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FEEDING ECOLOGY OF *SQUALIUS CEPHALUS* POPULATIONS FROM RIVER OITUZ

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KEYWORDS

Index diversity
Macroinvertebrates
Microplastics
Stomach contents

ABSTRACT

In the present study, the aim was the quantitative and qualitative analysis of macroinvertebrates from the stomach content of the *Squalius cephalus* population living in the Oituz River basin. The stomach contents were investigated using a binocular stereomicroscope and the macroinvertebrates were identified to the smallest possible taxon. In the stomach of 60 specimens of *Squalius cephalus*, 10 macroinvertebrate groups were identified with 184 specimens. Among the macroinvertebrate groups identified, *Coleoptera* and *Nematoda* were the most common, with 75% and 36.6%, respectively. The highest dominance index was calculated for the *Coleoptera* group with 60.68% followed by *Nematoda* with 28.8%. In 14 of these 60 stomachs, we found fish remains, represented by: scales, vertebrae, radii, heads, and even larger pieces of undigested or digested fish. In addition to these, we also identified: feathers, plant fibers, pebbles, fat drops, and microplastics. In the stomachs of the 60 specimens of chub, we identified 124 microplastics in the form of microfibers of different colors and sizes: 42 purple, 38 blue, 19 red, 13 black, and 12 brown. This material's widespread occurrence and ingestion indicate that future research is needed for an ample range of species and habitats to fully establish the potential effects of microplastics in the aquatic environment.

INTRODUCTION

A correct diet is necessary to determine the harmonious growth and normal development of the fish. To be able to learn the biology of a species (Sarre et al., 2000) to understand the trophic chains in which it is included, and also for the proper functioning of ecosystems (Cox et al., 2002) it is very important to understand how they feed (Buckland et al., 2017). In the research of the way of feeding fish, the habits were based for a long time on the quantitative and qualitative analysis of the contents of the stomach (Hynes, 1950). Macroinvertebrates are an important group of organisms in aquatic ecosystems because they reflect the physical, chemical, and biological quality of freshwater (Tupinambás et al., 2015). A worrying fact is the frequent appearance of microplastics in the fish's diet. Although in Romania, the study of microplastics is a novelty, at a global level, studies were carried out of all plastic materials manufactured in 2015, and the results were quite alarming because a percentage of 79% of plastic was thrown into landfills or natural environment, 12% was burned and only 9% was recycled, as it should be if not all, at least most plastics (Geyer et al., 2017). Pollutants are increasingly present as a direct result of negligible human activities, such as improper waste management and excessive consumption of certain chemicals. Pharmaceutical skin products such as creams, ointments, toothpaste, soaps, blushes, and lotions are not completely absorbed by the skin and contaminate surface waters (Friot et al., 2017). Globally, a major threat to freshwater ecosystems is the rapid change in land use that has intensified in the last decade

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(Barletta et al., 2010; Fierro et al., 2016). Fish can also consume products used in agriculture, which later end up in the water (Fierro et al., 2017) Ecological information is very important when developing conservation strategies and therefore includes an important element in the protection of species and ecosystems (Braga et al., 2012; Manko, 2016).

MATERIALS AND METHODS

The fish were caught using the electrofishing method (Ureche et al., 2010). Working principle: the anode and cathode, by immersion in the water, produce an electric field that causes a muscular response in the fish, forcing them to orient themselves towards the anode. Used properly, causes temporary paralysis of fish. Additional materials used for catching: storage vessels, and protective material. After the fish were captured and determined, they were moved to the dissection process, and then to the sorting of the intestines and stomach. In the laboratory, the stomach is placed in a formaldehyde solution, after which the contents are removed and analyzed. The contents of the stomach and intestine of the fish were investigated using a binocular stereomicroscope. The analyzed material was determined from a taxonomic point of view, and the obtained results were interpreted from a statistical point of view.

RESULTS AND DISCUSSION

Macroinvertebrates

In the stomach of 60 specimens of *Squalius cephalus*, 10 macroinvertebrate groups were identified with 184 specimens. In evolutionary order, the following taxonomic groups were identified: 53 Nemathoda, 1 Oligochaeta, 2 Crustacea, 3 Ephemeroptera, 1 Odonata, 2 Aphida, 1 Lepidoptera, 112 Coleoptera, 2 Diptera, 4 Chironomidae. Among the macroinvertebrate groups identified, Coleoptera and Nematoda were the most common, with 75% and 36.6%, respectively. The highest dominance index was calculated for the Coleoptera group with 60.68% followed by Nematoda with 28.8%. Results were statistically processed using ecological indices: Shannon-Wiener H(s)= 1.04 and Pielou evenness (J)= 0.454. This information can then be applied to obtain a better understanding of ecosystem status (Herman & Nejadhashemi, 2015). In 14 of these 60 stomachs, we found fish remains, represented by: radii (Figure 1), heads (Figure 2), vertebrae (Figure 3), scales (Figure 4), and even larger pieces of undigested or digested fish. In addition to these, we also identified: plant fibers (Figure 5), pebbles (Figure 6), fat drops (Figure 7), feathers (Figure 8), and microplastics. *Squalius cephalus* (Linnaeus, 1758) is one of the common and widespread fish species in Europe (Nyeste et al., 2019) has a wide geographical distribution and high ecological tolerance, this explains the fact that it is not very selective in its food.

Microplastics

We identified 124 microplastics in the form of microfibers, of different colors and sizes: 42 purple, 38 blue, 19 red, 13 black, and 12 brown. In percent (Figure 9), purple microfibers 33.8 %, blue microfibers 30.6 %, red microfibers 15.4%, black microfibers 10.5 %, and brown microfibers 9.7. In other research, the most dominant blue color of plastic (Güven et al., 2017), mostly black and blue (Renzi et al., 2019), but also blue and pink colors (Digka et al., 2018). The fact that fish consume microplastics of different colors proves that they come from various sources. Plastic degradation over time leads to their breakdown into small-sized particles, which can be easily ingested by fish (Zhao et al., 2021).

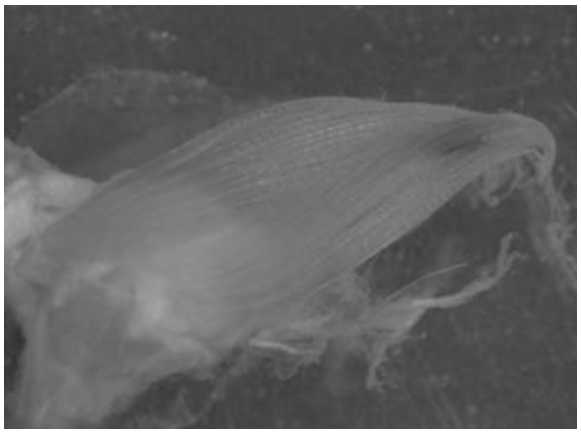

Figure 1. Fish radii – original photo

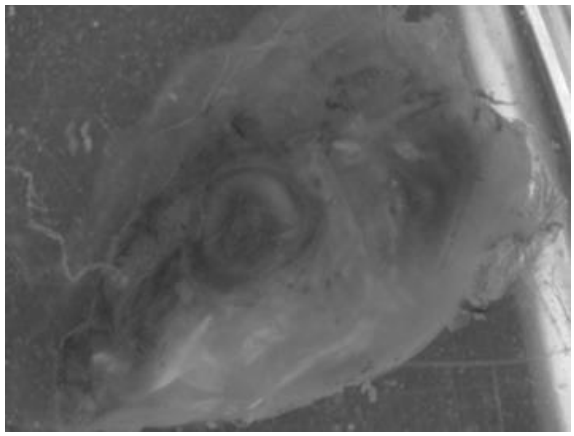

Figure 2. Fish head – original photo

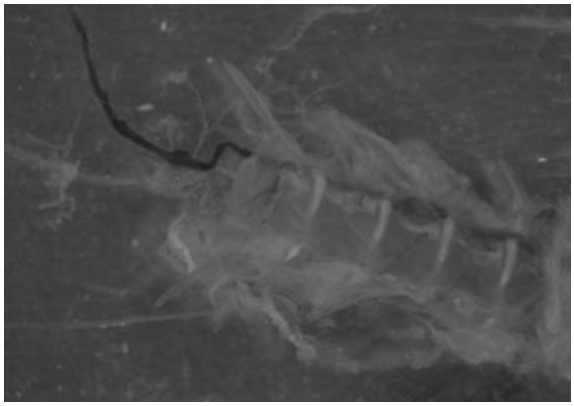

Figure 3. Fish vertebrae – original photo

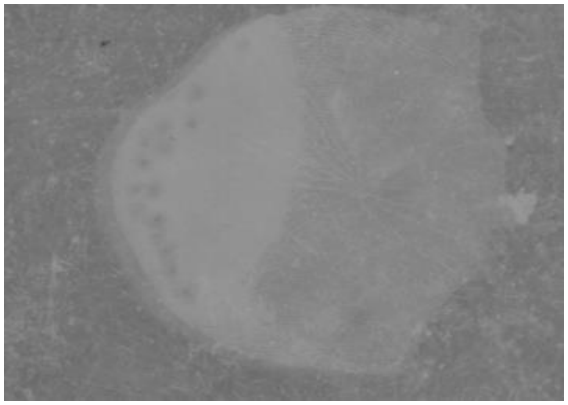

Figure 4. Fish scales – original photo

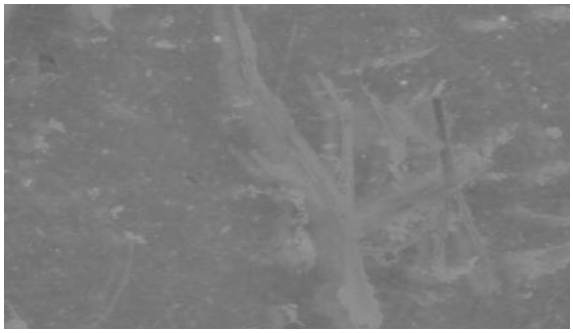

Figure 5. Plant fibers – original photo

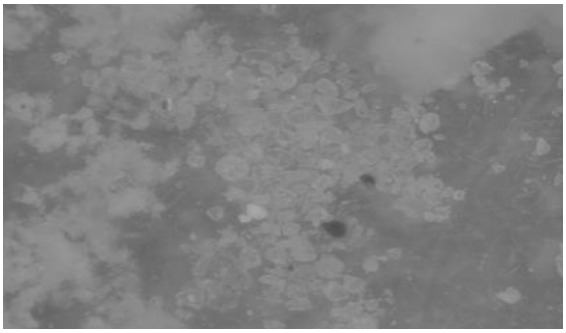

Figure 6. Pebbles – original photo

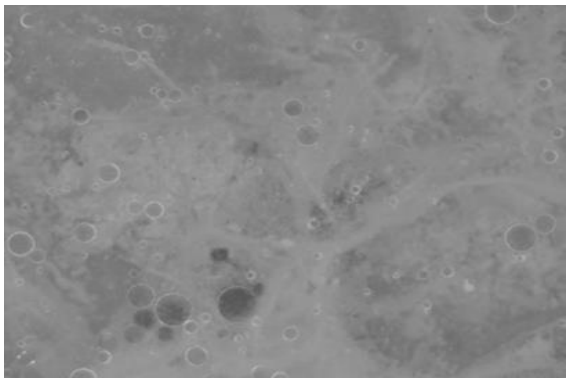

Figure 7. Fat drops – original photo

Figure 8. Feathers – original photo

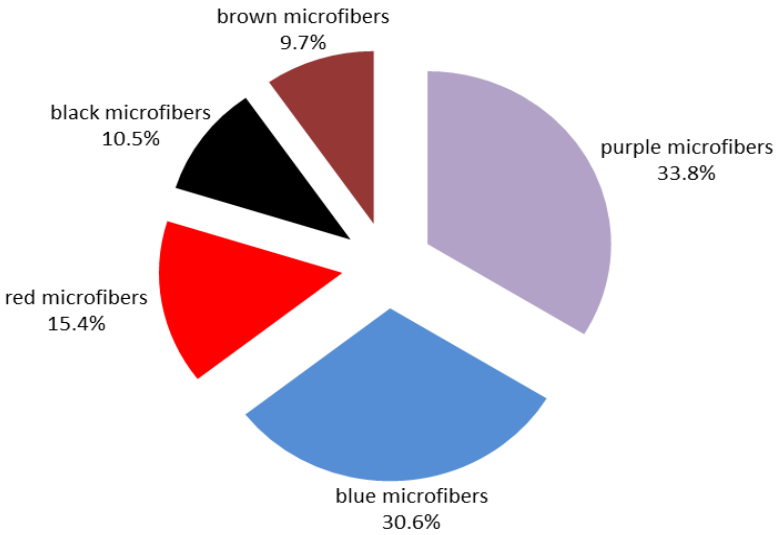

Figure 9. The color of microplastics

CONCLUSION

Among the groups of macroinvertebrates identified, *Coleoptera* and *Nematoda* are the most common. Almost all chub had fish scales in their stomachs, even other parts like radii or vertebrae. The diversity index H(s) indicates that the trophic spectrum is wide, but the value of the equity index is low, which means that the numerical distribution of prey items is not equitable. We found that a large percentage of the total stomachs contained microplastics, and the large number of microplastics found confirms the alarming data published by researchers in this field. Research is needed on the state of the water, but also of the organisms that live in it.

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