

## Checklist of sea spiders (Arthropoda: Pycnogonida) from the Persian Gulf and the Gulf of Oman with new record of *Endeis biseriata* (Böhm, 1879) for the region

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**Abstract:** This is the first record of a pycnogonid for the Iranian coast. It is also the first record of an *Endeis*, and of *Endeis biseriata*, for the waters of the Gulf of Oman. A single specimen was collected in an algal bed of *Padina* sp., along Chabahar Bay, in February 2017. It is deposited in the Zoology Museum of the University of Hormozgan. *E. biseriata* is probably a native Indo-Pacific species that now has a wide world distribution, being probably pantropical. Morphological and ecological notes, as well as the distribution range of *E. biseriata* and a checklist of the species of Pycnogonida from the region, are also provided.

**Key words:** Pantopoda, shallow water, benthic, algae

The Gulf of Oman is located between the Persian Gulf and Arabian Sea. The surface of the gulf is about 94,000 m<sup>2</sup>. Based on the International Hydrographic Organization, it is defined in the western part by an imaginary line running from Minab, in Iranian waters (north limitation), to Qabr al-Hindi, in the coastal waters of Oman (south limitation). In the eastern part it is limited from Ras Jiwani, on the border of Iran and Pakistan (in the north), to Ras al-Hadd, on the Oman coast (in the south). The Gulf of Oman is a deep area that reaches to 3000 m in its deepest part (in the east) (Reynolds, 1993).

Salinity and monsoons are the most important factors in the gulf that can affect physical and biological factors (such as temperature and biodiversity) in the area. The monsoons bring southwardly blowing cool winds in summer and northwardly blowing winds in winter. For this reason, the temperature is balanced between 22 and 31 °C (Reynolds, 1993; Piontkovski et al., 2012). Salinity can reach 37 psu in the area (Reynolds, 1993). A wide variety of habitats can be found in the intertidal region of the Gulf of Oman, such as muddy-sandy habitats in sheltered areas to sandy and rocky shores in the high-energy region (Naderloo, 2017). A high diversity of marine algae covers the coastal waters of the Gulf of Oman (Sohrabipour and Rabiei, 2007; Gharanjik and Rohani-Ghadikolaei, 2010). For this reason, we can conclude that a high diversity of marine animals inhabit the gulf. Until 2018 about 33,400

species of animals had been recorded from the Persian Gulf and the Gulf of Oman (Maghsoudlou et al., 2017).

There are more than 1400 pycnogonid species in the world that can be found on shorelines down to deep water in different habitats from tropical to polar waters (Lucena et al., 2015; Brenneis et al., 2017). The genus *Endeis* Philippi, 1843, belonging to the family Endeidae Norman, 1908, is a cosmopolitan genus, most often recorded in shallow waters. It currently possesses 18 valid species (<http://www.marinespecies.org/aphia.php?p=taxdetails&id=134588>). Because of the great similarity among the species of *Endeis* (Fry and Hedgpeth, 1969), it is a challenging task to identify a single specimen to the species level (Child, 1992). Females of this genus are especially very difficult to separate when not accompanied by the males (Stock, 1968; Clark, 1973). This is probably one of the genera most in need of revision among the pycnogonids (Marcus, 1940; Müller and Krapp, 2009).

To date, there is no record of this genus for the Persian Gulf and the Gulf of Oman. Two species, *Endeis meridionalis* (Böhm, 1879) and *E. mollis* (Carpenter, 1904), have been previously recorded from Pakistan (Clifton) (see Gul and Ghani, 2012). Therefore, this is the first record of an *Endeis* pycnogonid, *E. biseriata*, from Iran, in the Gulf of Oman. A checklist of the species of Pycnogonida of the Persian Gulf and the Gulf of Oman is also provided.

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During a study on the biodiversity of the Iranian coastal waters of the Gulf of Oman, a specimen of Pycnogonida was collected at low tide along Chabahar Bay in February 2017. Chabahar Bay (25°21'07.2.5"N, 60°36'04.1"E) is a semiclosed area located in the northern part of the Gulf of Oman, along the coasts of Iran (Figure 1).

The specimen was found in an algal bed of *Padina* sp., being attached to the surface of the algae. The specimen was anesthetized in cold water, fixed and preserved in ethanol at 96%, and identified based on Stock (1968, 1970) and Child (1990). The pycnogonid species is deposited in the Zoology Museum of the University of Hormozgan (Bandar-Abbas – Iran, ZUHPY 01).

The specimen was photographed with a digital camera (Nikon d5300). The pictures were edited with GIMP 2.0. Maps were made in Quantum GIS 2.18.

**Class Pycnogonida Latreille, 1810**

**Order Pantopoda Gerstäcker, 1863**

**Family Endeidae Norman, 1908**

**Genus *Endeis* Philippi, 1843**

***Endeis biseriata* Stock, 1968 (Figures 2 and 3)**

- *Phoxichilus meridionalis* Loman, 1908

**Material examined:** (ZUHPY 01) 1 female, 25°21'07.2.5"N, 60°36'04.1"E, Chabahar Bay, Iran, intertidal on *Padina* sp., col. Yasser Fatemi, February 2017.

**Diagnosis:** Elongated animal. Lateral processes separated by 2× their own diameter; with a dorsal small

tubercle (two in the first lateral process). Proboscis measuring 3/4 of body length; with the proximal third narrower than the remainder of the proboscis. Ocular tubercle pointed; smaller than the abdomen. Legs elongated. Coxa 1 short, with a dorsal spiniform tubercle. Coxa 2 elongated, almost the same size as coxae 1 and 3 together. Femur elongated, with few long setae; some legs with a constriction in the first half; distal region with two lateral tubercles and an elongated dorsal spur. Tibia 1 shorter than femur, with a dorsodistal tubercle having an apical seta. Tibia 2 longer than femur, with small setae. Propodus elongated and well curved; with three large heel spines; sola with 6 small spines. Main claw little more than half the length of the propodus. Auxiliaries 1/2 of main claw.

**Measurements (in mm):** Length of trunk: 3; length of proboscis: 1.7; length of ocular tubercle: 0.32; length of abdomen: 0.57; length of article of 3rd leg – coxa 1: 0.35; coxa 2: 1; coxa 3: 0.52; femur: 2.3; tibia 1: 2; tibia 2: 2.3; tarsus: 0.12; propodus: 0.86; main claw: 0.4; auxiliary claw: 0.2.

**Distribution:** Seget, West New Guinea (type locality), India, Indonesia (Stock, 1968); Philippines (Child, 1988); Australia (Child, 1990; Arango, 2001, 2003); Papua New Guinea (Child, 1996); USA (Hawaii) (Stock, 1968); Brazil (Stock, 1979, 1992b); Antigua and Barbuda? (Stock, 1992b); Red Sea (Stock, 1970); Madagascar (Stock, 1974) (Figure 3).

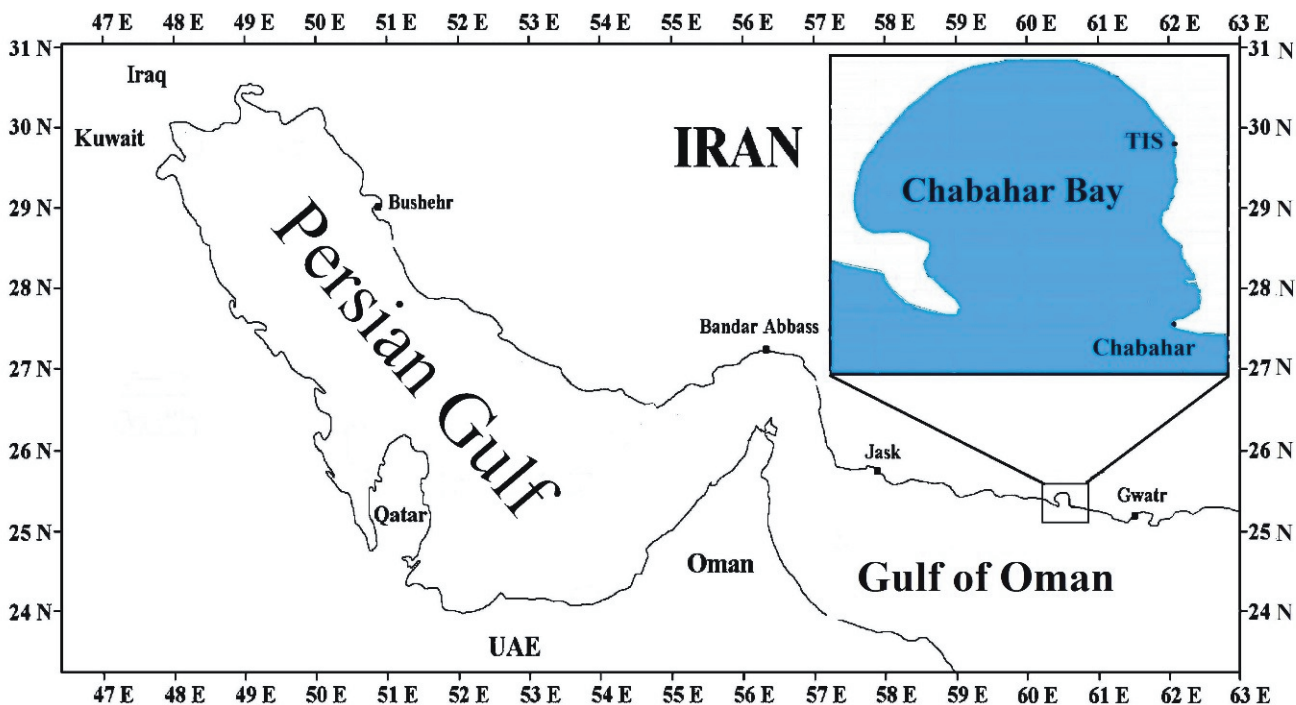
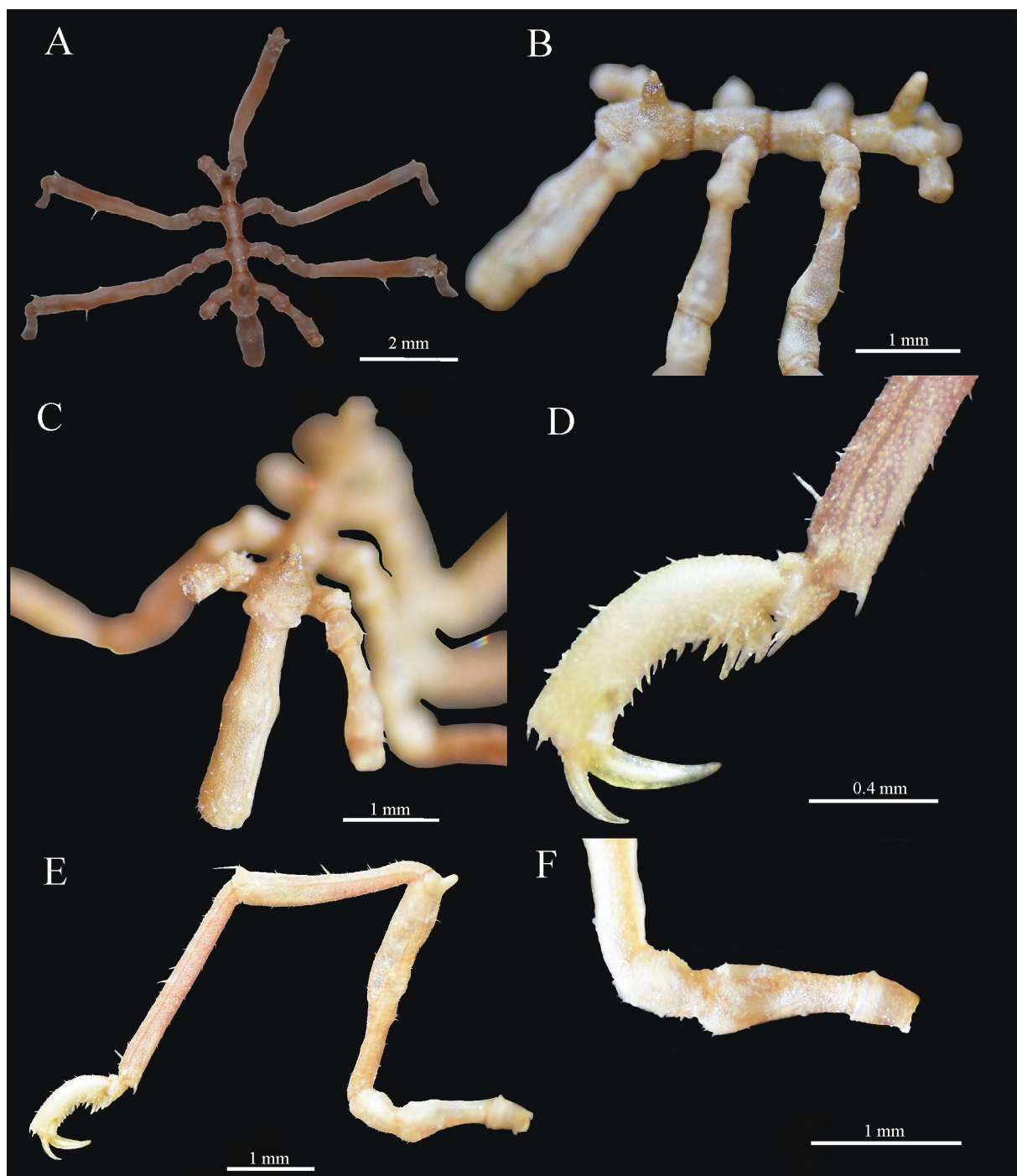


Figure 1. Sampled area and location of Chabahar Bay in the Gulf of Oman.

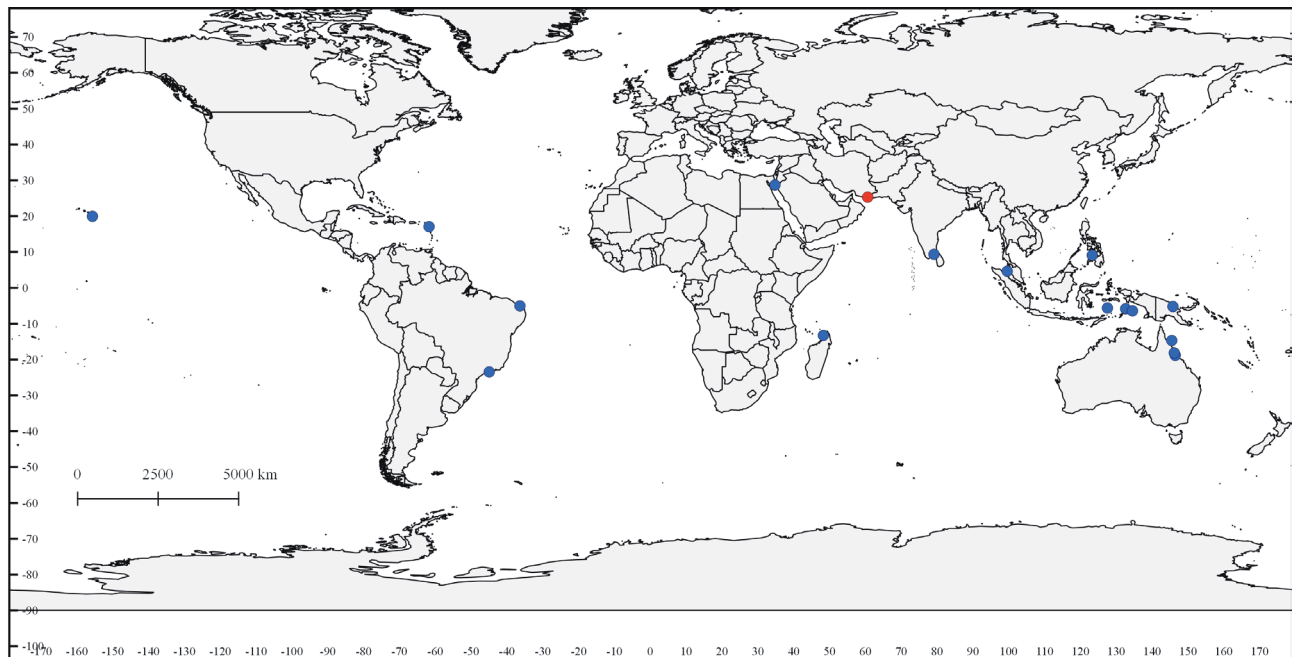


**Figure 2.** *Endeis biseriata*, female: A- dorsal view; B- lateral view; C- frontal view; D- propodus; E- third leg; F- coxae.

**Depth:** 0 to 46 m.

**Remarks:** *Endeis biseriata* is considered to probably represent a native Indo-Pacific species. However, it has a wide world distribution, being probably a pantropical species (Child, 1996; Carlton and Eldredge, 2009). According to Stock (1968) the main characters that

distinguish it from its congeners are the number of pores of the gland in the femurs of the males and the presence of a spur in the distal region of the femur, both possibly unique in the genus. Additionally, Child (1996) pointed out that the absence of a lateral intestinal cecum and elongated spines can be used as diagnostic characters.



**Figure 3.** Distribution of *Endeis biseriata* around the world. Blue circles: previous records; Red circle: present record.

Our specimen agrees with the description made by Stock (1968) (excluding male characteristics). The only variations were the length of the spur in the femur, which is slightly larger than that described for females, and smaller than that of males, as well as a small tubercle with an apical setae elongated at the dorsodistal margin of tibia 1. A slight constriction was observed in the proximal half of the femur of some legs.

According to Child (1990) variations occur in the size of femur spurs in individuals of *E. biseriata* from different parts of the world. While the Indo-Pacific populations generally have the pattern described by Stock (1968) (long in males and short in females), females recorded in Australia have more elongated spurs (Child, 1990), while Brazilian specimens have the spur shorter than originally described (Stock, 1979, 1992b). Although we analyzed a female specimen, it presents a more elongated spur, slightly smaller than that described by Stock (1968) for males and larger than that described for females.

Until 2018 about 33,400 species of animals were recorded from Iranian waters of the Persian Gulf and the Gulf of Oman (Maghsoudlou et al., 2017). However, many surveys are less than comprehensive, so we may anticipate that many more species will be found in the Gulf of Oman.

Based on the presence of high variety of marine habitats in the gulf, the high diversity of marine algae, and the considerable depths of the gulf and areas facing the open ocean (Reynolds, 1993; Gharanjik and Rohani-

Ghadikolaei, 2010; Sohrabipour and Rabiei, 2007), we may conclude that a moderate diversity of pycnogonids can be expected for the gulf. Currently, 16 pycnogonid species were recorded for the Gulf of Oman (Stock, 1992a), and eight species have been recorded from adjacent waters (Persian Gulf) by Stock (1968) and Child (2002) (Table).

Although the western region of the Arabian Sea is considered a center of endemism, there have been few studies on pycnogonids: those of Calman (1923 – India), Stock (1968 – Persian Gulf), Moazzam (1987 – Pakistan), Stock (1992a – Oman), Child (2002 – Saudi Arabia), Bartolino and Krapp (2007 – Socotra), and Gul and Ghani (2012 – Pakistan). These contributions comprise a total of 36 species recorded for the Arabian Sea. Of these, 16 were recorded for the Gulf of Oman, all restricted to Oman (see Stock, 1992a).

For Iranian waters, there is no record of Pycnogonida up to the present time. This is also the first record of the genus *Endeis* and of the species *E. biseriata* for the Gulf of Oman. Among species widely recorded in the world, only two have been recorded near the Gulf of Oman: *E. meridionalis* and *E. mollis* (see Gul and Ghani, 2012). These three species can be separated mainly by the presence of a spur in the distal femur of all legs of *E. biseriata* (absent in other species), elongate and strongly curved in *E. biseriata*, elongated and more erect in *E. mollis*, and more robust and short in *E. meridionalis*. In addition, the amount of spines in the sole of the propodus can aid in identification,

**Table.** Pycnogonids previously recorded from the Persian Gulf and the Gulf of Oman.

Family	Species	Persian Gulf	Gulf of Oman
Ammotheidae Dohrn, 1881	<i>Achelia boschi</i> Stock, 1992		X
	<i>A. lagenaria</i> Stock, 1992		X
	<i>A. watumu</i> (Müller, 1990)		X
	<i>Ammothella appendiculata</i> (Dohrn, 1881)		X
	<i>A. indica</i> Stock, 1954	X	
	<i>A. omanensis</i> Stock, 1992		X
	<i>Nymphopsis bathursti</i> Williams, 1940		X
	<i>Tanystylum bredini</i> Child, 1970		X
Ascorhynchidae Hoek, 1881	<i>Ascorhynchus corderoi</i> Du Bois-Reymond Marcus, 1952		X
	<i>A. dietheus</i> Child, 2002	X	
	<i>Ascorhynchus</i> sp.	X	
Family <i>incertae sedis</i>	<i>Pigrogromitus timsanus</i> Calman, 1927		X
Callipallenidae Hilton, 1942	<i>Callipallene gabriellae</i> Correa, 1948		X
	<i>Callipallene pectinata</i> (Calman, 1923)	X	
	<i>Propallene crassimanus</i> Stock, 1959		X
Nymphonidae Wilson, 1878	<i>Nymphon enteonum</i> Child, 2002	X	
Phoxichilidiidae Sars, 1891	<i>Anoplodactylus angulatus</i> (Dohrn, 1881)		X
	<i>A. digitatus</i> (Böhm, 1879)		X
	<i>A. glandulifer</i> Stock, 1954	X	X
	<i>A. tarsalis</i> Stock, 1968		X
	<i>A. tubiferus</i> (Haswell, 1885)	X	
	<i>A. turbidus</i> Stock, 1975	X	
Pycnogonidae Wilson, 1878	<i>Pycnogonum moolenbeeki</i> Stock, 1992		X

since *E. mollis* has 8 to 10 spines, *E. biseriata* 6 to 7, and *E. meridionalis* 5.

The presence of a spur in the distal region of the femur in *E. meridionalis* from Pakistan was mentioned by Gul and Ghani (2012). It is possible that it is actually *E. biseriata* and not *E. meridionalis*. However, only a detailed morphological analysis of the specimen can confirm our suspicion.

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