A FUNCTIONAL DIVISION OF *ELECTRONA CARLSBERGI* (TÅNING, 1932) AREA OF HABITAT IN RELATION TO THE LATITUDINAL ZONATION OF THE SOUTHERN OCEAN

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Abstract

During the cruise of the RV *Vozrozhdenie* (VNIRO, USSR) in March/April 1990 an integrated study survey was conducted in the Southern Atlantic along two meridional transects at 17° and 20°W in the latitudes from 37°30' to 55°30'S. The survey was mainly focussed on studies of distribution of adult and pre-spawning *Electrona carlsbergi* and also on searching for possible spawning areas of the species. During the survey the following zones within the study area were identified as having different vertical structures of water masses: Subtropical Zone, Subtropical Frontal Zone, Sub-Antarctic Zone, Polar Frontal Zone and Antarctic Zone. Samples of *E. carlsbergi* were analysed by length composition, sex ratio and maturity stages in relation to the location where samples had been taken. The following division of the *E. carlsbergi* area of habitat was suggested after the analysis: feeding area - Polar Frontal Zone; reproduction area - Sub-Antarctic Zone and Subtropical Frontal Zone. The centre of the species' area of habitat is in the Sub-Antarctic Zone because the greatest range of fish length and stages of gonad maturity has been observed in this zone.

Résumé

Au cours de la campagne du navire de recherche*Vozrozhdenie* (VNIRO, URSS) en mars/avril 1990, une campagne d'étude intégrée fut effectuée dans l'Atlantique sud, le long de deux transects méridiens à 17° et 20°W, entre les latitudes de 37°30' et 55°30'S. La campagne d'étude était principalement axée sur un examen de la répartition d'*Electrona carlsbergi* adulte et en état de préponte ainsi que sur la recherche des frayères potentielles de l'espèce. Durant la campagne d'étude, les zones suivantes, possédant chacune une différente structure verticale des masses d'eau, ont été identifiées dans l'aire étudiée: la zone subtropicale, la zone frontale subtropicale, la zone subantarctique, la zone frontale polaire et la zone antarctique. Des échantillons d'*E. carlsbergi* ont été analysés en matière de composition en longueurs, sex ratio et stade de maturité, relativement à la position de leur prélèvement. Après analyse, la division suivante de l'habitat d'*E. carlsbergi* a été proposée: aire d'alimentation - zone frontale polaire; aire de reproduction - zone subantarctique et zone frontale subtropicale. Le centre de l'aire d'habitation de l'espèce est présumé être dans la zone subantarctique, le plus grand éventail de longueurs et de stades de maturité des gonades ayant été observé dans cette zone.

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Резюме

В ходе рейса НИС *Возрождение* (ВНИРО, СССР) в марте - апреле 1990 г. в южном секторе Атлантики была выполнена комплексная съемка вдоль двух меридиональных разрезов между 17° и 20°з.д. и 37°30'-55°30'ю.ш. Основной целью съемки было изучение распределения взрослых и преднерестовых особей вида *Electrona carlsbergi*, а также поиск возможных нерестовых участков этого вида. В ходе съемки в изучаемом районе были выделены следующие зоны, характеризующиеся различной вертикальной структурой водных масс: субтропическая зона, субтропическая фронтальная зона, субантарктическая зона, полярная фронтальная зона и антарктическая зона. Был выполнен анализ размерного и полового состава и стадий половозрелости особей *E. carlsbergi* в зависимости от места сбора проб. В результате анализа было предложено следующее деление ареала распространения вида *E. carlsbergi*: район кормления - полярная фронтальная зона, район воспроизводства - субантарктическая зона и субтропическая фронтальная зона. Центральной частью ареала распространения этого вида является субантарктическая зона. В этой зоне наблюдался наиболее широкий диапазон размеров и стадий половозрелости.

Resumen

Durante el crucero del BI *Vozrozhdenie* (VNIRO, URSS) en marzo/abril de 1990, se efectuó una prospección de estudio integrado en el Atlántico austral, a lo largo de dos transectos en los meridianos 17° y 20°W y entre las latitudes 37°30' y 55°30'S. La prospección estuvo enfocada en el estudio de la distribución de *Electrona carlsbergi* en los estados adulto y previo al desove, y en la determinación de las posibles zonas de freza de la especie. Durante este estudio se establecieron zonas con distintos perfiles de masas de agua, dividiéndose éstas en: Subtropical, Frente Subtropical, Subantártica, Frente Polar y Antártica. Se analizó la composición por tallas, la proporción de sexos y estados de madurez de *E. carlsbergi* en función del lugar de recolección de las muestras. Posteriormente, una vez analizados los datos, se propuso la siguiente división del área en donde predomina la especie: área de alimentación - Zona del Frente Polar; área de reproducción - Zonas Subantártica y Subtropical. Se cree que el área de mayor concentración de la especie es la zona subantártica, ya que fue en esa área en donde se observó la mayor gama de tallas de peces así como individuos en distintas fases de maduración gonadal.

1. AIMS AND TASKS

The search for new fishing grounds and target species in recent years has opened up great opportunities for exploiting mesopelagic fish of the Southern Ocean (Lubimova *et al.*, 1983 a, b). One of the most promising of these is *Electrona carlsbergi* (Myctophidae). In the southern summer this species forms dense and fairly stable feeding concentrations near the southern boundary of the Polar Frontal Zone (PFZ). To date the basic distribution patterns, behaviour, timing and size of concentrations have been determined for this species in the PFZ waters in relation to environmental conditions (Maslennikov *et al.*, 1990). However, the question of the functional division of *E. carlsbergi*'s habitat is as yet unresolved. This is because only juvenile specimens typically inhabit the PFZ area where integrated studies of this species have been concentrated over a number of years (Kozlov and Zemsky, 1988). During the fifteenth cruise of RV *Vozrozhdenie* in 1989, the VNIRO conducted integrated studies in the central part of the Atlantic sector of the Southern Ocean on distribution of adult and pre-spawning fish and possible spawning areas.

2. MATERIALS AND METHODS

From 20 March to 10 April 1989, two longitudinal transects were made along 17° and 20°W in the latitudinal band between 37°30' and 55°30'S. The choice of these two meridians was dictated by the theory that the reproductive part of the *E. carlsbergi* distribution area coincides with the thalassic bathyal, in particular central oceanic ridges. It is assumed that dynamic conditions favourable for spawning occur in ridge areas, due to powerful meandering currents and an increased level of gyre activity. Therefore we attempted as far as possible to approximate the transects, for the most part in their northern sections, to the crest of the South Atlantic Ridge (Figure 1). A small-scale survey of the area bounded by 40°00' to 42°30'S and 16°00' to 17°00'W was also carried out. The distance between stations on the transects was 30 miles (each 30' of latitude and longitude in the small-scale survey area). Echosounding was used in the upper 1 000 m layer using the Neil Brown Mark IIIB system. Methodologies contained in the following works were used to define the boundaries of the frontal zones: Antipov *et al.*, 1987; Belkin *et al.*, 1988; Deacon, 1982.

Over the period of research 26 hauls were performed using a midwater cable trawl with a mouth opening of 3 600 m². Trawling speed was usually 3 to 3.5 knots; with a trawling duration of 1 hour.

Because of the known relationship between the distribution of *E. carlsbergi* and the Intermediate Antarctic Water Mass (Krefft, 1974) and also of the sub-Antarctic nature of the species, trawling depth to the north of the PFZ gradually increased from 140 to 600 m, which corresponds to the depth of the nucleus of this water mass in its northern sector. The depth of this nucleus (interim minimum salinity) was determined using data obtained from hydrological stations. Trawling stations were as far as possible spread evenly over the transects, depending on changes in vertical water structure (Figure 2). As a result, trawling was carried out whether readings from hydrological gear were available or not.

3. DISCUSSION OF RESULTS

3.1. Latitudinal Zonation Along Transects 17° and 20°W

Along the transects (Figures 3 and 4) we identified the following latitudinal zones from north to south (Figure 5): Subtropical Zone (STZ), Subtropical Frontal Zone (STFZ), Sub-Antarctic Zone (SAZ), Polar Frontal Zone (PFZ) and Antarctic Zone (AZ). The discovery in the central part of the South Atlantic, of a fairly broad STFZ bounded by two temperature/salinity fronts, together with analogous results obtained in the southern part of the Pacific Ocean (Belkin *et al.*, 1988; Kryukov and Sapozhnikov, 1987) off the southern coast of

Africa (Lutjeharms and Valentine, 1984; Lutjeharms, 1985; Lutjeharms and Foldvik, 1986) points at circumpolar distribution of STFZ (with the natural exception of Drake Passage). By comparison with current knowledge of this little-explored region (Clifford, 1983; Deacon, 1982; Gordon and Molinelli, 1982; Valentine and Lutjeharms, 1983), on our transects the Subtropical Front (STF, or the northern boundary of the STFZ) is located slightly further to the north, while the PFZ is much further to the south.

The northern boundary of the STFZ passed between 38° and 39°S and the southern boundary between 41°30' and 42°S at 20°W and between 42°30' and 43°S at 17°W. Moreover, an anticyclonic meandering current on the southern boundary of the STFZ (or a gyre formed in this frontal area) has been identified along the transect of 20°W at 44° to 45°S.

The northern boundary of the PFZ (Sub-Antarctic Front) at 20°W was located between 48° and 48°30'S. At 17°W this boundary was crossed three times (at 46°30' to 47°, 47°30' to 48° and 48°30' to 49°S) due to the meandering of the current.

The relatively extended nature of the meandering boundary of the PFZ (Polar Front) along the transect of 20°W (beginning from 54°S) was detected only at 52° to 53°S. At 17°W the southern boundary of the PFZ passed between 54°30' and 55°S. However, water structure typical for this front was noted over a series of stations made right up to 50°30'S. Therefore, considerable disruptions were detected along the longitudinal transects. This is connected with the strong meandering streams of the Antarctic Circumpolar Current (ACC) interacting with the South Atlantic Ridge.

3.2 Functional Division of the Area of Habitat of *E. carlsbergi*

More than 28 fish species of the Myctophidae family were taken in the course of trawling. *E. carlsbergi* was the most common species, being encountered in 20 of the 26 hauls. It was found in the catches of two hauls in the Antarctic Zone, four hauls in the PFZ, seven hauls in the SAZ, and seven hauls in the STFZ. The species was not encountered in the Subtropical Zone. Catch locations for *E. carlsbergi* are shown in Figure 6. Analysis of *E. carlsbergi* size composition and biological condition was performed with the boundaries of identified latitudinal zones kept in mind.

Size characteristics of *E. carlsbergi*. More than 2 000 specimens were measured along the transects. Data on changes in *E. carlsbergi* size (length) in relation to latitudinal zonation gives the following picture:

in the AZ - from 7.5 to 9.0 cm., M=8.06 cm, N=206;
in the PFZ - from 7.0 to 9.5 cm., M=8.20 cm, N=613;
in the SAZ - from 7.0 to 10.5 cm., M=8.6 cm, N=828;
in the STFZ - from 7.5 to 10.5 cm., M=8.73 cm, N=425.

The greatest length range was in the SAZ, while the highest modal length was in the STFZ. Minimal changes in length were noted in the PFZ and AZ, while the smallest modal lengths were also typical for these zones. In other words, an increase in the modal length occurs from south to north with the maximum variation in length being in the SAZ and the maximum length of adult specimens in the STFZ.

Maturation of *E. carlsbergi*. When examining the biological characteristics of the species, it should be noted that during our survey the change in maturation of male and female gonads was found to be related to the latitude of a place where the specimens were caught. This is the first time such information has been obtained and it deserves more detailed examination than other biological parameters.

During studies along the transects more than 800 specimens of *E. carlsbergi* underwent biological analysis. Figure 7 shows that fish with gonads only at the second stage of development are usually present in the AZ and PFZ. Specimens with both second stage and more mature gonads (up to fifth stage) are found in the SAZ. Moreover, within this zone the proportion of gonads at later stages of maturity increases from south to north. Only second and third stage gonads, almost in equal numbers, occur in the southern part of the SAZ (haul No. 58). Females with fourth and fifth stage gonads appear in the central part of the SAZ, while the number of fish with second stage gonads gradually decreases. Thus, the central part of the SAZ may be considered the main distribution area of maturing fish with gonads at the third stage of maturity. To the north of 45°S (possibly due to the influence of meandering currents/gyres in the STFZ), only individual specimens having second stage gonads are encountered, while adult fish with fourth and fifth stage gonads are the most common. The northern part of the SAZ is chiefly an area of pre-spawning specimens. The STFZ is dominated by fish of fifth stage gonad maturity and, as such, may be seen as a zone of distribution of adults capable of spawning. Maturing specimens with gonads still far from the spawning stage are encountered individually in this zone (e.g., one specimen with third stage gonads was found in haul No. 50).

In addition to the analysis of *E. carlsbergi* maturity in relation to the boundaries of latitudinal zones, we have taken another approach to presenting the data being analysed (see Figure 8). Representative hauls are represented on the horizontal axis, however only the absolute shift of trawling position from south to north, not the sequence of hauls, was taken into consideration. The number of fish at one or another stage of maturity (as a percentage of the total number), used as the basis for bioanalysis of each catch, is presented on the vertical axis. This method made it possible to identify three areas (zones) along the horizontal axis; a zone where only females at the second stage of maturity are present; a zone containing fish at various stages of maturity (from second to fifth) and a zone where fish at the fifth stage of maturity predominate. If one takes into account the zones in which the trawling was carried out it becomes clear that the first zone corresponds to the PFZ, the second to the SAZ, and the third to the STFZ.

Figure 9 shows the percentages of males and females of *E. carlsbergi* at different stages of maturity by latitudinal zones. All males and females analysed in the AZ and PFZ turned out to be at Stage II of maturity. The following percentages were obtained for the SAZ: females found at various stages of maturity, from Stages II to V, with the latter dominating significantly (Stage II - 7%, Stage III - 18%, Stage IV - 8%, Stage V - 67%); males were mainly Stage II, males at Stage V were absent (Stage II - 53%, Stage III - 33%, Stage IV - 14%). The situation is considerably different in the STFZ (males: Stage III - 1%, Stage IV - 1%, Stage V - 99%; females: Stage III - 36%, Stage IV - 62%, Stage V - 3%). In this zone both males and females at Stage II of maturity were present; the overwhelming majority of females had gonads at Stage V of maturity as did some males. Furthermore, there was only a small number of females at the Stage III of maturity. It must also be noted that, unlike females, males in the STFZ appear at the Stages III and IV as well as Stage V. Moreover, these types of specimens are extremely abundant.

In our opinion, all the above data on the different maturity stages of *E. carlsbergi* gonads for males and females prove that the STFZ is the part of the distribution area of habitat of this species in which reproduction takes place.

Having analysed the combined percentages of males and females at different stages of maturity by latitudinal zones, we will now examine the change in the ratio of gonad maturity in relation to change in male and female size.

Only females at Stage II (7.5 to 9.0 cm length) are encountered in the AZ (Figure 10). Although the condition of female gonads was similar in the PFZ, there was a notably wider range of length - from 7.0 to 9.5 cm. The largest range of size for females is in the SAZ (from 7.0 to 11.0 cm), where fish of all maturity stages are encountered. The greatest variety of

maturity stages was among specimens from 7.5 to 9.0 cm. Stage V of maturity begins to be identifiable in females from 8.0 cm long. For females 8.5 cm long, Stage V was found in 55% of specimens, and for females 10.0 cm and longer, in 100%. Large females from 8.5 to 10.5 cm are common in the STFZ where a distinct predominance of Stage V was noted for females of all sizes.

On the whole a similar picture emerges in respect of the change in percentages of male *E. carlsbergi* at different stages of maturity by latitudinal zones in relation to length (Figure 11). Males from 7.5 to 8.5 cm at Stage II are typical of the AZ. Only males at Stage II were found in the PFZ, however their size range was larger from 7.0 to 9.0 cm. The widest size range occurs in the SAZ (6.5 to 10.5 cm). All maturity stages except for the fifth are common in this zone, with males from 8.0 to 9.5 cm long commanding the greatest diversity of maturity stages. Males reach fullest maturity (Stage IV accounts for 22%) at 8.5 cm, while the gonads of 9.5 cm and longer specimens are exclusively at the Stage IV. Males at Stage II were not detected in the STFZ where the range of change in size, only 1.5 cm, is generally smaller (from 8.0 to 9.5), however, most specimens tend towards the upper end of the range. Stage IV of maturity begins when males attain 8.0 cm and is dominant from 8.5 cm (58%, 65% and 84% for fish of 8.5, 9.0 and 9.5 cm length respectively). Stage V of maturity was noted for males 9.0 cm in length. The largest percentage of Stage V of maturity (6%) among examined fish was observed at 9.5 cm, which is the maximum length in this zone.

It should be noted that only juvenile specimens of *E. carlsbergi* appeared in catches in the two southern zones (AZ and PFZ). Figure 12 shows the dynamics of change in sexual maturity of *E. carlsbergi* females at different lengths. Both juvenile and adult females are present in the SAZ. Adult specimens were noted at over 7.0 cm in length (15%), and from 7.5 to 11.0 cm practically all females had mature gonads. Only juvenile females from 8.0 to 10.5 cm were typical of the STFZ.

E. carlsbergi sex ratios in different latitudinal zones were the following:

AZ	-	males - 54%	females - 46%
PFZ	-	males - 49%	females - 51%
SAZ	-	males - 46%	females - 54%
STFZ	-	males - 51%	females - 49%

Figure 13 shows *E. carlsbergi* sex ratios by zones in relation to fish length. In the AZ males are predominant from 7.0 to 8.0 cm (7.5 cm - 67%, 8.0 cm - 62%). For specimens over 8.0 cm the sex ratio is almost equivalent with females being slightly dominant (53%) and for fish over 8.5 cm females account for 100%. In the PFZ a predominance of males was observed in specimens from 7.0 to 8.0 cm (67, 63, 67%); from 8.5 to 9.0 cm females begin to dominate and account for 100% at 9.0 cm and longer. The SAZ has a more complex sex ratio, where males of 7.0 to 8.0 cm in length are dominant, accounting for 93% of specimens at 8.0 cm. At 8.5 cm the situation is more even (48% males, 52% females) although the proportion of females thereafter increases, reaching 100% at 10.5 cm and longer. It must be noted that large males are typical of this area, accounting for 25% at 10.0 cm. For specimens from 7.5 to 9.0 cm in the STFZ a gradually decreasing predominance of males was observed (100, 88, 66%). At lengths over 9.0 cm females become predominant, overwhelmingly so at lengths over 10.5 cm.

E. carlsbergi weight, feeding and fat reserves. Weight of the species under investigation also changes by latitudinal zones. To the north, a trend was observed towards an increase in weight from 7.3 g in the PFZ to 11.2 g in the STFZ. Mean weight in the SAZ was 9.1 g. This tendency held true for weight analysis of males and females made separately. Males weighed 7.4 g in the PFZ, 8.5 g in the SAZ and 9.9 g in the STFZ. Correspondingly, females weighed 8.4, 10.2 and 10.7 g.

Feeding intensity also changes between the southern and northern areas. A decrease in feeding activity was observed between the PFZ and the STFZ, i.e. away from the main feeding area. The mean index of stomach fullness in the PFZ was 1.18, 1.01 in the SAZ and 0.96 in the STFZ.

Visually determined fat content was also subject to change depending on the latitude of the area where the fish was taken. It was 1.47 in the PFZ, 1.16 in the SAZ and 0.82 in the STFZ.

4. CONCLUSION

(i) After research carried out from March to April 1989 in the central part of the Atlantic sector of the Southern Ocean the following zones with different water structures were identified (from north to south): Subtropical Zone, Subtropic Frontal Zone, Sub-Antarctic Zone, Polar Frontal Zone and the Antarctic Zone.

(ii) On longitudinal transects along 17° and 20°W significant disruptions to latitudinal zonation due to strong meandering of the ACC and its interaction with the South Atlantic Ridge were identified. Thus, our data do not support the generally-held view that the ridge does not affect the dynamics of the ACC.

(iii) *E. carlsbergi* is closely linked with the Antarctic Intermediate Water Mass. This is supported by the increase in depth from south to north of water layers where the samples are taken. *E. carlsbergi* is a typical representative of mesopelagic ichthyofauna in the PFZ, SAZ and STFZ. The northern boundary of the STFZ limits the penetration of *E. carlsbergi* into the north. The species is not found in the Subtropical zone.

(iv) Analysis of *E. carlsbergi* length in relation to the latitude of catch location provided a picture contrary to the generally accepted biological law that the length and mass of living organisms increases from north to south. We have established that smaller fish inhabit the PFZ, the maximum range of body length is typical for the Sub-Antarctic and the largest body lengths are found in the STFZ. The above law obviously only applies when there is an even distribution of all species functional activities throughout the entire area in which the species exists, i.e. feeding and reproduction have to take place in all latitudinal zones. Considering the increase in body length from south to north (from the PFZ to the STFZ) our investigations show an exception to this biological law in connexion with the species' feeding activities on the southern periphery of its habitat and spawning in the northern part.

(v) Analysis of *E. carlsbergi* distribution at various stages of maturity shows that (a) only fish at Stage III of maturity occur in the PFZ; (b) SAZ is a zone of distribution mainly for fish at the Stages III and IV-V (southern and northern parts of the zone respectively); and (c) STFZ is primarily a zone of distribution for spawning fish.

(vi) The onset of sexual maturity of *E. carlsbergi* in the SAZ is observed at a length of over 7.0 cm, and at length over 7.5 cm all fish are mature. Adult females in the STFZ are noted at a length of over 8.0 cm.

(vii) Stage V of maturity is observed in the SAZ among *E. carlsbergi* females 8.0 cm and longer, reaching 100% at 10.0 cm. Stage V of maturity is observed among females of all sizes in the STFZ (8.5 to 10.5 cm).

(viii) *E. carlsbergi* feeding intensity decreases between the PFZ in the south and the STFZ in the north, i.e. between feeding and spawning areas.

(ix) Analysis of our data makes it possible to propose the following functional division of the *E. carlsbergi* area of habitat: PFZ - feeding area, SAZ and STFZ - reproduction area. Moreover, the SAZ is the centre of the species' habitat because it is precisely in this zone that the greatest range of lengths among specimens and females at all stages of maturity are observed.

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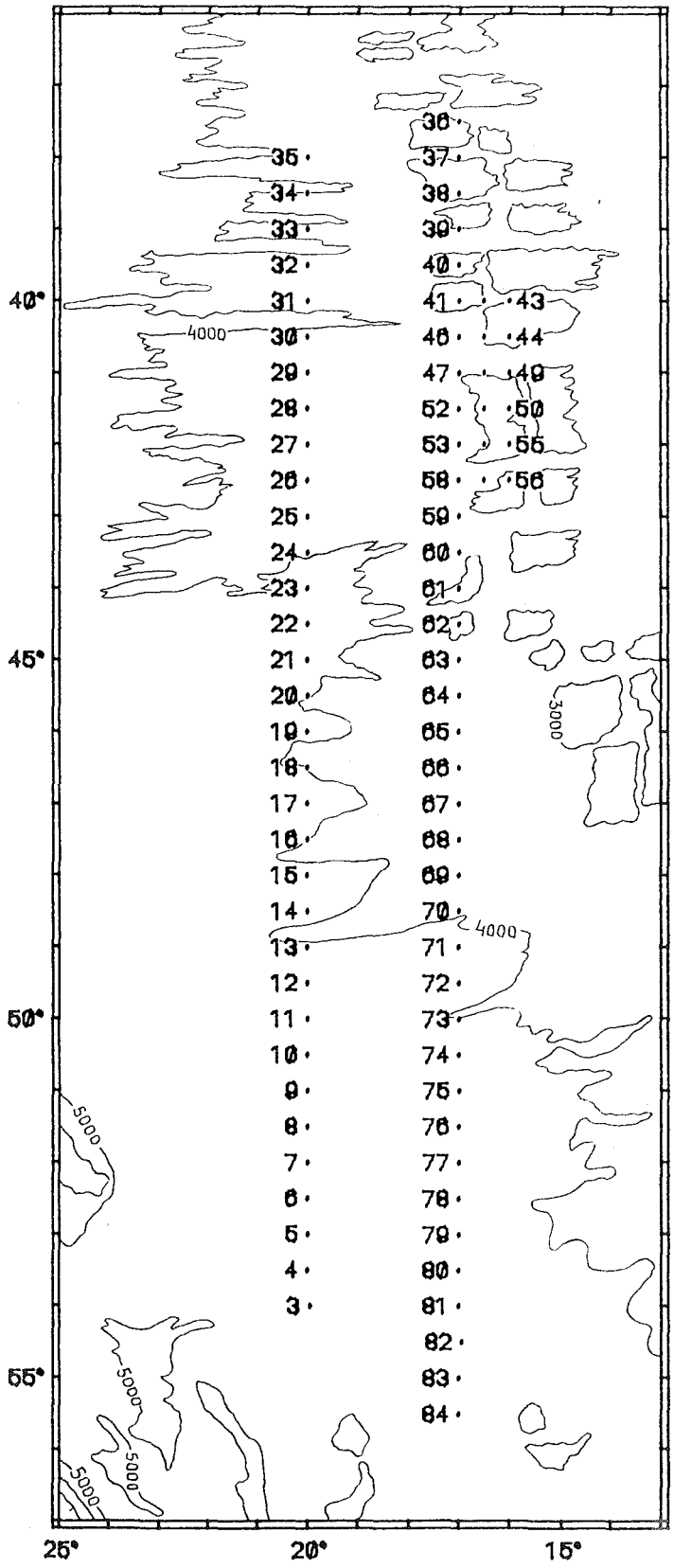


Figure 1: Locations of hydrological stations and bottom topography (GEBCO, 1984).

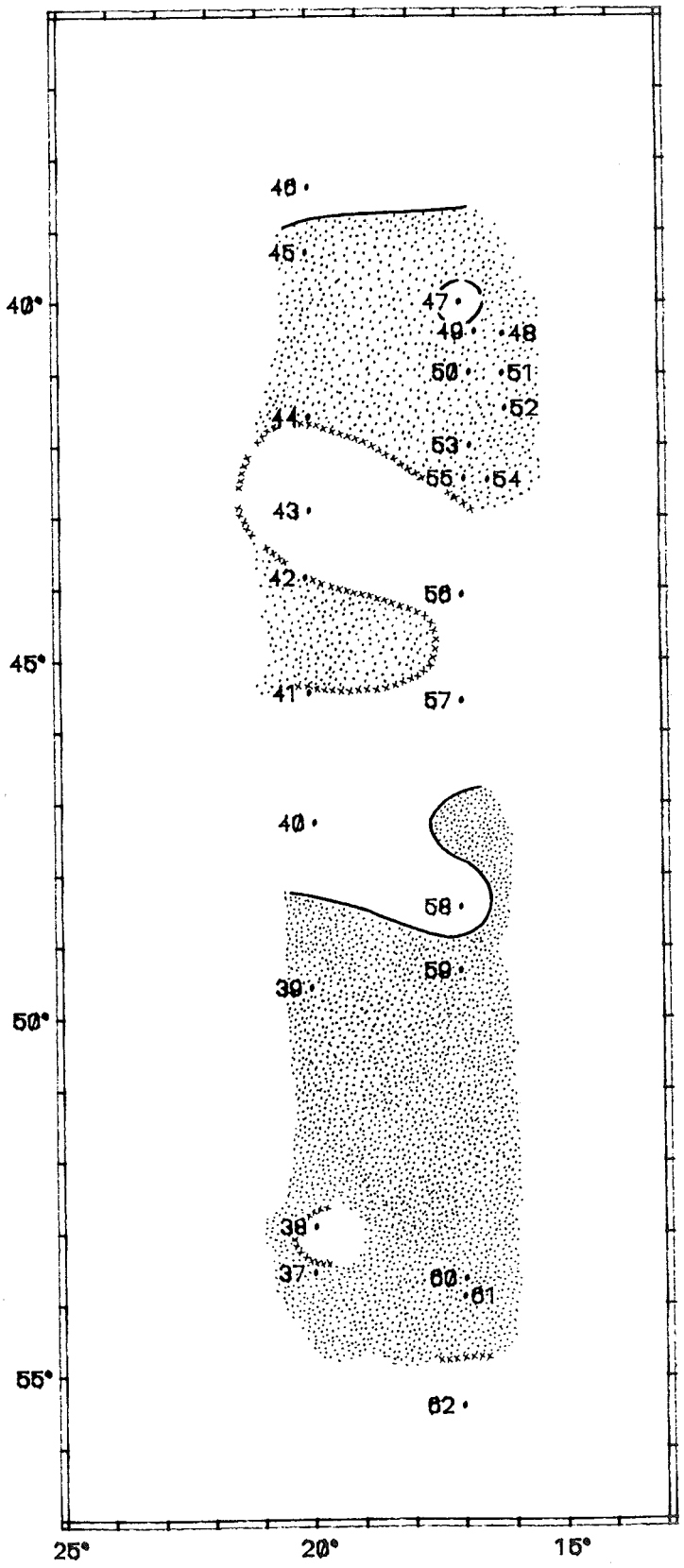


Figure 2: Locations of trawl stations.

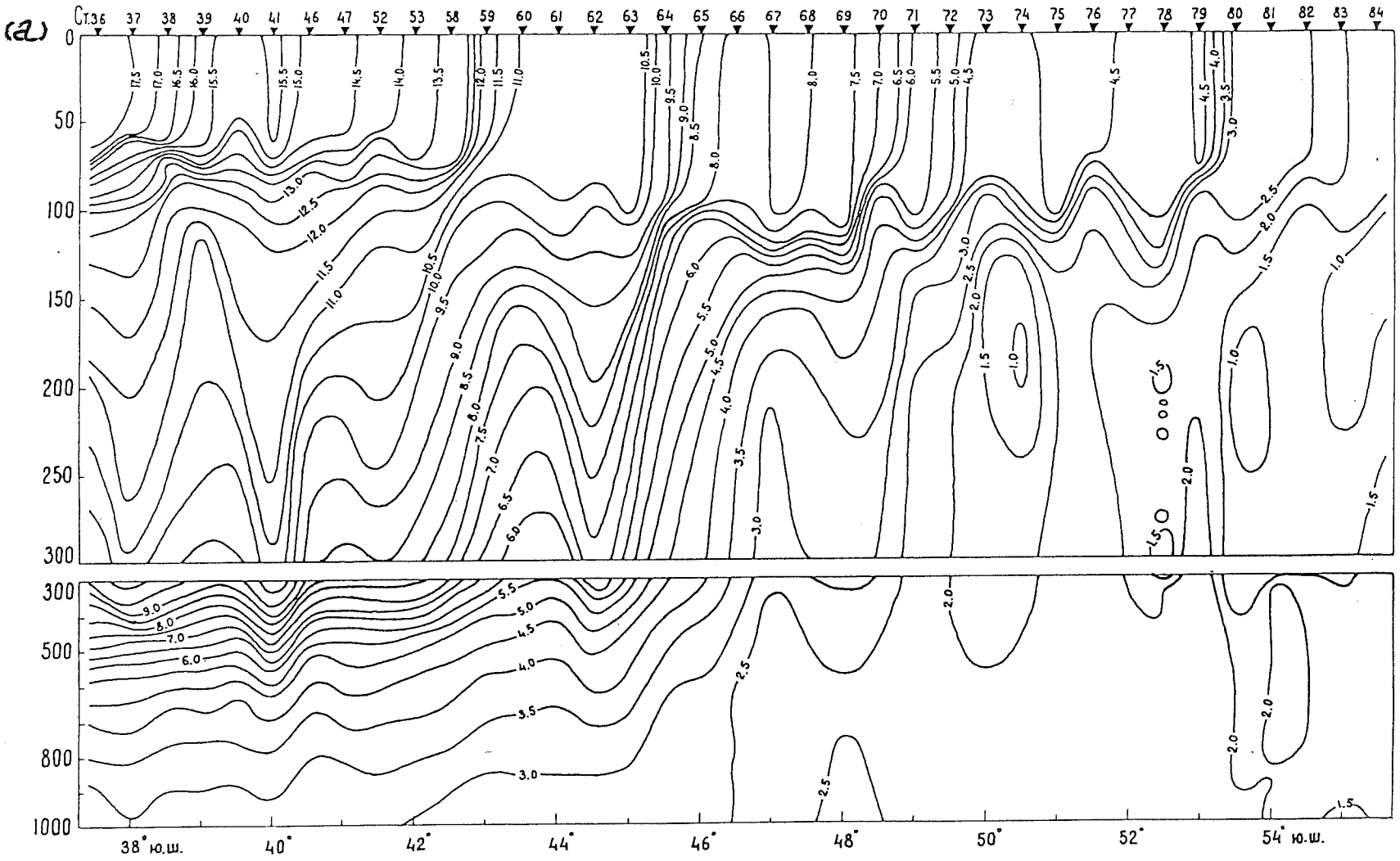
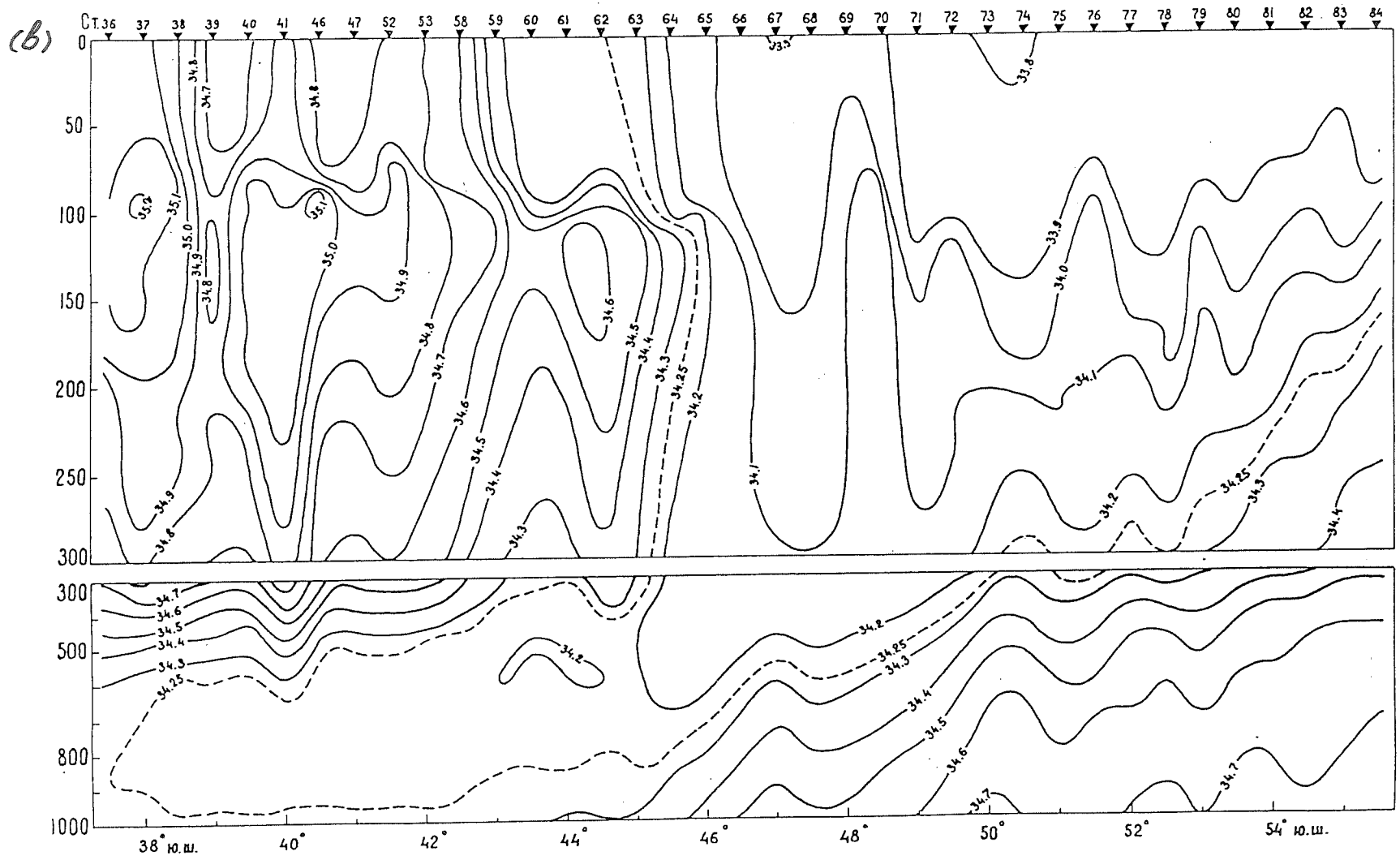


Figure 3: Temperature (a) and salinity (b) along the 17°W transect.


(b)
Ст. 36 37 38 39 40 41 46 47 52 53 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84
0
50
100
150
200
250
300
500
800
1000
35.2
35.1
35.0
34.9
34.8
34.7
34.6
34.5
34.4
34.3
34.25
34.2
34.1
34.0
33.8
38° ю.ш.
40°
42°
44°
46°
48°
50°
52°
54° ю.ш.

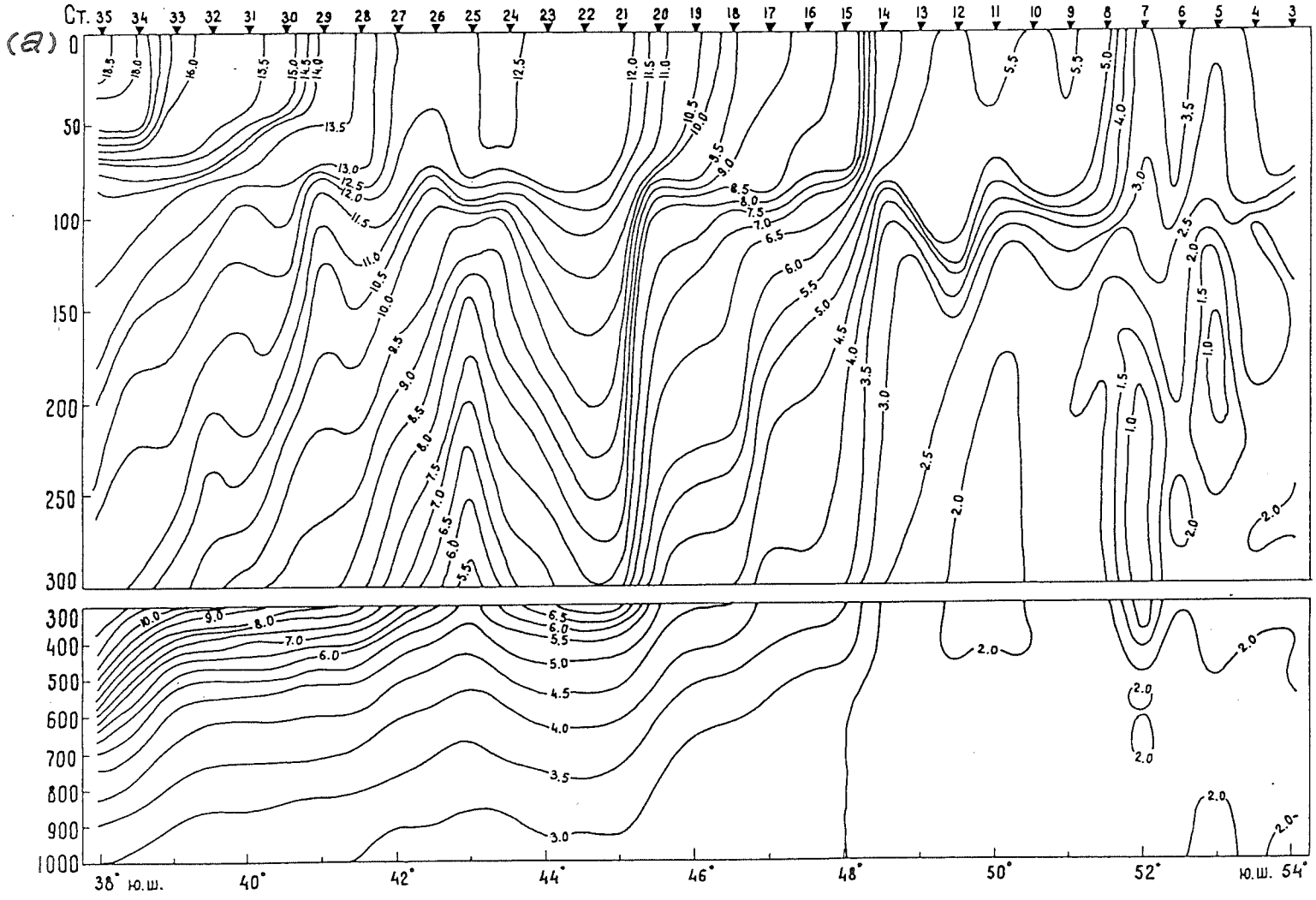
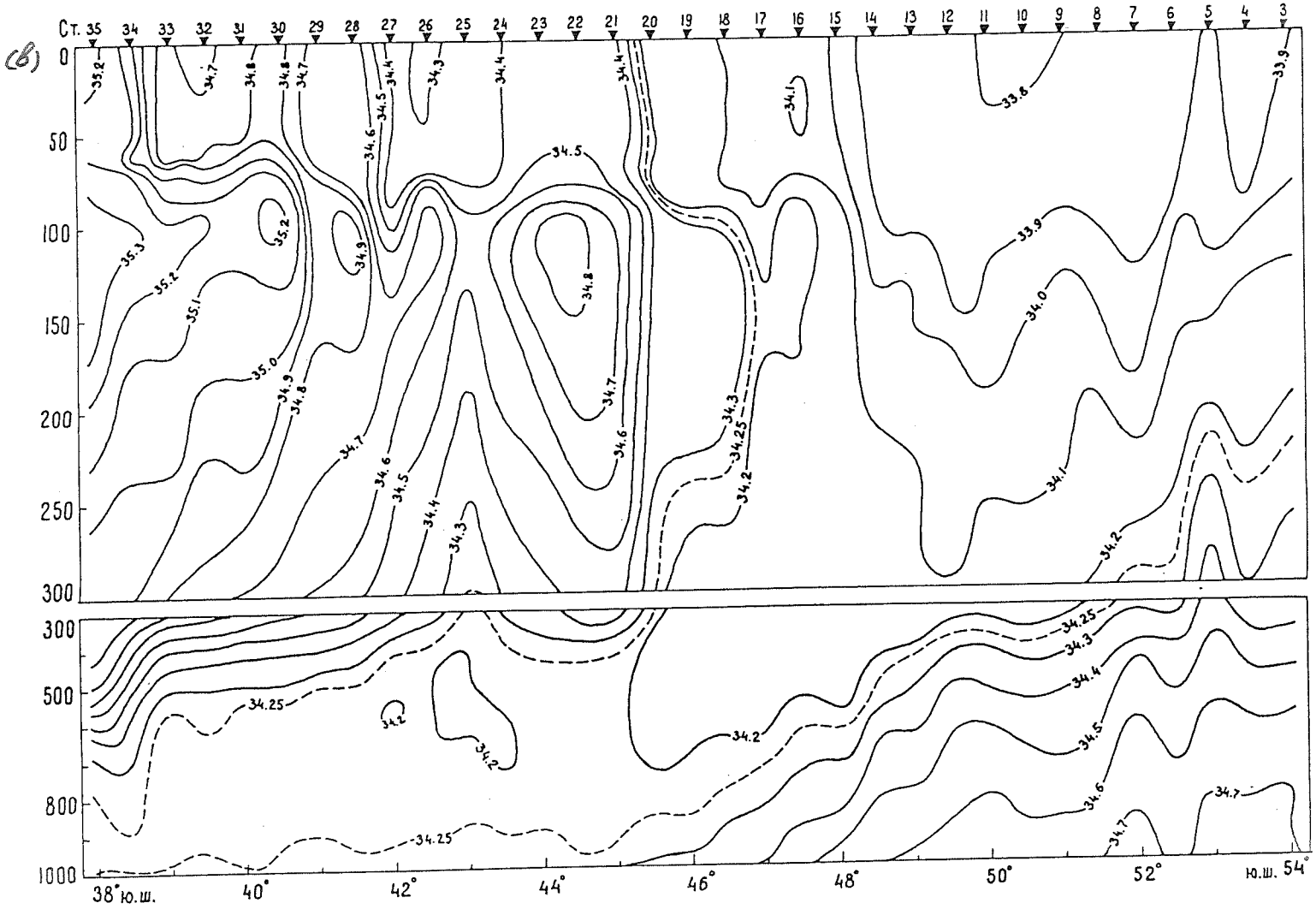


Figure 4: Temperature (a) and salinity (b) along the 20°W transect.


(б)
Ст. 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3
0
50
100
150
200
250
300
500
800
1000
35.2
34.7
34.8
34.8
34.7
34.6
34.5
34.4
34.3
34.4
34.4
34.1
33.6
33.9
35.3
35.2
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42°
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ю.ш. 54°

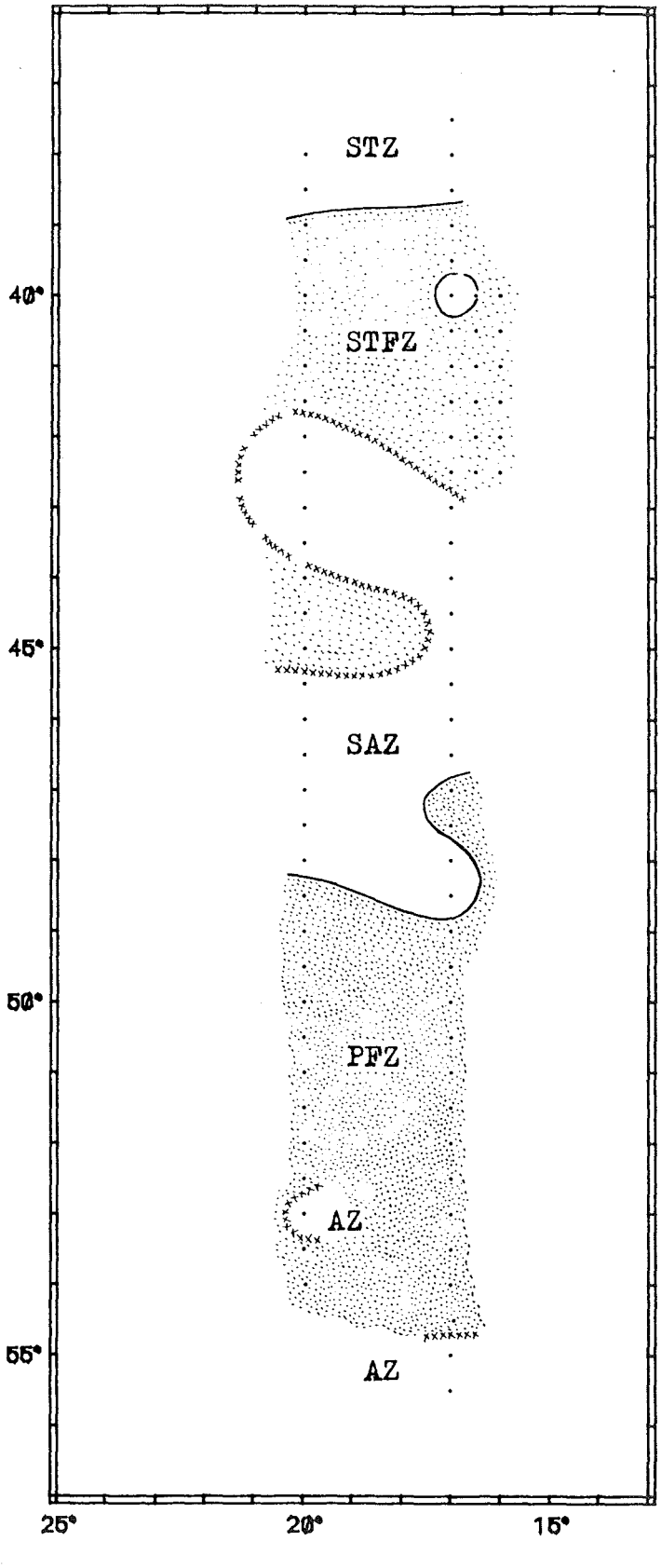


Figure 5: Boundaries of latitudinal zones: STZ - Subtropical zone; STZF - Subtropical Frontal zone; SAZ - Sub-Antarctic zone; PFZ - Polar Frontal zone; AZ - Antarctic zone.

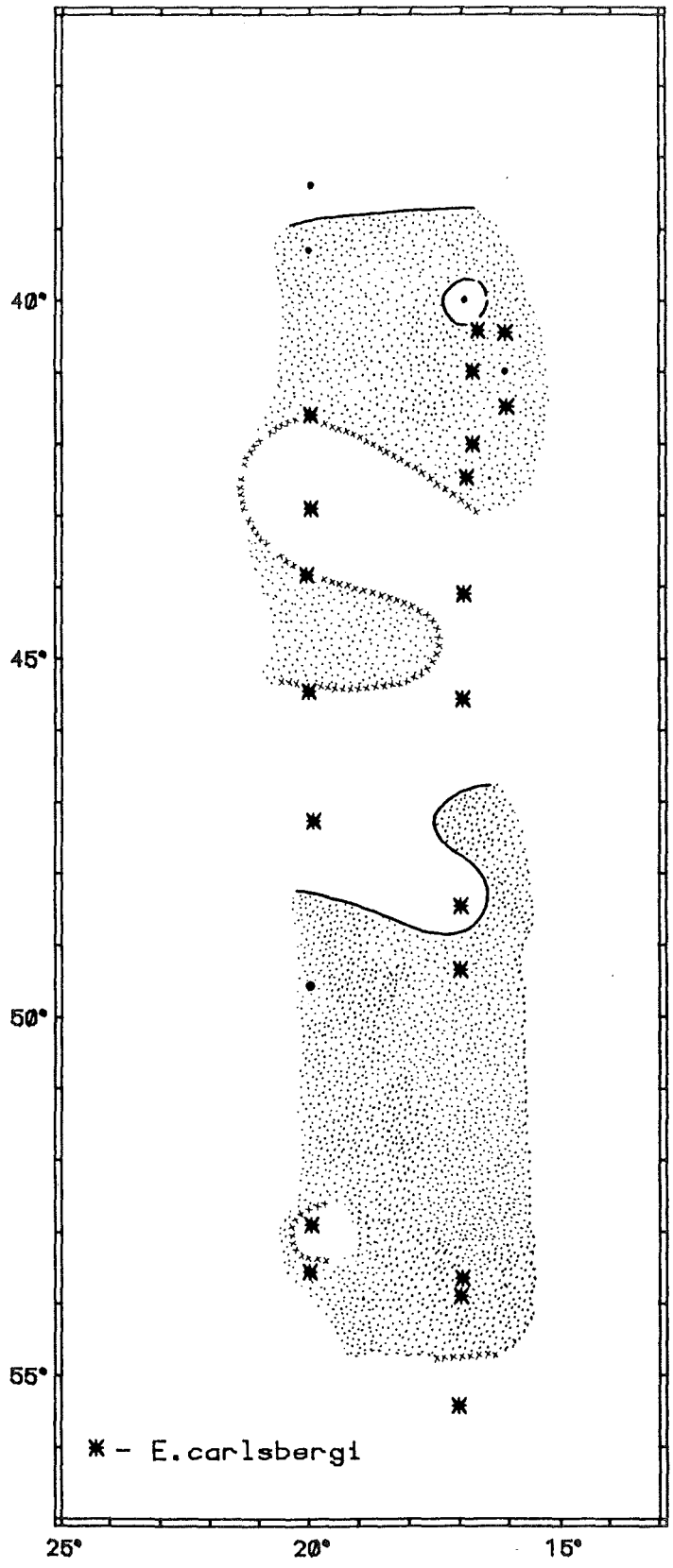


Figure 6: Distribution of *E. carlsbergi* catches along longitudinal transects.

- • non-representative hauls,
- * catches containing *E. carlsbergi.*

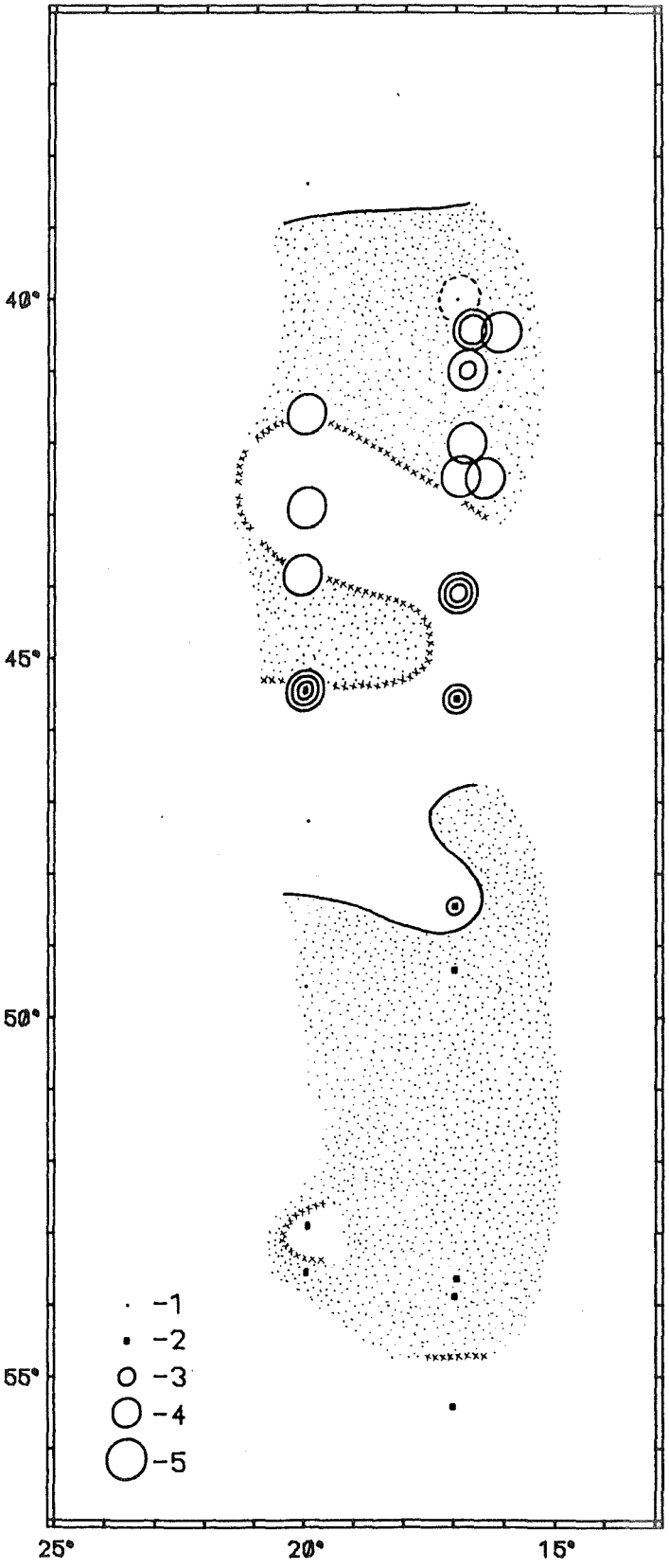


Figure 7: Distribution of female *E. carlsbergi* at various stages of maturity. 1 - non-representative hauls; 2, 3, 4, 5 - females at maturity Stages II, III, IV, V respectively.

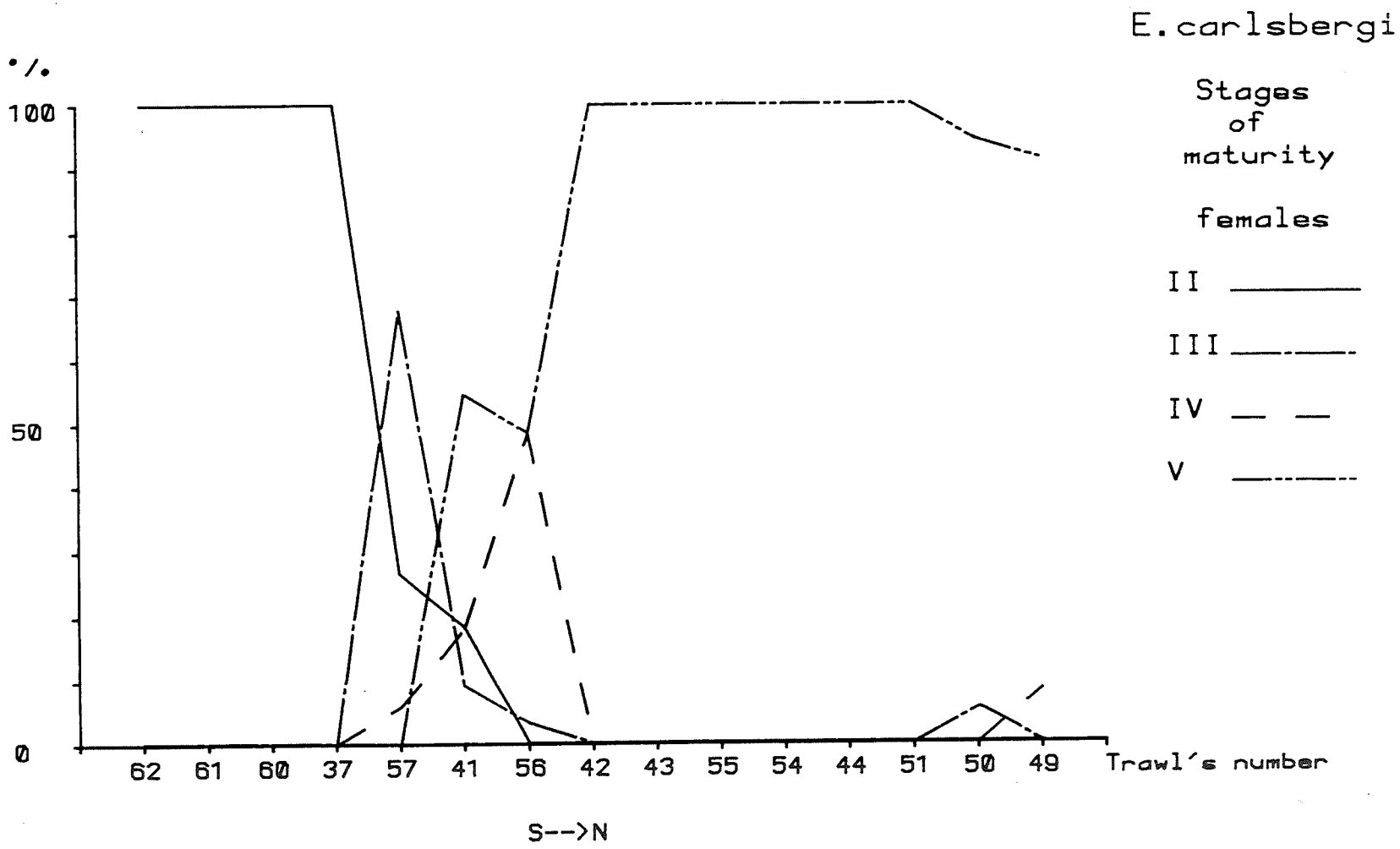


Figure 8: Percentages of males and females of *E. carlsbergi* in trawl catches at different maturity stages.

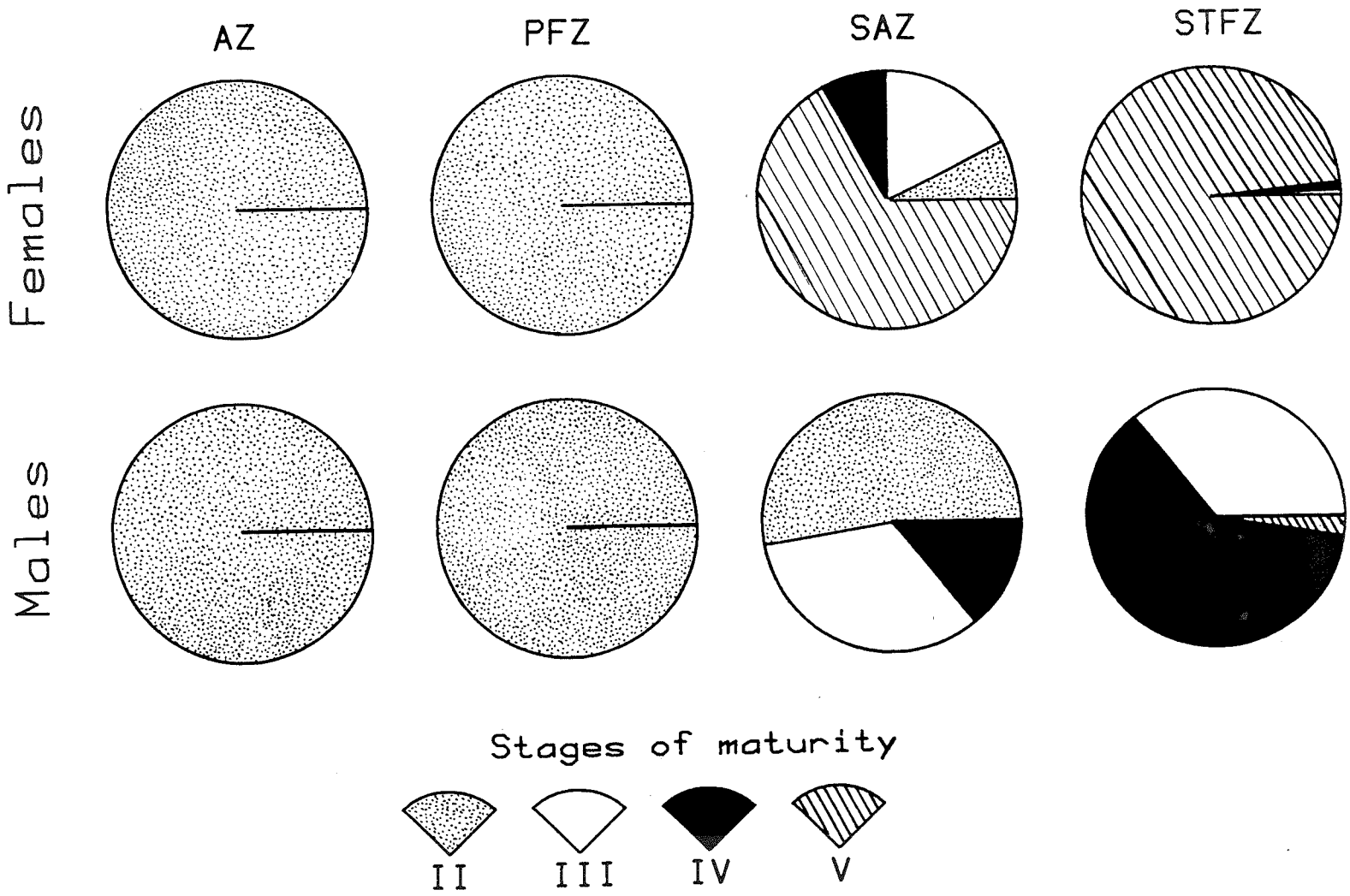


Figure 9: Percentages of males and females of *E. carlsbergi* at different maturity stages by latitudinal zones.

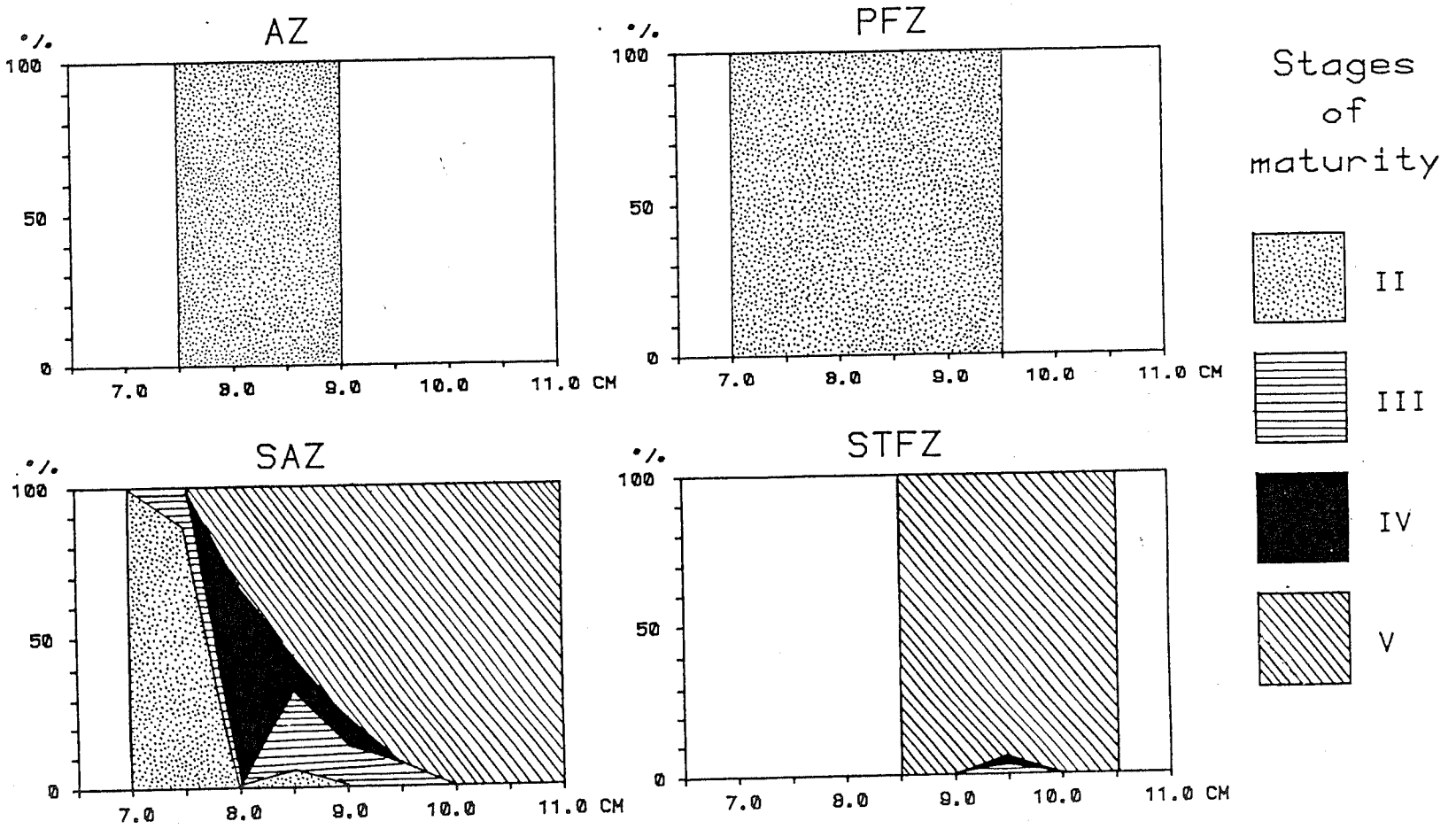


Figure 10: Percentages of females of *E. carlsbergi* at different maturity stages by latitudinal zones and fish lengths.

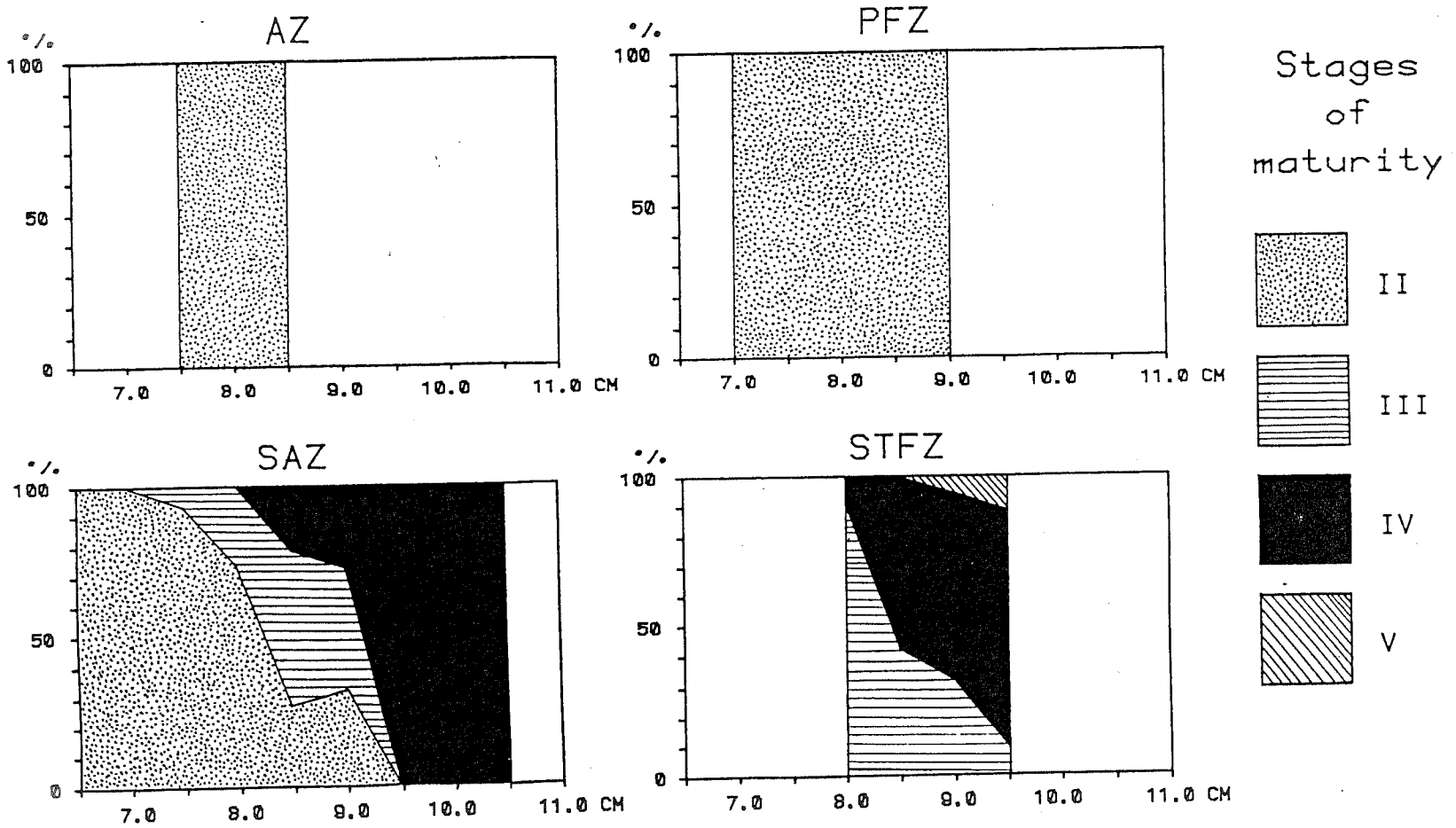
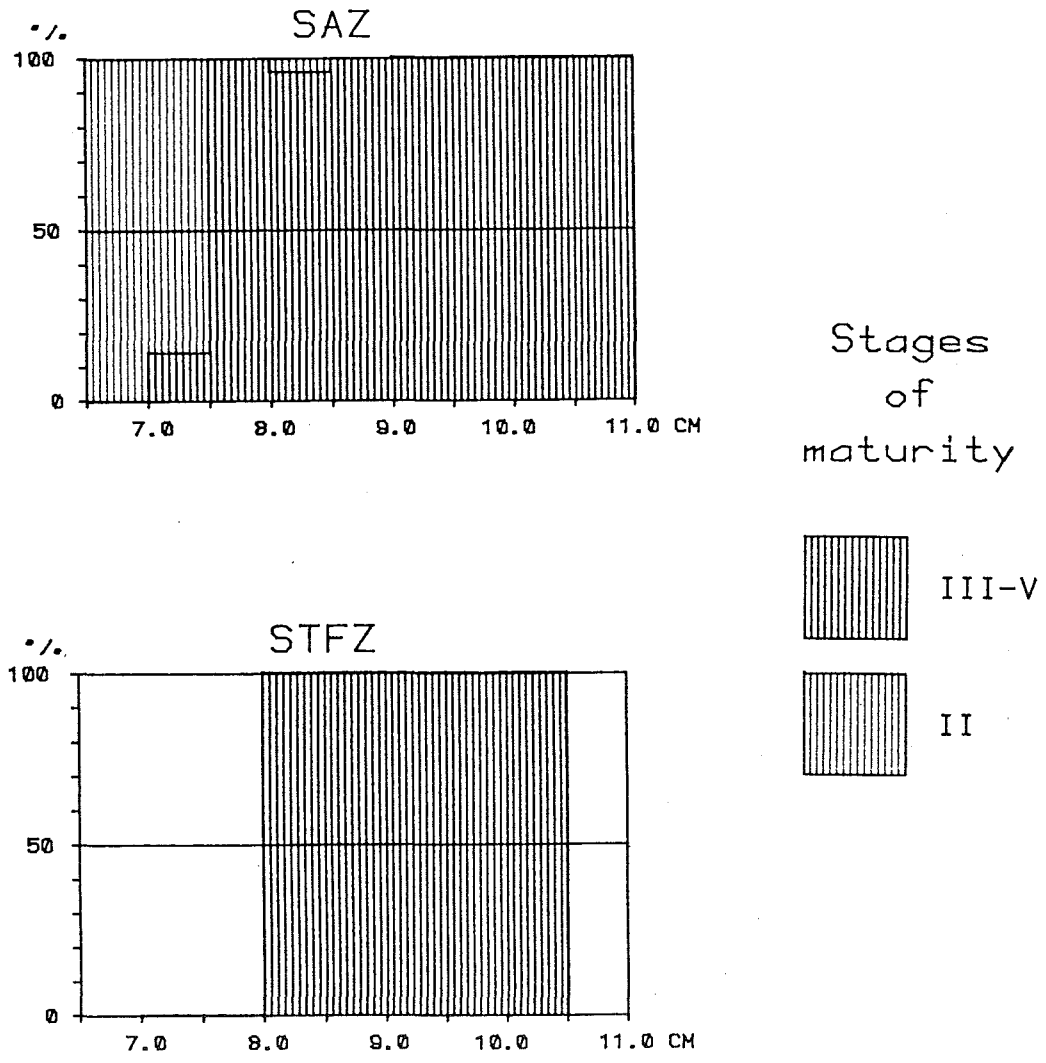


Figure 11: Percentage of males of *E. carlsbergi* at different maturity stages by latitudinal zones and fish lengths.



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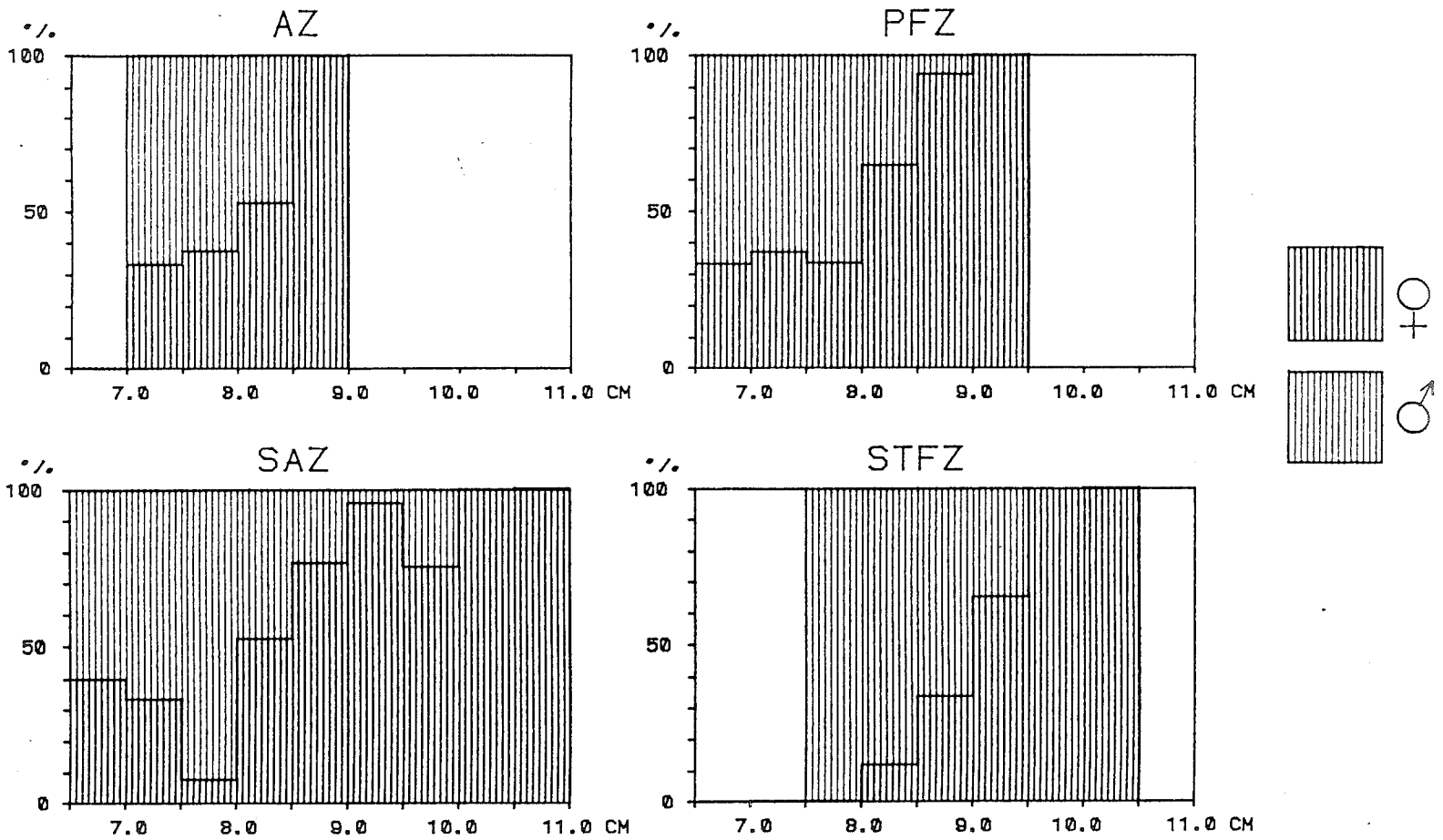

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