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Head: Professor Kazimierz Tarwid

Mirosława TARWID

ANALYSIS OF THE CONTENTS OF THE ALIMENTARY TRACT
OF PREDATORY *PELOPIINAE* LARVAE (*CHIRONOMIDAE*)*

Dissection of 122 alimentary tracts of *Procladius* sp. and *Pelopia punctipennis* L. led the author to the conclusion that under the conditions prevailing in eutrophic lakes *Procladius* is a predatory animal supplementing its diet with algae, while *Pelopia* is predatory to a slight degree only. Observations were made to ascertain the influence of regurgitation of part of the food, when formalin was used as a preserving agent, on the results of dissection and analysis of alimentary tracts.

Studies were made of two species, *Procladius* sp. and *Pelopia punctipennis* L., taken from three lakes in the Mazurian lake district: Lake Śniardwy (eutrophic, polymictic), Mikołajskie Lake (eutrophic, holomictic), and Lake Tałtowisko (mesotrophic, holomictic).

Analysis of the composition and amount of food of predatory *Chironomidae* larvae, on the basis of the contents of the alimentary tract, is difficult as these larvae under the influence of preserving agents regurgitate part of their food. The data obtained from dissecting alimentary tracts are therefore incomplete.

*Material collected and analysed in the Hydrobiological Laboratory under the guidance of Doc. Dr. Z. Kajak (Institute of Ecology, Polish Academy of Sciences).

Comparison of the full composition of the food of *Procladius* sp. with components of the food after part of it has been regurgitated as the result of preservation (mean contents of 1 alimentary tract)

Tab. I

Composition of food	Contents of alimentary tract after preservation	Regurgitated part of food	Whole contents of alimentary tract
	A	B	A+B
<u>Crustacea</u>			
<i>Cladocera</i>	0.38	0.31	0.69
<i>Copepoda</i>	0.21	0.03	0.24
<i>Ostracoda</i>	—	0.08	0.08
not identified	0.27	0.14	0.41
eggs of <i>Cladocera</i>	0.27	0.03	0.30
eggs of <i>Copepoda</i>	0.08	—	0.08
eggs non identified	0.03	—	0.03
	1.24 (68%)	0.59 (32%)	1.83 (100%)
<u>Algae</u>			
<i>Pediastrum</i>	—	0.14	0.14
<i>Pinnularia</i>	0.03	0.03	0.06
<i>Cymatopleura</i>	0.11	—	0.11
<i>Surirella</i>	0.03	—	0.03
<i>Navicula</i>	0.03	0.08	0.11
<i>Melosira</i>	0.08	—	0.08
<i>Cymbella</i>	0.11	0.11	0.22
<i>Amphora</i>	0.03	0.03	0.06
<i>Gyrosigma</i>	0.03	0.08	0.11
<i>Cyclotella</i>	0.11	0.50	0.61
<i>Diatoma</i>	0.03	0.08	0.11
<i>Caloneis</i>	0.03	—	0.03
<i>Epitemia</i>	—	0.08	0.08
<i>Anabena</i>	—	0.14	0.14
non identified	0.03	0.14	0.17
	0.65 (32%)	1.41 (68%)	2.06 (100%)
<u>Chironomidae</u>			
non identified	0.21 (87%)	0.03 (13%)	0.24 (100%)

The alimentary tracts of 85 fully-grown larvae were dissected and analyses were made of the contents during the period from May to July 1963. Investigation was made of part of the material to discover how much (what percentage) of their food is returned by the larvae while preserving with in 4% formalin, and whether the residue in the alimentary tract is representative from the aspect of qualitative composition.

Comparison of the full composition of the food of *Pelopia punctipennis* with the components of the food after part of it has been regurgitated as the result of preservation (mean contents of 1 alimentary tract)

Tab. II

Composition of food	Contents of alimentary tract after preservation	Regurgitated part of food	Whole contents of alimentary tract
	A	B	A+B
<u>Crustacea</u>			
<i>Cladocera</i>	1.0	0.8	1.8
eggs of <i>Cladocera</i>	0.2	0.2	0.4
eggs of <i>Copepoda</i>	—	0.2	0.2
	1.2 (50%)	1.2 (50%)	2.4 (100%)
<u>Algae</u>			
<i>Pediastrum</i>	0.8	0.2	1.0
<i>Pinnularia</i>	0.8	—	0.8
<i>Cymatopleura</i>	1.2	—	1.2
<i>Surirella</i>	0.6	0.2	0.8
<i>Navicula</i>	1.4	1.2	2.6
<i>Melosira</i>	1.8	0.8	2.6
<i>Cymbella</i>	0.8	0.2	1.0
<i>Amphora</i>	2.6	2.4	5.0
<i>Gyrosigma</i>	5.4	1.2	6.6
<i>Cyclotella</i>	0.4	0.2	0.6
<i>Diatoma</i>	—	0.4	0.4
<i>Epitemia</i>	—	0.2	0.2
<i>Nitzschia</i>	0.4	0.6	1.0
<i>Campylodiscus</i>	—	0.2	0.2
<i>Fragilaria</i>	0.2	0.4	0.6
<i>Oscillatoria</i>	0.4	0.2	0.6
	16.8 (67%)	8.4 (33%)	25.2 (100%)
<u>Chironomidae</u>			
not identified	0.2	0.2	0.4

For this purpose, in order to achieve uniformity of the contents of the alimentary tract, 37 larvae were kept in an aquarium and next preserved in separate test tubes in order to be able to compare the amount and composition of the food returned and that retained in the alimentary tract.

This analysis made it possible to obtain information on the ratio of regurgitated food to that retained in the alimentary tract (Tab. I, II), which showed that *Pelopia* ejects about 1/2 of animal food and about 1/3 of plant food, and *Procladius* — 1/3 of animal food and 2/3 of plant food.

Nevertheless, as far as the composition of food and the quantitative relations of its various components are concerned, although they are subject to some alteration in preserved individuals of both species (as the result of partial regurgitation of food) yet from the qualitative aspect they correspond to the complete initial composition of the food and permit of making a general assessment of quantitative relations. It is thus possible, on the basis of data from dissection of preserved material, to arrive at approximate conclusions as to the food preferences of the species examined (cf. list of algae).

Taking these data as a starting point, use was made of dissected material from 43 *Procladius* sp. larvae for comparison of the composition of the food of these larvae from the three lakes mentioned above (Tab. III). *Pelopia punctipennis* L. from Lake Śniardwy, represented by only 5 individuals, was also included in this table. On account of the very uniform character of the food of all the individuals of this species and the very striking difference in relation to *Procladius* sp. these data make it possible to assess this difference correctly.

As larvae of one species from the same lake had very similar composition of their food, comparison and analysis was made jointly for all the dissected larvae, distinguishing only between the different lakes.

In respect of the degree to which these two species are predatory, by many authors they are considered, on the basis of the presence in their alimentary tract of both animal and plant food, as forms with mixed food preferences (Belavskaja and Konstantinov 1956; Konstantinov 1958; Lufarov 1958). Kajak and Pieczyński (1966) in their experiments showed that these same species feed on *Chironomidae* larvae, although it does not form their main food, this applying particularly to *Pelopia punctipennis*. *Procladius* is considered to be more predatory than *Pelopia*. The comparison given in tables I and II confirms this view.

When we consider food from the aspect of its composition (Tab. III) we can see that *Procladius* sp. consumes far more varied crustacean food than *Pelopia punctipennis*. The differences between different lakes are minimal for *Procladius*. The amounts of algal food in the alimentary tracts of *Procladius* larvae from lakes Mikołajskie and Tałtowisko are very small, whereas in larvae from Lake Śniardwy the amounts are relatively great and very heterogeneous, as in the case of *Pelopia punctipennis*, for which algae appear to form their basic food.

Animal food formed the chief component of the food consumed by *Procladius* sp. larvae from Mikołajskie and Tałtowisko lakes and is also abundant in larvae from Śniardwy, contrary to *Pelopia*, despite the generally held opinion that this form is predatory. Similarly Kajak (1958) found in the old river bed of the Vistula that *Pelopia kraatzi* Kieff. was phytophagous as distinct from *Procladius* sp., which is predatory.

Comparison of the contents of alimentary tracts of *Procladius* sp. from three lakes, and of *Pelopia punctipennis* from Lake Śniardwy

Tab. III

Qualitative composition of food	<i>Procladius</i> sp.			<i>Pelopia punctipennis</i>
	Lake			Lake Śniardwy
	Mikołajskie	Tałowisko	Śniardwy	
<i>Crustacea</i>				
<i>Cladocera</i>	2.0	1.8	1.3	1.6
<i>Copepoda</i>	0.5	1.4	0.3	—
<i>Ostracoda</i>	0.1	0.3	0.1	—
not identified	0.9	0.2	0.7	—
eggs of <i>Cladocera</i>	1.3	—	0.1	0.8
eggs of <i>Copepoda</i>	0.2	0.3	0.2	—
unidentified eggs	—	0.1	0.1	—
<i>Harpacticidae</i>	—	0.1	—	—
	5.0 (83%)	4.2 (81%)	2.8 (35%)	2.4 (1%)
<i>Algae</i>				
<i>Pediastrum</i>	—	—	—	2.4
<i>Pinnularia</i>	—	—	—	2.8
<i>Cymatopleura</i>	0.2	—	0.2	8.8
<i>Surirella</i>	—	—	0.1	4.6
<i>Navicula</i>	0.2	—	0.4	94.4
<i>Melosira</i>	—	—	0.2	4.6
<i>Cymbella</i>	—	—	0.2	8.6
<i>Amphora</i>	0.1	—	0.3	60.6
<i>Gyrosigma</i>	—	—	0.1	20.6
<i>Stauroneis</i>	—	—	0.2	0.8
<i>Cyclotella</i>	—	—	0.1	4.2
<i>Diatoma</i>	—	—	0.1	13.4
<i>Epitemia</i>	—	—	—	0.4
<i>Nitzschia</i>	—	—	0.1	38.0
<i>Campylodiscus</i>	—	—	—	5.0
<i>Rhopalodia</i>	—	—	0.1	3.6
<i>Caloneis</i>	—	—	0.1	1.4
<i>Synedra</i>	—	—	0.1	35.4
<i>Pleurosigma</i>	—	—	—	3.0
<i>Fragilaria</i>	—	0.6	—	2.2
<i>Oscillatoria</i>	—	—	0.6	4.2
<i>Closterium</i>	—	0.1	—	—
not identified	—	—	1.5	—
	0.5 (8%)	0.7 (15%)	4.4 (56%)	319.0 (99%)
<i>Rotatoria</i>				
not identified	0.1 (1%)	0.1 (2%)	—	—
<i>Turbellaria</i>				
not identified	—	0.1 (2%)	—	—
<i>Chironomidae</i>				
not identified	0.4 (8%)	—	0.7 (9%)	—

Comparison of percent of filled alimentary tracts and percent of alimentary tracts with animal residue in larvae of *Procladius* sp. and *Pelopia punctipennis*

Tab. IV

		<i>Procladius</i> sp.			<i>Pelopia punctipennis</i>
		Lake			Lake
		Mikołajskie	Tańtowisko	Śniardwy	Śniardwy
All individuals	per cent of empty tracts	31	24	10	0
	per cent of full tracts	69	76	90	100
Individuals with full alimentary tracts	per cent of tracts with animal residue	100	94	100	60
	per cent of tracts without animal residue	0	6	0	40

The above conclusions are confirmed by statistics of filled and empty alimentary tracts, and also tracts in which animal residue was found, and those without animal residue (Tab. IV). Animals predominate in the food of *Procladius* sp., whereas in *Pelopia punctipennis* we found a far higher percentage of alimentary tracts in which there was no animal residue.

The number of individuals with empty alimentary tracts in material directly obtained from the lakes was as high as 30% in the case of *Procladius*. Similar data were obtained by Belavskaja and Konstantinov (1956), Konstantinov (1958) and Lufarov (1961).

In the light of the data on which Table I is based it was established that *Procladius* never regurgitates the whole of the food, but only part of it. It may therefore be concluded that the above field data on the number of empty alimentary tracts are to a great extent reliable.

Attention must be drawn to the fact that the contents of alimentary tracts are given in numbers of individuals of prey in Tables I, II and III. When treated in this way it is clear that *Cladocera* greatly predominates in the animal food, but if we treat it in units of biomass, representatives of *Chironomidae* are

approximately equal to crustaceans. The percentage of algae also would of course be considerably smaller from the aspect of biomass. On the other hand, according to the views put forward by Luferov (1961), the percentage of crustaceans may be overestimated as the result of the shells of these animals being retained in the terminal part of the alimentary tract.

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ANALIZA ZAWARTOŚCI PRZEWODÓW POKARMOWYCH DRAPIEŻNYCH LARW PELOPIINAE (CHIRONOMIDAE)

Streszczenie

Dokonano sekcji i analizy zawartości przewodów pokarmowych 85 wyrośniętych larw *Procladius* sp. i *Pelopia punctipennis* L. z trzech różnych limnologicznie jezior. Stwierdzono, iż przy konserwowaniu w 4% formalinie larwy *Pelopia* zwracają około 1/2 pokarmu zwierzęcego i 1/3 roślinnego, zaś *Procladius* około 1/3 pokarmu zwierzęcego i 2/3 roślinnego (tab. I, II).

U *Procladius* przeważa pokarm zwierzęcy, a u *Pelopia* – roślinny (tab. III, IV). Udział glonów w pokarmie larw *Procladius* z jeziora polimiktycznego (Śniardwy) jest znacznie większy niż w dwóch pozostałych jeziorach.

AUTHOR'S ADDRESS:

Mgr. Mirosława Tarwid,
Instytut Ekologii PAN,
Warszawa, ul. Nowy Świat 72,
Poland.