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Past and recent occurrence of Malacostraca glacial relicts in Polish lakes

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Malacostracan glacial relict species have been found in a total of 48 Polish lakes. All these lakes were inhabited by *Pallasea quadrispinosa* Sars, seven of them by *Mysis relicta* Loven, and two by *Pontoporeia affinis* Lindström. At present, because of pollution of the water, the number of lakes inhabited by the first two species has decreased significantly, while *P. affinis* Lindström has completely disappeared from Poland. In the western part of Poland, which has the highest degree of air pollution, two cases of the vanishing of some of the above species have been observed in recent years, i.e. during the 1980s.

1. Introduction

The occurrence of the three malacostracan glacial relicts, *Pallasea quadrispinosa* Sars, *Pontoporeia affinis* Lindström and *Mysis relicta* Loven was investigated in 77 Polish lakes in the years 1980–1989. Based on earlier investigations by Samter (1905), Demel (1923), Lundbeck (1926), Thienemann (1928), Segerstråle (1957), Mikulski (1965) and Wilga (1984) a list of 38 Polish lakes in which these species occur can be compiled. Of these, 32 have so far been revisited by the author, and the results of these investigations throw some additional light on the present and past degree of transparency of deeper Polish lakes.

2. Lakes studied, material and methods

The study was carried out in 77 Polish lakes located in the northern part of the country in the area once reached by the maximum Pleistocene glaciation (Fig. 1). The maximum depths of these lakes ranged between 22 and 109 m and their areas varied from 20 to 11 340 ha. The investigations were made in summer, mainly in July/August in the years 1980–1981 and 1987–1989.

The material was collected by the author by means of dredges, mainly the equilateral triangular model with an edge length of 30 cm, and in the last year of the study with a rectangular dredge of dimensions 30×50 cm. Additionally the material

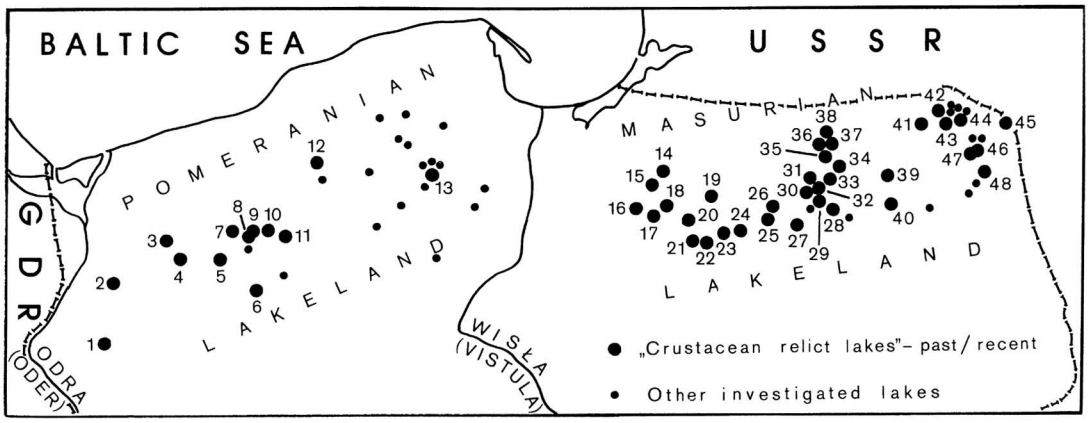

Fig. 1. Location of the Polish lakes in Table 1.

collected by Risto Väinölä in 1987 (with a beam trawl having an inlet width of 80 cm) was included. In all cases the mesh size employed was 1 mm.

3. Results and discussion

Only two species of Malacostraca relicts, i.e. *P. quadrispinosa* Sars and *M. relicta* Loven, are found in Polish lakes at present. Increasing contamination of the water has resulted in the total disappearance of the third species *P. affinis*, which in the 1920s inhabited, in large quantities, the profundal of Lake Miedwie in the Pomeranian Lakeland, and which in the 1950s was also found (Prof. Dr. Z. Kajak, pers. comm.) in Lake Piłakno in the Masurian Lakeland (Table 1). Investigations in other Polish lakes have so far not resulted in the discovery of *P. affinis*.

The historical data show that *P. quadrispinosa* once inhabited 38 Polish lakes, and the present author's investigations revealed another 10 localities (Table 1). Thus, this species was once found in a total of 48 Polish lakes. However, the present investigations revealed that *P. quadrispinosa* is no longer present in at least 13 of the "historical lakes". These are lakes mainly situated near the suburbs of towns and cities, and have been strongly polluted by municipal wastes.

In the 1920s *M. relicta* was observed in 7 lakes (Lundbeck 1926, Thienemann 1928, Willer 1928)

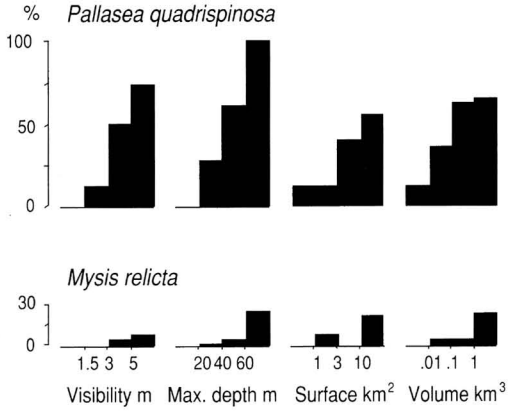

Fig. 2. Frequency of occurrence of relict crustacea in Polish lakes with differing Secchi disk visibility, maximum depth, surface area, and volume.

while it now inhabits only three lakes. It is interesting to note that in 1980 a relatively small population of this species was still observed in a fourth Polish lake. There is also a well documented case of the steady disappearance of *P. quadrispinosa* from another lake during the 1980s. It is noteworthy that these two cases of very recent disappearances of relict species concern lakes situated in the western part of the Pomeranian Lakeland, i.e. in northern Poland with its heavily polluted air (Godzik 1984).

Table 1. Past (p) and recent records (r) of the postglacial crustacean relicts *Pallasea quadrispinosa, Pontoporeia affinis* and *Mysis relicta* in Polish lakes; ? = to be checked in the early 1990s; common occurrence italicized (within brackets German names of lakes known as "glacial relict lakes" by Thienemann, Willer and Schellenberg). Numbers refer to Fig. 1.

Lake	Area ha	Max. depth m	*P.q.*	*P.a.*	*M.r.*
1 Myśliborskie (Soldiner See)	618	22	p		
2 Miedwie (Madü See)	3527	44	*p**	*p*	*p*
3 Woświn	811	28	p		
4 Ińsko (Enzig See)	487	42	p r		
5 Lubie (Gross Lübbe See)	1439	46	*p* r		p*
6 Betyń	877	41	p r		
7 Siecino	730	44	r		
8 Drawsko (Dratzig See)	1866	80	*p r*		*p r*
9 Żerdno (Sareben See)	205	36	*p r*		p *r*
10 Komorze	417	35	r		
11 Pile (Gross Pielburger See)	980	44	p r		
12 Bobęcimskie Wielkie (Papenzin See)	525	48	p		
13 Wdzydze Południowe	1456	68	*r*		
14 Wukśniki (Wuchsnig See)	117	68	p ?		
15 Narie (Narien See)	1240	44	p ?		
16 Ilińskie (Eiling See)	234	27	p ?		
17 Szeląg Wielki (Gross Schilling)	599	36	p ?		
18 Isąg (Eissin See)	396	55	p *r*		
19 Wadąg	495	35	p		
20 Wulpińskie	707	55	p r		
21 Pluszne (Gross Plautziger See)	903	52	p *r*		
22 Lańskie (Lansker See)	1042	53	p r		
23 Kośno (Kosno See)	552	45	p r		
24 Leleskie (Lehlensker See)	424	50	p *r*		
25 Babięty Wielkie	250	65	*r*		
26 Piłakno	259	57	p r	p	
27 Mokre (Mucker See)	841	51	p ?		
28 Śniardwy	11340	23	p ?		
29 Mikołajskie	498	26	p		
30 Tałty (Talter Gewässer See)	1831	51	p r		
31 Ryńskie			p		
32 Tałtowisko (Klein Talter See)	327	40	p		p
33 Jagodne	943	37	p		
34 Niegocin	2600	40	p		
35 Kisajno	1896	24	p		
36 Dobskie	1776	22	p		
37 Dargin (Dargainen See)	3030	38	p r		p ?
38 Mamry Północne (Mauer See)	2504	44	*p r*		*p r*
39 Łaśmiady	882	44	r		
40 Ełckie (Lyck See)	382	56	p		
41 Rospuda	342	39	*r*		
42 Hańcza	311	109	*p r*		
43 Szurpiły	81	47	r		
44 Szelment Wielki	356	45	r		
45 Gaładuś	729	55	*r*		
46 Wigry	2118	73	*p* r		
47 Białe Wigierskie	100	34	p *r*		
48 Serwy	460	42	r		

*Vanished during the 1980s.

Both species clearly prefer lakes with the highest transparency values, that is, lakes with the greatest maximum depth, the largest surface area and in consequence the greatest water volume (Fig. 2). The minimum Secchi disc visibility at which *P. quadrispinosa* was observed was 2.5 m, while it was 4.0 m for *M. relicta*. Similarly, the lowest values for the maximum depth are 34 and 36 m, for the surface area 81 and 205 ha, and for water volume 0.008 and 0.03 km^3, respectively.

In Finland, both species are known to occur also in significantly shallower lakes and are absent only from those with a maximum depth of less than 10 m (Särkkä, after Sushchenya et al. 1986). In Finland, as in Poland, the frequency of occurrence of these species increases with the maximum depth of the lake. In Finland *P. quadrispinosa* occurs in all lakes deeper than than 40 m, while *M. relicta* inhabits all lakes with a depth over 60 m. This occurrence limit is higher in Poland where *Pallasea* inhabits all lakes deeper than 60 m, and *M. relicta* is present in only one of the six lakes in this deepest class (Fig. 2).

In all the Polish lakes investigated, *M. relicta* inhabits practically the entire profundal. In the cleanest lakes *P. quadrispinosa* is distributed from the deepest parts up to the lower littoral. As the environmental conditions get worse in deep waters, *P. quadrispinosa* gradually withdraws from the deeper parts, finally inhabiting only the sublittoral and lower parts of the littoral.

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