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Spatial distribution of Div. 3NO cod in Canadian surveys and temporal distribution of bycatch in Canadian fisheries: possible means to decrease bycatch?

By

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Abstract

Based on STACFIS estimates of catch, Canadian fisheries have accounted for on average 32 % of the total Div. 3NO cod bycatch since 2000. This paper examines the spatial distribution of Div. 3NO cod in Canadian research vessel surveys and the temporal distribution of bycatch in Canadian fisheries to determine if there is scope to decrease bycatch through spatial or temporal avoidance of cod in Divisions 3NO. There were no consistent areas of high concentration observed in Canadian research vessel surveys from 2000-2007. This was true for both younger (ages 0-2) and older (ages 3 plus) fish and for spring and autumn surveys. This lack of a consistent spatial distribution indicates that there is little opportunity to avoid bycatch of Div. 3NO cod by restricting fishing to certain areas, at least in the period of the year covered by the spring and autumn surveys. There appears to be substantial potential to decrease bycatch of Div. 3NO cod in the Canada NL fishery for yellowtail flounder by avoiding fishing in certain months or decreasing the catch of yellowtail in the months with the highest bycatch. Cod bycatch could be reduced by 85% in this fishery if there were no directed fishing for yellowtail flounder during months 6-11. If months 7-11 were avoided bycatch could be potentially be reduced by 76% and if directed fishing for yellowtail flounder avoided months 7-10, bycatch could potentially be reduced by 66%.

Keywords: bycatch, 3NO cod, temporal avoidance.

Introduction

At the 2007 annual meeting of NAFO, a conservation plan and rebuilding strategy for Div. 3NO cod were adopted (FC WP 07/7, Revised) (Annex 10) by the Fisheries Commission. The aim is to attain a sustained level of Spawning Stock Biomass or recovery milestone above the Blim of 60 000 t, consistent with the NAFO PA Framework. The strategy calls for reduction in bycatch. Noting the rebuilding plan for Div. 3NO cod, Fisheries Commission requested Scientific Council to advise on a range of possible management measures to ensure by-catch of cod is kept at the lowest possible level. Based on STACFIS estimates, since 2000, Canadian fisheries have accounted for on average 32 % of the total Div. 3NO cod bycatch, with the percentage ranging from 16-64%. This paper examines the spatial distribution of Div. 3NO cod in Canadian research vessel surveys and the temporal distribution of bycatch in Canadian fisheries to determine if there is scope to decrease bycatch through spatial or temporal avoidance of cod in Division 3NO.

Methods

Distribution plots of number of cod per standard tow from Canadian spring and autumn research vessel surveys from 2000-2007 were produced. These plots were by age, with ages 0-2 and 3 plus combined. No plot was produced from the spring 2006 survey, which was not considered representative because of lack of coverage as a result of

mechanical difficulties with the survey vessel. Plots were of two types, both produced by ACON: expanding symbols and colour contours. The contour plots are not intended to be quantitative but rather to aid the visual representation of the results.

Data from the reported Canadian landings were examined (NL landings only, this constitutes on average 92% of the Canadian bycatch of Div. 3NO cod). The amount of bycatch was determined for each month of each year from 2000-2007. The amount of bycatch was calculated by directed species to compare the impact of different fisheries.

The yellowtail flounder fishery was found to take the largest amount of bycatch (see below) so further analyses focused on that fishery. The amount and percentage bycatch taken in each month, as well as the catch of yellowtail flounder taken in each month was calculated for each year. Based on the average percent bycatch per month in the yellowtail flounder fishery, scenarios were developed to examine the impact on bycatch of redistributing the yellowtail catch from months with the highest cod bycatch. In each scenario the total catch of yellowtail flounder was the same (12,500 t), the average catch during 2003-2005. During this period the TAC for yellowtail flounder was 14,500 or 15,000 t and the Canadian yellowtail flounder fishery took most/all of its quota. Thus 12,500 t would be the expected yellowtail flounder catch by Canada NL with a quota of 15,000 t. Average percent bycatch by month and average percent catch of yellowtail was calculated using data from 2000-2007 but excluding 2006. Data from 2006 were not included in the average percent bycatch per month, as catch of yellowtail flounder was low in that year and fishing only occurred in 3 months. A 12,500 t catch of yellowtail flounder was spread over all 12 months using the average percentage catch of yellowtail in each month, or over 6, 7, or 8 months, with an even distribution of catch across months. Fishing over 6 months avoided months 6-11, fishing over 7 months avoided months 7-11 and fishing over 8 months avoided months 7-10. A final scenario was examined where the catch of yellowtail in months 7-11 was decreased by 50% over what would usually be taken in those months and that catch distributed equally across the other months.

Results and Discussion

Distribution plots of cod in Div. 3NO are given in Fig. 1-8 for Canadian spring and autumn surveys from 2000-2007. Cod are generally widespread throughout Div. 3NO, although in low abundance. There were no consistent areas of high concentration. This was true for both younger (ages 0-2) and older (ages 3 plus) fish and for spring and autumn. This variability in the spatial distribution is consistent with previous studies (Colbourne and Murphy, MS 2000; Lilly et al. MS 2000; Walsh et al. MS 2001). Although Walsh et al. (MS 2001) did find that on average 49% of the juveniles were found on or west of the southeast shoal, they also found that the temporal and spatial pattern of juvenile cod was quite variable. This lack of a consistent spatial distribution indicates that there is little opportunity to avoid bycatch of Div. 3NO cod by restricting fishing to certain areas, at least in the period of the year covered by the spring and autumn surveys.

Examination of landings data from Canada NL shows a clear temporal trend with most bycatch of Div. 3NO cod being taken in the second half of the year, particularly in months 9 and 10 (Fig. 9). The most important fishery is the yellowtail flounder fishery which takes nearly 80% of the Canada NL bycatch of Div. 3NO cod (Table 1). The yellowtail flounder fishery has taken from 61-87% of the bycatch taken by Canada NL over the 2000-2007 period, except in 2006 when that fishery only operated for 3 months at a much reduced level.

Percent bycatch of Div. 3NO cod in the Canada NL yellowtail flounder fishery was highest in months 8-10 in almost every year (Fig. 10). Bycatch percentage was also high in July, a month when yellowtail fishing is generally limited to avoid catching spawning fish. Catch of yellowtail flounder on the other hand is generally distributed throughout the year with peaks in months 4-5 and 8-10 (Fig. 10). From 2000-2005 (years when the Canada NL yellowtail flounder fishery operated on a normal basis), catch in the first 6 months of the year made up on average 46% of the total yearly catch.

There appears to be substantial potential to decrease bycatch of Div. 3NO cod in the Canada NL fishery for yellowtail flounder by avoiding fishing in certain months (Table 2). Assuming average monthly bycatch rates, a fishery spread over the year in the pattern usually observed would take 400 t of cod bycatch. This is very similar to the 407 t of bycatch of 3NO cod taken on average by Canada NL with a yellowtail catch in the 12,500 t range. If the same amount of yellowtail flounder was caught but fishing did not occur in months 6-11, bycatch of 3NO cod could be reduced by 85% in this fishery. If months 7-11 were avoided bycatch could be potentially be reduced by 76%

and if directed fishing for yellowtail flounder avoided months 7-10, bycatch could potentially be reduced by 66%. It should be kept in mind that the Canada NL fishery has been operating only on a limited basis in July (month 7) so that this scenario (no fishing month 7-10) would result in a closure of 3 months compared to the current fishing practice. If the catch of yellowtail flounder in months 7-11 was decreased by 50% and that amount of catch equally distributed across the other months, the bycatch of cod in the Canada NL yellowtail flounder fishery could be expected to decline by 38%.

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Table 1. Div. 3NO cod bycatch (Kg) taken by directed species for fisheries conducted by Canada (NL) from 2000-2007. The percent of the total cod bycatch that is taken taken by each fishery is also shown.

Directed species	Cod bycatch (Kg)	Percent of total cod bycatch
100	52771	1.8
110	560	0.0
REDFISH	239255	8.3
130	32139	1.1
140	1731	0.1
YELLOWTAIL	2243882	77.4
144	29300	1.0
SKATE	185847	6.4
171	76266	2.6
177	38162	1.3

Table 2. Catch of yellowtail flounder and cod (tonnes) based on the mean percentage bycatch of cod each month in the yellowtail fishery, taking a yellowtail catch of 12,500 t over 12 months with normal catch pattern, 6, 7 or 8 months or 12 months with catch reduced in months 7-11 by 50%.

Month	percent bycatch	Fish in all months		Fish in 6 months		Fish in 7 months		Fish in 8 months		Reduce 7-11 by 50%	
		catch ytail	catch cod	catch ytail	catch cod	catch ytail	catch cod	catch ytail	catch cod	catch ytail	catch cod
1	0.08	425	0	2083	2	1786	1	1563	1	786	1
2	0.08	418	0	2083	2	1786	1	1563	1	779	1
3	0.03	669	0	2083	1	1786	1	1563	1	1030	0
4	0.30	1674	5	2083	6	1786	5	1563	5	2035	6
5	1.26	1743	22	2083	26	1786	23	1563	20	2104	27
6	2.54	711	18	0	0	1786	45	1563	40	1072	27
7	5.42	67	4	0	0	0	0	0	0	33	2
8	9.34	382	36	0	0	0	0	0	0	191	18
9	6.46	1562	101	0	0	0	0	0	0	781	50
10	7.73	1935	150	0	0	0	0	0	0	967	75
11	3.42	1827	63	0	0	0	0	1563	53	914	31
12	1.27	1100	14	2083	26	1786	23	1563	20	1461	19
sum		12513	412	12500	63	12500	99	12500	140	12153	256
bycatch reduction (%)					85		76		66		38

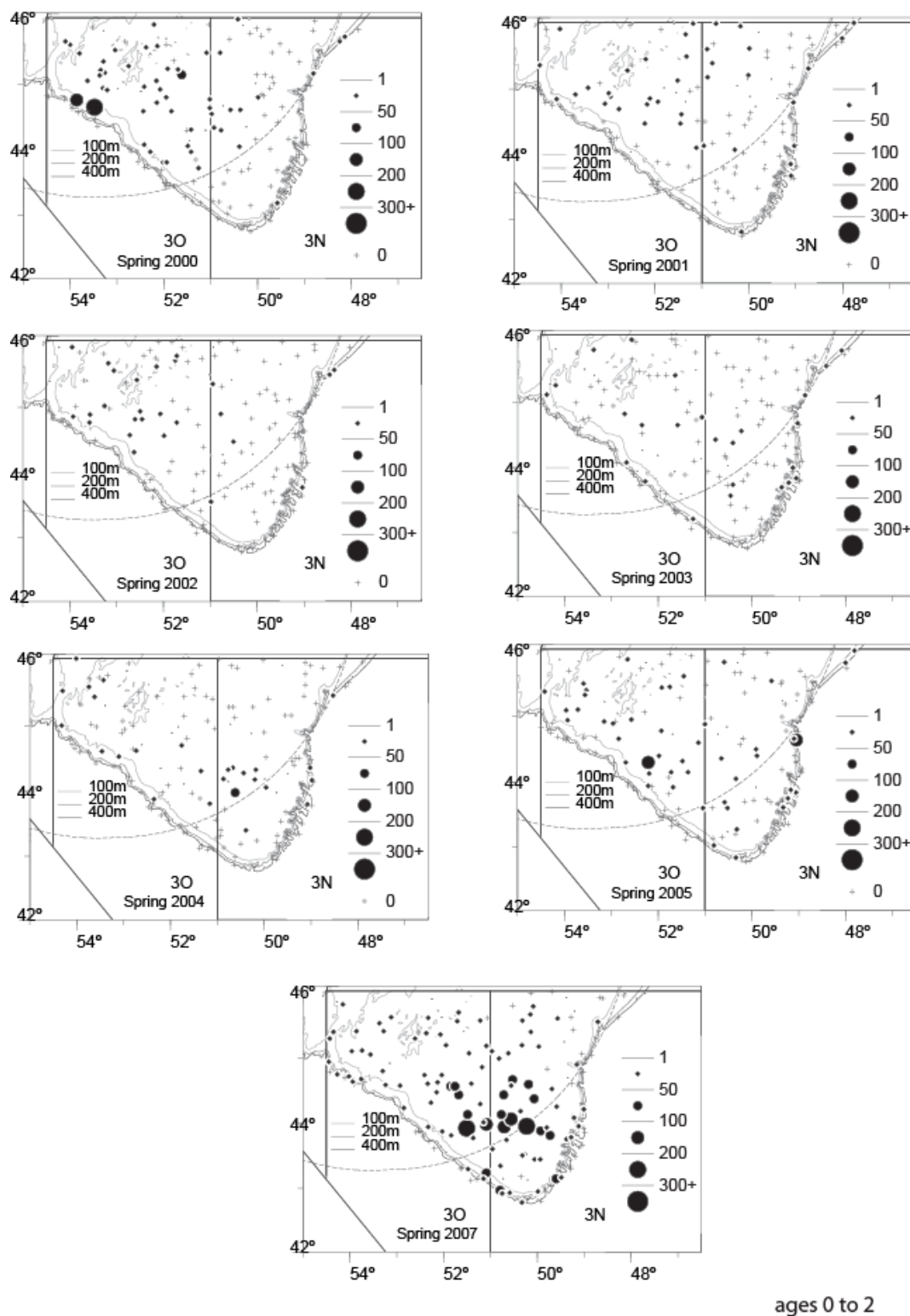


Figure 1. Expanding symbol plots of the number of cod in each set in Div. 3NO during Canadian spring surveys from 2000-2005 and in 2007. Ages 0 to 2 combined. The size of the symbol indicates the number of fish caught.

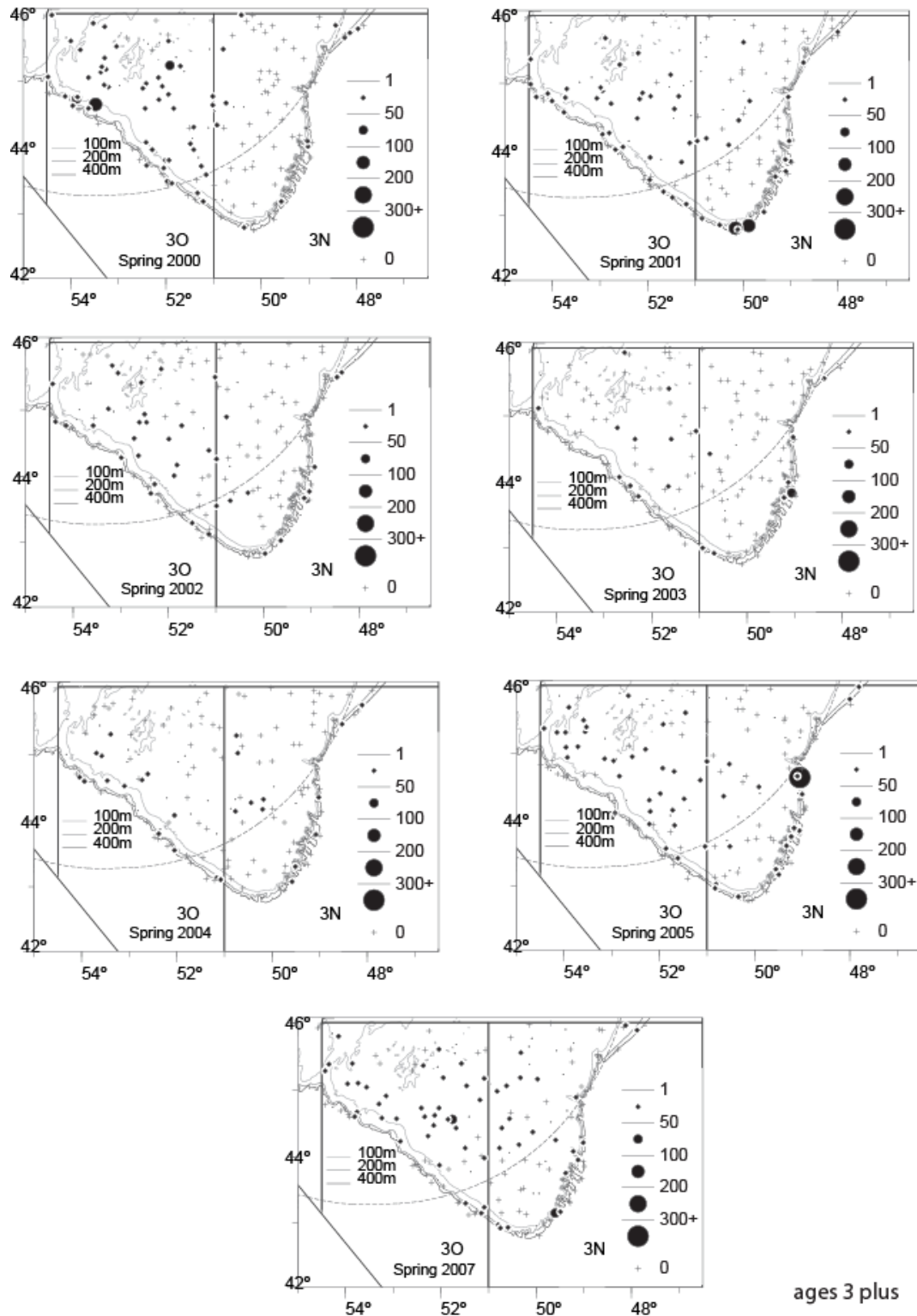


Figure 2. Expanding symbol plots of the number of cod in each set in Div. 3NO during Canadian spring surveys from 2000-2005 and in 2007. Ages 3 plus combined. The size of the symbol indicates the number of fish caught.

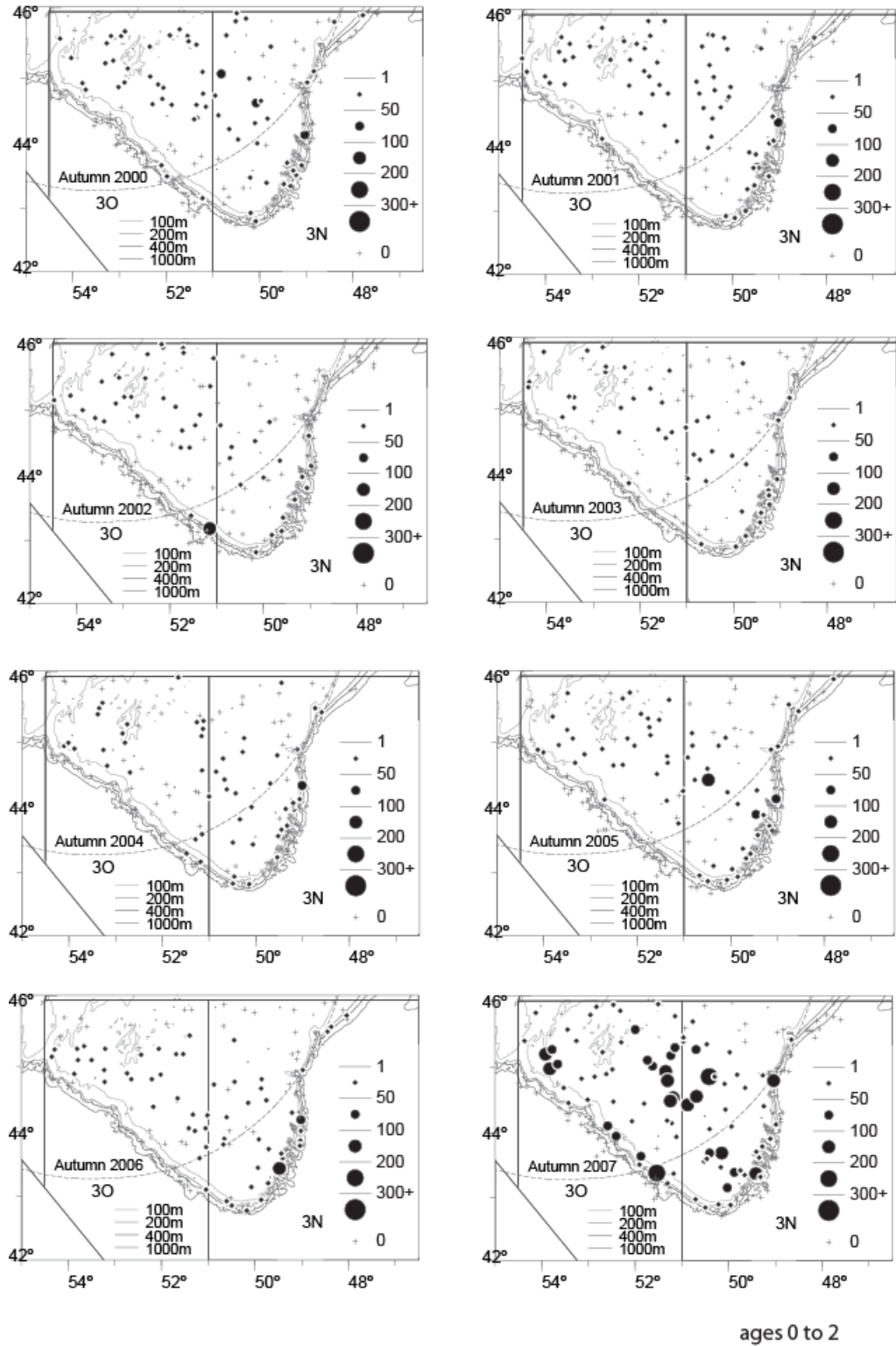


Figure 3. Expanding symbol plots of the number of cod in each set in Div. 3NO during Canadian autumn surveys from 2000-2007. Ages 0 to 2 combined. The size of the symbol indicates the number of fish caught.

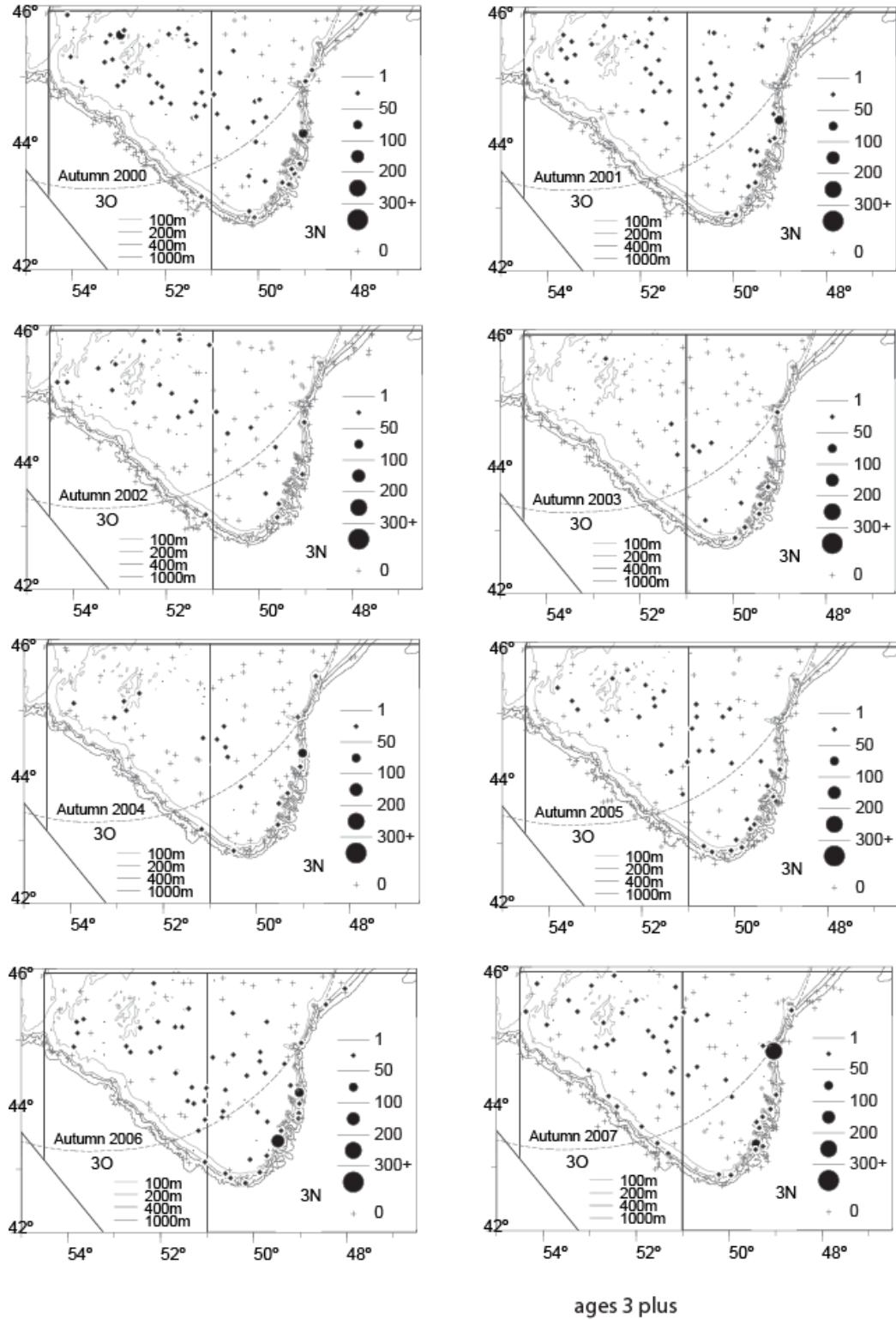


Figure 4. Expanding symbol plots of the number of cod in each set in Div. 3NO during Canadian autumn surveys from 2000-2007. Ages 3 plus combined. The size of the symbol indicates the number of fish caught.

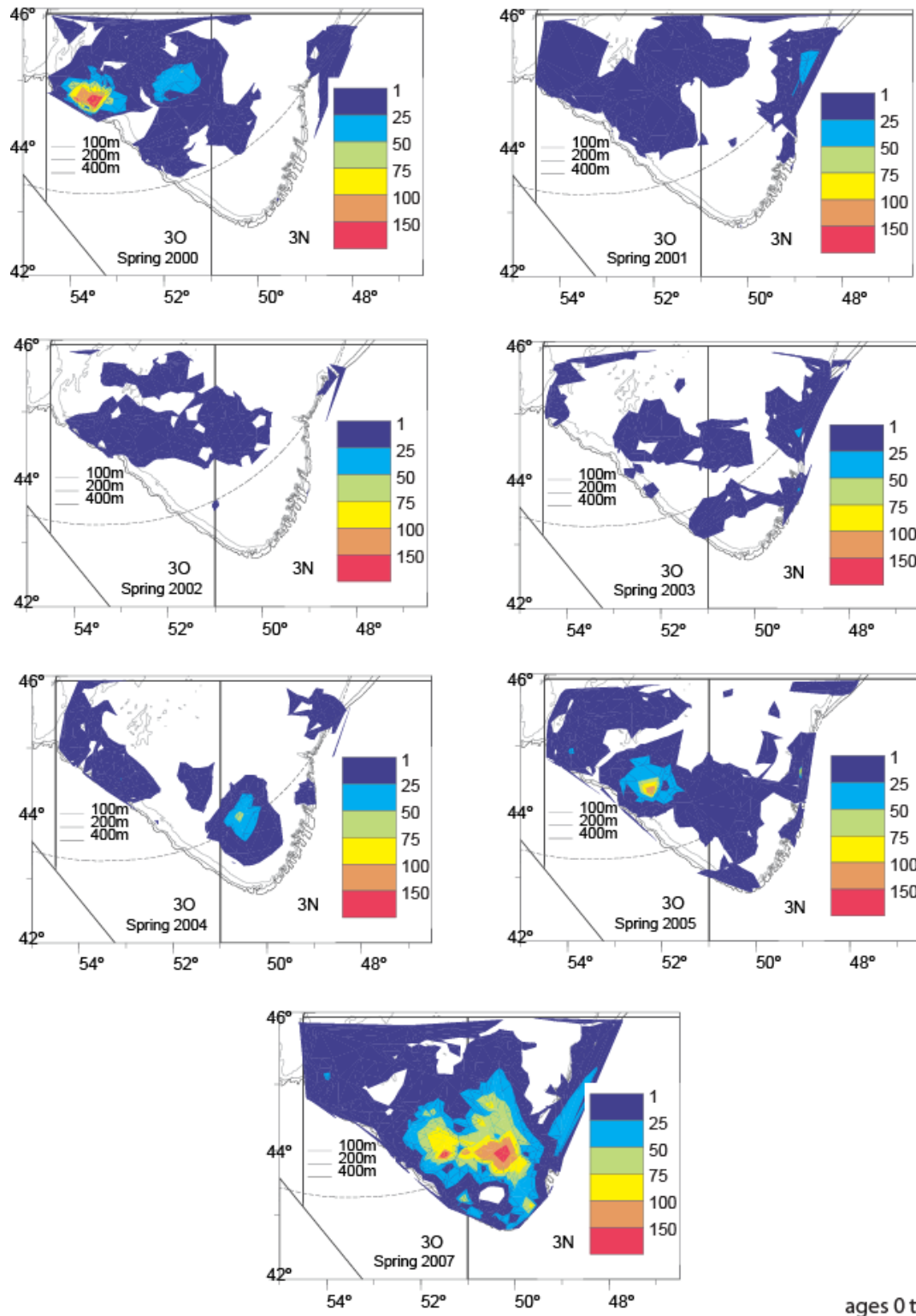


Figure 5. Contour plots of the number of cod in each set in Div. 3NO during Canadian spring surveys from 2000-2005 and in 2007. Ages 0 to 2 combined. The more red the colour the higher the number of fish caught.

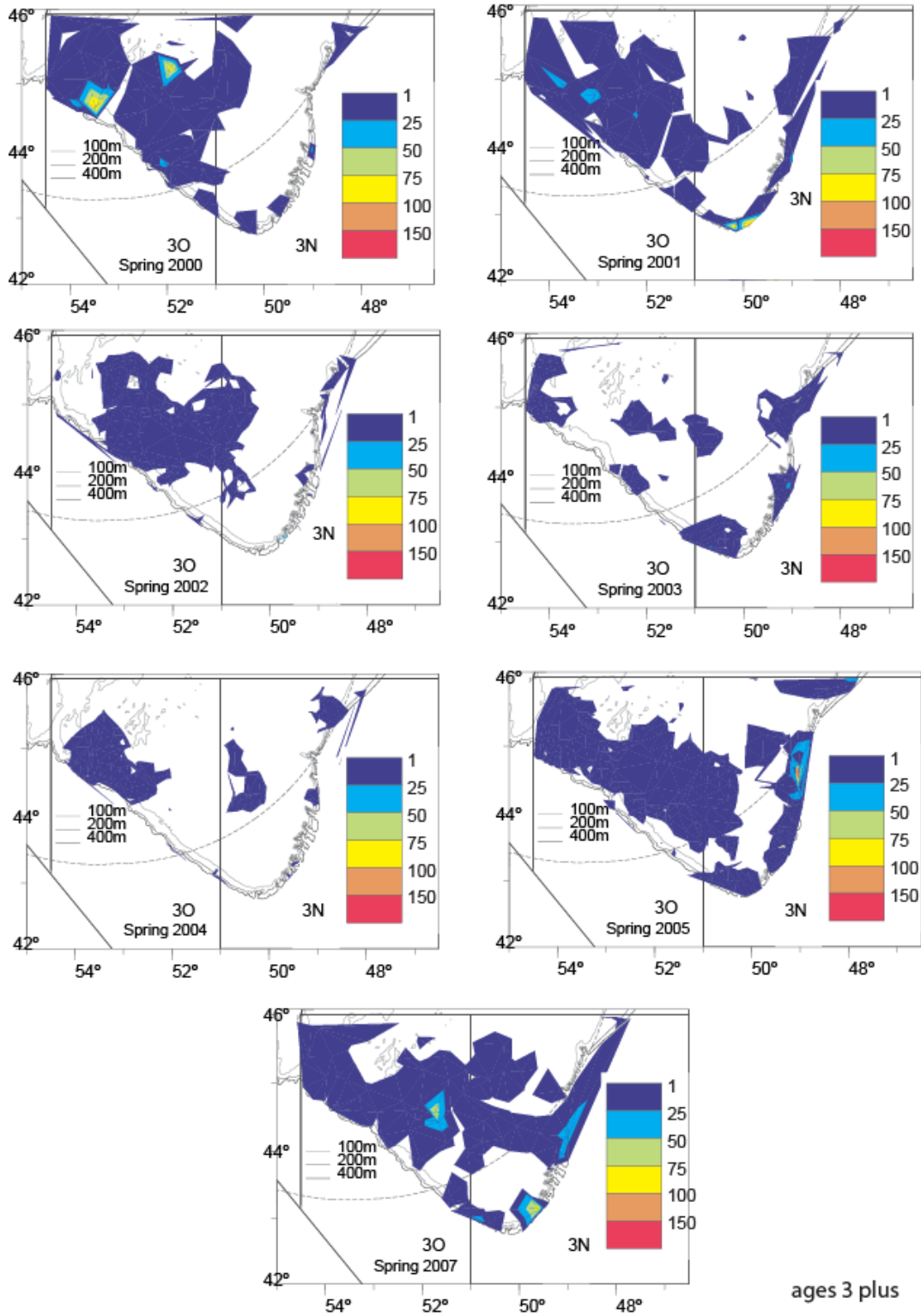


Figure 6. Contour plots of the number of cod in each set in Div. 3NO during Canadian spring surveys from 2000-2005 and in 2007. Ages 3 plus combined. The more red the colour the higher the number of fish caught.

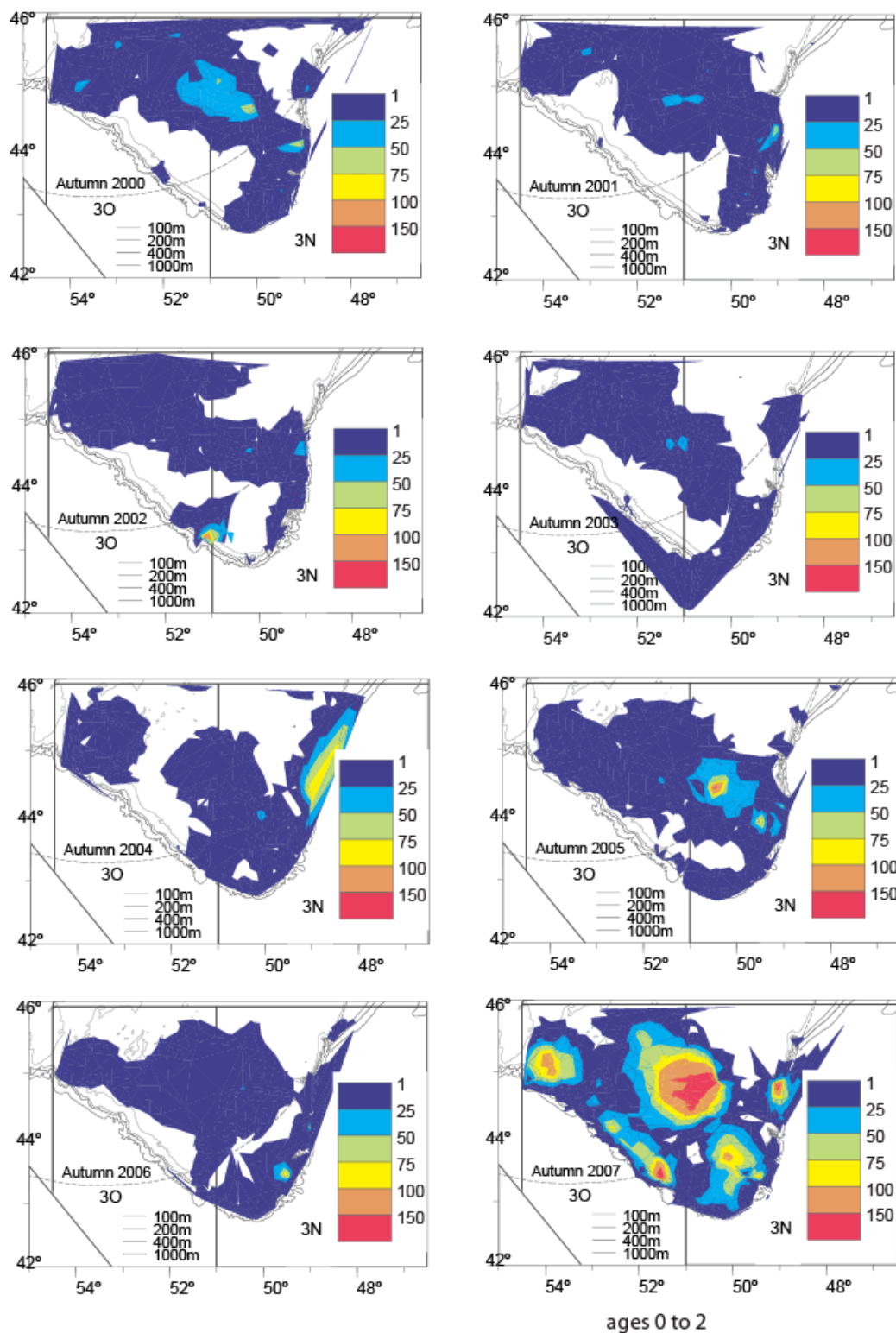


Figure 7. Contour plots of the number of cod in each set in Div. 3NO during Canadian autumn surveys from 2000-2007. Ages 0 to 2 combined. The more red the colour the higher the number of fish caught.

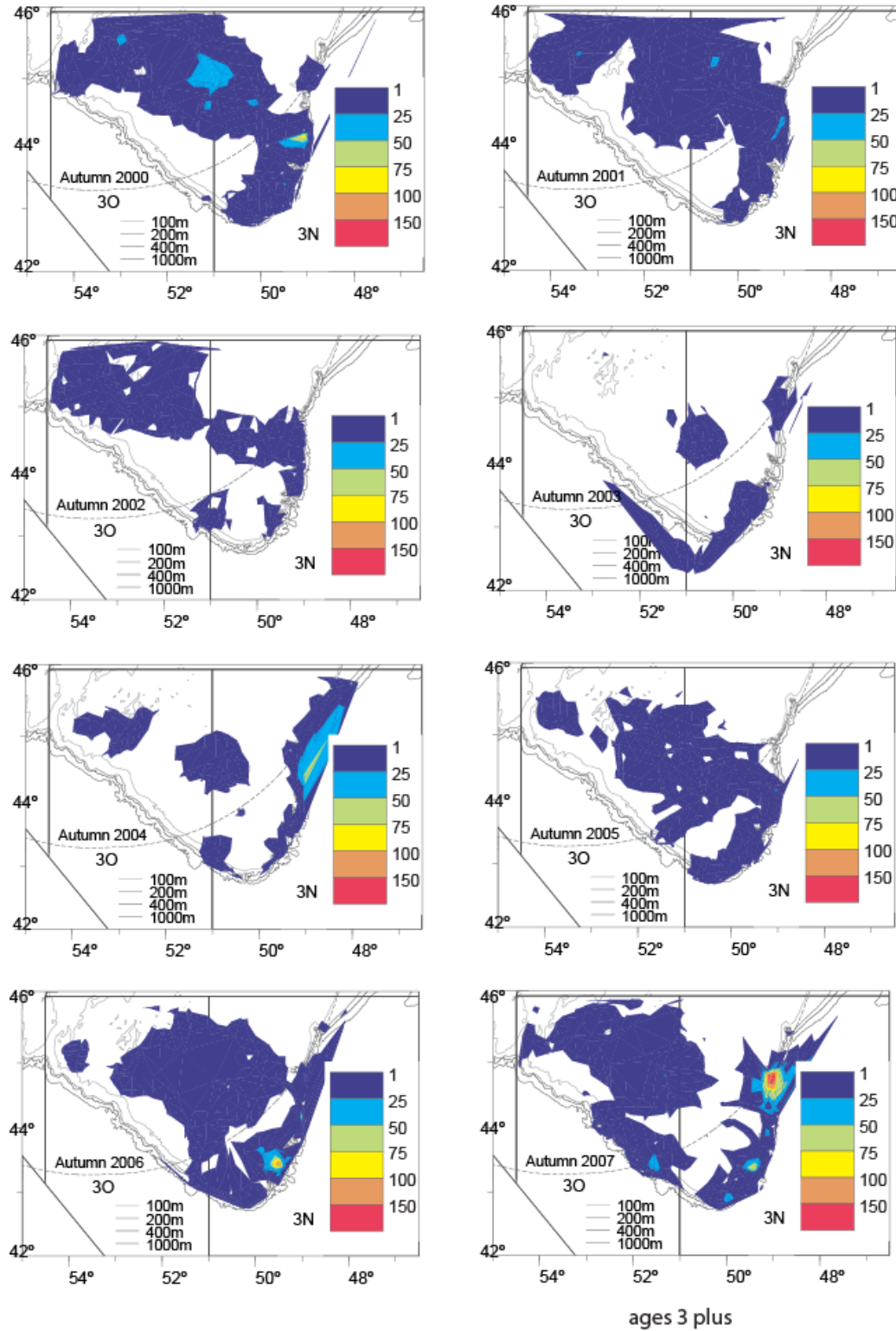


Figure 8. Contour plots of the number of cod in each set in Div. 3NO during Canadian autumn surveys from 2000-2007. Ages 3 plus combined. The more red the colour the higher the number of fish caught.

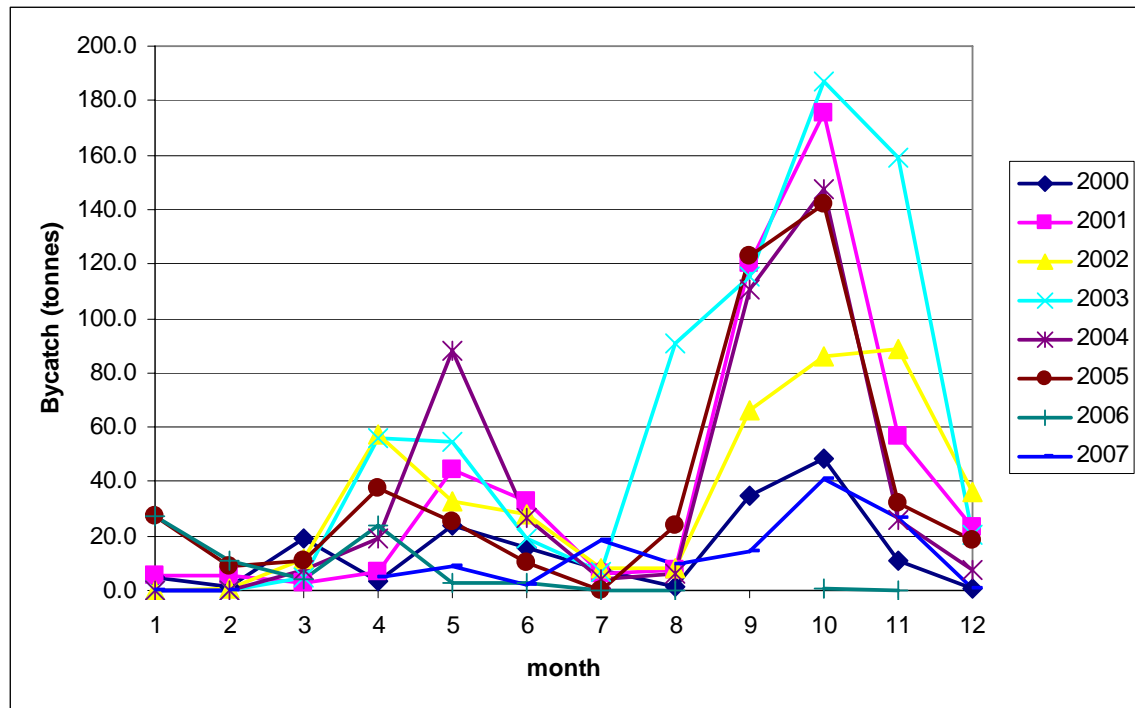


Figure 9. Bycatch (tonnes) of Div. 3NO cod by month and year in fisheries prosecuted by Canada NL.

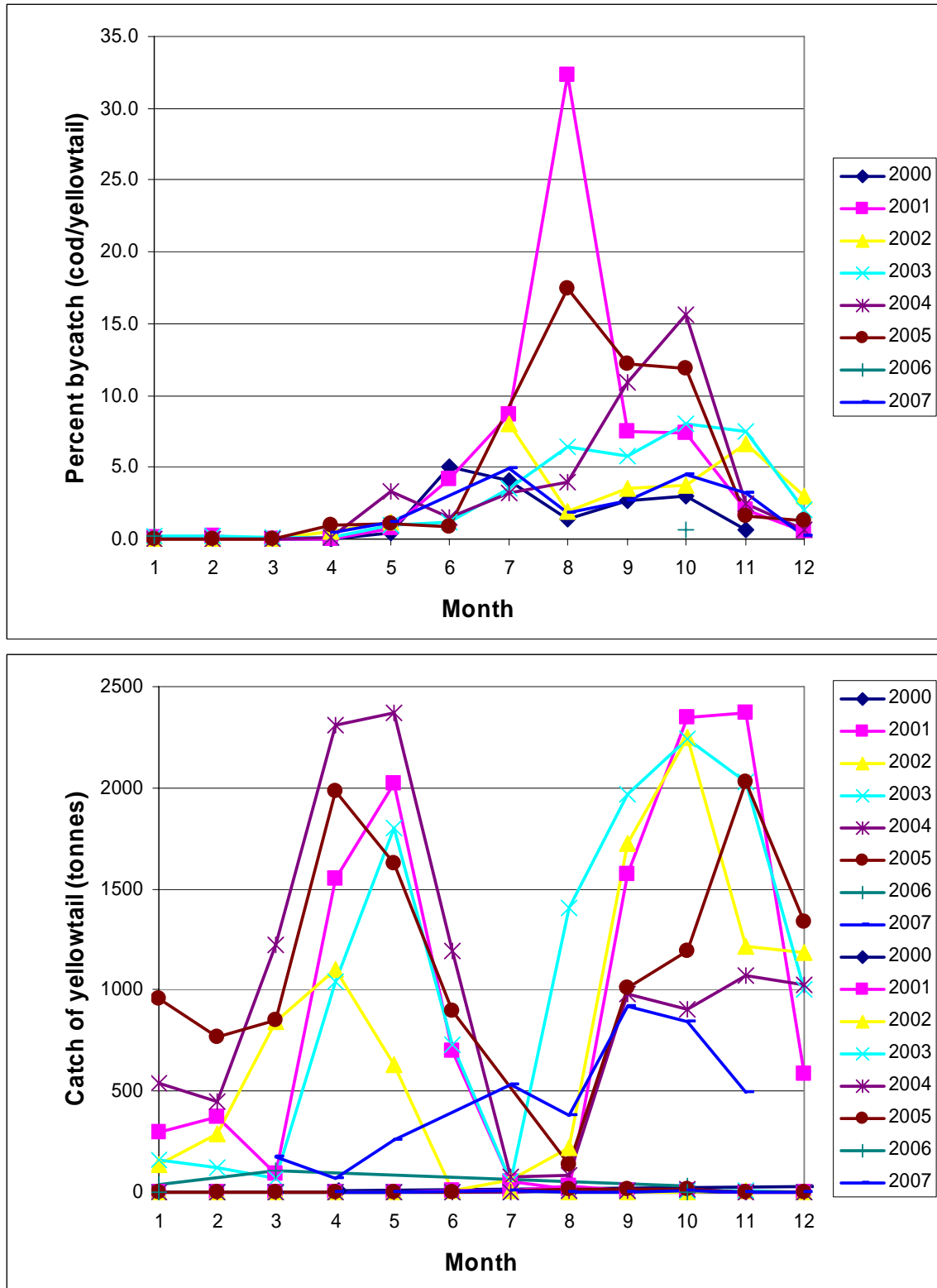


Figure 10. Percent bycatch of Div. 3NO cod in the Canada NL yellowtail flounder fishery by month and year (Top) and catch (tonnes) of yellowtail flounder by month and year in that same fishery.