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The macrobenthos in the red algal zone of Kiel Bay (Western Baltic)*

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Abstract

The macrofauna of the red algal zone of Kiel Bay is quantitatively investigated for the first time. 109 species were found of which 68 can be considered as genuine inhabitants of the phytal zone. The classification of the phytal fauna according to locomotory and feeding type, their abundance and biomass relative to water depth and their value as fish food were investigated in more detail.

Zusammenfassung

Das Makrobenthos in der Rotalgenzone der Kieler Bucht (Westliche Ostsee)

Die Makrofauna der Rotalgenzone in der Kieler Bucht wird zum ersten Mal quantitativ untersucht. Von 109 gefundenen Arten können 68 als gemeine Phytalbewohner angesehen werden. Die Phytalfauna wurde nach der Art und Weise ihrer Fortbewegung und Ernährung klassifiziert. Außerdem werden detaillierte Untersuchungen ihrer Abundanz und Biomasse im Verhältnis zur Wassertiefe durchgeführt und ihr Wert als Fischnahrung ermittelt.

Research area

The research area, near Boknis Eck (Kiel Bay, Western Baltic) in depths of 4 to 14 m, is characterized by its particularly heterogeneous structur. Uneven, stony ground with red algal cover dominates up to a depth of 10 m, and in greater depths sand and clay sediments with large amounts of floating algae are found (WEFER & FLEMMING, 1973; WEFER & Tauchgruppe, 1974; BLACK, 1974).

Sampling

The samples (sampling period 31.1.75 – 20.5.76) were taken mainly by dredging although the airlift and grab were also used. A total of 103 samples were examined.

The animals were removed from the algae in the laboratory, and both their frequency and the weight of the individual species were calculated. The values given for the fauna are always relative to the algal biomass. A small number of stomachs from fish (cod, *Gadus morhua* L., and whiting, *Merlangius merlangus* (L.)) caught in the red algal zone were also available.

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*The work is a summary of the diploma thesis of the author (Kiel, 1976).

Results and Discussion

The fauna of the red algal zone is composed of typical phytal, rocky substrate, sand, and mud species. The 109 species recorded indicate this area to be one of those richest in species of Kiel Bay (for shallow water, Zostera beds, benthos in depths of > 15 m, see WORTHMANN, 1975; GRÜNDEL, 1974; KÜHLMORGEN-HILLE, 1965; ARNTZ, 1971).

Because of its particular structure the phytal represents an unique environment in comparison to other benthic niches, such that the phytal fauna must be isolated from the rest of the benthos. 68 species were characterized as "phytal inhabitants".

Because of the bottom structure the *fauna of the vegetation - free areas* (Fig. 1) is necessarily heterogeneous. In addition to the hard bottom fauna of the uneven stony ground, sand and mud fauna are also found. The species preferring sand, e.g. *Cardium fasciatum*, are mostly found in the shallower areas.

On the basis of the composition of the dominant species the vegetation – free ground of the red algal zone resembles the deeper rather than the shallower areas of Kiel Bay(see WORTHMANN, 1975; ARNTZ, 1971).

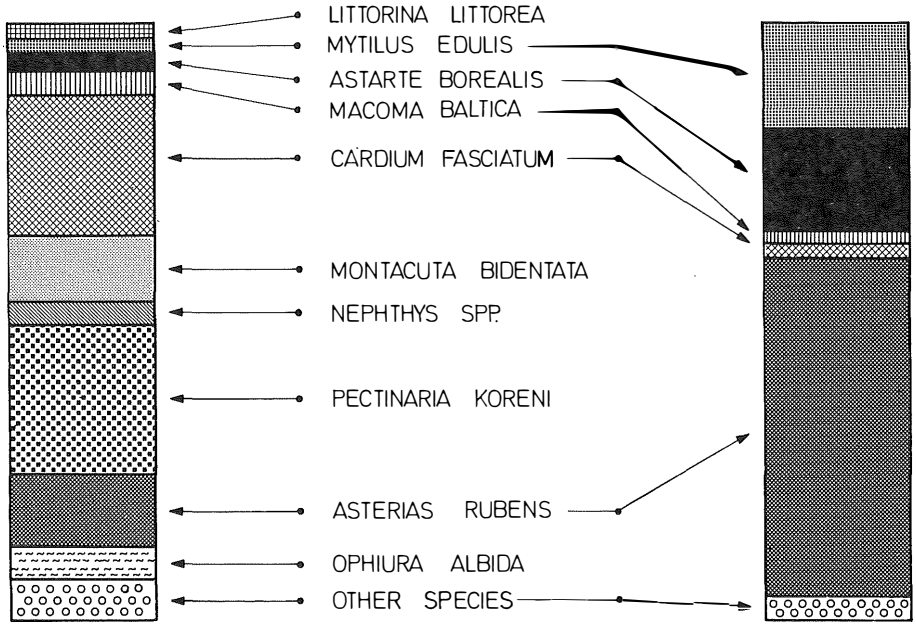

Figure 1

Composition of the fauna of the vegetation – free ground of the red algal zone in 6 – 14 m depth (Bycatch during sampling using the dredge) according to abundance (left) and biomass (right)

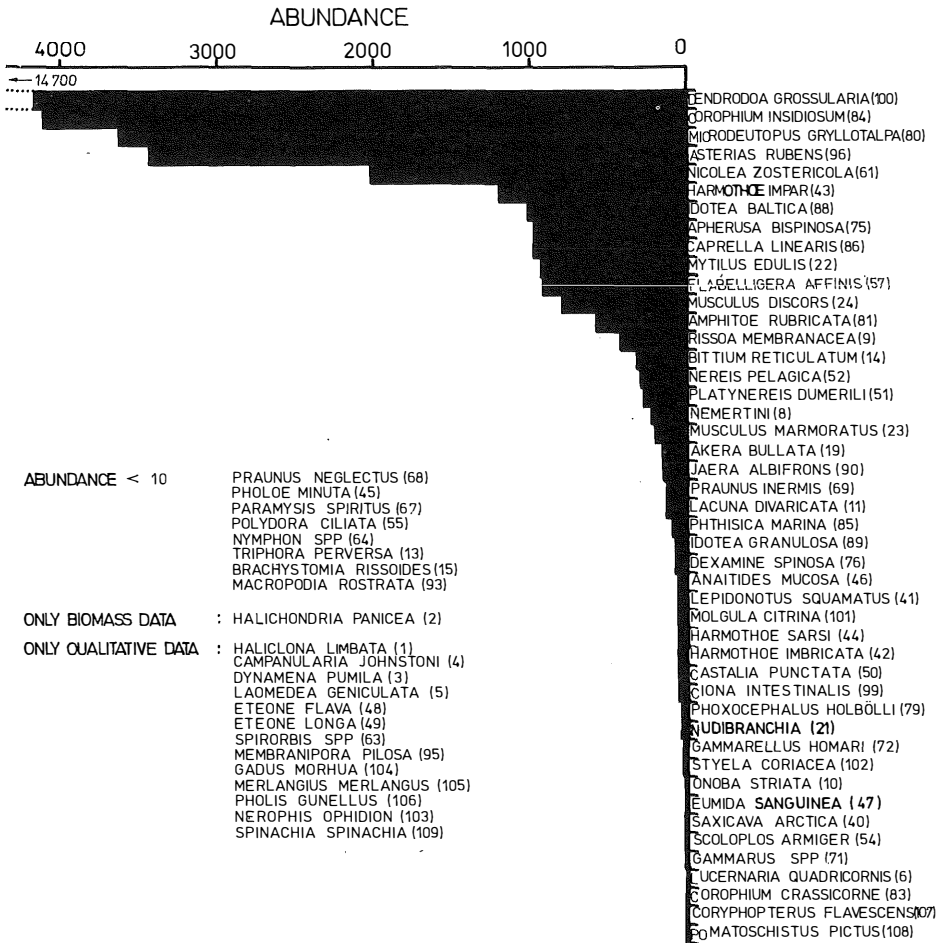

Figure 2

Frequency distribution of the phytal inhabitants for the total research period. Species which occurred in less than 10 individuals, and those for which only the biomass was determined, are separately noted. (The numbers in brackets are the numbers under which the species are handled in chapter 5.2. in the author's diploma thesis.)

The *actual phytal fauna* is composed to more or less the same extent of Mollusca, Crustacea, Polychaeta and *Asterias rubens* (Fig. 2 and 3). The crustaceans are the most abundant, and the polychaetes the most important in terms of biomass. For 60 g (wet weight) of algae the annual average total abundance was 190 individuals (max. 889, min. 32) and the mean total biomass 1.95 g (max. 14.40 g, min. 0.28 g). The two most dominant sessile species *Halichondria panicea* and *Dendrodoa grossularia* (average biomass: ca. 17 g and 7.6 g resp.) were not included in the calculations, as they themselves can be considered as a substrate for the other species.

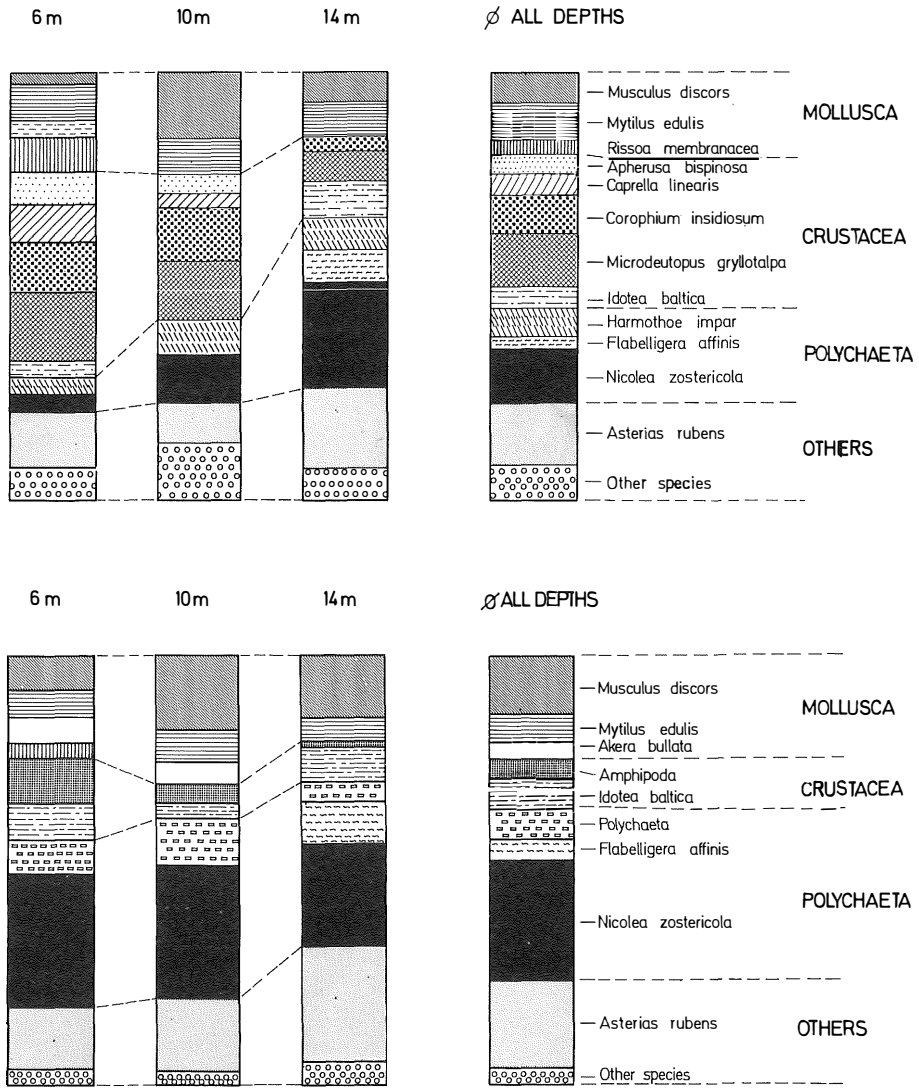

Figure 3

Composition of the phytal fauna (without *Dendrodoa grossularia* and *Halichondria panicea*) in 6 m, 10 m and 14 m depth and in the average of the three depth stages:
above: according to abundance
below: according to biomass

For the majority of the important species the year classes showed clearly defined maxima; closed annual cycles were typical for a few amphipods (e.g. *Corophium insidiosum*, Fig. 4), whilst apparently long term fluctuations are more the case for the polychaetes (Fig. 5) and some of the molluscs.

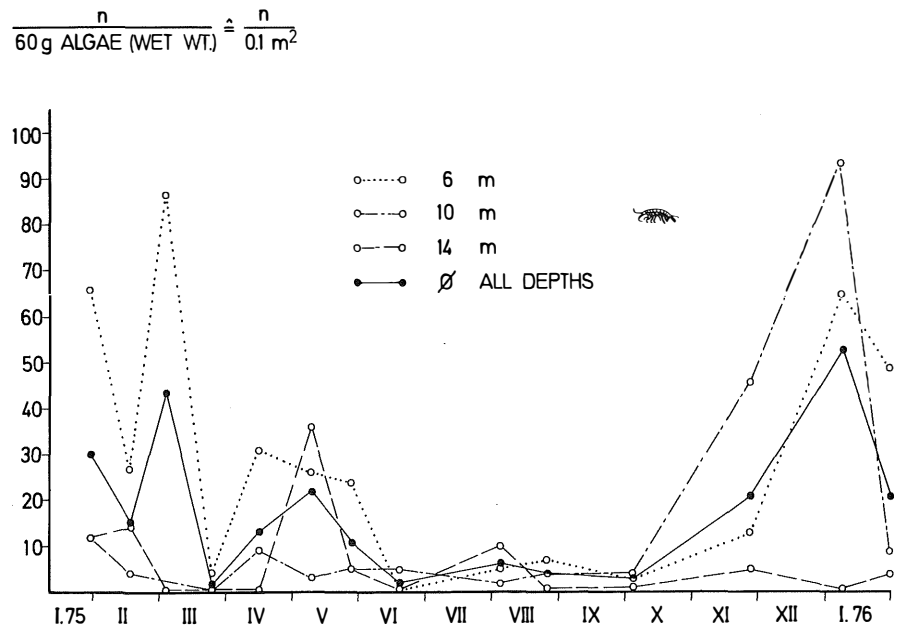

Figure 4

Depth-dependent seasonal cycle of the abundance of *Corophium insidiosum*

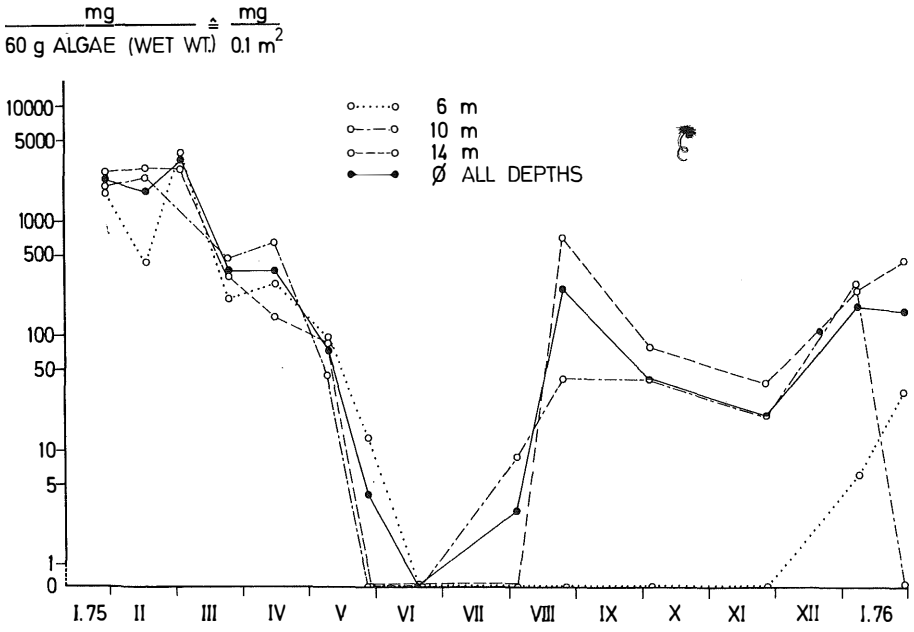

Figure 5

Depth-dependent seasonal cycle of the biomass of *Nicolea zostericola* (Ordinate: log. scale)

The phytal fauna was examined according to species, locomotory and feeding types. The composition of the most important species in differing phytal areas (LÜTHJE, 1976) is in close agreement with HAGERMAN's (1966) deep Fucus zone, the Zostera beds of Kiel Bay (GRÜNDEL, 1974), SARNINGHAUSEN's (1955) deep Fucus zone and the sublittoral algal zone described by SLOANE (1961). However there are considerable differences to KAUTSKY's (1974) deep red algal zone, SEGERSTRALE's (1928/44) shallow and v. OERTZEN's (1968) deep Fucus zone.

Thus general factors such as salinity, depth and degree of exposure mainly determine the faunal composition of an algal zone; within the phytal, also the structure of plants and the amount of sediment caught by the algae. The species composition of the algae is, in contrast, of little importance. With regard to *composition according to type of locomotion* the following principle can be applied: The more exposed and shallower the phytal, the greater the percentage of mobile clinging animals (e.g. *Gammarus* spp.), the more sheltered and deeper the phytal, the greater the number of ''sediment preferring'' species (e.g. tube building amphipods; see v. OERTZEN, 1968 and WIESER, 1959). The greatest differences in composition occurred at the water mark, in contrast to which the differences between the varying depths of the red algal phytal were minimal.

The red algal zone of kiel Bay is a fairly exposed area; however, its comparatively deep situation and the fine structure of the thalli of the algae ensures that a considerable amount of sediment is retained. This is reflected by the high percentage of hemisessile tube builders and detritus feeders. The increase in polychaetes and decrease in amphipods with increasing water depth are probably due to the same reasons.

The ''sediment content'' of the algae is also the decisive factor for *composition according to trophic groups*. WIESER (1959) was of a similar opinion: Under similar conditions of water movement a thick grass-like alga contains a much greater amount of seston feeders than a shrub-like alga (e.g. *Fucus serratus*). On the other hand, too high a sedimentation by algae in a sheltered area leads to a radical reduction of suspension feeders, whose gills and tentacles are quickly blocked under such conditions (WIESER, 1959).

When comparing different areas of the Baltic, salinity seems to be the decisive factor determining abundance and biomass of the phytal fauna (the lower the salinity the greater the number of individuals), while the importance of the algal structure is reduced. The following are estimated *values per m²* for the red algal fauna of Kiel Bay: total *abundance* 4700 individuals, discounting *Halichondria panicea* and *Dendrodoa grossularia*: 1900 individuals; total *biomass* 275 g and 20 g respectively. With reference to biomass the phytal fauna differs from the soft bottom fauna in the relatively higher number of individuals.

The development cycles of the algae and the sensitivity of the vegetation to too strong a water movement only allow the colonization of annual species, such that no high standing crop can develop. This colonization of the red algal phytal by relatively small, fast growing species, some of which produce more than one generation per year, can be seen in the sudden and frequent change of the dominant species.

Despite the low standing crop a fairly high *production of potentially utilizable food* can be shown. A ''minimum production'' (see ARNTZ, 1971) of 71.4 g/m²/yr. was estimated. This is within the order of magnitude calculated for the deeper areas of Kiel Bay. The carnivores of the red algal phytal are represented mainly (ca. 30%) by *Asterias rubens*, which mostly feed on the occasionally very abundant *Mytilus edulis*. Therefore

a strong predation from outside the system, presumably by fish, must take place. Further research is necessary to determine exactly what part of the available food the fish actually use. Initial analyses of cod and whiting stomachs indicated that in the red algal zone crustaceans (particularly amphipods and *Idotea*) are preferred to polychaetes and molluscs.

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