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MYSIDACEA
OF THE NORTH ATLANTIC

BY

P.M. HARGREAVES

REPORT NO. 264

1989

Natural Environment Research Council

INSTITUTE OF OCEANOGRAPHIC SCIENCES
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DOCUMENT DATA SHEET

AUTHOR
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PUBLICATION DATE 1989

TITLE
Mysidacea of the North Atlantic.

REFERENCE
Institute of Oceanographic Sciences Deacon Laboratory, Report, No.264, 64pp.

ABSTRACT

The vertical and horizontal distributions of the dominant species of Mysidacea in the North Atlantic Ocean are described based on data from net sampling carried out by the Biology Department of the Institute of Oceanographic Sciences Deacon Laboratory during 1969-1985. The data are drawn from samples taken with a Rectangular Midwater Trawl (RMT 8). These include vertical distributions data at various stations at 10° - 60°N, close to the 20° - 25°W meridians; at the Azores front; at five stations ranging from near Bermuda to 54°N; at three other stations between 39° and 46°N where seasonal fronts occur and at one station at Great Meteor East (31°N, 25°W). Data on infrequently occurring species at these stations are summarized. Species occurrences and abundances in oblique hauls from four other transects of stations in the North eastern Atlantic are given.

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KEYWORDS
ATLANTIC(N)
BIOLOGY
MYSIDACEA

CONTRACT
PROJECT
PRICE £18.00

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INTRODUCTION

This report is one of a series summarizing the Institute of Oceanographic Sciences Deacon Laboratory Biology Department data on vertical distribution of plankton and micronekton in the Northeastern Atlantic Ocean, some of which has been used in previous publications. It describes the geographical and vertical distribution of mysids recorded at several stations between 11°N and 60°N. Previous publications based on the samples, but describing distributions of various groups of macroplankton and micronekton, are to be found in ANGEL and FASHAM (1975), FASHAM and ANGEL (1975), BADCOCK and MERRETT (1977), PUGH (1975, 1977, 1986) and JAMES (1987). Data on the distribution of mysid species in various regions of the Atlantic have been given by TATTERSALL and TATTERSALL (1951), TATTERSALL (1955), MAUCHLINE and MURANO (1977), MAUCHLINE (1980, 1982), ROE (1984), HARGREAVES, et al. (1984), HARGREAVES (1985a) and ROE et al., (1987). Now with additional data it is possible to provide further detailed information on the horizontal and vertical distribution of mysids.

MATERIALS AND METHODS - HORIZONTAL HAULS

The overall sampling methods will be described in detail in a companion report (Institute of Oceanographic Sciences Deacon Laboratory (IOSDL) unpublished data), which will summarize information otherwise scattered in various National Institute of Oceanography or Institute of Oceanographic Sciences cruise reports. Prior to the late 1970's specimens were caught with the IOS midwater trawl (RMT 1+8), (BAKER et al,1973; ROE, et al., 1980) which simultaneously collected macroplanktonic and micronektonic samples. The present report describes data from the RMT 8 which has a nominal mouth area of $8m^2$ and a mesh size of 4.5mm. The nets are opened and closed acoustically via a net monitor which activates the release gear. Information on the depth of the net and its velocity is telemetered back to the ship. Since the late 1970's a multiple version of the RMT 1+8 has been used for sampling (ROE and SHALE 1979). Here three pairs of $1m^2$ and $8m^2$ nets are deployed within the same framework and can be operated in sequence at the required depths. The main logistic advantage is that there is a considerable saving in ship time spent on launching and retrieving the nets. It also improves the sampling strategies because the time spent between samples is greatly reduced.

At each station samples were taken systematically so that the whole water column between the near-surface and maximum depth was sampled. During the

earlier cruises (1969-1972) day and night samples were taken to certain maximum depths (see Table 1). During later cruises this sampling strategy was continued except that, more usually, depths below 900m were sampled irrespective of the time of day. Generally nets were fished at 100m depth intervals in the top 900-1000m but at 200m, 250m or 500m intervals below this depth.

So as to simplify the presentation of data in this report, the cruises are categorised into five groups depending on geographic position and/or sampling strategy. These are described in subsections (i-v) below and summarised in Table 1. At each station complementary Conductivity/Temperature/Depth (CTD) or Temperature/Salinity/Depth (TSD) profiles were obtained and these will be summarised in a companion IOSDL data report.

i) During 1969-1972, at various times of the year, a series of horizontal hauls were taken at six positions, approximately at 10° intervals of latitude between 11°N and 60°N and close to the 20°-25°W meridians, (Fig. 1 positions A-F). At each position samples were taken from the surface to a maximum depth of 2000-2500m, with the exception of the station at 18°N where the maximum was 1250m. For cruise reports see DAVID (1970), DAVID et al.,(1971; 1972) and FOXTON (1971).

ii) To provide further information on species vertical or horizontal distribution, during 1973/1979 samples were taken at several sites to maximum depths of 1500-4000m. These included one site in the Rockall Trough, two in the Porcupine Seabight, one site over the Azores/Biscay Rise, and one in oceanic water near to Bermuda, (Fig. 1, positions G-K). For cruise reports see DAVID and SWALLOW (1973), ANGEL (1978) and HERRING et al.,(1979).

iii) During May/June 1981 (Cruises 120/121) five stations were worked near to the Azores front within the area 30°-35°N, 30°-34°W, (Fig. 1, positions L-P, maximum depth 1400-2300m). The front delineates the edge of what is believed to be the southern branch of the south-easterly flowing N. Atlantic Drift/Gulf Stream which meanders in the region studied possibly as a result of the influence of seamounts, (GOULD 1982, 1985; KASE and SEIDLER (1982). Western Atlantic Water (WAW) can be distinguished from Eastern Atlantic Water (EAW) by the 15-16°C isotherm depth. To investigate changes in patterns of species distribution across the front one station was worked in the frontal zone (position N), one in WAW (L), one in EAW (P), one in an eddy of EAW (O), which

had pinched off from the meander a month earlier, and one in WAW inside one of the meanders (M). Details of sampling are given in cruise reports (FASHAM et al., 1981; ANGEL et al., 1981b).

During October/November 1980 prior to cruises 120/121 three stations were worked in the Azores front area to a maximum depth of 1100m (cruise 114, Fig. 1, positions Q-S). One station was worked in EAW (position S), and one in mixed EAW/WAW (R). In addition what was thought to be WAW was sampled but this was later found also to be mixed EAW/WAW (Q). However, the data obtained from all these positions proved to be useful to provide a seasonal comparison with the more recently acquired data from the frontal area. For details of sampling see IOS Cruise Report No. 108 (ANGEL 1981a).

iv) During March/April 1984 at 39°-46°N, 14°-15°W samples were collected to maximum depths of 800-1800m in order to study changes in the structure of the oceanic community where hydrographic stratification in the epipelagic and upper mesopelagic zone periodically results in a series of weak fronts. Details of sampling are given in IOS Cruise Report No. 168 (ANGEL et al., 1984). A series of hauls was taken in the vicinity of 39°N, 15°W and was repeated at the same position two - three weeks later (positions U,V respectively). A third series of samples was obtained at 45° - 46°N, 14°W (T), (Fig. 1). The two series at T and U were inadequate for a quantitative assessment of mysid species because poor weather conditions prevented sampling. However, the sampling at position V extended deep into the water column providing useful comparative data with other samples.

v) During June/July 1985 samples were collected at the Great Meteor East, in the vicinity of 31°N 25°W to a maximum depth of 5000m as part of a study, commissioned by the Department of the Environment, on the vertical distribution of macroplankton and micronekton between the surface and the sea floor and on general environmental conditions. For details of sampling see ROE et al., (1986; 1987).

In this report the vertical abundances of the dominant species at each station are illustrated by histograms of data standardised to numbers per 10,000m^3 of water filtered. The maximum depth shown is 2000m, (night data are shaded).

During some of the earlier sampling precise flow measurements were not made and for these samples flow has been standardised based on the duration of the haul assuming that the speed of nets was a constant 2 knots. The scales for the histograms vary between series according to the total numbers caught, rare occurrences are indicated with a + sign,(NS = No sample at this depth). Although the specimens were caught with opening/closing trawls some contamination of deep samples may occur by leakage when the net is closed, either en route to or from its fishing depths. However, the characteristics of the profiles imply that the amount of contamination is very low. Data from the 20° - 25°W series of stations were derived from the IOS Data Base (DOMANSKI, 1981) and only total numbers are available. The more recent data presented are analysed in more detail and include information on maturity stages.

With regard to the taxonomy, historically there has been some confusion over the designation of some Eucopia species. NOUVEL (1942a) considered that Eucopia unguiculata Willemöes-Suhm (1875) should be split into two species which he named Eucopia hanseni and Eucopia grimaldii. TATTERSALL and TATTERSALL (1951), while agreeing that E. grimaldii was a valid species, considered that E. hanseni was a junior synonym of E. unguiculata. The latter nomenclature is adopted here. Generally the arrangement and the number of spines on the telson of E. unguiculata were as described by TATTERSALL & TATTERSALL (1951), however there were occasionally slight variations seen.

With regard to life-history stages, there was no difficulty in sexing most species, but late juveniles of Eucopia were difficult to sex. The problem was further exacerbated by the occasional parasitic castration of some specimens. Specimens of Eucopia with well-developed or developing oostegites are classified as females. Mature specimens without oostegites and with well-developed pleopods and gills are classified as males, all other specimens are classified as juveniles.

DISTRIBUTION PATTERNS - HORIZONTAL HAULS

A species list and summary of distributions is given in Appendix I.

Eucopiidae

Eucopia was by far the most common genus of mysid sampled with the RMT 8 net in the mesopelagic zone. E. unguiculata, E. grimaldii and E. sculpticauda were

well represented. Distributions are described below under various subheadings according to sampling positions, (see Fig. 1 and Table 1).

Eucopia unguiculata (W.-Suhm 1875)

This species occurred throughout the sampling positions A-Z mainly between 500m and 1200m depth. At some stations there was a limited diel vertical migration of 100m or so. Vertical and geographic distributions at the various sampling positions are described below.

i) 20°-25°W (Positions A-F, (Fig. 2 (I))

E. unguiculata occurred between 11°N and 60°N (A-F) but was most abundant at 11°N (A), 40°N (D), and 60°N (F) with values of >50 specimens per $10^4 m^3$ water filtered. By day most specimens occurred between 500m and 1000m except at 30°-40°N (C and D) where the depth range extended to 1250/1500m. Several specimens also were found in deeper hauls but it is not clear whether these were contaminants. A slight diel vertical migration of 100m occurred at positions A and D but not at E or F. Temperature data for depths at which maximum numbers occurred at positions A-F are given in Table 2, the majority of specimens were found at temperatures of 6.8-10.7°C.

ii) off-Bermuda, Azores/Biscay Rise, Porcupine Seabight, Rockall Trough (Positions G-K, Figs 4, 5)

E. unguiculata occurred at positions H-K but was relatively sparse off Bermuda (G). Total numbers per $10^4 m^3$ are shown in Fig. 4 (1). Specimens occurred mainly in the 400-1500m depth range with maximum numbers of >50 specimens per $10^4 m^3$ between 700 and 1100m (H-K). A slight diel vertical migration appeared to have occurred at positions H-I. There were several specimens in hauls from below 1500m. The distribution of juveniles is given in Fig. 4 (II) with, by day, most specimens occurring below 700m except at position H where they were mainly below 500m. Males (Fig. 5 (I) and females (Fig. 5 (II) had similar overall depth ranges to the juveniles but a greater proportion of adults extended deeper.

iii) Azores front (Positions L-P, Figs 9, 10, Q-S Figs 16-17).

E. unguiculata occurred at all sampling positions L-P across the front with

broadly similar totals at four of the sampling sites (Fig. 9 (I), M-P), maximum values exceeding 35 specimens per 10^4m^3. However, there were far fewer specimens in WAW (L) where numbers did not exceed 10 specimens per 10^4m^3 by day or night. By day specimens were at 500-1200m, with maximum numbers at 800/900-1100m. The distribution of adult males and females are shown in Fig. 10 (I and II)). Both sexes had similar depth distributions but slightly more females than males were recorded. Juveniles were found mainly at 500-1000m with maximum numbers at 800-900m. A very limited diel vertical migration, mainly by adults occurred at three of the five positions (Fig. 9 (I)).

At positions Q-S E. unguiculata occurred below 600m by day. There was evidence for a slight vertical diel migration. Total numbers were broadly similar at Q and S (Fig. 16 (I)) with maximum values by day and night exceeding 40 specimens per 10^4m^3. The distribution of adult males and females are shown in Fig. 17 (I & II)); there were slightly fewer adults at position R (mixed EAW/WAW) than at Q and S. Juveniles were found mainly between 700 and 900m, (Fig. 16 (II)).

iv) Cruise 146 (Positions T-V, Figs 18, 19)

At position V, E. unguiculata was recorded in moderate numbers. By day it was mainly at 600m to at least 1400m with maxima of 70-80 specimens per 10^4m^3; there was evidence for a slight diel vertical migration. The water column at position U was sampled down to only 1100m (day) and 700m (night), values at these depths were similar to those at position V.

v) Great Meteor East, (Position W, Figs 21, 22)

By day E. unguiculata was mainly at 800-1200m with maximum values of 17 specimens per 10^4m^3 at 1000-1100m, (Fig. 21 (I)). By night the distribution pattern was similar but there was evidence of a slight upward diel migration over a depth range of about 100m. The vertical distribution of juveniles, males and females are given in Figs 21 and 22.

Eucopia grimaldii Nouvel, 1942

This species was recorded at most sampling positions at a depth range between 600m and 1500m. However, it was most abundant between 40°N and 60°N becoming more sparse to the south of the sampling area. Distributions at the

various sampling positions are described below.

i) 20°-25°W (Positions A-F (Fig 2 (II))

E. grimaldii occurred at all positions between 11°N and 60°N (A-F). It was most abundant at 40°-60°N and was sparse to the south of 30°N. Most specimens were found between 600m and 1500m (D-F) and there was no evidence for diel migration. Temperature data are given in Table 2.

ii) off-Bermuda, Azores/Biscay rise, Porcupine Seabight, Rockall Trough (Positions G-K, Figs 6, 7)

E. grimaldii occurred at positions H-K but was relatively sparse off Bermuda (G). Total numbers are given in Fig. 6 (1). Specimens occurred mainly at 900-1500m with maximum numbers at 1100-1300m (H-I). There was no evidence for diel vertical migration. The distribution of juveniles is shown in Fig. 6 (II). Males (Fig. 7 (I) and females (Fig. 7 (II) had similar overall depth ranges to the juveniles but a greater proportion of the population extended deeper.

iii) Azores front (Positions L-P (Figs 11, 12)

Relatively few specimens of E. grimaldii were recorded. Total numbers tended to be greatest in EAW (P) but here values did not exceed 5-6 specimens per $10^4 m^3$ by day or night. In EAW the depth range extended mainly from 1000-1500m and there was no evidence for diel migration. Generally juveniles had a similar depth range to the adults but, within this range, the majority tended to occupy shallower depths than adults.

iv) Azores front Cruise 114 (Positions Q-S) and Cruise 146 (Positions T-V)

Relatively few of this relatively deep-living species were recorded as, except at one position (S), the sampling depths did not exceed 1100m.

v) Great Meteor East (Position W Figs. 21 and 22).

A few specimens were found in day or night hauls mainly between 1200m and 1500m. Occurrences were intermittent and did not exceed 2 specimens per $10^4 m^3$

water filtered.

Eucopia sculpticauda Faxon 1893

This species was recorded at most sampling positions at a depth range between 600m and 1500m. However, it was most abundant between 11°N and 40°N, becoming more sparse to the north of the sampling area. Distributions at the various sampling positions are described below.

i) 20°-25°W (Positions A-F, Fig. 3)

E. sculpticauda was found at all positions between 11°N and 60°N (A-F) but was most abundant at 11°N - 40°N. Most specimens occurred at 600-800m but there was considerable variation in the extent of the lower depth range, the average being 1200-1500m. There was no evidence for diel vertical migration (Fig. 3). Temperature data are given in Table 2.

ii) Off-Bermuda, Azores/Biscay Rise, Porcupine Seabight, Rockall Trough (Positions G-K, Fig. 8)

E. sculpticauda occurred at positions G-K but was relatively sparse. Total numbers of adults per 10^4m^3 are shown in Fig. 8 (I). Specimens occurred mainly at 900-1500 and there was no evidence for diel vertical migration. The distribution of juveniles is given in Fig. 8 (II). They were relatively sparse and seemed to have similar distributions to the adults.

iii) Azores front (Positions L-P Figs 13, 14; Q-S)

Relatively few specimens were recorded in WAW (L) with values of <3 specimens per 10^4m^3 in any haul. At positions M-P, which include the front station and EAW, daytime values reached a maximum of 7-8 specimens per 10^4m^3. By night values were greatest at the front station and in EAW reaching a maximum of 16 specimens per 10^4m^3. The depth range extended mainly from 800m to 1400m; there was no evidence for diel vertical migration. Juveniles tended to occur at 800-1100m while most of the adults were recorded at 900-1400m. E. sculpticauda was recorded at positions Q and S (day and night) and at position R (night) mainly at 700-1100m with maximum values of 20 specimens per 10^4m^3. Juveniles were slightly more abundant at position S with values of up to 8 specimens per 10^4m^3. Relatively few adults were recorded and the majority were at positions Q

and S.

iv) Cruise 146 (Positions T-V, Fig. 20)

At positions T-V data for E. sculpticauda confirmed previous observations that the species is present in low-moderate numbers at these latitudes (Fig. 20).

V) Great Meteor East (Position W, Figs 21,22)

By day most E. sculpticauda were at 900-1400m with maximum values of 4 specimens per $10^4 m^3$ at 1000-1100m, (Fig. 21). By night the distribution pattern was similar and there was no evidence for diel vertical migration. The distribution patterns for males females and juveniles is given in Figs 21 and 22).

Eucopia australis

Azores front (Positions L-P) and Great Meteor East (Position W)

At the Azores front several specimens of this rare deep-living species were recorded deeper than 1000m; generally the samping was too shallow to obtain a quantitative assessment of this species.

At Great Meteor East this species were found intermittently at 1200-3500m. The adults tended to be large and fragile and were distinguishable only by subjective features such as the size and maturity of the specimens, shape of the eye and the formation of the spines on the telson. Generally this species was found at several other locations in deep water.

Lophogastridae

Gnathophausia

20°-25°W (Positions A-F), the Azores front (Positions L-S), Cruise 146 (Positions T-V) and Great Meteor East (Position W).

The genus Gnathophausia was well represented in the mesopelagic and bathypelagic zones. A detailed analysis of the geographic and vertical distribution of four species is in preparation (HARGREAVES, unpublished data) A summary is given below.

Gnathophausia zoea occurred mainly at 53°-60°N (E-F) but was rare at stations sampled to the south of 40°N. By day most specimens were at 600-1000m and several large specimens were taken in hauls down to 2000m. The data confirm TATTERSALL's (1955) observations that juveniles tend to live at shallower depths than adults. Generally there was slight diel vertical migration by part of the population. Gnathophausia gigas occurred at all positions between 30°N and 60°N (C-F) but was relatively uncommon. It had a bathypelagic distribution occurring intermittently at depths between 900-2000m (the lower limit of sampling).

Gnathophausia gracilis was found only at 11°-30°N (A-C) in very low numbers and below 1000m. Gnathophausia ingens also occurred infrequently and was taken mainly in hauls at 11°-30°N between 700 and 2000m by day. Juveniles tended to live at shallower depths than adults. By night juveniles and adults were found in the upper 500m.

At the Azores front (Positions L-P) Gnathophausia were represented in the mesopelagic and bathypelagic zones; a summary of the vertical distribution across the front of the Gnathophausia and other species is given in Table 6. The mesopelagic/bathypelagic species G. zoea was rare (M,P, 800-1000m). G. ingens was recorded at all except the EAW station (P). The latter species occurred intermittently mainly at 800-1000m by day and at 300-700m by night. In contrast the bathypelagic species G. gigas occurred at all stations except WAW (L). With one exception it was always recorded below 1000m (Fig. 15). G. gracilis was also rare and was found only at positions L, N and P, below 1000m (Fig. 15). At positions Q-S one specimen of G. gigas occurred in mixed EAW/WAW whilst, in contrast to data from positions L-P, G. ingens was recorded in EAW. During cruise 146 (positions T-V) G. ingens was recorded.

At Great Meteor East (W) a few G. ingens were recorded at 800-1000m (day) and at 300-400m (night). Three juveniles of the deeper-living G. gracilis occurred at 1200-1400m (day).A summary of the distribution of Gnathophausia species is given in Appendix I.

Lophogaster

The genus Lophogaster was relatively sparse. L. spinosus was found mainly between 30°N and 41°N with values not exceeding 3 specimens per $10^4 m^3$. Diel vertical migration was apparent specimens occurring between 100m and 900m by day and between 50m and 500m by night. Most specimens occurred in WAW at the Azores

front (see Table 6). A summary of the distribution of L. spinosus is given in Appendix I. No other species were recorded with the exception of Lophogaster cf. typicus of which a damaged specimen occurred at position (G).

Paralophogaster

Occurrences were rare. Two specimens of Paralophogaster glaber occurred off Bermuda. Two specimens cf.Paralophogaster atlanticus occurred at the Azores front.

Chalaraspidum

Several specimens of Chalaraspidum cf. alatum occurred at 11°-18°N (A-B) below 700m.

Other species of mysid

20°-25°W (Positions A-F), Off-Bermuda, Azores/Biscay Rise, Porcupine Seabight, Rockall Trough (Positions G-K), Azores front (Positions L-S), Cruise 146 (Positions T-V), Great Meteor East (Position W).

Boreomysis was the second most common genus recorded in samples from the eastern North Atlantic. At positions D-F Boreomysis microps was dominant with highest numbers recorded between 600m and 1250m (Table 3); also there were occasional occurrences at 11°N. Boreomysis bispinosa was very sparse occurring at 11° and 53°N mainly below 1250m. Boreomysis illigi and Boreomysis acuminata were recorded at 11°N (A). Maximum numbers of B. illigi were at 700-800m. B. acuminata was sparse and was recorded from below 900m. Most other species were relatively sparse in RMT 8 hauls. A summary listing of infrequently occurring species at positions A-F is given in Table 4.

At Rockall Trough, Porcupine Seabight, and the Azores/Biscay Rise (H-K) most other species occurred infrequently and their distributions were described previously by HARGREAVES (1985a, 1985b). Infrequently occurring species from the sampling site off Bermuda (G) are given in Table 5.

At the Azores front (L-P) most other species of Mysidacea occurred infrequently and a summary of their numbers and distribution is given in Table 6. During the earlier sampling at the front (Q-S) species occurrence was consistent with that shown in Table 6 except that Siriella thompsonii was found at depths up to 600m (day) and 1100m (night). During Cruise 146 (T-V) several

species were recorded. These included B. microps which occurred intermittently at 1000m and 1800m (day and night) and one specimen at 700-800m (night). Meterythrops picta occurred at 700-800m (T, night) and at 1300-1400m (V, day).

At Great Meteor East (W) Boreomysis species were relatively sparse but catches included the deep-living Boreomysis inermis below 3000m. Other species of Boreomysis were present but the specimens were damaged in the net and so were not identifiable with certainty. Other mysids included Euchaetomera typica which was recorded at 500-600m (day) and Siriella thompsoni which occurred at 1300-1400, (night) and was probably a contaminant from near-surface.

MATERIALS AND METHODS - OBLIQUE HAULS

A series of oblique RMT 8 hauls were taken between the surface and selected depths across four different lines of stations in the North Atlantic (Fig. 23). They were as follows:-

i) During February/March 1973 twelve oblique hauls were taken across an east-west transect between the surface and 1000m at 32°N 16°W-60°W. (Stations 8262-8279, line X).

ii) During April/May 1978 two north-south lines of stations were worked to investigate the possible effects of a series of weak intermittent hydrographic fronts on species distribution. Six oblique hauls between 10m and 1000m were taken at latitudes 42°-48°N and close to longitude 13°W (stations 9785-9790, line Y (1). A further eight oblique hauls, between 10m and 1000m were worked at latitudes 42°-50°N, close to longitude 17°W (Stations 9792-9799, line Y(2)).

iii) In April 1984 three further sets of RMT 8 oblique hauls were made at each of five stations between 39°32'N, 14°56'W and 45°53'N, 13°39'W (line Z). At each station hauls were made at 0-100m, 100-600/700m and 600/700m-1000m.

Full details of the RMT 8 net, sampling procedures, nomenclature and criteria used in the sexing of species are as described for the horizontal hauls.

DISTRIBUTION PATTERNS - OBLIQUE HAULS

Transect X (Figs 23-24)

Eucopia unguiculata was the dominant species throughout the transect. However, it was more numerous in hauls conducted to the east of the sampling area (maximum of 8-12 specimens per 10^4m^3 at stations 8262-8265), and numbers decreased progressively towards the station off Bermuda. Other species occurred relatively infrequently. Eucopia grimaldii was generally sparse but was most abundant to the west of the sampling area with a maximum of <1 specimen per 10^4m^3 at Stations 8276-8279. Eucopia sculpticauda was slightly more abundant towards the east with a maximum of 1.5 specimens per 10^4m^3 at Station 8262. Most other species were recorded too infrequently to assess further any changes in species composition from east to west.

Lines Y(1) and Y(2) and Z (Figs 23, 25, 26, 27)

Very little variation was seen in species distribution associated with changes in latitude. Eucopia unguiculata was the most abundant species with values of up to 35 specimens per 10^4m^3 on lines Y and with values of up to 84 specimens per 10^4m^3 at 44-46°N on line Z. The deep-living Eucopia grimaldii was recorded in moderate numbers in hauls to the north of 45°N on line Y(2) but it was sparse throughout line Y(1) and not found on Line Z. Eucopia sculpticauda was relatively sparse on lines Y but more abundant to the south of Line Z. Other species, most of which occurred infrequently showed no obvious distribution patterns. Boreomysis microps was recorded in low to moderate numbers intermittently along lines Y-Z but was slightly more abundant to the north of line Y(2) while Katerythrops oceanae was also recorded mainly to the north. Gnathophausia zoea was present intermittently in very low numbers.

DISCUSSION AND SUMMARY

This report provides an overview of the horizontal and vertical distribution of Mysidacea in the North Atlantic. Results from the RMT 8 hauls showed Eucopia unguiculata to be the dominant mysid species in the mesopelagic zone down to about 1000m and there was no obvious change in abundance with increasing latitude. It is clear that to the north of the area sampled Eucopia grimaldii was the dominant species at about 1000-1500m. However, to the south numbers of this species decreased while those of Eucopia sculpticauda gradually increased. For E. unguiculata there was a diel vertical migration at some stations.

However, this appears to be limited and diel vertical migration may remain undetected by the present sampling methods (PEARRE, 1979; ROE, 1984).

Although some species were recorded intermittently, combined data from the various cruises provided a pattern of their distribution. Clearly Boreomysis microps was abundant to the north. Many Boreomysis species are known to be bathypelagic (see HARGREAVES, 1985a) and it is surprising that more were not recorded at abyssal depths in Great Meteor East hauls. The four species of Gnathophausia recorded showed a clear pattern in distribution in that they were each confined to certain geographic or vertical ranges which tended not to overlap. For ease of reference all species recorded at positions A-Z (Fig. 28) are given in Appendix 1 together with key references.

Results from the Azores front stations were consistent with other data from these latitudes. The front represents a physical boundary between EAW and WAW, the latter being characterised partly by its low productivity (FASHAM et al., 1985). In terms of the presence or absence of species there is little to distinguish the populations of mysids in EAW to those in WAW. However, it is clear that the numbers of specimens are far fewer in WAW. A few infrequently occurring species seemed to predominate at given stations within the frontal area. With regard to transect X at 32°N, one might have expected a change in species composition or abundance from east to west associated with various water masses (see PUGH, 1975), however, these changes were slight. A few rare species tended to occur to the west of the transect but further data are needed to confirm this.

CASANOVA (1977) showed that morphological variations are seen in given species of Eucopia from different areas of the north Atlantic. This study revealed slight variations in the number of spines, on the telson of E. unguiculata, throughout the sampling area and this requires further investigation. It is hoped that these data will be useful for further analyses.

ACKNOWLEDGEMENTS

I wish to thank Mr. P. Foxton and Mr. C. Hayes who analysed the 20°-25°W material and Dr M.V.Angel who analysed the cruise 114 material. I also wish to thank colleagues who assisted in the collection of specimens and Dr. M.V. Angel, Dr. P.R. Pugh and Dr. J. Mauchline who advised on the manuscript.

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Table 1. Horizontal hauls: summary of the main sampling positions in the northeastern Atlantic (Positions A - W).

	Station	Position		Month/year	Max. depth sampled (m)	
(i)	7824	11°N 20°W	(A)	March 1972	2000	Day and/or night
	7089	18°N 25°W	(B)	Nov. 1969	1250	Day and night
	7856	30°N 23°W	(C)	Mar/Apr1972	2500	
	7406	40°N 20°W	(D)	Oct/Nov 1970	2500	
	7711	53°N 20°W	(E)	May/June 1971	2000	
	7709	60°N 20°W	(F)	April/May 1971	2000	
(ii)	8281	32°N 64°W	(G)	March 1973	3500	Day and/or night
	9801	42°N 17°W	(H)	May 1978	4000	
	9791	50°N 14°W	(I)	May 1978	1500	Day and/or night
	10115	50°N 14°W	(J)	Sept 1979	1500	
	10105	54°N 13°W	(K)	Aug/Sept 1979	1900	
(iii)	10380	30°N 34°W	(L)	June 1981	2300	Day and/or night
	10378	32°N 30°W	(M)	June 1981	1400	Day and night
	10376	33°N 33°W	(N)	May 1981	1700	Day and/or night
	10382	33°N 32°W	(O)	June 1981	1400	
	10379	35°N 33°W	(P)	June 1981	1700	Day and night
	10233	32°N 32°W	(Q)	Nov. 1980	1100	Day and night
	10222	30°N 30°W	(R)	Oct. 1980	1100	Day and/or night
	10228	33°N 32°W	(S)	Nov. 1980	1100	Day and night
(iv)	11050-11058	46°N 14°W	(T)	April 1984	800	Day and/or night
	11036-11047	39°N 15°W	(U)	Mar/April 1984	1095	
	11078-11095	39°N 15°W	(V)	April 1984	1800	
(v)	11261	31°N 25°W	(W)	June/July 1985	5000	Day and/or night

Table 2. Temperature at positions A-F (11°-60°N) at which maximum numbers of *Eucopia* species occur.

Time of year	Lat.° N	Long.° W	*E.unguiculata* Temperature °C	*E.grimaldii* Temperature °C	*E.sculpticauda* Temperature °C
March	11°	20°	7.0	5.1	6.3
November	18°	25°	7.5	6.0	7.0
April	30°	23°	8.7	7.1	9.0
Oct/Nov	40°	20°	10.7	7.4	7.0
May/June	53°	20°	6.8	5.5	4.8
April/May	60°	20°	7.0	4.3	6.0

Table 3. Occurrence of Boreomysis microps at 40°-60°N, 20°-25°W (Positions D-F). Numbers per $10^4 m^3$ water filtered.

Latitude	DAY		NIGHT	
40°N	Nos.	Depth (m)	Nos.	Depth (m)
	0.15	605-700	0.15	600-700
	-	700-800	4.71	700-790
	9.85	805-900	7.12	810-900
	3.10	900-1000	3.36	910-1000
	8.76	990-1250	7.19	1010-1250
	3.93	1250-1500	18.20	1260-1500
	3.87	1500-2000	1.78	1500-2000
53°N	3.14	410-500	6.62	400-500
	23.43	500-600	18.57	500-600
	30.71	605-700	54.84	605-700
	50.43	700-805	50.85	700-800
	34.40	800-900	40.63	800-900
	34.86	900-1000	27.54	900-1000
	19.90	1010-1250	1.15	1020-1250
	3.28	1260-1500	3.36	1250-1500
	0.29	1520-2000	0.15	1500-2000
60°N	-	200-300	0.14	205-300
	-	300-400	-	300-400
	-	405-500	0.75	405-500
	8.79	500-600	18.57	495-590
	24.60	600-700	45.19	600-700
	28.57	710-800	32.98	705-800
	20.30	810-900	27.40	800-900
	26.14	910-995	29.19	900-1000
	29.38	1010-1250	28.50	1000-1250
	14.60	1250-1500	13.00	1250-1500
	4.84	1525-2000	3.10	1520-2000

Table 4. Some relatively rare mysid species in the 20°-25°W #. (Positions A-F). Nos. per $10^4 m^3$ water filtered.

Species	Latitude (Position)	DAY Nos.	DAY Depth (m)	NIGHT Nos.	NIGHT Depth (m)
Chalaraspidum spp.	11°(A)	0.14	895-1000	0.21	1000-1250
		0.21	1000-1250	0.14	1250-1500
		-	-	0.14	1500-2000
	18°(B)	0.15	700-790	-	-
		0.15	910-1020	-	-
Arachnomysis megalops	18°(B)	-	-	0.60	200-300
Euchaetomera spp.	18°(B)	0.14	305-400	-	-
	30°(C)	0.53	200-300	0.14	200-300
		-	-	0.12	300-400
		-	-	0.70	400-500
	40°(D)	0.15	400-500	-	-
Caesaromysis hispida	18°(B)	8.18	300-400	9.17	210-300
		-	-	1.28	300-400
		-	-	0.71	410-500
		-	-	0.72	505-600
Katerythrops spp.	18°(B)	-	-	0.15	700-785
	30°(C)	0.14	500-600	-	-
	40°(D)	0.14	805-900	0.14	1000-1250
		0.43	910-1000	-	-
	53°(E)	1.26	400-500	1.31	400-500
		0.85	500-600	0.85	500-600
		-	-	0.15	600-700

Table 4 contd.

Species	Latitude (Position)	DAY Nos.	DAY Depth (m)	NIGHT Nos.	NIGHT Depth (m)
Katerythrops spp. (contd)	60°(F)	0.18	600-700	0.18	400-500
		0.15	800-900	0.14	495-590
		-	-	0.14	600-700
		-	-	0.41	700-800
Lophogaster spinosus	30°(C)	0.41	500-700	2.18	100-200
		-	-	0.28	200-300
		-	-	0.12	300-400
	40°(D)	-	-	0.15	110-195
Meterythrops picta	40°(D)	0.15	600-700	0.14	700-790
		1.03	805-900	0.12	1010-1265
		0.43	910-1000	-	-
		0.14	990-1250	-	-
		0.08	1250-1500	-	-
	53°(E)	1.50	400-500	1.02	400-500
		2.70	500-600	0.56	500-600
		3.13	600-700	1.09	600-700
		1.28	700-800	1.71	700-800
		0.14	800-900	0.79	800-900
		0.14	900-1000	0.29	900-1000
		0.07	1010-1250	0.07	1250-1500
		0.07	1520-2000	-	-
	60°(F)	0.57	500-600	0.94	400-500
		1.38	600-700	1.28	495-590
		0.99	700-800	2.39	600-700
		0.45	800-900	3.35	700-800
		1.01	910-995	2.32	800-900
		0.07	1000-1250	0.74	900-1000
		0.14	1250-1520	-	-
		0.07	1525-2000	-	-

Table 4 contd.

Species	Latitude (Position)	DAY Nos.	DAY Depth (m)	NIGHT Nos.	NIGHT Depth (m)
Longithorax fuscus	40°(D)	-	-	0.07	1260-1500
	53°(E)	0.14	800-900	1.59	900-1000
		1.38	900-1000	0.72	1020-1250
		0.92	1010-1250	-	-
		0.07	1260-1500	-	-
	60°(F)	0.42	910-995	0.14	900-1000
		-	-	0.18	1000-1250
		-	-	0.09	1520-2000
Petalophthalmus spp.	53°(E)	0.07	1010-1250	-	-

Table 5. Infrequently occurring species at Station 8281 (Position G). Nos. per $10^4 m^3$ water filtered.

Species	DAY		NIGHT	
	Nos.	Depth (m)	Nos.	Depth (m)
Arachnomysis leuckarti	0.29	190-300		
Boreomysis microps	2.07	1010-1250	1.04	905-1000
	0.82	1260-1500	1.37	1000-1250
	0.03	2500-3500	1.21	1250-1500
Eucopia australis	0.15	1260-1500	-	-
	0.06	2500-3500	-	-
Euchaetomera tenuis	0.17	405-500	0.30	405-505
Euchaetomera intermedia	-	-	0.14	205-300
Longithorax fuscus	0.07	1010-1250	0.15	1250-1500
Longithorax nouveli	0.29	700-800	0.46	605-700
	0.15	800-1000	-	-
Siriella thompsonii	-	-	0.14	205-400
	-	-	0.45	405-505
Gnathophausia gigas	0.21	1010-1250	0.14	1000-1250
	0.07	1250-1500	0.38	1250-1500
Lophogaster cf. typicus	0.03	2500-3000	-	-
Lophogaster spinosus	0.28	600-700	0.28	295-400
	0.29	700-800	0.15	405-505
Paralophogaster glaber	-	-	0.28	205-300

Table 6. Infrequently occurring species at the Azores front stations (L-P), nos per $10^4 m^3$ water filtered
D = Day, N = Night.

Species	L 10380 WAW		M 10378 W MNDR		N 10376 FRONT		O 10382 E. EDDY		P 10379 EAW	
	Nos	Depth(m)	Nos	Depth(m)	Nos	Depth(m)	Nos	Depth(m)	Nos	Depth(m)
Arachnomysis leuckarti	-	-	-	-	0.30	5-40D	-	-	-	-
					0.34	60-200D				
Boreomysis microps	-	-	0.23	1000-1100D	0.23	1095-1205D	-	-	0.83	1100-1200D
			0.21	1097-1200N	0.23	1295-1400D			0.68	1300-1400D
									0.41	1400-1500D
									0.35	1000-1100D
									0.46	1295-1400N
									0.69	1400-1495N
Euchaetomera tenuis	-	-	-	-	0.20	300-400D	-	-	0.21	300-400D
					0.23	1295-1400D			0.21	400-500D
					0.28	200-300N			0.75	400-500N
					1.04	400-500N	-	-	-	-
Euchaetomera typica	-	-	0.21	300-400D	0.69	60-200D	0.33	0-50N	0.86	50-100D
			0.32	52-105N	0.57	200-300N			0.67	50-100N
			0.35	105-200N						
Euchaetomera intermedia	-	-	-	-	0.17	60-200D	-	-	-	-
Katerythrops sp.	-	-	-	-	0.35	705-805N	-	-	0.21	900-995D
Meterythrops sp.	-	-	-	-	0.20	900-1005D	-	-	-	-
Siriella thompsonii	-	-	-	-	0.30	5-40D	0.42	300-400D	-	-
Gnathophausia gigas	-	-	0.43	1200-1295N	0.25	1100-1200N	0.50	1100-1200N	0.23	995-1100D
			0.47	1290-1415N	0.70	1398-1500N	0.30	1200-1300N	0.40	1100-1200D
					0.28	1498-1600N			0.40	1300-1400D
									0.32	900-1000N
									0.88	1100-1200N
									0.20	1200-1295N
									0.42	1495-1600N
Gnathophausia gracilis	0.23	1100-1200D	-	-	0.23	1100-1200D	-	-	0.21	1200-1300D
	0.21	1200-1300D			0.40	1400-1500D				
	0.23	1120-1200N			0.23	1300-1400N				
Gnathophausia ingens	0.44	900-1000D	0.64	800-900D	0.21	795-900D	0.20	800-900D	-	-
	0.35	400-500N	0.34	300-405N	0.30	300-400N	0.70	900-1000D		
			0.31	602-700N						
Gnathophausia zoea	-	-	0.32	902-1000N	-	-	-	-	0.20	800-900D
Lophogaster spinosus	0.24	400-500D	0.22	705-800D	-	-	-	-	0.33	50-100N
	2.12	500-600D	1.03	200-300N						
	1.06	600-700D								
	0.24	700-800D								
	0.21	800-900D								
	0.69	100-205N								
	1.33	300-400N								

Appendix 1. List of some Atlantic species and the positions at which they were recorded, (RMT8 net)

Species	Positions	References
Arachnomysis leuckartii Chun, 1887	G,N,S	Tattersall & Tattersall, 1951; Murano, 1977.
Arachnomysis megalops Zimmer, 1914	B	Zimmer, 1914; Murano, 1977.
Boreomysis microps G.O. Sars, 1883	A,D-K,M,N,P,S,T,V,X-Z	Tattersall & Tattersall, 1951
Boreomysis acuminata O. Tattersall, 1955	A	O. Tattersall, 1955
Boreomysis bispinosa O. Tattersall, 1955	A,E,H	" " "
Boreomysis illigi O. Tattersall, 1955	A	" " "
Boreomysis tridens G.O. Sars, 1870	F	Tattersall & Tattersall, 1951
Boreomysis inermis (W.-Suhm), 1874	W	G.O. Sars, 1885b
Chalaraspidum sp. W.-Suhm, 1895	A,B	
Caesaromysis hispida Ortmann, 1893	B	Banner, 1948; O. Tattersall, 1955; Murano, 1977.
Euchaetomera intermedia Nouvel, 1942	G,N,X	Nouvel, 1942b
Euchaetomera tenuis G.O. Sars, 1883	C,G,J,K,N,P,X	Ii, 1964
Euchaetomera typica G.O. Sars, 1883	J,M-S,W,X	Ii, 1964
Eucopia australis Dana, 1852	G,H,L-P,V,W,	Banner; 1954
Eucopia grimaldii Nouvel, 1942	A-S,U-Z	Tattersall & Tattersall, 1951

Appendix 1 contd

Species	Positions	References
Eucopia sculpticauda Faxon, 1893	A-S,U-Z	Tattersall & Tattersall, 1951
Eucopia unguiculata (W.-Suhm, 1875)	A-Z	" " " "
Gnathophausia gigas W.-Suhm, 1875	C-J,M-P,R,V	" " " "
Gnathophausia ingens (Dohrn,1870)	A-D,L-O,Q,S-W,X,Z	G.O. Sars, 1885a
Gnathophausia gracilis W.-Suhm, 1975	A-C,L,N,P,W	G.O. Sars, 1885a
Gnathophausia zoea W.-Suhm, 1875,	D-F,H-K,M,P,Y-Z	Tattersall & Tattersall, 1951
Katerythrops oceanae Holt & Tattersall, 1905	D-F,H-K,N,P,Y,X	" " " " Ii, 1964
Longithorax alicei Nouvel, 1942	R	Nouvel, 1942b
Longithorax fuscus Hansen, 1908	D-K,S,V,Y	Tattersall & Tattersall, 1951; Murano, 1976
Longithorax cf. nouveli O. Tattersall, 1955	G,X,	O. Tattersall, 1955; Murano, 1976
Lophogaster spinosus Ortmann, 1906	C,D,G,L,M,P,Q,R,U-X	Fage, 1942
Meterythrops picta Holt and Tattersall, 1905	D-F,H,J,K,Q,S,T,V,Z	Tattersall & Tattersall, 1951; Ii, 1964
Paralophogaster glaber Hansen, 1910	G,X	Hansen, 1910
Paralophogaster atlanticus W. Tattersall, 1937	Q	W. Tattersall, 1937
Petalophthalmus sp. (W.-Suhm, 1875)	E,H	
Siriella thompsonii M. Edwards, 1837	G,N,O,Q-S,X	Ii, 1964

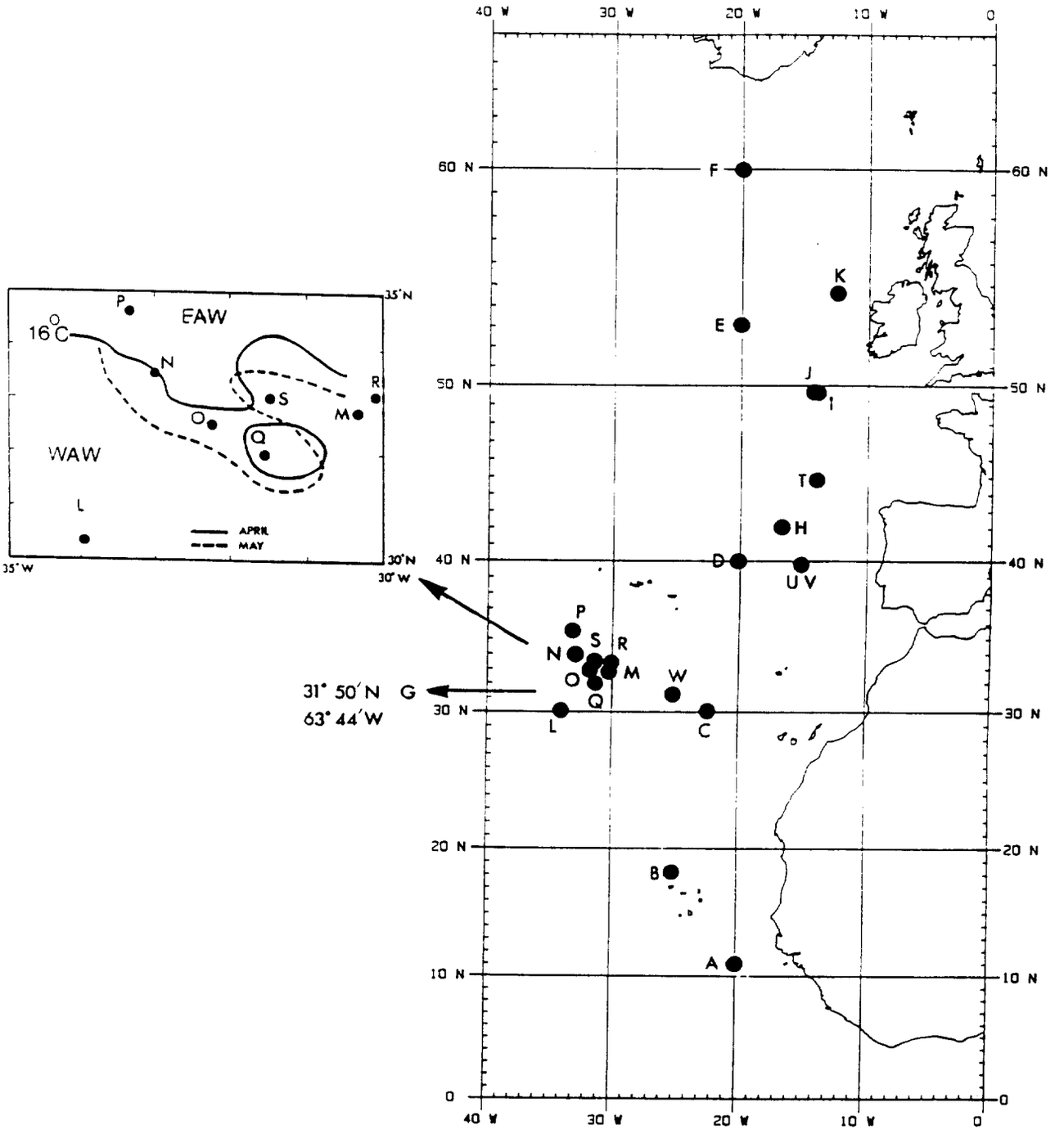

Fig. 1. Positions A-W. Inset: positions L-P Azores front (1981) defined by the location of the 16°C isotherm at 200m.

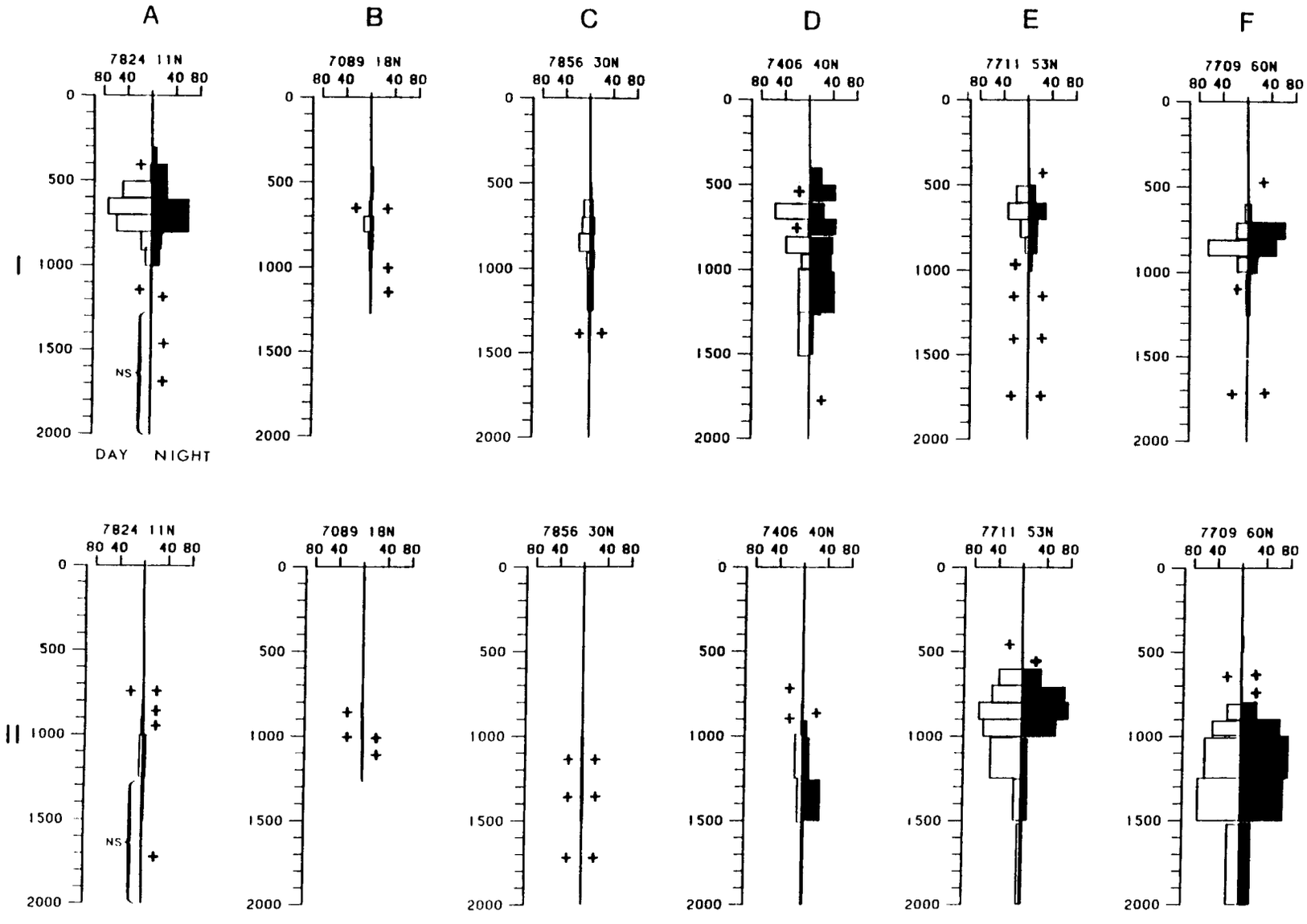

Fig. 2. The geographic and vertical distribution of species at positions A-F; I. Eucopia unguiculata; II Eucopia grimaldii, total numbers per $10^4 m^3$ (RMT 8).

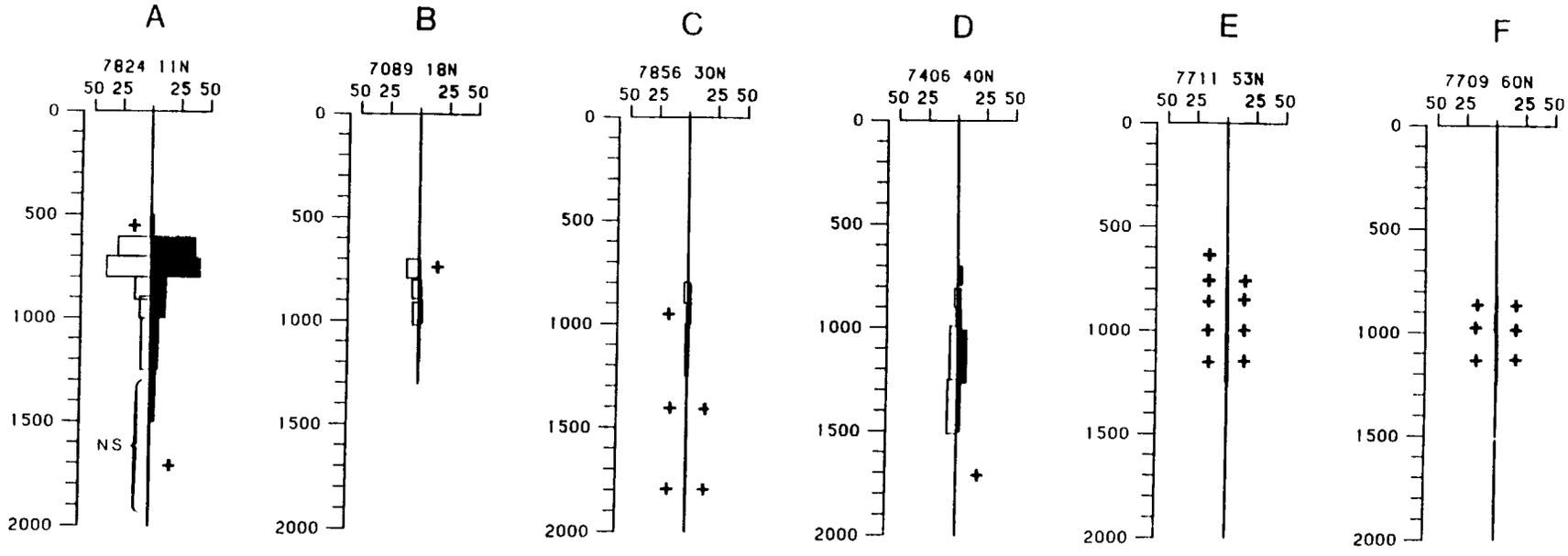

Fig. 3. The geographic and vertical distribution of Eucopia sculpticauda at positions A-F; total numbers per $10^4 m^3$ (RMT 8).

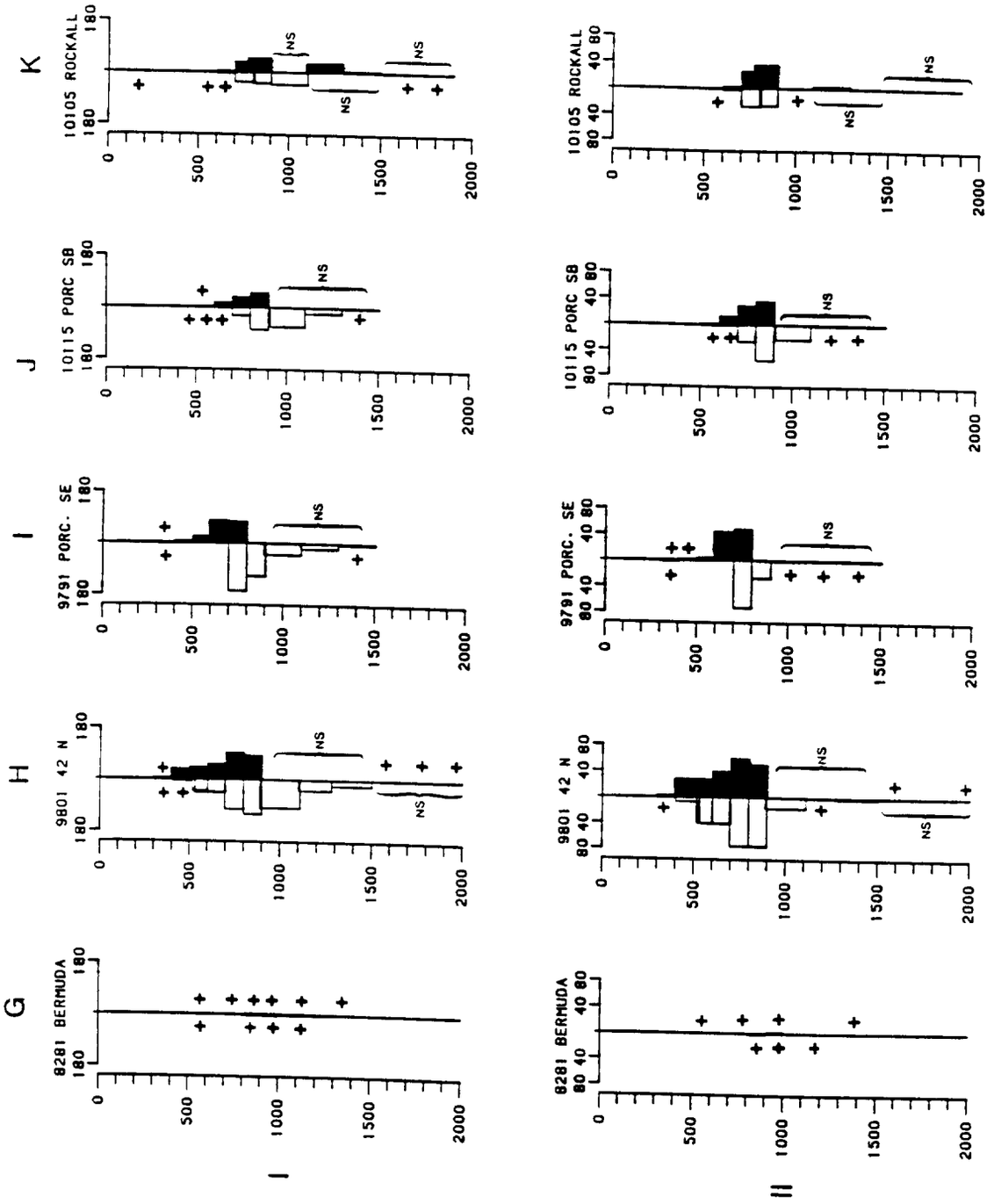

Fig. 4. The geographic and vertical distribution of Eucopia unguiculata at positions G-K; I. Totals. II. Juveniles, numbers per $10^4 m^3$ (RMT 8).

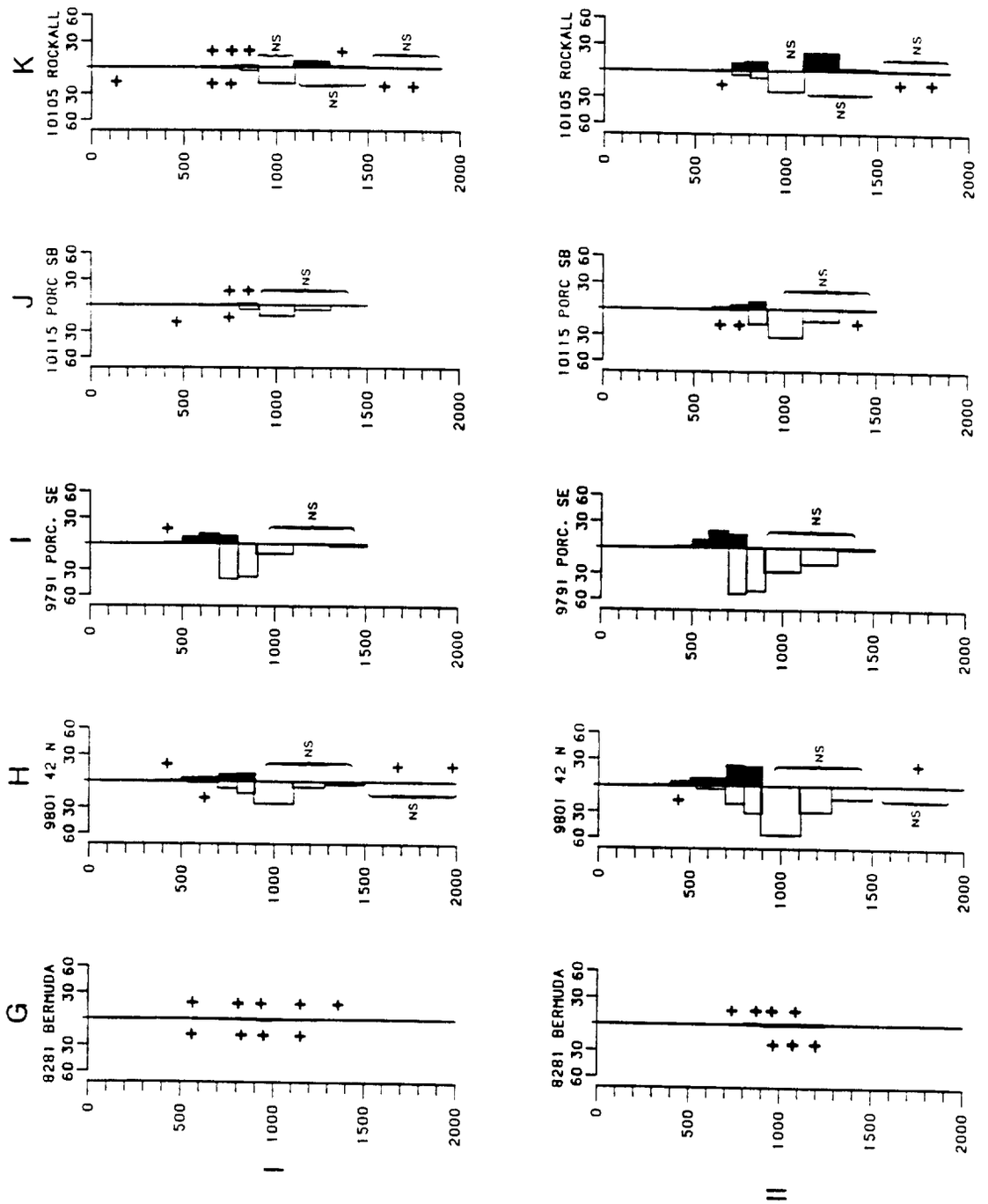

Fig. 5. The geographic and vertical distribution of Eucopia unguiculata at positions G-K; I. Males, II. Females, numbers per $10^4 m^3$ (RMT 8).

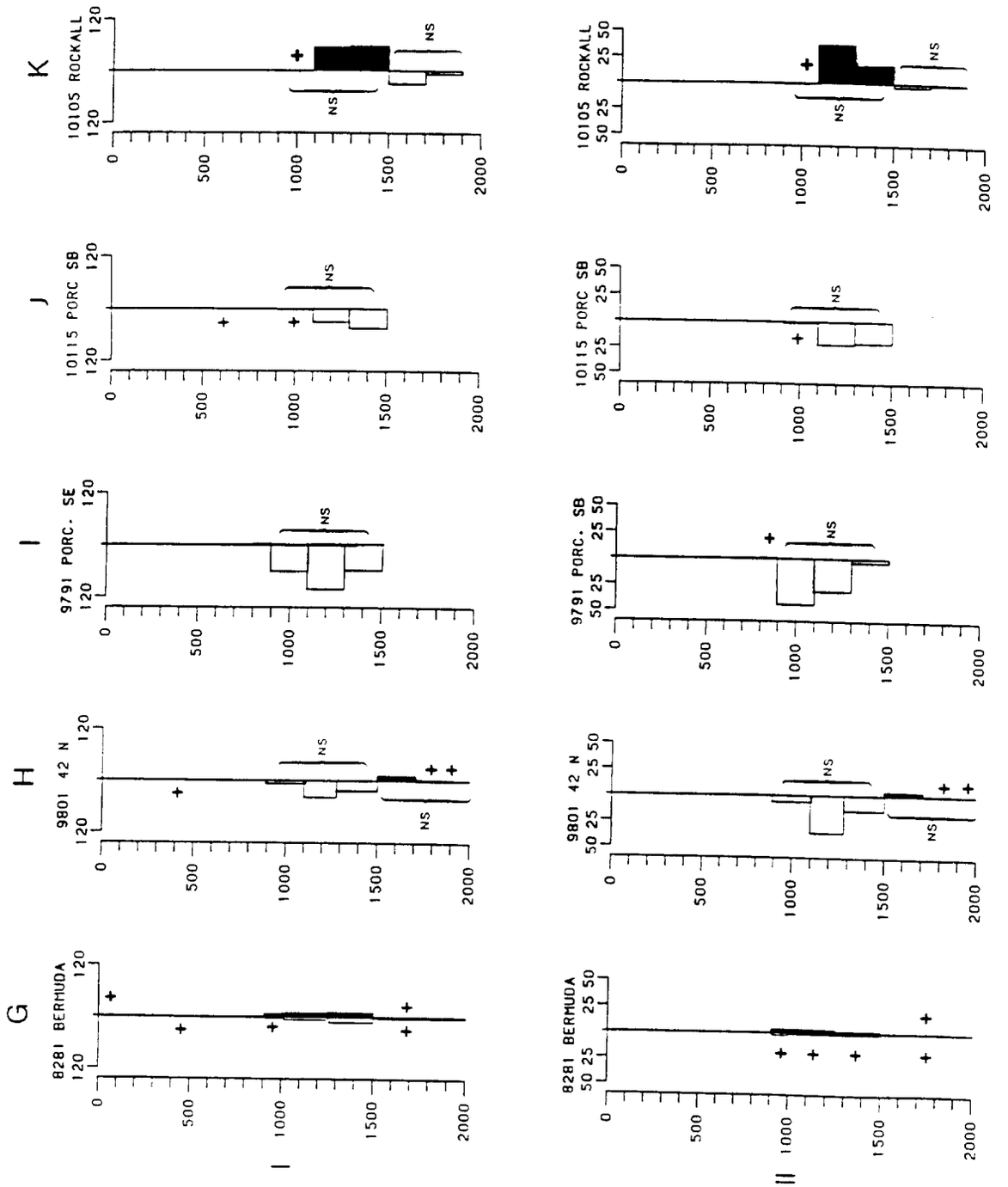

Fig. 6. The geographic and vertical distribution of Eucopia grimaldii at positions G-K; I. Totals II. Juveniles, numbers per $10^4 m^3$ (RMT 8).

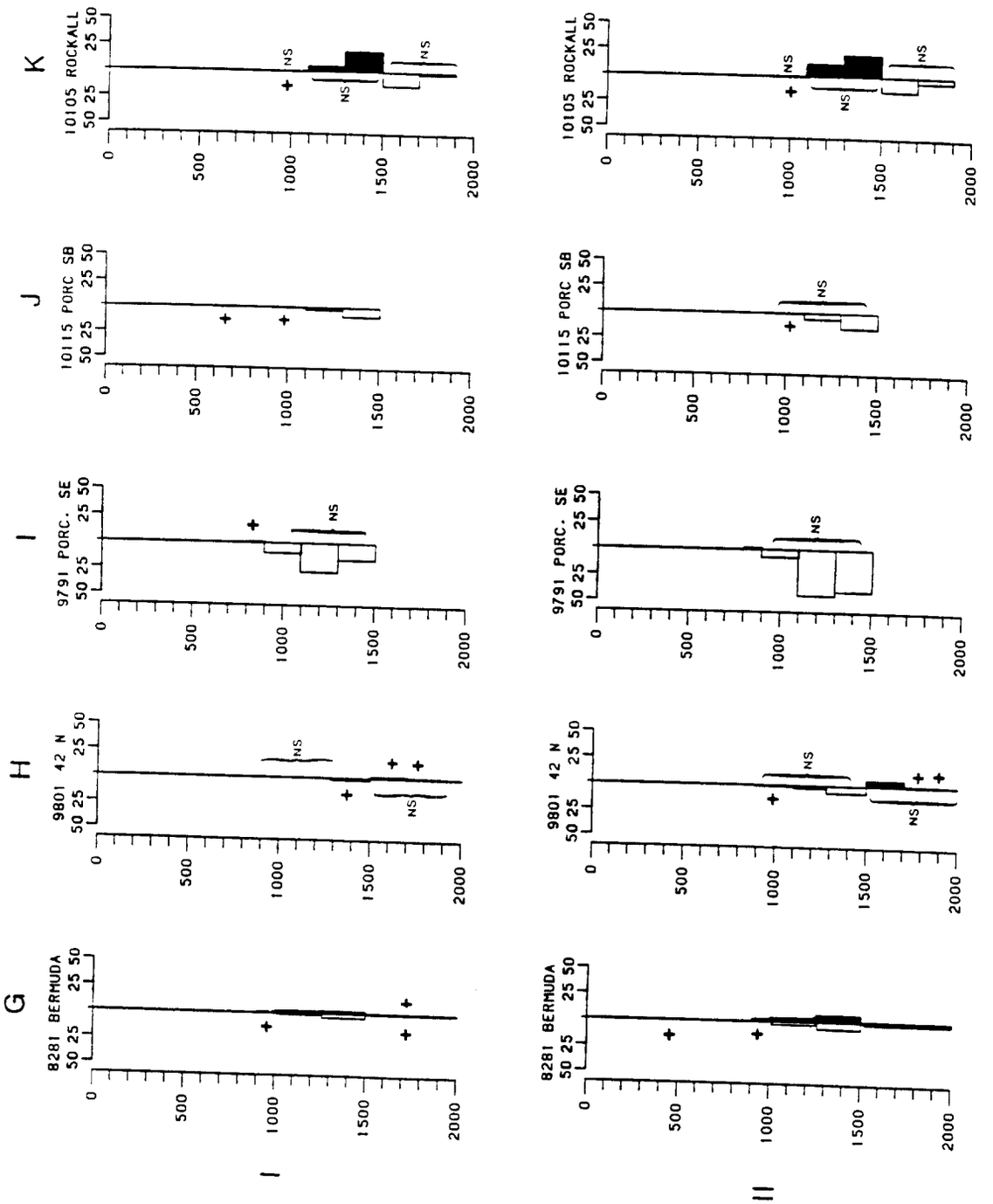

Fig. 7. The geographic and vertical distribution of Eucopia grimaldii at positions G-K; I. Males, II. Females, numbers per $10^4 m^3$ (RMT 8).

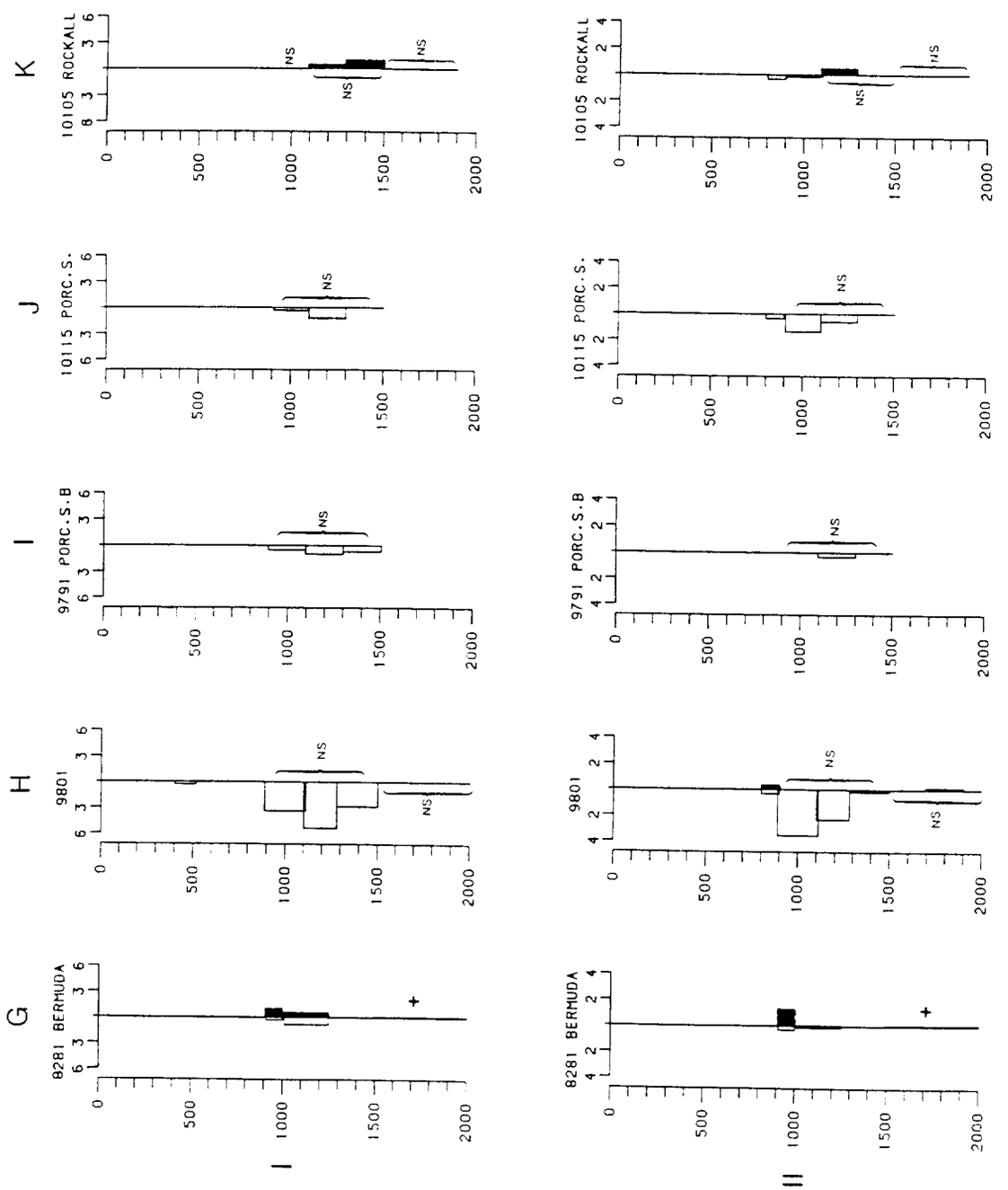

Fig. 8. The geographic and vertical distribution of Eucopia sculpticauda at positions G-K; I. Adults, II. Juveniles, numbers per $10^4 m^3$ (RMT 8).

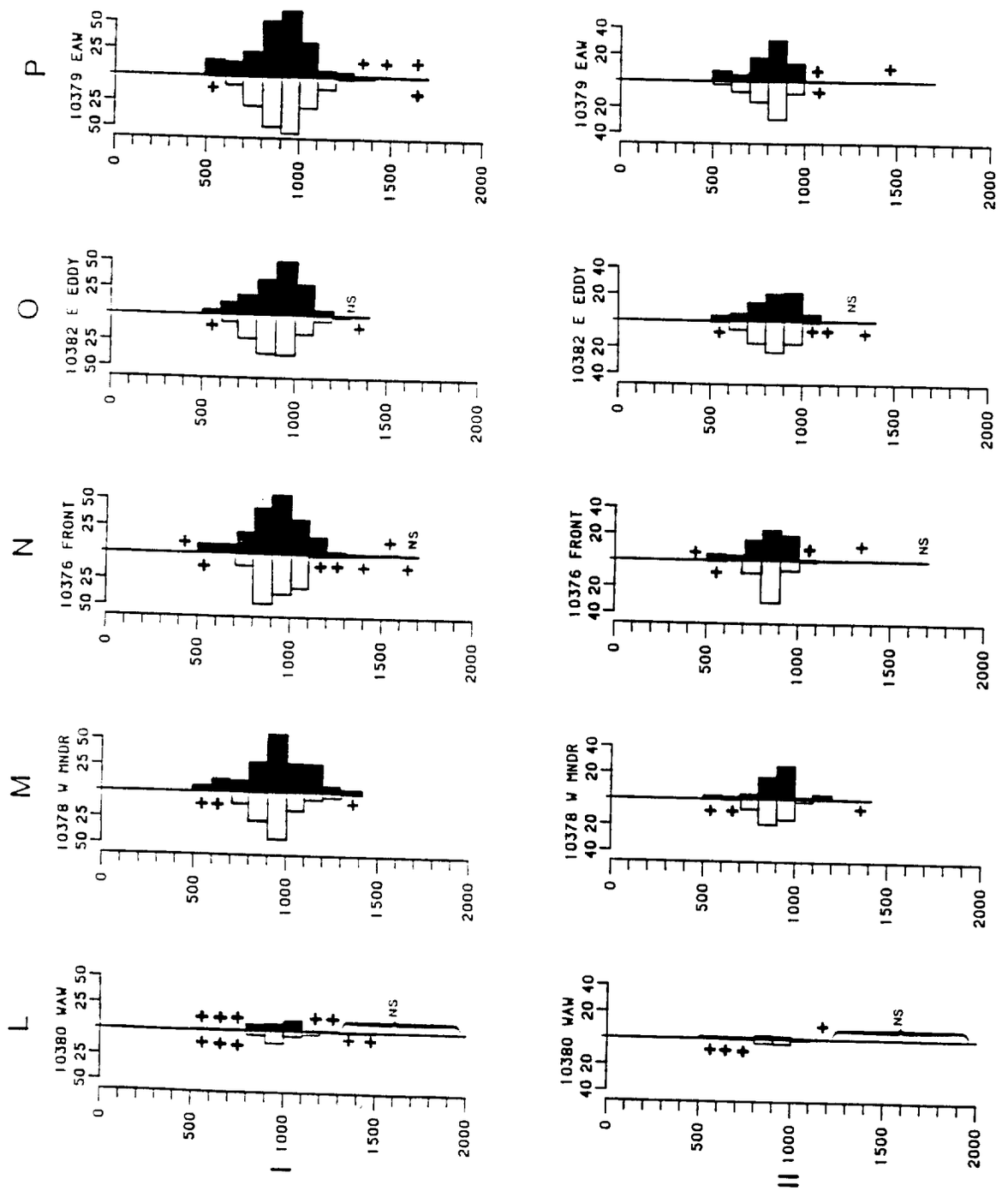

Fig. 9. The geographic and vertical distribution of Eucopia unguiculata at positions L-P; I. Totals II. Juveniles, numbers per $10^4 m^3$ (RMT 8).

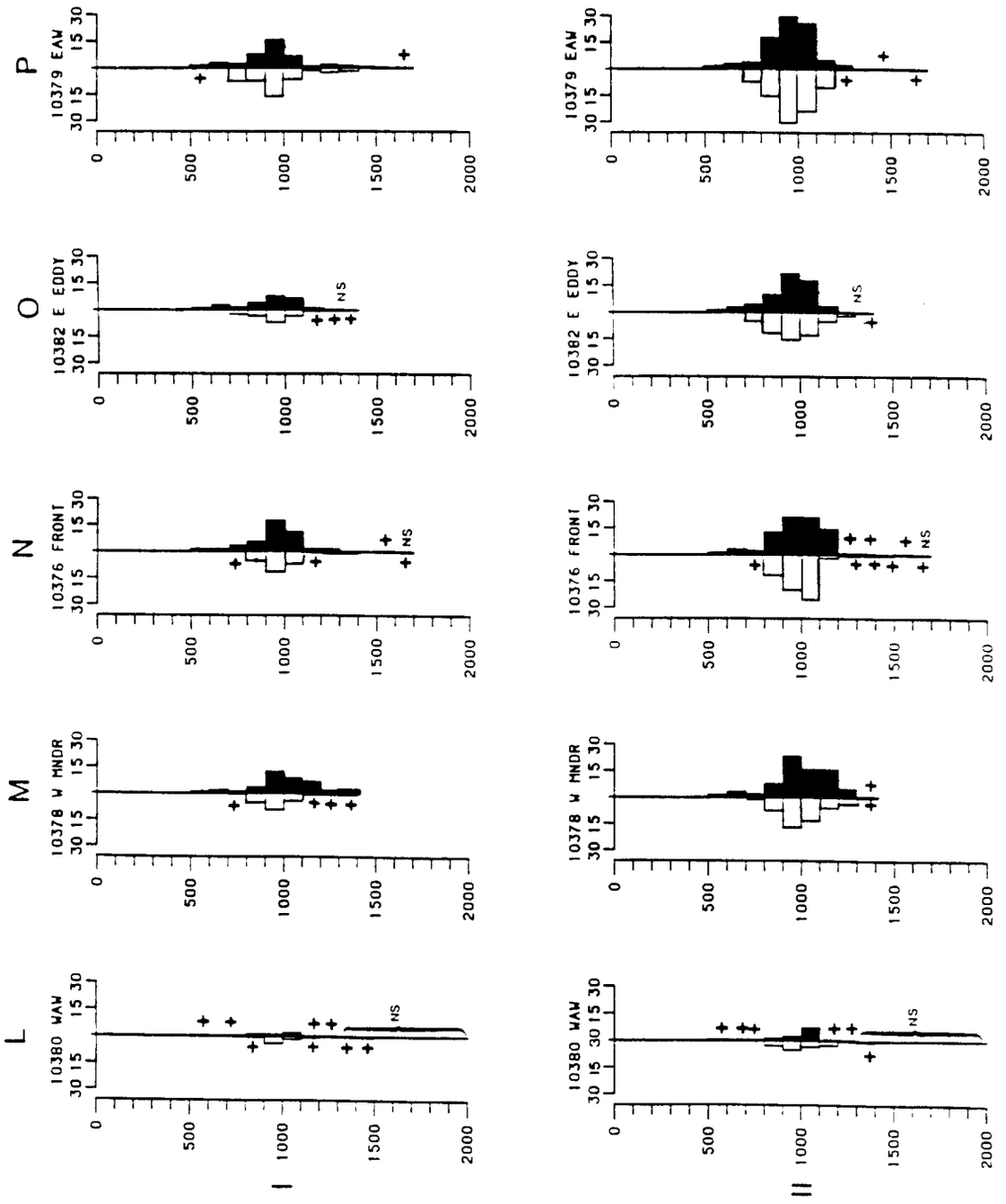

Fig. 10. The geographic and vertical distribution of Eucopia unguiculata at positions L-P; I. Males, II. Females, numbers per $10^4 m^3$ (RMT 8).

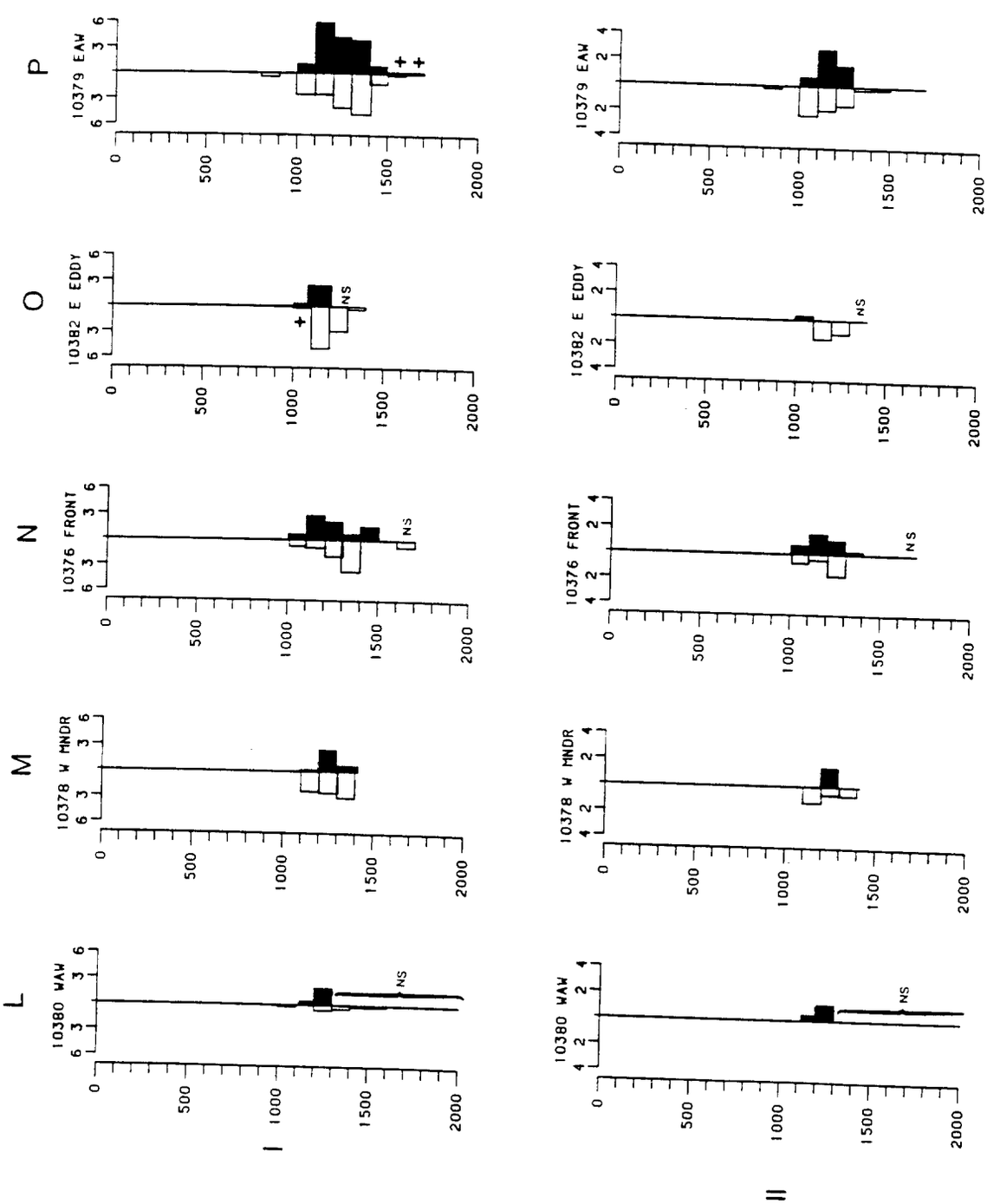

Fig. 11. The geographic and vertical distribution of Eucopia grimaldii at positions L-P; I. Totals; II. Juveniles, numbers per $10^4 m^3$ (RMT 8).

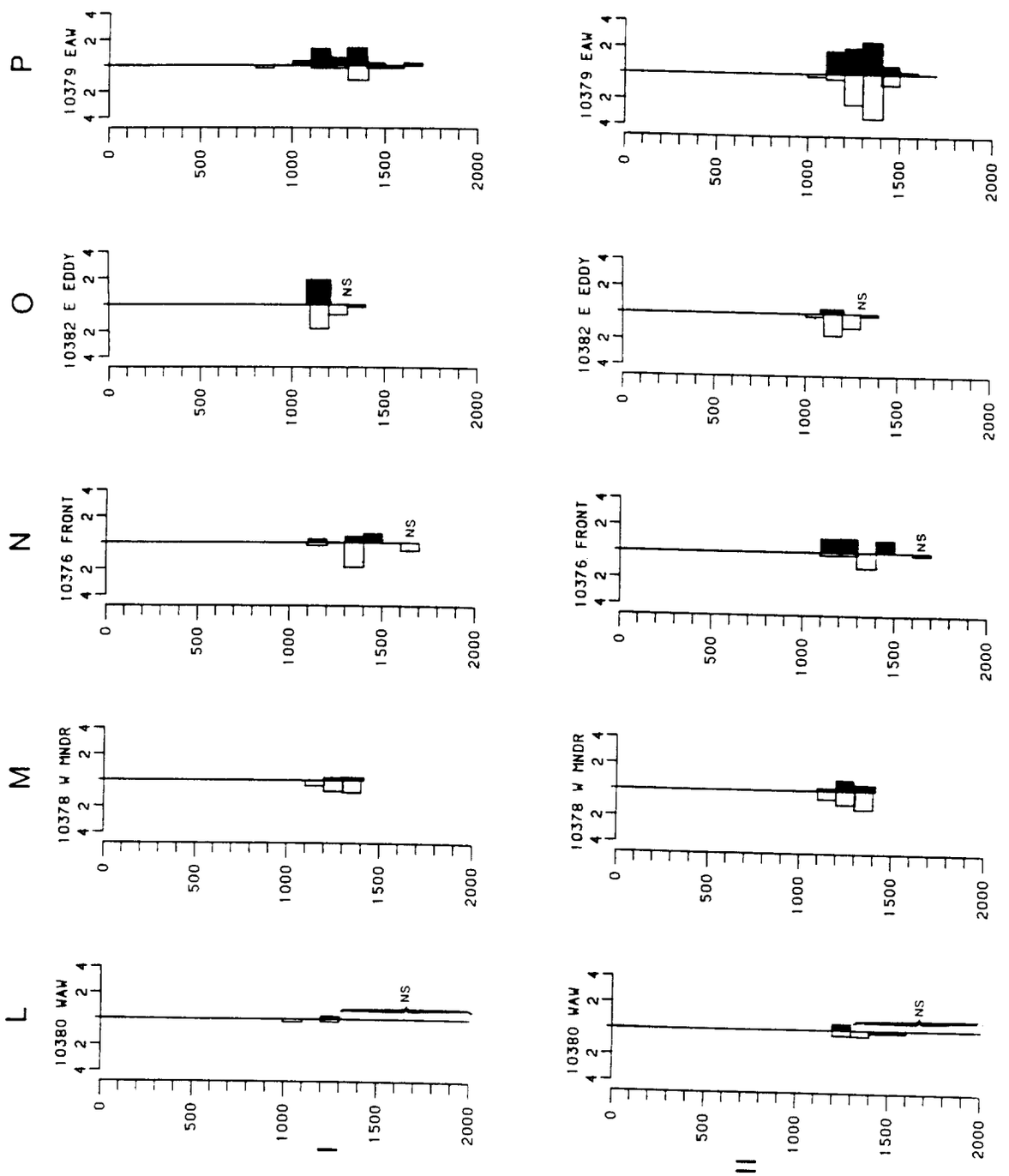

Fig. 12. The geographic and vertical distribution of Eucopia grimaldii at positions L-P; I. Males, II. Females, numbers per $10^4 m^3$ (RMT 8).

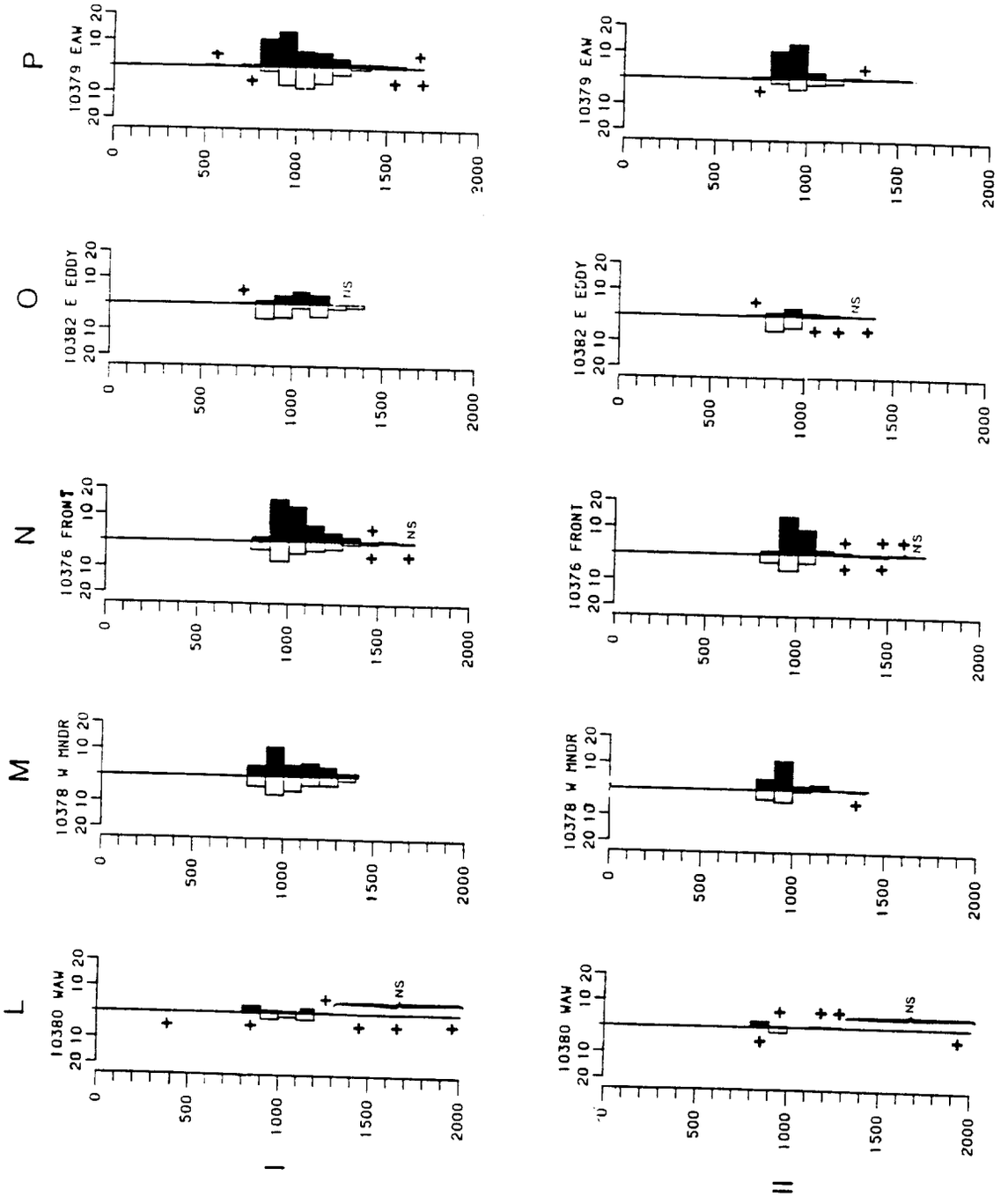

Fig. 13. The geographic and vertical distribution of Eucopia sculpticauda at positions L-P; I. Totals; II. Juveniles, numbers per $10^4 m^3$ (RMT 8).

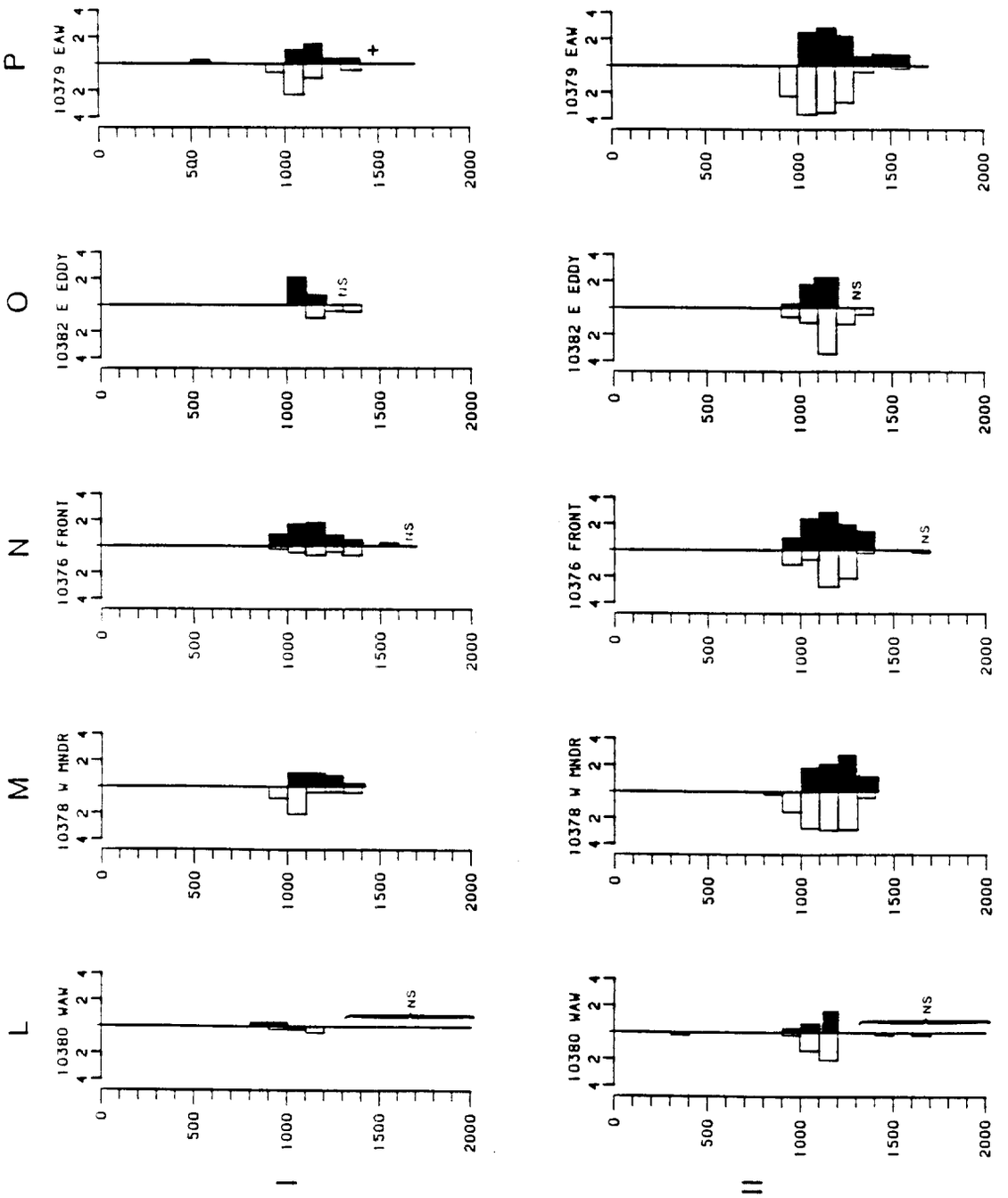

Fig. 14. The geographic and vertical distribution of Eucopia sculpticauda at positions L-P; I. Males, II. Females, numbers per $10^4 m^3$

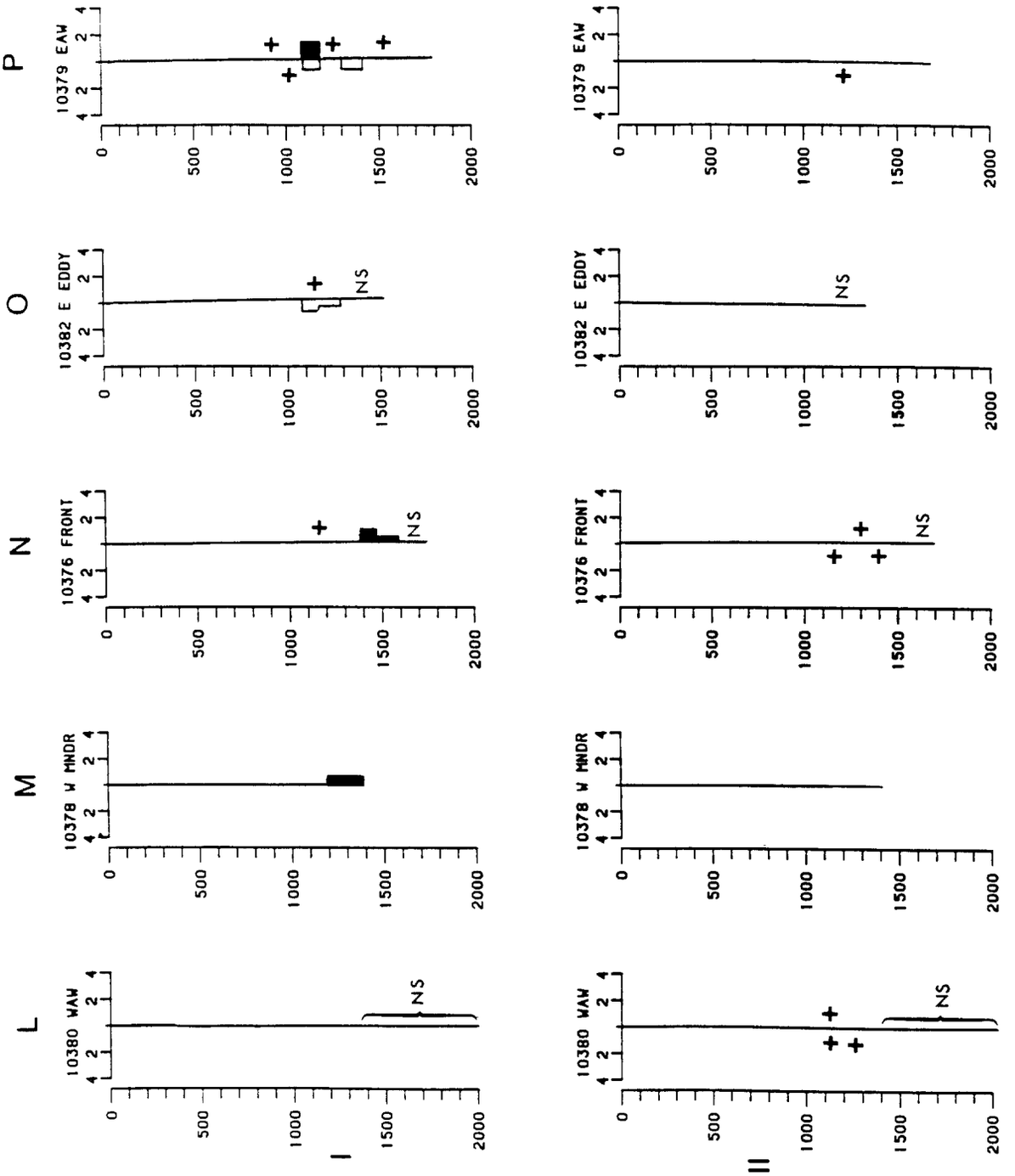

Fig. 15. The geographic and vertical distribution of Gnathophausia species at positions L-P; I. G. gigas totals; II. G. gracilis totals; numbers per $10^4 m^3$ (RMT 8).

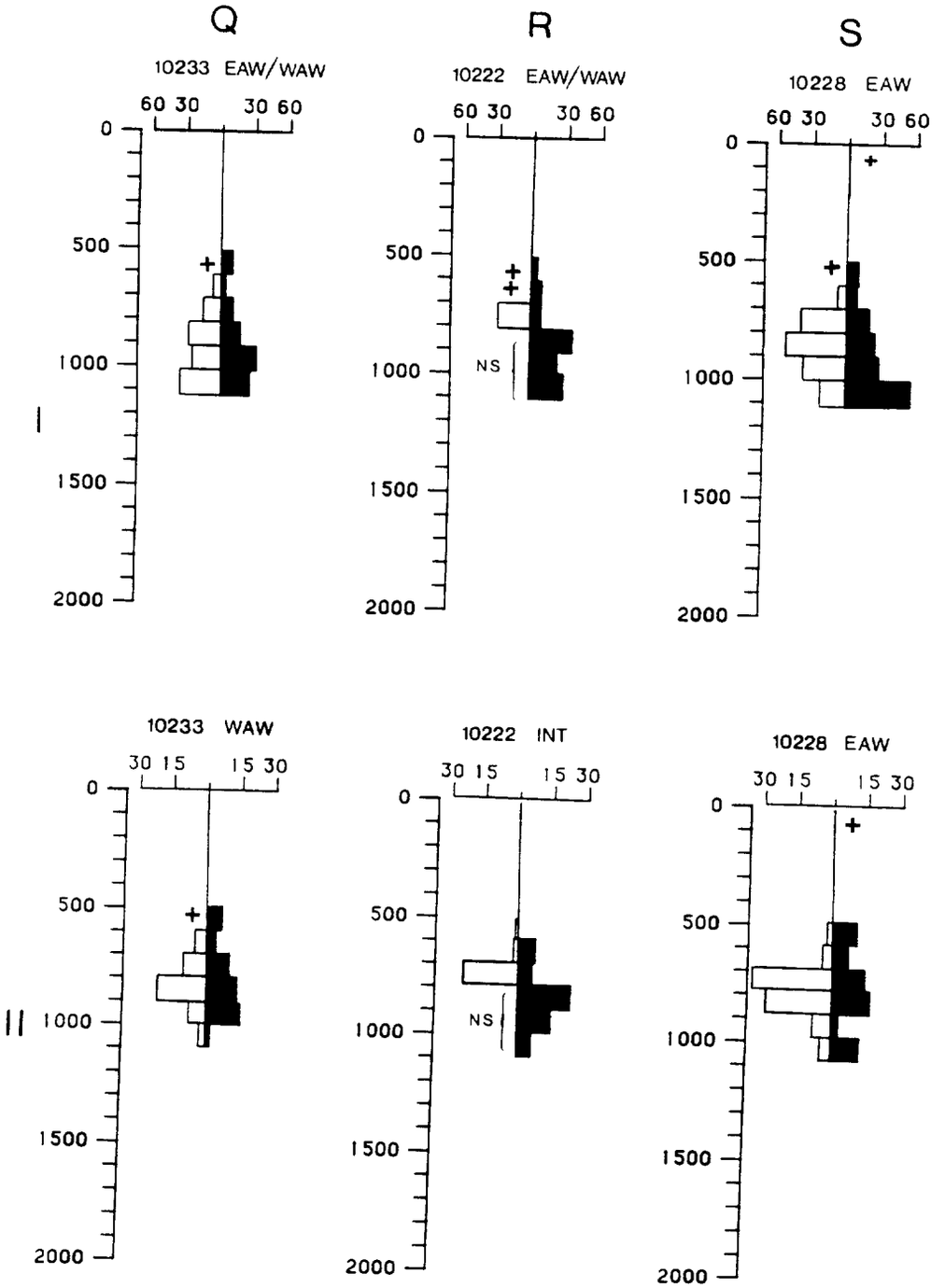

Fig. 16. The geographic and vertical distribution of Eucopia unguiculata at positions Q-S; I. Totals. II. Juveniles, numbers per $10^4 m^3$ (RMT 8).

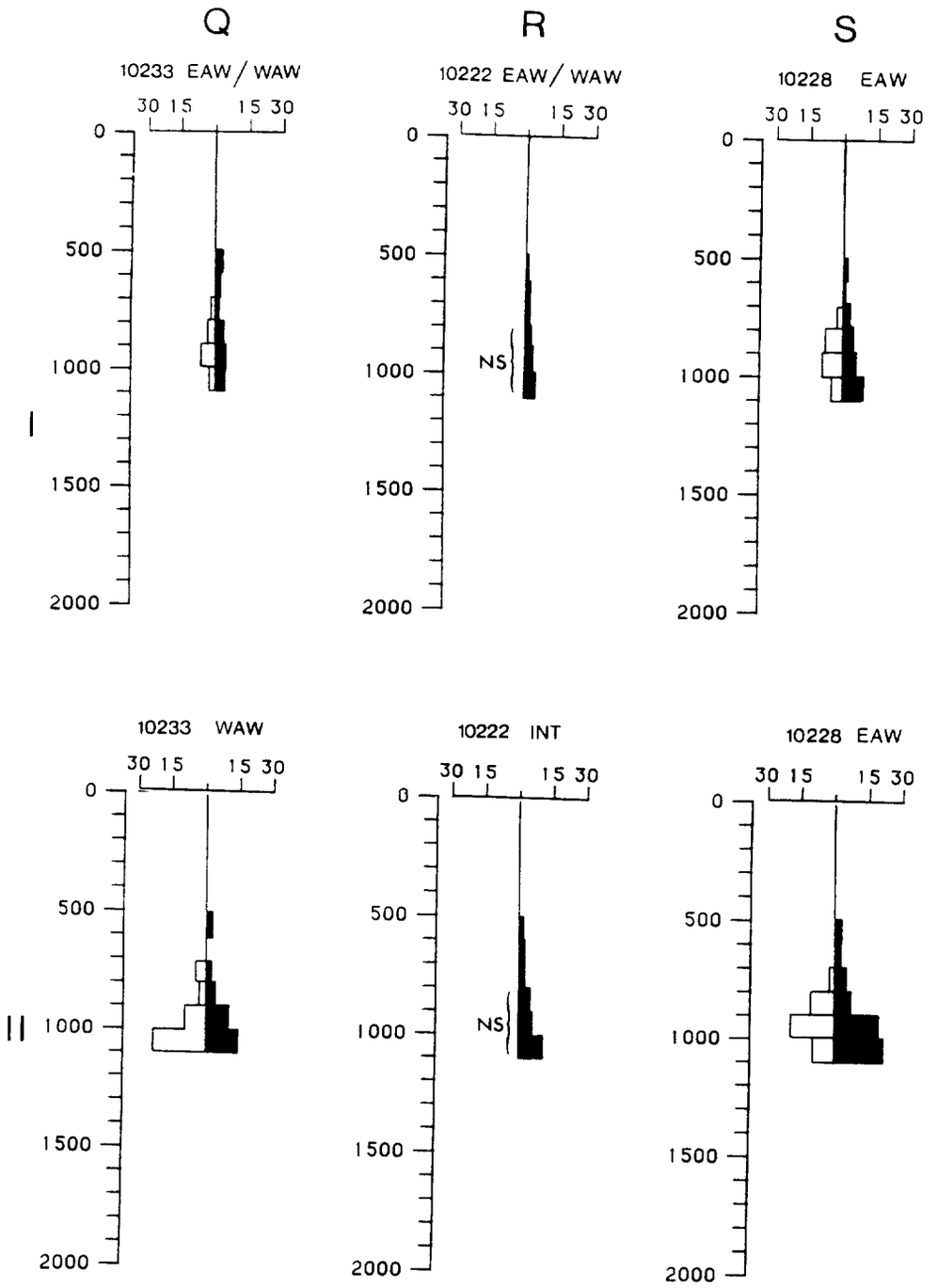

Fig. 17. The geographic and vertical distribution of Eucopia unguiculata at positions Q-S; I. Males, II. Females, numbers per $10^4 m^3$ (RMT 8).

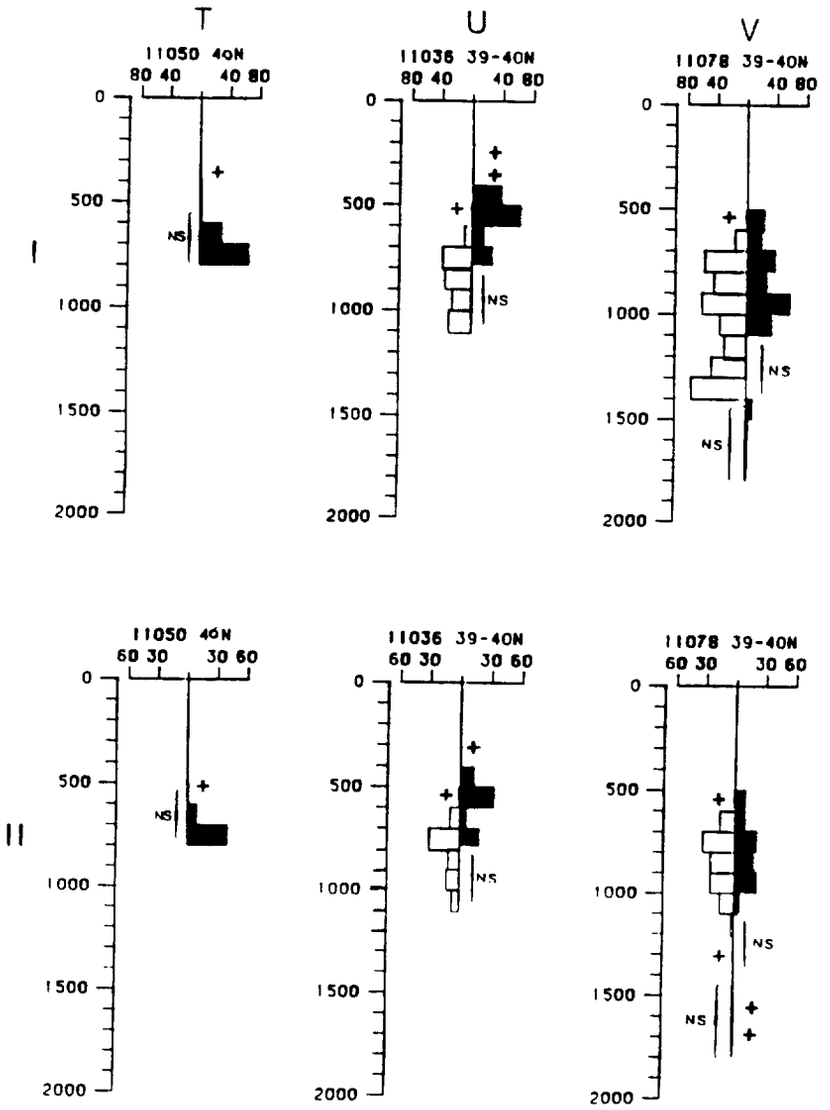

Fig. 18. The geographic and vertical distribution of Eucopia unguiculata at positions T-V; I. Totals, II. Juveniles, numbers per $10^4 m^3$ (RMT 8).

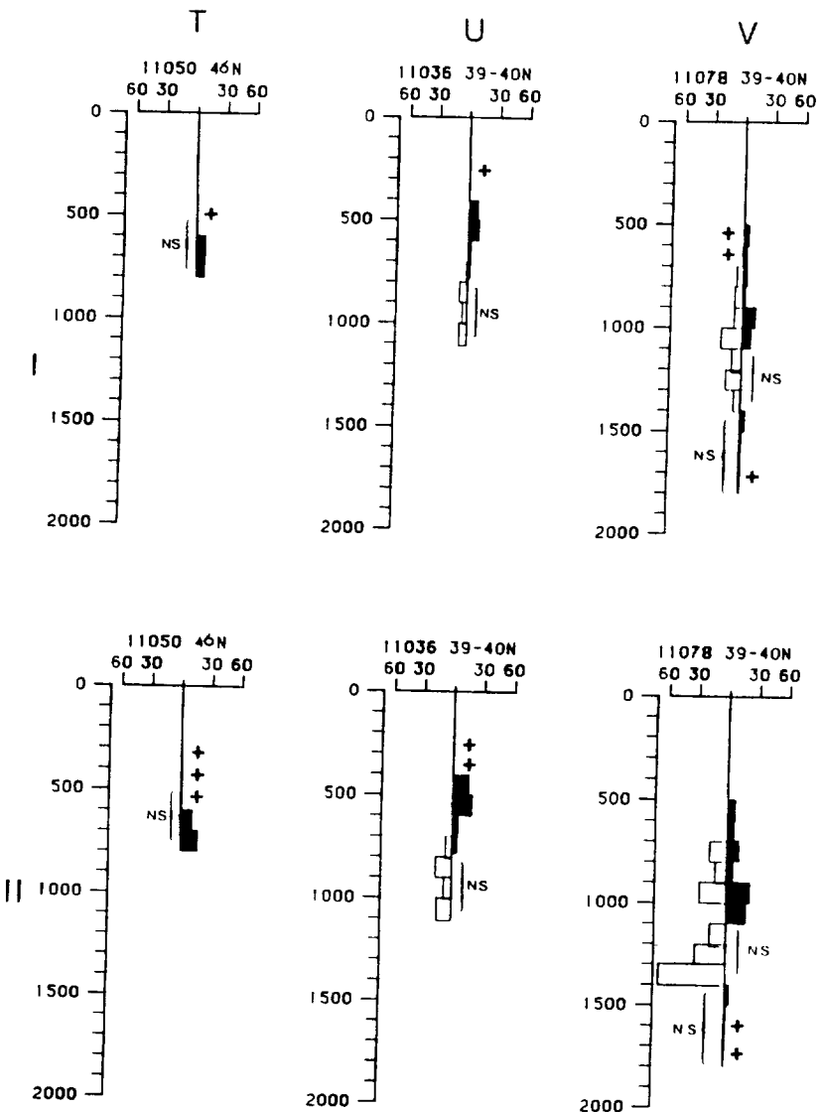

Fig. 19. The geographic and vertical distribution of Eucopia unguiculata at positions T-V; I. Males, II. Females, numbers per $10^4 m^3$ (RMT 8).

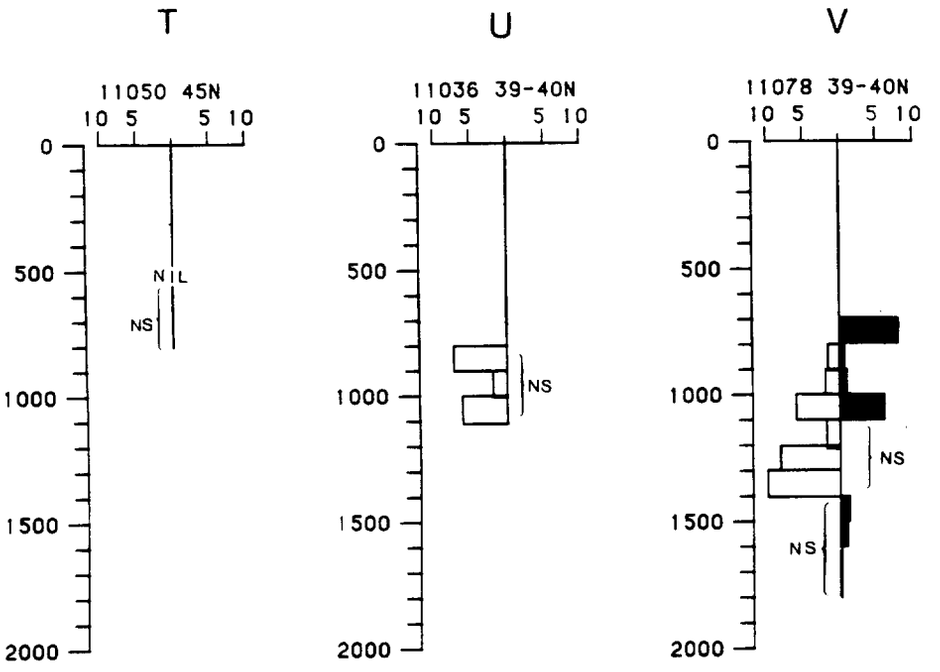

Fig. 20. The geographic and vertical distribution of Eucopia sculpticauda at positions T-V; Total numbers per $10^4 m^3$ (RMT 8).

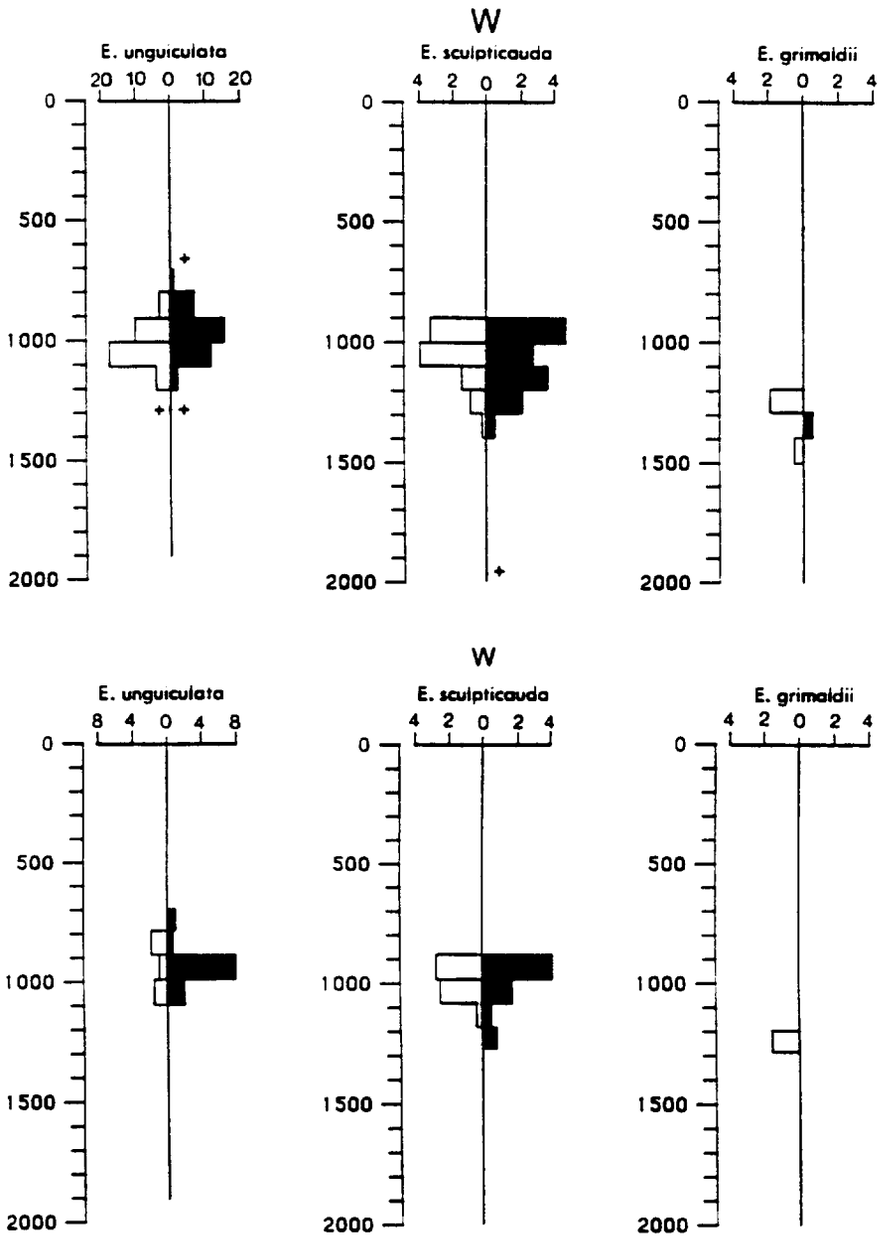

Fig. 21. The geographic and vertical distribution of Eucopia unguiculata, Eucopia sculpticauda and Eucopia grimaldii at position W; I. Totals, II. Juveniles, numbers per $10^4 m^3$ (RMT 8).

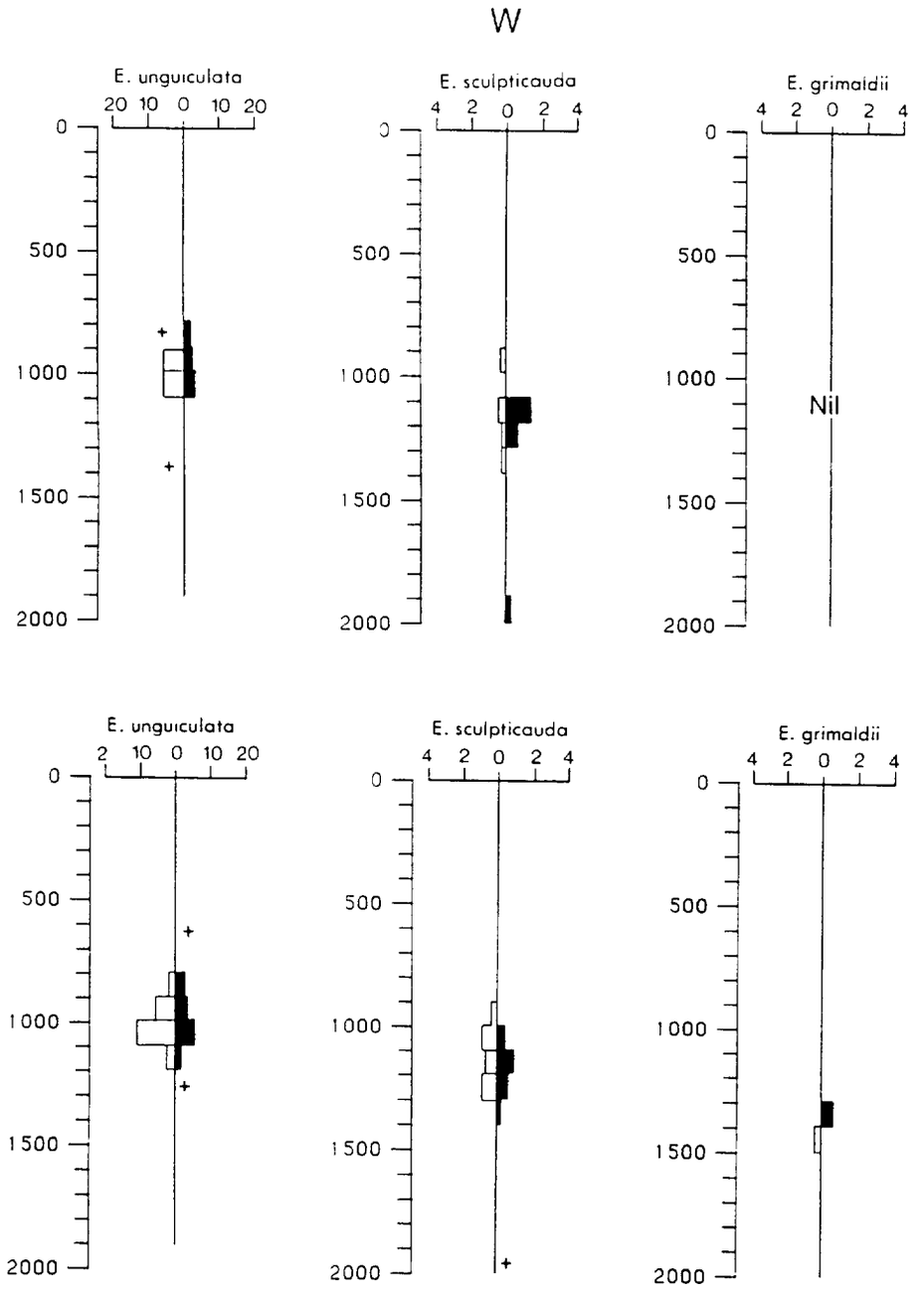

Fig. 22. The geographic and vertical distribution of Eucopia unguiculata, Eucopia sculpticauda and Eucopia grimaldii at position W; I. Males, II. Females, numbers per $10^4 m^3$ (RMT 8).

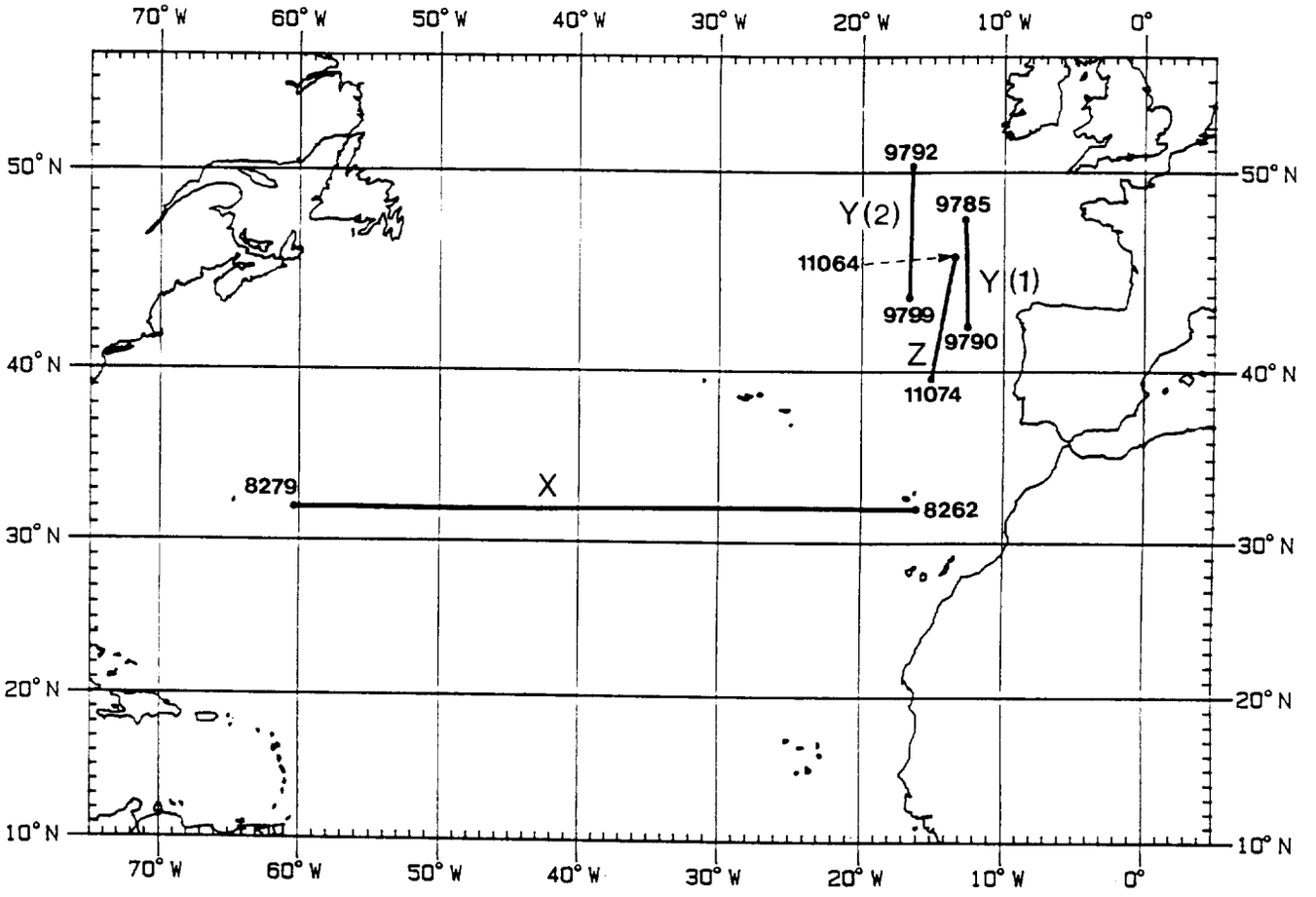

Fig. 23. Transects X, Y (I), Y (II), and Z - oblique hauls.

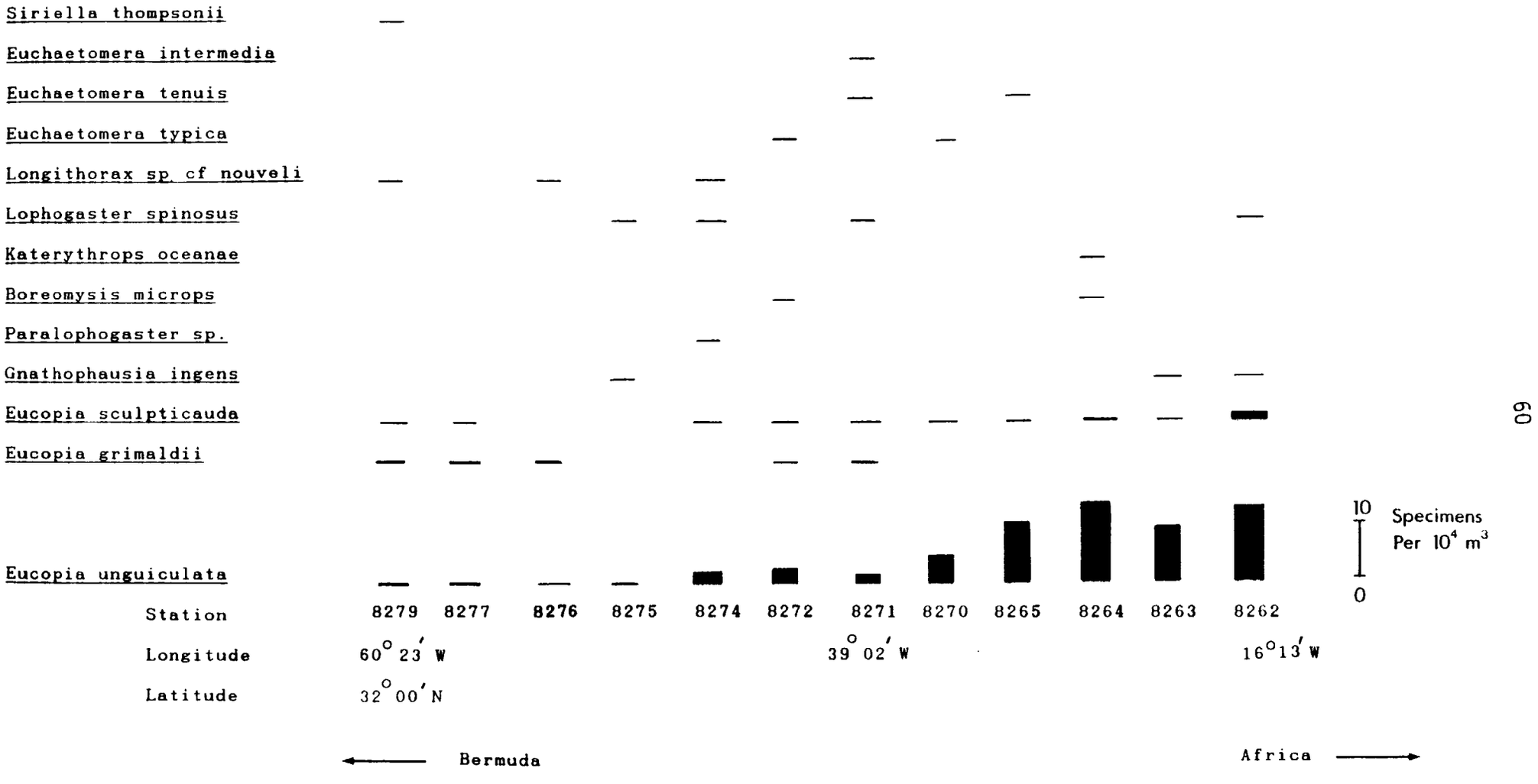

Fig. 24. Numbers of given species recorded in oblique hauls taken at 10-1000m on line X.

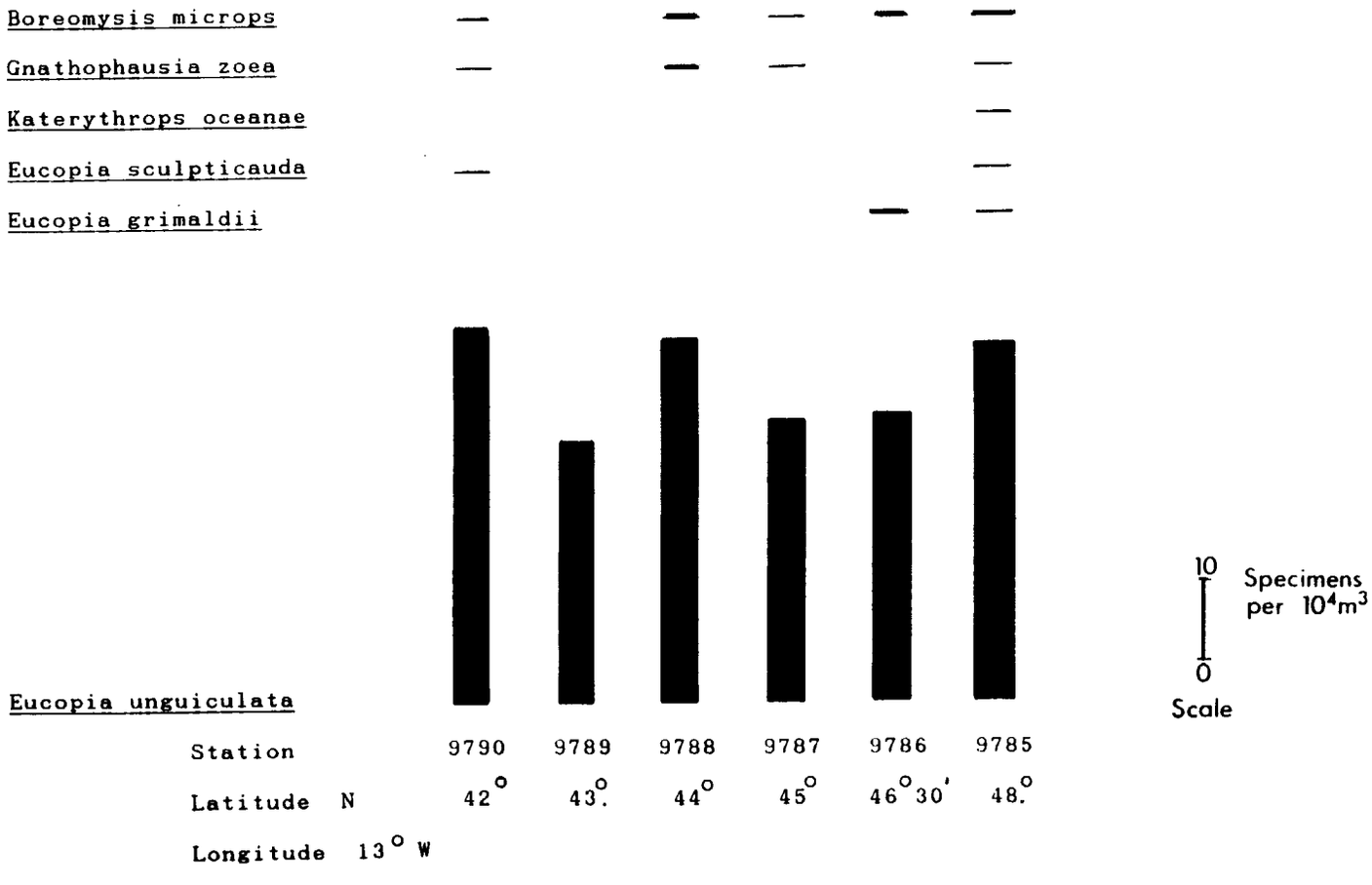

Fig. 25. Numbers of given species recorded in oblique hauls taken at 10-1000m on line Y(1).

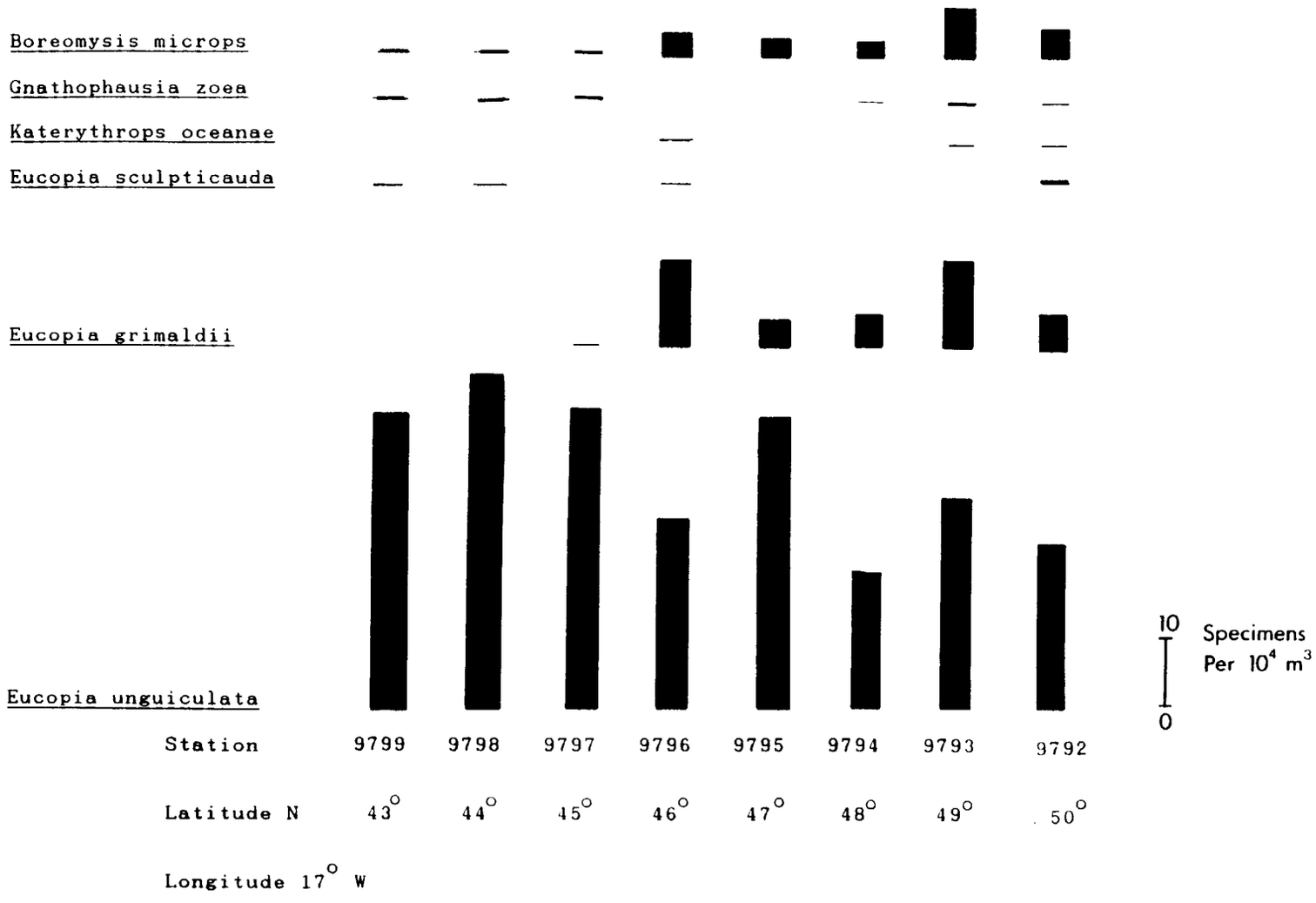

Fig. 26 Numbers of given species recorded in oblique hauls taken at 10-1000m on line Y(2).

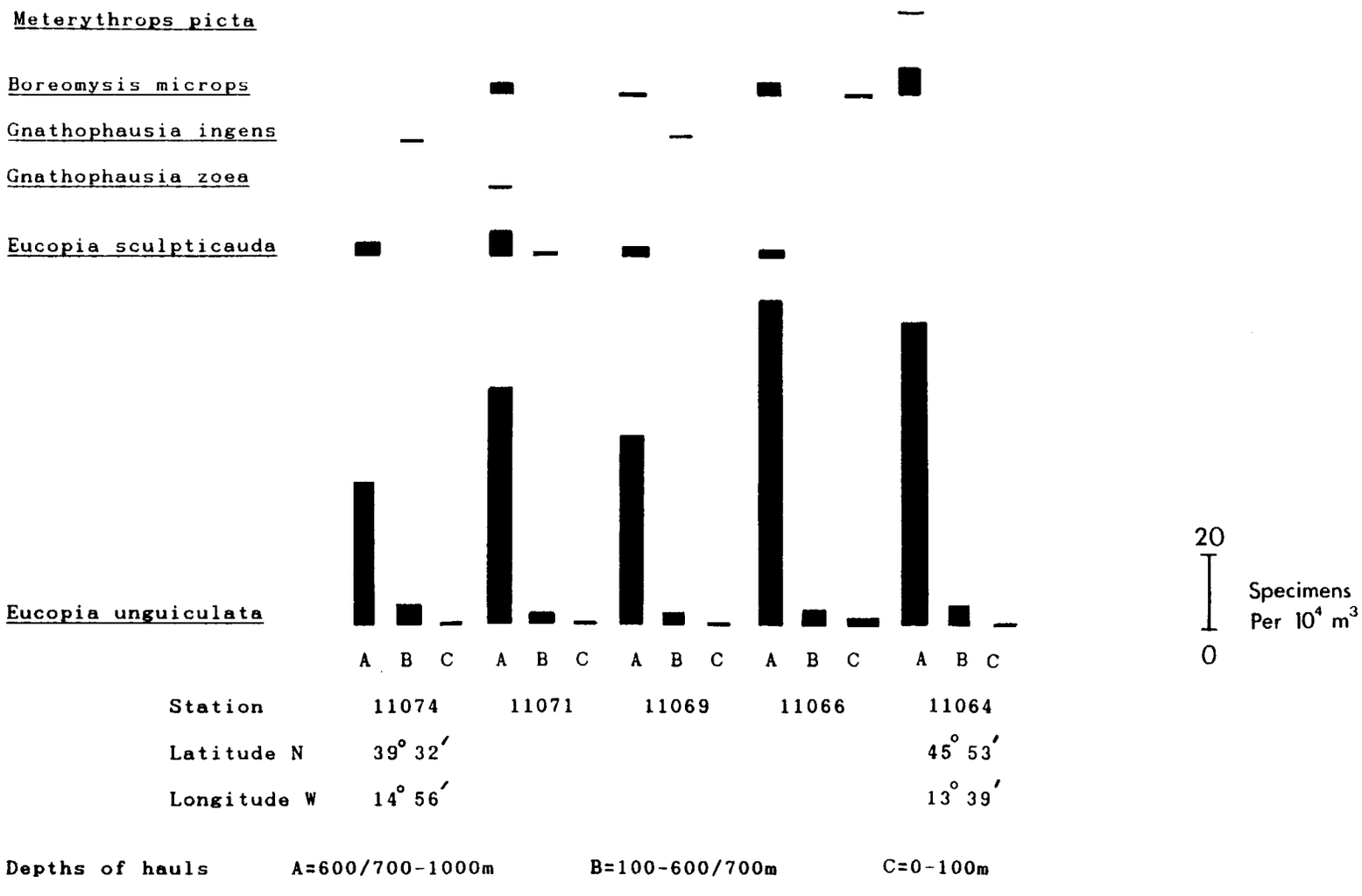

Fig. 27. Numbers of given species recorded in oblique hauls taken at 0-100m, 100-600/700m, 600/700-1000m on line Z.

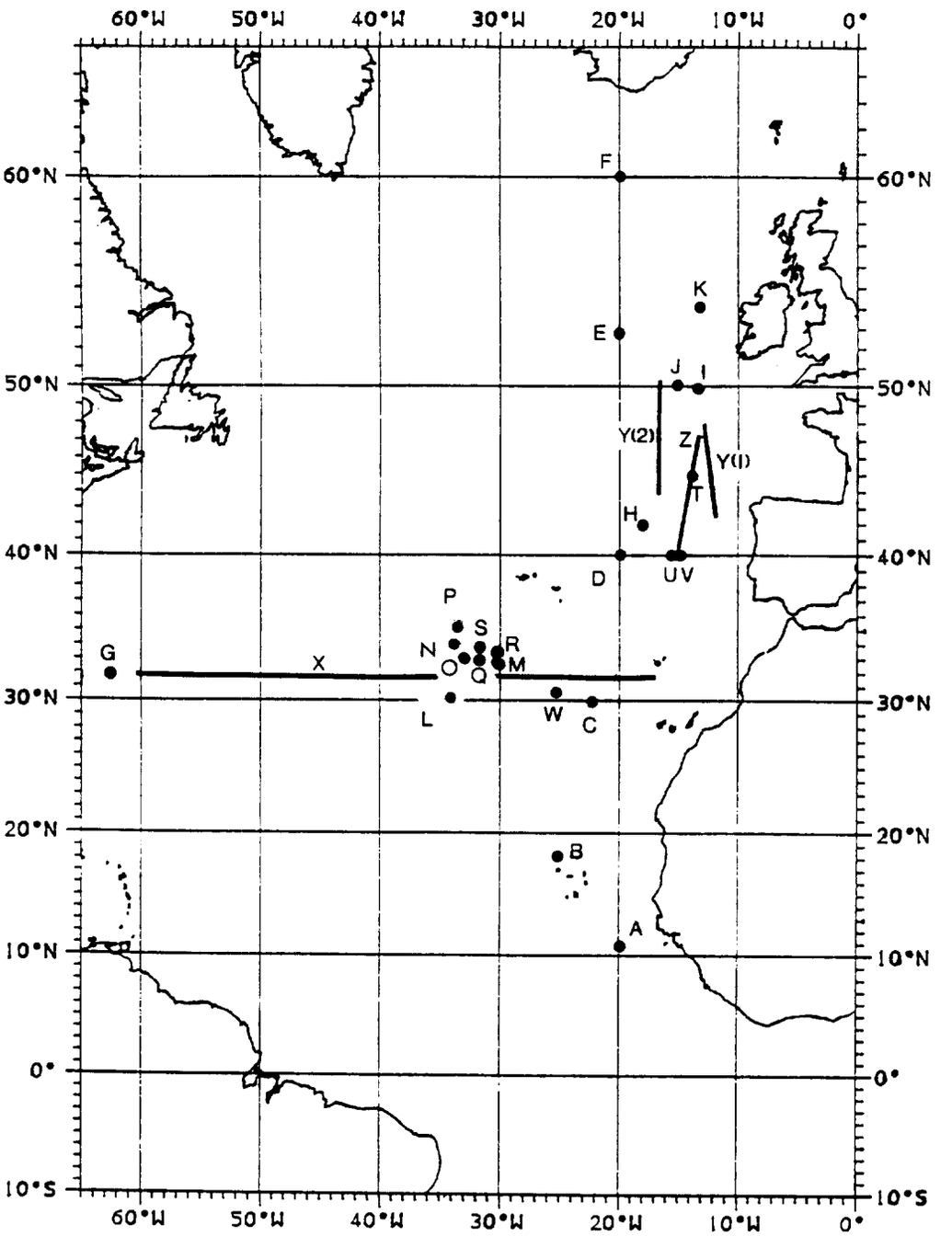

Fig. 28. Geographic positions A-Z (see Appendix 1).