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STUDIES ON THE FEEDING OF PLANKTONIC POLYPHAGE *ASPLANCHNA PRIODONTA* GOSSE *(ROTATORIA)**

ABSTRACT: Food composition and feeding intensity of *Asplanchna priodonta* Gosse have been studied. Direct hourly observations and a survey of stomachs of fixed females show that *Asplanchna priodonta* is a polyphagous species with a strong preference for animal food.

1. INTRODUCTION

Asplanchna priodonta Gosse is one of the biggest (body length up to 1.5 mm) rotifer species in plankton, and is also abundant and common in different types of waters (freshwater and brackish water – Kutikova 1970). In the lakes of the temperate zone it is a dicyclic species – the males appear in periods of maximum population numbers, i.e. in spring and autumn (Hutchinson 1967, Bregman 1968, Comita 1972, Hillbricht-Ilkowska et al. 1972). During the mass appearance of this species its biomass may attain 95% of total biomass of zooplankton as shown by the example of dystrophic lake Smolak (unpublished material). Studies on feeding of this rotifer species carried out in field on the remains found in alimentary canals (Erman 1962, Galkovskaya 1963, Nauwerck 1963, Hillbricht-Ilkowska et al. 1972) and in laboratory conditions (Pourriot 1965) show that this species may feed both on animal food (small crustaceans, rotifers) and on plant food (diatoms, blue-green algae). Some scientists consider this species as an obligatory predator (Sorokin and Mordukhaï-Boltovskaya 1962, Galkovskaya 1963, Bregman 1968, Dumont 1972) others – as a polyphage

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(Tribush 1960, Nauwerck 1963, Gliwicz 1969). Thus the necessity of studying each time the food preference in order to find the place of the species in the trophic structure of the examined wated body. Unlike the majority of rotifers, which feed by means of filtering particles drawn towards them by cilia, *Asplanchna* catches the food actively and swallows the prey in one piece (without tearing to pieces), thus proving its predatory character.

2. FIELD, AIM OF RESEARCH AND METHODS

The studies were conducted in two lakes with different trophy: Mikołajskie Lake (eutrophic, 460 ha of surface, mean depth 11 m) and lake Tałtowisko (b-mesotrophic, 327 ha of surface, mean depth 14 m) (Pieczyńska 1972).

The following were estimated: 1) food composition in alimentary canals of *A. priodonta* females from samples taken from February to November 1971; 2) food preference using Ivlev's index on the basis of not preserved material samples once in both lakes and during the maximal development of *A. priodonta* (October 1971); 3) method of food sampling and feeding intensity of *Asplanchna* according to the hourly observations of females (in vitro) during the abundant occurrence of *Ceratium hirundinella* in Mikołajskie Lake.

Food preference was estimated by comparing the food composition in the environment and the composition of remains in alimentary canals of *Asplanchna* females. The alimentary canals of females from the environment were surveyed under the microscope without preparation (making use of their transparency), identified and the number of remains was assessed. The total of 2 000 females from the material obtained in October 1971 from both lakes during the greatest abundance of *Asplanchna priodonta* in both lakes (several thousands of individuals/m^3), were surveyed. The material quantitatively sampled from February to November 1971 was used to make a list of organisms consumed by *A. priodonta*

In the period of mass development of *Ceratium hirundinella* i.e. in July and August, (this is an abundant species in Mikołajskie Lake of a size approximate to that of small rotifers consumed by *A. priodonta*) and numerous occurrence of *Asplanchna priodonta* hourly (in vitro) observations of isolated females were made. The females were placed on a Petri dish with concentrated natural food (consisting mainly of *Ceratium hirundinella)* at temperature close to that of surface lake layers (about 20°C). Recorded were: time of swallowing food, time of expelling the remains, food composition, and behaviour of the female. 100 hourly observations were made.

3. RESULTS

In both lakes *A. priodonta* occurs from early spring till late autumn from several tens to 8000 individuals per 1 m^3 (Mikołajskie Lake) and 6500 individuals (lake Tałtowisko). The maximum takes place in autumn, when the phytoplankton abundance decreases considerably. In the period preceding the maximum of *A. priodonta*, it has been observed

in both lakes that the numbers of rotifers increase (such as *Keratella cochlearis* Gosse, *Pompholyx sulcata* Hudson, *Trichocerca* sp., *Polyartha* sp.).

The percentage of empty stomachs among *A. priodonta* individuals collected all year and of those sampled in October 1971 from Mikołajskie Lake and lake Tałtowisko is similar (about 50%). In the material from October the percentage of stomachs having remains that could be identified was 37% for Mikołajskie Lake and 25% for lake Tałtowisko. In case of individuals from Mikołajskie Lake 567 food components were identified, for those in lake Tałtowisko – 402. Animal remains were 67% of all remains found in individuals from Mikołajskie Lake, and only 38% of those from lake Tałtowisko. These remains were mainly the cuticles of *Keratella cohlearis* Gosse (66% – in Mikołajskie Lake and 33% – in lake Tałtowisko) – a species, which in October 1971 was estimated as 70 individuals/l in Mikołajskie Lake and 115 individuals/l in lake Tałtowisko. Less frequently were found the remains of other small rotifers *(Keratella quadrata* Müller, *Pompholyx sulcata* Hudson, *Chromogaster ovalis* Bergendal, *Trichocerca* sp., *Polyarthra* sp.), which occured there in smaller numbers (only few individuals/l). The main food of *A. priodonta* in lake Tałtowisko were *Fragilaria* colonies (51% of all remains – Tab. I), whereas in Mikołajskie Lake the remains of infusorian *Codonella* reached 27%. Other diatoms (several tens to several thousands/l),although infrequently, were also found in stomachs.

Tab. I. Food preference of *Asplanchna priodonta*

g – percentage of food component in total number of components found in stomachs, *e* – percentage of food component in food complex in environment, *S* – value of Ivlev's index

Food component	Mikołajskie Lake			Lake Tałtowisko		
	g	*e*	*S*	*g*	*e*	*S*
Keratella cochlearis	66.02	1.84	0.94	33.18	3.84	0.79
Keratella quadrata				1.81	0.19	0.81
Chromogaster sp.	0.71	0.03	0.92			
Trichocerca sp.	0.35	0.03	0.84			
Polyarthra sp.	0.35	0.03	0.84	1.46	0.63	0.40
Pompholyx sulcata				2.76	1.09	0.44
Codonella	27.28	0.28	0.98	1.57	0.37	0.62
Ceratium hirundinella	0.35	0.09	0.59	0.40	0.19	0.36
Cyclotella	0.71	0.59	0.09	1.71	11.10	–0.73
Fragilaria	1.23	5.58	–0.64	50.63	56.31	–0.05
Melosira	1.06	50.67	–0.96	1.81	17.55	–0.81
Synedra	1.06	16.04	–0.88			
Tabellaria	0.88	24.82	–0.93	4.64	8.73	–0.30
	100.00	100.00		100.00	100.00	

The comparison of these two lakes shows that the contribution of animal food is higher in the more fertile lake (Mikołajskie Lake).

According to the material obtained in October 1971, the food preference of *A. priodonta* has been estimated using Ivlev's index of food preference (I v l e v 1955) used for invertebrates by G l i w i c z (1969):

$$S = \frac{g - e}{g + e}$$

where: g – percentage of a given food component in stomachs of *A. priodonta*;
e – percentage of a given food component in the food complex in the environment (food complex – list of organisms consumed by *A. priodonta* on the basis of material collected all year – Tab. II).

Tab. II. List of remains found in stomachs of *Asplanchna priodonta*
+++ – organisms found very frequently,
++ – frequently found organisms,
+ – rarely found organisms

Animal remains	
Keratella cochlearis	+++
K. quadrata	++
Polyarthra sp.	+
Trichocerca sp.	+
Chromogaster ovalis	+
Pompholyx sulcata	++
Gastropus stylifer Imhof	+
Rotifers' eggs	++
Codonella	+++
Plant remains	
Fragilaria (colonies)	+++
Tabellaria (colonies)	++
Synedra	+
Melosira (colonies)	++
Asterionella (colonies)	++
Cyclotella	+
Pediastrum	+
Ceratium hirundinella	+++
Blue-green algae	+

Index of food preference attains the highest values in case of animal organisms, including the infusorian *Codonella*, whereas it is close to zero for plant organisms, and is negative in majority of cases (Tab. I). According to this, it can be said, that *A. priodonta* is selective towards animal food. The comparison of both lakes allows to observe considerable differences in the value of Ivlev's index in relation to particular organisms. The general tendency of the indicated above preference of animal food is strongly marked in both lakes. The animal food consists mainly of small rotifers, mostly *Keratella cochlearis* (80–120 μ), *Pompholyx sulcata* (110–130 μ), *Keratella quadrata* (200–300 μ), *Chromogaster ovalis* (100–200 μ) and also *Polyartha* sp. Bigger rotifers from the *Filinia* and *Brachionus* genera, or representatives of *Cladocera* (also juvenile forms), despite their pre-

sence in the environment have not been found, which contradicts the data given by W a n i c z e k (1930), P a w ł o w s k i (1958) and G l i w i c z (1969).

The direct observations show that together with the increasing food density (number of *Ceratium* individuals/l) the number of effective gulps increases. Thus the feeding intensity of *A. priodonta* is proportional to the amount of food in the environment (Fig. 1, Tab. III).

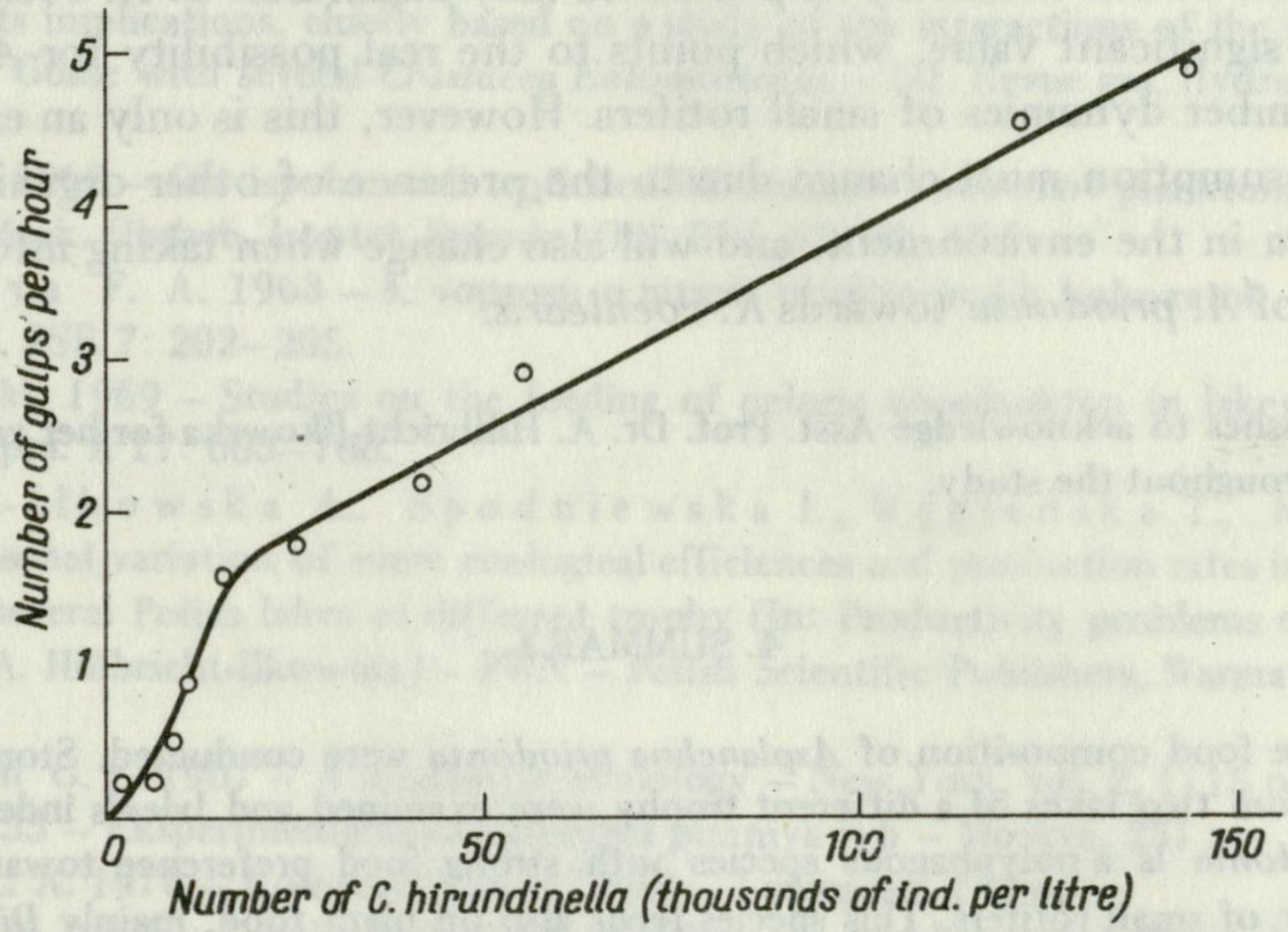

Fig. 1. Number of effective gulps in one hour depending on the density of *Ceratium hirundinella*

Tab. III. Number of effective gulps and mean time between gulps depending on the density of *Ceratium hirundinella*

Density of *C. hirundinella* (thousands of ind./1)	Number of gulps in 1 hour	Mean time between gulps (in minutes)
100–150	4.7	4.8
50–100	2.5	8.6
0–50	1.0	12.1

The mean time between gulps was 8 minutes and became shorter as the food density increased. This time was only longer in case of females, which rest after bearing young ones.

It has observed that *A. priodonta* can accumulate food (individuals) in stomach. The mean time of keeping a portion of food was about 14 min.; maximal number of individuals accumulated in a stomach was 11, and the average one – 2. Food digestion takes place quickly and variously digested remains are expelled.

These data allow to characterize the possible reducing effect of *Asplanchna* on the number of prey. And so, during the greatest density of *C. hirundinella* in Mikołajskie Lake (about 15×10^6 individuals/m^3), at an abundance of *A. priodonta* equal 375 indivi-

duals/m^3 this rotifer may reduce daily 1% of population of *Dinoflagellates*. This does not seem to be of great significance for the number dynamics of *Ceratium hirundinella*.

Assuming that the feeding intensity of *A. priodonta* with *Keratella cochlearis* individuals is similar to the intensity of feeding with cells of *Dinoflagellates* (the size of individuals is very similar), it can be calculated that at a high number of *A. priodonta* (about 20 individuals/l) and mean number of *K. cochlearis* (about 100 ind./l) the daily consumption rate of this rotifer by *A. priodonta* may attain 20% of *K. cochleraris* population. This is a significant value, which points to the real possibility for *A. priodonta* to control the number dynamics of small rotifers. However, this is only an estimated value, as the real consumption must change due to the presence of other organisms consumed by *A. priodonta* in the environment, and will also change when taking into consideration the selectivity of *A. priodonta* towards *K. cochlearis*.

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4. SUMMARY

Studies on the food composition of *Asplanchna priodonta* were conducted. Stomachs of *A. priodonta* females from two lakes of a different trophy were examined and Ivlev's index was calculated (Tab. I). *A. priodonta* is a polyphagous species with strong food preference towards animal food, consisting mainly of small rotifers. This species feeds also on plant food, mainly *Dinoflagellates* and diatoms (*Ceratium*, *Fragilaria*, *Astërionella* and others), and in some periods on green algae (Tab. II). In lakes with higher trophy (eutrophic Mikołajskie Lake) the contribution of animal food is higher than in the poorer lake (mesotrophic lake Tałtowisko). Direct hourly observations of live females of *A. priodonta* show that the feeding intensity of this species on *Ceratium hirundinella* is proportional to the prey density in the environment (Fig. 1). The mean time between gulps increases and the number of gulps decreases together with decreasing density of prey (Tab. III). The results of studies point to the possibility for *A. priodonta* to control the number dynamics of small rotifers. This has not been observed in the case of plant organisms.

5. POLISH SUMMARY (STRESZCZENIE)

Przeprowadzono badania nad składem pokarmu *Asplanchna priodonta*. Przejrzano żołądki samic *A. priodonta*, pochodzących z dwóch jezior o różnej trofii i obliczono wskaźnik Ivleva (tab. I). Stwierdzono, że *A. priodonta* jest gatunkiem wszystkożernym z wyraźną wybiórczością w kierunku pokarmu zwierzęcego, składającego się głównie z drobnych wrotków. Gatunek ten odżywia się również pokarmem roślinnym, głównie bruzdnicami i okrzemkami (*Ceratium*, *Fragilaria*, *Asterionella* i in.), a w pewnych okresach również glonami zielonymi (tab. II). W jeziorze o większej trofii (eutroficzne Jezioro Mikołajskie) udział pokarmu zwierzęcego był większy niż w jeziorze uboższym (mezotroficzne jezioro Tałtowisko). Na podstawie bezpośrednich godzinnych obserwacji żywych samic *A. priodonta* stwierdzono, że intensywność żerowania tego gatunku na *Ceratium hirundinella* jest proporcjonalna do zagęszczenia ofiary w środowisku (fig. 1). Średni czas między połknięciami wzrastał, a liczba połknięć malała przy zmniejszaniu się zagęszczenia ofiar (tab. III). Wyniki badań wskazują na realną możliwość kształtowania dynamiki liczebności drobnych wrotków przez *A. priodonta*. Nie stwierdzono tego w przypadku organizmów roślinnych.

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