ON THE SEX RATIO IN DEEP WATER CALANOIDEA

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When studying marine copepods the attention is drawn to the fact that in many species of these animals merely females are described; those species in which only male specimens are known represent an exception. This fact can hardly be explained by fortuity as it may be seen from fig. 1 (data taken from Brodsky, 1950) that the percentage of species in which merely females are known increases with the depth of habitat. If curve 2 of fig. 1 shows the incompleteness of our faunistic deep water collections, curve 1 mirrors the obvious prevalence of females over males at great depth. From the aspect of biology of deep water fauna this fact is of great interest.

The author who analysed this question (Bogorov, 1939) arrived at the conclusion that male specimens in copepods were short-lived and perished imme-
mediately after copulation (Campbell, 1934) which leads to the inequality of the sex ratio in our collections. Woodhead & Riley (1959) showed the males of Calanus finmarchicus (Gunner) to pass copepodid stage V more rapidly and to perish earlier in stage VI than the females. It was also pointed out (Bogorov, 1939) that the sex ratio in calanids (as well as in Oithona, Cyclopoida) undergoes sharp fluctuations in different species in various habitats. As far as we know, however, this question was not considered in detail.

The sex ratio of calanids belonging to different ecological groupings is worked out by the present author, using data on the vertical zonation of the plankton of the Kurile-Kamchatka trench found by Birstein, Vinogradov & Tchindonova (1954). The authors mentioned distinguish the following groups of pelagic animals:

1. Epiplankton, the whole life of which is passed in surface layers. To this group belong the littoral species, Acartia tumida Willey and Centropages memurrichi Willey, studied by the present author.

2. Bathypelagic plankton, which can be divided into two groupings: an upper pelagic one, the representatives of which breed in the producing zone (Calanus plumchrus Marukawa, C. cristatus Kröyer), and a lower bathypelagic one the reproduction of which proceeds deeper (in our material Candacia columbiae Campbell and Pareuchaeta japonica (Marukawa)).

3. Abyssal plankton. Unfortunately we failed to collect enough abyssal calanids to represent the third grouping.

Our material was collected in 1954-1959 in the Bering Sea and in the North-West Pacific. Only mature specimens were taken into consideration and since this part of their life cycle is not long, they occurred in samples but rarely. 112 Acartia tumida, 108 Centropages memurrichi, 522 Calanus plumchrus, 320 Calanus cristatus, 480 Candacia columbiae, and 731 Pareuchaeta japonica were analysed in all. The material being collected in all seasons and in an extensive area, an average was struck. The results are summarized in the graph of figure 2.

The graph shows the sex ratio in the representatives of the surface plankton, Acartia tumida and Centropages memurrichi, to be 1:1. In those of the upper bathypelagic grouping (Calanus plumchrus, C. cristatus) the percentage of males begins to decrease (down to 35.1 % in C. cristatus). Lower bathypelagic species (Candacia columbiae and Pareuchaeta japonica) are characterized by a clearly expressed prevalence of females and a drop in the percentage of males down to 23.07 and 12.05 %, respectively. At copepodid stage V the sex ratio in P. japonica is 62 % of females to 38 % of males, so that the prevalence of females is likewise found in non-mature calanids.

A shift of the sex ratio towards the prevalence of females can not be ascribed to decreasing temperature with increasing depth. According to Kinne's data (1953, 1959) low temperatures cause the opposite effect in Gammarus duebeni Lilljeborg and G. salinus Spooner. A trend towards a decrease in the number of males with