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Sibel Doğan
Fırat University, sibeldogan@firat.edu.tr, Elazığ-Türkiye
Mustafa Dörücü
Fırat University, mdorucu@firat.edu.tr, Elazığ-Türkiye

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ORCID ID	0000-0003-4569-5435	0000-0002-1330-4965
Corresponding Author	Sibel Doğan	

ASSESSMENT OF *Diplostomum spathaceum* AND *Neoechinorhynchus rutili* INFESTATIONS IN *Capoeta trutta* FROM KARAKAYA AND KEBAN DAM LAKES

ABSTRACT

This study was conducted to determine the parasite species present in *Capoeta trutta* individuals obtained from the Karakaya and Keban Dam Lakes in March 2024, to assess infection levels, and to examine the relationship between parasitism and fish length–weight parameters. A total of 80 fish were examined, with 40 specimens collected from each reservoir. All examined fish were found to be infected, and two parasite species, *Diplostomum spathaceum* and *Neoechinorhynchus rutili*, were identified. The total number of parasites was recorded as 1.815 in the Karakaya Dam Lake and 1.445 in the Keban Dam Lake. *D. spathaceum* was the dominant species, exhibiting 100% prevalence in both regions. The mean intensity of *N. rutili* was calculated as 114.33 in Karakaya and 88.85 in Keban. Correlation analyses revealed positive relationships between parasite abundance and both fish weight and length in the two dam lakes, with these associations being more pronounced in the Keban Dam Lake.

Keywords: Karakaya Dam Lake, Keban Dam Lake, Parasite, *Diplostomum spathaceum*, *Neoechinorhynchus rutili*

1. INTRODUCTION

Fish are considered one of the primary sources for meeting the human requirement for animal-based protein [1, 2 and 3]. Fish meat is rich in polyunsaturated fatty acids (PUFAs), essential minerals, omega-3 and omega-6 fatty acids, antioxidant compounds, and fat-soluble vitamins, indicating its high nutritional value and importance for human health [4]. Similar to other vertebrate groups, fish serve as intermediate or definitive hosts for numerous parasite species [5]. Parasitic infections can negatively affect fish growth performance, alter the behavior of infected individuals, and reduce immune resistance, thereby increasing susceptibility to secondary infections and decreasing survival rates. This can result in significant economic losses in fish production due to elevated mortality and tissue damage [6].

Fish are exposed to infections by a wide range of endoparasites, including protozoans, trematodes, cestodes, nematodes, and acanthocephalans. These parasites can disrupt body structures and adversely affect the normal functioning of infected organs [7]. As in all living organisms, the presence of parasites in fish is associated with multifaceted impacts, including resource exploitation, mechanical and physiological damage, toxic effects, negative influences on host nutritional status, and functional impairments caused particularly by parasite attachment to the gill lamellae [8, 9 and 10].

Industrial and agricultural activities continuously introduce various chemical and physical agents that cause damage to the natural environment [11 and 12]. Fish, occupying higher trophic levels in aquatic

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food webs, are constantly exposed to parasitic infestations. While low-level parasitism in fish is often negligible, high parasite loads can lead to serious problems. In particular, the larval stages of diplostomid parasites are significant pathogens capable of severely affecting fish populations in both natural and aquaculture environments [13 and 14].

Diplostomum species are considered important fish pathogens due to their complex life cycle involving three different hosts. In this cycle, snails of the family Lymnaeidae serve as the first intermediate host, fish as the second intermediate host, and piscivorous birds as the definitive host. The most pathogenic stage, the metacercaria, infects fish eye and/or brain tissues, potentially impairing vision and causing cataract formation in fish populations in both natural and cultured environments [15, 16 and 17]. Cataract development in this context has been associated with increasing economic losses in the fisheries industry [18 and 19].

Acanthocephalans (thorny-headed worms) have also gained increasing economic significance. These parasites attach to the intestinal wall using their proboscis, causing tissue damage that may result in bleeding, inflammatory reactions, and necrosis. Additionally, they consume both organic and inorganic nutrients from the host, leading to nutritional deficiencies and growth retardation. Infected fish may exhibit cachexia and various morphological deformities, which negatively affect their marketability [20].

Neoechinorhynchus rutili, an acanthocephalan parasite, inhabits the small intestine of freshwater fish [21]. In fish with high *N. rutili* infestations, severe adverse effects, including mortality, can occur. Due to their short proboscis, these parasites attach to the deeper layers of the intestinal mucosa, causing varying degrees of inflammation. Clinical signs of infection are reported to be more severe in juvenile fish [22 and 21]. Adult *N. rutili* parasites inhabit the intestines of fish species such as carp, trout, mullet, and blackfish [23].

2. RESEARCH SIGNIFICANCE

This study is significant as it provides quantitative data on parasite diversity, infection levels, and the relationship between parasitism and fish length–weight in *Capoeta trutta* populations from the Karakaya and Keban Dam Lakes. The comparative assessment of prevalence, mean intensity, and abundance of *Diplostomum spathaceum* and *Neoechinorhynchus rutili* contributes to understanding parasite dynamics in two distinct reservoir ecosystems. Furthermore, the statistically demonstrated positive relationships between parasite load and fish size offer a scientific basis for interpreting the ecological determinants of parasitism and its impacts on fish health. The findings serve as a valuable reference for monitoring natural fish stocks, informing fisheries management, and evaluating the health of aquatic ecosystems.

Highlights

- All examined *C. trutta* individuals from the Karakaya and Keban Dam Lakes were found to be infected with parasites.
- Two parasite species, *Diplostomum spathaceum* and *Neoechinorhynchus rutili*, were identified, with *D. spathaceum* being the dominant species in both dam lake.
- The total number of parasites was higher in the Karakaya Dam Lake compared to the Keban Dam Lake.
- Positive relationships between parasite abundance and both fish weight and length were observed in both the dam lake.
- The results indicate that fish size is an important factor influencing the level of parasitic infection.

3. MATERIALS AND METHODS

This study was conducted on *Capoeta trutta* individuals obtained dead from fishermen in the Karakaya and Keban Dam Lakes during March 2024. A total of 80 fish were examined, with 40 specimens collected from each reservoir. The total length and body weight of each specimen were measured and recorded. Necropsies were performed following the procedures described by Arda et al. [22].

The eyes of the fish were carefully removed using forceps and a scalpel and placed in Petri dishes containing 0.9% physiological saline. Lenses were examined under a stereomicroscope, counted using a pipette, and transferred to separate Petri dishes with physiological saline. The body cavity and internal organs were initially assessed macroscopically. During necropsy, the sex of each fish was determined, and internal organs were placed in Petri dishes for parasite examination under a stereomicroscope. The heart, swim bladder, and gall bladder were crushed using a dissection needle, while the liver was examined by pressing small pieces between a slide and a cover slip.

The intestines were opened with dissection scissors to release their contents, and parasites detected in the intestines were transferred to separate Petri dishes containing 0.9% physiological saline. Parasites were cleaned using a brush, counted, and then transferred to new Petri dishes with physiological saline. Subsequently, parasite samples were preserved in Eppendorf tubes containing 70% ethanol. Parasite identification was carried out using the diagnostic keys reported by Bykhovskaya-Pavlovskaya [24], Hoffman [25], Kennedy [26], Ekingen [8], and Williams and Jones [27].

Mean intensity, prevalence, and mean abundance of parasites were calculated using the formulas proposed by Bush et al. [28]:

- **Mean intensity** = Total number of parasites / Number of infected fish
- **Prevalence (%)** = (Number of infected fish / Total number of fish) × 100
- **Mean abundance** = Total number of parasites / Total number of fish

The relationship between parasite abundance and fish length and weight was evaluated using simple correlation analysis.

4. RESULTS AND DISCUSSION

In this study, conducted in March 2024, *Capoeta trutta* individuals obtained dead from fishermen in the Karakaya and Keban Dam Lakes were examined for parasitological infection. A total of 80 fish, with 40 specimens from each reservoir, were analyzed, and two parasite species, *Diplostomum spathaceum* and *Neoechinorhynchus rutili*, were identified.

The results showed that all 40 fish from the Karakaya Dam Lake were infected, with a total parasite count of 1.815. Similarly, all 40 fish from the Keban Dam Lake were infected, with a total of 1445 parasites recorded. In the Karakaya Dam Lake, the mean intensity, mean abundance, and prevalence of *N. rutili* were calculated as 114.33, 17.15, and 17.64%, respectively, while the corresponding values for *D. spathaceum* were 30.72, 30.72, and 100%. In the Keban Dam Lake, these values were 88.85, 15.52, and 17.50% for *N. rutili*, and 20.6, 20.6, and 100% for *D. spathaceum* (Table 1).

D. spathaceum was detected in the eye fluids of all examined *C. trutta* individuals from both dam lakes. The highest parasite density of *D. spathaceum* was observed in specimens from the Karakaya Dam Lake, with a total of 1,229 parasites recorded. In the Keban Dam Lake, 824 individuals of this parasite species were identified. These findings indicate that *D. spathaceum* was the dominant parasite species in both dams lake.

N. rutili was observed at higher intensity in *C. trutta* from the Karakaya Dam Lake, with a total of 686 parasites, while 621 individuals were recorded in the Keban Dam Lake. Regional comparison revealed that the total parasite load was higher in the Karakaya Dam Lake than in the Keban Dam Lake (Table 1).

When the relationship between parasitism and fish weight was evaluated, the correlation coefficient calculated for *N. rutili* in the Karakaya Dam Lake was 0.27, indicating a weak positive association. In the same reservoir, the correlation coefficient for *D. spathaceum* was calculated as 0.48, revealing a moderate positive relationship. In the Keban Dam Lake, the correlation coefficient for *N. rutili* was 0.89, demonstrating a strong positive association with fish weight. Likewise, the correlation coefficient of 0.67 calculated for *D. spathaceum* indicates a strong positive relationship between this parasite species and fish weight (Table 2).

Table 1. Infection levels by region in the total number of examined fish

Region	Total Number of Fish	Parasite Species	Uninfected	Infected	Total Number of Parasites	Intensity	Abundance	Percentage
Karakaya Dam Lake	40	*N.rutili*	6	34	686	11433	17.15	17.64
		D.spathaceum	0	40	1229	30.72	30.72	100
Keban Dam Lake	40	*N.rutili*	7	33	621	88.85	15.52	17.50
		D.spathaceum	0	40	824	20.6	20.6	100

Table 2. Relationship between parasitism and fish weight

Region	Parasite Species	Correlation Coefficient (r)
Karakaya Dam Lake	*N.rutili*	0.27
	D.spathaceum	0.48
Keban Dam Lake	*N.rutili*	0.89
	D.spathaceum	0.67

When the relationship between parasitism and fish length was examined, the correlation coefficient for *N. rutili* in the Karakaya Dam Lake was calculated as 0.61, indicating a strong positive relationship. In the same reservoir, the correlation coefficient for *D. spathaceum* was 0.42, reflecting a moderate positive association. In the Keban Dam Lake, the correlation coefficient for *N. rutili* was found to be 0.85, demonstrating a strong positive relationship with fish length. Similarly, the correlation coefficient of 0.64 calculated for *D. spathaceum* indicates a strong positive association between this parasite species and fish length (Table 3).

Table 3. Relationship between parasitism and fish length

Region	Parasite Species	Correlation Coefficient (r)
Karakaya Dam Lake	*N.rutili*	0.61
	D.spathaceum	0.42
Keban Dam Lake	*N.rutili*	0.85
	D.spathaceum	0.64

Overall evaluation of these findings indicates that parasite abundance increases with increasing fish weight and length; in other words, a positive relationship exists between fish size and the level of parasitic infection.

In the present study, the parasite fauna of a total of 80 *Capoeta trutta* individuals collected from the Karakaya and Keban Dam Lakes in March 2024 was examined, and two parasite species, *Diplostomum spathaceum* and *Neoechinorhynchus rutili*, were identified. The detection of *D. spathaceum* in all examined fish from both regions, with a calculated prevalence of 100%, clearly demonstrates that this species is the dominant parasite in both dam lake. The total parasite counts of 1.815 in the Karakaya Dam Lake and 1.445 in the Keban Dam Lake indicate a higher parasite burden in the Karakaya basin.

These findings are largely consistent with the results reported by Doğan and Dörücü [10]. In that study, a total of 2.846 parasites were identified in the Dicle River, comprising 2.109 *D. spathaceum* and 737 *N. rutili*, with mean intensity, abundance, and prevalence values reported as 66.18, 60.55, and 91.48%, respectively. In the Keban Dam Lake, a total of 2.554 parasites were recorded, including 1.817 *D. spathaceum* and 737 *N. rutili*, and the corresponding values for intensity, abundance, and prevalence were calculated as 54.80, 48.97, and 89.36%. Although the parasite numbers recorded in the present study were lower, both studies indicate that *D. spathaceum* was the dominant species and that the parasite load in the Karakaya/Dicle basin was higher than that in the Keban Dam Lake. This suggests that, despite differences in sampling periods and host characteristics, the general pattern of parasitism between the basins remains consistent.

These findings are also consistent with previous studies conducted in the Karakaya Dam Lake. Barata and Dörücü [23], in their study covering 126 *Capoeta trutta* individuals from the Kömürhan region of the Karakaya Dam Lake, reported the presence of *Diplostomum* sp. in the eye fluid and *Neoechinorhynchus rutili* in the intestines of this species. In the same study, 481 out of 513 examined fish were found to be infected, and the detection of *Diplostomum* sp. and *N. rutili* in multiple host species indicated that these parasites are widespread and persistent components of the Karakaya Dam Lake ecosystem. In the present study, the 100% prevalence of *D. spathaceum* in the Karakaya Dam Lake and its identification as the dominant species with 1,229 individuals reveal a numerically and ecologically consistent pattern with the findings reported by Barata and Dörücü [23].

When evaluated specifically for *D. spathaceum*, 1.229 individuals with a mean intensity of 30.72 were recorded in the Karakaya Dam Lake, whereas 824 individuals with a mean intensity of 20.6 were detected in the Keban Dam Lake. These results are in agreement with previous studies demonstrating the widespread occurrence of *Diplostomum* species in freshwater ecosystems. Prevalence values of 92.5% in Terkos Lake reported by Karatoy and Soylu [29], 74.97% in the Keban Dam Lake reported by Kavak and Şeker [30], and a mean intensity of 8.97 in the Çemişgezek region reported by Aktürk et al. [31] support this pattern. The higher intensity values obtained in the present study compared to some previous reports suggest that regional environmental conditions, host density, and the abundance of intermediate hosts may play a determining role in parasite load.

With respect to *N. rutili*, 686 individuals with a prevalence of 17.64% were recorded in the Karakaya Dam Lake, while 621 individuals with a prevalence of 17.50% were detected in the Keban Dam Lake. These prevalence values are highly consistent with the overall prevalence of 17.30% reported for the Keban Dam Lake by Kavak and Şeker [30]. In contrast, higher prevalence and intensity values reported by Dörücü et al. [32] (71.43% prevalence and a mean intensity of 36.8) and by İspir and Özcan [33] (54.16% prevalence and a mean intensity of 28.54) indicate that *N. rutili* infestations can vary considerably depending on host size, sampling location, and environmental factors. Furthermore, the

presence of thousands of *N. rutili* individuals reported from different dam lakes by Özcan et al. [34] and Özcan and Bozdoğan [35] supports the notion that this species exhibits a broad ecological tolerance.

The positive correlations identified in this study between parasite abundance and fish length and weight are also consistent with the existing literature. The weak relationship between *N. rutili* and fish weight in the Karakaya Dam Lake (r= 0.27) and the strong relationship observed in the Keban Dam Lake (r= 0.89) suggest that biotic and abiotic differences between the two ecosystems influence host–parasite interactions. Similarly, the positive associations between fish length and parasitism indicate that larger and older individuals are more exposed to parasite accumulation over time. Overall, the quantitative data obtained in this study demonstrate that the infestation dynamics of *D. spathaceum* and *N. rutili* in *C. trutta* largely align with previous findings, while also highlighting that parasite loads may vary substantially in response to regional environmental conditions.

5. CONCLUSIONS AND RECOMMENDATIONS

In this study, the parasite fauna of 80 *Capoeta trutta* individuals collected from the Karakaya and Keban Dam Lakes in March 2024 was investigated, and two parasite species, *Diplostomum spathaceum* and *Neoechinorhynchus rutili*, were identified. The 100% prevalence of *D. spathaceum* in both the dam lake and its determination as the dominant species indicate that this parasite has a widespread and persistent infestation potential within these ecosystems. The higher total parasite count recorded in the Karakaya Dam Lake (1.815) compared to the Keban Dam Lake (1.445) demonstrates that parasite loads differ between the two basins. In contrast, *N. rutili* exhibited a limited distribution in both dam lake, with relatively low prevalence values of 17.64% and 17.50%. The positive relationships identified between parasite abundance and fish length and weight further suggest that host size is an influential factor in determining the level of parasitic infection.

Based on these findings, regular monitoring of fish parasite fauna in the Karakaya and Keban Dam Lakes is recommended, particularly to assess the effects of highly prevalent species such as *D. spathaceum* on ecosystem integrity and fish health. Future studies incorporating larger sample sizes, multiple seasons, and a wider range of fish species would contribute to a more comprehensive understanding of the temporal and spatial dynamics of parasitism. In addition, integrated evaluation of environmental parameters alongside parasite loads would facilitate a deeper insight into host–parasite interactions in freshwater ecosystems.

ETHICAL STATEMENT

As the fish examined in this study were obtained dead from fishermen, approval from an Ethics Committee was not required.

CONFLICT OF INTEREST

The author(s) declare that they have no potential conflict of interest.

FINANCIAL DISCLOSURE

This research received no financial support.

DECLARATION OF ETHICAL STANDARDS

The authors of the article declare that the materials and methods used did not require ethics committee approval and/or regulatory approval.

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