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Vertical distribution and diurnal fluctuations of zooplankton in the Gotland Deep, June 1969, a Baltic Year study

Preliminary report

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Abstract

The study describes the results of zooplankton sampling during a short period of the International Baltic Year at station F 81 (BY 15 A) in the Gotland Deep. An analysis has been made of the abundance at different depths of the commonest species belonging to the groups: Copepoda, Cladocera, Rotifera, and ''others''. A clear diurnal pattern could be distinguished mainly for the copepods, which were strongly dominant. Their vertical distribution showed both interspecific differences and intraspecific differences between developmental stages. The cladocerans were still very rare at that time of the summer, their numbers being too low for any definite conclusions.

Zusammenfassung

Vertikalverteilung und tageszeitliche Fluktuationen des Zooplanktons im Gotlandtief im Juni 1969. Eine Studie im Rahmen des Baltischen Jahres

Die Studie beschreibt die Ergebnisse von Zooplanktonfängen während einer kurzen Periode des Internationalen Baltischen Jahres bei Station F 81 (BY 15 A) im Gotlandtief. Die Abundanz der häufigsten Arten aus den Gruppen Copepoden, Cladoceren, Rotatorien und ''andere'' aus verschiedenen Tiefen wurde analysiert. Ein klares tägliches Verteilungsmuster konnte hauptsächlich bei den Copepoden erkannt werden, die deutlich dominant waren. Ihre Vertikalverteilung zeigte sowohl zwischenartliche als auch innerartliche Unterschiede zwischen den Entwicklungsstadien. Cladoceren waren noch selten in dieser Zeit des Sommers, ihre Anzahl war zu gering für bestimmte Aussagen.

Material and methods

The samples were taken during a cruise of the RV Aranda, in the Gotland Deep at station F 81 (BY 15) (Fig. 1). Sampling was carried out on 7, 8, and 11 June, 1969. For this preliminary presentation only part of the material has been used as an example. The samples were taken with a 150 μm Nansen closing net, according to the Baltic Year 1969–70 Program Manual (The Baltic Oceanographers 1968), from 25–0, 50–25, 100–50, and 150–100 m (vertical hauls).

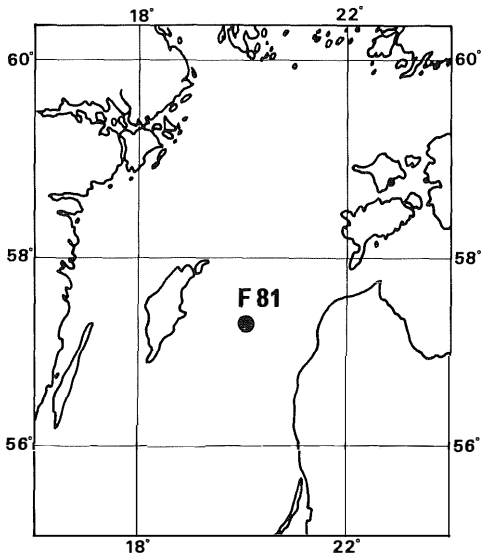

Figure 1
The sampling station

Weather and hydrography

The days of sampling were bright, cloudiness being 1/8 or less. The state of the sea varied from calm to moderate. The temperature was still low at that time of the summer, about 7 °C in the surface layer. The thermocline was situated between 15 and 20 m, and the permanent halocline lay in the region of 50 to 70 m. The values for oxygen saturation were 100 to 90% in the uppermost layer, 50% at about 60 m, and ca. 10% below the halocline, which corresponds to an oxygen content below 1 mg/l (Fig. 2).

The samples were taken about a fortnight before midsummer, i.e. at that time of the year when the contrast between day and night is at its minimum. On 8 June the sun rose at the sampling site at 01.45 GMT, and set at 19.32 GMT.

Results

Copepoda

Copepods were strongly dominant in the zooplankton community, the genera *Pseudocalanus*, *Acartia*, *Temora*, *Centropages*, *Eurytemora*, and *Oithona* being represented. Of these, *Pseudocalanus minutus elongatus* (BOECK) and *Acartia sp.* occurred in such quantities that conclusions regarding their vertical distribution and fluctuations can safely be drawn. When the sexes and different developmental stages had been separated (Figs. 3 and 4), a clear difference in behaviour could be discerned between *Pseudocalanus* and *Acartia*.

In *Pseudocalanus* the nauplii occurred mainly in the uppermost layer; most of the younger copepodids (I–III) occurred in the same layer, but considerable numbers were also found between 50 and 25 m. The older copepodids (IV–V) occurred mainly in the 50–25 m fraction, though some were found in the 100–50 m and 25–0 m layers. The older copepodids showed a slight tendency towards downward migration

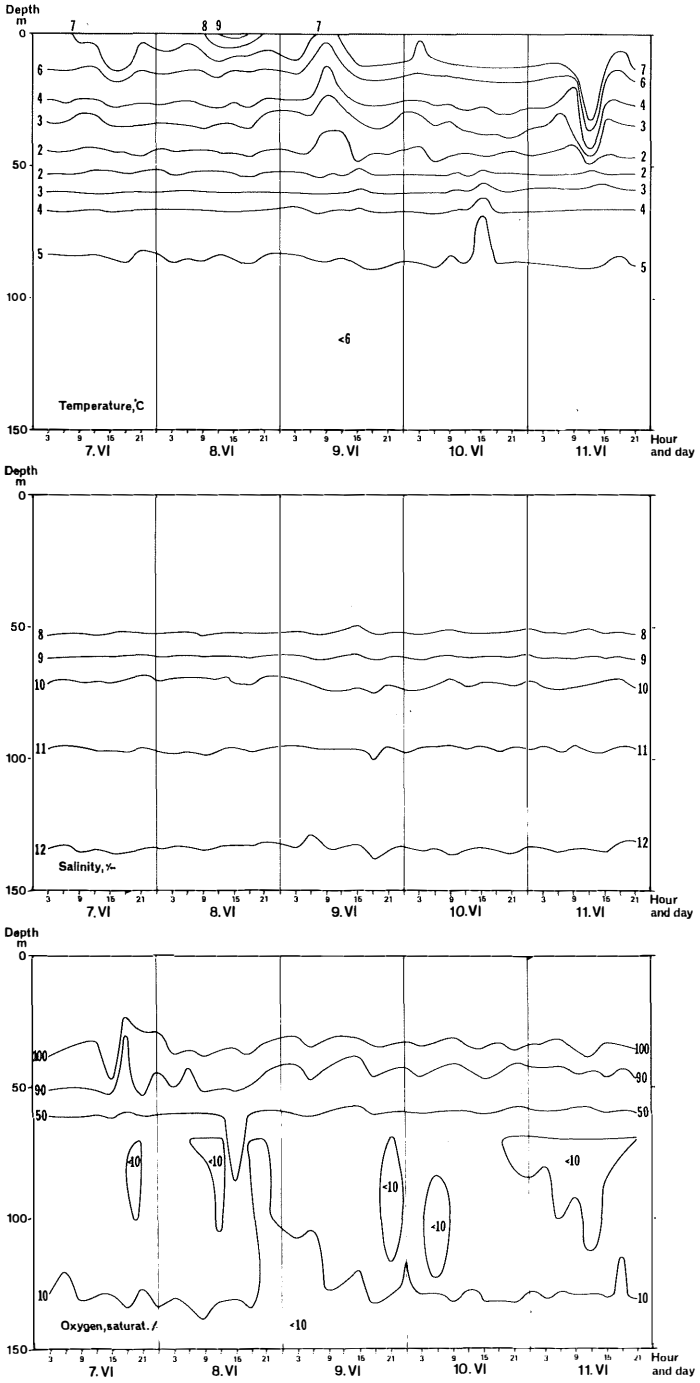

Figure 2
Hydrography at station F 81 for the period 7 to 11 June, 1969

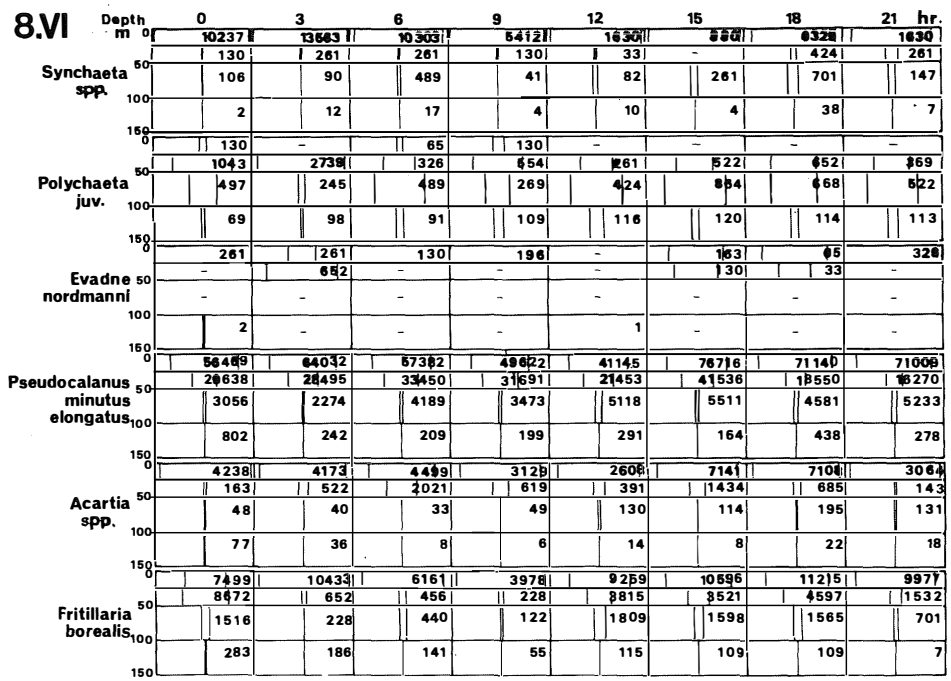

Figure 3

Vertical distribution and diel fluctuation of some plankters typical of Baltic zooplankton. The amounts of the species in each haul are shown as precentages of their occurrence in the entire water column sampled. Numbers represent individuals/10 m³

in the daytime. Adult individuals of both sexes had their main occurrence in the 100–50 m fraction and showed clear vertical migration, descending in the daytime.

The unit *Acartia sp.* comprises *A.* bifilosa and *A. longiremis*. The results for the two species are combined in the diagrams, since it was not possible to separate their nauplii and copepodiids IV–V.

The vertical distribution of *Acartia* differed clearly from that of *Pseudocalanus*. *Acartia* is mainly confined to the surface layer; all its developmental stages, including adults, occurred in greatest numbers between 25 and 0 m. Only adult females were found in noteworthy quantity in the 50–24 m layer, as well. They also migrated downwards in the daytime.

Centropages and *Temora* were so sparse that no detailed conclusions can be drawn. However, the results indicate that the nauplii and copepdids of Temora are in general bound to the uppermost layer (25–0 m), and that diel migration occurs among the adults.

Cladocera

The cladocerans were still very rare at that time of the summer, their numbers being too low for any definite conclusions. The most abundant species was *Evadne nordmanni* LOVÉN, which mainly occurred in the uppermost layer (Fig. 3).

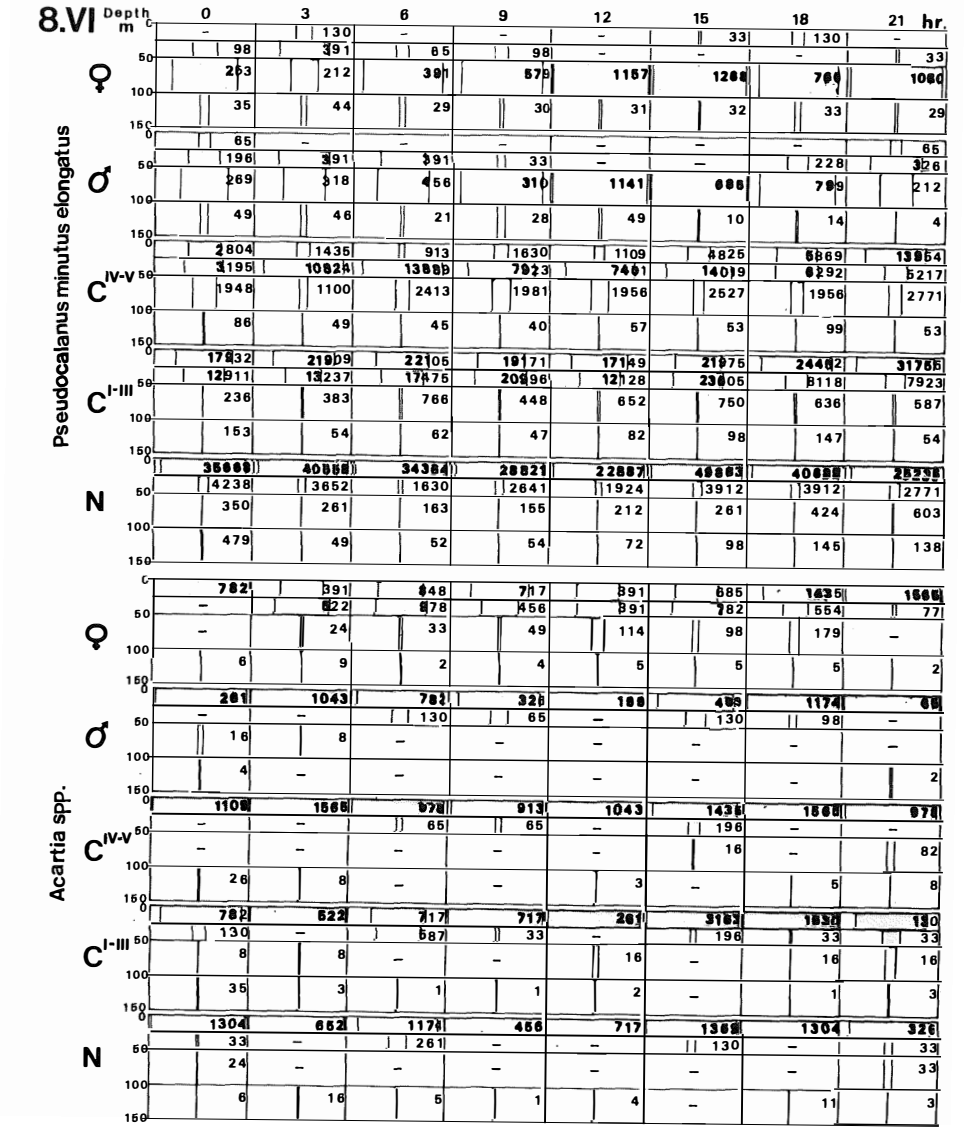

Figure 4

Vertical distribution and diel fluctuation of *Pseudocalanus minutus elongatus* BOECK and *Acartia sp.* shown separately for females, males, and different developmental stages. Percentage distribution and figures as in Figure 3.

Rotifera

The rotifers occurred chiefly in the uppermost layer (25–0 m). The dominant group was the genus *Synchaeta*. Other rotifers, as *Keratella cochlearis* (GOSSE) and *Keratella quadrata* (MÜLL.), were occasionally found in some of the samples. An aggregation of rotifers, evident for instance in *Synchaeta* sp., was often observed

in the 100–50 m fraction, and was presumably caused by accumulation of sinking animals in the halocline region (Figs. 1 and 3). The mesh size of the net used was presumably too large to give quantitative samples. No diel migration could be observed.

Others

Polychaeta larvae, most probably representing only *Harmothoe sarsi* (KINB.), generally preferred the layer between 100 and 50 m, but also occurred in noteworthy numbers in the 50–25 m and 150–100 m fractions, sometimes also in the uppermost layer (25–0 m) (Fig. 3). The appendicularian *Fritillaria borealis* LOHM. occurred mainly in the uppermost layer. It did not show any marked migratory trend.

Conclusion

Although the study was not planned to give a detailed picture of the vertical distribution of zooplankton, or to provide data especially for studying diel fluctuations, it showed evident interspecific differences in both respects. Differences were also apparent between the developmental stages of the same species, and in some cases (copepods) between adult females and males. This shows the importance of detailed analysis.

The results also show that zooplankton investigations, e. g. for monitoring purposes, should be thoroughly planned as regards, for instance, sampling design and statistical treatment of data. Factors such as patchiness should be considered in interpreting the results. In the present study the abundance values often fluctuated strikingly between the samples, presumambly mainly because of patchiness and horizontal currents.

References

THE BALTIC OCEANOGRAPHERS: The Baltic Year 1969–70. Program manual. 60 pp. Göteborg (1968)