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Distribution of redfish (*Sebastes* spp.) in the Gulf of St. Lawrence and in the Laurentian Channel based on RV surveys and commercial fishery catch rates

by

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Abstract

The analysis of the winter surveys in 3PsPn4RST from 1978 to 1993 has shown that, since 1990, redfish were more concentrated in the Cabot Strait area in January-February and that the concentration of fish overlapped the 3Pn and 3Ps boundary. The location of winter commercial catch rates agreed well with the survey data. In May, fishing shifted north into the Gulf of St. Lawrence and to the west side of the Laurentian Channel (4Vn and 4Vs boundary) until October. The catch rate data suggested also that the migration of Gulf of St. Lawrence redfish into the Cabot Strait area (South 4RT, 3Pn and 4Vn), started as early as November in the last 3 years. This does not correspond to the present management units (ie. 3Pn and 4Vn are still considered as Laurentian Channel or Unit 2 redfish). RV surveys in the Gulf of St. Lawrence generally showed a southward trend in the winter distribution of fish as they get larger in size. The distribution and the migration of the two species of redfish (*Sebastes mentella* and *S. fasciatus*) in the Gulf of St. Lawrence are believed to be different and further investigations are required to assess the impact on the fishery .

Résumé

L'analyse des relevés de poissons de fond dans les divisions 3Ps3Pn4RST de 1978 à 1993 a montré que le sébaste était concentré dans la région du détroit de Cabot en janvier et février. Cet observation semble s'être amplifiée depuis 1990 et les concentrations de sébaste débordent dans la sous-division 3Ps. La distribution des taux de capture de la pêche commerciale d'hiver supporte les données des relevés. En mai, les activités de pêche se déplacent vers le nord dans le golfe du Saint-Laurent, ainsi que vers le sud dans le chenal Laurentien, à la limite de 4Vn et 4Vs jusqu'au mois d'octobre. Les données de taux de capture analysées suggèrent que la migration du sébaste dans le région de du Détroit de Cabot (4RT,3Pn et 4Vn) a débuté aussi tôt que novembre au cours des trois dernières années ce qui ne concorde pas avec les unités de gestion présentement en place (i.e. 3Pn et 4Vn sont considérés comme du sébaste du chenal Laurentien ou Unité 2). La distribution du sébaste par groupe de longueur lors des relevés de poissons de fond a montré un déplacement vers le sud dans le détroit de Cabot à mesure que la taille des poissons augmente. La distribution et la migration des deux principales espèces de sébaste (*Sebastes mentella* and *S. fasciatus*) dans le golfe du Saint-Laurent semblent différentes et d'autres analyses sont requises afin de décrire l'impact sur la pêche.

Introduction

This research document describes the analyses on the distribution of redfish presented at the working group on oceanographic effects on stock migration and mixing (D'Amours *et al.*, 1994). This working group was established to examine stock mixing that occurs in Cabot Strait at the entrance to the Gulf of St. Lawrence. The concentration of redfish in this area was described in the late 1980's (Atkinson and Power 1991) and resulted in the establishment of new management units: Gulf of St. Lawrence redfish (or Unit 1)→ 4RST+ 4Vn3Pn (Jan-May); Laurentian Channel redfish (or Unit 2 redfish) → 3Pn4Vn (June-Dec) +3Ps +4VsWfgj. However, since 1990, the commercial fishery is reporting some changes in the distribution of redfish in the Gulf of St. Lawrence, particularly in winter, which require further analyses.

This paper presents the distribution of redfish catches from research vessel surveys conducted in Divisions 4RSTV3P from 1978 to 1994 and the location of catch rates from redfish trawlers in the same area for the period 1990-1993. The objective is to describe the distribution of redfish stocks in the Gulf of St. Lawrence and in the Laurentian Channel for the period covered assuming that both RV survey data and commercial catch rates reflect the distribution of the fish. However, ice conditions, DFO regulations (quota, bycatch) or company imposed regulations may be reflected significantly in the catch-rate data used to describe fish distribution and, thus, this information should be interpreted carefully.

Methods

RV survey data

Annual stratified random surveys have been conducted in Div. 4RST3Pn in January (*Gadus Atlantica*) from 1978 (except 1982) and in 3P from February to April since 1973 (*A.T.Cameron, A. Needler* and *W. Templeman*). For this paper, only the period 1978 to 1994 was analyzed in order to compare the two surveys (Appendix 1). It should be noted that for some years the two surveys were separated in time by one to two months and may account for some of the differences observed in the distribution patterns.

The total catches of redfish for each set were plotted on a map of the area. For the 4RST3Pn survey, all the successful sets were included whereas for the 3P survey only the successful sets in 3Ps were retained since Subdiv. 3Pn was not always covered prior to 1986. This reflects the management units of redfish for that period (4RST+ 3Pn4Vn (Jan.to May) → Gulf redfish; 3Pn4Vn (June to Dec.) +3Ps+4VsWfgj → Laurentian Channel redfish).

Redfish populations possess two characteristics that are useful to perform length based analyses: strong year-classes appearing periodically (every 8 to 15 years) and their slow growth. It is thus possible to follow in time the strong modal groups (year-classes) from the length frequencies of RV surveys and to analyze their geographical distribution. Thus, for each survey, length frequencies (Fig. 1) were examined to identify the important modal groups which correspond to one or two year-

classes. Five modal groups were identified and labeled with their presumed year of birth:

1- Modal group '1956' (1956 and 1958 year-classes)
2- " " '1970' (Beginning of 1970's year-classes)
3- " " '1980' (Beginning of 1980 year-class)
4- " " '1985' (1984-85 year-class)
5- " " '1988' (1987-88 year-class)

Length intervals corresponding to each modal group were determined visually and they are presented in Table 1. The same length intervals were used for both surveys because of the similarities in the length frequencies. These intervals were used to separate the length frequencies into the modal groups. The numbers of fish caught by length were transformed in to a weight in kg using the length-weight relationships given in Maguire *et al* (1983) and these catch by length were added for each modal group to obtain catches by modal group for both surveys. Plots of catches by modal group were then produced to assess the differences in distribution from year to year. The yearly weighted distribution of the latitude, longitude, depth and bottom temperatures were estimated for each group. The distributions of these variables were weighted (Chambers and Dunstan, 1986) by the catches and the strata areas to give a true representation of the locations of the modes. The medians of the distribution were used as estimators of location.

Commercial fishery CPUE

Data representing the redfish fishery were used to analyse its spatial distribution. For the Gulf, Quebec and Scotia-Fundy regions from 1990 to 1993, catch and effort data were extracted from the ZIFF data files. However, since catch and effort data from Newfoundland for these years do not include fishing position, only data from the observer program for the years 1990 to 1992 were used. The analysis was done for vessels of tonnage class 4 and over, directing for redfish with otter trawls and midwater trawls. The position of all sets was known to a precision of 10 minutes of latitude and longitude or better.

The catch rates (tons/hour) were standardized within each year, assuming multiplicative effects (Gavaris, 1980) for vessels and a predicted catch rate was estimated by 10 minute square and month. The *Cape Fame* was retained as the standard vessel since it had the highest number of observations as well as the best time and space coverage. The maps therefore represent the monthly evolution of the catch rate distributions predicted for the *Cape Fame*, during the years 1990 to 1993.

Results

RV survey data

a) Total catches distribution (Fig. 2)

From 1978 to 1986, the location of the highest catches occurred from the entrance of the Esquiman

Channel in 4RS to the south of Burgeo Bank in northern 3Ps. Beginning in 1987, larger catches were more concentrated between St.Georges Bay in southern 4R and Burgeo Bank. In 1988 to 1990, high catches were dispersed in the Laurentian Channel in and out the Gulf of St. Lawrence. Finally, in the last two years, the highest catches occurred outside the Laurentian Channel, in the southern most slopes of St. Pierre Bank in southern 3Ps.

b) Modal groups catches distribution (Figures 3 to 9)

The medians of the distribution of latitude and longitude are presented for the five modal groups (Figures 3 and 4), whereas the catches by mode plots are only presented for the '1980', '1985' and '1988' modal groups (Figures 5,6 and 7) since the distribution of the '1956' and '1970' modal groups was similar to the distribution of the total population (Fig. 2).

The geographical distribution (latitude and longitude) of the larger fish ('1956' and '1970' modal groups) does not show any trend during the whole time period in Div. 3Ps (Figures 3 and 4). However, the data suggests that these modal groups changed their distribution in Divs 4RST3Pn , mostly in 1991-93. They were more concentrated in the Cabot Strait area, very close to the Newfoundland coast.

The '1980' modal group showed up first in Subdiv. 3Pn and 3Ps in 1981 (Fig. 5) but afterward they seem to disperse in the whole area until 1988. Also, between 1983 and 1986, highest catches in the Gulf of St. Lawrence occurred in the Esquiman Channel. From 1989 onward, the '1980' modal group started to show a distribution pattern similar to the '1956' and '1970' modal groups (Cabot Strait area concentration).

The '1985' modal group was first observed in the Esquiman Channel in 1988 but its distribution extended southward in the following years (Figures 3 and 6). In 1992 and 1993, the highest catches were made along the southern edge of St. Pierre Bank, east of the Laurentian Channel. Also, small catches were observed within the Gulf. The decrease of the '1985' modal group in the Gulf is reflected in the length frequencies of redfish in Divs 4RST3Pn (Fig. 1). Recent works have shown that this year-class was dominated by *Sebastes fasciatus* in the Gulf of St.Lawrence and an important decrease in abundance was also observed in the summer groundfish survey (Morin and Bernier 1993).

The '1988' modal group first appeared sparsely in the Esquiman Channel, but also in 3Pn in 1990 (Fig. 7). From 1991, catches occurred both in the Esquiman Channel and off Rose Blanche Bank (3Pn), but the largest catches occurred on the slope of St.Pierre Bank at the intersection of the Hermitage and the Laurentian Channels. In 1992 and 1993, highest catches were found in 3Pn and 3Ps. This year-class is also dominated by *S. fasciatus* in the Gulf of St. Lawrence (Morin and Bernier, 1993).

The median of the depth distribution increased regularly for all the modal groups until the fish reached about 30 cm in length (Fig. 8). Above that , the depth distributions were similar at about 400 m. For both surveys, one year showed an important drop in the median depth: 1989 for the 4RST3Pn survey and 1991 for the 3Ps survey. These decreases may be due to a few high catches in shallower waters

in those years.

The distribution of catches of most modal groups relative to bottom water temperature varied from year to year (Fig. 9). However, in the 3Ps survey, the '1988' modal group occurred in warmer waters for the last two years.

Commercial fishery CPUE

The annual multiplicative models explained 62, 55, 62 and 53 percent of the variance of the log-catch rates in 1990-1993 respectively(Appendix 2-5). Both the vessel and the month-10'-square effects were significant. The geographical distribution of standardized catch rates is presented for each month (Figures 10-13).

The seasonal evolution of catch rates seems to be similar for the four years and is also comparable to previous years (Atkinson and Power, 1991). The best catch rates occurred in winter (November to April) in the south of Div. 4R, in Subdiv. 3Pn and north of Subdiv. 3Ps. In summer, from April to September, the best catch rates shifted gradually into the Gulf of St. Lawrence and to the west side of the Laurentian Channel. The shift back to the winter fishing grounds occurred mostly in October. In 1993, catch rates declined in April throughout the entire area (4RST3Pn4Vn in particular) and remained low for the remainder of the year.

We noted some changes in the catch-rate distribution in recent years. In 3Pn and 4Vn, fishing which previously started in December started in November and as early as October in 1993. Also, before 1992, fishing at the 4Vn:4Vs boundary occurred between April and October, but in 1992 and 1993, fishing in that area was confined to the June-August period. These distributional changes may be due mostly to changes in the distribution of redfish but the impact of other factors such as regulations and changes in management units is not clear at the moment.

Conclusion

The analysis of the winter surveys in 3PsPn4RST from 1978 to 1993 has shown that, since 1990, redfish were more concentrated in the Cabot Strait area in January-February and that the concentration of fish overlapped the 3Pn and 3Ps boundary. This change may be related to oceanographic changes and/or to the decline in abundance of redfish in the Gulf of St. Lawrence for the same period (Morin and Bernier, 1994). RV surveys in the Gulf of St. Lawrence generally showed a southward trend in the winter distribution of fish as they get older. The distribution and the migration of the two species of redfish (*Sebastes mentella* and *S. fasciatus*) in the Gulf of St. Lawrence are believed to be different and further investigations are required to assess the impact on the fishery .

The geographical distribution of commercial catch rates in winter agreed well with the survey data. The catch rate data suggested that the migration of Gulf of St. Lawrence redfish into the Cabot Strait area (South 4RT, 3Pn and 4Vn), started as early as November in the last 4 years. This does not

correspond to the present management units (ie. 3Pn and 4Vn are still considered as Laurentian Channel or Unit 2 redfish). Further analyses are needed to describe more precisely these movements. However, as a precautionary measure, catches in these subdivisions for the months of Nov. and Dec. should be considered as Unit 1 redfish.

It is necessary to emphasize the need for set positions in the Newfoundland catch and effort data to obtain a complete description of the distribution of redfish catches and CPUE in the Gulf of St. Lawrence and the Laurentian Channel area.

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Table 1. Length intervals (cm) used to divide the RV surveys length frequencies into modal groups.

	Modal group				
Year	1956	1970	1980	1985	1988
1978	>27	<=27			
1979	>29	<=29			
1980	>30	<=30			
1981	>30	15-30	<=14		
1982	>31	17-31	<=16		
1983	>31	18-31	<=17		
1984	>32	21-32	<=20		
1985	>33	23-33	<=22		
1986	>35	25-34	<=24		
1987	>34	27-34	<=26		
1988	>34	29-34	14-28	<=13	
1989		>30	18-30	<=17	
1990		>31	21-31	10-20	<=9
1991		>32	24-32	13-23	<=12
1992		>32	25-32	15-24	<=14
1993		>32	26-32	17-25	<=16

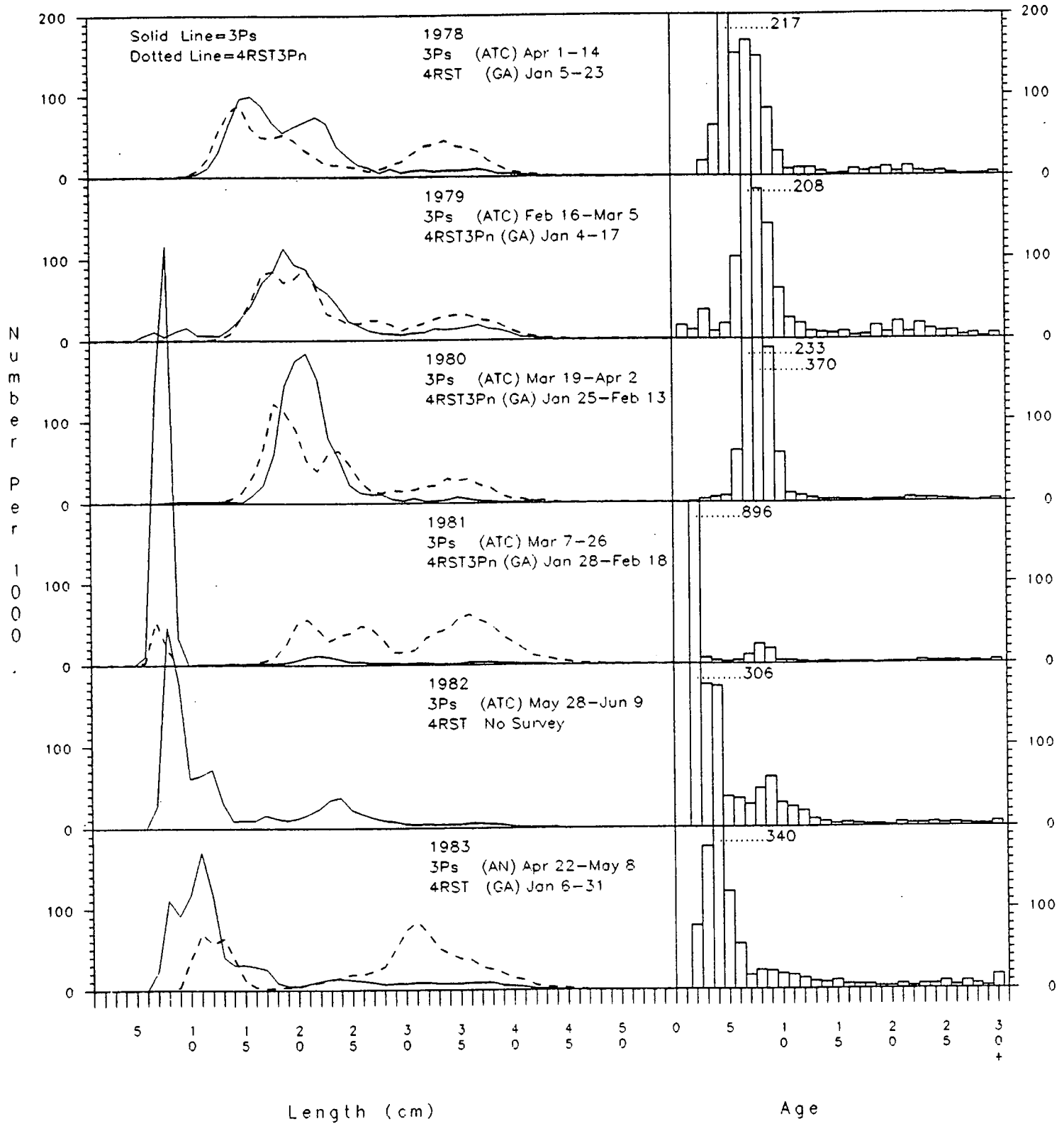


Figure 1. Length and corresponding age distribution from stratified-random research surveys conducted in Div. 4RS3Pn (Gadus Atlantica-GA) and Div. 3Ps (Wilfrid Templeman-WT, A.T. Cameron-ATC or Alfred Needler-AN) from 1978-1993. Age distribution applies to 3Ps surveys.

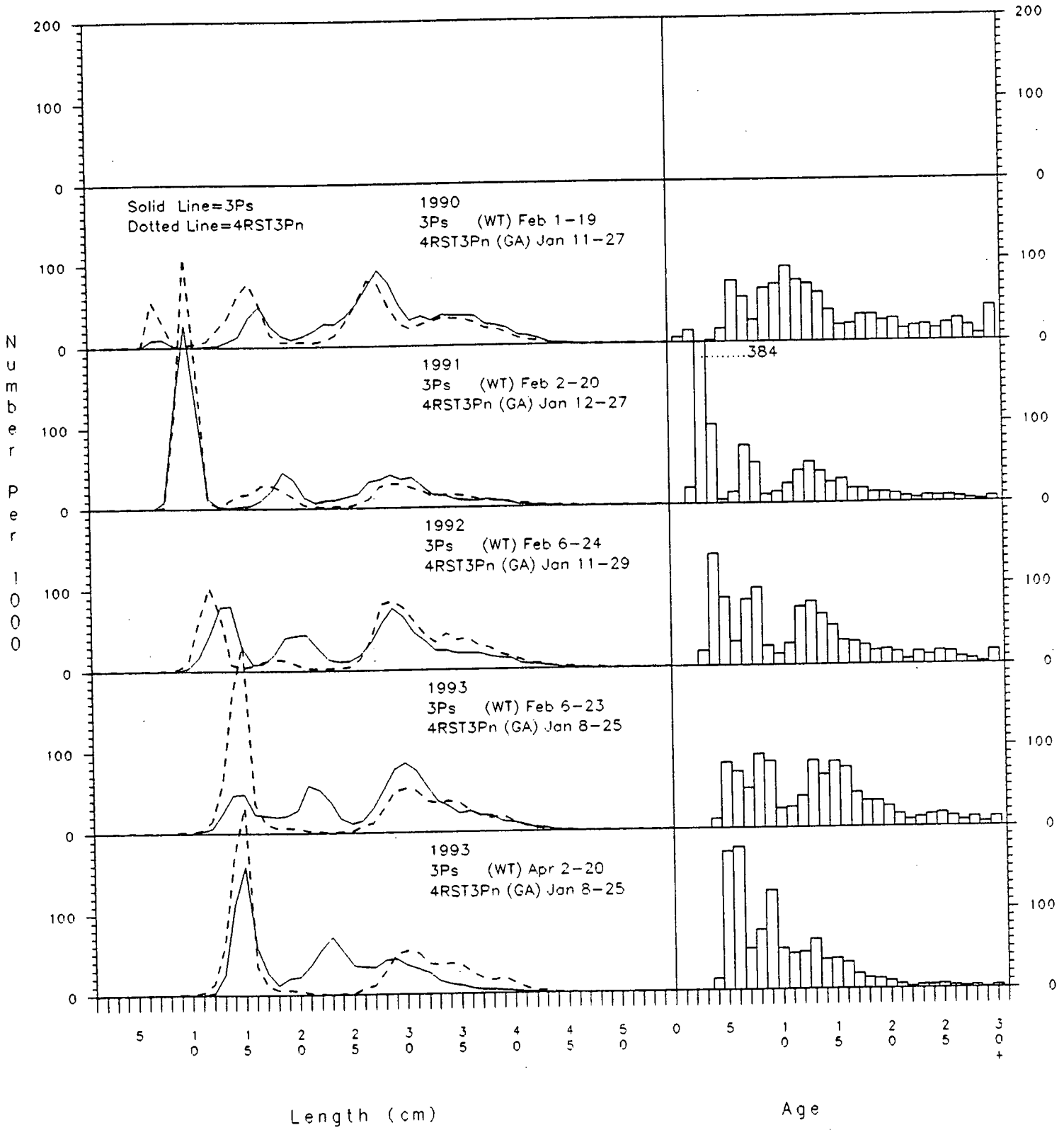


Figure 1. (continued)

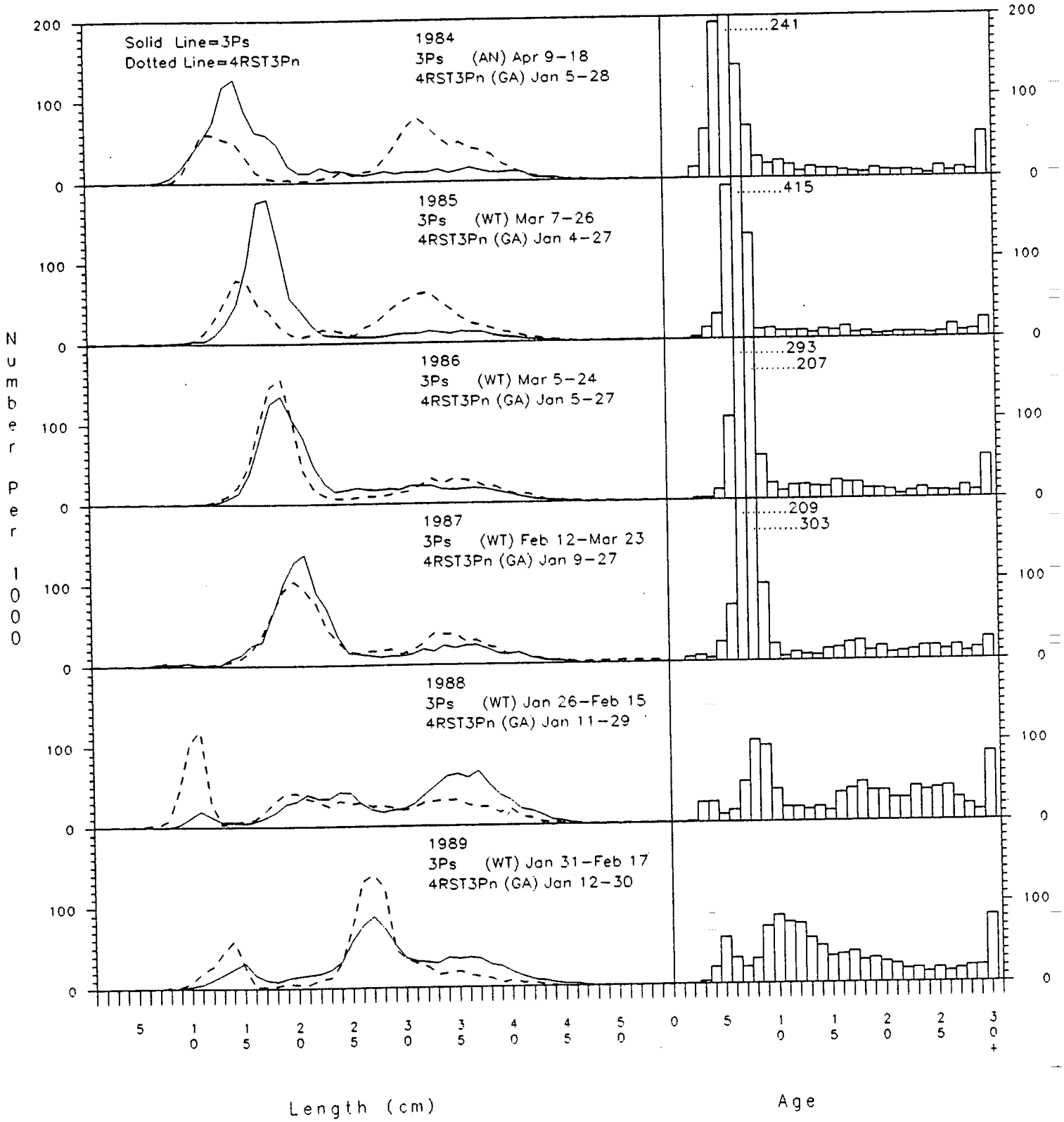


Figure 1. (continued)

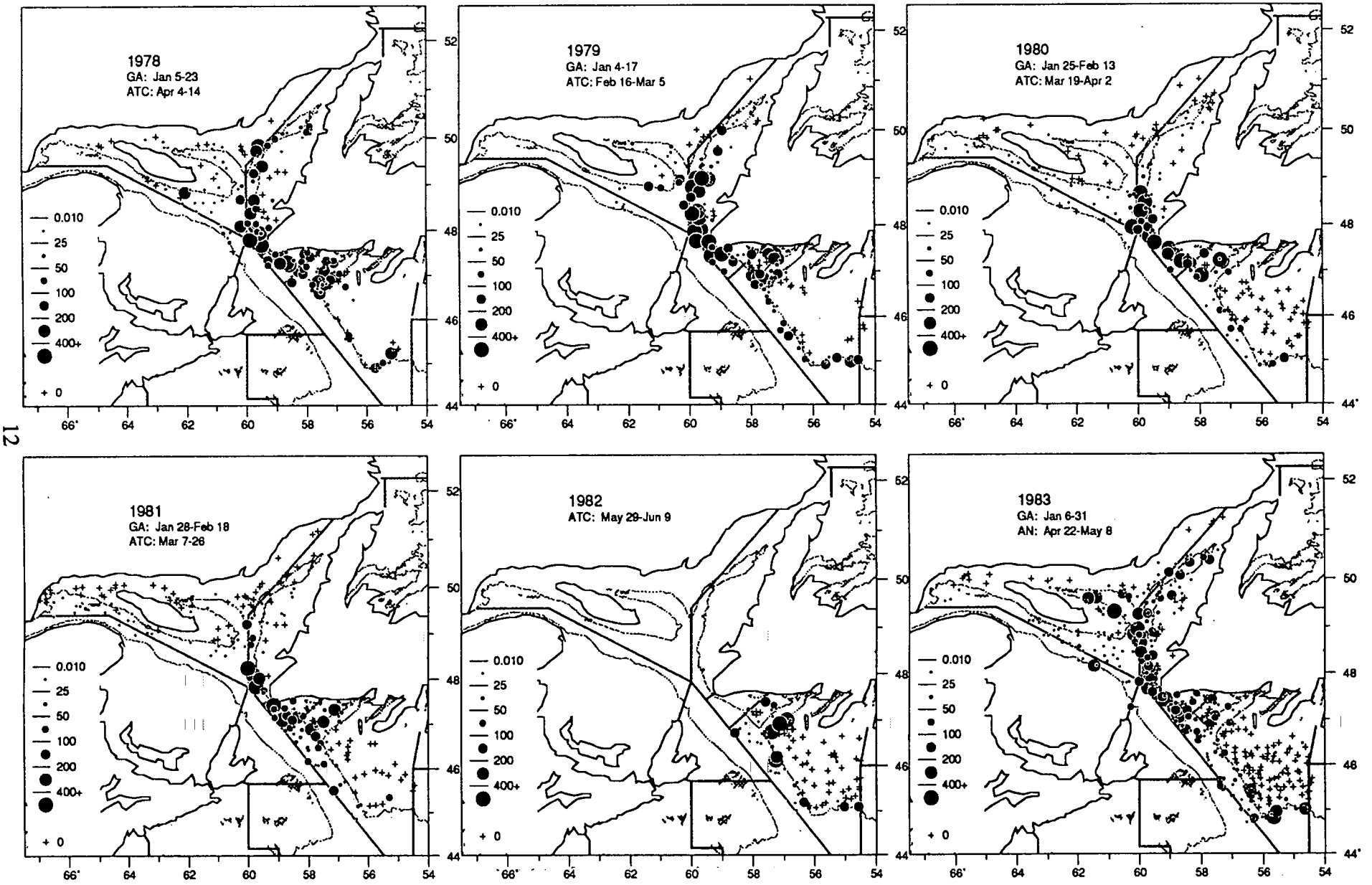


Fig. 2 Distribution of catches from stratified-random research surveys conducted primarily in January in Div. 4RST3Pn by the Gadus Atlantica, and generally during the February to April period in Div. 3Ps by the A. T. Cameron, Alfred Needler or Wilfred Templeman from 1978-1993. Catches are in Kg/30 minute tow. The 250 m contour line is plotted for reference.

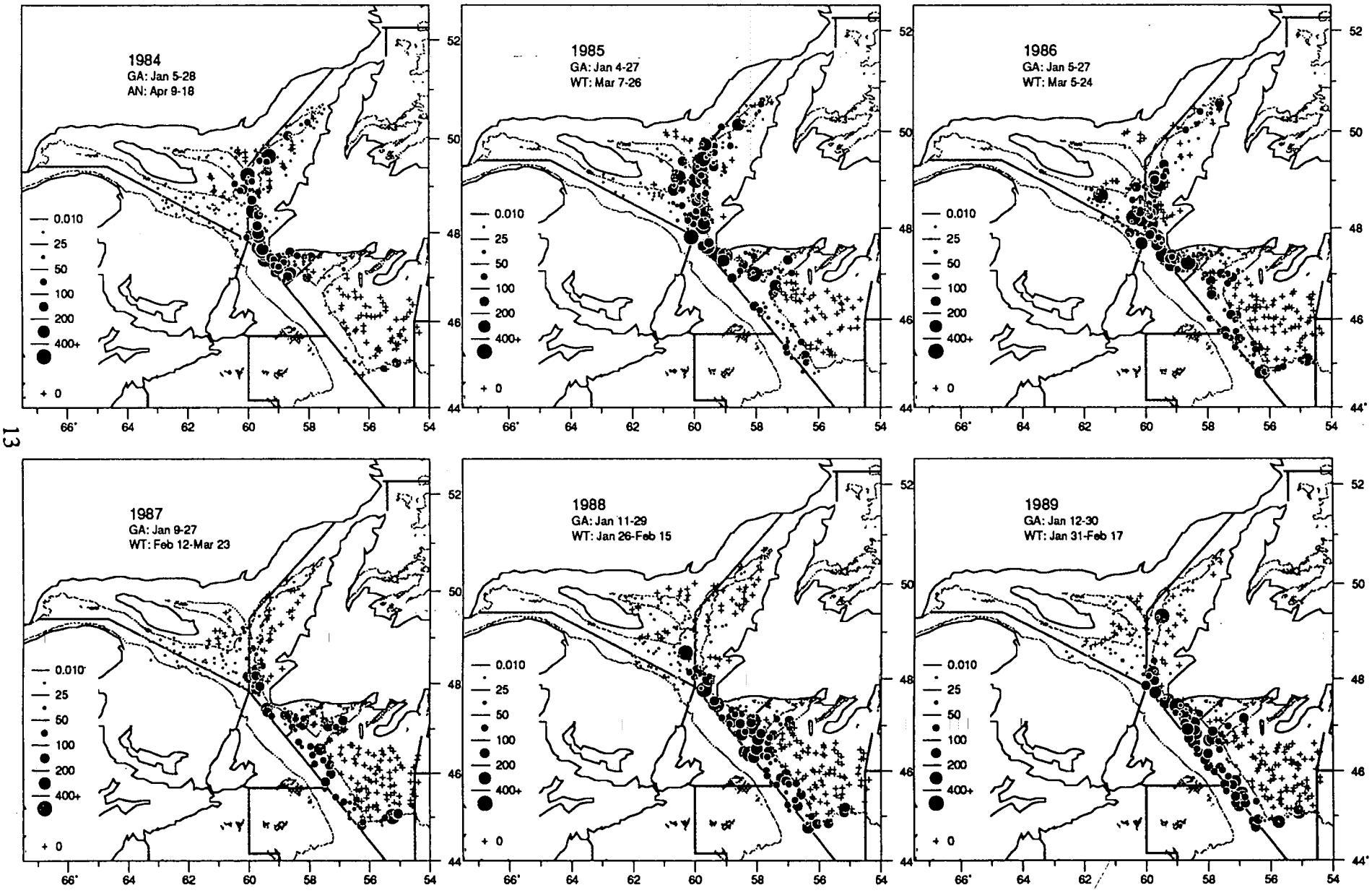
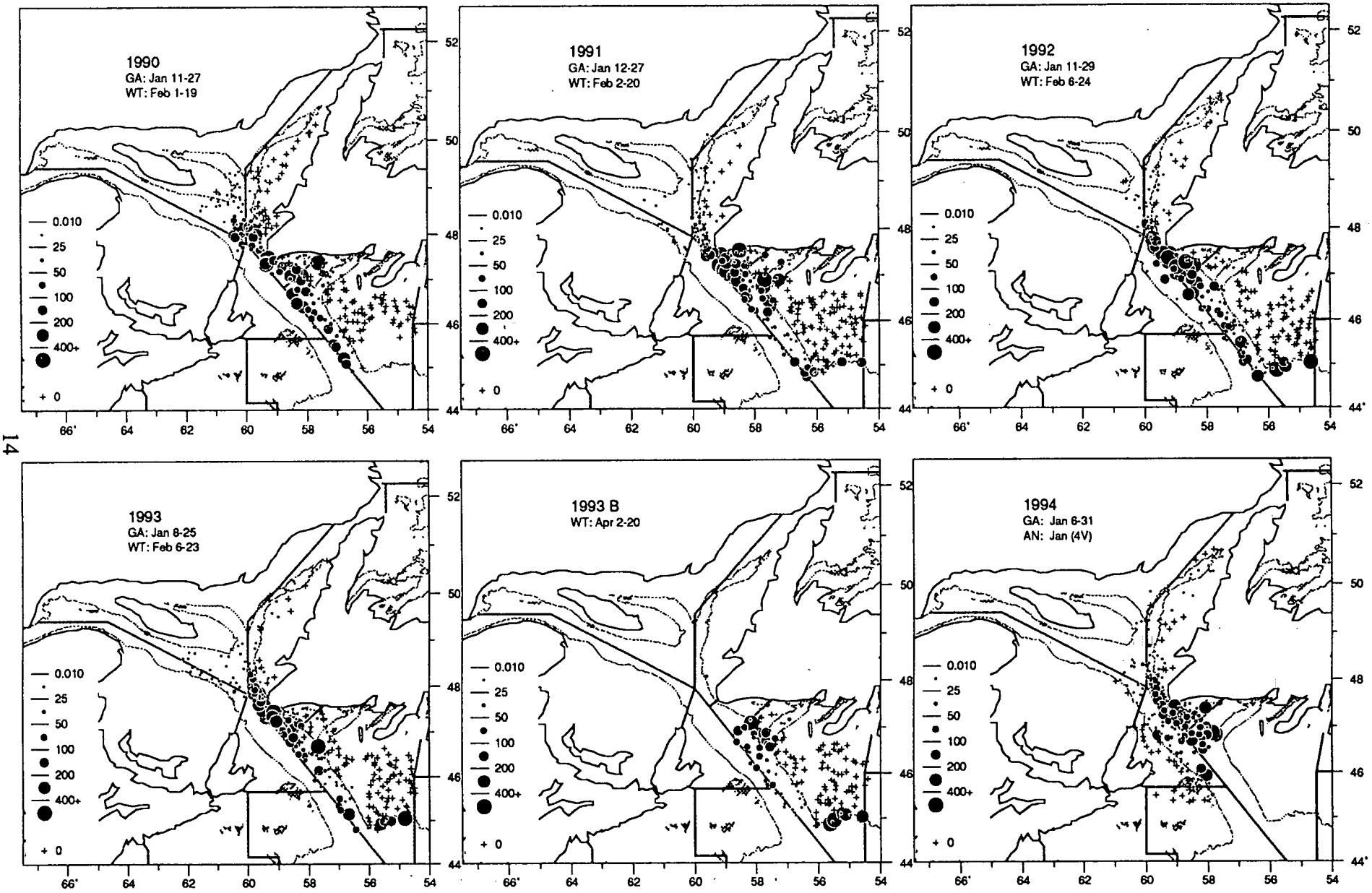


Fig. 2 (Continued, 'total catch')



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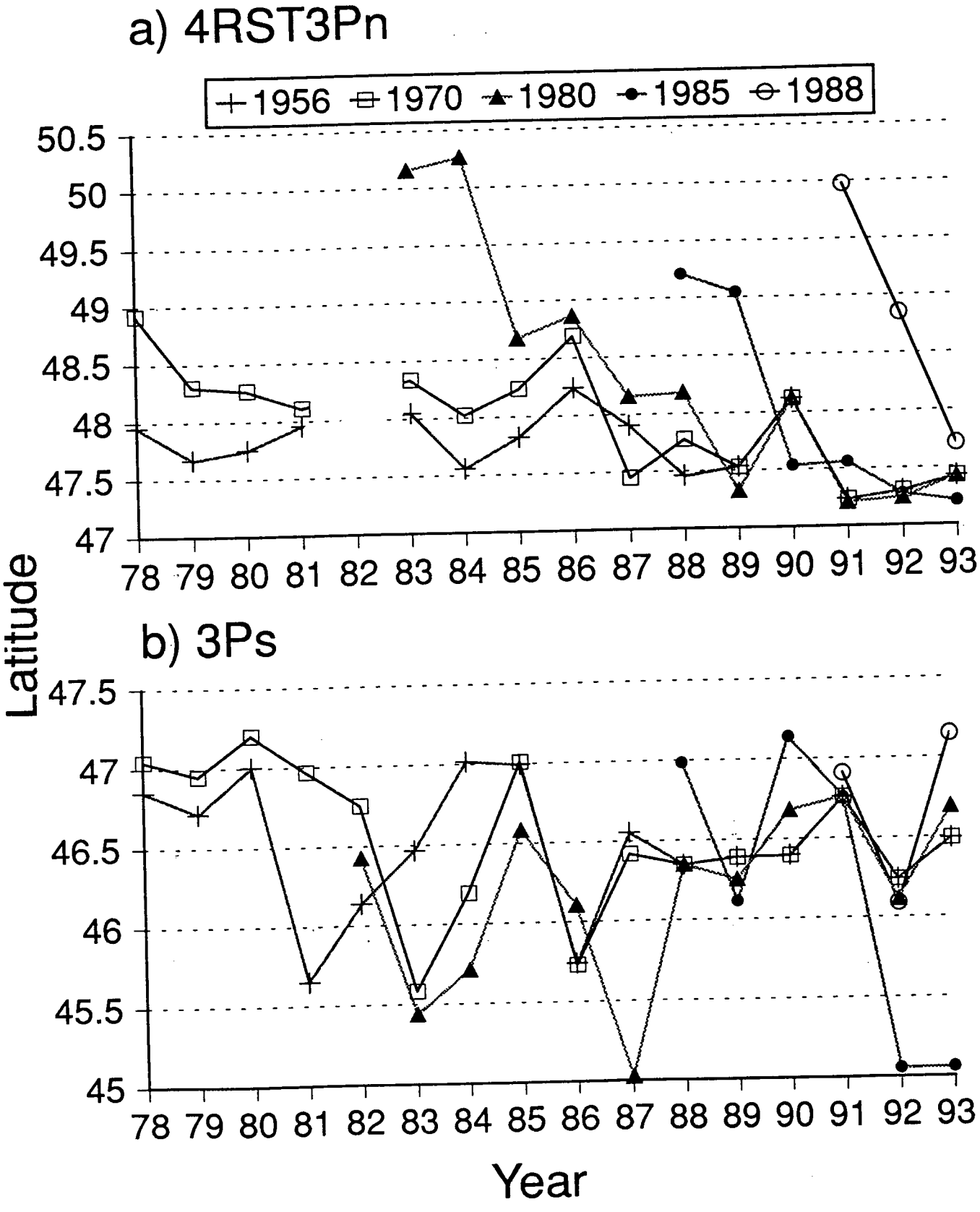

Figure 3. Median of the distribution of latitude weighted by the catches by mode and the surface of the strata for the two RV survey (1978-1993 period).

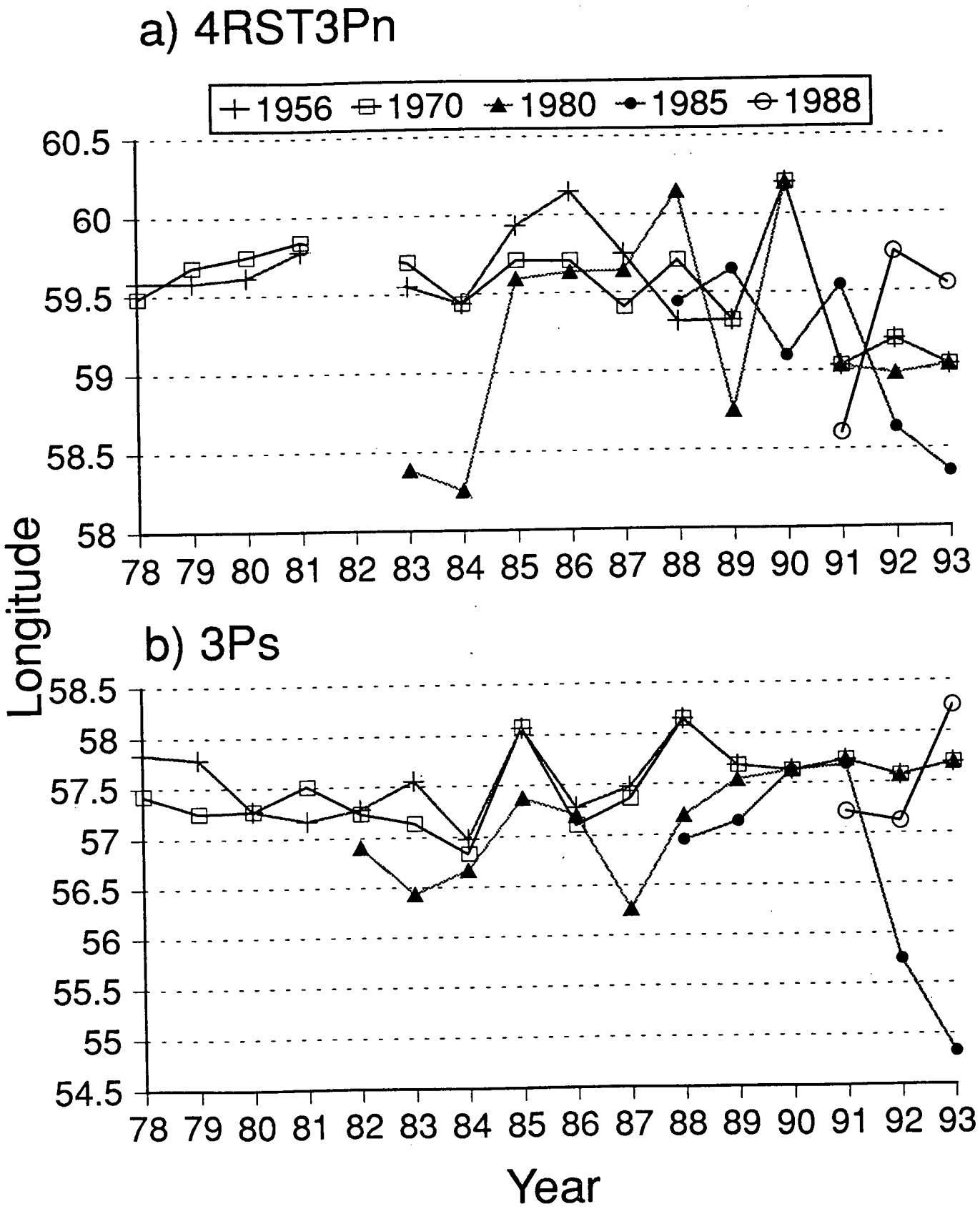

Figure 4. Median of the distribution of longitude weighted by the catches by mode and the surface of the strata for the two RV survey (1978-1993 period).

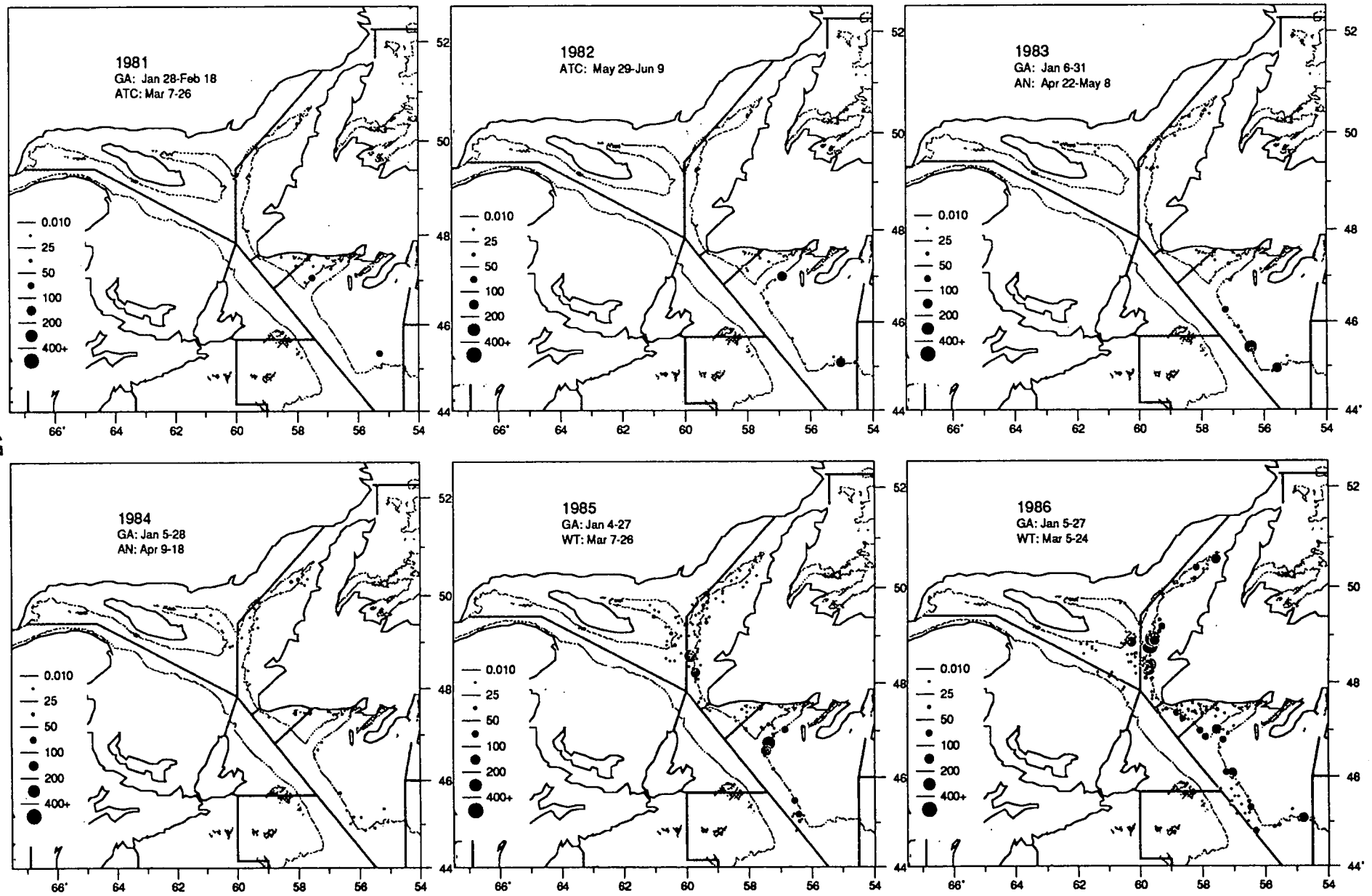

Fig. 5. Distribution of catches of the '1980' modal group from stratified-random research surveys conducted primarily in January in Div. 4RST3Pn by the Gadus Atlantica, and generally during the February to April period in Subdiv. 3Ps by the A.T. Cameron, A. Needler or W. Templeman from 1981-1993. Catches are in Kg/30 minute tow. The 250 m contour line is plotted for reference.

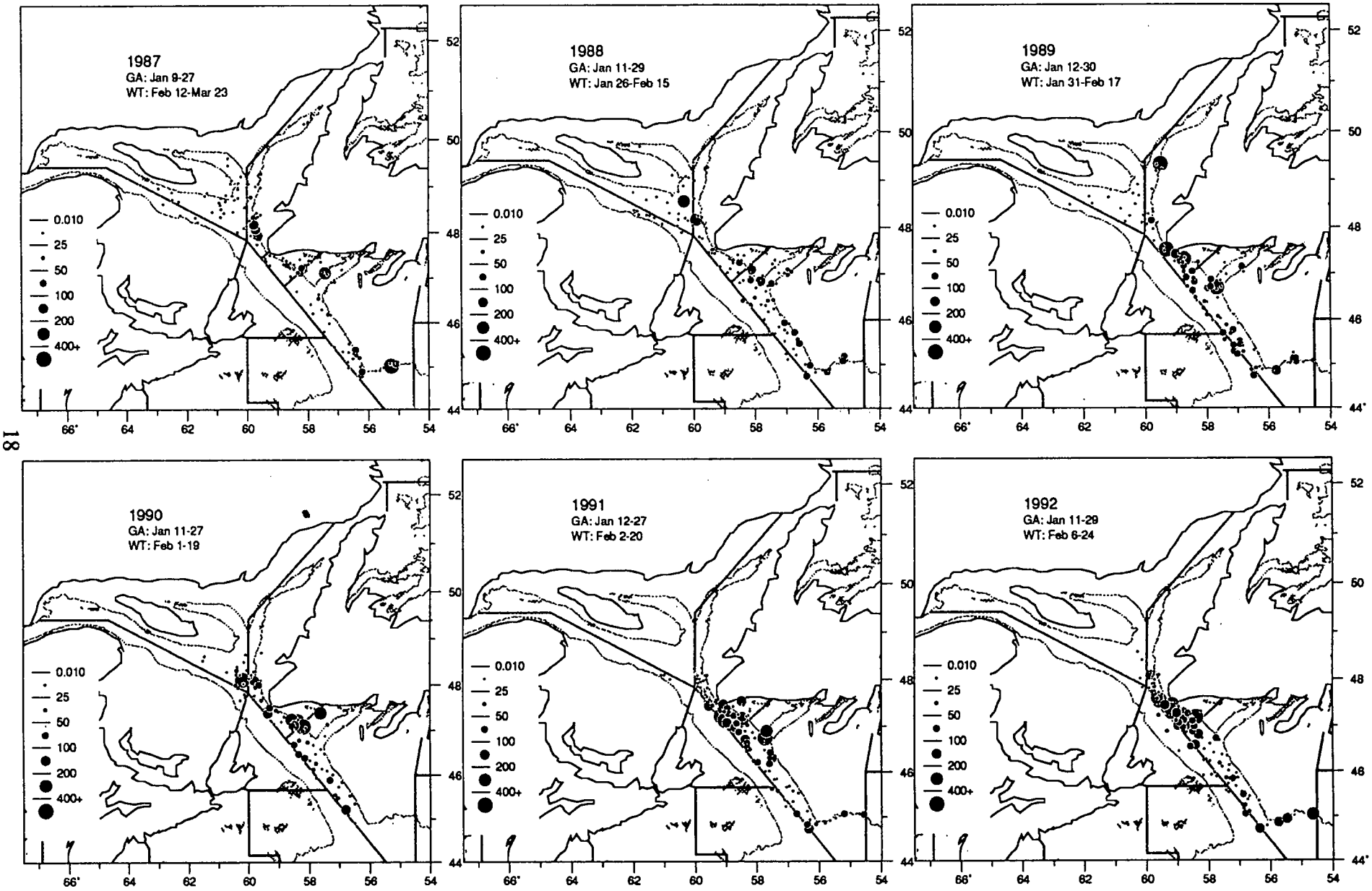

Fig. 5. (Continued, '1980' modal group)

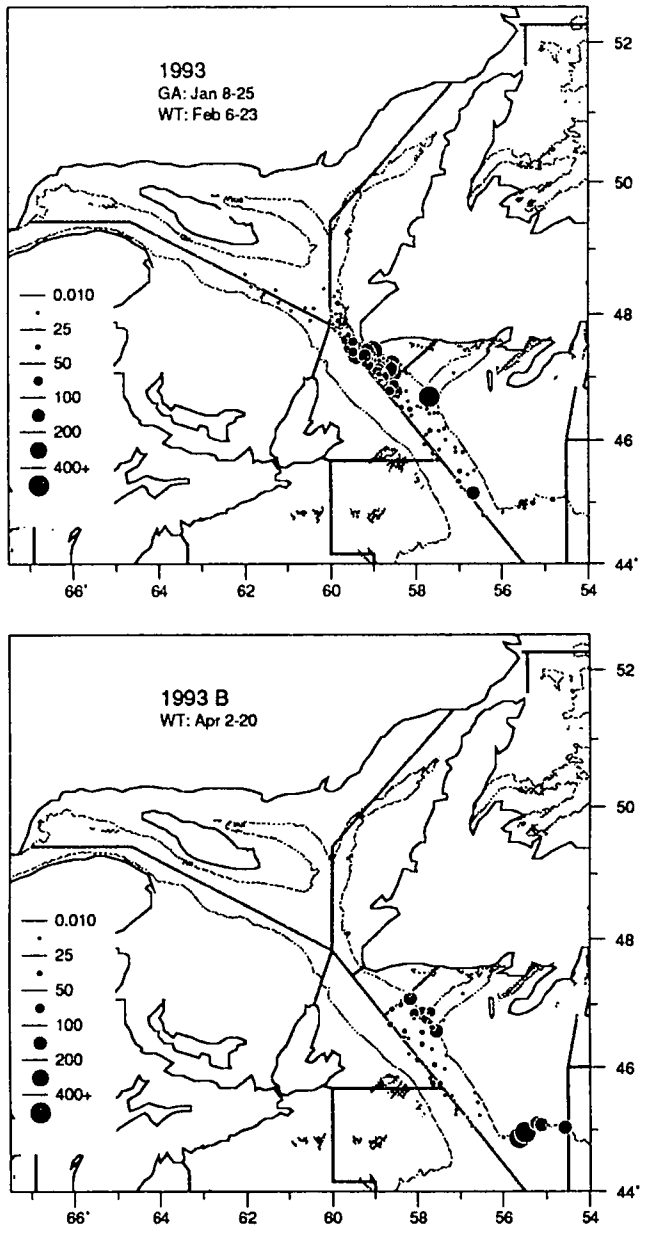

Fig. 5. (Continued, '1980' modal group)

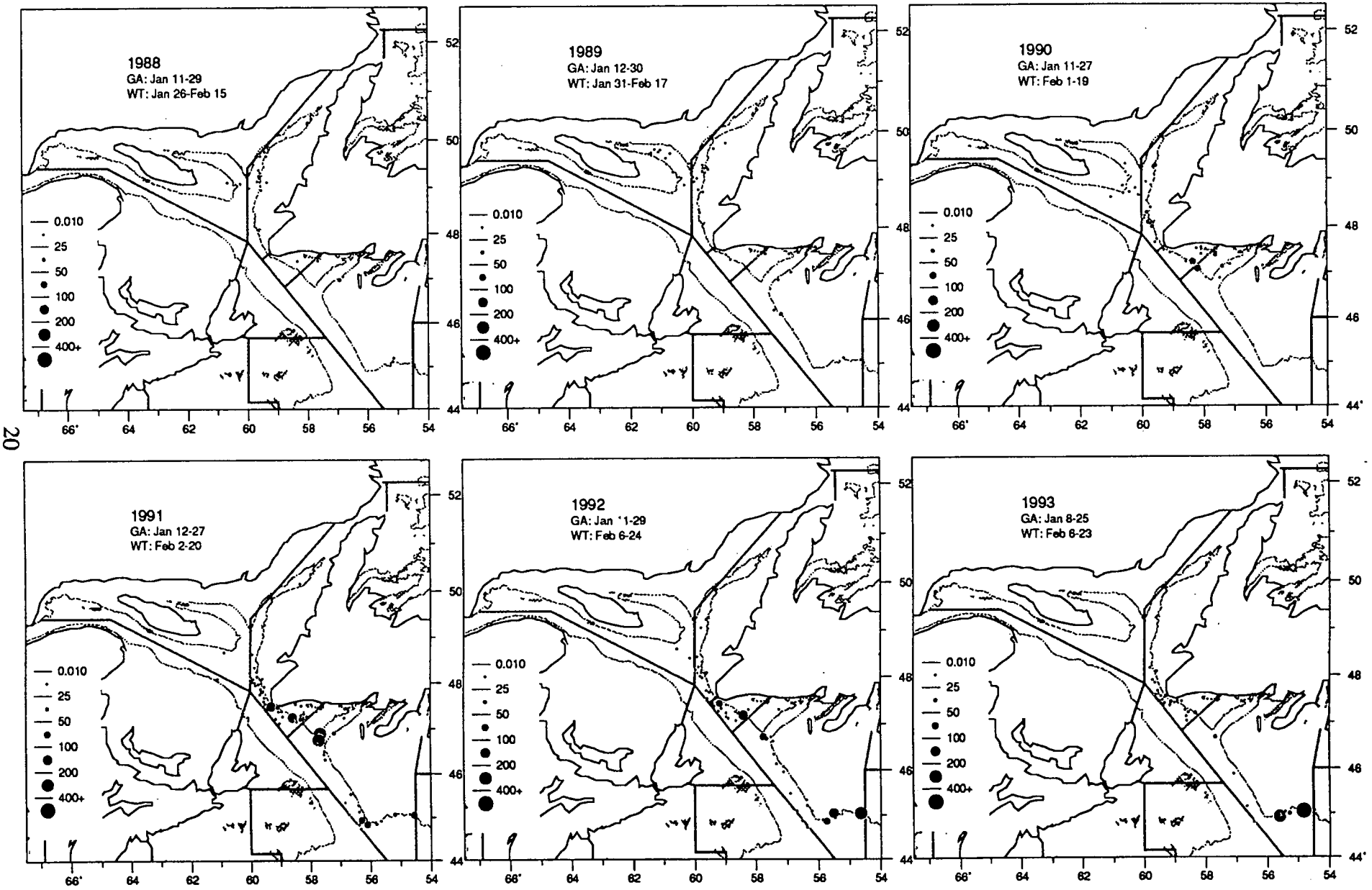

Fig. 6. Distribution of catches of the '1985' modal group from stratified-random research surveys conducted primarily in January in Div. 4RST3Pn by the Gadus Atlantica, and generally during the February to April period in Subdiv. 3Ps by the A.T. Cameron, A. Needler or W. Templeman from 1988-1993. Catches are in Kg/30 minute tow. The 250 m contour line is plotted for reference.

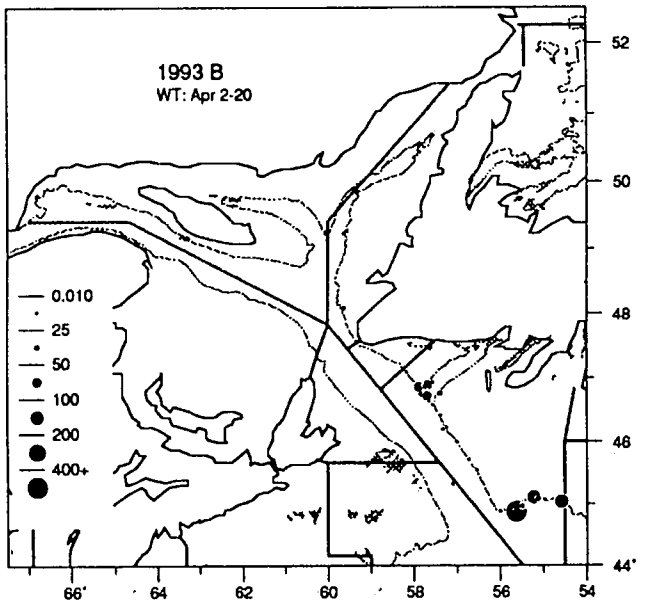

Fig. 6. (Continued, '1985' modal group)

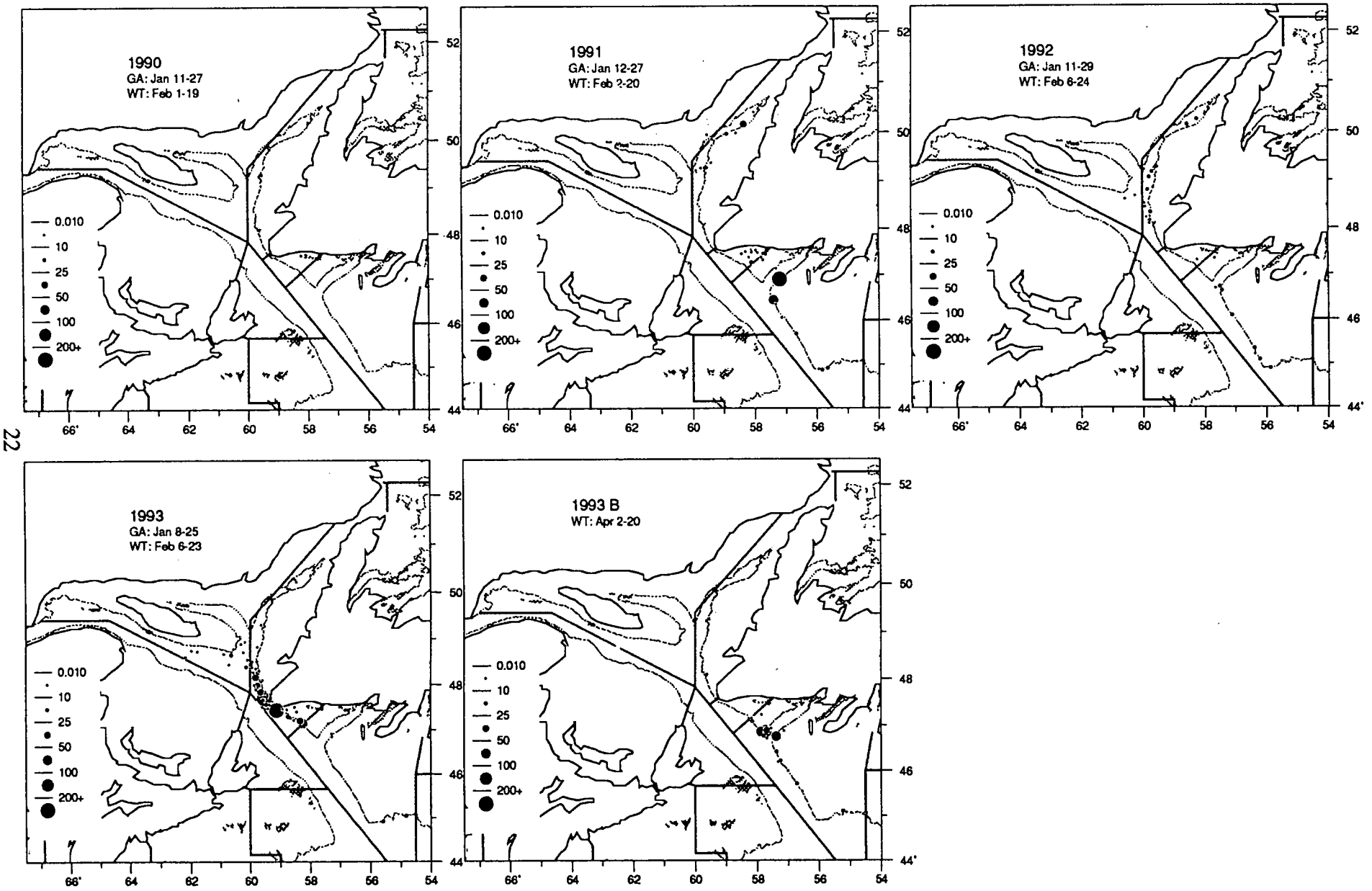

Fig. 7. Distribution of catches of the '1988' modal group from stratified-random research surveys conducted primarily in January in Div. 4RST3Pn by the Gadus Atlantica, and generally during the February to April period in Subdiv. 3Ps by the A.T. Cameron, A. Needler or W. Templeman from 1990-1993. Catches are in Kg/30 minute tow. The 250 m contour line is plotted for reference.

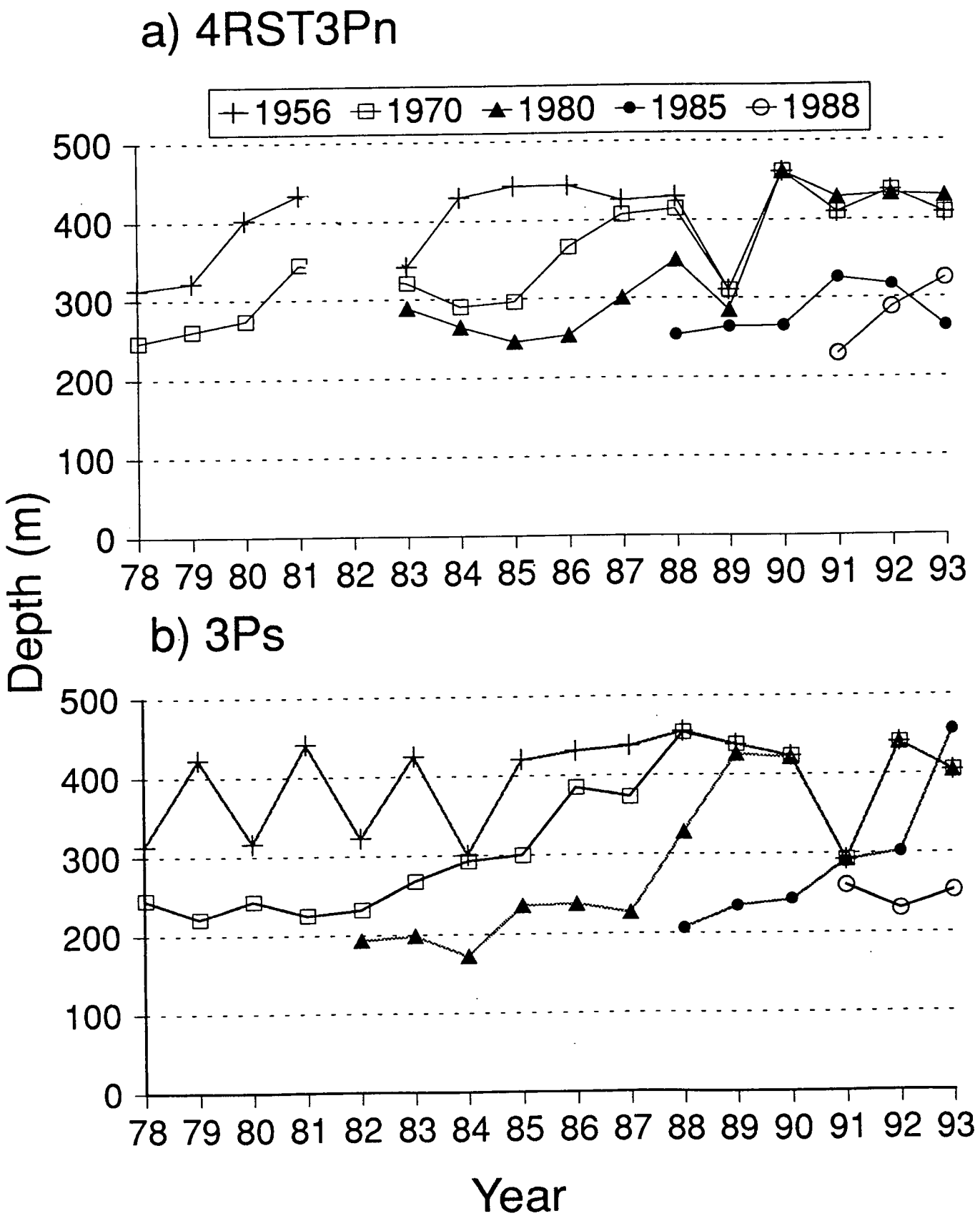

Figure 8. Median of the distribution of depth (m) weighted by the catches by mode and the surface of the strata for the two RV survey (1978-1993 period).

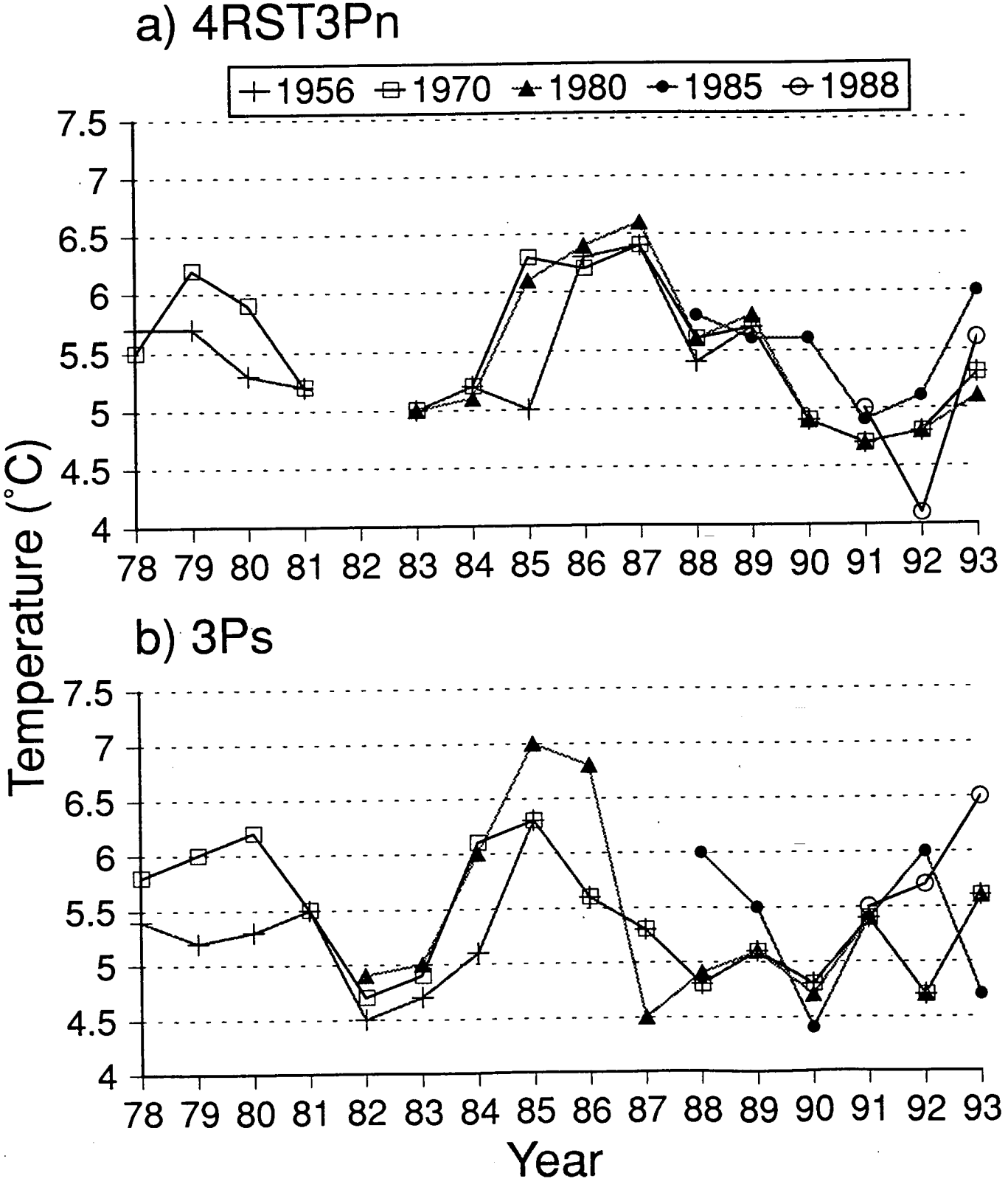

Figure 9. Median of the distribution of bottom water temperature (°C) weighted by the catches by mode and the surface of the strata for the two RV survey (1978-1993 period).

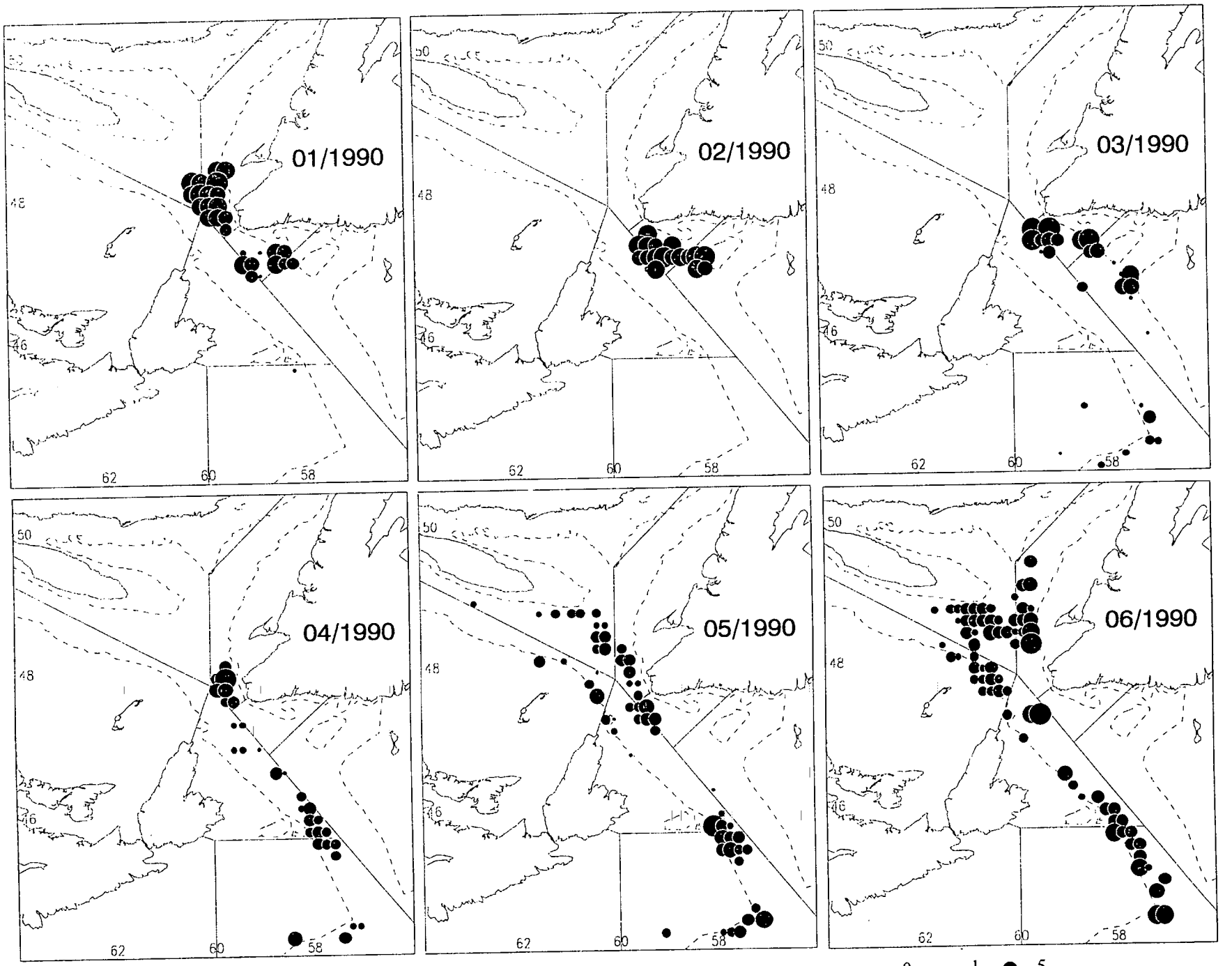

Fig. 10a. Monthly distribution of standardized commercial catch rates (t/h) in the Gulf of St. Lawrence and in the Laurentian Channel in 1990 (Jan.-June).

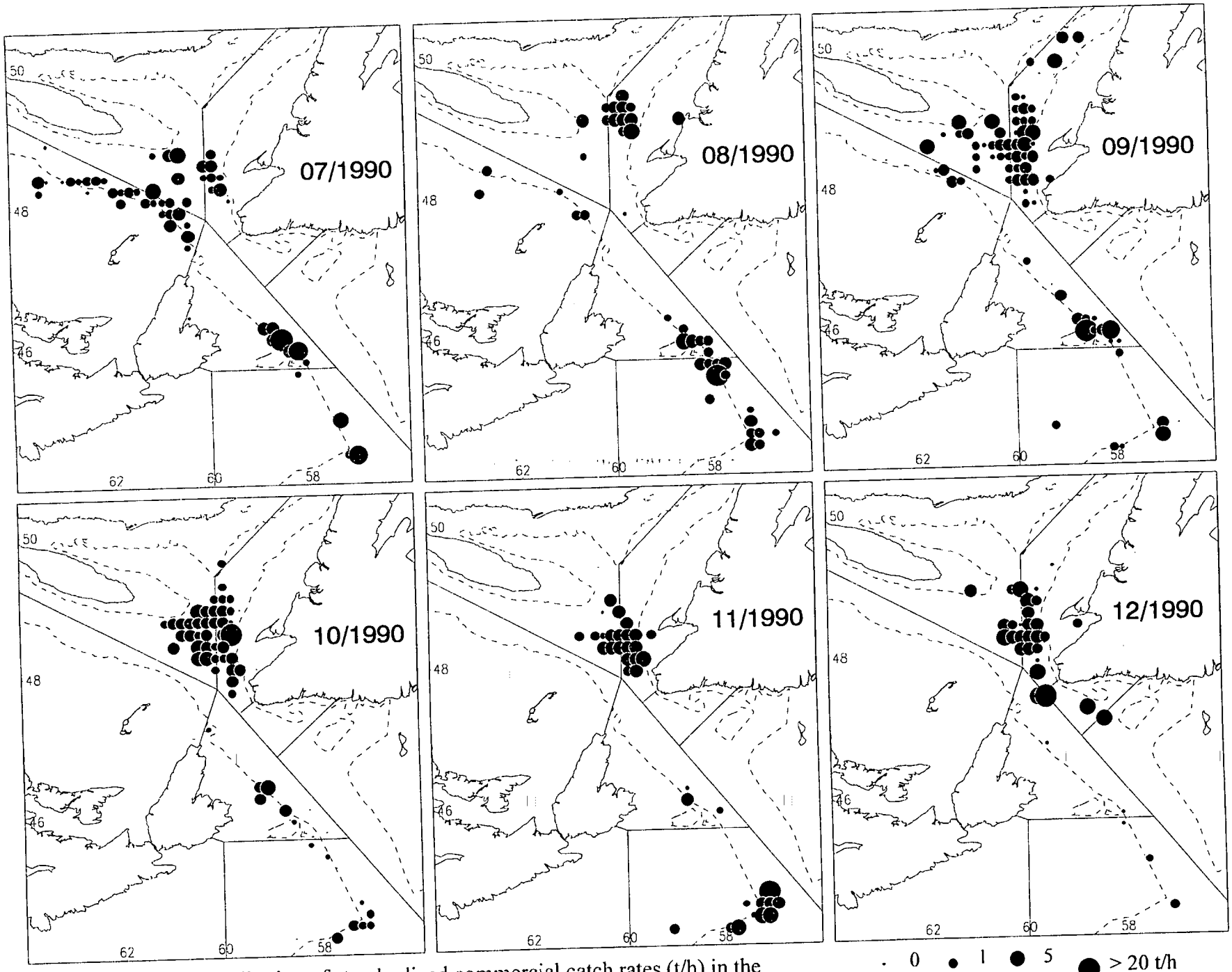

Fig. 10b. Monthly distribution of standardized commercial catch rates (t/h) in the Gulf of St. Lawrence and in the Laurentian Channel in 1990 (July-Dec.).

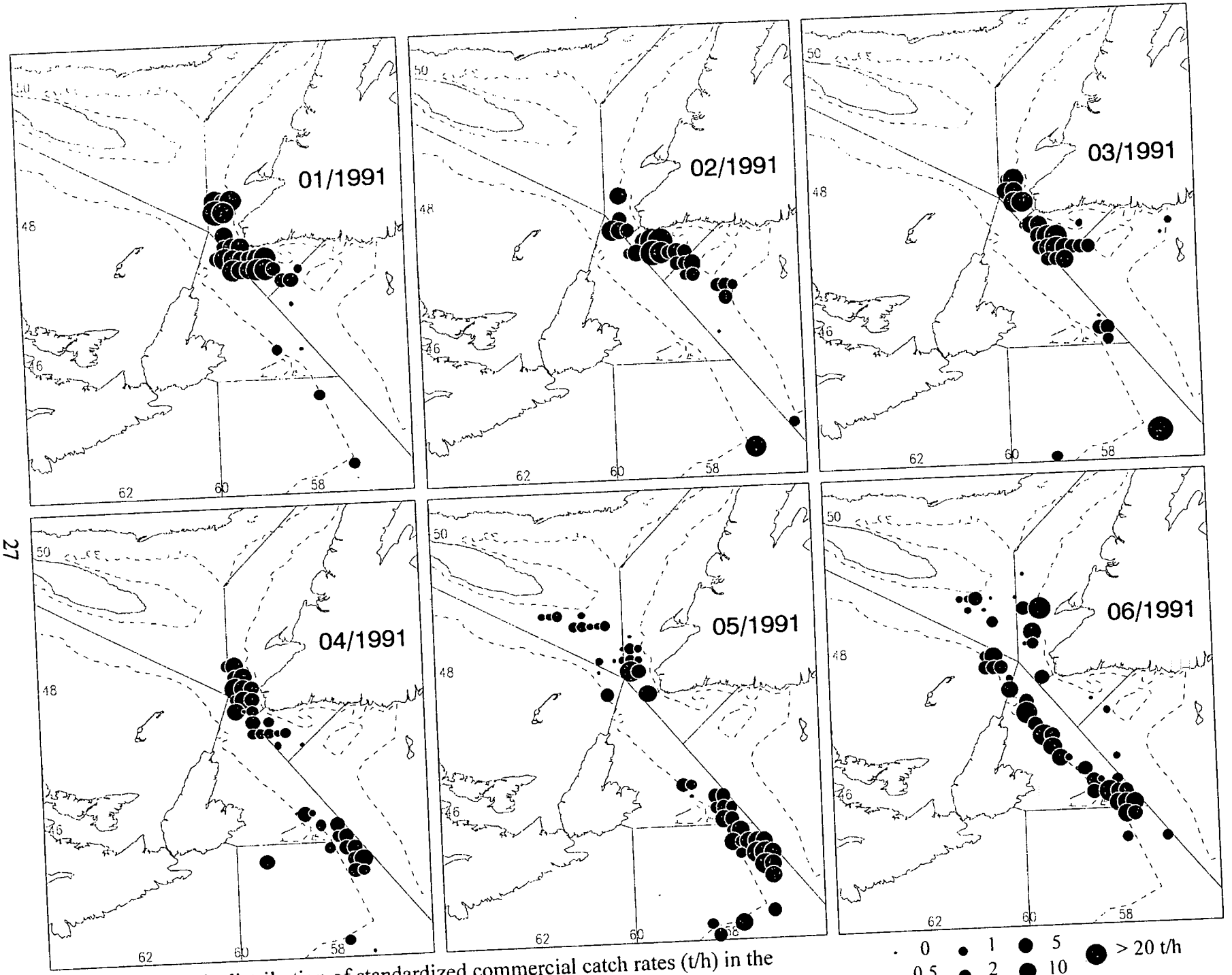

Fig. 11a. Monthly distribution of standardized commercial catch rates (t/h) in the Gulf of St. Lawrence and in the Laurentian Channel in 1991 (Jan.-June).

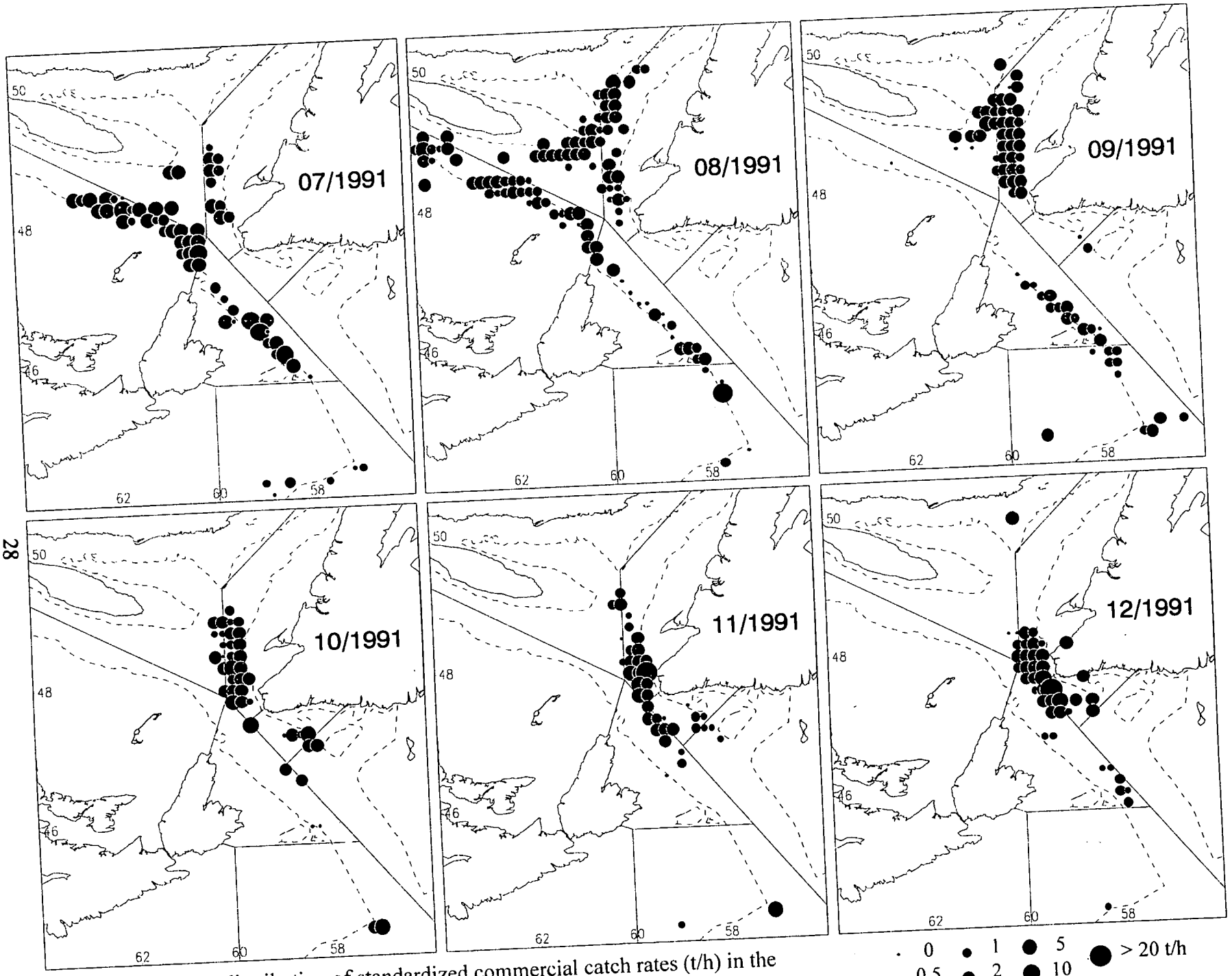

Fig. 11b. Monthly distribution of standardized commercial catch rates (t/h) in the Gulf of St. Lawrence and in the Laurentian Channel in 1991 (July-Dec.).

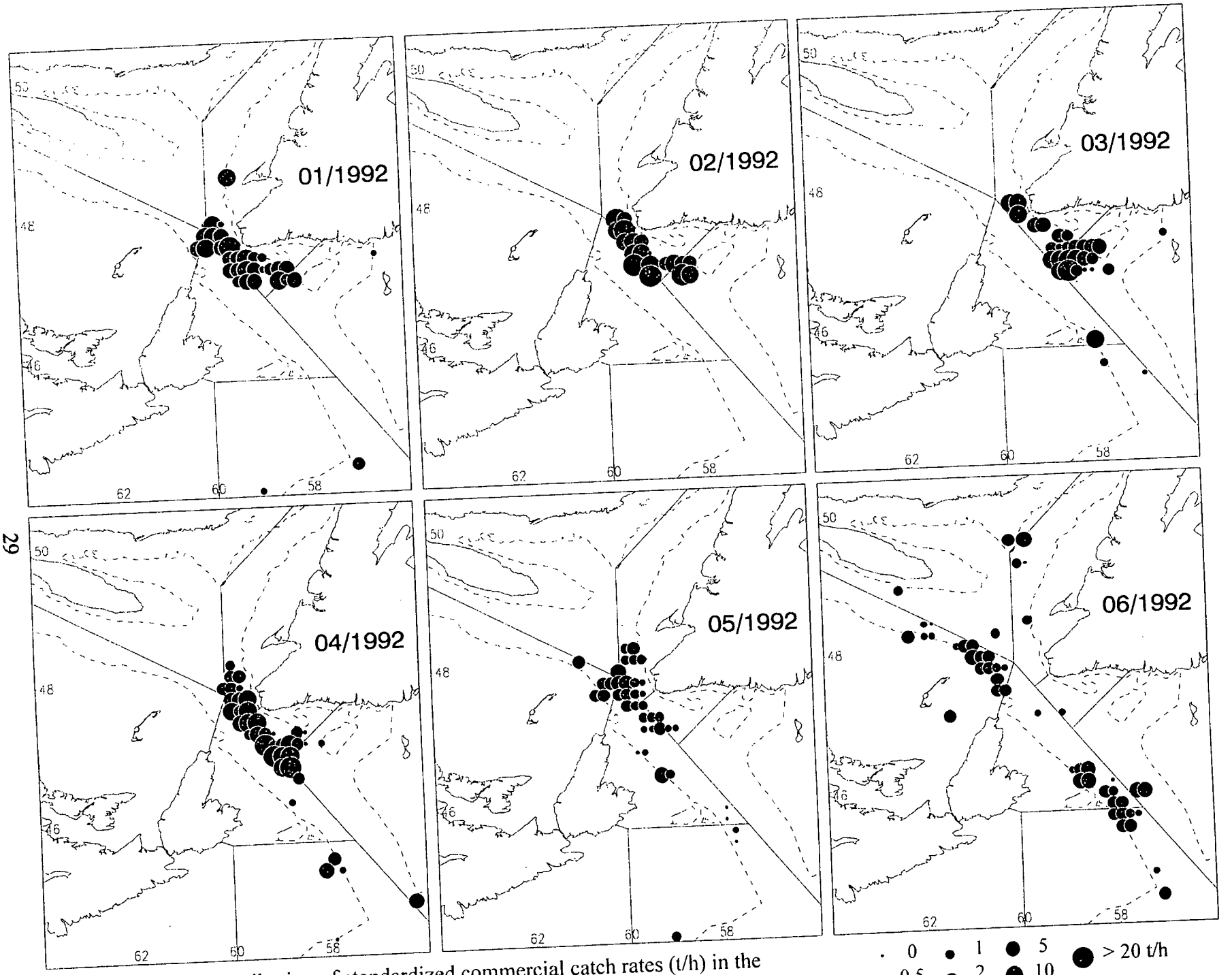

Fig. 12a. Monthly distribution of standardized commercial catch rates (t/h) in the Gulf of St. Lawrence and in the Laurentian Channel in 1992 (Jan.-June).

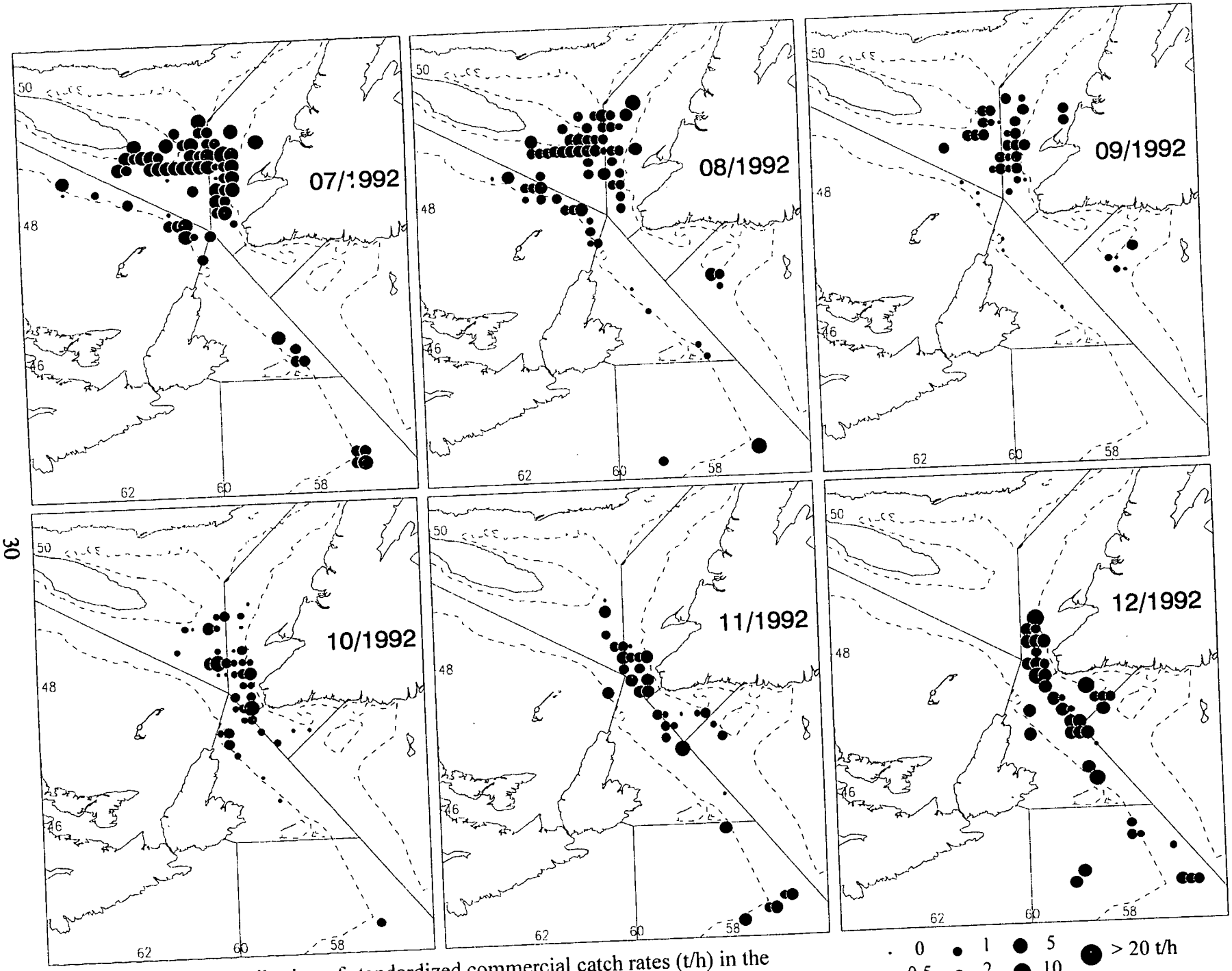

Fig. 12b. Monthly distribution of standardized commercial catch rates (t/h) in the Gulf of St. Lawrence and in the Laurentian Channel in 1992 (July-Dec.).

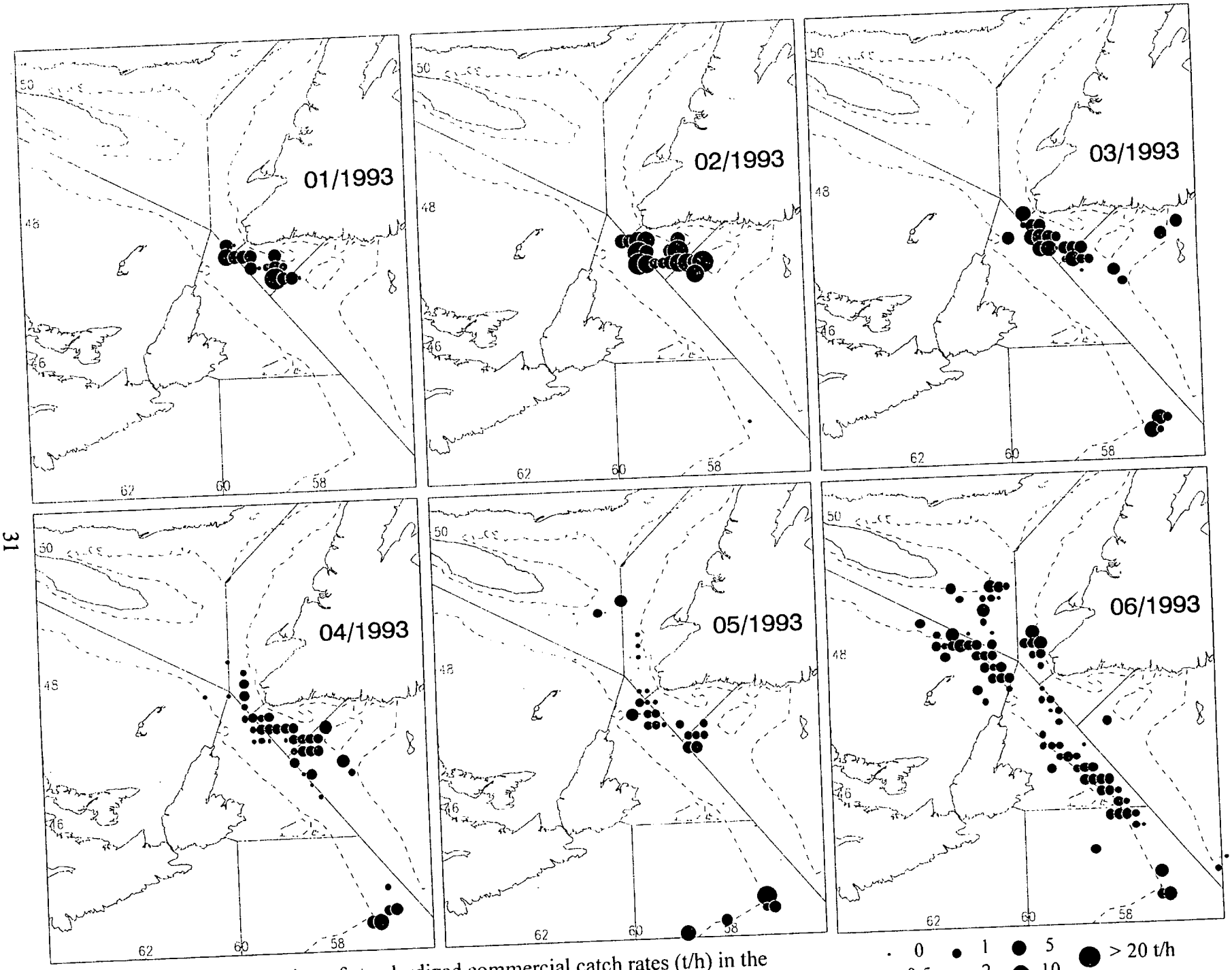

Fig. 13a. Monthly distribution of standardized commercial catch rates (t/h) in the Gulf of St. Lawrence and in the Laurentian Channel in 1993 (Jan.-June).

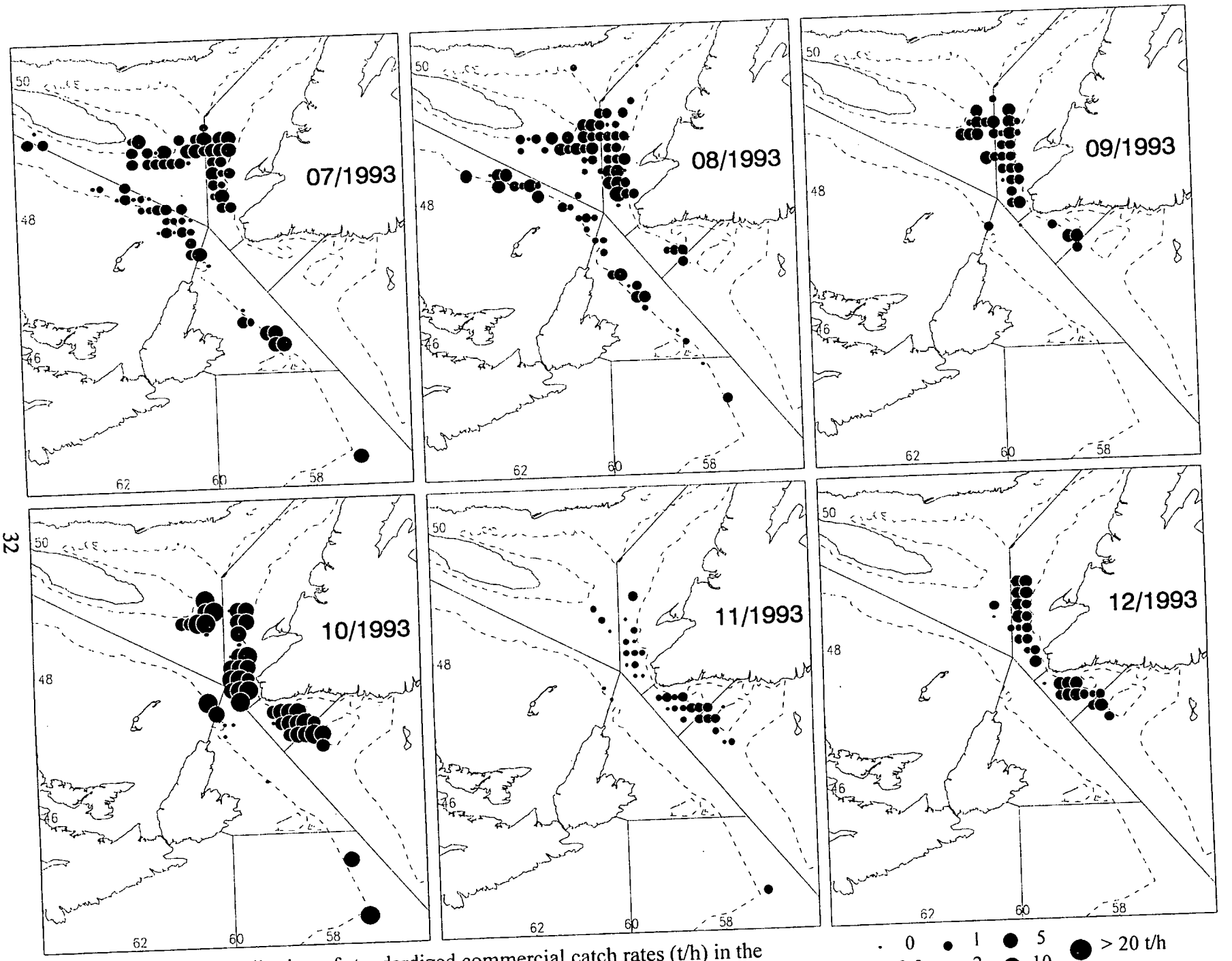

Fig. 13b. Monthly distribution of standardized commercial catch rates (t/h) in the Gulf of St. Lawrence and in the Laurentian Channel in 1993 (July-Dec.).

Appendix 1. Description of the two survey series (4RST3Pn and 3P)

a) 4RST3Pn survey

Year	Vessel	Date	Divisions covered
1978	*G. Atlantica*	Jan 5-23	4RST3Pn
1979	*G. Atlantica*	Jan 4-17	4RST3Pn
1980	*G. Atlantica*	Jan 25-Feb 13	4RST3Pn
1981	*G. Atlantica*	Jan 28-Feb 18	4RST3Pn
1982			
1983	*G. Atlantica*	Jan 6-31	4RST3Pn
1984	*G. Atlantica*	Jan 5-28	4RST3Pn
1985	*G. Atlantica*	Jan 4-27	4RST3Pn
1986	*G. Atlantica*	Jan 5-27	4RST3Pn
1987	*G. Atlantica*	Jan 9-27	4RST3Pn
1988	*G. Atlantica*	Jan 11-29	4RST3Pn
1989	*G. Atlantica*	Jan 12-30	4RST3Pn
1990	*G. Atlantica*	Jan 11-27	4RST3Pn
1991	*G. Atlantica*	Jan 12-27	4RST3Pn
1992	*G. Atlantica*	Jan 11-29	4RSTVn3Pn
1993	*G. Atlantica*	Jan 8-25	4RST3Pn
1994	*G. Atlantica*	Jan 6-31	4RST3P

b) 3P survey

1978	*A.T. Cameron*	Apr 4-14	3Ps only
1979	*A.T. Cameron*	Feb-16-Mar 6	3Ps only
1980	*A.T. Cameron*	Mar 19-Apr 2	3P
1981	*A.T. Cameron*	Mar 7-26	3P
1982	*A.T. Cameron*	May 29- Jun 9	3Ps only
1983	*A. Needler*	Apr 22- May 8	3P
1984	*A. Needler*	Apr 9-18	3Ps only
1985	*W. Templeman*	Mar 7-26	3Ps only
1986	*W. Templeman*	Mar 5-24	3P
1987	*W. Templeman*	Feb 12- Mar 23	3P
1988	*W. Templeman*	Jan 26-Feb 15	3P
1989	*W. Templeman*	Jan 31- Feb 17	3P
1990	*W. Templeman*	Feb 1-19	3P
1991	*W. Templeman*	Feb 2-20	3P
1992	*W. Templeman*	Feb 6-24	3P
1993	*W. Templeman*	Feb 6-23	3P
1993	*W. Templeman*	Apr 2-20	3P

Appendix 2. Results of the standardization with the multiplicative model of the 1990 commercial catch rates by month and by 10' grid. The standardization was done by vessel (standard: CFV 4049)

Regression of the log catch rates with the categories

General Linear Models Procedure
Class Level Information

Class	Levels	Values
month-10'grid	542	10GO61 10GQ61 10GR60 10GR61 10GR62 10GS58 10GS59 10GS60 10GS61 10GS62 10GS63 10GT54 10GT55 10GT56 10GT57 10GT58 10GT59 10GT60 10GT61 10GT62 10GU56 10GU57 10GU58 10GU59 10GU61 10GU62 10GV55 10GV58 10GV59 10GV60 10GV61 10GW58 10GW59 10GW60 10GW61 10GW62 10GX60 10GX62 10GX63 10GX65 10GY62 10GZ62 10HC59 10HH65 10HH66 10HI65 10HJ68 10HJ71 10HK69 10HL73 10HM71 10HN73 10HO74 10HP89 10HR77 10HS78 10HT76 10HT77 10HT78 10HU69 10HU73 10HU74 11GS59 11GT58 11GT60 11GU61 11GV55 11GV57 11GV58 11GV59 11GV60 11GV61 11GV62 11GV64 11GW58 11GW59 11GW60 11GW61 11GW62 11GX61 11GX62 11GX63 11GY61 11GY62 11HI68 11HJ68 11HK71 11HK72 11HR77 11HR78 11HS75 11HS77 11HS78 11HS79 11HT76 11HT77 11HT78 11HU66 11HU73 11HU74 12GQ64 12GS54 12GS59 12GS60 12GS62 12GT61 12GT62 12GU61 12GV58 12GV59 12GV60 12GV61 12GV62 12GV67 12GW58 12GW59 12GW60 12GW61 12GW62 12GW63 12GX60 12GX61 12GX62 12GY62 12GZ62 12HB62 12HB63 12HC68 12HD70 12HF63 12HL72 12HM72 12HP75 12HT78 1GV62 1GV63 1GW59 1GW60 1GW62 1GX59 1GX60 1GX61 1GX62 1GY60 1GY61 1GY62 1GZ61 1GZ62 1GZ63 1HA63 1HC65 1HC67 1HC69 1HC70 1HD65 1HD66 1HD69 1HD70 1HD71 1HE66 1HE67 1HM71 1HQ76 2HB65 2HC64 2HC65 2HC66 2HC68 2HD64 2HD65 2HD66 2HD67 2HD68 2HD69 2HD70 2HD71 2HD72 2HE65 2HE66 2HE71 2HE72 2HT78 3HB63 3HB65 3HC63 3HC64 3HC65 3HC66 3HC69 3HC70 3HD64 3HD65 3HD70 3HD71 3HE73 3HF74 3HF75 3HG69 3HG74 3HG75 3HH75 3HK77 3HQ69 3HQ76 3HR77 3HT77 3HT78 3HU66 3HU74 3HV71 4GX62 4GY61 4GY62 4GZ61 4GZ62 4HA62 4HA63 4HC63 4HC64 4HE63 4HE64 4HE66 4HG68 4HG69 4HI71 4HJ71 4HJ72 4HK72 4HK73 4HL72 4HL73 4HL74 4HM73 4HM74 4HM75 4HN75 4HT77 4HT78 4HU70 4HU76 5GS43 5GT51 5GT53 5GT55 5GT56 5GT58 5GU58 5GU59 5GV58 5GV59 5GW58 5GW59 5GW61 5GX51 5GX54 5GX61 5GX62 5GY58 5GY62 5GZ57 5GZ62 5GZ63 5HA58 5HA63 5HB62 5HB63 5HB64 5HC59 5HC60 5HC63 5HC64 5HC65 5HD60 5HD65 5HF62 5HI72 5HK73 5HL72 5HL73 5HL74 5HM73 5HM74 5HM75 5HN73 5HN74 5HN75 5HN76 5HO75 5HS77 5HT76 5HT78 5HU66 5HU73 5HU74 5HU75 6GP62 6GR61 6GR62 6GS60 6GT50 6GT52 6GT53 6GT54 6GT55 6GT56 6GT57 6GT61 6GT62 6GU53 6GU54 6GU55 6GU56 6GU57 6GU58 6GU60 6GU61 6GU62 6GV54 6GV55 6GV57 6GV58 6GV59 6GV60 6GV61 6GV62 6GW51 6GW55 6GW60 6GW61 6GW62 6GX52 6GX53 6GX55 6GY55 6GY56 6GY57 6GZ55 6GZ56 6GZ57 6GZ58 6HA56 6HA57 6HA58 6HA59 6HC59 6HC62 6HC63 6HE61 6HH66 6HI67 6HJ68 6HJ70 6HK71 6HK72 6HL72 6HL73 6HM72 6HM73 6HM74 6HN74 6HN75 6HO75 6HP74 6HP75 6HP76 6HQ78 6HR77 6HT76 6HT77 6HT78 7GS41 7GT54 7GT56 7GT57 7GT61 7GU60 7GU61 7GV40 7GV41 7GV43 7GV44 7GV45 7GV46 7GV47 7GV48 7GV57 7GV60 7GV61 7GV62 7GW40 7GW46 7GW49 7GW50 7GW51 7GW52 7GW54 7GW61 7GW62 7GX50 7GX53 7GX54 7GX55 7GX56 7GX58 7GX63 7GY55 7GY56 7GY57 7GZ56 7GZ58 7HA58 7HB58 7HH58 7HI67 7HI68 7HJ68 7HJ69 7HK70 7HK71 7HL72 7HM71 7HQ76 7HT77 7HT78 8GN60 8GP62 8GQ60 8GQ61 8GQ62 8GQ63 8GR57 8GR60 8GR61 8GR62 8GR63 8GR69 8GS62 8GS63 8GU57 8GV45 8GX44 8GX54 8GZ56 8GZ57 8GZ62 8HI67 8HJ69 8HK69 8HK70 8HK71 8HK72 8HL72 8HM71 8HM72 8HM73 8HM74 8HN73 8HN74 8HP72 8HQ77 8HR77 8HS77 8HS78 8HS80 8HT77 8HT78 9GL67 9GL69 9GN63 9GN66 9GO64 9GQ61 9GQ62 9GR61 9GR62 9GR63 9GS54 9GS58 9GS61 9GS62 9GS63 9GT52 9GT54 9GT55 9GT59 9GT61 9GT62 9GT63 9GU50 9GU56 9GU57 9GU58 9GU59 9GU60 9GU61 9GU62 9GU63 9GV45 9GV56 9GV58 9GV59 9GV60 9GV61 9GV62 9GV63 9GW50 9GW51 9GW52 9GW56 9GW60 9GW61 9GW62 9GX53 9GX54

Appendix 2 (continued).

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                9HE62 9HG65 9HH66 9HJ68 9HJ69 9HJ70 9HK69 9HK70 9HK71
                9HK72 9HL72 9HL73 9HM73 9HS65 9HS78 9HS80 9HT78 9HU72
                9HU73

CFV number  44  18 1565 1573 1574 1606 1607 1608 1609 1610 1611 1627
                1631 1657 1667 1849 4009 4013 4017 4022 4024 4025 4026
                4027 4035 4036 4043 4048 4053 4054 4061 17001 17003
                17004 17005 17007 17008 92593 130021 131582 152125
                152320 152613 152856 ~~~~stnd

                     Number of observations in data set = 2635


NOTE: Due to missing values, only 2092 observations can be used in this
      analysis.

                Regression of the log catch rates with the categories

                          General Linear Models Procedure

Dependent Variable: LOGCPUE     Log of catch rate
                                  Sum of        Mean
Source                    DF     Squares      Square    F Value    Pr > F
Model                    580  1677.444905    2.892146       4.19    0.0001
Error                   1511  1043.875193    0.690851
Corrected Total         2091  2721.320098

                R-Square         C.V.      Root MSE          LOGCPUE Mean
                0.616409     97.01674      0.831174              0.856733

                          DF  Type III SS  Mean Square  F Value    Pr > F
Source                    39   141.319411     3.623575       5.25    0.0001
CFV                      537  1193.702202     2.222909       3.22    0.0001
Month-10'grid

                          DF   Type IV SS  Mean Square  F Value    Pr > F
Source                    39   141.319411     3.623575       5.25    0.0001
CFV                      537  1193.702202     2.222909       3.22    0.0001
Month-10'grid

                                          T for H0:    Pr > |T|   Std Error of
Parameter                  Estimate    Parameter=0                 Estimate

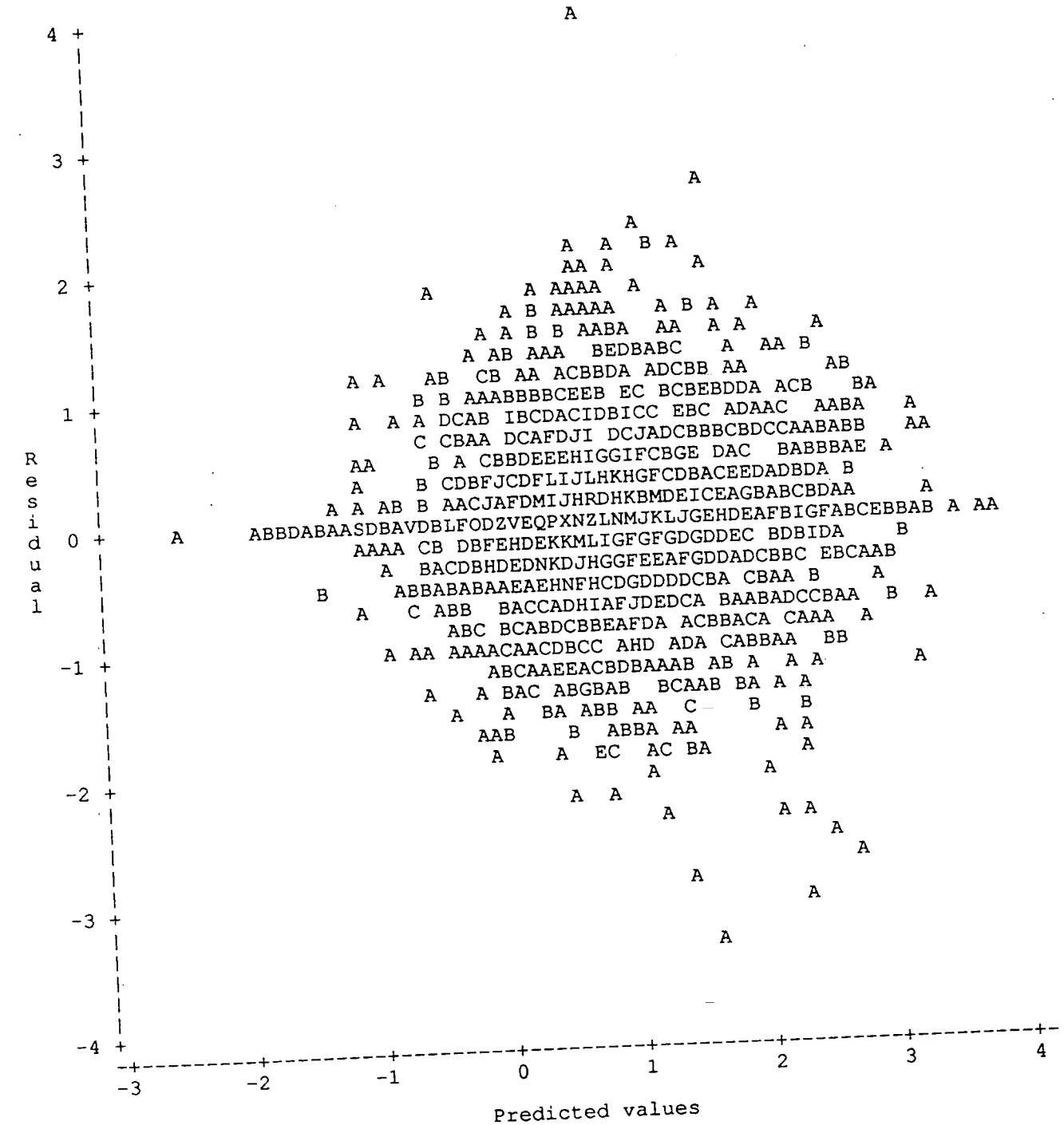
INTERCEPT          -0.277913093 B         -0.27       0.7879     1.03298789
CFV           18   -0.448989228 B         -1.51       0.1325     0.29829432
              1565 -3.632791514 B         -3.90       0.0001     0.93220804
              1573  1.577196078 B          1.19       0.2344     1.32586369
              1574 -1.153997475 B         -3.66       0.0003     0.31559970
              1606 -0.415234087 B         -0.31       0.7542     1.32586369
              1607 -0.593148362 B         -1.31       0.1899     0.45231643
              1608  0.408473868 B          1.41       0.1582     0.28929104
              1609 -1.331524819 B         -1.00       0.3154     1.32586369
              1610  0.588114157 B          1.73       0.0842     0.34037836
              1611 -1.029424036 B         -2.19       0.0284     0.46928618
              1627 -0.547060050 B         -4.06       0.0001     0.13480460
              1631  0.115224998 B          0.60       0.5485     0.19198886
              1657  0.277913093 B          0.21       0.8340     1.32586369
              1667  0.640921198 B          1.70       0.0893     0.37697987
              1849  0.189157279 B          0.56       0.5785     0.34039661
              4009 -0.057484765 B         -0.31       0.7573     0.18597689
              4013 -0.847819519 B         -3.99       0.0001     0.21270949
              4017  0.722822654 B          1.57       0.1155     0.45899467
              4022 -0.754754788 B         -1.77       0.0775     0.42720319
              4024  1.132894068 B          2.32       0.0204     0.48797165
              4025  0.283581425 B          0.69       0.4903     0.41100311
              4026 -0.317456938 B         -0.92       0.3575     0.34493222
```

Appendix 2 (continued).

	4027	-0.980681904 B	-2.00	0.0453	0.48943296
	4035	-1.108381268 B	-1.81	0.0710	0.61336239

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
CFV	4036	-0.555087576 B	-1.66	0.0969	0.33413411
	4043	-0.765138886 B	-2.23	0.0256	0.34241050
	4048	0.288161119 B	2.47	0.0135	0.11647716
	4053	0.063782370 B	0.52	0.6041	0.12299753
	4054	0.259968380 B	2.04	0.0415	0.12741631
	4061	0.886703218 B	2.12	0.0338	0.41733903
	17001	-0.047279370 B	-0.30	0.7662	0.15899196
	17003	0.151031958 B	0.97	0.3328	0.15589639
	17004	-0.049367775 B	-0.32	0.7494	0.15450167
	17005	0.317320073 B	0.78	0.4342	0.40562646
	17007	0.288410268 B	1.84	0.0665	0.15707891
	17008	-0.097029723 B	-0.67	0.5049	0.14547768
	92593	0.361375584 B	2.88	0.0040	0.12540806
	130021	-1.236280233 B	-2.42	0.0159	0.51191413
	131582	-0.233566857 B	-1.58	0.1138	0.14762978
	152125	0.380895761 B	2.46	0.0140	0.15479442
	152320	0.367538477 B	2.03	0.0423	0.18088246
	152613	-0.043827404 B	-0.27	0.7879	0.16285198
	152856	-0.019865829 B	-0.06	0.9530	0.33725323
	~~stnd	0.000000000 B	.	.	.

Appendix 2 (continued).



Appendix 3. Results of the standardization with the multiplicative model of the 1991 commercial catch rates by month and by 10' grid. The standardization was done by vessel (standard: CFV 4049)

Regression of the log catch rates with the categories

General Linear Models Procedure
Class Level Information

Class	Levels	Values
Month-10'grid	615	10GR61 10GS59 10GS60 10GS61 10GS62 10GT59 10GT60 10GT61 10GT62 10GU54 10GU60 10GU61 10GU62 10GV59 10GV60 10GV61 10GV62 10GW60 10GW61 10GW62 10GX61 10GX62 10GX63 10GY60 10GY61 10GY62 10GZ61 10GZ62 10GZ63 10HB63 10HC67 10HC68 10HC69 10HC70 10HD70 10HD71 10HF67 10HG69 10HK70 10HK71 10HP91 10HT77 10HT78 11GR60 11GS59 11GS60 11GT61 11GU61 11GV60 11GV62 11GW61 11GW62 11GX60 11GX61 11GX62 11GX63 11GY61 11GY62 11GY63 11GZ62 11GZ63 11HA62 11HA63 11HB63 11HB68 11HC63 11HC64 11HC65 11HC69 11HC70 11HD64 11HD65 11HD66 11HD69 11HD70 11HD71 11HE65 11HE72 11HF67 11HG67 11HH65 11HP92 11HT78 11HU66 11HW68 12GM60 12GW59 12GW60 12GW61 12GW62 12GX60 12GX61 12GX62 12GX63 12GX66 12GY60 12GY61 12GY62 12GY63 12GZ60 12GZ61 12GZ62 12GZ63 12HA61 12HA62 12HA63 12HA68 12HB62 12HB63 12HB64 12HC63 12HC64 12HC65 12HC67 12HC69 12HD64 12HD65 12HD66 12HD69 12HF63 12HF64 12HI70 12HI71 12HJ72 12HK72 12HK73 12HL73 12HU70 1GW61 1GW62 1GW63 1GX61 1GX62 1GZ62 1HA62 1HA63 1HA64 1HB61 1HB62 1HB63 1HB64 1HB65 1HB66 1HB67 1HC63 1HC64 1HC65 1HC66 1HC67 1HC68 1HC71 1HD69 1HD70 1HF70 1HJ68 1HJ71 1HN73 1HT77 2GX62 2GZ62 2HA61 2HA62 2HA63 2HB65 2HB66 2HB67 2HC63 2HC64 2HC66 2HC67 2HC68 2HC69 2HC70 2HD69 2HD70 2HD71 2HE70 2HE71 2HF74 2HF75 2HF76 2HG75 2HJ74 2HR83 2HT78 3GX61 3GX62 3GY61 3GY62 3GZ62 3GZ63 3HB63 3HB64 3HB65 3HB70 3HB81 3HC65 3HC66 3HC67 3HC80 3HD65 3HD66 3HD67 3HD68 3HD69 3HD70 3HD71 3HE66 3HE67 3HE68 3HJ72 3HK72 3HK73 3HL73 3HT78 3HT79 3HV66 4GW60 4GW61 4GX61 4GX62 4GY61 4GY62 4GY63 4GZ61 4GZ62 4GZ63 4HA61 4HA62 4HA63 4HB63 4HB65 4HC63 4HC64 4HC65 4HC66 4HC67 4HD66 4HD69 4HJ68 4HJ69 4HJ70 4HK71 4HK72 4HK73 4HL73 4HL74 4HM72 4HM74 4HM75 4HN64 4HN75 4HN76 4HO75 4HO76 4HU74 4HV77 4HW67 5GT50 5GT51 5GT52 5GT55 5GU54 5GU55 5GU56 5GU57 5GU58 5GV60 5GV61 5GW60 5GW61 5GW62 5GX57 5GX59 5GX60 5GX61 5GX62 5GY57 5GY60 5GY61 5GY62 5HA58 5HA63 5HI67 5HI68 5HJ68 5HJ71 5HJ72 5HK71 5HK72 5HK73 5HL72 5HL73 5HM73 5HM74 5HN73 5HN74 5HN75 5HN76 5HN77 5HO74 5HO76 5HO77 5HO78 5HP77 5HP78 5HQ78 5HT78 5HU70 5HU74 5HV71 5HW67 5HW68 5ZZ01 6GR61 6GT53 6GT54 6GT55 6GT57 6GT60 6GU54 6GU56 6GU57 6GU61 6GU63 6GV57 6GW61 6GW62 6GX61 6GX62 6GY56 6GY57 6GZ56 6GZ57 6GZ58 6HA59 6HA63 6HB59 6HC61 6HC69 6HD61 6HD71 6HE62 6HF59 6HF63 6HF64 6HG64 6HH65 6HH66 6HH72 6HI67 6HI68 6HJ69 6HJ70 6HJ72 6HK69 6HK71 6HK72 6HK73 6HL72 6HL73 6HL74 6HM73 6HM74 6HO73 6HO78 7GN30 7GR61 7GS61 7GS62 7GT56 7GT57 7GT61 7GT62 7GU56 7GU61 7GV44 7GV45 7GV46 7GV48 7GV49 7GV50 7GW47 7GW48 7GW50 7GW51 7GW52 7GW54 7GW56 7GW61 7GW62 7GX50 7GX51 7GX53 7GX54 7GX55 7GX62 7GX63 7GY55 7GY56 7GY57 7GY59 7GZ57 7GZ58 7GZ59 7HA57 7HA58 7HA59 7HB58 7HB59 7HD61 7HE62 7HF63 7HG62 7HG63 7HG65 7HG67 7HH66 7HH67 7HI67 7HI68 7HJ68 7HJ69 7HK70 7HL72 7HT77 7HT78 7HU66 7HU69 7HU74 7HV65 7HV67 7HW67 8GM65 8GM66 8GN62 8GN64 8GO60 8GO61 8GO62 8GP61 8GP62 8GQ58 8GQ60 8GQ61 8GQ62 8GR38 8GR41 8GR58 8GR59 8GR60 8GR61 8GR63 8GS37 8GS38 8GS39 8GS40 8GS41 8GS53 8GS56 8GS57 8GS58 8GS59 8GS60 8GT38 8GT39 8GT42 8GT48 8GT52 8GT53 8GT54 8GT55 8GT56 8GT57 8GT58 8GT62 8GU56 8GU58 8GU59 8GU61 8GV38 8GV44 8GV45 8GV46 8GV47 8GV48 8GV49 8GV50 8GV51 8GV61 8GV62 8GW46 8GW47 8GW48 8GW49 8GW50 8GW51 8GW52 8GW60 8GW61 8GW62 8GX51 8GX52 8GX53 8GX61 8GX62 8GX63 8GY54 8GY55 8GY56 8GY57 8GY62 8GZ55 8GZ57

Appendix 3 (continued).

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                8HK71 8HL71 8HL72 8HM72 8HN74 8HO74 8HT77 8HU74 9GI63
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                9HJ68 9HJ69 9HK70 9HK71 9HK72 9HL72 9HM67 9HM71 9HM73
                9HM74 9HN73 9HN74 9HO74 9HS79 9HS82 9HT65 9HT77 9HT78
                9HV78

CFV             47      18 1528 1563 1564 1566 1574 1607 1608 1609 1610 1611
                        1627 1631 1657 1667 4009 4017 4022 4024 4025 4026 4027
                        4035 4036 4043 4048 4053 4054 4061 8001 12647 17001
                        17003 17004 17005 17008 92593 101616 130019 130020
                        130021 131582 152125 152320 152613 152856 ~~~~stnd

                Number of observations in data set = 3170

NOTE: Due to missing values, only 2554 observations can be used in this
      analysis.
```

Appendix 3 (continued).

Regression of the log catch rates with the categories

General Linear Models Procedure

Dependent Variable: LOGCPUE Log of catch rate

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	660	1811.517858	2.744724	3.54	0.0001
Error	1893	1467.978353	0.775477		
Corrected Total	2553	3279.496211			

R-Square	C.V.	Root MSE	LOGCPUE Mean
0.552377	158.2079	0.880612	0.556617

Source	DF	Type III SS	Mean Square	F Value	Pr > F
CFV	46	187.041729	4.066125	5.24	0.0001
Month-10'grid	614	1275.301483	2.077038	2.68	0.0001

Source	DF	Type IV SS	Mean Square	F Value	Pr > F
CFV	46	187.041729	4.066125	5.24	0.0001
Month-10'grid	614	1275.301483	2.077038	2.68	0.0001

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT		-1.098612289 B	-1.25	0.2123	0.88061184
CFV	18	-0.479861476 B	-1.74	0.0824	0.27609660
	1528	-0.549042953 B	-1.86	0.0624	0.29442876
	1563	-0.903223732 B	-3.69	0.0002	0.24464135
	1564	-1.094078935 B	-4.62	0.0001	0.23680035
	1566	-0.995516037 B	-3.56	0.0004	0.27930771
	1574	-0.440999046 B	-0.67	0.5031	0.65850452
	1607	-1.193856437 B	-3.87	0.0001	0.30809241
	1608	-0.821872456 B	-2.48	0.0133	0.33175286
	1609	-0.268079660 B	-1.69	0.0918	0.15891055
	1610	-0.445025264 B	-2.13	0.0330	0.20856824
	1611	-0.700519789 B	-2.36	0.0183	0.29658746
	1627	-0.658948283 B	-4.65	0.0001	0.14155870
	1631	0.106725170 B	0.70	0.4810	0.15142805
	1657	-0.397315707 B	-0.62	0.5332	0.63750766
	1667	-1.031789835 B	-3.36	0.0008	0.30670752
	4009	-0.181674071 B	-0.97	0.3311	0.18687501
	4017	-0.704085372 B	-2.44	0.0148	0.28872360
	4022	-1.086028956 B	-1.78	0.0758	0.61123704
	4024	-0.290779573 B	-1.22	0.2210	0.23749718
	4025	-1.382122143 B	-2.36	0.0182	0.58472062
	4026	-0.938636681 B	-3.24	0.0012	0.29014705
	4027	-1.161778922 B	-3.71	0.0002	0.31334730
	4035	-2.724024443 B	-2.51	0.0121	1.08493839
	4036	-2.734626618 B	-2.76	0.0058	0.99063854

Appendix 3 (continued).

Regression of the log catch rates with the categories

General Linear Models Procedure

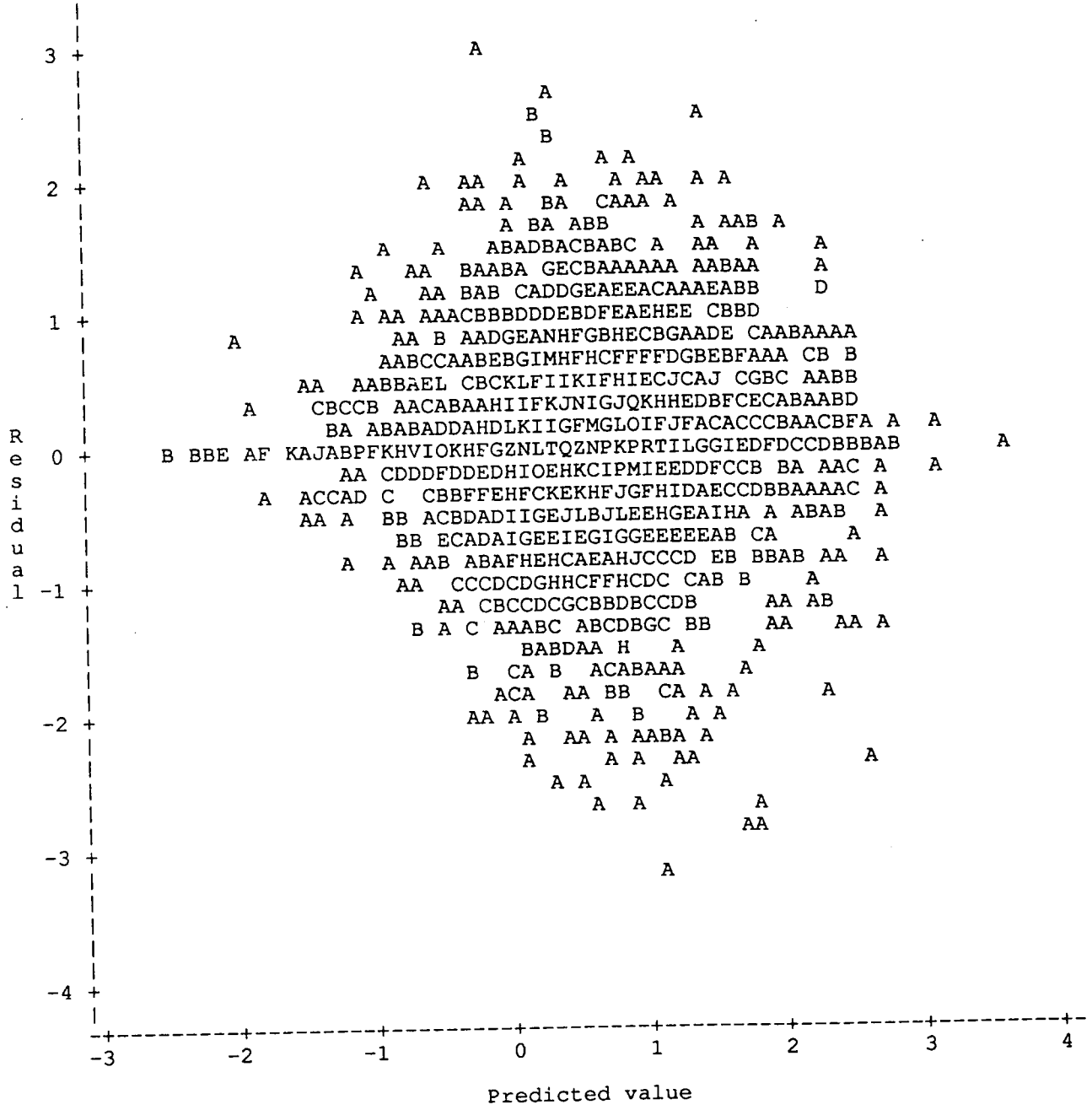
Dependent Variable: LOGCPUE Log of catch rate

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
CFV	4043	-0.774544509 B	-2.27	0.0236	0.34178568
	4048	-0.236734773 B	-1.78	0.0751	0.13293670
	4053	-0.377641394 B	-2.90	0.0038	0.13014109
	4054	-0.030593703 B	-0.22	0.8267	0.13975202
	4061	-0.347617306 B	-1.83	0.0674	0.18994991
	8001	-0.632409074 B	-3.55	0.0004	0.17815109
	12647	-0.515945454 B	-0.76	0.4460	0.67688249
	17001	-0.351252170 B	-2.43	0.0151	0.14435954
	17003	-0.279747576 B	-1.85	0.0643	0.15110349
	17004	0.070492256 B	0.54	0.5919	0.13146816
	17005	-0.403932220 B	-2.55	0.0109	0.15848411
	17008	-0.529047771 B	-3.81	0.0001	0.13883686
	92593	0.026339269 B	0.20	0.8436	0.13344488
	101616	-1.060905332 B	-2.00	0.0455	0.52999460
	130019	0.003108646 B	0.01	0.9926	0.33523888
	130020	-0.030496557 B	-0.16	0.8755	0.19462197
	130021	0.021672451 B	0.10	0.9226	0.22304202
	131582	-0.644821697 B	-3.49	0.0005	0.18452390
	152125	0.217902115 B	1.56	0.1201	0.14011739
	152320	-0.021887905 B	-0.15	0.8806	0.14568966
	152613	0.436465128 B	2.63	0.0085	0.16578357
	152856	-0.746279744 B	-0.73	0.4662	1.02396704
	~~stnd	0.000000000 B	.	.	.

Appendix 3 (continued).

Analysis of the residuals

Plot of RESIDU*PRED. Legend: A = 1 obs, B = 2 obs, etc.



Appendix 4. Results of the standardization with the multiplicative model of the 1992 commercial catch rates by month and by 10' grid. The standardization was done by vessel (standard: CFV 4049)

Regression of the log catch rates with the categories
General Linear Models Procedure
Class Level Information

Class	Levels	Values
Month-10'grid	35	10GR63 10GS58 10GS59 10GS60 10GS62 10GT55 10GT56 10GT58 10GT59 10GT62 10GV54 10GV59 10GV61 10GV62 10GW58 10GW59 10GW60 10GW61 10GW62 10GW63 10GX59 10GX60 10GX61 10GX62 10GX63 10GY62 10GY63 10GZ61 10GZ63 10HA61 10HA62 10HA63 10HB62 10HB63 10HC59 10HC60 10HC64 10HC68 10HC70 10HD60 10HD66 10HE61 10HG64 10HI66 10HT77 10HT78 11GS58 11GT57 11GT58 11GV58 11GW59 11GW60 11GW61 11GX60 11GX61 11GX62 11GX63 11GX67 11GY60 11GY62 11GZ61 11GZ63 11HA58 11HA62 11HA63 11HC64 11HC65 11HC67 11HC69 11HC70 11HD65 11HD66 11HD70 11HD71 11HD72 11HE65 11HE72 11HF67 11HJ72 11HM72 11HS79 11HS80 11HT77 11HT78 11HU74 11HW69 11HW70 11HX67 12GV62 12GW61 12GW62 12GX61 12GX62 12GX63 12GY62 12GZ61 12GZ62 12GZ63 12HA62 12HA63 12HB63 12HB68 12HC64 12HC65 12HC68 12HC69 12HC70 12HC71 12HD61 12HD65 12HD66 12HD70 12HE66 12HE67 12HF61 12HF66 12HF67 12HF68 12HG69 12HH61 12HI68 12HJ69 12HN73 12HO73 12HO74 12HP78 12HR67 12HS66 12HS79 12HS80 12HS81 12HW67 12HX67 1GU63 1GW69 1GY60 1GY61 1GY62 1GY66 1GZ60 1GZ61 1GZ62 1HA54 1HA59 1HA60 1HA62 1HA63 1HB63 1HB64 1HB65 1HB66 1HB67 1HB81 1HC63 1HC64 1HC65 1HC66 1HC67 1HC68 1HC69 1HC70 1HD64 1HD65 1HD66 1HD69 1HD70 1HD71 1HT78 1HV66 2GZ62 2GZ63 2HA62 2HA63 2HB63 2HB64 2HB65 2HC64 2HC65 2HC66 2HD64 2HD66 2HD68 2HD69 2HD70 2HD71 2HE66 2HE70 2HE71 3GY67 3GZ62 3GZ63 3HA63 3HB65 3HB66 3HC68 3HC69 3HC81 3HD67 3HD68 3HD69 3HD70 3HD71 3HD72 3HD73 3HE67 3HE68 3HE69 3HE70 3HE71 3HE72 3HF68 3HF69 3HF70 3HF71 3HF72 3HF74 3HG70 3HK72 3HL72 3HN73 3HO78 4GW61 4GX61 4GX62 4GY60 4GY61 4GY62 4GZ61 4GZ62 4GZ63 4HA61 4HA62 4HA63 4HB62 4HB63 4HB64 4HC63 4HC64 4HC65 4HC66 4HC69 4HC70 4HD65 4HD66 4HD67 4HD68 4HD69 4HD70 4HD72 4HE66 4HE67 4HE68 4HF67 4HF68 4HG69 4HI68 4HN73 4HO72 4HO74 4HR83 4HU73 5GW60 5GW61 5GW62 5GX55 5GX61 5GX62 5GX63 5GY60 5GZ58 5GZ59 5GZ60 5GZ61 5GZ62 5GZ63 5HA57 5HA58 5HA60 5HA61 5HA62 5HA63 5HB61 5HB62 5HB63 5HC63 5HC64 5HC65 5HD63 5HD64 5HD65 5HD66 5HD67 5HF62 5HF63 5HH65 5HH66 5HK73 5HL73 5HM74 5HN74 5HU66 5HV66 6GO60 6GO62 6GQ61 6GQ62 6GS46 6GV49 6GV50 6GV62 6GW46 6GW47 6GW49 6GW50 6GW58 6GW62 6GX53 6GX54 6GX55 6GY55 6GY56 6GY57 6GZ56 6GZ57 6GZ58 6GZ59 6HA58 6HB58 6HB59 6HD52 6HD63 6HD66 6HI67 6HI68 6HI69 6HJ68 6HJ69 6HJ72 6HK71 6HK72 6HK75 6HK76 6HL72 6HL73 6HM72 6HM73 6HM74 6HM75 6HN73 6HN74 6HR77 6HT78 7GM59 7GN30 7GO62 7GP35 7GP59 7GQ56 7GQ59 7GQ60 7GQ63 7GR51 7GR55 7GR57 7GR58 7GR60 7GR61 7GR66 7GS50 7GS51 7GS52 7GS53 7GS54 7GS58 7GS59 7GS60 7GS62 7GS63 7GS69 7GT49 7GT50 7GT53 7GT54 7GT55 7GT56 7GT57 7GT58 7GT59 7GT60 7GT61 7GT62 7GT63 7GU42 7GU55 7GU61 7GU62 7GU63 7GV42 7GV46 7GV57 7GV58 7GV61 7GV62 7GV63 7GW50 7GW61 7GW62 7GX55 7GX61 7GX62 7GY55 7GY56 7GY57 7GY63 7GZ57 7GZ58 7GZ60 7HB59 7HI68 7HJ70 7HK70 7HK71 7HS77 7HS78 7HT77 7HT78 8GN60 8GP64 8GQ57 8GQ59 8GQ60 8GQ61 8GQ63 8GR55 8GR58 8GR60 8GR61 8GR62 8GS51 8GS56 8GS57 8GS58 8GS59 8GS60 8GT51 8GT52 8GT53 8GT54 8GT55 8GT56 8GT57

Appendix 4 (continued)

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                    8GT58 8GT59 8GT60 8GT61 8GT62 8GT64 8GU58 8GU61 8GV46
                    8GV48 8GV52 8GV58 8GV60 8GV62 8GW50 8GW51 8GW52 8GW61
                    8GW62 8GX50 8GX52 8GX54 8GX62 8GY55 8GY56 8GY57 8GY62
                    8GZ58 8HA58 8HB58 8HB59 8HE73 8HE74 8HF63 8HF74 8HG59
                    8HH65 8HK71 8HL72 8HT78 8HU66 9GQ61 9GQ63 9GR58 9GR59
                    9GR63 9GR68 9GS51 9GS58 9GS59 9GS60 9GS62 9GS68 9GT56
                    9GT57 9GT58 9GT61 9GT62 9GU53 9GU61 9GU62 9GU63 9GV60
                    9GV61 9GV62 9GW59 9GW60 9GW61 9GW62 9GX55 9GX61 9GX62
                    9GX63 9GY57 9GY61 9GZ57 9HC60 9HD60 9HD76 9HE73 9HE74
                    9HF74 9HF75 9HI67

CFV          41     18 1528 1573 1607 1609 1610 1611 1627 1631 1657 1667
                    1670 1671 4009 4017 4022 4024 4025 4026 4027 4043 4046
                    4048 4053 4054 4061 8001 17001 17003 17004 17005 17008
                    92593 101616 130020 131582 152125 152320 152613 152856
                    ~~~~stnd


                  Number of observations in data set = 2696

NOTE: Due to missing values, only 2160 observations can be used in this
      analysis.
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Appendix 4 (continued)

Regression of the log catch rates with the categories

General Linear Models Procedure

Dependent Variable: LOGCPUE Log of catch rate

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	572	1608.711750	2.812433	4.48	0.0001
Error	1587	996.951525	0.628199		
Corrected Total	2159	2605.663274			

R-Square	C.V.	Root MSE	LOGCPUE Mean
0.617390	104.8505	0.792590	0.755924

Source	DF	Type III SS	Mean Square	F Value	Pr > F
CFV	38	119.883849	3.154838	5.02	0.0001
Month-10'grid	532	1299.634010	2.442921	3.89	0.0001

Source	DF	Type IV SS	Mean Square	F Value	Pr > F
CFV	38	119.883849	3.154838	5.02	0.0001
Month-10'grid	532	1299.634010	2.442921	3.89	0.0001

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT		-0.521270231 B	-0.90	0.3670	0.57763083
CFV	18	-0.836959667 B	-4.38	0.0001	0.19109001
	1528	-0.100944719 B	-0.41	0.6840	0.24793457
	1573	-0.731492738 B	-0.75	0.4559	0.98074267
	1607	-0.898508736 B	-2.59	0.0096	0.34663315
	1609	-0.348940335 B	-2.41	0.0162	0.14503761
	1610	-0.110901190 B	-0.60	0.5486	0.18483868
	1611	0.655356376 B	0.90	0.3665	0.72553261
	1627	-0.197609232 B	-1.23	0.2192	0.16075630
	1631	0.232952501 B	1.45	0.1460	0.16016939
	1657	0.675420911 B	0.69	0.4911	0.98074267
	1667	-1.007819818 B	-2.37	0.0180	0.42572435
	1670	0.301492206 B	0.53	0.5949	0.56684298
	1671	0.133124691 B	0.30	0.7668	0.44872419
	4009	-0.371377357 B	-2.43	0.0151	0.15261030
	4017	-1.082405216 B	-2.29	0.0224	0.47360550
	4022	-0.295558791 B	-0.29	0.7748	1.03286290
	4024	0.101326713 B	0.28	0.7824	0.36682113
	4025	0.099412025 B	0.21	0.8371	0.48354283
	4026	-0.020151976 B	-0.02	0.9835	0.97352634
	4027	0.531707340 B	0.65	0.5150	0.81650099
	4043	-0.239654774 B	-1.49	0.1360	0.16068263
	4046	0.289288557 B	0.34	0.7345	0.85291049
	4048	-0.070515762 B	-0.48	0.6313	0.14693036
	4053	-0.354932042 B	-2.26	0.0237	0.15675799

Appendix 4 (continued)

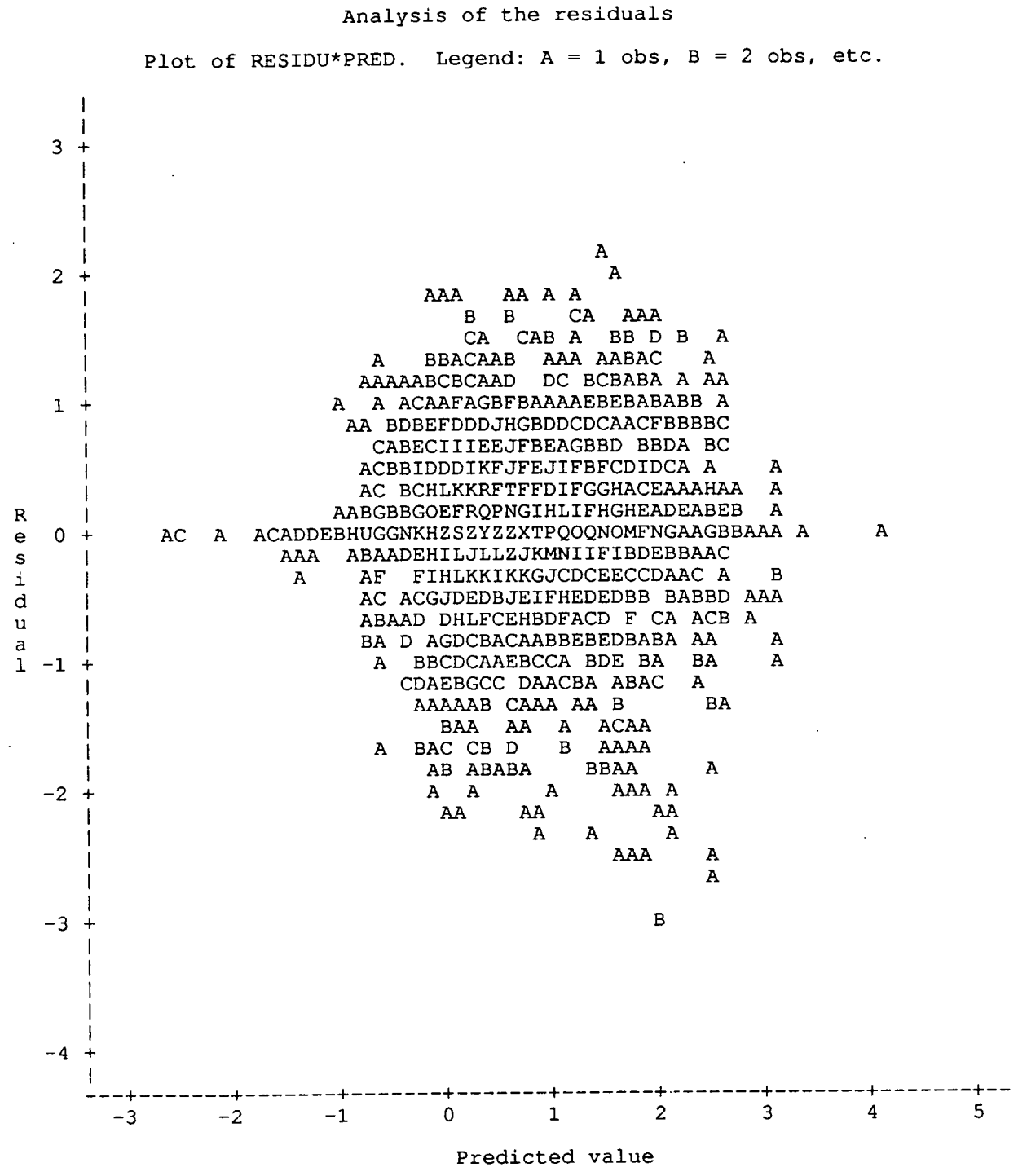
Regression of the log catch rates with the categories

General Linear Models Procedure

Dependent Variable: LOGCPUE Log of catch rate

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
CFV	4054	-0.547554830 B	-3.39	0.0007	0.16151458
	4061	0.256653433 B	1.38	0.1670	0.18562352
	8001	-0.579621452 B	-3.16	0.0016	0.18362425
	17001	-0.171876950 B	-1.23	0.2192	0.13984978
	17003	0.366699143 B	2.43	0.0153	0.15105630
	17004	0.039642533 B	0.27	0.7886	0.14781679
	17005	0.363778883 B	1.70	0.0900	0.21446050
	17008	-0.032225619 B	-0.22	0.8264	0.14686895
	92593	-0.267361403 B	-1.81	0.0705	0.14772005
	101616	0.115803551 B	0.31	0.7589	0.37731581
	130020	-0.248933707 B	-0.99	0.3226	0.25157052
	131582	-0.026890686 B	-0.19	0.8527	0.14475405
	152125	0.368152637 B	2.68	0.0075	0.13759452
	152320	0.369362793 B	2.70	0.0070	0.13680827
	152613	-0.001869543 B	-0.01	0.9923	0.19264155
	152856	-0.068057745 B	-0.28	0.7792	0.24274221
	~~stnd	0.000000000 B	.	.	.

Appendix 4 (continued)



Appendix 5. Results of the standardization with the multiplicative model of the 1993 commercial catch rates by month and by 10' grid. The standardization was done by vessel (standard: CFV 4049)

Regression of the log catch rates with the categories
General Linear Models Procedure
Class Level Information

Class	Levels	Values
Month-10'grid	577	10GK69 10GP29 10GR58 10GS58 10GS59 10GS61 10GS62 10GS63 10GT55 10GT56 10GT57 10GT58 10GT62 10GT63 10GU58 10GU62 10GV62 10GW61 10GW62 10GW63 10GX61 10GX62 10GX63 10GY61 10GY62 10GY63 10GZ61 10GZ62 10GZ63 10HA58 10HA62 10HB59 10HB66 10HB67 10HB68 10HB69 10HC60 10HC61 10HC66 10HC67 10HC68 10HC69 10HC70 10HC71 10HD60 10HD68 10HD69 10HD70 10HD71 10HD72 10HE72 10HF59 10HG75 10HH65 10HH66 10HO75 10HT77 11GQ62 11GS58 11GS62 11GT57 11GU58 11GU61 11GV59 11GV62 11GW61 11GW62 11GX61 11GX62 11GX63 11GY61 11GY62 11GZ62 11GZ63 11HA58 11HB59 11HB65 11HB66 11HB67 11HB68 11HC66 11HC67 11HC68 11HC69 11HC70 11HC71 11HC73 11HD68 11HD70 11HD71 11HD72 11HE72 11HF73 11HF74 11HS78 11HS79 11HT78 11HU73 12GS61 12GS62 12GT61 12GT62 12GT67 12GU58 12GU61 12GU62 12GV58 12GV61 12GV62 12GW60 12GW61 12GW62 12GX61 12GX62 12GY62 12GY63 12GZ63 12HB64 12HB66 12HB67 12HB68 12HC66 12HC67 12HC68 12HC69 12HC70 12HC71 12HD70 12HD71 12HD72 12HE72 12HT77 1HA62 1HA63 1HB62 1HB63 1HB64 1HB65 1HB68 1HC65 1HC66 1HC67 1HC68 1HC69 1HD68 1HD69 1HD70 1HD71 2HB62 2HB63 2HB64 2HB65 2HB69 2HC64 2HC65 2HC68 2HC69 2HD64 2HD65 2HD66 2HD67 2HD68 2HD69 2HD70 2HD71 2HD72 2HE71 2HR77 3GY70 3GZ69 3HA63 3HB63 3HB64 3HB65 3HB82 3HC61 3HC64 3HC65 3HC66 3HC67 3HC80 3HC81 3HD65 3HD66 3HD67 3HD68 3HD69 3HD70 3HE68 3HE69 3HE70 3HE71 3HF70 3HF74 3HG75 3HR79 3HS79 3HS80 3HT78 3HT79 3HX67 4GW60 4GX62 4GY62 4GZ57 4GZ60 4GZ62 4HA62 4HB62 4HB63 4HB64 4HB65 4HC63 4HC64 4HC65 4HC66 4HC67 4HC68 4HC72 4HD63 4HD64 4HD65 4HD67 4HD68 4HD69 4HD70 4HD71 4HE68 4HE69 4HE70 4HE71 4HF68 4HF74 4HG69 4HG70 4HG75 4HH70 4HI71 4HL74 4HQ79 4HR79 4HS79 4HS80 4HT77 4HT78 5GS60 5GT51 5GT54 5GT57 5GT58 5GV62 5GW62 5GX54 5GX61 5GX62 5GX63 5GY62 5GZ57 5GZ61 5HA62 5HA63 5HB59 5HB62 5HB63 5HB64 5HC61 5HC62 5HC63 5HC64 5HC65 5HC68 5HD63 5HD64 5HD65 5HD67 5HD70 5HE66 5HE68 5HE69 5HE70 5HF68 5HF69 5HK72 5HM76 5HP79 5HS77 5HS79 5HT77 5HT78 5HU72 5HV67 6GS52 6GS57 6GS58 6GS59 6GT53 6GT56 6GT57 6GT58 6GU56 6GV48 6GV56 6GW50 6GW52 6GW54 6GW57 6GW62 6GX50 6GX51 6GX52 6GX53 6GX54 6GX55 6GX57 6GX61 6GX62 6GX63 6GY51 6GY55 6GY56 6GY57 6GY62 6GY63 6GZ56 6GZ57 6GZ58 6GZ63 6HA57 6HA58 6HA59 6HB55 6HB59 6HB63 6HC56 6HC63 6HC64 6HD64 6HD65 6HE65 6HE71 6HF63 6HG63 6HG64 6HG65 6HG68 6HH65 6HH66 6HH67 6HI64 6HI67 6HI68 6HI69 6HJ62 6HJ68 6HJ69 6HJ70 6HJ71 6HK65 6HK70 6HK71 6HK72 6HL72 6HL73 6HM71 6HM72 6HM73 6HM74 6HN74 6HN75 6HP69 6HQ85 6HR77 6HR84 6HT77 6HT78 7GN30 7GQ39 7GQ60 7GR38 7GR39 7GR40 7GR51 7GR52 7GR57 7GR58 7GR59 7GR60 7GR62 7GR63 7GS51 7GS53 7GS54 7GS55 7GS58 7GS59 7GS60 7GS61 7GS62 7GS63 7GT51 7GT53 7GT54 7GT55 7GT56 7GT57 7GT58 7GT61 7GT62 7GU61 7GU62 7GU63 7GV46 7GV47 7GV50 7GV61 7GV62 7GW49 7GW50 7GW51 7GW52 7GW53 7GW61 7GW62 7GX52 7GX53 7GX54 7GX55 7GX57 7GX62 7GX63 7GY55 7GY56 7GY57 7GY58 7GZ54 7GZ55 7GZ56 7GZ57 7GZ58 7HA58 7HB58 7HB59 7HC60 7HG64 7HH64 7HH65 7HI67 7HI68 7HJ68 7HJ69 7HT78 7HW67 8GM57 8GM62 8GM65 8GP64 8GQ60 8GQ61 8GQ63 8GR58 8GR59 8GR60 8GR61 8GR62 8GS50 8GS51 8GS52 8GS54 8GS56 8GS58 8GS59 8GS60 8GS61 8GS62 8GS63 8GT50 8GT53 8GT55 8GT56 8GT57 8GT58 8GT59 8GT61 8GT62 8GU58 8GU59 8GU61 8GU62 8GU63 8GV43 8GV46 8GV47 8GV48 8GV58 8GV60 8GV61 8GV62 8GV63 8GW47 8GW49 8GW50 8GW51 8GW52 8GW61 8GW62 8GW63 8GX52 8GX57 8GX62 8GX63 8GX64 8GY55 8GY56 8GY62 8GZ56 8GZ57 8GZ58 8GZ59 8HA58 8HB59 8HB60 8HC60 8HC68

Appendix 5 (continued).

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                    8HC69 8HC70 8HD70 8HE61 8HE62 8HF63 8HF64 8HG64 8HG65
                    8HH65 8HJ69 8HK70 8HM72 8HP75 9GQ60 9GR58 9GR62 9GS57
                    9GS58 9GS59 9GS60 9GS62 9GS63 9GT52 9GT56 9GT57 9GT58
                    9GT60 9GT61 9GT62 9GT63 9GU61 9GU62 9GV59 9GV60 9GV61
                    9GV62 9GW61 9GW62 9GW63 9GX61 9GX62 9GX63 9GY62 9GZ62
                    9GZ63 9HB58 9HB59 9HB63 9HB67 9HB68 9HC69 9HC70 9HD70

CFV          29     18 1528 1607 1609 1610 1611 1627 4009 4022 4025 4027
                    4043 4048 4053 4054 8001 17001 17003 17004 17005 17008
                    92593 101616 125839 131582 152125 152320 152613 ~~~~stnd


                  Number of observations in data set = 3344


NOTE: Due to missing values, only 2766 observations can be used in this
      analysis.
```

Appendix 5 (continued).

Regression of the log catch rates with the categories

General Linear Models Procedure

Dependent Variable: LOGCPUE Log of catch rate

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	603	1537.965625	2.550523	3.98	0.0001
Error	2162	1387.191386	0.641624		
Corrected Total	2765	2925.157011			

R-Square	C.V.	Root MSE	LOGCPUE Mean
0.525772	295.4773	0.801014	0.271092

Source	DF	Type III SS	Mean Square	F Value	Pr > F
CFV	27	91.996270	3.407269	5.31	0.0001
Month-10'grid	575	1418.561389	2.467063	3.85	0.0001

Source	DF	Type IV SS	Mean Square	F Value	Pr > F
CFV	27	91.996270	3.407269	5.31	0.0001
Month-10'grid	575	1418.561389	2.467063	3.85	0.0001

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT		0.384235204 B	0.81	0.4198	0.47616713
CFV	18	-0.173902305 B	-1.08	0.2811	0.16129727
	1528	-0.018472743 B	-0.12	0.9072	0.15844930
	1607	-0.372766361 B	-1.28	0.2024	0.29231980
	1609	-0.341748632 B	-3.05	0.0023	0.11207322
	1610	-0.112125872 B	-0.95	0.3404	0.11757293
	1611	-0.356612675 B	-0.52	0.6002	0.68023653
	1627	-0.345058368 B	-1.81	0.0709	0.19097387
	4009	0.054185764 B	0.42	0.6778	0.13042271
	4022	-2.016876872 B	-4.04	0.0001	0.49968196
	4025	-1.492563649 B	-2.75	0.0060	0.54218340
	4027	-1.715472044 B	-3.87	0.0001	0.44363493
	4043	-1.113285313 B	-4.29	0.0001	0.25964442
	4048	-0.094825968 B	-0.86	0.3879	0.10979328
	4053	-0.122604608 B	-1.06	0.2894	0.11569492
	4054	-0.185415538 B	-1.69	0.0911	0.10968727
	8001	-0.054072095 B	-0.26	0.7920	0.20496868
	17001	0.070364255 B	0.56	0.5752	0.12553365
	17003	0.332511972 B	2.45	0.0143	0.13563571
	17004	0.408358710 B	2.96	0.0031	0.13795384
	17005	0.215879459 B	1.74	0.0820	0.12406478
	17008	0.076583802 B	0.61	0.5404	0.12507031
	92593	-0.144325595 B	-1.17	0.2409	0.12302686
	101616	-0.043459734 B	-0.34	0.7333	0.12754911
	125839	-1.077382384 B	-1.16	0.2477	0.93185797

Appendix 5 (continued).

Regression of the log catch rates with the categories

General Linear Models Procedure

Dependent Variable: LOGCPUE Log of catch rate

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
CFV	131582	0.120790758 B	1.13	0.2596	0.10712765
	152125	0.163047097 B	1.34	0.1792	0.12134103
	152320	0.030171812 B	0.23	0.8149	0.12884544
	152613	0.287294075 B	2.63	0.0086	0.10927461
	~~stnd	0.000000000 B	.	.	.

Appendix 5 (continued).