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DAILY FORAGING CYCLE, AND DAILY FOOD RATION OF ROACH *Rutilus rutilus* (L.) IN BACHOTEK LAKE (BRODNICKIE LAKELAND) IN SPRING

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ABSTRACT. Food composition, and feeding intensity of roach in a daily cycle was studied. Daily food ration, calculated according to Thorpe (1977) for roach of average body weight 6.44 g, at average water temperature 14.1°C, was equal to 2.5% of fish body weight.

Key words: ROACH, FOOD, DAILY RATION, LAKE.

INTRODUCTION

The share of roach in lake fishery catches in Poland is high and tends to increase. According to Szczerbowski (1993), in 1956-1984 roach catch increased 32 tons a year. Roach occurs commonly in most Polish lakes, predominating in the ichthyofauna.

Despite commercial importance of roach, no management optimization was attempted. In Bachotek Lake roach plays an important role in fishery catches, and in 1950-1970 predominated among 15 harvested fish species (its average yearly share exceeded 38%).

Fish growth is determined mainly by the quantity, composition, and availability of food organisms. Fish feeding is one of the main issues of ichthyological studies. Knowledge of feeding requirement allows to evaluate the effect of food on fish growth, and intra- or interspecific competition.

The aim of the present study was an evaluation of food composition in daily feeding cycle of roach in spring (during increasing feeding activity), and estimation of daily food ration.

MATERIAL AND METHODS

Feeding of roach in a daily cycle, and daily food consumption in spring was studied in the individuals beginning third year of life, of average individual body weight 6.44 g (5.00-9.91 g) and average body length 8.3 cm (7.7-9.0 cm). The fish were har-

vested in May 1998, in the littoral of Bachotek Lake. The lake is situated in Brodnickie Lakeland, near Brodnicki Landscape Park, and is a unique and valuable floristic reserve. Area of the lake is 211 ha, average depth 7.5 m, and maximum depth 24.3 m. Littoral, comprising 30% of lake area, reaches the depth of 5 m.

The fish were sampled using lift-net for 24 hours, at 3 hour intervals. Water temperature was measured. The fish were fixed in 4% formaldehyde solution. In the laboratory they were blotted, measured with 1 mm accuracy, and weighed up to 0.01 g. Digestive tracts were prepared, and their contents weighed with 0.01 g accuracy. Food organisms were separated and identified.

Food composition was expressed in percent of total food biomass, and consumption index was evaluated (I - $\%_{oo}$). Total number of 56 digestive tracts were studied, on the average 7 tracts in each sample.

Daily food ration of roach was evaluated (at average water temperature 14.1°C) according to Thorpe (1977), using the formula:

$$C = S_2 - S_1 + A,$$

where:

C – amount of food consumed in t hours between successive samplings ($t_2 - t_1$),

S_1, S_2 – relative digestive tract contents at the beginning (S_1), and at the end (S_2) of time interval between samplings (t = 3 hours),

A – food evacuation in $t_2 - t_1$ interval (equivalent to the weight of excrements produced by the digestive tract of average relative content 0.5 ($S_1 + S_2$).

$$A = 0.5\ (S_1 + S_2) - S_r,$$

where:

S_r – theoretical relative weight of food in fish digestive tract at the end of time interval

$$S_r = 0.5\ (S_1 + S_2)\ e^{-k2\ (t2 - t1)};$$

where:

e – base of natural logarithm,

k_2 – food digestion constant.

Amount of food consumed by a fish within $t_2 - t_1$ interval may be expressed as:

$$C = 0.5\ (3\ S_2 - S_1 - 2\ S_r).$$

Daily food ration is equal to C calculated for successive time intervals (weight of consumed and digested food).

RESULTS

COMPOSITION OF ROACH FOOD AND ITS DAILY VARIABILITY

Digestive tracts of roach contained mainly condensed plant food – periphytic, and planktonic algae. Additionally, some animal food was also found: cladocerans (*Pleuroxus uncinatus* Baird, *Alonella nana* (Baird)), copepods (*Limnocalanus sp.*), ephemeropterans (parts of abdomen, and limbs), and small molluscs: bivalves - (*Sphaericum sp.*) and snails (*Galba sp.*).

Main food component (algae) were found in all analysed digestive tracts. Also cladocerans played an important role, especially small *Pleuroxus uncinatus* occurring in 70% of the tracts, mainly in daytime. The remaining organisms - *Alonella nana*, *Limnocalanus sp.*, ephemeropterans, bivalves, and snails were found rarely, in small numbers, mainly in daytime.

DAILY RHYTHM OF ROACH FEEDING

Food consumption index values (I) describing feeding intensity of roach in daily cycle were the highest in the morning and afternoon, and considerably decreased in the evening and night. Feeding intensity curve (Fig. 1) shows 2 peaks. Between 11 p.m. and 4 a.m. the fish did not feed, and 60% of the digested tracts sampled at that time were empty.

DAILY FOOD RATION OF ROACH

Experimentally determined food evacuation constant (k_2) for roach at water temperature 14.1^{o}C was about 0.169. Daily food requirement of roach in third year of life, of average body weight 6.44 g, calculated according to Thorpe's method, was equal to 2.5% of fish body weight.

DISCUSSION

Analyses of food composition of various postembryonic stages of roach show little feeding plasticity during larval and early fingerling stages. For the first three weeks of life, roach feed on small rotifers (Matlak, Matlak 1976, Skaziński 1966). Later on, the fish switch to juvenile cladocerans (Panov, Sorokin 1966, Reyes-Marchant et al. 1992), and at 20 mm of body length - to large cladocerans (Hartman 1983, Hammer 1985). Fish over 50 mm readily switch to various food organisms (Hellawell 1972,

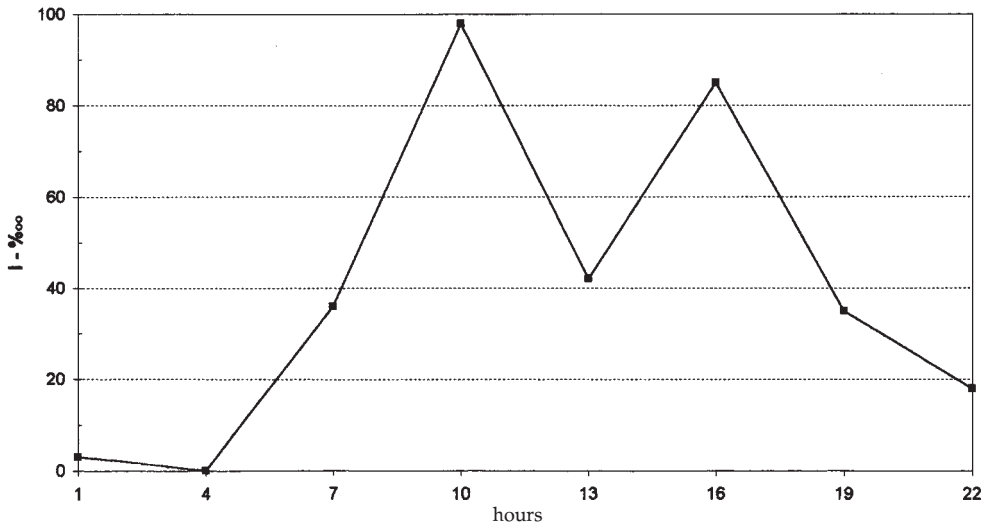

Fig. 1. Feeding intensity of roach in daily cycle expressed as average food consumption index (I - ‰).

Weatherley 1987). Food composition of roach depends also on water temperature (Szczerbowski et al. 1993).

Feeding intensity increases in daytime, and decreases at night. This is typical for visually-oriented predatory fishes active under good light conditions. A similar feeding pattern is observed in some non-predatory species – bleak, peled (Sozinov 1978, Zusser, after Sozinov), or tench larvae and fingerlings under pond conditions (Pyka 1997). The results of the present study revealed that lake-dwelling roach shows similar feeding activity pattern. After night-time starvation period, roach starts to feed in the morning and continues until the afternoon.

Daily food consumption depends on water temperature.This affects the rate of fish metabolism. It also depends on fish age and type of food. All these factors determine digestion rate coefficient - k_2 (Thorpe 1977), or R (Persson 1982) described with exponential function. For roach in the third year of life, at water temperature 14.1°C, the coefficient about 0.169 can be considered to be reliable.

Daily food ration of Bachotek Lake roach, calculated according to Thorpe (1977), taking into consideration digestion rate coefficient 0.169, was equal to 2.5%. Widely applied formula by Elliott and Persson (1978) seems little applicable for non-predatory fish feeding at low temperatures under natural conditions. This was also confirmed for tench fingerlings (Pyka 1997).

CONCLUSIONS

1. Food of roach in the third year of life, of average body weight 6.44 g and body length 8.3 cm, consisted mainly of periphytic and planktonic algae, with little addition of cladocerans, copepods, ephemeropterans, bivalves, and snails.
2. The roach showed feeding activity in the morning and afternoon.
3. Daily food ration calculated according to Thorpe was equal to 2.5% of fish body weight.

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STRESZCZENIE

WIOSENNY DOBOWY CYKL OŻYWIANIA SIĘ PŁOCI *Rutilus rutilus* (L.) W JEZIORZE BACHOTEK (POJEZIERZE BRODNICKIE). PRÓBA OKREŚLENIA DOBOWEJ RACJI POKARMOWEJ

W pracy omówiono odżywianie się płoci w trzecim roku życia w jeziorze, w okresie wiosny - w porze rosnącej aktywności pokarmowej. Zawartość przewodów pokarmowych określano wagowo. Przedstawiono intensywność żerowania płoci w różnych porach doby. Obliczono ich dobowe zapotrzebowanie na pokarm metodą Thorpe'go (1977). Dla ryb o średniej masie jednostkowej 6,44 g, w średniej dobowej temperaturze wody 14,1 ^{o} C wyniosło ono około 2,5 % średniej masy ryby.

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