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POSSIBILITIES OF USING ZOOPLANKTON REMOVED BY THE RIVER PŁONIA FROM LAKES TO FEED YOUNG FISH

MOŻLIWOŚCI WYKORZYSTANIA ZOOPLANKTONU WYNOSZONEGO Z JEZIOR PRZEZ RZEKĘ PŁONIĘ DO KARMIENIA NARYBKU

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The biomass of zooplankton removed by the river Płonia from the lake Płoń, amounting to ca 135 000 kg a year, can serve as food for about 5 million young fishes. There is a possiblity of utilizing this biomass to feed young fish cultured in ponds or cages.

INTRODUCTION

The fish culturists look forward to solving the problem of obtaining large quantities of zooplankton to feed young fish. Waters leaving certain lakes are possible sources of this valuable a natural food (Szlauer, 1974). The present paper is aimed at determining the biomass of zooplankton removed from the lakes Płoń and Żelewko, and indicating practical means of using these resources to feed young fish.

AREA AND METHODS OF STUDY

The investigations were carried out from October 1971 through October 1972 at two sites in the river Płonia (northwestern Poland). Site I was placed 100 m off the lake Płoń, while Site II in the village of Kołbacz, 1500 m off the lake Żelewko. Each month at the two sites the river flow and water temperature were measured and plankton collected from 200 l of water. Each time plankton was sampled twice: in the daytime and after

Table 1

Water flux and thermal conditions in the river Płonia behind the lakes Płoń (st. I) and Żelewko (st. II)

Hydrological data	Date	15 X	29 XI	17 XII	14 I	17 II	16 III	15 IV	24 V	15 VI	17 VII	18 VIII	15 IX	20 X.	annual mean
		1971			1972										
Water flux m^3/sec.	st. I	1.25	1.81	2.17	1.67	1.51	2.02	2.02	1.49	1.09	0.95	1.68	1.28	1.46	1.58
	st. II	2.52	2.71	2.93	1.82	3.21	3.70	3.75	3.34	1.82	0.85	1.35	2.10	2.58	2.51
Mean current velocity m/sec.	st. I	0.85	1.02	1.23	0.83	1.03	1.26	1.25	1.13	0.61	0.58	1.11	1.04	1.00	1.00
	st. II	0.26	0.36	0.38	0.21	0.45	0.55	0.54	0.46	0.26	0.16	0.19	0.27	0.35	0.34
Temperature °C	st. I	10.8	0.8	4.3	0.0	3.2	3.5	10.4	18.2	17.7	27.0	–	17.7	7.7	10.1
	st. II	10.8	2.8	4.7	0.0	1.5	3.0	9.2	17.0	17.3	22.2	19.4	15.5	8.1	10.1

dusk. The planktonic animals were counted and their biomass calculated basing on methods and table given by Kosova (1961), Hillbricht-Ilkowska and Patalas (1967), and Čislenko (1968). The biomass (mean of the day and night values) multiplied by the number of cubic metres flowing in the river resulted in the wet weight (biomass) of zooplankton removed from a lake per a time unit.

The lakes supplying the river Płonia with zooplankton differed in various aspects. The lake Płoń of 790 ha area and 4.5 m maximum depth belonged to an advanced eutrophication pond type. The lake Żelewko of 68 ha area and 6.5 m maximum depth had its entire bottom covered with submerged vegetation; the river Płonia affected the lake to a great extent by introducing waters from the mesotrophic lake Miedwie.

RESULTS

Current velocity, flows and thermal conditions in the river Płonia at Site I and II are presented in Table 1. Płonia leaves the lake Płoń through an artificial soft-bottom channel devoid of vegetation. The measurements were made (Site I) nearby a bridge in a place where the river resembled an impetuous stream. The maximum depth ranged within 0.49–0.89 m; the current velocity range was 0.58 (July) – 1.26 m/sec. (March); the river flow ranged from 0.95 (July) to 2.17 m^3/sec. (December). A mean annual flow was found to amount to 1.58 m^3/sec.

Beyond the lake Żelewko (Site II), Płonia is a river of a fairly fast current; in summer the whole river bed is overgrown by vegetation. The maximum depth ranged here within 0.83–1.40 m; a mean annual flow was 2.51 m^3/sec.

The present author gave up the idea of presenting an abundance and biomass of zooplankton found in the outflow, only wet weight (i.e., biomass) of zooplankton removed from a lake per unit of time (product of biomass and flow) is given. These data are contained in Tables 2 and 3.

The zooplankton removed from the lake Płoń (Site I) showed an immense abundance, hence its corresponding large biomass. In the outflow mainly *Daphnia* (particularly *Daphnia longispina*) were present, the maximum and mean biomasses amounting to 496.2 and 93.5 kg/day, respectively. Next to *Daphnia* was *Mesocyclops leuckarti*; the maximum and mean biomasses removed were 497.6 and 47.9 kg/day, respectively. *Chydorus sphaericus* was the third most numerously removed species, the maximum and mean biomasses amounting, respectively, to 463.2 and 41.6 kg/day. Next species in the row were as follows: *Bosmina, Asplanchna, nauplii, Cyclops, Eudiaptomus*. More detailed data with regard to biomasses of these species are to be found in Table 2. The zooplankters' groups determined as "Other *Cladocera*", "Other *Copepoda*", and "Other *Rotatoria*", played a minor part when compared to those enumerated above. However, even these animals were removed in tens of kilogrammes per day. Biomasses of four main groups of zooplanktonic animals, namely cladocerans, copepods, rotifers, and nauplii, removed from the lake Płoń in 24 hours reached the values of 184.8, 103.3, 46.6, and 37.2 kg, respectively. These are the mean values derived from data obtained throughout

Table 2

Wet weight of zooplankton carried from Lake Płoń through River Płonia, st. I (kg per day)

Species \ Date	15 X	29 XI	17 XII	14 I	17 II	16 III	15 IV	24 V	15 VI	19 VII	18 VIII	6 IX	20 X	Annual mean
	1971			1972										
Daphnia	8.5	40.2	10.3	14.8	1.0	0.4	18.8	496.2	26.3	0.0	463.9	90.5	45.1	93.5
Bosmina	127.1	167.1	121.0	50.6	2.5	0.4	3.6	2.2	20.0	0.0	9.1	0.3	13.7	39.8
Chydorus sphaericus	16.7	1.2	3.6	0.0	0.0	0.0	0.4	1.9	0.7	1.9	463.2	9.4	42.6	41.7
Other cladocerans	12.5	2.9	0.0	0.0	0.5	0.3	1.1	1.1	11.8	0.0	97.9	0.0	0.0	9.9
Eudiaptomus gracilis	13.0	17.9	24.7	28.1	40.0	0.9	26.3	20.0	33.2	1.7	0.0	0.7	45.8	19.4
Mesocyclops leuckarti	26.8	0.0	0.0	0.0	0.0	0.0	21.5	14.1	33.7	19.6	497.6	4.1	5.9	47.9
Cyclops	0.0	34.1	31.9	9.8	3.9	16.4	118.0	0.0	0.0	0.0	0.0	0.0	59.3	21.0
Other copepods	1.5	3.4	0.0	0.9	19.5	15.0	2.7	28.3	49.3	3.5	36.5	9.2	24.0	14.9
Asplanchna priodonta	10.6	37.6	95.0	43.9	61.4	20.6	120.5	0.8	98.4	0.0	0.0	1.8	0.4	37.8
Other rotators	5.0	2.4	4.5	4.4	13.2	3.4	25.1	5.8	4.5	1.5	36.9	2.3	5.6	8.8
Total	225.7	312.6	303.4	183.5	186.2	70.5	553.4	573.8	298.1	34.3	1637.3	129.0	326.6	371.9

Table 3

Wet weight of zooplankton carried from Lake Żelewko through River Płonia, st. II (kg per day)

Species \ Date	15 X	29 XI	17 XII	14 I	17 II	16 III	15 IV	24 V	15 VI	17 VII	18 VIII	15 IX	20 X	Annual mean
	1971			1972										
Bosmina	2.5	16.7	2.0	1.2	0.4	0.6	0.6	3.7	15.4	0.8	1.2	0.5	1.7	3.6
Ceriodaphnia quadrangula	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.2	1.6	1.1	0.8	0.7
Other cladocerans	1.9	0.4	0.9	0.1	0.2	0.0	0.0	0.0	3.4	6.7	0.7	0.4	1.5	1.2
Eudiaptomus	3.4	4.2	7.3	3.4	1.8	3.2	9.2	3.3	4.1	0.6	0.0	0.9	2.4	3.4
Thermocyclops	1.8	1.7	2.3	0.0	0.0	1.1	14.7	8.9	89.9	11.7	1.7	0.0	0.8	10.4
Mesocyclops leuckarti	0.9	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.9	3.8	1.6	0.8	0.0	0.7
Other copepods	3.0	20.5	41.1	2.0	2.1	7.4	26.3	14.6	3.9	12.5	4.4	1.8	0.6	10.8
Asplanchna priodonta	15.5	1.8	2.8	0.1	1.6	1.9	2.3	143.1	28.8	0.1	0.3	9.4	3.2	16.2
Other rotators	3.6	13.7	9.5	4.0	7.5	14.6	43.1	58.6	7.7	1.3	1.7	4.1	3.2	13.3
Total	35.7	60.7	67.1	11.7	19.3	36.7	133.3	239.4	156.7	43.3	16.4	21.1	15.1	65.9

the year. The maximum biomasses of the removed zooplankton were much higher, reaching respectively for cladocerans, copepods, rotifers, and nauplii 1,034.0, 534.1, 145.5, and 215.6 kg/day. A mean amount of 371.9 kg of zooplankton left the lake Płoń over a day; a maximum value as high as 1,637.2 kg/day was found on August 18. Table 2 gives information on a qualitative composition of zooplankton outflowing every mont. In seven months (January, May, August – December) *Cladocera* predominated by weight; a domination of copepods was found in March, June, and July. *Nauplii* prevailed only in April, while rotifers in February.

There were differences between the plankton biomasses removed during the daytime and at night. The greatest diurnal differences occurred in cladocerans, mainly in *Daphnia* and *Bosmina*, as well as in *Copepoda*. Over the whole period investigated, 8,370 and 7,033 g cladocerans/hr were the mean biomasses found at night and in the day, respectively. A biomass contributed by *Daphnia* was 4,953 and 2,842 g/hr at night and during the daytime, respectively. In the summertime clearly more *Daphnia* were removed at night, whereas in autumn (October, November 1971) a converse phenomenon was observed, namely more *Daphnia* were removed in the daytime. A removal of *Bosmina* in autumn showed a similar diurnal course to that of *Daphnia* at that time, while in summer no significant differences were found between the day – and night removal of *Bosmina*. No differences were found between the day and night removal of *Chydorus sphaericus*, 1,708 and 1,763 g/hr at night and in the daytime, respectively. In copepods the differences between the day and night removals were of the same type as in *Cladocera*. It was mainly *Mesocyclops leuckarti* that accounted for the larger removal of copepods at night. A day removal of *nauplii* and rotifers, 1,566 and 2,009 g/hr, respectively, were of the same order as at night, i.e., 1,535 and 1,873 g/hr, respectively. Totally 14,554 and 16,610 g of animals were removed in the daytime and at night, respectively.

Interrelationships between the flow, biomass, and removal of plankton by the revir Płonia at Site I are presented in Table 4 which shows the largest removal found in June, May, and August to correspond to the highest values of biomass, but it did not correlate so closely to the high water flow.

The components of zooplankton removed by the river Płonia from the lake Żelewko (Site II) can be listed according to the magnitude of their biomass. The list is opened by *Asplanchna,* a mean biomass of which, diurnally removed from the lake was 16.2 kg, the maximum biomass reachnig 143.1 kg/day (Table 3). The second place was taken by a multi-species group of "Other rotifers" with mean and maximum removals of 13.3 and 58.6 kg/day, respectively. *Thermocyclops* is listed after rotifers, with mean and maximum biomasses of 10.4 and 89.9 kg/day, respectively. The next places in the order are occupied by "Other *Copepoda", nauplii, Bosmina, Eudiaptomus, Ceriodaphnia*. The detailed data with regard to biomass of these animals are comprised in Table 3. A more general picture of zooplankton removal is offered by mean and maximum biomasses of four main zooplankton components: cladocerans, copepods, nauplii, and rotifers. The greatest biomas was an attribute of rotifers, a mean value of 29.5 kg/day and maximum of 201.6 kg/day being noted. A mean biomass of pooled copepods was 25.2 kg, while the

Table 4

Zooplankton removal by the river Płonia versus biomass and water flux
Station I

Date	15 X	29 XI	17 XII	14 I	17 II	16 III	15 IV	24 V	15 VI	19 VII	18 VIII	6 IX	20 X
	1971			1972									
Wet weight (kg) of zooplankton removed from the lake during 24 h	225.7	312.6	303.4	183.5	186.3	70.5	553.4	573.8	298.1	34.3	1637.3	129.0	326.6
Zooplankton biomass (g/m^3)	2.091	1.999	1.614	1.270	1.423	0.404	3.176	4.452	3.169	0.418	11.289	1.169	2.596
Water flux ($m^3/sec.$)	1.249	1.810	2.174	1.672	1.514	2.022	2.017	1.492	1.088	0.947	1.679	1.277	1.456

maximum was 98.9 kg. Nauplii removed diurnally weighed on average 5.4 kg and 37.0 kg at their maximum. The last place was occupied by cladocerans of mean and maximum wet weights of 5.6 and 18.8 kg/day, respectively. The last column of Table 3 summerizes the detailed data. As it can be seen, the maximum amount of zooplankton was removed in May, 239.4 kg/day, while the removals found in January and August were 11.7 and 16.4 kg/day, respectively. A mean biomass removed from the lake Żelewko was 65.9 kg/day. The data from Table 3 could also be considered from the point of view of weight determination of various zooplankters in a given period. Copepods dominated over a greater part of the year (January, April, June – August, November, December), rotifers prevailing in the remaining months (February, March, May, September, October). It is worth noting that the June predominance of copepods was caused by *Thermocyclops*, while the *Cyclops* copepodites were the dominants in November and December. On no occasion did cladocerans prevail by weight in the zooplankton removed, and a more substantial contribution of these crustaceans was found only in June, July, and November.

There were differences in weights of the zooplankton removed from the lake Żelewko at night and during the day. The largest differences were revealed in cladocerans, particularly in *Ceriodaphnia* and "Other cladocerans" made up chiefly by *Alona*. Mean values concerning the animals listed, calculated from the all-year data, were: total cladoceran removals at night and day of 295 and 169 g/hr, respectively; removals of *Ceriodaphnia* – 53 and 4 g/hr, respectively for night and day; "Other cladocerans" – 88 and 16 g/hr for night and day, respectively. Copepods showed lesser differences than cladocerans. A mean value for the total night removal was 1,117 g/hr, and 983 g/hr was an average for the daytime. Nocturnal and daily removals of *Mesocyclops leuckarti* were, respectively: 41 and 15 g/hr. 536 and 363 g of "Other copepods" left the lake every hour at night and during the day, respectively. More young stages (i.e., nauplii) were leavig the lake during the day (261 g/hr) than at night (207 g/hr), whereas rotifers were removed in equal amounts in day and night (1,220 and 1,237 g/hr respectively). The mean values were not always representative of true differences between the day and night removals in various seasons of the year. For example, *Bosmina coregoni* and *B. longirostris* were definitely more strongly removed during the day in winter than in summer. When treating the zooplankton in general terms, these differences become levelled out due to masses of nauplii and rotifers affecting the results. In general, the zooplankton biomass leaving the lake Żelewko at night was only by 9% larger than that removed during the day.

Interrelatioships between the flow, biomass, and zooplankton removal at Site II are shown in Table 5. They are of the same type as at Site I.

The zooplankton mass removed diurnally from the lake Płoń served as a basis for calculations of biomasses removed each month and over the year. Table 6 presents the converted data for the major zooplankton components. A factor of 30 (30 days in a month) was used in all conversions to monthly values. A sum of these values was assumed to represent the zooplankton biomass removed from the lake over a year. Treated in this way, the zooplankton removals found reached tens of tons, and the all-year quantity

Table 5

Zooplankton removal by the river Płonia versus biomass and water flux
Station II

Date	15 X	29 XI	17 XII	14 I	17 II	16 III	15 IV	24 V	15 VI	17 VII	18 VIII	15 IX	20 X
	1971			1972									
Wet weight (kg) of zooplankton removed from the lake during 24 h	35.7	60.7	67.1	11.7	19.3	36.7	133.2	239.4	156.7	43.3	16.4	21.1	15.1
Zooplankton biomass (g/m^3)	0.164	0.259	0.268	0.074	0.070	0.115	0.412	0.833	0.998	0.596	0.141	0.117	0.068
Water flux (m^3/sec.)	2.515	2.714	2.926	1.821	3.206	3.699	3.745	3.335	1.822	0.851	1.347	2.101	2.583

Table 6

Wet weight (kg) of zooplankton removed by the river Płonia from the lakes during particular months and throughout the year

A) from the lake Płoń

Month / Animal groups	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX	Annual removal from October 1971 through September 1972
Cladocera	4950	6330	4050	1950	120	30	720	15030	1770	60	31020	300	69 030
Copepoda	1230	1650	1710	1170	1890	960	5040	1860	3480	750	16020	420	36 180
Nauplii	120	180	360	930	1320	390	6480	120	600	180	960	330	11 970
Rotatoria	480	1200	3000	1440	2250	720	4380	210	3090	60	1110	120	18 060
Total	6780	9360	9120	5490	5580	2100	16620	17220	8940	1050	49110	3870	135 240
B) from the lake Żelewko													
Cladocera	204	513	87	39	18	18	18	111	564	321	105	60	2 058
Copepoda	270	807	1527	165	117	351	1509	804	2967	861	234	105	9 717
Nauplii	27	36	30	24	171	237	1110	219	75	78	93	63	2 163
Rotatoria	573	465	369	123	273	495	1362	6051	1095	42	60	405	11 313
Total	1074	1821	2013	351	579	1101	3999	7185	4701	1302	492	633	25 251

removed was found to amount to 135,240 kg. Similar calculations were performed using the data obtained at Site II,where the monthly values were found to range from 351 to 7,185 kg and a total yearly mass equalled 25,251 kg. The figures given, although only estimates, show a scale of the phenomenon of the zooplankton removal from lakes by the river Płonia.

DISCUSSION

The biomasses of zooplankton carried away by the river Płonia, given in the previous section, can be compared to those concerning the zooplankton carried by the river Drawa as studied in early spring 1972 in Złocieniec. From L. Szlauer's (1974) data it was calculated that Drawa was carrying 994 and 1,241 kg of zooplankton during March and April, respectively. During the same months, 2,100 and 16,620 kg of zooplankton were found out in the river Płonia at Site I. Therefore Płonia was at that time much richer in zooplankton than Drawa in Złocieniec, even when Site II of Płonia, a worse off of the two, was taken into account. No other data concerning the zooplankton removal that could be compared to the present results were found in the available literature.

The planktonic resources of the river Płonia at the place where it leaves the lake Płoń obviously are not exceptional. Many outflows are expected to reveal similar removals of zooplankton.

The zooplankton removed by the river Płonia can be considered as a food base for fish. At it is generally known, zooplankters are the first natural food of virtually all young freshwater fish. Many species feed on zooplankton also later on. Among the others, Ivlev (1955) and Pliszka (1956) showed the zooplankton to be the major food source for cyprinid fishes to their fourth – eight week of life, later on other animal groups taking over. In some fishes ot the family, e.g., in bream (*Abramis brama*), *Blicca bjoercna*, and also in perch (*Perca fluviatilis*), the trophic importance of zooplankton is considerable in older, several cm long individuals as well. Zooplankton is consumed over the entire life-span by many strict planktophages among the home ichthyofauna, the economically important species such as ablen and lavaret in their number. The nourishing role of zooplankton is very significant as evidenced by the food coefficient. The latter is not absolutely stable, but rather depends on the age of fish, species, etc. (Karzinkin, 1955). A value of 5 (5 kg of zooplankton required to produce 1 kg of fish) obtained from the mean of values of food coefficients quoted by the author mentioned, has been ascribed to the zooplankton.

The calculated total zooplankton biomass removed by the river Płonia over a year was divided by the adopted value of food coefficient, i.e., by 5. Thus the zooplankton of the river Płonia at Site I was found to serve as a potential feeding basis helping to produce 27,048 kg of non-predatory fish. This is not much if the weight obtained was treated in terms of consumptive fish, but from the point of view of feeding young fishes the situation looks different. The given weight of 27,048 kg of fish, when converted to young fishes 5 g each, equals to 5,409,600 individuals. The values given should be treated as

approximate ones. During the assessment procedure, a full utilization of the zooplankton removed (both crustaceans and rotifers) was assumed, which would be unlikely to found in nature. Hence the values given show only a potential trophic importance of the studied zooplankton for fish. It is understood that the figures would be different, should the assumed weight of young fishes be less or more than 5 g.

The calculations are considered in terms of young fishes owing to the necessity of culturing them for stocking as well as due to the fact that cultures of young fishes fed on zooplankton are more feasible than keeping fishes of consumptive size. Moreover, the successful attempts to feed young lavaret with river zooplankton are recorded in the literature (Anpilova et al., 1960; L. Szlauer, 1974).

Three basic ways of practical utilization of the river Płonia planktonic resources can be outlined:

1. Constructing flow-type ponds to raise young fish in the vicinity of the river Płonia's outflow from the lake Płoń, the ponds being provided with river water carrying the live zooplankton, a food for fish, in.
2. Placing cages with young fish in this part of the river, where the fishes could use up the zooplankton directly from the stream flowing through the cage built of a suitable coarse-mesh net.
3. Using devices sieving off the zooplankton carried by the river; the live zooplankton caught in this way could be used immediately as food and/or stored frozen.

The first two solutions are suggested by nature itself. The river Płonia's outflow from the lake Płoń constantly houses huge numbers of young fish finding a rich feeding ground there. The point of the solution proposed is that "wild" young fish (mainly roach) would be replaced by a more valuable spectrum of species in culture. An advantage of the first two solutions lies in the fact that there is no need of troublesome filtrating the water flowing from the lake in order to use the zooplankton. Purity of that water, its good oxygenation and flow are further advantageous factors supporting the proposals.

The third solution is basically an exploitation of the plankton leaving Płoń. The plankton caught could be a food source for young fishes kept even in other distant hatcheries. The studies and observations carried out showed that during certain periods, e.g., in May, the outflow contained almost pure zooplankton, devoid of algae. Such opportunities could be taken advantage of in order to obtain zooplankton for storage. A frozen reserve would be used, a need to do so arising.

A circumstance not to be disregarded is the fact that the zooplankton at Site I can be caught in winter when the lake is covered with ice.

To obtain zooplankton on a large scale, a filtration station equipped in appropriate sieves should be built. The station could, at the same time, serve as a centre for development of techniques for plankton sampling.

Apart from the three major ways of using the plankton, intermediate solutions are also possible to be applied; for example, in young fish cultures in ponds supplied by the river Płonia the zooplankton caught in the river could serve as food.

The occurrence of zooplankton in the river Płonia beyoud Płoń throughout all the seasons of the year enables to feed a range of fish species, from young ablen and lavaret hatching in March to young fish of spring-spawning species. Small amounts of zooplankton present in the river in March and April should not cause any major obstacle in obtaining it for feeding ablen and lavaret at the time. In the early spring zooplankton with only small addition of algae outflows from the lake, which makes the zooplankton catches much easier to obtain as the mesh-clogging is greatly reduced as opposed to periods of summer blooms.

CONCLUSIONS

1. The mean zooplankton biomass removed by the river Płonia from the lake Płoń over 24 hrs was 371.9 kg, to which amount cladocerans, copepods, rotifers, and nauplii contributed 184.8, 103.3, 46.6, and 37.2 kg, respectively. The annual biomass removed by the river reached 135,240 kg.
2. The mean biomas of zooplankton removed by the river Płonia from the lake Żelewko over 24 hrs was 65.9 kg, out of which 29.5, 25.2, 5.6, and 5.6 kg were the contributions of rotifers, copepods, cladocerans, and nauplii, respectively. The total annual removal was 25,251 kg of zooplankton.
3. Diurnal differences in biomasses of zooplankton removed were found, the largest ones concerning Cladocera. In summer, more cladocerans were removed during the night, while in autumn the proportions were reversed.
4. The biomass of zooplankton removed from the lake Płoń throughout one year is estimated as a basis able to produce about 5 million individuals of young fish up to the weight of 5 g each.
5. A possiblity is indicated to construct culture ponds supplied with the river Płonia water rich in zooplankton. Young fish can also be kept in cages submerged in the river; mass catches of zooplankton for fish food are another solution.
6. The presence of zooplankton in the river Płonia during all the seasons of the year offers a possibility of an utilization of these resources to feed young fishes of various species spawning in different periods.

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MOŻLIWOŚCI WYKORZYSTANIA ZOOPLANKTONU WYNOSZONEGO Z JEZIOR PRZEZ RZEKĘ PŁONIĘ DO KARMIENIA NARYBKU

Streszczenie

W latach 1971–1972 badano zooplankton wynoszony przez rzekę Płonię z jezior Płoń i Żelewko. Rzeka wynosiła z jeziora Płoń głównie skorupiaki – *Daphnia, Mesocyclops, Chydorus, Bosmina.* Średnia biomasa zooplanktonu wynoszonego w ciągu 24 godzin była równa 371,9 kg; w tym *Cladocera* – 184,8 kg, *Copepoda* – 103,3 kg, *Rotatoria* – 46,6 kg, *nauplius* – 37,2 kg. Masa zooplanktonu wyniesiona podczas roku z jeziora, osiągnęła wartość 135 240 kg. Na ogół więcej zooplanktonu wynosiła rzeka w okresie nocnym, zwłaszcza *Cladocera*. Przewaga wynoszenia *Daphnia* i *Bosmina* w okresie nocnym była bardzo wyraźna w okresie letnim, natomiast w październiku i listopadzie stwierdzono zjawisko odwrotne – przewagę wynoszenia tych zwierząt w okresie dziennym. Biomasę zooplanktonu wynoszonego z jez. Żelewko tworzyły głównie *Rotatoria* – średnio 29,5 kg/dobę. Średni dobowy ciężar pozostałych składników wyniósł: *Copepoda* – 25,2 kg; *nauplius* – 5,6 kg, *Cladocera* – 5,6 kg. Ogółem wypływało z jez. Żelewko 65,9 kg/dobę zooplanktonu, a w skali rocznej – 25 251 kg. Również tu stwierdzono wyraźną przewagę wynoszenia *Cladocera* w okresie nocnym. Biomasa zooplanktonu wynoszonego z jez. Płoń w ciągu jednego roku stanowi potencjalną bazę pokarmową do wyhodowania około pięciu milionów narybku ryb niedrapieżnych do ciężaru osobniczego 5 g. Istnieje możliwość wybudowania w rejonie wypływu rzeki Płoni z jez. Płoń, stawów do podchowu narybku, zasilanych bogatą w zooplankton wodą tej rzeki. Możliwe też jest hodowanie narybku w sadzach zanurzonych w rzece lub masowe odławianie zooplanktonu, przeznaczonego do karmienia ryb. Obecność zooplanktonu w rzece Płoni we wszystkich porach roku stwarza możliwość wykorzystania go do karmienia narybku gatunków ryb o różnym okresie rozrodu.

ВОЗМОЖНОСТИ ИСПОЛЬЗОВАНИЯ ЗООПЛАНКТОНА, ВЫНОСИМОГО ИЗ ОЗЁР ВОДАМИ РЕКИ ПЛОНЯ, В КАЧЕСТВЕ КОРМА ДЛЯ МОЛОДИ РЫБ

Резюме

В 1971-72 гг. исследовали зоопланктон, выносимый водами реки Плоня из озёр Плонь и Желевко. Река выносила из оз. Плонь главным образом ракообразных:

Средняя биомасса зоопланктона, выносимого речными водами за 24 часа, составляла 371,9 кг, в том числе кладоцеры – 184,8 кг, копеподы – 103,3 кг, ротатории 46,6 кг науплиуса – 37,2 кг. Масса зоопланктона, вынесенного за год из озера, составляла 135 240 кг. Наибольшее количество зоопланктона река выносила в ночное время, особенно кладоцеры. Наибольшее количество дафний и босмин уносилось речными водами в ночное время преимущественно в летний период; в октябре же и ноябре наблюдалось обратное явление: наибольшее количество этих организмов выносилось речными водами в дневное время. Биомасса выносимого из оз. Желевко зоопланктона состояла главным образом из ротаторий – в среднем 29,5 кг, в сутки. Среднесуточный удельный вес остальных компонентов составлял: копеподы – 25,2 кг, науплиусы 5,6 кг, кладоцеры – 5,6 кг. Всего из оз. Желевко выносилось в сутки 65,9 кг зоопланктона, а в годовом масштабе – 25 251 кг. Здесь же установлено преобладание кладоцеры среди выносимой речными водами массы зоопланктона в ночное время. Биомасса зоопланктона, выносимого из озера Плонь за один год, является потенциальной кормовой базой для выращивания около пяти миллионов молоди нехищных рыб до единичного веса 5 г. Существует возможность сооружения в районе выхода р. Плони из оз. Плонь выростных прудов, снабжаемых богатой зоопланктоном речной водой. Возможно также выращивание молоди в садках, погружённых в реку, или же массовое вылавливание зоопланктона для кормления рыб. Наличие зоопланктона в р. Плоне в любое время года создаёт условия для использования его для кормления молоди рыб с разным периодом размножения.

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