Roczniki Naukowe Polskiego Towarzystwa Zootechnicznego, t. 17 (2021), nr 4, 37-44
DOI: 10.5604/01.3001.0015.6995

The influence of age on the occurrence of internal parasites in perch (*Perca fluviatilis* L.) from Lake Góreckie in Wielkopolski National Park

Wojciech Andrzejewski[1], Tomasz Uzar[2], Agnieszka Pękala-Safińska[3], Maria Urbańska[4], Katarzyna Serwańska-Leja[2#], Agnieszka Pociecha[5]

[1]Institute of Zoology, Division of Inland Fisheries and Aquaculture, Poznań University of Life Sciences, Wojska Polskiego 71C, 60-625 Poznań, Poland
[2]Department of Animal Anatomy, Poznań University of Life Sciences, Wojska Polskiego 71C, 60-625 Poznań, Poland
[3]Department of Preclinical Sciences and Infectious Diseases, Poznań University of Life Sciences, Wołyńska 35, 60-637 Poznań, Poland
[4]Institute of Zoology, Department of Zoology, Poznań University of Life Sciences, Wojska Polskiego 71C, 60625 Poznań, Poland
[5]Institute of Nature Conservation, Polish Academy of Sciences, Adama Mickiewicza 33, 31-120 Kraków, Poland

SUMMARY

European perch (*Perca fluviatilis*) is a widespread species of freshwater fish. The most frequently isolated parasites in this species are endoparasites, such as trematodes, cestodes and nematodes. The purpose of the study was to determine the presence of parasite species found in perch and the correlations between the occurrence of parasites and age in fish from the Lake Góreckie reserve, located in Wielkopolski National Park. Among 139 examined perch, parasites were found in 69,8%. The analysis showed parasite species from the genera *Acanthocephalus*, *Cammallanus*, *Neoechinorhynchus*, *Triaenophorus*, *Proteocephalus* and *Tetracotylus*. The most common parasitosis was taeniasis. The analyses showed that occurrence of parasites correlates with the age of perch. Older fish were more often infected with parasites, especially of the genus *Triaenophorus*.

KEY WORDS: perch, parasites, fish age, national park, post-glacial lake

[#] Corresponding author e-mail: katarzyna.leja@up.poznan.pl
Received: 08.12.2021 Received in revised form: 23.12.2021
Accepted: 27.12.2021 Published online: 30.12.2021

INTRODUCTION

The European perch (*Perca fluviatilis* L.) is a common freshwater fish which is widely distributed in Europe and Asia and has been successfully introduced to New Zealand and Australia. It is the intermediate and definitive host of many parasites, especially endoparasites, such as trematodes, cestodes and nematodes (Bikhovskaya-Pavlovskaya and Kulakova,1987; Carney and Dick, 1999; Behrmann-Godel and Brinker, 2005; Wierzbicka et al., 2005; Kuchta et al., 2009). Information concerning the parasites of perch can be found in widely published literature (Rolbiecki, 2006; Halmetoja et al., 2000), but still little is known about aspects such as the age dynamics of infections with endoparasites. Parasites provide a great deal of biological information about their host, regarding migration, differences in diet, and food web structure (Williams et al., 1992; MacKenzie et al., 1995; Marcogliese et al., 2006). On the other hand, parasitism may influence the behaviour of fish (hosts), resulting in changes in their habitat and increasing vulnerability to predators (Seppälä et al., 2008). Infection with parasites increases the relative risk of mortality in the host (Behrmann-Godel and Brinker, 2005). In this paper we determined the occurrence of parasites in perch from Lake Góreckie, Wielkopolski National Park. Perch is common in water bodies and has a diverse diet, and for these reasons it is the definitive or intermediate host of many parasite species. Therefore, this fish species was selected for our study. The influence of age on the occurrence of parasites in perch has not yet been examined in detail.

The aim of this study was to answer the following questions:

- What parasites occur in perch in Lake Góreckie?
- Which species of endoparasites are more frequently observed in perch in Lake Góreckie?
- Is there a correlation between the occurrence of the endoparasite and the age of perch?

MATERIALS AND METHODS

Sampling points were established in Lake Góreckie, located in Wielkopolski National Park (western Poland), which is a post-glacial ribbon lake. In total, 139 samples of perch were collected from Lake Góreckie in autumn 2018. All collected fish were examined for parasites. The specimens were sampled using Nordic multi-mesh gill nets (height 1,5 m, length 30 m, composed of 12 panels 2,5 m in length with mesh size of 5; 6,25; 8; 10; 12,5; 16; 19,5; 24; 29; 35; 43 and 55 mm), according to Appelberg (2000). The total length and weight of the fish were measured. Age estimation was based on the scales above the lateral line according to the method suggested by Nautiyal (1990). The fish were examined a few hours after capture. The body cavity, liver and gastrointestinal tract of all specimens were examined. Parasites were identified live or after fixation in 75% alcohol. They were examined using techniques recommended for individual parasite taxa (Lonc and Złotorzycka, 1994; Jara and Chodyniecki, 1999) and identified using the following publications: Bykhovskaya-Pavlovskaya et al. (1962), Grabda-Kazubska and Okulewicz (2005), Pojmańska (1981), Pojmańska et al. (2007), and Pojmańska and Niewiadomska (2008). The Mann-Whitney U test was used to determine the dependence between the prevalence of parasites and the age of the fish (Sol et al., 2003). The Pearson test was used to determine the correlation between the number of parasites (intensity of infection) and the age of the fish. Statistica 6.0 software was used to analyse statistical correlations.

RESULTS AND DISCUSSION

The correlations between the length and weight of fish and the occurrence of parasites in 139 fish were studied. The main observation from the analysis was that older and larger fish have more parasites. The characteristic features of the fish are presented in Table 1.

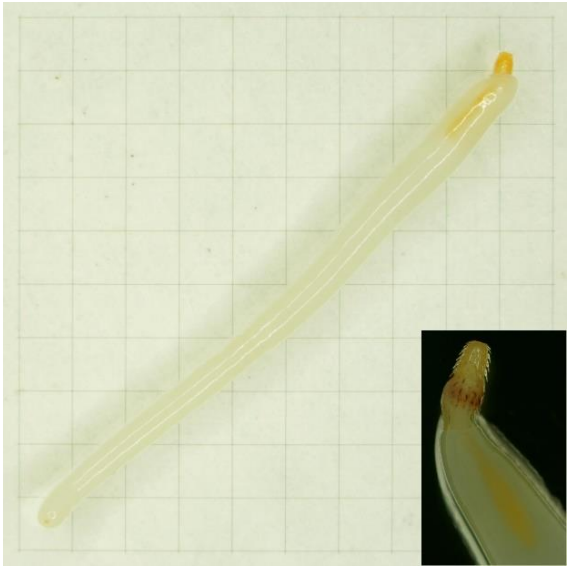
Table 1

Prevalence of parasites in the perch population by age (N - number of fish, N1 - number of infected fish; N2 - number of parasites; LC - standard length; M - weight)

Age	N	N1	N2	LC [mm] min- max	M [g] min-max
1+	15	5	14	91 – 107	13,57 – 21,63
2+	32	16	45	105 – 125	20,88 – 30,27
3+	27	17	53	125 – 158	42,73 – 62,53
4+	12	7	27	143 – 158	42,73 – 62,53
5+	14	14	38	166 – 189	63,61 – 128,26
6+	18	17	42	194 – 219	130,65 – 181,02
7+	21	21	56	235 – 236	192,25 – 295,5
Total	139	97	275	91 – 236	13,57 – 295,5

The analysis indicated that 97 perch (69,8%) were infected. Seven fish age classes were distinguished. Parasitological examination revealed six parasite species: Cestoda (*Triaenophorus nodulosus*, Phot. 1, *and Proteocephalus cernuae*), Acanthocephala (*Acanthocephalus lucii*, Phot. 2, and *Neoechinorhynchus rutili*), Nematoda (*Camallanus lacustris*), and Trematoda (*Tetracotyle percae*).

Phot. 1. *Triaenophorus nodulosus* (phot. A. Pociecha)



Phot. 2. *Acanthocephalus lucii* (phot. A. Pociecha)

The most frequent parasites in the perch were cestodes. There were 0-8 parasites in one individual. The prevalence of parasites in the perch is shown in Table 2.

Table 2

Prevalence of parasites in the perch population from Lake Góreckie (ACA - *Acanthocephalus lucii*; NEO - *Neoechinorhynchus rutili*; TRIA - *Triaenophorus nodulosus*; PRO - *Proteocephalus cernuae*; CAMA - *Camallanus lacustris*; TETRA - *Tetracotyle percae*)

	ACA	NEO	TRIA	PRO	CAMA	TETRA
Parasites in perch (%)	26,7	29	38,8	2,2	1,1	2,2

The Mann-Whitney U test showed a dependence between prevalence of parasites and perch ages (Fig. 1).

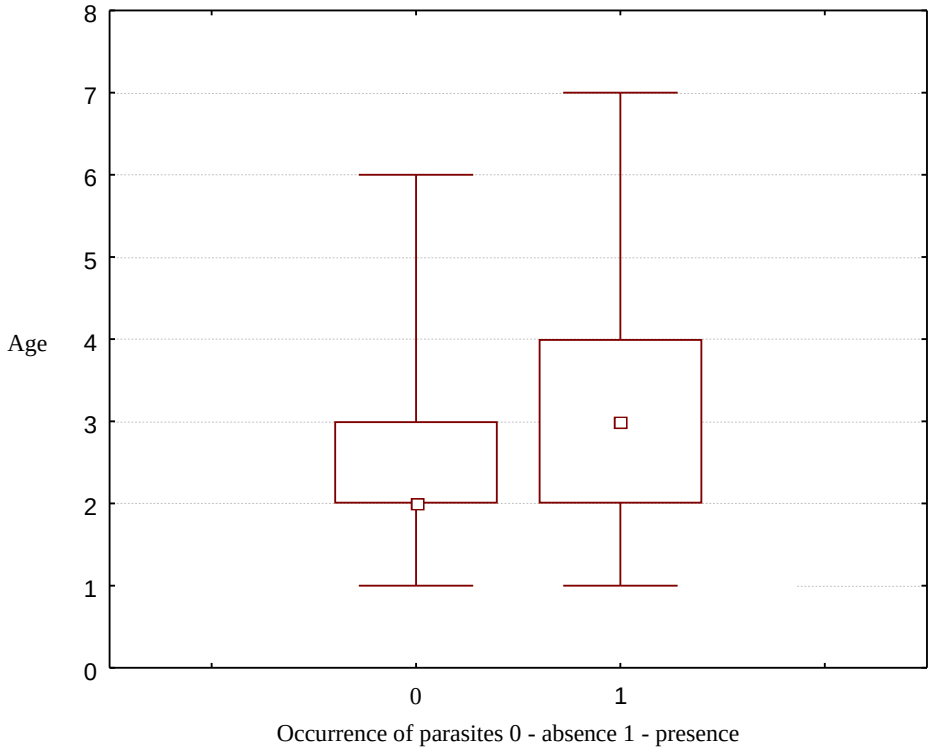


Fig. 1. Relationship between occurrence of parasites and age of perch (Mann–Whitney U test; U=783; P = 0,02)

Differences between groups of fish depending on age were shown. A significant dependence between the number of parasites and perch age was shown only for *Triaenophorus nodulosus* ($P < 0,05$) (Table 3). The most abundant parasites were *Triaenophorus nodulosus* and *Neoechinorhynchus rutili*. Contrasting results were obtained by Kuchta et al. (2009), who found that the nematode *Camallanus lacustris* dominated among perch. In the Vistula Lagoon, Rolbiecki (2006) observed different parasites to those occurring in Lake Góreckie, without *Acanthocephalus lucii* or *Triaenophorus nodulosus.* Kuchta et al. (2009) concluded that Lake Góreckie contains six species of perch parasites. However, Wierzbicki (1970) isolated 15 parasite species, and Halmetoja et al. (2000) found 18 parasite species. The results of our study showed that perch from ages 3+ to 4+ were often infected by parasites, especially from the genera *Triaenophorus*, *Neoechinorhynchus* and *Acanthocephalus.* Our observation is confirmed by Kuształa (2010). In that study the occurrence of monogenic flukes was observed to be higher in larger fish. Kuchta et al. (2009) observed that the species richness and prevalence of parasites increased in older perch fry. Similar results were reported by Zelmer and Arai (1998), who found more parasites in older yellow perch (*Perca flavescens*) individuals. According to Rolbiecki (2006), parasitic species transmitted via food are closely linked to the type of food ingested by the fish. Food preferences change with fish size (age), and thus the parasitic fauna changes as well. Our analysis indicates that the abundance (intensity of infection) of *Triaenophorus nodulosus* increased with the age of the fish. Rolbiecki (2006) indicated that the abundance of parasites was correlated with the body size of cyprinids and percids. Many parasites actively attack the host. In that case, host size is the most important factor facilitating infection. In short, larger fish, with a large body surface, are a target that free-living parasites can easily spot and colonize. Thus, differences in parasitic infection between fish length classes could be due to body size (fish body surface area), the volume of water swallowed during active breathing by the fish, the type of food ingested, life history (migrations, aggregation of fish fry and spawning adults), and the degree of resistance, as well as accumulation of parasites (particularly larvae), predation (elimination of infected fish), and commercial fish farming (Rolbiecki 2006).

Table 3

Correlation between number of parasites and age of perch ($r = 0,26$; $P < 0,05$)
(ACA - *Acanthocephalus lucii*; NEO - *Neoechinorhynchus rutili*; TRIA - *Triaenophorus nodulosus*; PRO - *Proteocephalus cernuae*; CAMA - *Camallanus lacustris*; TETRA - *Tetracotyle percae*)

	ACA	NEO	TRIA	PRO	CAMA	TETRA
Pearson test	0,10	0,17	**0,26**	0,01	-0,05	0,14

REFERENCES

1. Appelberg M. (2000). Swedish standard methods for sampling freshwater fish with multi-mesh gillnets. Fiskeriverket Information, 1, 32
2. Behrmann-Godel J., Brinker A. (2005). Biology and Ecology of Perch Parasites. In: Couture P. and Pyle G. (ed.) Biology of Perch, 193-229, Boca Raton: CRC Press
3. Bikhovskaya-Pavlovskaya I. E., Kulakova A. P. (1987). Opredelitel' parazitov presnovodnych ryb fauny SSSR. T. 3. [Key of Parasites in freshwater fishes of the fauna USRR, part 3] In: Bauer O.N., Nauka, Leningrad 583 pp
4. Bykhovskaya-Pavlovskaya I.E., Gusev A.V., Dubinina N.A., Izyumova T.S., Smirnova T.S., Sokolowskaya I.L., Shtein G.A., Shulman S.S., Epstein U.M. (1962). Opredelitel' parazitov presnovodnych ryb fauny SSSR.T.1.[Key to parasites of freshwater fish of the U.S.S.R. part 1] In: Bykhovskij B.E., Izd. Akademii Nauk SSSR, Lenigrad, 776 pp
5. Carney J. P., Dick T. A. (1999). Enteric helminths of perch (Perca fluviatilis L.) and yellow perch (Perca flavescens Mitchill): stochastic or predictable assemblages? Journal of Parasitology, 85: 785-795
6. Grabda-Kazubska B., Okulewicz A. (2005). Pasożyty ryb Polski (klucze do oznaczania). Nicienie – Nematoda.[Polish fish parasites (keys for marking).Nematode – Nematoda]. PTP Warszawa
7. Halmetoja A., Valtonen E.T., Koskenniemi E. (2000). Perch (Perca fluviatilis) parasites reflect ecosystem conditions: a comparison of a natural lake and two acidic reservoirs in Finland. International Journal of Parasitology, 30: 1437-1444
8. Jara Z., Chodyniecki A. (1999). Ichtiopatologia.[Ichthyopathology].Wyd. AR Wrocław, 478
9. Kuchta R., Čech M., Scholz T., Soldánová M., Levron C. (2009). Endoparasites of European perch Perca fluviatilis fry: role of special segregation. Diseases of aquatic organisms, 86: 87-91
10. Kuształa M. (2010). Metazoan parasites of roach Rutilus rutilus (L.,1758) bream Abramis brama (L.,1758) and perch Preca fluviatilis (L.,1758) from lakes and Łyna watershed. Wiadomości Parazytologiczne, 56(1): 81-82
11. Lonc E., Złotorzycka J. (1994). Zajęcia praktyczne z parazytologii dla studentów biologii. [Practical classes on parasitology for biology students]. Wyd. Uniwersytetu Wrocławskiego
12. MacKenzie K., Williams H. H., Williams B., McVicar A. H., Siddall R. (1995). Parasites as indicators of water quality and the potential use of helminth transmission in marine pollution studies. Advances in Parasitology, 35: 85-144
13. Marcogliese D. J., Gendron A. D., Plante C., Fournier M., Cyr D. (2006). Parasites of spottail shiners (Notropis hudsonius) in the St. Lawrence River: effects of municipal effluents and habitat. Canadian Journal of Zoology, 84(10): 1461-1481
14. Nautiyal P. (1990). Natural history of Garhwal Himalayan mahseer: Growth rate and age composition in relation to fishery, feeding and breeding ecology. In Proceedings of the Second Asian Fisheries Forum, Tokyo, 769-772
15. Pojmańska T. (1981). Pasożyty ryb Polski (klucze do oznaczania). Tasiemce – Cestoda. [Polish fish parasites (keys for marking). Tapeworms – Cestoda]. PAN Warszawa

16. Pojmańska T., Niewiadomska K., Okulewicz A. (2007). Pasożytnicze Helminty Polski. Gatunki, żywiciele, białe plamy. Monografie Parazytologiczne, Polskie Towarzystwo Parazytologiczne. [Parasitic Helminty of Poland. Species, hosts, white spots. Parasitological Monographs, Polish Parasitological Society]. Warszawa, 18(1): 360
17. Pojmańska T., Niewiadomska K. (2008). Typ: Płazińce - Platy-helminthes. Gromada: Tasiemce - Cestoda, Przywry mo-nogeniczne - Monogenea. Typ Kolcogłowy - Acanthoce-phala. W: Fauna Polski. Charakterystyka i wykaz gatunków. [Type: Plaziniece - Platyhelminthes. Gromada: Tapeworms - Cestoda, Monogenic glands - Monogenea. Colchus type - Acanthoce-phala. In: Polish Fauna. Characteristics and list of species]. Ed: Bogdanowicz W., Chudzik E., Pilipiuk I., Skibińska E. Muzeum i Instytut Zoologii PAN Warszawa III, 349-500
18. Rolbiecki L. (2006). Correlation between the occurrence of parasites and body length of roach, carp bream, European perch, zander, and ruffe in the Vistula Lagoon estuary. Oceanological Hydrobiological Studies, 35(3): 257-267
19. Seppälä O., Valtonen E.T. Benesh D.P. (2008). Host manipulation by parasites in the world of dead-end predators: adaptation to enhance transmission? Proceedings of the Royal Society, 275: 1611-1615, doi: 10.1098/rspb.2008.0152
20. Sol D., Jovani R., Torres J. (2003). Parasite mediated mortality and host immune response explain age-related differences in blood parasitism in birds. Oecologia, 135(4): 542-547
21. Wierzbicki K. (1970). The parasite fauna of the perch, Perca fluviatilis L. Lake Dargin. Acta Parasitologica Polonica, 18(5): 45-55
22. Wierzbicka J., Wierzbicki K., Piasecki W., Śmietana P. (2005). A comparative study on the parasite fauna of perch, Perca fliviatilis L., collected from a freshwater coastal lake, brackish-water Baltic Sea, and interconnecting cannal. Wiadomości Parazytologiczne, 51(4): 295-302
23. Williams H.H., Mac Kenzie K., Mac Carthy A.M. (1992). Parasites as biological indicators of the population biology, migrations, diet, and phylogenetics of fish. Revievs Fish Biology and Fisheries, 2: 144-176, doi: 10.1007/BF00042882
24. Zelmer D. A., Arai H. P. (1998). The contributions of host age and size to the aggregated distribution of parasites in yellow perch, Perca flavescens, from Garner Lake, Alberta, Canada. The Journal of Parasitology, 24-28

Acknowledgements

This work was paid for with the research funding (No. 508.511.01) of the Division of Inland Fisheries and Aquaculture, Faculty of Veterinary Medicine and Animal Science, Poznan University of Life Sciences, Poland, and additional funding from the Institute of Nature Conservation, Polish Academy of Sciences (Kraków, Poland).