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The Canadian Fishery for Yellowtail Flounder in NAFO Divisions 3LNO in 2002 and 2003.

by

W. B. Brodie, D. W. Kulka, and D. Power

Northwest Atlantic Fisheries Center, Science Branch, Department of Fisheries and Oceans
P.O. Box 5667, St. John's, Newfoundland, Canada AIC 5XI

Abstract

The catch of yellowtail flounder by Canadian vessels in NAFO Divisions 3LNO in 2003 was approximately 12,700 tons, the highest by this fleet since 1987. The catch increased from just under 10,000 tons in 2002, when effort was lower because of problems with by-catch of American plaice. Length compositions of yellowtail were similar in both years, with about 40% of the catch numbers coming from lengths in the range 36-39 cm. Much of the Canadian catch in 2002-2003 came from Div. 3N, mostly in areas just north and west of the Southeast Shoal. Otter trawl continues to be the dominant gear in this fishery. CPUE increased in 2003, although it is difficult to compare CPUE with periods prior to 1998, due to the changes in the fishery and the fleet behaviour. Avoidance of by-catch of species under moratorium, such as American plaice and cod, continues to be a major influence on the Canadian fishery for yellowtail flounder.

Introduction

Yellowtail flounder (*Limanda ferruginea*) is distributed off Newfoundland across much of the shallow portions of the Grand Banks within Northwest Atlantic Fisheries Organization (NAFO) Div. 3L, 3N, 3O and Subdiv. 3Ps (Fig.1), as well as in many inshore areas around the coast. Early research survey work showed that the largest concentrations in Canadian Atlantic waters were located on the south-central part of the Grand Bank in waters less than 100 m (Pitt, 1970; Walsh *et al*., 2002b). A mixed trawl fishery began in the early-1960s in Div. 3L, 3N and 3O, following drastic declines in the haddock stock and fishery. For much of the period up to 1994, yellowtail flounder was exploited primarily as a part of this mixed fishery with cod (*Gadus morhua*) and American plaice (*Hippoglossoides platessoides*). Following declines in stock abundance, the directed fishery for yellowtail flounder was closed by NAFO Fisheries Commission from 1 January 1994 until 1 August 1998. Since the reopening in 1998, the fishery has increased, following increases in stock abundance. Pitt (1970), Walsh *et al*. (2002a) and Kulka (1999, 2000, 2001, 2002) provide further details on the historical fishery. Canada is allocated 97.5% of the Div. 3LNO yellowtail flounder quota by Fisheries Commission, and one company, Fishery Products International Limited, holds approximately 90% of the Canadian allocation. This paper presents information on the Canadian fishery for yellowtail flounder in 2002 and 2003.

The Canadian fishery for yellowtail flounder in Div. 3LNO, since its reopening in 1998, has been much different than the fishery prior to 1994. The major difference is that the 2 other species which were often part of the mixed fishery, namely cod and American plaice, have remained closed to directed fishing. Thus a major factor in the prosecution of the yellowtail flounder fishery since 1998 has been the avoidance of by-catch of these species. This makes it difficult to compare the fishery from the pre and post-moratorium periods, given that the fleet was operating under very different rules in these periods.

The recent conservation measures for Canadian fleets fishing for Div. 3LNO yellowtail flounder can be summarized as follows (from Kulka, 2002):

- Canadian vessels will be restricted to fishing inside 200 miles in Div. 3LNO.
- A minimum mesh size of 145 mm will be used when directing for Div. 3LNO yellowtail flounder.
- The by-catch protocols will be applied pursuant to Part I, Section A.4(b) of the NAFO Conservation and Enforcement Measures, which states that "In cases where a ban on fishing is in force, incidental catches of the species concerned may not exceed 1,250 kg or 5%, whichever is the greater". The percentage is calculated as the percentage, by weight, for each species of the total catch retained on board.
- The small fish protocols will be applied with a minimum fish size of 30 cm for yellowtail flounder in Div. 3LNO. Areas will be closed for the specified fleet sector for a minimum of 10 days when the number of undersized yellowtail flounder reaches or exceeds 15% of the catch. The fishery can only re-open following a test fishery indicating that small fish is no longer a problem.
- Vessels directing for Div. 3LNO yellowtail flounder will be subject to 100% observer coverage inside 200 miles in order to facilitate monitoring of conservation measures and collection of data.
- A dockside-monitoring program is to be in place to monitor all landings.

In addition, there were voluntary measures taken by the fleet, including use of rigid sorting grates in the trawls to reduce by-catch (primarily cod), and closure of the fishery during the peak spawning time for yellowtail flounder, approximately 15 June to 31 July.

Methods

Fishery observers collected geo-referenced (latitude and longitude) information on the catch, effort, size of fish and other details of the capture of yellowtail flounder such as gear configuration and fishing strategies from the 1998-2003 large-vessel yellowtail flounder fishery. Each vessel greater than 100 feet in length (100% of Canadian quota in 2002, 99.2% in 2003) was required to carry an observer on all trips in this fishery. It is estimated that 6,241 fishing sets were prosecuted by 14 vessels in the 2002 directed Canadian fishery, and 6,219 sets by 16 vessels in 2003. The number of tows in each year was derived from the ratio of landed catch to observed catch, applied to the number of observed sets.

Catch information prior to 2003 came from the NAFO statistical database. Additional data for 2002 and 2003 were compiled from a statistical database (ZIF) maintained by the Canadian Department of Fisheries and Oceans.

Potential mapping in SPANS (Anon, 1997; Kulka, 1998) was used to convert the commercial catch and effort to surface maps describing the distribution of the yellowtail flounder fishery in NAFO Div. 3N and 3O. This follows the methodology used in recent papers on this fishery, e.g. Kulka (2002).

A multiplicative model was used to analyze the catch and effort data for this stock as in assessments prior to the moratorium (Brodie *et al*., 1994), and in recent years (Walsh *et al*., 2002a). Because data from NAFO Statistical Bulletins exist only from 1974 onward in a format that identifies yellowtail as a main (directed fishery) species, it was decided to use Canada (Newfoundland) trawler data from 1965 to 1993, along with 1998-2003 data obtained from the Statistics Branch of the Department of Fisheries and Oceans in St. John's to derive a standardized catch rate series. It should be noted that for some years, particularly the late-1970s, the Canadian fleet provided the only source of CPUE data for this stock. The historical data used in the model were the same data used to calculate the CPUE series in previous assessments (Walsh *et al*., 2002a). Factors included in each model were a combination country-gear-tonnage-class category type (CGT), month, NAFO Division and year. Consistent with previous catch rate standardizations individual observations of catch less than 10 tons or effort less than 10 hours fished were eliminated prior to analysis. Subsequently, any remaining categories with less than five data points in total were also eliminated. Plots of residuals from a preliminary run indicated data with higher levels of catch and effort tended to be less variable, therefore a weighted regression was conducted.

Description of the Fishery

Catch trends

Table 1 shows the catch history of the Div. 3LNO yellowtail flounder stock, by year and country, with the total Canadian catch listed from 1960-2003. The Canadian catch peaked at just over 28,000 tons in 1973, but has not exceeded 18,500 tons since then. The average from 1974 to 2003, excluding the moratorium years of 1994-97, is 10,847 tons. Catches by the Canadian fleet increased steadily from 1998 to 2003 (Table 1), except for a decline in 2002 when by-catch of American plaice necessitated a reduction in effort. The 2003 catch of 12,697 tons is the highest by Canada since 1987.

Canadian catches from 1973 onward are shown in Table 2, by year, division and gear. With the exception of the 1991-1993 period when Canadian vessels pursued a mixed fishery for American plaice and yellowtail in Div 3O, the majority of catches has been taken in Div. 3N, by otter trawls. Canadian catches in Div. 3N were relatively stable between 7,700 and 8,700 tons from 2000-2003. The Canadian catch of yellowtail flounder in Div. 3O in 2003 of 4,482 tons was the second highest in this Division, and was similar to the peak value in 1992.

The fishery in both 2002 and 2003 was almost all otter trawl, with small catches by seine in 2002, and a very small amount of gillnet catch in inshore Div. 3L in both years (Table 3). Catches were taken in all months, and temporal patterns were very similar in both years, with peak monthly catches occurring in October. Over 57% of the landed weight was taken in the last 4 months in both 2002 and 2003. In both years, over 86% of the observed catch came from a depth range of 50-70 m. Average tow duration during 2002 was 2.65 hrs covering 14.65 km., compared to 2.47 hrs and 13.9 km in 2003. A significant part of the catch in 2003 (approximately 12%) was taken by a larger vessel class (TC 6) new to the Canadian fishery, which froze yellowtail at sea to be re-processed subsequently at shore-based plants.

The use of sorting grates was widespread in 2002 (present in 67% of observed sets), but declined to only 20% of observed sets in 2003. This likely contributed to an increase in cod by-catch from 2.1% of the observed catch in 2002 to 3.5% in 2003. American plaice has been the main by-catch in the Canadian fishery for yellowtail flounder since 1998. During 2001 to 2003, it constituted about 10% (range 9.7 to 10.4) of the total catch observed in the yellowtail flounder directed fishery, compared to about 4-6% during 1998 to 2000.

Length composition

At-sea observers measured in excess of 210,000 yellowtail flounder in each of 2002 and 2003. Observed codend mesh sizes ranged from 145 to 155 mm in 2002 and 2003 with a predominance at 149-152 mm in both years. The length frequencies observed in 2002 and 2003 were very similar, with a mode at 36-37 cm (Fig 1). About 40% of the catch in numbers in each year was between 36 and 39 cm in length. This is virtually identical to the results for 2000 and 2001 (Kulka, 2002). Annual mean lengths in the Canadian fishery since the beginning of 2000 ranged from 37.6 to 38.3 cm. About 2% of the catch in numbers in 2002 and 2003 was less than 30 cm, slightly lower than in 2000 and 2001, and well below the small fish protocol of 15%.

Otoliths were collected in both years, but ageing of samples has not been carried out in recent years, pending the outcome of detailed studies on ageing methodology (Dwyer *et al*., 2003).

Spatial pattern

Since the fishery reopened in 1998, much of the distribution of effort by the Canadian fleet has been relatively localized (Kulka, 2002). In 2000-2003, much of the Canadian catch came from the area in central Div. 3N, just to the north and west of the Southeast Shoal (Fig. 2, 3). Other important locations include an area on the Div. 3L/3N border, and an area in Div. 3O just east of 52 degrees longitude. Unstandardized CPUE was in excess of 1 ton/hour in several locations during 2000-2003, including an area on the border between Div. 3L and 3N (Fig. 4, 5).

CPUE

Tables 4A and 4B show the results of the CPUE analysis and Fig. 6 shows the standardized series from 1965 to 2003. In the top panel of Fig. 6, the catch per unit of effort declined steadily from 1965 to 1976, then increased marginally to a relatively stable level from 1980-85. The index again declined sharply in 1986 and remained at this relatively low level through to 1990. In 1991 the CPUE declined by almost half to the lowest level observed. The catch rate in 1998, after four years of the stock under moratorium, increased sharply to a level comparable to the late-1960s. Catch rates increased by a further 20% between 1998 and 2000 and were comparable to the highest on record, i.e. at the start of the directed fishery in 1965. CPUE declined in 2001 and 2002, then increased in 2003. Monthly coefficients (Table 4A) indicated that CPUE was highest during the fall period.

Standardizations of the data separately by division (Fig. 6, lower panel) showed that, overall, the historical trends were the same, although the catch rate is generally lower in Div. 3O than in Div. 3N, and that large fluctuations tend to occur more frequently in Div. 3O, primarily before 1985. In the period since the resumption of the directed fishery from 1998-2003, catch rates showed opposite trends within each division between 1998 to 1999 (Div. 3N up, Div. 3O down) and again between 2000 to 2001 (Div. 3N down, Div. 3O up). CPUE increased in both areas in 2003, and CPUE in Div. 3O was slightly higher than in Div. 3N.

The fluctuations in the combined index from 1990 to 1993 was due primarily to the switch in effort of the fleet to Div. 3O. A substantial part of the effort labelled 'directed' for one species or the other in this Division was actually effort directed at a mixed fishery for American plaice and yellowtail flounder during 1991-1993. Given this major shift in the fishery from the 1965-90 to 1991-93, some caution must be used in comparison of catch rates between these periods. Nonetheless, it is reasonable to interpret the 1991-93 values for CPUE as an indication that the stock was at a low level. Since the resumption of the fishery in 1998, there has been a by-catch restriction of 5% for both American plaice and cod which directly affected the fishing pattern of the Canadian fleet. The vessels spent additional time searching for good catches of yellowtail flounder with low by-catches of both restricted species, which they found mainly in the central and northern areas of Div. 3N. Once again, caution should be used in comparing post-moratorium catch rates with other fishery periods. However, the overall CPUE since 1998, under the constraint of 5% by-catch limitations, suggests that the stock size is at a relatively high level, in agreement with survey indices (Walsh *et al*., 2002a; Maddock-Parsons *et al*., 2003). Data from the Canadian fleet indicate that by-catch of American plaice has been particularly problematic during 2001 to 2003. No attempt has been made to account for this factor in the CPUE analyses.

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Table 1. Nominal catches by country and TACs (tons) of yellowtail in NAFO Divisions 3LNO. Only Canadian catch has been updated for 2003.

Year	Canada	France	USSR/Rus.	S.Korea[a]	Other [b]	Total	TAC
1960	7	-	-	-	-	7	
1961	100	-	-	-	-	100	
1962	67	-	-	-	-	67	
1963	138	-	380	-	-	518	
1964	126	-	21	-	-	147	
1965	3,075	-	55	-	-	3,130	
1966	4,185	-	2,834	-	7	7,026	
1967	2,122	-	6,736	-	20	8,878	
1968	4,180	14	9,146	-	-	13,340	
1969	10,494	1	5,207	-	6	15,708	
1970	22,814	17	3,426	-	169	26,426	
1971	24,206	49	13,087	-	-	37,342	
1972	26,939	358	11,929	-	33	39,259	
1973	28,492	368	3,545	-	410	32,815	50,000
1974	17,053	60	6,952	-	248	24,313	40,000
1975	18,458	15	4,076	-	345	22,894	35,000
1976	7,910	31	57	-	59	8,057	9,000
1977	11,295	245	97	-	1	11,638	12,000
1978	15,091	375	-	-	-	15,466	15,000
1979	18,116	202	-	-	33	18,351	18,000
1980	12,011	366	-	-	-	12,377	18,000
1981	14,122	558	-	-	-	14,680	21,000
1982	11,479	110	-	1,073	657	13,319	23,000
1983	9,085	165	-	1,223	-	10,473	l9,000
1984	12,437	89	-	2,373	1,836 [b]	16,735	17,000
1985	13,440	-	-	4,278	11,245 [b]	28,963	15,000
1986	14,168	77	-	2,049	13,882 [b]	30,176	15,000
1987	13,420	51	-	125	2,718	16,314	15,000
1988	10,607	-	-	1,383	4,166 [b]	16,158	15,000
1989	5,009	139	-	3,508	1,551	10,207	5,000
1990	4,966	-	-	5,903	3,117	13,986	5,000
1991	6,589	-	-	4,156	5,458	16,203	7,000
1992	6,814	-	-	3,825	123	10,762	7,000
1993	6,747	-	-	-	6,868	13,615	7,000
1994	-	-	-	-	2,069	2,069	7,000 [d]
1995	2	-	-	-	65	67	0 [d]
1996	-	-	-	-	232	232	0 [d]
1997	1	-	-	-	657	658	0 [d]
1998	3,739	-	-	-	647	4,386	4,000
1999	5,746	-	96	-	1,052 [b]	6,894	6,000
2000 [c]	9,463	-	212	-	1,486	11,161	10,000
2001 [c]	12,238	-	148	-	1,759	14,145	13,000
2002 [c]	9,959	-	103	-	636	10,698	13,000
2003 [c]	12,697						14,500
2004							14,500

[a] South Korean catches ceased after 1992

[b] includes catches estimated from Canadian surveillance reports

[c] provisional

[d] no directed fishery permitted

Table 2. Canadian catches of yellowtail flounder by division, from 1973 to 2003. Data from 2003 are from preliminary Canadian ZIF statistics and may be slightly different from STATLANT data.

	OTTER TRAWL				
YEAR	3L	3N	3O	3LNO	OTHER GEARS
1973	4,188	21,470	2,827	28,475	17
1974	1,107	14,757	1,119	16,983	70
1975	2,315	13,289	2,852	18,456	2
1976	448	4,978	2,478	7,904	6
1977	2,546	7,166	1,583	11,295	0
1978	2,537	10,705	1,793	15,035	56
1979	2,575	14,359	1,100	18,034	82
1980	1,892	9,501	578	11,971	40
1981	2,345	11,245	515	14,105	17
1982	2,305	7,554	1,607	11,466	13
1983	2,552	5,737	770	9,059	26
1984	5,264	6,847	318	12,429	8
1985	3,404	9,098	829	13,331	9
1986	2,933	10,196	1,004	14,133	35
1987	1,584	10,248	1,529	13,361	59
1988	1,813	7,146	1,475	10,434	173
1989	844	2,407	1,506	4,757	252
1990	1,263	2,725	668	4,656	310
1991	798	2,943	2,284	6,025	564
1992	95	1,266	4,633	5,994	820
1993	0	2,062	3,903	5,965	782
1994	0	0	0	0	0
1995	0	0	0	0	2
1996	0	0	0	0	0
1997	0	1	0	1	0
1998	0	2,968	742	3,710	29
1999	0	5,636	107	5,743	3
2000	1,409	7,733	278	9,420	43
2001	183	8,709	3,216	12,108	130
2002	22	7,707	2,035	9,764	195
2003	28	8,186	4,482	12,696	1

Table 3a. Canadian catches (ZIF data) of yellowtail by Div, month, and gear, 2002.

	3L		3N		3O		3LNO
	OT	Gillnet	OT	Seine	OT	Seine	Total
Jan					134		134
Feb			289		2		291
Mar			845		1		846
Apr			1128		16		1144
May	1		560	57	2	3	623
Jun			3		20		23
Jul		1	41		20		62
Aug	20	5	185	23	13		246
Sep			1413	22	400	37	1872
Oct			1249		1045		2294
Nov			1143	32	47	1	1223
Dec			852	8	331	5	1196
Total	21	6	7708	142	2031	46	9954

Summaries: GN=6 3L=27
OT=9760 3N=7850
Seine=188 3O=2077

Table 3b. Canadian catches (ZIF data) of yellowtail by Div, month, and gear, 2003.

	3L		3N	3O	3LNO
	OT	Gillnet	OT	OT	Total
Jan			149	9	158
Feb			122		122
Mar			70		70
Apr			1043		1043
May			1016	788	1804
Jun	1		615	117	733
Jul	4	1	30	24	59
Aug	16		359	1041	1416
Sep			913	1080	1993
Oct	6		1553	689	2248
Nov	1		1703	323	2027
Dec			613	411	1024
Total	28	1	8186	4482	12697

Table 4A . ANOVA results and regression coefficients from a multiplicative model utilized to derive a standardized catch rate series for Yellowtail flounder in NAFO Div. 3LNO (2003 based on preliminary data).

REGRESSION OF MULTIPLICATIVE MODEL
MULTIPLE R..... 0.733
MULTIPLE R SQUARED..... 0.537

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARE	F-VALUE
INTERCEPT	1	4.96E1	4.96E1	
REGRESSION	50	8.27E0	1.65E-1	20.925
Cntry|Gear|TC	3	8.90E-1	2.97E-1	37.532
Division	2	8.05E-1	4.02E-1	50.897
Month	11	6.05E-1	5.50E-2	6.952
Year	34	5.56E0	1.63E-1	20.670
RESIDUALS	901	7.12E0	7.91E-3	
TOTAL	952	6.50E1		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VAR #	REG. COEF	STD. ERR	NO. OBS
Cntry|Gear|TC(1)	3125	INT	0.137	0.118	952
Division(2)	34				
Month(3)	10				
Year(4)	65				
(1)	3114	1	-0.302	0.033	162
	3124	2	-0.235	0.033	153
	3126	3	0.015	0.076	25
(2)	32	4	-0.216	0.028	204
	35	5	-0.231	0.028	217
(3)	1	6	-0.139	0.080	22
	2	7	-0.305	0.075	25
	3	8	-0.222	0.061	39
	4	9	-0.192	0.051	65
	5	10	-0.174	0.044	124
	6	11	-0.260	0.044	123
	7	12	-0.266	0.045	125
	8	13	-0.174	0.045	122
	9	14	-0.039	0.045	105
	11	15	-0.096	0.051	64
	12	16	-0.050	0.058	49
(4)	66	17	-0.020	0.150	11
	67	18	-0.096	0.150	12
	68	19	-0.252	0.145	14
	69	20	-0.420	0.136	20
	70	21	-0.404	0.122	42
	71	22	-0.428	0.121	41
	72	23	-0.548	0.121	45
	73	24	-0.437	0.121	50
	74	25	-0.862	0.123	37
	75	26	-0.851	0.123	38
	76	27	-0.928	0.131	26
	77	28	-0.768	0.125	38
	78	29	-0.732	0.122	51
	79	30	-0.699	0.121	47
	80	31	-0.605	0.126	30
(4)	81	32	-0.602	0.128	30
	82	33	-0.703	0.131	24
	83	34	-0.516	0.130	23
	84	35	-0.571	0.130	28
	85	36	-0.554	0.127	30
	86	37	-0.870	0.128	30
	87	38	-0.819	0.128	30
	88	39	-0.901	0.130	26
	89	40	-0.922	0.141	17
	90	41	-0.764	0.141	16
	91	42	-1.386	0.134	24
	92	43	-1.254	0.136	21
	93	44	-0.869	0.134	23
	98	45	-0.276	0.150	11
	99	46	-0.193	0.144	12
	81	32	-0.581	0.118	30
	82	33	-0.670	0.122	24
	83	34	-0.532	0.120	24
	84	35	-0.556	0.120	28
	85	36	-0.514	0.117	30
	86	37	-0.846	0.119	30
	87	38	-0.788	0.118	30
	88	39	-0.876	0.121	26
	89	40	-0.878	0.132	17
	90	41	-0.720	0.133	16
	91	42	-1.334	0.124	24
	92	43	-1.186	0.128	21
	93	44	-0.811	0.124	23
	98	45	-0.245	0.140	11
	99	46	-0.171	0.134	12
	100	47	-0.083	0.122	24
	101	48	-0.283	0.121	20
	102	49	-0.364	0.123	19
	103	50	-0.212	0.127	34

LEGEND FOR AVOVA RESULTS:
CGT CODES: 3114 = Can(NFLD) TC 4 Side Trawler
3124 = " TC 4 Stern Trawler
3125 = " TC 5 "
3126 = " TC 6 "
DIVISION CODES: 32 = 3L, 34 = 3N, 35 = 3O

YEAR CODES: 100=2000, 101=2001, etc.

Table 4B . Standardized catch rate index for Yellowtail flounder in NAFO Div. 3LNO from a multiplicative model utilizing HOURS FISHED as a measure of effort. (2003 based on preliminary data).

PREDICTED CATCH RATE

	LN TRANSFORM		RETRANSFORMED				% OF CATCH IN
YEAR	MEAN	S.E.	MEAN	S.E.	CATCH	EFFORT	THIS ANALYSIS
1965	0.1368	0.0139	1.143	0.134	3075	2690	39.5
1966	0.1168	0.0120	1.122	0.123	4185	3731	32.7
1967	0.0410	0.0127	1.039	0.117	2122	2042	44.0
1968	-0.1150	0.0096	0.891	0.087	4180	4694	52.6
1969	-0.2836	0.0072	0.753	0.064	10494	13930	30.8
1970	-0.2675	0.0036	0.767	0.046	22814	29745	54.4
1971	-0.2913	0.0034	0.749	0.044	24206	32318	58.4
1972	-0.4112	0.0032	0.664	0.038	26939	40545	53.9
1973	-0.2997	0.0031	0.743	0.041	28492	38357	74.4
1974	-0.7249	0.0037	0.485	0.030	17053	35133	82.0
1975	-0.7139	0.0035	0.491	0.029	18458	37608	72.1
1976	-0.7909	0.0054	0.454	0.033	7910	17423	60.5
1977	-0.6307	0.0042	0.533	0.034	11295	21183	44.4
1978	-0.5949	0.0034	0.553	0.032	15091	27296	61.5
1979	-0.5624	0.0033	0.571	0.033	18116	31719	73.0
1980	-0.4687	0.0048	0.627	0.043	12011	19162	65.1
1981	-0.4653	0.0047	0.629	0.043	14122	22452	73.6
1982	-0.5658	0.0055	0.569	0.042	11479	20188	48.2
1983	-0.3796	0.0050	0.685	0.048	9085	13260	50.2
1984	-0.4341	0.0053	0.649	0.047	12437	19172	54.7
1985	-0.4170	0.0042	0.660	0.043	13440	20357	50.6
1986	-0.7328	0.0045	0.481	0.032	14168	29433	62.5
1987	-0.6822	0.0043	0.506	0.033	13420	26502	66.4
1988	-0.7640	0.0050	0.466	0.033	10607	22738	57.1
1989	-0.7854	0.0080	0.456	0.041	5009	10986	40.0
1990	-0.6273	0.0078	0.534	0.047	4966	9298	45.8
1991	-1.2490	0.0060	0.287	0.022	6642	23138	48.0
1992	-1.1171	0.0063	0.327	0.026	6809	20791	59.4
1993	-0.7324	0.0059	0.481	0.037	6747	14020	68.4
1998	-0.1393	0.0102	0.869	0.087	3739	4303	91.3
1999	-0.0563	0.0085	0.945	0.087	5746	6081	94.2
2000	0.0509	0.0052	1.054	0.076	9423	8943	99.2
2001	-0.1714	0.0052	0.844	0.061	12240	14509	96.5
2002	-0.2259	0.0056	0.799	0.060	9958	12467	98.0
2003	-0.0754	0.0040	0.929	0.059	13820	14873	91.3

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.075

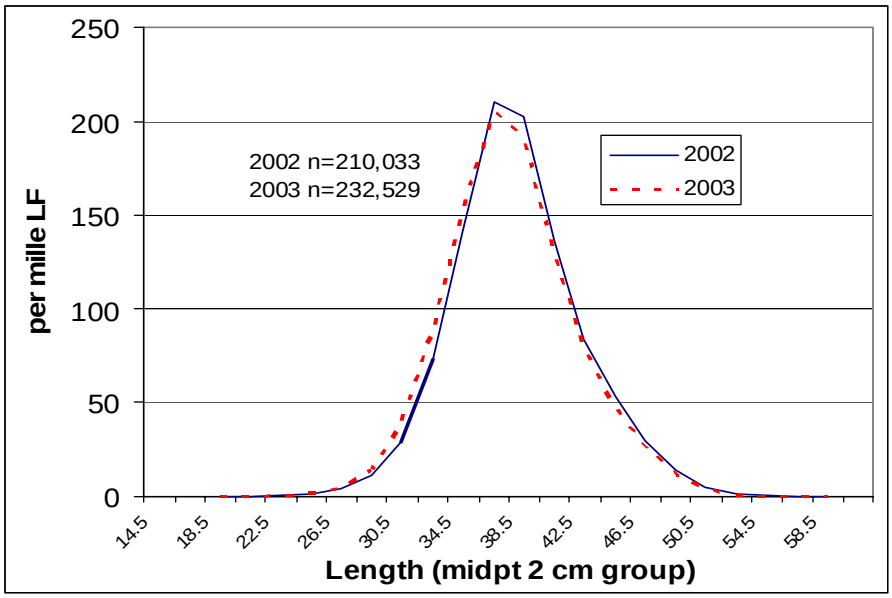


Fig 1. Length frequency of Canadian catches of yellowtail flounder in Div 3LNO in 2002 and 2003.

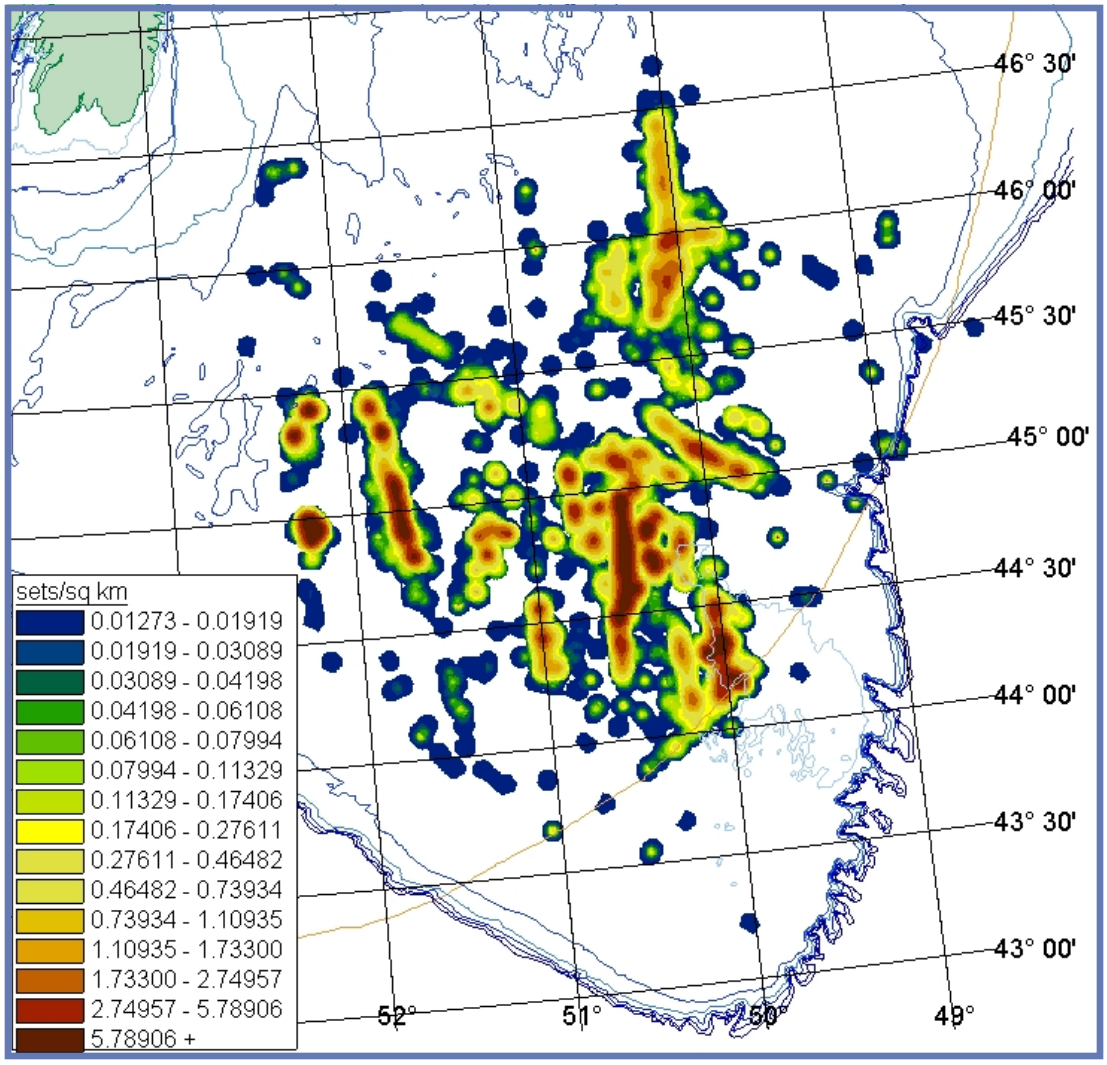


Fig. 2. Yellowtail flounder fishing grounds, Canadian vessels, 2000-03. Colours depict density of fishing effort (sets per sq. km).

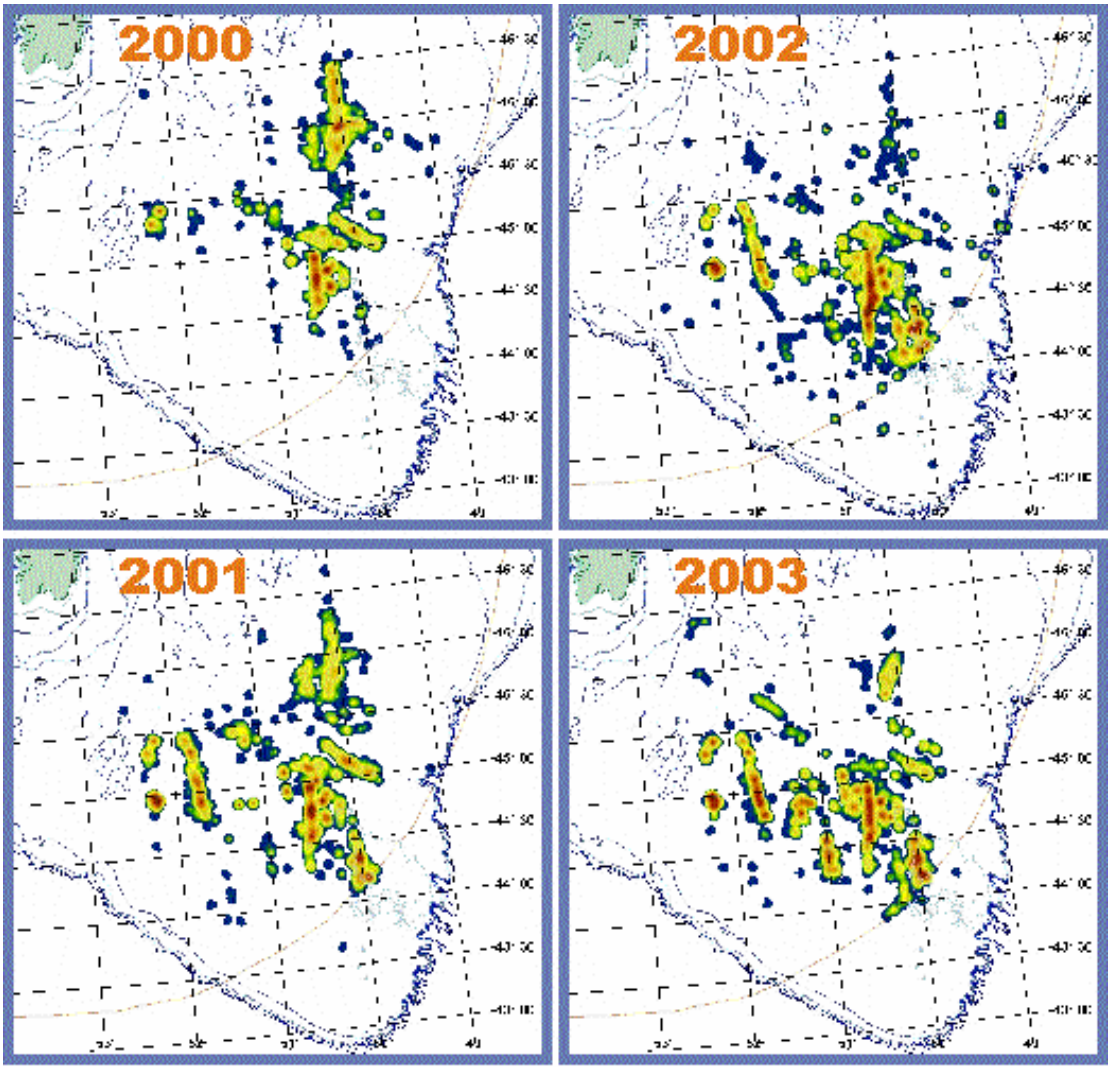


Fig. 3. Yellowtail flounder fishing grounds, Canadian vessels. Colours depict density of fishing effort (sets per sq. km). See Fig. 2 for legend.

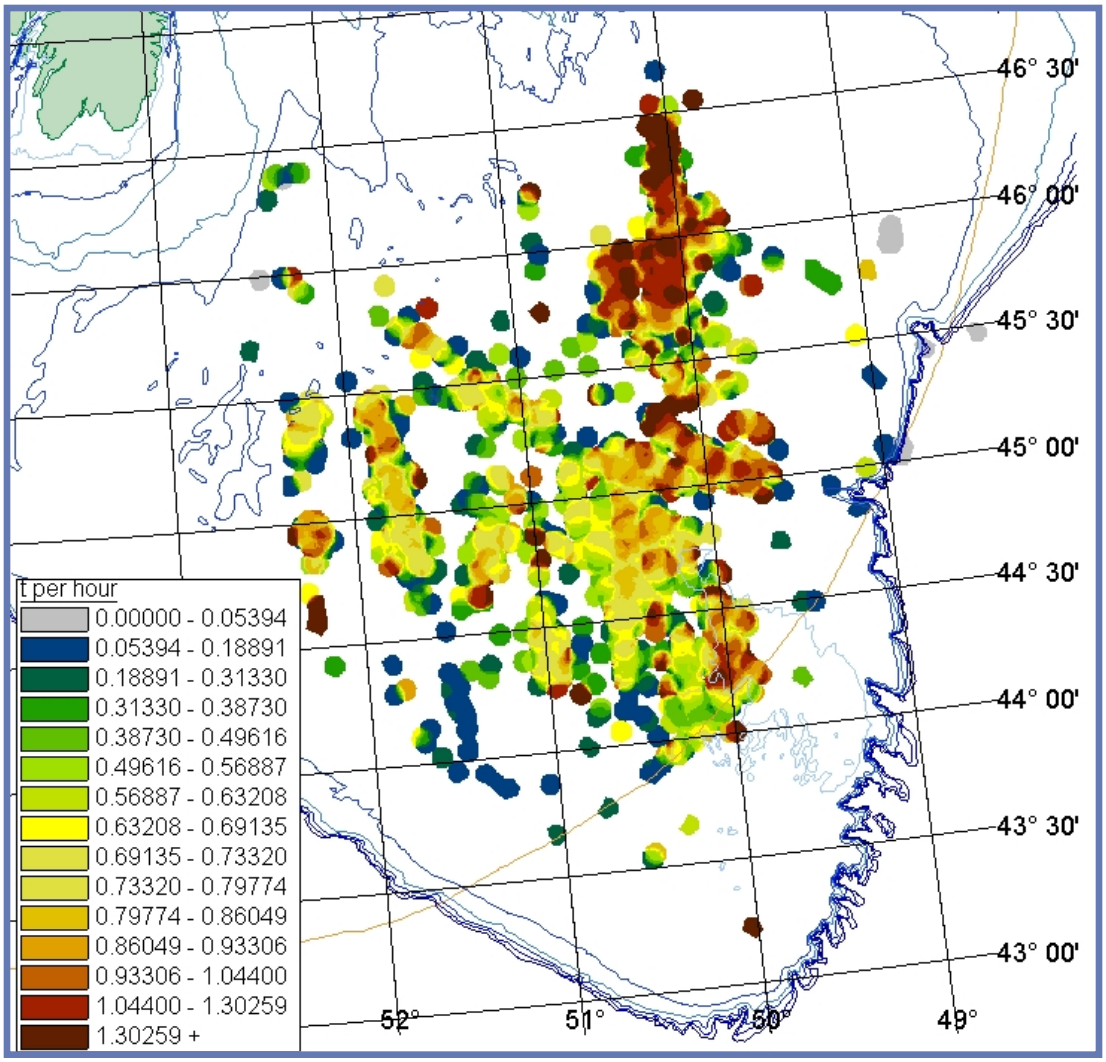


Fig. 4. Fishing grounds 2000-2003 combined, Canadian vessels, depicting catch rate (tons per hour, unstandardized) of yellowtail flounder.

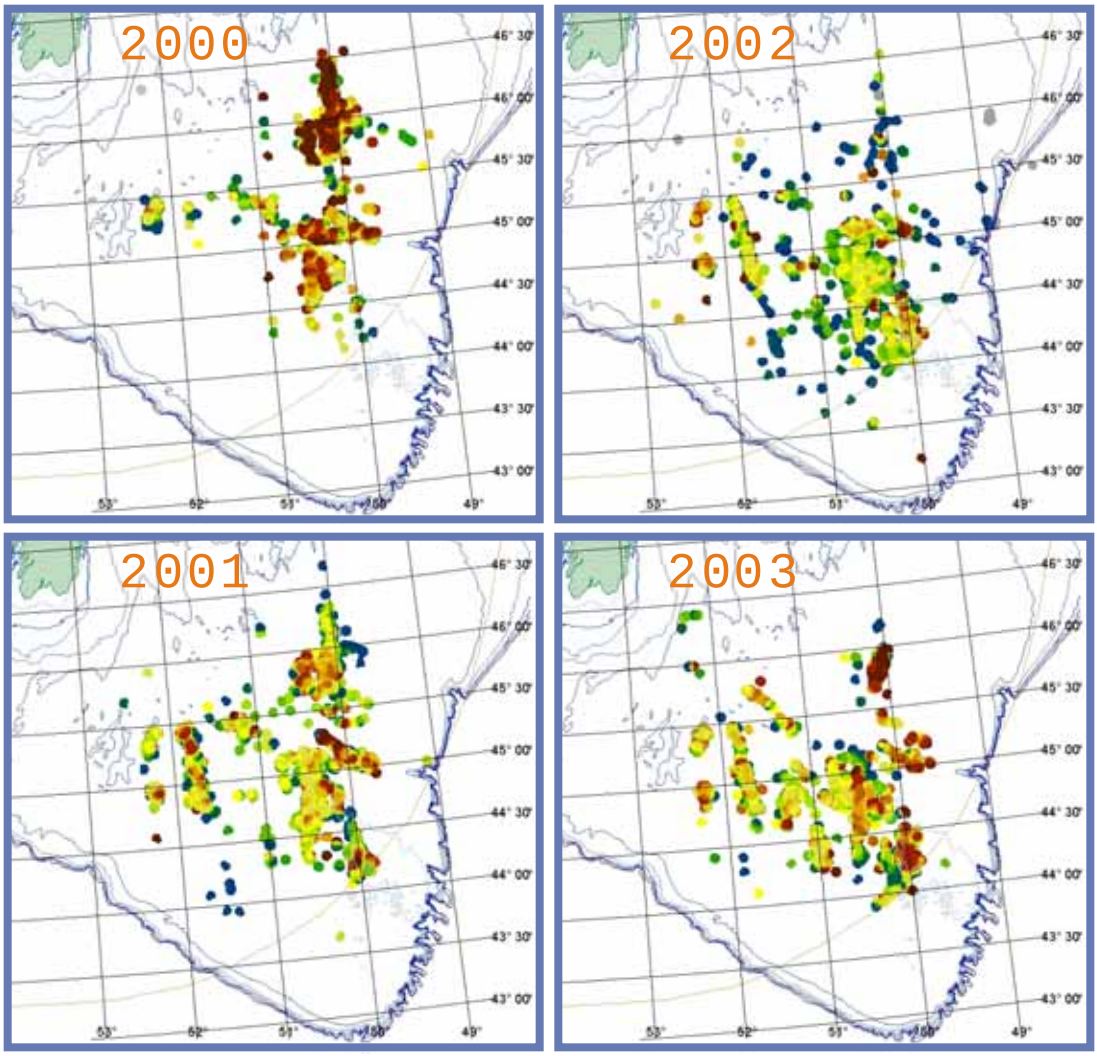
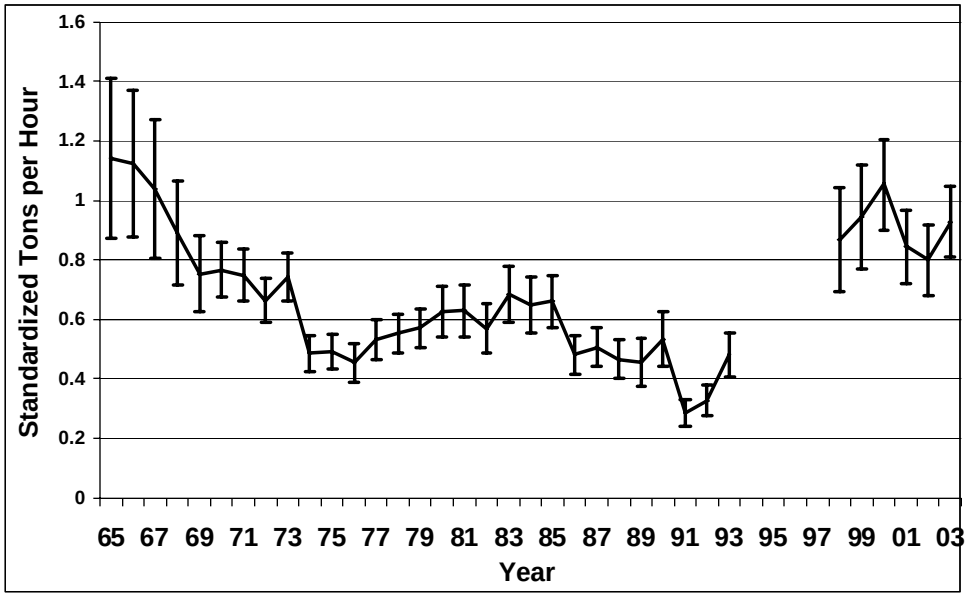


Fig. 5. Fishing grounds 2000-2003, Canadian vessels, depicting catch rate (tons per hour, unstandardized) of yellowtail flounder.

A) Div. 3LNO from 1965-1993,1998-2003



B) Div 3N and 3O separately from 1965-1993,1998-2003

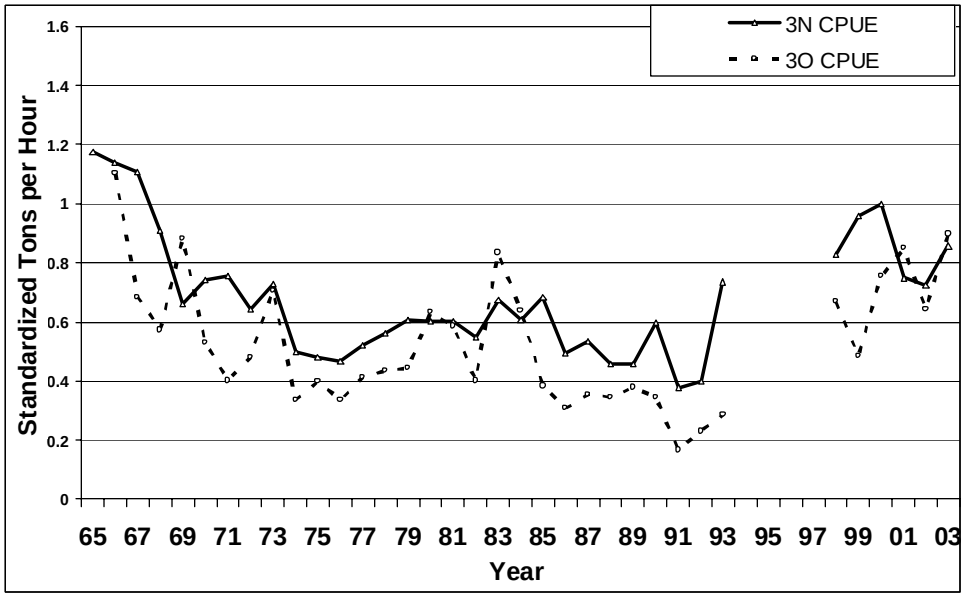


Fig. 6. Standardized CPUE ± 2 s.e. for Yellowtail flounder in Div. 3LNO from 1965-1993 and 1998-2003 (preliminary) under different treatments of the database. From 1991-1993 the fishery was a mixed fishery with American plaice. There was no directed fishery from 1994-1997.