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The Oligothermic Pseudocalanus elongatus Against the Climatic Back-Ground

by
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In the southern Baltic waters the copepods are numerously represented in the micro-zooplankton. Their percentage predomination in the compostion of the zooplankton is most conspicuous during the autumn and winter months. In this period they make up about 95% of the plankton mass. In spring the copepods are less numerous (about 20%), and in summer their percentage participation in the zooplankton is 30%.

The following species of copepods are found in the southern Baltic: Acartia longiremis, A. bifilosa, Temora longicornis, Eurytemora spp., Centropages hamatus, Pseudocalanus elongatus, Limnocalanus grimaldi and Oithona similis.

Pseudocalanus elongatus is the most numerous of these. The percentage of this species in the group of copepods is lowest in spring, amounting to 5.7%; in summer it increases to 15% and in autumn and winter the percentage of Pseudocalanus elongatus in the group of copepods is on the highest viz. about 20% [xx)]. One of the most peculiar features of this species is its tendency to populate the cold waters of the Baltic. In the annual cycle this species was noted in largest quantities in waters of 0° to 5°C (815 individuals per m^3). In temperatures from 5° to 10°C it occurred in markedly smaller quantities (295 individuals m^3), and at temperatures above 10° its occurrence was at a minimum (208 individuals m^3). These figures represent mean values for the 1956-1959 period, 1956 being the coldest and 1959 one of the warmest years of the 1951-1960 period.

The predisposition of Pseudocalanus elongatus for low temperatures is reflected in its spacial distribution, such as it is described in the following against the back-ground of the thermal conditions peculiar for different seasons in the southern Baltic.

In winter (February-March) while the temperature within the whole water column is relatively uniform, ranging from 0° to 5°C, Pseudocalanus elongatus is found within the whole water-mass from the bottom to the surface (Figure 1). It is found not only in the open sea, but also in coastal waters and in shallow basins.

In early spring, together with the increasing insolation and the gradual warming of the top-water layer of the sea, the older development stages, particulary the adult males and females, start descending into the deeper layers (Figures 2 and 3), thus in the top-water layer remain merely the youngest development stages of this species i.e., copepodits of the orders I - III, together with the nauplii (Figure 4).

In the upper water layer the two last-mentioned development stages find the conditions they need for their further development. Trophic conditions are good, since the light energy and nutrients are sufficient; thus the young copepods have enough phytoplankton to feed on.

Spring does not, however, show typically the oligothermic character of the species, since the migration towards deeper waters undertaken by the older development stages of this species is probably a result of increasing insolation, and not the effect of temperature, the upper water layers being in this season still relatively cold.

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xx) The percentages given above concern the years 1967/1968.

Table 1. Insolation and temperature in the top-water layer in the Gdańsk Deep during the first half of 1959.

Month	I	II	III	IV	V	VI
Number of insolation hours per month	50	80	140	200	350	310
Temperature of the surface water (°C)	5.1	1.6	2.9	4.0	7.0	13.5

It seems, therefore, that in the first half of the year, but particularly in early spring, the light factor is the more important one in governing the vertical distribution of the older stages of this species. At the same time this factor introduces the bi-stratification in the vertical occurrence of the younger and older reproduction stages of Pseudocalanus elongatus which is so typical for this season.

This species preference for low temperatures is the most noteworthy feature as late as in summer, when there is a decided thermal bi-stratification (Figure 5). In the heated surface-water layer this copepod is either absent or found in extremely small quantities. The isotherm of 8°C constitutes a sharp limit with regard to both the vertical and horizontal distribution of this copepod. Already beneath the thermal discontinuity layer which in this season is relatively thin, Pseudocalanus elongatus occurs in abundance.

It should be mentioned that all samples from stations along the cross section from the Ustka town to the Bornholm Deep were taken only in the day-time, in order to avoid complication of the vertical distribution pattern by diurnal migrations undertaken by this species at night.

It is not probable that the 8° isotherm, which in day-time restricts so strictly the vertical distribution of Pseudocalanus elongatus, coincides precisely with an eventual photic boundary. It rather seems that the negative phototaxis which is very distinctly demonstrated when this species moves towards the sea-surface at night should be considered a factor of second order as compared with temperature, although at day-time it co-operates with the latter in restricting the distribution of the species. Nevertheless, attention should be drawn to the fact that the occurrence of Pseudocalanus elongatus in the top-water layer at night coincides with the times of sunrise and sunset, thus indicating a rather close correlation between the illumination and diurnal movements. The relatively short stay at night in the warm surface waters, commended by the trophic factor being of a rather great significance for this species, can after all, fit into the limits of its tolerance.

In autumn the temperature of the upper water layer in the sea is considerably lower (10°-12°C). At this time, and particularly in late autumn (December) Pseudocalanus elongatus returns to the surface waters even in coastal areas of the Baltic. In this season the insolation to the sea-surface decreases, and this also contributes significantly to populating the upper water layer by the species under consideration.

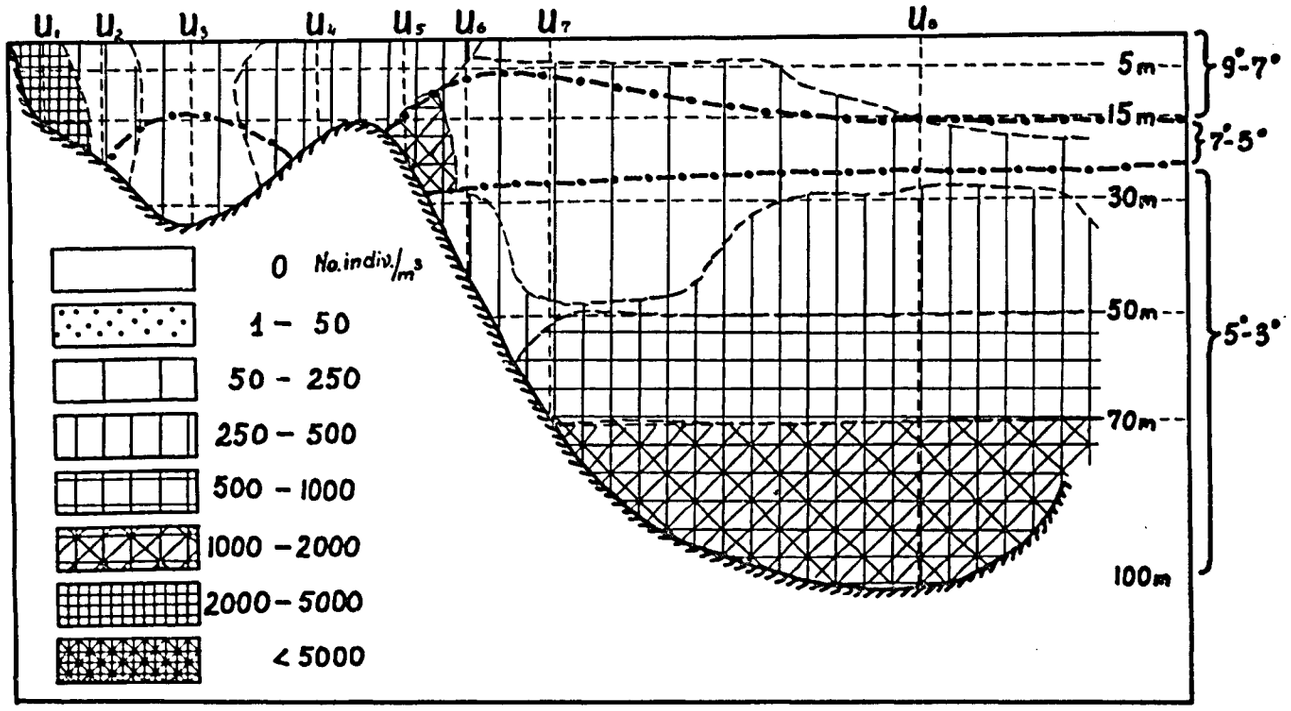

Figure 2. Occurrence of the copepodits (the orders IV to VI) of Pseudocalanus elongatus from the coastal zone to the Bornholm Basin in spring 1967.

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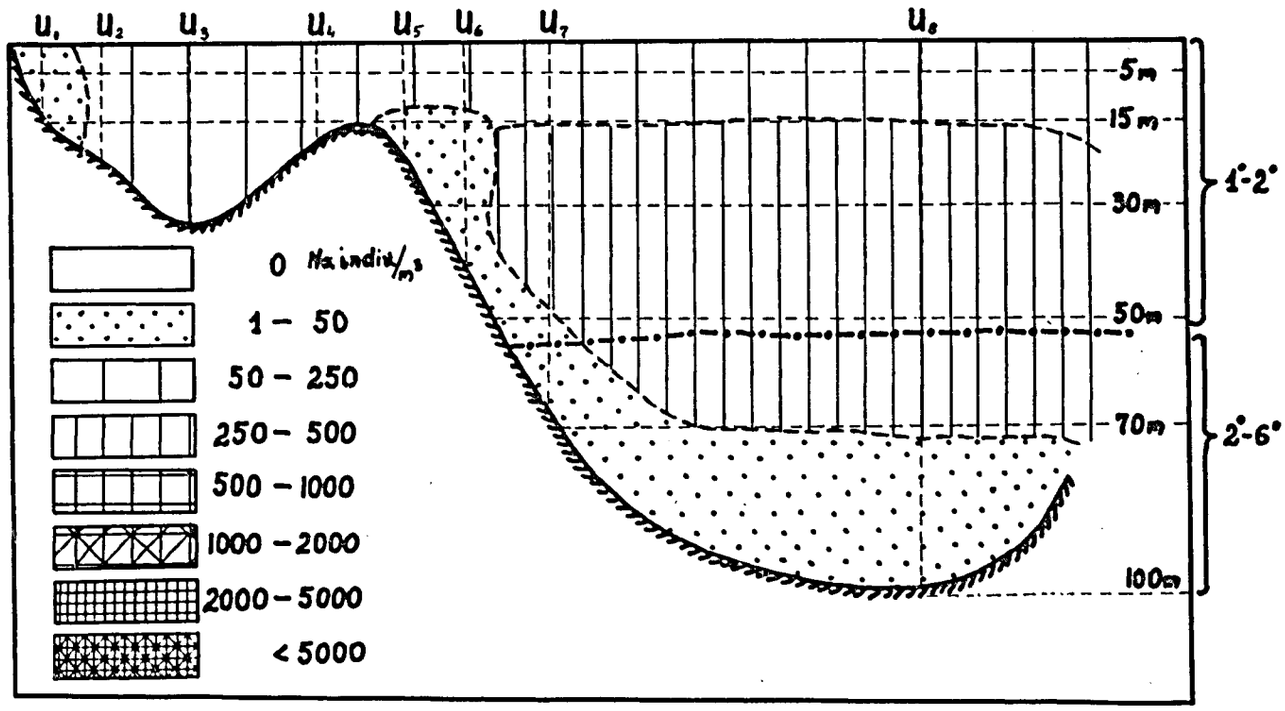

Figure 1. Occurrence of Pseudocalanus elongatus from the coastal zone to the Bornholm Basin in winter 1968.

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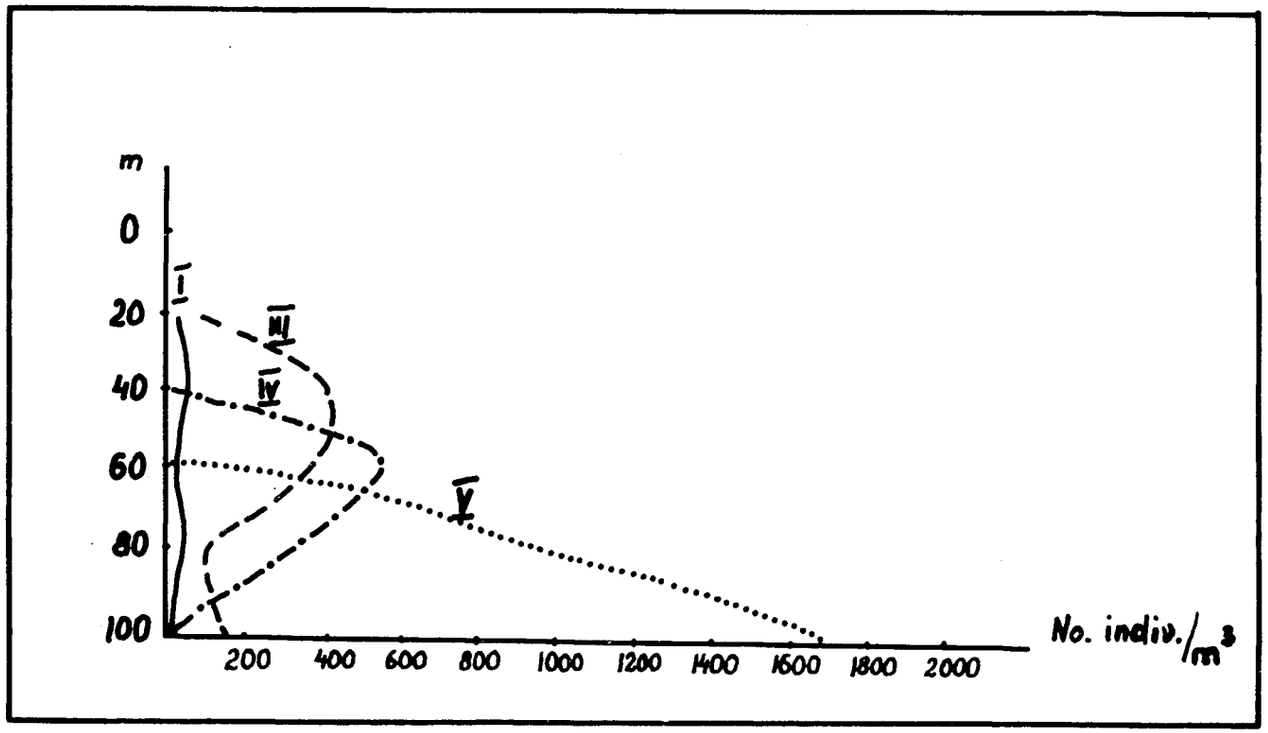

Figure 3. Stratified distribution of males and females of Pseudocalanus elongatus in particular months in 1959 at station U_8.

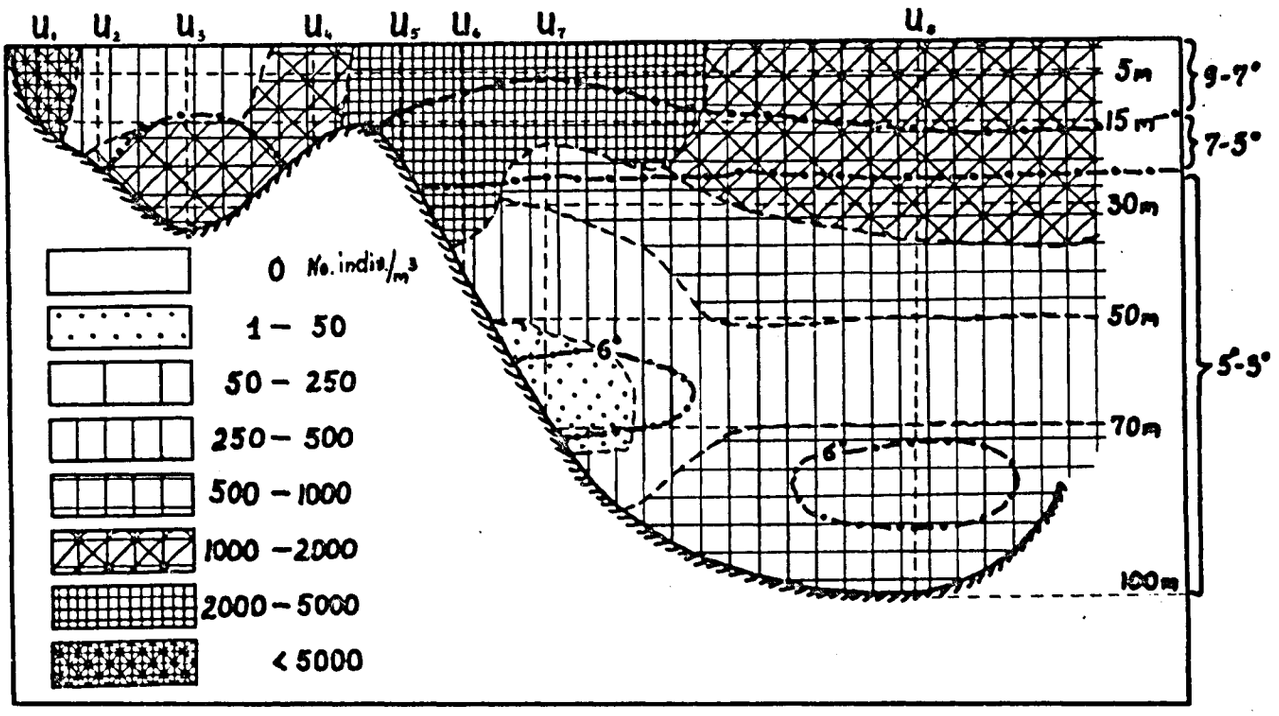

Figure 4. Occurrence of the copepodits (the orders I to III) of Pseudocalanus elongatus from the coastal zone to the Bornholm Basin in spring 1967.

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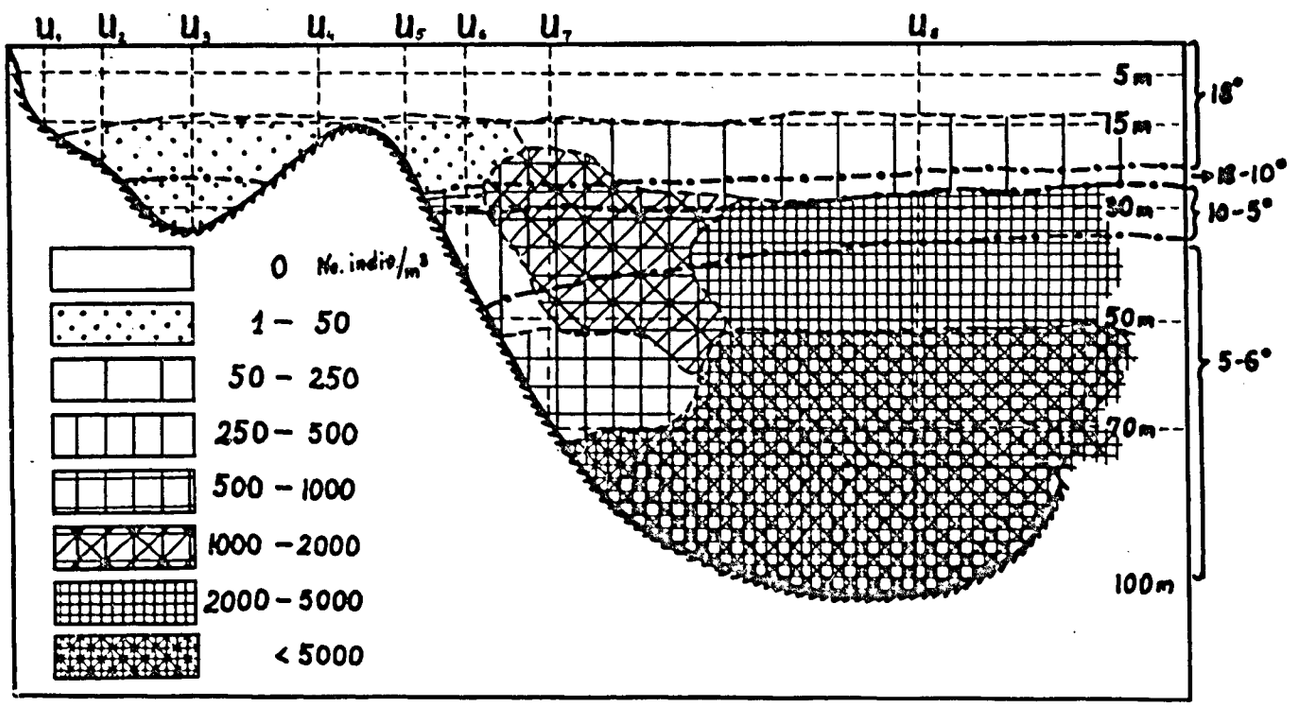

Figure 5. Occurrence of Pseudocalanus elongatus from the coastal zone to the Bornholm Basin in summer 1968.