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Update on Cooperative Surveys of Yellowtail Flounder in NAFO Divisions 3LNO, 1996-2002.

by

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Abstract

Results from cooperative grid surveys conducted in July showed that catch rates of yellowtail flounder were consistently high in July surveys (580-840 kg/hr) from 1996 through 2002. The 2002 CPUE for yellowtail was the highest in the series, but similar to the July surveys in 1998 and 2000. Catches of American plaice, cod and thorny skate also varied but were relatively stable at a lower level (less than 230 kg/hr) in those same surveys. The 2002 survey of the expanded grid area gave similar results compared to the 2001 expanded grid survey, with the yellowtail CPUE increasing again in 2002.

Introduction

Cooperative trawl surveys directed for yellowtail flounder have been conducted in NAFO Divisions 3NO by the Canadian Department of Fisheries and Oceans (DFO) Newfoundland Region and a Newfoundland based fishing company, Fisheries Products International (FPI) Ltd. since July 1996. While the scientific and technical support for the surveys are the responsibility of DFO, FPI provides the vessel, crew, fishing gear, and related operating expenses for the surveys. These surveys are designed to provide data on the spatial distribution and abundance of yellowtail flounder in the survey area. The surveys also provide information on species such as American plaice, cod and thorny skate, which are taken as by-catches in the commercial fishery for yellowtail. This paper summarizes the results from the surveys completed in 1996 to 2002.

The surveys were designed to cover approximately 9 500 square nautical miles, corresponding to the area where the yellowtail flounder stock was mainly distributed. Fifteen surveys covering the original grid area were conducted, 1 in 1996, 4 each in 1997 and 1998, 3 in 1999 and 1 each in 2000 to 2002. Surveys in the last three years covered an expanded grid area adjacent to the original grid, covering a further area equal in size to the original grid.

Methods and Materials

Originally, the surveys were designed to cover an area of approximately 9 500 square nautical miles (bolded grid, Fig. 1), corresponding to the area where the yellowtail flounder stock is mainly distributed, and where the FPI fishery operated in most years prior to the 1994 NAFO-imposed moratorium on fishing. The original survey area grid is divided into l00 equal-sized blocks, and the same pre-selected position is fished, if possible, in each block in every survey. These positions were selected at the start of the first survey by FPI, based on their understanding of yellowtail abundance and distribution, and their knowledge of the fishing grounds. Some of the areas in the grid represent well-known fishing grounds for yellowtail, while other areas were not traditionally fished. All aspects of the fishing operation, including vessel, skipper, trawl gear, and tow speed and duration were kept standard within and between surveys, and aspects such as tow direction and time of day have been kept constant for a given tow between surveys where possible. Fifteen surveys of the original grid area were conducted, 1 in 1996, 4 each in 1997 and 1998, 3 in 1999, and 1 each in 2000 to 2002. A July survey has been carried out in each of the 7 years.

In 2000, the grid area was expanded to cover an additional 100 blocks, an area equal in size and adjacent to the original grid (Fig. 1). Additional coverage was added in each of Divisions 3L, 3N, and 3O. This expansion was necessary so that the survey would cover a larger portion of the yellowtail flounder stock, which has expanded its range since the start of the grid survey series in 1996. Blocks in the expanded grid area are identified by row and column, with the exception of the labelled blocks. This expanded grid was surveyed immediately following the July survey of the original grid, using the same vessel and fishing protocols.

The vessel used in all surveys to date was the *Atlantic Lindsey*, a 44 m total length, 665 G.R.T., 1500 HP commercial stern trawler in FPI's Newfoundland fleet. The fishing gear used is an Engel (96) 145 Hi-Lift otter trawl, with rockhopper footgear, and is reflective of trawls historically used by FPI in the yellowtail fishery (see Walsh and McCallum 1999 for details). Brodie et al. (1997) give an in-depth comparison of this trawl used onboard the *Atlantic Lindsey* with the standard survey gears (Enge1 145 Hi-Lift otter trawl, and Campelen 1800 shrimp trawl) used by the DFO institute, Northwest Atlantic Fisheries Center (NAFC). There are major differences in the footgear, sweep/bridle lengths and mesh size. Unlike trawls used in research vessel (r.v.) surveys, no small mesh liner was used in the 156mm codend of this commercial trawl. All trawl components were measured prior to use, to ensure consistency within and between trips. Trawl performance was monitored with SCANMAR during each fishing set, which is one-hour in duration at a speed of 3.0 knots (see Walsh and McCallum 1999).

Catch numbers and weights of all yellowtail flounder in the catch of each set were recorded. Similar catch data on other species such as American plaice, cod and thorny skate were also collected, along with biological sampling (size and maturity) data for yellowtail. Some temperature data have been collected using XBT's. Results from the original grid surveys are also compared with data from spring and fall stratified random surveys done by DFO (Walsh et al. 2000). Results from the expanded grid area are reported separately in this paper.

Results and Discussion

Catches from the original grid surveys: In the surveys of the original grid, between 50 and 89 fishing sets were conducted during each survey (Table 1a). For yellowtail, plaice, cod and thorny skate, catch weights per tow in every March survey were lower than in other surveys (Table 1a, Fig.2). Considering just the July surveys (Fig. 4) no obvious trend in catch rates is seen in the original grid area, although CPUE for yellowtail and A. plaice follow the same pattern, with the exception of 1996-97. NAFO division 3N shows higher catches of yellowtail and plaice than division 3O in the July surveys, but lower catch rates of cod (Fig. 5). Overall, yellowtail and A. plaice CPUE were highest in July of 1998 and July of 2002, and yellowtail was lowest (excluding March data) in May-June of 1999 (Table 1, Fig. 2).

Overall, 12 common blocks were fished in the 15 trips following the original grid design. To investigate the by-catch of American plaice, the ratio of American plaice to yellowtail flounder was calculated in the common blocks fished in all fifteen surveys (Table 2). Several sets produced by-catch ratios less than 5% (highlighted), but no block consistently produced by-catch ratio of less than 5%, the current by-catch limit in the Canadian fishery for yellowtail. Furthermore, the overall mean by-catch for all but one block exceeded the 5% by-catch ratio, although one other block was also at 5%. Excluding the ratios from the March 1999 survey, the majority of catches with a by-catch less than 5% occurred in the central portion of the grid (bounded by F4-H7). Largest by-catches of plaice are found in the southwest corner of the grid in Div 30.

The July surveys (conducted from 1996 through 2002) have 39 common blocks. Tables 3 and 4 give catch rates for yellowtail flounder and American plaice in these common blocks. By-catch ratios of less than 5% are most frequently found in the central portion of the grid (Table 5), and four blocks have an average American plaice by-catch ratio equal to or lower than 5%. Another seven blocks had plaice to yellowtail ratios between 5 and 10% on average.

Figure 10 also gives an indication of the distribution of yellowtail catches and American plaice by-catch. For each July survey, blocks fished are marked to indicate whether or not the catch criterion of >700 kg/hr was met (✓ or ✗). A shaded block indicates that for that level of yellowtail catch, the by-catch of American plaice was less than 5% (plots on the left) or 10% (plots on the right). Blank blocks were not fished. Figure 11 shows the same information for yellowtail catches greater than 500 kg/hr. Many of the blocks surveyed met this yellowtail catch criteria and

2000 had the fewest with American plaice by-catch below 5% or 10%. In July 2002, seven sets had yellowtail catches above 700 kg and A. plaice by-catch below 5%, while 21 sets had yellowtail catches above 700 kg and by-catch of A. plaice at 10% or less. This represented an increase from the numbers of sets in 2001which met these criteria (5 sets at 5% or less, 17 sets at 10% or less).

Catches from the expanded grid area: Catch data from the expanded grid area, surveyed for the first time in August 2000, are included in Table 1b and Figure 3. Catch rates in the expanded grid area have remained relatively constant for each of the four species examined in the three years surveyed (Fig. 3) Catches of the main species were lower in the expanded grid compared to the original grid, with the exception of cod in 2001. Mean catch weight of yellowtail was higher than that for cod and American plaice in both grid areas. The ratio of American plaice to yellowtail catch was less than 5% in two blocks in the expanded grid area in 2002 (Table 2b). Distributions of the catches of 4 species from the 2001 and 2002 surveys are shown in Figs 6-9. No major changes in distribution or CPUE of any of these species are apparent from 2001 to 2002, although average CPUE of yellowtail in the expanded grid area increased by about 10% in 2001 and 2002.

Length Composition: Length composition of male and female yellowtail caught during the 15 surveys are shown in Fig. 12. In all surveys, less than 2% of fish captured were smaller than 26 cm in length and less than 11% of the catch was composed of individuals less than 30cm in length (Table 6). Typically, yellowtail 26-46 cm in length make up the bulk of the length frequencies of the catches and furthermore, female frequencies tended toward larger sizes than male frequencies in all surveys. The percentage of yellowtail above 40 cm in length has been at the lowest levels in the most recent surveys. Otoliths were not collected during the grid surveys and therefore age compositions have not been calculated at this time.

The male portion of the catch is given on each of the length frequency plots and is summarized in Figure 13. March surveys show a higher percentage of males in the catch than surveys at other times, and a slight decline in male composition is apparent over the time series.

Comparison of results with research vessel data: The distribution of yellowtail from the 11 stratified random research vessel surveys conducted by DFO with the Campelen trawl in Div. 3LNO from 1995-2000 (6 fall surveys and 5 spring) was shown in Maddock et al. (2000 and 2001). Results from the 2002 surveys are shown in Fig 14, and compared with the mean numbers per tow from 2001. The grid, which is not part of the design of the DFO r.v. surveys, is superimposed on these plots, and in most surveys, the majority of the yellowtail is caught within the boundaries of the grid. There was a decline in the percentage of yellowtail found in the original grid from 1996 to 2000 in the spring, and from 1995-2001 in the fall (Table 7). In the first four surveys (fall 95 to spring 97), between 80 and 90% of yellowtail were located within the grid. Since then, less than 81% of yellowtail in any survey were located in the grid area. The lowest values occurred in the fall surveys during 2000 and 2001, when only 40 - 47% of yellowtail in the surveys were found within the grid. Spring 2002 percentages were similar to 2001 (between 74 and 80%), while fall 2002 percentages increased to levels similar to 1998.

Data from the 2000-2002 spring and fall DFO surveys were also superimposed on the expanded grid, used for the first time in the grid surveys in 2000. For the spring surveys, about 80 - 90% of yellowtail were contained within the expanded grid boundaries, with the 2002 percentage being the lowest (Table 8). During the 2000 and 2001 fall surveys, only 56-67% of yellowtail were found inside the expanded grid, although this increased to about 80% in 2002. Most yellowtail outside the expanded grid, both in spring and fall, were located to the south.

Overall, these observations are consistent with observed increases in the area of distribution of yellowtail flounder in recent years, as seen in both the survey and commercial fishery data. These increases in the range of distribution are also consistent with increases in stock size since the late 1990's, following reductions in stock size and distribution range in the early to mid 1990's (Brodie et al. 1998).

Observations on sexual maturity of yellowtail: In all surveys thus far, with the exception of November 1998, observations on sexual maturity of yellowtail have been collected. These were generally obtained at sea by sampling 300-400 fish from each of 2 fishing sets per day, although the March 1998 data were collected from port samples immediately following the survey. Fig. 15 indicates that on average, about 78% of the female yellowtail caught was mature, and that there was a slight increasing seasonal trend in the 4 surveys in 1997 and the 3 in 1999. The July

1999 survey had the highest percentage of mature females in the time series of July surveys (Fig. 16), while the proportion mature from the 1999 – 2002 surveys was higher than that from 1996 to 1998.
A closer look at the data from the 7 July surveys (Fig. 17) showed that most mature females had spawned prior to the surveys, particularly in 1997-2000. The July 1997 survey had the highest percentage of females judged to be maturing following a recent spawning (Sp. P Mat AN), and the lowest percentage of females with hydrated eggs (Mat B and Mat C stages). This suggests that spawning may have been earliest in 1997, although mean bottom temperature in depths <100 m on the Grand Bank during spring 1997 was the lowest in the years covered by the grid surveys (Colbourne and Bowering 2001). The high percentage of spent females in 1999 corresponds with the highest mean temperature (<100 m bottom depth) in spring surveys of this area since 1983. In 1996, 2001, and 2002, it appears that spawning had not been completed in the grid area by July, as evidenced by the higher number of females either with hydrated eggs or eggs in pre-spawning condition (Mat A stage). In these 3 years, similar numbers of mature females were judged to be in pre-spawning and spawning condition. The percentage of spent females in 2002 was similar to the value seen in 2001, and combined with the high percentage of pre-spawning females (Mat A,B,C) in these two years, suggests that spawning may have been later in 2001 and 2002 than in 1997-2000. Mean temperatures at <100 m bottom depth in DFO's spring surveys of 2001 and 2002 were lower than in 1998-2000, but higher than in 1997.

Conclusions

Cooperative surveys between DFO and FPI in Divisions 3LNO indicate that CPUE for yellowtail flounder in the July surveys of the original grid have been around 600-800 kg/hr, and have averaged about 800 kg/hr in the last 3 surveys (2000-02). American plaice CPUE ranged from 100 to 230 kg/hr in the July surveys, averaging about 210 kg/hr in the last 3 surveys. Overall catch rates in the expanded grid surveys are slightly lower for all species considered when compared to the original grid. CPUE of cod and A. plaice are similar from 2000 to 2002, while CPUE for thorny skate and yellowtail increased in this period.

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Table 1a. Catches (kg/hr) by species and trip from FPI/DFO cooperative grid surveys, original grid area.

Species	Trip	Trip #	N	Mean	StdDev	Max	Min
Yellowtail Flounder	Jul96	1	83	693.51	478.81	2503.57	34.00
	Mar97	2	68	123.99	605.47	4972.44	0.00
	May/Jun97	3	82	608.03	602.88	4607.00	24.50
	Jul97	4	85	666.41	478.62	3369.10	17.50
	Nov97	5	50	627.37	926.85	5931.00	3.50
	Mar98	6	84	74.99	91.65	427.74	0.00
	May/Jun98	7	73	653.62	504.02	2872.62	67.00
	Jul98	8	78	803.78	533.24	2678.27	0.00
	Nov98	9	63	553.61	776.78	5726.06	1.00
	Mar99	10	73	145.21	136.96	536.40	0.30
	May/Jun99	12	80	506.49	400.74	2289.83	57.60
	Jul99	13	64	583.61	341.74	1488.97	8.00
	Jul00	14	65	802.74	521.12	3319.19	62.00
	Jul01	16	72	752.24	416.05	1979.66	6.36
	Jul02	21	78	835.31	421.28	2065.76	20.00
American Plaice	Jul96	1	83	106.73	125.89	942.94	3.00
	Mar97	2	68	20.44	44.23	234.50	0.00
	May/Jun97	3	82	168.57	133.70	759.80	3.50
	Jul97	4	85	180.92	265.55	1654.40	0.00
	Nov97	5	50	131.78	94.88	492.90	23.30
	Mar98	6	84	19.49	40.31	246.74	0.00
	May/Jun98	7	73	173.18	111.74	785.46	33.02
	Jul98	8	78	229.29	361.15	2197.82	12.72
	Nov98	9	63	136.74	106.51	471.60	13.78
	Mar99	10	73	17.53	47.55	330.00	0.00
	May/Jun99	12	80	176.22	158.31	890.08	21.20
	Jul99	13	64	151.72	175.80	975.20	8.48
	Jul00	14	65	219.43	203.19	1117.24	30.18
	Jul01	16	72	187.95	269.04	1534.35	22.79
	Jul02	21	78	224.90	388.24	3180.00	12.72
Cod	Jul96	1	83	105.64	282.99	2509.09	0.00
	Mar97	2	68	0.76	1.95	10.00	0.00
	May/Jun97	3	82	43.82	65.66	308.00	0.00
	Jul97	4	85	71.38	110.58	644.00	0.00
	Nov97	5	50	72.08	103.38	411.50	0.00
	Mar98	6	84	3.09	10.46	55.00	0.00
	May/Jun98	7	73	55.47	95.07	400.00	0.00
	Jul98	8	78	106.47	248.92	1273.80	0.00
	Nov98	9	63	41.18	121.01	917.70	0.00
	Mar99	10	73	1.94	10.24	86.00	0.00
	May/Jun99	12	80	70.91	139.40	1005.87	0.00
	Jul99	13	64	192.85	773.21	6067.20	0.00
	Jul00	14	65	69.71	126.80	877.80	0.00
	Jul01	16	72	74.28	109.88	739.20	0.00
	Jul02	21	78	76.52	144.17	849.60	0.00
T. Skate	Jul96	1	83	62.48	74.05	435.50	0.00
	Mar97	2	68	28.00	50.74	281.00	0.00
	May/Jun97	3	82	33.61	36.77	135.00	0.00
	Jul97	4	85	96.99	174.70	922.50	0.00
	Nov97	5	50	166.27	239.29	1216.00	0.00
	Mar98	6	84	43.48	88.55	502.74	0.00
	May/Jun98	7	73	25.04	60.55	450.00	0.00
	Jul98	8	78	113.97	160.28	975.00	0.00
	Nov98	9	63	102.82	108.36	440.00	0.00
	Mar99	10	73	45.28	106.55	595.00	0.00
	May/Jun99	12	80	54.10	47.81	258.67	5.40
	Jul99	13	64	72.27	68.38	429.00	0.00
	Jul00	14	65	114.68	142.23	743.75	3.00
	Jul01	16	72	70.43	74.85	318.00	0.00
	Jul02	21	78	70.70	83.90	424.80	2.00

Table 1b. Catches (kg/hr) by species and trip from FPI/DFO cooperative grid surveys, expanded grid area.

Yellowtail Flounder	Aug00	15	83	419.32	346.50	1519.49	10.00
	Aug01	17	80	451.42	374.19	1704.48	14.50
	Aug02	22	89	506.04	417.49	2536.59	11.00
American Plaice	Aug00	15	83	132.05	173.57	934.51	6.00
	Aug01	17	80	129.90	205.68	1159.46	5.30
	Aug02	22	89	125.68	160.01	1040.42	2.65
Cod	Aug00	15	83	51.96	58.05	340.80	0.00
	Aug01	17	80	88.30	199.69	1674.40	0.00
	Aug02	22	89	74.02	102.34	714.00	0.00
T. Skate	Aug00	15	83	12.47	30.64	227.50	0.00
	Aug01	17	80	14.51	37.39	224.00	0.00
	Aug02	22	89	17.27	26.26	146.00	0.00

Table 2a. Ratio of American plaice to yellowtail flounder catch, by block, from common blocks fished in fifteen surveys of the original grid area.

Block	Jul96	Mar97	May97	Jul97	Nov97	Mar98	May/ Jun98	Jul98	Nov98	Mar99	May/ Jun99	Jul99	Jul00	Jul01	Jul02	Ratio Mean	Total plaice/ Total ytail
G04	0.04	0.04	0.14	0.07	0.08	0.05	0.18	0.05	0.03	0.16	0.12	0.02	0.04	0.05	0.05	0.07	0.05
F05	0.01	0.34	0.05	0.02	0.02	0.26	0.03	0.01	0.06	0.07	0.12	0.15	0.08	0.06	0.01	0.08	0.03
H04	0.12	0.07	0.17	0.11	0.19	0.04	0.11	0.04	0.15	0.02	0.22	0.19	0.07	0.04	0.06	0.11	0.10
G03	0.14	0.22	0.28	0.08	0.83	0.03	0.20	0.05	0.11	0.03	0.32	0.02	0.11	0.11	0.09	0.17	0.12
A01	0.18	0.50	0.44	0.11	0.09	0.02	0.36	0.10	0.25	0.02	0.06	0.14	0.17	0.20	0.28	0.19	0.16
A05	0.08	0.10	0.38	0.21	0.32	0.12	0.39	0.36	0.32	0.01	0.49	0.14	0.12	0.07	0.13	0.22	0.22
A03	0.08	0.33	0.91	0.06	0.65	0.33	0.45	0.26	0.38	0.00	0.38	0.11	0.05	0.19	0.24	0.29	0.18
G07	0.11	0.11	0.29	0.12	0.13	0.06	0.21	0.37	0.12	0.04	0.48	0.45	1.57	0.28	0.27	0.31	0.25
H08	0.17	0.47	0.26	0.25	0.20	0.26	0.35	0.05	0.38	0.09	1.68	1.44	0.65	1.58	0.62	0.56	0.57
B02	0.14		0.39	0.33	1.15		0.51	0.20	1.28	0.24	0.43	0.45	0.32	0.19	0.14	0.44	0.34
C10	0.20	0.97	0.51	0.34	6.52	0.28	0.27	0.61	3.57	0.38	0.28	0.16	0.19	0.15	0.58	1.00	0.37
B09	1.65	1.25	3.66	0.56	19.57	4.18	0.36	7.70	28.15	11.17	1.47	2.73	0.34	0.49	1.28	5.64	1.25

Table 2b. Blocks from the expanded grid surveys, August 2000 and 2001, in which the ratio of plaice to yellowtail catch was under 5 percent.

Trip	Block	Yellowtail (kg/hr)	American Plaice (kg/hr)	Cod (kg/hr)	Thorny Skate (kg/hr)	Ratio (Plaice/Ytail)
Aug00	151	305.04	9.54	55.20	34.00	0.03
Aug00	505	688.37	28.62	16.80	0.00	0.04
Aug00	604	659.21	26.50	13.80	9.00	0.04
Aug01	162	196.98	5.30	410.40	224.00	0.03
Aug02	151	538.94	10.6	273.60	35.00	0.02
Aug02	601	64.00	2.65	52.80	0.00	0.04

Table 3. Catches of yellowtail (kg/hr) in the common blocks fished in July surveys (original grid).

	Yellowtail							
Block	**96**	**97**	**98**	**99**	**00**	**01**	**02**	**Mean**
A01	1315.86	997.64	2236.80	1488.97	1132.44	1979.66	934.82	1440.88
A03	1086.85	690.78	835.10	520.21	3319.19	797.39	711.33	1137.26
A05	1410.51	167.00	418.65	720.18	398.90	403.37	899.73	631.19
A07	576.73	845.50	572.27	516.58	438.24	779.90	907.66	662.41
A08	325.95	637.30	270.55	554.12	301.90	651.60	681.18	488.94
B02	321.00	482.30	379.29	124.50	165.74	163.06	295.56	275.92
B04	492.90	90.00	219.58	178.76	384.38	304.06	630.75	328.63
B06	756.00	612.00	666.10	665.60	489.45	1074.30	1289.32	793.25
B08	642.20	857.00	506.90	649.10	340.29	563.70	740.67	614.27
B09	254.20	582.34	26.00	101.00	486.75	302.58	141.00	270.55
B10	146.50	17.50	0.00	8.00	62.00	34.45	63.00	47.35
C05	942.59	606.50	542.12	333.26	914.32	594.98	943.72	696.78
C07	526.79	1240.50	2383.01	747.90	928.84	620.79	646.76	1013.51
C08	115.38	720.50	333.14	1438.47	174.90	337.20	368.36	498.28
C10	1430.89	1014.13	503.63	528.18	722.29	556.38	503.86	751.34
D04	668.14	567.38	593.45	465.55	632.81	1328.60	923.26	739.88
D05	739.76	635.75	928.76	624.04	796.84	760.83	1094.13	797.16
D08	471.87	481.50	698.63	752.12	586.63	1083.22	888.16	708.88
D09	684.76	513.20	903.64	682.98	965.14	1360.21	1136.24	892.31
E01	713.85	3369.10	2678.27	710.46	851.43	751.58	666.08	1391.54
E10	557.09	483.38	694.02	632.36	805.87	1096.10	1063.59	761.77
F02	1037.00	653.25	858.87	671.33	607.61	1275.68	744.62	835.48
F04	1032.34	704.00	1869.00	529.45	1471.18	1606.27	1875.01	1298.18
F05	1818.10	1396.97	2284.75	170.50	959.57	959.32	1906.62	1356.55
F06	955.94	728.30	1385.96	1087.21	1478.99	886.68	2065.76	1226.98
F08	1755.34	639.19	1469.34	830.30	1401.36	1063.85	1689.75	1264.16
F09	836.83	354.25	704.09	913.36	1095.84	675.05	910.60	784.29
G01	664.77	538.50	301.76	296.04	453.21	373.86	433.74	437.41
G03	344.68	518.50	1039.25	667.28	642.23	742.41	462.76	631.02
G04	868.66	451.13	899.02	538.87	1096.56	837.70	1098.37	827.19
G05	502.54	528.50	1169.70	338.33	833.59	705.11	847.73	703.64
G07	721.72	711.25	1042.11	589.41	246.13	655.72	887.16	693.36
H02	600.77	977.44	1198.47	853.26	1417.99	944.28	761.41	964.80
H04	357.56	684.70	941.39	419.57	688.98	641.64	531.70	609.36
H08	736.71	631.62	734.97	220.94	579.75	884.33	903.70	670.29
H09	485.07	269.74	463.14	344.20	888.43	569.87	762.55	540.43
I01	278.50	483.15	824.50	807.22	488.63	391.93	515.95	541.41
I03	441.88	857.50	567.89	163.00	870.36	496.83	855.15	607.52
J08	507.58	439.67	477.88	196.20	296.26	484.86	442.50	406.42
Mean	721.17	696.90	887.74	566.12	779.87	762.55	851.90	

Table 4. Catches of plaice (kg/hr) in the common blocks fished in July surveys (original grid).

	American Plaice							
Block	**96**	**97**	**98**	**99**	**00**	**01**	**02**	**Mean**
A01	232.80	114.27	218.90	204.56	187.90	388.49	261.50	229.77
A03	84.50	40.95	213.38	56.53	176.89	149.46	168.54	127.18
A05	110.00	35.00	152.64	104.41	47.70	26.50	119.78	85.15
A07	29.50	220.50	76.32	27.32	63.60	29.68	68.90	73.69
A08	220.50	111.10	100.70	138.48	142.60	49.70	90.60	121.95
B02	45.00	158.70	77.23	56.00	53.00	30.74	42.40	66.15
B04	111.50	15.50	42.40	12.72	30.18	26.50	24.38	37.60
B06	34.00	37.03	56.71	68.04	72.08	97.52	93.50	65.55
B08	158.00	173.90	47.70	120.58	225.12	137.20	84.80	135.33
B09	420.23	326.93	200.10	276.16	166.10	149.10	180.00	245.52
B10	270.00	146.75	253.49	140.50	209.27	116.60	237.14	196.25
C05	47.00	88.64	120.84	50.46	110.72	73.14	110.40	85.89
C07	151.00	231.20	431.42	73.60	110.74	113.42	136.30	178.24
C08	53.08	88.05	179.62	714.75	403.78	148.86	142.06	247.17
C10	293.00	349.50	309.68	85.10	138.07	81.84	292.76	221.42
D04	41.00	66.50	49.82	21.52	48.58	71.55	34.80	47.68
D05	10.00	149.00	222.60	39.01	74.67	47.17	92.22	90.67
D08	124.00	96.00	389.90	385.90	496.72	218.56	169.60	268.67
D09	163.50	232.78	330.46	190.37	479.48	272.14	232.14	271.55
E01	80.00	130.40	120.66	15.90	208.14	87.98	58.30	100.20
E10	147.50	265.25	189.21	263.73	352.92	306.09	248.64	253.33
F02	47.50	35.63	34.98	47.40	75.79	118.19	45.58	57.87
F04	8.00	38.09	33.92	8.48	36.57	42.40	40.81	29.75
F05	20.00	22.25	15.90	26.00	74.61	54.06	12.72	32.22
F06	23.00	0.00	56.18	55.12	95.84	83.74	73.96	55.41
F08	91.00	73.92	326.75	171.92	424.94	146.28	149.34	197.74
F09	67.50	85.12	302.10	311.11	438.84	158.26	123.78	212.39
G01	42.00	49.90	72.08	31.80	81.62	28.62	34.98	48.71
G03	47.50	39.15	54.06	15.90	70.78	80.56	41.34	49.90
G04	39.00	30.57	44.52	8.48	41.87	42.40	51.94	36.97
G05	20.00	39.78	31.80	29.68	127.73	74.20	57.56	54.39
G07	80.00	86.80	382.66	265.27	386.47	184.97	242.09	232.61
H02	67.00	92.81	80.56	122.96	367.56	237.44	258.38	175.24
H04	42.00	75.28	40.78	79.50	48.76	23.85	31.80	48.85
H08	124.00	155.40	33.92	317.21	376.83	1394.96	562.73	423.58
H09	74.50	280.35	411.81	171.72	1117.24	631.58	624.43	473.09
I01	86.50	214.60	114.48	57.71	121.90	142.04	168.54	129.40
I03	81.00	274.38	216.24	9.00	79.50	106.53	193.98	137.23
J08	387.00	1654.40	2197.82	975.20	403.86	1534.35	3180.00	1476.09
Mean	107.02	162.21	211.14	147.44	209.46	197.61	225.20	

Table 5. Ratio of American plaice to yellowtail flounder catch from common blocks fished in July surveys (original grid).

	Ratio American plaice/yellowtail								
Block	**96**	**97**	**98**	**99**	**00**	**01**	**02**	**MEAN**	**Total Plaice/Total Ytail**
F04	0.01	0.05	0.02	0.02	0.02	0.03	0.02	0.02	0.02
F06	0.02	0.00	0.04	0.05	0.06	0.09	0.04	0.04	0.05
G04	0.04	0.07	0.05	0.02	0.04	0.05	0.05	0.04	0.04
F05	0.01	0.02	0.01	0.15	0.08	0.06	0.01	0.05	0.02
D04	0.06	0.12	0.08	0.05	0.08	0.05	0.04	0.07	0.06
F02	0.05	0.05	0.04	0.07	0.12	0.09	0.06	0.07	0.07
G05	0.04	0.08	0.03	0.09	0.15	0.11	0.07	0.08	0.08
G03	0.14	0.08	0.05	0.02	0.11	0.11	0.09	0.09	0.08
B06	0.04	0.06	0.09	0.10	0.15	0.09	0.07	0.09	0.08
H04	0.12	0.11	0.04	0.19	0.07	0.04	0.06	0.09	0.08
E01	0.11	0.04	0.05	0.02	0.24	0.12	0.09	0.10	0.07
A07	0.05	0.26	0.13	0.05	0.15	0.04	0.08	0.11	0.11
D05	0.01	0.23	0.24	0.06	0.09	0.06	0.08	0.11	0.11
G01	0.06	0.09	0.24	0.11	0.18	0.08	0.08	0.12	0.11
B04	0.23	0.17	0.19	0.07	0.08	0.09	0.04	0.12	0.11
C05	0.05	0.15	0.22	0.15	0.12	0.12	0.12	0.13	0.12
A03	0.08	0.06	0.26	0.11	0.05	0.19	0.24	0.14	0.11
A05	0.08	0.21	0.36	0.14	0.12	0.07	0.13	0.16	0.13
F08	0.05	0.12	0.22	0.21	0.30	0.14	0.09	0.16	0.16
A01	0.18	0.11	0.10	0.14	0.17	0.20	0.28	0.17	0.16
C07	0.29	0.19	0.18	0.10	0.12	0.18	0.21	0.18	0.18
H02	0.11	0.09	0.07	0.14	0.26	0.25	0.34	0.18	0.18
I03	0.18	0.32	0.38	0.06	0.09	0.21	0.23	0.21	0.23
B08	0.25	0.20	0.09	0.19	0.66	0.24	0.11	0.25	0.22
B02	0.14	0.33	0.20	0.45	0.32	0.19	0.14	0.25	0.24
F09	0.08	0.24	0.43	0.34	0.40	0.23	0.14	0.27	0.27
I01	0.31	0.44	0.14	0.07	0.25	0.36	0.33	0.27	0.24
A08	0.68	0.17	0.37	0.25	0.47	0.08	0.13	0.31	0.25
D09	0.24	0.45	0.37	0.28	0.50	0.20	0.20	0.32	0.30
C10	0.20	0.34	0.61	0.16	0.19	0.15	0.58	0.32	0.29
E10	0.26	0.55	0.27	0.42	0.44	0.28	0.23	0.35	0.33
D08	0.26	0.20	0.56	0.51	0.85	0.20	0.19	0.40	0.38
G07	0.11	0.12	0.37	0.45	1.57	0.28	0.27	0.45	0.34
H08	0.17	0.25	0.05	1.44	0.65	1.58	0.62	0.68	0.63
C08	0.46	0.12	0.54	0.50	2.31	0.44	0.39	0.68	0.50
H09	0.15	1.04	0.89	0.50	1.26	1.11	0.82	0.82	0.88
B09	1.65	0.56	7.70	2.73	0.34	0.49	1.28	2.11	0.91
J08	0.76	3.76	4.60	4.97	1.36	3.16	7.19	3.69	3.63
B10	1.84	8.39		17.56	3.38	3.38	3.76	6.39	4.14

Table 6. Length compostion of Yellowtail flounder (sexes combined). Asterisk indicates expanded grid area.

		Percentage of Yellowtail		
Trip	Trip #	<26cm	<30cm	>=40cm
Jul96	1	1.90	6.31	26.41
Mar97	2	1.62	6.72	21.05
May/Jun97	3	1.11	5.80	26.88
Jul97	4	1.19	7.70	24.81
Nov97	5	0.16	2.73	31.49
Mar98	6	1.56	8.97	25.36
May/Jun98	7	0.88	6.05	24.81
Jul98	8	1.74	10.28	21.61
Nov98	9	0.79	5.81	24.56
Mar99	10	0.55	6.63	22.37
May/Jun99	12	0.62	5.99	24.90
Jul99	13	0.34	3.67	28.41
Jul00	14	0.64	4.45	21.88
Aug00 *	15	0.15	2.65	18.12
Jul01	16	0.63	4.84	20.05
Aug01 *	17	0.15	2.72	18.01
Jul02	21	0.80	5.76	16.64
Aug02*	22	0.18	2.96	17.92

Table 7. Numbers and weights of yellowtail caught in the original grid area during DFO stratified random surveys in Div. 3LNO.

Yr/season	**Ytail in original grid area**		**Yellowtail in survey**		**Pct of total catch in grid**	
	Numbers	Weight (kg)	Numbers	Weight (kg)	% nos	%wt
95F	19842	4528	22276	4997	89.1%	90.6%
96S	14695	3878	16937	4619	86.8%	84.0%
96F	7038	1899	8640	2141	81.5%	88.7%
97S	12059	2807	15010	3882	80.3%	72.3%
97F	10640	2928	17349	5037	61.3%	58.1%
98S	14841	4016	21134	5822	70.2%	69.0%
98F	8987	2507	12512	3696	71.8%	67.8%
99S	21718	5147	34998	9895	62.1%	52.0%
99F	12778	2946	18570	4978	68.8%	59.2%
00S	14183	3924	23131	7263	61.3%	54.0%
00F	9091	2784	22438	6507	40.5%	42.8%
01S	26003	6900	32446	8939	80.1%	77.2%
01F	15396	4365	32783	9475	47.0%	46.1%

Table 8. Numbers and weights of yellowtail caught in expanded grid area during DFO stratified random surveys Div. 3LNO during 2000 and 2001.

Yr/Season	**Ytail in exp. grid area**		**Yellowtail in survey**		**Pct in grid**	
	Number	Wgt (kg)	Number	Wgt (kg)	% nos	% wgt
00S	20798	6453	23131	7263	89.9	88.8
00F	12574	3759	22438	6507	56.0	57.8
01S	29295	8000	32446	8939	90.3	89.5
01F	21456	6338	32783	9475	65.4	66.9

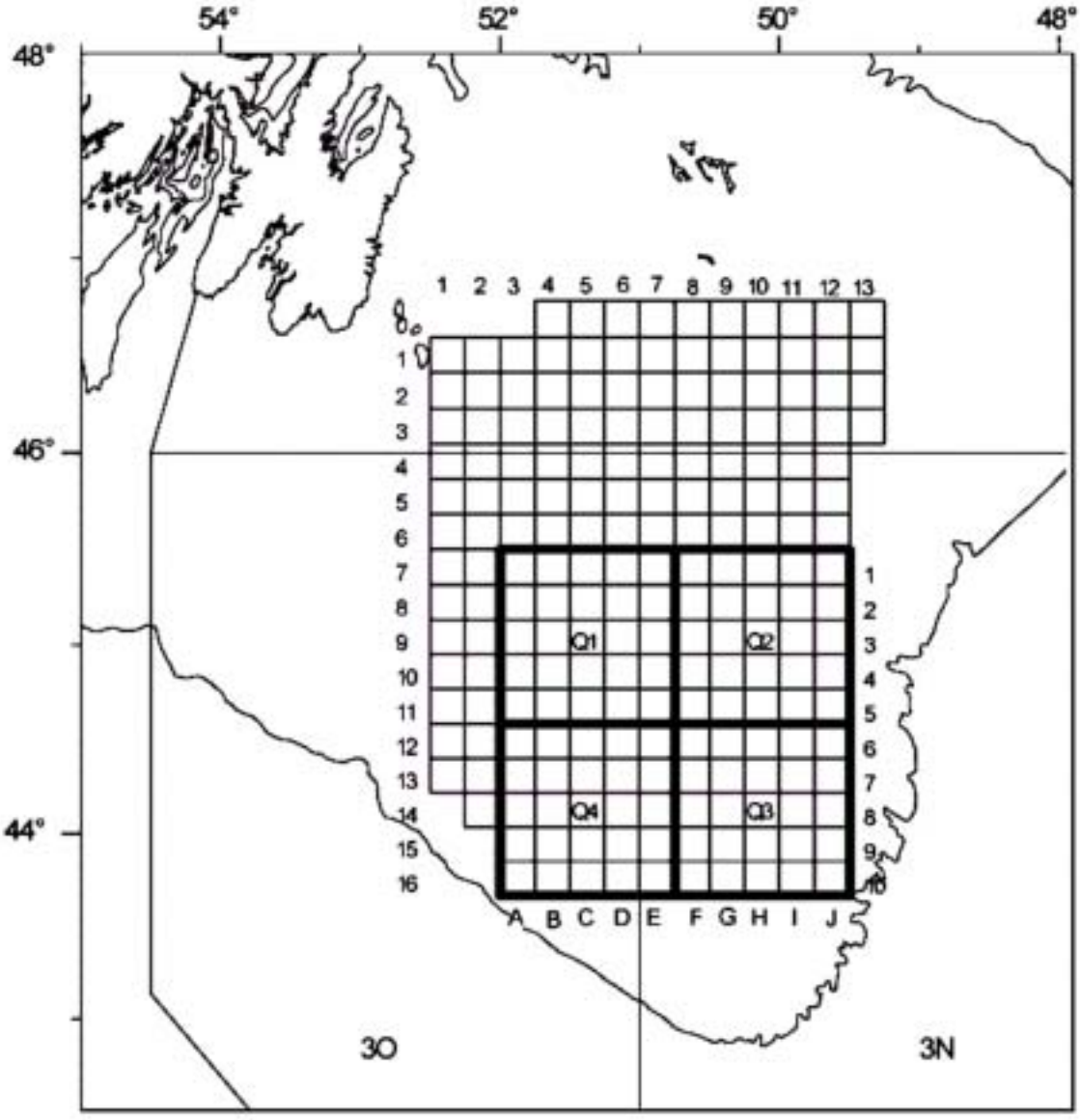


Fig. 1. Location of grid used in cooperative surveys directed at yellowtail flounder. Original grid bolded with 5x5 blocks per quadrant. Expanded grid surveyed in 2000-2002.

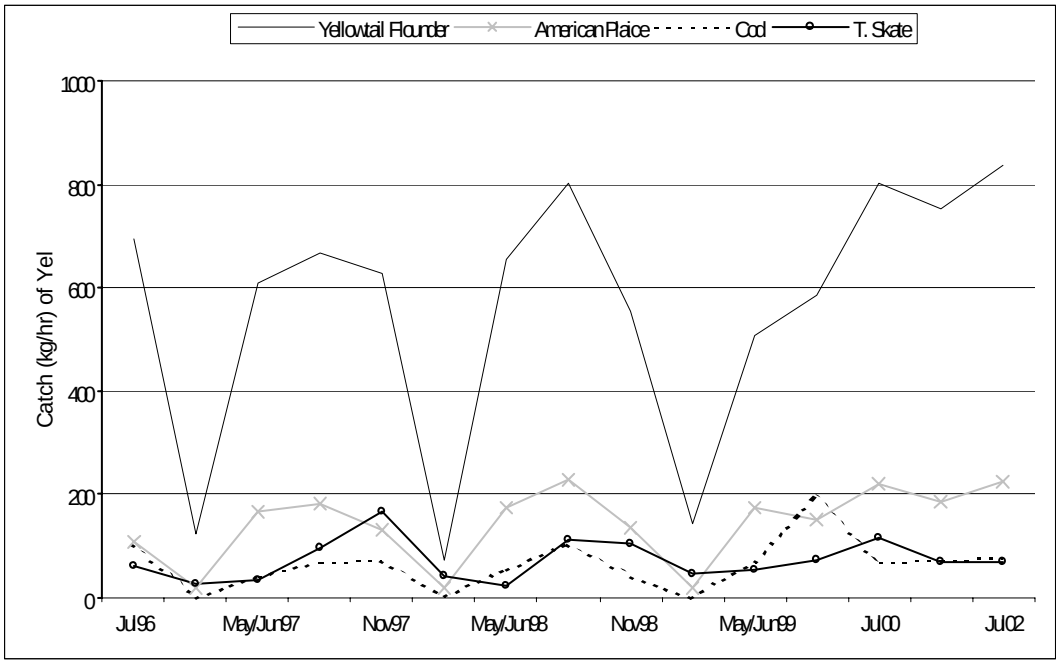


Figure 2. Mean catch (kg/hr) of yellowtail, American plaice, cod and thorny skate caught in original grid surveys from 1996-2002.

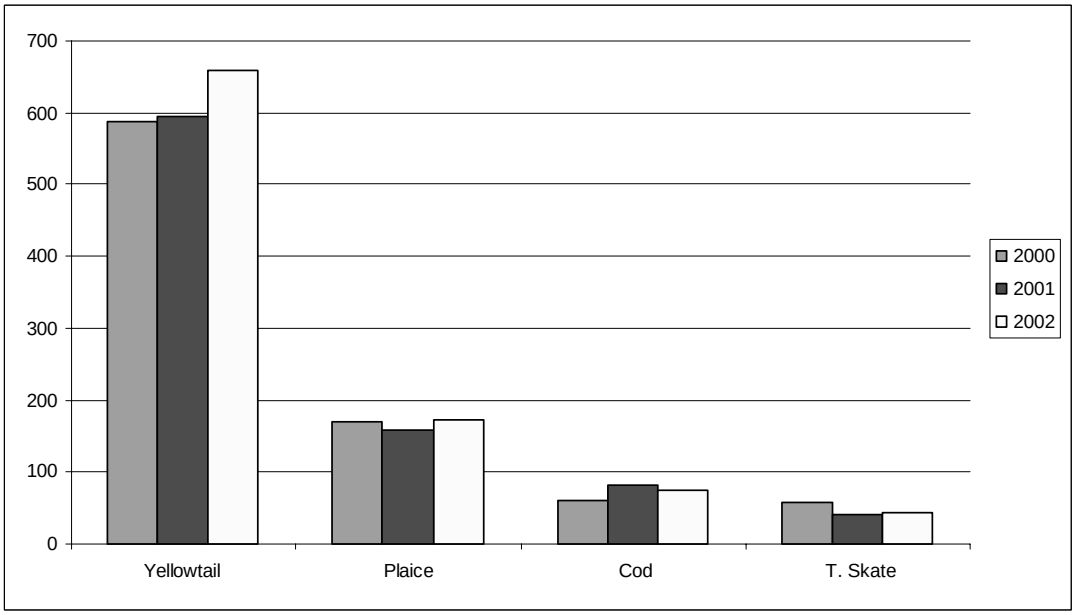


Figure 3. Catch (kg/hr) of yellowtail, American plaice, cod and thorny skate caught in surveys covering the original grid area in addition to an expanded grid area.

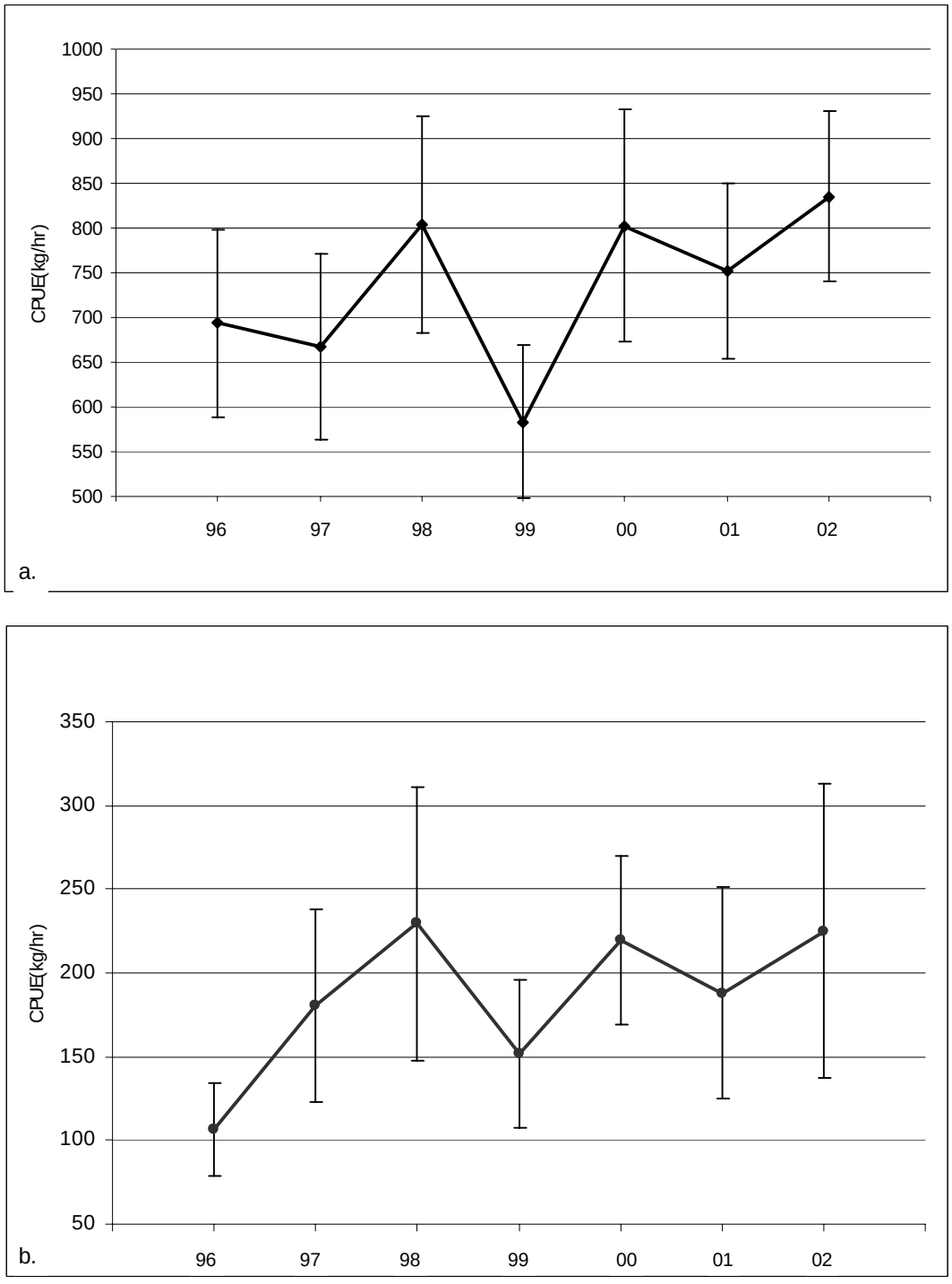


Figure 4. Average catches for yellowtail flounder (a) and American plaice (b) for July surveys only Data are mean ± 2 SE.

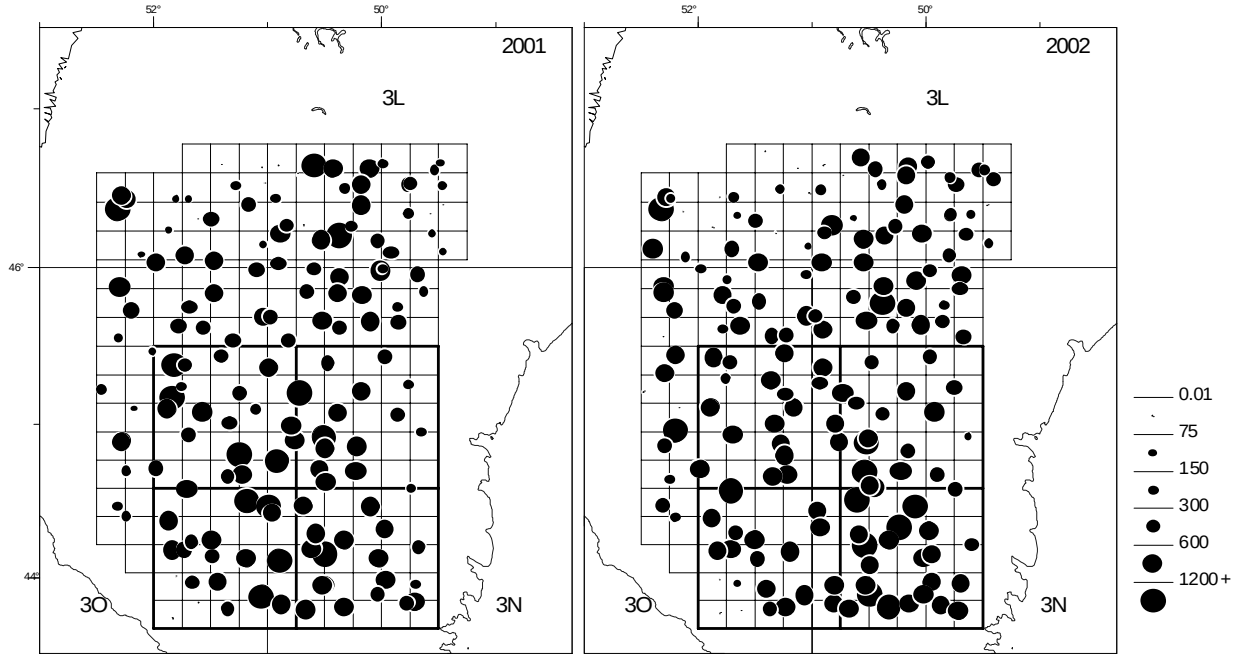


Figure 6. Distribution of yellowtail flounder catches (kg per standard 3Nm. tow) from industry grid surveys conducted in NAFO Div. 3LNO in 2000 and 2001.

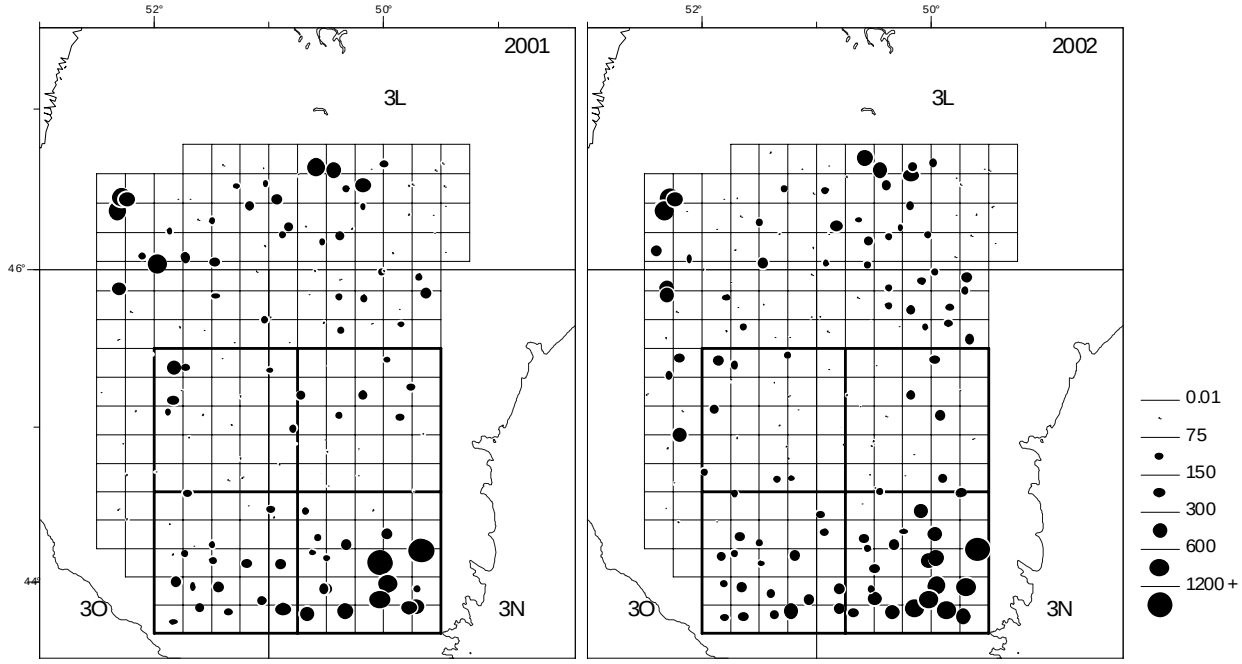


Figure 7. Distribution of American plaice catches (kg per standard 3Nm. tow) from industry grid surveys conducted in NAFO Div. 3LNO in 2000 and 2001.

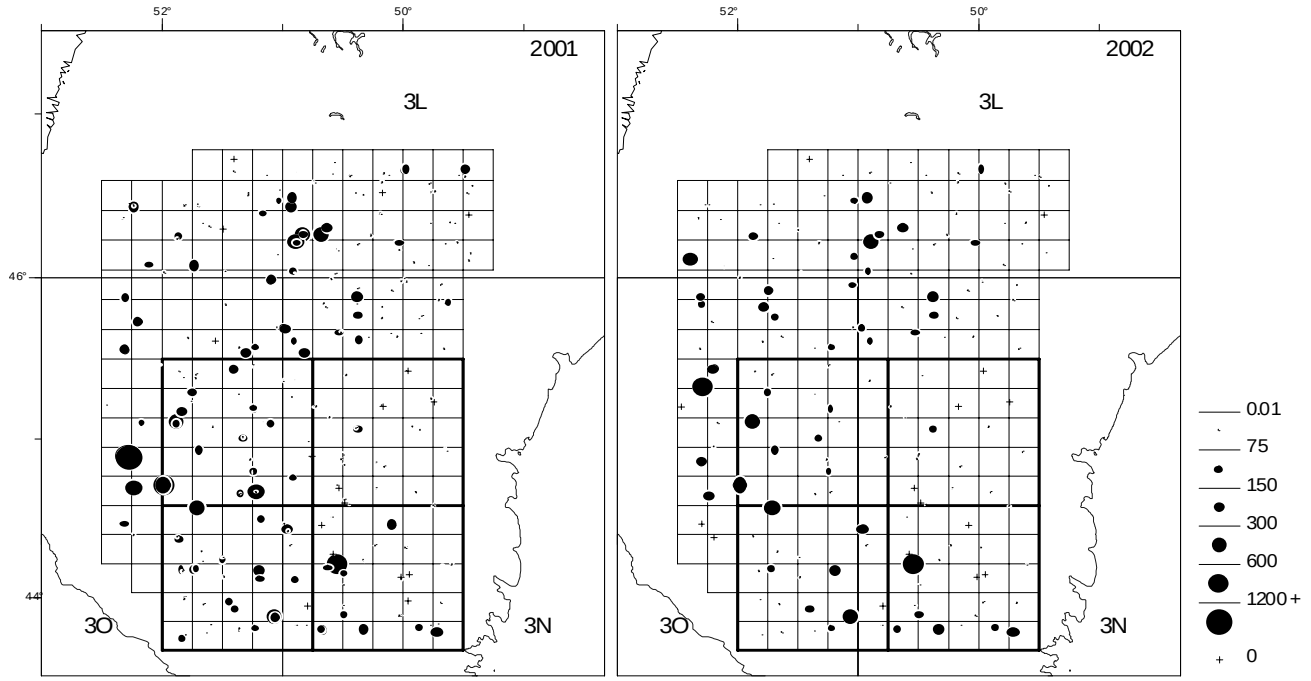


Figure 8. Distribution of atlantic cod catches (kg per standard 3Nm. tow) from industry grid surveys conducted in NAFO Div. 3LNO in 2000 and 2001.

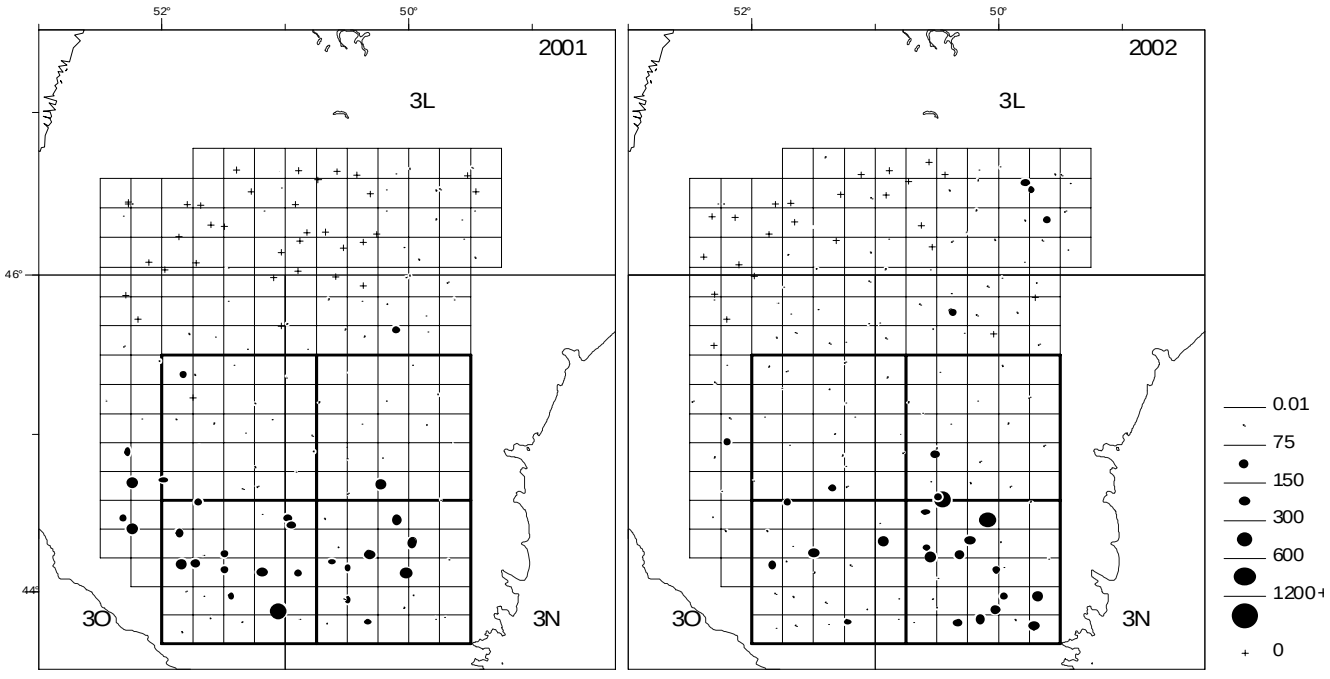


Figure 9. Distribution of thorny skate catches (kg per standard 3Nm. tow) from industry grid surveys conducted in NAFO Div. 3LNO in 2000 and 2001.

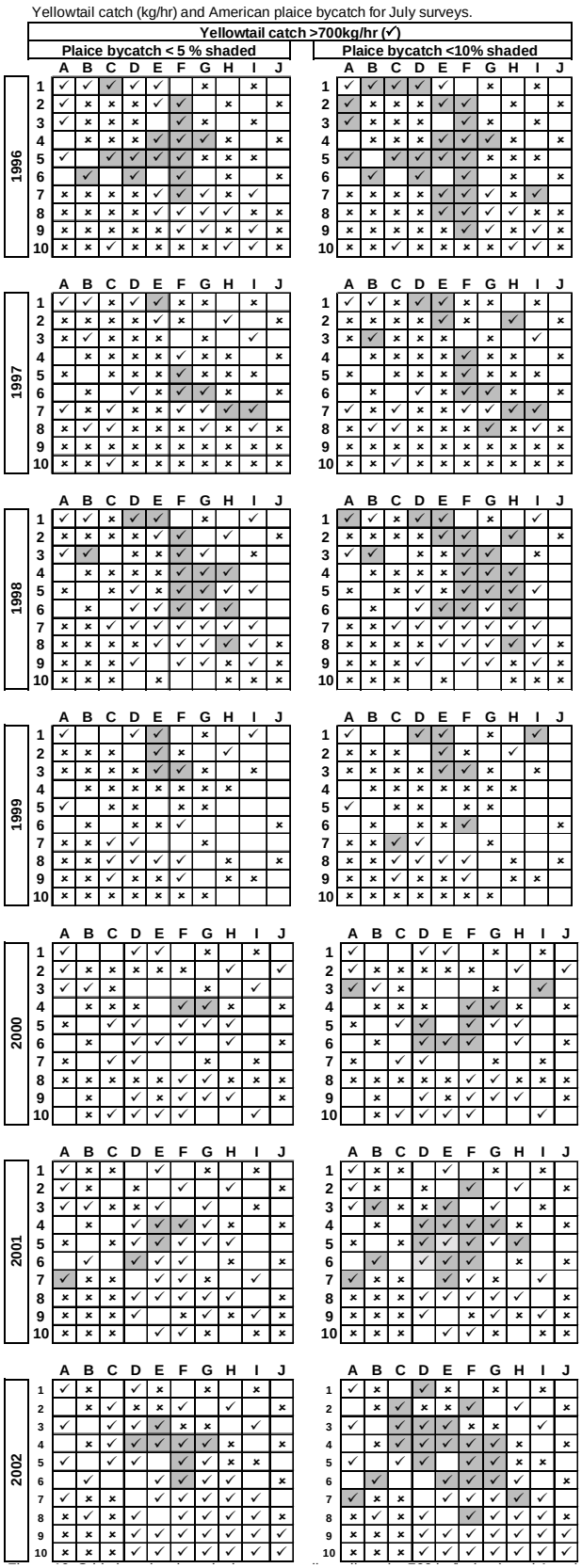


Fig. 10. Grid plots showing whether or not yellowtail catch >700 kg/hr (✓or ×) and American plaice by-catch less than 5% or 10% at this catch level (shaded blocks) for July surveys.

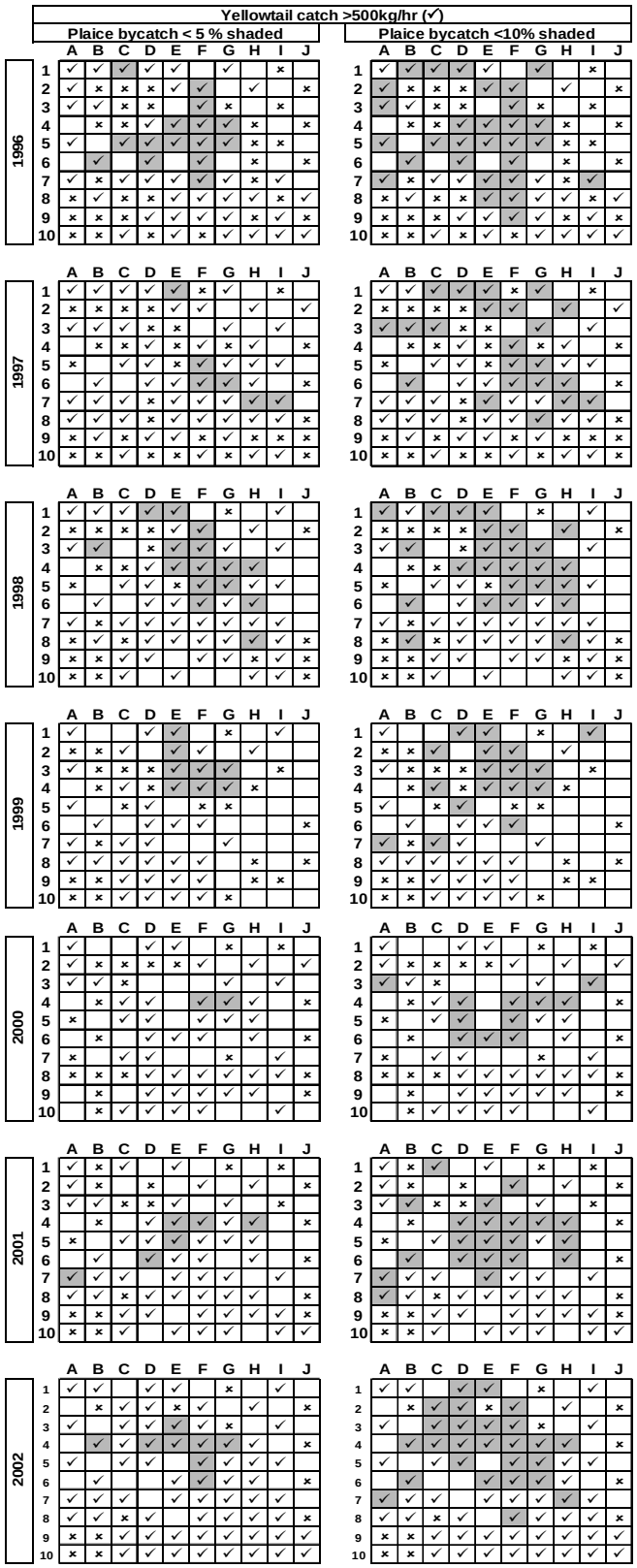


Fig. 11. Grid plots showing whether or not yellowtail catch >500 kg/hr (✓or ×) and American plaice by-catch less than 5% or 10% at this catch level (shaded blocks) for July surveys.

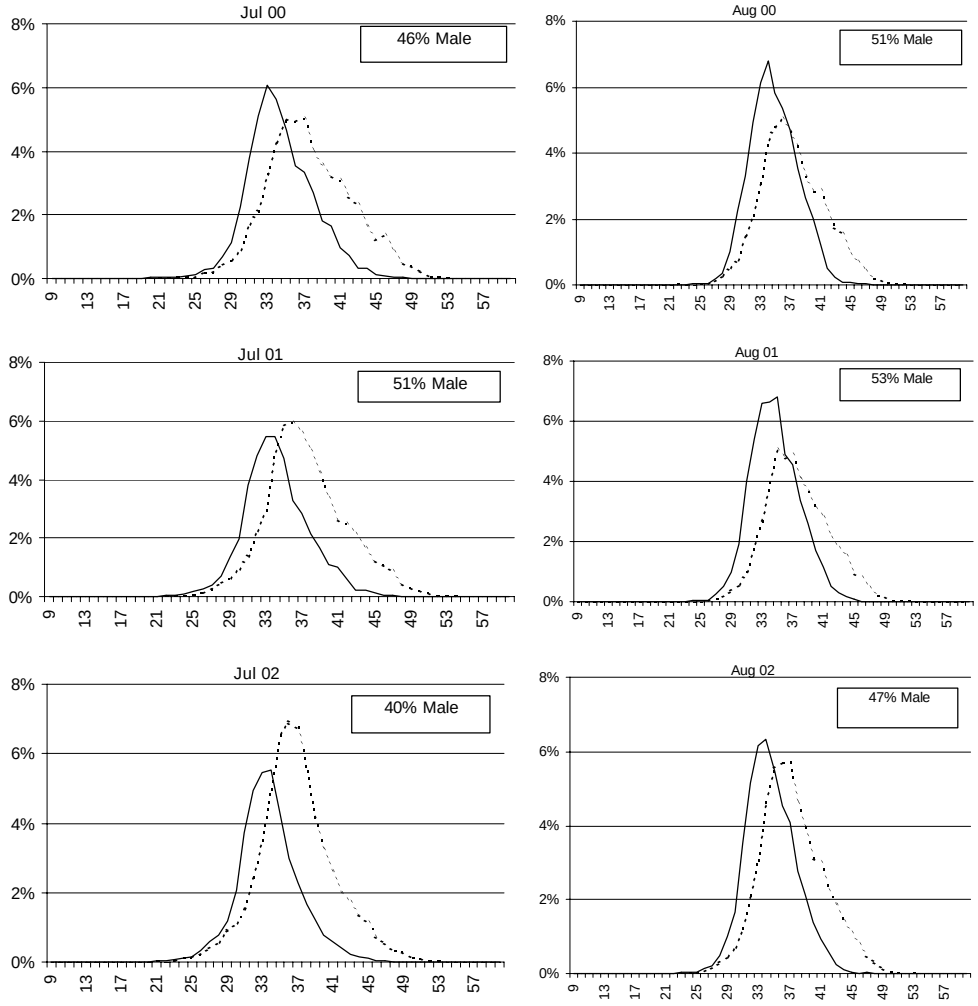
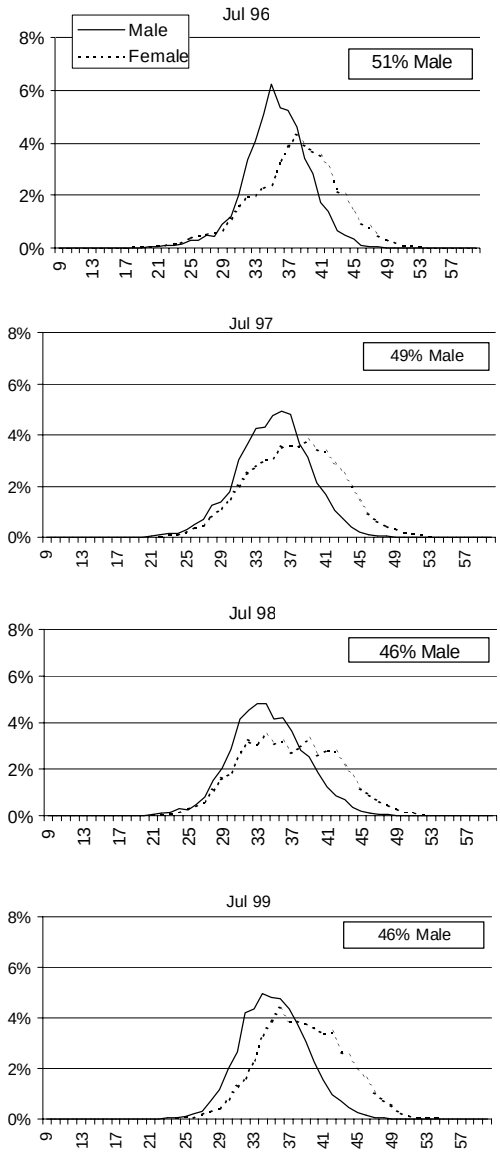


Figure 12. Length compostion of yellowtail flounder caught in the Atlantic Lindey July surveys (original grid) and expanded grid area (Aug plo



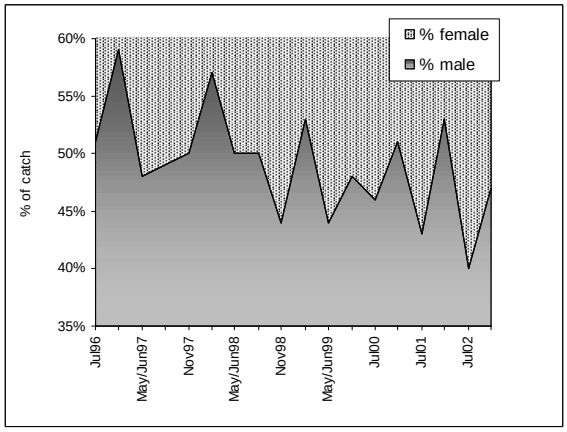


Figure 13. Sex ratio of yellowtail flounder catch for the Atlantic Lindsey surveys

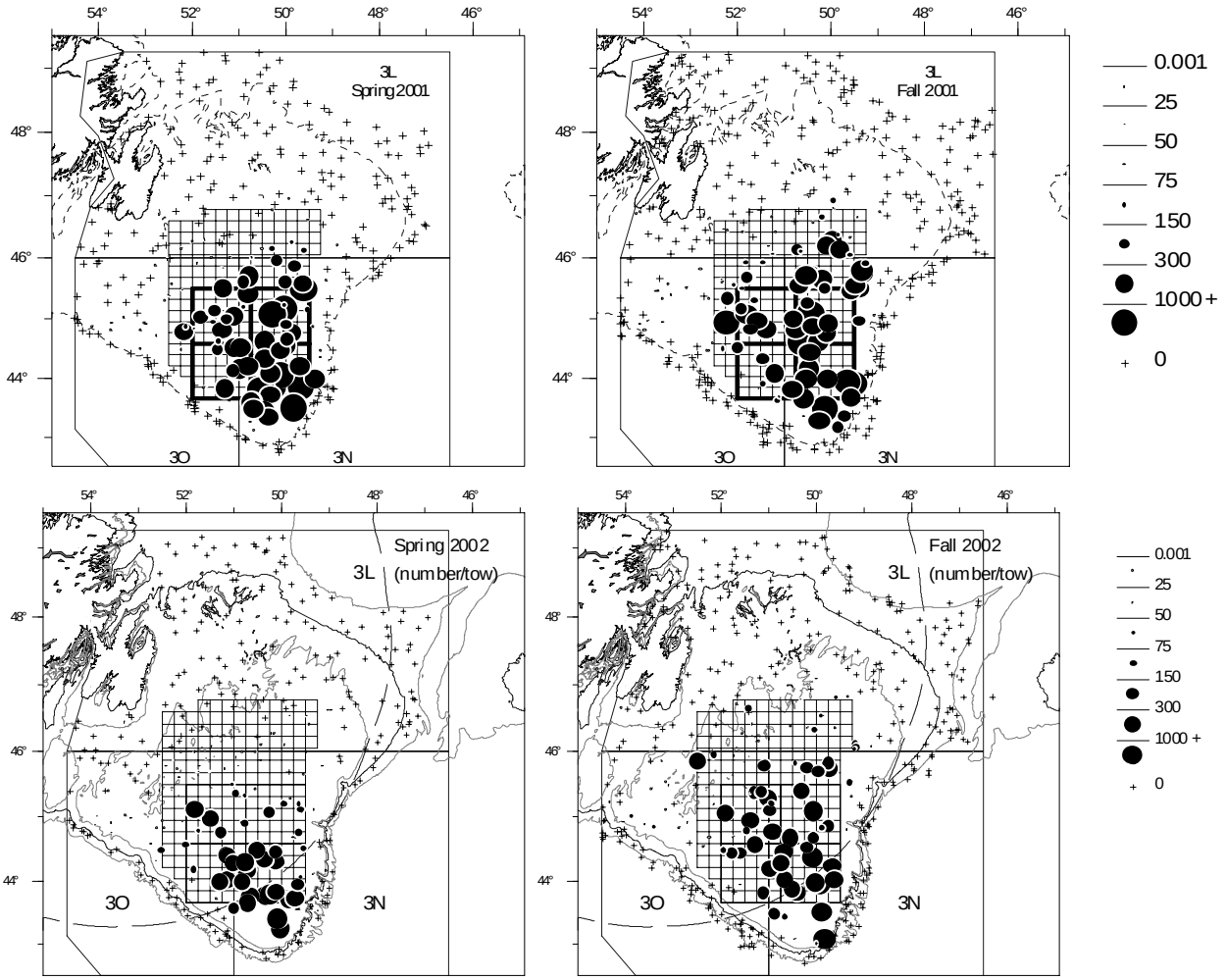


Figure 14. Distribution of yellowtail flounder catches (number/tow) from stratified random spring and fall surveys conducted in 2000 and 2001with a Campelen 1800 trawl in Div. 3LNO. Grid used in DFO-FPI suveys is depicted for illustration.