

Freshwater Biological Association

FBA Translation (New Series) No. 161

Title: Influence of starvation on selected temperatures in the young of bream, roach and perch.

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Reference: Inf. Byull. Biol. vntr. Vod. No. 50, 42-45

Original language: Russian

Date of publication of original: 1981

Translator: J.E.M. HORNE

Date of publication of translation: 1983

Number of pages of translation: 4

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Works devoted to the influence of starvation on temperature selection by fishes are few and their conclusions are contradictory (1-4).

We determined the influence of brief, up to 14 days, starvation on temperature selection by young fishes.

The experiments were carried out in August-September 1976 on fingerling bream (Abramis brama L.), roach (Rutilus rutilus L.) and perch (Perca fluviatilis L.) with body lengths of 3-5 cm and weight 0.5-1.2 g. The young fish were caught in the littoral by seine-nets or small drag-nets. Immediately after catching the fish they were put in acclimatization boxes. The period of acclimatization did not exceed 2 days for bream and roach at a temperature of 20 °C and 6 days for perch at 17 °C. The temperature of acclimatization did not essentially differ from the temperature of the water-body. Before the start of the experiment and for the first 10 days of the experiment the fish were fed with oligochaetes, earthworms and daphnia, after that feeding discontinued. At the end of a 10-14 day period the giving of food was resumed. The method of thermogradient investigations was described in detail earlier (2).

In each experiment 10 individuals were used. Every day in the interval of time from 0800 to 2200 hours were plotted visually 10 points - the distribution of the animals in the thermogradient. Thus, for one day observations were obtained of 100 values of temperatures selected by fish. For statistical analysis we used 10 modal values of selected temperatures for one day of the experiment. With respect to each day with the help of a computer we calculated the arithmetical mean of the selected temperatures and the standard deviation. The arithmetical means for the periods of feeding and starvation were compared by the standard significance criteria of Student.

Fingerlings of all 3 species already in the first day migrated into the temperature zone 23-28 °C (see fig.). Perch in the initial period of feeding showed great stability of selected temperature. The absence of food led to a change in the character of the reaction - the fish were concentrated in the colder parts of the gradient. However, if the bream and roach at the end of starvation selected the zone with a temperature of 15-20 °C, then with young perch appreciable (more than 2 °C) variations of selected temperature were not recorded. Nevertheless, in a comparison of sated and starved fish differences in reaction were proved for all three species ($P < 0.001$).

During the 24-36 hours after the resumption of feeding the fish returned to the warm part of the gradient with a temperature of 23-27 °C. Fingerling bream here did not attain the original level of selected temperatures. The range of variation of the modal selected temperatures, determined according to the mean square deviation (see fig.), in separate days reached 10 °C.

The conducted experiments showed that initially, up to 14 days, starvation naturally decreased the level of selected temperatures: in bream by 4.8 °C, in roach by 4.7 °C, in perch by 1.2 °C (see table). On young of bream and roach starvation showed up more sharply than on fingerling perch. In relation to the level of food saturation in the first period the tendency of selection of the colder zone by bream and roach does not appear at once, but on the second to eighth day.

The lowering of the selected temperatures under the influence of starvation may be connected with a lowered level of normal metabolism, so noted by Chan Yao Tsin, Javid & Anderson (1,4). Ulvestad & Zar in experiments on the influence of starvation on the thermopreference of the common shiner (Notropis cornutus) in autumn at water temperature from 4 to 9 °C did not consider the possible influence of the season of the year, therefore they did not obtain the response of the fish (5). As was shown by us earlier, some species of cyprinids, in particular young roach, bream and white bream, in the autumn period cease selection of the higher temperatures (2). In the experiments of Doudoroff (3) with the predatory and stenothermal fish girella (Girella nigricans), the absence of reaction involves less susceptibility of the predators to the influence of starvation.

Thus, our experiments have shown that in the summer season the factor of starvation significantly changes the reaction to the gradient of temperature in young cyprinids - roach and bream. For representatives of the percids - young of the common perch - this influence is unimportant. The obtained results demonstrate the possibility of quantitative estimation of the degree of starvation of fish, underline investigations, and allow more precise evaluation of the seasonal dynamics of temperature selection by poikilothermic animals. This it is important to take into account in developing acological methods of attracting and repelling aquatic organisms.

Figure caption

Selected temperatures by sated and starved fish with change of feeding rhythm.

a - bream, b - roach, c - perch.

1 - mean selected temperature for day of experiment with sated fish.

2 - the same for starved fish.

Table

Changes of reaction of fish in temperature gradient

Availability of food	Mean selected temperature, °C		
	Bream	Roach	Perch
Present	26.6	25.3	25.0
Absent	21.8	20.6	23.8
Present	23.3	24.6	25.4

the necessity of taking into account the season of the year in similar

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