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# Fauna fitofilna zbiornika zaporowego w Goczałkowicach

# The phytophilous fauna of the dam reservoir at Goczałkowice

Wpłynęło 7 lutego 1973 r.

Abstract — Investigations on the phytophilous fauna of the dam reservoir at Goczałkowice were carried out in the years 1964—1967. Their purpose was to make a quantitative and qualitative study of the vegetation fauna and to determine the degree of connection between individual species and groups of animals and plants as well as to compare this fauna with the bottom fauna of the reservoir.

In the investigations the following species of plants were included: *Batrachium aquatile*, *Myriophyllum spicatum*, *Polygonum amphibium*, *Potamogeton lucens*, *P. crispus*, *Elodea canadensis*, and *Glyceria aquatica*.

The investigations on the dam reservoir at Goczałkowice were initiated by Prof. Starmach and are being continued under his direction. In 1953—1954, before the reservoir was filled, they were begun by comprehensive hydrobiological studies of the River Vistula from its springs down to the territory of the future reservoir. The collectively conducted investigations included the study of the geological substratum and of the soils in the river valley, the hydrography, hydrochemistry and microbiology, the communities of aquatic plants and animals, and the vegetal cover of the valley.

The results of these studies provided a fairly precise description of the river and of the area where the reservoir was, to be, hence they gave the basis for the future determination of the changes which would occur there.

Immediately after the filling of the reservoir systematic investigations of the whole metabolic cycle in the reservoir were begun, including the physical and chemical factors (Bombówna 1962, Krzyżanek 1963), bacterial flora (Paluch 1958, 1961), phytoplankton (Mrozińska-Webb 1964, Rumek 1957), zooplankton (Mleczko 1965), benthos (Grzybowska 1958, Kysela 1958, Kwiatkowska 1963, Krzyżanek 1965, 1966, 1973, Zaćwilichowska 1965a, 1965b, 1965c), the fauna of fish (Kołder 1964, Skóra 1964a, 1964b, Wajdowicz 1958, 1961) and birds (Bocheński 1961), higher flora

(Pawłowski 1954, 1958, Ćwiertnia 1962, 1966, Mazur 1958, Kuflikowski 1968, 1971), the re-shaping of the banks of the reservoir (Pasternak 1964) and the geological substratum and soils (Pasternak 1962).

In connection with the complex investigations of the reservoir the study of the fauna occurring in the vegetation seemed necessary since it formed an important link in the metabolic processes in the reservoir.

This fauna, called epifauna, fauna in the vegetation, phytophilous, or vegetation fauna (German Wegetationsfauna, Russian fauna zaroslej) is besides benthos and plankton an important food for fish. It is one of the least studied problems of hydrobiology. Attempts at any comprehensive interpretation of its role are rarely found in the literature and are usually based on relatively scarce materials or are limited to certain fragments of the problem.

The first study of the vegetation fauna was carried out by Wundsch (1923) who stressed that its role was becoming more and more appreciated by the ichthyologists.

Wunder (1936) was chiefly concerned with the larvae of *Chironomidae*, and investigated them from the point of view of their distribution on various species of plants.

The necessity of studies of the vegetation fauna was stressed by Starmach (1954a, 1954b, 1958c, Starmach, Bombówna 1965). The under-water plants, as the substratum and the feeding ground of the larvae of insects and other aquatic animals, considerably extend the production surface of the bottom, which becomes enlarged by the surface of each separate plant.

Stube (1958) noticed greater richness of the epifauna as compared with benthos and its easier accessibility for fish since its density on a surface unit is much greater than that of the bottom fauna. In recent years a growing interest in the vegetation fauna of ponds, lakes, and dam reservoirs has been observed (Ponyi 1957, Stube 1958, Gurzęda 1959, Matlak 1961, 1963a, 1963b, Fomenko 1963, 1964, Macan 1965, 1966, Zimbalevskaja 1964, 1967, and Quade 1969).

## Material and method

The investigations on the vegetation fauna were carried out in 1964—1967. The material was collected from June to September at intervals of about 1 month, thus from the beginning to the end of the vegetation of the investigated plants. In October the majority of species of plants were decomposed. In 1965 the material was collected only once as the vegetation was almost totally killed from the middle of July to the end of the year.

The above-mentioned investigations were conducted on dominant plants occurring in large one-species communities. The samples were taken from

the following plant species: *Polygonum amphibium* L., *Batrachium aquatile* Wimmer, *Myriophyllum spicatum* L., *Potamogeton crispus* L., *P. lucens* L., *Elodea canadensis* Rich., and *Glyceria aquatica* Wahl.

*Elodea canadensis* was taken into consideration only in the last years of the investigations since it did not previously occur in such numbers as would allow the collection samples.

The investigators of the vegetation fauna have used various methods in their works, however, all these methods are imperfect, hence no common standards so far exist for the comparison of the fauna of individual plant species.

A frequently used method was the calculation of the density of populations in relation to the surface of the bottom covered by the investigated plants. This method, however, cannot be applied in more precise investigations since the number of plants on 1 square metre of the bottom is not constant.

Krecker (1939) applied a different method in his work on the fauna of submerged plants of Lake Erie. This was based on the linear measurements of the investigated plants, the length of 10 feet being taken as the unit. This was not the proper method in the investigations mentioned above since the shoots of plants of the same length did not have the same number of side shoots. Even the plants of the same species had from 2 to 7 shoots *(Myriophyllum spicatum, Potamogeton lucens, P. crispus,* and *Polygonum amphibium).*

In Poland Hilbricht (1953) in her investigations on the vegetation fauna treated a handful of plants as a sample. This method is uncomparable since the sizes of plants of various species differ considerably and the "handful" of individual investigators is also unequal.

Karassowska and Mikulski (1960) in their work on animal organisms of submerged and floating vegetation of Lake Druzno applied a method based on a surface unit, assuming that the counting of the vegetation fauna of one type of assemblage will be comparable with others if the sample contains a certain sector of the vegetation assemblage (e.g. 1 sq.m.) of maximum density.

Starmach (1954a) also stressed the necessity of considering the quantitative data based either on a surface unit covered by given plants or on their volume.

In the present work the volume method, also used by Matlak (1963a, b), was applied. It is not faultless but in the most comparable of all the known methods, independently of the size and density of the plants. In practice it was based on dipping a pail at the point of greatest density of plants of a given species, drawing up the plants with a rapid movement, and cutting them off from their lower parts. After the plants had been thoroughly washed and the animals separated, their volume was measured in a suitably graded container.

This method was applied to all submerged plants with the exception of *Glyceria aquatica* whose shoots to at least half their length protruded above

the water surface and were not settled by the aquatic fauna. In the case of this plant the protruding shoots were first cut off and then the submerged ones were drawn up in the pail. This plant caused much trouble in collecting samples but it could not be omitted as it dominated in the reservoir.

The animal material separated from the plants was fixed in 4 per cent formalin and worked out in the Hydrobiological Station at Goczałkowice.

The present work is a part of the monographic description of the dam reservoir at Goczałkowice. The formation of large patches of homogeneous vegetation may cause specific conditions for animal communities. Hence the aim of the investigations was to study possible regularities in the distribution and structure of these communities, as well as to determine the degree of connection of individual species or groups of animals to corresponding species of plants. It may in some measure explain the nutritive value of various vegetation communities as habitats of the vegetation fauna which is an important food for fish.

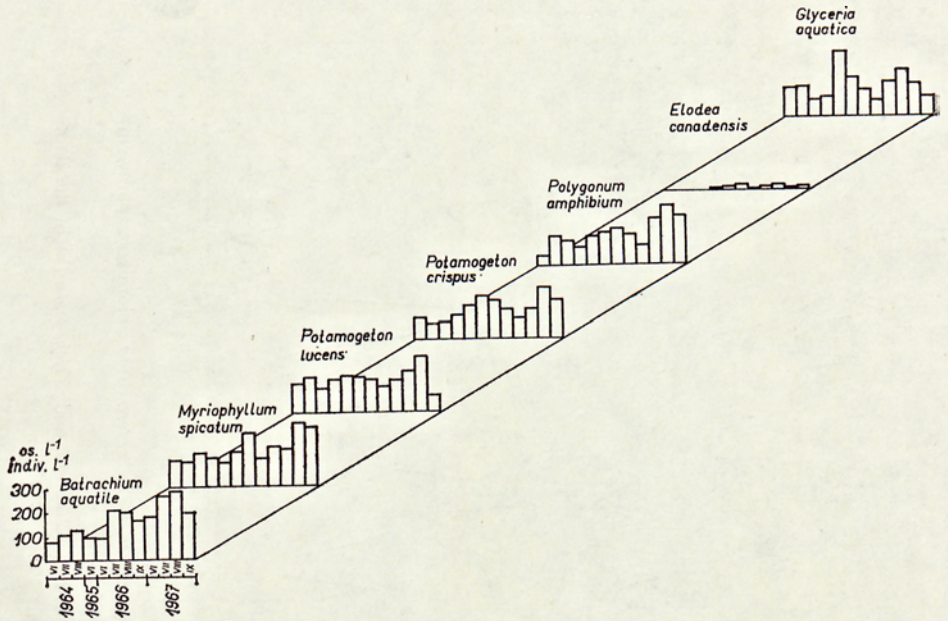
## The course of development of the most important groups of vegetation fauna

In the obtained material 24 systematic groups were determined of which only the most important will be discussed in the paper. These are: *Oligochaeta*, *Hirudinea*, *Cladocera* and *Copepoda* (jointly), *Ephemeroptera* and *Odonata*, *Coleoptera*, *Trichoptera*, *Chironomidae*, and *Gastropoda*.

*Oligochaeta*. 11 species of *Oligochaeta* were found forming a very numerous group of animals on the investigated vegetation; only the larvae of *Chironomidae* were more numerous. The exception was *Elodea canadensis* where only scarce individuals of *Pristina longiseta* (Ehr.), *P. aequiseta* Bourne *Stylaria lacustris* (L.), *Nais pseudoobtusa* Pig., and *N. obtusa* Gervais were observed. *Stylaria lacustris* dominated on all investigated plants. It should be mentioned that no species of the *Chaetogaster* group occurred on *Elodea canadensis*.

The development maximum of *Oligochaeta* on *Glyceria* occurred in June and at the beginning of July but not in August as was observed on other species of plants. This may be explained by the fact that *Glyceria aquatica* develops about a month later than other plants. The course of development of *Oligochaeta* on individual plants is presented in Fig. 1 and their percentage share in Fig. 4.

*Hirudinea*. 10 species of leeches were identified, occurring in small numbers with the exception of *Elodea canadensis* where they amounted to over 19 per cent of all animals. The following dominance of the species of leeches was observed: *Helobdella stagnalis* (L.) dominated on *Glyceria aquatica*, on *Elodea canadensis Herpobdella octooculata* (L.) and *Helobdella stagnalis* (L.) amounted to 85 per cent of all leeches on this plant, whire *Piscicola*




Ryc. 1. Rozwój *Oligochaeta* na poszczególnych gatunkach roślin zbiornika zaporowego w Goczałkowicach w latach 1964—1967

Fig. 1. The development of *Oligochaeta* on individual species of plants of the dam reservoir at Goczałkowice in the years 1964—1967

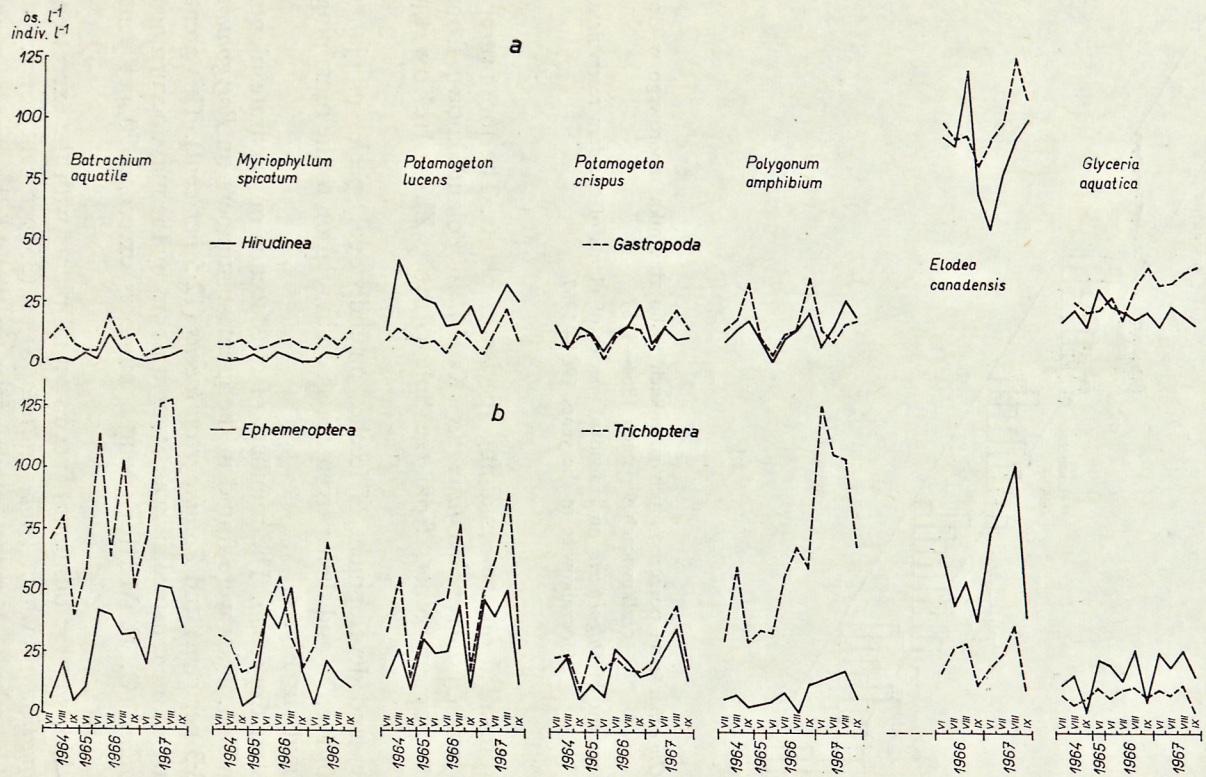
*geometra* (L.) prevailed on the remaining species of plants. The most rarely found species was *Cystobranchus fasciatus* (Koll.), in Poland known from only a few sites, among others from the Soła (Zięba, Zaćwilichowska 1966).

The number and development of leeches on individual species of plants are presented in Fig. 2a and their percentage share in relation to the remaining groups of animals in Fig. 4.

*Cladocera* and *Copepoda*. The numbers of crustaceans on separate plants was very diversified. They were found in the greatest numbers on *Polygonum amphibium* (13·3 per cent) and *Potamogeton lucens* (12·5 per cent). This great percentage share of the crustaceans was brought about by the mass occurrence of *Sida crystallina* (O. F. Müller), whose numbers exceeded 70 per cent of all crustaceans.

*Sida crystallina* was the dominant species on all plants with the exception of *Glyceria aquatica* on which *Alona guttata* Sars (35 per cent) occurred in the greatest numbers. A more detailed investigation of the development of crustaceans was impossible because the samples were rarely collected.

*Ephemeroptera* and *Odonata*. 9 species of mayflies were found on the investigated vegetation. They formed the most numerous group of animals




Ryc. 2. Sezonowa zmienność liczebności *Hirudinea* i *Gastropoda* (a), *Ephemeroptera* i *Trichoptera* (b) w zbiorniku zaporowym w Goczałkowicach w latach 1964—1967

Fig. 2. Seasonal variability in number of *Hirudinea* and *Gastropoda* (a), *Ephemeroptera* and *Trichoptera* (b) in the dam reservoir at Goczałkowice in the years 1964—1967

on *Elodea canadensis* (Fig. 4). Two species, *Baetis rhodani* Pict. and *B. pumilus* Burm., attracted great numbers of mayflies to this plant. Apart from this these species were found only on *Glyceria aquatica* though in small numbers. On the remaining plants *Caenis macrura* Steph., *C. moesta* Bgtss., and *C. horaria* (L.) occurred in the greatest numbers. The course of development of mayflies is presented in Fig. 2b.

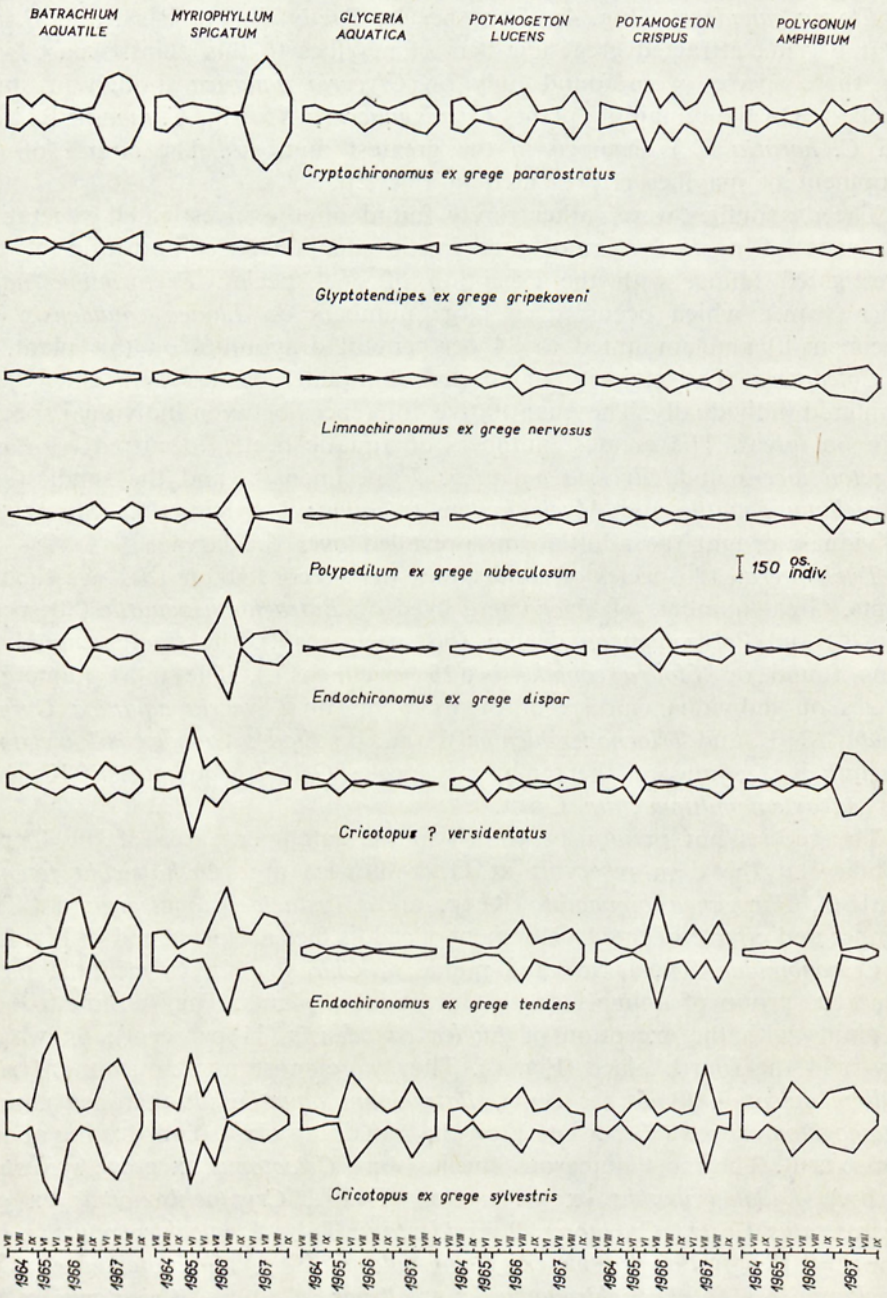
The dragonflies were rather rarely found on the investigated vegetation and were of no great importance in the qualitative composition of the investigated fauna, with the exception of one species, *Erythromma najas* (Hanesem.), which occurred in large numbers on *Elodea canadensis* (46 specimens/l.) and amounted to 84 per cent of dragonflies on this plant.

*Coleoptera.* The majority of species of aquatic beetles were chiefly encountered individually. The quantitative differences between individual species were not great. The greatest numbers of aquatic beetles occurred on *Potamogeton lucens* and *Glyceria aquatica:* 7 specimens/l., and the smallest on *Batrachium aquatile* and *Myriophyllum spicatum:* 1 specimen/l. Among the individuals caught the adult forms prevailed over the larvae.

*Trichoptera.* 12 species of caddis flies were recorded on the investigated plants. Great numbers of *Trichoptera* lived on *Batrachium aquatile* (80 specimens/l.) and *Polygonum amphibium* (66 specimens/l.), the smallest numbers being found on *Elodea canadensis* (25 specimens/l.). The most numerous species on individual species of plants were: on *Glyceria aquatica Cyrnus flavidus* Mc L. and *Triaenodes bicolor* Curt., on *Elodea canadensis Phryganea punctata* Retz., and on the remaining species *Orthotrichia tetensii* (Kolbe) and *Agraylea multipunctata* Curt.

The species not previously known in the catchment area of the Upper Vistula and the dam reservoir at Goczałkowice are: *Orthotrichia tetensii* (Kolbe), *Phryganea bipunctata* Retz. and *Mystacides longicornis* L. The number and course of the development of caddis flies are presented in Fig. 2b.

*Chironomidae.* The larvae and pupae of *Chironomidae* formed the most numerous group of animals on the investigated plants. They dominated on all plants with the exception of *Elodea canadensis* (11 per cent), on which they held the fourth place (Fig. 4). They were most numerous on *Myriophyllum spicatum* (81·5 per cent), *Batrachium aquatile* (79 per cent), and *Potamogeton crispus* (73 per cent), on the remaining plants constituting about 65 per cent. The most numerous species were *Cricotopus* ex grege *sylvestris* (Fabr.), *Endochironumus* ex gr. *tendens* Fabr., *Cryptochironomus* ex gr. *pararostratus* Lenz., *Cricotopus* ? *versidentatus* Tsh., *Limnochironomus* ex gr. *nervosus* (Staeg.), *Polypedilum* ex gr. *nubeculosum* (Mg.), *Glyptotendipes* ex gr. *gripekoveni* Kieff., *Endochironomus* ex gr. *dispar* (Mg.), and *Cricotopus* ex gr. *algarum* Kieff., which constituted over 95 per cent of all *Chironomidae.* The percentage share of these species is presented in Table I and their development and variability in individual years and seasons in Fig. 3.

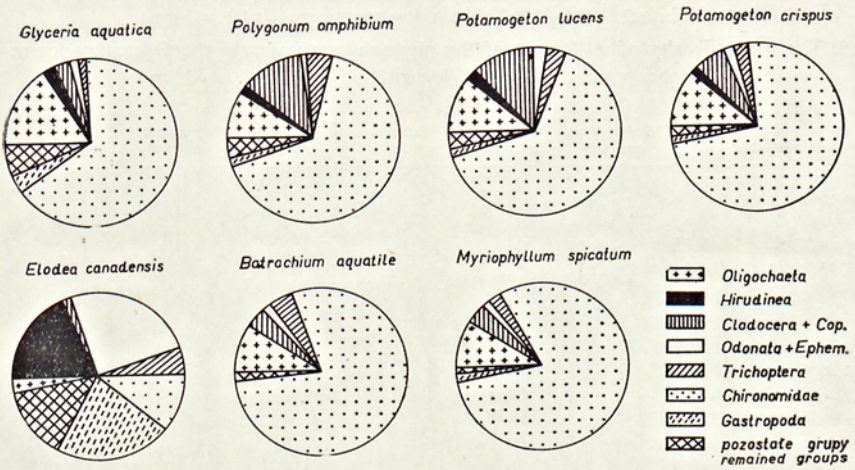



Ryc. 3. Ilość i przebieg rozwoju dominujących gatunków *Chironomidae*

Fig. 3. The number and development of the dominant species of *Chironomidae*

Tabela I. Udział procentowy dominujących gatunków Chironomidae na poszczególnych roślinach
Table I. The percentage share of the dominant Chironomidae species on individual plants

| Gatunek - Species | Batrachium aquatile | | | | Myriophyllum spicatum | | | | Potamogeton lucens | | | | Potamogeton crispus | | | | Polygonum amphibium | | | | Glyceria aquatica | | | | Elodea canadensis | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1964 | 1965 | 1966 | 1967 | 1964 | 1965 | 1966 | 1967 | 1964 | 1965 | 1966 | 1967 | 1964 | 1965 | 1966 | 1967 | 1964 | 1965 | 1966 | 1967 | 1964 | 1965 | 1966 | 1967 | 1966 | 1967 |
| Cricotopus ex grege sylvestris (Fabr.) | 22.8 | 35.3 | 33.8 | 28.6 | 22.4 | 39.2 | 19.1 | 12.8 | 18.1 | 26.0 | 27.0 | 19.4 | 18.8 | 30.8 | 16.0 | 20.3 | 32.8 | 36.8 | 30.8 | 27.4 | 23.7 | 11.3 | 50.4 | 48.3 | 12.6 | 13.4 |
| Cryptochironomus e.gr. pararostratus Lenz | 20.1 | 9.3 | 4.2 | 20.6 | 20.4 | 5.9 | 3.0 | 33.5 | 24.9 | 10.6 | 20.5 | 16.8 | 21.4 | 9.4 | 25.9 | 24.2 | 26.2 | 13.6 | 9.5 | 11.5 | 17.4 | 6.5 | 20.0 | 25.8 | 12.0 | 8.3 |
| Endochironomus e.gr. tendens Fabr. | 22.2 | 1.1 | 8.1 | 24.4 | 21.9 | 6.6 | 29.3 | 22.8 | 20.1 | 4.7 | 20.5 | 24.7 | 19.6 | 3.0 | 29.7 | 26.3 | 7.6 | 9.2 | 31.1 | 5.5 | 11.8 | 11.5 | 4.1 | 7.3 | 10.8 | 8.3 |
| Cricotopus ? versidentatus Tsh. | 10.9 | 38.9 | 7.5 | 7.7 | 9.7 | 33.0 | 10.2 | 6.3 | 8.9 | 26.5 | 5.5 | 5.2 | 13.3 | 36.0 | 1.0 | 8.9 | 6.0 | 18.3 | 3.3 | 27.2 | 13.2 | 37.6 | 2.5 | 2.2 | 6.0 | 7.4 |
| Endochironomus e.gr. dispar Mg. | 4.6 | | 11.6 | 5.6 | | | 19.4 | 11.4 | 5.5 | 3.4 | 3.7 | 4.0 | | | 13.2 | 10.0 | 3.6 | | 5.6 | 2.7 | 3.6 | 3.8 | 3.1 | 1.7 | | |
| Limnochironomus e.gr. nervosus (Staeg.) | 4.8 | | | 2.9 | 5.8 | | 1.4 | 5.1 | 4.1 | 13.1 | 9.5 | 10.5 | 4.2 | 3.8 | 6.0 | 4.5 | | 1.5 | 6.9 | 16.2 | | | | | 10.2 | |
| Polypedilum e.gr. nubeculosum Mg. | 2.5 | | 4.8 | 3.9 | 5.5 | | 13.1 | 2.8 | 5.5 | 1.7 | 3.6 | 5.9 | 8.6 | | 3.7 | 1.6 | 3.6 | 2.6 | 5.5 | 3.7 | 4.2 | | 3.3 | | 11.4 | 7.4 |
| Cricotopus e.gr. algarum Kieff. | | 2.1 | | | 1.9 | 3.1 | | | | 10.6 | | | 2.6 | 11.0 | | | 6.2 | 10.3 | | | 3.2 | 5.0 | | | | |
| Glyptotendipes e.gr. gripekoveni Kieff. | 3.5 | 1.9 | 6.0 | 4.0 | 4.1 | | 1.1 | 2.8 | 5.5 | 1.5 | | | 5.0 | | 1.6 | 1.1 | | | | 1.7 | 9.2 | | | 1.7 | | |
| Corynoneura celeripes Winn. | | | 2.5 | | | | | | | | | 2.6 | | | | | 2.6 | | 2.3 | | | | | 1.7 | 7.2 | 11.1 |
| Cryptochironomus sp. (Tend. gen. Nr.7) Lip. | | | | | | | | | | | | | | 1.1 | | | 7.0 | | | | 6.9 | 2.3 | | | | |
| Psectrocladius e.gr. psilopterus Kieff. | | 6.2 | | | | 3.7 | | | | | | | | | | | | 2.6 | | | | 3.3 | | | | |
| Sergentia coracina Zett. | | 3.0 | | | | 2.1 | | | | | | | | 1.8 | | | | | | | | 7.7 | | | | |
| Limnophyes sp. | | | | | | | | | | | | | | | | | | | | | | | | | 11.4 | |
| Pelopia vilipennis Kieff. | | | | | | | | | | | | | | | | | | | | | | | | | | 7.9 |




Ryc. 4. Skład procentowy fauny naroślinnej na poszczególnych gatunkach roślin w zbiorniku zaporowym w Goczałkowicach w latach 1964—1967

Fig. 4. The percentage share of the vegetation fauna on individual species of plants in the dam reservoir at Goczałkowice in the years 1964—1967

Among *Chironomidae* certain interdependences of the development of species were observed. This could be most distinctly seen in the dominant species. Two kinds of dependence may be observed: 1) some species develop, as it were, antagonistically to each other, i.e. with the increase in the number of one species a rapid decrease in the other follows, e.g. *Endochironomus* ex gr. *tendens* Fabr. and *Cricotopus* ex gr. *sylvestris*, *Cryptochironomus* ex gr. *pararostratus* Lenz and *Glyptotendipes* ex gr. *gripekoveni* Kieff., or *Polypedilum* ex gr. *nubeculosum* Mg. and *Endochironomus* ex gr. *dispar* Mg.; 2) species developing simultaneously, e.g. *Endochironomus* ex gr. *tendens* Fabr. and *E.* ex gr. *dispar* (Mg.), or *Glyptotendipes* ex gr. *gripekoveni* Kieff. and *Polypedilum* ex gr. *nubeculosum* (Mg.). The similar phenomenon of mutual action was also observed in less numerous species.

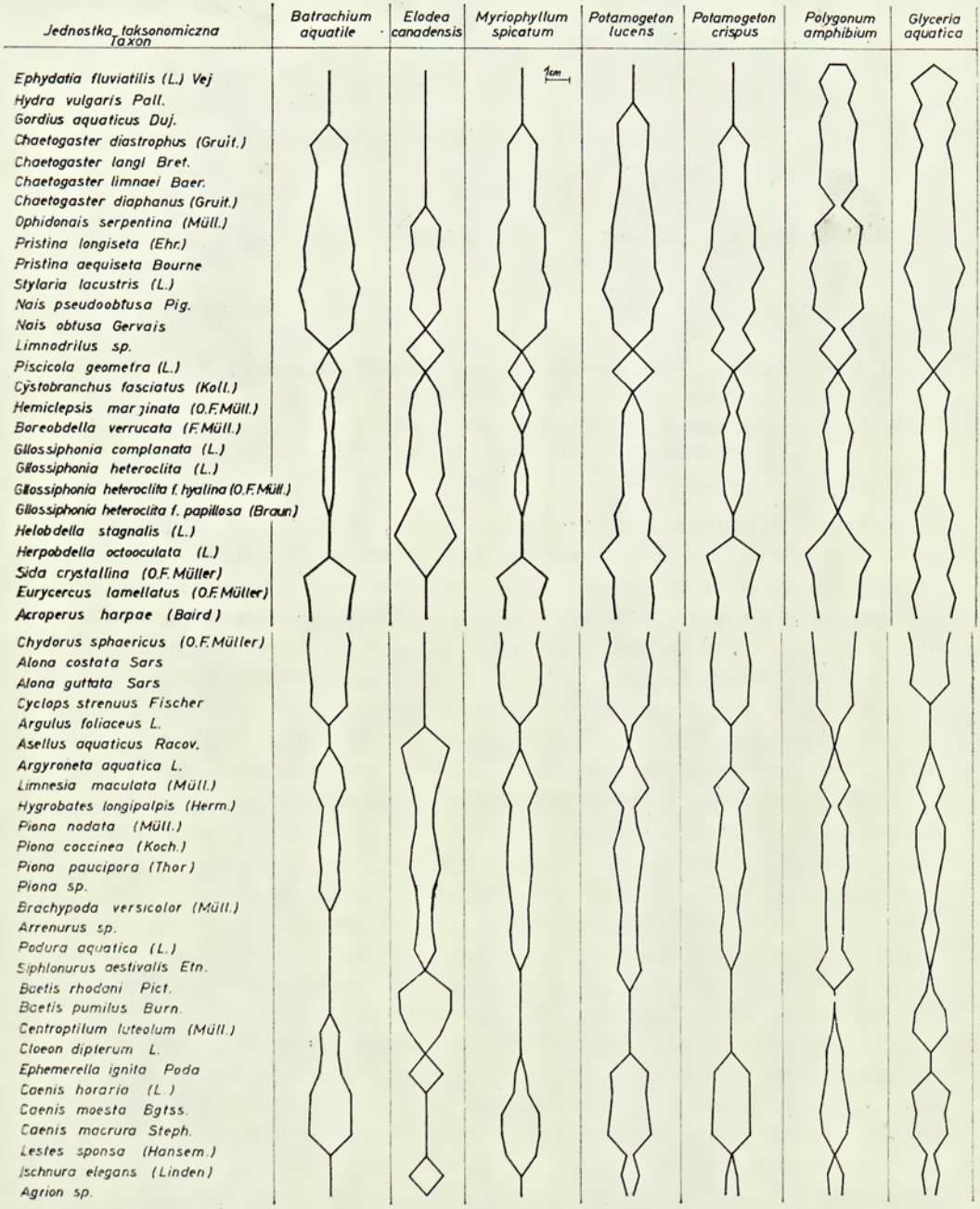
*Gastropoda.* The number of snails was very variable on individual plants. They were found in the greatest numbers on *Elodea canadensis* (20·5 per cent), followed by *Glyceria aquatica* (3·5 per cent), while on the remaining plants they ranged from 0·5—1·5 per cent. The smallest number of snails were encountered on *Batrachium aquatile* and *Myriophyllum spicatum.*

The most numerous species on the investigated plants were: on *Elodea canadensis Acroloxus lacustris* L., on *Polygonum amphibium Radix limosa* L. and *Acroloxus lacustris* L., on *Glyceria aquatica Valvata naticina* Mke., and on the remaining plants *Succinea putris* L. The development of snails is shown in Fig. 2a.

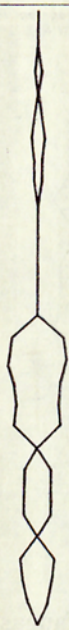
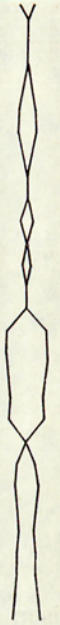
The mean density of settlement of all species occurring on the investigated vegetation is given in Fig. 5.

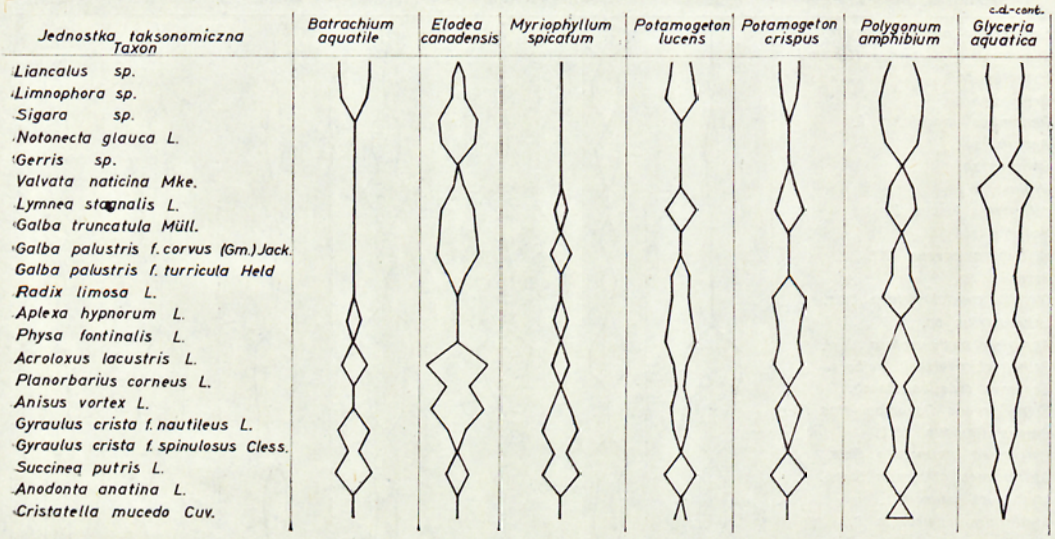
Ryc. 5. Średnia gęstość zasiedlenia fauny fitofilnej w zbiorniku zaporowym w Goczałkowicach w latach 1964—1967 (skala logarytmiczna, lg 10 = 1 cm)

Fig. 5. The mean density of settlement of the phytophilous fauna in the Goczałkowice reservoir in the years 1964—1967 (logarithmic scale, lg 10 = 1 cm)



c.d.-cont.

| Jednostka taksonomiczna Taxon | Batrachium aquatile | Elodea canadensis | Myriophyllum spicatum | Potamogeton lucens | Potamogeton crispus | Polygonum amphibium | Glyceria aquatica |
|---|---|---|---|---|---|---|---|
| Erythromma najas (Hansem.) |  |  |  |  |  |  |  |
| Somatochlora metallica (Linden) | | | | | | | |
| Hygrotus sp. | | | | | | | |
| Deronectes sp. | | | | | | | |
| Platambus maculatus L. | | | | | | | |
| Agabus sp. | | | | | | | |
| Rhantus sp. | | | | | | | |
| Ilybius sp. | | | | | | | |
| Colymbetes fuscus L. | | | | | | | |
| Haliplus sp. | | | | | | | |
| Peltodytes caesus Dft. | | | | | | | |
| Berosus sp. | | | | | | | |
| Crenitis punctatostriata Letz. | | | | | | | |
| Lithodactylus sp. | | | | | | | |
| Agraylea multipunctata Curt. | | | | | | | |
| Orthotrichia tetensii Kolbe | | | | | | | |
| Ecnomus tenellus Ramb. | | | | | | | |
| Polycentropus flavomaculatus Pict. | | | | | | | |
| Cyrnus flavidus McL. | | | | | | | |
| Phryganea bipunctata Retz. | | | | | | | |
| Athripsodes aterrimus Steph. | | | | | | | |
| Mystacides azurea L. | | | | | | | |
| Mystacides longicornis L. | | | | | | | |
| Triaenodes bicolor Curt. | | | | | | | |
| Oecetis ochracea Curt. | | | | | | | |
| Oecetis furva Ramb. | | | | | | | |
| Nymphula nympheata L. | | | | | | | |
| Paraponyx stratiotata L. | | | | | | | |
| Acentropus niveus Oliv. |  |  |  |  |  |  |  |
| Tanytarsus ex grege mancus (Walk.) | | | | | | | |
| Cryptochironomus e. gr. gripekoveni Kieff. | | | | | | | |
| Cryptochironomus e. gr. pararostratus Lenz. | | | | | | | |
| — sp. / Tendipedinae genuinae Nr. 7 Lip. | | | | | | | |
| Glyptotendipes e. gr. gripekoveni Kieff. | | | | | | | |
| Limnochironomus e. gr. nervosus (Staeg.) | | | | | | | |
| Polypedilum e. gr. convictum (Walk.) | | | | | | | |
| Polypedilum e. gr. nubeculosum (Mg.) | | | | | | | |
| Endochironomus e. gr. dispar (Mg.) | | | | | | | |
| Endochironomus e. gr. tendens Fabr. | | | | | | | |
| Sergentia coracina (Zett.) | | | | | | | |
| Microtendipes e. gr. chloris (Mg.) | | | | | | | |
| Psectrocladius e. gr. dilatatus v. d. Wulp | | | | | | | |
| — e. gr. psilopterus Kieff. | | | | | | | |
| Cricotopus e. gr. sylvestris (Fabr.) | | | | | | | |
| Cricotopus e. gr. algarum Kieff. | | | | | | | |
| Orthocladius semivirens Edw. | | | | | | | |
| Cricotopus ? versidentatus Tsh. | | | | | | | |
| Limnophyes sp. | | | | | | | |
| Corynoneura celeripes Winn. | | | | | | | |
| Pelopia villipennis Kieff. | | | | | | | |
| Ablabesmyia e. gr. monilis (L.) | | | | | | | |
| Bezzia sp. | | | | | | | |
| Stilobezzia sp. | | | | | | | |
| Tipula sp. | | | | | | | |
| Hermione sp. | | | | | | | |
| Tabanus sp. | | | | | | | |




## Comparison of the vegetation and bottom faunas of the reservoir

Investigations of the bottom fauna (Krzyżanek 1973) were carried ou parallel to the those of the vegetation fauna of the Goczałkowice reservoir. On this basis the two groups may be compared and the qualitative and quantitative differences shown.

*Oligochaeta.* Comparison of *Oligochaeta* in the two environments was impossible because they were not determined in the bottom fauna; however, on the basis of investigations of the vegetation and bottom faunas of the River Dniepr it may be assumed that these are different species of that order (Fomenko 1964). In the Goczałkowice reservoir the percentage share of the vegetation *Oligochaeta* ranged from 3·2 per cent on *Elodea canadensis* to 16·5 per cent on *Glyceria aquatica*, and in the bottom fauna from 23 to 51 per cent (Krzyżanek 1973).

*Hirudinea.* The majority of species of leeches occur in both environments. This is a distinctly eurytope group of animals. Yet the percentage share of species was different. The most numerous species were *Piscicola geometra* (L.) and *Glossiphonia complanata* (L.) on plants, and *Helobdella stagnalis* (L.) in the bottom fauna. The leeches constituted from 0·1—2·1 per cent of the bottom fauna and from 0·6—19·2 per cent *(Elodea canadensis)* on plants.

*Ephemeroptera* and *Odonata.* The fauna of mayflies is described in detail in both environments. Six species were recorded in the bottom fauna and nine on the vegetation, five species being common. Both in the vegetation fauna and in the bottom fauna most numerous were species of the genus *Caenis.* The percentage share of mayflies ranged from 0·3—2·1 per cent in

the bottom fauna and from 0·5 *(Polygonum amphibium)* to 15 per cent *(Elodea canadensis)* on plants.

The dragonflies distinctly prevailed on plants, where 5 species were encountered, while in the benthos only 1 species was found occurring sporadically.

*Trichoptera.* The vegetation fauna of caddis flies very considerably differed from the bottom fauna. 12 species occurred on plants and 8 in the benthos only *Polycentropus flavomaculatus* Pict., *Mystacides azurea* L., and *Oecetis ochracea* Curt. being common for the two environments. Moreover, in the bottom fauna *Holocentropus picicornis* Steph., *Mystacides nigra* L., *Limnophilus* sp., and *Molannodes* sp. were encountered.

A certain quantitative difference was also observed. The caddis flies amounted to 0·4—3·1 per cent in the benthos and from 1 *(Glyceria aquatica)* to 5·3 per cent *(Polygonum amphibium)* on plants.

*Chironomidae.* The number of *Chironomidae* was much greater in the benthos, e.g. 31 species occurred in 1967 (Krzyżanek 1973). Among the bottom *Chironomidae* periodical changes in the numbers of species are observed. Certain species disappear while others appear. In the vegetation fauna 22 species occurred, some of them being encountered in the benthos, but the number of individuals of these same species was very varied in both environments.

In the quantitative composition of the benthos *Procladius Skuze*, *Chironomus plumosus* (L.), *Cryptochironomus* ex gr. *defectus* (Kieff.) and *C.* ex gr. *conjugens* (Kieff.) had the largest share, thus the species absent in the vegetation fauna, with the exception of the last which was very rarely found on plants.

The most numerous species in the vegetation fauna were: *Cricotopus* ex gr. *sylvestris* (Fabr.), *Cryptochironomus* ex gr. *pararostratus* Lenz., *Endochironomus* ex gr. *tendens* Fabr., *E. dispar* (Mg.), *Cricotopus* ? *versidentatus* Tsh., *Limnochironomus* ex gr. *nervosus* (Staeg.), and *Glyptotendipes* ex gr. *gripekoveni* Kieff.

In the bottom fauna the *Chironomidae* constituted 39·3—64·8 per cent and on the plants 63·3 *(Potamogeton lucens)* to 81·5 *(Batrachium aquatile)*, and only 11 per cent on *Elodea canadensis.*

*Gastropoda.* The fauna of snails was fairly differentiated in both environments, 10 species being found in the benthos (Krzyżanek 1973) and 14 species on plants. Among them only 3 species were common for the bottom and vegetation faunas: *Radix limosa* L., *Planorbarius corneus* L., and *Anisus vortex* L. Besides these species also *Radix auricularia* L., *Valvata piscinalis* Müll., *V. pulchella* Stud., *Planorbis planorbis* L., *Anisus spirorbis* L., and *Viviparus viviparus* L. occurred in the bottom fauna.

The percentage share of snails was 5·1—12·5 in the bottom fauna and from 0·3 *(Batrachium aquatile)* to 3·5 *(Glyceria aquatica)* on the plants. The only exception was *Elodea canadensis* where 20·5 per cent of snails lived.

In the benthos *Radix limosa* L. and *R. auricularia* L. dominated while on plants the dominance depended on the species: on *Elodea canadensis* *Acroloxus lacustris* L. was most numerous, on *Polygonum amphibium* *Radix limosa* L., on *Glyceria aquatica* *Valvata naticina* Mke., and on the remaining species of plants *Succinea putris* L.

## Discussion of results

The present paper is the first description of the vegetation fauna in the dam reservoir at Goczałkowice. It is concerned with the whole macrofauna occurring on the above-mentioned vegetation. The majority of species of animals occurring in this reservoir are among the fairly widespread ones associated with rich aquatic vegetation.

The aquatic plants form a suitable environment for animals, enabling them to obtain food, and are also a rich source of plant detritus which is important as direct or indirect food for invertebrates and fish.

They also form a suitable place for laying eggs and attaching cocoons as well as supply material for building cases for the larvae of caddis flies. Hence, in the vegetation zone specific communities of the vegetation fauna develop composed of the larvae of *Chironomidae*, *Oligochaeta*, caddis flies, mayflies, dragonflies, snails, aquatic month, „water mites" *(Hydracarina)*, aquatic beetles, as well as some species of cladocerans, chiefly *Sididae* and *Chydoridae*.

On the investigated plants the most numerous group of animals were *Chironomidae*. The only exception was *Elodea canadensis*, on which *Ephemeroptera* were most numerous. From *Chironomidae* 63·3 per cent occurred on *Potamogeton lucens*, 81·5 per cent on *Myriophyllum spicatum*, and only 11 per cent on *Elodea canadensis*.

Among *Chironomidae* the greatest percentage share was found for *Cricotopus* ex gr. *sylvestris* (Fabr.), *C.* ? *versidentatus* Tsh., *Cryptochironomus* ex gr. *pararostratus* Lenz., *Endochironomus* ex gr. *tendens* Fabr., *E.* ex gr. *dispar* Mg., *Limnochironomus* ex gr. *nervosus* Staeg., and *Glyptotendipes* ex gr. *gripekoveni* Kieff.

The second place with regard to number was taken by *Oligochaeta*, from 9·4 *(Myriophyllum spicatum)* to 11·6 per cent *(Glyceria aquatica)*, and only 3·2 per cent on *Elodea canadensis*, followed by *Cladocera* from 1 per cent on *Elodea canadensis* to 13·2 per cent on *Polygonum amphibium*, *Gastropoda* from 0·3 per cent on *Batrachium aquatile* to 3·5 per cent on *Glyceria aquatica*, and as many as 20·5 per cent on *Elodea canadensis*; *Odonata* and *Ephemeroptera* from 0·5 per cent on *Polygonum amphibium* to 2·5 per cent on *Potamogeton lucens* and 25·2 per cent on *Elodea canadensis*; *Trichoptera* from 1 per cent on *Glyceria aquatica* to 5·3 on *Elodea canadensis*, followed in turn by *Hirudinea*, from 0·2 per cent on *Batrachium aquatile* to 2·5 per cent on *Glyceria aquatica* and 19 per cent on *Elodea canadensis*.

The remaining groups of animals were not very numerous and were of no great importance in the quantitative composition of this fauna. The average density of all species of the vegetation fauna per 1 litre of plants is shown in Fig. 5.

The development of this fauna was different from that of the bottom fauna. No sudden quantitative decreases in the vegetation fauna were observed even in the period of mass flights of adult insects. Perhaps it was brought about by the much shorter vegetation period of the plants which lasted about half a year.

A characteristic property of the vegetation fauna was the great stability of occurrence of more numerous species in the years of the investigations. The variability of dominance of certain species was only seasonally noted and depended on the length of the development cycles of individual species.

The comparative material of the vegetation fauna from other dam reservoirs is rather small because the majority of the investigators of this fauna worked on ponds and lakes, only certain selected groups of animals being taken into consideration.

The phytofauna of the dam reservoir at Goczałkowice is most similar to the vegetation fauna of the River Dniepr and its dam reservoirs (Fomenko 1964, Zimbalevskaja 1967a, b). The majority of species occurring in these reservoirs is similar to those which occur in the Goczałkowice reservoir and the dominance of certain groups of animals is similar *(Oligochaeta, Hirudinea,* and *Cladocera)*.

A great similarity of the vegetation fauna of the carp pond at Goczałkowice was also found (Kuflikowski 1970) but this might be brought about by the fact that the water to the above ponds was fed from the reservoir.

## Conclusions

1. On all the investigated plants the greatest numbers of species was found in the *Chironomidae* group.

2. The greatest number of animals were also found within the *Chironomidae* group, further groups being arranged in the following order: *Oligochaeta, Cladocera, Ephemeroptera* and *Odonata, Gastropoda,* and *Hirudinea.* The remaining groups had no great share in the quantitative composition of this fauna. On *Elodea canadensis* a quite different dominance was observed, *Chironomidae* being as far as the fourth place.

3. In the *Chironomidae* population the most numerous were *Cricotopus* ex gr. *sylvestris* (Fabr.), *C.* ? *versidentatus* Tsh., *Cryptochironomus* ex gr. *pararostratus* Lenz, *Endochironomus* ex gr. *tendens* Fabr., *E.* ex gr. *dispar* Mg., *Limnochironomus* ex gr. *nervosus* Staeg., and *Glyptotendipes* ex gr. *gripekoveni* Kieff.

4. The highest degree of constancy of occurrence was shown by *Cricotopus* ex gr. *sylvestris* (Fabr.), *Cryptochironomus* ex gr. *pararostratus* Lenz, *Endochironomus* ex gr. *tendens* Fabr., and *Cricotopus versidentatus* Tsh. Thus the vegetation fauna of the Goczałkowice reservoir may be classified as of the "*Cricotopus* ex gr. *sylvestris* — *Cryptochironomus* ex gr. *pararostratus* — *Endochironomus* ex gr. *tendens* — *Chricotopus* ? *versidentatus*" type.

5. The greatest intensity of development of the vegetation fauna occurred in July and August.

6. On the basis of the above investigations certain characteristic communities of animals on individual species of plants were found.

7. These communities of animals are more similar to each other on species of plants of similar morphological shape.

8. The greatest numbers of specimens of vegetation fauna were collected on *Batrachium aquatile* (1692 specimens/l.) and the smallest on *Elodea canadensis* (483 specimens/l.).

9. The quantitative and qualitative composition may in a certain degree be influenced by the distance from the bank, especially in *Chironomidae*, *Ephemeroptera*, *Odonata*, *Trichoptera*, and *Lepidoptera*.

## STRESZCZENIE

Celem powyższej pracy było zbadanie fauny naroślinnej w zbiorniku zaporowym w Goczałkowicach. Tworzenie się w nim dużych jednogatunkowych płatów roślinności może stwarzać specyficzne warunki dla pewnych grup zwierząt jak również i poszczególnych gatunków. Badania powyższe miały właśnie za zadanie wyśledzenie ewentualnych prawidłowości w rozmieszczeniu i strukturze tych ugrupowań.

Chodziło w nich również o ustalenie stopnia przywiązania poszczególnych gatunków czy grup zwierząt do danych gatunków roślin, może to bowiem w pewnej mierze określić wartość różnych skupień roślinnych jako siedlisk fauny naroślinnej stanowiącej pokarm dla ryb.

Materiał do badań pobierano w latach 1964—1967 w okresie od czerwca do września w odstępach miesięcznych. W badaniach tych zostały uwzględnione następujące gatunki roślin: *Batrachium aquatile*, *Myriophyllum spicatum*, *Polygonum amphibium*, *Potamogeton lucens*, *P. crispus*, *Elodea canadensis* i *Glyceria aquatica*.

Przy poborze prób zastosowano metodę objętościową polegającą na pobraniu jednego litra materiału roślinnego, a następnie oddzieleniu zwiarząt.

W wyniku przeprowadzonych badań stwierdzono:

1. Pewne charakterystyczne ugrupowania zwierząt na poszczególnych roślinach.

2. Ugrupowania tych zwierząt były bardziej zbliżone do siebie na gatunkach roślin o podobnym wyglądzie morfologicznym.

3. Stwierdzono odmienny przebieg rozwoju niż u fauny dennej. Nie notowano dużych spadków ilościowych fauny naroślinnej nawet w okresach masowych wylotów owadów dorosłych, co może jest powodowane krótszym okresem wegetacyjnym roślin.

4. Średnia gęstość zasiedlenia na poszczególnych gatunkach roślin wynosiła: na *Batrachium aquatile* 1692 os./l, *Myriophyllum spicatum* 1584 os./l, *Polygonum amphibium* 1266 os./l, *Potamogeton lucens* 1180 os./l, *P. crispus* 1060 os./l, *Glyceria aquatica* 824 os./l i *Elodea canadensis* 483 os./l.

5. Na wszystkich roślinach najliczniej reprezentowaną grupą były *Chironomidae*, od 63,3% na *Potamogeton lucens* do 81,5% na *Myriophyllum*. Wyjątek stanowiła tylko *Elodea canadensis* (11%), na której najliczniej wystąpiły *Ephemeroptera*.

6. Znaczny wpływ na rozmieszczenie fauny naroślinnej mogła mieć głębokość zanurzenia poszczególnych gatunków roślin. W zbiorniku goczałkowickim nie można było tego prześledzić, ponieważ skupienia tych samych gatunków roślin występują na podobnych głębokościach. Przypuszczenia te oparte są na podstawie rozmieszczenia fauny dennej zbiornika w strefie obrzeża i głębinowej (Zaćwilichowska 1965a, 1965b, 1965c).

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