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Distribution and Abundance of Small Redfish
on the Flemish Cap

by

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ABSTRACT

Canadian research surveys to determine the distribution and abundance of various groundfish species on Flemish Cap have been conducted from 1978 to 1981. Relatively high numbers of redfish less than 10 cm were caught in 1979 and 1981. In both years the juveniles appeared to be localized in the southwestern quarter of the Cap within the 225-300 m depth range approximately. The small fish in 1979 and 1981 were determined to be the 1977 and 1979 year-classes respectively which did not correspond to previously reported estimates of redfish larval abundance. A better understanding of the growth of redfish from the larval to juvenile stage on Flemish Cap could help to resolve this apparent discrepancy. From the analysis of redfish stomachs at sea, cannibalism was observed in 1979 and 1981 and might have occurred in 1978 and 1980.

INTRODUCTION

Canadian research surveys to determine the distribution and abundance of various groundfish species on Flemish Cap have been conducted by the *Gadus Atlantica* over the past four years (1978-81) during January and February. Although the net used on the *Gadus* was not specifically designed to catch small fish, juvenile redfish were caught in relatively high numbers in 1979 and 1981.

The occurrence of small redfish in 1979 and 1981 permitted preliminary examination of their preferred habitat. Comparisons of estimates of juvenile abundance from the groundfish surveys with those from previous larval surveys (Anderson and Akenhead 1981) were made so that the hypothesis of a positive relationship between larval and juvenile abundance indices, assuming if both are reliable indicators of absolute abundance, might be evaluated.

The data from redfish stomachs was examined for evidence of cannibalism, a factor of possible importance to variability in year-class strength.

MATERIALS AND METHODS

Random stratified surveys have been conducted in January-February by the research vessel *Gadus Atlantica* from 1978-81. Tows were typically 30 min. long using an Engel high rise otter trawl (1 1/8" liner in codend) and were conducted on a 24 hour basis. The numbers of successful sets completed in each of the years 1978-81 were 133, 95, 130 and 142 respectively.

The numbers of small redfish at length per tow was recorded and the stratified mean numbers per tow was calculated as an index to abundance. From stratified otolith collections made during the research cruises the ages of the small redfish were determined by the second author and checked with a second experienced reader at the NAFC laboratory, St. John's. The relative year-class strengths of juvenile redfish as estimated from the groundfish surveys were compared with the relative strengths suggested by larval surveys in the same area (Anderson and Akenhead 1981).

The stomach contents of redfish selected for otolith samples have been routinely examined at sea and the degree of fullness and the principal food item noted. These data were examined to affirm the presence or suggest the absence of cannibalism in redfish.

RESULTS

ABUNDANCE AT LENGTH

Small redfish were found in relatively high numbers in two of the four surveys, 1979 and 1981. The mean catch per tow at length for small redfish (Table 1) shows 7 and 8 cm fish to be predominant in both years. The peak in 1979 was not sampled at larger sizes in the two subsequent years. For the rest of this study, only the results for 1979 and 1981, when sizable numbers of small redfish were caught, are considered.

In both years the small fish were found in a few sets in a restricted portion of the southwestern quarter. The distribution of catches of 1-10 cm and 7-8 cm fish in 1979 are shown in Fig. 1 and 2 and the same maps for 1981 are shown in Fig. 3 and 4. The abundance of small fish appeared to be higher in 1981 than in 1979, principally due to one very large catch of 9267 fish under 10 cm in 1981.

ABUNDANCE AT AGE

The 7 and 8 cm fish in 1979 were determined to be predominantly two year olds (1977 year-class) with some 7 cm fish being one year olds (1978 year-class). The distribution and abundance of one and two year olds over the Cap in 1979 are shown in Fig. 5 and 6 respectively. In 1981, the 7 and 8 cm fish were determined to be from the 1979 year-class (two year olds). Their distribution is shown in Fig. 7. The 1979 year-class appeared to be stronger than the 1977 year-class at two years old, principally due to one extremely large catch in 1981. The 1977 year-class was not sampled in surveys subsequent to 1979.

DEPTH AND TEMPERATURE

The sets with small redfish ranged in depth between 224 and 332 m in 1979 and between 232 and 280 m in 1981. One set made at 462 m in 1981 caught small fish. Adult redfish are found commonly over the Cap from 250 to 700 m.

The temperature range in 1979 over the Flemish Cap was between 3.4 and 4.4C, the lower temperature mainly associated with depths greater than 500 m. Temperatures were slightly lower in 1981, ranging between 3.3 and 4.0C. In 1979, small redfish were found between 3.9 and 4.3C and in 1981 between 3.6 and 3.9C. In comparison, the temperatures over the entire Cap in the depth ranges where small redfish were encountered ranged from 3.7 to 4.4C and from 3.6 to 4.0C in 1979 and 1981 respectively.

STOMACH ANALYSIS

The majority of stomachs examined in each year were either empty or everted (Table 2) making the sample size of stomachs containing food items small, especially in 1978. In each year, unspecified fish were named in a few cases as the major food item. This category might include redfish. However, only in 1979 and 1981 were redfish positively identified in a few cases as the major food item.

DISCUSSION

HABITAT OF SMALL REDFISH

The few sets in which small redfish were caught in both years prohibits a definite delineation of preferred habitat. However, the present data would tentatively suggest that small redfish concentrate in the southwestern quarter of the Flemish Cap at depths of 225-330 m approximately. The depth and location would appear to be more important controlling factors than temperature.

Temperature varied more between years than did the general depth and location. The small redfish were found in the warmer temperatures experienced on the Cap each year which may have been chiefly a function of the depth and location. Cooler water temperatures were most often associated with greater depths.

As small fish are not caught efficiently by the net used for groundfish surveys, sets having no small redfish need not imply that small redfish could not exist there. Sets with small redfish would suggest that they may occur in abundance at these locations.

AGEING OF SMALL REDFISH

The accuracy of age interpretation by otoliths may sometimes be verified in the case where a single large year-class has occurred after and preceding many very small year-classes. Sandeman (1961) followed the 1953 year-class in Hermitage Bay for six years from December of 1953, when they were about 60 to 80 mm, up to 1959. Otoliths (and scales to age four) were used to age the fish. The first hyaline zone was taken to correspond with the first year of life although Sandeman expressed the opinion that the pelagic stage might last longer than the period from May when the larvae are extruded to December of the same year when small redfish are found on the bottom.

Mayo et al. (MS 1980) were able to test the accuracy of their interpretation of otoliths in a similar fashion using the large 1971 redfish year-class in the Gulf of Maine. An earlier study by Kelly and Barker (1961) had established that young redfish in the Gulf of Maine settled to the bottom between August and November of their first year of life at an average length of 40-50 mm.

Sandeman (1961) and McKone and Legge (MS 1980) affirmed the use of otoliths as indicators of age in redfish whether or not an absolute age could be unequivocally determined. Redfish otolith readers at the St. John's laboratory have found the otoliths of one and two year old redfish from the Flemish Cap typically difficult to read, the annuli being indistinct. At older ages, with several annuli laid down, the otoliths usually become easier to read, but the absolute age remains difficult to conclusively verify.

Radtke (MS 1980) presented data which suggested that the growth rate of redfish larvae of 11-24.5 mm from the Flemish Cap ranged between 0.14 and 0.17 mm per day with a possible accelerated rate with size. Unfortunately, no observations were made on the growth rate of larvae greater than about 25 mm. Kelly and Barker (1961) described the growth and distribution of redfish larvae in the Gulf of Maine during the pelagic stage. They observed an average growth rate of about 0.30 mm per day over a four or five month period prior to their movement to the bottom in the fall. The work of Radtke (MS 1980) and Postolaky (MS 1980) suggest that redfish larval growth on the Flemish Cap must be considerably slower than in the Gulf of Maine. If larvae extruded at the beginning of May at 5-6 mm grew at a rate of 0.17 mm per day, they would reach a maximum length of about 48 mm by January 1.

Larval surveys to Flemish Cap in July 1978 and 1979 suggested relatively good survival of larvae in 1978 while heavy mortality appeared to have reduced the abundance in 1979 (Anderson and Akenhead 1981). In July 1980, the abundance of redfish larvae was observed to be lower than in 1978 but not the apparent

failure that it was in 1979 (Anderson, pers. comm.). In keeping with these observations, one would expect to find an abundance of two year olds in the groundfish surveys in 1980 and few in 1981 (If one year olds are close to 5 cm in January, very few would be expected to be caught in the trawl.). Instead, the observed pattern was one of relatively high abundance of two year olds in 1979 and 1981 and low in 1980. To rationalize the apparent lack of correspondence between the surveys at the two different life stages, one may postulate a few of several possible causes. Either or both of the surveys may not be reliable indicators of abundance. A measure of abundance of larvae in July may not be related to abundance at two years old if high variable mortality continues throughout the period. As the groundfish trawl only catches small redfish sporadically in a given year, it may measure concentrations of fish rather than abundance. Due to the indistinct quality of the first few annuli of the otoliths collected from small redfish on the Flemish Cap, ages may be in error. The 7 and 8 cm fish caught in 1979 and 1981 may actually be one year olds or three year olds. A better knowledge of the growth and distribution of redfish from the larval to juvenile stage on the Flemish Cap would help to resolve this problem.

STOMACH ANALYSIS

The gross analysis of redfish stomachs at sea would suggest that cannibalism does exist. It may be of some significance that the years in which redfish were positively identified in the stomachs were also the years in which small redfish were caught in sizable numbers during the groundfish surveys. However, the small number of stomachs with food which result from the frequent occurrence of completely or partially everted stomachs preclude any definite conclusions.

SUMMARY

Small redfish were caught in relatively high numbers during the groundfish surveys on the Flemish Cap in 1979 and 1981. In both years, the small fish were concentrated in a restricted region of the southwest quarter of the Cap within the 225-330 m depth range approximately. The majority of these fish in 1979 were aged as two-year-olds, placing them one year out of phase with the peaks in larval abundance observed by Anderson and Akenhead (1981) in 1978 and 1980 (Anderson, pers. comm.). The available data on redfish larval growth on the Flemish Cap lend more support to the conclusion that the small fish would be two year olds rather than one year olds. However, redfish larval growth has only been observed up to July on the Flemish Cap. Information on the growth of redfish fry throughout the fall and the timing of movement to the bottom would aid the interpretation of otoliths and the evaluation of a relationship between estimates of abundance at the larval and early juvenile stages.

Cannibalism was observed in 1979 and 1981 and might have occurred in 1978 and 1980. The importance of this form of predation on year-class strength could not be determined from the data.

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Table 1. Catch per tow at length of small redfish (*Sebastes mentella*) less than 10 cm from Canadian research surveys to Flemish Cap, 1978-81.

Length (cm)	1978	1979	1980	1981
5				
6		0.14	0.01	0.04
7		1.67	0.04	36.10
8		1.39	0.20	34.51
9	0.01	0.18	0.16	0.06
10	0.02	0.35	0.22	0.04

Table 2. The number of redfish stomachs examined at sea, with the number empty, everted or containing food. Of those with food, the number containing redfish or unidentified fish are listed.

Year	No. stomachs examined	No. empty	No. everted	No. with food items	No. with redfish	No. with fish (unidentified)
1978	605	503	76	26		8
1979	595	393	117	85	8	6
1980	585	241	277	67		5
1981	640	260	240	140	2	10

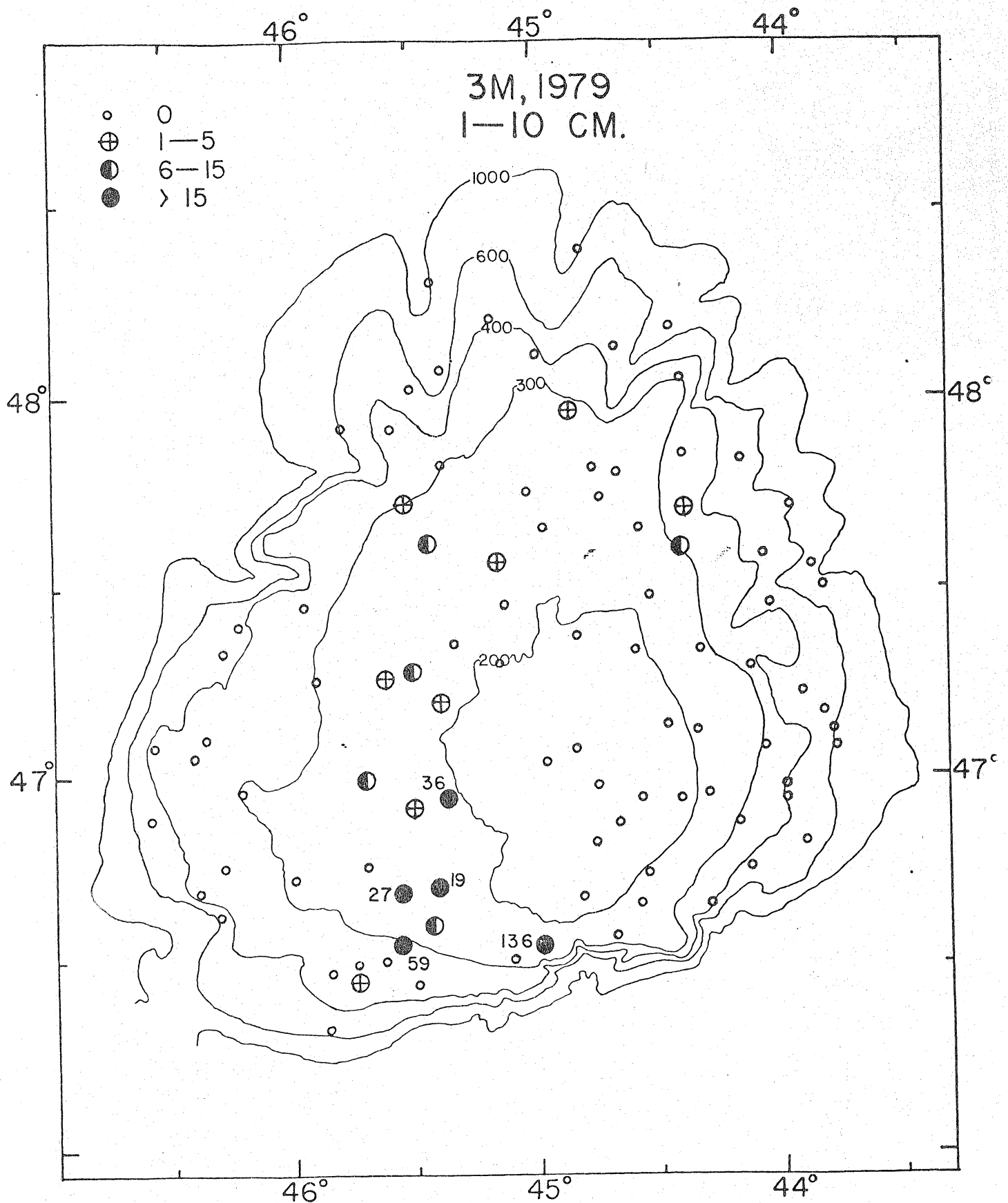


Fig. 1. Distribution and abundance of redfish less than 10 cm (numbers per tow) on Flemish Cap, 1979. Where catches totaled more than 15 fish, the exact numbers caught are noted.

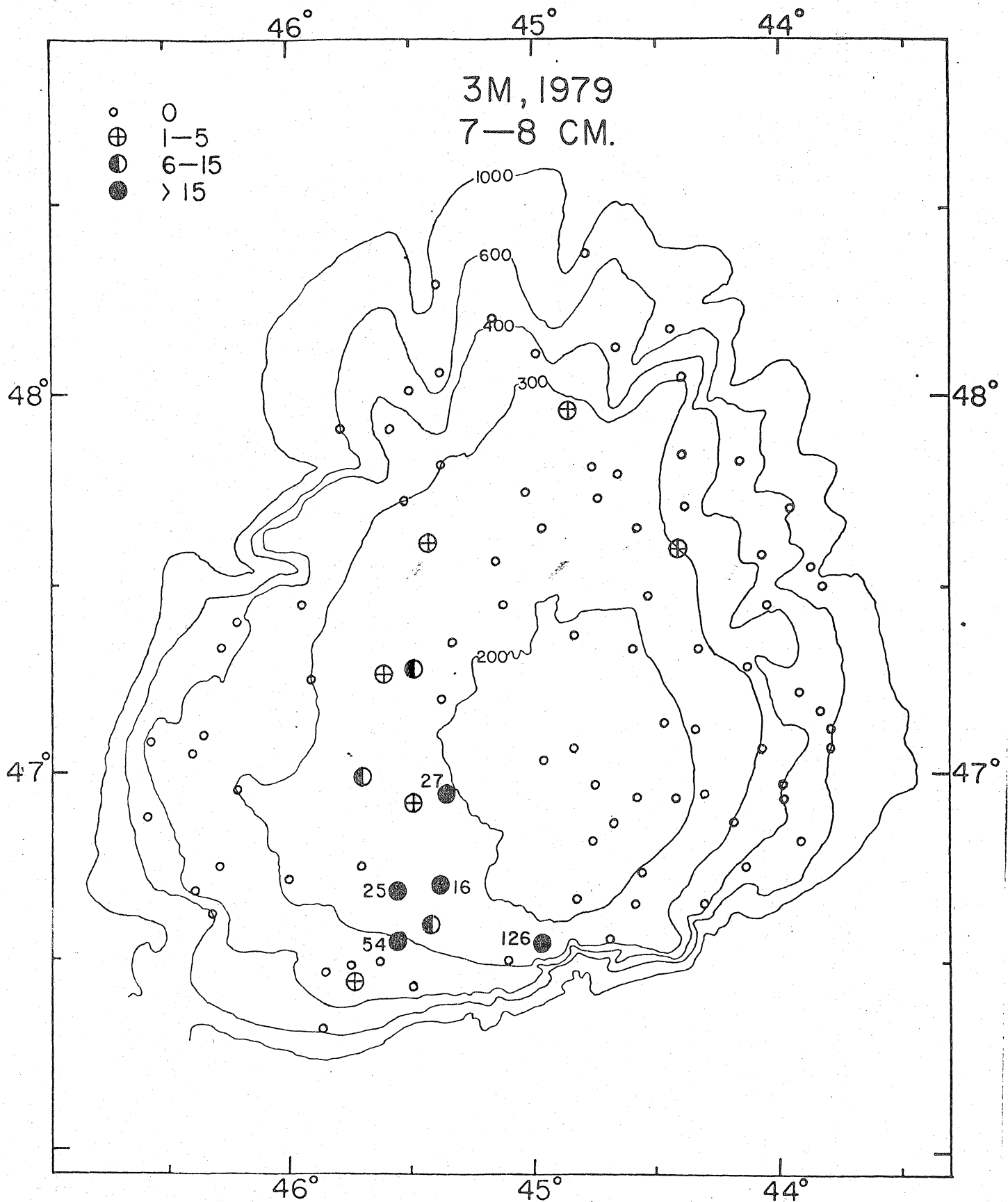


Fig. 2. Distribution and abundance of 7-8 cm redfish (numbers per tow) on Flemish Cap, 1979. Where catches totaled more than 15 fish, the exact numbers caught are noted.

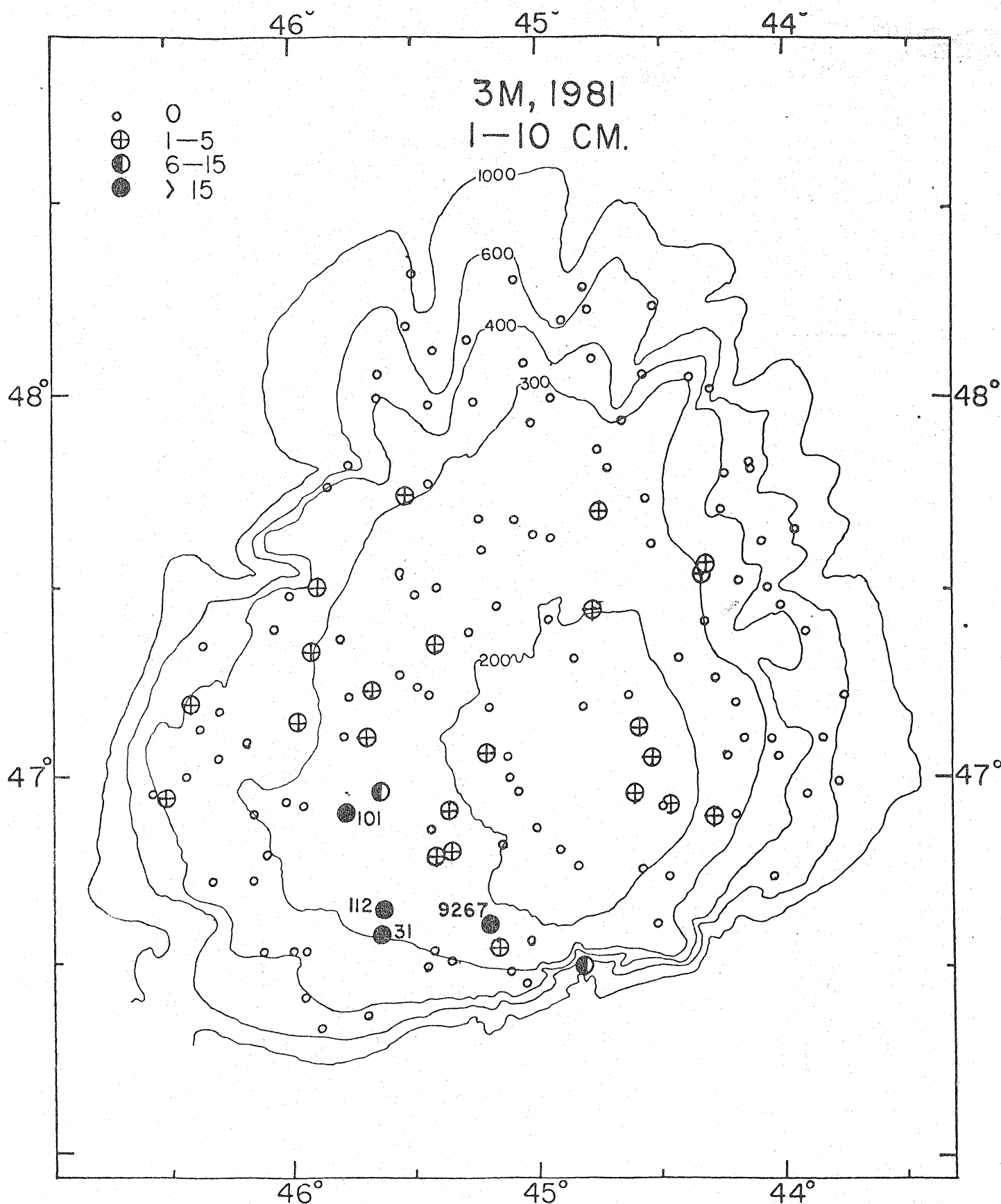


Fig. 3. Distribution and abundance of redfish less than 10 cm (numbers per tow) on Flemish Cap, 1981. Where catches totaled more than 15 fish, the exact numbers caught are noted.

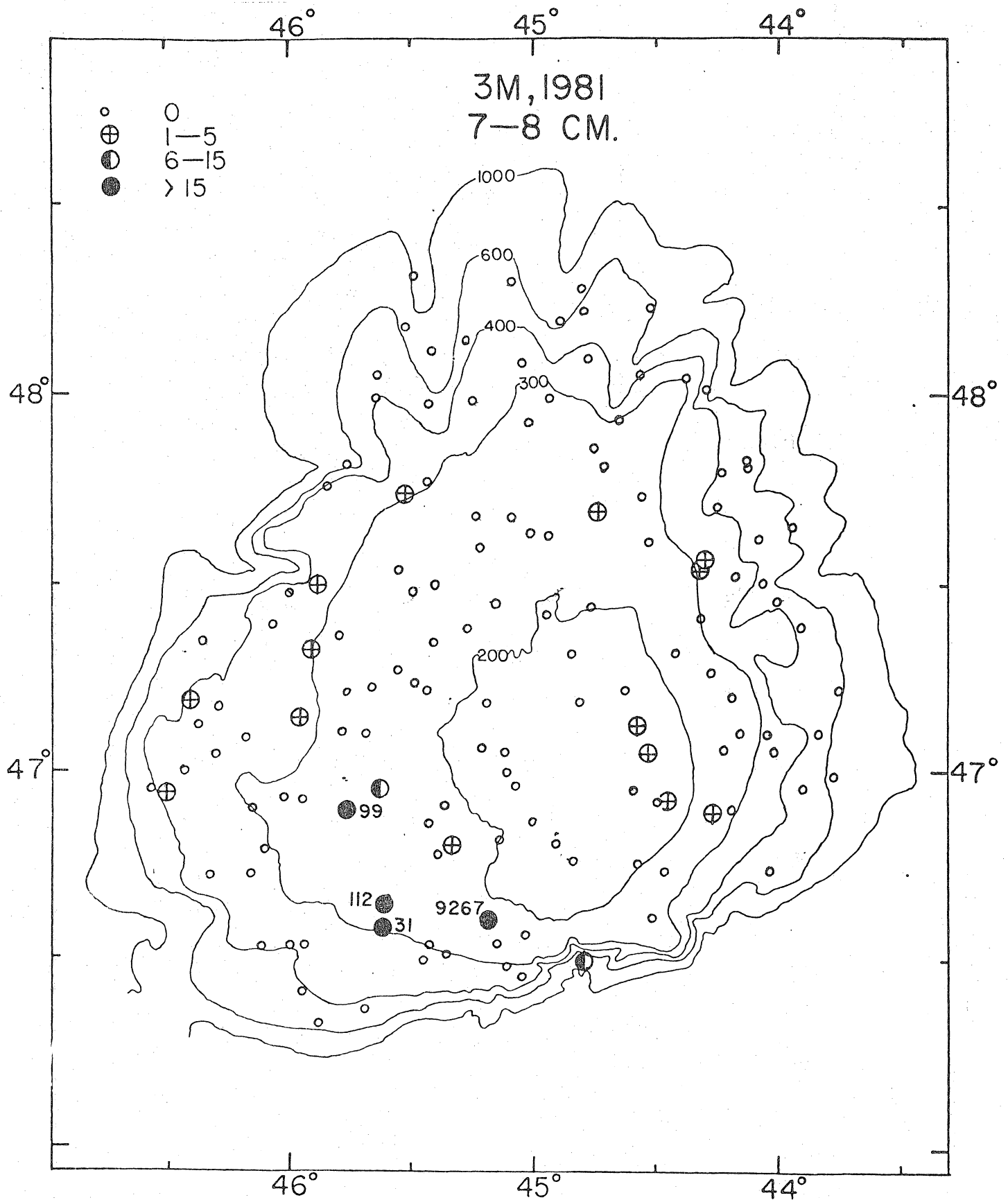


Fig. 4. Distribution and abundance of 7-8 cm redfish (numbers per tow) on Flemish Cap, 1981. Where catches totaled more than 15 fish, the exact numbers caught are noted.

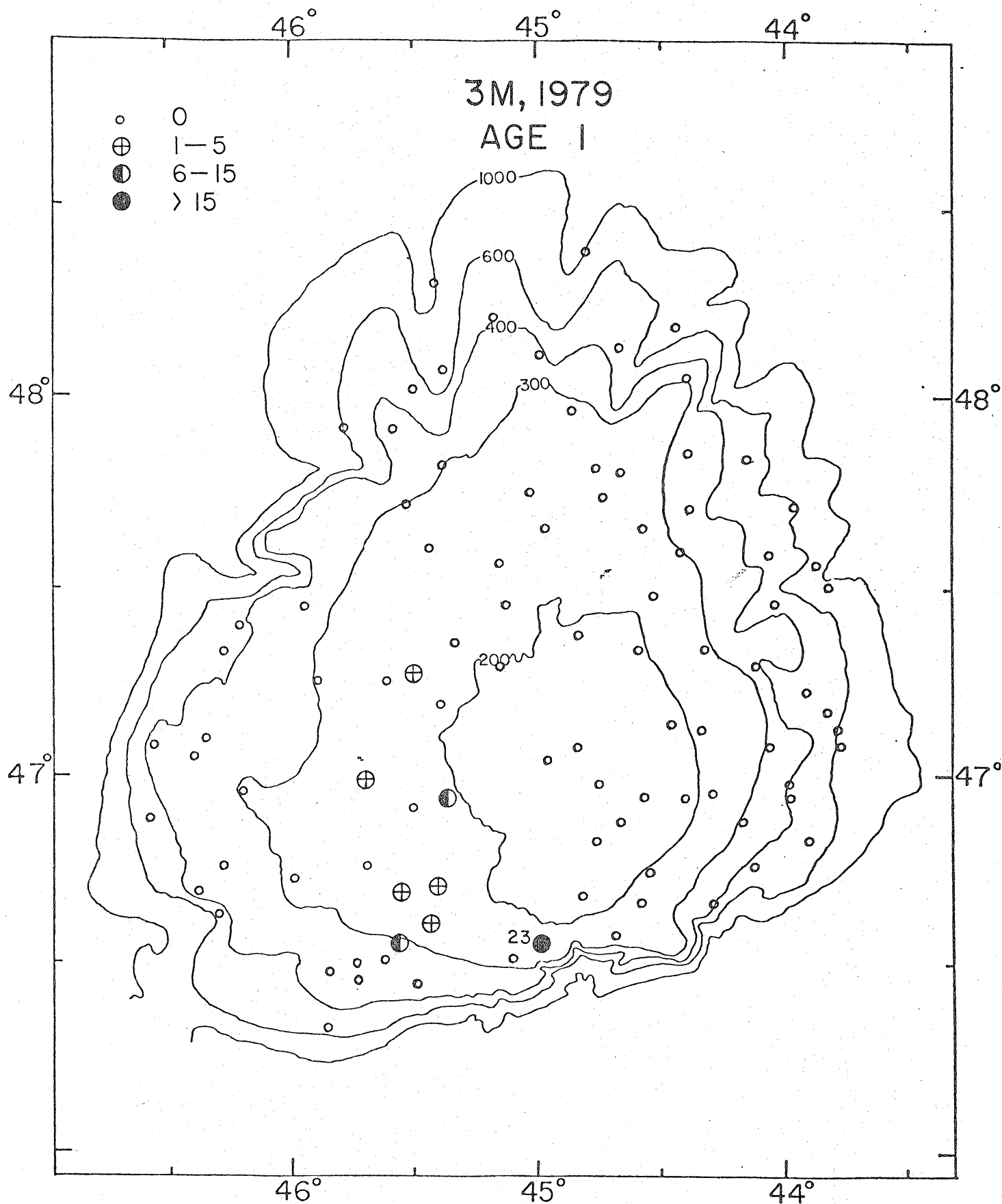


Fig. 5. Distribution and abundance of redfish, age 1, (numbers per tow) on Flemish Cap, 1979. Where catches totaled more than 15 fish, the exact numbers caught are noted.

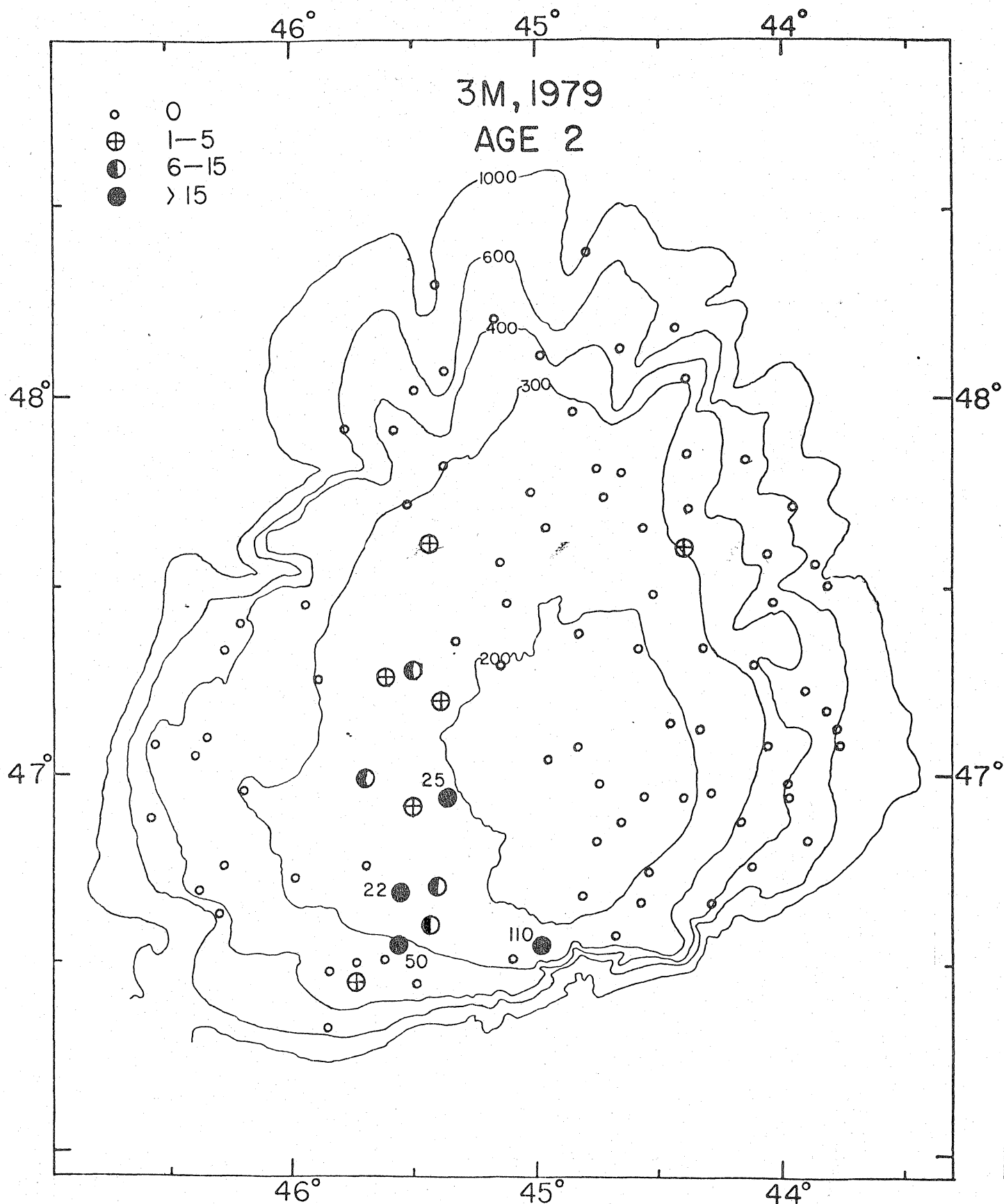


Fig. 6. Distribution and abundance of redfish, age 2, (numbers per tow) on Flemish Cap, 1979. Where catches totaled more than 15 fish, the exact numbers caught are noted.

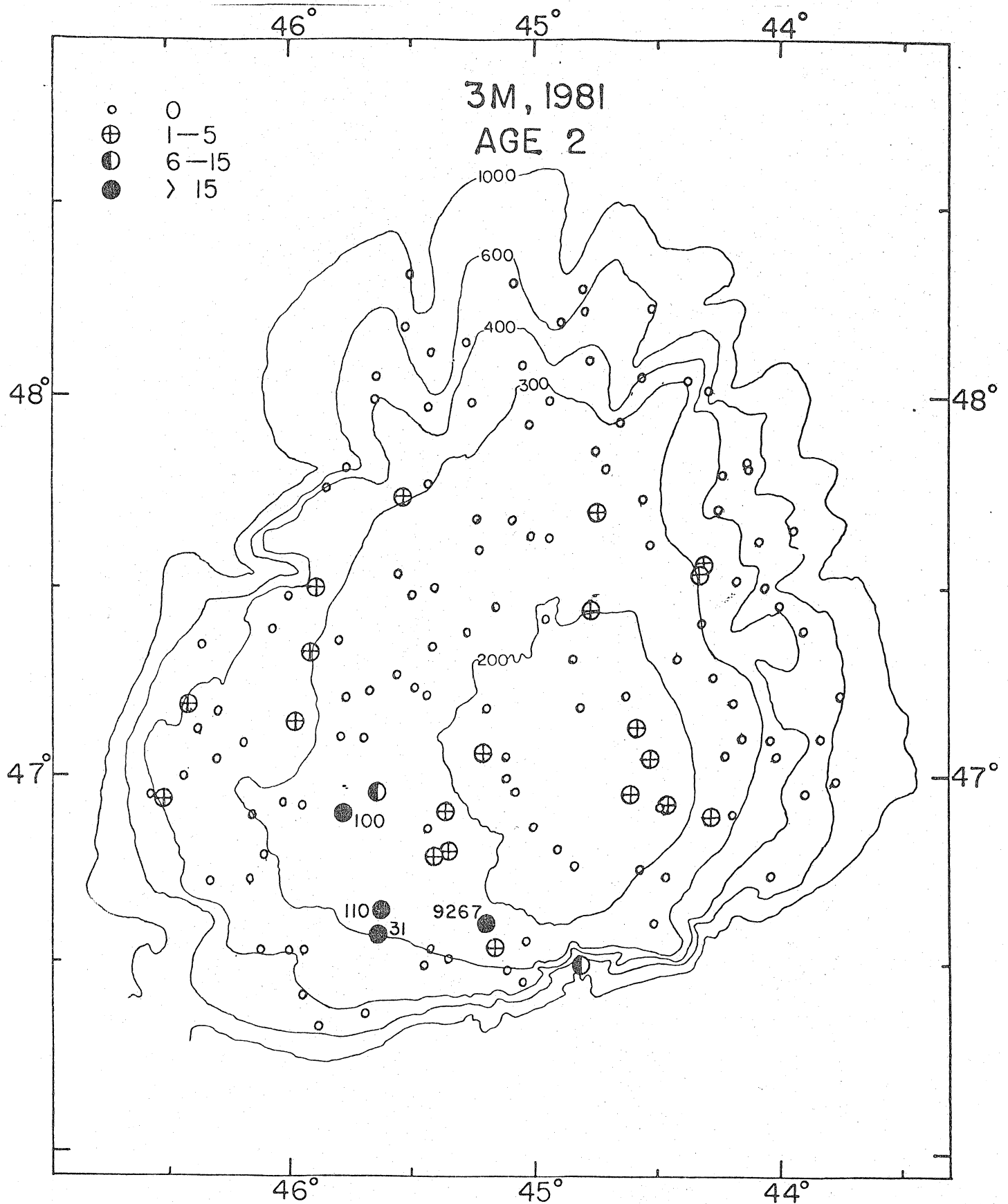


Fig. 7. Distribution and abundance of redfish, age 2, (numbers per tow) on Flemish Cap, 1981. Where catches totaled more than 15 fish, the exact numbers caught are noted.