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SHORT COMMUNICATION KISA MAKALE

Circulus (Mollusca-Gastropoda) species of the Turkish coasts with a note on the presence of *Circulus octoliratus* (Carpenter, 1856)

Türkiye kıyılarının *Circulus* (Mollusca-Gastropoda) türleri ve *Circulus octoliratus* (Carpenter, 1856)'un bulunuşu hakkında bir bilgi notu

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Abstract: The present study is dealing with three *Circulus* species recorded along the Turkish coasts (İskenderun Bay, Levantine coast of Türkiye). Of the identified species, *Circulus novemcarinatus* and *Circulus octoliratus* are non-indigenous species originated outside the Mediterranean Sea, whereas *Circulus striatus* is a native one distributed in the eastern Atlantic Ocean and Mediterranean Sea. While *Circulus novemcarinatus* was recorded at depths between 9 and 60 m, *Circulus octoliratus* and *Circulus striatus* were encountered at shallow depths (5-11.7 m, respectively). Within the present study some morphological and distributional characteristics of the investigated species are described.

Keywords: *Circulus*, Gastropoda, morphology, distribution, İskenderun Bay, Türkiye

Öz: Bu çalışmada Türkiye kıyılarından (İskenderun Körfezi) örneklenen *Circulus* türleri konu edilmektedir. Tayin edilen türlerden *Circulus novemcarinatus* ve *Circulus octoliratus* yabancı kökenli türler olup, *Circulus striatus* ise yerli türdür ve Doğu Atlantik Okyanusu-Akdeniz dağılımlıdır. *Circulus novemcarinatus* 9-60 m arasındaki derinliklerde bulunmuş olmasına karşın, *Circulus octoliratus* ve *Circulus striatus* sığ derinliklerden örneklenmişlerdir (sırasıyla 5 ve 11,7 m). Bu çalışmada, incelenen türlerin bazı morfolojik ve dağılım özellikleri ele alınmıştır.

Anahtar kelimeler: *Circulus*, Gastropoda, morfoloji, dağılım, İskenderun Körfezi, Türkiye

INTRODUCTION

The genus *Circulus* was established as a subgenus of *Trochus* with type species *Delphinula duminyi* Requien, 1848 (=*Valvata striata* Philippi, 1836) (Jeffreys, 1865). The representatives of the genus are rather small molluscs having a shell with smooth multispiral protoconch and a circular, flat teleoconch with a wide and deep umbilicus. On the whorls there are spiral cords only, of which some are prominent and forming keels. The genus was described in detail by Oliver and Rolán (2011).

In the studies carried out in the past (Fretter and Graham, 1962; Oliver and Rolán, 2011), the genus *Circulus* was investigated within the family Tornidae (subfamily Circulinae) than it was moved in the family Vitrinellidae (WoRMS, 2022), which taxon was upgraded to family rank in the work by Bouchet et al. (2017).

The present study is focusing on the morphologic and distributional features of three *Circulus* species recorded along the Turkish coasts.

MATERIAL AND METHODS

In the past two decades, various cruises and research projects were performed in different areas along the Turkish coasts and a large amount of benthic materials were collected. Among the sampled materials from İskenderun Bay (Levantine coast of Türkiye) some *Circulus* specimens were found, which are dealing with herein (Figure 1).

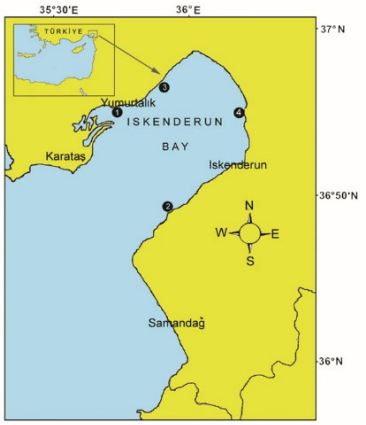

Figure 1. Map of the area where the investigated specimens were sampled

The material was sampled with a Van Veen Grab at depths between 5 and 60 m on soft bottoms. The specimens belonging to different species were deposited in the museum of the Faculty of Fisheries at Ege University (ESFM), (İzmir-Türkiye).

RESULTS AND DISCUSSION

SYSTEMATICS

Order: Littorinimorpha Golikov and Starobogatov, 1975

Family: Vitrinellidae Bush, 1897

Genus: *Circulus* Jeffreys, 1865

Circulus novemcarinatus (Melvill, 1906) (Figure 2)

Cyclostrema novemcarinatum; Melvill, 1906: 22, pl. 3, fig. 3, 3a (*original description*).

Circulus novemcarinatus; Janssen et al., 2011: 421, pl. 18, fig.1.

Lodderia novemcarinata; Bosch et al., 1995: 38, fig. 64.

Lodderia novemcarinata; Öztürk et al., 2015: 207, fig. 2.

Materials: Sta. 1, 11.07.2010, 9 m, sandy mud, 2 spm (ESFM-GAS/2010-48); Sta. 1, 02.07.2014, 9 m, sandy mud, 3 spm (ESFM-GAS/2014-7); Sta. 2, 07.09.2019, 60 m, mud with shell fragments, 2 spm (ESFM-GAS/2019-14).

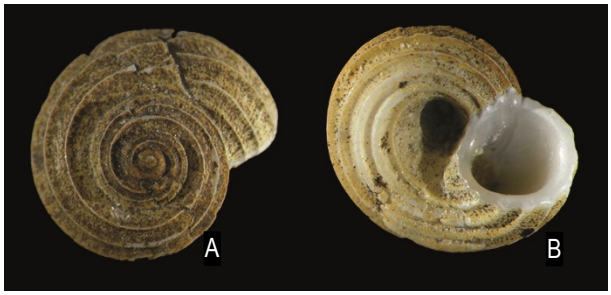

Figure 2. *Circulus novemcarinatus*: dorsal and ventral views of a specimen (d_A=d_B=5.1 mm, sandy mud, 9 m)

The type locality of the species is Gulf of Oman (Melvill, 1906) and since 2010 *Circulus novemcarinatus* is known to be distributed also in the Mediterranean Sea (Öztürk et al., 2015). Among the *Circulus* species encountered along the Turkish coasts, *C. novemcarinatus* is characteristic with its shell much stronger and more acute spiral carinae (keel), and more evident growth striae between the spiral ribs. The first record of the species from the Mediterranean Sea is based on the work by Öztürk et al. (2015) where the species was investigated in detail.

Circulus novemcarinatus is a non-indigenous species distributed in Gulf of Oman, Persian Gulf, Arabian Sea and Red Sea (Bosch et al., 1995; Janssen et al., 2011) and Mediterranean Sea (Öztürk et al., 2015). The species is considered among the established alien taxa being sampled multiple times.

Circulus octoliratus (Carpenter, 1856) (Figure 3)

Cyclostrema octolirata Carpenter, 1856: 169, with type locality Red Sea.

Circulus octoliratus (Carpenter, 1856); Janssen et al., 2011: 422, pl. 18, fig. 2.

Circulus octoliratus (Carpenter, 1856); Ovalis and Mifsud, 2019: 267-270, figs. 1 A-C.

Material: Sta. 3, 11.07.2018, 7.3 m, sand, 1 spm (36°51'22"N-35°54'57"E) (ESFM-GAS/2018-13).

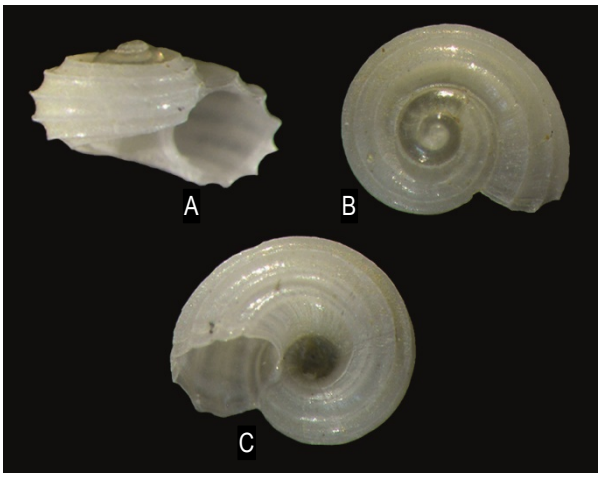

Figure 3. *Circulus octoliratus*: different views of the sampled specimen (A=B=C; h=0.5 mm; d=1.5 mm)

The type locality of the species is the Red Sea and it was described as *Cyclostrema octolirata* by Carpenter (1856). Then, Janssen et al. (2011) also recorded it from the same locality and indicated that the species was common in several localities in the Red Sea. Janssen et al. (2011), also mention of some specimens from Philippinnes identical to *C. octoliratus*. The species most probably entered into the Mediterranean via the Suez Canal, and was first recorded from Taşucu in August 2018 (Turkish Levantine coast) and published by Ovalis and Mifsud (2019). During marine sediment surveys carried out near Haydar Aliev pipeline terminal jetty at Ceyhan (İskenderun Bay, Levantine Sea) in July 2018, a single specimen of the species was found in a sandy biotope at a depth of 7.3 m.

Circulus octoliratus is characteristic with a shell consisting nearly of body whorl. Protoconch multispiral and smooth. The transition scar to the teleoconch is evident. Teleoconch circular and flat, with a wide and deep umbilicus. On the last whorl there are eight spiral cords of which the subsutural one overlaps the suture. Inside of umbilicus longitudinally striated. White in colour.

Circulus octoliratus is distributed in the Red Sea and Philippines (Janssen et al., 2011). In the Mediterranean, the

first recorded locality of *Circulus octoliratus* should be İskenderun Bay (July 2018) instead of Taşucu (August 2018).

Circulus striatus (Philippi, 1836) (Figure 4)

Delphinula duminyi; Requien, 1848: 64.

Circulus costulatus; Locard, 1889: 283-307.

Skeneia striatula; Weinkauff,1862: 301-371, pl.13, figs 7-9.

Materials: Sta. 4, 14.09.2005, 5 m, sand, 1 spm (ESFM-GAS/2005-150); Sta. 3, 04.08.2013, 7.3 m, sand, 1 spm (ESFM-GAS/2013-211); Sta. 3, 02.07.2014, 11.7 m, sandy mud, 1 spm (ESFM-GAS/2014-134).

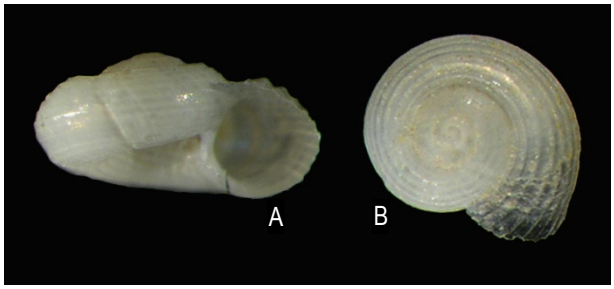

Figure 4. *Circulus striatus*: ventral and dorsal views of the recorded specimen (A=B; h=0.7 mm; d=1.3 mm)

Shell flat with about 3.5-4.0 convex teleoconch whorls. Body whorl is about 90 % of the shell. Spire small and looks like a bulge on the last whorl. Protoconch multispiral, smooth, with no ornamentation and its end is less obvious. On the whorls there are spiral cords not forming keels and they are as width as the half of the interspaces. Umbilical side is almost smooth or with less evident spiral cords. Aperture circular. Umbilicus wide and deep with four or five umbilical cords. Operculum corneous and rounded. The species was investigated in detail by Oliver and Rolan (2011).

Circulus striatus is distinguished from the other congeneric species distributed in the Mediterranean by having spiral cords, not keels. The species is distributed in the eastern Atlantic Ocean and Mediterranean Sea (Oliver and Rolan, 2011). Along the Turkish coasts it was previously recorded from the Levantine Sea (Bitlis et al., 2012), Aegean Sea (Demir, 2003) and Sea of Marmara (Oberling, 1969-1971).

In the world ocean, although is known to be distributed 233 *Circulus* species, only three species were reported from the Mediterranean Sea up to date, of which *Circulus novemcarinatus* and *Circulus octoliratus* are alien species originated outside the Mediterranean Sea. *C. novemcarinatus* is considered among the established species, whereas *Circulus octoliratus*, after a fresh shell recorded by Ovalis and Mifsud (2019) in Taşucu, some empty shells were also found on Israeli coast by Edelman-Furstenberg et al. (2020). With record of an alive specimen from İskenderun Bay, the species can be considered among the established alien species.

CONCLUSION

Consequently, in the last decades, although, a large quantity of soft benthic material was studied from the Turkish coasts and the selecting process have been made under stereomicroscope, a few *Circulus* specimens were found only. This fact suggests that, in addition to their very small size, the population density of the genus representatives may be also low, especially in the eastern Mediterranean basin.

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AUTHOR CONTRIBUTIONS

Bilal Öztürk: Designing of the study, identification of the investigated species, writing of the draft, submission, writing-review and editing. Banu Bitlis: Designing of the study, sorting the materials into taxonomic groups and checking the original draft. Neslihan Türkçü: Sorting the materials into taxonomic groups and checking the original draft.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest or competing interests.

ETHICS APPROVAL

No specific ethical approval was necessary for the study.

DATA AVAILABILITY

For any questions the corresponding author should be contacted.

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