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Update on the burrowing shrimps (Axiidea and Gebiidea) of the Persian Gulf and Gulf of Oman, Iran including first finding of *Corallianassa martensi* (Miers, 1884) in Iranian waters

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Abstract

An annotated checklist of the extant burrowing shrimps (infraorders Axiidea and Gebiidea) of southern waters of Iran is presented for the first time. Six species of Gebiidea and 18 species of Axiidea have been documented from the southern waters of Iran, based on published literature. The species belong to six families: Upogebiidae (6 species), Axiidae (1), Callianassidae (5), Callianideidae (1), Callichiridae (9) and Ctenochelidae (2). The Persian Gulf with 18 species appears to be more diverse than the Gulf of Oman with four species, and two species are common in the both gulfs. *Corallianassa martensi* (Miers, 1884) is recorded for the first time across the Iranian coast. The present finding is based on specimens collected from the Chabahar, Gulf of Oman coast. A brief diagnosis and illustrations of *C. martensi* are provided.

Key words: Marine biodiversity, Persian Gulf, Crustacean taxonomy, Decapoda, Iran

Introduction

The Persian Gulf and Gulf of Oman are among some of the most important coastal areas in the world due to the high volume of oil transported through them. Despite its political importance, however, they suffer from numerous environmental problems. Monitoring and documenting the biodiversity along the coasts of the Persian Gulf is very important since the area is under extreme pressure due to natural and anthropogenic factors including: oil spills, coastal development, urban sewage, burgeoning tourism, sedimentation, agriculture fertilizers, immigration of invasive species, and global warming (Khan, 2008; Krupp and Abuzinada, 2008). The intertidal zone of the Persian Gulf and Gulf of Oman comprises habitats such as mangroves, sandy-mud, muddy, sandy, rocky and muddy-sand shores dominated by mollusk shells and shell fragments. These diverse habitats provide a suitable environment for a wide variety of organisms adapted for a fossorial lifestyle, such as the so-called ‘ghost shrimps’, ‘mud shrimps’ or preferably ‘burrowing shrimps’ of the infraorder Axiidea de Saint Laurent, 1979 and Gebiidea de Saint Laurent, 1979. Species are the fundamental unit of biodiversity (Mayr, 1982); and therefore, a proper checklist of species in each region is vital. The first comprehensive study on burrowing shrimps of the Persian Gulf and Gulf of Oman was carried out by Sepahvand et al. (2013) which documented 13 species in this group of cryptic

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decapods. Sakai (2002; 2005) and Dworschak (2009) reported species of burrowing shrimps from the Persian Gulf but more recently Sepahvand et al. (2015; 2016; 2018a, b) have identified more species, using molecular and morphological approaches.

The classification of burrowing shrimps has been subject to much controversy in the recent decade (see Felder and Robles, 2009; Robles et al., 2009; Poore et al., 2019). In a recent phylogenetic study on Callianassidae and related families by Poore et al. (2019), seven families were recognized.

Here, we provide a comprehensive and updated review on burrowing shrimps (Axiidea and Gebiidea) of the Persian Gulf and Gulf of Oman. In addition, we reported the first finding of the burrowing shrimp *Corallianassa martensi* (Miers, 1884) from Chabahar, Gulf of Oman, Iran. The aim of this checklist is to provide a baseline that should be of value for future environmental studies in the regions as well as stimulating further regional work on the taxonomy and biodiversity of Iran.

Material and Methods

Specimens of the new record were collected from intertidal, sandy-muddy substrates with boulders from Chabahar, located on the coast of the Gulf of Oman (25°21′25″N; 60°36′17″E). A lever was used for lifting boulders or splitting the layered rocks to expose the specimens.

The examined material for this study is deposited in the Iranian National Institute for Oceanography Collection (INIOC).

Results

According to our review of the literature and new records of burrowing shrimps, five families of Axiidea [Axiidae Huxley, 1879 (one species), Callianassidae Dana 1852 (5 species), Callianideidae Kossmann, 1880 (one species), Callichiridae Manning and Felder, 1991 (nine species), Ctenochelidae Manning and Felder, 1991 (two species)] and one of Gebiidea [Upogebiidae Borradaile, 1903 (six species)] have representatives recorded along the southern coast of Iran. With this new record for *Corallianassa martensi*, presented herein, a total of 24 species of burrowing shrimps is recorded from the Persian Gulf and Gulf of Oman (Table 1).

Systematic account

Order Decapoda Latreille, 1802
Infraorder Axiidea de Saint Laurent, 1979
Family Callianassidae Dana, 1852
Corallianassa Manning, 1987
Corallianassa martensi (Miers, 1884) (Figs. 1 and 2)

Restricted Synonymy

Callianassa martensi Miers, 1884: 13–15, pl. 1 fig. 1 [type locality: Mauritius].
Corallianassa martensi - Dworschak, 2014: 233, figs. 2, 10c. - Komai et al. 2015: 40–51, figs 14–19, 20D-F (complete synonymy).
Material examined: 1 ovigerous female (INIOC2-110) (TL: 75 mm, CL: 15 mm).

Coloration in life: Body generally yellowish translucent; carapace whitish with tinge of yellowish on rostrum to post-rostral area and transverse band of similar color medially on dorsal oval. Cornea dark. Chelae and carpi of chelipeds mottled with white and yellow-brown; merus with tinge of yellow-brown dorso-distally.

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Remarks: *Corallianassa martensi* was described from Mauritius by Miers (1884) on the basis of a single male specimen. The species is widely distributed in the Indo-West Pacific (Komai et al., 2015) but the only previous record from the Middle East was by Tirmizi (1974) who recorded it from the northern Arabian Sea.

The specimens from Gulf of Oman agree well with the re-descriptions by Dworschak (2014) and Komai et al. (2015). The color of the Oman specimen agrees well with figure 20 from Komai et al. (2015). *Corallianassa martensi* is distinguishable from other species of this genus in Iran. For example, *Corallianassa coutierei* (Nobili, 1904) has unarmed ischium and merus of the large cheliped and an unarmed third maxilliped and fourth pereopod. The propodus of the minor cheliped of *C. martensi* is longer than the carpus, the dactylus is longer than the carpus, and the cutting edge of the fixed finger is unarmed except for a single triangular tooth located medially. These characters are predominantly in contrast to those described for *C. martensi* by Dworschak (2014) and Komai et al. (2015). Telson (Fig. 2A) about 1.4 times wider than long, subtrapezoidal, broadest at base; posterolateral corners obtusely angular, each bearing tuft of long setae; dorsal surface anteromedially elevated, posterior margin of this median elevation forming blunt ridge bearing median cluster of very short stiff setae flanked by clusters of long stiff setae; lateral margins slightly sinuous, unarmed. Uropodal endopod (Fig. 2B) lanceolate, longer than telson, more than twice as long as wide; uropodal exopod (Fig. 2B) with strongly elevated dorsal plate, almost twice endopod length.

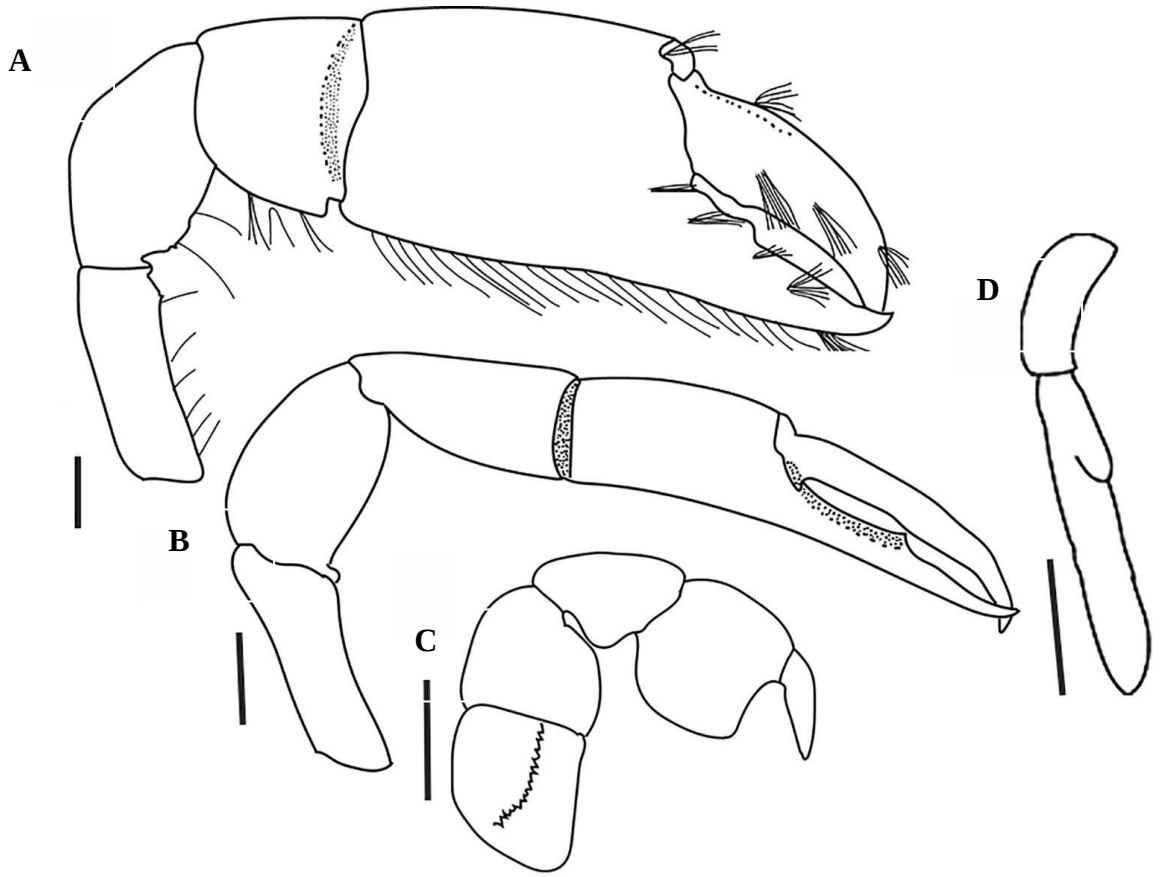

Figure 1: *Corallianassa martensi* (Miers, 1884); female (INIOC2-110), cl: 15 mm, from Gulf of Oman, Iran. Female larger cheliped, outer view (A), female minor cheliped, outer view (B), third maxilliped, inner view (C), and female first pleopod, mesial view (D). Scale bar = 1 mm.

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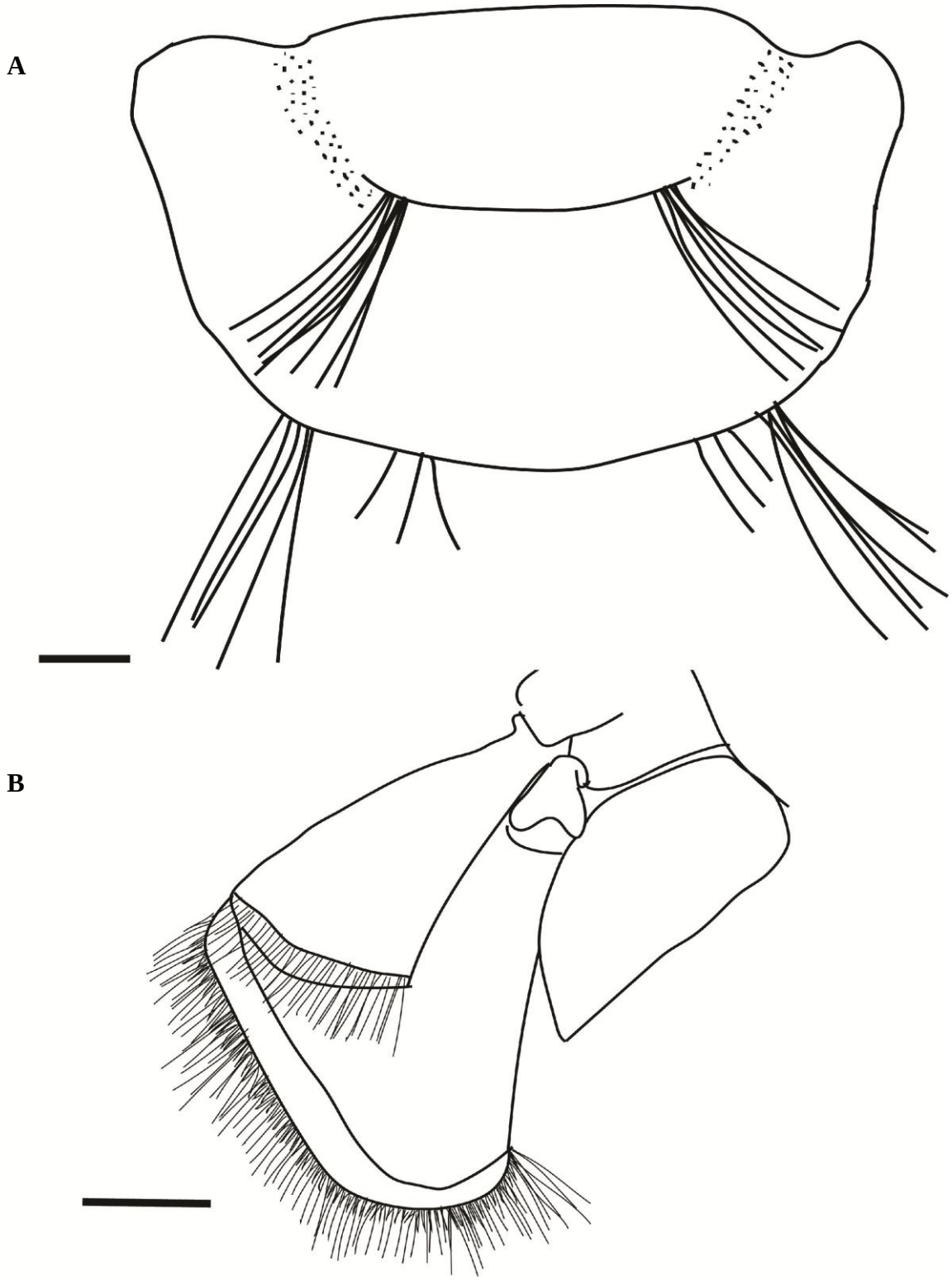

Figure 2: *Corallianassa martensi* (Miers, 1884); female (INIOC2-110), cl: 15 mm, from Gulf of Oman, Iran. Outer view of female telson (A), and female uropod (B). Scale bar = 1 mm.

Discussion

Twenty-four species of burrowing shrimps have now been recorded from the Persian Gulf and Gulf of Oman, 18 in Axiidea and six in Gebiidea (Table 1).

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Table 1: Records of burrowing shrimps (Axiidea and Gebiidea) collected from the Persian Gulf and Gulf of Oman.

Infraorder	Family	Species	Location and Reference(s)
Axiidea	Axiidae (1)	*Calocarides longispinis* (McArdle, 1901)	Persian Gulf (Sakai, 2011)
	Callianassidae (5)	*Aqaballianassa ehsani* (Sepahvand, Tudge and Momtazi, 2018)	Persian Gulf (Sepahvand et al., 2018b)
		Aqaballianassa thorsoni (Sakai, 2005)	Persian Gulf (Sakai, 2005)
		Callianassa persica Sakai, 2005	Persian Gulf (Sakai, 2005)
		Paratrypaea bouvieri (Nobili, 1904)	Gulf of Oman (Sepahvand et al., 2013)
		Pugnatrypaea iranica (Sepahvand, Momtazi and Tudge, 2015)	Persian Gulf (Sepahvand et al., 2015)
	Callianideidae (1)	*Callianidea typa* H. Milne Edwards, 1837	Persian Gulf (Sepahvand et al., 2013)
	Callichiridae (9)	*Balsscallichirus masoomi* (Tirmizi, 1970)	Persian Gulf (Sepahvand et al., 2013)
		Corallianassa coutierei (Nobili, 1904)	Gulf of Oman (Sepahvand et al., 2013)
		Corallianassa martensi (Miers, 1884)	Gulf of Oman (present study)
		Michaelcallianassa indica Sakai, 2002	Persian Gulf (Sakai, 2002; Sepahvand et al., 2013)
		Mucrollichirus mucronatus (Strahl, 1862)	Persian Gulf (Sepahvand et al., 2013)
		Neocallichirus calmani (Nobili, 1904)	Persian Gulf, Gulf of Oman (Sakai, 2005)
		Neocallichirus darvishi Sepahvand, Komai, Momtazi and Shahabi, 2018	Persian Gulf (Sepahvand et al., 2018a)
		Neocallichirus jousseaumei (Nobili, 1904)	Persian Gulf, Gulf of Oman (Sepahvand et al., 2013)
		Neocallichirus manningi Kazmi and Kazmi, 1992	Gulf of Oman (Sepahvand et al., 2013, Sepahvand et al., 2018a)
	Ctenochelidae (2)	*Gourretia qeshmensis* Sepahvand, Rastegar-Pouyani and Momtazi, 2016	Persian Gulf (Sepahvand et al., 2016)
		Paragourretia coolibah (Poore and Griffin, 1979)	Persian Gulf (Dworschak, 2009; Sepahvand et al., 2013)
Gebiidea	Upogebiidae (6)	*Austinogebia spinifrons* (Haswell, 1881)	Persian Gulf (Dworschak, 2009)
		Neogebicula cf. *wistari* Ngoc-Ho, 1995	Persian Gulf (Dworschak, 2009)
		Upogebia carinicauda (Stimpson, 1860)	Persian Gulf (Sakai, 1982; Sepahvand et al., 2013)
		Upogebia darwinii (Miers, 1884)	Persian Gulf (Sakai, 1982; Sepahvand et al., 2013)
		Upogebia pseudochelata Tattersal, 1921	Persian Gulf (Sakai, 1982; Sepahvand et al., 2013)
		Upogebia savignyi (Strahl, 1862)	Persian Gulf (Sakai, 1982; Sepahvand et al., 2013)

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Only one record is new for the region. The others have been recorded from few localities. Five species, *Neocallichirus darvishi* Sepahvand, Komai, Momtazi and Shahabi, 2018; *Aqaballianassa ehsani* (Sepahvand, Tudge and Momtazi, 2018); *Pugnatrypaea iranica* (Sepahvand, Momtazi and Tudge, 2015); *Callianassa persica* Sakai, 2005 and *Gourretia qeshmensis* Sepahvand, Rastegar-Pouyani and Momtazi, 2016 are only known from the Persian Gulf and Gulf of Oman, their type localities. The remaining 19 species have a wider distribution across the Indo-West Pacific.

The Persian Gulf with 18 species is more diverse than the Gulf of Oman with four species, correlating with its longer coastline and more diverse habitat types (Sepahvand et al., 2013). In addition to the limited sampling of the Gulf of Oman, differences in species composition are most likely related to biological parameters and physical oceanography. Despite several attempts, no burrowing shrimps were found along the entire coast of the northwest Persian Gulf (including Khuzestan and the eastern part of Bushehr Provinces) possibly due to the degraded nature of the habitat including a dominance of very soft sediments, higher salinity and/or pollution. In the present study, six species of Upogebiidae were found on the Persian Gulf coast but no upogebiids were recorded from the Iranian coast of the Gulf of Oman. This might be related to the rough wave action of the exposed shores with a scarcity of soft sediment, which is crucial for burrow construction, and lining of the burrow walls in these species.

The Persian Gulf has a similar number of species to other regions in the Indian Ocean. For instance, the Red Sea, with an area of 438,000 km^2, has 29 recorded burrowing shrimp species (Sakai et al., 2014), while the Persian Gulf (at 251,000 km^2), is slightly larger than half the Red Sea, has 19 species. This occurs in spite of the generally harsh environmental conditions of the Persian Gulf, i.e. high salinity and fluctuating temperatures (Jones, 1986; Sheppard et al., 1992).

The present material helps to better understand distributional patterns, as the Iranian coast stretches from the west to the east. It would be premature to draw firm conclusions from the limited material here reported but two issues deserve note. The first is that the species richness in the northern Persian Gulf and Gulf of Oman seems to be higher than that in the south and a second observation is that most species recorded during the last years are in the intertidal zones (see Sepahvand et al., 2013; 2016; 2018a, b), although collection bias cannot be ruled out in this latter issue.

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