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ICHTHYOFAUNA AND INVASIVE FISH THREATS IN FRESHWATER ECOSYSTEMS OF KARABURUN PENINSULA (İZMİR, TÜRKİYE)

Sevan AĞDAMAR[1], Ümit ACAR[1*]

[1*]*Çanakkale Onsekiz Mart University, Bayramiç Vocational School, Department of Forestry, Çanakkale, Türkiye*

Sevan Ağdamar, agdamars@gmail.com (https://orcid.org/0000-0002-1268-0379),
Ümit Acar, umitacar@comu.edu.tr (https://orcid.org/0000-0003-2515-5490),

*Corresponding author: Ümit Acar, umitacar@comu.edu.tr

Abstract

This study investigates the diversity of freshwater fish species in the Karaburun Peninsula and assesses the impact of invasive species on these ecosystems. Extensive electrofishing fieldwork was conducted to sample fish populations in various water bodies. Our findings highlight the presence of native and invasive species, and we discuss the implications for conservation and management, emphasizing the need for proactive measures to protect these vulnerable habitats.

Keywords: Invasive species, *Carassius gibelio*, *Gambusia holbrooki*, Biodiversity

Introduction

Ecosystems consist of a variety of habitats created by interacting organisms and their environment. Understanding species richness, which refers to the variety and abundance of species, is crucial for biodiversity conservation (Demirsoy, 1989). Freshwater ecosystems, in particular, are significant biodiversity hotspots but are highly vulnerable to extinction pressures (Strayer and Dudgeon, 2010). Turkey's freshwater fish fauna is notable for its species richness and endemism, shaped by geographical and climatic factors over geological timescales (Balık, 1995).

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Freshwater fish are essential bio-indicators of environmental health and play a critical role in ecosystem functioning (Pont et al., 2006). The introduction of invasive species poses a significant threat to native biodiversity, leading to alterations in community structure and ecosystem dynamics (Gozlan et al., 2010). This study aims to assess the ichthyofaunal diversity in the Karaburun Peninsula, identify invasive species, and propose conservation strategies to mitigate their impact.

Material and Method

Fieldwork was conducted from November 2020 to August 2021 across multiple sites on the Karaburun Peninsula, including various reservoirs and streams (Table 1). Fish sampling was performed using a portable electro-shocker (SAMUS 1000). Fish specimens were identified, measured, and released back into their habitats. The map (Figure 1) was created using R (version 4.4.1) and R Studio (version 2024.04.2) software.

Fish were collected using standard electrofishing techniques, ensuring minimal harm to the specimens (Cowx & Lamarque, 1990). The collected fish were anesthetized with clove oil before measurements. The total length (TL) and weight (W) of each specimen were recorded. Data were analyzed using statistical software to determine species richness, diversity indices, and the presence of invasive species (Zar, 1999).

Table 1. Fish data on the sampling locations in Karaburun Peninsula.

| Sampling sites		
Locality no	**Locality name**	**Coordinates**
1	Balıklıova Stream	38.420043, 26.589001
2	Bozköy Reservoir	38.626234, 26.465123
3	Eğlenhoca Reservoir	38.526560, 26.559442
4	Karareis Reservoir	38.495556, 26.427778
5	Küçükbahçe Stream	38.562778, 26.367500
6	Parlak Reservoir	38.613056, 26.406667
7	Salman Reservoir	38.583611, 26.389167
8	Yelkentaş Stream	38.476944, 26.438333

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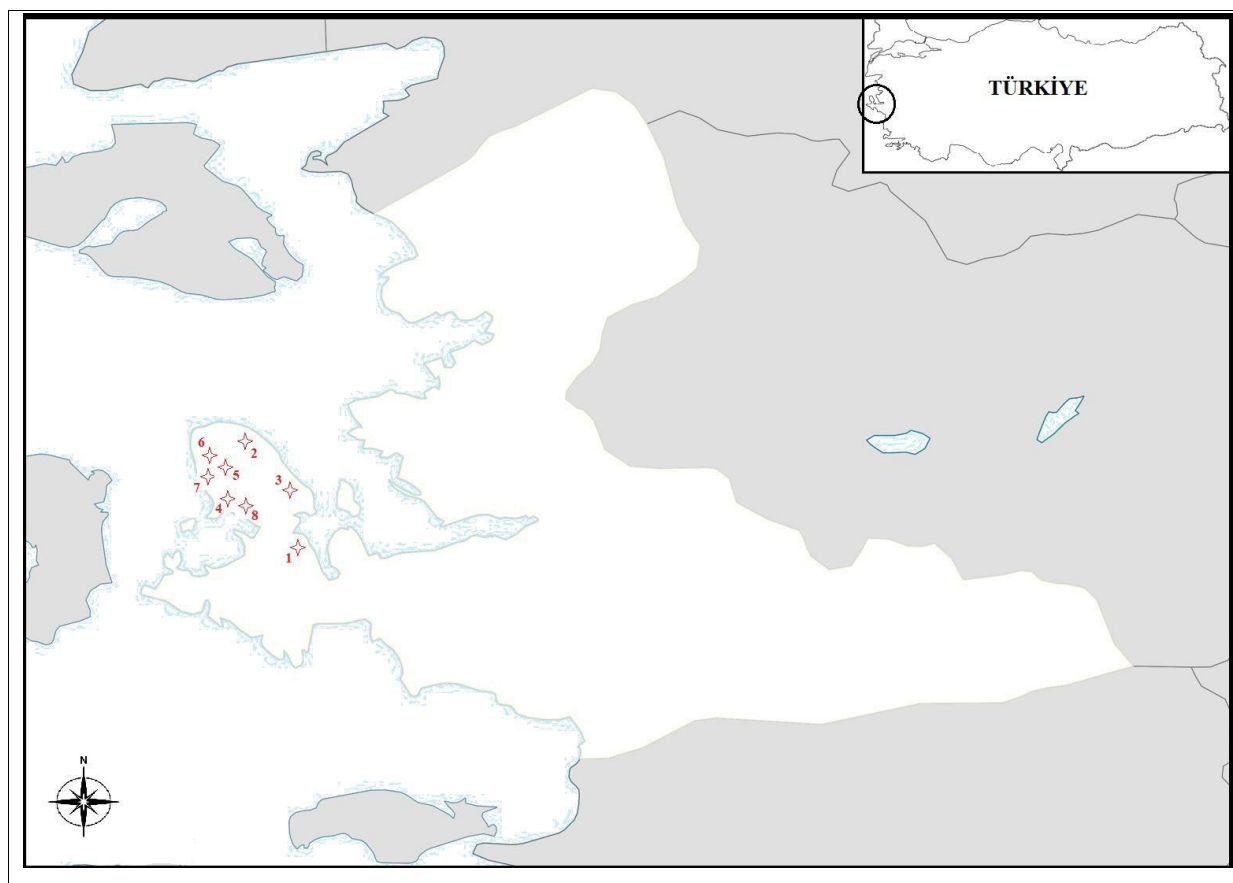
Figure 1. Map of Karaburun Peninsula. Numbers refer to studied water bodies in the peninsula (1: Balıklıova Stream, 2: Bozköy Reservoir, 3: Eğlenhoca Reservoir, 4: Karareis Reservoir, 5: Küçükbahçe Stream, 6: Parlak Reservoir, 7: Salman Reservoir, 8: Yelkentaş Stream).

Results

Our study identified six fish species from five families in the freshwater systems of the Karaburun Peninsula. Notable findings include the presence of invasive species such as *Carassius gibelio* and *Gambusia holbrooki*, which pose significant threats to native biodiversity (Table 2).

Table 2. Determined specimens of each native, invasive and translocated species caught in the sampling sites of the Karaburun Peninsula

Species	Sampling Sites							
	Balıklıova Stream	Bozköy Reservoir	Eğlenhoca Reservoir	Karareis Reservoir	Küçükbahçe Stream	Parlak Reservoir	Salman Reservoir	Yelkentaş Stream
Native species								
Anguilla anguilla	■				■		■	■
Chelon labrosus	■							
Invasive species								
Carassius gibelio		■				■		
Gambusida holbrooki			■			■		
Translocated species								
Atherina boyeri					■			■
Cyprinus carpio			■			■		

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Species diversity was quantified using Shannon-Wiener and Simpson's diversity indices, revealing significant differences between native and invaded sites (Magurran, 2004). The impact of invasive species on native fish communities was assessed by comparing abundance and biomass metrics (Ricklefs, 2008).

Discussion

The decline in fish biodiversity is primarily due to habitat modification, pollution, and the introduction of non-native species. The presence of invasive species such as *Atherina boyerii* and *Cyprinus carpio* in the study area is concerning and suggests anthropogenic influences on ecosystem health. Similar trends have been observed in other regions; for example, Gozlan et al. (2010) documented the detrimental impacts of invasive fish species in European freshwater ecosystems, where invasive species outcompete and displace native species.

Britton et al. (2011) demonstrated that invasive species like the topmouth gudgeon (*Pseudorasbora parva*) significantly disrupt native fish populations through competition and predation. These findings align with our observations in the Karaburun Peninsula, where invasive species have altered the community structure of native fish populations. Similarly, Copp et al. (2009) highlighted the ecological consequences of non-native fish introductions in European inland waters, underscoring the need for robust risk assessments and management strategies to mitigate these impacts.

In North America, Strayer and Dudgeon (2010) emphasized the importance of maintaining habitat connectivity and implementing biosecurity measures to prevent further introductions of invasive species. This approach is critical for the Karaburun Peninsula, where habitat fragmentation and pollution have exacerbated the pressures on native fish species.

Invasive species management should prevent introductions and control existing populations through integrated pest management (Simberloff et al., 2013). Effective management strategies include public awareness campaigns and stakeholder involvement to ensure community support for conservation initiatives (Pimentel et al., 2005). Continuous monitoring and adaptive management are crucial to address the dynamic nature of ecosystem changes and emerging threats.

The results of this study align with findings from other regions, indicating that invasive species are a pervasive threat to freshwater biodiversity worldwide. Buisson et al. (2008) reported that climate change accelerates the turnover of stream fish assemblages, further complicating the conservation of native species. Similarly, Belletti et al. (2020) found that over a million barriers fragment Europe's rivers, impeding fish migration and exacerbating the impacts of invasive species.

Conclusion

This study underscores the need for comprehensive management plans to address the threats posed by invasive species in the Karaburun Peninsula's freshwater ecosystems. Conservation efforts should focus on habitat protection, pollution control, and the regulation of species introductions. Future research should monitor invasive species' long-term impacts and the effectiveness of implemented management strategies. The integration of local community knowledge and scientific research is essential for the development of effective conservation policies.

AQUATIC ANIMAL REPORTS

Ethical approval

 Ethical review and approval were waived for this study.

Informed consent

 "Not available".

Data availability statement

 The authors declare that data can be provided by corresponding author upon reasonable request.

Conflicts of interest

There is no conflict of interests for publishing this study.

Contribution of authors

Ümit Acar: Conceptualization, Data curation, Formal analysis, Writing original draft
Sevan Ağdamar: Investigation, Methodology, Writing original draft, Statistical analyses

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