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THE SHARE OF WATER MITES (*HYDRACARINA*) IN THE FOOD
OF THREE SPECIES OF FISH IN LAKE WARNAK

(*Ekol. Pol.* 18: 445—452). Water mites are common, however not a too numerous component of the food of tench, carp and crucian carp, their share in the food biomass is small, similar to their share in the biomass of the invertebrate fauna, which inhabits the environment. In fish alimentary canals smaller species dominate, contrary to the environment.

A problem of feeding of fish on water mites is a part of a wider and not well known problem: do water mites have an enemy in the natural environment, and who it is. On the basis of the results of laboratory experiments, and of literature review concerning the eating of water mites by predators (invertebrates as well as vertebrates) Cloudsley-Thompson (1947) has found that it was small. Bright colours of water mites are, according to him, an aposematic ones (warning colour of animals with uneatable flesh and of a repugnant taste). The opinion of Cloudsley-Thompson was recently confirmed among the others by Pritchard (1964). This author carried out

laboratory and field investigations upon the predation of dragonflies (*Anisoptera*). He found that apart from a wide spectrum of dragonflies food, and the lack of food preference, only *Hydracarina* and *Coleoptera* were liberated after being caught; however the *Hydracarina* were present in the food, but only to a small extent. It can be assumed, that predators reduce the numbers of water mites only to a very small extent. More considerable reduction of their numbers takes place probably during the early stages of their complicated development cycle, and especially in the stage of parasitic larvae (Pieczyński 1961, Mitchell 1964, Efford 1965). This thesis, supported only by some results of few papers needs further examination in other investigations.

Research on fish food (based on the analyses of alimentary canals contents) showed, that water mites are a seldom and not numerous component of fish food. This conclusion, based on the literature review, was introduced by Cloudsley-Thompson (1947) and supported later by Pliszka (1956), who said that water mites are, especially in summer, consumed by fish, but they never are even a secondary component of fish food. In many through papers on the fish food water mites are not even mentioned among the food components (among the others Vaas 1959, Lapinskajte 1961, Maksimova 1961).

The purpose of this paper was an estimation of the occurrence and share of water mites in the fish food and in the environment, among the fauna inhabiting the zone of lake overgrown by macrophytes.

AREA AND METHODS

The area of investigations was lake Warniak, with the surface area 38.4 ha and the mean depth 1.5 m, eutrophic, representing a type of a natural pond in the meaning of Stangenberg (acc. to Zachwieja 1965). The lake is overgrown with vegetation to a large extent; emergent macrophytes occupy 4.8 ha (with dominating *Phragmites communis* Trin.), submerged macrophytes overgrow 29.1 ha (*Ceratophyllum demersum* L. is a dominant among them) (Bernatowicz 1969). The investigations were carried out from May to September, 1967. In this period five fishings were done with a help of an electric aggregate on monthly intervals, and at the same time invertebrate fauna was sampled. Gut contents of three fish species were analysed: tench (*Tinca tinca* (L.)), carp (*Cyprinus carpio* L.) which was introduced into the lake for experimental reasons, and crucian carp (*Carassius carassius* (L.)). Quantitative samples of invertebrates were collected from the submerged vegetation zone with the help of Macan's sampler (of a sampling area 0.1 m²) – a modification used by Czechoslovakian hydrobiologists for pond investigations (Dvořák 1965). When sampling, the apparatus was sinking in soft bottom due to its considerable

weight, thus the sample contained not only the fauna inhabiting the vegetation, but also the surface layer of sediment. Samples were washed on a sieve with the mesh size 0.4×0.4 mm. A total of 75 samples were collected with this sampler on three sampling stations, at the depth 0.7–1.0 m. For a thorough knowledge of the qualitative composition of water mites, parallel samples were collected with the help of a dipper (a wire hoop of diameter 10 cm, fastened on a handle, with a bag made of a bolting cloth of a mesh size 0.25×0.25 mm sewed to a hoop; a sample consisted of 20 sweeps of a dipper). A total of 45 samples were collected with a help of a dipper.

RESULTS

Analysis of fish gut contents showed that water mites are a common, however not very numerous component of fish food, but their share in the food biomass is insignificant. All these parameters attained their highest values for crucian carp (Tab. I). A similar share of water mites in the food

The character of occurrence of water mites in alimentary canals of the investigated species of fish in lake Warniak

Period of investigations: May-September 1967; in frames – range

Tab. I

Elements compared	Tench	Carp	Crucian carp
Total number of investigated alimentary canals	131	67	68
Number of alimentary canals with food	98	61	56
Frequency of water mites in alimentary canals with food (in %)	23.5	41.0	60.7
Mean numbers of water mites in 1 alimentary canal with food	1.2 (0–42)	2.2 (0–29)	7.8 (0–45)
Share of water mites in the food biomass (in %)*	0.5 (0.0–1.1)	0.4 (0.0–1.0)	22.0** (4.5–40.0)

* Plankton crustaceans, molluscs and adult terrestrial insects, as well as plants and detritus were not included in the food biomass.

** When the numerous plankton crustaceans are included in the biomass of food of crucian carp, the share of water mites decreases down to 2.2%. Plankton crustaceans have an insignificant share in the food of tench and carp.

of crucian carp was found by Uspenskaja (1953) in lake Zarosloe, one of the five water bodies investigated by this author, which was similar to lake

The share of water mites in the total numbers and biomass of the invertebrate fauna (excluding molluscs) inhabiting the zone of submerged vegetation in lake Warniak

Mean values for the period May-September 1967, per 1 m² of the bottom area

N – numbers of individuals, B – biomass (in mg)

Average fresh weight of plants per 1 m² (data from the Macan's sampler): station I – 3.6 kg (*Chara* sp. 69.6%, *Stratiotes aloides* L. 29.9%), station II – 0.5 kg (*Ceratophyllum demersum* L. 68.1%, *S. aloides* 24.3%), station III – 1.2 kg (*C. demersum* 51.2%, *S. aloides* 47.2%)

Tab. II

Elements compared		Station I		Station II		Station III	
		Mean	Range	Mean	Range	Mean	Range
Whole fauna	N	7,629	3,672–15,856	5,055	2,088–10,018	5,491	2,326–8,828
	B	13,929	9,532–19,143	6,898	4,578–10,158	10,042	6,954–14,003
<i>Hydracarina</i>	N	133	28–316	21	10–34	88	16–188
	B	176	34–358	18	9–37	102	28–223
Share of <i>Hydracarina</i> (in %)	N	1.7	0.4–4.7	0.4	0.1–1.0	1.6	0.3–2.8
	B	1.3	0.2–2.6	0.3	0.2–0.5	1.0	0.2–2.8

Qualitative composition of water mites in fish alimentary canals and in the zone of submerged vegetation in lake Warniak

Framed — dominant forms, N — number of individuals

Tab. III

Species	Fish alimentary canals						Environment	
	Tench		Carp		Crucian carp		N	%
	N	%	N	%	N	%		
<i>Hydrachna</i> sp.	—	—	—	—	—	—	1	<0.1
<i>Eylais</i> sp.	—	—	—	—	—	—	1	<0.1
<i>Hydrodroma despiciens</i> (Müller 1776)	—	—	—	—	—	—	30	1.7
<i>Lebertia</i> sp.	—	—	—	—	—	—	2	0.1
<i>Oxus ovalis</i> (Müller 1776)	—	—	—	—	1	0.5	6	0.3
<i>Frontipoda musculus</i> (Müller 1776)	4	8.2	1	3.4	3	1.4	14	0.8
<i>Limnesia maculata</i> (Müller 1776)	1	2.0	—	—	—	—	433	24.3
<i>L. undulata</i> (Müller 1776)	2	4.1	—	—	—	—	40	2.2
<i>Hygrobates longipalpis</i> (Hermann 1804)	—	—	1	3.4	9	4.3	16	0.9
<i>Unionicola crassipes</i> (Müller 1776)	2	4.1	—	—	1	0.5	257	14.4
<i>Neumania vernalis</i> (Müller 1776)	—	—	2	6.9	—	—	3	0.2
<i>Hydrochoreutes krameri</i> Piersig 1894	—	—	1	3.4	2	1.0	39	2.2
<i>Piona coccinea</i> (Koch 1836)	—	—	—	—	7	3.4	192	10.8
<i>P. longipalpis</i> (Krendowskij 1878)	—	—	—	—	—	—	10	0.6
<i>P. neumani</i> (Koenike 1883)	—	—	—	—	—	—	8	0.4
<i>P. rotunda</i> (Kramer 1879)	—	—	—	—	—	—	72	4.0
<i>P. variabilis</i> (Koch 1836)	—	—	—	—	—	—	41	2.3
<i>Piona</i> sp. (nymphae)	—	—	—	—	—	—	76	4.3
<i>Forelia liliacea</i> (Müller 1776)	—	—	1	3.4	6	2.9	16	0.9
<i>Brachypoda versicolor</i> (Müller 1776)	1	2.0	9	31.0	138	66.7	32	1.8
<i>Midea orbiculata</i> (Müller 1776)	—	—	1	3.4	4	1.9	1	<0.1
<i>Mideopsis orbicularis</i> (Müller 1776)	3	6.1	6	20.7	30	14.5	26	1.5
<i>Arrenurus affinis</i> Koenike 1887	—	—	1	3.4	—	—	2	0.1
<i>A. albator</i> (Müller 1776)	1	2.0	1	3.4	3	1.4	—	—
<i>A. bicuspidator</i> Berlese 1885	—	—	—	—	—	—	97	5.5
<i>A. crassicaudatus</i> Kramer 1875	—	—	—	—	2	1.0	13	0.7
<i>A. latus</i> Barrois et Moniez 1887	2	4.1	—	—	—	—	—	—
<i>A. maculator</i> (Müller 1776)	—	—	—	—	—	—	1	<0.1
<i>A. tricuspikator</i> (Müller 1776)	4	8.2	—	—	—	—	188	10.6
<i>A. globator</i> (Müller 1776)	27	55.1	4	13.8	1	0.5	3	0.2
<i>A. perforatus</i> George 1881	2	4.1	1	3.4	—	—	26	1.5
<i>A. sinuator</i> (Müller 1776)	—	—	—	—	—	—	3	0.2
<i>Arrenurus</i> sp.	—	—	—	—	—	—	130	7.3
Total number of individuals	49		29		207		1779	
Number of species	11		12		13		29	

Warniak (shallow, muddy, 80% of the area overgrown by vegetation). The share of water mites in the food biomass of a crucian carp in lake Zarosloe was 19% (biomass without plankton crustaceans), or 1.8% (of the whole biomass), while in the material from lake Warniak 22.0 and 2.2%, respectively.

This insignificant share of water mites in the food biomass of fish (especially of tench and carp) can be explained by their character of occurrence in the zone of submerged macrophytes. The average share of water mites in the numbers as well as in the biomass of invertebrate fauna inhabiting this zone does not exceed 2% (Tab. II).

The species composition of water mites found in alimentary canals of fish is very differentiated (Tab. III). A total of 20 species were found in the fish gut contents, while in the zone of submerged vegetation – 29 species. For the investigated species of fish a similar number of species of water mites was found (11, 12 and 13), apart from significant differences in the numbers of investigated individuals. It is worth noticing, that the forms most numerous in the fish alimentary canals are not dominants in the environment (Tab. III). This result suggested an assumption, that possibility the sizes of individuals of particular species are of decisive significance (e.g. *Limnesia maculata* and *Arrenurus tricuspikator* – dominants in the environment, found in the alimentary canals only sporadically, are characterized by a large size; they are also bright coloured forms, contrary to many small forms). An analysis of size distribution of water mites in the alimentary canals showed that small forms (500–1000 μ) were real dominants, while in the environment they were not numerous. There is also a considerable share of larger forms (1000–2000 μ) in the environment (Fig. 1). It is worth mentioning that this is not a result of a bigger share of nymphs, in alimentary canals, which are much smaller.

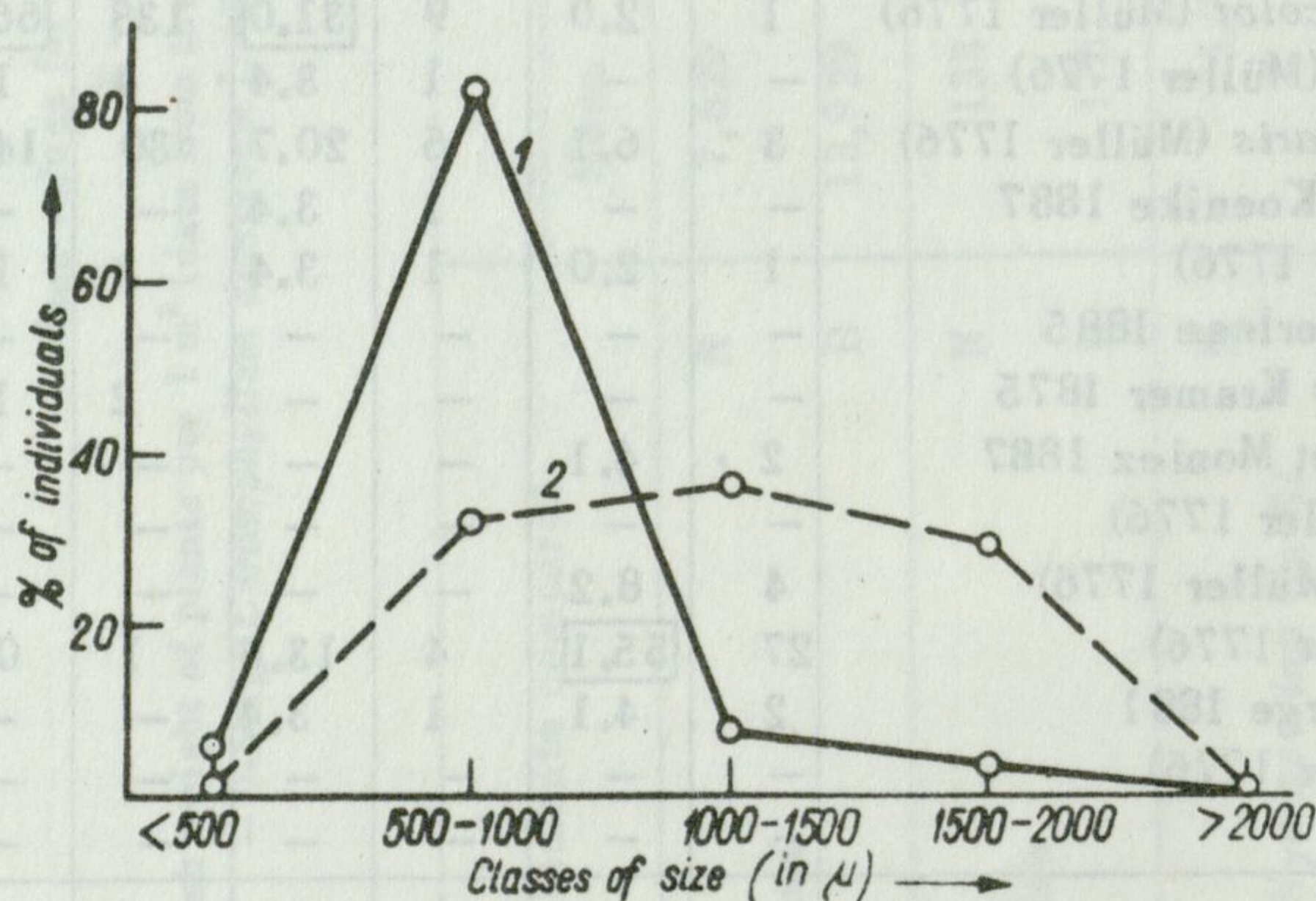


Fig. 1. Size distribution of water mites in fish alimentary canals (1) and in the environment (2)

On the contrary, the share of nymphs in gut contents is even lower than in the environment (7.3 and 32.9%, respectively).

Species of water mites, which dominate in fish gut contents are small and poorly coloured, and they are probably caught by fish incidentally, together with other representative of the invertebrate fauna, which form the basic part of food. Big, bright coloured species of water mites are avoided by fish. The thesis of incidental catching of small species of water mites can be applied not only to tench and carp, but also to crucian carp, where the share of water mites in food is relatively the highest. Plankton crustaceans are a numerous component of the food of crucian carp. Water mites are caught most probably from water together with these minute organisms.

REFERENCES

1. Bernatowicz, S. 1969 – Macrophytes in the lake Warniak and their chemical composition – *Ekol. Pol. A*, 17: 447–467.
2. Cloudsley-Thompson, J. L. 1947 – The edibility of *Hydracarina* – *Naturalist (London)*, 882: 166–168.
3. Dvořák, J. 1965 – Odhad produkce makrofauny původního porostu tvrdé vegetace kaprového rybníka – *Bul. VUR (Vodňany)*, 1: 7–16.
4. Efford, I. E. 1965 – Ecology of the watermite *Feltria romijni* Besseling – *J. Anim. Ecol.* 34: 233–251.
5. Lapinskajte, Ja. S. 1961 – Donnaja fauna prudov „Rita Ausma”, ee dinamika i rol v pitanii karpa – *Vilnius, avtoref.* 19 pp.
6. Maksimova, L. P. 1961 – Pitanie i stepen ispolzovanija estestvennyh i isskustvennyh kormov gibridami karpa s amurskim sazanom – *Izv. Gos. Naučn. issled. Inst. Ozern. rečn. rybn. choz.* 65–95.
7. Mitchel, R. D. 1964 – A study of sympatry in the water mite, genus *Arrenurus* (family *Arrenuridae*) – *Ecology*, 45: 546–558.
8. Pieczyński, E. 1961 – Numbers, sex ratio, and fecundity of several species of water mites (*Hydracarina*) of Mikołajskie Lake – *Ekol. Pol. A*, 9: 219–228.
9. Pliszka, F. 1956 – Znaczenie organizmów wodnych jako pokarmu ryb w świetle badań polskich – *Pol. Arch. Hydrobiol.* 3: 429–458.
10. Pritchard, G. 1964 – The prey of dragonfly larvae (*Odonata*, *Anisoptera*) in ponds in Northern Alberta – *Can. J. Zool.* 42: 785–800.
11. Uspenskaja, V. D. 1953 – Pitanie obyknovennogo karasja v uslovijach pojmenennyh ozer r. Kljazmy – *Trudy vsesojuzn. gidrobiol. Obšč.* 5: 349–364.
12. Vaas, K. F. 1959 – Studies on the production and utilization of natural food in Indonesian carp ponds – *Hydrobiologia*, 4: 308–392.
13. Zachwieja, J. 1965 – Obserwacje nad całkowitym zanikiem tlenu w jeziorze Warniak podczas zimy 1959/1960 – *Pol. Arch. Hydrobiol.* 13 (26): 29–41.

UDZIAŁ WODOPÓJEK (*HYDRACARINA*) W POKARMIE TRZECH GATUNKÓW RYB W JEZIORZE WARNIAK

Streszczenie

Analizowano występowanie wodopójek w przewodach pokarmowych trzech gatunków ryb (lin, karp i karaś) oraz w strefie roślinności zanurzonej jeziora, w okresie maj-wrzesień 1967 r. Stwierdzono, że wodopójki są częstym choć niezbyt licznym komponentem pokarmu ryb, a ich udział w biomacie pokarmu jest nieznaczny (tab. I), zbliżony do udziału w biomacie fauny bezkręgowej zasiedlającej środowisko (tab. II). Skład jakościowy wodopójek notowanych w przewodach pokarmowych ryb jest bardzo zróżnicowany, przy czym dominują inne gatunki niż w środowisku (tab. III). Wynika to z faktu że w przewodach pokarmowych wyraźnie przeważają gatunki o drobnych rozmiarach, podczas gdy w środowisku nie należą one do najliczniejszych i duży udział mają formy o znacznych rozmiarach (fig. 1). Gatunki wodopójek o drobnych rozmiarach i słabym ubarwieniu są prawdopodobnie chwytane przez ryby przypadkowo, razem z innymi przedstawicielami fauny bezkręgowej, stanowiącymi podstawowy składnik pokarmu. Gatunki wodopójek o dużych rozmiarach i jaskrawym ubarwieniu są przez ryby omijane.

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