

TADEUSZ KUFLIKOWSKI

Fauna naroślinna stawów karpowych w Goczalkowicach**Fauna in vegetation in carp ponds at Goczalkowice**

Wpłynęło 18 października 1969 r.

Abstract — Investigation on the fauna living in the vegetation of carp ponds at Goczalkowice were carried out in 1966. The aim of the work was to study qualitatively, and to some extent quantitatively, the fauna living in the vegetation and to show the similarities and dissimilarities between the pond fauna and that of the Goczalkowice dam reservoir. In the investigation the following plant species were taken into consideration: *Elodea canadensis*, *Polygonum amphibium*, *Glyceria aquatica*, *Phragmites communis*, and communities of heterogenous land and aquatic plants, especially the grasses forming submerged meadows.

The aim of the present work was to carry out a qualitative and quantitative investigations on the fauna living in the vegetation in the carp ponds at Goczalkowice and to compare it with that living in the vegetation in the dam reservoir at Goczalkowice.

The ponds at Goczalkowice are situated below the dam of the reservoir on the left bank of the river Vistula near the embankments. They are divided into two groups: the upper one named „Na Maćkach”, and the lower one called „Rontoki”. The investigations were carried out in the former group in which there were a small number of very large and deep ponds. Samples were taken from the ponds „Maciek Borowy” and „Maciek Wielki”, both of which were supplied with water directly from the reservoir. The large superficies of these ponds is covered with vascular vegetation. The chemical properties of the water and the soil in the ponds was investigated by Pasternak (1959, 1968).

The two environments have some similar characteristics, such as the depth (the shallow parts of the reservoir, where the depth does not exceed 2 m., cover a very large area), the species composition of the vegetation, and some chemical properties of the water (pH and alkalinity).

Basic difference is constituted by the periodical flooding and draining of the ponds as well as the different temperature of the water and the considerable undulation in the reservoir. The temperature of the water, noted when the samples were taken, was always 3°—6°C higher in the ponds. The water in the reservoir undulates very frequently and strongly, the waves often reaching a height of 1 m. or even, when a strong west and south-west wind is blowing 2 m.

Material and methods

The material for the investigations on fauna in the vegetation of the ponds and the reservoir was collected in 1966 from June to September, at approximately monthly intervals, i. e. from the beginning of the vegetation of the plant studied up to its conclusion, as at the end of September the plants began to decay rapidly. The investigation covered the plant species dominant in ponds, soft submersed as well as hard emergent flora, and included the species *Elodea canadensis*, *Polygonum amphibium*, *Glyceria aquatica*, *Phragmites communis* as well as communities of other land and aquatic plants, especially those of grasses and rushes forming submerged meadows.

Those investigating fauna in vegetation applied various, all of which, however, were far from perfect and to this day there are no common patterns for comparing fauna living upon particular plant species. A method often used was that of calculating the density of the population in proportion to the area of the bottom covered by the investigated plant. This method, however, is unsuitable for more exact investigations, as the number of plants on one square metre is not identical. Kreckler used an interesting method (Karassowska and Mikulski 1960). This was based upon the linear measurements of the plant investigated, assuming 10 feet as a unit. This method also was unsuitable for the present investigations, as the material was gathered from emergent plants as well as from undervater meadows. In Poland investigations on fauna in vegetation were carried out by Hilbricht (1953); this author took a handful as the (unit) sample. This method cannot be used for comparison as „a handful” may vary with each individual investigator. Moreover, the author classified the animals only into the larger systematic groups and treated them as ecological types. Starmach (1954) also emphasized the necessity of taking into account quantitative data based either on a unit of space overgrown with the plants or on the plant volume.

The present investigation was carried out by the volume method proposed by Starmach. In such places with the densest agglomeration of congeneric plants a bucket was gently lowered and, with a rapid horizontal movement, the plants were collected together with the

substratum and torn away sharply with the bucket, the plants being held down with the hand. After the animals had been separated, the volume of the plants was measured in a suitably graduated vessel. In the case of *Glyceria aquatica* and *Phragmites communis*, first the sprouts emerging from the water were cut off, and a few days later samples were taken in such a way that, in taking out the plants with the bucket, the sprouts were cut off with a knife. Taking samples of these plants was extremely difficult but they could not be omitted, as both species predominated in the ponds investigated. Of each plant species a single sample was taken. The animal material separated from the plants was fixed with 4 per cent formalin and worked out at the Hydrobiological Station at Goczalkowice.

The details of the work are presented in the sections dealing with particular plants and not in the order of animal groups. It seemed that such a presentation would be clearer to the reader interested in the usefulness of particular plant species for pond economy. For those interested in invertebrate fauna the discussion of animal groups presented in Table I is clearer.

Composition of fauna in vegetation

Elodea canadensis

Nematomorpha. The only representative of the class was *Gordius aquaticus* D u j., found on this plant only once. The species occurs fairly frequently in the bottom fauna of the reservoir.

Oligochaeta. Only two species were found, i.e., *Stylaria lacustris* (L.) and *Pristina longiseta* E h r e n b. Both species occurred in small numbers and their part in the total amount of the animals caught was insignificant.

Hirudinea were the most numerous animal group on this plant. The dominant species was *Herpobdella octooculata* (L.) considered by nearly all investigators as a very common leech. Also very numerous were *Helobdella stagnalis* (L.), *Piscicola geometra* (L.), and *Boreobdella verrucata* (F. M ü l l.) found with numerous progeny (up to 33 individuals). *Hemiclepsis marginaa* (O. F. M ü l l.) was a frequent component of the fauna in vegetation, though less numerous than the preceding species. *Glossiphonia complanata* L., which was most frequent on aquatic vegetation forming dense clumps, was also found in considerable quantities both in stagnant and in flowing waters. The remaining leech species: *Glossiphonia heteroclita* L., *G. heteroclita* f. *hyalina* (O. F. M ü l l.), and *G. heteroclita* f. *papillosa* (B r a u n) were rare and usually appeared singly, so that they did not play any important role in the leech fauna.

Isopoda. The only representative of the order was *Asellus aquaticus* R a c o v. It was found during the whole investigation period in very large

Tabela I. Skład jakościowy i ilościowy fauny narosłinniej (próbki z objętości 1 litra)
 Table I. Qualitative and quantitative composition of fauna in vegetation (samples from 1 litre of volume)

	Elodea canadensis		Polygonum amphibium		Glyceria aquatica		Phragmites communis		Zbiornisko innych roślin podmokłych community of other submerged plants	
	15.VI 9.VII 5.VIII 8.IX	15.VI 9.VII 5.VIII 8.IX	15.VI 9.VII 5.VIII 8.IX	16.VI 9.VII 5.VIII 8.IX	16.VI 9.VII 5.VIII 8.IX	16.VI 9.VII 5.VIII 8.IX	16.VI 9.VII 5.VIII 8.IX	15.VI 9.VII 5.VIII 8.IX	15.VI 9.VII 5.VIII 8.IX	15.VI 9.VII 5.VIII 8.IX
Spongiaria										
Ephydatia fluviatilis (L.)			4	5						
Cnidaria										
Hydra vulgaris Fall.			23	37						
Nematomorpha										
Gordius aquaticus Duj.	1	3	8	10	12	53	79	65		
Oligochaeta										
Chaetogaster diastrophus (Gruth.)			10	7	5	12	15	1	5	22
- langi Bertsch			8	10	9	5	13	1	6	1
- limnei Baer			2	6	1	8	4	4	6	2
- diaphanus (Gruth.)			4	2	3	13	6	2	3	10
Pristina longisetata Ehrenb.			5	4	1	9	10		5	4
Stylaria lacustris (L.)	2	3	9	12	8	53	68	41	17	24
Nais pseudoobtusa Fig.	4	7	156	188	105	252	284	196	30	71
- obtusa Gervais			16	12	6	9	2	6	15	3
Limnodrilus sp.			9	4	5	15	2	12	3	29
Hirudinea									4	6
Piscicola geometra (L.)	8	16	4	4	1	10	12	19	1	8
Hemiclepsis marginata (O.F.Müll.)	3	9	3	4	4	2	5	5	1	6
Boreobdella verrucata (F.Müll.)	1	15	9	7	2	4	2	2	1	3
Glossiphonia complanata L.	5	11	7	7	2	2	2	6	2	4
- heterocolita L.	4	9	5	5	3	3	3	1	2	2
- heterocolita fo. hyalina (O.F.Müll.)	2	3	7	2	2	2	3	1	1	6
- heterocolita fo. papillosa (Braun)	1	5	4	3	2	2	2	4	1	3
Helobdella stagnalis (L.)	13	14	24	5	3	8	2	4	3	7
Herpobdella octoculata (L.)	76	82	125	2	6	11	27	36	2	11
Isopoda										
Asellus aquaticus Racov.	50	36	65	61					6	11
Araeae										
Argyroneta aquatica L.	4	5	1	3					2	1
Acarina										
Mimesia maculata (O.F. Müll.)	2	4	7	2	4	3	3	5	5	11

<i>Limasia</i> sp.	2	1	1	4	4	5	3	2	2	4	6	9	7	4
<i>Uniconicola crassipes</i> (Müll.)	2	1	3	4	4	2	2	2	2	2	2	3	7	2
<i>Piona coccinea</i> Koch.	1	3	3	3	2	4	3	4	4	4	5	5	5	2
<i>Piona</i> sp.	1	2	5	5	2	2	3	2	2	2	1	5	5	7
<i>Arrenurus</i> sp.	4	9	7	2	1	8	4	2	2	2	5	21	36	18
Ephemeroptera	2	17	11	8	2	1	4	1	2	2	17	37	13	21
<i>Beetis rhodani</i> Pict.	4	2	2	10	2	1	2	5	5	3	7	17	22	6
- <i>pumilus</i> (Burm.)	2	2	3	6	8	13	5	5	1	1	6	14	23	17
<i>Cloeon dipterum</i> L.	2	3	7	5	11	8	15	5	5	2	2	7	3	8
<i>Ephemereilla ignita</i> (Poda)	4	9	13	4	7	13	6	6	2	1	10	28	15	25
<i>Caenis moesta</i> Bengt.														
- <i>maurura</i> Steph.														
Odonata														
<i>Ictes sponsa</i> (Hans.)	2	4	4	4	4	2	6	1	1	3	1	2	2	4
<i>Pistynemis pennipes</i> (Fall.)	1	7	2	2	2	5	1	2	2	2	9	7	3	5
<i>Agrion</i> sp.	33	69	84	54	2	4	3	5	3	3	3	3	13	5
Erythronema naias (Hans.)														
Coleoptera														
<i>Platambus maculatus</i> L.	1	2	3	4	2	4	2	5	3	2	3	7	1	5
<i>Helmis mangui</i> Bed.														
<i>Esolus</i> sp.	1	4	3	4	2	4	2	4	2	2	2	3	2	2
<i>Ilybius</i> sp.	3	5	5	2	2	2	1	1	1	2	3	4	4	3
<i>Halipilus</i> sp.														
<i>Rhantus</i> sp.														
<i>Berosus</i> sp.														
Megaloptera														
<i>Sialis flavilabera</i> (L.)	4	4	2	2	2	2	2	4	2	1	3	4	1	3
Trichoptera														
<i>Agraylea multipunctata</i> (L.)	6	4	4	4	23	15	42	22	2	4	2	5	4	3
<i>Ecnomus tenellus</i> Ramb.	2	2	8	8	4	2	8	11	2	3	3	4	2	3
<i>Polycentropus flavomaculatus</i> Fict.														
<i>Cynurus flavidus</i> Mc L.	1	13	7	14	5	2	4	6	3	2	4	7	11	3
<i>Phryganea bipunctata</i> Metz.	8	2	3	3	3	4	6	4	4	2	3	2	5	2
<i>Limnophilus</i> sp.	2	4	3	3	2	4	2	4	2	2	4	6	4	2
<i>Mystacides azurea</i> L.														
- <i>longicornis</i> L.														
<i>Trienodes bicolor</i> Curt.	3	5	8	11	4	3	5	3	3	1	4	3	1	9
<i>Leptocerus annulicornis</i> Steph.	4	8	11	7	2	3	2	4	2	1	2	5	3	4
<i>Oecetis ochracea</i> Curt.														
- <i>furva</i> Ramb.														

quantities on water-thyme, apart from which it was encountered only in the community of heterogenous submerged plants.

Arenae. Only one species, *Argyroneta aquatica* L., was encountered. It occurred in small numbers throughout the whole vegetation period. Apart from water-thyme it was found only on the plants forming submerged meadows.

Acarina occurred in small quantities throughout the investigation period. Quantitative differences between particular species were so slight that none could be said to be dominant. *Piona coccinea* Koch. were the most frequently found, other species of *Acarina* usually occurring singly.

Ephemeroptera were found in fairly considerable quantities. Here occurred species also appearing in the bottom fauna (Sowa 1961). The dominant species was *Baetis pumilus* (Burm) followed by *Caenis macrura* Steph. and *Baetis rhodani* Pict. The remaining species, namely *Ephemerella ignita* (Poda) and *Caenis moesta* Bengt., were less numerous.

Odonata. *Erythromma naidis* (Hans) predominated among the three species found. On water-thyme it was so numerous that the two remaining species, *Platycnemis pennipes* (Pall.) and *Agron* sp. constituted only 4 per cent of the whole amount. *Platycnemis pennipes* (Pall.) occurs also in rivers (Sowa 1961).

Coleoptera usually occurred singly and in most cases as adult forms. Most of them were found among the bottom fauna of ponds and rivers (Sowa 1961, Zaciwlichowska 1965) and some species, such as *Platambus maculatus* (L.), *Helmis maugeri* Bed., and *Esolus* sp., occur in mountain streams (Krzanoski, Fiedor, Kuflikowski 1965).

Trichoptera. Investigators of invertebrate fauna are agreed that this group of animals is characteristic of aquatic plant communities. *Trichoptera* larvae found on water-thyme were represented mainly by the large species such as *Phryganea bipunctata* Retz., *Leptocerus annulicornis* Steph., and *Triadenodes bicolor* Curt. *Agraylea multipunctata* Curt., found also in mountain streams, was the most numerous species among the small larvae. Other species were found more rarely. *Phryganea bipunctata* Retz is unknown in the area of the basin of the upper Vistula.

Lepidoptera. On this plant only two species of butterfly larvae were found: *Nymphula nymphaea* L. and *Paraponyx stratiotata* L. Water-thyme was the only plant where they were found in considerable quantities.

Chironomidae. With regard to the number of individuals they took fourth place after *Hirudinea*, *Gastropoda*, and *Ephemeroptera*, together with *Odonata*. Most numerous were the following species: *Endochironomus* ex grege *tendens* F., *Cricotopus* ex grege *sylvestris* (Fabr.), *Cryptochironomus* ex grege *pararostratus* Lentz, *Endochironomus* ex grege *dispar* Mg., and *Limnochironomus* ex grege *nervosus* Staeg. The most rarely found were *Psectrocladius* ex grege *dilatatus* v.d. Wulp., *Ablabesmyia* ex

grege *monilis* (L.), *Tanytarsus* ex grege *manicus* W alk, and *Psectrocladius* ex grege *psilopterus* Kieff..

Hemiptera. *Sigara* sp. and *Plea leachi* M c G r. et K i r k. were the only species found upon water-thyme. *Sigara* sp. was fairly frequent, but *Plea leachi* was found only once.

Gastropoda. The snail fauna in lakes and ponds with luxuriant aquatic and uliginose vegetation is usually rich and very varied. Water-thyme is particularly favourable for the development of this animal group, hence they were qualitatively and quantitatively very numerous. In quantity they were second only to leeches. *Anisus vortex* L., predominated. Among common and very numerous species *Aplexa hypnorum* L. and *Lymnea stagnalis* L. were encountered. *Viviparus viviparus* L., *Radix limosa* L., *Galba truncatula* Müll., *Physa fontinalis* L., *Segmentina nitida* Müll., and *Bathymophalus contortus* L. were also fairly numerous.

Polygonum amphibium

Spongiaria. Fresh-water sponges were represented by *Ephydatia fluviatilis* (L.) found only on this plant. A small number of colonies were seen only in August and September, although in the ponds investigated they often populated the roots and branches of trees and bushes.

Cnidaria. The only representative was *Hydra vulgaris* P all. found in large quantities especially at the end of the vegetation period on decaying plant leaves.

Oligochaeta constituted a very numerous group of animals second only to the *Chironomidae* larvae. The dominant species was *Stylaria lacustris* L., which constituted 30 per cent of the whole number of *Oligochaeta* found on this plant. *Nais pseudoobtusa* Pig., *Pristina longiseta* Ehrenb., and *Chaetogaster diastrophus* (Gruith.) were also found in large quantities. The remaining species were of no particular importance in the quantitative composition of the group.

Hirudinea. In comparison with the number of leeches on *Elodea canadensis* their number on *Polygonum amphibium* was insignificant. *Piscicola geometra* (L.) predominated, other species being found in much smaller numbers (Table I).

Acarina were usually found in small numbers or even singly. It seems probable that their number was much larger, but because of their exceptional mobility and shyness they were difficult to catch by the applied method of taking samples. The most numerous was *Limnesia maculata* (O. F. Müll.).

Ephemeroptera. The number of *Ephemeroptera* larvae was much larger than on *Elodea canadensis*. The most frequent and numerous species were *Caenis macrura* Steph., *C. moesta* Bengt., *Ephemerella ignita* (Poda), and *Cloeon dipterum* L.

Odonata were found only occasionally. Not a single species was seen in June.

Coleoptera. On aquatic plants beetles do not constitute a very large group of animals either quantitatively or qualitatively. In most cases they were found singly. On this plant *Platambus maculatus* L. occurred most often.

Trichoptera. The number of *Trichoptera* larvae and chrysalids was larger than on water-thyme. *Agraylea multipunctata* Curt. and *Polycentropus flavomaculatus* Pict. were the only two species to appear numerous.

Chironomidae constituted over 80 per cent of the total number of animals occurring on this plant, where they had evidently found excellent living conditions. *Cryptochironomus ex grege pararostratus* Lenz predominated, but *Cricotopus ex grege sylvestris* (Fabr.), *Cricotopus? versidentatus* Tsh., *Endochironomus ex grege tendens* F., and *Limnochironomus ex grege nervosus* Staeg. were also found in large numbers.

Hemiptera. The most numerous species, found throughout the investigation period was *Plea leachi* McGr. et Kirk. The total number of Hemiptera was larger on *Polygonum amphibium* than on water-thyme.

Gastropoda were very rarely found on this plant and usually singly. There were fewer species of snails than on water-thyme. The only fairly numerous species were *Lymnea stagnalis* L. and *Galba palustris* f. *turricula* Held.

Glyceria aquatica

Cnidaria. *Hydra vulgaris* Pall. occurred in masses. On none of the other investigated plants did it appear so numerous. It was found in the greatest numbers at the end of the vegetation of the plant.

Oligochaeta. The enormous quantities of *Oligochaeta* found on this plant demonstrated the excellent conditions for their development. The dominant species, which particularly effected the number of *Oligochaeta*, was *Stylaria lacustris* (L.), constituting over 40 per cent of the total. The large quantity of *Pristina longiseta* Ehrenb. is also worthy of mention.

Hirudinea. The quantity of leeches was much larger than on *Polygonum amphibium*, the most numerous species being *Herpobdella octoculata* (L.) and *Piscicola geometra* (L.). The remaining species were found in smaller quantities.

Ephemeroptera and *Odonata* were extremely rare and had no importance in the quantitative composition of fauna living upon this plant.

Coleoptera. The number of beetles was almost identical to that found on *Polygonum amphibium*. Adult individuals prevailed over larvae.

Trichoptera. All the species found occurred in very small numbers. In most cases they were encountered singly.

Chironomidae larvae constituted the most numerous group of animals on

this plant. *Cryptochironomus ex grege pararostratus* Lenz decidedly predominated over *Limnochironomus ex grege nervosus* Staeg., *Endochironomus ex grege dispar* Mg., and *Cricotopus ex grege sylvestris* (Fabr.). The most rarely found were *Psectrocladius ex grege psilopterus* Kieff., *Ablabesmyia ex grege monilis* L., and *Pelopia vilipennis* Kieff.

Gastropoda were very numerous on this plant, their number being inferior only to that of larvae of *Chironomidae* and *Oligochaeta*. The most numerous were *Lymnea stagnalis* L., *Galba truncatula* Müll., *Radix auricularia* L., and *Viviparus viviparus* L. The remaining species were much rarer and did not constitute a significant quantitative component of the snail fauna.

Phragmites communis

Oligochaeta occurred here very numerous though not in such large quantities as upon *Glyceria aquatica*. The species dominance was almost identical on the two plants except that *Nais obtusa* Gervais occurred in greater numbers on *Phragmites communis*.

Hirudinea. The number of leeches was only slightly smaller than on *Glyceria aquatica*. The species *Herpobdella octoculata* (L.), *Helobdella stagnalis* (L.), and *Piscicola geometra* (L.) were dominant.

Acarina, *Ephemeroptera*, *Coleoptera*, and *Trichoptera* were very few in number and encountered only occasionally, while *Isopoda*, *Aranae*, and *Odonata* did not appear at all.

Chironomidae also occurred in large quantities, though not so large as on *Polygonum amphibium* or *Glyceria aquatica*. The dominant species here was *Cryptochironomus ex grege pararostratus* Lenz over *Limnochironomus ex grege nervosus* Staeg. and *Cricotopus ex grege sylvestris* (Fabr.) while *Pelopia vilipennis* Kieff., *Psectrocladius ex grege psilopterus* Kieff., *Psectrocladius ex grege psilopterus* Kieff. and *Ablabesmyia ex grege monilis* (L.) were found very rarely.

The remaining groups of animals, i.e. the remaining *Diptera Hemiptera*, and *Gastropoda* occurred in small numbers. None of the species in these groups of animals could be quantitatively determined as the differences between them were so small.

Submerged plant community

Nematomorpha. *Gordius aquaticus* Duj. was more numerous here than on any of the investigated plants.

Oligochaeta occurred relatively numerously. *Stylaria lacustris* (L.) was distinctly dominant over other species. Considerable quantities of *Chaetogaster diastrophus* (Grith.) were also encountered.

Hirodinea were found only occasionally. Their number was so small that it may be assumed that they occurred here only by chance.

Acarina. On no plant were so many encountered as here. The dominant species was *Lymnesia maculata* (O. F. Müll.) followed by *Piona concinna* Koch.

Ephemeroptera. All of the species occurring on these plants were encountered in very large numbers. The most numerous species was *Baetis rhodani* Pict.

Odonata and *Coleoptera* were found in small quantities. Among *Odonata* the species *Erythromma najas* (Hans.) and among *Coleoptera* the species *Platambus maculatus* L. occurred slightly more numerously.

Trichoptera. In this plant community forming a submerged meadow they were fairly numerous. Nearly all of the species found on the investigated plants occurred. Most numerous was *Cyrmus flavidus* McL.

Chironomidae. The majority of *Chironomidae* larvae species were present in large quantities. The most numerous were *Cricotopus? versidentatus* Tsch., *Endochironomus ex grege dispar* Mg., *Cryptochironomus ex grege pararostratus* Lenz, *Cricotopus ex grege sylvestris* (Fabr.), and *Polydium ex grege nubeculosum* Mg. *Psectrocladius ex grege dilatatus* v.d. Wulp., *P. ex grege psilopterus* Kieff., and *Ablabesmyia ex grege monilis* (L.), however, were very rarely encountered.

Hemiptera. All of the species found here were very numerous. It should be stressed that on none of the plants investigated were such large numbers of *Hemiptera* found. There occurred adult individuals as well as larvae. *Sigara* sp. proved to be the most numerous.

Gastromopoda were found in small quantities, similarly as on *Polygonum amphibium*. Only *Bathynomphalus contortus* L. and *Segmentina nitida* Müll. were slightly more numerous. Except on *Elodea canadensis* these species were rather rare.

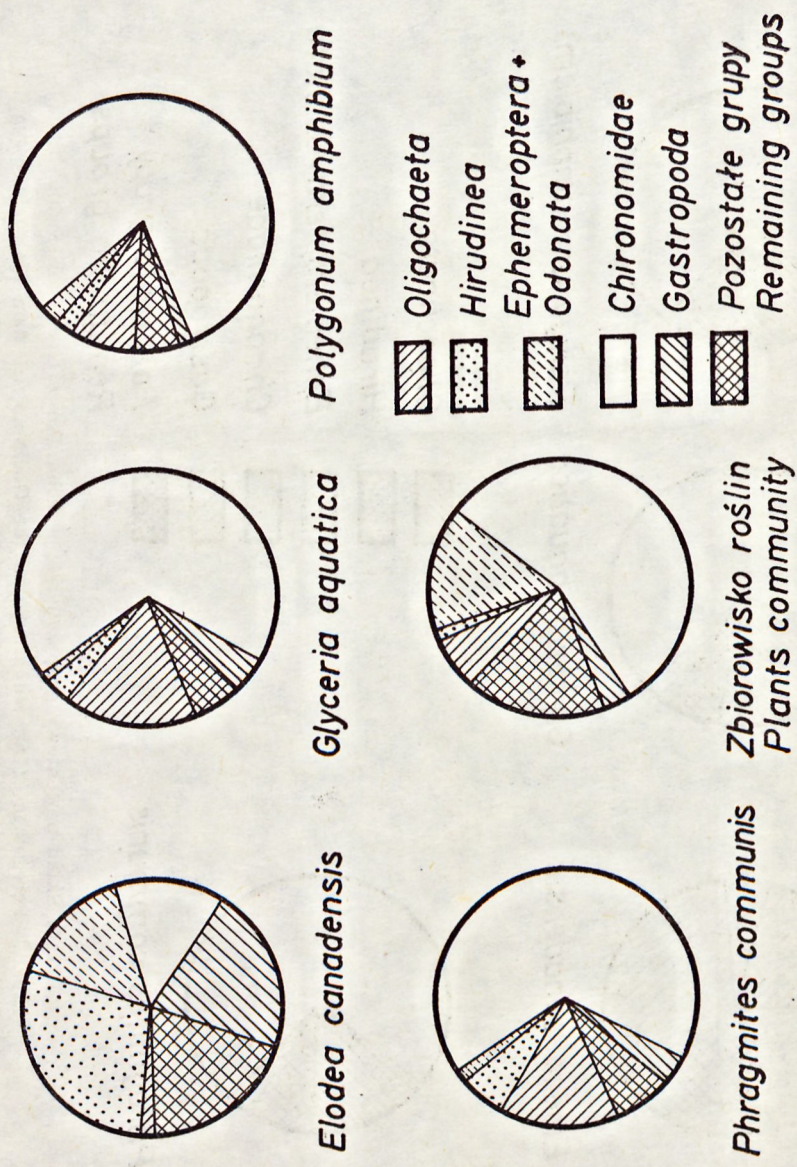
Comparison of fauna in vegetation in the ponds and the reservoir

Spongiaria were very rare in both environments. Small colonies were found almost exclusively on *Polygonum amphibium*.

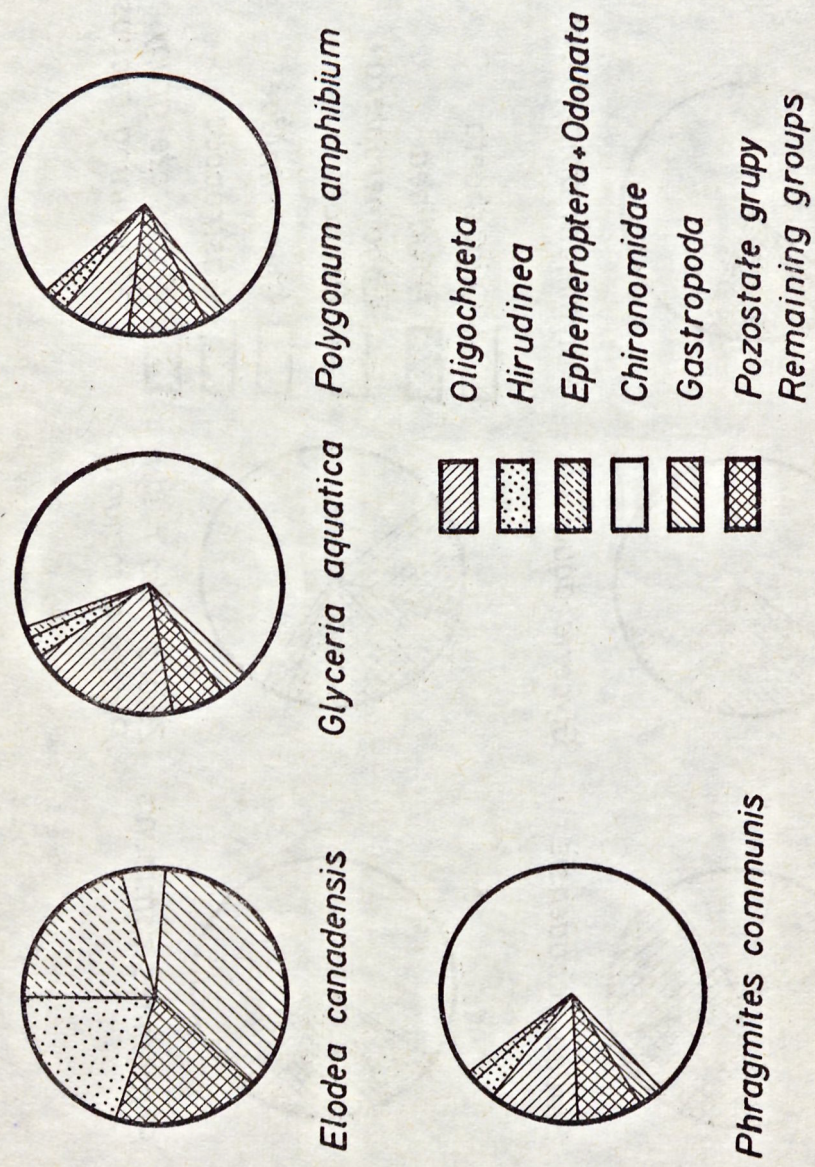
Cnidaria were somewhat more numerous, especially in the ponds. In both environments their largest populations were on *Glyceria aquatica*.

Nematorpha were rarely found on the vegetation investigated. The largest number of individuals were found on other submerged plant communities in the ponds.

Oligochaeta were very numerous both in the ponds and in the reservoir (fig. 1 and 2). Nine species were determined in the ponds and eleven in the reservoir. The species dominance was very similar. The most numerous



Ryc. 1. Skład procentowy grup zwierząt w stawach.
 Fig. 1. Percentage of animal groups in the ponds.



Ryc. 2. Skład procentowy grup zwierząt w zbiorniku w Goczałkowicach.
 Fig. 2. Percentage of animal groups in the Goczałkowice dam reservoir.

were *Stylaria lacustris* (L.), *Pristina longiseta* Ehrenb., *Nais obtusa* Gervais, and *N. pseudoobtusa* Pig. The largest quantities of *Oligochaeta* occurred on *Glyceria aquatica* and *Polygonum amphibium*.

Hirudinea formed a very numerous group of animals both in the ponds and in the reservoir. The number of species was the same in the two environments, but the number of individuals was larger in the ponds. The species dominance was almost identical. The largest number of leeches occurred on *Elodea canadensis*, where they were the dominant animal group. The dominant species was *Herpobdella octooculata* (L.), followed by *Helobdella stagnalis* (L.) and *Piscicola geometra* (L.).

Isopoda occurred in both environments almost exclusively on *Elodea canadensis*. The number of *Asellus aquaticus* Raco v. on this plant was fairly large. It was also found in the community of other plants in the pond.

Aranae were very rare both in the ponds and in the reservoir. They were found mainly on *Elodea canadensis* and on the submerged meadow.

Acarina were not a very numerous group of animals on the investigated vegetation. In the ponds they were found in somewhat larger quantities, especially on the community of other submerged plants. In the reservoir nine species were determined and in the ponds six.

Ephemeroptera were much more often encountered in the ponds than in the reservoir. In the ponds they occurred most numerous on the submerged plant community, on *Polygonum amphibium* and *Elodea canadensis*. *Caenis macrura* Steph. and *Baetis rhodani* Pict. were found in large quantities.

Odonata were also more numerous in the ponds. In both environments *Erythromma najas* (Hans.) predominated distinctly, because of their mass occurrence on *Elodea canadensis*.

Coleoptera occurred in small numbers on all the plants investigated in both environments. In the reservoir fourteen species were found but in the ponds only seven. Somewhat incomprehensibly, the very common beetle of the genus *Agabus* was not encountered in the ponds. In the reservoir it was one of the most numerous representatives of *Coleoptera*.

Trichoptera were qualitatively very similar in the two environments, but they were more numerous in the reservoir. It was characteristic that the larvae of larger species such as *Phryganea bipunctata* Retz., *Leptocerus annulicornis* Steph., and *Triaenodes bicolor* Curt., mainly occurred on *Elodea canadensis*, and those of smaller ones on *Polygonum amphibium*. The smallest quantities of *Trichoptera* were found on *Phragmites communis* and on *Glyceria aquatica*.

Lepidoptera occurred very rarely on any of the plants in the two environments with the exception of *Elodea canadensis*, on which slightly larger numbers were found.

Chironomidae constituted the most numerous group of animals in the vegetation investigated, both in the ponds and in the reservoir. The species

dominance was similar though the number of species and of individuals in the reservoir was larger. 22 groups of species were determined in the reservoir but only 13 in the ponds. In the ponds *Cryptochironomus ex grege pararostratus* Lenz dominated, followed by *Limnochironomus ex grege nervosus* Staeg., *Cricotopus ex grege sylvestris* (Fabr.), and *Cricotopus? versidentatus* Tsch., while in the reservoir *Cricotopus ex grege sylvestris* (Fabr.) dominated, followed by *Endochironomus ex grege tendens* F. and *Cryptochironomus ex grege pararostratus* Lenz.

The remaining *Diptera* were very rare in both environments and did not play any important role in the quantitative composition of the fauna.

Hemiptera were found in small quantities. They were somewhat more numerous in the heterogenous plant community in the ponds.

Gastropoda occurred very numerously on the vegetation investigated. In the ponds a far greater number of snails were found than in the reservoir. The number of species was also larger in the ponds where 16 species were determined, there being only 14 in the reservoir. In both environments the largest quantities of *Gastropoda* were found on *Elodea canadensis*. The most numerous were *Lymnea stagnalis* L., and *Anisus vortex* L. in the ponds and *Physa fontinalis* L. and *Gyraulus crista* f. *navitileus* L. in the reservoir. Neither *Bathynomphalus contortus* L. nor *Segmen-tina nitida* Müll. were observed in the reservoir.

Conclusions

Analysis of the results of the investigation on fauna in vegetation showed that there were some groups of animals characteristic of particular plants. It may also be supposed that some species are more attached to a given plant species, being very rarely elsewhere. Among such species were: *Erythromma naid* (Hans.), *Phryganea bipunctata* Retz., *Leptoce-rus annulicornis* Steph., *Nymphula nymphæata* L., and *Paraponyx stratiotata* L. The results of investigations on the vegetation of the dam reservoir at Goczałkowice confirmed this assumption. The percentage participation of particular animal groups in the ponds and in the reservoir was very similar. Nevertheless the number of individuals per 1 l. of plants and the number of species differed. As far as the number of species was concerned, this was much larger in the reservoir, while the number of individuals per 1 l. varied according to the group. For example, the number of *Hirudinea*, *Ephemeroptera*, *Odonata*, and *Gastropoda* was somewhat greater in the ponds, while *Chironomidae* and *Trochoptera* were more numerous in the reservoir. On the basis of the results of the present investigation and of others carried out the Goczałkowice reservoir, where a far greater number of plants were gathered, it may be concluded that the grouping of animals on various species of like morphological appearance are similar.

On the basis of the content of natural food in the alimentary canal of carp (S z u m i e c 1966), an attempt was made to determine the usefulness of particular plant species in food economy. As a criterion of usefulness was taken the occurrence of large numbers of the animals found in the alimentary canal of carp, i.e. *Chironomidae* larvae, *Ephemeroptera*, *Oligochaeta*, and *Trichoptera*. In the light of these investigations, it would seem that *Polygonum amphibium* and *Glyceria aquatica* are the most suitable plants in pond economy. In the reservoir the best from this aspect are *Batrachium aquatile*, *Myriophyllum spicatum*, *Ceratophyllum demersum*, and *Potamogeton lucens*. The mentioned species did not occur in ponds or were encountered in very small numbers.

STRESZCZENIE

Celem niniejszej pracy było zbadanie jakościowe i ilościowe fauny naroślinnej stawów karpowych w Goczalkowicach oraz wykazanie podobieństw i różnic pomiędzy tą fauną a fauną naroślinną zbiornika zaporowego w Goczalkowicach. Stawy te usytuowane są poniżej zapory wodnej zbiornika w odległości ok. 500 m, na lewym brzegu Wisły, w pobliżu wałów ochronnych. Obydwa środowiska mają pewne cechy zbliżone takie jak: głębokość (teren pływiczny w zbiorniku nie przekraczający 2 m głębokości jest bardzo rozległy), skład gatunkowy roślin i niektóre właściwości chemiczne wody, badane stawy otrzymują bowiem wodę ze zbiornika.

Zasadniczą różnicą jest okresowe zalewanie i wypuszczanie wody ze stawów oraz różnica temperatur i duże falowanie wody w zbiorniku.

Materiał pobierano w 1966 roku w okresie od czerwca do września, w odstępach mniej więcej miesięcznych. W badaniach tych zostały uwzględnione następujące gatunki roślin: *Elodea canadensis*, *Polygonum amphibium*, *Glyceria aquatica*, *Phragmites communis* oraz zbiorowisko roślin lądowych i wodnych, a w szczególności traw i sitów, stanowiących podwodną łąkę. Objętość roślin z pobraną fauną mierzono w wyskalowanym naczyniu. Liczby podane w tabeli wskazują ilość osobników na 1 litr danej rośliny.

W wyniku przeprowadzonych badań stwierdzono:

1). Podobne skupienia gatunków lub grup zwierząt na tych samych gatunkach roślin w obydwu środowiskach, co wyklucza w jakimś stopniu przypadkowość zasiedlenia przez tę faunę.

2). Pewne różnice ilościowe w obydwu środowiskach. W zbiorniku stwierdzono większe ilości *Chironomidae* i *Trichoptera*, natomiast w stawach więcej *Hirudinea*, *Ephemeroptera* i *Gastropoda*.

LITERATURA

- Karassowska K. i Mikulski J., 1960. Studia nad zbiorowiskami zwierzęcymi roślinności zanurzonej i pływającej jeziora Druzno. Ekologia Polska — Seria A. Tom 8, 16.
- Ko w n a c k a M., 1963. Ślimaki (*Gastropoda*) stawów rybnych w Gołyszcu i Landeku. Acta Hydr. 5, 2—3, s. 173—188.

- Krzanowski W., Fiedor E., Kuflikowski T., 1965. Fauna denna kamienisto-prądowych siedlisk dolnych odcinków Białego Dunajca, Rogoźnika i Lepienicy. Zeszyty Nauk. UJ. Prace Zool. 9.
- Matlak O., 1963. Obserwacje nad zasiedlaniem strzałki i manny przez fitofilne larwy *Tendipedidae*. Gosp. Rybna 8, s. 18.
- Matlak O., 1963. Występowanie zwierząt bezkręgowych na roślinach wodnych w stawach rybnych. Acta Hydr., 5, 1, s. 1—30.
- Pasternak K., 1959. Gleby gospodarstw stawowych dorzecza Górnej Wisły. Acta Hydr., 1, 3—4, s. 221—238.
- Pasternak K., 1968. Zmienność składu chemicznego wody w stawach o różnym usytuowaniu dna względem lokalnego poziomu erozyjnego. Acta Hydr., 10, 4, s. 525—532.
- Sowa R., 1961. Fauna denna rzeki Bajerki. Acta Hydr. 3, 1, s. 1—32.
- Starmach K., 1954. Metody badań środowiska stawowego. Biul. Zakł. Biol. Stawów, PAN, 2, s. 10—21.
- Starmach K., 1954. O potrzebie szczegółowych badań stawów rybnych Kosmos, 2(7), s. 148—172.
- Szumiec J., 1966. Udział pokarmu naturalnego przy żywieniu karpia. Acta Hydr., 8, Suppl. 1, 1—11, s. 193—253.
- Wróbel S., 1964. Próby określenia zapotrzebowania składników pokarmowych w stawach. Acta Hydr., 6, 1, s. 12—19.
- Zaćwilichowska K., 1965. Bentos obrzeża Zbiornika Goczalkowickiego w 1960 r. Acta Hydr., 7, 2—3, s. 155—165.

Adres autora — Author's address

mgr Tadeusz Kuflikowski

Zakład Biologii Wód, Polska Akademia Nauk, Stacja Hydrobiologiczna w Goczalkowicach, pow. Pszczyna