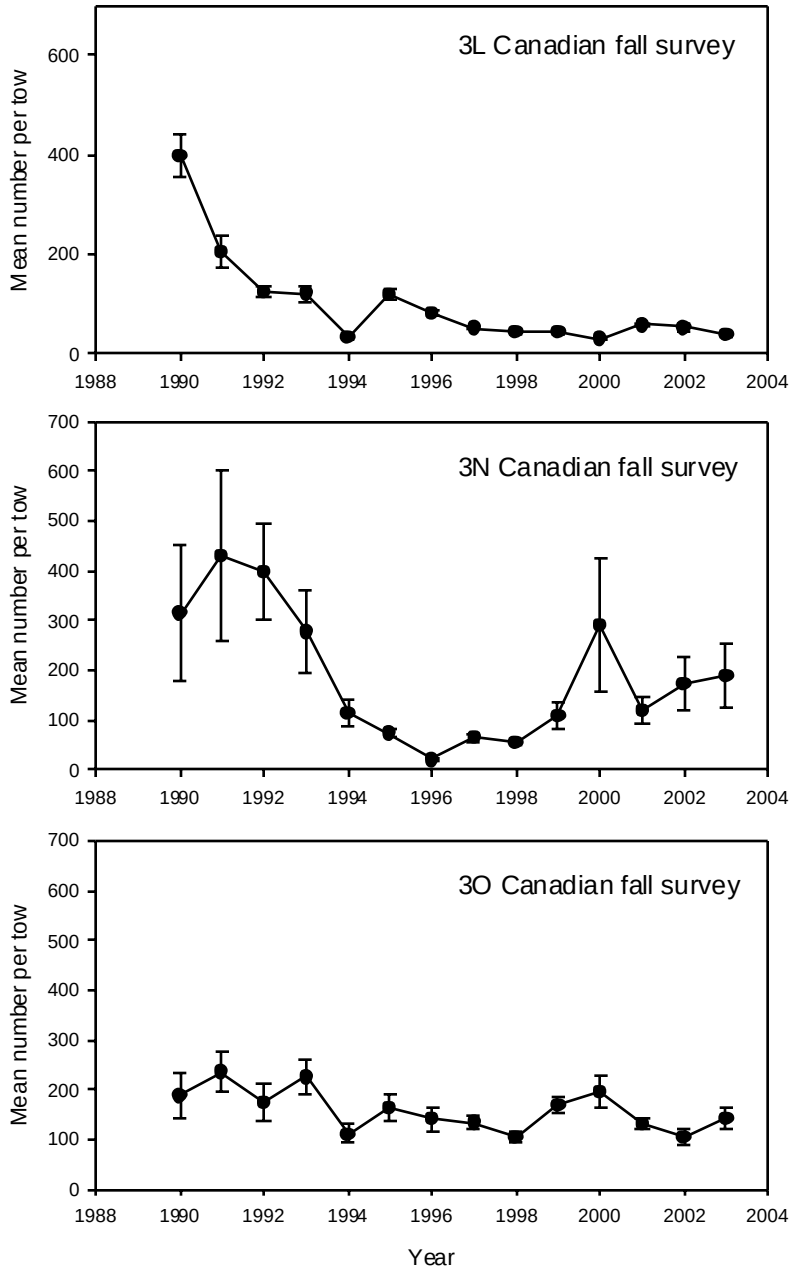


Figure 11. Mean (± 1 Std. Dev.) number per tow of American plaice from Canadian fall surveys of Div. 3L, 3N and 3O.

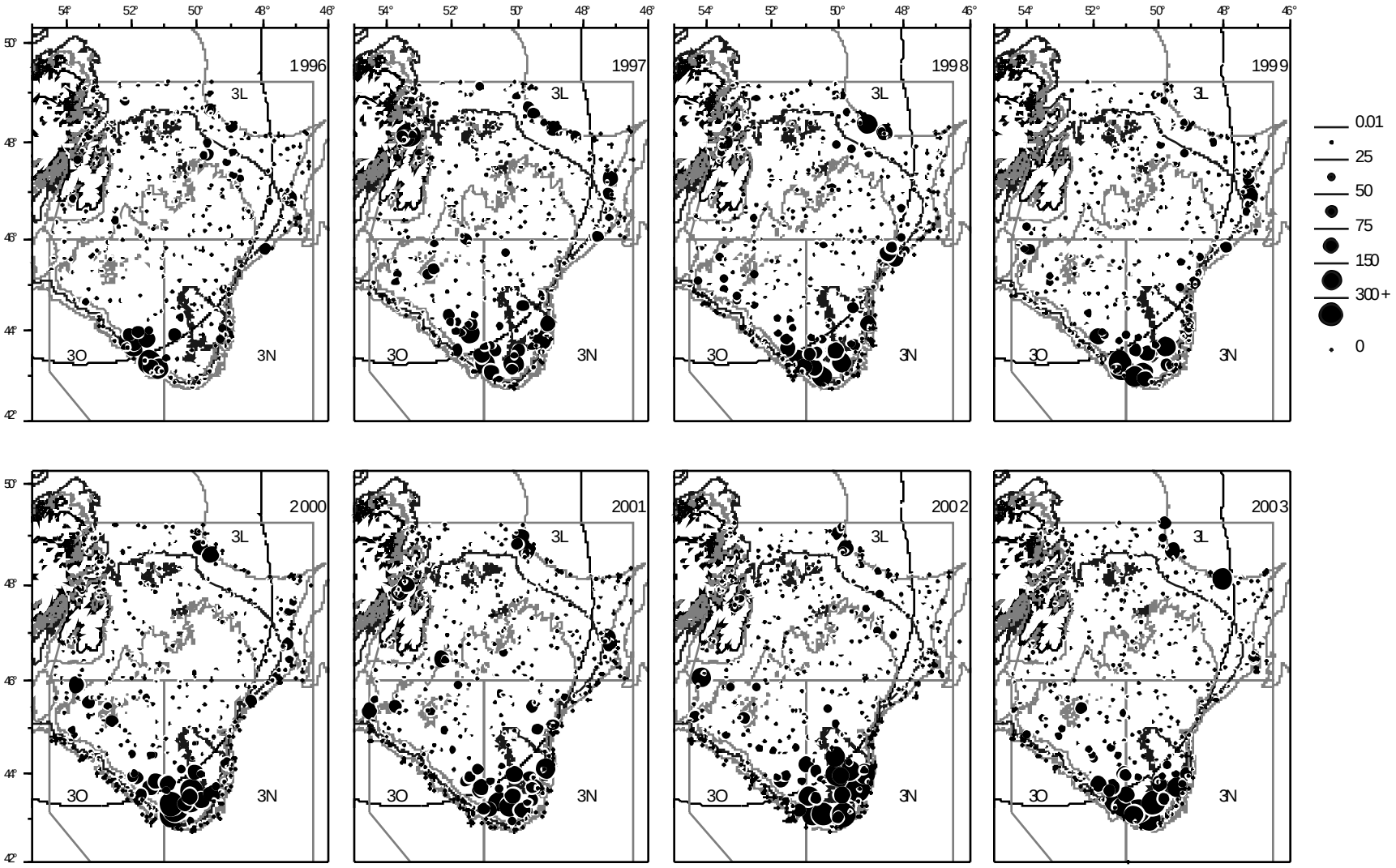


Fig. 12. Catch per tow (kg) of American plaice in fall surveys from 1996-2003.

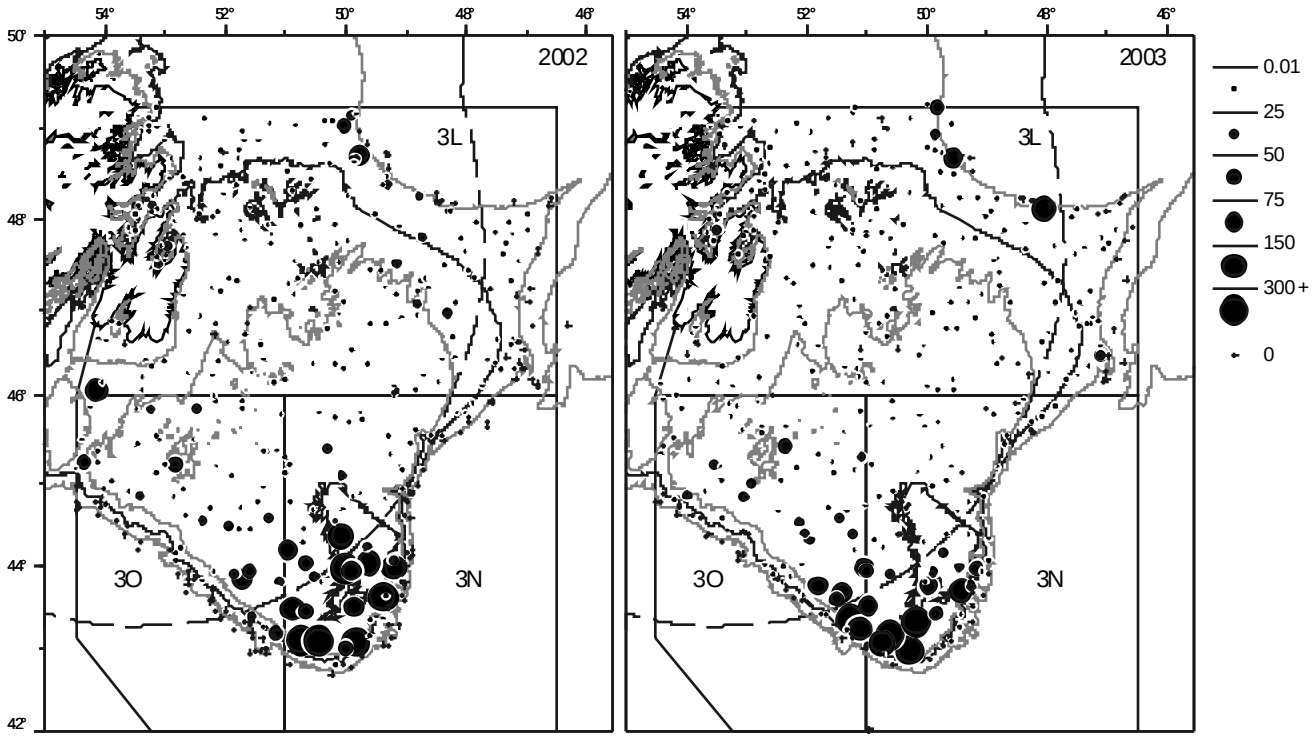


Fig. 13. Comparison of catch per tow (kg) for American plaice for 2002 and 2003 fall surveys.