Northwest Atlantic Fisheries Organization

Serial No. N4686 **NAFO SCR Doc. 02/73**

SCIENTIFIC COUNCIL MEETING – JUNE 2002

Description of the 2001 Yellowtail Flounder Fishery on the Grand Banks with a Comparison to Past Years

by

D. W. Kulka

Department of Fisheries and Oceans
P O Box 5667, St. John's, Newfoundland, Canada A1C 5X1

Abstract

The yellowtail fishery on the Grand Banks was prosecuted for the fourth year in 2001 following a 3-year moratorium. Monitoring of the 2001 fishery in the form of nearly full coverage by fishery observers facilitated a detailed examination of the catch, effort and biological parameters of the fishery. The results were compared to 1998-2000. The fishery starting on in mid Jan. 2001 and ending in December was prosecuted at locations similar to 2000 covering plus three new grounds, all covering 15% of the total area of the Grand Bank where bottom depth was less than 100 m (compared to 12% in 2000). Fishing occurred over a narrow depth range, mainly between 50 and 70 m. Effort was targeted for yellowtail flounder since 1998 in contrast to the past (pre-1994) practise of taking yellowtail in a mixed fishery over a much more extensive area of the Grand Bank. Yellowtail flounder was again successfully exploited as a single target species rather than part of a mixed fishery (per the historical fishery) by concentrating effort where it was most abundant and other species were minimal. Directed otter trawl catch of yellowtail in 2001 was 12,095 t up from 9,414 t in 2000, 6,609 t in 1999 and 3,795 t in 1998. Minimization of bycatch was achieved by targeted spatial concentration of effort and the use of a sorting grate with average spacing of 123 mm. Yellowtail dominated the catch in all areas and American plaice was the most common bycatch.Bycatch levels of cod and plaice were somewhat higher in 2001 than previous years (plaice – 4.2% 1998, 4.4% in 1999, 6% on 2000, 10.4% in 2001, cod – 2.3% in 1998, x% in 1999, 1.2% in 2000, 3.1% in 2001). Size of fish taken was similar to 1998 and 1999. Over all areas fished, using an average codend mesh size of 149 cm, average size of males and females in the catch was 36.4 and 39.3 cm respectively, very similar to 1998-2000. A total of 23.4 million individuals were estimated to have been removed by the fishery compared to 7.3, 12.9 and 17.9 million in 1998, 1999 and 2000.

Introduction

Yellowtail flounder (*Pleuronectes ferruginea*) is distributed off Newfoundland across much of the shallow portions of the Grand Banks within NAFO (Northwest Atlantic Fisheries Organization) Divisions 3L, 3N, 3O and Subdivision 3Ps (Fig.1). Early research survey work showed that the largest concentrations in Canadian Atlantic waters were located on the central part of the bank in less than 100 m (Walsh et al. 2000, Walsh et al. 2001a). A mixed trawl fishery was initiated in Divisions 3L, 3N and 3O in 1960 during an expansion of fishing effort by Canada to the offshore and yellowtail flounder was found to be commercially viable. Since that time, until 1994, yellowtail had been exploited primarily as a part of a mixed fishery with cod (*Gadus morhua*) and American plaice (*Hippoglossoides platessoides*). Effort occurred mainly during the summer months over a large proportion of the Grand Bank. Over that period, total annual catches varied ranging between 7 t in 1960 and 39,259 t in 1972 (Walsh et *al.* 1998). Except for the peak years of 1985 and 1986, catches between 1976-93 were in the range of 10,000 to 18,000 t. Walsh et *al.* (1999, 2000, 2001b) provides further details of the historic fishery.

A productive mixed fishery for over 30 years, the NAFO Fisheries Commission closed the Grand Bank to directed fishing for yellowtail, plaice and cod in 1994. This action was taken even though a 7,000t TAC (Total Allowable

Catch) for yellowtail had been recommended for that year. The fishery was closed because TAC's had been exceeded each year from 1985 to 1993, unreported catches outside 200 miles were a concern and overlapping cod and plaice stocks were in decline (NAFO Scientific Council). From 1995 until 1997, the only commercial catches of yellowtail on the Grand Banks occurred outside Canada's 200 mile limit, Reported as bycatch in other fisheries, 2,069 t was reported as taken primarily by Spain in 1994 subsequently falling to less than 300 t annually in 1995-97. Following 3 years of closure, the NAFO Scientific Council indicated that yellowtail in 3LNO was abundant enough to support a limited fishery in 1998 and an expanded fishery in 1999 with further expansion in 2000. The Council stipulated that the fishery be carefully monitored and sampled including 100% coverage by Canadian fishery observers.

Stock assessments for yellowtail in 3LNO from 1994 to 1996 indicated low biomass and a moratorium on fishing for yellowtail (as well as plaice and cod) remained in affect in those years. In 1997, no analytical assessment of yellowtail was possible due mainly to uncertainties with catch and catch-at-age data (NAFO Scientific Council). However, given the reduced mortality due to the three year moratorium on fishing, many age classes were contributing significantly to the biomass and that the stock size had increased since 1994. Thus, the Council indicated that the stock should be able to sustain a limited fishery and a commercial fishery for yellowtail flounder was re-instituted in 1998. However, the stock biomass had not returned to historic levels and Scientific Council recommended that the TAC not exceed 4,000 t for 1998. Based on increased biomass of fully recruited fish, the quota was increased to 6,000 t for 1999. Of this, 5,850 t was allocated to Canada to be fished solely within the 200 mile limit. NAFO allocated 80 t to the European Union and the remainder to "other". The quota was allocated in this manner based primarily on pre-moratorium allocations. In 2000 and 2001, the quota was increased to 10,000 t and 13,000 t respectively, again the largest proportion allocated to the Canadian offshore fleet.

The current paper focuses on spatial and temporal aspects of the 2001 fishery in comparison to 1998-2000 and the pre-moratorium fishery based on fishery observer data. The spatially detailed information collected by fishery observers was of use in assessing the impact of the fishery on the Grand Bank stocks and of benefit to industry is terms of strategic planning for upcoming fisheries. The analyses look at both catch and bycatch trends and size of yellowtail flounder taken in the fishery. It examines spatial configuration of the fishing activity with respect to the distribution of yellowtail, plaice and cod derived from research surveys.

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 such as gear configuration and fishing strategies from the 1998-2001 large vessel yellowtail fishery in a manner specified in Kulka and Firth (1987). Observer data for Maritimes based vessels (amounting to only 2% of the catch) were not available for this analysis and 65-100 ft vessels were not monitored. It is estimated that a total of 5,488 fishing sets were prosecuted in the 2001 directed Canadian offshore fishery. A ratio of the landed to the observed catch of yellowtail was used to adjust observed bycatch weight to an estimate of total weight caught for each species taken in the fishery. Table 1 lists by month and NAFO Division, catch, effort and fishery statistics for the 2001 Canadian offshore vessel yellowtail fishery: number of sets prosecuted and catch, average catch rates for yellowtail flounder, American plaice and cod, average depth fished, average codend mesh size and average sorting grate space used.

Potential mapping in SPANS (Anon 1997) was used to convert the commercial catch and effort to surface maps describing the distribution of the fishery and the distribution of yellowtail in NAFO Divisions 3N and 3O. The potential mapping method transforms points (fishing sets consisting of catch (tonnes) per hour for the commercial fisheries data and standardised catch (kg) per tow for survey data) to a continuous surface spatially depicting differential densities of fish (catch rate subareas) or density of fishing effort (areas depicting differential in sets per km^2) by placing a circle around each point. The values of all points that fall within the circle (i.e. all points that are located within a specified distance of the circled point) is averaged and this value is assigned to the area encompassed by the circle. The procedure is repeated for each point creating overlapping circular areas equal to the total number of sets. A further averaging takes place where the circles overlap resulting in the creation of many more areas. The values from resulting areas are assigned to an underlying quadcell (a quadcell being a variable sized raster dividing the study area into a fine grid). An integration of classified quadcells forms a surface depicting density of the fish. For this method, by choosing the appropriate circle size, the technique effectively smoothes the data at its maximum resolution, i.e. at the spatial distance of the fishing sets without extrapolating beyond the

bounds of the data or interpolating within the matrix of points. Refer to Anon (1997) and Kulka (1998) for a more detailed technical description of the potential mapping method and quadcell structure within SPANS and its application to mapping and biomass analyses of marine species.

For commercial fisheries data, a circle radius of 6 km was selected from a range of 1 to 8 km circles based on the criteria described above. Choosing this size had the added advantage that it corresponded the spatial scale of fishing effort. The length of a fishing set i.e. a typical set by a trawler fishing for yellowtail in 1998-2001 extended over about 13 km (corresponding to a circle radius of 6.5 km). Thus, calculations of areas fished at the spatial resolution of fishing activity reflected the true extent of the fishing grounds. The fishery took place at the conjunction of Divisions 3L, 3N and 3O. Both density of fishing and catch rates for yellowtail, plaice and cod were mapped.

Biological monitoring of the 2001 yellowtail fishery comprised the collection at sea by observers of catch lengths and ageing materials (otoliths) by sex. However, difficulties in interpretation of the growth rings of the otoliths prevented ageing of the fish (Dwyer et *al*. 2001). This information was gathered using the protocols outlined in Kulka and Firth (1987). The length samples materials covered all time periods and areas fished allowing for a detailed spatio-temporal analysis of fish sizes in the catches. Table 2 specifies the catch (landings) and sample weight, number of fish measured and number of otoliths collected for the analysis of fish size in the commercial catches by NAFO Division and month. A total of 1,807 length samples were taken comprising 367,587 fish were measured and sexed from the catches of the yellowtail fishery. Due to high the high level of coverage, the yellowtail catches were intensely sampled for length by sex. Proportion of total catch sampled was high, about 1.6% by weight and 1.1% by number. For all samples, weight was obtained by direct measurement. Sampling was spread proportionately across all fishing grounds and time periods and were spatially well distributed. Each length frequency was adjusted to the catch weight for each set prior to estimation of numbers caught by sex for each length group by area (fishing ground) and by month. Numbers of fish at age were estimated. Other narrative information including industry opinions on the fishery, fishing strategies and the stock status recorded in observer trip reports are also discussed in the context of patterns observed in the data.

Results and Discussion

Description of the Fishery

Historically (pre-1994), the directed Canadian fishery was prosecuted offshore by otter trawlers > 100 ft and it was this fleet sector that received most of the Canadian allocation from the fishery when the fishery was re-opened in 1998. Since the reopening, 9 vessels in 1998, 15 vessels in 1999 and 2000 and 19 vessels in 2001 participated in the large vessel fishery. In 2001, 97% or 12,676 t of the quota of 13,000 t was allocated to Canada, all to vessels > 100 ft, similar to previous years. Against this allocation, 12,075 t of yellowtail flounder was taken in the directed otter trawl fishery (Table 4a). Yellowtail comprised 81% of the total catch in 2001 down from 90% in 2000. Bycatch comprised mainly American plaice (1,565 t, up from 616 t), skates (604 t, up from 164 t in 2000), cod (470 t, up from 125 t in 2000) and striped wolffish (70 t, up from 6 t in 2000). Virtually all of the plaice and cod were kept while 35% of the skate (primarily thorny, *Raja radiata*) were discarded. A total of 61 other species were captured incidentally in smaller amounts (total bycatch amounted to 2,917 t). This compares to 49 species (and 1,031 t of bycatch) recorded in the 2000 catches.

Yellowtail flounder taken by vessels < 100 ft in 2000 and 2001 (otter trawls, shrimp trawls, Scottish seines, and gillnets) were strictly in the form of bycatch. In 1998 and 1999, one vessel < 100 ft directed for yellowtail flounder. The manner in which the quota was allocated between 1998 and 2001 is summarized in Table 3a.

Time and area restrictions changed over time. For 1998, it was recommended that fishing should take place only after peak spawning was completed in June-July and the start date was set for Aug. 1. In 1999, fishing was permitted year round except from June 15-July 31, the peak period of spawning. There were no time restrictions in 2000 or 2001. The period of fishing in that year was Jan. 9 to Dec. 7. Fishing on the northern part of the Grand Bank (NAFO Div. 3L) was prohibited in 1998 given the continued low biomass index in this area but was opened to fishing in 2000 and 2001 as the biomass estimates in this area was considered to have increased sufficiently to sustain exploitation. Historically, NAFO Div. 3L was not an area of dense concentration of yellowtail and thus was not an important fishing ground for this species. Only 1.5% of the offshore otter trawl catch was taken in NAFO Div. 3L in 2001.

Based in part on recommendations from NAFO, Atlantic Canada Conservation Harvesting Plans (CHP's) for vessels >100 ft were used to define the parameters of the yellowtail fishery in 1998 through 2001. Restrictions were put in place to minimize bycatch of cod and American plaice still under moratorium: "Pursuant to NAFO Conservation and Enforcement Measures, "incidental catches of (each of plaice and cod) could not exceed 1,250 kg or 5% by weight of the total weight on board, whichever is greater". Exceeding this level would result in closure for 10 days and the invocation of a test fishery before reopening.

Net material used was restricted to diamond configuration and minimum mesh size permitted was 145 mm. Based on an earlier recommendation, the 1999 CHP specified use of a minimum 155 mm diamond mesh in the codend. However, mesh size as small as 145 mm were observed in 1998-2001 and the average mesh size for 2001 was 149 (range of 145-158) mm, similar to years past (Fig, 2, Table 3b). Average mesh size used was consistent among areas and months (Table 1). Catch rate of Yellowtail flounder, American plaice and cod varied little in relation to mesh sizes used (Fig. 2).

Although vessels were not required by regulation to use sorting grates for the purpose of reducing bycatch, all Newfoundland vessels employed a rigid grate most of the time as a measure to maintain bycatch below the 5% threshold that would lead to closure of the fishery. An earlier joint study by Industry Development Division of Fisheries and Oceans and the fishing industry (Hickey et *al.* 1995) showed that by use of a rigid vertically oriented grate, cod bycatch could be reduced at locations where they mixed with flatfish species. Kulka (2000) reported on the effectiveness of the grate in the 1998-1999 fisheries. The grate spacing varied between 95 and 155 mm averaging 123 mm in 2001 (slightly higher than in past years, Table 3b). Grate spacing used was consistent among areas and months (Table 1).

A small fish protocol was employed in all years to avoid excessive catch of small (not yet mature) fish. Under this directive, if the number of undersized fish exceeded 15% of the catch on any day, an area would be closed to yellowtail fishing for 10 days. For monitoring purposes, yellowtail flounder were considered undersized if less than 30 cm.

The 2001 Conservation Measures for Canadian Fleets Fishing for 3LNO Yellowtail Flounder can be summarized as follows:

- Canadian vessels will be restricted to fishing inside 200 miles in 3LNO.
- A minimum mesh size of 145mm will be used when directing for 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 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 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 terms of Spawning and Juvenile fish areas, closed areas were considered but were not implemented.

Monthly trends in the catch and effort for the 2001 yellowtail fishery (Table 1 and Fig. 3) are similar to what was observed in 2000. Most of the effort was concentrated April, May, October and November although fishing occurred in all months except July and August,. The period of non-fishing in July and August was an effort by the industry to minimize fishing during spawning. It may also have had the effect of reducing bycatch of American plaice. Fig.4 shows that the catch rate of American plaice was increasing during the period prior to July. Catches were correspondingly high during those months. Catch rates of yellowtail flounder were (Fig. 4 and Table 1) lowest in the early part if the year, averaging about 0.4 t per hour until May. From May onward, catch rate averaged about 0.8 t per hour. American plaice catch rates were also lowest in the early part of the fishery increasing to about 0.2 t per hour during April. In the fall, catch rates were low in Oct., increasing into Dec. Cod catch rates remained low through the fishing season. In terms of area, the highest yellowtail, American plaice and cod catch rates were achieved in NAFO Div. 3O.

A full description of the 1998, 1999 and 2000 fisheries can be found in Kulka (1999, 2000 and 2001).

Spatial analysis of the Canadian fishery

At depths less than 100 m, the Grand Bank is a large, relatively flat area covering 135,000 km^2 (Fig. 1). Yellowtail flounder are distributed over most of this area in varying densities (Kulka 2000, Walsh et *al.* 2000). The records collected by fishery observers show that the 2001 fishing grounds for yellowtail covered 21,273 km^2 or 15% of the area of the Grand Bank at depths less than 100 m. This area fished in 2001 was about 20% bigger than in 2000 but only 33% of the area covered by the historical (pre-1994) fishery (Fig. 5). The historic fishery covered a more extensive area since it targeted not only yellowtail but also cod and American plaice in a mixed fishery. Proportion of each of the three target species sought in the historic fishery and thus grounds fished resulted from market requirements. Fishing location since 1998 resulted from a bycatch minimization strategy. Thus, 95% of the effort occurred between 50 and 90 m in the 1998-2001 fisheries whereas the pre-1994 fisheries were dispersed over a greater range of depths where concentrations of cod and plaice overlapped with yellowtail flounder.

The 2000 and 2001 fisheries took place mainly at two distinct locations near the intersection of Divisions 3L, 3N and 3O (Fig. 6, the two main grounds delineated by boxes in Fig. 6a). In 2000, the northern ground comprised about 40% of the total fishing effort while the southern box comprised 55% of the effort. An increase in area fished in 2001 was due to an expansion to three new areas fished (encircled in Fig. 6b), one located just east of the Whale Deep and the other a southward expansion of the south ground (lower box, Fig. 6a) centred at Lat 45^0. Average depth fished in the northern box was somewhat shallower at the southern location (57 m) compared to 74 m for the northern box. Much of the area fished in 1998 to 2001 corresponded with of locations of high catch rates of yellowtail flounder seen in the pre-1994 fisheries (refer to Fig. 7c, left panel).

As in 1998-2001, about half of the total area fished contained 98% of the fishing sets. Thus, fishing effort for yellowtail flounder was again highly localized compared to the pre-moratorium mixed fishery that was considerably more dispersed. The concentration of effort was the result of targeting of areas where yellowtail flounder were aggregated and other species, primarily American plaice and cod were dispersed. A detailed description of grounds fished in previous years is provided in Kulka (1999, 2000 and 2001).

Catch rate (t per hour), reflecting local density of the yellowtail flounder varied over the area fished (Fig. 7). The areas that produced the best catch rates in 1991-93 were similar to the highly fished areas in 1998 to 2001 except for the area straddling the 3LN border. This northern ground was the most productive area since 1999 where catches often exceeded 1 t per hour but where catch rates were very low in previous years. Over most of the area fished (except near the 3NO border), catch rates were lower in 2001 compared to 2000. Table 3c shows that the average catch rate of yellowtail flounder was 20% lower in 2001 compared to 2000 but similar to 1998.

Distribution of plaice bycatch rates in 2001 is similar to what was observed in 2000 (Fig. 8b vs. 8a) and 1998 and 1999 (Kulka 2001). Plaice catch rates although variable were generally higher north of Lat. 45^0 and in the vicinity of the Southeast Shoal. Areas of high catch rates of American plaice tended to correspond with areas of high yellowtail flounder catch rates making it difficult to avoid some bycatch pf plaice. The three new areas fished in 2001 (circled areas in Fig. 7) tended to have a mix of catch rates. The proportion of American plaice in the catch was higher in 2001 compared to 2000 and earlier years (10.4% of the catch in 2001 comprised American plaice vs. 6% in 2000). For cod, the highest catch rates occurred on the periphery of the grounds where plaice were relatively low (Fig. 9) but was low at all locations fished.

The depth range fished was for yellowtail flounder was quite narrow, between 28 and 88 m concentrated mainly between 50 and 70 m (Fig. 10). The fishery in NAFO Div. 3N was shallower than in 3O which was shallower than 3L. Catch rates of yellowtail flounder were lowest at depths < 40 m although effort at those depths was very limited. American plaice catch rates increased with depth over all areas fished. Cod varied little over the depth ranges fished

The relationship between density of yellowtail (reflected by catch rate) and density of plaice and cod bycatch is further illustrated in Fig. 11. In both 2000 and 2001, high plaice catch rates corresponded with high yellowtail rates while cod is higher where yellowtail is low. Thus avoidance of plaice bycatch is problematic, particularly in 2001. Catch rates of American plaice were considerably higher in relation to yellowtail flounder catch rates. Thus, the fleet concentrated its 2001 effort where yellowtail flounder catch rates were less than optimal (0.4-0.6 t per hour) in order

to avoid excessive plaice bycatch (Fig. 1b). This resulted in a lower average catch rate of 0.732 t per hour in 2001 vs. 0,910 t per hour in 2000. Table 3c shows that plaice comprised 10.4% of the total catch in the 2001 directed yellowtail fishery compared to 6% in 2000, 4.4% in 1999 and 4.2% in 1998. Cod bycatch in 2001 was 3.1% compared to 1.6% in 2000, 2.3% in 1998 to 1.2% in 2000.

Length and Age Composition

Table 2, listing fish sampling statistics and numbers of fish caught by area by month, shows that the sampling of size by sex in the fishery was very intense. Overall, 1.6% of the total tonnage of fish landed from the otter trawl fishery was sampled (1.53% in 2000, 1.6% in 2001). Fishery observer records indicated that 12,075 t of yellowtail flounder were taken in the 2001 directed Canadian fishery compared to 9,409 t in 2000. It is this number that is used in the calculation of removals (numbers at length). In total, it is estimated that 6.3 million males and 11.6 million females were removed by the directed offshore fishery (Table 5b). Length frequencies of commercial catches of yellowtail are illustrated in Figure 12. Across all Divisions and time periods, the shape of the catch frequencies were uni-modal with an average size of 38.3 cm and a range of 15 to 59 cm in 2001 and very nearly the same in 2000, 37.7 cm and a range of 10 to 63 cm (Table 5). In 2001, males averaged 36.3 cm, females 39.2 cm.

Figure 12a (2000) and b (2001) and Table 5a (2000) and b (2001) indicate that mean and mode of males and females was consistent among NAFO Divisions. The shapes of both the male and female curves and the average size of males and females were similar to what was observed in 1999 and 2000 (Kulka 2000, 2001). It was estimated that a total of 23 million fish were taken in the 2001 fishery compared to 7.3, 12.9 and 17.9 million fish in 1998, 1999 and 2000. The increased numbers related to increased catches rather than changes in size of fish caught.

Conclusions

Intense monitoring of the 1998-2001 yellowtail fisheries in the form of nearly full coverage by fishery observers facilitated a detailed spatial and temporal examination of the fishery. Across all years, in terms of meeting both management and commercial objectives, analyses of the observer data indicate that the 2001 fishery for yellowtail can be considered largely successful. Nearly all of the quota was taken, catch rates of yellowtail were higher than what was achieved just prior to closure of the fishery in 1991-93 (because of localized fishing on areas of high abundance), bycatch of plaice and cod was minimized (due to the localized fishing and employment of a sorting grate, although plaice bycatch slightly exceed the 5% cutoff) and small fish (less than 30 cm) constituted only a very small proportion of the catch (using codend mesh ranging from 145 to 160 mm. In 2001, although there were very limited data available on maturities, the protracted season meant that part of the fishery did take spawning fish. However, the industry kept effort to a minimum during peak spawning season in the summer (no fishing in July and August in 200 and 2001). Unlike pre-moratorium years, the 1998-2001 fisheries were truly directed for yellowtail and concentrating effort where yellowtail was abundant resulted in protection of the depressed cod and plaice stocks in Divisions 3N and 3O and higher average catch rates than in past years.

However, some industry participants in this fishery continue to suggest that bycatch restrictions set out in the management plans resulted in yellowtail being exploited over a very restricted area thus hampering the ability to fish for yellowtail over the entire extent of its distribution. For 2001, the fishery was extended further to the to the south and west. Bycatch of American plaice increased to 10% but this does not appear to be a result of the expanded are fished but rather an increase in abundance over the entire area fished. While the existence of other (un-fished) yellowtail concentrations is possible, fishing activity being limited to the 2001 grounds did not appear to negatively affect the ability of the fleet to sustain very good catch rates (although catch rate of yellowtail flounder was lower by 20% on average in 2001 compared to 2000). Based on historic patterns, it seems likely that if the fishing effort in were to be extended to areas covered by the historic fishery, this would likely result in lower catch rates of yellowtail flounder and an increase in bycatch. An additional concern is that yellowtail might be over-exploited within the localized areas fished. However, there was no evidence of cropping out on the grounds fished.

References

Anon, 1997. SPANS. Vers. 7. Prospector Reference Manual. TYDAC Research Inc.

Dwyer, K., S. J. Walsh, S. E. Campana and M. F. Veitch 2001. Analysis of Age Validation Studies in Yellowtail Flounder. NAFO SCR Doc. 01/51, Serial No. N4429. 13 p.

Hickey, W. M., G. Brothers and D. L. Boulos 1995. A study of cod/flatfish separation in otter trawls with the use of rigid grates. Can. Tech. Rep. Fish. Aquat. Sci. No. 2027 35p.

Kulka, D. W. and J. R. Firth 1987. Observer Program Training Manual - Newfoundland Region. Can. Tech. Rpt. Fish. Aquat. Sci. No. 1355 (Revised). 197 p.

Kulka, D. W. 1991. A description of fisheries in the vicinity of significant oil discovery areas off Newfoundland. Can. Tech. Rep. Fish. Aquat. Sci. No. 1787 126 p.

Kulka D. W. 1998. SPANdex - SPANS geographic information system process manual for creation of biomass indices and distributions using potential mapping. DFO Atl. Fish. Res. Doc. 98/60 28p.

Kulka, D. W. 1999. A re-emerging fishery – Description of the 1998 yellowtail flounder fishery on the Grand Banks with a comparison to the historic effort. NAFO SCR Doc. 99/61 38 p.

Kulka, D. W. 2000. Re-emergence of a traditional fishery in a different form - description of the 1998 and 1999 yellowtail flounder fishery on the Grand Banks with a comparison to the historic mixed fishery. NAFO SCR Doc. 00/58, Serial No. N4299. 45 p.

Kulka, D. W. 2001. Description of the 2000 Yellowtail Flounder Fishery on the Grand Banks with a Comparison to the 1998 and 1999 Fishery. SCR Doc. 01/71, Serial No. N4449. 23 p.

Walsh, S. J. 1992. Factors influencing distribution of juvenile yellowtail flounder (*Limnada ferruginea*) on the Grand Bank of Newfoundland. Neth. J. Sea Res. 29:193-203.

Walsh, S. J., W. B. Brodie, M. Veitch, D. Orr, C. McFadden and D. Maddock-Parsons 1998. An assessment of the Grand Bank Yellowtail flounder stock in NAFO Divisions 3LNO. NAFO SCR Doc. 98/72 78p.

Walsh, S. J., W. B. Brodie, M. J. Morgan, D. Power and M. Veitch 1999. The 1999 assessment of Grand Bank yellowtail flounder stock in NAFO Divisions 3LNO. NAFO SCR Doc. 99/68 x p.

Walsh, S. J., M. J Veitch, M. J. Morgan, W. R. Bowering and W. B. Brodie 2000. Distribution and abundance of yellowtail flounder (Limanda ferruginea) on the Grand Bank NAFO Divisions 3LNO as derived from annual Canadian bottom trawl surveys. NAFO SCR Doc. 00/35 54 p.

Walsh, S. J., M. F. Veitch, and W. B. Brodie 2001a. Yellowtail Flounder (Limanda ferruginea) Distribution and Abundance on the Grand Bank, NAFO Divisions 3LNO, 1984-2000. NAFO SCR Doc. 01/50 40 p.

Walsh, S. J., M. J Morgan, D. Power and C. Darby 2001b. The Complete 2001 Assessment of Grand Bank Yellowtail Flounder Stock in NAFO Divisions 3LNO. NAFO SCR Doc. 01/76 59 p.

Table 1. Catch, effort and fishery statistics for the 2001 Canadian offshore vessel yellowtail fishery by NAFO Division and month. Upper panel shows number of sets prosecuted and catch. Middle panel show average catch rates for yellowtail flounder, American plaice and cod. Lower panel shows average depth fished, average codend mesh size and average sorting grate space used.

	# of sets				Yellowtail Catch (t)			
Month	**3L**	**3N**	**3O**	**All**	**3L**	**3N**	**3O**	**All**
Jan	3	205	0	208	0	302	0	302
Feb	3	313	2	318	0	390	0	390
Mar	1	70	8	79	0	93	1	94
Apr	5	753	5	763	0	1,466	1	1,467
May	99	780	77	956	158	1,858	157	2,174
Jun	0	2	282	284	0	1	703	704
Sep	3	237	430	670	6	545	1,080	1,631
Oct	0	575	559	1,134	0	1,231	1,183	2,414
Nov	0	826	114	940	0	2,229	180	2,409
Dec	0	126	7	133	0	476	15	490
All	114	3,886	1,485	5,485	165	8,590	3,320	12,075

	Avg chr yellow (t/hr)				Avg chr plaice (t/hr)				Avg chr cod (t/hr)			
Month	**3L**	**3N**	**3O**	**All**	**3L**	**3N**	**3O**	**All**	**3L**	**3N**	**3O**	**All**
Jan	0.019	0.442		0.436	0.001	0.039		0.039	0.000	0.001		0.001
Feb	0.010	0.346	0.011	0.340	0.001	0.035	0.003	0.034	0.000	0.001	0.000	0.001
Mar	0.008	0.385	0.036	0.344	0.000	0.038	0.012	0.035	0.000	0.000	0.005	0.001
Apr	0.031	0.541	0.087	0.535	0.001	0.059	0.129	0.059	0.000	0.000	0.013	0.000
May	0.573	0.792	1.075	0.792	0.137	0.135	0.224	0.143	0.003	0.004	0.034	0.006
Jun		0.528	0.835	0.833		0.200	0.239	0.239		0.000	0.029	0.028
Sep	0.711	0.738	0.872	0.824	0.071	0.037	0.089	0.071	0.033	0.086	0.043	0.058
Oct		0.705	0.746	0.725		0.065	0.152	0.108		0.042	0.073	0.058
Nov		0.861	0.483	0.815		0.076	0.087	0.077		0.014	0.043	0.018
Dec		1.933	0.759	1.869		0.309	0.285	0.308		0.016	0.002	0.016
All	0.517	0.717	0.789	0.732	0.120	0.082	0.149	0.101	0.004	0.016	0.051	0.025

	Avg depth (m)				Avg codend (mm)				Avg Grate space (mm)			
Month	**3L**	**3N**	**3O**	**All**	**3L**	**3N**	**3O**	**All**	**3L**	**3N**	**3O**	**All**
Jan	76	52		53	147	147		147	123	121		121
Feb	79	51	71	52	147	148	149	148	123	123	120	123
Mar	71	58	73	60	147	148	149	148	124	122	123	122
Apr	73	57	76	57	150	149	148	149	122	123	121	123
May	194	68	71	81	149	150	149	150	123	123	122	123
Jun		57	70	70		148	149	149			123	123
Sep	78	55	69	64	146	149	149	149	120	125	125	125
Oct		55	70	62		150	149	149		122	122	122
Nov		57	71	59		150	151	150		123	122	123
Dec		51	66	52		150	151	150		123	123	123
All	178	58	70	64	149	149	149	149	123	123	123	123

		Average			Catch (t)			Average CPUE (t)		
NAFO Div.	**# of sets**	**Grate space (mm)**	**Depth (m)**	**Codend mesh (cm)**	**Yellow tail**	**Plaice**	**Cod**	**Yellow tail**	**Plaice**	**Cod**
3L	114	123	178	149	184	40	1	0.517	0.120	0.004
3N	3,886	123	58	149	8,690	930	173	0.717	0.082	0.016
3O	1,485	123	70	149	3,201	542	232	0.789	0.149	0.051
Total	5,485	123	64	149	12,075	1,512	407	0.732	0.101	0.025

Table 2. Landings and biological sampling coverage of the Canadian fishery for yellowtail, by fishing ground, by month for the 2001 yellowtail fishery. Table includes samples collected by both port samplers and fishery observers.

NAFO Division	Month	[1] Landings (t)	[2] Catch weight sampled (t)	Percent of catch sampled (by weight)	Number of Samples	Number measured	Male Avg Length (cm)	Female Avg Length (cm)
3L	Jan	0	0.045	100.0%	1	188		
	Feb							
	Mar							
	Apr	0	0.09	100.0%	2	211		
	May	155	8.765	5.7%	82	16,531		
	Jun	0	0.325	100.0%	2	543		
	Jul	3	0.464	15.5%	3	788		
	Aug	19	0.715	3.8%	5	1,312		
	Sep	6	4.669	77.8%	49	9,268		
	Oct	1	0.618	100.0%	7	1,199		
	Nov							
	Dec							
	All	184	16	8.5%	151	30,040	35.8	38.3
3N	Jan	298	5.029	1.7%	57	9,435		
	Feb	374	6.715	1.8%	72	13,986		
	Mar	91	10.566	11.6%	127	20,705		
	Apr	1,543	26.183	1.7%	246	52,538		
	May	1,837	19.912	1.1%	178	41,110		
	Jun	3	1.178	39.3%	15	2,150		
	Jul	35	1.148	3.3%	8	2,103		
	Aug	27	0.918	3.4%	5	1,775		
	Sep	528	11.967	2.3%	110	23,627		
	Oct	1,157	23.526	2.0%	230	45,864		
	Nov	2,221	24.781	1.1%	225	46,946		
	Dec	576	2.238	0.4%	15	4,153		
	All	8,690	134	1.5%	1,288	264,392	35.8	38.8
3O	Jan							
	Feb	0	0.022	100.0%	1	45		
	Mar	1	0.127	12.7%	1	261		
	Apr	1	0.442	44.2%	4	882		
	May	169	3.287	1.9%	21	5,232		
	Jun	687	11.407	1.7%	111	22,878		
	Jul	20	0	0.0%				
	Aug	9	0	0.0%				
	Sep	1,032	10.536	1.0%	98	19,119		
	Oct	1,099	10.225	0.9%	99	18,723		
	Nov	174	3.253	1.9%	32	5,757		
	Dec	9	0.115	1.3%	1	258		
	All	3,201	39	1.2%	368	73,155	36.7	40.6
All	Jan	298	5	1.7%	58	9,623		
	Feb	374	7	1.8%	73	14,031		
	Mar	92	11	11.6%	128	20,966		
	Apr	1,544	27	1.7%	252	53,631		
	May	2,161	32	1.5%	281	62,873		
	Jun	690	13	1.9%	128	25,571		
	Jul	58	2	2.8%	11	2,891		
	Aug	55	2	3.0%	10	3,087		
	Sep	1,566	27	1.7%	257	52,014		
	Oct	2,257	34	1.5%	336	65,786		
	Nov	2,395	28	1.2%	257	52,703		
	Dec	585	2	0.4%	16	4,411		
	All	12,075	189	1.6%	1,807	367,587	36.1	39.2

[1] Observed catch weight adjusted to landings
[2] Total weight of fish samples

Table 3a. Quotas and Allocations for the 1998-2001 yellowtail fisheries.

	Quota							# of vessels	
	Nfld			Maritimes	Canada				
	> 100 ft	65-100 ft	Total	> 100 ft	Total	Other	Total	> 100 ft	65-100 ft
1998	3,581	54	3,635	202	3,837	163	4,000	9	
1999	5,439	136	5,575	275	5,850	150	6,000	15	
2000	9,109	280	9,389	40	9,429	571	10,000	15	
2001	12,235		12,235	441	12,676	324	13,000	19	0

Table 3b. Catch, by-catch and fishery summary for the 1998-2001 yellowtail fisheries.

	CPUE (t per hour)		
	Yellowtail	**Plaice**	**Cod**
1998	0.766	0.037	0.020
1999	0.889	0.043	0.012
2000	0.910	0.063	0.013
2001	0.732	0.100	0.025

Table 3c. Catch, by-catch rates and fishery summary for the 1998-2001 yellowtail fisheries.

	Catch (t)	**% of total catch**		**Avg Mesh**	**Avg Grate**	**Avg**
	Yellowtail	**Plaice**	**Cod**	**Size (mm)**	**Size (mm)**	**Depth (m)**
1998	3,795	4.1%	2.3%	148	115	60
1999	6,609	4.4%	1.3%	150	120	61
2000	9,283	6.0%	1.6%	150	120	62
2001	12,075	10.4%	3.1%	149	123	64

Table 4a. Breakdown of all species captured during the 2001 yellowtail fishery.

Species	# Sets	Kept (t)	Discard (t)	Total (t)	% Kept	% Discarded	% of Catch	t per Hour
MUSSEL	1	0.000	0.001	0.001	0.00%	0.00	0.00	0.0003
9613	1	0.000	0.001	0.001	0.00%	0.00	0.00	0.0003
Cancer sp	1	0.000	0.001	0.001	0.00%	0.00	0.00	0.0004
HERMIT CRAB	1	0.000	0.001	0.001	0.00%	0.00	0.00	0.0004
SPIDER CRAB NS	2	0.000	0.002	0.002	0.00%	0.00	0.00	0.0003
CRAB NS	1	0.000	0.002	0.002	0.00%	0.00	0.00	0.0007
MUSSEL	2	0.000	0.002	0.002	0.00%	0.00	0.00	0.0003
OC QUAHOG	3	0.000	0.003	0.003	0.00%	0.00	0.00	0.0003
9615	2	0.000	0.004	0.004	0.00%	0.00	0.00	0.0005
CUSK	1	0.005	0.000	0.005	100.00%	100.00	0.00	0.0017
LUMPFISHES NS	1	0.000	0.005	0.005	0.00%	0.00	0.00	0.0014
THREEBEARD ROCKLING	2	0.000	0.005	0.005	0.00%	0.00	0.00	0.0006
ILLEX	5	0.003	0.003	0.006	50.00%	50.38	0.00	0.0003
BLUE HAKE	2	0.007	0.000	0.007	100.00%	100.00	0.00	0.0009
BLACK DOGFISH	3	0.000	0.008	0.008	0.00%	0.00	0.00	0.0009
SPINY DOGFISH	4	0.000	0.009	0.009	0.00%	0.00	0.00	0.0007
OCTOPUS	3	0.000	0.010	0.010	0.00%	0.00	0.00	0.0007
ALLIGATORFISH	4	0.000	0.010	0.010	0.00%	0.00	0.00	0.0008
SEA URCHIN	13	0.000	0.013	0.013	0.00%	0.00	0.00	0.0003
POLLOCK	3	0.028	0.000	0.028	100.00%	100.00	0.00	0.0029
HARP SEAL	1	0.000	0.030	0.030	0.00%	0.00	0.00	0.0083
PORBEAGLE	1	0.000	0.046	0.046	0.00%	0.00	0.00	0.0118
Hyas corarctatus	48	0.000	0.058	0.058	0.00%	0.00	0.00	0.0003
Neolithodes grim	10	0.000	0.062	0.062	0.00%	0.00	0.00	0.0014
8483	11	0.000	0.068	0.068	0.00%	0.00	0.00	0.0018
REDFISH	15	0.081	0.000	0.081	100.00%	100.00	0.00	0.0014
CAPELIN	68	0.000	0.089	0.089	0.00%	0.00	0.00	0.0004
PALLID SCULPIN	14	0.000	0.098	0.098	0.00%	0.00	0.00	0.0016
TH SCULPIN	9	0.000	0.162	0.162	0.00%	0.00	0.00	0.0043
RIBBED SCULPIN	42	0.000	0.176	0.176	0.00%	0.00	0.00	0.0012
BLUE SHARK	1	0.000	0.186	0.186	0.00%	0.00	0.00	0.0607
EELPOUT NS	73	0.104	0.090	0.194	53.61%	53.62	0.00	0.0009
MAKO	2	0.068	0.205	0.273	24.91%	24.94	0.00	0.0864
SEA STAR	106	0.000	0.279	0.279	0.00%	0.00	0.00	0.0008
SEA URCHIN	118	0.000	0.296	0.296	0.00%	0.00	0.00	0.0008
SP WOLFISH	17	0.415	0.000	0.415	100.00%	100.00	0.00	0.0063
MONKFISH	60	0.571	0.000	0.571	100.00%	100.00	0.00	0.0029
AT HKEAR SCULPIN	63	0.000	0.605	0.605	0.00%	0.00	0.00	0.0029
Lithodidae	1	0.000	0.667	0.667	0.00%	0.00	0.00	0.0001
WOLFISHES NS	8	0.705	0.000	0.705	100.00%	100.00	0.00	0.0220
GREENLAND SHARK	1	0.000	0.777	0.777	0.00%	0.00	0.01	0.1933
S H SCULPIN	62	0.000	0.801	0.801	0.00%	0.00	0.01	0.0008
TOAD CRAB ns	244	0.000	0.849	0.849	0.00%	0.00	0.01	0.0001
SANDLANCE	535	0.000	1.009	1.009	0.00%	0.00	0.01	0.0006
NFLD LUMPFISH	40	0.000	1.023	1.023	0.00%	0.00	0.01	0.0074
COMMON LUMPFISH	180	0.000	1.159	1.159	0.00%	0.00	0.01	0.0016
ROUGHD GRENADIER	14	1.170	0.000	1.170	100.00%	100.00	0.01	0.0193
SNOW CRAB	479	0.000	1.454	1.454	0.00%	0.00	0.01	0.0010
Hyas araneas	686	0.000	2.257	2.257	0.00%	0.00	0.02	0.0010
WINTER FLOUNDER	1	2.519	0.000	2.519	100.00%	100.00	0.02	0.0014
WHITE HAKE	340	3.311	0.000	3.311	100.00%	100.00	0.02	0.0031
N WOLFISH	42	3.695	0.165	3.861	95.70%	95.72	0.03	0.0254
HALIBUT	130	2.530	1.393	3.923	64.49%	64.49	0.03	0.0006
TURBOT	15	13.678	0.000	13.678	100.00%	100.00	0.09	0.2179
HADDOCK	445	13.835	0.000	13.835	100.00%	100.00	0.09	0.0100
SEA CUCUMBER	1,343	0.000	21.425	21.425	0.00%	0.00	0.14	0.0046
WITCH	1,226	24.608	0.009	24.617	99.96%	99.96	0.16	0.0068
SCULPIN NS	1,799	0.000	31.124	31.124	0.00%	0.00	0.21	0.0054
SEA RAVEN	1,776	0.005	35.653	35.658	0.01%	0.01	0.24	0.0062
LH SCULPIN	2,301	0.000	38.843	38.843	0.00%	0.00	0.26	0.0048
ST WOLFISH	1,135	70.004	0.012	70.016	99.98%	99.98	0.47	0.0125
COD	3,332	469.814	0.046	469.860	99.99%	99.99	3.13	0.0240
SKATES NS	5,270	208.469	395.469	603.938	34.52%	34.52	4.02	0.0258
PLAICE	5,472	1565.035	0.085	1565.120	99.99%	99.99	10.43	0.0653
YELLOWTAIL	5,485	12093.348	2.236	12075.584	99.99%	99.98	80.57	0.4518

Table 4b. Breakdown of all species captured during the 2000 yellowtail fishery.

Species	# sets	Kept Wt (t)	Discard Wt (t)	Total Wt (t)	% Kept	% Discarded	% of Catch	t per hour
Atl. Herring	1	0	0	0	0.00%	100.00%	0.000%	0.0003
Dusky Seasnail	1	0	0	0	0.00%	100.00%	0.000%	0.0004
RH Grenadier	1	0	0	0	0.00%	100.00%	0.000%	0.0004
Pandalus borealis	1	0	0	0	0.00%	100.00%	0.000%	0.0005
Iceland scallop	1	0	0	0	0.00%	100.00%	0.000%	0.0004
Neolithodes grim	1	0	0	0	0.00%	100.00%	0.000%	0.0003
Grenadier NS	1	0	0	0	0.00%	100.00%	0.000%	0.0007
Lithodes maja	1	0	0	0	0.00%	100.00%	0.000%	0.0006
Mailed sculpin	2	0	0	0	0.00%	100.00%	0.000%	0.0003
Loligo pealei	1	0	0	0	0.00%	100.00%	0.000%	0.0010
Black dogfish	1	0	0.01	0.01	0.00%	100.00%	0.000%	0.0020
Lumpfishes NS	1	0	0.01	0.01	0.00%	100.00%	0.000%	0.0017
Atl hookear sculpin	3	0	0.01	0.01	0.00%	100.00%	0.000%	0.0006
Sea urchin	6	0	0.01	0.01	0.00%	100.00%	0.000%	0.0003
Squid NS	7	0	0	0.01	0.00%	0.00%	0.000%	0.0004
Illex	8	0	0.01	0.01	0.00%	100.00%	0.000%	0.0004
Spiny dogfish	5	0	0.02	0.02	0.00%	100.00%	0.000%	0.0010
Pollock	3	0.03	0	0.03	100.00%	0.00%	0.000%	0.0031
Spider crab ns	15	0	0.03	0.03	0.00%	100.00%	0.000%	0.0007
Nor wolffish	9	0.04	0	0.04	100.00%	0.00%	0.000%	0.0016
Harp seal	1	0	0.05	0.05	0.00%	100.00%	0.000%	0.0300
Nfld lumpfish	8	0	0.05	0.05	0.00%	100.00%	0.000%	0.0021
Greenland cod	1	0.06	0	0.06	100.00%	0.00%	0.001%	0.0171
Flounder NS	1	0.09	0	0.09	100.00%	0.00%	0.001%	0.0300
Spot wolffish	9	0.1	0	0.1	100.00%	0.00%	0.001%	0.0034
SH sculpin	46	0	0.14	0.14	0.00%	100.00%	0.001%	0.0011
Sea urchin	150	0	0.15	0.15	0.00%	100.00%	0.001%	0.0004
Sandlance	170	0	0.19	0.19	0.00%	100.00%	0.002%	0.0007
Capelin	78	0	0.22	0.22	0.00%	100.00%	0.002%	0.0012
Monkfish	19	0.19	0.05	0.24	79.17%	20.83%	0.002%	0.0041
Common Lumpfish	78	0	0.32	0.32	0.00%	100.00%	0.003%	0.0014
Toad crab NS	327	0	0.52	0.52	0.00%	100.00%	0.005%	0.0006
White jhake	74	0.5	0.02	0.53	94.34%	3.77%	0.005%	0.0022
Hyas corarctatus	221	0	0.98	0.98	0.00%	100.00%	0.010%	0.0015
Eelpouts NS	242	0.18	0.96	1.14	15.79%	84.21%	0.011%	0.0016
Attl halibut	64	1.32	0.05	1.37	96.35%	3.65%	0.013%	0.0073
Snow Crab	593	0	1.53	1.53	0.00%	100.00%	0.015%	0.0009
Hyas areneaus	797	0	2.98	2.98	0.00%	100.00%	0.029%	0.0013
St Wolffish	217	5.35	0.02	5.37	99.63%	0.37%	0.052%	0.0081
Witch	700	6.43	0.11	6.54	98.32%	1.68%	0.063%	0.0030
Haddock	279	12.16	0.03	12.19	99.75%	0.25%	0.118%	0.0136
Sea cucumber	1,099	0	15.22	15.22	0.00%	100.00%	0.148%	0.0045
Sculpin NS	802	0	19.27	19.27	0.00%	100.00%	0.187%	0.0079
Sea Raven	1,069	0	23.61	23.61	0.00%	100.00%	0.229%	0.0071
LH Sculpin	1,568	0	31.67	31.67	0.00%	100.00%	0.307%	0.0065
Cod	1,990	125.94	0.08	126.02	99.94%	0.06%	1.222%	0.0208
Skates Ns	2,995	7.54	156.51	164.05	4.60%	95.40%	1.591%	0.0180
Plaice	3,503	616.02	0.33	616.35	99.95%	0.05%	5.976%	0.0591
Yellowtail	**3,519**	**9,282.03**	**0.97**	**9,283.00**	99.99%	0.01%	90.003%	**0.8829**
Total		10,057.98	256.13	10,314.13				

Table 5a – Statistics of yellowtail sizes in the commercial fishery in 2000.

NAFO		Landed	cm						
Div	Sex	Wt (t)	Mean	Median	Stdev	Min	Max	Mode	# of fish
3L	Male	1,407	36.8	36.5	2.9	20	50	37	1,035,433
	Female		39.1	38.5	3.7	24	54	38	1,517,583
3N	Male	7,724	36.2	35.5	3.5	10	51	37	5,103,244
	Female		38.9	38.5	4.1	10	63	38	9,793,830
3O	Male	278	36.4	35.5	3.3	23	47	36	222,451
	Female		39.9	39.5	4.2	20	55	40	288,174
3LNO	Male	9,409	36.3	35.5	3.4	10	51	37	6,361,129
	Female		39.0	38.5	4.0	10	63	38	11,599,587
3LNO	Both sexes		37.7	37.0	3.7	10.0	57.0	37.5	17,960,716

Table 5b – Statistics of yellowtail sizes in the commercial fishery in 2001.

2001				**(cm)**						
NAFO		**Landed**	**% LE**							
Div	**Sex**	**Wt (t)**	**30 cm**	**Mean**	**Median**	**Stdev**	**Min**	**Max**	**Mode**	**# of fish**
3L	Male		3.97	35.8	35.5	2.93	27	48	37	141,168
	Female		1.29	38.3	37.5	3.56	27	51	37	195,034
	Total	183	2.41	37.3	36.5	3.58	27	51	37	336,202
3N	Male		6.41	35.8	35.5	3.66	20	56	35	5,287,783
	Female		1.45	38.8	37.5	4.09	15	59	37	12,085,583
	Total	8,690	2.96	37.9	37.5	4.19	15	59	37	17,373,366
3O	Male		4.26	36.7	36.5	3.57	20	50	38	1,844,215
	Female		1.37	40.6	40.5	4.35	20	59	41	3,851,231
	Total	3,192	2.31	39.4	38.5	4.50	20	59	38	5,695,447
3LNO		12,065	2.76	38.3	37.5	4.33	15	59	37	23,405,015

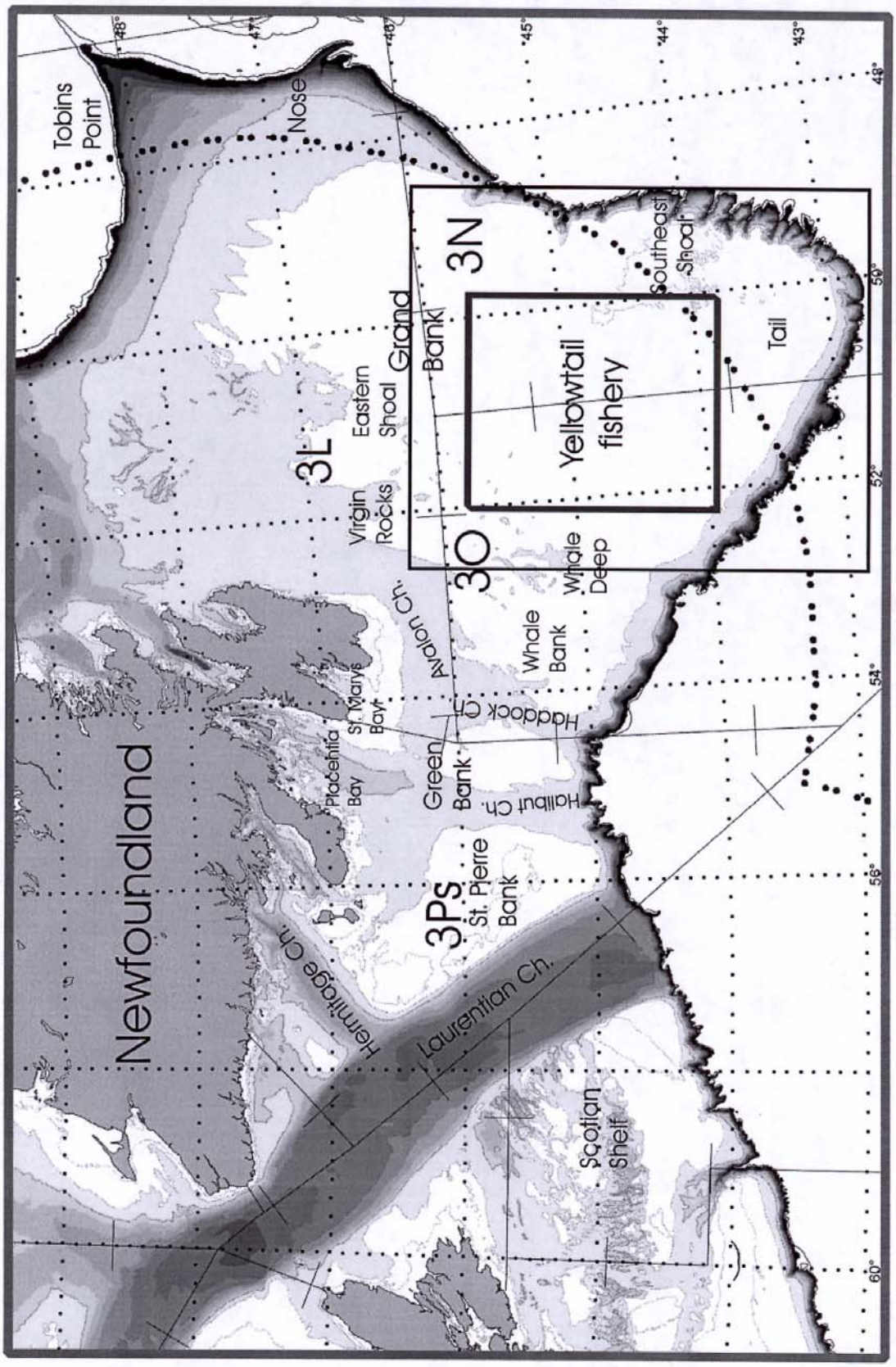


Fig. 1. Features of the Grand banks showing NAFO Divisions, the 200 mile limit, specific locations and bathymetry (0 to 450 m by 50 m then 500 to 1000 m by 100m). The inner box illustrates the extent of the 1998 yellowtail fishery. The outer box shows the area illustrated in subsequent map figures.

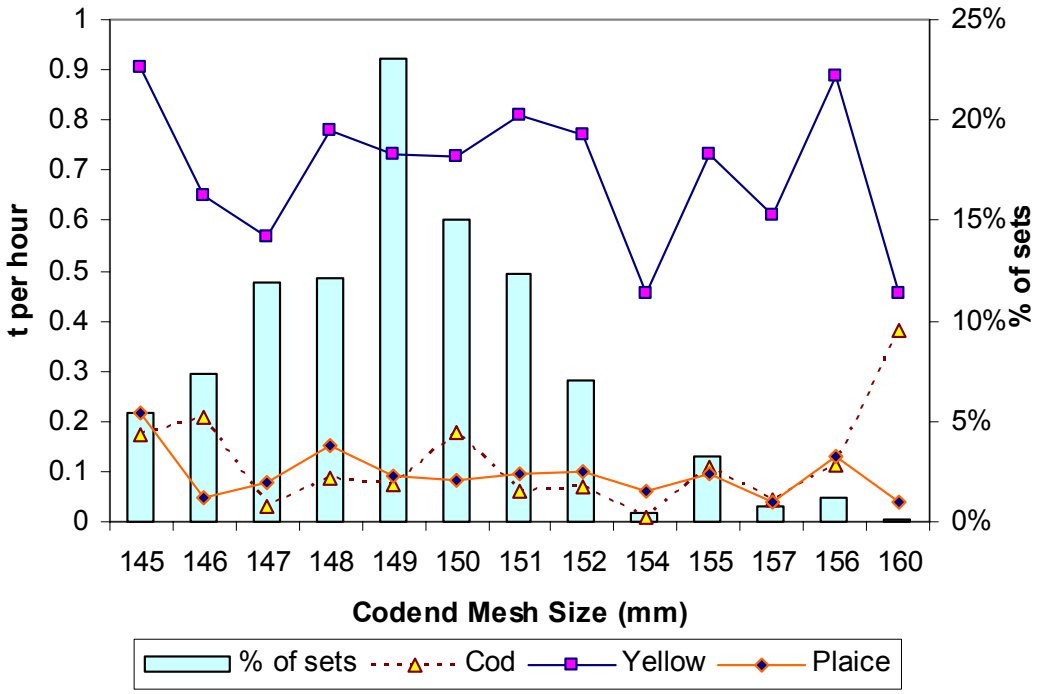


Fig. 2. Proportion of effort and catch rate of yellowtail flounder, American plaice and cod in relation to mesh size used in the 2001 yellowtail fishery.

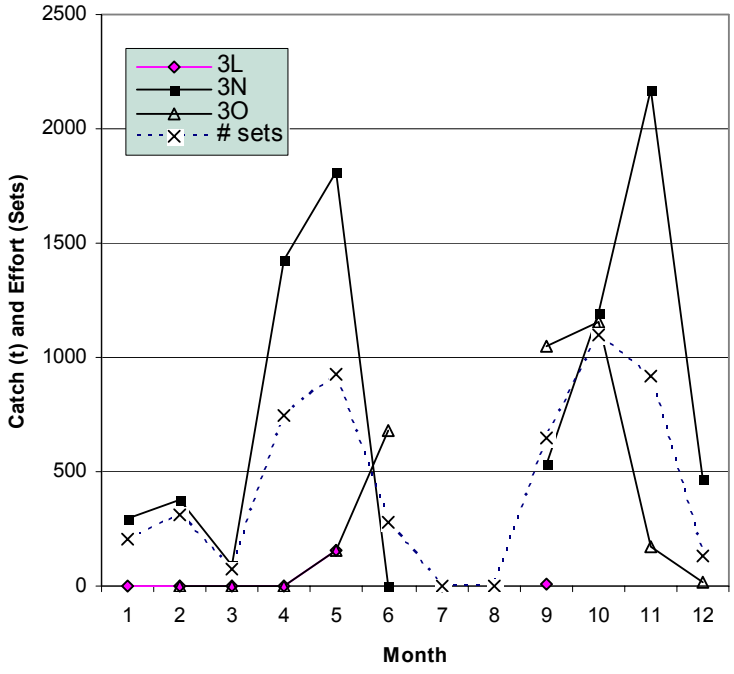


Fig. 3. Monthly trends in catch (tonnes of yellowtail) and effort (number of sets) for the 2001 yellowtail fishery. Solid lines depict catch (t) by NAFO Division.

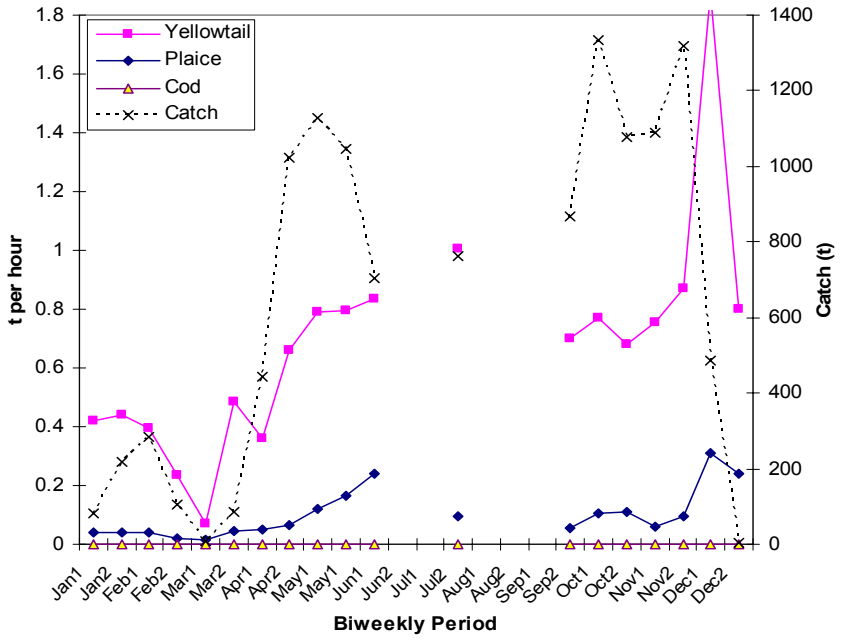


Fig. 4. Biweekly trends in catch rate (t per hour) for the 2000 yellowtail fishery (solid lines). Dashed line depicts yellowtail catch.

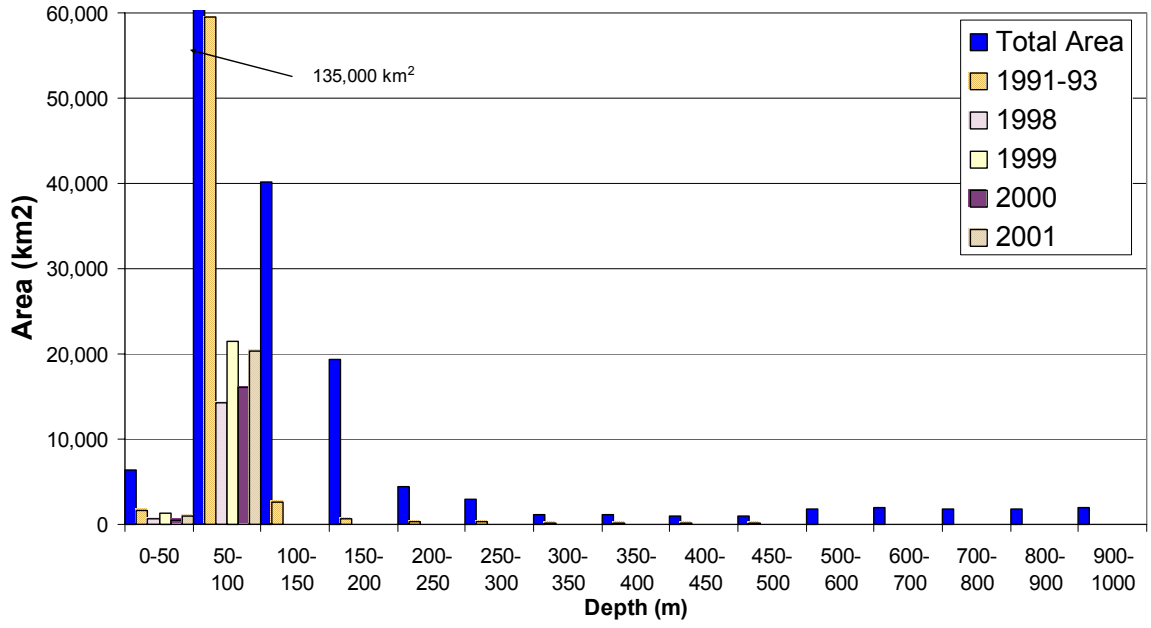


Fig. 5. Area (km^2) of the Grand Banks (solid bars) in comparison to the extent of the yellowtail flounder fishing grounds in 1991-1993, 1998, 1999, 2000 and 2001. The available are at depths of 50-100 m (135,000 km^2) is off the scale of the y axis.

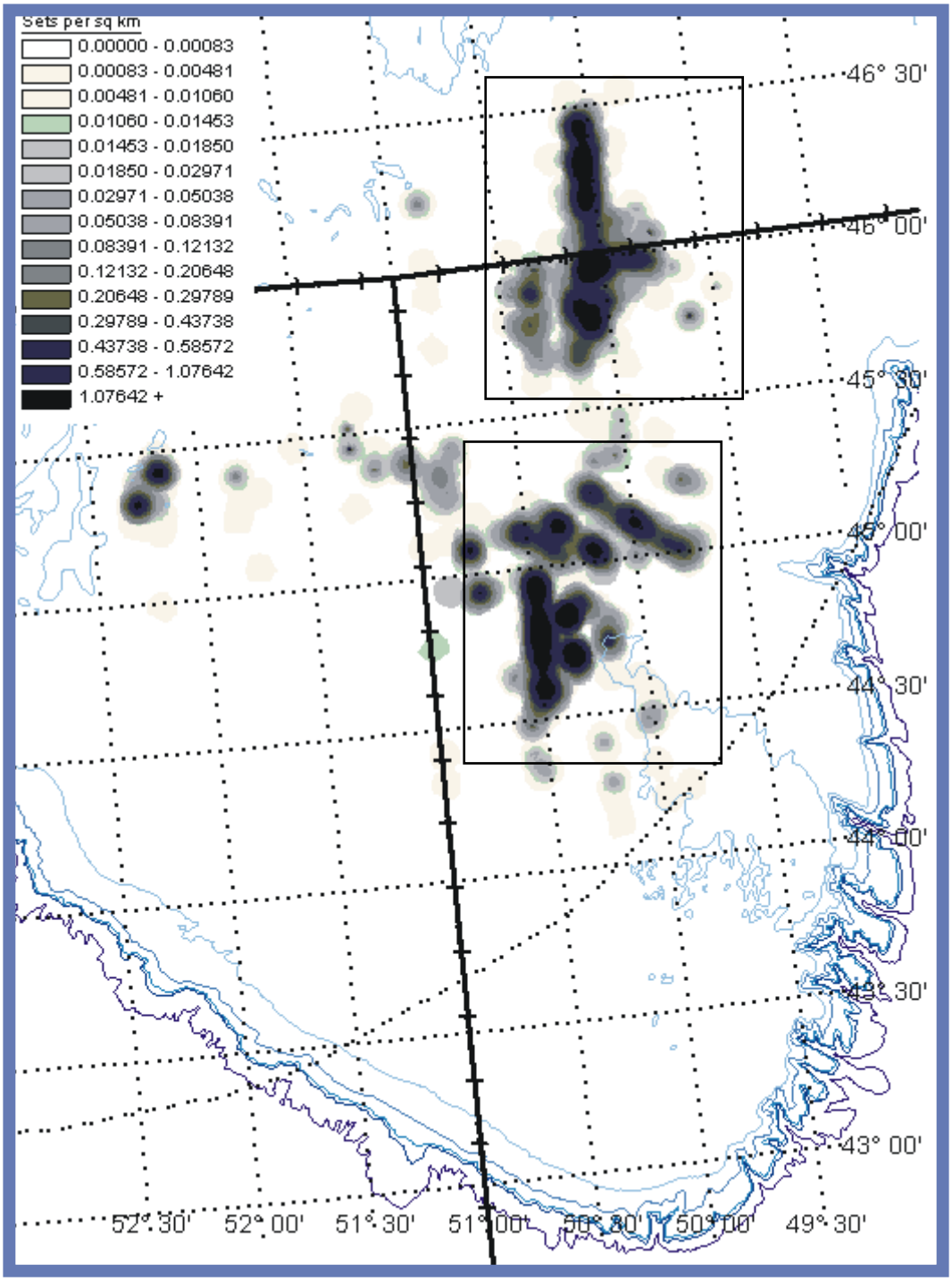


Fig. 6a. Fishing grounds for yellowtail flounder in 2000. Darker grey shades denote more densely fished areas. Refer to Fig. X for a description of catch rates within fishing density classes. Ovals show new areas fished in 2001 compared to 2000 (see Fig. 5b).

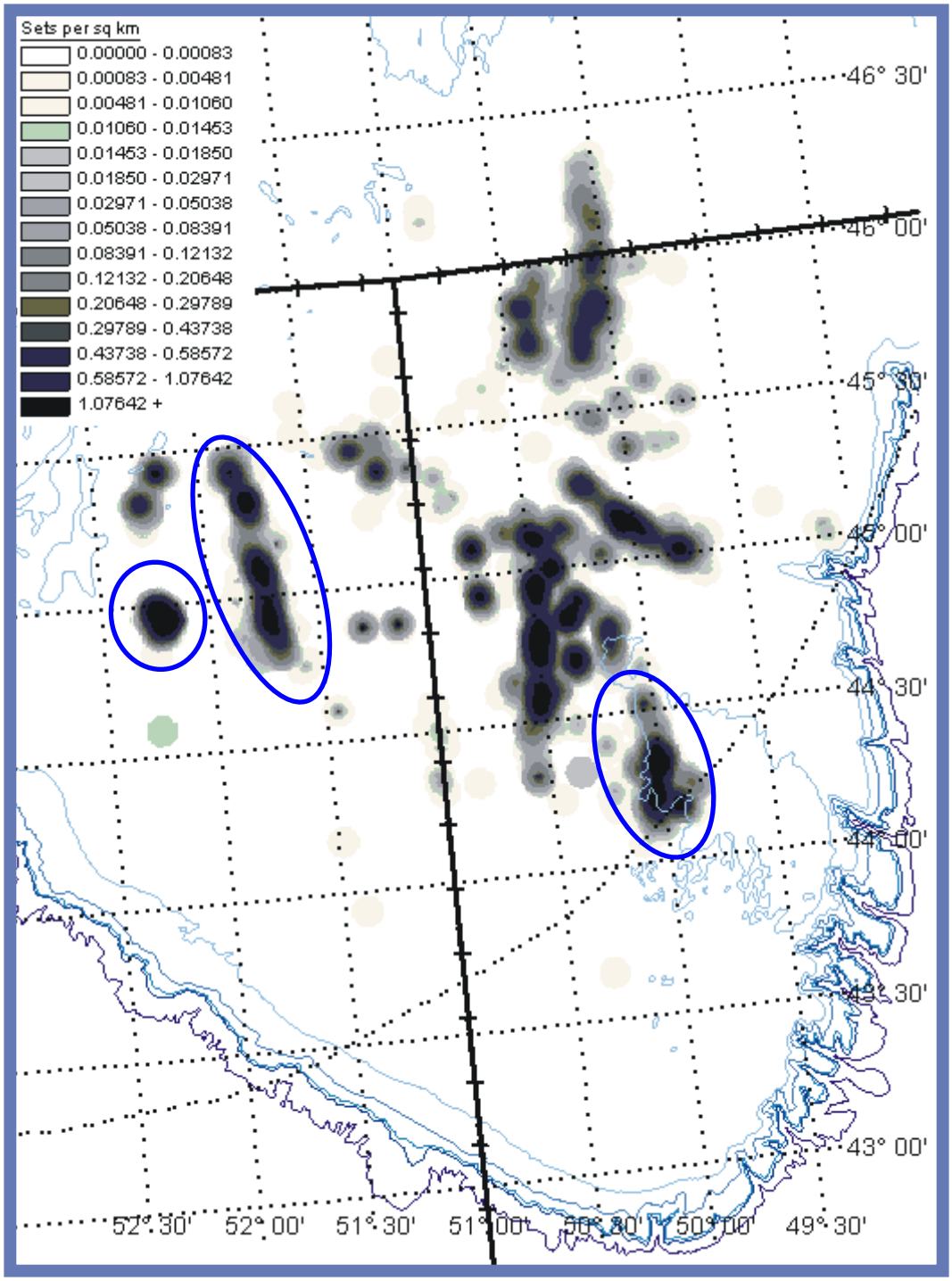


Fig. 6b. Fishing grounds for yellowtail flounder in 2001. Darker grey shades denote more densely fished areas. Refer to Fig. X for a description of catch rates within fishing density classes.

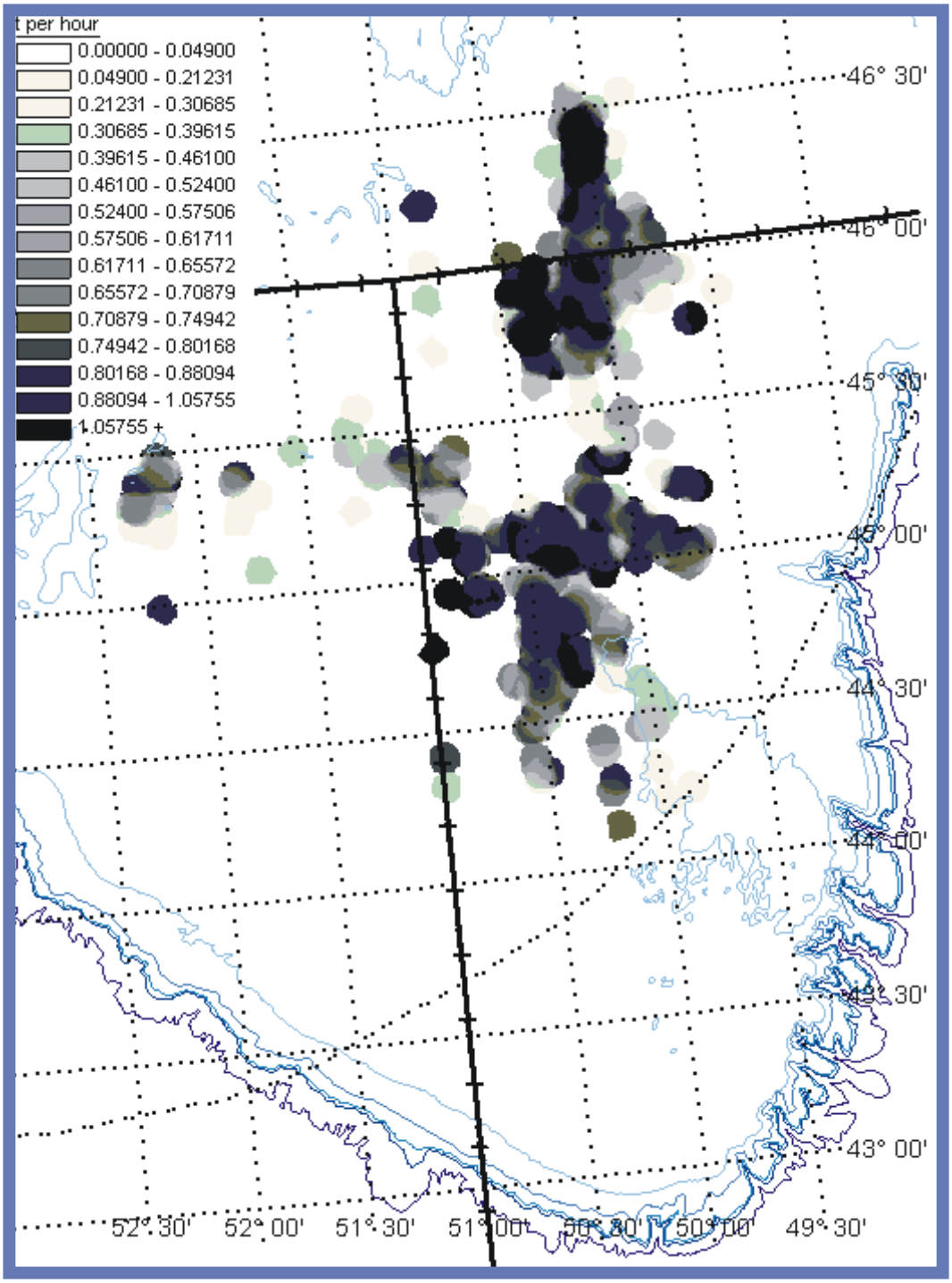


Fig. 7a. Density (catch per hour) of yellowtail from the fishery for the 2000 fishery on the Grand Banks

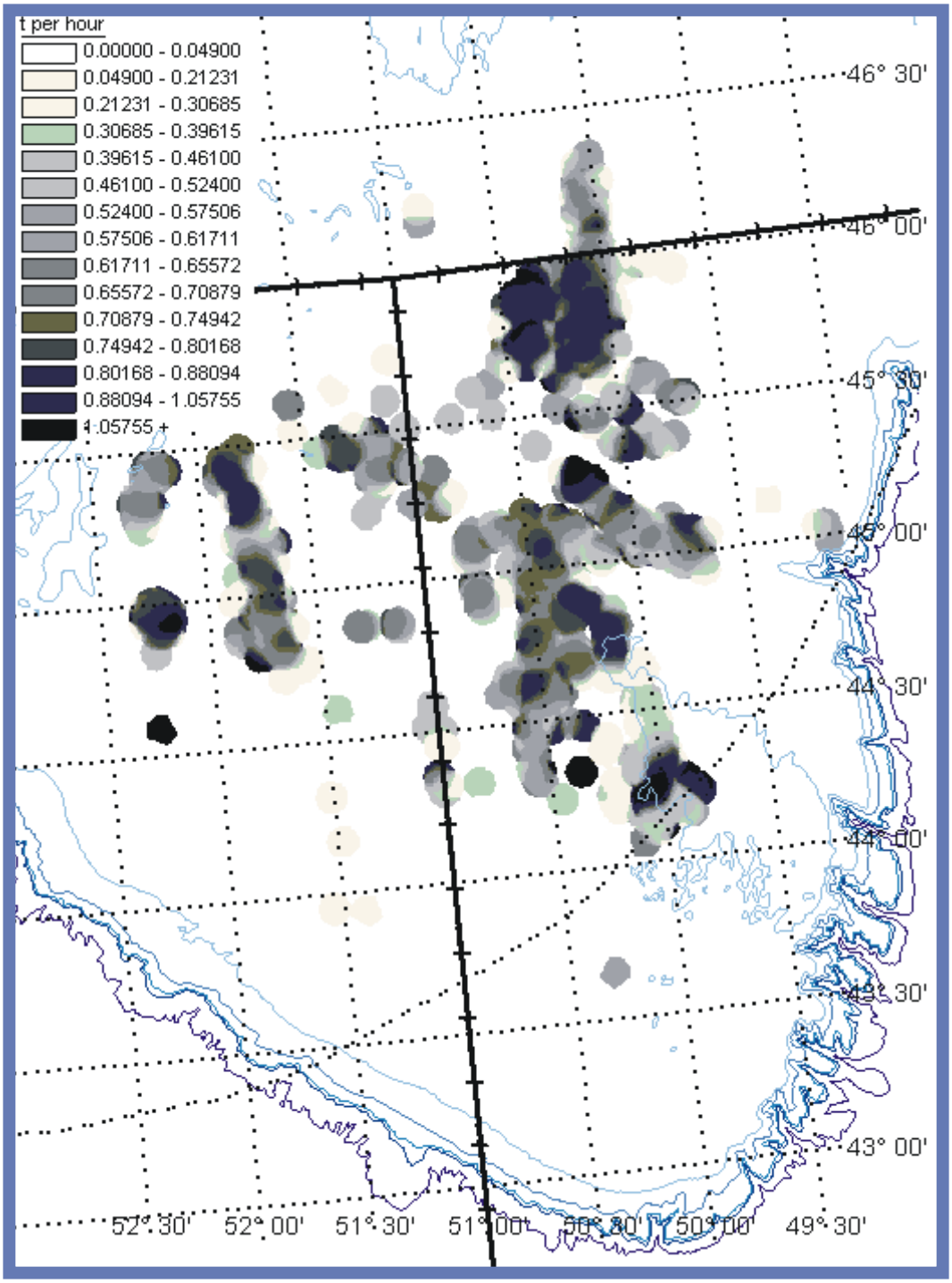


Fig. 7b. Density (catch per hour) of yellowtail from the fishery for the 2000 fishery on the Grand Banks.

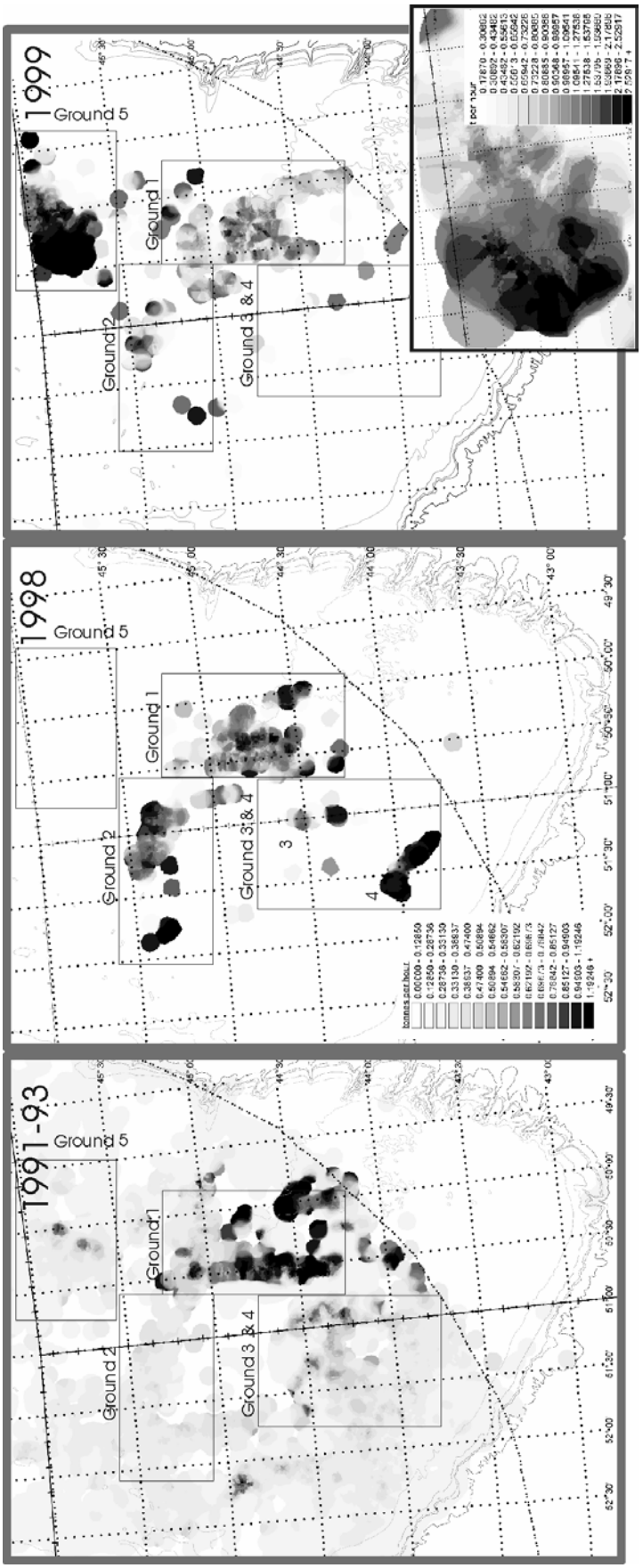


Fig. 7c. Fishing grounds for yellowtail flounder in 1991-1993 (left panel), 1998 and 1999. Darker grey shades denote higher catch rates of yellowtail.

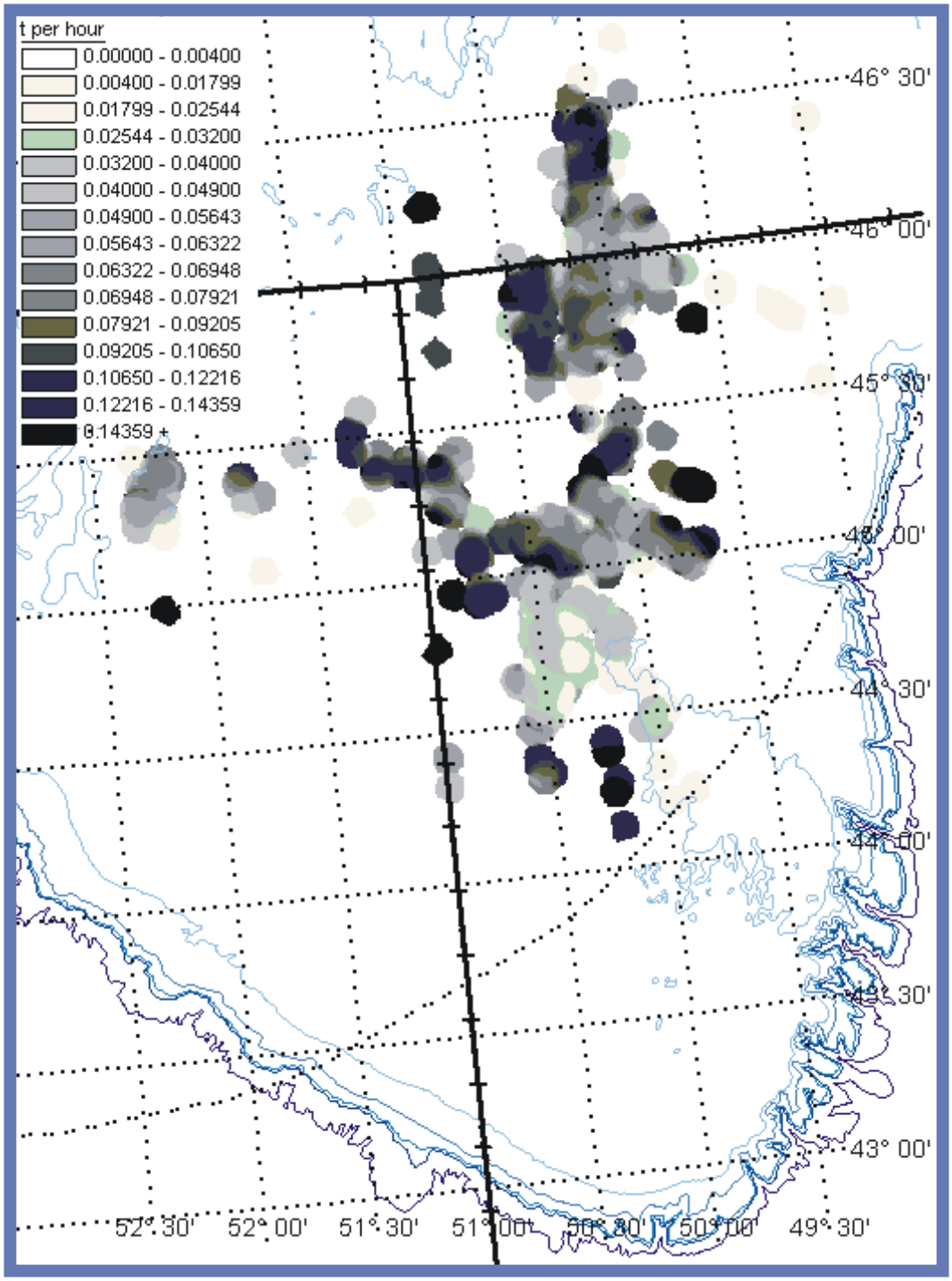


Fig. 8a. Density (catch per hour) of American plaice from the yellowtail fishery for 2000 on the Grand Banks.

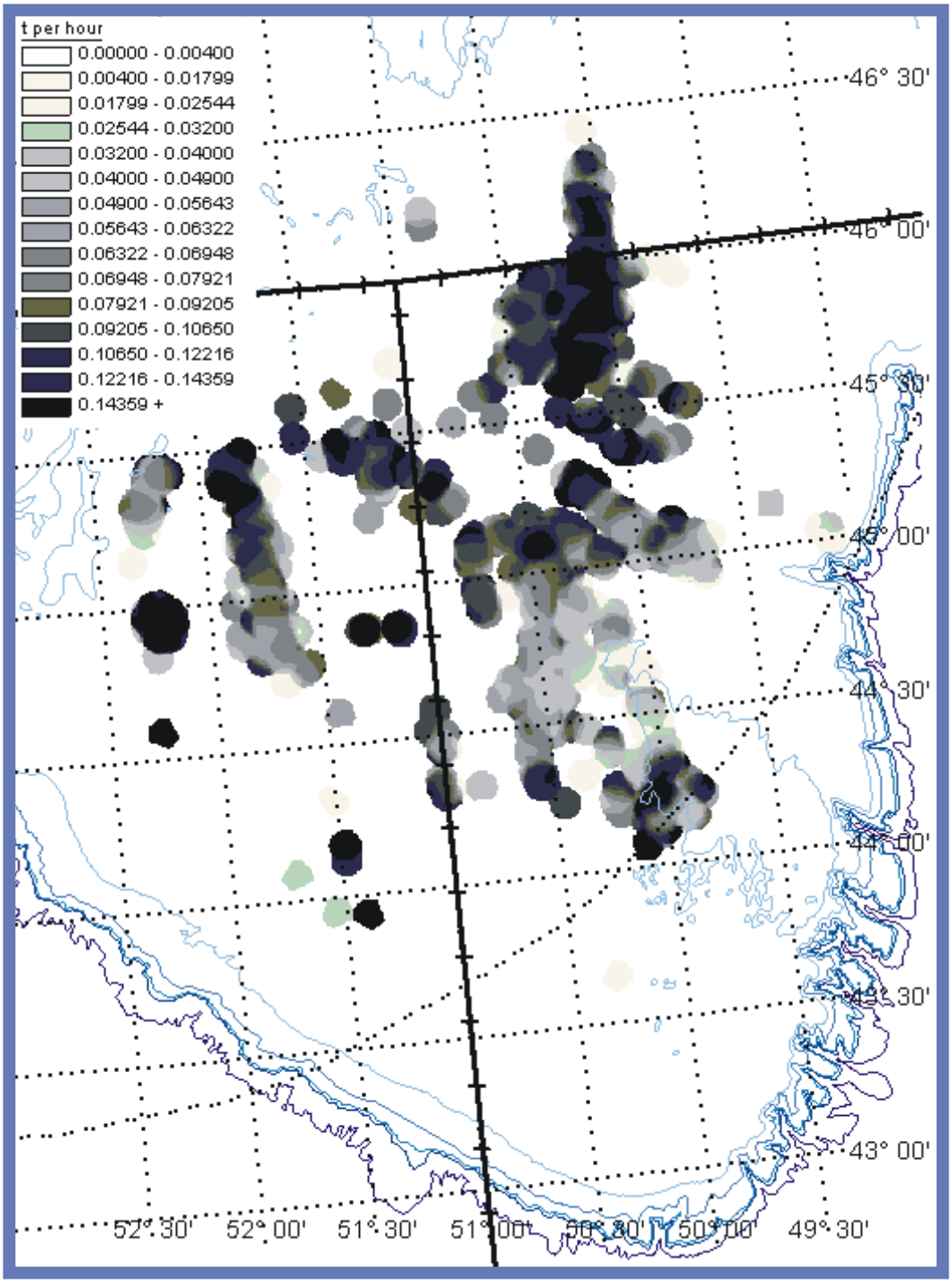


Fig. 8b. Density (catch per hour) of American plaice from the yellowtail fishery for 2001 on the Grand Banks.

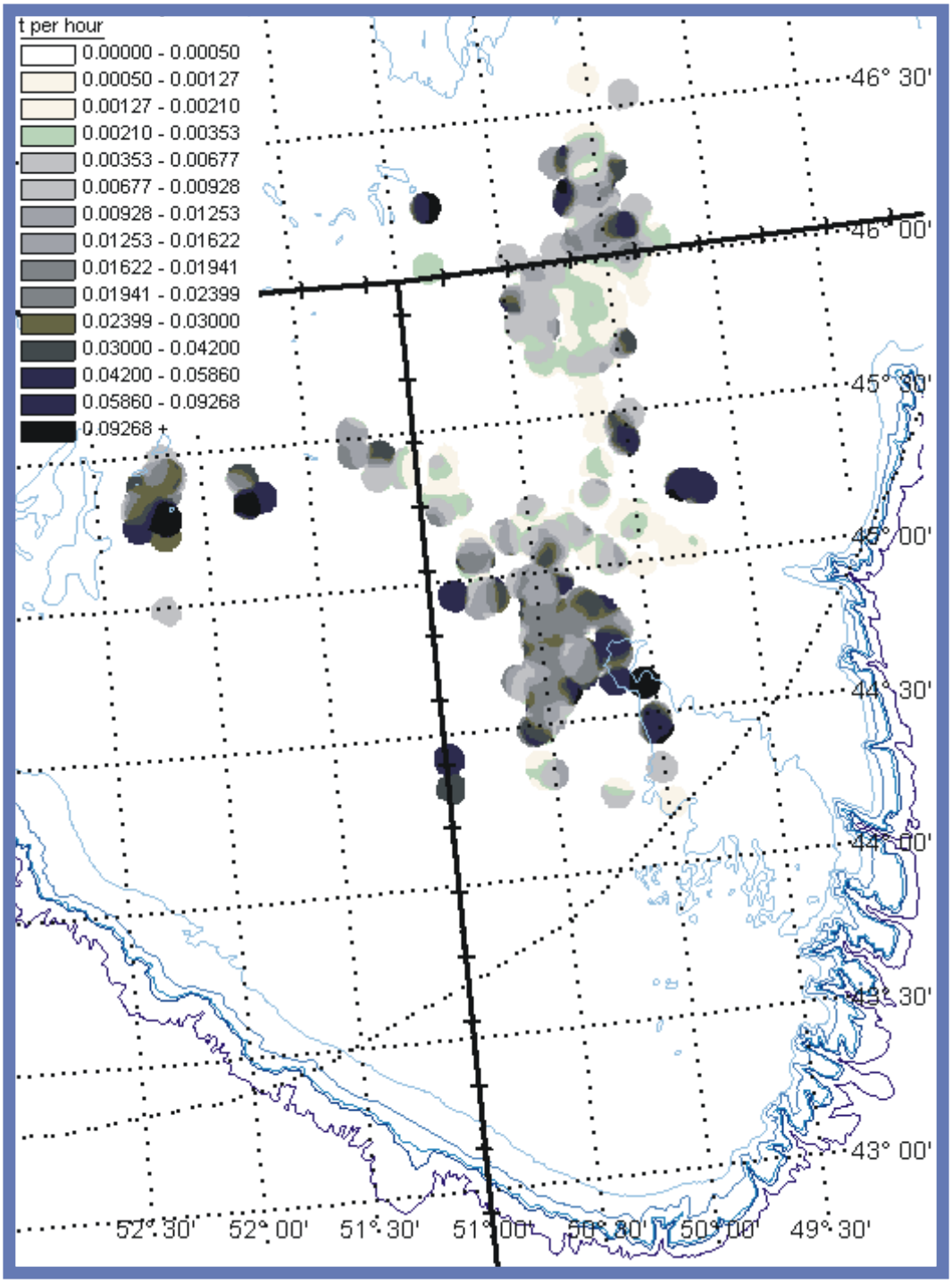


Fig. 9a. Density (catch per hour) of cod from the yellowtail fishery for 2000 on the Grand Banks.

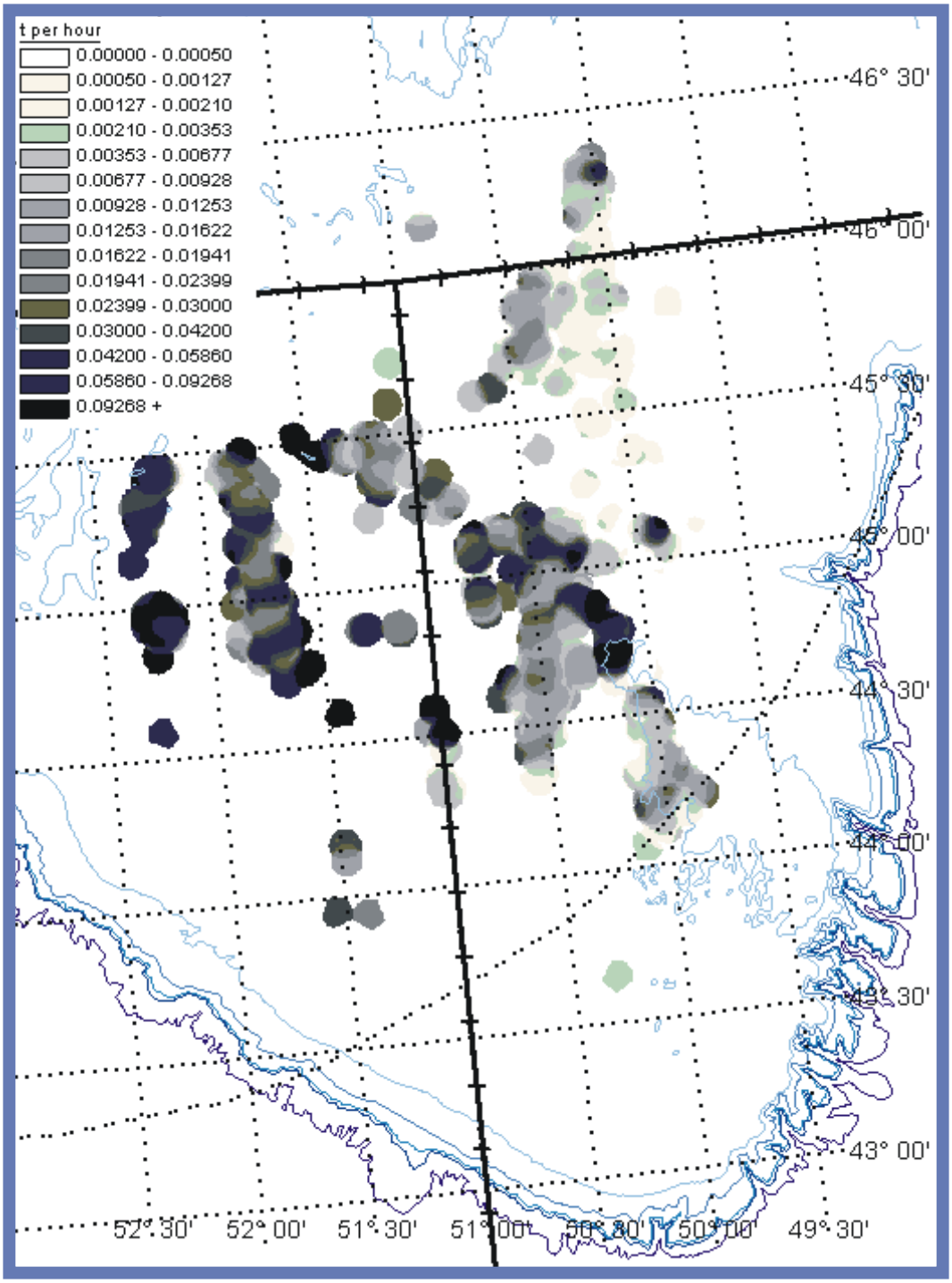


Fig. 9b. Density (catch per hour) of cod from the yellowtail fishery for 2001 on the Grand Banks.

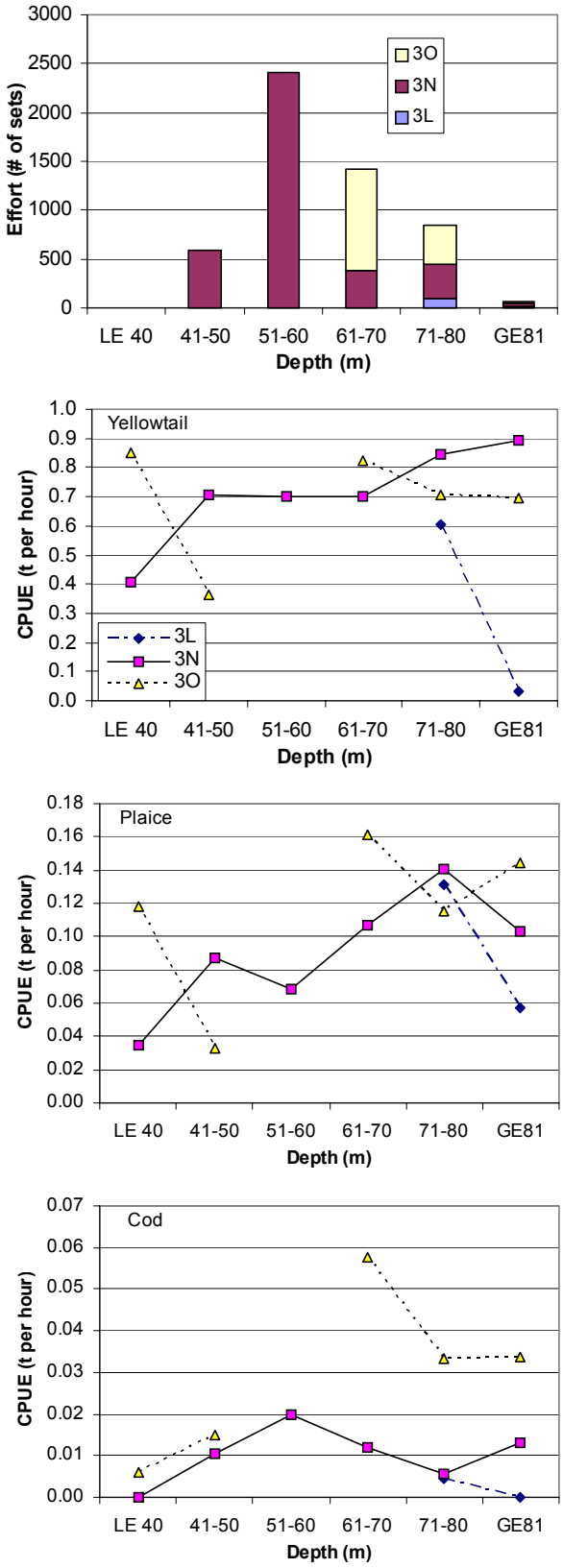


Fig. 10. Description of the 2001 yellowtail fishery by depth. Upper pane\l shows numbers of sets prosecuted by depth. Lower panels show average catch rate by depth for yellowtail, American plaice and cod for each NAFO Division.

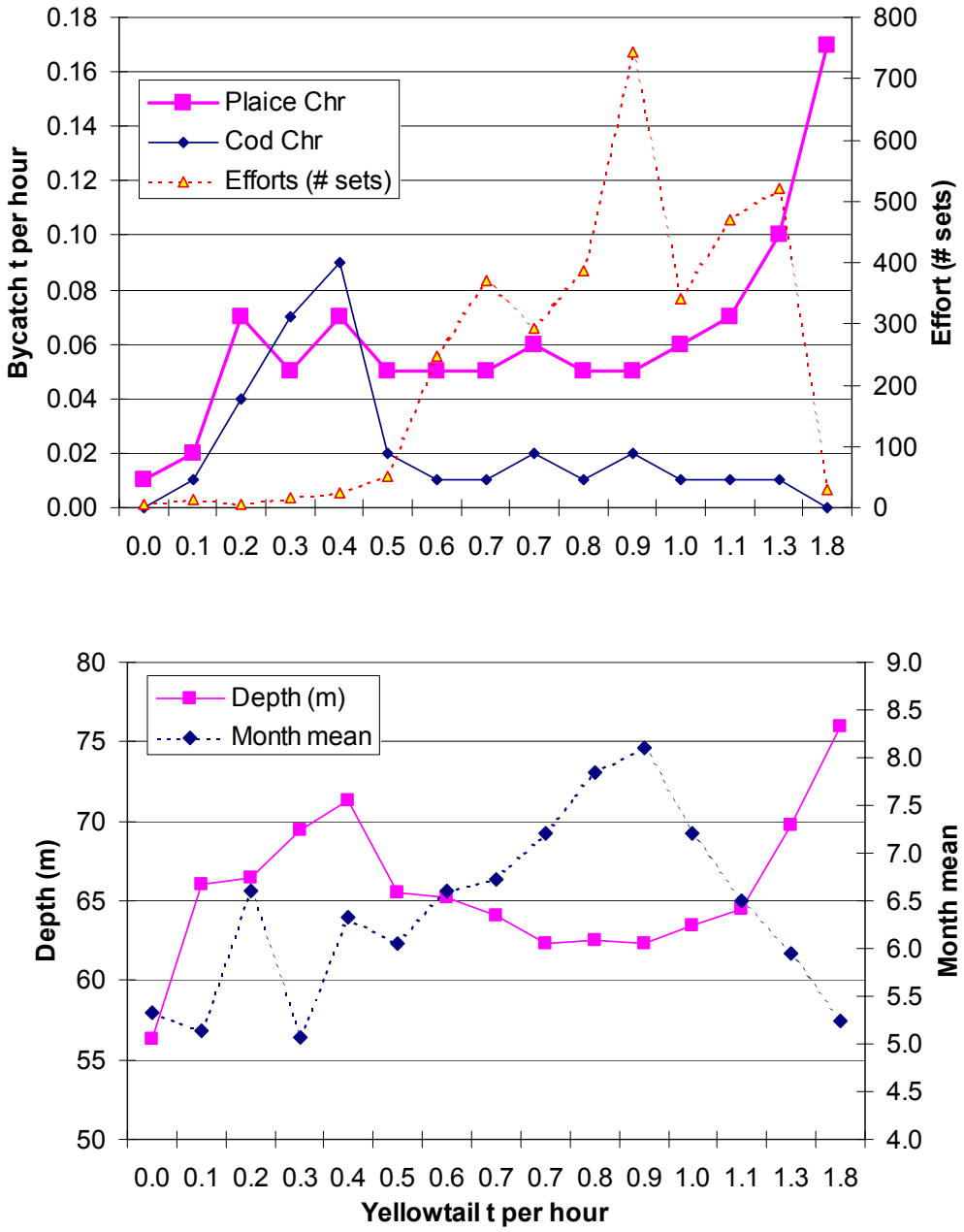


Fig. 11a. By-catch per hour (cod and plaice), effort, depth and month with respect to yellowtail catch per hour for the 2000 yellowtail fishery.

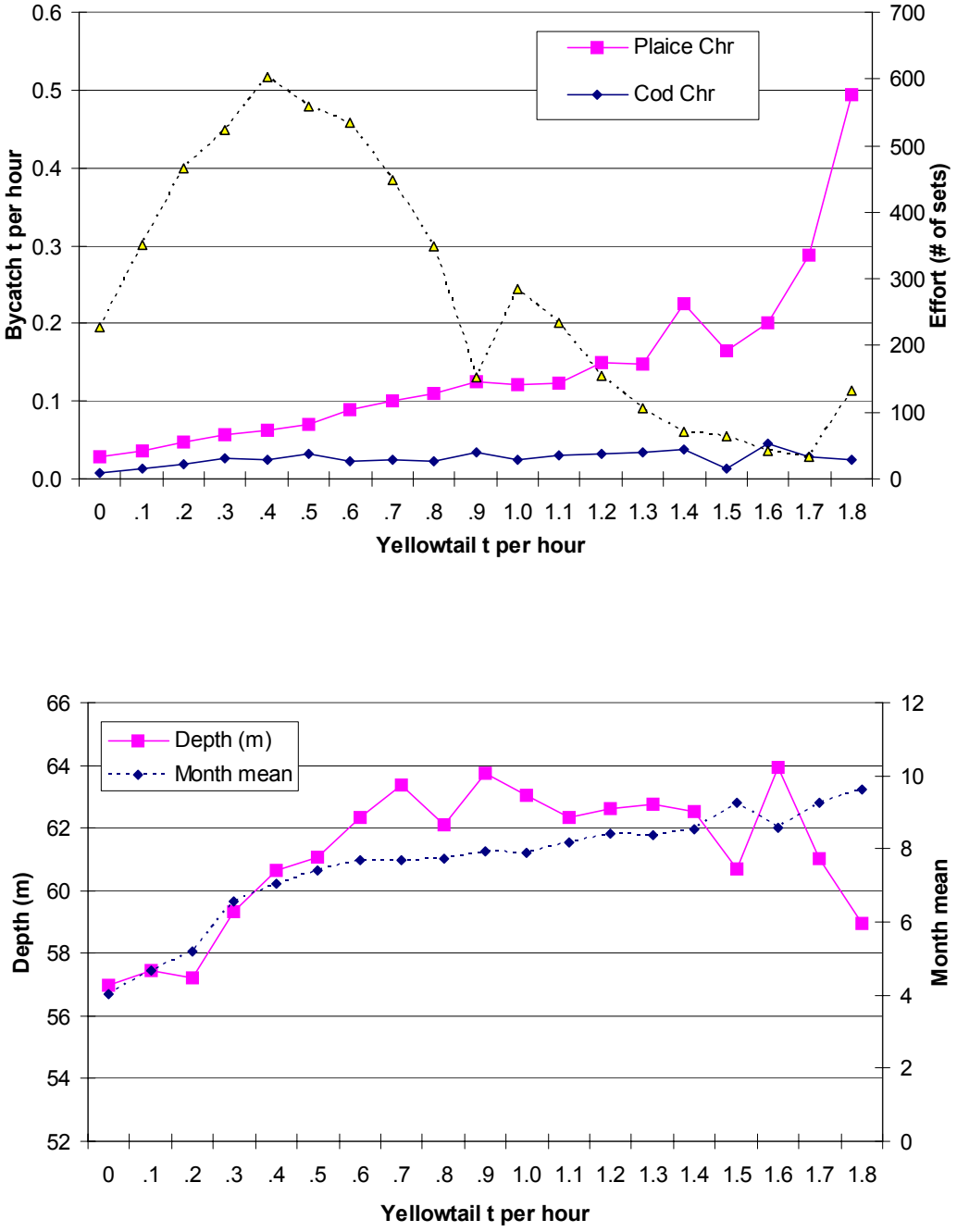
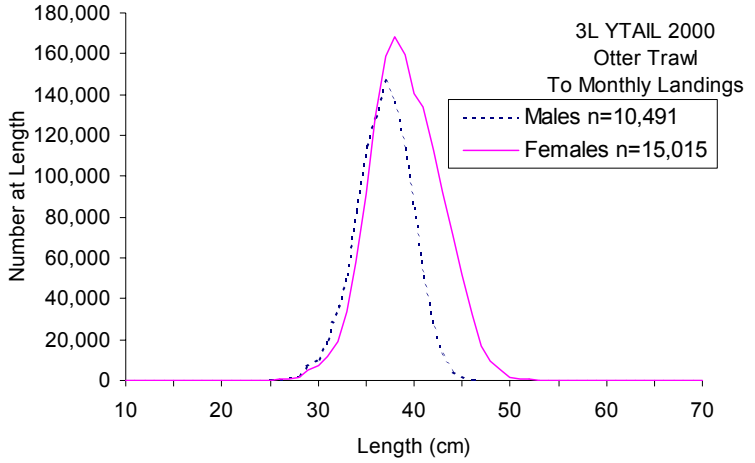
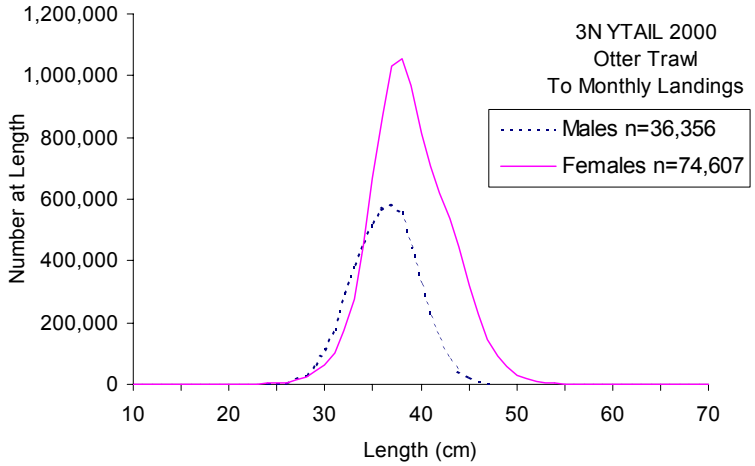


Fig. 11b.By-catch per hour (cod and plaice), effort, depth and month with respect to yellowtail catch per hour for the 2001 yellowtail fishery.





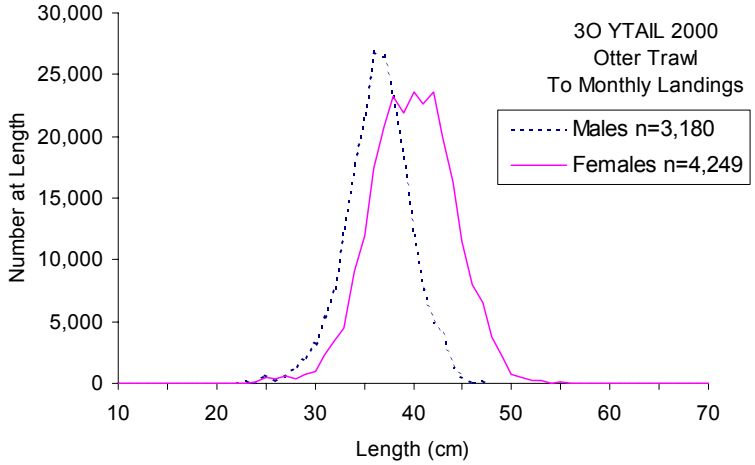


Fig. 12a. Frequency of numbers of yellowtail by length taken from the 2000 fishery, by NAFO Division.

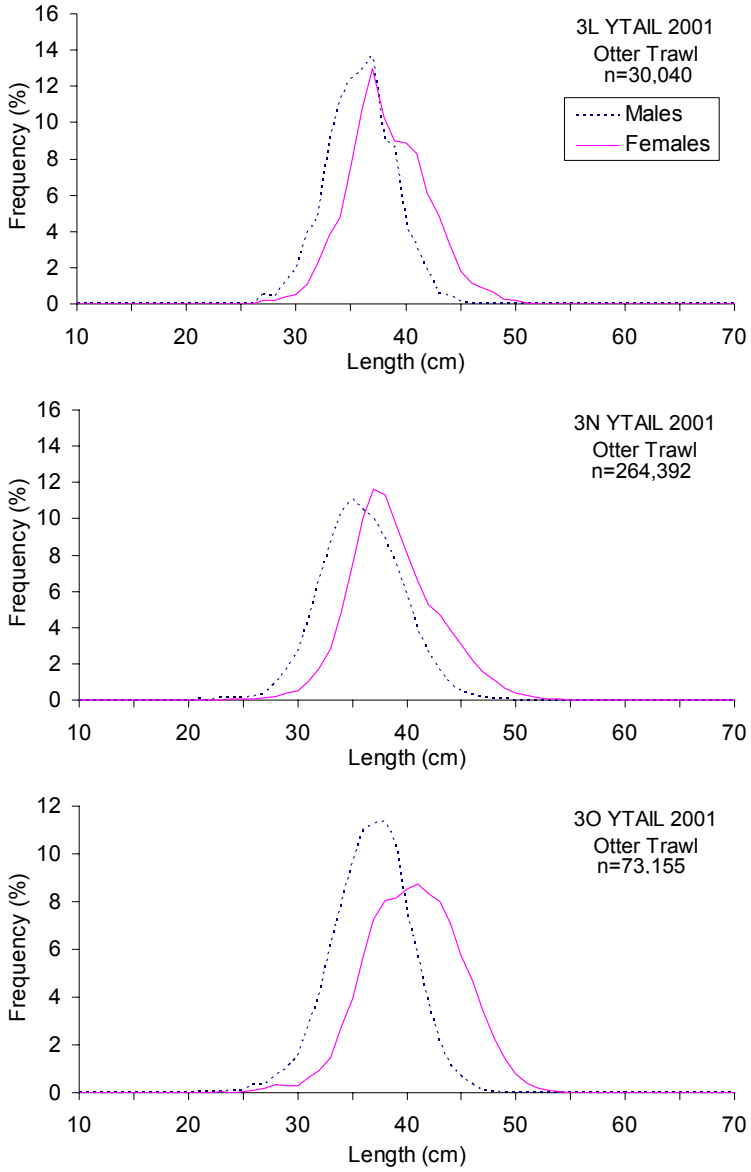


Fig. 12b. Frequency of numbers of yellowtail by length taken from the 2001 fishery, by NAFO Division.

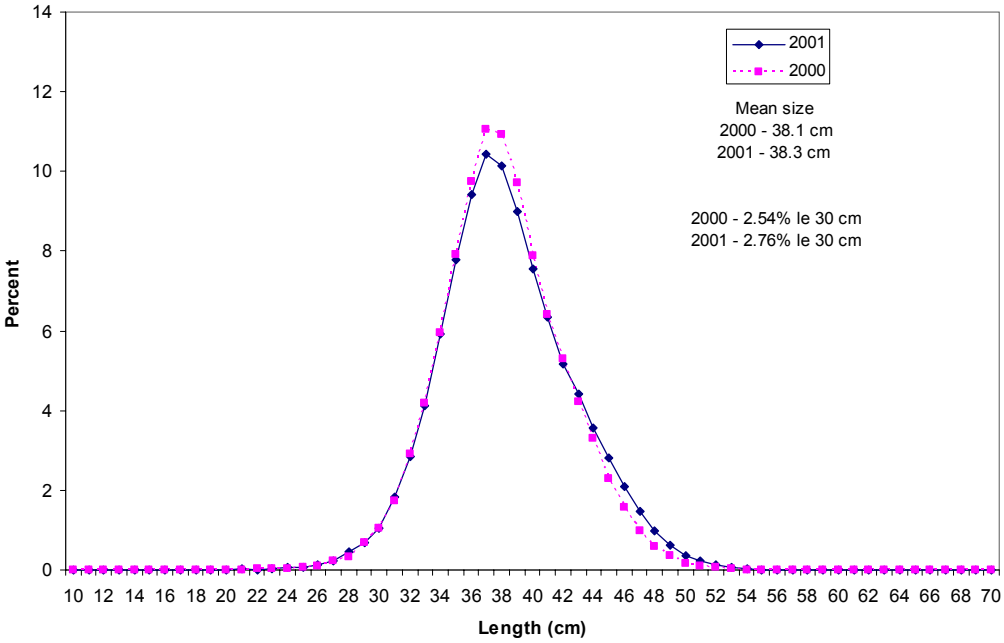


Fig. 12c. Length frequency of yellowtail flounder, sexes combined for 2000 and 2001.

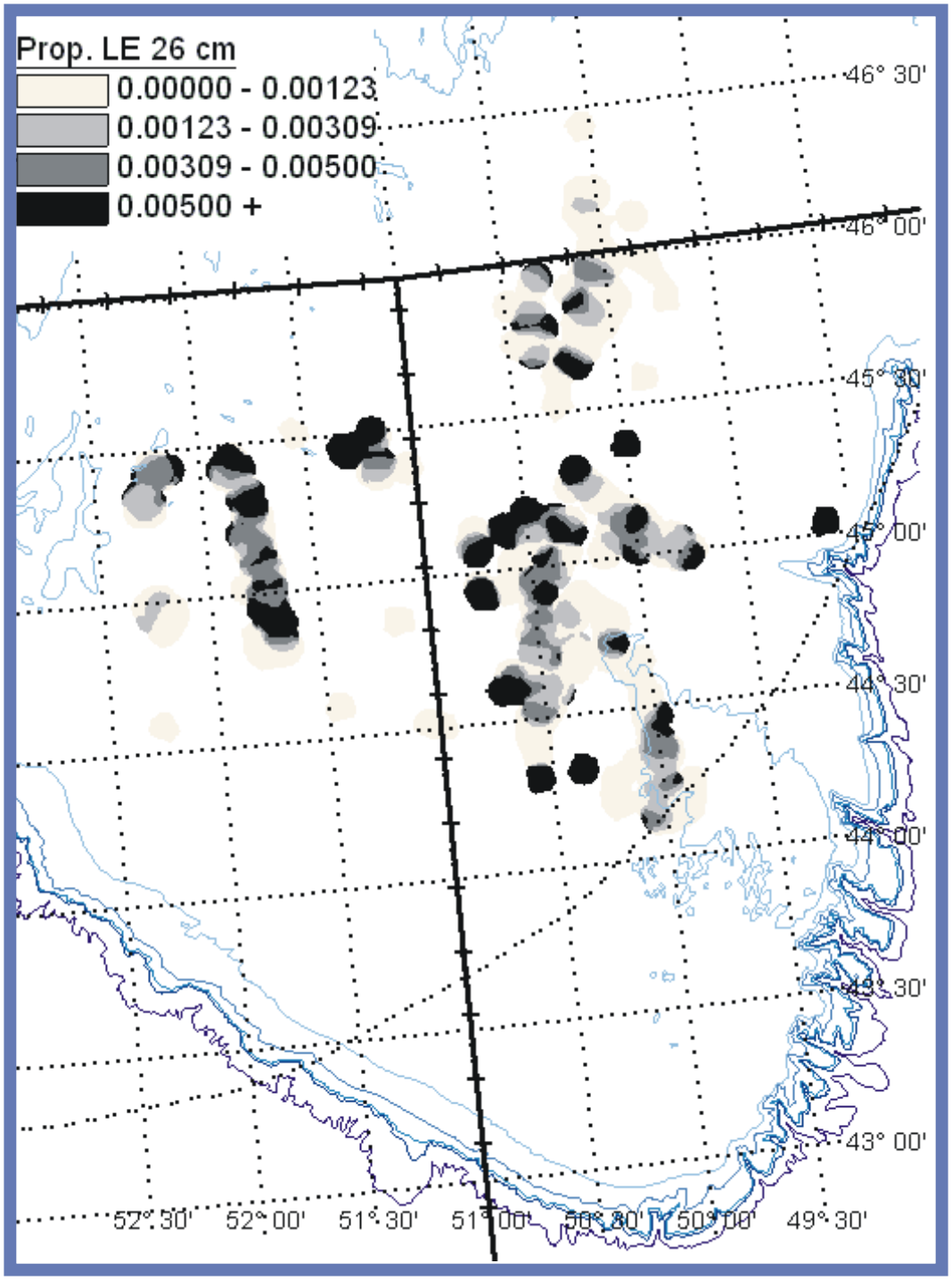


Fig. 13a. Proportion of yellowtail flounder less than 26 cm.

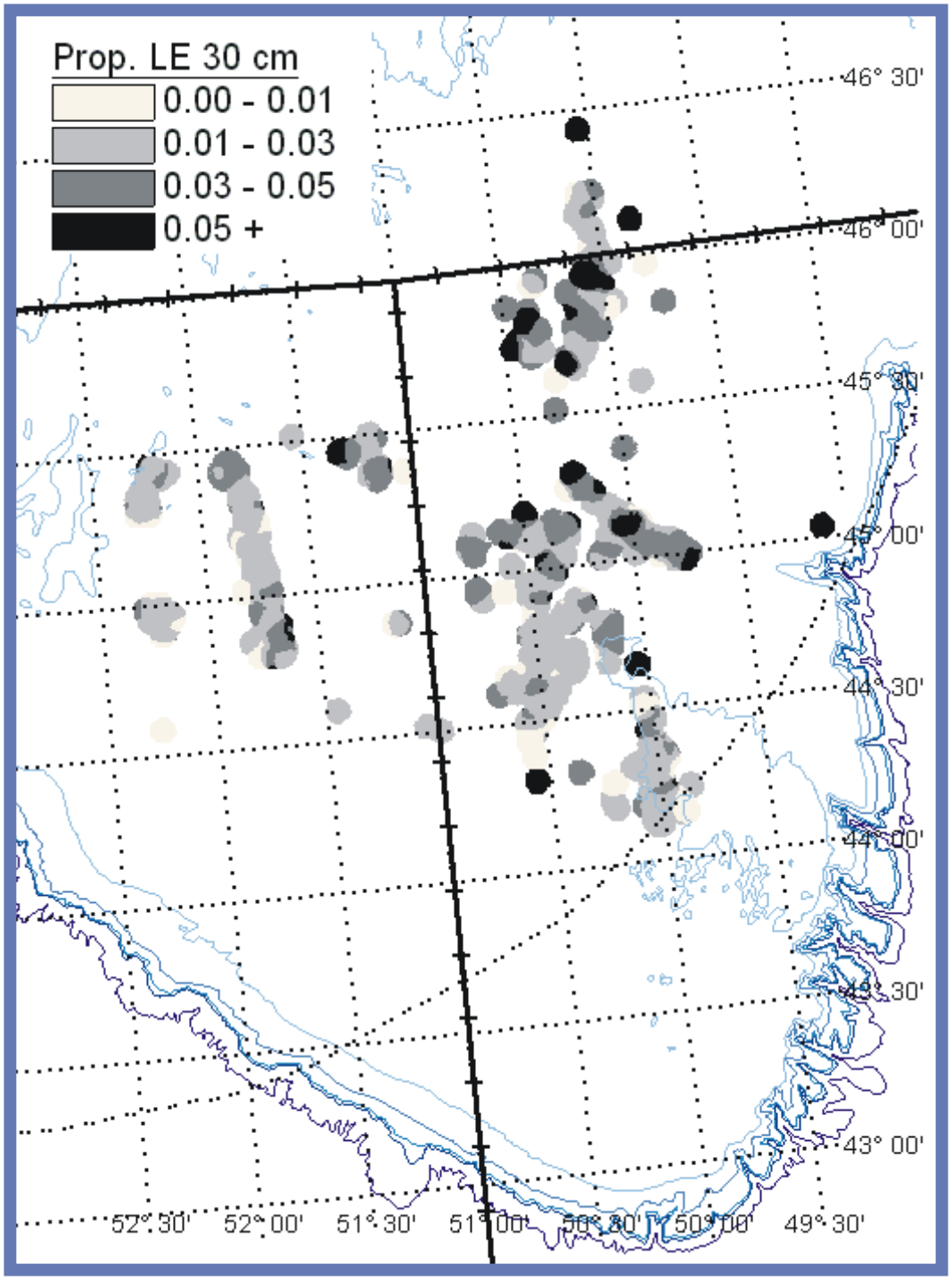


Fig. 13b. Proportion of yellowtail flounder less than 30 cm.

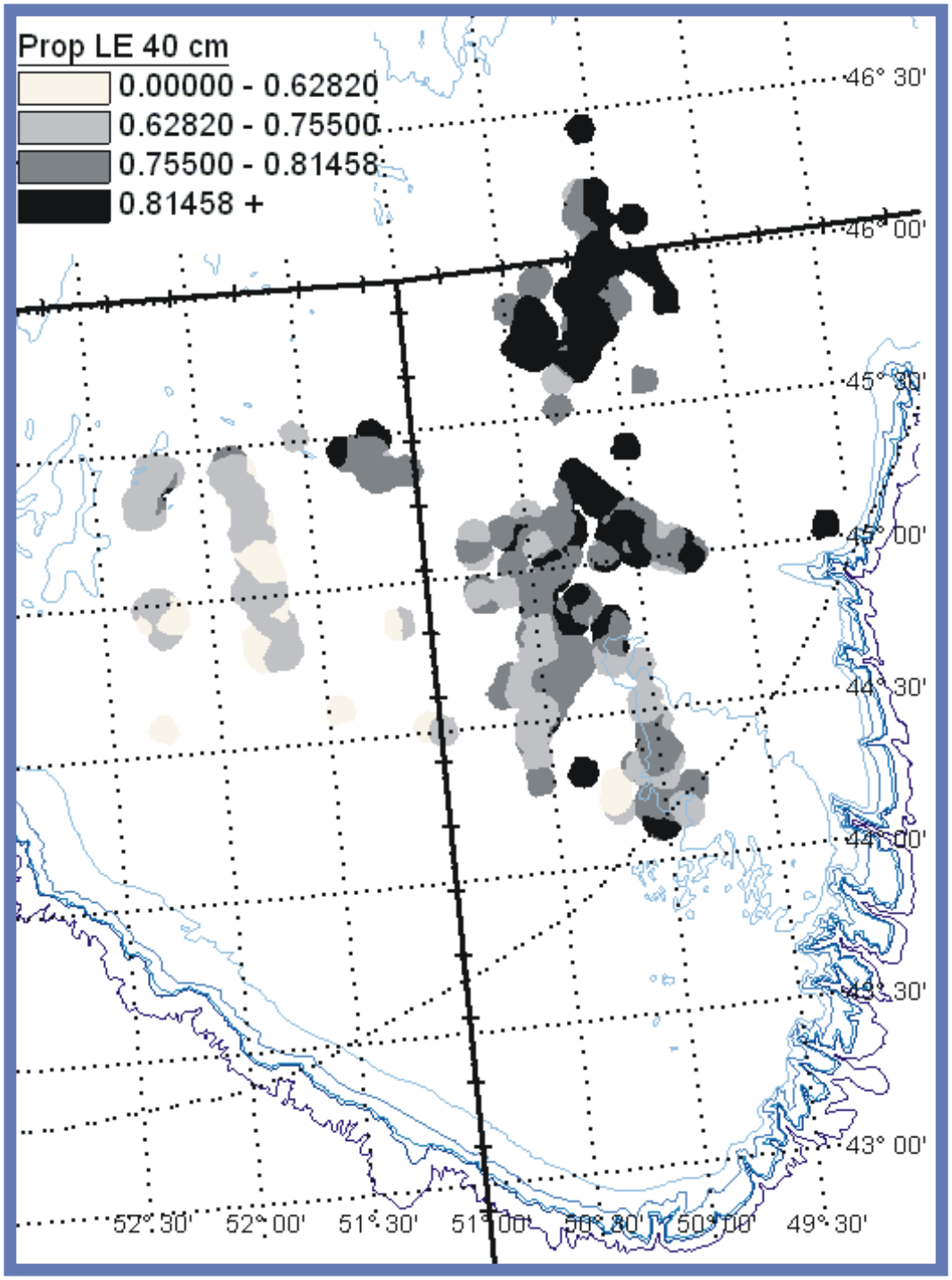


Fig. 13c. Proportion of yellowtail flounder less than 40 cm.