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Upper limits of the depth range and temperature tolerance of the Baltic Pontoporeia affinis (Crustacea, Amphipoda)

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In the Tvärminne area (SW Finland) the cold-stenothermal glacial relict *Pontoporeia affinis* occurs, even abundantly, at lesser depths than reported for other Baltic waters. The upper limit of temperature tolerance observed at Tvärminne is also clearly higher than suggested for the Baltic *P. affinis* in a recent paper.

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As is well known, *Pontoporeia affinis* is a typical inhabitant of deep localities with soft bottom. As regards the upper limit of its occurrence in the Baltic, ANKAR & ELMGREN (1976) state that in the Askö area (S of Stockholm) the amphipod is very rare above 10 m and has never been found at depths of 3 m or less. For comparison they refer to data given in publications by BERGH (1973), JÄRVEKÜLG (1973), and the present author (1973). BERGH records that in the Tvären bay (S of Stockholm) *Pontoporeia* did not occur at 10 m or less; JÄRVEKÜLG gives a minimum depth of 4 m for Estonian waters, and in my paper of 1973 the shallowest Tvärminne locality (SW Finland) discussed had a depth of 3 m. It is of interest that in the Tvärminne waters *P. affinis* has been found in quantity in remarkably shallow situations. My paper of 1933 (Table 1) gives one locality with only 1.5 m depth and quantitative sampling (programme of the Institute of Marine Research, Helsinki) in the Krogarviken bay (near the Tvärminne Zoological Station; maximum depth 3 m) has shown that at an annually visited station with 2.5 m depth high densities of the amphipod may be observed (see Table below).

ANKAR (1977) points out that in shallow water temperature determines the upper limit of the Baltic *P. affinis*, which does not tolerate high temperatures. This conclusion is correct, as the species is a cold-stenothermal glacial relict, but the upper limit of temperature tolerance in the Baltic lies considerably higher than suggested by ANKAR. He quotes SMITH (1972), who summarized the results of studies on the upper limit of temperature tolerance of the *Pontoporeia* living in Lake Superior, USA: "The field and laboratory experiences reported here indicate that the temperature of 14.5° C given by EKMAN (1915) and THIENEMANN (1926, 1928) (for European lakes) as the upper tolerance limit of *Pontoporeia affinis* is probably too high for the species in Lake Superior". SMITH's observations, however, relate to *Pontoporeia hoyi*, a species distinct from the Baltic *P. affinis* (SEGERSTRÅLE 1977). The North American species may be less tolerant of high temperatures than its relative in the Baltic. This is suggested by observations made by DADSWELL (1974) in connection with his extensive sampling of the glacial relicts of North American lakes: *Pontoporeia* was never found if the temperature was above 14° C.

In the Tvärminne area *P. affinis* tolerates considerably higher temperatures. I observed (SEGERSTRÅLE 1937) that in the Krogarviken locality, with a depth of 3 m, this amphipod tolerated about 22° C during four successive days in 1932. In a population kept in an aquarium for a whole summer and exposed to temperatures exceeding 20° for 6 days (maximum 20.7°), a considerable proportion survived. In deeper water naturation requires 2—3 years (SEGERSTRÅLE 1937), but in Krogarviken the young bred in the spring reach sexual maturity

in the same year. The reason for this may be that the feeding conditions are better there than in deeper water, where the bottom is much finer and presumably rather poor in nutrients (SEGERSTRÅLE 1933a, 1937).

In Krogarviken *Pontoporeia* may exhibit markedly high densities even in years with summer temperatures exceeding 18 and 19°. This is demonstrated by the following observations from this locality:

Date (1966)	Temperature (2.5 m depth)	Date (1967)	Temperature (2.5 m depth)
2 July	16.0	1 July	10.1
9 »	16.7	12 »	8.6
16 »	11.9	15 »	11.6
23 »	13.9	22 »	15.2
30 »	18.2	29 »	16.3
6 Aug.	17.7	5 Aug.	19.5
13 »	16.0	13 »	14.8
20 »	12.1	20 »	14.8
27 »	12.1	27 »	16.0

Density of *Pontoporeia*: 18 Aug. 1966 2289 ind./m², 14 Aug. 1967 1324 ind./m².

The fact that the Baltic *P. affinis* tolerates higher temperatures than freshwater populations is in agreement with studies on other crustaceans, e.g. the amphipod *Gammarus duebeni*, which suggest that the range of temperature tolerance is widest in optimal salinities (KINNE 1953). As *P. affinis* is a typical brackish-water species, being smaller in size and even exhibiting signs of morphological reduction in fresh waters (SEGERSTRÅLE 1957), it can be expected to tolerate higher temperatures in the more favourable environment offered by the brackish Baltic.

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