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## Distribution of *Pararotalia calcariformata* McCulloch on the Turkish coastline

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### Abstract

Benthic foraminiferal assemblages were investigated in 28 surface samples taken from the south-eastern Mediterranean coast of Turkey. Alien species *Edentostomina cultrata* (Brady), *Pyrgo denticulata* (Brady), *Articulina alticostata* Cushman, *Sorites orbiculus* (Forskål), *Bulimina biserialis* Millett, *Cymbaloporeta plana* (Cushman), *Amphistegina lobifera* Larsen and *Pararotalia calcariformata* McCulloch, which are originated from the Indo-Pacific were recorded in the samples.

**Keywords:** Benthic foraminifera, surface sediments, shallow water, Gulf of Mersin, Turkey.

### Introduction

Sixty-eight alien foraminifers were recorded in the Mediterranean (Zenotos et al., 2012). *Pararotalia calcariformata* McCulloch was newly added to the alien species list of the Mediterranean and first described from the infralittoral ecosystem of the north-eastern Mediterranean (Meriç et al., 2013). The identification of the species in the eastern Mediterranean has been confusing, due to the morphologic variabilities. The earliest records were reported as *Eponides repandus* (Fichtel and Moll) (Yanko et al., 1994) and *Pararotalia spinigera* Le Calvez (Avşar and Yanko, 1995; Bresler and Yanko, 1995; Yanko et al., 1998; Avşar, 2002; Meriç et al., 2004; Hyams-Kaphzen et al., 2008; Arieli et al. 2011). After Meriç et al. (2013), the species were referred as *Pararotalia calcariformata* (Hyams-Kaphzen et al., 2014; Schmidt, 2015; Schmidt et al., 2015; Titelboim, 2017). Furthermore, living specimens of *Pararotalia calcariformata* were cultured under nature conditions and the relationship between the Indo-Pacific and Mediterranean specimens was confirmed based

on taxonomic and genetic investigations (Schmidt, 2015).

*Pararotalia calcariformata* has been previously reported from various regions in Turkey (Figure 1). The main objective of the present study is to determine its distribution along the Turkish coastline.

### Material and Method

In the Gulf of Mersin, twenty-eight grab samples were collected from three transects which are parallel to the coastline between Deliçay and Tarsus streams (Figure 1). The depths of the transects were between 4 and 15 m. The samples were dried at 50 °C. For sub-sampling, 5 g of dry sediment was weighed, soaked in 10% H<sub>2</sub>O<sub>2</sub> for about 24 hours and then washed on a 63 µm sieve. The residues were dried at 50 °C and sieved through 125, 250, 500, 1000 and 2000 µm sieves. Benthic foraminiferal taxa were examined separately in each sieve fraction using a binocular microscope.

Data were extracted from previously published studies, in which *Pararotalia calcariformata*

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have been reported, to figure out its distribution along the Turkish coastline.

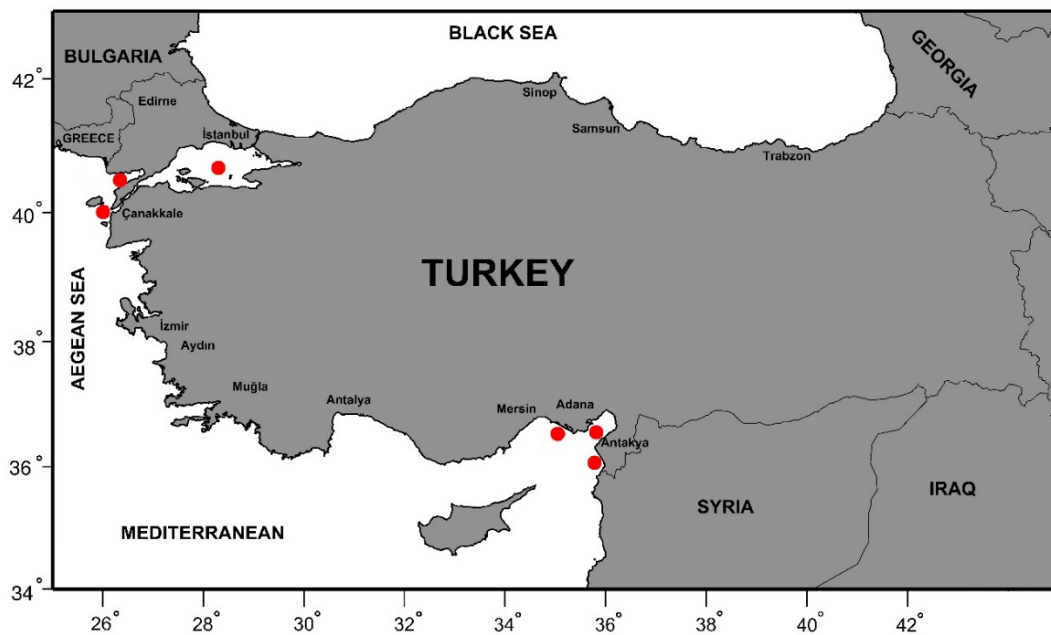


Fig. 1. Records of *Pararotalia calcariformata* McCulloch along the Turkish coastline.

## Results and Discussion

*Pararotalia calcariformata* McCulloch were observed in 12 samples out of 28 sediment samples from Mersin (Figure 2). The foraminiferal fauna of the study area have been found to be highly diverse, but the population densities were low (Meriç et al., 2012). A total of 64 benthic foraminiferal species belonging to 39 genera have been previously identified. Besides *Pararotalia calcariformata*, the most common species observed were *Adelosina cliarensis* (Heron-Allen and Earland), *Triloculina marioni* Schlumberger, *Bulimina elongata* d'Orbigny, *Ammonia parkinsoniana* (d'Orbigny), *A. tepida* Cushman, *Criboelphidium poeyanum* (d'Orbigny) and *Elphidium advenum* Cushman (Meriç et al., 2012). Except *Pararotalia calcariformata*, seven Indo-Pacific originated species, *Edentostomina cultrata* (Brady), *Pyrgo denticulata* (Brady) *Articulina alticostata* Cushman, *Sorites orbiculus* (Forskål), *Bulimina biserialis* Millett, *Cymbaloporetta plana* (Cushman) and *Amphistegina lobifera* Larsen have also been observed.

*Pararotalia calcariformata* has been first observed along the Israeli coasts in the Mediterranean and its abundance in the area suggests that it has been introduced to Israel in the Eastern Mediterranean (Yanko et al., 1994). However, its absence in the Red Sea (no records were found until now) indicates that it might have been transported via ballast waters or attached to vessels visiting the Israeli coasts. It has been commonly observed on the Levantine coasts (Yanko et al., 1994; Avşar and Yanko, 1995; Bresler and Yanko, 1995; Avşar, 2002; Hyams-Kamphzen et al., 2008, Arieli et al., 2011; Meriç et al., 2012; Hyams-Kamphzen et al., 2014; Schmidt, 2015; Öviz, et al., 2015; Schmidt et al., 2015; Simav et al., 2015; Gazioğlu, 2013, 2018) and has also been reported from the northern Aegean Sea (Avşar, 2002; Meriç et al., 2004) and Sea of Marmara (Kırcı-Elmas and Meriç, 2016).

Based on the distribution pattern and recent records of the species, it seems to be dispersed northwards in the eastern Mediterranean and then westwards along the Turkish coasts, following the surface currents, finally reaching the northern Aegean (Figure 3). Considering

the directions of the upper layer and lower layer currents in the Turkish Strait System (Ünlüata et al., 1990; Gazioglu et al., 2002), it is more probable that *Pararotalia calcariformata* is entered the Sea of Marmara via the lower layer

current which carries the more saline waters of the Mediterranean through the Dardanelles into the Sea of Marmara

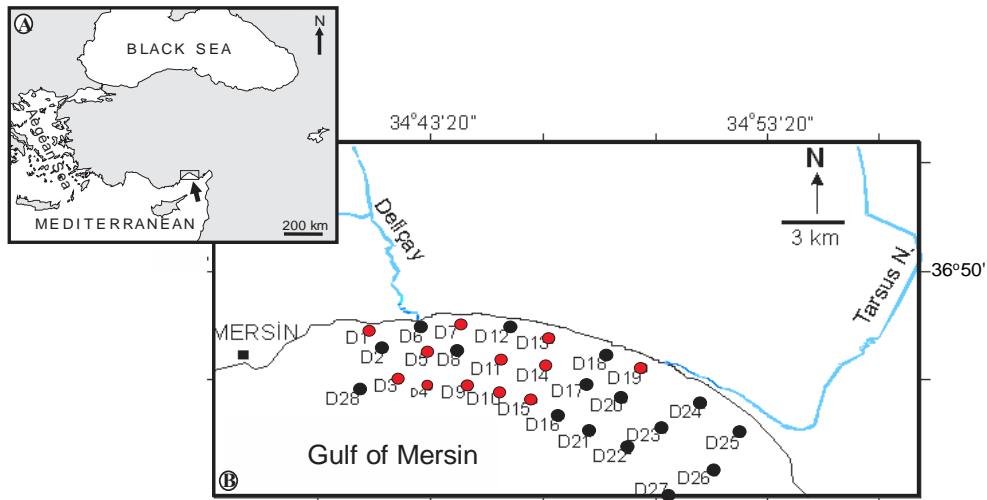


Figure 2. A. Map of the study area in Mersin. B. Locations of surface sediment samples. Red circles indicate that the sample contains *Pararotalia calcariformata* McCulloch.

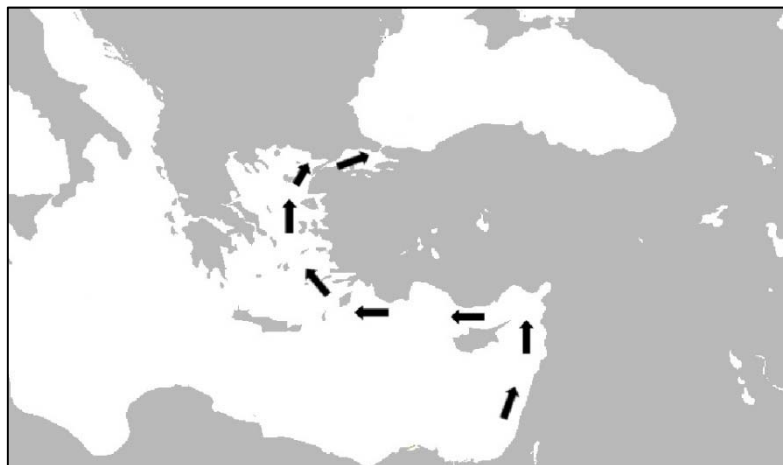


Figure 3. Probable dispersion pathway of *Pararotalia calcariformata* McCulloch in the eastern Mediterranean (modified from Meriç et al., 2015; Okuş et al., 2004-2006).

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