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DISTRIBUTION AND MORPHOMETRIC CHARACTERISTICS OF *Patella* SPECIES (ARCHAEOGASTROPODA) IN MERSIN-VIRANŞEHIR REGION OF THE NORTHEASTERN MEDITERRANEAN SEA

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Abstract: The main objectives of this study were to define the *Patella* species and determine their distribution and morphometry in Mersin-Viranşehir region. 99 samples were collected from three stations, each being six m^2. To determine the distribution of organisms in supralittoral, mediolittoral and infralittoral zones all individuals collected from these zones, were fixed in 4% formaldehyde and transported to laboratory for identification and morphometric measurements. First lateral teeth of radula and characteristic teeth appendages were used for taxonomic examinations. Two patella species, *Patella caerulea* and *Patella rustica* were identified in Mersin-Viranşehir region. *P.caerulea* and *P.rustica* were constituted 88.89% and 11.11% of *Patella* species in the area respectively. *P. caerulea* was found in mediolittoral and upper infralittoral zones, whereas *P.rustica* was mainly distributed in supralittoral zones of the stations studied. Morphometric measurements of the specimens collected were carried out to find out whether these measurements could be used in species differentiation. Radula length to shell length ratio (RL:SL) of *P.caerulea* was calculated as 1.04 (range, 0.94-1.08) whereas this ratio was 2.03 (range, 1.97-2.08) for *P.rustica*. As a conclusion, it was suggested that RL:SL ratio should be used together with radula teeth characteristics for the identification of two *Patella* species of Viranşehir coast.

Keywords: *Patella*, Archaeogastropoda, Northeastern Mediterranean Sea, Mersin-Viranşehir

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Özet: **Mersin-Viranşehir Bölgesinde (Kuzey-Doğu Akdeniz) Yaşayan *Patella* (Archaeogastropoda) Türlerinin Dağılımı ve Morfometrik Özellikleri**

Bu çalışma Mersin-Viranşehir sahilindeki *Patella* türlerinin tespiti, dağılımı ve morfometrik özelliklerinin belirlenmesi amacıyla yapılmıştır. Çalışmada, araştırma bölgesi olan Viranşehir sahilinde 6 m^2'lik 3 örnekleme alanı belirlenerek, bu alanlardan toplam 99 *Patella* bireyi toplanmıştır. Her örnekleme alanında türlerin zona bağlı dağılımının belirlenmesi amacıyla infralittoral, mediolittoral ve supralittoral zonlarda bulunan tüm bireyler, içerisinde % 4'lük formaldehit bulunan örnekleme kaplarına ayrı ayrı konularak teşhis ve morfometrik ölçümler için laboratuara getirilmiştir. Taksonomik incelemelerde *Patella* genusu için taksonomik değeri olan radulanın 1. lateral diş ve çıkıntılı diş karakterleri üzerinden tür teşhisleri yapılmıştır. İncelemeler sonucunda Mersin-Viranşehir bölgesinde *Patella caerulea* ve *Patella rustica* olmak üzere *Patella* genusundan 2 türün dağılım gösterdiği belirlenmiştir. Araştırma bölgesinde *P.caerulea* ve *P.rustica*'nın dağılım oranları sırasıyla % 88.89 ve % 11.11 olarak saptanmıştır. *P. caerulea*'nın üst infralittoral ve mediolittoral zonda, *P.rustica*'nın ise supralittoral zonda dağılım gösterdiği tespit edilmiştir. Ayrıca toplanan bireylerin morfometrik ölçümleri yapılarak, bu ölçümlerin türlerin ayrımında kullanılıp kullanılamayacağı değerlendirilmesi yapılmıştır. *P.caerulea*'nın radula uzunluğunun kabuk uzunluğuna oranı (RU/KU) ortalama 1.04 (0.94-1.08) olarak belirlenirken, *P.rustica*'nın RU/KU değeri 2.03 (1.97-2.08) olarak saptanmıştır. Viranşehir sahilinde dağılım gösteren iki *Patella* türünün tanımlanmasında RU/KU değerinin, taksonomik değeri olan radula diş karakterleri ile birlikte kullanılabileceği sonucuna varılmıştır.

Anahtar Kelimeler: *Patella*, Archaeogastropoda, Kuzey-Doğu Akdeniz, Mersin-Viranşehir

Introduction

Rock cliffs, which are a part of seashore ecosystem, are rich zones regarding to biological diversity. In these areas where the effects of tides are the most common, great changes happen in ecological factors such as salinity and temperature. Rocky tidal zones constitute feeding and nesting grounds for various kinds of organisms including man. However, today, tidal zones face some threats such as excess hunting activities and water pollution (domestic, industrial and agricultural).

Patella species which are a part of rocky tidal zones belong to *Patellidae* family of the class Gastropoda**.** These species hold onto rocks very tightly and make up groups above and below the sea level. *Patella* species generally share the same habitat with *Trichodesmium sp.* from Cyanophyta, *Fucus vesiculosus* (Linnaeus, 1753) from Phaeophyta, *Semibalanus balanoides* (Linnaeus, 1767) from Cirripedia, *Littorina sp.* from Gastropoda, *Acartia tonsa* (Dana, 1848) from Copepoda, *Brachidontes pharaonis* (Fischer, 1870) from Bivalvia and *Gammarus pulex* (Linnaeus, 1758) from Amphipoda (Ayas *et al.,* 2008). As rocky tidal zones shelter numerous individuals belonging to various species, interrelationships between species are very common. Although these relationships have some characteristics of collective life, competition may also be observed because of nutrition and settlement areas**.** *Patella* species get into spatial competition with some other species of fauna and flora as well. In a study carried out by Arrontes *et al.* (2004), it was stated that *Patella* species were in a spatial competition with *Fucus vesicolosus* (Phaeophyta).

In the Mediterranean, *Patella* genus is represented by six species, namely *P. caerulea* L., *P. aspera* Lam. (= *P. ulyssiponensis* Gmelin), *P. rustica* L. (= *P. lusitanica* Gmelin), *P. ferruginea* (Gmelin, 1791), *P. intermedia* (Murray in Knapp, 1857) and *P. nigra* (Da Costa, 1771) (Badino and Sella, 1980; Öztürk and Ergen, 1999; Mauro *et al.*, 2003, Guerra-Garcia *et al.*, 2004, Espinosa *et al.*, 2007, Ayas *et al.*, 2008). Among these species, *P. ferruginea* which is a Mediterranean endemic, took place in the most endangered sea species list in 1992 (Guerra-Garcia *et al.*, 2004). *P. caerulea* which is another kind of Mediterranean endemic is one of the most common species of Mediterranean shores. (Sotorelli and Margotrigiano, 2005). *P. aspera* and *P.*

rustica can be found both in Mediteranean and Atlantic shores. These patellid species live on different vertical zones of rocky shores (Mauro *et al.*, 2003).

Patella species being herbivores feed on algs living in littoral zone. Whereas *P. rustica* living in supralittoral zone feed on epilitic and endolitic Cyanophyceae species, *P. caerulea* living in mediolittoral zone also mostly feed on Cyanophyceae species. Besides, *P. caerulea* can also feed on other main algea classes including Cyanophyceae species (Della Santina *et al.*, 1993).

In a number of pollution studies, it has been suggested that *Patella* species could be used as pollution indicators (Cravo *et al.*, 2002; Sotorelli and Margotrigiano, 2005; Nakhle *et al.*, 2006, Ayas *et al.*, 2009). It has been found out that *P. caerulea* individuals of which samples have been taken from different shores of Italy reflected Cd levels in the surrounding waters (Campanella *et al.* 2001, Conti and Cecchetti 2003). It is becoming more important to carry out research on the distrubution and biology of the species belonging to this genus, which in fact can be used as a biological indicators, as the pollution of sea ecosystem continues increasingly. Although a number of studies have been carried out on the distribution and ecology of *Patella* species (Barnister, 1975; Guerra and Gaudencio, 1986; Della Santina and Chelazzi, 1991; Navaro *et al.*, 2005), very few studies have been carried out on the distribution of patellids of our country's rocky tidal zones, which are one of the dominant genus (Öztürk and Ergen, 1999, Ayas *et al.*, 2008). The aim of the present study was to contribute to this field to some extent.

Materials and Methods

Samplings were carried out in March 2008. Individuals belonging to *Patella* genus were collected from the rocky tidal zone of anthropogenic Viranşehir shore (Figure 1). Samples were taken from 1.5 m above and 0.5 m below the sea level, totalling two meters vertically and three meters horizontally, from three area each covering six square meters. In each sampling area, all the individuals belonging to *Patella* in infralittoral, mediolittoral and supralittoral zones were collected. Individuals were placed into jars containing 4% formaldehit and tagged. 99 *Patella* individuals were dissected in the laboratory, their radulas ripped of and their lengths were measured. The species identification was made in terms of morphological appearances of the radula teeth. The morphometric measurements of *Patella* shells were done using a caliper. Morphological appearances of the first lateral radula tooth and radula teeth with projections, which are placed in width rows from the central axis on radula, were taken into account in species identificatiton (Piette and Gaillard, 1959; Gaillard, 1987; Öztürk and Ergen, 1999).

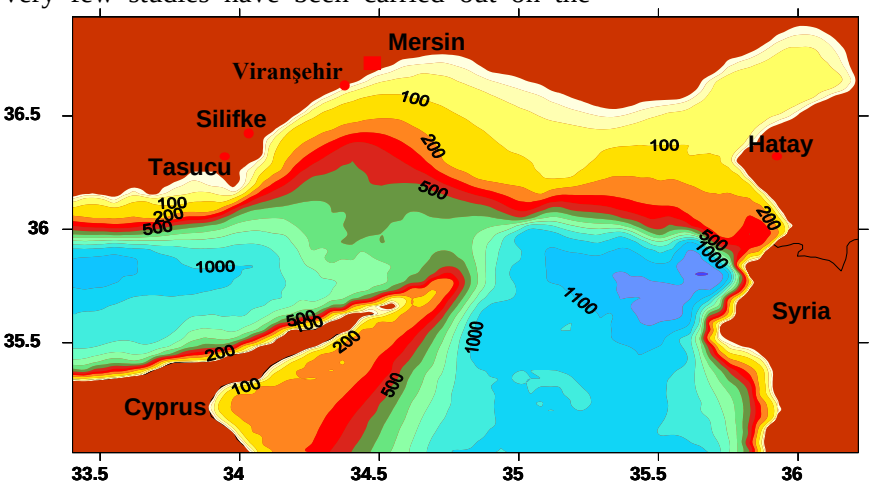

Figure 1. Sampling zone map (Mersin-Viranşehir)

Results and Discussion

Table 1. Morphological measurements of two *Patella* species distributed at Viranşehir coasts.

Species	NS	%	SL (min-max)	SW (min-max)	SH (min-max)	RL $\bar{X}$	RL/SL $\bar{X}$	RL/SL (min-max)
P. caerulea	88	88.89	19.0-39.0	15.0-33.0	5.0-11.0	27.48	1.04	0.94-1.08
P. rustica	11	11.11	21.0-42.5	18.0-37.0	7.0-16.0	66.86	2.03	1.97-2.08

NS-Number of specimens, SL-Shell length, SW-Shell width, SH-Shell height, RL-Radula length

Anthropogenic Viranşehir shores have lost its sand as a result of sea filling. The region has turned into a rocky shore and became the habitat for tidal zone species. Some morphological measurements and radula lengths of the patellids *P. caerulea* and *P. rustica,* distributed in Anthropogenic Viranşehir rocky areas**,** are given in Table 1.

Patella caerulea Linnaeus, 1758

88.89% of all the samples collected from Viranşehir consisted of *P. caerulea* individuals. This species is distributed in upper infralittoral and mediolittoral zones vertically 15 cm below sea level in infralittoral and 35 cm above sea level in mediolittoral. This vertical zone area is under the influence of sea water because of tides and waves. It has been observed that the individuals are mostly found in an area 25 cm above the sea level.

In *P. caerulea* individuals, 1. lateral tooth attached to the bottom of radula is convex. On the contrary, *P. rustica*'s protruding tooth is 3 pieced (Öztürk and Ergen,1999). One piece of protruding tooth is smaller compared to the other two, and the middle protrusion is the longest one. These characteristics are important in the identification of *P. caerulea*.

The length of radula in *P. caerulea* (RL) varied between 20.4-41.1 mm, with an average length of 27.48mm. While the average shell length (SL) was 26.41mm, it changed between 19.0-39.0 mm. RL/SL ratio changed between 0.94-1.08, its average being as 1.04. The width of shell (SW) was 22.32 mm on average, and changed between 15.0 mm and 33.0 mm. While the average shell height (SH) was 7.36 mm, it changed between 5.0-11.0 mm (Table 1).

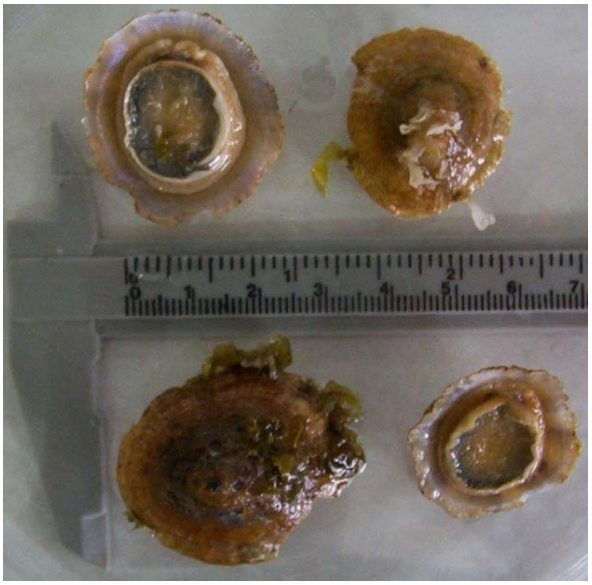

Figure 2. The appearence of *P. caerulea*

Patella rustica Linnaeus, 1758

11.11% of the samples collected were *P. rustica* individuals. This species is found in supralittoral zone. The individuals of this species were found 50 cm above the sea level. It was observed that they mostly settled between 50mm and 80cm.

In *P. rustica* radulas, the bottom of 1. lateral tooth attached to radula was curved**.** Protruding tooth of *P. rustica* was 2 pieced. Because of this characteristic, it can be easily distinguished from the other *Patella* species (Öztürk and Ergen, 1999). One of its pieces was longer than the other and these characteristics are significant in the identification of *P. rustica*. It was found that *P. rustica* shells were more conical and higher.

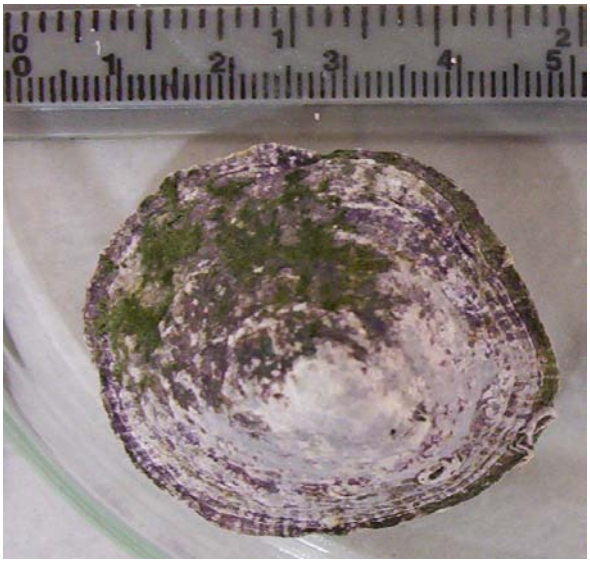

Figure 3. The general appearence of *P. rustica*

RL of *P. rustica* changed between 42.7-85.3 mm, with an average of 66.86 mm. The average SL was 32.96 mm, and it varied between 21.0-42.5 mm. RL/SL ratio was between 1.97-2.08, averaging to 2.03. While SW was 28.36 mm on average, it changed between 18.0-37.0 mm. SH was 12.5 mm on average, and it varied between 7.0-16.0 mm (Table 1).

It was found that whereas *P. caerulea* distributed in upper infralittoral and mediolittoral zone, *P. rustica* lived in supralitoral zone. The identified vertical distribution of these species showed similarities with the results of Ayas *et al*., (2008), Navaro *et al*., (2005) and Della Santina *et al.*, (1993). *P. caerulea* population (%88.89) were more dominant than *P. rustica* population (%11.11). In their habitats which was also shown by Ayas *et al*., (2008) and Öztürk and Ergen (1999).

Shell height of *P. rustica* individuals were bigger than *P. caerulea* individuals. SH of *P. caerulea* which lived above the sea level was more than the ones living below the sea level. These findings are similar to the results of Öztürk and Ergen's (1999) study. According to Öztürk and Ergen (1999), Orton (1929) and Gamulin-Brida (1974), in animals living in dry habitats, longer shell was an adaptive characteristic against dehydration. The fact that *P. rustica* live higher above the sea level than *P. caerulea* explains why their shell is higher. Similarly, the fact that *P. caerulea* which are not directly related to the sea water have more conical and higher shell is an adaptive characteristic to dry habitats. As these two species living on Viranşehir anthropogenic rocks have different shell heights for adaptive reasons, it was found that this could not be used in the identification of species. Mauro *et al.*, (2003) stated that the species belonging to *Patella* genus showed morphological changes because of environmental factors, and that is why shell shape and color could not be used in the differentiation of patellid species.

Conclusion

It was concluded that RL/SL could be used in the differentiation of the species. However, as ecological conditions cause changes in patellids morphometric characteristics, it can be suggested that radula teeth should also be used with RL/SL ratios in the identification of species.

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