*Ann. Zool. Fennici 27:231–235*
Helsinki 10 December 1990

ISSN 0003-455X


Biology and ecology of glacial relict Crustacea, Conference 20–23 April 1988, Tvärminne, Finland

# The recent distribution of glacial relict Malacostraca in the western and southern Baltic

Jörg Köhn

*Sektion Wirtschaftswissenschaften, Universität Rostock, Parkstraße 6, Rostock 1, D-2500, FRG*

Data lists of benthos monitoring and cod gut analyses were used to check the recent distribution of *Mysis relicta, Saduria entomon, Pontoporeia affinis* and *P. femorata* in the western and southern Baltic. Specimens of *Mysis* were identified, all of them proving to belong to *M. mixta*. The limit of distribution was established for the western and southern Baltic.

## 1. Introduction

The history of the spread of glacial relict Malacostraca is well known (Thienemann 1928, 1950, Segerstråle 1982). Ekman (1940) has published distribution maps of two *Pontoporeia* species. However, notes on the distribution in the western and southern Baltic are often inconsistent.

A knowledge of the distribution of glacial relicts (molluscs and malacostracans) permits us to draw conclusions as to environmental conditions in different regions below the thermocline, especially in relation to the oxygen content of the near bottom water.

The distribution of the following species has been reinvestigated: *Mysis relicta* Lovén, 1862, *Saduria entomon* (Linnaeus, 1758), *Pontoporeia affinis* Lindström, 1855, and *P. femorata* Krøyer, 1842. The necessity of exploring the present status of these species following their decline in frequency and changes in the environment below a depth of 20 m in the study area is obvious (Schulz 1969, Gosselck et al. 1984, 1985).

## 2. Material and methods

The available literature has been reviewed for notes on the distribution of the species known as glacial relicts in the western and southern Baltic. Specimens in collections (e.g. of the Zoological Museum of Berlin, and of the Department of Biology at Rostock University) have been redetermined. Data lists of around 500 samples from about 200 stations were examined for the occurrence of glacial relict malacostracans.

The samples were taken using grabs, dredges, hyperbenthos-dredges, plankton nets, and young-fish trawls. Analyses of gut contents were also undertaken. Data on the frequency of *S. entomon* and *P. femorata* of Arkona Sea origin have been plotted.

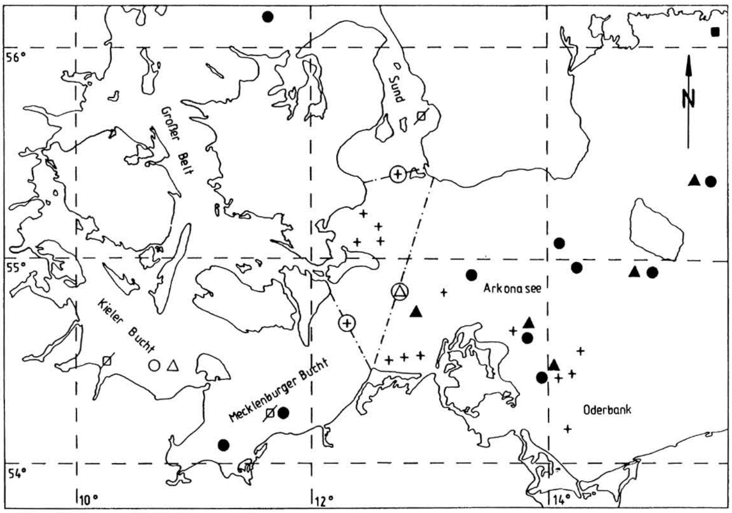


Fig. 1. Distribution map of glacial relict malacostracans in the southern and western Baltic. Unfilled symbols = earlier findings, square = *Mysis relicta*, cross = *Saduria entomon*, triangle = *Pontoporeia affinis*, circle = *P. femorata*.

## 3. Results

The distribution map in Fig. 1 shows that:

1) *M. relicta* does not occur south of latitude 56°N. All specimens determined as *M. relicta* belong to other species, mainly to *M. mixta*.
2) *S. entomon* does not occur in the Lübeck and Kiel Bight. It is common east of the line Darßer Ort – Hestehoved (Falster).
3) *P. affinis* apparently has the same distribution as *S. entomon*, but is less frequent west of Rügen.
4) *P. femorata* is distributed in the western and southern Baltic and it is also encountered in Kattegat and Skagerrak, but it is not so frequent as it formerly was.

Gut analyses support these results. The guts of cod from Lübeck and Mecklenburg Bight do not contain any glacial relict malacostracans.

### *Saduria entomon*

A comparison of specimens from the Arkona Sea and Gotland Sea shows that those from the later area are about 58% larger than those from the Arkona Sea. The observed maximum size of Arkona Sea Saduria caught by young-fish trawl has been established as 51 mm. It is not known whether this is caused by temperature, depth or salinity, or to all these factors combined. The low frequency of females in young-fish trawl samples is also interesting. *Saduria* did not, and does not, occur below 40 m, its frequency between 35 and 40 m decreasing in line with eutrophication.

### *Pontoporeia femorata*

Gosselck (1985) mentioned a tenfold increase in frequency in the Arkona Sea compared with Löwe's (1963) results.

Except for the results of unusually favourable conditions in 1980 — observable in all species — a tendency to decrease in frequency since 1984 has been observed. These results have also previously been established through comparing the findings of Blanc (1884) and Remane (um 1930) in the Kiel Bight with those of Kühlmorgen-Hille (1965), and of Lenz (1875) in the Lübeck Bight with those of Gosselck et al. (1984, 1987), and finally of Löwe (1963) in Mecklenburg Bight with those of Schulz (1969), Gosselck et al. (1984, 1987) and Köhn (1989). *P. femorata* has been found recently only in low numbers in restricted areas in all these regions, or it is now completely lacking.

*Pontoporeia affinis*

This species has been collected frequently by Löwe (1963) in the Arkona Sea. It showed high frequencies in relation to its occurrence near the limit of its distribution (243 ind./$m^2$, Table 1). We found *P. affinis* only sporadically in the grab and dredge samples, as well as in the guts of cod.

*Mysis relicta*

Many findings have been recorded from the western and southern Baltic. However, all of these are referrable to other species:

*M. mixta* juveniles are often incorrectly identified as those of *M. relicta*, and also as those of *Gastrosaccus spinifer*, *Praunus flexuosus* and *P. inermis*.

It should be pointed out that all the notes in the literature regarding the distribution of *M. relicta* in the western and southern Baltic require checking and that the specimens in collections should be reassessed. I suggest that *M. relicta* does not occur in this area. It is frequent north of latitude 56°N.

## 4. Discussion

100 years ago *Pontoporeia*-species were found frequently in the Kiel and Lübeck Bight (Lenz 1875, Blanc 1884) and they usually occurred in shallow areas (within a depth range of 6–7 m) as well. Remane (in the 1930s) was able to collect them in the same region and he was unable to detect any effect of the dumping of domestic wastes on the benthic fauna over larger areas. Nowadays oxygen defiency is a familiar process

Table 1. Data on the distribution, relation to depth and sediment preferences of glacial relict Malacostraca, results of Löwe (1963).

| | Depth range | Number of stations | Bottom | Species |
|---|---|---|---|---|
| Arkona Sea | 40–68 m | 21 | mud | *P. affinis, P. femorata,* |
| | | 24 | clay | *S. entomon* |
| | 6–40 m | 94 | sand | *P. affinis, P. femorata,* |
| | | 26 | clay | *S. entomon* |
| | | 1 | mud | |
| E Belt Sea (near Rostock) | 11–20 m | | | *P. affinis, P. femorata, (S. entomon)* |
| Sediment preferences | *P. affinis* | mud : clay : sand | = 0.6 : 15.2 : 84.2 | |
| | *P. femorata* | | = 9.6 : 71.1 : 19.3 | |
| | *S. entomon* | | = 0.1 : 61.5 : 38.4 | |
| Depth preferences | *P. affinis* | <40 m : >40 m | = 5.1 : 94.9 | |
| | *P. femorata* | | = 28.4 : 71.6 | |
| | *S. entomon* | | = 29.6 : 70.4 | |

Notes:

*S. entomon* "fehlt im Kattegat ... in der östlichen Beltsee tritt sie nicht mehr auf", nach Ekman (1909). 1 Fund im Kattegat, Arkona Sea 9 ind./$m^2$

*P. affinis* Arkona Sea 243 ind./m2 (=4526 t)

*P. femorata* "eurybiotisch, mit geringen ökologischen Erfordernissen ... Salzwassersubmergenz", Arkona. Sea 204 ind./$m^2$ (=5196 t), Kiel Bight 6–15 m

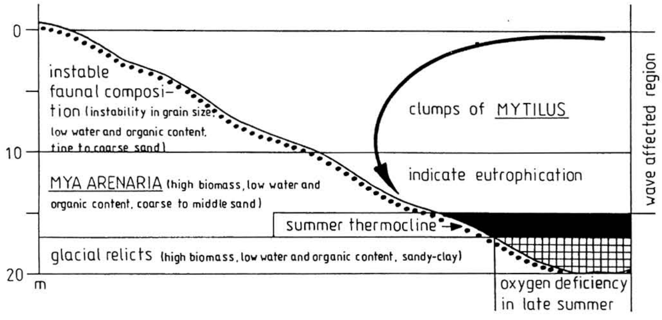


Fig. 2. The model of settlement of a sandy bottom in the Mecklenburg Bight.

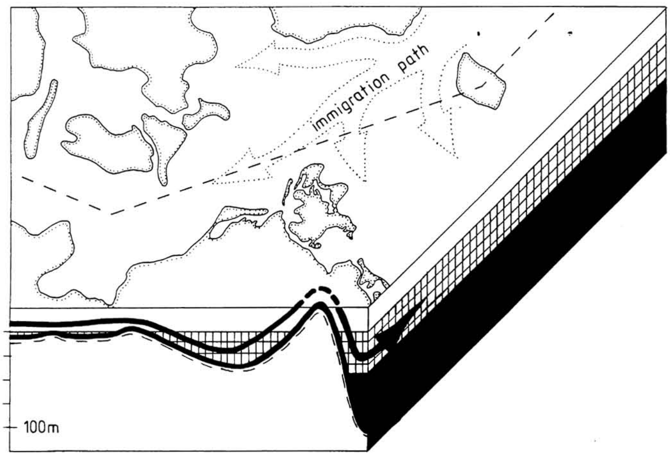


Fig. 3. The immigration of glacial relict Malacostraca in relation to the currents of deep and surface waters, black = permanent stagnated deep water, cross-hatching = water body influenced temporary by oxygen defiency (c.f. Jansson 1978).

in the near bottom waters of the Kiel, Lübeck and Mecklenburg Bights (Weigelt 1985, Rumohr 1986, Weigelt & Rumohr 1986, Köhn 1989). This phenomenon has been caused by the eutrophication rife in all regions of the Baltic (Demel & Mulicki 1954, Andersin et al. 1978, Bonsdorff 1980, Kachalova & Lagzdins 1982, Gosselck & Georgi 1984).

On the one hand, peracarids have brood protection with direct development — the whole process of reproduction of the observed species is coupled to the benthic environment — but on the other hand, they are able to leave inhospitable conditions, especially a decrease in the oxygen content of the water. For this reason they have been called "transitory emigrants" (Rosenberg et al. 1975). Emigration and immigration depend on the expansion of affected areas. Possibly glacial relict malacostracans emigrate in shallow areas below or near the summer thermocline and immigrate when the oxygen content increases again (detectable in the distribution by depth in the Riga Gulf, see Kostrickina et al. 1980). However, the whole area below the thermocline may be affected by oxygen depletion during the summer stagnation (Weigelt 1985, Köhn 1989). Eutrophication leads to a higher water content and organic enrichment of the presediment and possibly in this way to higher oxygen requirements caused by intrasedimentary processes and bacterial activity on particulate organic matter. These processes combined may be the reason for the expansion and frequency of periods of low oxygen concentration in the near bottom waters. A general migration of the macrofauna is also detectable in the shifting of high biomasses in the region of the summer thermocline at depths of 17–22 m, and this includes the glacial relict molluscs and malacostracans (Fig. 2).

Eutrophication and the shortness of periods with a sufficient oxygen concentration in the deep water may have affected the distribution and frequency of glacial relict malacostracans. Nevertheless, immigration into formerly "dead areas" for glacial relicts is much more difficult now due to the eutrophication of large intervening areas. The mode of immigration has to be changed as the passage through the deep basins is now either impossible or of minor importance. A route must be taken parallel to the coasts, avoiding the deeper areas. In this way the distances are much longer and the time needed for returning increases in contrast to the shorter periods of favourable conditions in the western and southern Baltic (Fig. 3). The consequences are seen in the present lower frequencies of occurrence.

## References

Andersin, A.-B., Lassig, J., Parkkonen, L. & Sandler, H. 1978: The decline of macrofauna in the deeper parts of the Baltic proper and the Gulf of Finland. — Kieler Meeresforsch. Sonderh. 4:23–52.

Apstein, C. 1909: Die Isopoden der Ostsee. — Schr. Naturw. Ver. Schleswig-Holstein 14:34–50.

Blanc, H. 1884: Die Amphipoden der Kieler Bucht nebst einer histologischen Darstellung der "Calceoli". — Carol. Deutsche Akad. Naturforsch. 47:37–104.

Bonsdorff, E. 1980: Macrozoobenthic recolonization of a dredged brackish water bay in SW Finland. — Ophelia suppl. 1:145–155.

Bruun, A. F. 1924: On Chiridothea entomon (L.) in the southern and western Baltic. — Carol. Deutsche Akad. Naturforsch. 83:1–12.

Demel, K. & Mulicki, Z. 1954: Quantitative investigation on the biological bottom productivity of the South Baltic. — Prace Morsk. Inst. Rybni Gdynia 7:75–126.

Ekman, S. 1940: Die schwedische Verbreitung der glazialmarinen Relikte. — Verh. Internat. Ver. Limnol. 9:37–58.

Enequist, P. 1950: Studies on the soft-bottom amphipods of the Skagerrak. — Zool. Bidrag Uppsala 28:297–492.

Gosselck, F. 1985: Untersuchungen am Makrozoobenthos des Arkonabeckens (südliche Ostsee). — Fischereiforsch. 23(4):28–32.

Gosselck, F. & Georgie, F. 1984: Benthic recolonization of the Lübeck Bight (western Baltic) in 1980/81. — Limnologica 15:407–414.

Gosselck, F., Doerschel, F. & Doerschel, T. 1987: Further developments of macrozoobenthos in the Lübeck Bay, following recolonization in 1980/81. — Int. Rev. Ges. Hydrobiol. 72(5):631–638.

Jansson, B.-O. 1978: The Balthic — a system analyses of a semienclosed Sea. — Adv. Oceanogr. 131–183.

Kachalova, O. L. & Lagzdins, G. S. 1982: Benthic fauna of the southern part of the Gulf of Riga. — In: Environment and Hydrobiocoenosis: 181–198. Zinatna, Riga.

Köhn, J. 1986: Malacostraca der Ostsee-Bestimmungstabellen mit Angaben zur Ökologie und Verbreitung der Arten. — Diplomarbeit Rostock. 275 pp.

— 1989: Zur Ökologie sandiger Böden der Mecklenburger Bucht. — Dissertation Rostock. 180 pp.

Köhn, J. & Gosselck, F. 1989: Bestimmungsschlüssel für die Malacostraca der Ostsee. — Mitt. Zool. Mus. Berlin 65(1):3–114.

Kostrićkina, E. M., Sidrevic, L. L. & Kaleja, M. A. 1980: Die mehrjährige Dynamik der Fauna der Ostsee. — Fischereiforsch. 35:665–703.

Kühlmorgen-Hille, G. 1965: Qualitative und quantitative Veränderungen in der Bodenfauna der Kieler Bucht in den Jahren 1953–1965. — Kieler Meeresforsch. 21:167–191.

Lenz, H. 1875: Die wirbellosen Thiere der Travemünder Bucht. — Jahresber. Komm. Wiss. Unters. Deutscher Meere Kiel, 2/3:1–24.

Löwe, F. K. 1963: Quantitative Benthosuntersuchungen in der Arkonasee. — Mitt. Zool. Mus. Berlin 39:247–349.

Rosenberg, R., Nilsson, K. & Landler, L. 1975: Effects of a sulphat pulp mill on the benthic macrofauna in a firth of the Bothnian Sea. — Merentutkimuslaitoksen Julkaisuja / Havsforskninginstitutets Skrifter 239:289–300.

Rumohr, H. 1986: Historische Indizien für Eutrophierungserscheinungen (1875–1939) in der Kieler Bucht (westliche Ostsee). — Meeresforsch. 31(2): 115–123.

Schulz, S. 1969: Das Makrozoobenthos der südlichen Beltsee (Mecklenburger Bucht und angrenzende Seegebiete). — Beitr. Meeresk. 26:21–46.

Segerstråle, S. G. 1982: The immigration of glacial relicts into Northern Europe in the light of recent geological research. — Fennica 160(2):303–312.

Stephensen, K. 1929: Amphipoda. — Tierwelt Nord- und Ostsee, Xf. 188 pp.

Thienemann, A. 1950: Verbreitungsgeschichte der Süßwassertierwelt Europas. — Binnengewässer 18:1–809.

Weigelt, M. 1985: Auswirkungen des Sauerstoffmangels 1981 auf Makrozoobenthos und Bodenfische in der Kieler Bucht. — Ber. Inst. Meeresk. 138:1–122.

Weigelt, M. & Rumohr, H. 1986: Effects of wide-range oxygen depletion on benthic fauna and demersal fish in Kiel Bay 1981–1983. — Meeresforsch. 31:124–136.