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Research Article

# First Recording of *Melanopsis costata* (Olivier, 1804) in Anamur (Dragon) Stream and Göksu River, Mersin, Türkiye and Measurement of Some Biometric Parameters

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**Abstract:** In this study, some biometric characteristics of the freshwater snail *Melanopsis costata* (Olivier, 1804) were determined in the Anamur (Dragon) Stream and Göksu River (Mersin, Turkey). Weight (A) (g), shell width (KG) (mm), shell height (KY) (mm), aperture length (AU), and width (AG) (mm) measurements were made on the samples taken from different stations. Morphological relationships were determined by multivariate statistical evaluation. The highest values in terms of shell length and weight were evaluated as 24.46 mm and 1.496 g in Karakaya Village (Göksu River). The data were evaluated with Principal Component Analysis (PCA), a flexible statistical method used to understand the relationships between variables and explain a large part of the data set. Samples taken from different stations showed a strong relationship between aperture width and spir height. The species is not mentioned as a new record in the study area

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## 1. Introduction

Melanopsis snails, a freshwater genus of Prosobranchia, a subclass of Gastropoda, are abundant in the lakes, springs, and rivers of the Middle East. It lives widely in the Mediterranean, however little is known about the taxonomy of the genus and the evolutionary processes experienced by its populations. The shell structure of the genus *Melanopsis* is soft, costatic, elongated, grooved, banded, and completely black, located in a small area. It is known to be extremely variable (Gürlek et al., 2012; Kişin, 2019). The initial whorls and protoconch of *M. costata* are often worn away, and the lower whorls are characterized by ridges. *M. costata* commonly resides in wetlands, trenches, rivers, lakes, and irrigation channels (Farahnak et al., 2006). *M. costata* frequently hybridizes with *M. buccinoidea*, and fossil evidence suggests that these species have been interbreeding for the past 1.5 million years (Heller et al., 2005). Geldiay and Bilgin (1969) collected Mollusc samples from some regions of Türkiye and identified the samples of *Melanopsis costata* species were identified. Bilgin (1980) compared *M. costata costata* and *M. costata chantrei* species conchologically and reported that there was no difference at the subspecies level. Bilgin (1986) compared the species *M. costata* and *M. preamorsa* and mentioned that *M. costata* could be a subspecies. Ustaoğlu et al. (2003) studied the malacofauna of Yuvarlak Çay

(Köyceyiz-Muğla) and reported the presence of *M. costata* belonging to the Gastropoda class. Naser (2006) conducted a study on samples collected from different regions in the south of Iraq to clarify some uncertainties regarding the Melanopsidae family and reported the existence of *M. costata, M. nodosa*, and *M. subtingitana*. Şereflişan et al. (2009) reported *M. praemorsa ferussaci* and *M. costata costata* species along with other species belonging to the Gastropoda class, as well as the physicochemical parameters of Gölbaşı (Hatay). Kişin (2019) reported the presence of M. *costata* in different water resources [Kuzgun Stream (Mersin), Burnaz Stream (Hatay), Gölbaşı Lake (Hatay), Asi River (Hatay), Seyhan Dam Lake (Adana)].

One of the areas of study is the Anamur (Dragon) Stream located in the southernmost part of the Taşeli Plateau in the south of Türkiye. Anamur Stream, which takes its source from the Taşeli Plateau, is a short stream developed on the slopes of this plateau facing the Mediterranean. Akyol (1947) stated that the Anamur Stream constitutes one of the important marginal rivers in the Mediterranean Region. Anamur Stream, which originates from karst springs on the southern slopes of Taşeli Plateau, flows into the Mediterranean in the Anamur Plain. Anamur Stream, which takes its source from the karst springs around Sugözü and Boğuntu, is formed by the merger of Sugözü Stream flowing in the south direction and Güney Stream further south (Sunkar and Uysal, 2014). Göksu River is the largest river in the Eastern Mediterranean Basin. The upper basin of the river, which originates from the mountainous areas at an altitude of 1500 m in the Central Taurus Mountains, is dominated by neogene sedimentary and karst carbonate bedrock. Göksu basin, which has a steep topography, is characterized by deep valleys and passages carved into neogene sedimentary and carbonate bedrock (Akbulut et al., 2009). This river has the largest drainage area of the Eastern Mediterranean Basin with 11213 km$^2$ and is 260 km long; It is located within the provincial borders of Antalya, Konya, Karaman, and Mersin (Tekin and Can, 2019). While the branches above Mut District constitute the upper basin, the approximately 126 km long section from here to the Mediterranean represents the lower basin (Küçük et al., 2021). This study is the first scientific report on the population of *Melanopsis costata* (Olivier, 1804) living in the Anamur (Dragon) Stream and Göksu River. In the current study, it was aimed to determine the biometric characteristics of *M. costata* in the Anamur (Dragon) Stream and Göksu River.

## 2. Material and Methods

*M. costata* used in the study was collected from Anamur (Dragon) Stream-station 1 (36.144530, 32.889564-36.631662, 33.367752 North/East) and Göksu River (Hamamköy-station 2-36.631662, 33.367752 North/East and Karakaya Village-station 3-36.434773, 33.780039 North/East) between August and September 2024 (38°39'58”-28°21'03”, 38°42'47”-28 °23'54”, 38°41'29”-28°21'38”, North/East) (Figure 1).


Figure 1. Sampling area, Anamur (Dragon) Stream (S1) and Göksu River [Hamamköy (S2) and Karakaya village (S3)].

To collect the samples, metal-framed scoops and shovels, and a rake for bottom dredging were used, individuals were collected by hand from sand and national areas up to 1 m water depth, and the samples were stored in styrofoam boxes at +4 °C. Identification and identification of the collected snails were carried out by comparing them with descriptions and drawings of different *Melanopsis* species available in the literature (Glöer, 2002 and 2019; Kruglov, 2005; Glöer and Girod, 2013; Gürlek, 2015) (Figure 2).

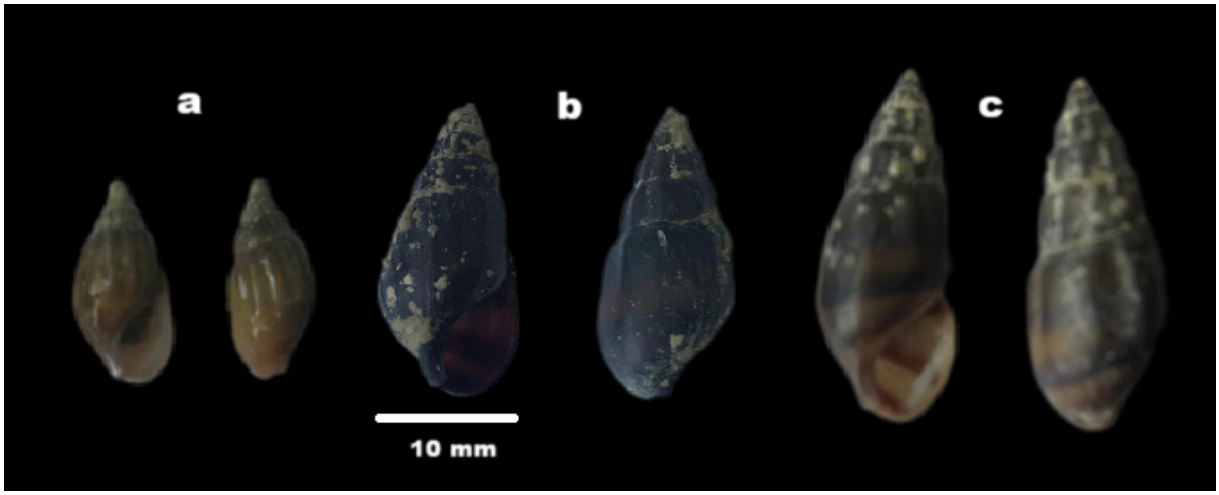


Figure 2. *Melanopsis costata* collected from a) Anamur (Dragon) Stream and Göksu River [b) Hamamköy and c) Karakaya village].

Shell measurements [shell length (SL), shell width (SW), aperture length (AL) and width (AW), spir height (SpH), body whorl height (BWH)] were made with a digital caliper (±0.01 mm), and weight measurements were made with a precision scale (±0.001 g) (Figure 3).

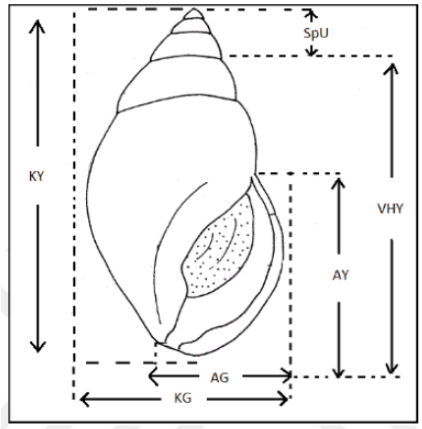


Figure 3. Morphometric measurement of *Melanopsis costata* (Gürlek et al., 2012).

Correlation analysis was used to determine the relationships between biometric parameters, and Microsoft Excel® was used to analyze and process the data. Principal component analysis (PCA) was applied using the Past 4.03 program to determine the relationships between variables.

## 3. Results and Discussion

With a conical and elongated shell, the protoconch and initial whorls of *M. costata* are often worn down, whereas the lower whorls exhibit ribbed patterns. It typically displays a combination of brown, yellow, or greenish tones, occasionally accompanied by darker spots or stripes. Its body is soft and generally light in color with some pigmentation (Farahnak et al., 2006). Fossil evidence reveals that

*M. costata* and *M. buccinoidea* have been interbreeding for approximately 1.5 million years with frequent hybridization occurring between the two species (Heller et al., 2005). In the current study, the presence of *Melanopsis costata* in the Anamur (Dragon) Stream and Göksu River was reported for the first time. Due to phenotypic variations in shell morphology, species identification is very complicated in most taxa, and the similarity of shell characters may cause many new species to be overlooked in research.

For both contemporary and subfossil melanopsids, shell size is a trait that shows considerable variability. Notable differences in size can be observed among adult specimens even within the same phenotype (Neubauer et al., 2014). In the present study, the means of shell length, shell width, aperture length and width, spir height, body whorl height, and weight for Stations 1, 2, and 3 are presented in Table 1. Kişin et al. (2019) reported the highest measurements for shell length, and shell width were 23.7 mm and 11.6 mm from Osmaniye Hemile Bridge and the lowest measurements were 12.3 mm and 6.6 mm from Adana Seyhan Dam, respectively. In the present study, the highest values of SL and W were measured as 24.46 mm and 1.496 g from Station 3. Extrinsic factors were often discussed as the cause of morphological changes in melanopsid gastropods (e.g., Glaubrecht, 1993 and 1996; Michel, 1994; Bandel, 2000; Heller and Sivan, 2002; Neubauer et al., 2014). Increased availability of organic material and light in streams with other external conditions promote larger shell growth leading to populations composed of bigger individuals. The lack of riparian vegetation leads to more light reaching the streambed, along with greater alkalinity, higher calcium levels, and an increased flow of organic matter resulting in greater availability of food (periphytic algae) and it may lead to more noticeable growth (Delay and Pontier, 1997, Dillon, 2000; Lanzer, 2001; Lacerda et al., 2011).

Table 1. The means of the shell characteristics (SL, SW, AL, AW, SPH) and weight (W) of *M. costata*

| | **Station 1** | **Station 2** | **Station 3** |
|---|---|---|---|
| **SL (mm)** | 12.63±3.40 | 17.68±3.58 | 19.01±3.85 |
| **SW (mm)** | 6.27±1.42 | 7.74±1.29 | 8.86±1.71 |
| **AL (mm)** | 7.18±1.77 | 7.68±2.00 | 9.99±1.86 |
| **AW (mm)** | 4.38±1.25 | 5.55±0.98 | 5.68±0.99 |
| **SpH (mm)** | 2.83±1.31 | 2.27±0.49 | 5.17±1.48 |
| **BWH (mm)** | 9.80±2.23 | 14.90±3.19 | 13.83±2.75 |
| **W (g)** | 0.34±0.25 | 0.70±0.30 | 0.86±0.35 |

PCA (Principal components analysis) showed a strong relationship between spir height (SPH) and weight (W) (Figure 4). In gastropods, these morphometric traits may show correlated variation, possibly revealing the influence of underlying biological and ecological factors on shell growth and body weight (Akça Atıl et al., 2024). The removal of riparian forests and pollution by domestic sewage in freshwater ecosystems lead to habitat destruction and alteration, creating conditions capable of inducing or accelerating intraspecific morphological variations (Durrant, 1977; Lanzer, 1996; Lacerda et al., 2011).

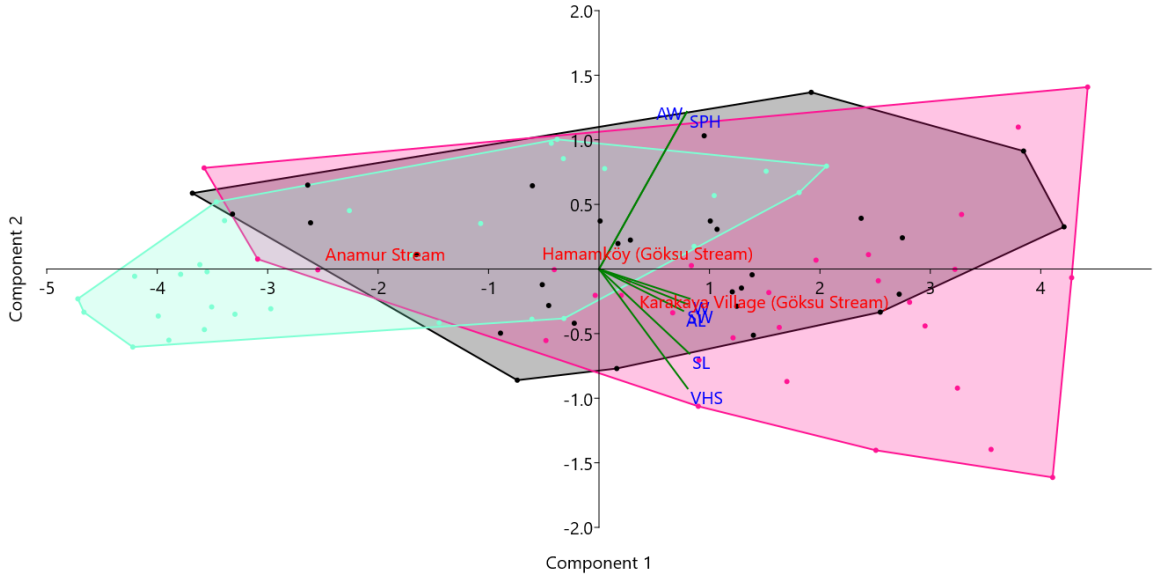


Figure 4. Biplot of Principal Component Analysis (PCA) analysis of the shell characteristics (SL, SW, AL, AW, SPH) and weight (W) of *M. costata*.

Weight-length relationships are particularly used in the assessment of stocks and the calculation of population production in various regions and habitats (Kutluyer Kocabaş et al., 2022). Body length and weight variations in freshwater snail species are associated with fluctuations in water salinity and temperature and, variations in stocking density, feeding frequency, and food type (Catalan and de Chavez, 2023). Additionally, species and populations undergo morphological comparisons and life history determinations (Ricker, 1973; Anderson and Gutreuter, 1983; Beyer, 1991; Pauly, 1993; Richter et al., 2000; Kutluyer Kocabaş et al., 2022). In this study, there was a strong correlation between shell length-shell width, shell length-aperture length, shell length-body whorl height, shell length-weight, shell width-aperture length, shell width-body whorl height, shell width-weight, aperture length-body whorl height and aperture length-weight in different stations (Figures 5, 6 and 7).

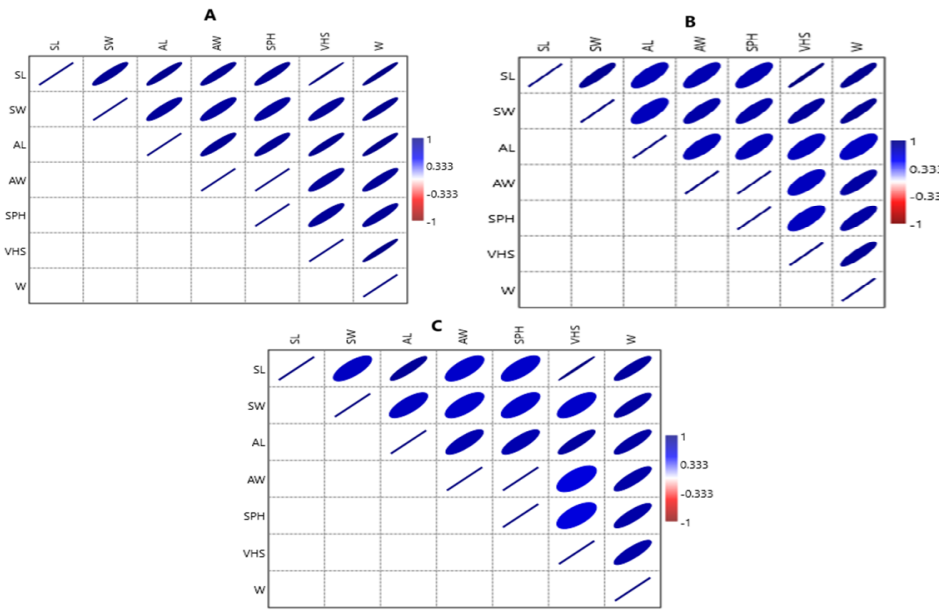


Figure 5. Correlation matrix of the shell characteristics (SL, SW, AL, AW, SPH) and weight (W) of *M. costata* in A) Anamur (Dragon) Stream, B) Hamamköy (Göksu River) and C) Karakaya village (Göksu River).

## Conclusion

In conclusion, the Anamur (Dragon) Stream and Göksu River (Hamamköy and Karakaya Village) are new locality records for *M. costata* in our country. The morphological differences observed at different stations will be caused by effects such as nutrition, water chemistry in the habitats, and water temperature, and the possibility of subspeciation or even speciation is quite high. Because Anatolia has very high diversity and endemism, especially for Molluscs. For this reason, further studies in the molecular taxonomy of the study materials will support our results and clarify the status of the genus in our country while investigating the possible reasons for morphological differentiation.

## Ethical Statement

Ethical approval is not required for this study because an ethics certificate was not required for invertebrates in Türkiye.

## Conflict of Interest

The authors declare that there are no conflicts of interest.

## Funding Statement

No financial support was received.

## Author Contributions

F.K.K.: Designed the study, performed the laboratory study and interpreted the data, and prepared the manuscript. M.K.: He carried out the sampling and laboratory work of the species. All authors contributed to writing and editing the manuscript. All authors read and approved the final manuscript.

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