I.O.S.

THE DISTRIBUTION OF EUPHAUSIIDS ALONG 32°N IN THE ATLANTIC OCEAN

BY

P.T. JAMES

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ABSTRACT

A study of the horizontal distributions of euphausiids was made during February 1973 along 32°N in the North Atlantic by sampling a line of 12 stations using RMT 1+8 combination nets from 16°W to 60°W. The nets were fished obliquely at night from 1000 metres to the surface. The numbers/1000m^3 and percentage distribution were calculated at each station for the 32 species of euphausiids which were identified. 6 groups of associated species were recognised subjectively by the similarity with which their abundances fluctuated along the transect. 13 species showed no evidence of any zoogeographic trend, but for the remaining 19 species, however, there is some evidence of a correlation between the water temperature and their distributions.

The distributions suggest a zoogeographic boundary near the mid Atlantic Ridge between 27° - 34°W corresponding to the border between the 18°C Sargasso Sea Water and the water of the Eastern North Atlantic. This boundary was not a strong one and most species were distributed on both sides but there were changes in the dominance. 9 species were more abundant in the Eastern North Atlantic whereas 6 species were more abundant in Sargasso Sea Water. 2 species occurred at the extreme western end of the transect in the Sargasso Sea possibly advected there by the Gulf Stream and may prove to be good indicators of water mass. 2 species on the other hand occurred only at the extreme easterly stations and were probably at the southerly limit of their range advected in the Canary Current. The remaining two species were found only in small numbers sporadically along the transect. The relationship of water temperature to the distributions of euphausiid species is discussed and it is concluded that it influences the distribution and recruitment of larvae which in turn reflect the distribution of adults. In addition to the zoogeographic results two taxonomic problems are clarified concerning firstly the sexual dimorphism in *Nematobrachion flexipes*, and secondly the presence of large and small forms of *Thysanoessa gregaria*.

INTRODUCTION

During February and March 1973, the Institute of Oceanographic Sciences participated in the Mid Ocean Dynamics Experiment (MODE) and a line of 12 stations was worked in the North Atlantic along 32°N using the RMT 1+8 combination net system (Baker et al., 1973) fished down to 1000 metres.

In the Atlantic Ocean very little is known about the east/west distribution of subtropical euphausiids because most of the previous accounts have been based on data collected either in the N.E. Atlantic (Baker, 1970; Marshall, 1948; Einarsson, 1945), or in the N.W. Atlantic (Wiebe et al., 1976; Wiebe and Boyd, 1978; Lewis, 1954; Grice and Hart, 1962). So this line of stations worked across the central N. Atlantic along 32°N from 16°-60°W provides a useful link between these two sets of geographically separate studies.

The current literature on the zoogeographic distribution of pelagic organisms in the Atlantic has been summarised for mesopelagic fishes by Backus et al. (1965, 1970, 1977), and Backus and Craddock (1977), and for Foraminifera by Bé and Tolderland (1971). Angel (1979) discussed zoogeography of Atlantic plankton, and east-west diversity in oceans generally were discussed by Shih (1979). Pugh (1975), when he analysed the distribution of siphonophores along this 32°N transect using factor analysis, found that the 19 most common species could be divided into 6 groups of species with similar horizontal distributions showing varying degrees of affinity for the eastern and western ends of the transect. He related the distributions of these species groups to the hydrography. However, Angel (1979), who analysed the distribution of ostracods found no clear boundaries, and the east-west changes that were present were clinal. The euphausiids reported on here are the third group to be studied and assessed for their usefulness as indicator species.

MATERIALS AND METHODS

Twelve stations were worked at approximately 3 degree intervals along 32°N from 16°W - 60°W (Table 1). At each position the measurement of the temperature salinity depth profile to 2000m preceded trawling with an RMT 1+8 combination system (Baker et al., 1973). The nets were launched with the ship steaming at approximately 2.5 knots and opened just below the surface. They were fished obliquely down through the water column with the warp being paid out at $0.3 m.s^{-1}$. The ship's speed was regulated so that the nets speed through the water was maintained at 2±0.2 knots (i.e. ~$1 m.s^{-1}$) to ensure that the angle of the net was as consistent as possible. Paying out continued until the net reached a depth of 1000m, when it was closed acoustically and then recovered.

Samples were fixed initially in 4% buffered formaldehyde in sea water and later back in the laboratory were sorted into the main taxonomic groups and then preserved in Steedman preserving fluid (Steedman, 1976). Euphausiids were identified from one eighth fractions of RMT 1 samples, and $\frac{1}{2}$ or $\frac{1}{4}$ fractions of RMT 8 samples; fractioning was done using a Folsom plankton splitter (McEwan et al 1954) after large specimens had been picked out of the RMT 8 samples to avoid damaging them; these larger specimens included Thysanopoda cristata, Thysanopoda pectinata, Thysanopoda cornuta, Nematobrachion flexipes and Thysanopoda microphthalma. Fractioning using the Folsom splitter is satisfactory up to euphausiid body lengths of about 20mm.
Specimens up to 15mm in length are more effectively sampled by the RMT 1 than the RMT 8, above this length the RMT 8 is more effective (James, unpublished). A total length of 15mm was, therefore, used to divide the data into two sets for which the RMT 1 or the RMT 8 results were more representative. For species with a length near to 15mm the higher density from either net was used. The RMT 8 filtered a mean volume of 61,840m^3 and the RMT 1 and mean volume of 7,730m^3. The large volumes of water filtered resulted in small-scale patchiness being smoothed.

Adult, sub-adult, and larval specimens were all identified using taxonomic characters given by Boden et al. (1955), Brinton (1979) and Casanova (1974). A sub-adult is an animal possessing rudimentary external reproductive characters, whereas in adults these characters are fully developed. Adult females have well developed chitinised thelyca to which ripe spermatophores or sperm masses are attached after fertilisation. Adult males have fully developed petasmae with ripe spermatophores in the ejaculatory ducts. Adolescent specimens are devoid of any external sexual characters. The point of transition from larvae to adolescent was considered to be when the middle pair of posterior lateral spines were lost from the telson. In interpreting the data, the adults and sub-adults have been grouped together, and larval and adolescent specimens have been treated separately. The young stages of closely related specimens such as Nematoscelis microps and Nematoscelis atlantica are difficult to identify and these were grouped together as Nematoscelis spp., as were the young stages of Thysanopoda aequalis and Thysanopoda obtusifrons. Additional data are available from 30°N 23°W (Station 7856) and 32°N 65°W (Station 8281) where a complete series of vertically stratified samples from the surface to 2000m were taken both by day and night. These data are used to augment the transect data.

RESULTS

Thirty-two species and 3 ecotypes of euphausiids were identified and these are listed in Table 2. Each species was counted and the counts expressed as numbers/1000m^3 water filtered, and these data are given in Tables 3-7. The figures (2-4) illustrate the way in which the abundance of the species fluctuated along the transect and show how several groups of species each have similar geographical patterns of abundance. Some species predominate either in the east or in the west and others are more or less equally abundant along the transect. Although these groups were originally picked out subjectively, three of the species groups were given a measure of objective validation by rank correlation analysis. Not all larval stages were identified, but those that were showed very similar distributions to the adults/sub-adults, and adolescents.

Group 1 (Fig. 2) is made up of 9 species which were more abundant at the eastern end of the transect and became progressively less abundant towards the west. Three of these species Nematobrachion flexipes, Nematobrachion boopis and the short form of Stylocheiron longicorne had peak abundances at either 20°W or 23°W; Nematoscelis microps increased to a peak at 34°W and its abundance decreased sharply to the west whereas Euphausia hemigibba and Nematoscelis atlantica showed a more gradual westerly reduction in abundance. The first three of these species showed a sharp decline in abundance slightly to the east of the frontal zone between the 18°C Sargasso Sea Water (Worthington, 1959) and the Eastern Atlantic water which occurred between Station 8265 and 8270, whereas the latter three still occurred in high densities in the front. The predominance of these group 1 species in the eastern region of the North Atlantic is reflected in the data from vertical series at 23°W and 64°W (Table 8). The eastern peaks of abundance of N. atlantica and N. microps were respectively made up of the 3/4 and 0/0 forms of males which have been shown to occur principally in the North Atlantic Central Water (James, 1973, Gopalkrishnan, 1975). The species with the most abundant adults and sub-adults in this group were E. hemigibba, S. longicorne (short form), and N. atlantica. The peak concentrations of these three species (Fig. 2) expressed as numbers/ $1000m^3$ in the RMT 1 were 19.05, 14.67 and 3.01 respectively. N. flexipes and N. boopis (RMT 8 data) were slightly less abundant with peak concentrations of 8.97 and $0.68/1000m^3$.

Group 2 was the largest group containing 12 species. These were all species for which no particular geographical distribution pattern is evident (Fig. 3). They are probably all eurythermal subtropical species (Ekman 1953) which have wide geographical ranges in the subtropical oceans. The most abundant species in this group were S. suhmi (maximum density $6.78/1000m^3$ in the RMT 1 at Station 8264), Thysanopoda aequalis (max. density $8.43/1000m^3$ in the RMT 1 at Station 8271), and Stylocheiron elongatum (max. density $5.71/1000m^3$ RMT 1 Station 8279). The remaining species in this group are not abundant in the Atlantic Ocean (Baker, 1970; Leavitt, 1935; James, unpublished data), and include T. pectinata, S. maximum, T. cristata, B. ambylops, Thysanopoda egregia and Thysanopoda cornuta. Brinton (1962) reports that all these species are wide ranging in the world oceans. Bentheuphausia ambylops, T. egregia and T. cornuta are all deep mesopelagic to bathypelagic in their vertical range and so their low abundance in the samples along the transect is not unexpected (Table 6).

The third group includes 6 species (Fig. 4) which were more abundant in the Sargasso Sea Water and again these findings are supported by the data from the vertical series at 32°W and 64°W (Table 8). It is noteworthy that Thysanoessa gregaria is the species that was captured in greatest densities in this survey, $27.43/1000m^3$ in the RMT 1 at Station 8279. S. abbreviatum was also quite abundant and occurred in maximum densities of $3.69/1000m^3$ at Station 8271 (RMT 8) and $2.29/1000m^3$ at Station 8279 (RMT 1).

Thysanopoda obtusifrons, however, was taken in rather small numbers, its highest density of $0.36/1000m^3$ (RMT 8) was at Station 8276. The distribution of this group compares well with the geographical distribution of one of Pugh's (1975) groups of siphonophores (Group 2+). E. tenera and Stylocheiron robustum are also included in this group as they were found in small numbers in a pattern of distribution which suggested that they have an affinity for warmer water (Fig. 4).

The fourth group includes 3 species Euphausia americana, Thysanopoda tricuspidata (Fig. 5) and the 1/2 ecotype of Nematoscelis microps which is found only in South Atlantic Central Water (James, 1973). These species were taken in small numbers and may have been advected into the Sargasso Sea. Unpublished records at IOS show that these species are more commonly found in the Guinean province of Backus and Craddock (1977) , so their presence in the western hauls of the transect may be due to their being carried into the area by the Equatorial Current. These species may prove to be good indicators of water transport.

The fifth group of euphausiids is made up of Euphausia krohni and Meganyctiphanes norvegica (Fig. 5) which were restricted to the eastern end of the transect in the region which was influenced by either the Canary Current or the upwelling off the Northwest African coast. The euphausiid species in this group are typically more northern in their distribution and are not found in mid-Atlantic at these lower latitudes (Mauchline and Fisher 1967).

The sixth group comprises only 2 species Thysanoessa longicaudata and Nematoscelis megalops; specimens of these two species were found in very small numbers in isolated hauls at Stations 8272 and 8279, and at Station 8265 respectively. Both of these species are abundant in temperate and subarctic latitudes (Mauchline and Fisher, 1969; Mauchline, 1980) and their occurrence in these samples may either result from their submergence into deeper colder water originating at the polar front (Dietrich, 1964) or their advection within cold-core eddies (e.g. Wiebe et al., 1976). Either explanation would account for the presence of 49 adults and 45 adolescents of T. longicaudata at depths between 600m and 3500m at 32°N 64°W (Station 8281). At 60°N 20°W, T. longicaudata is normally found in the surface layers by night, and at 0-700m by day, but small numbers are found at depths down to 2000m (James, unpublished data).

Rank correlation and community coefficient analyses

Rank correlations using the Kendall method (Kendall, 1955) were used to compare all pairs of species that were present at more than 8 stations. The matrix of correlations is shown in Table 9, which shows that there were a large number of significant positive correlations between group 1 species. However, no clear pattern of relationship emerged between species in either group 2 or group 3. The only significant negative correlations occurred between species in groups 1 and 3 to some extent this corroborated these subjective groupings.

Three species in group 1, N. microps, S. longicorne and to a lesser extent T. microphthalma had positive rank correlations with some of the group 2 species. This probably results from a number of the species in group 2 having high peaks of abundance to the west of the front similar to the abundance peaks of the group 1 species in the eastern section of the transect, beyond where the 18°C Sargasso Sea Water was encountered.

The existence of two distinct east/west communities of euphausiids was interesting and to examine this further, coefficients of community were calculated using the method described by Odum (1971), and the indices of dissimilarity were compared by using multidimensional scaling techniques (Kruskal, 1964). The configurations of the indices were plotted in 2 dimensions and provided an ordination of the community along the transect, such that each index of dissimilarity in each dimension was plotted for each position along the transect (Fig. 6). A clear gradient emerged in the euphausiid communities supporting the suggestion of an east-west change related to the water masses. According to Odum (1971), the steeper the gradient, the more pronounced are the physical and biological boundaries which in some way influence the community. The boundary of the Sargasso Sea Water between 27°W and 34°W (between Stations 8265-8270) appears to be associated with sharp numerical changes in the abundance of groups of eastern and western species. However, in addition to the clear east-west trend, the coefficient of community fluctuated along the transect, particularly in relation to the first dimension of variability. These fluctuations may result from scales of community patchiness which cannot be discriminated by this type of sampling. They may have been caused by mesoscale eddies or other large-scale hydrographic features, or even differences in the short-term history of the parcels of water sampled.

Taxonomy and sexual dimorphism in T. gregaria and N. flexipes.

During the routine identification of euphausiids some variation was noted in the size of T. gregaria. Hansen (1913) pointed out that this species was subject to variation in size, length and shape of the sixth abdominal segment and in the development of the prehensile legs. In this study a more robust form was identified with a length of greater than 10mm. Small and large forms were distinguished using this length as the character for separating them. Townsend and Brinton (personal communication) have observed large forms of T. gregaria in the Californian current and that the population may be separated into northern and southern groups of different size. The reproductive organs of these two forms in the Atlantic were identical except in size but there was a strong sexual dimorphism of the eye and of the pre-anal spines in agreement with Nemoto (1966). In adult male specimens the eyes are rounder than those of females, and the males do not have any denticulations on the pre-anal spines in contrast to the females. The females of large forms possessed 7-11 denticulations, whereas the small females have between 2 and 5. Large males measured between 10.52 - 12.53mm (mean 11.24mm, N = 20); small males between 6.51 - 9.69mm, N = 41). Large females ranged between 11.02 - 14.20mm (mean 12.6mm, N = 33), and small females from 6.68 - 10.52mm (mean 8.56mm, N = 29). All these measurements were taken from the tip of the rostrum to the tip of the telson. Thysanoessa gregaria was categorized in group 3, but large forms were common in the Sargasso Sea west of the station at 27°W (station 8265), whereas the small form extends right across the transect albeit in small densities. The two forms coexisted at moderate densities at 60°W (Station 8279). It is not possible to decide if the two forms either represent different genotypes which may be in competition or are phenotypes reflecting the previous environmental history of the community. At Station 8281 where the sampling was much more intensive only the small form was abundant. A previous undescribed sexual dimorphism was observed in Nematobrachion flexipes; the third abdominal photophore is absent in the male and both the second and third are absent in the female. Specimens from widely distributed stations in the N.E. Atlantic showed that these characters are widespread and consistent. Brinton (personal communication) confirmed that this dimorphism occurs in Pacific specimens.

DISCUSSION

The mid Atlantic Ridge occupies the central third of the Atlantic Ocean and consists of crest and flank provinces (Heezen et al., 1959). The shallow rugged topography rises steeply to the surface in places and according to Heezen et al., (1959), the average sounding over these submarine mountains is

1828 metres. It is unlikely that the Ridge will have a direct effect as a zoogeographic barrier to euphausiids which largely occupy the top 1000 metres of the water column. However, the ridge divides the Atlantic Ocean into oceanic basins containing water of slightly differing hydrographic properties and it is interesting to try to relate those hydrographic properties along the transect to the position of the ridge and the distributions of the organisms. Worthington (1959) and Istoshin (1962) described a characteristic core of water in the Sargasso Sea which they referred to as 18°C water. Worthing's criteria describe a body of water that is nearly isothermal and isohaline at 17.9°±o.3°C and 36.5°/oo ±0.01 and he found this 18°C water extended as far west as 40°W.

The 18°C water can be identified in the T.S. sections shown in Figure 1 Two temperature envelopes, A and B, are seen whose separation approximately coincides with the position of the centre of the ridge at 39°W. Using Worthington's criteria the 18°C water extended from 60°W (Station 8279) to 34°W (Station 8270) at depths between 150m and 250 metres i.e. corresponding to the geographical distribution of temperature envelope B. In this envelope water temperatures down to depths of 700 - 800m is warmer than the water east of 34°W which corresponds to envelope A and extends along the transect from 18° to 30°W (Stations 8262-8263). Below 800 metres the temperature in envelope B is colder than the temperature in envelope A except at 34°W (Station 8270) which was the transition zone between the two water types where there was probably a major oceanic front nearby. Pugh (1975) described these water bodies along the transect in greater detail and further investigations of the front have been carried out during Discovery Cruises 114 and 119-122.

Backus and Craddock (1977) divided the Atlantic Ocean into 23 pelagic faunal provinces on the basis of acoustic reverberation levels. The transect along 32°N traverses the North Atlantic subtropical region which is subdivided into the provinces they termed the North African Subtropical Sea and the Northern Sargasso Sea. The boundary between these two provinces lies near the crest of the Mid-Atlantic Ridge. The transect was also close to Backus and Craddock's border separating the northern and southern components of the subtropical Atlantic and it is suggested by Backus et al., (1977), that this hypothetical line corresponds to the subtropical convergence described by Wust (1928). However, the precise location of this convergence in the Northern Atlantic or even if it exists, is subject to some speculation (e.g. Foxton and Fasham

1979.)

The majority of the species have been categorised into three groups on the basis of their abundances but on a presence and absence basis most occurred at almost every station. So the front between the two main water masses is not a strong zoogeographic barrier which excludes any species from living in either of the two provinces defined by Backus and Craddock (1977), and this is supported by the way the group 2 species showed no trend in their abundances along the transect (Fig. 2). However, the other two main groups of species showed evidence of east-west trends in abundance so the two water masses do influence the structure of the euphausiid communities in some way.

Factors that may influence their distributions may include water temperature, surface currents, and biological factors. Temperature is a parameter that has been used extensively in attempts to define marine zoogeographic distributions (Banse, 1964; Rudd, 1936; Pugh, 1975; Moore and Corwin, 1956; Einarsson, 1942; Moore, 1952). However, as Roger (1974) pointed out, the use of temperature by itself for defining horizontal distributions of adult euphausiids is unrealistic, since migrant species experience temperature ranges of up to 18°C in the Pacific and 10°C in the Atlantic during the course of their diel vertical migrations. Along the 32°N transect, the temperature difference between the two water masses at any specific depth amounted to only 5°C at mesopelagic depths and 2-3°C at epipelagic depths. Fowler et al. (1971) and Brinton and Townsend (1980) have shown that the larval euphausiids are sensitive to small temperature changes and that recruitment is reduced if the temperature rises by only a degree or two. Moore (1952) had already suggested that euphausiids were less able to tolerate increases in temperature than decreases.

The vertical distribution of larvae in groups 1-3 at 32°N 23°W (Station 7856) and 32°N 64°W (Station 8281) are plotted in Figs. 7 and 8 for most species, although in some species larvae were either not caught it was not possible to identify them positively.

The majority of the larvae group 1 species had centres of their daytime vertical distributions within the top 200m, the exceptions being N. flexipes and 32°N 64°W and E. brevis and probably N. boopis at 30°N 23°W where presumably their larvae hatched at deeper depths; Brinton (1967) and Lewis (1954) drew similar conclusions about the depth distribution of the larvae of E. hemigibba, S. longicorne and E. brevis in the Californian and Florida currents. For these group 1 species in the warmer surface water the survival rate of larvae is presumably less. On the basis of Moore's (1952) hypothesis, the larvae could sink to deeper layers, but in these oligotrophic waters this would take them below the nutrient rich surface layers to depths where there would be insufficient food. Fig. 7 shows that in two of the three group 1 species that were found at 32°N 64°W, the larvae appeared to be responding to temperature and occurred deeper in the water column (i.e. in S. longicorne and N. flexipes). In one species N. microps / N. atlantica the larvae occurred shallower in much warmer water at 32°N 64°W. This apparent contradiction may result from the taxonomic difficulty of separating these two closely related species.

Group 1 species tend to be much less abundant in the Sargasso Sea where productivity tends to be lower than in the eastern sector (Costlow, 1971). In the Sargasso Sea interspecific competition is likely to be higher (Huston, 1979) because although the waters are more oligotrophic the species richness of the community is higher.

Figure 8 shows the distribution of group 2 species larvae, which, with the exception of S. abbreviatum, tend to occur shallower than the larvae of group 1 species. In particular there is little evidence of deep tails to their vertical distributions, the larvae of these species appear to be less able to tolerate colder water than species with deep distributional tails. The shallow surface distribution of S. carinatum is corroborated by Brinton (1970). In a later paper Brinton (1979), also described the distribution of the larvae of T. gregaria (short form), S. carinatum and E. tenera which are generally more tropical and do not appear to tolerate the colder temperatures at 23°W.

Group 3 species which were more abundant from east to west had much deeper centres to their larval distributions (Fig. 8). Brinton (1967) found that the vertical range of S. elongatum and S. maximum was 100-300m by day and 110-180m by night. In the present study these species had long tails to their vertical distributions and must presumably be able to adapt to the colder temperatures in the mesopelagic zone and so are unlikely to be physiologically prevented from inhabiting the cooler eastern region. The relevance of larval ecology in the explanation of global euphausiid distributions has received little attention previously, although Brinton (1962) associated the geographical ranges of *T. tricuspidata* and *E. tenera* with the restriction of their larvae to warm water. The different patterns of vertical distribution of the larvae of the species may be related to their ability to adapt to temperatures differ by as little as 3°C. Species whose larvae have long tails to their vertical distributions have an ability to survive in colder subsurface water and so are good indicators of the colder water. The presence of *N. microps* 1/2 and *T. tricuspidata* in the warmer Sargasso Sea is possibly the result of transport from the south via the Equatorial Currents. The presence of northern group 6 species, *T. longicaudata* and *N. megalops* is attributed to southern transport in deeper layers.

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TABLE 1. 32°N transect station numbers and positions where RMT 1+8 sampling was carried out.

Station no.	Date 1973	Position		Net	Depth of haul (m)
8262	24.ii	32°5.2'N 32°8.3'N	16°13.7'W 16°16.7'W	RMT 1+8	0-1000
8263	25.ii	32°5.9'N 32°11.7'N	20°26.1'W 20°28.2'N	RMT 1+8	0-1000
8264	26.ii	32°11.2'N 32°17.0'N	23°49.2'W 23°49.7'W	RMT 1+8	0-1000
8265	27.ii	32°1.0'N 32°6.8'N	27°12.1'W 27°11.5'W	RMT 1+8	0-1000
8270	1.iii	32°0.5'N 32°6.4'N	34°22.7'W 34°21.9'W	RMT 1+8	0-1000
8271	2.iii	31°58.0'N 31°58.4'N	39°2.4'W 39°7.9'W	RMT 1+8	0-1000
8272	3.iii	31°57.7'N 31°50.5'W	43°37.4'W 43°35.0'W	RMT 1+8	0-1000
8274	4.iii	31°58.2'N 31°57.1'N	47°18.5'W 47°25.6'W	RMT 1+8	0-1000
8275	5.iii	32°1.4'N 32°4.6'N	50°33.5'W 50°38.9'W	RMT 1+8	0-1000
8276	6.iii	31°55.8'N 31°55.5'N	54°5.0'W 54°11.4'W	RMT 1+8	0-1000
8277	8.iii	32°5.4'N 32°5.4'N	57°40.0'W 57°47.5'W	RMT 1+8	0-1000
8279	8.iii	32°21.7'N 32°27.0'N	60°23.6'W 60°22.0'W	RMT 1+8	0-1000

Table 2. List of the species found along the 32° transect arranged in their observed zoogeographical grouping.

Group 1.

Nematobrachion flexipes (Ortmann, 1893)
Euphausia hemigibba Hansen, 1910
Nematoscelis atlantica Hansen, 1910
Stylocheiron longicorne G.O. Sars, 1883
Thysanapoda microphthalma G.O. Sars, 1885
Nematobrachion boopis (Colman, 1905)
Euphausia brevis Hansen, 1905
Nematoscelis microps G.O. Sars, 1883, form o/o
Euphausia gibboides Ortmann, 1893

Group 2.

Nematoscelis tenella, G.O. Sars, 1883, form 1,2/23
Stylocheiron elongatum G.O. Sars, 1883
Thysanopoda aegualis Hansen, 1905
Stylocheiron suhmi G.O. Sars, 1883
Stylocheiron affine Hansen, 1910
Stylocheiron maximum Hansen, 1908
Nematobrachion sexspinosum Hansen, 1910
Bentheuphausia amblyops G.O. Sars, 1885
Thysanapoda cristata G.O. Sars, 1883
Thysanopoda pectinata Ortmann, 1893
Thysanopoda cornuta Illig, 1905
Thysanopoda egregia Hansen, 1905

Group 3.

Stylocheiron carinatum G.O. Sars, 1883
Thysanoessa gregaria G.O. Sars, 1883
Euphausia tenera Hansen, 1905
Thysanopoda obtusifrons G.O. Sars, 1883
Stylocheiron robustum Brinton, 1962
Stylocheiron abbreviatum G.O. Sars, 1883

Group 4

Euphausia krohni (Brandt, 1851)

Meganyctiphanes norvegica (M. Sars, 1857)

Group 5

Thysanopoda tricuspidata Milne-Edwards, 1837

Nematoscelis microps form 1/2

Euphausia americana Hansen, 1911

Group 6

Thysanoessa longicaudata (Kroyer, 1846)

Nematoscelis megalops G.O. Sars, 1883

TABLE 3 Adults and subadults in RMT 1 expressed as numbers /1000m^3

STATION NUMBER	8262	8263	8264	8265	8270	8271	8272	8274	8275	8276	8277	8279	TOTAL
Species													
Group 1													
N. flexipes	3.97	6.52	2.26	-	1.00	1.21	1.80	-	-	-	-	-	16.76
E. hemigibba	12.90	6.52	14.67	12.30	19.05	8.43	5.41	4.01	1.01	5.41	6.44	2.28	98.43
N. atlantica 3/4	-	1.09	-	1.03	3.01	2.41	2.71	-	-	-	-	-	10.25
S. longicorne short	1.99	2.17	14.67	2.05	2.01	2.41	4.51	1.00	-	-	6.44	1.14	38.39
T. microphthalma	-	-	-	-	-	-	-	-	-	-	-	-	0
N. boopis	-	1.09	-	-	-	-	-	-	-	-	-	-	1.09
E. brevis	15.88	18.48	9.03	16.41	31.08	-	32.47	5.01	2.03	9.73	21.17	4.57	165.86
N. microps 0/0	0.99	3.26	6.80	4.1	8.02	7.23	0.90	1.00	2.03	2.16	1.84	3.43	41.76
E. gibboides	-	-	-	-	-	-	-	-	-	-	-	-	0
Group 2													
N. tenella 1,2/2,3	0.99	-	2.26	2.05	2.02	1.21	1.80	-	1.01	1.08	0.92	-	13.34
S. elongatum	-	2.17	5.01	3.08	1.00	4.82	4.51	3.01	-	-	3.69	5.71	33.00
T. aequalis	3.97	1.09	1.13	2.05	4.01	8.43	5.41	1.00	1.01	-	1.84	3.43	33.37
S. suhmi	0.99	1.09	6.78	1.03	3.01	6.02	1.80	6.02	6.08	6.49	6.44	-	45.75
S. affine	-	1.09	3.39	1.03	3.01	4.82	-	-	-	1.08	0.92	2.28	17.62
S. maximum	-	-	-	-	-	-	-	-	-	-	-	-	0
N. sexspinosum	-	-	-	-	-	-	-	-	-	-	-	-	0
B. amblyops	-	-	-	-	-	-	-	-	-	-	-	-	0
T. cristata	-	-	-	-	-	-	-	-	-	-	-	-	0
T. pectinata	-	-	-	-	-	-	-	-	-	-	-	-	0
T. cornuta	-	-	-	-	-	-	-	-	-	-	-	-	0
T. egregia	-	-	-	-	-	-	-	-	-	-	-	-	0
Group 3													
S. carinatum	-	-	-	-	1.00	2.41	1.80	1.00	1.00	1.08	2.76	3.43	14.48
E. tenera	-	-	-	-	2.01	1.21	-	-	-	-	3.68	2.28	9.18
T. gregaria (both forms)	1.99	3.26	1.13	4.10	23.06	21.69	3.61	19.05	6.08	2.16	2.76	27.43	116.32
T. obtusifrons	-	-	-	-	-	-	-	1.00	-	-	-	-	1.00
S. robustum	-	-	-	-	-	-	-	-	-	-	-	-	0
S. abbreviatum	0.99	1.09	-	2.05	2.01	-	0.90	-	-	1.08	-	2.29	10.41
Group 4													
E. krohni	2.98	-	-	1.03	-	-	-	-	-	-	-	-	4.01
M. norvegica	-	-	-	-	-	-	-	-	-	-	-	-	0
Group 5													
T. tricuspidata	-	-	-	-	-	-	-	-	-	-	-	-	0
N. microps 1/2	-	-	-	-	-	-	-	-	-	-	-	1.14	1.14
E. americana	-	-	-	-	-	-	0.90	-	-	-	-	-	0.90
Group 6													
T. longicaudata	-	-	-	-	-	-	-	-	-	-	-	-	0
N. megalops	-	-	-	-	-	-	-	-	-	-	-	-	0

TABLE 4 Adolescents in RMT 1 expressed as numbers/1000m^3

STATION NUMBER	8262	8263	8264	8265	8270	8271	8272	8274	8275	8276	8277	8279	TOTAL
Species													
Group 1													
N. flexipes	-	14.13	1.13	2.05	1.00	-	-	3.01	-	-	1.84	2.29	25.45
E. hemigibba	28.78	18.48	31.59	17.44	12.03	2.41	2.71	3.01	2.03	4.32	17.49	10.29	150.58
S. longicorne short	5.96	4.35	18.05	13.33	24.06	16.87	0.90	3.01	1.02	9.73	10.13	4.57	111.98
T. microphthalma	-	-	-	-	-	2.41	-	-	-	-	0.92	1.14	4.47
N. boopis	0.99	-	-	2.05	-	-	-	-	-	-	-	-	3.04
E. brevis	8.93	38.04	19.18	16.41	46.12	22.89	2.71	5.01	2.03	14.05	-	8.00	183.37
N. microps/N. atlantica	3.97	9.78	7.90	3.08	25.06	14.46	4.51	-	2.03	7.57	21.17	2.29	101.82
E. gibboides	5.96	2.17	4.51	2.05	1.00	-	-	-	-	-	-	-	15.69
Group 2													
N. tenella 1,2/2,3	-	3.26	3.39	2.05	13.03	2.41	1.81	-	2.03	4.32	3.68	1.14	37.12
S. elongatum	0.99	2.17	15.80	5.13	18.05	15.06	9.02	2.01	2.03	4.32	10.13	-	84.71
T. aequalis/obtusifrons	7.94	3.26	12.41	3.08	9.02	10.84	4.51	3.01	4.06	4.32	-	2.29	64.74
S. suhmi	-	2.17	5.64	-	3.01	7.23	-	1.02	2.03	7.67	5.52	-	34.29
S. affine	-	2.17	1.13	-	1.00	0.90	0.90	-	-	1.08	1.84	2.29	11.31
S. maximum	-	-	-	-	-	-	-	-	-	-	0.92	-	0.92
N. sexspinosum	-	-	-	-	-	-	-	-	-	-	-	-	0
B. amblyops	-	-	-	-	-	-	-	-	-	-	-	-	0
T. cristata	-	-	-	-	-	-	-	-	-	-	0.92	-	0.92
T. pectinata	-	-	-	-	-	-	-	-	-	-	0.92	-	0.92
T. cornuta	-	-	-	-	-	-	-	-	-	-	-	-	0
T. egregia	-	-	-	-	-	-	-	-	-	-	-	-	0
Group 3													
S. carinatum	-	-	2.26	-	-	-	-	-	-	1.08	0.92	-	4.26
E. tenera	-	-	-	-	-	1.21	-	-	-	-	-	-	1.21
T. gregaria (both forms)	12.90	15.22	4.51	2.05	75.19	38.55	48.70	6.09	2.03	14.05	3.68	4.48	227.45
S. robustum	-	-	-	-	-	-	-	-	-	-	-	-	0
S. abbreviatum	-	-	6.77	-	12.03	8.43	10.82	4.01	2.03	2.16	3.68	1.14	51.07
Group 4													
E. krohni	-	-	-	1.03	-	-	-	-	-	-	-	-	1.03
M. norvegica	-	-	-	-	-	-	-	-	-	-	-	-	0
Group 5													
T. tricuspidata	-	-	-	-	-	-	-	-	-	-	-	-	0
N. microps 1/2	-	-	-	-	-	-	-	-	-	-	-	-	0
E. americana	-	-	-	-	-	-	-	-	-	-	0.92	-	0.92
Group 6													
T. longicaudata	-	-	-	-	-	-	0.90	-	-	-	-	-	0.90
N. megalops	-	-	-	-	-	-	-	-	-	-	-	-	0

TABLE 5 Larvae in RMT 1 expressed as $No/1000m^3$

STATION NUMBER	8262	8263	8264	8265	8270	8271	8272	8274	8275	8276	8277	8279	Total
Species													
Group 1													
N. flexipes	-	2.17	-	-	-	-	-	-	-	-	-	-	2.17
E. hemigibba	14.89	5.43	-	31.80	6.02	4.82	0.90	1.02	-	-	12.89	12.57	90.34
S. longicorne short	11.91	11.96	9.03	3.08	5.01	10.84	6.31	6.02	2.03	7.57	8.29	4.57	86.62
T. microphthalma	-	-	-	-	-	-	-	-	-	-	-	-	0
N. boopis	-	-	-	-	-	-	-	-	-	-	-	-	0
E. brevis	31.76	41.30	11.28	32.82	93.23	20.48	9.02	3.01	8.11	30.27	37.75	27.43	346.45
N. microps/atlantica	1.99	10.87	6.77	3.08	32.08	3.62	2.71	-	-	1.08	7.37	3.43	73.0
E. gibboides	3.00	2.17	-	-	-	-	-	-	-	1.08	-	-	6.25
Group 2													
N. tenella 1,2/2,3	-	-	-	1.03	8.02	-	-	-	-	-	-	1.18	10.23
S. elongatum	-	-	3.39	2.05	2.01	-	-	1.01	-	-	-	1.14	9.60
T. aequalis/obtusifrons	4.96	4.35	4.51	5.13	6.02	1.21	1.80	1.02	4.06	7.57	1.04	2.29	44.76
S. suhmi	-	-	-	-	2.01	1.21	6.02	-	-	2.16	1.84	-	13.24
S. affine	-	-	-	-	-	-	-	-	-	-	-	-	0
S. maximum	-	-	-	-	-	1.20	-	-	-	1.08	-	-	2.28
N. sexspinosum	-	-	-	-	-	-	-	-	-	-	-	-	0
B. amblyops	-	-	-	-	-	-	-	-	-	-	-	-	0
T. cristata	-	-	-	-	-	-	-	-	-	-	-	-	0
T. pectinata	-	-	-	1.03	-	-	-	-	-	-	-	-	1.03
T. cornuta	-	-	-	-	-	-	-	-	-	-	-	-	0
T. egregia	-	-	1.13	-	-	-	-	-	-	-	-	-	1.13
Group 3													
S. carinatum	-	-	-	-	-	-	-	-	-	-	-	-	0
E. tenera	-	-	-	-	1.00	-	-	-	-	-	-	-	1.00
T. gregaria (both forms)	5.96	1.09	1.13	5.13	5.01	-	21.65	-	-	-	20.55	40.00	100.22
S. robustum	-	-	-	-	-	-	-	-	-	-	-	-	0
S. abbreviatum	2.97	3 26	1.13	1.03	2.01	6.02	11.73	5.01	1.01	5.41	11.05	6.86	57.49
Group 4													
E. krohni	-	-	-	-	-	-	-	-	-	-	-	-	0
M. norvegica	-	-	-	-	-	-	-	-	-	-	-	-	0
Group 5													
T. tricuspidata	-	-	-	-	-	-	-	-	-	-	-	-	0
N. microps 1/2	-	-	-	-	-	-	-	-	-	-	-	-	0
E. americana	-	-	-	-	-	-	-	-	-	-	-	-	0
Group 6													
T. longicaudata	-	-	-	-	-	-	-	-	-	-	-	-	0
N. megalops	-	-	-	-	-	-	-	-	-	-	-	-	0

TABLE 6 Adults and subadults in RMT 8 expressed as numbers 1 [illegible]0m^3

STATION NUMBER	8262	8263	8264	8265	8270	8271	8272	8274	8275	8276	8277	8279	TOTAL
Species													
Group 1													
N. flexipes	1.67	8.97	3.81	0.63	0.56	0.53	0.73	0.63	0.16	0.34	0.06	0.73	18.82
E. hemigibba	3.78	2.38	4.09	7.28	4.83	1.81	1.69	3.51	0.25	1.52	0.37	0.89	32.40
N. atlantica 3/4	-	0.95	2.47	1.41	1.50	0.53	0.62	0.44	0.03	0.27	-	0.18	8.40
S. longicorne short	0.31	0.61	1.69	0.82	0.69	0.98	0.45	0.13	0.16	1.69	0.20	0.21	7.94
T. microphthalma	0.12	0.22	0.02	0.21	0.11	0.02	0.13	0.06	0.06	0.06	0.06	0.14	1.21
N. boopis	0.14	0.68	0.49	0.14	0.06	0.10	0.14	0.19	0.03	0.14	-	0.05	2.16
E. brevis	1.06	2.58	1.13	5.85	4.01	0.15	3.72	0.06	0.10	1.59	1.11	0.39	21.75
N. microps 0/0	0.68	2.79	3.10	3.70	5.64	3.61	3.78	3.13	0.48	2.50	1.24	1.32	31.97
E. gibboides	-	0.27	0.07	0.06	0.31	-	0.06	-	-	0.20	0.12	0.05	1.14
Group 2													
N. tenella 1,2/2,3	-	0.68	1.76	2.08	2.44	0.98	1.13	0.53	1.27	1.08	0.43	0.45	12.83
S. elongatum	0.25	0.68	1.48	2.00	1.07	1.96	3.21	1.57	0.38	1.28	0.29	0.41	14.58
T. aequalis	0.56	0.48	2.96	2.27	1.50	1.05	0.34	1.24	2.13	1.84	1.15	0.45	15.97
S. suhmi	-	-	0.14	0.13	0.25	0.68	0.17	0.50	2.03	0.51	-	0.07	4.48
S. affine	0.06	0.20	0.71	0.26	0.44	-	0.28	0.63	0.03	0.68	0.17	0.05	3.51
S. maximum	0.02	0.07	0.08	0.13	-	0.08	0.06	-	0.02	0.03	-	0.07	0.56
N. sexspinosum	0.05	-	0.11	-	0.09	0.10	0.06	-	0.03	0.08	0.06	-	0.58
B. amblyops	0.02	-	-	-	-	-	-	-	-	-	-	-	0.02
T. cristata	-	-	0.02	0.02	-	0.02	-	-	-	0.02	-	-	0.08
T. pectinata	-	0.02	-	-	-	-	0.01	-	-	-	-	-	0.03
T. cornuta	-	-	-	-	-	-	0.02	-	-	-	-	-	0.02
T. egregia	-	-	-	-	-	-	-	-	-	-	-	-	0
Group 3													
S. carinatum	-	-	0.21	0.06	0.44	0.30	0.56	0.38	-	1.42	0.26	0.18	3.81
E. tenera	-	-	-	0.06	0.56	0.15	0.06	-	0.13	0.14	0.12	0.18	1.40
T. gregaria (both forms)	0.06	0.41	0.21	0.45	2.44	6.25	4.28	25.19	4.37	2.33	0.37	7.43	53.79
T. obtusifrons	-	0.07	-	0.08	0.31	0.15	0.06	0.31	0.11	0.36	0.23	0.09	1.77
S. robustum	-	-	-	0.06	0.06	0.23	0.09	-	-	0.09	0.03	0.04	0.60
S. abbreviatum	0.37	0.68	1.55	0.88	1.50	3.69	2.72	1.32	0.41	1.35	1.18	1.87	17.52
Group 4													
E. krohni	0.68	0.07	-	9.04	-	-	-	-	-	-	-	-	9.79
M. norvegica	-	-	0.34	0.02	-	-	-	-	-	-	-	-	0.36
Group 5													
T. tricuspidata	-	-	-	-	-	-	-	0.13	-	-	0.01	0.07	0.21
N. microps 1/2	-	-	-	-	-	-	-	-	-	-	-	0.34	0.34
E. americana	-	-	-	-	-	-	-	-	-	0.03	-	-	0.03
Group 6													
T. longicaudata	-	-	-	-	-	-	0.17	-	-	-	-	-	0.17
N. megalops	-	-	-	0.03	-	-	-	-	-	-	-	-	0.03

TABLE 7 Adolescents in RMT 8 expressed as numbers/1000m^3

STATION NUMBER	8262	8263	8264	8265	8270	8271	8272	8274	8275	8276	8277	8279	TOTAL
Species													
Group 1													
N. flexipes	0.95	1.63	0.63	0.85	0.13	0.53	0.28	0.63	0.25	0.14	0.20	0.14	6.36
E. hemigibba	1.06	1.22	1.55	0.58	0.69	-	0.11	0.19	0.25	0.14	0.03	0.07	5.89
N. atlantica 3/4	-	-	-	0.32	-	-	-	-	0.06	0.07	-	0.02	0.47
S. longicorne short	0.06	-	0.07	-	-	0.08	-	-	-	0.03	0.03	-	0.27
T. microphthalma	0.12	0.14	0.56	0.71	0.19	-	0.30	-	0.19	0.24	0.14	0.09	2.68
N. boopis	0.06	0.61	0.07	0.26	0.25	0.08	0.06	-	-	-	-	0.04	1.43
E. brevis	0.50	0.27	0.07	0.14	0.06	-	0.06	-	0.06	0.10	0.17	0.07	1.5
N. microps 0/0	0.93	1.16	0.49	1.86	1.75	0.60	0.85	0.63	0.44	0.71	0.03	0.04	9.49
E. gibboides	0.25	-	0.14	0.19	0.06	-	-	0.06	-	-	0.32	-	1.02
Group 2													
N. tenella 1,2/2,3	-	0.07	0.35	0.83	0.31	0.23	0.28	0.13	0.10	0.57	0.17	0.12	3.16
S. elongatum	-	-	0.28	0.13	0.13	0.38	0.23	0.19	0.16	0.17	0.12	0.11	1.90
T. aequalis	0.19	0.27	1.13	0.90	0.19	-	0.51	-	0.25	0.37	0.07	0.05	3.93
S. suhmi	-	-	-	-	-	-	-	-	-	0.03	-	0.04	0.07
S. affine	-	-	-	-	-	-	-	0.06	-	-	0.06	0.02	0.14
S. maximum	0.06	0.14	0.21	-	-	0.08	0.06	0.06	-	-	-	-	0.61
N. sexspinosum	-	-	-	0.06	-	-	-	0.06	-	0.10	0.09	-	0.31
B. amblyops	0.62	0.07	0.07	-	-	0.08	-	-	0.03	-	-	0.02	0.89
T. cristata	-	-	0.14	0.06	-	-	0.11	0.19	0.03	0.03	-	0.02	0.58
T. pectinata	-	-	-	-	-	-	-	-	-	-	-	-	0
T. cornuta	-	-	-	-	-	-	0.11	-	-	0.03	-	0.05	0.19
T. egregia	-	0.20	-	-	0.06	-	-	-	-	0.03	-	-	0.29
Group 3													
S. carninatum	-	-	-	-	-	-	-	0.06	-	0.03	0.03	0.02	0.14
E. tenera	-	-	-	-	-	-	-	-	-	-	0.03	-	0.03
T. gregaria	-	0.07	-	0.06	0.19	-	0.06	-	-	0.03	-	0.57	0.98
T. obtusifrons	-	-	-	0.06	0.19	-	0.06	0.38	0.32	0.17	0.14	0.04	1.36
S. robustum	-	-	-	-	-	-	-	-	-	-	-	-	0
S. abbreviatum	0.06	0.07	0.49	0.14	0.81	0.68	1.24	1.13	0.16	1.32	0.32	0.09	6.51
Group 4													
E. krohni	0.06	-	-	-	-	-	-	-	-	-	-	-	0.06
M. norvegica	-	-	-	-	-	-	-	-	-	-	-	-	0
Group 5													
T. tricuspidata	-	-	-	-	-	-	-	-	-	-	-	-	0
N. microps 1/2	-	-	-	-	-	-	-	-	-	-	-	-	0
Group 6													
T. longicaudata	-	-	-	-	-	-	0.06	-	-	-	-	-	0.06
N. megalops	-	-	-	-	-	-	-	-	-	-	-	-	0

TABLE 8 Numbers of euphausiids/1000m^3 from day and night hauls at 30°N 23°W (Station 7856) and 30°N 60°W (Station 8281). All adolescents and larvae are from the RMT 1. The net used to determine the number of adults and subadults is shown in the column headed 'net'

Species	Net	Adults/Subadults 23°W	Adults/Subadults 60°W	Adolescents/Larvae 23°W	Adolescents/Larvae 60°W
Group 1					
N. flexipes	RMT 8	0.74	0.30	0.04	0.97
E. hemigibba	RMT 1	11.44	1.13	21.96	0.24
N. atlantica	RMT 1	0.45	0.12	0.09	0.02
S. longicorne short	RMT 1	3.62	1.17	8.24	2.20
T. microphthalma	RMT 8	0.46	0.02	0.19	0.03
N. boopis	RMT 8	0.09	0.005	0.24	0.21
E. brevis	RMT 1	16.56	17.77	59.65	17.17
N. microps 0/0	RMT 1	1.91	1.62	1.51	4.51
E. gibboides	RMT 8	0.32	0.061	0.60	0.11
Group 2					
N. tenella 1,2/2,3	RMT 1	0.31	0.51	0.16	4.30
S. elongatum	RMT 1	0.93	1.16	1.91	2.08
T. aequalis	RMT 1	0.49	0.42	1.24	0.43
S. suhmi	RMT 1	0.63	2.47	0.23	9.28
S. affine	RMT 1	0.84	0.77	0.73	0.52
S. maximum	RMT 8	0.02	0.011	0.08	0.32
N. sexspinosum	RMT 8	0.03	0.02	0.003	0.006
B. amblyops	RMT 8	0.03	0.05	0.05	0.12
T. cristata	RMT 8	0	0	0.03	0.10
T. pectinata	RMT 8	0.0007	0.001	0.10	0
T. cornuta	RMT 8	0.001	0.003	0.01	0.05
T. egregia	RMT 8	0	0	0.009	0.003
Group 3					
S. carinatum	RMT 1	2.02	1.44	0.05	7.45
T. gregaria (both forms)	RMT 1	0.09	9.23	16.11	27.88
E. tenera	RMT 1	0.006	1.65	0	3.77
T. obtusifrons	RMT 8	0.157	0.31	0.24	0.27
S. robustum	RMT 8	0.02	0.02	0	0
S. abbreviatum	RMT 8	0.18	0.35	0.74	2.70
Group 4					
E. krohni	RMT 8	0	0	0	0.05
M. norvegica	RMT 8	0	0	0	0
Group 5					
T. tricuspidata	RMT 8	0.007	0.09	0.0007	0.003
N. microps 1/2	RMT 8	0	0	0	0
E. americana	RMT 1	0.003	0.24	0.003	0.25
Group 6					
T. longicaudata	RMT 1	0	0.15	0	0.17
N. megalops	RMT 8	0	0	0	0

Group		S. abbreviatum	S. carinatum	T. obtusifrons	S. suhmi	S. elongatum	T. aequalis	S. affine	N. tenella	E. brevis	E. hemigibba	N. flexipes	N. microps o/o	N. boopis	S. longicorne (short)	T. microphthalma
3	T. gregaria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	S. abbreviatum		.	.	.	++	.	.	.	.	.	.	.	.	.	.
	S. carinatum			.	.	.	.	.	.	.	.	–	.	–	.	.
	T. obtusifrons				+	.	.	.	.	.	.	–	.	.	.	.
	S. suhmi					+	.	.	.	.	.	–	.	.	.	.
2	S. elongatum						.	+	+	.	.	.	+	.	+	.
	T. aequalis							.	.	.	.	.	.	.	+	.
	S. affine								.	.	.	.	+	.	+	+
	N. tenella									.	.	.	++	.	.	.
1	E. brevis										+	+	+	+	.	.
	E. hemigibba											+	+	+	+	.
	N. flexipes												.	++	.	.
	N. microps o/o													.	+	.
	N. boopis														.	.
	S. longicorne (short)															.

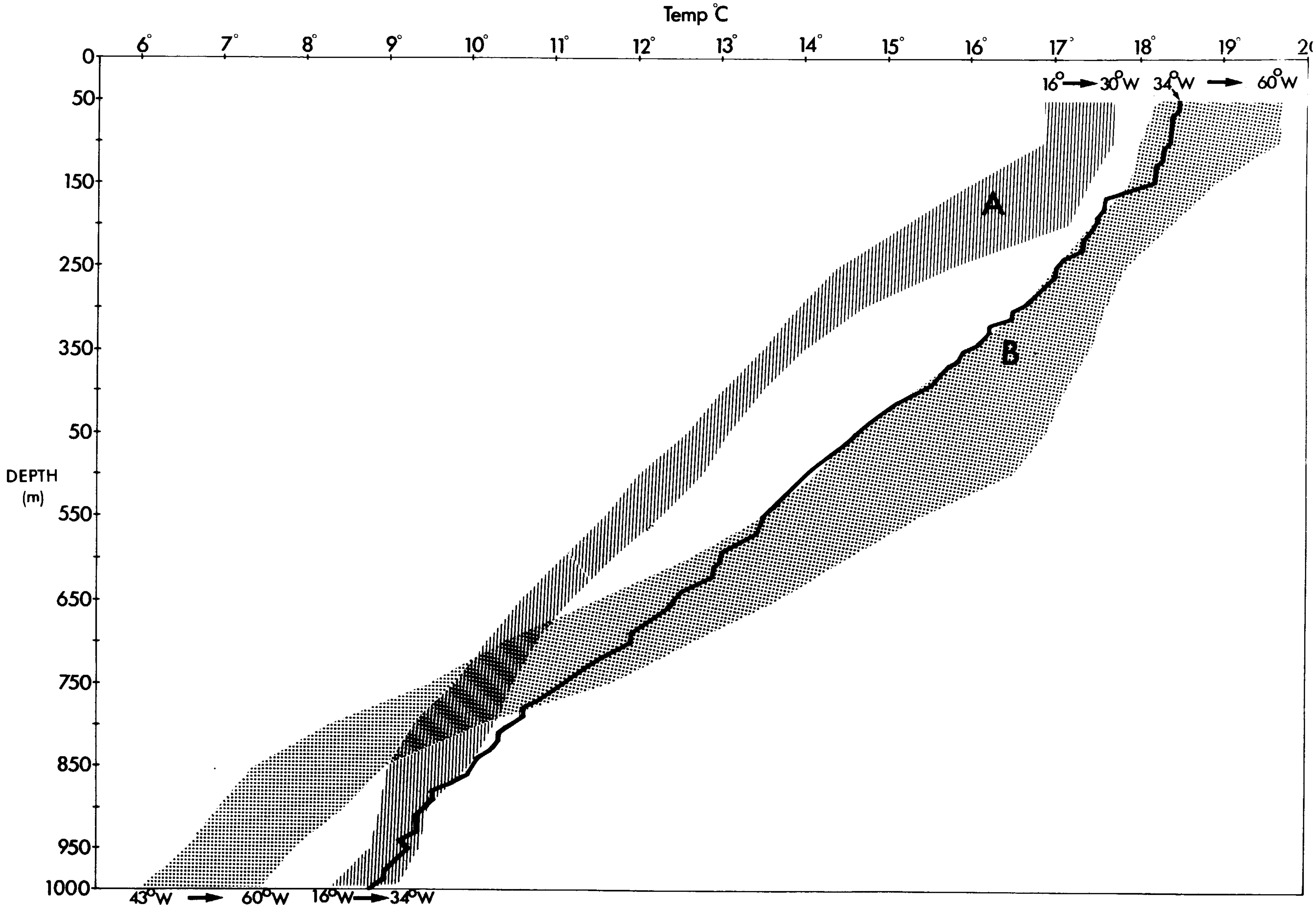
Table 9. Rank correlation matrix between species ++p > 99% + p > 95%

. not significant

– p > 5%

FIGURES 1-8

Figure 1. Temperature profiles at the 13 stations along the transect at which TSD observations were made. Envelope A includes the stations from 16°-30°W and envelope B 39°-60°W. The profile at 34°W is shown individually and lay close to the boundary of the 18°C water.



Temp °C
6° 7° 8° 9° 10° 11° 12° 13° 14° 15° 16° 17° 18° 19°
DEPTH (m)
0 50 150 250 350 50 550 650 750 850 950 1000
16° → 30°W 34°W → 60°W
A
B
43°W → 60°W 16°W → 34°W

Figure 2. Abundances of adults/subadults and larvae or adolescents of the nine species in group 1, expressed as numbers per $1000m^3$ along the 32°N transect. The net providing the data for each individual species is shown.

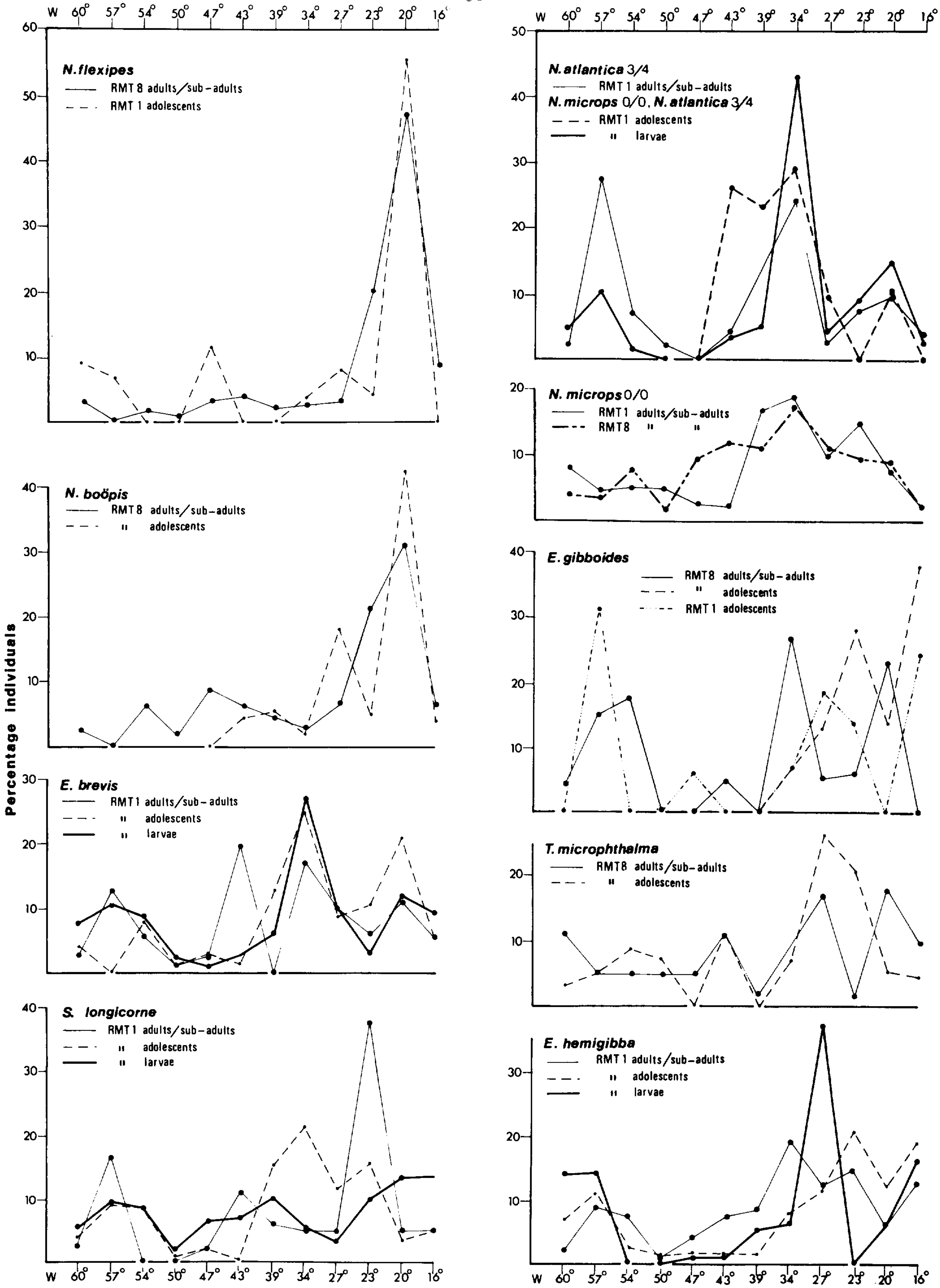

Percentage Individuals
W 60° 57° 54° 50° 47° 43° 39° 34° 27° 23° 20° 16°
N. flexipes
RMT 8 adults/sub-adults
RMT 1 adolescents
N. boöpis
RMT 8 adults/sub-adults
" adolescents
E. brevis
RMT 1 adults/sub-adults
" adolescents
" larvae
S. longicorne
RMT 1 adults/sub-adults
" adolescents
" larvae
N. atlantica 3/4
RMT 1 adults/sub-adults
N. microps 0/0, N. atlantica 3/4
RMT 1 adolescents
" larvae
N. microps 0/0
RMT 1 adults/sub-adults
RMT 8 " "
E. gibboides
RMT 8 adults/sub-adults
" adolescents
RMT 1 adolescents
T. microphthalma
RMT 8 adults/sub-adults
" adolescents
E. hemigibba
RMT 1 adults/sub-adults
" adolescents
" larvae

Figure 3. Abundances of adults/subadults and larvae or adolescents of eight of the species in group 2, expressed as numbers per $1000m^3$ along the 32°N transect. The net providing the data for each individual species is shown.

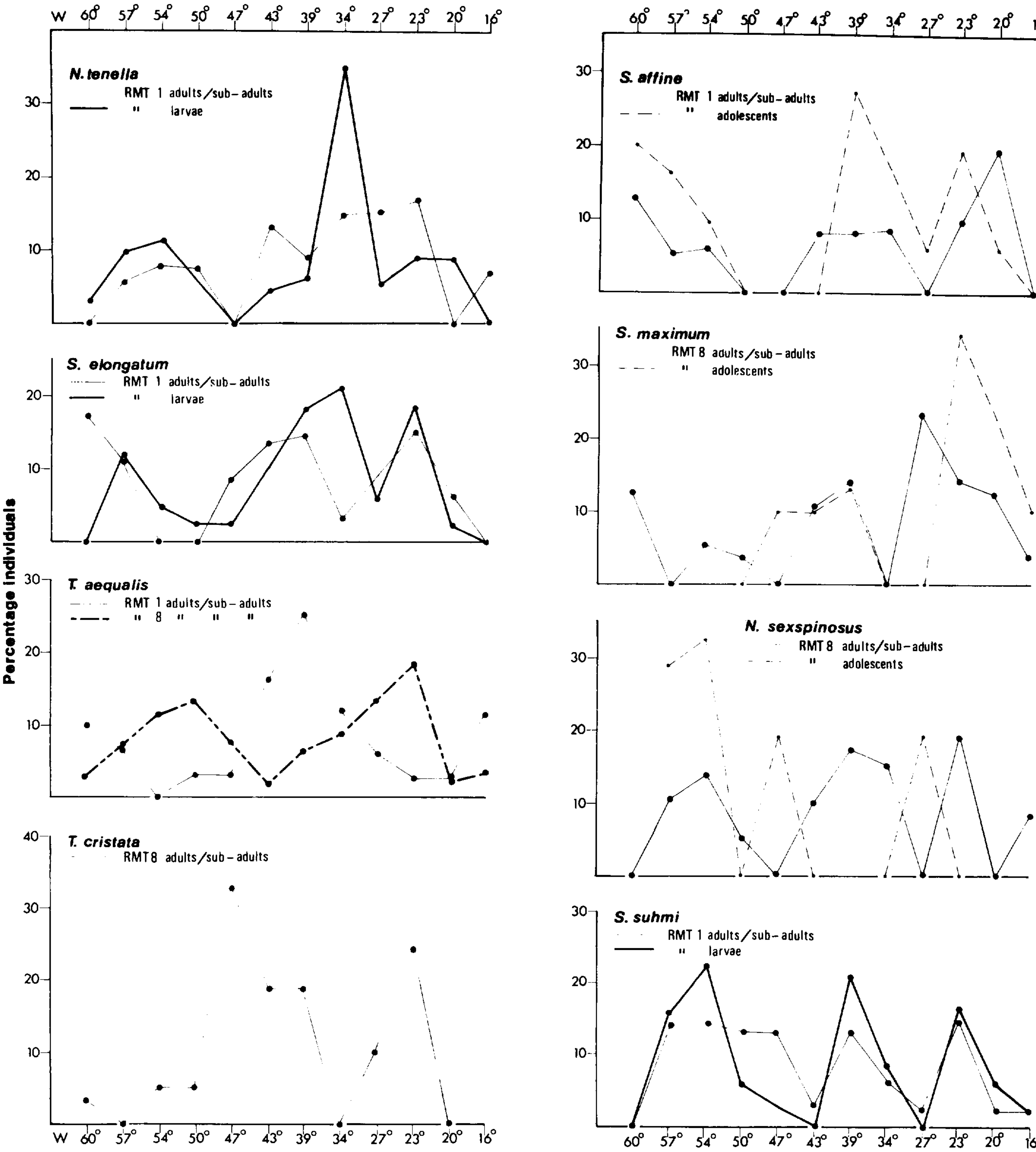

N. tenella
RMT 1 adults/sub-adults
" larvae
S. elongatum
RMT 1 adults/sub-adults
" larvae
T. aequalis
RMT 1 adults/sub-adults
" 8 " " "
T. cristata
RMT8 adults/sub-adults
Percentage individuals
S. affine
RMT 1 adults/sub-adults
" adolescents
S. maximum
RMT 8 adults/sub-adults
" adolescents
N. sexspinosus
RMT 8 adults/sub-adults
" adolescents
S. suhmi
RMT 1 adults/sub-adults
" larvae
W 60° 57° 54° 50° 47° 43° 39° 34° 27° 23° 20° 16°

Figure 4. Abundances of adults/subadults and larvae or adolescents of the six species in group 3, expressed as numbers per $1000m^3$ along the 32°N transect. The net providing the data for each individual species is shown.

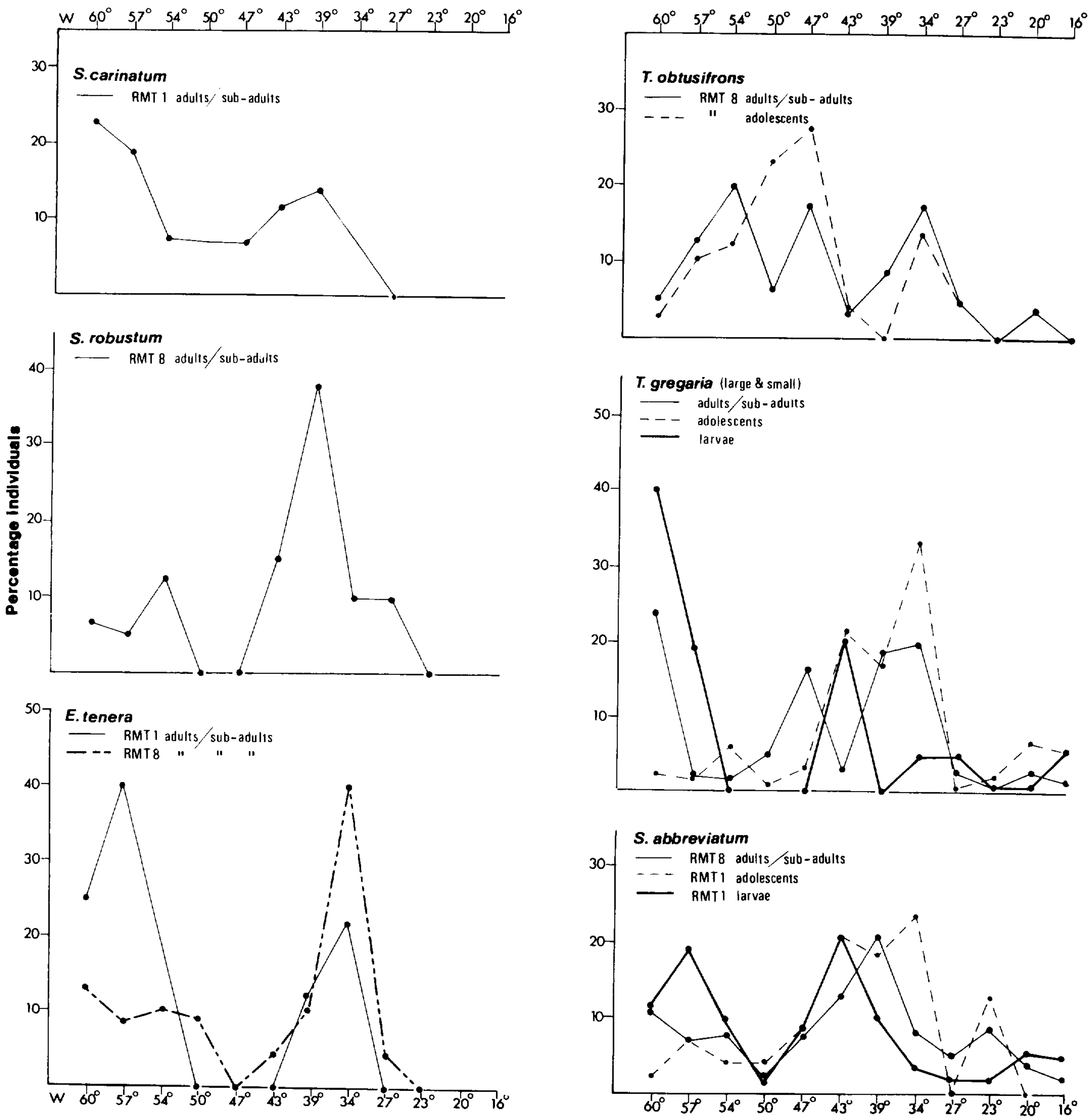

W 60° 57° 54° 50° 47° 43° 39° 34° 27° 23° 20° 16°
S. carinatum
RMT 1 adults/ sub-adults
S. robustum
RMT 8 adults/sub-adults
Percentage Individuals
E. tenera
RMT 1 adults/sub-adults
RMT 8 " " "
T. obtusifrons
RMT 8 adults/sub- adults
" adolescents
T. gregaria (large & small)
adults/sub-adults
adolescents
larvae
S. abbreviatum
RMT 8 adults/sub-adults
RMT 1 adolescents
RMT 1 larvae
10
20
30
40
50

Figure 5. Abundances of adults of the two species in group 4 and one species from group 3, expressed as numbers per $1000m^3$ along the 32°N transect. The net providing the data for each individual species is shown.

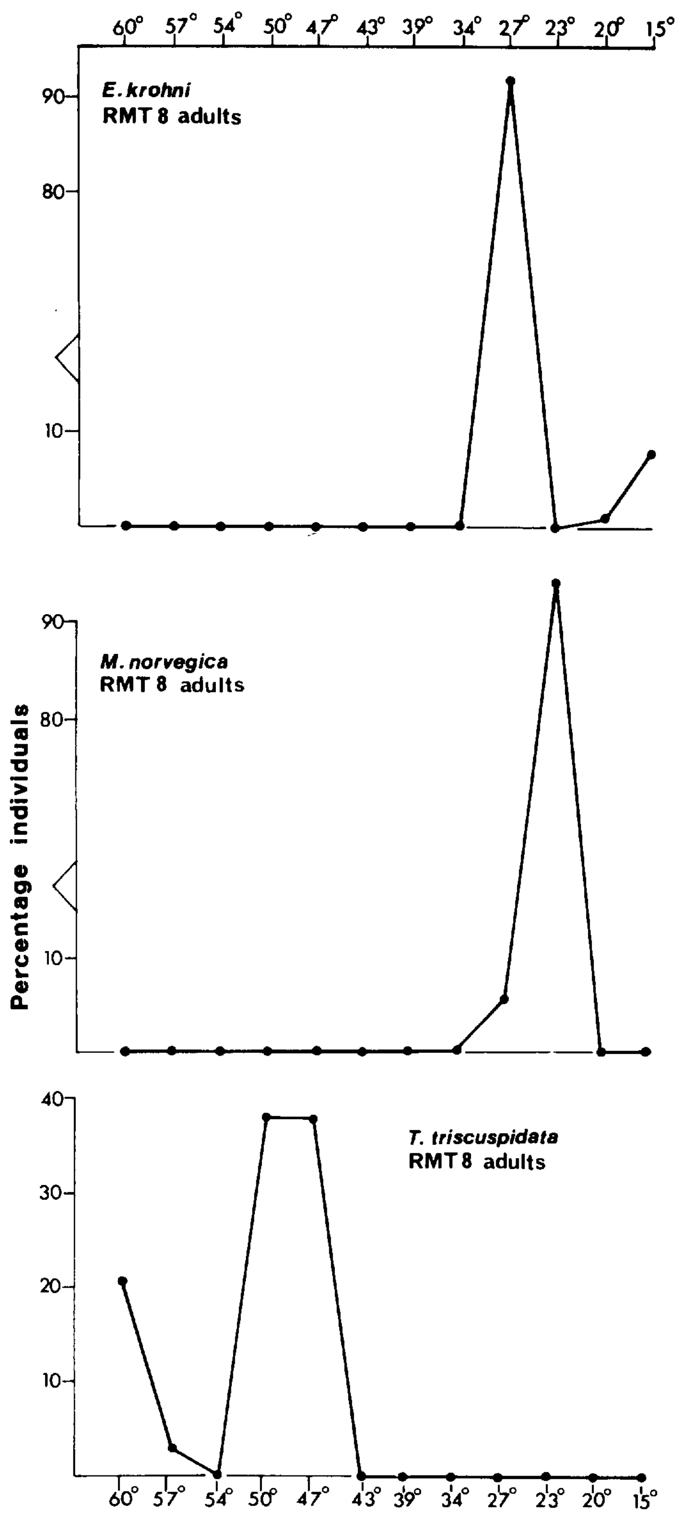

60° 57° 54° 50° 47° 43° 39° 34° 27° 23° 20° 15°
E. krohni
RMT 8 adults
90
80
10
M. norvegica
RMT 8 adults
Percentage individuals
40
30
20
T. triscuspidata
RMT 8 adults
60° 57° 54° 50° 47° 43° 39° 34° 27° 23° 20° 15°

Figure 6. Plots of the ordination values in two dimensions derived from a Kruskal analysis (multi-dimensional scaling) of the euphausiid data from the transect, showing the marked clinal trend in the first dimension of the analysis.

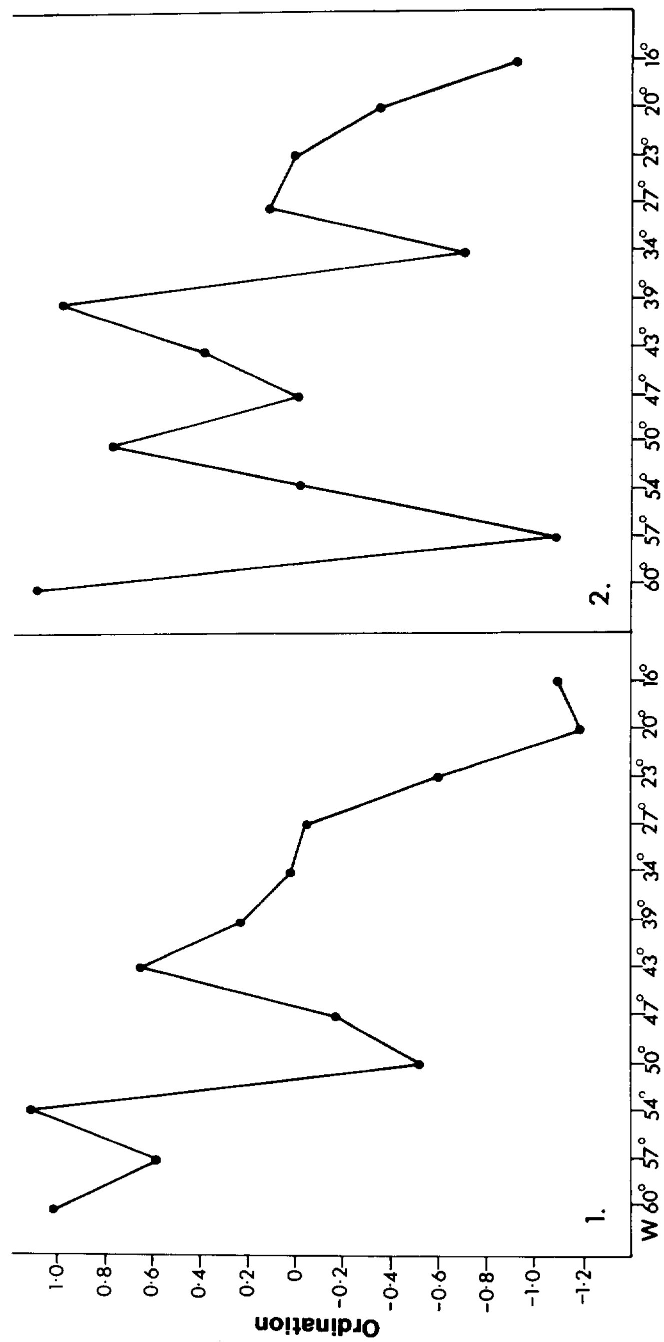

Ordination
1·0
0·8
0·6
0·4
0·2
0
-0·2
-0·4
-0·6
-0·8
-1·0
-1·2
1.
W 60° 57° 54° 50° 47° 43° 39° 34° 27° 23° 20° 16°
2.
60° 57° 54° 50° 47° 43° 39° 34° 27° 23° 20° 16°

Figure 7. Full distributional range by day (D) and night (N) and zones occupied by the middle 50% of the populations of larvae of some of the species in group 1 at Station 7856 30°N 23°W (solid) and Station 8281, 32°N, 65°W (hatched). The numbers show the sizes of the larval populations sampled.

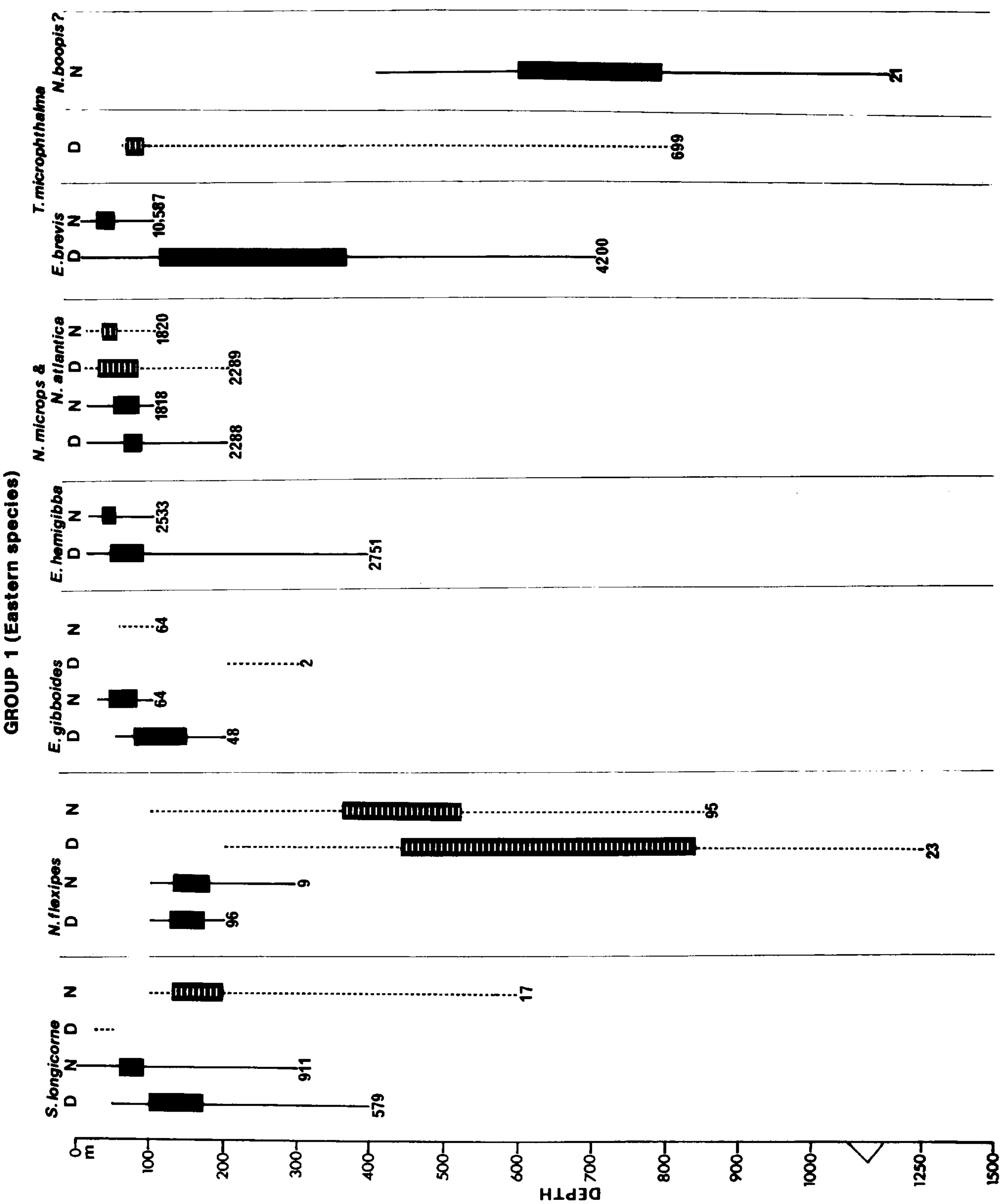
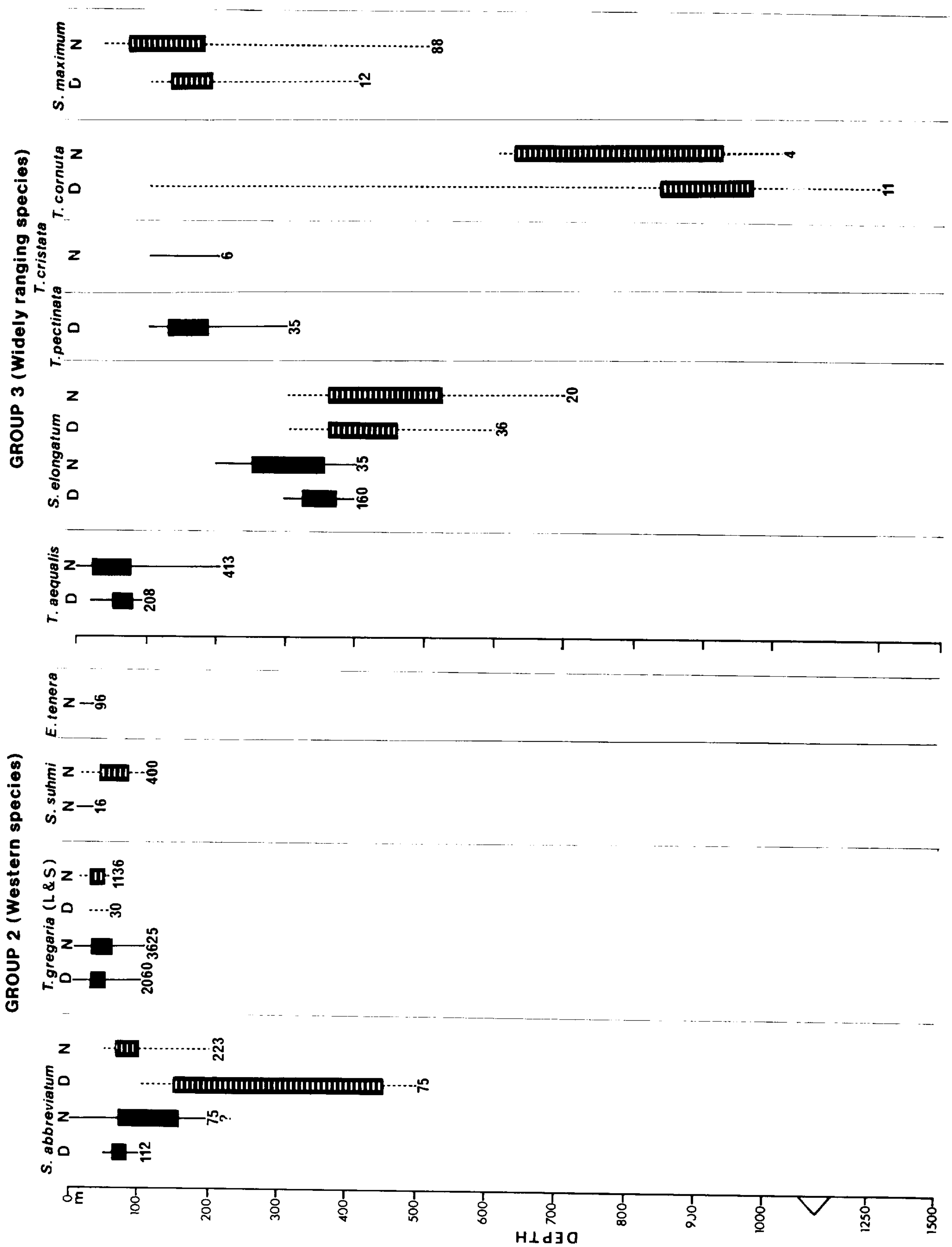

GROUP 1 (Eastern species)
S. longicorne
N. flexipes
E. gibboides
E. hemigibba
N. microps & N. atlantica
E. brevis
T. microphthalma
N. boopis ?
D
N
579
911
17
96
9
23
95
48
64
2
2751
2533
2288
1818
2289
1820
4200
10.587
699
21
DEPTH
0 m
100
200
300
400
500
600
700
800
900
1000
1250
1500

Figure 8. Full distributional range by day (D) and night (N) and the zones occupied by the middle 50% of the populations of larvae of four of the group 2 species and the six group 3 species at Station 8756, 30°N 23°W (solid) and Station 8281, 32°N 65°W (hatched). The numbers show the sizes of he larval populations sampled.


GROUP 2 (Western species)
GROUP 3 (Widely ranging species)
S. abbreviatum
T. gregaria
T. gregaria (L & S)
S. suhmi
E. tenera
T. aequalis
S. elongatum
T. pectinata
T. cristata
T. cornuta
S. maximum
D
N
112
75
?
75
223
2060
3625
30
1136
16
400
96
208
413
160
35
36
20
35
6
11
4
12
88
DEPTH
0
m
100
200
300
400
500
600
700
800
900
1000
1250
1500