JEMH

Growth and reproduction of Moina rectirostris (Leydig) and Ceriodaphnia quadrangula (O.F. Müller) with feeding on detritus.

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Moskva, VNIRO.

The significance of detritus in the nutrition of aquatic animals, especially of the small representatives of the zooplankton, has been studied very slightly.

There are works in which are determined the growth, fertility and maturing of M. rectirostris with feeding on algae and bacteria (Zarinskaya, 1939; Vasil'eva, 1959; Kryuchkova, 1967; Walander Ander, 1940, and others).

The authors of these works established that in M. rectirostris with feeding on protococcal and single-celled green algae and bacteria the beginning of formation of eggs takes place in 2 - 4 days. The young appear in 4 - 6 days. In 1 - 3 days the females form a new generation. The average number of young, born of one female, according to data of various authors, varies from 12 to 45 individuals (maximum 100).

Work devoted to the study of the growth and fertility of Ceriodaphina quadrangula is little, and data on the productive effect of detritus on M. rectirostris and C. quadrangula are not known to us.

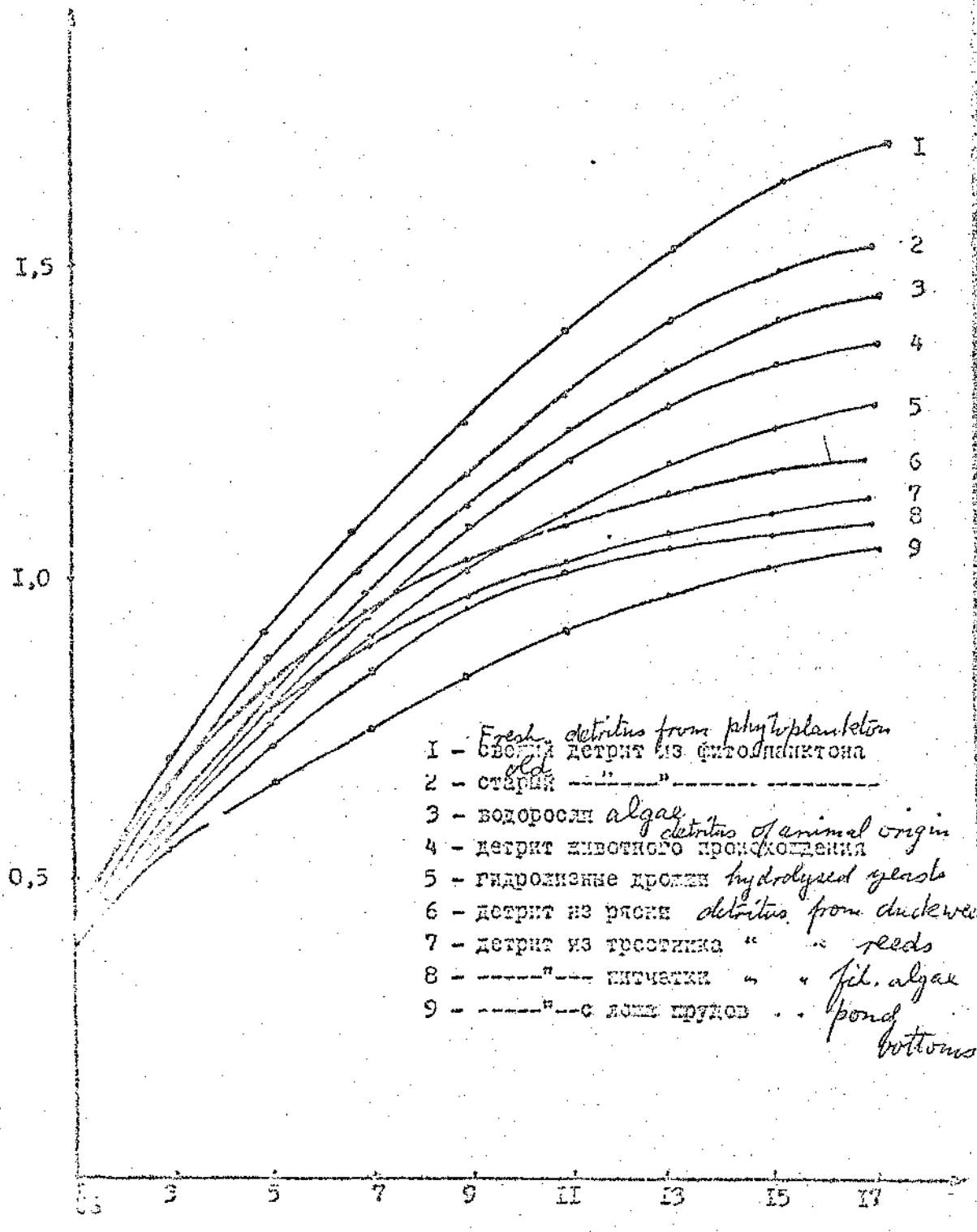
Under laboratory conditions we established that the fundamental pond forms of Cladocera, among them M. rectirostris and C. quadrangula are fed on detritus of natural origin.

The diel ration for M. rectirostris with feeding on detritus, formed principally of algae, comprised 51·3% of the moist weight of the animal (mean of 24 experiments), and for C. quadrangula - 28·3 (mean of 30 experiments).

In order to determine the assimilability and productive effect of detritus, we set up experiments, permitting (us) to characterize the rate of growth, speed of maturing and fertility of M. rectirostris and C. quadrangula with feeding of them on detritus of different composition and age.

Рост *Moina rectirostris* на различных кормах Fig. 1

Growth of *Moina rectirostris* on different foods.



The work was carried out in the summer of 1967 at the base of the pond fish farm "Yakot" under the guidance of Candidate of Biological Science I.B. Bogatova.

The crustaceans for the experiments were taken from laboratory cultures.

The young of M. rectirostris and C. quadrangula vacating the brood chamber of the maternal organism, we transplanted to little beakers of 100 ml volume, with a food medium. (One specimen per beaker).

The experiments we carried out on young (aged 10 - 15 days) and old (aged 40 - 45 days) detritus, formed basically of phytoplankton, and also detritus of animal origin (organisms of the zooplankton), from higher vegetation (reeds, duckweed, and water-pepper), from filamentous algae and from the bottom of ponds. As control food served hydrolysed yeast and planktonic algae.

Detritus for the experiments we obtained in polyethylene fish tanks established in ponds, and detritus from the bottom of ponds we collected on the day of their draining.

During the experiments we conducted observations on the linear growth of the crustaceans, recorded the time of depositing the first parthenogentic eggs and considered the number of eggs deposited by one female during the time of the experiment.

The measurement of the crustaceans and the renewing of the food medium we carried out after every two days. At the beginning of the experiment and before renewing of the food medium we took samples for calculating the total quantity of bacteria.

The temperature of the water in the experimental beakers varied from 18 to 21°.

Experiments were conducted with five-fold replications. Altogether 105 experiments were carried out with M. rectirostris and 100 with C. quadrangula.

Besides this, experiments were conducted with all the above-enumerated foods, which we treated in Lugol's solution. The concentration utilized (2 2-3) killed the basic mass of bacteria and at the same time did not show a "fatal*" effect on the crustaceans.

We did not succeed in obtaining complete sterilisation of the food, but the quantity of bacteria in all experiments with the use of Lugol's solution was kept to a minimum.

* the word "nubitel'nogo" looks like a misprint

The greatest linear growth of both species of crustacean was on fresh detritus from phytoplankton, on old detritus it was somewhat lower. The growth of the animals on algae was even lower.

Thus in the first case after 17 days of the experiment the length of M. rectirostris attained 1·68 mm, C. quadrangula - 1·34 mm, in the second after the same period respectively - 1·42 and 1·25 mm, and in the third -1·35 and 1·11 mm.

Such conformity was observed in all experiments. This testifies that young detritus of algal origin possesses a higher food value than old.

In proportion to the age of the detritus is observed a lowering of the nutrient matter and the numbers of bacteria in its particles (Rodina, 1963).

Retardation of the rate of growth of the crustaceans on algae evidently is connected with the small availability and low assimilability of the contents of the algal cells, and also with the number of bacteria in these experiments. We showed that the numbers and biomass of bacteria were significantly higher in experiments in which we used fresh detritus as food, lower in experiments on old detritus and even lower on algae (Table 1 and Figs 1, 2, 3).

Linear growth of M. rectirostris and C. quadrangula on detritus from zooplankton was comparatively low. Evidently, this food appears poor value for the crustaceans, since in natural conditions they basically consume vegetable food. It is possible that these organisms are not adapted for the digestion of food of animal origin.

The low growth of the animals on hydrolysed yeasts may be explained first of all by the small content of bacteria in this food, and also the lower food value of them by comparison with algae and detritus of algal origin.

The rate of growth of the crustaceans on detritus from the bottom of ponds was very low. Probably this is explained by the fact that the detritus is old; besides that, there was in it more than 90% inorganic admixture.

Linear growth of the animals on detritus from filamentous algae and higher vegetation was comparatively high, but lower than on detritus from phytoplankton.

A very high rate of growth of the crustaceans was recorded on detritus from duckweed. The length of M. rectirostris at the end of the experiment reached 1·2 mm, C. quadrangula 1·1mm. On detritus from reeds and filamentous algae we noted that growth was lower. In experiments using as food detritus from water pepper and a mixture of higher vegetation the crustaceans of M. rectirostris died. The length

of C. quadrangula on detritus from water pepper after 17 days reached 0·85 mm, and on detritus from a mixture of higher vegetation, 0·94 mm.

We showed the numbers and biomass of bacteria in these experiments to differ little from analogous indicators in the experiments on algal detritus. Evidently, particles of this food were less accessible to the animals. And detritus from water pepper and a mixture of higher vegetation, in all probability, possessed a certain toxicity for the crustaceans.

On food treated with Lugol's solution 80 experiments with M. rectirostris and 75 with C. quadrangula were carried out. In all experiments the rate of growth of the animals was lower than the rate of growth on corresponding food not treated with Lugol's solution. This testifies that bacteria contribute a boost to the food value of detritus. But growth of the crustaceans in these experiments did not significantly fall behind the norm. This confirms our proposition, that as determining factors of the food value of detritus appear its origin and degree of decomposition, and the quantity of bacteria is an additional factor.

On the basis of the data on linear growth was calculated the diel increase (according to Vinberg, 1956), expressed as a percentage of the initial length of the animals.

Very high growth (Table 2) was recorded in experiments on fresh detritus from phytoplankton, not treated with Lugol's solution (M. rectirostris - 20·9%, C. quadrangula - 21·1%), and very low on detritus from the bottom of ponds (16·5 and 16·2%) and on detritus from filamentous algae (16·9 and 16%).

The average number of young per female after the time of the experiments maintains the same principle (Table 3).

It follows to record that in experiments using Lugol's solution the numbers of young in broods of M. rectirostris did not exceed 10, and in C. quadrangula, 7. In experiments without this solution the numbers of young reached 40 and more in M. rectirostris and 35 in C. quadrangula.

On detritus of algal origin (fresh and old) the crustaceans matured earlier altogether in 4 days.

In experiments in which live plankton algae were used as food, maturity came in 4 - 5 days.

In experiments using Lugol's solution, maturity came later.

This testifies that food with a reduced content of bacteria cannot provide for normal development of the animals, but has the ability to support it to a certain level.

The experiments carried out showed that detritus of different origins, and age is assimilated even by such small forms of Cladocera as M. rectirostris and C. quadrangula. These animals grew, matured and produced progeny in almost all the experiments.

Characteristics of the rate of growth, time of maturity and fertility of M. rectirostris and C. quadrangula testify to this, that of all tested foods the greatest food value was provided by detritus of algal origin. The food value of algae in our experiments was lower. In the experiments on detritus from zooplankton the crustaceans grew worse, therefore its food value for the crustaceans is small. Yeast, detritus from pond bottoms, from filamentous algae, water pepper and mixed higher vegetation provide still lower food value.

The food value of detritus from duckweed and reeds is comparatively high, but significantly lower than detritus from phytoplankton.

This principle was also observed in the experiments of food which was treated with Lugol's solution.

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Rodina, A.G. Content of bacteria in detritus of Lake Priladozha. Mikrobiologiya, 32, 6, 1963.

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Number of bacteria in experiments. Table 1.

Таблица I

Численность бактерий в опытах[x]

Вид корма / Kind of food	В начале опыта / at beginning		В конце опыта / at end of experiment			
			M. rectirostris		C. quadrangula	
	I	2	1	2	1	2
Yeast	0,80	-	0,67	-	0,61	-
Detritus from phytoplankton						
- fresh	21,70	0,06	20,26	0,04	17,79	0,03
- old	13,20	0,45	12,20	0,39	12,20	0,44
Algae	7,01	0,11	6,85	0,11	7,01	0,10
Detritus from zooplankton	19,31	0,15	17,66	0,14	19,01	0,15
" " pond bottoms	15,85	0,25	11,20	0,60	12,50	0,66
" " reeds	10,85	0,05	10,15	0,05	10,63	0,05
" " duckweed	11,25	0,02	10,12	0,02	10,29	0,02
" " filamentous algae	9,05	0,10	10,01	0,07	8,78	0,50
" " water pepper	10,27	0,03	10,03	0,03	9,32	0,01
" " mixed higher vegetation	11,90	0,10	10,78	0,06	9,62	0,07

x/ In tables 1, 2, 3 in the cols. under 1 are data of the results of experiments without use of Lugol's solution. In cols. under 2, with use of this solution.

Rate of growth of animals with different feeding. Table 2

Темп роста животных при разном питании Таблица 2

Kind of food / Вид корма	Daily increase % / Суточный прирост, %			
	M. rectirostris		C. quadrangula	
	I	2	I	2
Yeast	I6,0	-	I6,7	-
Detritus from phytoplankton				
fresh	20,9	I9,8	3I,3	I9,04
old	I9,4	I8,8	I8,9	I8,5
Algae	I9,0	I8,4	I8,5	I7,8
Detritus from zooplankton	I8,5	I8,0	I8,2	I6,4
" " pond bottoms	I6,5	I6,0	I6,2	I5,8
" " duckweed	I7.	I5,8	I8,I	I6,5
" " reeds	I6,9	I6,2	I6,9	I6,0
" " filam. algae	I6,2	I5,8	I6,0	I5,6
" " water pepper	-	-	I5,6	I5,I
" " mixed higher vegetation	-	-	I6,4	I5,9

No. of young and time of maturing Table 3

Количество молоди и сроки созревания Таблица 3

Kind of food / Вид корма	Average No. of young / female after 17 days / Количество молоди в среднем на одну самку за I7 дней				Time of maturing / Время созревания, дни / days.			
	M. rectirostris		C. quadrangula		M. rectirostris		C. quadrangula	
	I	2	I	2	I	2	I	2
Yeast	I5,5	-	-	-	5	-	7	-
Detritus from phytoplankton								
fresh	5I,6	9,9	35,2	6,9	4	6	4	6
old	50,2	5,7	34,5	4,5	4	9	4	-
Algae	42,6	4,2	34,8	4,7	4-5	8	4-5	8
Detritus from zooplankton	-	-	2I,6	4,4	-	-	I2	-
" " pond bottoms	23,7	4,5	25,6	-	8	I2	I2	-
" " reeds	-	-	5,0	-	-	-	I2	-
Detritus from duckweed	20,4	2,5	I9,0	2,2	I0	-	8	I2
" from filaments	-	-	-	-	-	-	-	-
" from water pepper	-	-	-	-	-	-	-	-
" from mixed higher vegetation	-	-	-	-	-	-	-	-

Growth of Ceriodaphnia quadrangula on different foods.

Рост Ceriodaphnia quadrangula на различных кормах

Fig. 2
Рис. 2

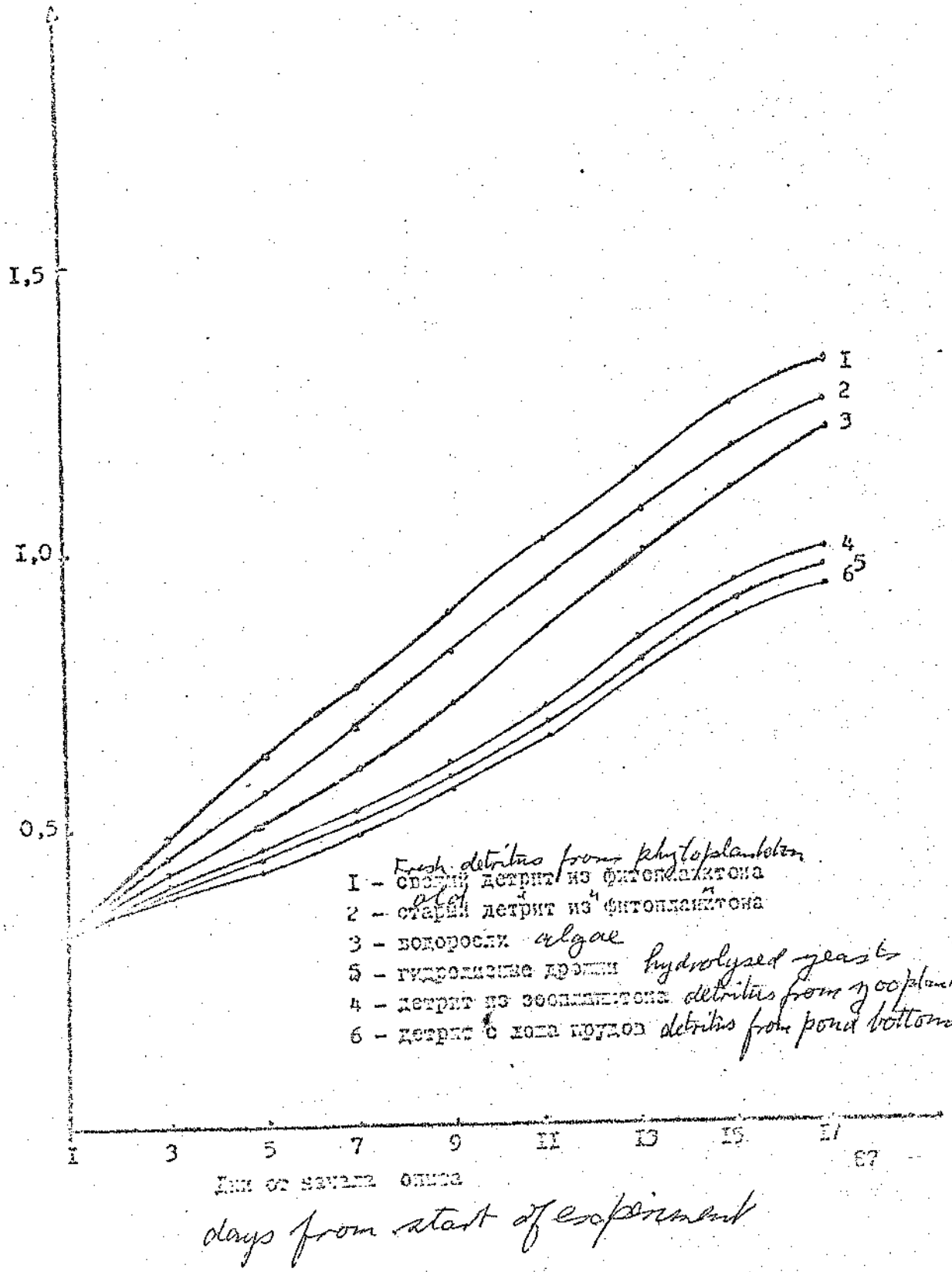

Рис. I

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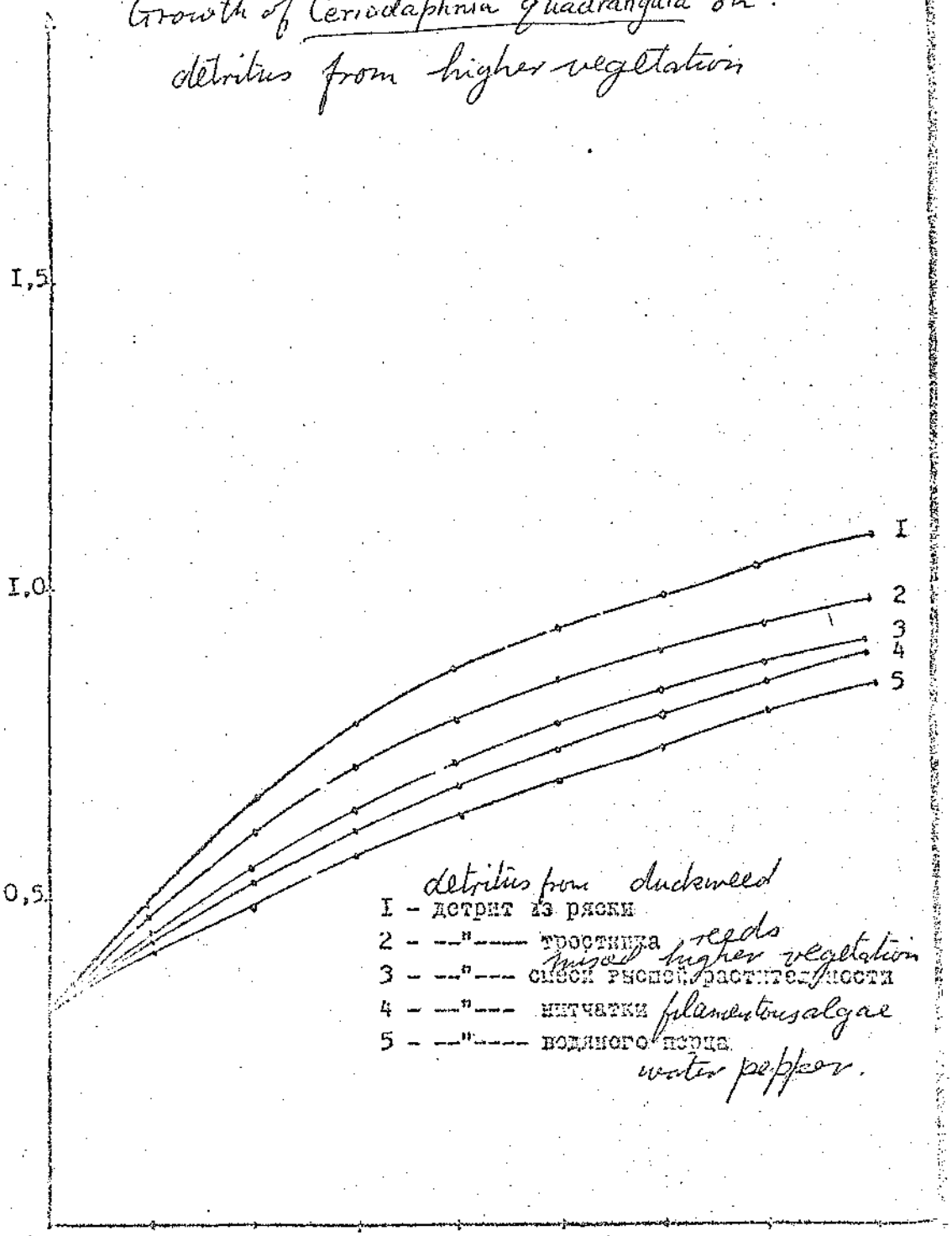
Рост *Ceriodaphnia quadrangula* на детрите из высшей растительности.

Growth of Ceriodaphnia quadrangula on detritus from higher vegetation



Notice

Please note that these translations were produced to assist the scientific staff of the FBA (Freshwater Biological Association) in their research. These translations were done by scientific staff with relevant language skills and not by professional translators.