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Ecology of Species of the Genus ACARTIA in the Baltic

by

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In the Baltic the genus Acartia is represented by three species:-

1. Acartia bifilosa Giesbrecht
2. Acartia tonsa Dana
3. Acartia longiremis Lilljeborg

By some scientists this genus is often treated as a whole, without being broken down to particular species. (Halme (1958), Lindquist (1959) and Waldmann (1959)).

The method of counting and treating Acartia bifilosa and Acartia longiremis, or Acartia bifilosa and Acartia tonsa together, or even all three species together, is not legitimate due to very distinct differences in their morphology and particularly in their ecology. This tends to confuse the rôle and significance of each species in the general biology of the Baltic. It should be stressed that all the Polish planktologists, Mańkowski (1948), Rzóska (1939), Ciszewski (1962), Wiktor (1963), Rozańska (1963), as well as this author, Siudziński (1966), while treating the species of Acartia, always have analysed them separately.

The different requirements in respect of the ecology of the species mentioned can be determined on the basis of investigations carried out by planktologists in the southern Baltic and adjoining areas.

Acartia bifilosa Giesbrecht

Acartia bifilosa occurs in all four seasons. The peak of development of this species falls in full summer, but in winter the number of individuals per m^3 is smaller. Two maxima of occurrence have been observed, and this is reflected in the two maxima of occurrence of nauplii in this region of investigation.

Two intense occurrences of females could be ascertained: in late spring and in late summer (like the occurrences of the nauplii). In both these periods the presence of females with spermatophores was observed.

The males, which occur from spring to autumn, showed a maximum in full summer, but during the whole investigation period the females always predominated rather markedly in number. Sometimes the author succeded in finding some males with spermatophores attached.

Young stages of copepodites of the orders I and II occurred exceptionally abundant in May and at the beginning of June. They were then more frequent than the mature specimens. From about mid-June the older copepodites of the orders V and VI prevailed (counted as number of individuals per m^3 of water).

This species is more numerous in the coastal zone of the southern Baltic than in its open waters. It occurs most abundantly in the Firth of Puck, particularly in summer.

As concerns the vertical distribution, it has been found that Acartia bifilosa is a surface species, since in the period of its appearance and maximum occurrence, i.e. in spring and summer, it predominates in the upper water layer. In summer it is very abundant in the layer of 0 m to 20 m depth.

An analysis of the occurrence of this species in particular ranges of temperature showed that the largest numbers of individuals per m^3 occurred in temperatures higher than 10°C (91%). Between 5° and 10°C the number of individuals per m^3 amounted to 7,6%, and in temperatures from 0° to 5°C hardly 1,4% was observed.

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Taking into consideration the occurrence of this species in surface waters it may be said, that the bulk of Acartia bifilosa is found in waters with a salinity lower than 10‰, but sporadically it was found where the salinity was higher than 10‰, and also in waters with a salinity lower than 4‰.

Generally speaking the biological characteristic of this species is as follows:- Acartia bifilosa is a species peculiar for the coastal zone and surface waters, as well as for the brackish-water environment, and seems to be an eurythermic species with a high optimum, as well as an euryhalinic one with a low optimum. It is most frequently found in the range of 4‰ to 10‰ salinity.

Acartia tonsa Dana

Acartia tonsa avoids the open waters of the Baltic. It is most numerous in the bays and particularly in the firths (in the Firth of Puck it occurs in abundance).

This species occurs from May to November, and reaches its maximum in August.

The appearance of adult females of Acartia tonsa, and of males more numerous than females, is observed from July with a marked maximum in August and a fall at the beginning of October. In this period males with spermatophores were found together with females, the latter carrying no egg sacs, but having spermatophores attached to the abdomen. Those females were most numerously found in August when the signs of reproduction were most conspicuous.

The juvenile stages (copepodites I and II) were found as early as May. Sometimes single individuals were present even at the end of April. Together with the increase in temperature in May and June affecting the surface and shallow waters of the area investigated (Firth of Puck), the occurrence of copepodites of the stages III, IV and V was noted. In July full maturity (i.e. the stage VI) was attained. After the peak in August, from the end of September, when the juvenile stages reappeared, the number of individuals of this species gradually decreased until they vanished completely in November. It is therefore doubtful whether the juvenile stages of copepodites then appearing could survive the winter, especially in shallow places, where in summer Acartia tonsa is so abundant (Firth of Puck).

In respect of the horizontal distribution, it has been noticed that this species appeared in May in the Firth of Puck earlier and more abundant in comparison with the other areas investigated. This was a result of quicker warming of its waters in spring. In July and particularly in August and partially also in September, Acartia tonsa attains its maximum in the Firth of Puck.

As concerns the vertical distribution, this species was found only in surface waters (0 m to 15 m depth). In plankton samples from horizontal surface hauls of 5 minutes duration, Acartia tonsa was extremely abundant.

It has been stated that the highest abundance of this species is restricted to optimum temperatures between 16° and 18°C, while the optimum salinity lies at 6 to 7‰.

Generally speaking, this species is remarkably thermophile and particular to brackish waters.

Acartia longiremis Lilljeborg

This crustacean was found during the whole year. In the coastal zone its occurrence was sporadic, in the open and deep waters, however, it occurred in extremely large quantities.

The peak of the occurrence of this species was noted in the autumn-winter period, until the moment of strong development of thermophile forms characteristic for the coastal zone and surface waters, such as Acartia tonsa and A. bifilosa.

The reproduction of this species takes place, generally, in warm months in the cold bottom waters. In the coastal zone the reproduction of this species is markedly shifted on to the winter and early spring months, due to its oligothermic character.

In fact, the reproduction of this species takes place during the whole year.

In connection with what was said above, adult males and females, as well as the developing stages of this species can be found during the whole year but in different zones. The females were often found with spermatophores attached to the abdomen.

In warm periods the species can only seldom be found in the water layer of 0 m to 20 m depth. Beneath this layer, down to the bottom, its distribution is homogenous with a slight tendency to increase at the bottom. During winter these animals are also observed in the layer from 0 m to 20 m depth, showing here sometimes even the relatively largest number per m^3.

Therefore, it is easy to understand that during summer this species is absent from the waters of the shallow Firth of Puck.

At the time of the most numerous occurrence of this species, the temperature oscillated from 5° to 10°C; at temperatures higher than these, the species was scarse or sporadic.

Being found in deep waters, where the salinity amounts to 16‰ and even more, as well as in the coastal zone with salinity oscillations between 5 and 7‰, Acartia longiremis may be considered a neritic, boreal and rather stenothermic species which is in the Baltic very euryhaline.

During winter Acartia longiremis is representing the genus Acartia while the other species, A. tonsa and A. bifilosa are either entirely absent or occurring only in minimum quantities.

Table 1. Occurrence of Species of the Genus Acartia.

Environmental conditions

Species	Temperature			Salinity		
	0-5°C	5-10°C	>10°C	5-7‰	7-10‰	>10‰
Acartia tonsa	-	x	xxx	xxx	x	-
Acartia bifilosa	x	xx	xxx	xxx	xxx	x
Acartia longiremis	xxx	xx	x	x	xx	xxx

Seasons

Species	Winter	Spring	Summer	Autumn
		shallow waters		
Acartia tonsa	-	x	xxx	x
Acartia bifilosa	x	xx	xxx	xx
Acartia longiremis	xx	x	-	x
		open and deep waters		
Acartia tonsa	-	-	x	-
Acartia bifilosa	x	x	xx	x
Acartia longiremis	xx	x	xxx	xx

Distribution

Species	Firths	Gulfs	Open waters	Depths		
				0-20 m	20-50 m	50-100 m
Acartia tonsa	xxx	xx	x	xxx	x	-
Acartia bifilosa	xxx	xxx	xx	xxx	xx	x
Acartia longiremis	x	xx	xxx	x	xx	xxx

x - sporadic or not numerous

xx - numerous

xxx - very numerous or massed