Electronic Journal of University of Aden for Basic and Applied Sciences
EJUA-BA Vol. 4 No. 1 (2023)
https://doi.org/10.47372/ejua-ba.2023.1.227
ISSN: 2708-0684

RESEARCH ARTICLE

NEW RECORDS OF BRACHYURAN CRABS SPECIES (CRUSTACEA-DECAPODA) IN GULF OF ADEN- YEMEN

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Received: 12 March 2023 / Accepted: 25 March 2023 / Published online: 31 March 2023

Abstract

The information on the biodiversity of crustaceans, especially brachyuran crabs on the northern shore of the Gulf of Aden is even more limited and almost completely unknown. The coasts in the south of the Arabian Peninsula at the Gulf of Aden have not received much attention, with few studies in the field of marine biodiversity in general and brachyuran crabs in particular. There is a large gap in knowledge on the fauna of brachyuran crabs inhabiting the coastline in this region, so; this study aims to fill the gap in the data in this part of the Arabian Peninsula. In this study, 1750 brachyuran crab specimens were collected from 36 sites along the Yemeni coastal waters in the Gulf of Aden. These specimens were collected by hand, hand nets, snorkeling up to 2 m depth, SCUBA diving. Moreover, trawl nets were used up to 300 meters and small fish traps. All these specimens were transferred to ZSM for identification (by morphological characteristics and morphological characteristics of the gonopods) and putting together all information such as sex, measurements, locations, collection dates, habitats, and collectors of the specimens. This study recorded 163 brachyuran crabs' species belonging to 17 super families, 28 families and 110 genera. Of the 163 species, 53 species represent the first record for Yemeni coastal waters at the Gulf of Aden. Moreover, 8 species were considered the first recorded in the marine waters of the Arabian Peninsula is given.

Keywords: New records, Decapoda, Brachyuran crabs, Gulf of Aden.

1. Introduction

The Red Sea and Gulf of Aden region are globally renowned for their unique and beautiful marine and coastal environments, the diversity of species inhabiting them, the high degree of endemism [1-7].

Marine and coastal ecosystems of the Red Sea include subtidal soft bottoms, sandy shores, muddy shores, rocky shores, mangroves, seagrass, coral reefs, coral communities and salt marshes [3]. Typical features of the western coast of the Red Sea are coastal lagoons and sheltered bays. Several of these lagoons are fringed by mangrove [3] while the coastline along the Gulf of Aden consists of rocky cliffs which alternate with long stretches of littoral and sublittoral sand dunes [8] with some wetlands, mangroves, muddy shores, lagoons and coral communities [9-12].

Many biodiversity studies have been conducted in the Yemeni coastal waters at Red Sea and Socotra Islands by the Strategic Action Program (SAP) and PERSGA in Marine Protected Areas (MPA). The Global Environmental Facility (GEF) and other donors such as the Islamic Development Bank (IsDB) and UNEP funded these initiatives. Still, these studies are rare and lack in the Gulf of Aden. Studies indicate that too few published studies exist which additionally concentrate on the extreme west with the southern shores of the Gulf of Aden in the area of Djibouti and western Somalia [13, 14].

The information on biodiversity of crustaceans, especially brachyuran crabs on the northern shore of the Gulf of Aden is even more limited and almost completely unknown. The coasts in the south of the Arabian Peninsula from the Strait of Hormuz to the Gulf of Aden have not received much attention, with few studies in the field of marine biodiversity in general and brachyuran crabs in particular. There is a large gap in knowledge on the fauna of brachyuran crabs inhabiting the coastline in this region [8, 9,11, 15-19].

The early studies in these coastal waters in the Gulf of Aden such as; [20-28, 16, 29-32].

The first extensive study of fauna of the brachyuran crabs in shallow waters at the Gulf of Aden, Sikha Island and Bir Ali was conducted in 1999 by [17]. This study was based on three cruises of the former Soviet research vessels RN "Akademik Petrovsky" (Cruise AP-14) and RN "Odissey" (Cruises 0-33, 0-34) between 1980-1984 to the Western Indian Ocean including Yemeni coastal waters. Here the study included some fauna of the brachyuran crabs and recorded 28 species.

The second extensive study of coastal and marine habitats in the Gulf of Aden, Hadramout and Shabwa Governorates was in 2005 by a SMF team [33]. This study covered 35 sites between coordinates 14° 01,838' - 14° 49,351' N and 48° 22,947' - 50° 00,970' E and recorded 45 brachyuran crabs, belonging to 15 families. Unfortunately, however, it has not been completed or published yet. The data of [3] therefore became part of this present study.

The only Yemeni study in the field of brachyuran crabs in any Yemeni coastal waters is the M.Sc study by the first author of this present scientific paper conducted during the period of May 2008 to May 2010 on the coasts at Gulf of Aden. In this study 15 different habitats were visited and 60 brachyuran crabs were recorded belonging to 32 genera and 14 families. After that time [19] and [34] recorded many brachyuran species in the Yemeni coastal waters at the Gulf of Aden.

Also the team of biodiversity at the Centre for Environmental Studies and Sciences, University of Aden (CESS) has done a number of survey studies in eight sites during 2003- 2011 to cover the lack of data in the Yemeni southern coastline from Bab Al-Mandab on the west to the Haof (boundary with Oman). These sites are Bab Al-Mandab, Khor Umeira, Ras Imran, Shuqra, Sharma-Jethmun, Dabout, Sayhut and Haof. Unfortunately, these data studies were unpublished and have been lost during the civil war in March 2015 in Aden city.

It is clear from the above that Yemeni coastal waters at Gulf of Aden and Arab Sea harbors unique and diverse marine biota, especially crustaceans, decapods, brachyuran crabs. It lacks studies in this field, which help to fill the gap in the data in this part of the Arabian Peninsula. This area has diverse habitats from sandy and rocky shores to mangroves and coral communities.

It is clear from the above that the Yemeni coastal waters at the Gulf of Aden and the Arab Sea harbor unique and diverse marine biota, especially crustaceans, decapods, and brachyuran crabs since it maintains diverse habitats from sandy and rocky shores to mangroves and coral communities. However, it lacks a species list of the brachyuran crabs.

For these reasons, this study aims to:

- Using the data for better knowledge on brachyuran crabs in the western part of the Indian Ocean and on possible biogeographical boundaries in the Arabian Peninsula and fill the gap.
- Provide knowledge on the environments appropriate for the presence of these brachyuran crabs in the different marine habitats at Gulf of Aden.
- Compare the new information obtained on brachyuran crab species distribution in the Yemeni coastal waters at Gulf of Aden with previous studies and their findings.

2. Materials and Methods

2.1: Samples

In this study 1750 brachyuran crab specimens were collected by hand, hand nets, snorkeling up to 2 m depth, and SCUBA diving. Moreover, trawl nets were used up to 300 meters, and small fish traps. from 36 sites along the Yemeni coastal waters at the Gulf of Aden (Fig. 1 & table).

These samples were collected from different habitats such as; sand, rock (sandy shore with small and medium rocks in the intertidal zone up to the subtidal zone); sand; rock; rock, algae (rocky shore covering by algae in the intertidal zone); mud flat; mud, rock (mud flat with small and medium rocks in the intertidal zone); subtidal rock, corals (rocky shore with corals in the subtidal zone); corals; sponge and subtidal sand (Plate. 1) including different depth zones such as the supralittoral, intertidal and sublittoral zone up to 300 meters depth.

The 1750 brachyuran crab specimens for this study were obtained from four different sources:

(i): 623 specimens from Rostock University collected by Wolfgang Wranik (RUWW) between 1983 and 2010.

(ii): 514 specimens from Senckenberg Museum Frankfurt (SMF) collected by [33] were collected from the sites on the coasts of Hadramout and Shabwa Governorates during period time 14-28 May 2005.

(iii): 608 specimens from Aden University collected by Abdullah Al-Hindi (AUAA) during the period 2008-2017.

(iv): Five specimens from Museum of Marine Science and Biological Research Authority-Aden-Yemen (MMSBRA) collected between 1984 and 2008.

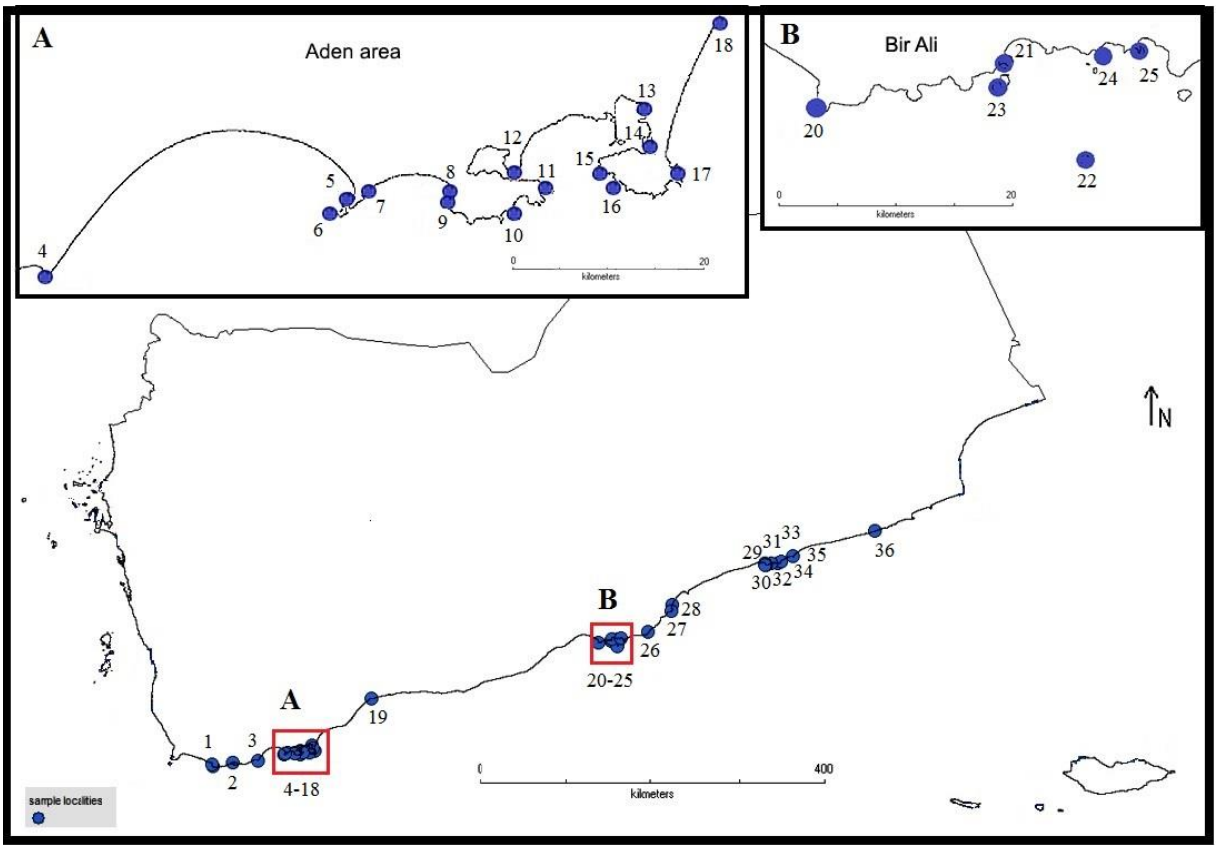

Fig. 1: Collecting sites at the Yemeni coastal waters at Gulf of Aden.

2.2: Specimens identification

Two methods were used to identify brachyuran crab species:

2.2.1: Morphological characteristics

Taxonomic characters of carapace, chelipeds, walking legs, pleon segments and eyestalks. Photos were taken either with digital cameras DMC FX12 or Nikon D7000. At ZSM a photomacroscope M400, and in the laboratory of Rostock University a photomacroscope Olympus SZ-CTV were used.

All specimens of RUWW, SMF and AUAA were transferred to Zoologische Staatssammlung München (ZSM) for identification with important data such as sex, measurements, locations, collection dates, habitats, collectors of the specimens and compared with ZSM specimens.

Some species have a carapace completely covered by hairs, and hence it is difficult to identify them with conventional morphological analyses, for example: *Lewindromia unidentata* (Rüppell, 1830), *Pilumnus vespertilio* (Fabricius, 1793), *Pilumnus incanus* and *Camposcia retusa* (Latreille, 1829). In those cases, analyses with the µCT device at ZSM, a Phoenix Nanotom m (GE Measurement & Control, Wunstorf, Germany) cone beam CT scanner at a voltage of 100 kV and a current of 80-120 mA, were done. Isosurface rendering of the volumes were created VGStudio MAX 2.2 software (Volume Graphics, Heidelberg, Germany) hat allowed to "remove "the setation from the specimens in order to show the carapace surface (Plate 2).

2.2.2: Morphological characteristics of the gonopods

In the present study, male gonopods (G1 & G2) of 94 species were examined (Plate. 3). Some species were only available as females, other only as dry samples in which it is difficult to open the abdomen and excise the gonopods.

These gonopods samples (G1 & G2) were kept in 70% ethanol solution in small plastic jars. Photos were taken at the Institut für Biowissenschaften Meeresbiologie in Rostock University with the photomacroscope Olympus SZ-CTV to identify and classify species by gonopods' characteristics such as shapes and sizes. G1can be very slender, S-shaped, comma-shaped, stout, sinuous. G2 can be short, more than quarter length of G1, or elongate, as long as or longer than G1, or comma-shaped or not comma-shaped.

Plate. 1: Selected habitats of the coast of Yemen: **A.** Sandy shore at site 18 with sand pyramids constructed by *Ocypode saratan* (Forskål, 1775); **B.** Habitat of the sand, rock at site 7; **C.** Mud flat at site 12; **D.** Rocky shore at site 9; E. Rocky shore at site 36, *Lydia tenax* (Rüppell, 1830) found in this habitat; **F.** Bahra Island at site 6 (Photo: Gamal Bawazir); **G.** Habitat of the sand, rock at site 9, *Pseudozius caystrus* (Adams & White, 1849) found in this habitat; **H.** Coral communities (*Porites lobata*; Dana, 1846 and *Porites harrisoni*; Veron, 2000) at site 11 (Photo: Gamal Bawazir); **I.** *Pocillopora damicornis* (Linnaeus, 1758), a common coral species at site 6; most crabs of the genus *Trapezia* were found in this habitat; **J.** Sponges in subtidal zone at site 12 with some individuals of *Portunus (Portunus) segnis* (Forskål, 1775) that prefer this habitat to sandy rocky shore with algae (Photo: Gamal Bawazir); **K.** Subtidal rock and corals at site 11; some individuals of *Carpilius convexus* (Forskål, 1775) were found in this habitat (Photo: Gamal Bawazir); **L.** Mud flat at site 4

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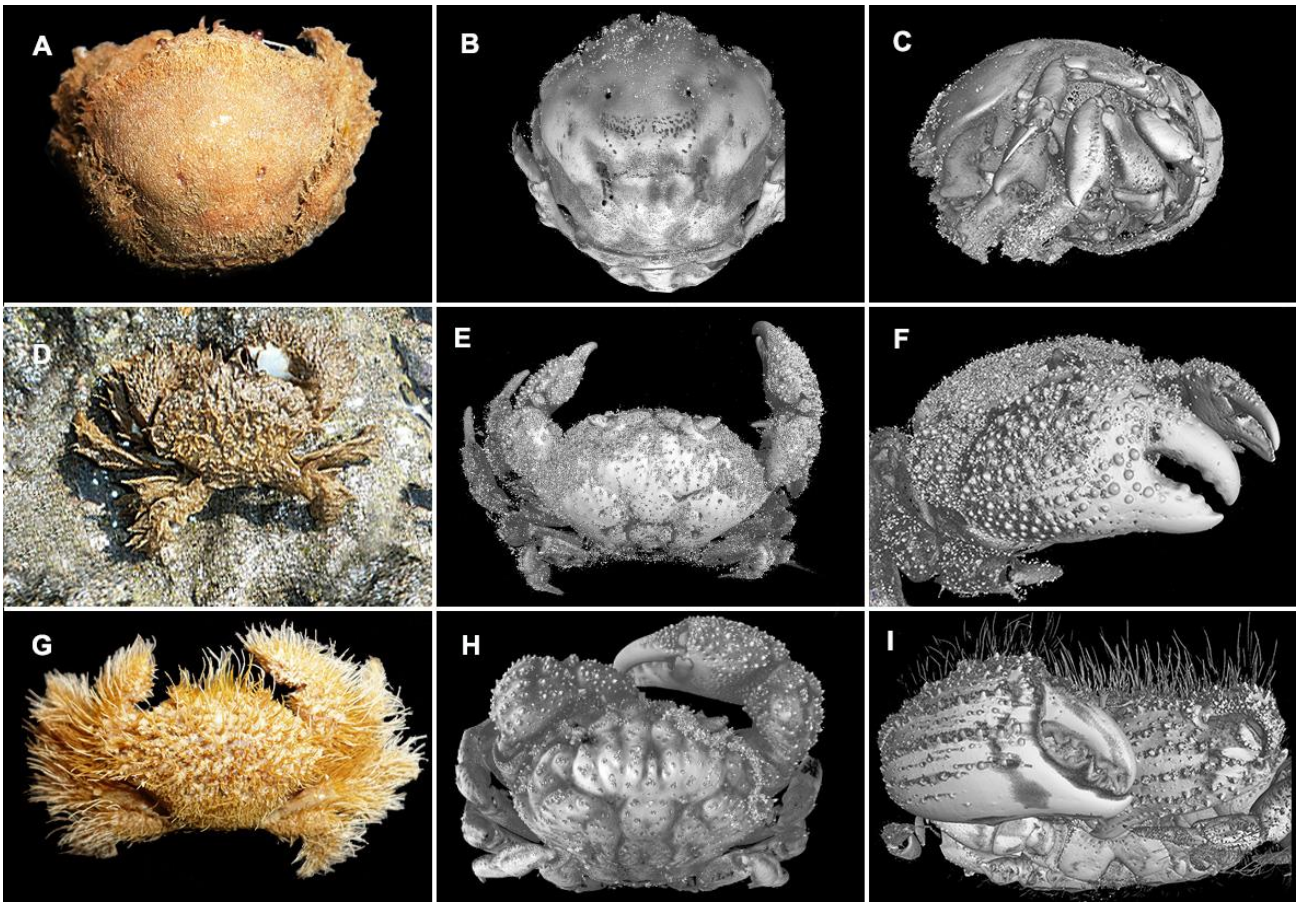

Plate. 2: A. Dorsal view of *Lewindromia unidentata* (Rüppell, 1830), the carapace covered completely by hairs; **B, C.** Dorsal and lateral views of the *Lewindromia unidentata* of the µCT volume; **D.** Dorsal view of *Pilumnus vespertilio* (Fabricius, 1793), the carapace covered completely by hairs; **E, F.** Dorsal and lateral views of *Pilumnus vespertilio* of the µCT volume; **G.** Dorsal view of *Pilumnus incanus* (Forskål, 1775), the carapace covered completely by hairs; **H, I.** Dorsal and ventral views of *Pilumnus incanus* after isosurface rendering of the µCT volume.

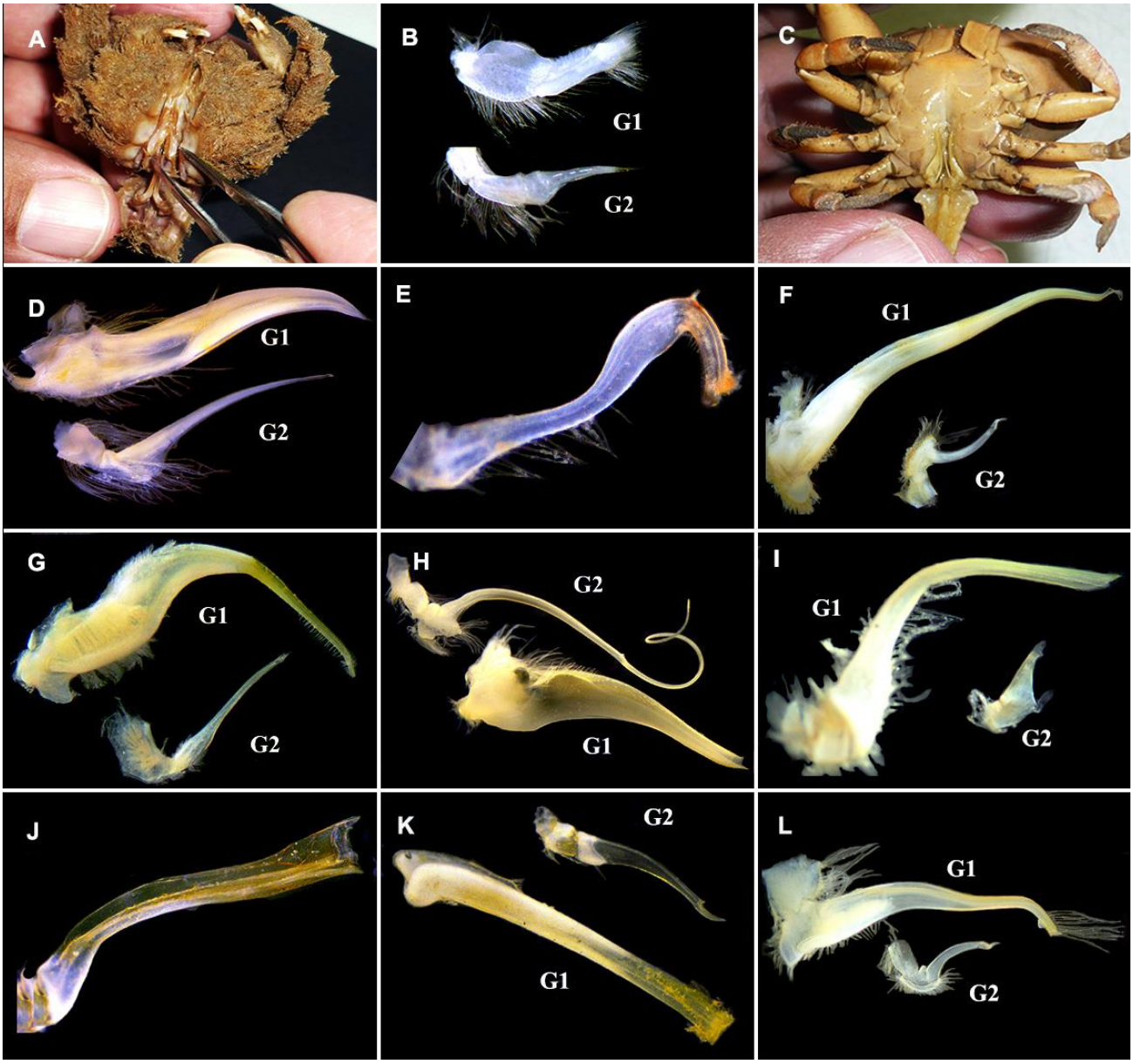

Plate. 3: Gonopods: A. Ventral view of *Lewindromia unidentata* (Rüppell, 1830), showing the G1 & G2 position; **B.** G1 & G2 of *Cryptodromia fallax* (Latreille in Milbert, 1812), **C.** Ventral view of *Epixanthus frontalis* (H. Milne Edwards, 1834), showing the G1 & G2 position; **D.** G1 & G2 of *Calappa hepatica* (Linnaeus, 1758); **E.** G1 & G2 of *Dotilla sulcata* (Forskål, 1775)**, F.** G1 & G2 of *Etisus laevimanus* Randall, 1840; **G.** G1 & G2 of *Charybdis (Goniohellenus) longicollis* Leene, 1938; **H.** G1 & G2 of *Lydia tenax* (Rüppell, 1830)**, I.** G1 & G2 of *Micippa platipes* Rüppell, 1830; **J.** G1 of *Sunipea indicus* (Alcock, 1895); **K.** G1 & G2 of *Aulacolambrus granulosus* (Miers, 1879)**, L.** G1 & G2 of *Pilodius areolatus* (H. Milne Edwards, 1834).

3. Results

In the present study, 1750 specimens of brachyuran crabs were examined. Their analyses revealed 163 species belong to 17 superfamilies, 28 families and 110 genera (Fig. 2& Table. 2). Of the 163 species, 53 species represent the first record for Yemeni coastal waters in the Gulf of Aden. Moreover, for eight species were considered the first recorded in the marine waters of the Arabian Peninsula (Plate. 4).

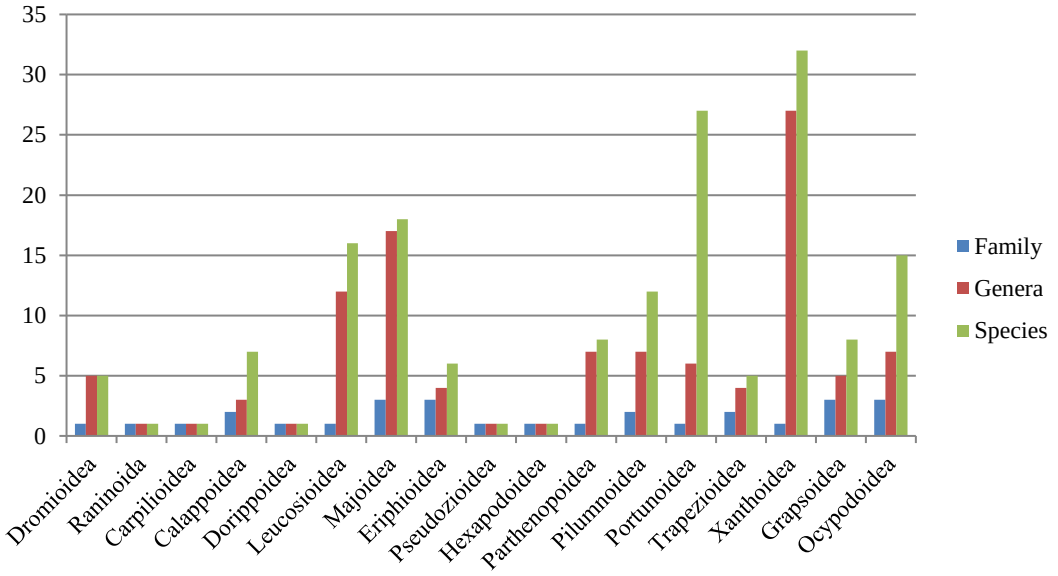

Fig. 2: Number of species, genera and families in all the superfamilies in Gulf of Aden.

Table. 2: The brachyuran crabs which were recorded in the Gulf of Aden sites in the present study, first record in Yemeni coastal waters at Gulf of Aden (▲), and first record in marine waters of the Arabian Peninsula (●).

Superfamily	Family	Species name
Dromioidea	Dromiidae	*Lauridromia dehaani* (Rathbun, 1923)
		Epigodromia granulata (Kossman, 1878)
		Lewindromia unidentata (Rüppell, 1830) ▲
		Ascidiophilus caphyraeformis Richters, 1880 ▲
		Cryptodromia fallax (Latreille in Milbert, 1812)
Raninoida	Raninidae	*Notosceles serratifrons* (Henderson, 1893) ●
Carpilioidea	Carpiliidae	*Carpilius convexus* (Forskål, 1775)
Calappoidea	Calappidae	*Calappa philargius* (Linnaeus, 1758) ▲
		Calappa hepatica (Linnaeus, 1758)
		Calappa capellonis Laurie, 1906
		Calappa gallus (Herbst, 1803)
		Mursia bicristimana Alcock & Anderson, 1894
	Matutidae	*Ashtoret lunaris* (Forskål, 1775)
		Ashtoret picta (Hess, 1865)
Dorippoidea	Dorippidae	*Dorippe frascone* (Herbst, 1785)
Eriphioidea	Eriphiidae	*Eriphia smithii* MacLeay, 1838
		Eriphia sebana (Shaw & Nodder, 1803)
	Menippidae	*Menippe rumphii* (Fabricius, 1798)
	Oziidae	*Epixanthus frontalis* (H. Milne Edwards, 1834)
		Epixanthus corrosus A. Milne-Edwards, 1873
		Lydia tenax (Rüppell, 1830)
Hexapodoidea	Hexapodida	*Hexapinus simplex* Rahayu & Ng, 2014 ●
Leucosioidea	Leucosiidae	*Coleusia biannulata* Tyndale-Biscoe & George, 1962 ▲
		Leucosia anatum (Herbst, 1783)
		Ebalia abdominalis Nobili, 1906
		Ryphila cancellus (Herbst, 1783)

		Philyra granigera Nobili, 1906
		Hiplyra variegata (Rüppell, 1830)
		Philyra cf. globus (Fabricius, 1775)
		Nobiliella jousseaumei (Nobili, 1906)
		Ixa holthuisi Tirmizi, 1970 ▲
		Arcania undecimspinosa de Haan, 1841
		Arcania cf. tuberculata Bell, 1855
		Myra subgranulata Kossmann, 1877 ▲
		Arcania gracilis Henderson, 1893 ▲
		Cryptocnemus cf. pentagonus Stimpson, 1858 ▲
		Leucisca rubifera (Müller, 1887) ▲
		Nursilia dentata Bell, 1855 ▲
Majoidea	Majidae	*Schizophrys aspera* H. Milne Edwards, 1834
		Micippa platipes Rüppell, 1830
		Cyclax spinicinctus Heller, 1861
		Majidae.gen. sp. 1
		Seiitaoides cf. stimpsonii (Miers, 1884)
	Epialtidae	*Stilbognathus cervicornis* (Herbst, 1803)
		Hyastenus hilgendorfi De Man, 1887 ▲
		Hyastenus brockii de Man, 1887 ▲
		Huenia heraldica (De Haan, 1837)
		Acanthonyx limbatus A. Milne-Edwards, 1862 ▲
		Simocarcinus simplex (Dana, 1851)
		Tylocarcinus styx (Herbst, 1803)
		Menaethius monoceros (Latreille, 1825)
	Inachidae	*Macropodia formosa* Rathbun, 1911
		Cyrtomaia cf. goodridgei McArdle, 1900 ●
		Sunipea indicus (Alcock, 1895)
		Camposcia retusa (Latreille, 1829) ▲
		Inachus dorsettensis (Pennant, 1777)
Parthenopoidea	Parthenopidae	*Daldorfia horrida* (Linnaeus, 1758)
		Aethra scruposa (Linnaeus, 1764) ●
		Daldorfia spinosissima (A. Milne-Edwards, 1862) ▲
		Parthenope longimanus (Linnaeus, 1758) ▲
		Rhinolambrus longispinus (Miers, 1879) ●
		Furtipodia petrosa (Klunzinger, 1906) ▲
		Aulacolambrus granulosus (Miers, 1879) ●
		Aulacolambrus hoplonotus (Adams & White, 1849) ▲
Pilumnoidea	Pilumnidae	*Eurycarcinus orientalis* A. Milne-Edwards, 1867
		Eurycarcinus integrifrons de Man, 1879
		Pilumnus vespertilio (Fabricius, 1793)
		Pilumnus cf. minutus De Haan, 1835
		Glabropilumnus levimanus (Dana, 1852) ▲
		Pilumnus savignyi Heller, 1861 ▲
		Echinoecus pentagonus (A. Milne-Edwards, 1879) ▲
		Pilumnus incanus (Forskål, 1775)
		Actumnus tesselatus Alcock, 1898 ▲

		Actumnus asper (Rüppell, 1830)
		Pilumnopeus convexus (Maccagno, 1936)
	Galenidae	*Halimede tyche* (Herbst, 1801) ▲
Portunoidea	Portunidae	*Charybdis (Goniohellenus) smithii* MacLeay, 1838
		Charybdis (Charybdis) feriata (Linnaeus, 1758)
		Charybdis (Charybdis) natator (Herbst, 1794)
		Charybdis (Charybdis) orientalis Dana, 1852
		Charybdis (Charybdis) annulata (Fabricius, 1798)
		Charybdis (Charybdis) hellerii (A. Milne-Edwards, 1867)
		Charybdis (Goniohellenus) longicollis Leene, 1938
		Scylla serrata (Forskål, 1775)
		Carupa tenuipes Dana, 1852
		Portunus (Portunus) segnis (Forskål, 1775)
		Portunus (Xiphonectes) arabicus (Nobili, 1906)
		Cycloachelous orbitosinus (Rathbun, 1911)
		Portunus (Xiphonectes) longispinosus (Dana, 1852)
		Portunus (Xiphonectes) guinotae Stephenson & Rees, 1961 ▲
		Portunus (Portunus) sanguinolentus (Herbst, 1783)
		Thalamita crenata Rüppell, 1830
		Thalamita prymna (Herbst, 1803)
		Thalamita admete (Herbst, 1803) ▲
		Thalamita poissonii (Audouin, 1826)
		Thalamita mitsiensis Crosnier, 1962 ●
		Thalamita sexlobata Miers, 1886
		Thalamita bandusia Nobili, 1906
		Thalamita gatavakensis Nobili, 1906 ●
		Thalamita quadrilobata Miers, 1884
		Thalamita sp.
		Thalamita cf. crosnieri Vannini 1983
		Thalamita cf. stephensoni Crosnier 1962
Trapezioidea	Tetraliidae	*Tetralia cavimana* Heller, 1861
		Tetraloides nigrifrons (Dana, 1852) ▲
	Trapeziidae	*Trapezia cymodoce* (Herbst, 1801)
		Trapezia tigrina Eydoux & Souleyet, 1842
		Quadrella coronata Dana, 1852 ▲
Pseudozioidea	Pseudoziidae	*Pseudozius caystrus* (Adams & White, 1849)
Xanthoidea	Xanthidae	*Atergatis integerrimus* (Lamarck, 1818)
		Xanthias sinensis (A. Milne-Edwards, 1867)
		Leptodius exaratus (H. Milne Edwards, 1834)
		Platypodia cf. pseudogranulosa Serène, 1984
		Macromedaeus voeltzkowi (Lenz, 1905) ▲
		Zosimus aeneus (Linnaeus, 1758) ▲
		Cymo quadrilobatus Miers, 1884 ▲
		Cymo andreossyi (Audouin, 1826) ▲
		Lophozozymus anaglyptus (Heller, 1861)
		Luniella spinipes (Heller, 1861)

		Lybia plumosa Barnard, 1946 ▲
		Cyclodius granulatus (Targioni-Tozzetti, 1877) ▲
		Neoliomera sabaea (Nobili, 1906) ▲
		Glyptoxanthus meandrinus (Klunzinger, 1913) ▲
		Actaeodes hirsutissimus (Rüppell, 1830)
		Actaeodes tomentosus (H. Milne Edwards, 1834)
		Paractaea rufopunctata (H. Milne Edwards, 1834)
		Chlorodiella nigra (Forskål, 1775)
		Chlorodiella laevissima (Dana, 1852) ▲
		Pilodius areolatus (H. Milne Edwards, 1834) ▲
		Demania mortenseni (Odhner, 1925) ▲
		Forestiana depressa (White, 1848) ▲
		Etisus laevimanus Randall, 1840
		Liomera rubra (A. Milne-Edwards, 1865) ▲
		Neoxanthops lineatus (A. Milne-Edwards, 1867)
		Epiactaea margaritifera (Odhner, 1925)
		Actaea cf. bocki Odhner, 1925
		Xanthias cf.canaliculatus Rathbun, 1906
		gen. sp. 1
		gen. sp. 2
		gen. sp. 3
Grapsoidea	Grapsidae	*Grapsus albolineatus* Latreille in Milbert, 1812
		Grapsus tenuicrustatus (Herbst, 1783)
		Metopograpsus messor (Forskål, 1775)
		Metopograpsus thukuhar (Owen, 1839)
		Grapsus granulosus H. Milne Edwards, 1853
		Geograpsus crinipes (Dana, 1851) ▲
	Varunidae	*Thalassograpsus harpax* (Hilgendorf, 1892)
	Plagusiidae	*Percnon planissimum* (Herbst, 1804) ▲
Ocypodoidea	Dotillidae	*Dotilla sulcata* (Forskål, 1775)
	Macrophthalmidae	*Macrophthalmus (Macrophthalmus) grandidieri* A. Milne-Edwards, 1867 ▲
		Macrophthalmus (Macrophthalmus) sulcatus H. Milne Edwards, 1852
		Macrophthalmus (Mareotis) depressus Rüppell, 1830
		Chaenostoma boscii (Audouin, 1826)
		Macrophthalmus (Macrophthalmus) serenei Takeda & Komai, 1991
		Macrophthalmus (Macrophthalmus) graeffei A. Milne-Edwards, 1873 ▲
		Chaenostoma sinuspersici (Naderloo & Türkay, 2011)
		Macrophthalmus (Mareotis) laevis A. Milne-Edwards, 1867
	Ocypodidae	*Ocypode jousseaumei* (Nobili, 1906)
		Ocypode saratan (Forskål, 1775)
		Ocypode cordimana Latreille, 1818
		Austruca albimana (Kossmann, 1877)
		Cranuca inversa (Hoffmann, 1874)
		Gelasimus hesperiae (Crane, 1975) ▲

3.1: Faunistics and biodiversity

In the present study 163 species of brachyuran crabs were recorded in Gulf of Aden, belonging to 17 superfamilies, 28 families and 110 genera. Fifty three species considered the first records in this region. 104 species were recorded exclusively in this region, and have not been recorded in any other region of the Yemeni coastal waters at the Red Sea, Arab Sea and Indian Ocean.

Xanthoidea and Portunoidea were dominating in Gulf of Aden with 32 species (20% of all species) and 27 species (16%), respectively, followed by Majoidea with 18 species (11%) and Leucosioidea with 16 species (10%). Raninoida, Carpilioidea, Dorippoidea, Pseudozioidea and Hexapodoidea were represented by less species than the other superfamilies, with 1 species each (1% only of the total species number; Fig. 3).

In the Gulf of Aden region, different habitats were found and studied, i.e. sandy shores, rocky shores, mud flats, sponge area, coral communities. Mangroves are present only at site 33 but unfortunately, there were no samples collected from this habitat.

Most brachyuran crab species in the Gulf of Aden region were recorded from four habitats, subtidal sand, subtidal rock and corals, sand with rock as well as mud flats.

In the subtidal sand habitat, 29% percent of the total number of species was recorded, corresponding to a total of 48 species. Among these were 8 species of Parthenopidae found in this habitat, and 11 species of Leucosiidae.

In the subtidal rock and corals habitat, 17% percent of the total number of species (28 species in total) were recorded. Of these, 8 were dominant: *Trapezia cymodoce* and *Trapezia tigrina* from Trapeziidae; *Schizophrys aspera* from Majidae; *Cyclodius granulatus*, *Luniella spinipes*, *Chlorodiella nigra* and *Cymo andreossyi* from Xanthidae and *Carpilius convexus* from Carpiliidae.

The third habitat was sand with rock with 15% percent of the total number and 25 species. Five of these species were dominant in this habitat, namely *Leptodius exaratus* and *Xanthias sinensis* from Xanthidae; *Pseudozius caystrus* from Pseudoziidae; *Epixanthus frontalis* from Oziidae and *Thalassograpsus harpax* from Varunidae.

In the fourth habitat (mud flat), 8% percent of the total numbers of species, in total 13 species were harvested. Three of them were dominant in this habitat: *Eurycarcinus orientalis* from Pilumnidae; *Macrophthalmus (Mareotis) depressus* from Macrophthalmidae and *Austruca albimana* from Ocypodidae.

Other habitats (rock, mud rock, sponge, sand and rock with algae) varied in species number as well (1-7). On rock 4% percent of the total number of species, i.e. 7 species, were recorded. Three of these were dominant in this habitat, *Grapsus albolineatus* from Grapsidae; *Eriphia smithii* from Eriphiidae and and *Lydia tenax* from Oziidae.

Mud, rock contained 4% percent of the total number of species and 7 species in total. Two of these were dominant in this habitat, *Metopograpsus messor* from Grapsidae, intertidal zone and *Thalamita crenata* from Portunidae, 0.5-1 m depth.

The habitat sponge had 4% percent of the total number of species, 7 species in total. One of these was dominant, *Lewindromia unidentata* from Dromiidae.

In sand and rock with algae fewer species than in other habitats were found. In sand, 2.5% percent of the total number of species (4 species) was recorded. Two of them were dominant in this habitat: *Dotilla sulcata* from Dotillidae, and *Ocypode saratan* from Ocypodidae.

The rock with algae habitat had 0.6% percent of the total number of species (1 species). The single species recorded in this habitat was *Percnon planissimum* from Plagusiidae.

Eight species were first recorded in the marine waters of the Arabian Peninsula at the Red Sea, Gulf of Aden, Arabian Sea, and Socotra Islands. These species belong to 6 families. Eight species were recorded in the Gulf of Aden. These species are: *Notosceles serratifrons* from Raninidae, record in Gulf of Aden, site 7, 50 m depth; *Hexapinus simplex* from Hexapodidae, record in Gulf of Aden, sample localities 7, 20-50 m depth; *Cyrtomaia cf. goodridgei* from Inachidae, record in Gulf of Aden, site 9, 30 m depth; *Aethra scruposa*, *Aulacolambrus granulosus* and *Rhinolambrus longispinus* from Parthenopidae. *Aethra scruposa* record in Gulf of Aden, site 15, 2 m depth, *Aulacolambrus granulosus* record in Gulf of Aden, sites 5, 7, 9, 10, 30, 2-60 m depth, *Rhinolambrus longispinus* record in Gulf of Aden, site 30, 21-24 m depth.

The last 2 species from Portunidae that were recorded for the first time in the Arabian Peninsula are *Thalamita gatavakensis* recorded in the Gulf of Aden, site 30, 2 m depth and *Thalamita mitsiensis*, recorded in the Gulf of Aden, site 9, 15 m depth.

In addition to these species, we recorded another rare species, *Inachus dorsettensis* from Inachidae in the Gulf of Aden at site 30, 300 m depth. This species was record earlier by Griffin (1974) in the mouth of the Gulf of Aden at 75-175 m depth. These are the only records of this species in any marine waters of the Arabian Peninsula at the Red Sea, Gulf of Aden, Arabian Sea, Gulf of Oman and Arabian Gulf until now.

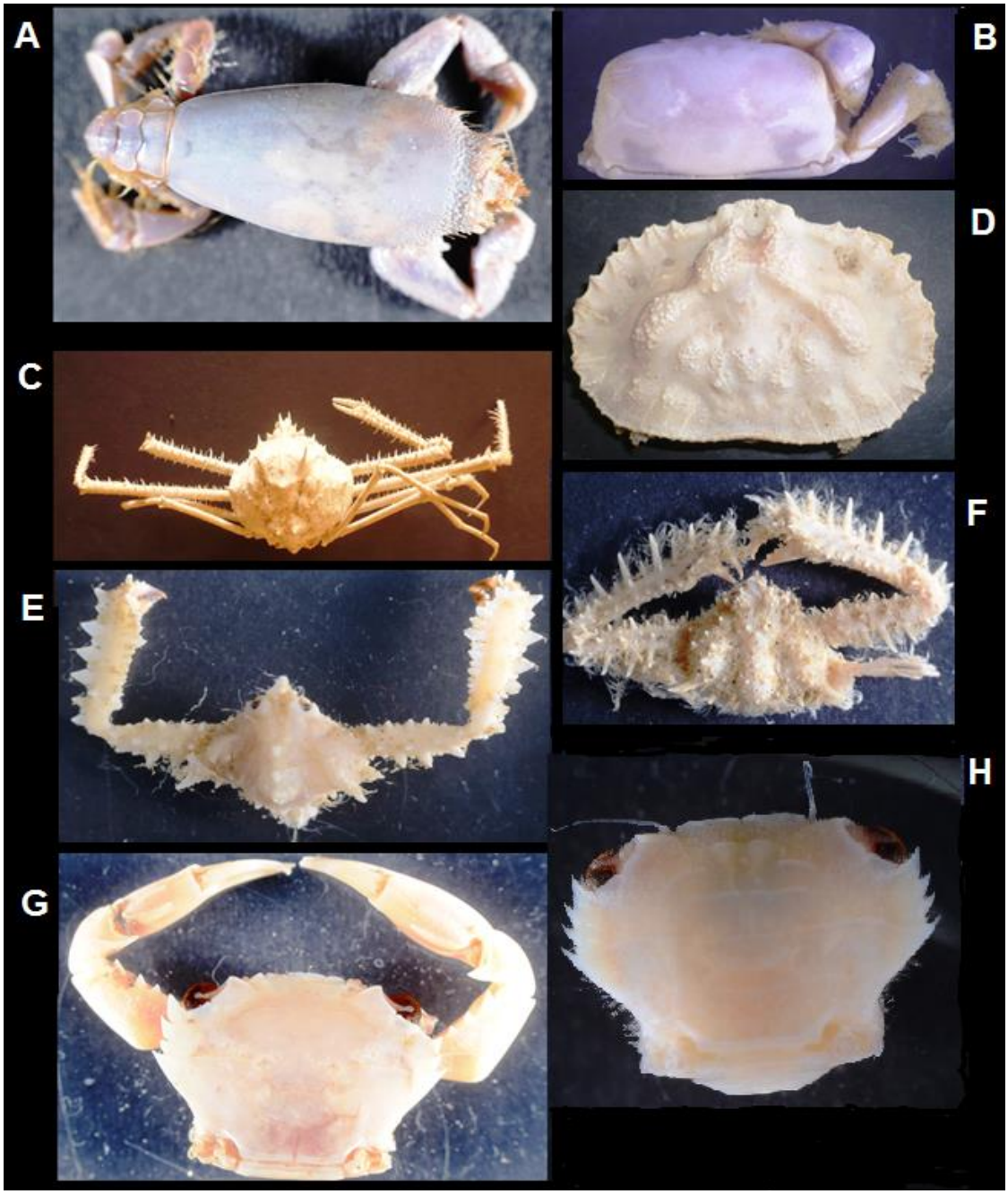

Plate 4: A. *Notosceles serratifrons*, ♂ CL 14.6 mm, CW 8 mm; **B**. *Hexapinus simplex*, ♂ CL 4.9 mm, CW 6.6 mm; **C**. *Cyrtomaia cf. goodridgei*, ♀ CL 45 mm, CW 45.2 mm; **D**. *Aethra scruposa*, ♀ CL 48.2 mm, CW 68.8 mm; **E**. *Rhinolambrus longispinus*, ♀ CL 8.4 mm, CW 10 mm; **F**. *Aulacolambrus granulosus*, ♂ CL 10.6 mm, CW 11.8; **G**. *Thalamita mitsiensis*, ♂ CL 9.1 mm, CW 12.3 mm; **H**. *Thalamita gatavakensis*, ♂ CL 4.8 mm, CW 7.5 mm.

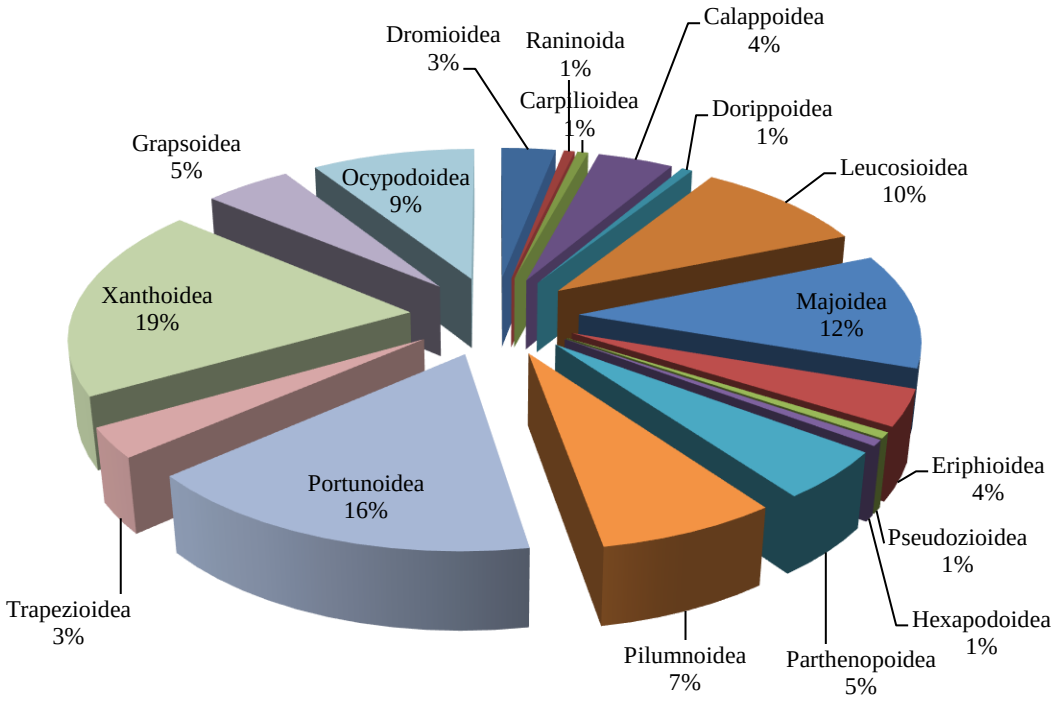

Fig. 3: The percentage of the species counts per superfamilies in Gulf of Aden.

4. Discussion

General discussion

A basic aim of this study is the extension of knowledge on brachyuran crab species in Yemeni coastal waters. This was done based on data from [11], intensive collections of specimen during 2013-2017 by the author, material collected by RUWW 1983-2010, and processing of samples from different previous investigations from museum collections. Additionally data from the literature were used for interpretation.

The area of Aden where most species were found in this study comprises many different habitats such as sandy shores, rocky shores, mud flats, sponge and corals communities. This may be the reason, besides the intensity of collecting activities and methods, why many species are found here. Conversely, one might expect that in other areas, too, many more species may be detected, if the same high effort and intensive sampling work could be invested in the future. Another cause for the abundance of species in the Gulf of Aden are the existence of islands and possibly an influence of upwelling during the southwest monsoon giving additional food as microalgae blooms to the local benthic fauna. The islands are concentrated in two areas in the Gulf, the area of Bir Ali (includes 4 islands, e.g. Sikha, Hallaniya, Ghadda Rayan) and the Aden area (includes 17 islands, among these Labour Island, Mabtoha and Bahra). In addition, the abundance of coral communities between these islands adds to the diversity of habitats. The current study in the area helps reduce the lack of knowledge and may foster investigations in the area.

The coasts in the south of the Arabian Peninsula at Gulf of Aden and Arabian Sea have not received much attention and studies in marine biodiversity field and specially in brachyuran crabs, leading to a large gap in knowledge on the fauna of brachyuran crabs in this region [8, 11, 15-18, 35]

There are several reasons for this knowledge gap in southern Arabia, for instance a connection between scientific expeditions and colonial movements. When reading the list of crustaceans in the British Museum, which was prepared by [36], there are no samples from the Arabian Peninsula. Most samples from the Arabian Peninsula date after the British colonisation. Focusing on the major and important cities in the south of the Arabian Peninsula (Aden during time 1838-1967 and Mukalla during time 1937-1967), the British left the regions between the two cities, a huge area inhabited by Arabian tribes, largely unstudied. Foreign researchers did not approach it during the period of British colonisation of southern Yemen.
Another reason is the system of government in southern Yemen (Yemeni Socialist Party, 1970-1990). This system worked to enhance relations to socialist countries, and therefore prevented, despite exceptions like the Japanese involvement, many researchers from capitalist countries from research in the south of the Arabian Peninsula. The lack of local researchers also played a role in this knowledge gap in southern Arabia.

The biodiversity of brachyuran crabs at the northern shore of the Gulf of Aden are even more limited and almost completely unknown. Some previous scattered

studies on brachyuran crabs in this area are by [20]who recorded one species, [21] 26 species, [22] with one species, [23] 5 species, [24] 3 species, [25] one species, [26] 3 species, [27& 28] 3 species, [16] 19 species, [17] 28 species, [29] 2 species, [31] record a new subspecies from genus *Charybdis*, [32] 2 species, [11] 60 species; [35] with14 species and [34] 30 species, one of them; *Plagusia squamosa* (Latreille, 1804) considered the first records in Gulf of Aden.

The total species number from these studies which recorded the brachyuran crabs in the Gulf of Aden was 100 species (see table 3 in the appendix). Thirty-two species of them not found in the present study.

In this present study, we try covering the large gap in knowledge on the fauna of brachyuran crabs inhabiting in the Gulf of Aden. 1750 specimens were collected in this study from 36 sites at Gulf of Aden and 163 species were recorded. When we compare this result with previous studies, we did not find any intensive study in this area, except for [17]. They sampled two sites only (Sikha Island and Bir Ali) at Gulf of Aden. Twenty-eight species were recorded in this study.

The total species number from these previous studies and the present study recorded 196 species (see table 3 in the appendix).

One species (*Eucrate crenata*) has not been recorded in any site at Gulf of Aden after 1905 when it was recorded by [21]. Presently this species was disappeared from Gulf of Aden.

Also *Calocarcinus africanus* from Trapeziidae, only known from three syntypes collected between Aden and Abyan (Zanzibar), seems to have disappeared from the Gulf of Aden and Indonesia since 1908.

Species distribution

According to [8], the Western Indian Ocean is divided into four subregions, the Arabian Peninsula, East and southern Africa including Madagascar and the other islands, Pakistan (western India and Sri Lanka) and the Maldive Islands, linked with parts of the Eastern Indian Ocean.

When considering the results of the present study we find that the brachyuran crab species in Yemeni coastal waters are similar to the brachyuran crab species which are known from the surrounding of the Arabian Peninsula, that is Red Sea, Gulf of Aden, Arabian Sea, Gulf of Oman and Arabian Gulf (see table 4). This result is consistent with the division of [8] in that the Arabian Peninsula is one region in general. Moreover, [37] mention that the xanthid faunal composition of Dhofar shows similarity to Somalia, the Arabian Gulf, Mozambique, the Maldives, the Gulf of Aden, and the Red Sea. This result was supported by [38] and the present study supports this distribution too.

Exceptions to this pattern are the new species that were first recorded on the Arabian Peninsula and the endemic species in Socotra Island. These species are *Hexapinus simplex* (Type locality: Ekas, Lombok, Indonesia), *Notosceles serratifrons* (Type locality: Sri Lanka), *Cyrtomaia cf. goodridgei* (Type locality: Sri Lanka), *Aethra scruposa* (Type locality: India), *Rhinolambrus longispinus* (Type locality: unknown), *Aulacolambrus granulosus* (Type locality: South China Sea), *Thalamita mitsiensis* (Type locality: Madagascar) and *Thalamita gatavakensis* (Type locality: Indo-West Pacific). The occurrence of these new records still has to be confirmed by more and rigorous sampling, especially since some of these results are based on only one specimen. The possible occurrence of fauna elements from the distant Indian Ocean (and maybe Pacific Ocean) is in principle in accordance with [37]. Despite the gap of information, the possibility of the presence of these species in the Gulf of Aden exists. Currents may transfer species to the Arabian Peninsula, abilities to swim (two of them portunide crabs) may provide gradual migration. Commercial and fishing vessels can transport larvae and adults, especially since the Gulf of Aden and Bab Al-Mandab are international shipping trade routes and important passages for oil tankers.

There seem to be some differences in fauna to the Arabian Gulf. At the Gulf of Aden some species were recorded for the first time which were also earlier recorded in the Red Sea, but not recorded in the Arabian Sea, Gulf of Oman and Arabian Gulf up to now, these species are: *Dorippe frascone*, *Ashtoret picta*, *Hyastenus brockii*, *Sunipea indicus*, *Camposcia retusa*, *Daldorfia horrida*, *Furtipodia petrosa*, *Aulacolambrus hoplonotus*, *Echinoecus pentagonus*, *Glyptoxanthus meandrinus*, *Actaeodes hirsutissimus*, *Neoliomera sabaea*, *Liomera rubra*, *Forestiana depressa*, *Neoxanthops lineatus*, *Geograpsus crinipes* and *Percnon planissimum*.

Three species from genus *Ocypode* that are widespread in sandy shores at the Red Sea, Gulf of Aden and Arabian Sea, but are not recorded in the Arabian Gulf, also supporting some differences.

On the other hand, fauna elements like *Actumnus tesselatus*, an endemic species and type locality in Arabian Gulf according [39], connect the Arabian Gulf with the regions further west. *Actumnus tesselatus* was recorded in the present study at site 30 in Gulf of Aden.

The problems that arise from difficulties of species identification may be shown in the following example. [17] recorded *Lydia annulipes* in Gulf of Aden, Aden coasts (1♀, 4♂♂), however, this species is easily confused with the very similar *Lydia tenax*. During the present study and earlier survey (2008-2017) *Lydia annulipes* was not seen in Aden coasts. Probably the identity can be questioned, because *Lydia tenax* is the common species in Aden coasts.

As in many coast worldwide, constructions and land use are going on at the Yemini coast, too. Risk assessment

and monitoring to guide and protect coastal habitats while making use of these natural resources would be a necessary task. A number of species found in this study are widespread and common, but there have been no real stock assessments, there are no data on population size and population trends. Other species might be rare and even endangered. One the one hand there are not sufficient data, but there are still significant environmental impact effects going on, such as sewage and pollutants from land and sea side (heavily used shipping route) and habitat destruction, overfishing especially for *Portunus* (*Portunus*) *segnis*, destruction of coral reefs.

Acknowledgements

We extend our thanks to everyone who helped us in this work by providing samples and financial and technical support, and we especially mention Dr. Wolfgang Wranik and the staff of the Institute für Biowissenschaften-Meeresbiologie- Rostock University, and we would also like to thank the team of researchers and the staff of Zoologische Staatssammlung München (ZSM), and all the staff of the department of biology in Aden University and the staff of the Marine Science and Biological Research Authority (MSBRA)- Yemen.

Table 4: Shows the widespread of brachyuran crabs species in the Arabian Peninsula coastal waters on the RS: Red Sea, GA: Gulf of Aden, AR: Arab Sea, GO: Gulf of Oman and AG: Arabian Gulf. (+) present, (-) absent.

Family	Species name	RS	GA	AS	GO	AG
Eriphiidae	*Eriphia smithii* MacLeay, 1838	+	+	+	+	+
Portunidae	*Charybdis (Goniohellenus) smithii* MacLeay, 1838	+	+	+	+	+
	Charybdis (Charybdis) hellerii (A. Milne-Edwards, 1867)	+	+	+	+	+
	Charybdis (Goniohellenus) longicollis Leene, 1938	+	+	+	+	+
	Scylla serrata (Forskål, 1775)	+	+	+	+	+
	Carupa tenuipes Dana, 1852	+	+	-	+	+
	Portunus (Portunus) segnis (Forskål, 1775)	+	+	+	+	+
	Portunus (Xiphonectes) longispinosus (Dana, 1852)	+	+	+	+	+
	Portunus (Portunus) sanguinolentus (Herbst, 1783)	+	+	+	+	+
	Thalamita crenata Rüppell, 1830	+	+	+	+	+
	Thalamita prymna (Herbst, 1803)	+	+	-	+	+
	Thalamita sexlobata Miers, 1886	+	+	-	+	+
Tetraliidae	*Tetralia cavimana* Heller, 1861	+	+	+	+	+
Trapeziidae	*Trapezia cymodoce* (Herbst, 1801)	+	+	+	+	+
Pseudoziidae	*Pseudozius caystrus* (Adams & White, 1849)	+	+	+	+	+
Xanthidae	*Xanthias sinensis* (A. Milne-Edwards, 1867)	+	+	+	+	+
	Leptodius exaratus (H. Milne Edwards, 1834)	+	+	+	+	+
	Lophozozymus anaglyptus (Heller, 1861)	+	+	+	+	+
	Luniella spinipes (Heller, 1861)	+	+	+	+	+
	Chlorodiella nigra (Forskål, 1775)	+	+	+	+	+
	Epiactaea margaritifera (Odhner, 1925)	+	+	+	-	+
Grapsidae	*Grapsus albolineatus* Latreille in Milbert, 1812	+	+	+	+	+
Varunidae	*Thalassograpsus harpax* (Hilgendorf, 1892)	+	+	+	+	+
Dotillidae	*Dotilla sulcata* (Forskål, 1775)	+	+	+	+	+
Macrophthal-midae	*Macrophthalmus (Mareotis) depressus* Rüppell, 1830	+	+	+	+	+
Ocypodidae	*Ocypode saratan* (Forskål, 1775)	+	+	+	+	-
	Austruca albimana (Kossmann, 1877)	+	+	+	+	+

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Appendix:

Table 1: Names of the 35 sites on the Yemeni coastal waters at Gulf of Aden, coordinates and description the habitats in these sites:

No	Name of site	Coordinates	Habitats
1	Sukaia	12°37.554 N 43°54.546 E	Sand, rock; sponge.
2	Ras al- Ara	12°36.132 N 43°55.106 E	Sand; sand, rock; subtidal sand.
3	Khor Umeira	12°39.085 N 44°08.577 E	Sand; sand, rock; rock; sponge.
4	Qa'wah	12°40.186 N 44°25.002 E	Sand; sand, rock; subtidal sand.
5	Ras Imran	12°44.967 N 44°43.313 E	Sand, rock; corals; subtidal sand; sponge.
6	Bahra	12°44.011 N 44°42.158 E	subtidal rock, corals; corals; sponge.
7	Imran	12°45.404 N 44°44.569 E	Sand; sand, rock; rock; subtidal sand; corals.
8	Salahadeen	12°45.233 N 44°49.390 E	Sand
9	Faqum	12°44.996 N 44°49.301 E	Sand; sand, rock; rock; subtidal sand; subtidal rock, corals; corals; sponge.
10	Little Aden	12°44.027 N 44°53,095 E	Sand; sand, rock; rock; subtidal sand; subtidal rock, corals; corals; sponge; rock, algae.
11	Mabtoha	12°45.560 N 44°55.048 E	Rock; subtidal rock, corals; corals.
12	Khor bir Ahmed	12°46.324 N 44°53.281 E	Mud flat; mud, rock; rock; sand; sponge; subtidal sand.
13	Mansora Bridge	12°50.371 N 45°01.079 E	Mud, rock
14	Labour Island	12°48.117 N 45°01.474 E	Mud flat; mud, rock; sand, rock; sand; subtidal sand; corals.
15	Al arossah	12°46.387N 44°58.329 E	Rock; sand, rock; subtidal rock, corals; subtidal sand.
16	Gold Mohur	12°45.552N 44°59.185 E	Sand; sand, rock; rock; subtidal sand; corals.
17	Sirah	12°46.403N 45°03.006 E	Rock.
18	Abyan coast	12°48.485 N 45°02.381 E	Sand; sand, rock; rock; subtidal sand; corals.
19	Shuqra	13°21.185N 45°40.412 E	Sand; mud flat; sand, rock; subtidal sand.
20	Belhaf	13°58.622' N 48°10.746' E	Rock; sand, rock.
21	Bay E of Bir Ali	14°00.368' N 48°19.324' E	Rock; sand; sand, rock; subtidal sand; corals; sponge.
22	Sikha	13°55.822' N 48°23.147' E	Sand, rock; subtidal sand; corals.
23	Hallaniya	13°59.225' N 48°19.050' E	Sand, rock; subtidal sand; subtidal rock, corals; corals.
24	Ghadda Rayan	14°00.656' N 48°23.911' E	Rock; subtidal sand; corals.
25	Ras Majdaha	14°00.868' N 48°25.572' E	Sand, rock; subtidal sand; subtidal rock, corals; sponge.
26	Wadi Hager	14°05.344' N 48°43.490' E	Sand.
27	Ras Burum	14°19.692' N 48°59.755' E	Sand, rock; corals.
28	Mukalla	14°30.535 N 49°05.078 E	Sand; rock; sand, rock.
29	Maqrugha	14°49.229' N 50°00.952' E	Rock; subtidal sand; subtidal rock, corals; corals; sponge
30	Ras Sharma	14°49.382' N 50°01.392' E	Sand, rock; subtidal sand; corals; sponge.
31	Al-Quran	14°50.872' N 50°00.818' E	Sand, rock; rock; subtidal sand.
32	Wadi Jethmun	14°50.622' N, 50°05.281' E	Sand; sand, rock.
33	Between Ras Bin Ramdan and Ras Baghashawa	14°50.474' N 50°09.505' E	Corals.

34	Ras Baghashawa	14°51.828' N 50°11.911' E	Rock; subtidal sand; sponge.
35	Ras Qusair	14°55.120' N 50°19.592' E	Corals.
36	Sayhut	15°11.912 N 51°14.014 E	Sand; rock; sand, rock.

Table 3: Shows the comparing for the Gulf of Aden between the present study* and [17]** with other studies***: [20]+[1], [21]+[2], [22]+[3], [23]+[4], [24]+[5], [25]+[6], [26] +[7], [27& 28]+[8], [16]+[9], [29]+[10], [30]+[11], [31] +[12], [32]+[13], [11]+[14], [35]+[15], Present (+) and absent (-).

Family	Taxon	*	**	***
Dromiidae	*Lauridromia dehaani* (Rathbun, 1923)	+	-	+[11], +[14]
	Epigodromia granulata (Kossman, 1878)	+	-	-
	Cryptodromia fallax (Latreille in Milbert, 1812)	+	-	+[11]
	Cryptodromia hilgendorfi De Man, 1888	-	-	+[11]
	Cryptodromia pentagonalis (Hilgendorf, 1879)	-	-	+[2]
	Ascidiophilus caphyraeformis Richters, 1880	+	-	-
	Lewindromia unidentata (Rüppell, 1830)	+	-	-
Raninidae	*Notosceles serratifrons* (Henderson, 1893)	+	-	-
Carpiliidae	*Carpilius convexus* (Forskål, 1775)	+	-	-
Calappidae	*Calappa hepatica* (Linnaeus, 1758)	+	-	-
	Calappa capellonis Laurie, 1906	+	-	-
	Calappa gallus (Herbst, 1803)	+	-	-
	Calappa philargius (Linnaeus, 1758)	+	-	+[14]
	Mursia bicristimana Alcock & Anderson, 1894	+	-	-
Matutidae	*Ashtoret lunaris* (Forskål, 1775)	+	-	+[2], +[7], +[14]
	Ashtoret picta (Hess, 1865)	+	-	+[7]
	Matuta victor (Fabricius, 1781)	-	-	+[2], +[7], +[14]
Dorippidae	*Dorippe frascone* (Herbst, 1785)	+	-	+[14]
Eriphiidae	*Eriphia smithii* MacLeay, 1838	+	+	+[14]
	Eriphia sebana (Shaw & Nodder, 1803)	+	-	+[14]
Oziidae	*Epixanthus frontalis* (H. Milne Edwards, 1834)	+	-	-
	Epixanthus corrosus A. Milne-Edwards, 1873	+	-	-
	Lydia tenax (Rüppell, 1830)	+	-	-
	Lydia annulipes (H. Milne-Edwards 1834)	-	+	-
Menippidae	*Menippe rumphii* (Fabricius, 1798)	+	-	-
Hexapodidae	*Hexapinus simplex* Rahayu & Ng, 2014	+	-	-
Leucosiidae	*Coleusia biannulata* Tyndale-Biscoe & George, 1962	+	-	-
	Leucosia anatum (Herbst, 1783)	+	-	+[11]
	Hiplyra quamosal (Rüppell, 1830)	+	-	+[2]
	Philyra granigera Nobili, 1906	+	-	-
	Ebalia abdominalis Nobili, 1906	+	-	+[11]
	Nobiliella jousseaumei (Nobili, 1906)	+	-	+[2]
	Nucia tuberculosa A. Milne-Edwards, 1874	-	-	+[2]
	Ryphila cancellus (Herbst, 1783)	+	-	+[11]
	Philyra cf. globus (Fabricius, 1775)	+	-	-
	Nursilia dentata Bell, 1855	+	-	-

	Cryptocnemus cf. pentagonus Stimpson, 1858	+	-	-
	Leucisca rubifera (Müller, 1887)	+	-	-
	Arcania gracilis Henderson, 1893	+	-	-
	Ixa holthuisi Tirmizi, 1970	+	-	-
	Myra subgranulata Kossmann, 1877	+	-	-
	Arcania cf. tuberculata Bell, 1855	+	-	-
	Arcania undecimspinosa de Haan, 1841	+	-	+[11]
Epialtidae	*Acanthonyx limbatus* A. Milne-Edwards, 1862	+	-	-
	Stilbognathus cervicornis (Herbst, 1803)	+	-	-
	Tylocarcinus styx (Herbst, 1803)	+	-	-
	Huenia heraldica (De Haan, 1837)	+	-	-
	Simocarcinus simplex (Dana, 1851)	+	-	-
	Hyastenus hilgendorfi De Man, 1887	+	-	-
	Hyastenus brockii de Man, 1887	+	-	-
	Menaethius monoceros (Latreille, 1825)	+	-	-
Majidae	*Schizophrys aspera* H. Milne Edwards, 1834	+	-	+[14]
	Micippa platipes Rüppell, 1830	+	-	-
	Seiitaoides cf. stimpsonii (Miers, 1884)	+	-	-
	Cyclax spinicinctus Heller, 1861	+	-	-
	Majidae.gen. sp. 1	+	-	-
Inachidae	*Sunipea indicus* (Alcock, 1895)	+	-	-
	Cyrtomaia cf. goodridgei McArdle, 1900	+	-	-
	Camposcia retusa (Latreille, 1829)	+	-	-
	Macropodia quamos Rathbun, 1911	+	-	-
	Inachus dorsettensis (Pennant, 1777)	+	-	-
Pseudoziidae	*Pseudozius caystrus* (Adams & White, 1849)	+	+	+[14]
Parthinopidae	*Daldorfia horrida* (Linnaeus, 1758)	+	-	+[14]
	Aethra scruposa (Linnaeus, 1764)	+	-	-
	Daldorfia spinosissima (A. Milne-Edwards, 1862)	+	-	-
	Parthenope longimanus (Linnaeus, 1758)	+	-	-
	Furtipodia petrosa (Klunzinger, 1906)	+	-	-
	Rhinolambrus longispinus (Miers, 1879)	+	-	-
	Aulacolambrus granulosus (Miers, 1879)	+	-	-
	Aulacolambrus hoplonotus (Adams & White, 1849)	+	-	-
Pilumnidae	*Eurycarcinus orientalis* A. Milne-Edwards, 1867	+	-	+[14]
	Eurycarcinus integrifrons de Man, 1879	+	-	+[2], +[11], +[14]
	Pilumnus vespertilio (Fabricius, 1793)	+	-	-
	Pilumnus minutus De Haan, 1835	+	-	+[14]
	Pilumnus eudaemoneus Nobili, 1906	-	-	+[2]
	Glabropilumnus levimanus (Dana, 1852)	+	-	-
	Pilumnopeus convexus (Maccagno, 1936)	+	-	+[11]
	Pilumnus incanus (Forskål, 1775)	+	-	-
	Actumnus tesselatus Alcock, 1898	+	-	-

	Actumnus asper (Rüppell, 1830)	+	-	+[2]
	Pilumnus savignyi Heller, 1861	+	-	-
	Echinoecus pentagonus (A. Milne-Edwards, 1879)	+	-	-
	Calocarcinus africanus Calman, 1909	-	-	+[5], +[6]
Galenidae	*Halimede tyche* (Herbst, 1801)	+	-	-
Portunidae	*Charybdis (Goniohellenus) smithii* MacLeay, 1838	+	+	+[9],+[11], +[12], +[14], +[15]
	Charybdis (Goniohellenus) omanensis Leene 1938	-	+	+[9],+[12]
	Charybdis (Charybdis) feriata (Linnaeus, 1758)	+	-	+[14], +[15]
	Charybdis (Charybdis) natator (Herbst, 1794)	+	-	+[14], +[15]
	Charybdis (Charybdis) orientalis Dana, 1852	+	-	+[14], +[15]
	Charybdis (Charybdis) annulata (Fabricius, 1798)	+	-	+[14], +[15]
	Charybdis (Charybdis) hellerii (A. Milne-Edwards, 1867)	+	+	+[14], +[15]
	Charybdis (Goniohellenus) longicollis Leene, 1938	+	-	-
	Podophthalmus vigil (Weber, 1795)	-	-	+[2], +[9],+[11]
	Portunus (Portunus) segnis (Forskål, 1775)	+	+	+[14], +[15]
	Portunus (Xiphonectes) arabicus (Nobili, 1906)	+	+	+[9]
	Portunus (Xiphonectes) quamosa (A. Milne-Edwards, 1861)	-	-	+[9]
	Cycloachelous orbitosinus (Rathbun, 1911)	+	-	+[9],+[11]
	Cycloachelous granulatus (H. Milne Edwards, 1834)	-	-	+[9],+[11]
	Xiphonectes alcocki (Nobili, 1906)	-	+	-
	Portunus argentatus (A. Milne-Edwards 1861)	-	+	-
	Portunus (Portunus) sanguinolentus (Herbst, 1783)	+	-	+[9],+[11], +[14], +[15]
	Portunus (Xiphonectes) longispinosus (Dana, 1852)	+	-	+[9]
	Portunus (Xiphonectes) guinotae Stephenson & Rees, 1961	+	-	-
	Portunus (Achelous) dubius (Laurie, 1906)	-	+	-
	Scylla serrata (Forskål, 1775)	+	-	+[9], +[14], +[15]
	Carupa tenuipes Dana, 1852	+	-	-
	Thalamita crenata Rüppell, 1830	+	-	+[9],+[11], +[14], +[15]
	Thalamita prymna (Herbst, 1803)	+	-	+[9], +[14], +[15]
	Thalamita admete (Herbst, 1803)	+	-	-
	Thalamita poissonii (Audouin, 1826)	+	-	+[9]
	Thalamita mitsiensis Crosnier, 1962	+	-	-
	Thalamita sexlobata Miers, 1886	+	-	+[9],+[11]
	Thalamita bandusia Nobili, 1906	+	-	+[9]
	Thalamita gatavakensis Nobili, 1906	+	-	-
	Thalamita cf. crosnieri Vannini 1983	+	-	-
	Thalamita quadrilobata Miers, 1884	+	-	+[9]

	Thalamita savignyi A. Milne-Edwards, 1861	-	-	+[9]
	Thalamita foresti Crosnier, 1962	-	-	+[9]
	Thalamita indistincta Apel & Spiridonov, 1998	-	-	+[9]
	Thalamita sp.	+	-	-
	Thalamita cf. stephensoni Crosnier 1962	+	-	-
	Thalamita aff. Exetastica Alcock 1899	-	+	-
	Thalamita chaptalii (Audouin, 1826)	-	-	+[2]
Trapeziidae	*Trapezia cymodoce* (Herbst, 1801)	+	+	+[2],+[10], +[14]
	Trapezia tigrina Eydoux & Souleyet, 1842	+	+	+[10]
	Trapezia rufopunctata (Herbst, 1799)	-	-	+[2], +[14]
	Quadrella coronata Dana, 1852	+	-	-
	Calocarcinus africanus Calman, 1909	-	-	+[5]
Tetraliidae	*Tetraloides nigrifrons* (Dana, 1852)	+	-	-
	Tetralia cavimana Heller, 1861	+	-	-
Euryplacidae	*Eucrate crenata* (De Haan, 1835)	-	-	+[2]
Xanthidae	*Atergatis integerrimus* (Lamarck, 1818)	+	-	+[14]
	Demania mortenseni (Odhner, 1925)	+	-	-
	Etisus laevimanus Randall, 1840	+	-	+[11]
	Xanthias sinensis (A. Milne-Edwards, 1867)	+	+	+[2], +[14]
	Lybia quamos Barnard, 1946	+	-	-
	Platypodia cf. pseudogranulosa Serène, 1984	+	-	-
	Leptodius exaratus (H. Milne Edwards, 1834)	+	+	+[11], +[14]
	Leptodius sanguineus (H. Milne-Edwards 1834)	-	+	+[2], +[14]
	Macromedaeus crassimanus (A. Milne-Edwards 1867)	-	+	+[11], +[14]
	Macromedaeus voeltzkowi (Lenz, 1905)	+	-	-
	Forestiana depressa (White, 1848)	+	-	-
	Hypocolpus diverticulatus (Strahl, 1861)	-	-	+[2]
	Neoliomera sabaea (Nobili, 1906)	+	-	-
	Neoxanthops lineatus (A. Milne-Edwards, 1867)	+	-	+[2]
	Neoxanthias impressus (Lamarck 1818)	-	+	-
	gen. sp. 1	+	-	-
	gen. sp. 2	+	-	-
	gen. sp. 3	+	-	-
	Chlorodiella laevissima (Dana, 1852)	+	-	-
	Chlorodiella nigra (Forskål, 1775)	+	+	+[2]
	Liocarpilodes harmsi (Balss 1934)	-	+	-
	Cyclodius granulatus (Targioni-Tozzetti, 1877)	+	-	-
	Cyclodius drachi (Guinot, 1964)	-	+	-
	Zosimus aeneus (Linnaeus, 1758)	+	-	-
	Psaumis cavipes (Dana, 1852)	-	-	+[2],+[11]
	Zozymodes pumilus (Jacquinot 1852)	-	+	-
	Glyptoxanthus meandrinus (Klunzinger, 1913)	+	-	-
	Actaea cf. bocki Odhner, 1925	+	-	-
	Actaeodes hirsutissimus (Rüppell, 1830)	+	+	-

	Actaeodes tomentosus (H. Milne Edwards, 1834)	+	+	$+^{2}$
	Paractaea rufopunctata (H. Milne Edwards, 1834)	+	-	$+^{2},+^{3},+^{5}$
	Epiactaea margaritifera (Odhner, 1925)	+	-	$+^{2},+^{5},+^{11}$
	Lophozozymus anaglyptus (Heller, 1861)	+	+	-
	Pilodius areolatus (H. Milne Edwards, 1834)	+	-	-
	Xanthias cf. canaliculatus Rathbun, 1906	+	-	-
	Cymo andreossyi (Audouin, 1826)	+	-	-
	Cymo quadrilobatus Miers, 1884	+	-	-
	Cymo melanodactylus Dana, 1852	-	-	$+^{2}$
	Liomera rubra (A. Milne-Edwards, 1865)	+	-	-
	Pseudoliomera speciosa (Dana 1852)	-	+	$+^{2}$
	Lachnopodus subacutus (Stimpson 1858)	-	+	$+^{14}$
	Luniella spinipes (Heller, 1861)	+	-	$+^{6}$
Grapsidae	*Grapsus albolineatus* Latreille in Milbert, 1812	+	-	$+^{11}$, $+^{14}$
	Grapsus tenuicrustatus (Herbst, 1783)	+	-	$+^{11}$, $+^{14}$
	Grapsus granulosus H. Milne Edwards, 1853	+	-	$+^{11}$, $+^{14}$
	Metopograpsus messor (Forskål, 1775)	+	-	$+^{1}$, $+^{11}$, $+^{14}$
	Metopograpsus thukuhar (Owen, 1839)	+	-	$+^{14}$
	Geograpsus crinipes (Dana, 1851)	+	-	-
Varunidae	*Thalassograpsus harpax* (Hilgendorf, 1892)	+	-	$+^{2},+^{11}$
Plagusiidae	*Percnon planissimum* (Herbst, 1804)	+	-	-
Macrophthalmidae	*Macrophthalmus (Macrophthalmus) sulcatus* H. Milne Edwards, 1852	+	-	$+^{14}$
	Macrophthalmus (Macrophthalmus) grandidieri A. Milne-Edwards, 1867	+	-	-
	Macrophthalmus (Mareotis) depressus Rüppell, 1830	+	-	$+^{11}$, $+^{14}$
	Macrophthalmus (Macrophthalmus) graeffei A. Milne-Edwards, 1873	+	-	-
	Macrophthalmus (Macrophthalmus) serenei Takeda & Komai, 1991	+	-	-
	Chaenostoma boscii (Audouin, 1826)	+	-	-
	Macrophthalmus (Mareotis) laevis A. Milne-Edwards, 1867	+	-	-
	Chaenostoma sinuspersici (Naderloo & Türkay, 2011)	+	-	-
Dotillidae	*Dotilla sulcata* (Forskål, 1775)	+	-	$+^{2}$, $+^{14}$
Ocypodidae	*Ocypode saratan* (Forskål, 1775)	+	-	$+^{8}$, $+^{11}$, $+^{14}$
	Ocypode cordimana Latreille, 1818	+	-	$+^{8}$
	Ocypode jousseaumei (Nobili, 1906)	+		$+^{8}$, $+^{11}$, $+^{14}$
	Austruca albimana (Kossmann, 1877)	+	-	$+^{11}$, $+^{14}$
	Cranuca inversa (Hoffmann, 1874)	+	-	-
	Gelasimus hesperiae (Crane, 1975)	+	-	-

مقالة بحثية

تسجيل جديد لأنواع السرطانات قصيرات البطن (قشريات- عشريات الارجل) في خليج عدن- اليمن

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استلم في: 12 مارس 2023 / قبل في: 25 مارس 2023 / نشر في 31 مارس 2023

المُلخّص

المعلومات المتعلقة بالتنوع الحيوي للقشريات، وخاصة السرطانات قصيرات البطن على السواحل الشمالية لخليج عدن محدودة للغاية وغير معروفة تمامًا. لم تحظ السواحل في جنوب شبه الجزيرة العربية الواقعة على خليج عدن بالكثير من الاهتمام، الا القليل من الدراسات في مجال التنوع الحيوي البحري بشكل عام وسرطانات البحر بشكل خاص. هناك فجوة معرفية كبيرة حول السرطانات قصيرات البطن في جنوب الجزيرة العربية الواقعة على خليج عدن، لذلك؛ تهدف هذه الدراسة إلى سد الفجوة المعرفية في البيانات في هذا الجزء من شبه الجزيرة العربية. في هذه الدراسة، تم جمع 1750 عينة من السرطانات قصيرات البطن من 36 موقعًا على طول المياه الساحلية اليمنية في خليج عدن. تم جمع هذه العينات باليد، والشباك اليدوية، والغطس حتى عمق 2 متر، والغوص تحت الماء، علاوة على ذلك، تم استخدام شباك الجر حتى عمق 300 متر، ومصائد الأسماك الصغيرة. تم نقل جميع هذه العينات إلى متحف التاريخ الطبيعي في مدينة ميونخ- المانيا ZSM لتصنيفها (من خلال الخصائص المورفولوجية، والخصائص المورفولوجية لأعضاء التناسل الذكرية). تم تسجيل جميع المعلومات الخاصة بالعينات والتي شملت الجنس والقياسات والمواقع وتواريخ الجمع والموائل وجامعي العينات. اسفرت هذه الدراسة الى تسجيل 163 نوعًا من السرطانات قصيرات البطن تنتمي إلى 17 فوق عائلة، مندرجة تحتها 28 عائلة، و 110 جنسا، من بين هذه الانواع؛ 53 نوعًا تعتبر تسجيل جديد في خليج عدن، علاوة على ذلك، تعتبر 8 أنواع منها تسجيل جديد في المياه البحرية لشبه الجزيرة العربية.

الكلمات المفتاحية: تسجيل جديد، عشريات الارجل، سرطانات قصيرات الطن، خليج عدن.

How to cite this article:

A. Al-Hindi, S. Forster, M. Apel and R. Melzer, “NEW RECORDS OF BRACHYURAN CRABS SPECIES (CRUSTACEA-DECAPODA) IN GULF OF ADEN- YEMEN”, *Electron. J. Univ. Aden Basic Appl. Sci.*, vol. 4, no. 1, pp. 106-129, Mar. 2023. DOI: https://doi.org/10.47372/ejua-ba.2023.1.227