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Seasonal Structure of the Stratification and Distribution of Micro-Zooplankton along the Coastal Zone of the Bornholm Basin

by

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In this contribution the author demonstrates the occurrence of the stratified structure as indicated by particular species of the micro-zooplankton, from the coastal zone to the deepest areas of the Bornholm Deep.

The material for this contribution has been collected during all four seasons, namely May, August and December of 1967 and March 1968. The investigations were carried out at 8 stations along the section Ustka-Bornholm Deep. (Figure 1). The sampling was performed by means of the modified Nansen and Hensen nets fitted with the gauze No.16. The following division of the water column was used: 15-0 m; 30-15 m; 50-30 m; 70-50 m and 98-70 m. Taking into consideration the temperature stratification of the water masses as well as the insolation, the water column was divided into three layers: the surface layer, the intermediate layer and the botton layer. In the surface layer two zones were distinguished, the coastal zone and the zone of the open sea. All investigations were made at daytime in order to eliminate the effects of diurnal movements, which would have deformed the pattern of the virtual distribution of the species. Of the material collected only 80 samples were used for this contribution. The number of individuals of each species was calculated per 1 m^3 of the water. In the graphs attached (Figures 2, 3, 4 and 5) the size of the squares illustrates the mean quantities of the particular species within the water layer concerned.

The species composition, as well as the vertical distribution of the micro-zooplankton, are closely related to the seasons. The changes are most conspicuous in the surface waters, which in the course of the annual cycle, are affected mostly by the thermic regime. Already the increase in insolation and warming of the top water layer, which takes place in spring, results in an exuberent development of zooplankton and particularly of Cladocera of the species Evadne nordmanni (51% of the total). A considerable part of the spring mass of zooplankton is made up by copepods (about 25%). Other groups occur in smaller quantities (Rotatoria 3,5%, larvae of molluscs 3,5%, Appendicularia 13%) (Table 1).

The upper water layer is, in spring, inhabited above all by nauplii of copepods (Figure 2) and of the oligotherm species, Acartia bifilosa. Also Evadne nordmanni is numerous in this layer, and further the juvenile stages of copepods (copepodites of the stages I-III), as well as larvae of molluscs and rotatorians. The species or groups mentioned above (except the nauplii) develop especially abundantly in the coastal regions of the sea and over the banks. Their numerical predomination in these parts of the sea is two or three times greater than in the surface waters of the open sea.

In deeper waters, beyond the photic layer (below ± 30 m depth), the number of species is several times smaller than in the surface water layer. In these deeper areas juvenile stages of copepods are decidedly predominant in the intermediate water layer of 30-70 m depth, while Pseudocalanus elongatus is the dominating species in the bottom water (70-92 m depth).

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The highest development of the plankton is found in summer. Not only is the temperature of the surface waters the highest at that time but it is also relatively high at greater depths (until 40 m depth). In summer the species Bosmina coregoni maritima is predominant (about 65%) and consequently the other species of plankton animals are less abundant. The remaining part of the plankton is made up by copepods (about 30%). Of these, Pseudocalanus is the most numerous. (Table 1).

In the warmest season the upper water layers of the Baltic are the most productive zone in respect of the development of the Cladocera, Bosmina coregoni maritima, as well as of the larvae of molluscs and copepods (Figure 3).

In the coastal surface waters in the area of the banks the larvae of molluscs and copepods are twice as numerous as in the surface waters of the open sea. In the surface waters of the central regions of the sea the number of individuals of particular species per m^3 was as follows:-

Bosmina coregoni maritima	2-3 times,
Centropages hamatus	6 times,
Temora longirenis	5 times,

and of Pseudocalanus elongatus, several times greater than in the coastal surface waters.

In the intermediate and bottom layers Bosmina coregoni maritima was prevailing as well, but the quantity was not so large. The waters were here mainly populated by the copepods Pseudocalanus elongatus, Temora longicornis and Oithona similis.

At the beginning of December as well as during the winter, a marked impoverishment of the species composition was observed, since the Cladocera does not occur in this period. At this time the number of species is also conspicuously lower.

The copepods make up the main part of the zooplankton (92-96%) (Table 1). The oligotherm Pseudocalanus elongatus and nauplii of copepods are decidedly prevailing. During the cold season the distribution of species is uniform (Figures 4 and 5). The coastal areas of the sea are again populated by species which had been absent from the highly warmed waters of the coastal zone during the spring and summer period.

Table 1. Percentage of particular groups and species in the mass of micro-zooplankton in Bornholm Deep 1967/1968.

Groups	Species	Spring		Summer		Autumn		Winter	
		Percentage participation of							
		groups	species	groups	species	groups	species	groups	species
Rotatoria	-	3,4	-	-	-	4,6	-	-	-
Annelida	Trochophora	0,1	-	-	-	3,1	-	1,4	-
Cladocera	Evadne nordmanni	67,1	65,6	65,8	x	-	-	-	-
	Bosmina coregoni maritima		1,5		65,8		-		-
	Podon internedius		-		x		-		-
	Podon poliphenoides		-		x		-		-
	Podon leuckarti		0,3		-		-		-
Copepoda	Acartia bifilosa	24,5	7,1	29,8	2,9	96,7	8,8	92,4	0,6
	Acartia longirenis		-		x		1,6		0,5
	Temora longicornis		0,4		3,4		21,5		10,3
	Eurythemora sp.		-		-		-		-
	Centropages hamatus		x		2,7		4,7		7,3
	Pseudocalanus elongatus		7,4		15,0		20,7		19,1
	Oithona similis		0,6		1,8		0,5		7,7
	Nauplii		9,0		4,0		34,2		46,9
Mollusca	Veliger of Lamellibranchia	3,5	3,5	4,4	4,4	0,3	0,3	-	-
	Veliger of Gastropoda	-	-	-	-	-	-	-	-
Appendicularia	Frittilaria borealis	1,3	1,3	-	-	-	-	6,2	6,2

x = 1%

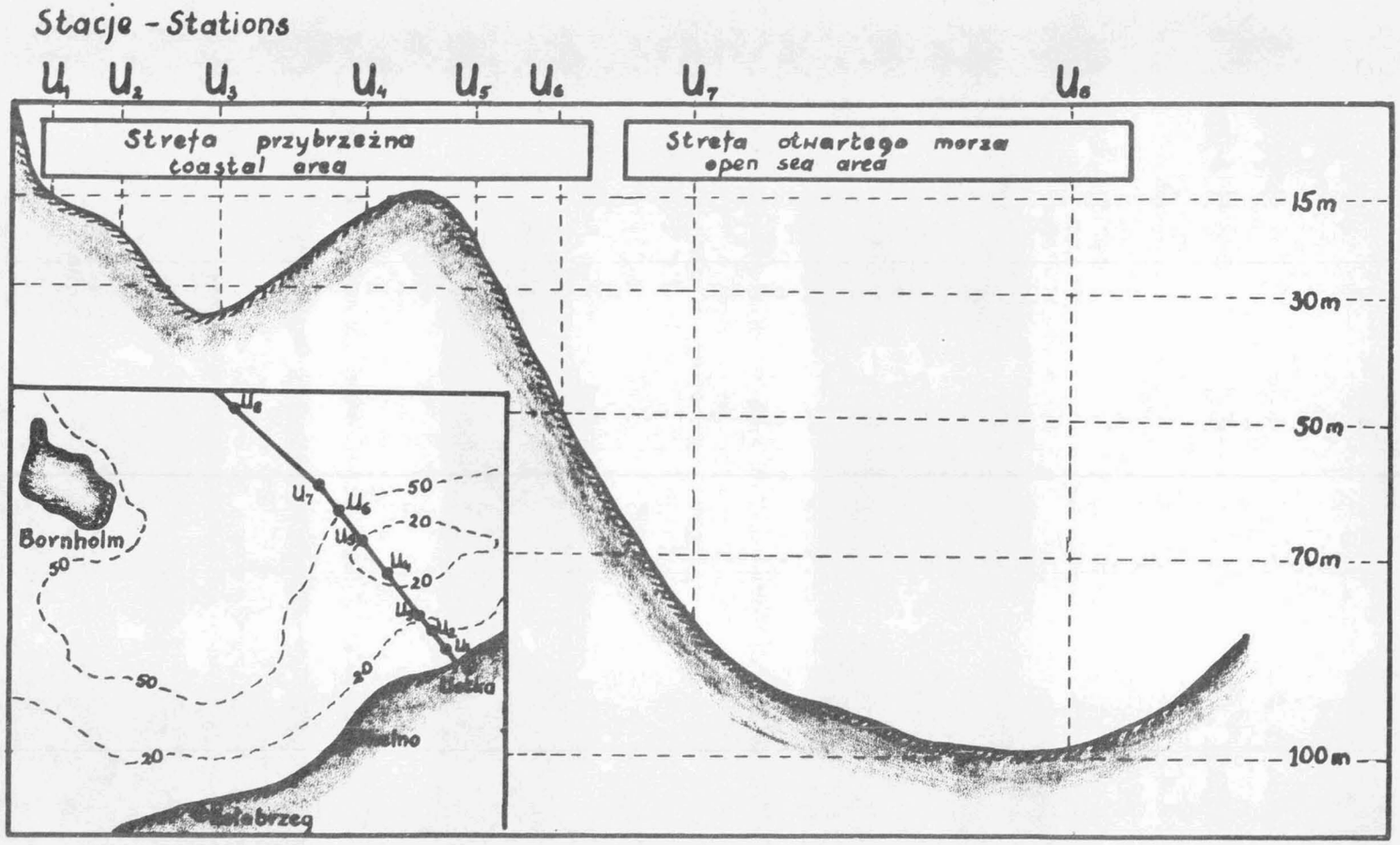

Figure 1. Location of stations and divisions of the investigated water layers from the coastal zone to the Bornholm Basin.

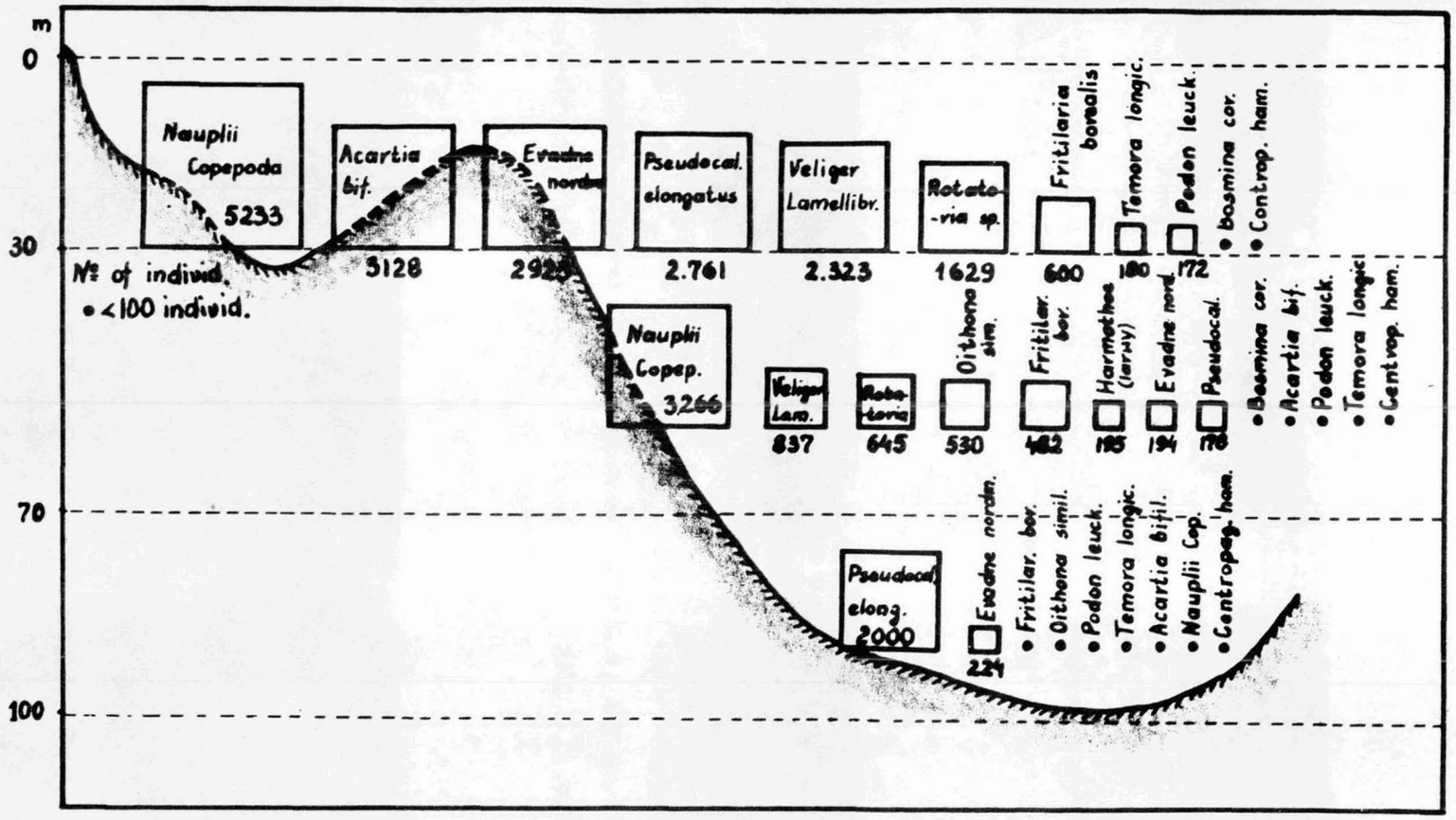

Figure 2. Mean values for spring distribution of microplankton species in the surface, middle and bottom layers from the coastal zone to the Bornholm Basin.

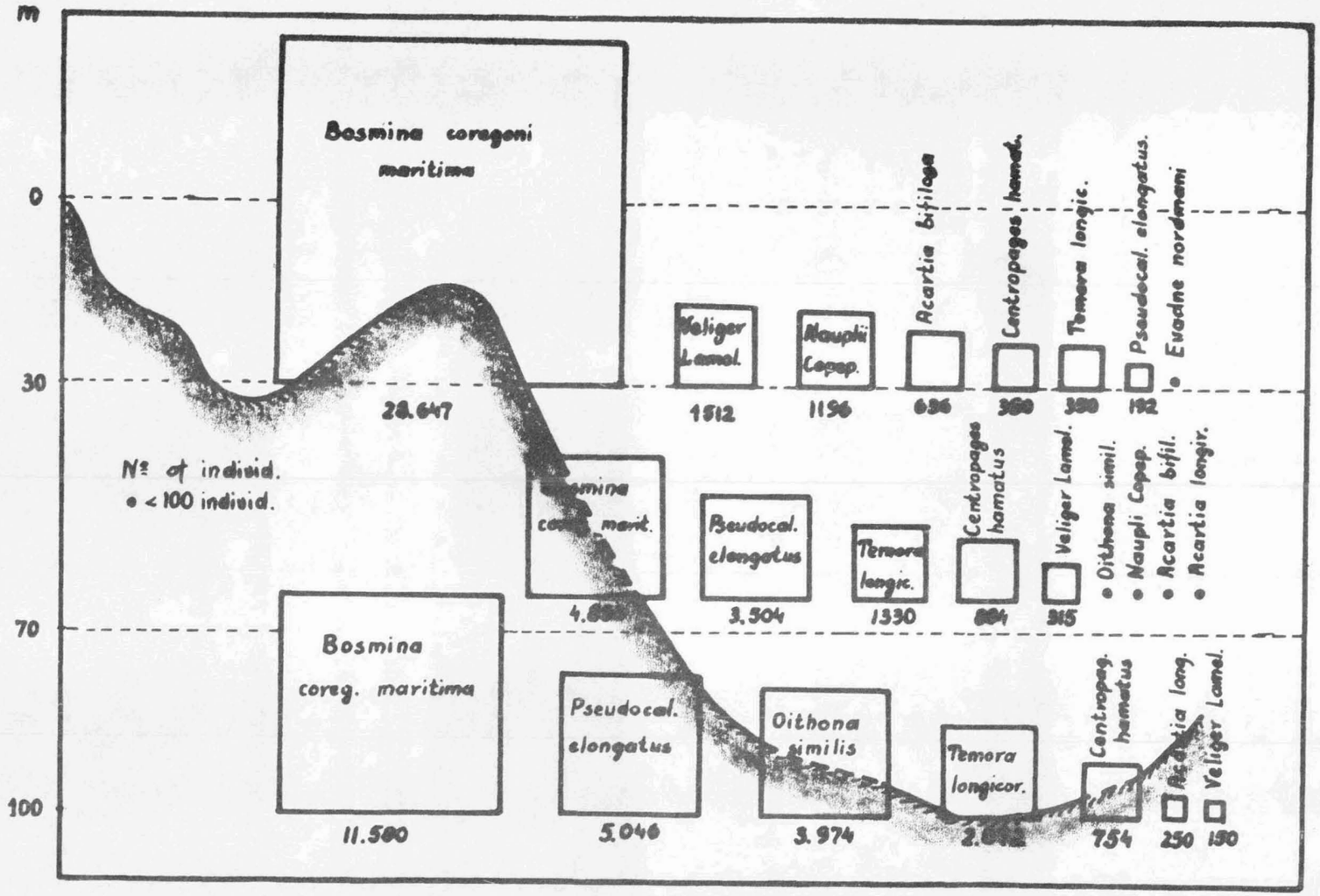

Figure 3. Mean values for summer distribution of microplankton species in the surface, middle and bottom layers from the coastal zone to the Bornholm Basin.

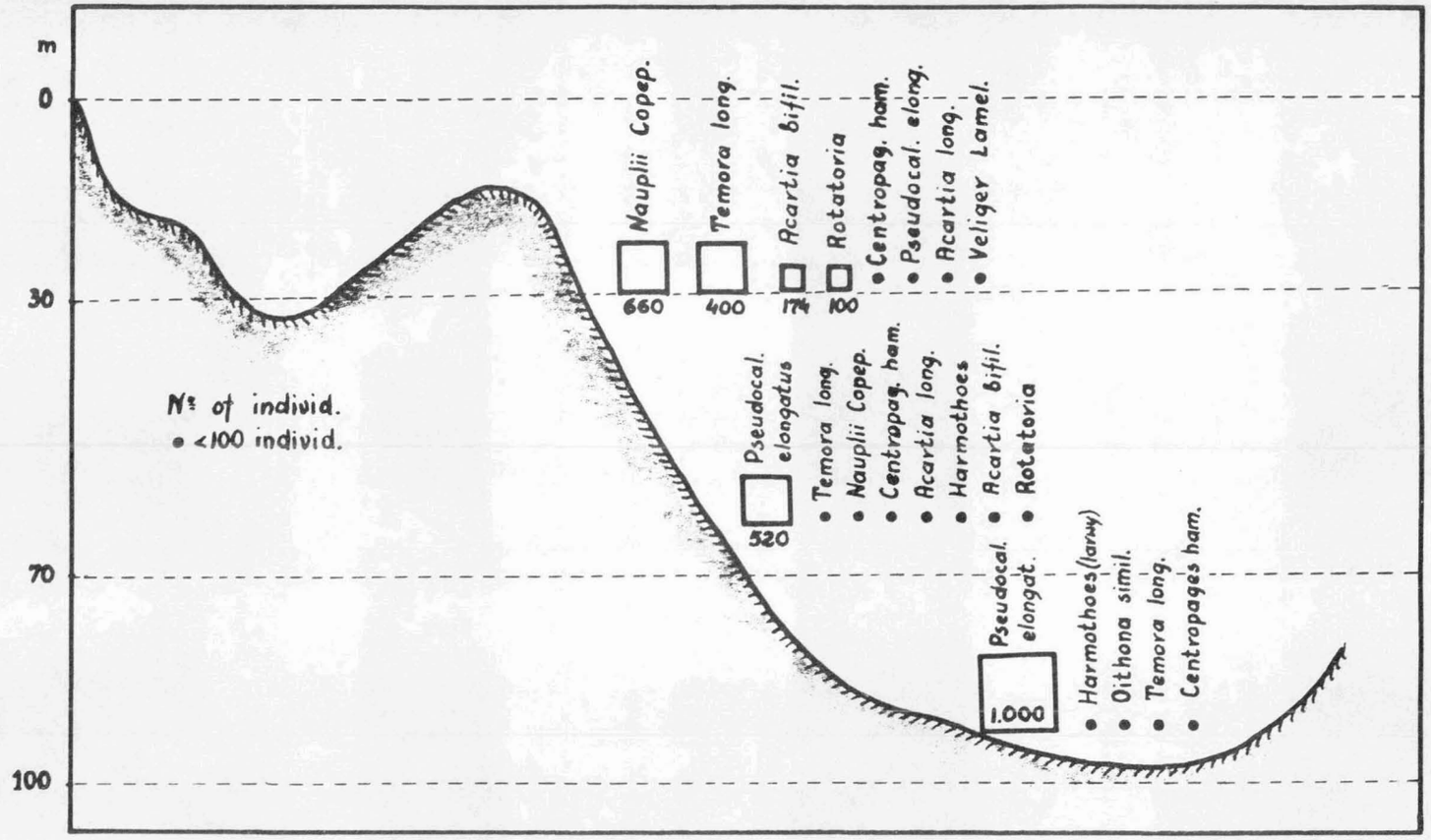

Figure 4. Mean values for autumn distribution of microplankton species in the surface, middle and bottom layers from the coastal zone to the Bornholm Basin.

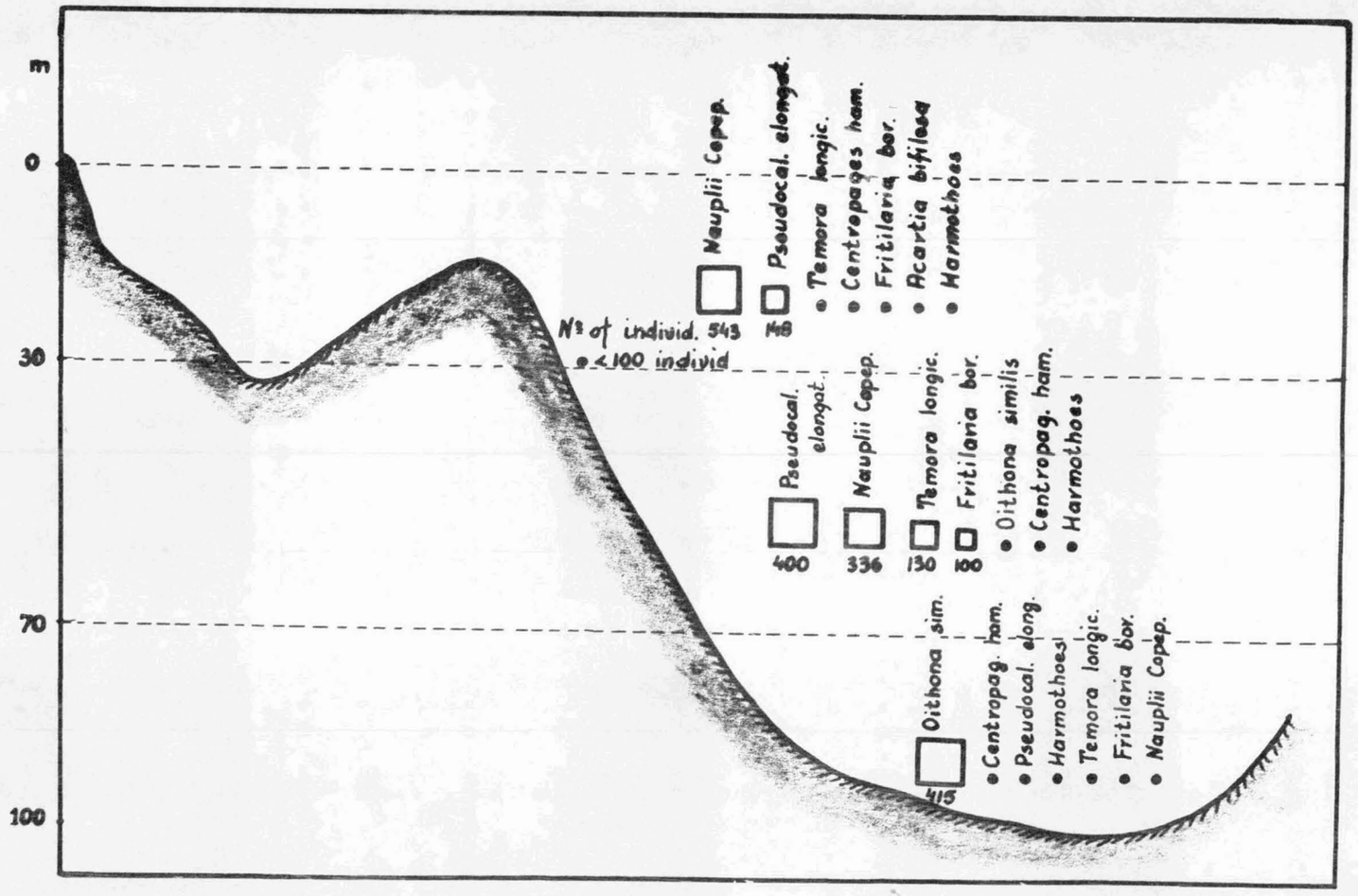

Figure 5. Mean values for winter distribution of microplankton species in the surface, middle and bottom layers from the coastal zone of the Bornholm Basin.