Anna SZCZYGLIŃSKA

DIET COMPOSITION AND DAILY FEEDING PATTERNS OF
RUTILUS RUTILUS (L.) IN WŁOCLAWEK DAM RESERVOIR IN 1982–1984

SKŁAD POKARMU ORAZ DOBOWY RYTM ODŻYWIANIA SIĘ PŁOCI
RUTILUS RUTILUS (L.) W ZBIORNIKU WŁOCLAWSKIM,
W LATACH 1982–1984

CHAIR OF ZOOLOGY, ACADEMY OF AGRICULTURE AND TECHNOLOGY, OLSZTYN

The work gives both; a qualitative composition of the trout's feed for various body length classes and relations between feeding intensity and exposure to light within the twenty-four hours. Surveys were conducted on 1035 individuals caught between 1982 and 1984 within the Włocławski Reservoir. A composition of the trout's feed, typical, in general, for particular body length classes, was lacking in macrophytes, with a small amount of *Dreissena* being replaced by the molluscs from *Pisidium* genus. A clear twenty-four hours feeding rhythm, with brake during the night, was noted. The thesis on the relation between the feeding intensity and water temperature has been confirmed.

INTRODUCTION

Roach (*Rutilus rutilus* L.) is a typical euryphagic species, able to find a suitable ecological niche in almost every water body. It predominates the ichthyofauna of most mezo- and eutrophic lakes of Europe and constitutes an important factor in the lake metabolism (Prejs 1976a, Brabrand 1985). To a large extent roach feeds on plants although this type of food is avoided by most non-predatory fishes (with the exception of rudd and dace) (Prejs 1973, 1976b, 1984, Prejs and Jackowska 1978). When there are no macrophytes and preferred molluscs, this fish is able to utilise other food resources. Many authors (Želtenkova 1949, Skóra 1972, Klimczyk-Janikowska 1978, Niederholzer and

Table 1

56

Numbers of samples, and mean values of the index of fullness of the roach guts
collected in particular months in 1982–1984.

T – water temperature (°C), n – total number of collected guts
n_f – number of full guts, P – mean value of index of fullness (%)

Month	1982				1983				1984			
	T	n	n _f	P	T	n	n _f	P	T	n	n _f	P
April	00.0	110	25	123	15.0	37	13	129	11.6	124	108	100
May	18.0	12	5	196	–	–	–	–	13.0	67	45	165
June	24.0	59	33	278	–	–	–	–	17.0	53	18	93
July	20.4–24.0	58	27	250	21.0	58	35	122	17.5	76	50	87
August	–	–	–	–	–	–	–	–	23.6	78	51	177
September	19.0	17	9	96	–	–	–	–	13.0	90	64	68
October	10.1	55	43	127	12.0	61	29	167	13.0	80	59	91

Hofer 1980) pointed to considerable plasticity of roach. Its digestive system is adapted to different environmental conditions, this being due to high proteolytic activity (Hofer 1979).

The aim of the studies was to determine the amount and diet composition of roach in Włocławek Dam Reservoir and to establish the daily feeding patterns of this fish.

MATERIAL AND METHOD

Studies were carried out on the materials collected in 1982–1984. In the first two years the fishes were caught with gill nets. Tow nets were used in the last year, the catches being performed 6 times daily, at even intervals. Fishes of body length 12 to 24 cm were caught. Totally, 1035 food tracts were collected (Tab. 1). All the fishes were measured and weighed, and their food tracts were preserved in 4% formalin. Water temperature was measured at the same depth (10 cm below the surface) and the same time.

Percentages of particular food components were determined in relation to total food weight. To achieve this the volume-score method was applied. Particular components were not weighed separately due to considerable damage of the mollusc shells, their mixing with the filamentous algae, digestion of the food etc. Frequency of occurrence of the most important components was calculated for the samples collected in 1984. Data obtained in the last year of the studies were used to establish the relationship between food consumption rate water temperature and light. To achieve this average indices of gut filling with the food were calculated for subsequent samples collected during 24 hours. The materials were obtained in the period April – August.

RESULTS

Food composition of roach in Włocławek Dam Reservoir.

Food of roach consisted of a variety of components: plants, animals and detritus. *Bacillariophyta*, filamentous "*Chlorophyta*", and unidentified vascular plants (roots, stems, seeds etc. related to as "*Tracheophyta*") represented the most important food components.

Mollusca were most important among the animals consumed by roach. They were represented most of all by *Pisidium* sp., *Viviparus viviparus*, *Valvata* sp., *Dreissena polymorpha* and *Bithynia* sp. *Chironomidae* larvae and pupae were also consumed, as well as some *Entomostraca* such as *Leptodora kindtii*, *Daphnia* sp., *Bosmina* sp., *Alona* sp., and *Cyclops* sp.

Detritus and sand was always found in the food tracts.

Taxons	12,1 - 16,0			16,1 - 20,0						20,1 - 24,0						
	VI	VII	X	IV	V	VI	VII	IX	X	IV	V	VI	VII	IX	X	
	n	16	7	19	11	2	15	14	4	18	14	3	2	6	5	6
Bacillariophyta	+	o	+		□		●	+			●					
Chlorophyta	□	□	●		□	□	■	+	o		□		●	o		
Tracheophyta	●	●	●		□	●	□	■	●		□		o	□		
Viviparus viviparus	+					●			o			■	□			
Valvata sp.			+	●					o	●						+
Bithynia sp.				o						●						
Pisidium sp.	□	●	□			□	●		□		●		■		■	
Dreissena polymorpha				o						o	o					+
Molusca n. det.	●		o	■		●			□	■	●					
Entomostraca	+	+	+		+	+	+	□			+			+		
Chironomidae larvae	o	+	□	+	o	+	+		o	+	+		+		o	
Chironomidae pupae	+	+				+	+	+						□		
Detritus	o	□	□	+	□	●	●	□	●	+	●			□		
Sand	+		+	+	●	o	+		o	+	+		+	+

Fig. 1. Percentage composition of roach diet in 1982 in the body length (l.c) classes

Fig. 2. Percentage composition of roach diet in 1983 in the body length (l.c) classes

Taxons	12,1 - 16,0							16,1 - 20,0							20,1 - 24,0							
	IV	V	VI	VII	VIII	IX	X	IV	V	VI	VII	VIII	IX	X	IV	V	VI	VII	VIII	IX	X	
	n	37	29	11	24	25	19	22	56	11	6	14	17	21	20	15	5	1	12	9	24	17
Bacillario- phyta	+							+	+				+			+						+
Chlorophyta	○	●	+	○	□	○	+	○	●	○	○	□	●	●	○	●			●	□	○	
Tracheophyta	□	●	□	○	□	○	○	□	□	□	□	□	□	●	+	□	□	□	●	●	□	+
Viviparius viviparius					+				+		□					○			●	○	○	
Valvata sp.						○	○			●	●	●	□	○	●	□	●	□	●	□	○	
Bithynia sp.													+			○				○	+	
Pisidium sp.		□	+		●	●	□	○	□	+			□	□	□	●	●		□	■	□	■
Dreissena polymorpha	○							+								○			●	+	+	
Mollusca n. det.			●	○			●			●	□		○		○			○			○	
Entomostraca	●	□	+	○	+	●	+	●	+		●	+	●	+	○	+		●		+	+	
Chironomidae larvae	□	●	□	●	●	●	□	□	●	□	○	○	○	□	□		●	○	○	+	●	
Chironomidae pupae		□	□	■	●	□	●		●	□	+	+	□	+		○		○	+	○		
Detritus	□	□	○	○	□	□	●	□	●	□	□	□	□	○	□	□	□	□		●	+	
Sand	○	○	+	○	+		+	○	+	●	○		+	+	○	●	●	○		○	+

Fig. 3. Percentage composition of roach diet in 1984 in the body length (l.c) classes

Food composition and body length of the fishes.

Roach 12.1 to 16.0 cm long consumed filamentous Chlorophyta, vascular aquatic plants, small molluscs from the genus *Pisidium*, detritus, and in 1984 also *Chironomidae* larvae and pupae. Supplementary food recedents and subrecedents consisted of the diatoms, crustaceans from the genus Copepoda and Cladocera (*Leptodora kindti* most of all) and other small molluscs (*Valvata* sp.) (Fig. 1–3). Cyanophyta, *Hepaticae*, *Rotatoria*, *Nematoda*, *Oligochaeta* (bristles), *Tardigrada*, *Hirudinea*, *Hydracardina* and *Insecta* imago were also found in negligible amounts.

Roach of body length 16.1–20.0 cm consumed more *Mollusca*. *Pisidium* sp. predominated but other forms also appeared: *Viviparus viviparus*, *Valvata* sp., *Bithynia* sp. and *Dreissena polymorpha* (Fig. 1–3). In summer, plants became more abundant reaching over 50% of total volume of the food consumed (for instance in August and September 1982, Fig. 1).

Fishes of body length from 20.1 to 24.0 cm fed mostly on molluscs which represented over 60% of the food volume (Fig. 1–3).

Seasonal differences in the food composition

Share of particular components in roach food differed in the 3 years of studies. These variations were caused by the food availability.

In spring and autumn (April, October 1982–1984) molluscs predominated. Their percentage never dropped below 60%, and sometimes reached even 100% (April 1982, Fig. 1– 3). In other months molluscs were also consumed but at a lower rate than in spring and autumn.

Since May till September the fishes readily consumed Chlorophyta and fragments of vascular aquatic plants. In May and September 1982 these components represented over 50% of the food volume (Fig. 1) and in 1983 and 1984 they predominated the summer food of roach (Figs. 2 and 3).

In 1984 the percentage of *Chironomidae* larve and pupae increased considerably. Fishes belonging to the first size group fed on these organisms most intensively in June and July (Fig. 3). *Chironomidae* were consumed by more than half of the fishes, and their frequency of occurrence increased to over 50% (Tab. 2).

Detritus was always an important food item of roach in all size classes and all seasons (Fig. 1–3, Tab. 2).

Relationship between feeding rate, daily light patterns and water temperature

Daily feeding patterns of roach were analysed taking advantage of the samples collected during 24-hour periods from April till August 1984. Feeding rate depended on daily light pattern. Filling of the guts with food decreased noticeably after sun-set, reaching zero levels between midnight and 3.00 hours a.m. (Fig. 4). Before the sun-rise

Table 2

Index of frequency of occurrence of the most important components
in the food of roach in 1984, without taxons 50%

Months	Size classes (in cm)					
	12.1–16.0		16.1–20.0		20.1–24.0	
IV	<i>Chlorophyta</i>	59	<i>Chlorophyta</i>	50	<i>Tracheophyta</i>	87
	<i>Tracheophyta</i>	92	<i>Tracheophyta</i>	91	<i>Chironomidae</i> L.	87
	<i>Copepoda</i>	73	<i>Copepoda</i>	52	<i>detritus</i>	73
	<i>Chironomidae</i> l.	84	<i>Chironomidae</i> l.	80		
	<i>detritus</i>	97	<i>detritus</i>	91		
V	<i>Tracheophyta</i>	59	<i>Chlorophyta</i>	64	<i>Chlorophyta</i>	60
	<i>Copepoda</i>	55	<i>Pisidium</i>	55	<i>Tracheophyta</i>	60
	<i>Chironomidae</i> l.	55	<i>Chironomidae</i> l.	64	<i>detritus</i>	60
	<i>Chironomidae</i> p.	59	<i>Chironomidae</i> p.	55		
	<i>detritus</i>	62				
VI	<i>Tracheophyta</i>	82	<i>Tracheophyta</i>	67		
	<i>Chironomidae</i> l.	91	<i>Chironomidae</i> l.	67		
	<i>Chironomidae</i> p.	82	<i>Chironomidae</i> p.	67		
VII	<i>Chironomidae</i> l.	58	<i>Tracheophyta</i>	64	<i>Valvata</i>	58
	<i>Chironomidae</i> p.	88				
VIII	<i>Chlorophyta</i>	76	<i>Chlorophyta</i>	82	<i>Pisidium</i>	89
	<i>Tracheophyta</i>	80	<i>Tracheophyta</i>	76	<i>Chironomidae</i> l.	67
	<i>Chironomidae</i> l.	80	<i>Chironomidae</i> l.	65		
	<i>detritus</i>	72	<i>detritus</i>	65		
IX	<i>Cladocera</i>	58	<i>Chironomidae</i> p.	52	<i>Tracheophyta</i>	58
	<i>Chironomidae</i> l.	79			<i>Valvata</i>	54
	<i>Chironomidae</i> p.	79				
	<i>detritus</i>	63				
X	<i>Pisidium</i>	68	<i>Pisidium</i>	75	<i>Pisidium</i>	100
	<i>Chironomidae</i> l.	77	<i>Chironomidae</i> l.	70	<i>Chironomidae</i> l.	71

Fig. 4. Daily patterns of the roach gut filling with food in particular months in 1984.

the fishes fed quite intensively, the highest values being observed from 2 to 3 hours after sun-rise. With the exception of April, no samples were obtained between 8.00 hours a.m. and 4.00 hours p.m. so nothing can be said of the feeding rate during daytime. From 2 to 3 hours before sun-set the feeding rate was similar as at dawn (Fig. 4).

Differences in the filling of the guts with food suggest that the feeding rate depended on light. Roach feeds during daytime, while at night the food is not taken or the feeding rate is very low.

Due to the short period of observations (May – August) it was very difficult to state whether the rate of feeding depended also on water temperature. Samples collected in September and October (Tab. 1) originated from night catches only, so the feeding rates could not have been determined, and these data were not used in analysing the daily feeding patterns and their relation with light and temperature. Nevertheless, it was observed that the rate of feeding was different in April: At water temperature of 9°C, the feeding rate was low and the fish intestines were filled with little food from $69^0/_{000}$ at night to $137^0/_{000}$ at daytime (Fig. 4). Low water temperature did not favour searching for the food. Digestion rate was also slow, this being confirmed by low number of empty guts (13% only in a sample consisting of 124 fishes Tab. 1). As the water temperature increased to 14°C in May and to 18.6°C–23.6°C in other months filling of the guts with food increased to 200, 250 or even $300^0/_{000}$ at daytime. During night the intestines were rather empty, this being due to no food uptake at this time and more rapid digestion caused by higher temperatures. In this period night samples contained more empty intestines than in April. From May till August percentage of empty intestines amounted to 33%, 66.35% and 34% in the samples collected at night. The differences in the gut filling with food at daytime and at night increased with increasing water temperature (Fig. 4).

DISCUSSION

Abundant literature on the feeding behaviour of roach suggests that smaller fishes feed on a variety of plant and animal organisms such as *Cyanophyta*, *Chlorophyta*, *Bacillariophyta*, vascular plants, *Rotatoria*, larvae of *Trichoptera*, *Simulium*, *Ephemeroptera*, larvae and pupae of *Chironomidae*, *Cladocera*, *Copepoda*, *Ostracoda*, and detritus (Bogatova 1963, Skóra 1964, Mann 1973, Prejs 1976b, Gasser 1976, Terlecki et al. 1977, Niederholzer and Hofer 1980, Ionova 1981). This variety results from different conditions in the habitats of small roach. Small fishes usually occupy areas overgrown with the macrophytes, in which animal and plant organisms are fairly abundant (Prejs 1976b). Considerable variety of the food components is maintained up to about fourth year of the fish life, i.e. to body length of about 16 cm (Skóra 1972). Bigger fishes usually penetrate the bottom, and composition of their food becomes less variable with noticeable domination of one, two or at most three components. These are usually represented by Mollusca, macrophytes and filamentous algae. Roach in Lake Warniak fed mostly on the macrophytes, *Potamogeton* and *Elodea* most frequently (Prejs 1973). In a

Tirol Lake Möserer roach controlled underwater meadows of *Chara* by feeding on young growths of this plant (Hofer and Niederholzer 1978). *Chara* and *Potamogeton* were the main components of roach food in Lake Oyeren in Norway (Brabrand 1985). However, specimens bigger than 16 cm usually feed on molluscs, the preferred species being *Dreissena polymorpha*, *Pisidium* sp., *Valvata* sp., *Bithynia* sp., and *Viviparus viviparus* (Żeltenkova 1949, Skóra 1964, Prejs 1976b, Terlecki et al. 1977, Prejs and Jackowska 1978). Żeltenkova pointed to the fact that most other fishes avoid those molluscs which possess thick and hard shells such as *Dreissena polymorpha*, while roach is well able to feed on these organisms and attains considerable weight gains in lakes rich in molluscs (Kempe 1962). Intestines of bigger fishes frequently contain shells of larger molluscs (own observations, Choińska 1984 unpubl.). Size of the fish mouth increases with the age so that older roach can feed even on fairly large molluscs. However in case of *Dreissena polymorpha*, 2 to 3 years old individuals are usually consumed (Choińska 1984, unpubl.). Older animals cannot be eaten because they stick firmly to the substrate and possess too thick shells, so that their consumption requires considerable energy expence by the fish.

Composition of roach diet in Włocławek Dam Reservoir is quite typical though poorer than in other waters. Lack of typical components such as the macrophytes results from their lack in the environment. Underwater meadows of *Potamogeton*, 200–300 m long, were observed only along the shore of the reservoir. Remnants of vascular plants, described as "*Tracheophyta*" were usually of detrital origin as in most cases they consisted of small unidentified fragments of roots and stems. No plant leaves were ever found in the fish guts and no other characteristic plant fragments allowing for their identification.

In Włocławek Dam Reservoir roach preferred *Pisidium*, *Valvata* and *Viviparus* over *Dreissena*. According to Wiśniewski (unpubl. data) *Dreissena* was a most abundant molluscs in the reservoir. It formed a permanent shoal of over 10 km along the left bank of the Vistula River near Dobiegniew, and just in front and behind the dam, at a depth of about 7 m. Big specimens, of shell size up to 41,7 mm in length, were found in the reservoir. However this species was more abundant only in the diet of roach over 16 cm l.c. in 1983.

Fairly high and constant percentage of detritus in the fish diet is typical of this species (Mann 1973, Gasser 1976, Niederholzer and Hofer 1980).

The observed relationship between the feeding rate and water temperature is a common biological phenomenon noted for all fish species. For instance, bream, tench and crucian carp in Lake Warniak fed most intensively in summer while in October at water temperature of 10°C, the rate of feeding decreased rapidly (Prejs 1973). Mann (1973) observed the highest numbers of empty intestines in roach, sometimes over 50% since September till April. Hofer and Niederholzer (1980) found that the index of gut filling with food depended directly on water temperature, and that a 4°C decrease of the temperature reduced food uptake by 50%.

Most authors agree that fishes feed most intensively in summer and less so in autumn,

winter and early spring. According to Prejs (1976b) roach fed at a high rate for a period of 130 days. The same was observed in Włocławek Dam Reservoir, in which the fish fed most intensively since May till August.

Daily feeding patterns of roach have not been extensively studied so far. Earlier works dealt either with the fish fry or were conducted in laboratory conditions. Hruška (1956) observed empty guts early in the morning and concluded that roach did not feed at night. In the experiments by Mann (1965) conducted in conditions resembling the natural ones, peak of oxygen consumption by the fishes was observed at sun rise. This points to rapid increase of fish activity at this time of the day, i.e. also to feeding. Ionova (1981) observed feeding behaviour of roach fry in summer in natural conditions and found that the fishes fed through the day but ceased to feed at night. Index of the gut filling with food was high between 12.00 and 21.00 hours and decreased since 22.00 hours, the minimum being noted from 2.00 to 4.00 hours, when empty guts were found most frequently. The fishes commenced to feed at 4.00 hours.

According to Kogan et al. (1980) the index of intestine filling in roach fry reached a first maximum at 5.00 hours, a second maximum at 15.00–17.00 hours, and a third one at 19.00 to 21.00 hours. At dusk the fishes moved to deeper waters and ceased to feed. Consequently, the discussed index decreased from $506^0/_{000}$ at 21.00 hours, to $306^0/_{000}$ at 23.00 hours, $67^0/_{000}$ at 1.00 hours and $14^0/_{000}$ at 3.00 hours. Hence, the daily feeding patterns of roach in the Volga River was characterised by a few peaks and a break at night. Studies carried out in Włocławek Dam Reservoir showed that also adult roach conformed to this pattern. Due to insufficient amount of data it was not possible to establish whether there was one, or more maxima of the feeding intensity, but the fishes certainly did not feed at night.

REFERENCES

- Bogatova I.B., 1963: O piščevych odnošenijach u ozernych ryb. Vopr. Ichtiol. 3: 336–346. (in Russian)
- Brabrand A., 1985: Food of roach (*Rutilus rutilus*) and ide (*Leuciscus idus*): significance of diet shift for interspecific competition in omnivorous fishes. *Oecologia* (Berlin) 66: 461–467.
- Elliot J.H., L. Persson, 1978: The estimation of daily rates of food consumption for fish. *Journal of Animal Ecology* 47: 977–991.
- Ermolin 1979: Kolicestvennaja charakteristika pitnija lesca *Abramis brama* (L.) w Seraovskom vodochranilišce. Vopr. Ich. 19, 6: 1091–1097.
- Gasser M., 1976: Ökologie von Barsch, Rotaugen und Salmoniden im Piburger see. Dissertation zur Erlangung des Doktorgrades an der Philosophischen Fakultät der Leopold-Franzens-Universität Innsbruck.
- Hofer R., H. Forstner and R. Rettenwander, 1983: Duration of gut passage and its dependence on temperature and food consumption in roach, *Rutilus rutilus* L. laboratory and field experiments. *J. Fish. Biol.* 20: 289–299.
- Hofer R., Niederholz R., 1978: Einfluss der Rotaugenpopulation auf den Charabestand (Armleuchteralgen) des Möserer Sees (Tirol) Österreichs fischerei. 31, 1: 12–17.

- Hofer R., 1979: The adaptation of digestive enzymes to temperature, season and diet ich roach, *Rutilus rutilus* and rudd *Scardinius erythrophthalmus*; *Proteases* J. Fish. Biol. 15: 373–379.
- Hofer R., Niederholzer R., 1980: The feeding of roach (*Rutilus rutilus* L.) and rudd (*Scardinius erythrophthalmus* L.). II. Feeding experiments in the laboratory – *Ekol. pol.* 28: 61–70.
- Hruška V., 1956: Príspevek k potravni biologii plotice v Tuni Poltrube. *Biologica* 2: 161–207. Universitas Carolina. (in Czech)
- Ionova V.A., 1981: Sutočnyj ritm i racion pitaniya molodi vobly *Rutilus rutilus* Caspicus (Jak.) v elementarnykh populacijach. *Voprosy ichtiologii* 21, 3: 474–481. (in Russian)
- Jobling M., 1981: Mathematical models of gastric emptying and the estimation of daily rates of food consumption for fish. *J. Fish. Biol.* 19: 245–257.
- Kempe, O., 1962: The growth of the roach *Leuciscus rutilus* (L.) in some swedish lakes. *Rep. Drottningholm* 44:42–104.
- Klimczyk-Janikowska M., 1978: Influence of wa med water on the growth and the feeding of the roach (*Rutilus rutilus* L.). *Acta Hydrobiologica* 20, 2: 175–185.
- Kogan A.V. Nekrasova H.P., Popova J.K., 1980: Osobennosti pitaniya molodi plotvy *Rutilus rutilus* (L.) i okunia *Perca fluviatilis* L. v period pokatnoj migracii w reke. *Voprosy Ichtiologii* 20, 3: 508–516. (in Russian)
- Mann K.H., 1965: Energy transformations by a population of fish in the river Thames. *J. Anim. Ecol.* 34: 253–275.
- Mann R.H., 1973: Observations on the age, growth reproduction and food of the roach *Rutilus rutilus* (L.) in two rivers in southern England. *J. Fish. Biol.* 5: 707–736.
- Niederholzer R., Hofer R., 1980: The feeding of roach (*Rutilus rutilus* L.) and rudd (*Scardinius erythrophthalmus* L.) 1: Studies on natural populations. *Ekol. pol.* 28: 45–59.
- Persson L., 1982: Rate of food evacuation in roach (*Rutilus rutilus* L.) in relation to temperature, and the application of evacuation rate estimates for studies on the rate of food consumption. *Freshwater Biology*, 12: 203–210.
- Prejs A., 1973: Experimentally increased fish stock in the pond type Lake Warniak IV. Feeding of introduced and autochthonous non-predatory fish. *Ekol. pol.* 21, 30: 465–505.
- Prejs A., 1976a: The role of fish in the detritus formation. in: *Selected problems of lake littoral ecology*, ed. Pieczyńska E. University of Warsaw: 173–179.
- Prejs A., 1976b: Fishes and their feeding habits, in “*Selected problems of lake littoral ecology*. ed. Pieczyńska E., University of Warsaw: 155–171.
- Prejs A., 1978: Lake macrophytes as the food of roach (*Rutilus rutilus* L.) and rudd (*Scardinius erythrophthalmus* L.). II. Daily intake of macrophyte food in relation to body size of fish – *Ekol. pol.* 26: 537–553.
- Prejs A. Jackowska H., 1978: Lake macrophytes as the food of roach (*Rutilus rutilus* L.) and rudd (*Scardinius erythrophthalmus* L.). I. Species composition and dominance relations in the lake and food – *Ekol. pol.* 26: 429–438.
- Prejs A., 1984: Herbivory by temperate freshwater fishes and its consequences. *Environmental Biology of Fishes*. 10, 4: 281–296.
- Skóra S., 1964: Charakterystyka płoci (*Rutilus rutilus* L.) ze Zbiornika Goczałkowskiego. [The characteristics of the roach (*Rutilus rutilus* L.) living in the Goczałkowie Reservoir]. *Acta Hydrobiol.* 6, 4: 351–374.
- Skóra S., 1972: Płoc (*Rutilus rutilus* L.) zbiornika zaporowego w Przeczycach. [The roach (*Rutilus rutilus* L.) from the dam reservoir in Przeczycze]. *Acta Hydrobiol.* 14, 4: 399–418.
- Terlecki J., J. Szczerbowski, A. Martyniak, 1977: Pokarm leszcza, krapia, uklei i płoci w rzece Pisie Warmińskiej. [Food of the bream, burbot, bleak roach in the Pisa River]. *Rocz. Nauk Roln. S.H.*, 98, 2: 149–167.

Zeltenkova M. V., 1949: Sostav piščy i rost nekotorych predstavitelej vida *Rutilus rutilus* (L.). Zool. Ž. 28: 257–268. (in Russian)

Anna Szczyglińska

SKŁAD POKARMU ORAZ DOBOWY RYTM ODŻYWIANIA SIĘ PŁOCI *RUTILUS RUTILUS* (L.)
W ZBIORNIKU WŁOCŁAWSKIM, W LATACH 1982–1984

STRESZCZENIE

Skład pokarmu płoci był dość typowy dla gatunku, choć uboższy niż w jeziorach z rozwiniętym litoralem. Osobniki młodsze o długości do 16 cm l.c. odżywiały się nitkowatymi *Chlorophyta*, drobnymi fragmentami *Tracheophyta*, larwami i poczwarkami *Chironomidae*, drobnymi *Crustacea*, małżami z rodzaju *Pisidium* oraz detritusem. W pokarmie płoci powyżej 16 cm l.c. zdecydowanie dominowały mięczaki: *Pisidium* sp., *Viviparus viviparus*, *Valvata* sp., *Bithynia* sp., *Dreissena polymorpha*. Zróżnicowanie składu pokarmu wiązało się również z zasobnością zbiornika w poszczególnych sezonach objętych badaniami.

Na podstawie odłowów prowadzonych 6 razy w ciągu doby określono rytmikę dobową odżywiania się gatunku. Stwierdzono wyraźny związek intensywności żerowania z oświetleniem. Pobieranie pokarmu rozpoczynało się wraz z rozwidnianiem, osiągając wysoki poziom w 2 do 3 godzin po wschodzie słońca. Żerowanie ustawało po zachodzie słońca, w nocy jelita zazwyczaj były puste.

Potwierdzona została teza o związku intensywności żerowania z temperaturą wody. W kwietniu przy średniej temperaturze wody 9°C jelita były bardzo słabo wypełnione. Podwyższenie temperatury w następnych miesiącach wpłynęło na wyraźny wzrost pobierania pokarmu. Jednocześnie wyraźnie zwiększyła się różnica w napełnieniu jelit w dzień i w nocy.

Author's Address¹

Dr. Anna Szczyglińska

Katedra Zoologii

Akademia Rolniczo-Techniczna

Kortowo

Olsztyn 10–957

Polska (Poland)

Received: 1987.06.03²