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# Preliminary Results of European Cod Tagging Programme in NAFO Division 3M (Second Year)

by

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## Abstract

A tagging cruise was carried out in Flemish Cap between February 20th and March 9th. A total of 433 cod were tagged.

Length/weight relationships have been calculated through biological sampling for cod and American plaice. Sex-ratio and maturity by length and age have been studied for both sexes of cod. Sex-ratio and maturity by length have been studied for females of American plaice.

Feeding analysis of cod has been studied and different indices have been calculated for its prey. The daily variability in feeding habits has also been analysed.

A macroscale map of currents in the area during the period of the cruise is presented.

To the present 34 tags have been recovered from the two experiments and the recovery of these tags is discussed.

## Introduction

1992 was the second year of a cod tagging programme started in 1991. The objectives of this programme were to determine by means of tagging, the degree of isolation of cod population that inhabits Flemish Cap and its relationship with adjacent areas and to study some biological parameters, such as maturity and length-weight relationships of cod and American plaice.

The first results from the 1991 tagging cruise have been presented to NAFO (de Cárdenas and Moguedet; 1992). In this paper, we complement this information and also give the preliminary results of the 1992 tagging cruise.

## Material and Methods

The cruise was made aboard the Russian R/V Atlantida from February 20th to March 9th in 1992. Hauls of twenty minutes duration were made using a Lofoten gear of 20 mm mesh-size (fig.1).

LEA tags were used to tag most of the cod, since they produced much better results the previous year than the T-bar type (de Cárdenas and Moguedet; 1992).

In the biological sampling, which was carried out on cod not

useful for tagging, and on American plaice, the following information was collected: length, weight, sex and gonad maturity stage. Otoliths and stomach contents from cod were also collected and analysed on board.

Length-weight relationships and sex ratio were calculated. The percentages of maturity by length and sex for cod and American plaice were fitted to logistic curves.

In the stomach content analysis, food items were separated into taxonomic categories. Fish and decapod crustaceans were identified where possible to species, but other groups were combined into higher order taxa.
For each prey species the following information was collected: percentage in relation to volume of stomach content, number of specimens of each prey, state of digestion and size.

Four indices were used to estimate the relative importance of each prey in the diet:

1.- Frequency of occurrence (percentage), only stomachs containing food were considered (Dunn, 1954; Kennedy & Fitzmaurice,1972)

$$F = ns/Ns*100$$

2.- Percentage by number

$$N = np/Np*100$$

3.- Percentage by volume. Volume was measured applying the ecological feeding project (Bowman, 1982) using a "trofometro", a piece of equipment consisting of several different sized half-cylinders built into a tray, in such a way that they form horizontal semi-cylindrical moulds. The stomach content weight can be estimated by this method due to the good correlation ($r^2$=.9853) between these two variables (Olaso, 1990).

$$V = vp/Vp*100$$

4.- Relative Importance Index

$$IRI = (N + V) * F$$

Where
ns = Number of stomachs with a specific prey
Ns = Total number of stomachs analysed
np,vp = Number, Volume of a specific prey
Np,Vp = Number, Volume of the total prey

Physical data was collected by a CTD Mark III, in 44 stations distributed between the latitudes 46º 20' N. 48º 30' N. and longitudes 44º W. 46º 57' W. In each station data of temperature, salinity and depth were measured from water column up to a depth of 200 m. Dynamic height was calculed for each station with referrence to the 200 mb level and a map of geostrophic currents of the sampled area was made.

## Results

### Tagging.

A total of 433 cod were tagged in the 58 hauls carried out during the cruise (table 1 and fig. 2), 423 LEA tags were used, and in the 10 remaining cases blue T-bar tags were used. The length distribution of tagged specimens is shown in table 2 and figure 3.

The average length of the tagged cod was 60 cm, ranging from 28 to 118 cm. The specimens tagged in 1992 did not reach the exceptionally large sizes of the specimens tagged in this division in 1991 (de Cárdenas and Moguedet, 1992) and are more in line with the habitual sizes in this bank.

**Length/weight relationship.**

The length-weight relationship for cod was calculated from a sample of 587 specimens with sizes ranging from 11 to 88 cm (fig. 4). The equation obtained was:

$$Wi(kg.) = 0.00000661 * Li(cm.)\ 3.0834$$

That of American plaice was obtained from a sample of 594 pairs of values with a size range from 15 to 55 cm (fig. 5). The calculated equation was:

$$Wi(Kg.) = 0.00000233 * Li(cm.)\ 3.401$$

**Sex-ratio.**

The general percentage of cod females in the sample was 48% and tendencies were not observed when this percentage was analysed as a function of size or age (table 4 and fig. 6a and 6b).

In the case of American plaice, the general percentage of females in the sample was also 48%, but we observe an higher proportion of males between 30 and 40 cm., and from 45 cm. upwards almost all the specimens were female (table 5 and fig.7).

**Maturity by length**

The percentage of mature female cod is presented in table 6 and fig. 8a, $L_{50}$ for 1992 (53.5 cm and about five years old) was estimated to be very close to the value obtained in 1991 (52.1 cm)and also close to that calculated for 2J3KL (Xu et al). However the range 25-75 was significantly lower (7 cm instead of 20 cm). This was probably due to the fact that in 1991 there were only 19 specimens in the maturity range (de Cárdenas and Moguedet, 1992).

If we look at age, it can be seen (Fig. 8b) that the females of cod begin their maturity at age 4 and reach 50% at approximately age 5. These value are lower than those estimated for Div. 2J3KL (Xu et al., 1991), which would indicate a faster growth in Div 3M.

In table 7 and fig. 9 the mature percentage of male cod is presented. $L_{50}$ for 1992 (45 cm and about four years old) is 3 cm higher than the 1991 estimation (de Cárdenas and Moguedet, 1992). If we look at age (fig. 9b) it can be seen that male reach maturity at a year faster than females.

We only had sufficient data to make a maturity fit for American plaice females, which is presented in table 8 and fig. 10. The value of L50 for 1992 was 41.65 cm, slightly higher than that of 1991 (36.7 cm). The range 25-75 of both years was similar (4 cm).

**Feeding analysis**

377 cod stomachs were analysed, with an emptiness index of 29%. The volumetric average of the stomachs containing food was 6,57 cc. Crustaceans are the most common prey (F=75%), followed by fish (F=52%). The rest of the groups have low levels of frequency, with poliquets, echinoderms and molluscs appearing in a small percentage. Examining the percentage in volume the most important prey taxa are fish, and within these the families Myctophidae and Scorpaenidae are prominent (Fig. 11).

In tab. 9 the prey taxa with their corresponding indices (F,N, V, IRI) are listed. As can be seen crustaceans have the highest frequency of occurrence and percentage by number, and from these the caridea infraorder stands out, with the families Pandalidae and Pasiphaeidae. Fish are represented by V=61%, the families Myctophidae and Scorpaenidae being the most consumed. Cannibalism has not been detected in this survey. There are characteristic prey (IRI): hyperiid amphipods (889),

Parapasiphaea sulcatifrons (77) and Pandalus borealis (236) within the crustaceans, and Notoscopelus spp.(683) and Sebastes spp. (331) within fish.

In tab. 10 cod diet is shown, expressed as percentage by volume, by size range. Food varies as a function of size: Specimens smaller than 24 cm. (1 year), feed mainly on crustaceans, mainly hyperiid amphipods. As size increases they become more ichthyophagous: specimens of 25 to 49 cm. (2, 3, 4 years) show a very varied diet, while those greater than 50 cm. (5+ years) consume almost exclusively fish. The emptiness index increases with size, above all from 50 cm. This could be due to the fact that for fish of age 5+ this is the spawning season.

Two twenty-four hour experiments were carried out to observe cod feeding habits throughout the day. As the prime objective of the survey is cod tagging, the number of stomachs analysed during the twenty-four hour periods was low, since most of the catch was tagged. Nevertheless, from 71 stomachs in 24 hours1 and 40 stomachs in 24 hours2, we have been able to infer two maximums and one minimum of volumetric average: the maximums were found between 8 and 12 hours, and between 16 and 20 hours; the minimum was found between 4 and 8 hours (fig. 12).

**Physics.**

In fig. 13 the distribution map of geostrophic currents is represented from the dynamic topography with referrence to the 200 mb level.

Part of the water flow which comes from Labrador current passes to the north of the bank, around 48º N, constituting a flow in the direction W-E. Over the shallowest part of the bank the circulation is anticyclonic, with a large area of convergence and flows of very low intensity. Over the area of one hundred fathoms a moderately intense flow in the direction W-E is appreciated, which probably converges in the atlantic flow in the direction S-W and which appears as an intense flow to the S-W area of the shallow area of the bank. Similarly it can be appreciated that the Labrador current flows through the most occidental area, through Flemish Pass.

This geostrophic circulation found during the period February-March is quite similar to that described in the literature for the same time of the year in this area (e.g. Kudlo et al., 1983).

**Geographical distribution of recaptures.**

The data from the tags recovered up to the present appears in tab. 11. This is divided into 3 sections, the first section corresponding to those recaptured following the cruise of April 1991, the second corresponding to those recaptured following the cruise of February-March 1992, and the third indicates the tags that were recovered without the fish,from both cruises, possibly due to the tag having become dislodged, the death of the fish or the tag being thrown into the sea by fishermen after recapture.

The routes from the areas of tagging to the locations of recaptures, appear in fig. 14 for the first two sections and in fig. 15 for the third section.

As can be seen in fig. 14 and tab. 13, 17 tags have been recovered to date from the survey carried out in 1991, two of these coming from outside Flemish Cap, implying that a certain number of cod have migrated from Flemish Cap to neighbouring areas. The importance of this migration is difficult to quantify, firstly because of the scarce number of recaptures, and secondly because the difference in mortality rates due to fishing in the two areas is unknown, but the fact that 12 % of the tags have been recovered outside the area is still very significant.

The sizes of the specimens recaptured outside the area are found to be within the range corresponding to the ages 5 and 6 (50-70 cm.), which we had proposed as that having the highest probability of migration (de Cárdenas et al., 1992).

In the second section of tab. 13 the recaptures corresponding to the tagging survey of 1992 can be seen. Up to the present only 13 tags have been recovered. Two of these were recovered in the same month as the survey, and all these tags were recovered in Flemish Cap. The fact that a moratorium has been established in divisions 2J3KL since July will undoubtably affect the results of the experiment this year, preventing their comparison with those of a normal year.

Lastly, in the third section of tab. 13 and in fig. 15, there are five tags from both cruises, which were found on the eastern coast of the Atlantic and which began to appear from eight months after tagging. As can be seen only the LEA tags have been recovered in this way. This type of tag floats, as it is slightly less dense than sea water, and for one of the reasons previously mentioned must have become dislodged from the fish, being transported to the western coasts of northern Europe by the Atlantic current.

The recovery of five of these tags indicates that there has been a certain percentage of losses of tags (mortality by tagging, dislodging, not returning). This could be important since on one hand the probability of finding one of these tags on a beach must be smaller than that of finding a tagged cod in the catch, and on the other hand, the T-bar tags with which more than half of the specimens in the 1991 survey were tagged do not float, and so cannot be recovered in the case of dislodging or the death of the specimen.

## Conclusions

**Tagging.-**

- This year 433 cod with an average length of 60 cm were tagged.

**Biological parameters obtained for cod.-**

- The length/weight relationship estimated was:

$$Wt(Kg) = 0.00000661 \times Lt(cm)^{3.0834}$$

- The sex-ratio is close to 50%.

- The size at 50% maturity for cod females was 53.47 cm and the range 25-75 was 6.97 cm.

- The age at 50% maturity for females was 5 years and the range 25-75 was 10 months.

- The size at 50% maturity for cod males was 45.19 cm and the range 25-75 was 7.66 cm.

- The age at 50% maturity for males was 4 years and the range 25-75 was 10 months.

**Biological parameters for American plaice.-**

- The length/weight relationship estimated was:

$$Wt(Kg) = 0.00000233 \times Lt(cm)^{3.401}$$

- The sex-ratio is close to 50%. As expected in this species, a tendency of the proportion of females to increase as size increases is observed.

- The size at 50% maturity for American plaice females was 41.65 cm and the range 25-75 was 4.03 cm.

**Feeding analysis.-**

- In winter 1992 in the south-western Flemish Cap bank, cod feed mainly on decapod crustaceans (Pandalus borealis and Pasiphaeidae) and fish (Sebastes spp. and Myctophidae), becoming more ichthyophagous with age. Daily feeding rhythms were observed, the volumetric average increasing and the emptiness index decreasing twice per 24 hours, at 10 hours and 18 hours.

**Physics.-**

- The map of geostrophic currents shows a similar circulation pattern as can be found in the literature for February-March, a period in which cod spawning takes place. There is a certain water flow from the Labrador current which penetrates Flemish Cap.

**Recovered tags.-**

- To the present 35 tags have been recovered:

- Of the 17 recovered from 1991, 2 have been found within Grand Bank.

- 4 tags from the same year and one from 1992 were found without the fish, washed up on beaches, which could be interpreted as an indication of a certain mortality due to tagging.

- The 13 tags from the cruise of this year have all been recaptured in Flemish Cap.

- The moratorium established in the 2J3KL stock is undoubtedly affecting the recovery of tags.

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| Haul | Date | Haul-out Time | Lat. | Long. | Depth | Haul-in Time | Lat. | Long. | Depth |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 20-Feb-92 | 9.10 | 46.3274 | 44.3140 | 282 | 9.25 | 46.3280 | 44.3000 | 309 |
| 2 | 20-Feb-92 | 15.55 | 46.3120 | 45.0120 | 290 | 16.15 | 46.3189 | 44.5695 | 264 |
| 3 | 21-Feb-92 | 8.30 | 46.2900 | 45.4300 | 374 | 8.57 | 46.3076 | 45.4563 | 378 |
| 4 | 21-Feb-92 | 11.25 | 46.3030 | 45.4670 | 417 | 11.48 | 46.2940 | 45.4607 | 420 |
| 5 | 21-Feb-92 | 14.13 | 46.3139 | 45.4811 | 402 | 14.33 | 46.3087 | 45.4749 | 407 |
| 6 | 21-Feb-92 | 18.08 | 46.3095 | 45.4501 | 374 | 18.30 | 46.3000 | 45.4350 | 371 |
| 7 | 22-Feb-92 | 11.16 | 46.2993 | 45.4617 | 412 | 11.36 | 46.3108 | 45.4727 | 408 |
| 8 | 22-Feb-92 | 14.33 | 46.3004 | 45.4547 | 408 | 14.52 | 46.2907 | 45.4440 | 418 |
| 9 | 22-Feb-92 | 18.07 | 46.3186 | 45.4557 | 405 | 18.27 | 46.3088 | 45.4463 | 418 |
| 10 | 22-Feb-92 | 21.44 | 46.3090 | 45.4636 | 405 | 22.05 | 46.2985 | 45.4554 | 410 |
| 11 | 23-Feb-92 | 2.22 | 46.3081 | 45.4651 | 398 | 2.42 | 46.2978 | 45.4572 | 404 |
| 12 | 23-Feb-92 | 5.51 | 46.3001 | 45.4509 | 402 | 6.11 | 46.2898 | 45.4450 | 406 |
| 13 | 23-Feb-92 | 9.08 | 46.3086 | 45.4678 | 396 | 9.28 | 46.2907 | 45.4602 | 397 |
| 14 | 23-Feb-92 | 13.57 | 46.3647 | 46.0935 | 369 | 14.21 | 46.3705 | 46.0735 | 361 |
| 15 | 23-Feb-92 | 17.26 | 46.3079 | 46.0486 | 412 | 17.50 | 46.3075 | 46.0278 | 407 |
| 16 | 24-Feb-92 | 9.11 | 46.3100 | 46.0315 | 409 | 9.31 | 46.3024 | 46.0063 | 410 |
| 17 | 24-Feb-92 | 13.08 | 46.3068 | 46.0278 | 410 | 13.28 | 46.3048 | 46.0081 | 409 |
| 18 | 24-Feb-92 | 15.30 | 46.3080 | 46.0173 | 409 | 15.52 | 46.3032 | 46.0011 | 410 |
| 19 | 24-Feb-92 | 17.46 | 46.3060 | 46.0170 | 407 | 18.06 | 46.3035 | 46.0030 | 408 |
| 20 | 25-Feb-92 | 10.39 | 46.4309 | 46.2746 | 485 | 10.59 | 46.4193 | 46.2645 | 482 |
| 21 | 25-Feb-92 | 13.27 | 46.3677 | 46.0572 | 366 | 13.47 | 46.3735 | 46.0384 | 358 |
| 22 | 25-Feb-92 | 15.45 | 46.3085 | 46.0249 | 408 | 16.05 | 46.3070 | 46.0070 | 409 |
| 23 | 25-Feb-92 | 18.11 | 46.3141 | 46.0451 | 410 | 18.31 | 46.3136 | 46.0300 | 410 |
| 24 | 26-Feb-92 | 8.25 | 46.4950 | 46.3621 | 641 | 8.45 | 46.4858 | 46.3457 | 642 |
| 25 | 26-Feb-92 | 12.59 | 46.5085 | 46.2666 | 398 | 13.19 | 46.4950 | 46.2495 | 401 |
| 26 | 26-Feb-92 | 16.35 | 46.5360 | 46.1580 | 305 | 16.55 | 46.5240 | 46.1570 | 311 |
| 27 | 28-Feb-92 | 7.55 | 48.0300 | 45.5150 | 798 | 8.15 | 48.0120 | 45.5170 | 797 |
| 28 | 28-Feb-92 | 10.39 | 47.5807 | 45.5117 | 707 | 10.59 | 47.5900 | 45.4989 | 695 |
| 29 | 28-Feb-92 | 13.52 | 47.5696 | 45.4699 | 522 | 14.12 | 47.5790 | 45.4595 | 514 |
| 30 | 28-Feb-92 | 17.04 | 47.5800 | 45.4000 | 398 | 17.24 | 47.5920 | 45.3930 | 396 |
| 31 | 29-Feb-92 | 7.40 | 47.5280 | 45.3660 | 336 | 7.50 | 47.5310 | 45.3600 | 335 |
| 32 | 04-Mar-92 | 7.51 | 47.1108 | 45.2801 | 243 | 8.11 | 47.1000 | 45.2579 | 232 |
| 33 | 04-Mar-92 | 12.54 | 47.2670 | 45.3700 | 270 | 13.14 | 47.2575 | 45.3454 | 262 |
| 34 | 04-Mar-92 | 16.15 | 47.2949 | 45.2104 | 242 | 16.35 | 47.2912 | 45.1904 | 234 |
| 35 | 04-Mar-92 | 18.15 | 47.2949 | 45.1878 | 239 | 18.35 | 47.2969 | 45.1752 | 235 |
| 36 | 05-Mar-92 | 7.25 | 46.4133 | 45.3652 | 245 | 7.45 | 46.4022 | 45.3543 | 242 |
| 37 | 05-Mar-92 | 10.20 | 46.3237 | 45.4778 | 398 | 10.40 | 46.3100 | 45.4763 | 417 |
| 38 | 05-Mar-92 | 16.12 | 46.3019 | 45.4474 | 409 | 16.32 | 46.2925 | 45.4400 | 412 |
| 39 | 05-Mar-92 | 18.57 | 46.3160 | 45.4858 | 410 | 19.17 | 46.3067 | 45.4790 | 408 |
| 40 | 06-Mar-92 | 8.23 | 46.3090 | 46.0082 | 406 | 8.43 | 46.3131 | 46.0024 | 400 |
| 41 | 06-Mar-92 | 10.23 | 46.2872 | 45.5531 | 411 | 10.45 | 46.2810 | 45.5325 | 420 |
| 42 | 06-Mar-92 | 12.32 | 46.3098 | 45.4675 | 400 | 12.45 | 46.3211 | 45.4760 | 395 |
| 43 | 06-Mar-92 | 15.01 | 46.3545 | 45.5086 | 385 | 15.21 | 46.3459 | 45.4955 | 389 |
| 44 | 06-Mar-92 | 17.40 | 46.3095 | 45.4620 | 411 | 18.00 | 46.2987 | 45.4592 | 411 |
| 45 | 07-Mar-92 | 7.40 | 46.3110 | 46.0935 | 402 | 8.00 | 46.3038 | 46.0804 | 404 |
| 46 | 07-Mar-92 | 11.20 | 46.3373 | 46.0822 | 403 | 11.40 | 46.3200 | 46.0687 | 407 |
| 47 | 07-Mar-92 | 14.55 | 46.3253 | 46.0789 | 405 | 15.19 | 46.3196 | 46.0605 | 407 |
| 48 | 07-Mar-92 | 18.22 | 46.3198 | 46.0668 | 406 | 18.42 | 46.3140 | 46.0512 | 407 |
| 49 | 07-Mar-92 | 22.03 | 46.3213 | 46.0700 | 405 | 22.23 | 46.3155 | 46.0519 | 406 |
| 50 | 08-Mar-92 | 2.16 | 46.3190 | 46.0890 | 402 | 2.36 | 46.3208 | 46.0630 | 403 |
| 51 | 08-Mar-92 | 8.04 | 46.3104 | 46.0391 | 407 | 8.24 | 46.3089 | 46.0140 | 407 |
| 52 | 08-Mar-92 | 14.02 | 46.3031 | 46.0660 | 420 | 14.25 | 46.3068 | 46.0476 | 410 |
| 53 | 08-Mar-92 | 16.35 | 46.3097 | 46.0455 | 407 | 16.55 | 46.3056 | 46.0327 | 408 |
| 54 | 09-Mar-92 | 7.40 | 46.3373 | 45.4894 | 394 | 8.00 | 46.3255 | 45.4814 | 407 |
| 55 | 09-Mar-92 | 11.05 | 46.4147 | 45.5610 | 310 | 11.26 | 46.4077 | 45.5678 | 317 |
| 56 | 09-Mar-92 | 14.21 | 46.3132 | 46.0514 | 409 | 14.42 | 46.3076 | 46.0362 | 411 |
| 57 | 09-Mar-92 | 16.21 | 46.3008 | 45.5920 | 408 | 16.41 | 46.3035 | 46.0115 | 408 |
| 58 | 09-Mar-92 | 17.56 | 46.3035 | 45.5955 | 405 | 18.16 | 46.2983 | 45.5785 | 405 |

Table 1.- Characterictics of the hauls.

| Lt. cm | NUM |
|---|---|
| 28 | 1 |
| 31 | 2 |
| 34 | 3 |
| 37 | 16 |
| 40 | 22 |
| 43 | 20 |
| 46 | 26 |
| 49 | 41 |
| 52 | 25 |
| 55 | 27 |
| 58 | 23 |
| 61 | 43 |
| 64 | 40 |
| 67 | 39 |
| 70 | 26 |
| 73 | 32 |
| 76 | 16 |
| 79 | 6 |
| 82 | 7 |
| 85 | 4 |
| 88 | 2 |
| 94 | 3 |
| 97 | 1 |
| 103 | 3 |
| 109 | 3 |
| 115 | 1 |
| 118 | 1 |
| Total | 433 |

Table 2.- Length composition of tagged cod.

| Tag Report Form | | | | | | |
|---|---|---|---|---|---|---|
| Country Spain and Portugal | Institutions: IEO P. O. Box 240 Santander Spain<br>INIP Av. de Brasilia 1400 Lisboa Portugal<br>*IIM Eduardo Cabello 8 Vigo Spain* | | | | Year 1992 | |
| Species | NAFO Div. | Location | Date | Type of Tag | Range of serial | number of releases |
| Atlantic cod | 3M | Flemish Cap | Feb-Mar | LEA | A0001-A4496 | 423 |
| | | | | Blue T-bar | B4750-B4760 | 10 |

Table 3.- Tag report form with the results of the tagging cruise submitted to NAFO.

| Total length | Males | Females | %Females |
|---|---|---|---|
| 22 | 19 | 15 | 0.44 |
| 27 | 38 | 65 | 0.63 |
| 32 | 43 | 41 | 0.49 |
| 37 | 30 | 27 | 0.47 |
| 42 | 27 | 15 | 0.36 |
| 47 | 18 | 17 | 0.49 |
| 52 | 23 | 11 | 0.32 |
| 57 | 18 | 10 | 0.36 |
| 62 | 15 | 12 | 0.44 |
| 67 | 11 | 9 | 0.45 |
| 72 | 3 | 2 | 0.40 |
| 77 | 1 | 1 | 0.50 |
| 82 | 1 | 1 | 0.50 |
| Total | 247 | 226 | 0.48 |

(a) Length

| Age | Males | Females | % Females |
|---|---|---|---|
| 2 | 66 | 73 | 0.53 |
| 3 | 55 | 59 | 0.52 |
| 4 | 64 | 47 | 0.42 |
| 5 | 14 | 9 | 0.39 |
| 6 | 44 | 35 | 0.44 |
| 7 | 4 | 3 | 0.43 |
| Total | 247 | 226 | 0.48 |

(b) Age

Table 4.- Sex-ratio of 3M cod by length (a) and by age (b).

| Length cm. | Males | Females | % of Females |
|---|---|---|---|
| 25 | 1 | | 0.00 |
| 27 | 4 | 4 | 0.50 |
| 29 | 3 | 7 | 0.70 |
| 31 | 6 | 4 | 0.40 |
| 33 | 30 | 6 | 0.17 |
| 35 | 70 | 8 | 0.10 |
| 37 | 96 | 20 | 0.17 |
| 39 | 62 | 23 | 0.27 |
| 41 | 21 | 46 | 0.69 |
| 43 | 13 | 38 | 0.75 |
| 45 | 3 | 43 | 0.93 |
| 47 | 1 | 40 | 0.98 |
| 49 | 1 | 20 | 0.95 |
| 51 | | 14 | 1.00 |
| 53 | | 5 | 1.00 |
| 55 | | 3 | 1.00 |
| 57 | | 1 | 1.00 |
| Total | 311 | 282 | 0.48 |

*Table 5.- Sex-ratio of 3M American plaice.*

| Lt cm. | Immature | mature | % maturity | Theoretical |
|---|---|---|---|---|
| 22 | 9 | 0 | 0.00 | 0.00 |
| 25 | 29 | 0 | 0.00 | 0.00 |
| 28 | 42 | 0 | 0.00 | 0.00 |
| 31 | 24 | 0 | 0.00 | 0.00 |
| 34 | 21 | 0 | 0.00 | 0.00 |
| 37 | 16 | 1 | 0.06 | 0.01 |
| 40 | 13 | 0 | 0.00 | 0.01 |
| 43 | 8 | 0 | 0.00 | 0.04 |
| 46 | 8 | 1 | 0.11 | 0.09 |
| 49 | 10 | 2 | 0.17 | 0.20 |
| 52 | 4 | 1 | 0.20 | 0.39 |
| 55 | 1 | 4 | 0.80 | 0.62 |
| 58 | 1 | 6 | 0.86 | 0.81 |
| 61 | 1 | 7 | 0.88 | 0.91 |
| 64 | 0 | 7 | 1.00 | 0.97 |
| 67 | 0 | 9 | 1.00 | 0.99 |
| 70 | 0 | 1 | 1.00 | 0.99 |
| Total | 187 | 39 | 0.17 | |

Number of examples involved= 46

$L_{25}$ = 49.99
$L_{50}$ = 53.47
$L_{75}$ = 56.96

$Range_{25-75}$ = 6.97

(a) Length

| Age | Immature | mature | % maturity | Theoretical |
|---|---|---|---|---|
| 1 | 3 | 0 | 0.00 | 0.00 |
| 2 | 77 | 0 | 0.00 | 0.00 |
| 3 | 65 | 0 | 0.00 | 0.00 |
| 4 | 35 | 4 | 0.10 | 0.07 |
| 5 | 6 | 3 | 0.33 | 0.54 |
| 6 | 1 | 29 | 0.97 | 0.95 |
| 7 | 0 | 3 | 1.00 | 1.00 |
| Total | 187 | 39 | 0.17 | |

Number of examples involved= 78

$L_{25}$ = 4.54
$L_{50}$ = 4.94
$L_{75}$ = 5.34

$Range_{25-75}$ = 10 months

(b) Age

Table 6.- Female maturity of 3M cod by length (a) and by age (b).

| Lt cm. | Immature | mature | % maturity | Theoretical |
|---|---|---|---|---|
| 22 | 13 | 0 | 0.00 | 0.00 |
| 25 | 17 | 0 | 0.00 | 0.00 |
| 28 | 27 | 0 | 0.00 | 0.01 |
| 31 | 32 | 0 | 0.00 | 0.02 |
| 34 | 16 | 0 | 0.00 | 0.04 |
| 37 | 19 | 3 | 0.14 | 0.09 |
| 40 | 19 | 1 | 0.05 | 0.18 |
| 43 | 6 | 4 | 0.40 | 0.35 |
| 46 | 1 | 6 | 0.86 | 0.56 |
| 49 | 6 | 11 | 0.65 | 0.75 |
| 52 | 2 | 10 | 0.83 | 0.88 |
| 55 | 0 | 9 | 1.00 | 0.94 |
| 58 | 0 | 19 | 1.00 | 0.98 |
| 61 | 0 | 11 | 1.00 | 0.99 |
| 64 | 0 | 9 | 1.00 | 1.00 |
| 67 | 0 | 4 | 1.00 | 1.00 |
| 70 | 0 | 1 | 1.00 | 1.00 |
| Total | 158 | 88 | 0.34 | |

Number of example involved= 88

$L_{25}$ = 41.36
$L_{50}$ = 45.19
$L_{75}$ = 49.02

$Range_{25-75}$ = 7.66

(a) Length

| Age | Immature | mature | % maturity | Theoretical |
|---|---|---|---|---|
| 2 | 90 | 0 | 0.00 | 0.01 |
| 3 | 42 | 3 | 0.07 | 0.07 |
| 4 | 25 | 29 | 0.54 | 0.51 |
| 5 | 1 | 13 | 0.93 | 0.93 |
| 6 | 0 | 38 | 1.00 | 1.00 |
| 7 | 0 | 4 | 1.00 | 1.00 |
| 8 | 0 | 1 | 1.00 | 1.00 |
| Total | 158 | 88 | 0.34 | |

Number of examples involved= 113

$L_{25}$ = 3.56
$L_{50}$ = 3.99
$L_{75}$ = 4.41

$Range_{25-75}$ = 10 months

(b) Age

Table 7.- Male maturity of 3M cod by length (a) and by age (b).

| Lt cm. | Immature | mature | % maturity | Theoretical |
|---|---|---|---|---|
| 32 | 2 | 0 | 0.00 | 0.01 |
| 33 | 4 | 0 | 0.00 | 0.01 |
| 34 | 5 | 0 | 0.00 | 0.02 |
| 35 | 3 | 0 | 0.00 | 0.03 |
| 36 | 7 | 0 | 0.00 | 0.04 |
| 37 | 11 | 2 | 0.15 | 0.07 |
| 38 | 9 | 2 | 0.18 | 0.12 |
| 39 | 11 | 1 | 0.08 | 0.19 |
| 40 | 20 | 4 | 0.17 | 0.29 |
| 41 | 18 | 4 | 0.18 | 0.41 |
| 42 | 8 | 14 | 0.64 | 0.55 |
| 43 | 4 | 12 | 0.75 | 0.68 |
| 44 | 2 | 17 | 0.89 | 0.78 |
| 45 | 3 | 21 | 0.88 | 0.86 |
| 46 | 1 | 23 | 0.96 | 0.91 |
| 47 | 2 | 14 | 0.88 | 0.95 |
| 48 | 0 | 10 | 1.00 | 0.97 |
| 49 | 0 | 10 | 1.00 | 0.98 |
| 50 | 0 | 8 | 1.00 | 0.99 |
| 51 | 0 | 6 | 1.00 | 0.99 |
| 52 | 0 | 4 | 1.00 | 1.00 |
| 53 | 0 | 1 | 1.00 | 1.00 |
| 54 | 0 | 2 | 1.00 | 1.00 |
| 55 | 0 | 1 | 1.00 | 1.00 |
| 56 | 0 | 1 | 1.00 | 1.00 |
| Total | 110 | 157 | 0.59 | |

Number of examples involved= 203

$L_{25}$ = 39.63
$L_{50}$ = 41.65
$L_{75}$ = 43.66

Range$_{25-75}$ = 4.03

Table 8.- Female maturity of American plaice.

Gadus morhua

| | F | N | V | IRI |
|---|---|---|---|---|
| CRUSTACEANS | | | | |
| AMPHIPODA | | | | |
| Other Amphipoda | 1.87 | 0.24 | 0.02 | 0.49 |
| Other Hyperiidea | 24.25 | 32.45 | 4.15 | 887.53 |
| COPEPODA | 1.87 | 9.43 | 0.08 | 17.74 |
| CRUSTACEA | | | | |
| Other Crustacea | 3.36 | 0.44 | 0.05 | 1.62 |
| DECAPODA | | | | |
| Caridea | | | | |
| Other Caridea | 1.12 | 0.29 | 0.14 | 0.48 |
| Crangonidae | | | | |
| Other Crangonidae | 2.24 | 1.11 | 0.44 | 3.47 |
| Pontophilus norvegicus | 0.37 | 0.05 | 0.10 | 0.06 |
| Total Crangonidae | 2.61 | 1.16 | 0.54 | 4.44 |
| Decapoda | | | | |
| Other Decapoda | 1.12 | 0.19 | 0.09 | 0.32 |
| Other Natantia | 22.01 | 4.45 | 5.33 | 215.32 |
| Hippolytidae | | | | |
| Lebbeus polaris | 0.75 | 0.10 | 0.11 | 0.16 |
| Spirontoraris lilljeborgi | 0.37 | 0.05 | 0.05 | 0.04 |
| Total Hippolytidae | 1.12 | 0.15 | 0.16 | 0.34 |
| Oplophoridae | | | | |
| Acanthephyra pelagica | 1.49 | 0.44 | 1.16 | 2.39 |
| Paguridea | | | | |
| Other Paguridea | 1.49 | 0.19 | 0.83 | 1.53 |
| Pandalidae | | | | |
| Pandalus borealis | 14.18 | 5.17 | 11.49 | 236.28 |
| Pasiphaeidae | | | | |
| Other Pasiphaeidae | 8.58 | 3.00 | 4.40 | 63.50 |
| Parapasiphaea sulcatifrons | 7.84 | 4.01 | 5.80 | 76.88 |
| Total Pasiphaeidae | 16.42 | 7.01 | 10.20 | 282.56 |
| Penaeidea | | | | |
| Other Penaeidea | 0.37 | 0.10 | 0.51 | 0.23 |
| EUPHAUSIACEA | | | | |
| Other Euphausiacea | 1.12 | 0.15 | 0.06 | 0.23 |
| ISOPODA | | | | |
| Other Isopoda | 0.37 | 0.05 | 0.02 | 0.02 |
| MYSIDACEA | | | | |
| Other Mysidacea | 7.46 | 3.77 | 1.64 | 40.36 |
| Total CRUSTACEANS | 75.00 | 65.67 | 36.47 | 7660.03 |

**Table 9.- Frequency of occurrence (F), Percentage by number (N), Percentage by volume (V) and Relative Importance Index (IRI) of the prey found in the cod stomach contents.**

| | F | N | V | IRI |
|---|---|---|---|---|
| ECHINODERMS | | | | |
| Other Ophiuroidea | 1.12 | 0.19 | 0.01 | 0.23 |
| Other Holoturoidea | 0.37 | 0.05 | 0.12 | 0.06 |
| Total ECHINODERMS | 1.49 | 0.24 | 0.14 | 0.56 |
| MOLLUSCS | | | | |
| Cephalopoda | | | | |
| Other Decapoda | 1.12 | 0.15 | 1.13 | 1.43 |
| Sepiolidae | | | | |
| Sepiola sp. | 0.37 | 0.05 | 0.31 | 0.13 |
| Total MOLLUSCS | 1.49 | 0.19 | 1.44 | 2.43 |
| OTHER | | | | |
| Unidentified | 1.87 | 0.24 | 0.07 | 0.59 |
| Total OTHER | 1.87 | 0.24 | 0.07 | 0.59 |
| FISH | | | | |
| Gadidae | | | | |
| *Gadus morhua* | 0.37 | 0.05 | 0.02 | 0.02 |
| Macrouridae | | | | |
| Macrourus berglax | 0.75 | 0.10 | 1.53 | 1.21 |
| Nezumia bairdi | 0.37 | 0.05 | 2.56 | 0.97 |
| Total Macrouridae | 1.12 | 0.15 | 4.09 | 4.74 |
| Fish larval | 0.37 | 0.10 | 0.01 | 0.04 |
| Myctophidae | | | | |
| Notoscopelus spp. | 18.66 | 18.96 | 17.65 | 682.85 |
| Other Myctophidae | 11.19 | 8.03 | 6.69 | 164.79 |
| Total Myctophidae | 29.48 | 26.98 | 24.34 | 1512.84 |
| Other Pisces | | | | |
| Pisces indeterminates | 13.43 | 2.08 | 4.79 | 92.21 |
| Scorpaenidae | | | | |
| Sebastes spp. | 12.69 | 2.80 | 23.32 | 331.42 |
| Alepocephalidae | | | | |
| Alepocephalus spp. | 1.49 | 0.19 | 0.96 | 1.72 |
| Chauliodontidae | | | | |
| Chauliodus sloani | 0.37 | 0.29 | 0.20 | 0.18 |
| Malacosteidae | | | | |
| Malacosteus niger | 0.75 | 0.10 | 3.02 | 2.33 |
| Searsiidae | | | | |
| Normichthys operosus | 0.37 | 0.05 | 0.41 | 0.17 |
| Total FISH | 51.87 | 32.79 | 61.15 | 4871.99 |
| VARIOUS | | | | |
| Cnidaria | | | | |
| Other Cnidaria | 0.75 | 0.10 | 0.31 | 0.30 |
| Polychaeta | | | | |
| Other Polychaeta | 5.60 | 0.73 | 0.21 | 5.26 |
| Thaliacea | | | | |
| Thaliacea | 0.37 | 0.05 | 0.03 | 0.03 |
| Total VARIOUS | 6.72 | 0.87 | 0.56 | 9.58 |
| TOTAL NUMBER OF STOMACHS | 377 | | | |
| NUMBER OF EMPTY STOMACHS | 109 | | | |

**Table 9 cont.- Frequency of occurrence (F), Percentage by number (N), Percentage by volume (V) and Relative Importance Index (IRI) of the prey found in the cod stomach contents.**

*Gadus morhua*

| Cod length (cm.) | 12-19 | 20-24 | 25-29 | 30-39 | 40-49 | 50-69 | 70-89 | TOTAL |
|---|---|---|---|---|---|---|---|---|
| CRUSTACEANS | 86.0 | 90.54 | 57.84 | 43.17 | 45.92 | 17.26 | 25.61 | 36.53 |
| AMPHIPODA | 78.0 | 53.55 | 8.44 | 1.50 | 5.76 | 3.83 | - | 4.17 |
| Other Amphipoda | - | 1.33 | 0.05 | - | - | 0.01 | - | 0.02 |
| Hyperiidea | 78.0 | 52.23 | 8.39 | 1.50 | 5.76 | 3.82 | - | 4.15 |
| Other Hyperiidea | 78.0 | 52.23 | 8.39 | 1.50 | 5.76 | 3.82 | - | 4.15 |
| COPEPODA | - | 7.83 | 0.31 | - | - | - | - | 0.08 |
| CRUSTACEA | - | 0.72 | 0.20 | 0.07 | - | - | - | 0.05 |
| Other Crustacea | - | 0.72 | 0.20 | 0.07 | - | - | - | 0.05 |
| DECAPODA | 8.0 | 28.43 | 45.86 | 39.12 | 37.35 | 13.43 | 25.61 | 30.52 |
| Caridea | - | - | 0.44 | 0.08 | 0.36 | - | - | 0.14 |
| Other Caridea | - | - | 0.44 | 0.08 | 0.36 | - | - | 0.14 |
| Crangonidae | - | - | - | 0.98 | 0.79 | 0.12 | - | 0.54 |
| Other Crangonidae | - | - | - | 0.98 | 0.27 | 0.12 | - | 0.44 |
| Pontophilus norvegicus | - | - | - | - | 0.52 | - | - | 0.10 |
| Decapoda | 8.0 | 6.75 | 4.75 | 7.22 | 4.08 | 3.51 | 25.61 | 5.43 |
| Other Decapoda | - | - | - | - | 0.46 | - | - | 0.09 |
| Other Natantia | 8.0 | 6.75 | 4.75 | 7.22 | 3.62 | 3.51 | 25.61 | 5.34 |
| Hippolytidae | - | - | - | 0.32 | 0.25 | - | - | 0.16 |
| Lebbeus polaris | - | - | - | 0.32 | - | - | - | 0.11 |
| Spirontoraris lilljeborgi | - | - | - | - | 0.25 | - | - | 0.05 |
| Oplophoridae | - | - | - | 0.94 | 4.19 | - | - | 1.17 |
| Acanthephyra pelagica | - | - | - | 0.94 | 4.19 | - | - | 1.17 |
| Paguridea | - | 1.81 | 0.88 | 1.74 | 0.65 | - | - | 0.84 |
| Other Paguridea | - | 1.81 | 0.88 | 1.74 | 0.65 | - | - | 0.84 |
| Pandalidae | - | 13.86 | 32.10 | 12.81 | 14.06 | 3.43 | - | 11.51 |
| Pandalus borealis | - | 13.86 | 32.10 | 12.81 | 14.06 | 3.43 | - | 11.51 |
| Pasiphaeidae | - | 6.02 | 7.69 | 15.03 | 10.41 | 6.37 | - | 10.22 |
| Other Pasiphaeidae | - | 6.02 | 4.21 | 7.39 | 6.96 | - | - | 4.41 |
| Parapasiphaea sulcatifrons | - | - | 3.49 | 7.64 | 3.45 | 6.37 | - | 5.81 |
| Penaeidea | - | - | - | - | 2.56 | - | - | 0.51 |
| Other Penaeidea | - | - | - | - | 2.56 | - | - | 0.51 |
| EUPHAUSIACEA | - | - | - | 0.01 | 0.27 | - | - | 0.06 |
| Other Euphausiacea | - | - | - | 0.01 | 0.27 | - | - | 0.06 |
| ISOPODA | - | - | - | 0.05 | - | - | - | 0.02 |
| Other Isopoda | - | - | - | 0.05 | - | - | - | 0.02 |
| MYSIDACEA | - | - | 3.03 | 2.42 | 2.55 | - | - | 1.64 |
| Other Mysidacea | - | - | 3.03 | 2.42 | 2.55 | - | - | 1.64 |
| ECHINODERMS | - | - | 0.04 | 0.01 | - | 0.39 | - | 0.14 |
| Other Ophiuroidea | - | - | 0.04 | 0.01 | - | 0.02 | - | 0.01 |
| Other Holoturoidea | - | - | - | - | - | 0.37 | - | 0.12 |

**Table 10.- Cod diet expressed as a Percentage by Volume, by length range and total.**

| Cod length (cm.) | 12-19 | 20-24 | 25-29 | 30-39 | 40-49 | 50-69 | 70-89 | TOTAL |
|---|---|---|---|---|---|---|---|---|
| MOLLUSCS | - | - | 3.29 | 0.26 | 5.22 | - | - | 1.44 |
| CEPHALOPODA | - | - | 3.29 | 0.26 | 5.22 | - | - | 1.44 |
| Other Decapoda | - | - | - | 0.26 | 5.22 | - | - | 1.13 |
| Sepiolidae | - | - | 3.29 | - | - | - | - | 0.31 |
| Sepiola sp. | - | - | 3.29 | - | - | - | - | 0.31 |
| OTHER | - | 2.29 | 0.44 | - | 0.09 | - | - | 0.08 |
| UNIDENTIFIED | - | 2.29 | 0.44 | - | 0.09 | - | - | 0.08 |
| FISH | 14.00 | 6.69 | 37.60 | 56.33 | 48.48 | 81.32 | 74.39 | 61.26 |
| GADIFORMES | - | - | - | 0.70 | 6.52 | 7.72 | - | 4.11 |
| Gadidae | - | - | - | - | 0.08 | - | - | 0.02 |
| Gadus morhua | - | - | - | - | 0.08 | - | - | 0.02 |
| Macrouridae | - | - | - | 0.70 | 6.44 | 7.72 | - | 4.10 |
| Macrourus berglax | - | - | - | 0.70 | 6.44 | - | - | 1.53 |
| Nezumia bairdi | - | - | - | - | - | 7.72 | - | 2.57 |
| FISH LARVA | - | - | - | - | 0.03 | - | - | 0.01 |
| MYCTOPHIFORMES | - | 6.02 | 25.91 | 38.53 | 22.89 | 10.89 | 14.63 | 24.38 |
| Myctophidae | - | 6.02 | 25.91 | 38.53 | 22.89 | 10.89 | 14.63 | 24.38 |
| Notoscopelus spp. | - | - | 15.39 | 28.94 | 13.50 | 9.53 | 14.63 | 17.68 |
| Other Myctophidae | - | 6.02 | 10.53 | 9.59 | 9.39 | 1.36 | - | 6.71 |
| OTHER FISH | 14.00 | 0.66 | 7.26 | 1.76 | 2.45 | 6.00 | 59.76 | 4.79 |
| Pisces indeterminates | 14.00 | 0.66 | 7.26 | 1.76 | 2.45 | 6.00 | 59.76 | 4.79 |
| PERCIFORMES | - | - | 4.43 | 9.51 | 16.59 | 49.02 | - | 23.36 |
| Scorpaenidae | - | - | 4.43 | 9.51 | 16.59 | 49.02 | - | 23.36 |
| Sebastes spp. | - | - | 4.43 | 9.51 | 16.59 | 49.02 | - | 23.36 |
| SALMONIFORMES | - | - | - | 5.83 | - | 7.69 | - | 4.60 |
| Alepocephalidae | - | - | - | 2.75 | - | - | - | 0.96 |
| Alepocephalus spp. | - | - | - | 2.75 | - | - | - | 0.96 |
| Chauliodontidae | - | - | - | - | - | 0.61 | - | 0.20 |
| Chauliodus sloani | - | - | - | - | - | 0.61 | - | 0.20 |
| Malacosteidae | - | - | - | 1.92 | - | 7.08 | - | 3.03 |
| Malacosteus niger | - | - | - | 1.92 | - | 7.08 | - | 3.03 |
| Searsiidae | - | - | - | 1.16 | - | - | - | 0.41 |
| Normichthys operosus | - | - | - | 1.16 | - | - | - | 0.41 |
| VARIOUS | - | 0.48 | 0.80 | 0.23 | 0.28 | 1.03 | - | 0.56 |
| CNIDARIA | - | - | - | - | - | 0.93 | - | 0.31 |
| Other Cnidaria | - | - | - | - | - | 0.93 | - | 0.31 |
| POLYCHAETA | - | 0.48 | 0.80 | 0.23 | 0.28 | - | - | 0.21 |
| Other Polychaeta | - | 0.48 | 0.80 | 0.23 | 0.28 | - | - | 0.21 |
| TUNICATA | - | - | - | - | - | 0.10 | - | 0.03 |
| Thaliacea | - | - | - | - | - | 0.10 | - | 0.03 |
| TOTAL NUMBER OF STOMACHS | 9 | 23 | 81 | 113 | 65 | 76 | 10 | 377.00 |
| NUMBER OF EMPTY STOMACHS | 4 | 2 | 16 | 28 | 16 | 35 | 8 | 109.00 |
| MEAN STOMACH CONTENT (cc) | 0.28 | 0.72 | 2.82 | 7.61 | 7.52 | 10.80 | 4.10 | 6.57 |
| MEAN LENGTH | 14.22 | 23.00 | 27.12 | 33.78 | 44.35 | 58.21 | 78.00 | 39.15 |

**Table 10 cont.- Cod diet expressed as a Percentage by Volume, by length range and total.**

**Tagging experiment in April 1991**

| | | Tagging | | | | | Recapture | | | | | ** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| code | length | date | long. | lat. | depth* | Div. | date | long. | lat. | depth* | Div. | days |
| A2555 | 65 | 09-04-91 | 46° 08 W | 46° 43 N | 350 | 3M | -------- | -- -- - | -- -- - | --- | 3M | -- |
| A0279 | 77 | 10-04-91 | 46° 09 W | 46° 42 N | 353 | 3M | 25-04-91 | 46° 00 W | 47° 00 N | 310 | 3M | 15 |
| A0226 | 58 | 12-04-91 | 46° 00 W | 46° 40 N | 345 | 3M | 27-05-91 | 44° 34 W | 47° 13 N | 160 | 3M | 45 |
| A2580 | 67 | 10-04-91 | 46° 08 W | 46° 40 N | 360 | 3M | 26-05-91 | 44° 25 W | 47° 15 N | 180 | 3M | 46 |
| A2210 | 50 | 10-04-91 | 46° 08 W | 46° 40 N | 360 | 3M | 25-06-91 | 47° 10 W | 47° 31 N | 240 | 3L | 75 |
| B4909 | 52 | 10-04-91 | 46° 07 W | 46° 40 N | 360 | 3M | 03-07-91 | 44° 41 W | 46° 53 N | - | 3M | 83 |
| A0299 | 65 | 10-04-91 | 46° 09 W | 46° 43 N | 350 | 3M | 09-07-91 | 44° 30 W | 47° 02 N | 145 | 3M | 89 |
| A2268 | - | 10-04-91 | 46° 10 W | 46° 42 N | 353 | 3M | 25-07-91 | 44° 23 W | 47° 15 N | 140 | 3M | 105 |
| A2214 | 102 | 10-04-91 | 46° 08 W | 46° 40 N | 360 | 3M | 26-07-91 | 46° 13 W | 47° 01 N | 215 | 3M | 106 |
| A2281 | 79 | 10-04-91 | 46° 10 W | 46° 42 N | 350 | 3M | 31-07-91 | -- -- - | -- -- - | --- | 3M | 112 |
| B4919 | 98 | 10-04-91 | 46° 07 W | 46° 39 N | 350 | 3M | 02-08-91 | -- -- - | -- -- - | --- | 3M | 114 |
| B2033 | 72 | 10-04-91 | 46° 10 W | 46° 42 N | 353 | 3M | 05-08-91 | -- -- - | -- -- - | --- | 3M | 117 |
| B4925 | 83 | 10-04-91 | 46° 07 W | 46° 39 N | 362 | 3M | 08-08-91 | 44° 35 W | 46° 55 N | 128 | 3M | 120 |
| B2020 | 66 | 10-04-91 | 46° 10 W | 46° 42 N | 350 | 3M | 15-08-91 | 44° 43 W | 47° 02 N | 137 | 3M | 130 |
| B4914 | 73 | 10-04-91 | 46° 07 W | 46° 39 N | 360 | 3M | 09-10-91 | 44° 44 W | 47° 03 N | 146 | 3M | 182 |
| B4893 | 68 | 10-04-91 | 46° 07 W | 46° 40 N | 360 | 3M | 06-12-91 | 52° 35 W | 44° 00 N | 170 | 3O | 240 |
| A2556 | 48 | 09-04-91 | 46° 08 W | 46° 43 N | 350 | 3M | 16-06-92 | 44° 32 W | 47° 05 N | 220 | 3M | 431 |

**Tagging experiment in Feb.-Mar. 1992**

| | | Tagging | | | | | Recapture | | | | | ** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| code | length | date | long. | lat. | depth* | Div. | date | long. | lat. | depth* | Div. | days |
| A0018 | 62 | 21-02-92 | 45° 46 W | 46° 30 N | 420 | 3M | 02-03-92 | 44° 31 W | 46° 53 N | 135 | 3M | 11 |
| A0168 | 50 | 24-02-92 | 46° 00 W | 46° 30 N | 410 | 3M | 09-03-92 | 45° 00 W | 46° 28 N | 502 | 3M | 14 |
| A0342 | 52 | 07-03-92 | 46° 09 W | 46° 31 N | 403 | 3M | 31-03-92 | 44° 20 W | 46° 55 N | 200 | 3M | 24 |
| A0368 | 49 | 07-03-92 | 46° 06 W | 46° 32 N | 407 | 3M | 09-04-92 | 45° 36 W | 47° 10 N | 167 | 3M | 34 |
| A0376 | 71 | 07-03-92 | 46° 07 W | 46° 33 N | 405 | 3M | 26-06-92 | 44° 32 W | 47° 05 N | 150 | 3M | 111 |
| A0464 | 77 | 09-03-92 | 46° 00 W | 46° 30 N | 408 | 3M | 05-07-92 | 44° 34 W | 47° 03 N | 143 | 3M | 118 |
| A0161 | 67 | 24-02-92 | 46° 01 W | 46° 30 N | 410 | 3M | 28-06-92 | 44° 32 W | 47° 05 N | 225 | 3M | 125 |
| A0330 | 69 | 07-03-92 | 46° 09 W | 46° 31 N | 403 | 3M | 12-07-92 | 44° 56 W | 46° 56 N | 154 | 3M | 127 |
| A0138 | 72 | 25-02-92 | 46° 04 W | 46° 31 N | 410 | 3M | 04-07-92 | 44° 35 W | 46° 56 N | 134 | 3M | 130 |
| A0436 | 49 | 07-03-92 | 46° 06 W | 46° 32 N | 406 | 3M | 01-09-92 | 44° 27 W | 46° 55 N | 162 | 3M | 178 |
| A0186 | 49 | 21-02-92 | 45° 46 W | 46° 30 N | 418 | 3M | 23-09-92 | 45° 07 W | 47° 07 N | 208 | 3M | 215 |
| A0143 | 51 | 24-02-92 | 46° 00 W | 46° 30 N | 408 | 3M | 05-11-92 | 44° 26 W | 47° 00 N | 158 | 3M | 255 |
| A0043 | 47 | 21-02-92 | 45° 46 W | 46° 29 N | 418 | 3M | 21-11-92 | 44° 38 W | 47° 03 N | 162 | 3M | 274 |

**Tags recovered on beaches without fish**

| | | Tagging | | | | | Recapture | | | ** |
|---|---|---|---|---|---|---|---|---|---|---|
| code | length | date | long. | lat. | depth* | Div. | date | Place | Country | days |
| A2527 | 48 | 07-04-91 | 46° 18 W | 46° 58 N | 310 | 3M | 25-11-91 | Bantry Bay | Ireland | 232 |
| A0251 | 67 | 13-04-91 | 47° 16 W | 46° 45 N | 400 | 3L | 07-03-92 | Galway Bay | Ireland | 329 |
| A2229 | -- | 10-04-91 | 46° 08 W | 46° 40 N | 360 | 3M | 22-03-92 | Ballydoregar Beach | Ireland | 347 |
| A2586 | 64 | 10-04-91 | 46° 07 W | 46° 40 N | 360 | 3M | 10-07-92 | Lonstrup (judland) | Danmark | 457 |
| A0365 | 67 | 07-03-92 | 46° 06 W | 46° 32 N | 405 | 3M | 09-03-93 | Cornwall | England | 367 |

* metres ** Days before recapture

**TABLE. 11.- Data of the recoverie tags. Code starting with "A" are LEA type; tags whos code starts with "B" are T-bar type.**

# BOTTOM TRAWL GEAR

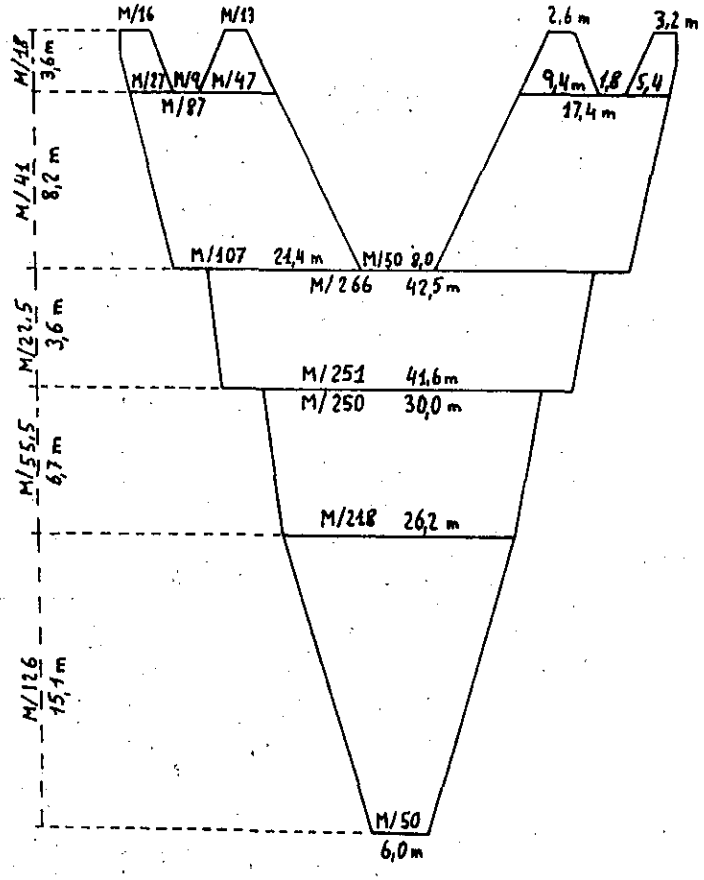



Figure 1.- Trawl gear used in the survey.

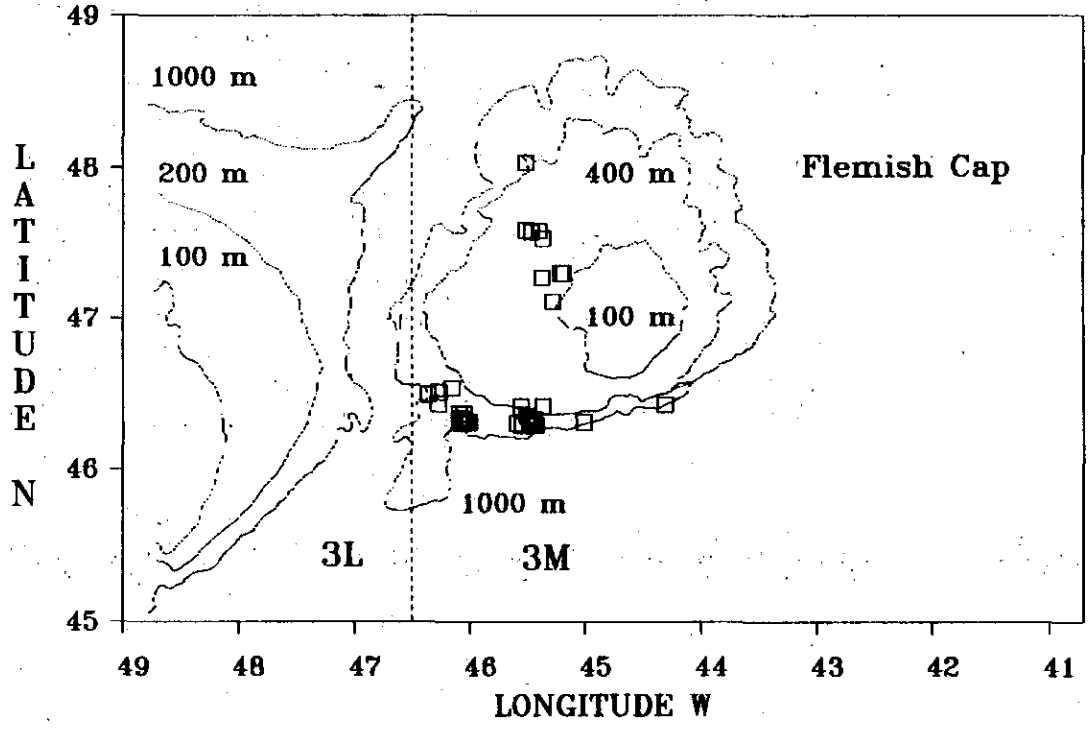



Fig. 2.- Geographical location of the hauls.

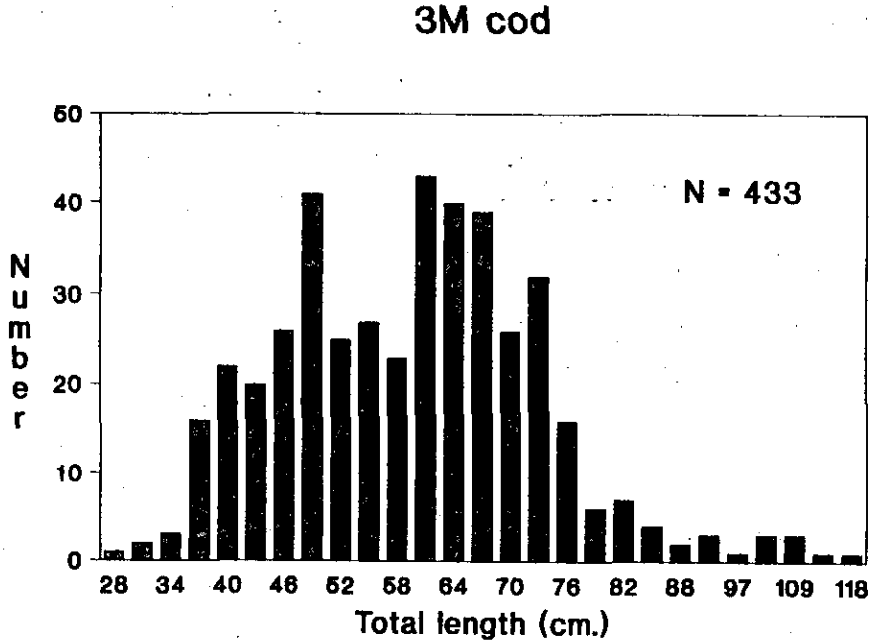



Fig. 3.- Length distribution of tagged cod.

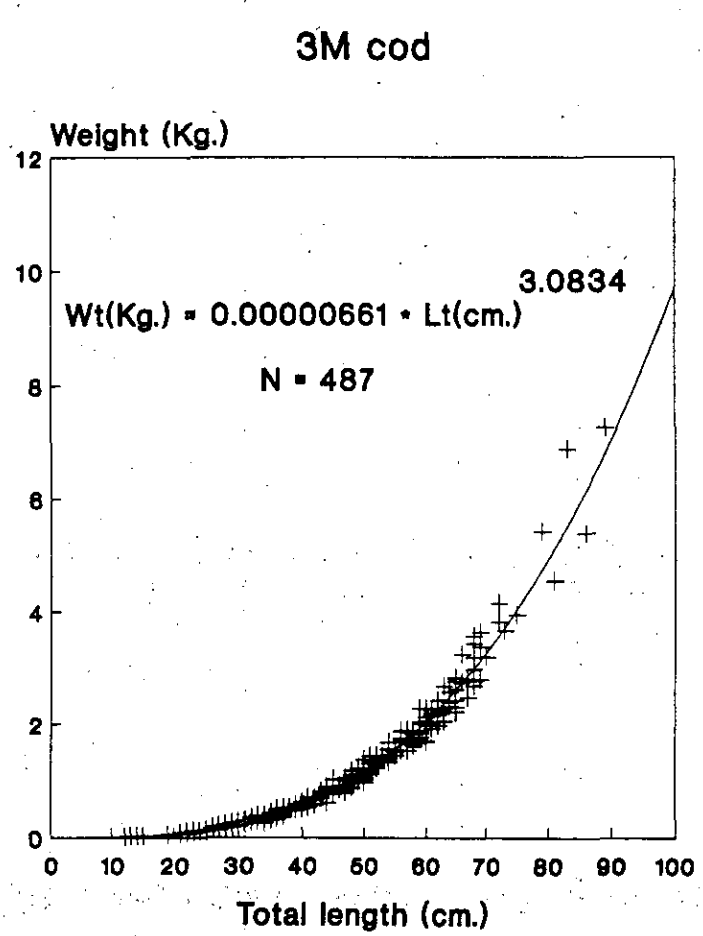



Fig. 4.- Length-Weight relationship.

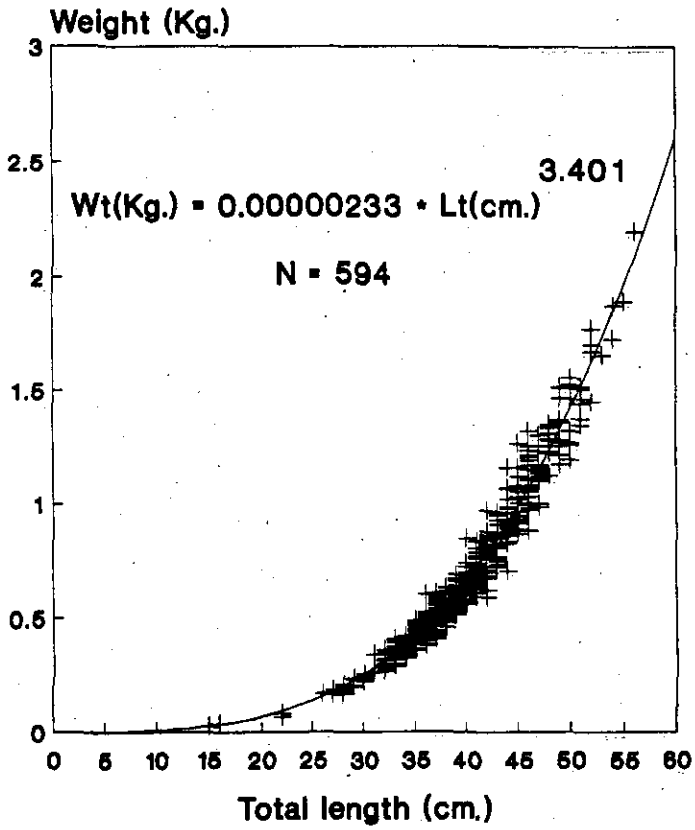
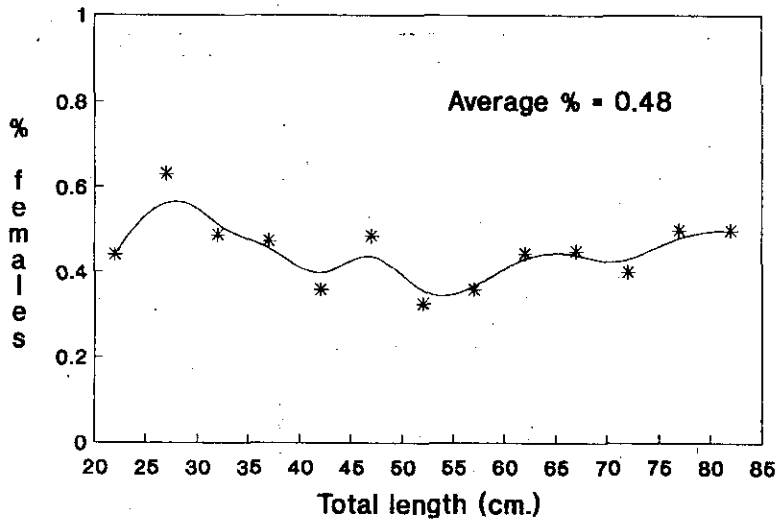
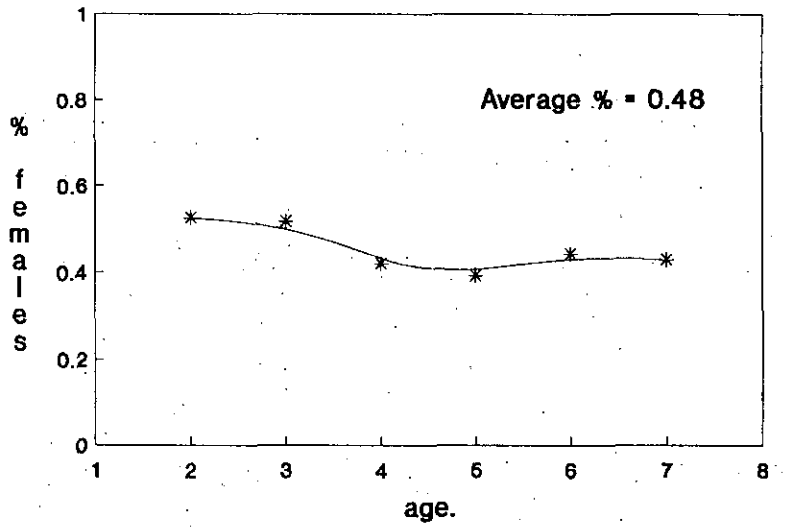



Fig. 5.- Length-weight relationship.

3M cod




a) Percentage of females by length.




b) Percentage by age of females.

Fig. 6.- Percentage of females by length (a) and by age (b).

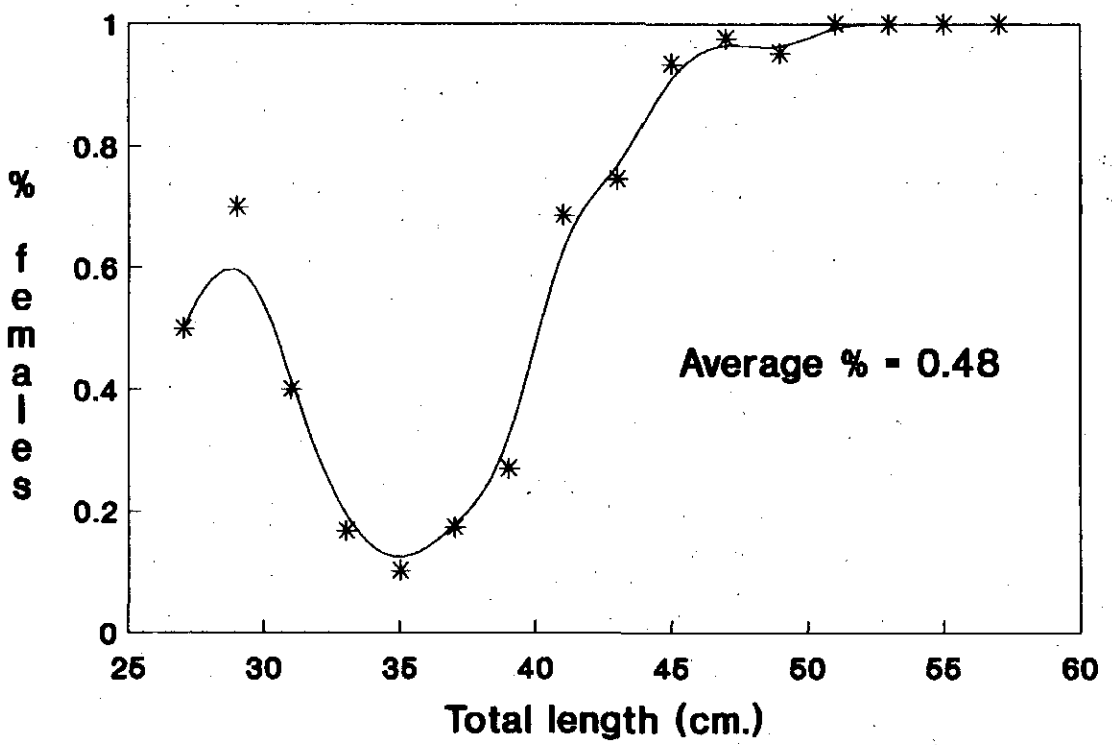
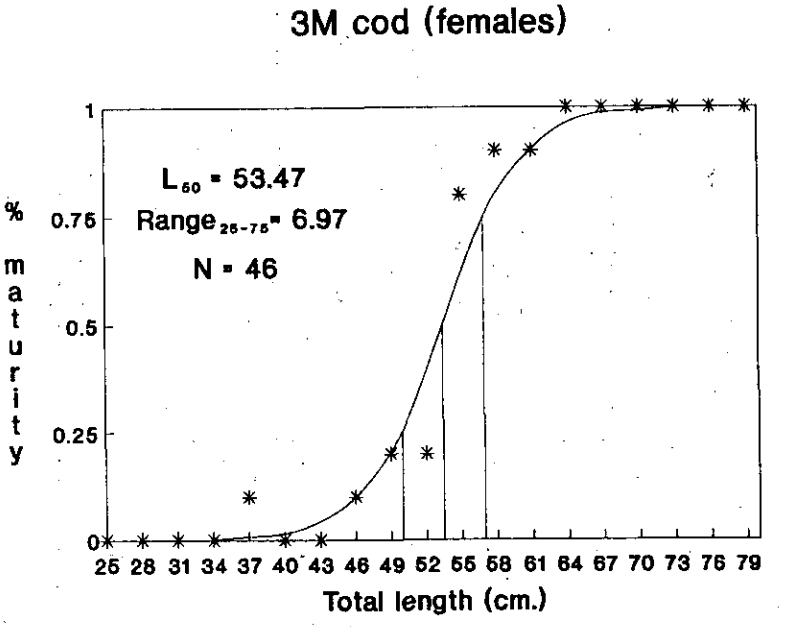
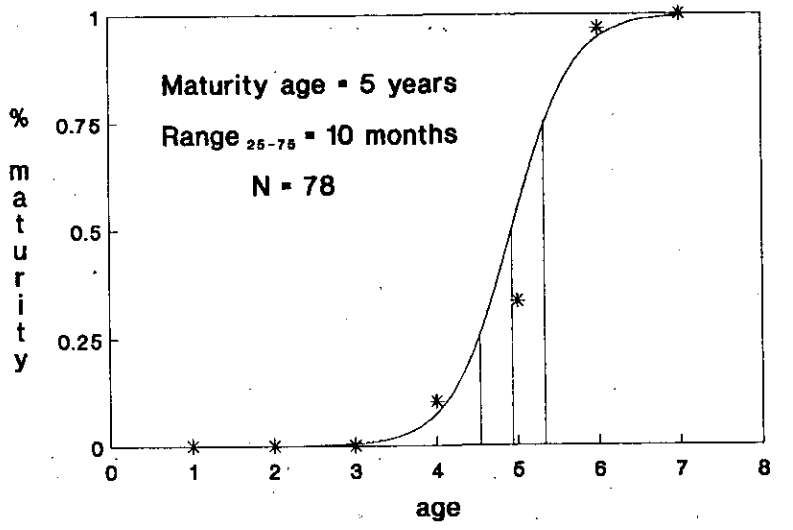



Fig. 7.- Percentage by length of females




a) Maturity by length.




b) Maturity by age.

Fig. 8.- Maturity percentage by length (a) and by age (b), fitted to a logistic curve.

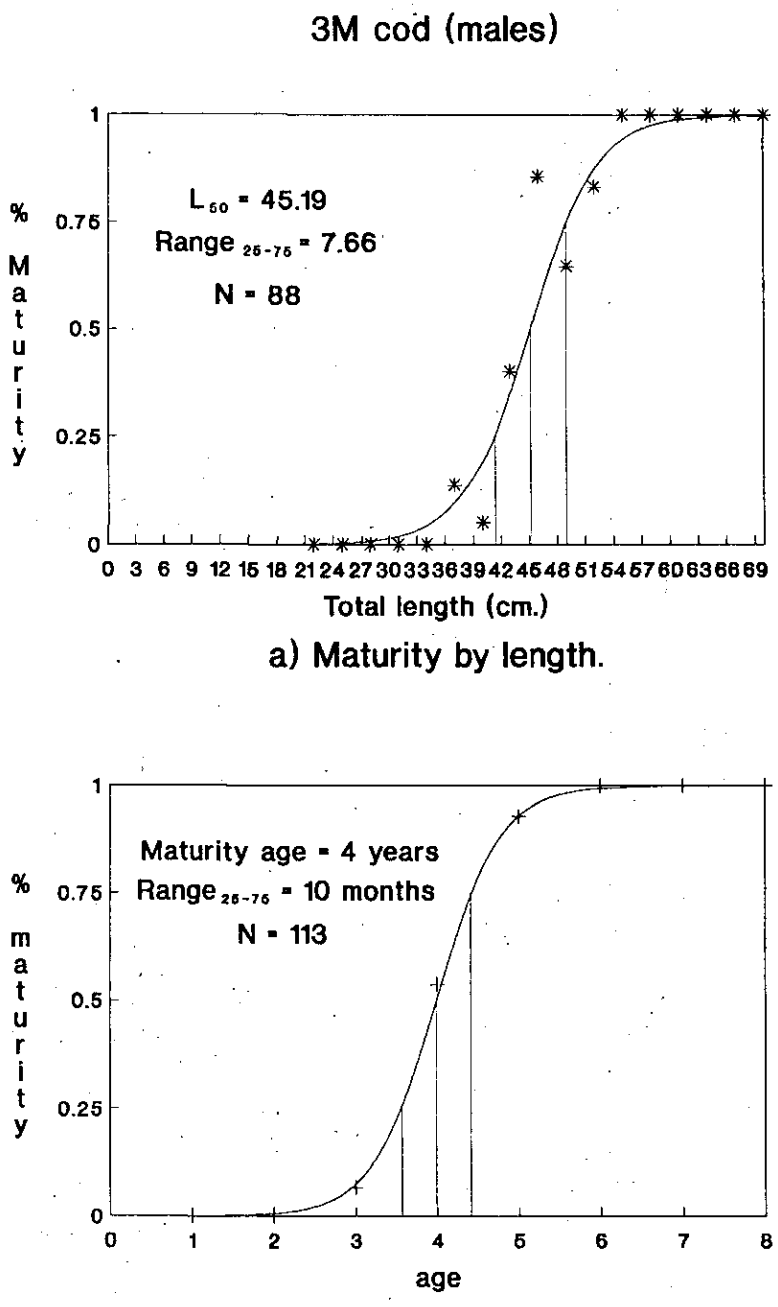



Fig. 9.- Maturity percentage by length (a) and by age (b), fitted to a logistic curve.

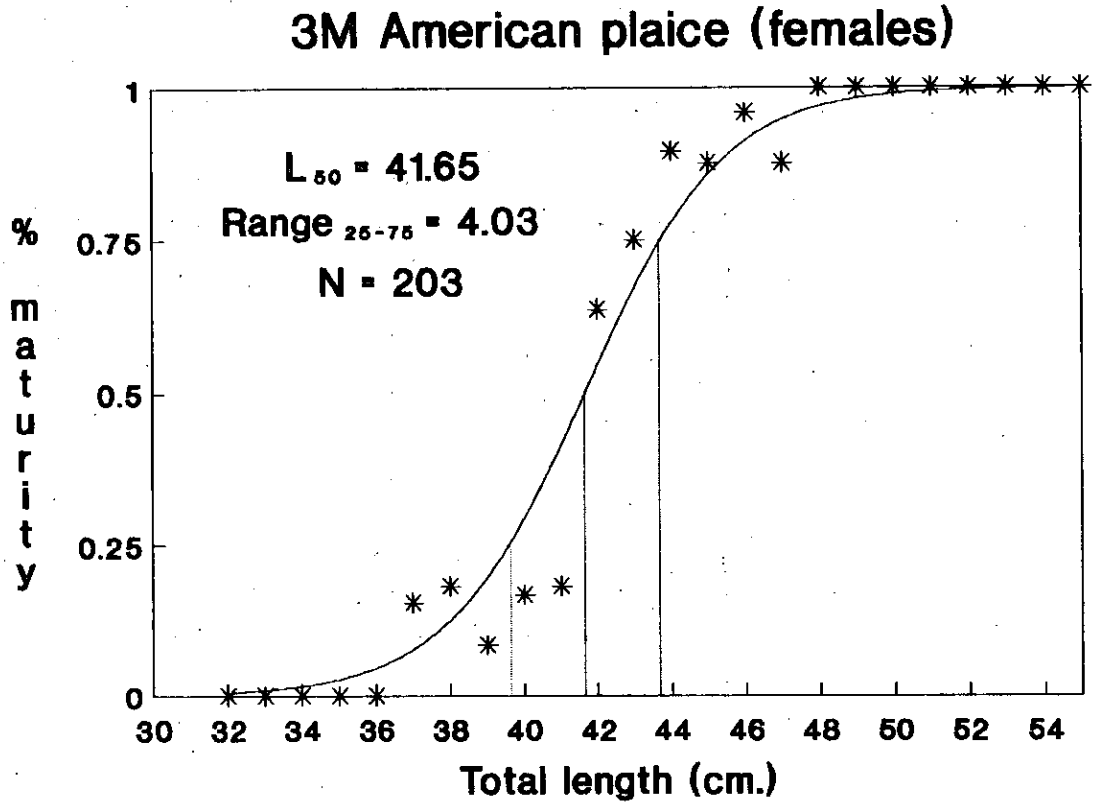



Fig. 10.- Maturity by length.

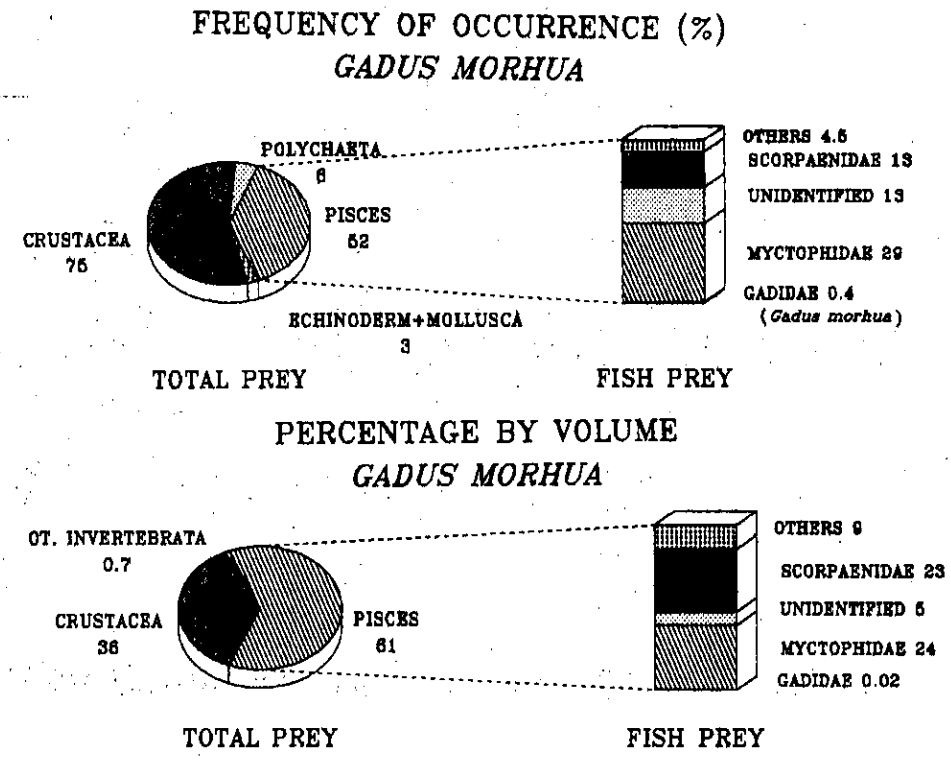
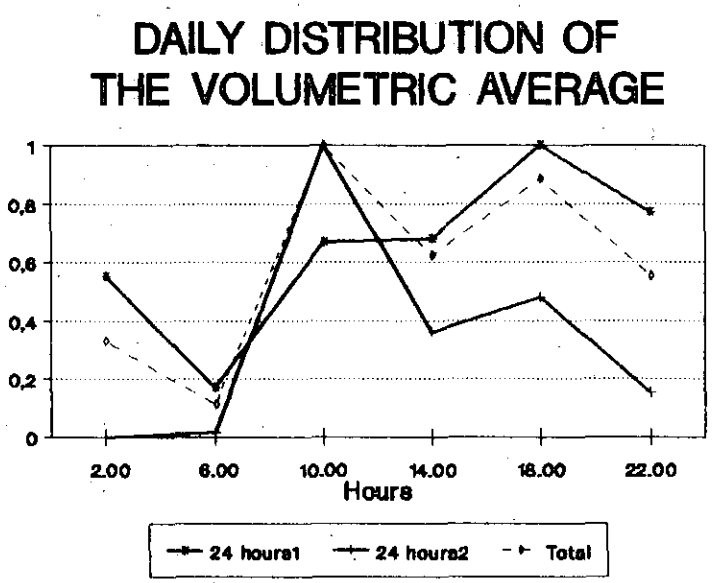



Fig. 11.- Food of cod in Flemish Cap in winter. Prey groups expressed as percentage by frequency and volume.



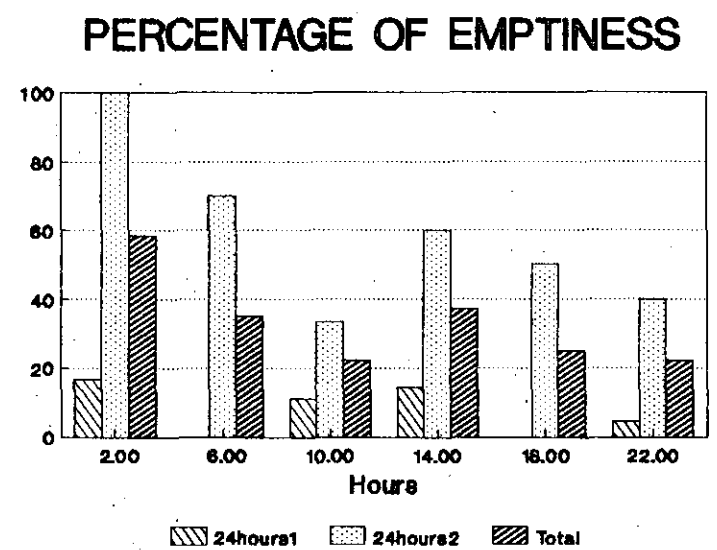




Fig. 12.- Daily distribution of the volumetric average and of the percentage of emptiness of the cod stomachs.

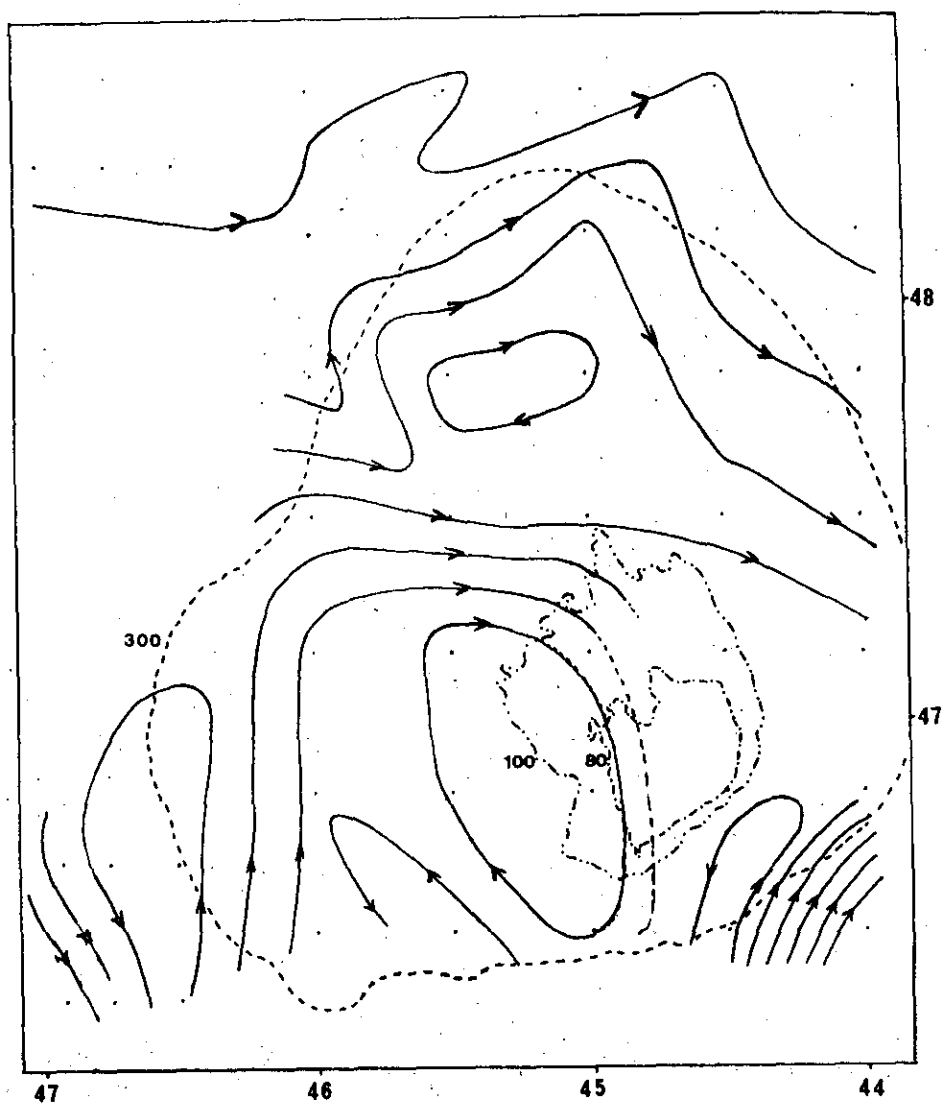



Fig. 13.- Distribution map of geostrophic currents in Flemish Cap. Depth in fathoms.

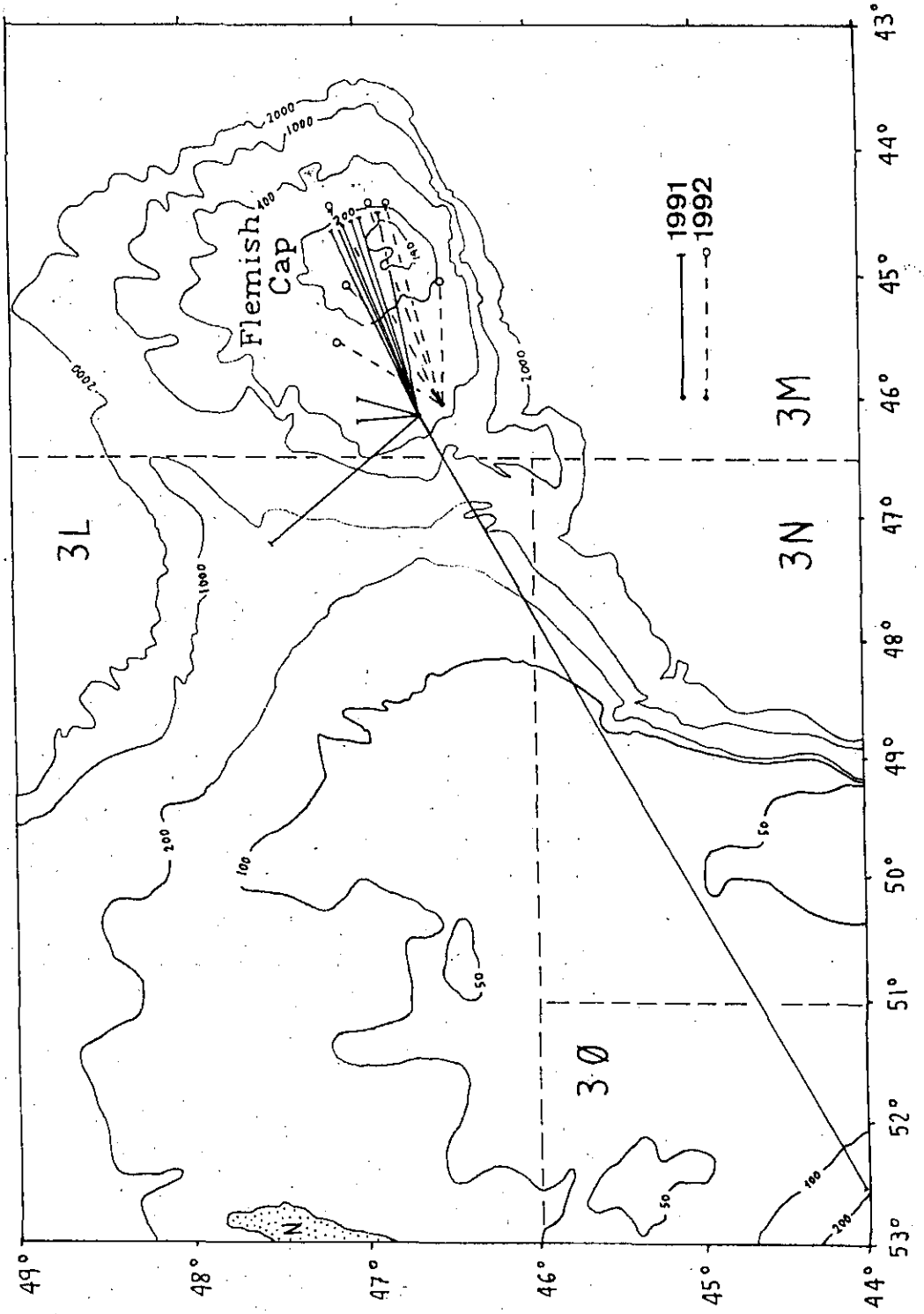



Fig. 14.- Map showing the routes of the recaptured cod. The continuous line indicates individuals tagged in 1991 and the dotted line in 1992.

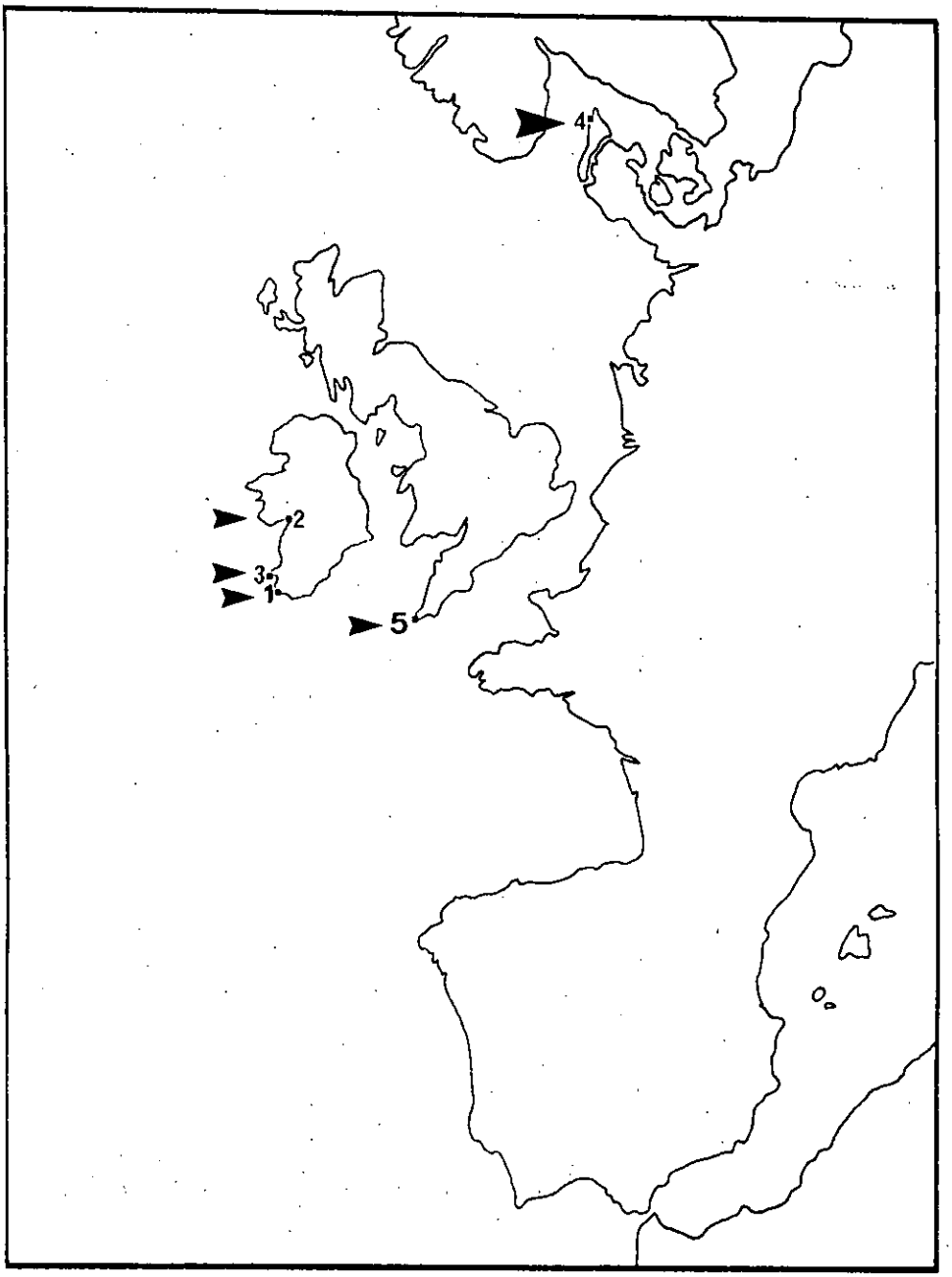



Fig. 15.- Map showing the locations of the tags recovered without fish.