

Arch. Ryb. Pol.	Archives of Polish Fisheries	Vol. 6	Fasc. 1	107 - 113	1998
--------------------	---------------------------------	--------	---------	-----------	------

FEEDING OF CHUB (*Leuciscus cephalus* L.) FRY IN KONIŃSKIE LAKES

Halina Wilkońska, Jarosław Żelepień

The Stanisław Sakowicz Inland Fisheries Institute in Olsztyn

ABSTRACT. Feeding of chub fry of body length 1.0-8.0 cm in 3 heated lakes was studied. The fish fed on zooplankton (mainly crustaceans), insects and plants. Growing fish chose bigger prey. Only larvae (2 cm) ate Rotatoria, 2.0-5.0 cm long fry fed mainly on insect larvae and pupae, and fish over 5.0 cm preferred filamentous algae (90% of diet).

Key words: CHUB, FOOD OF FRY, HEATED LAKES

INTRODUCTION

Including of Konińskie lakes into the cooling system of "Konin" and "Pątnów" power plants resulted in alteration of hydrological and thermal status of the lakes (Zdanowski 1994). The lakes lost their natural status of stagnating reservoirs, and constant flow of large amounts of water created favourable conditions for rheophilic fish such as chub. This resulted in an increase of chub fry number in the fish community of shallow littoral of heated Konińskie lakes (Wilkońska 1994). Detailed analysis of age and size structure of chub population revealed considerable variability of body length, indicating batch spawning (Wilkońska, Żelepień 1994). The present paper provides further results of the studies on chub fry in Konińskie lakes.

MATERIAL AND METHODS

The study concerned feeding of chub fry in Licheńskie, Gośławskie and Ślesieńskie lakes. The fish were harvested in July 1993, and in May, June, August and September 1994. Total number of 170 alimentary tracts of 1-8 cm chubs were analysed (tab. 1). Size classes: 2.0, 2.1-5.0, and 5.1-8.0 cm corresponded to ranges of body length of chub cohorts (Wilkońska, Żelepień 1994). Species composition of prey in terms of numbers and weight share, and frequency of each species, are shown in tab. 2. Biomass of countable diet components (crustaceans and insects) was calculated according to the standards for crustaceans (Bottrell et al. 1976), for Chironomidae (Mackey 1977, Wilda 1984), and for other insects (Smock 1980).

TABLE 1

List of collected material

Lake	Licheńskie			Gosławskie			Ślesieńskie
Kl. długości (cm)	< 2,0	2,1-5,0	5,1-8,0	< 2,0	2,1-5,0	5,1-8,0	2,1-5,0
16.05.94	6			10			
7.06.94		10			10		
23.07.93		16	17			16	50
1.08.94							10
1.09.94			5			10	10
Total	6	26	22	10	10	26	70

Non countable items (algae, macrophyte remains, detritus) were weighed with 0.0001 g accuracy. As regards Oligochaeta remains, only frequency was calculated.

RESULTS

Species composition of food of each size class of chub over the study period is shown in tab. 2. The smallest fish, larvae below 2 cm, harvested in May in Licheńskie and Gosławskie lakes, fed exclusively on zooplankton and insects. Zooplankton comprised over 63% of total numbers, but insects - 99% of total biomass of the ingested organisms (tab. 2). In both lakes, zooplanktonic part of the fish diet consisted of Rotatoria, particularly numerous in Gosławskie (19.2%), and crustaceans: small littoral-dwelling Cladocera such as *Bosmina* sp., *Alona* sp., *Chydorus* sp., and Copepoda. In Gosławskie Lake share of both groups was similar (21.9 and 28.1%), and in Licheńskie - Cladocera predominated (50%). Another component of the fish diet - insects - consisted of: Diptera imagines (55% in Licheńskie, and 58% in Gosławskie), and larvae and pupae, mainly of Chironomidae (44 and 40.6% respectively): *Tanytarsus* sp., *Trichoclaudius* sp., *Cricotopus* sp. in Licheńskie Lake, and *Stictochironomus* sp. in Gosławskie.

Fry of body length 2.1-5.0 cm, irrespective of the lake or harvest date, fed mainly on insects that comprised up to 100% of the fish diet. Share of crustaceans decreased, and new component appeared in fish food: non countable items (tab. 2). The diet of fish harvested in June from Licheńskie and Gosławskie lakes lacked zooplankton, and in fish from Licheńskie Lake - filamentous algae predominated (85% of biomass). Fish from Gosławskie fed mainly on insect imagines, predominantly Diptera (71.2%

TABLE 2

Percentage in the numbers (L), weight (M) and frequency of food components in three size classes of chub from Konin lakes

Date	16.05.94						7.06.94						23.07.93						01.08.94						01.09.94											
Length class (cm)	<2.0						2.1-5.0						5.1-8.0						2.1-5.0						5.1-8.0											
Lake	Lichenskie			Goslawskie			Lichenskie			Goslawskie			Lichenskie			Goslawskie			Ślesĩskie			Goslawskie			Ślesĩskie			Lichenskie			Goslawskie					
Food components	L	M	C	L	M	C	L	M	C	L	M	C	L	M	C	L	M	C	L	M	C	L	M	C	L	M	C	L	M	C						
	L	M	C	L	M	C	L	M	C	L	M	C	L	M	C	L	M	C	L	M	C	L	M	C	L	M	C	L	M	C						
Zooplankton																																				
Rotatoria	3.6	0.0	33.3	19.2	0.0	20.0																														
Cladocera	50.0	0.8	66.7	21.9	0.1	40.0				65.1	11.3	10.0	87.4	19.2	100	39.9	0.9	82.3																		
Copepoda	9.4	0.3	16.7	28.1	1.2	40.0							0.4	0.1	24.0				63.4	7.5	93.7	4.9	0.1	10.0	3.2	0.0	10.0									
Crustaceans and other													0.9	6.6	24.0	0.8	0.5	17.7																		
ogółem	63.0	1.1	88.3	69.2	1.3	90.0				65.1	11.3	10.0	88.7	25.9	100	40.7	1.4	100	63.4	7.5	93.7	4.9	0.1	10.0	3.2	0.0	10.0									
Insects																																				
Ephemeropteran.																1.0	7.4	52.0	6.2	1.3	64.7	9.8	5.2	87.5	6.5	3.6	20.0	9.4	4.7	30.0	33.3	0.6	40.0	20.0	1.7	20.0
Trichoptera																			1.9	0.5	23.5															
Chironomidae l.	18.2	38.5	100	16.8	39.5	50.0				4.4	2.4	20.0	22.3	61.8	10.0	4.0	26.4	82.0	21.6	10.3	94.1	20.3	48.1	100	32.9	17.7	60.0	16.0	7.9	60.0						
Chironomidae p.	3.1	5.5	16.7	1.0	1.1	10.0	4.7	0.7	100	1.9	1.2	20.0	4.1	12.4	56.2	2.1	15.2	62.0	12.1	3.2	94.1	5.5	2.1	87.5												
Diptera im.	15.7	54.9	50.0	13.0	58.1	50.0	28.6	4.3	20.0	71.2	79.2	100	2.1	5.2	25.0	1.2	5.0	56.0	11.8	4.8	94.1	0.7	1.5	56.2	55.7	60.8	90.0	71.4	71.5	100	66.7	2.5	60.0	50.0	5.0	40.0
Hymenoptera im.										1.0	1.1	10.0	3.3	2.5	43.7	0.4	2.9	24.0																		
Tysanoptera im.										2.5	2.5	20.0	1.3	2.2	18.7	0.8	5.4	4.4																		
Coleoptera im.										2.5	2.9	30.0	1.8	4.6	37.5				0.7	0.5	23.5											10.0	2.2	30.0		
Corixidae im.										2.9	3.2	20.0							0.4	2.9	24.0	5.0	1.7	64.7	0.3	1.4	18.7						20.0	1.1	20.0	
Owady inne																1.4	8.9	24.0																		
Total	37.0	98.9	100	30.8	98.7	100	100	14.9	60.0	100	100	100	34.9	88.7	100	11.3	74.1	100	59.3	22.3	100	36.6	58.3	100	95.1	82.1	100	96.8	84.1	100	100	3.1	80.0	100	10.0	60.0
Uncountable components																																				
Oligochaeta																																				80.0
Detritus																																				
Makrophytes																																				
Filamenous algae																																				
Seeds																																				
Total																																				

TABLE 3

Average size of food items ingested by chub in Licheńskie Lake

Length class (cm)	2,1-5,0		5,1-8,0	
Food component	mm	SD	mm	SD
Crustaceans	0.81	0.03	2.73	0.6
Chironomidae larvae	7.67	3.17	8.03	2.28
Imago insects	6.81	1.12	13.14	4.01

of total number and 79.2% of total food biomass). Chironomid juveniles were rare. Oligochaeta remains were a new food item, found in 30% of the fish under study (tab. 2). Fish harvested in July from Licheńskie and Ślesieńskie lakes fed exclusively on crustaceans and insects. Among crustaceans Cladocera predominated (*Daphnia* sp., *Sida* sp. in Licheńskie, and *Bosmina* sp., *Daphnia* sp. in Ślesieńskie). It is noteworthy that Copepoda, Ostracoda and Gammaridae were present in the fish diet only in Ślesieńskie Lake (tab. 2). Among insects, Chironomidae larvae and pupae were most numerous, and comprised 74% of total fish food in Licheńskie Lake, and 41% in Ślesieńskie. In Licheńskie – *Chironomus* sp., *Tanytarsus* sp., and *Cricotopus* sp. predominated, while in Ślesieńskie – *Tanytarsus* sp., *Cricotopus* sp., *Endochironomus* sp., *Cryptochironomus* sp., *Limnochironomus* sp., and *Stictochironomus* sp. were most numerous. Imagines of flying insects caught by fish from water surface were also an important component of the diet. Coleoptera were numerous in gut of fish from Licheńskie Lake, and Tysanoptera, Hymenoptera and Diptera (Simuliidae, Dolichopodidae, Melusinidae) in fish from both lakes. They comprised 14.5% of total food mass in Licheńskie Lake, and 32.5% in Ślesieńskie. Chub diet was similar in both months: dominated by the insects with a small addition of Copepoda (5.3% of food weight). Among the insects, Chironomidae comprised 39.9% of the total number of food items in August, and 71% in September. Non countable food also appeared – seeds (about 11% of the food weight), macrophytes in September (48%) and detritus in August (6.2%) (tab. 2).

Fry of body length 5.1-8.0 cm were harvested in July 1993 and in September 1994 from Licheńskie and Gosławskie lakes. Species composition of the fish food was similar as in smaller fish (2.1-5.0 cm), but was different in size. Fish chose larger species of crustaceans and insects (tab. 3). In July, Cladocera were fairly numerous in both lakes (*Sida* sp., *Eurycercus* sp., *Simocephalus* sp.), particularly in Gosławskie Lake (63.4% of the total number of fish food items). Among insects, share of flying species decreased

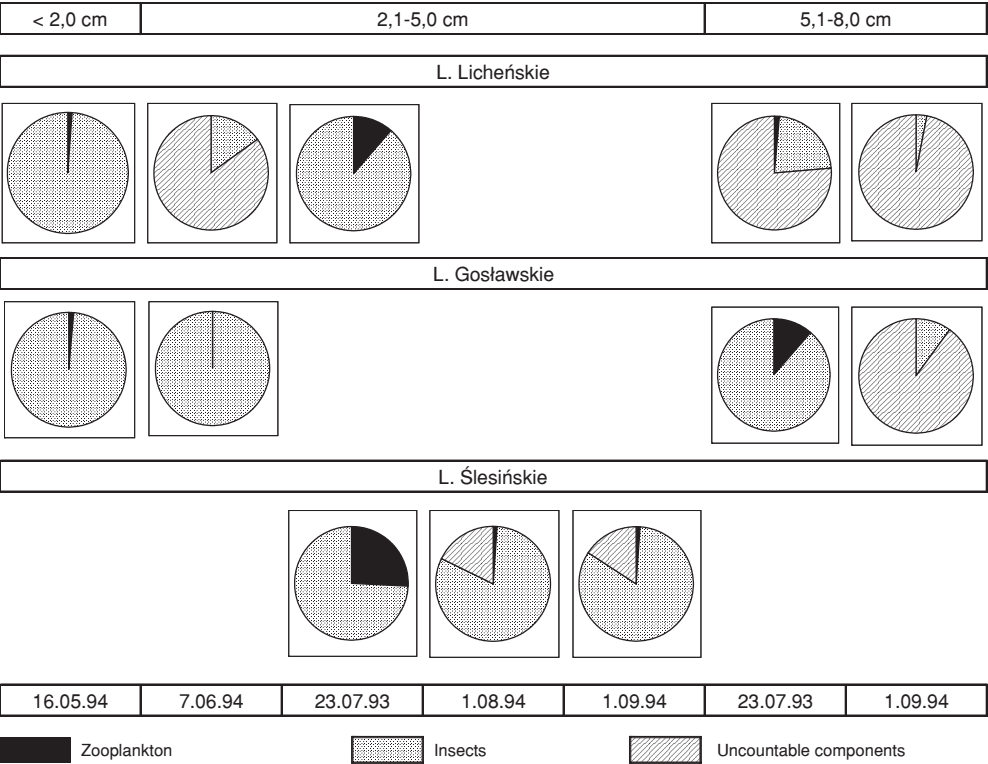
considerably. Chironomidae larvae and pupae predominated, comprising 33.7 and 13.5% of food numbers and biomass in Licheńskie, and in Gośląskie 25.8 and 50.2% respectively. Ephemeroptera nymphs were also present. Share of non countable food items increased, especially of filamentous algae (up to 70.7% of the total food biomass in Licheńskie, and 32.1% in Gośląskie). Macrophytes, detritus and Oligochaeta remains were also present in 80% of fish from Gośląskie Lake. In September, the fish food lacked crustaceans, and among insects only Ephemeroptera and Diptera were present. At that time non countable items predominated in the fish diet – 97 and 90% of the total food biomass (tab. 2).

DISCUSSION

Food of chub fry consisted of 3 groups of organisms: zooplankton, insects (larvae and imagines), plants (algae, macrophytes) and detritus, often with annelid remains. Share of these components in the fish diet was related to fish size and the lake (tab. 2, fig. 1). Larvae under 2 cm fed on Rotatoria, crustaceans, and small flying insects. 2.1-5.0 cm long fry preferred crustaceans which were most numerous in the fish diet, but insects predominated in the biomass. The largest fry (5.1-8.0 cm) fed mainly on insects and plants. Along with fish growth, size of their food changed, which was evident in Licheńskie Lake samples (tab. 3). Crustaceans captured by the 5.1-8.0 cm long fish were three -fold, and insects- two fold larger than those found in guts of 2.1-5.0 cm long chubs.

Differences of fish food in various lakes resulted from environmental factors. Ślesieńskie Lake, with a narrow littoral zone devoid of macrophytes, favoured pelagic crustaceans and flying insects carried by the waves and wind. Both groups were characteristic chub diet components in this lake. In Licheńskie Lake, particularly rich in filamentous algae, chub ate them while searching for larvae. On the other hand, in a large and rich in macrophytes littoral zone of Gośląskie Lake, chub fed also at the bottom, which is suggested by the presence of Oligochaeta and detritus in the guts of over 50% of individuals (tab. 2).

In the diet of chub fry under study, animal food predominated in small fish under 5.0 cm. Bigger fish fed mainly on plants. According to Jakubowski et al. (1979), chub from Licheńskie Lake of body length up to 14 cm consumed mostly molluscs, macrophytes and insects. Data of other authors, unfortunately, concern only older chub from various lakes, and indicate that fish fed mainly on algae, macrophytes,



Rys. 1. Weight share of the major food items in three length classes of chub

caddisflies, frogs and other fish (Horoszewicz 1964, Klimczyk 1965, Martyniak et al. 1976).

Changes in chub diet with the fish growth included type and size of the food items (tab. 3). A similar shift was observed by Mann (1976) in fish from English rivers. Switching from animal to plant food, and feeding on small benthic organisms by the fish from Licheńskie Lake, was probably caused by poor availability of large larvae of Chironomidae. Absence of these organisms might have resulted from thermal conditions. At high temperature, metamorphosis of the insects was shortened. It should be stressed that only 2.1-5.0 cm fry fed on wide variety of organisms, which suggests that many prey organisms were available only for this size class. This was confirmed by fish diet composition in Licheńskie and Ślesieńskie lakes. In the two lakes, chub showed similar preferences despite the differences in food availability observed by Leszczyński (1976).

REFERENCES

1. Bottrell H., Duncan A., Gliwicz Z. M., Grygier E., Herzing A., Hilbricht-Ilkowska A., Kurasawa H., Larsson P., Węgłęska T. 1976 - A review of some problems in zooplankton production studies - Norw. J. Zool. 24, s: 419-456.
2. Horoszewicz L. 1964 - Pokarm ryb drapieżnych w Wiśle - Rocz. Nauk Rol., B, 84, s: 293-314.
3. Jakubowski H., Penczak T., Urbanowicz K. 1979 - Morfologia i biologia klenia (*Leuciscus cephalus* L.) z wód zrzutowych elektrowni w Koninie - Rocz. Nauk Rol., H 99, 3, s: 151-178.
4. Klimczyk M. 1965 - Kleń (*Leuciscus cephalus* L.) z Górnej Wisły, Soły i Sanu - Acta. Hydrobiol. 7, s: 225-268.
5. Leszczyński L. 1975 - Wpływ zrzutu wód podgrzanych na faunę denną jezior konińskich. I. stosunki ilościowe i skład jakościowy fauny dennej jezior okolic Konina - Rocz. Nauk Rol. 97, H 3, s: 7-27.
6. Mackey A. P. 1977 - Growth and development of larval Chironomidae - Oikos 28, s: 270-275.
7. Mann R. H. K. 1976 - Observation on the age, growth, reproduction and food of the chub *Squalius cephalus* (L.) in the River Stour, Dorset. J - Fish Biol., 8, s: 265-288.
8. Martyniak A., Terlecki J., Szczerbowski J. A. 1976 - Odżywianie się szczupaka, klenia i miętusa w rzekach zlewiska Łyny - Rocz. Nauk Rol., H 97, s: 63-78.
9. Smock L. A. 1980 - Relationship between body size and biomass of aquatic insects - Freshwater. Biol. 10, s: 375-383.
10. Wilda T. J. 1984 - The production of five genera of Chironomidae (Diptera) in Lake Norman a North Carolina reservoir - Hydrobiol. 108, s: 145-152.
11. Wilkońska H. 1994 - Changes in the efficiency of natural reproduction and survival of fish larvae in heated Konin Lakes - Arch. Ryb. Pol. vol. 2, fasc. 2, s: 285-299.
12. Wilkońska H., Żelepień J. 1994 - Characteristics of chub (*Leuciscus cephalus* L.) fry in heated Konin Lakes - Arch. Ryb. Pol. vol.2, fasc. 2, s: 321-332.
13. Zdanowski B. 1994 - Characteristic of heated Konin Lakes, pollution sources: main results and conclusion - Arch. Ryb. Pol. vol.2, fasc. 2, s: 139-160.

STRESZCZENIE

ODŻYWIANIE SIĘ NARYBKU KLENIA W JEZIORACH KONIŃSKICH

Badano skład ilościowo-jakościowy narybku klenia od 1.0 - 8.0 cm Lc w 3 podgrzewanych jeziorach konińskich (tab. 1). Niezależnie od długości klenie odżywiały się zooplanktonem, owadami i roślinnością (tab. 2). Najmniejsze klenie (2 cm Lc) żerowały na *Rotatoria* i małych skorupiakach oraz drobnych owadach latających (Diptera). Podstawą diety narybku 2.1-5.0 cm były larwy i poczwarki *Chironomidae*. U największych kleni (5.0-8.0 cm) dominowały glony nitkowate i roślinność (tab. 2, rys.1). Wielkość ofiar zmniejszała się wraz z wielkością narybku (tab. 3). Skorupiaki wyjadane przez narybek 5.0-8.0 były 3-krotnie, a owadów 2-krotnie większe niż występujące w diecie kleni 2.0-5.0 cm.

ADRES AUTORÓW:

Doc. dr hab. Halina Wilkońska
Mgr inż. Jarosław Żelepień

Instytut Rybactwa Śródlądowego
Zakład Ichtiologii
10-719 Olsztyn
ul. Oczapowskiego 10