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First Record of *Dreissena caputlacus* (Schütt, 1993) and *Dreissena polymorpha gallandi* (Locard, 1893) in Çamlığöze Dam Lake (Sivas, Türkiye) and Evaluation of Some Biometric Parameters

Çamlığöze Baraj Gölü'nde (Sivas, Türkiye) *Dreissena caputlacus* (Schütt, 1993) ve *Dreissena polymorpha gallandi* (Locard, 1893)'nin İlk Kaydı ve Bazı Biyometrik Parametrelerin Değerlendirilmesi

ABSTRACT

In this study, the presence and biometric characteristics of *Dreissena caputlacus* (Schütt, 1993) and *Dreissena polymorpha gallandi* (Locard, 1893) populations were determined in Çamlığöze Dam Lake. Shell length (SL), shell height (SH), shell width (SW) data of individuals collected in the study area were used with a digital caliper; The weights of individuals (W) were determined using precision scales. The means of SL, SW, SH and W in *D. caputlacus* and *D. polymorpha gallandi* were determined as 22.66±4.33 and 30.03±3.17 mm, 15.88±4.16 and 14.54±1.46 mm; 13.37±2.85 and 14.51±1.41 mm; 94±1.12 and 3.29±0.95 g, respectively. According to principal component analysis, there was a strong relationship between SH, SW, SL and W for both species. For *D. caputlacus* and *D. polymorpha gallandi*, 82.283% and 94.502% of the total variance was explained by two principal components. *D. caputlacus* and *D. polymorpha gallandi* populations from Çamlığöze Dam Lake were reported for the first time in this study.

Keywords: Çamlığöze dam lake, *Dreissena caputlacus*, *Dreissena polymorpha gallandi*

Öz

Bu çalışmada, Çamlığöze Baraj Gölü'nde dağılım gösteren *Dreissena caputlacus* (Schütt, 1993) ve *Dreissena polymorpha gallandi* (Locard, 1893) türlerinin varlığı ve biyometrik özelliklerinin belirlenmesi amaçlanmıştır. Çalışma alanında toplanan bireylere ait kabuk uzunluğu (KU), kabuk yüksekliği (KY), kabuk genişliği (KG) verileri dijital kumpas ile; bireylerin ağırlıkları (A) hassas terazi kullanılarak belirlenmiştir. *D. caputlacus* ve *D. polymorpha gallandi*'de KU, KG, KY ve A ortalamaları sırasıyla 22,66±4,33 ve 30,03±3,17 mm; 15,88±4,16 ve 14,54±1,46 mm; 13,37±2,85 ve 14,51±1,41 mm; 1,94±1,12 ve 3,29±0,95 g olarak belirlenmiştir. Temel bileşenler analizine göre, her iki tür için kabuk yüksekliği, kabuk genişliği, kabuk uzunluğu ve ağırlık arasında güçlü bir ilişki olduğu belirlenmiştir. *D. caputlacus* ve *D. polymorpha gallandi* için toplam varyansın %82,283 ve %94,502'lük kısmının iki temel bileşen tarafından açıklanmıştır. Çamlığöze Baraj Gölü'nden *D. caputlacus* ve *D. polymorpha gallandi* populasyonları bu çalışma ile ilk kez rapor edilmiştir.

Anahtar Kelimeler: Çamlığöze baraj gölü, *Dreissena caputlacus*, *Dreissena polymorpha gallandi*

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Introduction

Anatolia has an important position in the paleoartic region in terms of biological resources, as it is a peninsula rich in species diversity. Although Türkiye does not have large internal water resources, it has a rich habitat and species diversity due to paleogeographic developments and hydrogeographic connections. However, this situation is also suitable for exotic and invasive species (Yıldırım et al. 2019; 2023).

Species belonging to the genus *Dreissena* are among the most common invasive invertebrates in Türkiye's inland waters. In addition to the suitability of many inland waters for this genus, fishing activities and the lack of adequate controls have allowed individuals of this genus to easily invade new areas. Although there is a consensus on the invasiveness of *Dreissena*, there are different opinions about which species of *Dreissena* are invasive (Geldiay & Bilgin, 1973; Yıldırım et al., 2019; Yıldız et al., 2018).

In recent molecular phylogenetic studies, *Dreissena* has been divided into three subgenera: *Dreissena*, *Pontodreissena* and *Carinodreissena*. These include *Pontodreissena*, *D. caputlacus* and *D. rostriformis* species. *D. caputlacus* is widespread in Türkiye. The subgenus *Carinodreissena* includes the taxa *D. carinata* and *D. blanci*; both live in ancient lakes on the Balkan Peninsula. However, there is no record of its distribution in Türkiye. The subgenus *Dreissena* is represented by two subspecies: *D. polymorpha anatolica* and *D. polymorpha gallandi*. *D. polymorpha anatolica* is endemic to lakes in southern Türkiye near the northern Mediterranean coast. *D. polymorpha gallandi* is of Pontocaspian origin and is known to be widely distributed in most of Eurasia and North America (Gelembiuk et al., 2006). In studies conducted in Türkiye to date, *D. caputlacus*, *D. p. anatolica* and *D. p. gallandi* taxa have been reported to be widespread (Gürlek et al., 2019).

Çamlığöze Dam Lake is located in Suşehri district of Sivas province. The dam lake was built between 1987 and 1998 for irrigation, energy production and flood control. The lake area is 5 km² and the maximum depth is 30 m. The average annual energy production in the lake is 102 GWh/year (Aydoğan, 2004; Dirican & Musul, 2009). This study is the first scientific report on the population of *D. caputlacus* (Schütt, 1993) and *D. p. gallandi* (Locard, 1893) living in Çamlığöze Dam Lake and some of their biometric characteristics.

Methods

D. caputlacus (n: 30) and *D. p. gallandi* (n: 60) used in the study were sampled from Çamlığöze Dam Lake (Sivas) (x: 424471.02 y: 4455477.23) (x,y coordinate: WGS_1984_UTM_Zone_37N (6°) (Figure 1) in August 2024.

Metal framed scoops and shovels were used in suitable places to collect samples; rakes were used for screening and individuals were collected by hand from sand and silt areas up to 1 m water depth. In addition, samples were collected by diving in deeper areas (at depths of 10-15 m) (Figure 2), and then the samples were stored in styrofoam boxes at +4°C. Identification of the collected species was performed by comparing them with descriptions and drawings of different *Dreissena* species available in the literature (Yıldırım et al., 2023).

Shell measurements [shell length (SL), shell height (SH) and shell width (SW))] were made with a digital caliper (± 0.01 mm) (Figure 3), and weight (W) measurements were made with a precision scale (± 0.001 g). The formula $W=a*Lb$ and its logarithmic transformation ($\log(W)=a+b*\log(L)$) were used to calculate length-weight relationships.

Microsoft Excel® was used to analyze and process the data. Principal component analysis (PCA) was performed using PAST4.03 software to explore the relationships between the variables

Figure 1.
Çamlığöze Dam Lake.

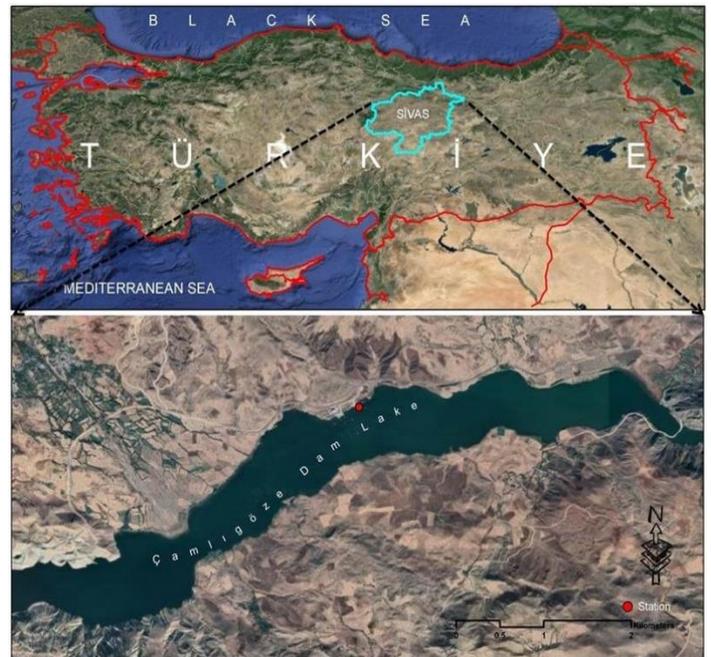


Figure 2.
Sample collection.



Figure 3.
a. *Dreissena caputlacus* b. *Dreissena polymorpha gallandi*.



Results and Discussion

D. caputlacus was described from Adıyaman Gölbaşı Lake and it was characteristically known with transverse stripes on it (Schütt, 1993). As a feature of the Family, there is no tooth protrusion on the hinge that keeps the shells together, there is an elastic hinge bond that connects the shells together. It is one of the endemic mussel species of Türkiye. It has also been determined that the species is widespread in Menzelet Dam Lake, Almus Dam Lake (Tokat) and Kartalkaya Dam Lake (Kahramanmaraş) while it was previously known in the Seyhan River, Seyhan Dam, Sır Dam Lake, Kurtağılı Dam Lake (Yozgat), Probably the center of evolution of the species is Gölbaşı Lake, which is the type locality. For the higher temperatures, living examples of the species can only be found in the coastal zone during the summer months. However, quite dense and large populations of the species are found in lakes and ponds that have hydrogeographic connections with Gölbaşı Lake. They show a biofouling effect in energy production systems, especially in the Ceyhan dam lake (Yıldırım et al., 2023). *D. polymorpha gallandi* is found in regions close to the sea (Marmara and Black Sea) in Türkiye. Although they are very similar to the nominal subspecies *D. polymorpha polymorpha*, they differ in their zoogeographical features and thinner and more shaped structures. In current study,

the presence of *D. caputlacus* and *D. polymorpha gallandi* in Çamlığöze Dam Lake (Sivas, Türkiye) was revealed for the first time.

In this study, the mean of SL, SW, SH and W in *D. caputlacus* and *D. polymorpha gallandi* were determined as 22.66 ± 4.33 and 30.03 ± 3.17 mm; 15.88 ± 4.16 and 14.54 ± 1.46 mm; 13.37 ± 2.85 and 14.51 ± 1.41 mm; 1.94 ± 1.12 and 3.29 ± 0.95 g. respectively. Akkuş et al. (2019) reported in their study in Van Province Sarımeşmet Dam Lake that the largest shell length and weight values in *D. polymorpha* were 43.74 mm and 9.85 g. Kocabaş and Kutluyer Kocabaş (2021) reported that the mean of SL, SW, SH and W in *D. polymorpha* population obtained from Demirköprü Dam Lake was 30.48 ± 5.40 , 14.48 ± 2.33 , 14.72 ± 3.02 and 5.19 ± 0.94 (2.38-7.47 g), respectively. In this study, the highest values of SL and W were determined as 36.34 mm and 4.96 g. The decrease of water level in Çamlığöze Dam Lake has negatively affected the living environments of mussels, so it is expected that the W values will be reduced as a result of the presence of nutrients in the environment and changing water parameters (Akkuş et al., 2019). The mechanisms underlying the introduction of *Dreissena polymorpha* (zebra mussel) into the dam ecosystem remain uncertain; however, anthropogenic vectors are strongly implicated. This invasive bivalve species, which sustains itself by filtering suspended particulate matter and nutrients from the water column, may have been inadvertently transported via aquaculture-related activities (Haltiner et al., 2023; Karatayev et al., 2015; Yıldırım et al., 2023). Specifically, the use of boats for the translocation of cultured fish between aquatic systems is considered a probable pathway for its spread (Akkuş et al., 2019; Bobat et al., 2002; Schall, 2019). A precedent for such introduction exists in the case of North American freshwater ecosystems, where zebra mussels were first introduced through the discharge of ballast water from transoceanic vessels (Bobat et al., 2004). Moreover, the species' capacity to survive extended periods in moist, non-submerged environments further enhances its potential for passive dispersal across regions (Bobat et al., 2002; Bobat et al., 2004; DSİ, 2005).

Kocabaş and Kutluyer (2021) used Bartlett's test and KMO to verify the usefulness of Principal component analysis (PCA) and reported that PCA was useful in summarizing the correlation matrix (KMO=0.79). and Bartlett's test data were determined to be significant ($p=.000$; $p<.001$) in *D. polymorpha* population in Demirköprü Dam Lake. They determined that 94.379% of the total variance in *D. polymorpha* was explained by two principal components and there was a strong relationship among SL, SW, SH and W. Similarly, in this study, 82.283% of the total variance in

D. polymorpha gallandi and 94.502% in *D. caputlacus* were explained by two principal components, useful in summarizing the correlation matrix ($KMO_{D. polymorpha gallandi}=0.711$; $KMO_{D. caputlacus}=0.83$) and Bartlett's test data were determined to be significant ($p=.000$; $p<.001$). Therefore, PCA was useful, and the variables are interrelated. In addition, there was a strong relationship among SL, SW, SH and W for both species (Figures 4 and 5).

Figure 4.

Principal components analysis of variables [Shell length (SL), Shell height (SH), Shell width (SW) and Weight (W)]; *D. polymorpha gallandi*.

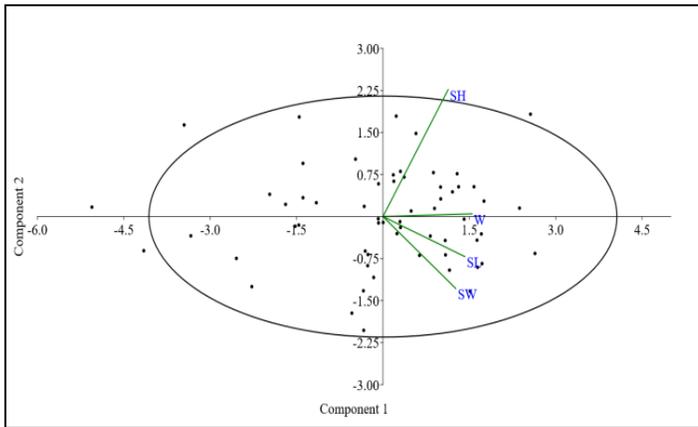
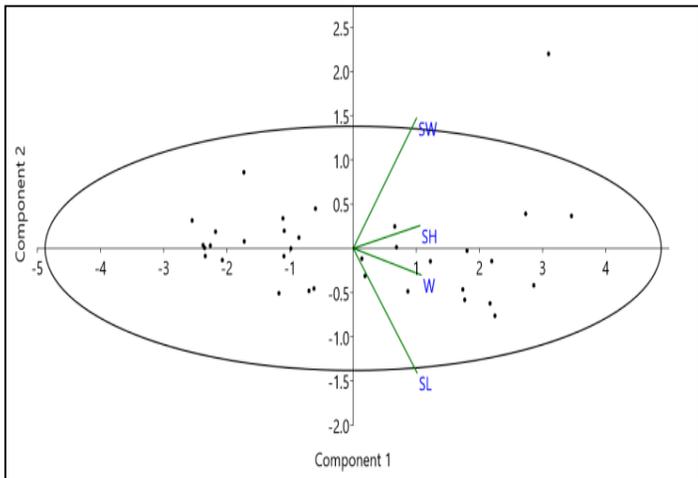


Figure 5.

Principal components analysis of variables [Shell length (SL), Shell height (SH), Shell width (SW) and Weight (W)]; *D. caputlacus*.



Kocabaş and Kutluyur (2021) reported that there was a strong correlation between shell length-shell width, shell length-shell height, shell width-shell height, shell width-weight and shell height-weight in *D. polymorpha*. In this study, there was a strong correlation between shell length-shell width and shell length-weight in the *D. polymorpha gallandi* (Table 1). In *D. caputlacus*, there was a strong correlation between shell length-shell width, shell length-shell height, shell length-weight, shell width-shell height,

shell width-weight and shell height-weight (Table 2).

Table 1.

Correlation matrix between measured parameters for *D. p. gallandi*. parameters for *D. caputlacus*.

Variables	SL	SW	SH	W
SL		0.521	0.368	0.749
SW	0.521		0.310	0.579
SH	0.368	0.310		0.558
W	0.749	0.579	0.558	

Table 2.

Correlation matrix between measured parameters for *D. caputlacus*.

Variables	SL	SW	SH	W
SL		0.727	0.807	0.880
SW	0.727		0.834	0.829
SH	0.807	0.834		0.916
W	0.880	0.829	0.916	

Conclusion and Recommendations

In conclusion, habitat and physiological conditions can influence the shell calcification process and morphometric parameters during maturation, growth and reproduction, as well as the growth, morphology and relative proportions of Mollusca shells. This finding regarding the reporting of *D. caputlacus* and *D. polymorpha gallandi* in Çamlığöze Dam Lake indicates the presence of a stable population for the native Mollusk fauna of this species. Invasion of dam areas by zebra mussels will pose a major problem for the reproductive migration of fish species in the environment. Therefore, it is necessary to prevent transporting of the zebra mussel from Çamlığöze Dam to other streams and lakes by taking precautions.

Peer-review: Externally peer-reviewed.

Ethics Committee Approval: Since the species included in the study is an invertebrate, approval from the Local Animal Research Ethics Committee is not required.

Author Contributions: Concept -C.K.; Design- C.K.; Supervision- C.K.; Resources- C.K.; Data Collection and/or Processing- C.K., F.K.K., M.K., N.B.; Analysis and/or Interpretation- C.K., F.K.K., M.K., M.E.G.; Literature Search- F.K.K., M.K.; Writing Manuscript- F.K.K., M.K., N.B., M.E.G.

Conflict of Interest: The authors have no conflicts of interest to declare.

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