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ANDRZEJ KOWNACKI, and MARTA KOWNACKA

THE BOTTOM FAUNA OF THE LAKES MORSKIE OKO AND WIELKI STAW IN THE POLISH TATRA MOUNTAINS

The present investigations were concerned with the bottom fauna of the two largest Tatra lakes: the Morskie Oko, and the Wielki Staw.

The Morskie Oko lying near the upper timber line in the Valley of the Rybi Potok, in spite of its being situated at an altitude of only 1392·8 m., is reckoned among high-mountain lakes. With an area of 34·928 ha., the lake is 862 m. long and 568 m. wide. The length of its shore-line amounts to 2509 m. It has a maximum depth of 50·8 m., the mean depth being 28·4 m.; its capacity is 9,935,000 m.^{3} (Wit-Ziemońska 1962). It is a typical morainic lake. The bottom near the shore is covered with big boulders among which lie stones. At a depth of 10 m. it becomes covered with slime mixed with small stones and sand. At 50 m. the slime forms a thick layer containing numerous plant remains (needles of coniferous trees, pieces of wood, remains of stalks and roots), and in a somewhat smaller amount remnants of insects (elytra of *Coleoptera*, head capsules of *Tendipedidae*).

The Wielki Staw, lying in the Valley of the Five Polish Lakes in the mountain-pine zone at an altitude of 1664·6 m., is the deepest Tatra lake (maximum depth 79·3 m., mean depth 37·7 m.). With an area of 34·352 ha., the lake is 998 m. long and 508 m. wide. Its shore-line is 2492 m. long and its capacity 12,967,000 m.^{3}. The bottom near the shore is covered with boulders and stones, and further on with slime whose thickness increases with depth. At smaller depths gravel and sand prevail in the slime. Head capsules of *Tendipedidae* and some ephipia of *Daphnia* are found here, while at a greater depth plant remains, ephipia of *Daphnia*, remnants of insects and tubules of *Chironomidae* increase in number. At a depth of 80 m. *Daphnia* eggs and ephipia are very numerous.

Bottom sampling in the Tatra lakes encounters many difficulties; the stony bottom makes it impossible to take samples to the depth of 10 m. without the use of a diving suit. Up 20 m. the slime still contains a very large amount of stones which often prevent the sampler from closing.

A sampler of the Birge-Eckman type was used in these investigations. The samples were preserved with 4 per cent formalin. Sampling in the Wielki Staw was carried out from two linked up dinghys and in the Morskie Oko from a wooden boat lent for this purpose by the manager of the Shelter-house. Samples from the inshore zone of the Morskie Oko (from depths of 1, 3, and 8 m.) were taken by a diver. The material from the Wielki Staw was collected on 22. III., 19. VI., and 13. VII. 1963, and on 5. VII., and 23. VII. 1964, from the Morskie Oko on the 12. IX. 1962, and on 20. VI., 12. VII., and 12. IX. 1963.

SYSTEMATIC OBSERVATIONS

The systematic list of species found in the Morskie Oko and Wielki Staw is assembled in Table I. Representatives of 42 species were encountered in these lakes. *Oligochaeta, Nematoda, Ostracoda, Colembola,* and *Acarina* were determined only as to order.

Cnidaria

Hydra rubra Lewes. 18 individuals were found in the Morskie Oko near the shore at a depth of 1—8 m. They were determined from the colour of the body. This species is reported by Minkiewicz (1914) from the Tatra Mts from the inshore zone of the Morskie Oko, of the Czarny Staw below Rysy, and of the Wielki and Przedni Staw in the Valley of the Five Polish Lakes; Hrabé (1942) reports it from the Górny Ciemnosmreczyński Staw Lake.

Turbellaria

Planaria alpina Dana. 16 individuals were found in the Wielki Staw near to the shore. This is a very common species in the cold Tatra lakes and streams (Minkiewicz 1914, Hrabé 1942, Gieysztor 1962, Dudziak 1952, Obr 1955).

Other species of this phylum could not be determined on account of the method of preservation applied in these investigations.

Mollusca

Ancylus fluviatilis Müll. 17 individuals were found on stones of the inshore zone of the Morskie Oko at a depth of 1—8 m., and 1 individual in the Wielki Staw near the shore. It is reported by Minkiewicz (1914) from the Morskie Oko and by Obr (1955) from stones in the outflow of the lake Dolne Rohackie (alt. 1550 m.). This species is more common in the lower lying sections of streams (Urbański 1963).

Pisidium sp. Single individuals were found in the inshore zone of the Morskie Oko and Wielki Staw.

Ephemeroptera

Amelatus inopinatus Eaton. Large numbers of larvae were caught in the Wielki Staw on stones near the shore at the beginning of July 1963 and 1964. Most of them were at the stage before metamorphosis. Close to the shore and on the surface of water imagos and subimagos were caught at the same time. This species is reported by Hrabé (1942) from the Zielony Staw below Krywań and from the Ciemnosmreczyński Staw, by Kamler (1930) from the Czarny Staw below Rysy, from lakes of the Valley of the Five Polish Lakes and from the Valley Gąsienicowa, and from streams.

Ecdyonurus (Heptagenia) lateralis Curt. 1 large larva was caught in the Wielki Staw on stones near the shore on 5th July 1964. Hitherto, this species has not been reported from the Polish Tatra Mts. Zelinka (1953) found one larva in the Biely Váh at an altitude of 800 m.

Plecoptera

Nemoura cinerea Retz. Adult larvae of this species were fairly frequently found in the Wielki Staw in July 1964 on stones of the inshore zone. At the same time a male individual was caught close to the shore. This is a species common in streams and lakes. Reported from the Tatra by Hrabé (1942), Winkler (1957), Kamler (1964), and Wojtas (1964).

Megaloptera

Sialis flavilaterata L. 3 large larvae were found in March 1963 in the Wielki Staw at a depth of 7 and 17 m., and a small larva in September 1963 on stones in the Morskie Oko. Hrabé (1942) reports this species from the Szczrbskie Pleso, and Obr (1955) from lakes of the Western Tatra at an altitude of 1550—1650 m.

Trichoptera

Polycentropinae. 4 very small larvae were caught in the inshore zone of the Morskie Oko. They could not be determined more exactly.

Sericostomatidae. 1 small larva was found on stones in the Morskie Oko at a depth of 8 m.

Apatania sp. Larvae were frequently found in July in the Wielki Staw on stones near to the shore.

Limnophilidae. They were fairly frequently found on stones of the inshore zone of the Wielki Staw.

Tendipedidae.

Procladius Scuze. Larvae were found in great numbers throughout the year in the slime of the Wielki Staw at a depth of 7·5 to 80 m. On the other hand, they were not encountered on stones of the inshore zone. In the Morskie Oko they only appeared on stones at a depth of 8 m. and in slime at a depth of 10 m. This is the most common midge in the Tatra lakes (Zavřel 1935, and Hrabé 1942).

Anatopynia sp. 11 larvae were caught in March in the slime of the Wielki Staw at a depth of 7·5 and 17 m., and in September on stones of the inshore zone of the Morskie Oko at a depth of 1—5 m. They differ from *Procladius* larvae in the yellow colouring of teeth, glossa, and mandible, and by a bicuspid paraglossa.

Ablabesmyia tetrasticta Kieff. 2 larvae were found near the shore of the Morskie Oko in September.

Ablabesmyia ex gr. *monilis* (L.). 5 larvae were found in the Morskie Oko at the depth 10 m.

Simultaneously, young larvae of the genus *Ablabesmyia* were encountered, but unfortunately they could not be determined as to species.

Corynoneura ex gr. *scutellata* Winn. Larvae frequently occurring in July on stones near the shore of the Wielki Staw. 1 specimens was found in slime at a depth of 20 m. They also occur in the Wyżnie Mnichowe Stawki (Kownacki, Kownacka 1965).

Prodiamesa olivacea Meig. 1 individual was found in the Morskie Oko on stones near the shore. They are numerous in lakes of the Tatra foot-hills, occurring singly in the higher lying water basins (Zavřel 1935, Hrabé 1942).

Heterotrissocladius marcidus Walk. 4 larvae were found on stones of the inshore zone of the Morskie Oko to a depth of 8 m. and 1 specimen in the Wielki Staw at a depth of 7 m. This is one of the most common species in the Tatra Mts (Zavřel 1935, Hrabé 1942); Gliwicz (1963) reports it as the only representative of *Tendipedidae* in the Zielony Staw Gąsienicowy.

Synorthocladius semivirens Kieff. 12 larvae and 2 pupae were caught in July in the inshore zone of the Wielki Staw on stones covered with algae. This is a species very common in mountain streams and submontane rivers.

Psectrocladius ex gr. *psilopterus* Kieff. Numerous larvae were found in the Morskie Oko near the shore to the depth of 8 m., and one at a depth of 50 m. In the

Wielki Staw they were found on stones near the shore and in slime at a depth of 20 m. In the Tatra Mts this species often occurs in the lakes of the Tatra foot-hills, being less frequently encountered in the higher lying water reservoirs (Zavřel 1935, Hrabé 1942).

Most of the larvae belonging to the genera *Trichocladius*, *Eucricotopus*, and *Rheorthocladius* cannot be distinguished from one another and so far they have not been fully investigated (Henning 1948). Thienemann (1944) discriminates among these genera several species, classing the remainder into large groups of species. In the material examined in the present investigations 4 species belonging to the group *silvestris* were distinguished:

Eucricotopus group *silvestris* I — greenish with a yellow head, bunches of bristles on segments IV—IX, shorter by half than the segment. Brown procerci with four or six bristles. The mandible and labium are dark brown, the middle tooth of the labium is somewhat lighter and broader than the lateral ones, of the type "saxicola". 3 mm. long.

Eucricotopus group *silvestris* II — greenish, 3 mm. long, dark head. From segment IV to X long bunches of bristles, longer than the segment.

Eucricotopus group *silvestris* III — greenish, with a dark head. Labium and mandibles of the type "bicinctus", on segments IV—X the bunches of bristles are formed of at least 20 bristles. The longest bristle is almost as long as the segment. 5 mm. long.

Eucricotopus group *silvestris* IV — green, 2·5 mm. long; brown head. Bunches of bristles from segment IV to IX, shorter by half than the segment. Labium of the type "saxicola".

All these species occurred in masses in July in the Wielki Staw on stones near the shore.

Microtendipes ex gr. *chloris* Meig. 4 larvae were found in the stony inshore zone of the Morskie Oko. Zavřel (1935), and Hrabé (1942) report this species from lakes of the Tatra foot-hills and of the mountain-pine zone.

Pentapedilum exsectum Kieff. 3 larvae were caught in the Morskie Oko on stones at a depth of 8 m.

Limnochironomus ex gr. *nervosus* Staeg. Numerous larvae often occur on stones and in slime in the inshore zone of the Morskie Oko up to a depth of 10 m.

Lauterbornia ex gr. *gracilenta* (Holmgr.). Larvae of this group were frequently found in the Wielki Staw in slime at a depth of 7 to 60 m. On the other hand, they were not encountered on stones near the shore. This is a typical inhabitant of large lakes of the alpine and mountain-pine zone (Zavřel 1940, Hrabé 1942).

Micropsectra ex gr. *praecox* (Meig). Larvae were frequently found on stones of the inshore zone of the Morskie Oko. 1 specimen was caught in the Wielki Staw in slime at a depth of 7 m. These larvae were frequently encountered in the river Białka and in its Tatra tributaries (Kownacki, Kownacka 1965).

Tanytarsus lobatifrons Kieff. 2 larvae of this species were found in the Wielki Staw in slime at a depth of 20 m.

Tanytarsus ex gr. *gregarius* Kieff. Single larvae were found in the inshore zone of the Morskie Oko and in the Wielki Staw in slime at a depth of 17 m. These larvae were frequently encountered in the Tatra waters (Zavřel 1935, Hrabé 1942).

Tanytarsus ex gr. *lauterborni* Kieff. 1 larva was caught in the Morskie Oko on stones at a depth of 3 m.

Very young *Tanytarsini* larvae were found both in the inshore zone of the Morskie Oko and in slime in the Wielki Staw, but unfortunately they could be not determined.

THE VERTICAL DISTRIBUTION OF ANIMALS

The vertical distribution of the investigated fauna varies according to the depth (Table I).

In the Wielki Staw the fauna richest in number of individuals and variety of species is that living on stones near to the shore. *Planaria alpina*, *Ancylus fluviatilis* and *Trichoptera* larvae were found here. Among *Tendipedidae*, *Orthocladinae* larvae are the dominant form. In layers of slime with sand lying among stones at a depth

Table I

Composition of the bottom fauna of the lakes Morskie Oko and Wielki Staw

Lake	Morskie Oko			Wielki Staw				
Substrat	stones		slime	stones	slime			
Depth (m)	1 - 3	8-10	51	1	7,5	17-25	30-60	80
Hydra rubra	x	x						
Planaria alpina				x				
Oligochaeta	x	x	x	x	x	x	x	x
Nematodes	x	x	x	x	x	x	x	x
Ancylus fluviatilis	x	x		x				
Pisidium sp.	x				x			
Colembola				x				
Amelatus inopinatus				x				
Ecdyonurus (Heptagenia) lateralis				x				
Nemura cinerea				x				
Sialis flavilaterata	x				x	x		
Polycentropinae	x	x						
Apatania sp.				x				
Limnophilidae				x	x			
Sericostomatidae		x						
Procladius sp.		x			x	x	x	x
Anatopynia sp.	x				x	x		
Ablabesmyia tetrasticta	x							
- gr. monilis		x						
- sp. (small)	x	x						
Corynoneura gr. scutellata				x		x		
Prodiamesa olivacea	x							
Heterotrissocladius marcidus	x	x			x			
Synorthocladius semivirens				x				
Psectrocladius gr. psilopterus	x	x	x	x		x		
Eucricotopus gr. silvestris I				x				
- - II				x				
- - III				x				
- - IV				x				
Microtendipes gr. chloris	x							
Pentapedilum exsectum		x						
Limnochironomus gr. nervosus	x	x						
Lauterbornia gr. gracilenta					x	x	x	
Micropsectra gr. praecox	x				x			
Tanytarsus lobatifrons						x		
- gr. gregarius	x					x		
- gr. lauterborni	x							
Tanytarsini (small)	x	x		x				
Coleoptera				x				

of 7·5 m. the number of species is much smaller than on the stones of the inshore zone. No representatives of *Turbellaria* and *Mollusca*, or *Ephemeroptera* and *Plecoptera* larvae were caught, nor were many of the numerous *Orthocladinae* larvae. On the other hand, *Procladius* and *Lauterbornia* gr. *gracilenta* larvae, representatives of bottom slime, were encountered here for the first time. At a depth of 17 to 25 m. the number of species decreases to about 10. Apart from *Tanytarsus lobatifrons* and *Tanytarsus* gr. *gregarius* larvae, found only at this depth, there occur species encountered in the shallower parts of the basin, such as *Sialis flavilaterata*, *Anatopynia* sp., and *Corynoneura* gr. *scutellata*. At a depth of 30—60 m. the only forms encountered were *Oligochaeta*, as well as *Procladius* and *Lauterbornia* gr. *gracilenta* larvae. At a depth of 80 m. the number of individuals and species is greatly reduced. Of the 6 samples collected from this depth only in 2 were single *Procladius* larvae, and in 1 were *Oligochaeta* found.

In the Morskie Oko the greatest numbers of animals and species are also to be found on stones near the shore, whereas in slime at a depth of 50 m. bottom fauna is lacking almost entirely. Only single specimens of *Oligochaeta* and one *Psectrocladius* gr. *psilopterus* larva were found here.

In spite of some similarities in the vertical distribution, the composition of bottom fauna in the Morskie Oko differs from that of the Wielki Staw. In the Morskie Oko *Procladius* larvae were very rarely encountered, *Lauterbornia* gr. *gracilenta* not being found at all. On stones near the shore *Tendipedini* larvae prevailed in this lake but were not observed in the Wielki Staw, while *Orthocladinae* were chiefly represented by *Psectrocladius* gr. *psilopterus*.

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Authors' address:

Mgr Marta Kownacka and Mgr Andrzej Kownacki
Zakład Biologii Wód, Polska Akademia Nauk, Kraków, ul. Sławkowska 17.