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Recent distribution of glacial relict Malacostraca in the lakes of Mecklenburg

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The recent distribution of *Mysis relicta*, *Pallasea quadrispinosa* and *Pontoporeia affinis* have been investigated and compared with distribution data from the 1920s. *P. affinis* has not been found recently. *M. relicta* occurs frequently in only one lake, while at two other sites its presence is now questionable. Only *P. quadrispinosa* exhibits a distribution similar to that which it had 60 years ago, but its frequency is decreasing. The decrease in the range of all these species is caused by a decrease in the oxygen concentration in the profundal of the lakes following increasing eutrophication.

1. Introduction

Glacial relict Malacostraca have been investigated in the deeper lakes of Mecklenburg (Samter 1905, Thienemann 1926, 1928, Lundbeck 1926). The species arose there during the period of the "Pommersches Stadium" of the Weichselian glaciation about 10 000 years ago. In eight Mecklenburg lakes Weltner & Samter and Thienemann found the following species: *Mysis relicta* Lovén, 1862, in 5 lakes, *Pontoporeia affinis* Lindström, 1855, in 2 lakes and *Pallasea quadrispinosa* Sars, 1867, in 5 lakes. The recent distribution is given in Table 1 and illustrated in Fig. 1.

The results of our investigations between 1985 and 1987 of the occurrence of these glacial relicts are presented in this paper. Small triangular and rectangular dredges, gut analyses of *Coregonus albula*, and the observations of divers have been used to establish the recent distribution.

2. The distribution of glacial relict Malacostraca and data on their biology

2.1. *Mysis relicta*

This species is frequent in two lakes near Feldberg (Breiter Luzin, Carwitzer See/Zansen) and has recently been found in Unteruckersee and Lake Tollense. However, we were unable to find it there. Specimens caught there in 1986 were frequent in very shallow water; the population consists exclusively of egg-bearing females. We

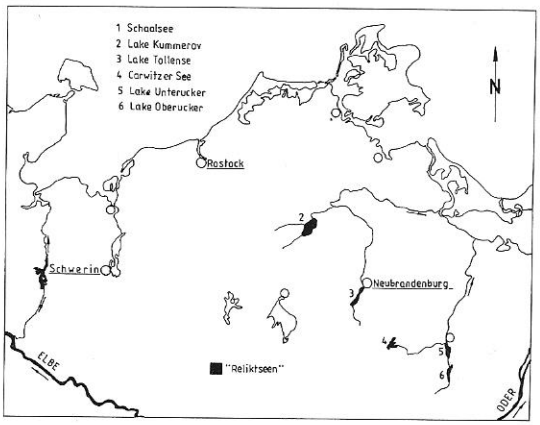

Fig. 1. Lakes of Mecklenburg. Relict lakes black.

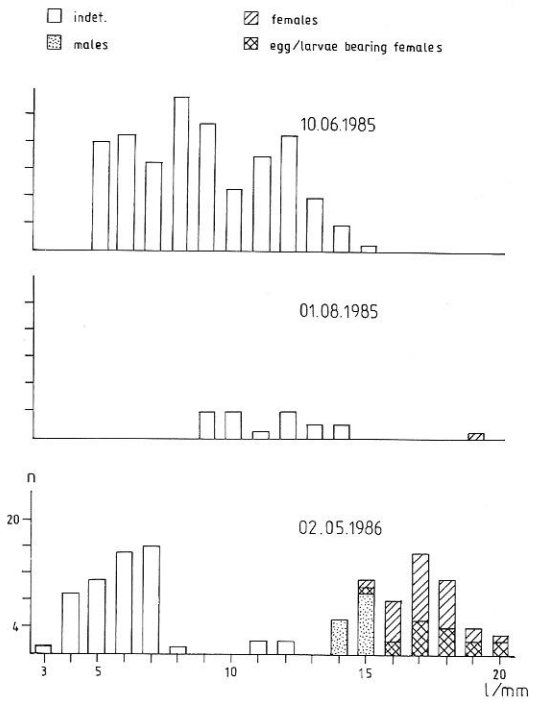

Fig. 2. Population structures of *Mysis relicta* from Breiter Luzin.

suggest that these observations point to unsuitable conditions in deeper water and the occurrence of the species in these two lakes is now uncertain. In addition, gut analyses show that *M. relicta* is not included in the prey of *Coregonus albula* in Lake Tollense.

All biological data are of Breiter Luzin origin.

Compared to Thienemann's (1928) findings, the distribution in 1985 was reduced, possibly due to eutrophication (input of phosphates) in the Hausseebucht. Domestic wastes from Feldberg were dumped in the Haussee until 1985. By 1987 this region had been repopulated by *M. relicta* (observations by divers). Divers in early June found that a high population density occurs at depths of 6–7 m at night and at 9–10 m during the day. The specimens exhibit a strong attachment to the sediment surface and a high frequency in dense swarms (30 specimens per 400 cm^2). In Lake Tollense it was observed in 1982 that *Mysis relicta* left deeper parts of the lakes during the summer stagnation. It could not, however, survive the higher temperature above the thermocline. Nowadays *Mysis* is lacking there.

The results of population studies from Breiter Luzin are given in Fig. 2. The release of larvae usually takes place from April to May; only 38% of all females have been detected as egg-bearing individuals. Spawning occurs in females larger than 14 mm. Juveniles grow throughout the year, attaining 15 mm in length by December. We suggest in comparison with the results of population studies and the length frequency in specimens preyed on by *Coregonus albula* that the number of larger specimens decreases throughout the year due to selective predation by fish. In addition, swarms containing juveniles occur in shallow waters, whereas adults are common in deeper waters. This may bring about a difference in the pattern of predation, as the shallow water breeding *C. a. albula* is a seasonal predator, while the deep water breeding *C. a. luciensis* is a permanent one. The life-span amounts to 18 months. The fertility of females can reach a maximum of 54 larvae per female although it is normally much lower (l≥17 mm, $\bar{x}$=16.5; l=15–17 mm, $\bar{x}$=9.3). Males are usually smaller than females (males: n=14, l=14.6±0.5 mm; females: n=43, l=17.4±1.2 mm), and are less frequent (25% of the whole population).

The gut contents of *M. relicta* in one May sample (Table 2) consisted of zooplankton (80%), phytoplankton (10%) and detritus (10%).

Table 1. The recent distribution of glacial relict Malacostraca in Mecklenburg lakes. + occurring, (+) uncertain, – lacking.

	Mysis relicta	*Pontoporeia affinis*	*Pallasea quadrispinosa*
Breiter Luzin	+	–	–
Schmaler Luzin	(+)	–	–
Carwitzer See/ Zansen	+	–	–
Lake Tollense	(+)	(+)	+
Lake Unterucker	(+)	(+)	+
Lake Oberucker	–	–	+
Lake Kummerov	–	(+)	+
Schaalsee	–	–	+

Table 2. The gut contents of *Mysis relicta* in Breiter Luzin (n=20, 02.05.86, adults).

Zooplankton (80% vol)
14 copepods (calanoids, cyclopoids), 8 *Bosmina* spp., 32 *Keratella quadrata*,1 *K. cochlearis*, 39 *Brachionus* spp.,1 ciliate

Phytoplankton (10% vol)
Cyclotella spp., *Stephanodiscus* spp., *Fragillaria* spp., *Oscillatoria* spp., *Gomphoshaeria* ?, *Aphanothecea* ?

Detritus (10% vol)

Table 3. *Mysis relicta* in the food of *Coregonus albula*.

	26.04.85	19.06.86	25.07.86	13.08.86	25.09.86
Guts with *Mysis*	41.4	–	36.8	52.3	50.0
Guts with other food	44.8	33.0	52.6	33.3	18.8
Guts with other food	13.8	66.0	10.5	14.3	31.2
Dominance of *Mysis* in guts	61.0	–	64.0	77.0	74.0

M. relicta is dominant in the food of *C. albula* in Breiter Luzin (52–77%), preyed upon by preference in the early morning. The annual yield of *C. albula* in Breiter Luzin attains 5 000 kg (Table 3). Using a food quotient of 2.0 the annual production of *M. relicta* has been calculated as 6 000 kg. This calculation shows the importance of *M. relicta* in this lake.

2.2. *Pontoporeia affinis*

We were unable to find any specimens in dredged samples and in the guts of fish. The species has died out during the last 60 years due to oxygen depletion in the near bottom water as a consequence of eutrophication (cf. Thienemann 1926, Waterstraat & Köhn 1989).

2.3. *Pallasea quadrispinosa*

This amphipod exhibits nearly the same distribution as that recorded by Thienemann (1928). Its frequency is, however, decreasing and its presence is restricted to a narrower depth and site range than earlier (cf. Thienemann 1926 and Lundbeck 1926). Recently it has not been observed in the deepest parts of the lakes (except Lake Kummerow) during the summer (Table 4).

Table 4. Depths of occurrence of *Pallasea quadrispinosa* in Mecklenburg lakes.

	Depth of occurrence	Maximum depth of lake
Lake Tollense	12–25 m	35 m
Lake Kummerow	0–18 m	18 m
Lake Unterucker	8–11 m	18 m
Lake Oberucker	2–10 m	?
Lake Schaal	10–20 m	72 m

The results of population studies point to a larval release twice each season (November to May). It is uncertain, however, whether one female can reproduce itself once or twice a season.

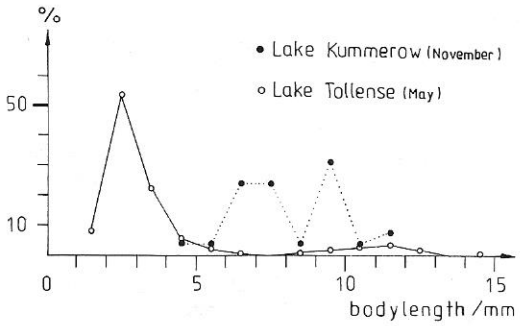

Fig. 3. Population structures of *Pallasea quadrispinosa* at two different sites and times.

Perhaps juveniles of the first generation begin reproduction in November and individuals of the second generation later on. This is a possible explanation for the long reproduction period. Reproduction does not occur in summer, contrary to Thienemann's findings. Growth per month reaches 1 mm on average (results in Fig. 3).

3. Discussion

The recent distribution of the glacial relict Malacostraca reflects the situation in the hypolimnion and profundal in Mecklenburg lakes (Table 1 and 4). It is possible that *P. quadrispinosa* will die out in Schaalsee, Unter- and Oberuckersee. Eutrophication has been observed in all these lakes, and has been particularly closely investigated in the lakes near Feldberg (Koschel 1985). The hypolimnion of the lakes is free of dissolved oxygen in late summer (except in Breiter Luzin). A decrease in phosphate input is expected after 1995 when the accumulated phosphate resources of the Haussee are reduced. This will occur as a consequence of the protective measures introduced for the lakes around Feldberg and will be of importance first of all for the lakes Breiter und Schmaler Luzin and for Lake Carwitzer/Zansen.

Glacial relict fish exhibit a similar distribution and history of dissemination in Mecklenburg lakes to the glacial relict Malacostraca (Thienemann 1950, Segerstråle 1982). The occurrence of glacial relict fish where the populations are autochthonous points to the incidence of glacial relict Malacostraca, and repopulation of lakes by fish and Malacostraca is perhaps possible in the same manner. A programme to protect the lakes of Feldberg has been adopted and its implementation begun; discussions on protecting Lake Tollense and Lake Kummerow have also been instigated. The lakes should become oligotrophic or β-mesotrophic in the future. We assume that we will be able to repopulate these lakes with glacial relicts. These attempts will be of interest in relation to securing the food resources of *Coregonus albula* and possibly also of *Cottus gobio* and *C. poecilopus*, as well as to providing a reliable indicator of changes in environmental conditions.

References

Koschel, R. 1985: Das Feldberger Seengebiet. — Natur und Umwelt im Bezirk Neubrandenburg 3:1–96.

Lundbeck, J. 1926: Die Bedentierwelt norddeutscher Seen. — Arch. Hydrobiol., suppl. 7:1–473.

Samter, M. 1905: Die geographische Verbreitung von Mysis relicta, Pallasea quadrispinosa, Pontoporeia affinis in Deutschland als Erklärungsversuch ihrer Herkunft. — Berlin: 1–33.

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

Thienemann, A. 1926: Pontoporeia affinis und Pallasea quadrispinosa in den norddeutschen Seen. — Naturwiss. 14:50–51.

— 1928: Die Reliktenkrebse Mysis relicta, Pontoporeia affinis, Pallasea quadrispinosa und die von ihnen bewohnten norddeutschen Seen. — Arch. Hydrobiol. 19:521–582.

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

Waterstraat, A. & Köhn, J. 1989: Ein Beitrag zur Fauna des Kummerower Sees, Erstnachweis des Amphipoden Echinogammarus ischnus Stebbing, 1899, in der DDR. — Arch. Freunde Naturg. Mecklb. 29:93–106.