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# THE AMPHIPOD FAUNA OF LAKE KUMMEROW (MECKLENBURG, GERMAN DEMOCRATIC REPUBLIC) WITH REFERENCE TO *ECHINOGAMMARUS ISCHNUS* STEBBING, 1899

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## ZUSAMMENFASSUNG

Angaben zur Verteilung, Biologie und zum möglichen Einwanderungsmodus der Amphipoden *Pallasea quadrispinosa* Sars, *Corophium curvispinum* (Sars) und *Echinogammarus ischnus* Stebbing wurden im Kummerower See gesammelt. Für *E. ischnus* wurde der Erstnachweis für die DDR erbracht. Tiere dieser Art weichen in morphologischer Hinsicht von Beschreibungen in der Literatur ab, daher wurden Tiere dieser Population beschrieben und gezeichnet. Die Häufigkeit des Glazialrelikts, *Pallasea quadrispinosa*, nahm in den letzten Jahren ab, während die Amphipoden, *C. curvispinum* und *E. ischnus*, im Flachwasser sehr häufig sind. Die letztgenannten Arten bevorzugen die *Dreissena*-Klumpen als Habitat. *Pontoporeia affinis*, ein weiteres Glazialrelikt, starb innerhalb der letzten 60 Jahre aus.

## INTRODUCTION

Our knowledge of the biology and distribution of limnic invertebrates is often incomplete. It is surprising that new species are to be found in areas which have been previously investigated and it is possible that these species have been living there for years. The registration of the native fauna is becoming more and more important in relation to the process of eutrophication and the ageing of lakes within short periods due to the sensitivity of species to changes in environmental conditions caused by domestic, industrial and agricultural wastes.

Native gammarids have died out in their home water as a consequence of the dumping of wastes (Meijering, 1971; Pieper & Meijering, 1983). These waters may possibly be repopulated by related but in fact alien species (Schmitz, 1960; Bulnheim, 1976, 1980; Herhaus, 1978). In the case of such rapid changes in faunal composition the accurate identification of species takes on crucial importance as an indicator of unsteady conditions. This is especially the case in relation to the determination of *Gammarus*-species.

In 1985 the distribution of glacial relicts in Mecklenburg was investigated. In Lake Kummerow *Pallasea quadrispinosa* Sars, 1867 and another gammaridean amphipod initially identified as *Gammarus lacustris* Sars, 1863, were caught. Reinvestigation of the material showed that all specimens of the *Gammarus*-material belong to *Echinogammarus ischnus* Stebbing, 1899.

In November 1987 the occurrence of amphipod species in Lake Kummerow was again inspected.

## METHODS AND INVESTIGATED AREA

Samples of the sediment from different depths and *Dreissena*-clumps in shallow water were taken by a triangular dredge (mesh-width 2 mm) at six arbitrarily chosen stations. The material was stored in formalin (4%) buffered with borax. The animals were later separated in the laboratory. Attendant species were determined where possible. A part of the sample was stored alive in an aquarium at 10°C for two months.

Lake Kummerow (fig. 1) is one of the largest in Mecklenburg, occupying about 2.500 ha and having a maximum depth of 18 m. The lake is of glacial origin. Thienemann (1928) characterized it as a "Zungenbeckensee" and classified it as a lake of the *Chironomus*-type. The lake is part of the river Peene system and is used for shipping, the caging of salmon trout, and extensive fisheries. The water quality is damaged by agricultural and to a lesser degree by domestic wastes.

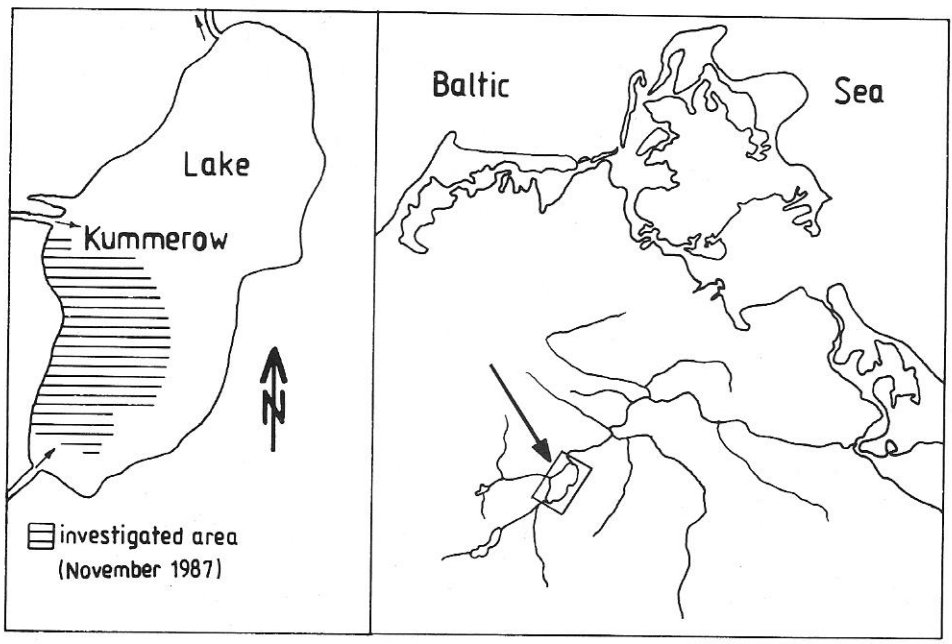


Fig. 1. Location of Lake Kummerow in Mecklenburg, and investigated area in 1987.

## RESULTS

Three amphipod species were found in Lake Kummerow in 1987. Samter (1905) and Thienemann (1928) detected the occurrence of *Pontoporeia affinis* Lindström, 1855 and *Pallasea quadrispinosa*. The first of these has died out in the last 60 years, probably because of decreasing oxygen content in the profundal as a result of increasing eutrophication. The second species is common but shows a decrease in frequency compared with Thienemann's findings, where he mentions that the species showed mass development in the *Chara*-beds (table I). After convection in autumn *P. quadrispinosa* also occurs in shallow water. When the water temperature decrease to 8°C, reproduction begins. Females bear 30 eggs or embryos on an average. The reproduction period lasts from early November until late May. The species shows no preference for a special habitat but usually occurs deeper than the thermocline in summer.

The immigrated *Corophium curvispinum* (Sars, 1895) shows high frequencies in shallow water. The tubes of this species are fixed on hard substrates like bow-nets and their poles. On these substrates the population density is remarkably high (7-8 ind./cm$^2$). But the species also shows a particular preference for the biochorion *Dreissena*-clumps. This amphipod is very common in shallow waters (0-2 m), breeds in summer, the reproductive period terminating in late October (table II). Various size classes point to several (4-5) generations per year.

The second ponto-caspian immigrant *Echinogammarus ischnus* was found in high abundance in 1985 as well as in 1987 but scarcely ever outside the *Dreissena*-clumps. The determination of the species was difficult because of differences in morphology compared with the description in the available literature (Wagler, 1937; Schellenberg, 1942). The best features to detect the species seem to be the third uropod and the telson (Jaździewski, 1975). As a consequence we give a description of specimens of the Lake Kummerow population and illustrate the features (fig. 2).

### **Echinogammarus ischnus** Stebbing, 1899

Length up to 11 mm in male, 8 mm in female. Body *Gammarus*-like, without dorsal teeth, urosome segments 1-3 with dorsal spine groups. Head with a small triangular rostrum; lateral lobes reduced; eyes moderately large, reniform. Antenna 1 peduncle moderately setose, articles of about the same length; flagellum 17 to 22-articulate; accessory flagellum 4 to 6-articulate. Antenna 2 densely setose; usually shorter than antenna 1 or of about the same length in males; articles 4 and 5 of peduncle and flagellum with dense and distinctive covering of long, fine, curled setae; calceoli absent. Mandible palp 3-articulate; article 2 with irregular ventral setae; article 3 with 5 up to 7 setal groups on outer surface, ventral setae irregular. Gnathopod 1 of median size; basis long; ischium, merus short, ventrally setose; carpus shorter than pro-

TABLE I

Characteristic features of the observed depth compared with the results of Thienemann

| Depth range | Short characterisation, observed in 1926 | Depth range | Short characterisation, observed in 1987 |
|---|---|---|---|
| 2-3 m | among *Chara* a lot of *Pallasea*, *Asellus*, *Valvata*, Hydracarina... | 0.2-3.0 m | hard sandy bottom with shell residues, *Dreissena*-clumps and beds with few *Pallasea*, a lot of *Corophium* and *Echinogammarus*, *Unio*..., attached to fishinggears *Dreissena*-clumps with *Corophium* and *Echinogammarus*, tubes of *Corophium* make the gear slimy |
| 5-6 m | living *Dreissena*, *Pallasea*... | 3-8 m | Gyttja, *Chironomus plumosus*, few *Pallasea* |
| 6-7 m | typical sublittoral, including a mass of *Dreissena* clumps, dead *Dreissena*, *Anodonta*, many Hydracarina, *Asellus*, *Tanypus*, *Molanna*, *Piscicola*, *Pallasea*, only a few *Pontoporeia* | 8-10 m | Gyttja, organic residues, dead mussels |
| | few *Pontoporeia* | | |
| 12-13 m | grey mud, *Pisidium*, *Chironomus*-larvae, *Tanypus*, Oligochaeta, dead *Dreissena*, plant residues... | 12-14 m | Gyttja, *Pisidium*, *Chironomus*-larvae, Oligochaeta |
| 15-16m | black mud, only few *Pallasea*, fewer *Pontoporeia*, few *Chironomus*-larvae, a lot of livng *Pisidium* and *Sphaerium* | 15-18 m | Gyttja, *Chironomus*-larvae, Oligochaeta only few *Pallasea* |

TABLE II

Notes on the population structure of the amphipods (%)

| Species | <2 mm | >2 mm | | | Notes |
|---|---|---|---|---|---|
| | | ♂ | ♀⁻ | ♀⁺ | |
| *P. quadrispinosa* | — | 30 | 55 | 15 | One size class |
| *C. curvispinum* | 32 | 14 | 54 | — | Various size classes, a lot of very small recruits |
| *E. ischnus* | 5 | | 95 | | Two or three size classes |

♂ = males; ♀⁻ = females without marsupium; ♀⁺ = egg or embryo bearing females.

podus; propodus oval, palm oblique and weakly sinuous, ventral margin densely setose. Gnathopod 2 slightly larger than 1, similar in form; propodus with 4 to 5 setal groups on inner surface. Pereiopods 3-4 similar in size; merus and carpus anteriorly with distal lobes terminating in 1 or 2 strong spines, merus with an additional spine on anterior margin, posterior margin setose with or without spines; propodus and dactylus slender. Pereopod 7 without a postero-distal angle; merus, carpus and propodus similar in length and slender, especially the carpus spinous; basis with only few setae. Coxal plates 1-4 of medium size; 1-3 rectangular; 4 terminating in a pointed posterior angle, posterior margin sinuous, distal margin straight. Epimeral plate 3 terminating in a pointed posterior angle, posterior margin without setae or spines, ventral margin rounded. Urosome segments spinous, segments 1 and 2 with a median and two lateral spines, with or without setae; segment 3 only with lateral spines, median spine absent. Uropod 3 peduncle short with distal spines; outer ramus elongated, 2-articulate, spinous; inner ramus small, in length about one-seventh of outer ramus, with apical spines. Telson cleft to the base, each lobe with 3 apical and 2 dorsal spines. Female gnathopods smaller than in males, setae on ventral margin of antenna 2 straight.

*Echinogammarus ischnus* reproduces in summer, the reproductive period terminating in late September. Specimens belong to 2 or 3 size classes pointing to 2 to 3 generations per year. Females usually bear fewer than 20 eggs or embryos. Amongst other food the species preys on ostracods, which occur in large numbers in the *Dreissena*-clumps.

The three ponto-caspian species—*Dreissena polymorpha* (Pallas, 1771), *Corophium curvispinum* and *Echinogammarus ischnus*—are closely connected in the biochorion *Dreissena*-clumps. The clumps have a median size range from 2 to 5 cm (mean length of the mussel 7.72 ± 4.56 mm, with a size-scale from 1.0 up to 28.5 mm). Approximately 10 *Corophium* and up to 40 *Echinogammarus* live in every clump. The close relation of these species led us to investigate this biochorion. We found a close resemblance to the biochorion *Mytilus*-clumps from the Baltic Sea (table III).

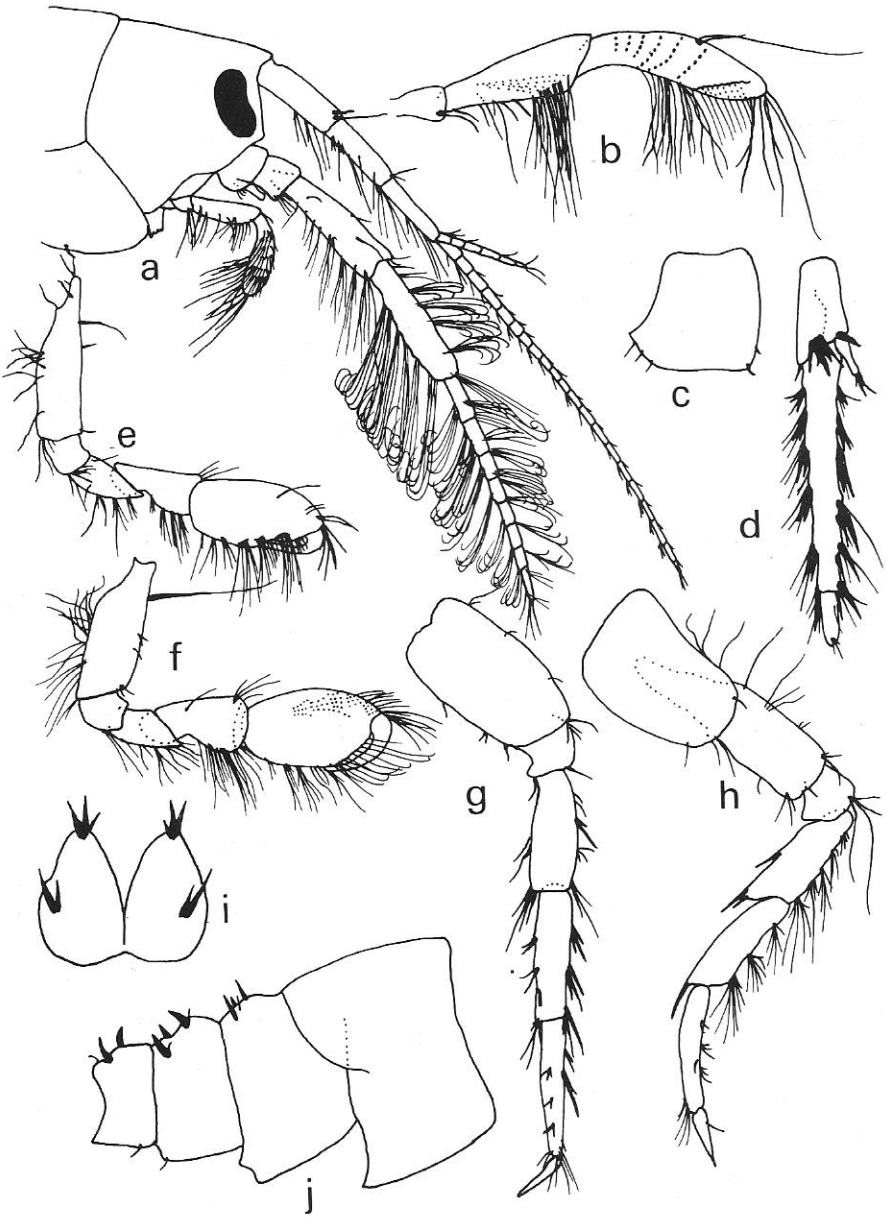


Fig. 2. *Echinogammarus ischnus* Stebbing, male. (a) head and antennae; (b) mandible palp; (c) coxal plate 4; (d) uropod 3; (e) gnathopod 1; (f) gnathopod 2; (g) pereopod 7; (h) pereopod 3; (i) telson; (j) urosome segments and epimeral plate 3.

TABLE III

Species composition within mussel-clumps

| Freshwater (Lake Kummerow, depth range 0.4-2.0 m) | Brackish water* (Baltic Sea, depth range 8-16 m) |
|---|---|
| Clumps of *Dreissena polymorpha* (Pallas) | Clumps of *Mytilus edulis* L. |
| Attendant species: | Attendant species: |
| Cnidaria | |
| *Hydra* spp. | *Laomedea* spp. |
| Plathelminthes | |
| *Planaria torva* (O. F. Müller) | |
| Nemertini | |
| | *Lineus ruber* (O. F. Müller) |
| Nemathelminthes | |
| Nematoda spp. | Nematoda spp. |
| Mollusca | |
| *Potamopyrgus jenkinsi* (Smith) | *Hydrobia ulvae* (Pennant) |
| *Ancylus fluviatilis* O. F. Müller | |
| *Valvata piscinalis* (O. F. Müller) | |
| *V. pulchella* Studer | |
| | *Parvicardium ovale* (Sowerby) |
| | *Mya arenaria* L./juvenile |
| Annelida | |
| Oligochaeta/Tubificidae | Oligochaeta/*Peloscolex* spp. |
| *Glossiphonia complanata* (L.) | |
| *Haementaria costata* (Fr. Müller) | |
| *Helobdella stagnalis* (L.) | |
| *Herpobdella octoculata* (L.) | |
| *Piscicola geometra* (L.) | |
| | *Capitella capitata* (Fabricius) |
| | *Heteromastus filiformis* (Claparède) |
| | *Fabricia sabella* (Ehrenberg) |
| | *Polydora ciliata* (Johnston) |
| Crustacea | |
| Ostracoda spp. | Ostracoda spp. |
| | *Cyathura carinata* (Krøyer) |
| *Echinogammarus ischnus* Stebbing | *Jaera albifrons* Leach |
| | *Gammarus oceanicus* Segerstråle |
| | *G. salinus* Spooner |
| *Corophium curvispinum* (Sars) | *Melita palmata* (Montagu) |
| | *Corophium insidiosum* Crawford |
| Insecta | |
| *Glyptotendipes* spp./larvae (Chironomida) | Chironomidae spp./larvae |
| *Caenis horaria* (L.)/larvae (Ephemeropta) | |

* Salinity range 10 to 18‰.

## DISCUSSION

The composition and distribution by depth of important members of the fauna of Lake Kummerov has changed in the last 60 years (table I). In relation to the amphipods the following conclusions may be drawn:

1. *Pontoporeia affinis* is now lacking because of eutrophication and the resulting oxygen depletion in the deeper parts of the lake.
2. The frequency of *Pallasea quadrispinosa* is decreasing. Mass occurrence is lacking.
3. The newcomers *Corophium curvispinum* and *Echinogammarus ischnus* show high frequency in shallow water related to their preferred habitat; *Dreissena*-clumps preferably occur at depths between 0 and 2 m.

The process of eutrophication is underlined by the high abundance of *Chironomus plumosus*-type larvae and the high frequency of oligochaetes in the profundal. The cisco—*Coregonus albula* L.—died out around 1860 (Thienemann, 1928). But the process can also be detected in the littoral.

Data of the biology of the three amphipod species are rare in the literature. *Pallasea quadrispinosa* is used to repopulate Scandinavian lakes; if it will be possible to compare all biological data it will also be possible to protect this species in Mecklenburg. Thienemann (1928) also found females of *Pallasea* with eggs or embryos in summer in shallow water. We cannot explain this phenomenon.

*Corophium curvispinum* is the most successful immigrant amphipod in Europe and also occurs in slightly brackish water. Acclimatization attempts are often successful but increasing pollution can destroy populations of this species (Jaźdźewski, 1980; Leppäkoski, 1984). Species of the genus are common on muddy bottoms or in microhabitats with organic enrichment.

*Echinogammarus ischnus* is primarily an euryhaline, riverine species preferring large, slow moving rivers (Jaźdźewski, 1980) also occurring in the open Black Sea (Bačescu, 1966). We, however, found it in an eutrophicated freshwater lake, scarcely ever outside the biochorion described. This could have been overlooked by other authors. The preference for mussel-clumps may be due to the euryplasticity for which ponto-caspian species are well known (Băcescu, 1966) or may also be a consequence of its immigration.

The three ponto-caspian species are ecologically so closely connected that it is conceivable that they immigrated together. The probable route of immigration seems to be the Dnieper, Vistula and finally the Oder systems with their well developed canal systems. *Dreissena* was found in the Oder system in the first half of the 19th century, and *Corophium curvispinum* in 1910. *Chaetogammarus*—an earlier synonym of *Echinogammarus*—was discovered in the Vistula system in 1931 (Băcescu, 1966). Herhaus (1978) found *E. ischnus* in the Ems river. No observations of this species between Vistula and Ems were known. Our investigation of *E. ischnus* is the first evidence of this species in the German Democratic Republic. A possible explanation of these isolated localities can be found in the extinction of the populations of *Echinogammarus* in the Oder and Weser systems, caused by pollution or changes in ion composition of the water (Jaźdźewski, in litt.). Yet the species is euryhaline and shows also high abundances in eutrophic lakes; it may therefore simply have been overlooked in the areas between the large river systems. We would suggest that

the small size of the amphipods and limited knowledge of the amphipod fauna in general combined with their close biological connections are arguments which support the assumption that they still occur in areas between the large river systems as well as that all three ponto-caspian species—*Dreissena*, *Corophium* and *Echinogammarus*—immigrated together.

Nevertheless a lot of work still needs to be done to establish the real distribution of these as well as other amphipods in Europe, this because of continuing changes in the conditions of freshwater systems and acclimatization attempts to repopulate rivers and lakes in order to provide food for demersal fishes.

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