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CONTRIBUTION TO THE SEA CUCUMBER FAUNA (ECHINODERMATA: HOLOTHUROIDEA) AT THE VICINITY OF BAB EL-MANDAB, RED SEA, YEMEN

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Abstract

The present work is dealing with the sea cucumber (holothuroids) fauna at the vicinity of Bab El-Mandab area, at the entrance of the Red Sea, Yemen. Holothuroid fauna were collected from five sites, these are: Bab El-Mandab, El-Khokha, El-Makha harbor, Gulf of Aden and mangrove area. A total of 28 species belonging to 3 orders, 4 families and 9 genera were reported. Bab El-Mandab area had the highest species diversity; it comprised 22 species represented 78.6 % of the total recorded species. Followed by El-Khokha and El-Makha areas; they included 15 (53.6 %) and 11 (39.3 %) species respectively. On the other hand, mangrove area contained the lowest number of species, being 3 species (10.7 %). Genus *Holothuria* comprised the largest number of species and included 13 species (46.4 %), however, there were five genera each one was represented by only one species. The results of the present work and previous studies indicated that there are 12 species considered to be new record for such area. Among 28 holothuroids species recorded in the study sites, there are 5 species (17.9%) considered to be endemic to the Red Sea. Habitat distribution revealed that sandy habitat had the largest number of species, 22 species (78.6 %), followed by coral habitat (dead and live corals), 18 species (64.3 %), sea-grass bed 15 species (53.6 %) and the rocky habitat (46.4 %). Notes on the status of species, species diversity and density, habitat and geographical distribution are giving.

Introducion

The holothuroids (sea cucumbers) are conspicuous element of the reef fauna in many parts of the world and in particularly achieved in the Red Sea (Campbell, 1987). Bab-El-Mandab area, Yemen, (the entrance of the Red Sea) is valued as a unique environment with a wide range of habitats. However, it is a fragile environment, affected easily by disturbances or changes in the environmental conditions. As a result of extensive sampling in the Red Sea and Gulfs of Aqaba and Suez as well as the adjacent areas (James, 1976; James and Pearse, 1969; Clark and Rowe, 1971; Roman, 1980; Fouda and Hellal, 1987; Hellal, 1990; Hasan, 2001; 2003; Hasan and Hasan, 2004), there is considerable knowledge of the echinoderm faunas of these areas. In spite of the importance of holothuroid fauna in the Red Sea, very little attention was given to them, and only few records of holothuroids were

encountered (Hasan, 2001; Abou-Zeid *et al.*, 2002; Hellal, *et al.*, 2002; 2007; Hasan and Hasan, 2004). Cherbonnier was one of the pioneers, who mad an intensive work on the holothuroid fauna of the Gulf of Aqaba in 1962, and recorded only 15 species. In the following years, 14 species were recorded by James and Pearse (1969). Many lists indicating the holothuroids fauna from the Red Sea were given by different authors. These lists summarized as follow: 80 holothuroid species (included deep sea holothuroids) well known in the list given by Clark and Rowe (1971) and Price's list in 1982 from the Red Sea and its Gulfs; 36 species by Hasan (2001) from the Red Sea; 14 species by Hasan (2003) from the Gulf of Aqaba; 25 species by Hasan and Hasan (2004) from the Gulf of Aqaba and 36 species by Hellal *et al.*, (2007) from the Red Sea.

The distribution study of a holothuroid population provides an understanding to how environmental factors affect its life. There is an obvious limit to the species distribution linked to substrate, depth, hydrodynamics, settlement, and distance from shore in addition to the availability of food (Young and Chia, 1982; Massion and Doumen, 1986; Kerr *et al.*, 1993; Hasan and Hasan, 2004). Nowadays, factors affecting distribution of sea cucumbers include substrate (Roberts, 1979; Mercier *et al.*, 1999), availability of food (Wiedemeyer, 1992; 1994), variety of niches and natural predators (Boffi, 1972; Guille and Ribes, 1981; Mezali, 2001; Hasan, 2001; Hellal *et al.*, 2007), depth (Price, 1982; Lokani *et al.*, 1996) and human impacts (Hasan, 2003; Hasan and Hasan, 2004).

The goal of this paper is to survey the sea cucumber fauna at Bab-El-Mandab area to give spot light on the biodiversity and density of holothuroid species, the effect of human impacts and natural ecological factors on their distribution as well as to compare between holothuroid fauna at such area and other parts of the Red Sea.

Materials And Methods

Regular visits to survey the holothuroid fauna at Bab El-Mandab area, (the entrance of the Red Sea) Yemen were conducted during the period from November 2005 to January 2009. The survey covered 5 sites; these were Gulf of Aden (12.676426 N, 43.234352 E) the neighboring part and closed to Bab El-Mandab, the vicinity of Bab El-Mandab (12.677559 N, 43.461743 E), mangrove at fishing village (12.678784 N, 43.461592 E), El-Makha harbor (13.311088 N, 43.234352 E) and El-Khokhah (13.805160 N, 43.240907 E). The surveyed sites were chosen according to

their different habitats and a variety of ecological conditions, besides including both near shore and offshore sites (Meion Island). The sites were varied between highly protected and well sheltered habitats (Bab El-Mandab, Mangrove and El-Khokhah), exposed habitat (Gulf of Aden) and other subjected to the human impacts (El-Makha harbor).

Three line transects (60 meters length) were made at each site starting from the highest water mark parallel to the shore and covering different zones and habitats. The transects were made to cover the back reef, mid reef and fore reef at reef flat, then at reef slope up to 5 meters depth. Along each transect 5 quadrates were made each 5 X 5 meters. At each study site the following data were determined: (a) number of holothuroid species; (b) species density; (c) status of each species, (d) records of human impacts and (e) description of different biotopes of reef and type of substrate. Samples of representative holothuroid fauna of each site were collected and preserved in 10 % sea water formalin. The samples were transported to the laboratory, faculty of Science, Ibb University, where they were sorted and identified using the available standard keys such as (Rowe, 1969; Clark and Rowe, 1971; Cherbonnier, 1988; and Hellal *et al.,* 2002).

The status of each species was determined using the following categories: (a) the term "**Rare species**" was applied when only one to five individuals of a species were present; (b) the term "**Common species**" was given for species have more than 5 and less than 10 individuals and (c) the term "**Abundant species**" for a species has more than 10 individuals. In this work, the terms used in the species description and identification according to Cherbonnier (1988), Hasan (2001) and Hellal *et al*., (2002).

Results

I- Systematic account

Order: Aspidochirotida

Family: Holothuriidae

Genus: *Actinopyga* Bronn, 1860

Actinopyga crassa Panning, 1944

Actinopyga crassa Panning, 1944: 51, fig. 19; Cherbonnier, 1955 b: 137, Pl, 27; Cherbonnier and Feral, 1984a: 664, Fig., 3; Cherbonnier, 1988: 24-27, fig., 6.

Materials examined: Five specimens were examined from Bab el Mandab at the

entrance of the Red Sea.

Habitats: *Actinopyga crassa* usually found in the subtidal areas, particularly seagrass patches and sand patches, as well as the sandy lagoon in the reef. This species never found on the reef crest or reef slope, but could be found on the sandy slope at depths ranged from 3 to 8 meters.

Status: Common species.

Distribution: *Actinopyga crassa* is restricted in their distribution. It is recorded from the Red Sea, East Africa, Southeast Arabia, Madagascar, New Caledonia and New Guinea.

***Actinopyga echinites* (**Jaeger, 1833)

Synonyms:

Mulleria echinites Jaeger, 1833: 17, Pl. 3, Fig. 6

Actinopyga echinites*:* Cherbonnier, 1955 b: 136, Pl. 25; Rowe, 1969: 131, Fig. 3; Clark and Rowe, 1971: 176, Pl. 27, fig. 1; Rowe and Doty, 1977: 228, Fig. 2e, Pl. 6c; Tortonese, 1980: 104.

Holothuria (Actinopyga) echinites: Panning, 1929: 129, Fig. 12

Actinopyga echinites echinites Panning, 1944: 48, Fig. 17

Materials examined: Seven specimens were examined from Bab el Mandab, El Khokhah and El Makha.

Habitats: *Actinopyga echinites* rarely found in the intertidal zone and it is most frequent in the subtidal area. It occupies the dead and live coral habitats, and the sand patches among corals. It is also found on reef front and reef slope, as well as seagrass beds.

Status: Common species.

Distribution: *Actinopyga echinites* is common in certain places in the Indo-Pacific region. It is recorded from the Red Sea; East Africa; Southeast Arabia; Indonesia and Australia.

Actinopyga mauritiana (Quoy and Gaimard, 1833)

Synonyms:

Holothuria mauritiana Quoy and Gaimard, 1833: 138

Mulleria mauritiana Brandt, 1835: 74

Actinopyga mauritiana*:* Bell, 1887: 633, Pl. 39, Fig. 1; Panning, 1944: 55, fig. 23-24; Cherbonnier, 1952: 41, fig. 16; 1955: 139; Clark and Rowe, 1971: 176, Pl. 27, fig. 3; Rowe and Doty, 1977: 228, fig. 2f, Pl. 6d; Tortonese, 1980: 104.

Materials examined: Eleven specimens were examined from all studied sites except mangrove area.

Habitats: *Actinopyga mauritiana* usually found in the subtidal zone and never exist in the intertidal ones. It is abundant in sandy areas and sand lagoons in the coral reef. It is rarely found in corals. Also very few individuals were seen in grassy areas.

Status: Abundant species.

Distribution: *Actinopyga mauritiana* is a world wide species in their distribution and very common through the Indo-West-Pacific regions including the Red Sea.

Genus: *Bohadschia* Jaeger, 1833

Bohadschia cousteaui Cherbonnier, 1954

Bohadschia cousteaui Cherbonnier, 1954 a: 252; 1955b: 133, Pl. 23, fig. a; 1963: 5; 1967: 55; 1988: 292, Pl. 15, fig. a-j.

Materials examined: Three specimens were examined from El-Khokhah area.

Habitats: *Bohadschia cousteaui* is a subtidal species, occasionally found in the intertidal areas. This species found mainly in the rocky areas, it also found in both dead and live corals at depths ranged between 3 to 20 meters deep.

Status: Common species.

Distribution: *Bohadschia cousteaui* was described for the first time from the Red Sea (type locality) by Cherbonnier in 1954, and never recorded from any other locality. But in 1988, the same author recorded this species based on two small specimens from Madagascar Island and mentioned that this species needs more confirmation. Thus this species was considered to be endemic to the Red Sea, and recorded in the present study from southern Red Sea for the first time.

Bohadschia mitsioensis Cherbonnier, 1988

Bohadschia mitsioensis Cherbonnier, 1988: 36-40, Pl. 12, Fig. a-h.

Materials examined: Eleven specimens were examined from all studied areas.

Habitats: *Bohadschia mitsioensis* occupy different habitats such as sand, seagrass, rocks and dead corals. The more favour habitat for this species is the rocky substrates.

Status: Common species.

Distribution: *Bohadschia mitsioensis* is very restricted in its distribution, it only found in Red Sea and Madagascar Island.

Remarks:

Bohadschia mitsioensis was described for the first time by Cherbonnier in 1988, from Madagascar Island at East Africa based on two specimens. On the other hand, Hasan (2001) and Hellal *et al*. (2007) recorded this species from different localities in the Red Sea proper (particularly the Northern part) and Gulf of Aqaba. They considered this species to be new record for the entire Red Sea. In the present study, this species recorded from Bab El-Mandab area for the first time.

Bohadschia steinitzi Cherbonnier, 1963

Bohadschia steinitzi Cherbonnier, 1963: 6-8, Pl. 2, Fig. a-k; 1988:292

Materials examined: 7 specimens were examined from Bab El-Mandab and El-Khokhah.

Habitats: *Bohadschia steinitzi* mainly live in the subtidal area at depths ranged between 5 to 25 meters. It prefers the sand lagoons and sand patches, they never found in coral areas.

Status: Common species.

Distribution: *Bohadschia steinitzi* is endemic to the Red Sea.

Bohadschia tenuissima (Semper, 1868)

Synonyms:

Holothuria tenuissima Semper, 1868: 85, 248, Pl. 30, Fig. 20

Bohadschia marmorata tenuissima Panning, 1944: 42

Bohadschia tenuissima: Cherbonnier, 1955a: 135, Pl. 22; 1984: 675; 1988: 46-48, fig. 16, A.

Materials examined: Two specimens were examined from Bab El-Mandab area.

Habitats: *Bohadschia tenuissima* lives in the sandy habitats and coral patches, also it can be found in the sandy area with seagrass at depth up to 25 meter (Cherbonnier, 1988).

Status: Rare species.

Distribution: *Bohadschia tenuissima* was recorded from the Red Sea, Ceylon area, Bay of Bengal, East Indies, Philippine Island, China and South Japan, and South Pacific Islands.

Bohadschia vitiensis (Semper, 1868)

Synonyms:

Holothuria vitiensis Semper, 1868: 80, 247, Pl. 30, Fig. 12

Holothuria clemens Ludwig, 1875: 107, Pl.7 Fig. 49

Bohadschia marmorata vitiensis*:* Panning, 1944: 40, Fig. 11

Bohadschia vitiensis: Pearson, 1914: 170; Cherbonnier, 1988: 292.

Materials examined: Five specimens were examined from Bab-El-Mandab and El-Makha.

Habitats: *Bohadschia vitiensis* can live in two types of habitats, sandy habitat, which includes seagrass patches and coral habitats especially the living corals.

Status: Common species.

Distribution: *Bohadschia vitiensis* was recorded from the Red Sea, East Africa, Madagascar Island, Bay of Bengal, Indonesia, New Caledonia Soma and Fiji Islands. The recording of this species from Bab El-Mandab area considered to be a new record for the first time.

Remarks:

Cherbonnier described *Bohadschia vitiensis* in 1988, from Madagascar Island at East Africa. In their studies Hasan (2001) and Hellal *et al.* (2007) recorded this species for the first time from many localities in the northern Red Sea and the Gulf of Aqaba. The characters of specimens collected from the studied sites are in full agreement with the description given by Cherbonnier (1988). Thus, *Bohadschia vitiensis* is considered to be a new record for the southern Red Sea.

Genus: Labidodemas Selenka, 1867

Labidodemas rugosum **(**Ludwig, 1875)

Synonyms:

Holothuria rugosa Ludwig, 1875: 110, Pl.7, Fig. 33 d-e

Labidodemas rugosum**:** Rowe, 1969: 133; Clark and Rowe, 1971: 176, fig. 88a, Pl. 28, fig. 14; Tortonese, 1980: 104, fig. 3.

Materials examined: Two specimens were examined from Bab El-Mandab area.

Habitats: *Labidodemas rugosum* is found buried in sand under rocks and dead coral edges in the subtidal areas. Also, Hasan (2001) found it at depths up to 30 meters.

Status: Rare species.

Distribution: *Labidodemas rugosum* recorded by many authors from the Red Sea, Maldives area, Bay of Bengal, East Indies, North Australia, Philippine Islands and South Pacific Islands.

Remarks:

Labidodemas rugosum usually found with the sympatric species *L. semperianum* in many localities (Clark and Rowe, 1971), but differ from the latter species in the presence of much more spinose tables than those found in *L. semperianum* among spicules. Many authors recorded *Labidodemas rugosum* from different localities in the Indo-Pacific regions and confirm the same differences (Rowe, 1969; Clark and Rowe, 1971; Tortonese, 1980). In the present study, the characters of the examined specimens are in full agreement with *L. rugosum* description.

Genus: ***Holothuria*** Linnaeus**, 1767**
Subgenus: *Halodeima* Pearson, 1914
Holothuria (Halodeima) atra Jaeger, 1833

Synonyms:

Holothuria atra Jaeger, 1833: 22; Panning, 1934: 30, fig. 22.

Holothuria affinis: Brandt, 1835: 56

Holothuria (Halodeima) atra: Pearson, 1914: 170-171; Rowe, 1969: 137-138, fig. 7; Clark and Rowe, 1971: 176, Pl. 27, fig. 11.

Halodeima atra: Heding, 1940a: 120; Panning, 1944: 61, fig. 29; Cherbonnier, 1951 b: 14, Pl. 2, fig. 11-14; 1955 b: 141, Pl. 29, fig. a-b.

Materials examined: Twenty specimens were examined from all studied areas.

Habitats: *Holothuria atra* lives mainly in sandy and muddy areas as well as seagrass beds and rarely recorded from mangrove areas. It also found on the coral rubbles and stones on the reef, and among dead and live corals. This species can live in depths from 0.5 to 6 meters deep and seen in their habitats covered with a thin layer of sand and small stones, which adhesive to the animal by its mucus excretion.

Status: Abundant species.

Distribution: *Holothuria* (*Halodeima) atra* is a cosmopolitan species.

Remarks:

H (Halodeima.) atra easily distinguished from *H. (Halodeima) edulis* by the uniformly black or dark brown body colouration, and by the discs of the table which are slightly more developed than those of the later species. *H. atra* is also similar in

uniformly dark colour to *H. (Mertensiothuria) leucospilota*, but can be distinguished from it by the spinelets crowning the table spires, which form a maltase cross, rather than the small cluster in *H. (Mertensiothuria) leucospilota.* In the later species, buttons are also present among the spicules, whereas in *H. atra* buttons are lacking. *H. (Mertensiothuria) leucospilota* also has the habit in life of stretching out in a thin snake-like form.

Holothuria (Halodeima) edulis (Lesson, 1830)

Synonyms:

Holothuria edulis Lesson, 1830: 125, Pl. 46, Fig. 2.

Trepang edulis: Jaeger, 1833: 24

Holothuria fuscocinerea: Selenka, 1867: 337, Pl. 19, Fig. 86

Holothuria signata: Ludwig, 1875: 23, Fig. 36

***Halodeima edulis*:** Ohshima, 1935: 144; Panning, 1944: 65, fig. 32; Cherbonnier, 1951 a: 399, fig. 3; 1955 b: 142 Pl. 19 fig. c

***Holothuria (Halodeima) edulis*:** Clark and Rowe, 1971: 176, Pl. 27, Fig. 14; Price, 1983: 87; Cherbonnier, 1988: 75-76 fig. 79 A- H.

Materials examined: Six specimens were examined from Bab El-Mandab, Gulf of Aden and El-Makha areas.

Habitats: *Holothuria edulis* found mostly on coral fragments and coral rubbles and on the dead and live corals. It is mostly occupy the fore reef.

Status: Common species.

Distribution: *Holothuria edulis* is widely distributed but less frequent than *H. atra* and recorded from many localities in the Indo-Pacific region included the Red Sea.

Subgenus: *Thymiosycia* Pearson, 1914

Holothuria (Thymiosycia) arenicola (Semper, 1868)

Synonyms:

Holothuria arenicola Semper, 1868: 81 Pl. 20 & 30 Fig. 13, Pl. 35 Fig. 4.

Holothuria maculata Herouard, 1893: 133 Pl. 7, Fig. B

Brandtothuria sp.: Deichmann, 1958

Holothuria (Microthele) paramicrothele: Caso, 1967: 4

Holothuria (Thymiosycia) arenicola: Rowe, 1969: 147; Clark and Rowe, 1971: 178, Pl. 28, fig. 3; Tortonese, 1980; Price, 1983: 87, Pl. 93 fig. 50.

Materials examined: Seven specimens were examined from El-Makha and El-Khokhah.

Habitats: *Holothuria arenicola* generally found in more than one habitat. It is usually found in sand beaches and sandy lagoons, in rocky substrates and in dead and live corals.

Status: Common species.

Distribution: *Holothuria arenicola* is a world wide distributed species.

Remarks:

H. (Thymiosycia) arenicola is a very distinctive holothurian species, individuals of which could be readily identified in the field, by the usually greyish-cream colouration with paired dark markings dorsally. The body appearance and spicules configuration in the collected specimens agree with the descriptions and illustrations given by some authors (e.g. Semper, 1868; Rowe and Doty, 1977; Clark and Rowe, 1971; and Price, 1983). *H. (Thymiosycia) arenicola* could be distinguished from the other species belonging to the subgenus *Thymiosycia* by the colour pattern and by the smaller tentacles and papillae. In addition to, its spicules are much smaller than those found in the other related species belonging to this subgenus.

Holothuria (Thymiosycia) conusalba, Cherbonnier and Feral, 1985

Holothuria (Thymiosycia) conusalba Cherbonnier and Feral, 1985: 695-697, Pl. III, Fig. 16.

Materials examined: Two specimens were examined from Bab-El-Mandab.

Habitats: *Holothuria conusalba* is buried completely in sand vertically, leaving a small hole on the sea floor. It is found mainly on sandy or muddy beaches in the subtidal region and in the seagrass areas.

Status: Rare species.

Distribution: *Holothuria conusalba* is very restricted in their distribution and recorded only from the Red Sea, New Caledonia and Australia.

Remarks:

Cherbonnier and Feral (1985) described *Holothuria conusalba* for the first time from New Caledonia. However, in his study Hasan (2001) indicated that *Holothuria (Thymiosycia) conusalba* is a new record for the Northern Red Sea holothurian

fauna. The characters of specimens collected from Bab El-Mandab site are in full agreement with the description given by Cherbonnier and Feral (1985). Thus, *H. conusalba* is considered to be a new record for the southern Red Sea.

Holothuria (Thymiosycia) hilla Lesson, 1830

Synonyms:

Holothuria (Fistularia) hilla Lesson, 1830: 226, Pl. 78

Holothuria monacaria: Panning, 1935: 69-70, Fig. 47 (Non *H. Monacaria* Lesson, 1830).

Holothuria hilla: Cherbonnier, 1951 a: 532-534, Fig. 1

Holothuria gyrifer**:** Domantay, 1954: 343-344.

Brandtothuria gyrifer**:** Deichmann, 1958: 294-295, Pl. 1, Fig. 16-18.

Holothuria (Thymiosycia) hilla**:** Rowe, 1969: 147; Clark and Rowe, 1971: 178, Pl. 28, fig. 9; Tortonese, 1980: 107; Price, 1983: 87, Pl. 93, fig. 51.

Materials examined: Four specimens were examined from Gulf of Aden and El-Khokhah.

Habitats: *Holothuria hilla* exists in sand and sand lagoons among coral reef, and also found in dead and live corals and rocks, mainly in the subtidal areas.

Status: Common species.

Distribution: *Holothuria hilla* is a cosmopolitan species.

Remarks:

H. (Thymiosycia) hilla easily distinguished from *H. (Thymiosycia) arenicola* by different appearance and colouration, and by the buttons and tables which are much larger and have relatively larger holes. Also this species is very similar in appearance with *H. (Thymiosycia) impatiens*, but the latter species is often mottled with black markings and generally has a rough and more warty appearance. *H. (Thymiosycia) hilla* also has tables with a large central hole, whereas in *H. (Thymiosycia) impatiens* the central hole is relatively small and similar in size to the peripheral ones and the whole table is much larger than those in *H. hilla.*

Holothuria (Thymiosycia) impatiens (Forskaal, 1775)

Synonyms:

Fistularia impatiens Forskaal, 1775: 121 Pl. 39, Fig. 6

Holothuria impatiens: Haacke, 1880: 46; Panning, 1935: 86, fig. 72; 1941: 7, fig.5 & 6; 1944: 70 fig. 37; Heding, 1940 a: 121, fig. 5; Tortonese, 1953: 224; Clark and Spincer Davis, 1966: 599, 603.

***Holothuria impatiens concolor*:** H.L. Clark, 1921: 179

***Holothuria impatiens lutea*:** H.L. Clark, 1921: 179

Holothuria impatiens pulchra: H.L. Clark, 1921: 179, Pl. 19 Fig. 3

Holothuria (Thymiosycia) impatiens: Pearson, 1914: 171; Rowe, 1969: 145, fig. 13; Clark and Rowe, 1971: 178, Pl. 26, fig. 2, Pl. 28, fig. 8; Tortonese, 1980: 107; Price, 1983: 88, 95, fig. 52.

Materials examined: Six specimens were examined from Bab El-Mandab and El-Makha.

Habitats: *Holothuria (Thymiosycia) impatiens* usually found in the subtidal area on some coral genera such as *Stylophora*, *Porites* and *Acropora*. It also occupied the rocky and dead coral substrates. It rarely found in sandy habitat and if do, occupied only the coarse sand with small coral fragments.

Status: Common species.

Distribution: *H. impatiens* is widely distributed in the Indo-West Pacific region with a considerable abundance

Remarks:

In the present study, the colour of collected individuals (mottled greyish or reddish brown) is very similar to those collected from other areas by Price (1983) and Rowe and Doty (1977). *Holothuria (Thymiosycia) impatiens* can be easily distinguished from the other related species in the same subgenus from the Red Sea by the more warty external appearance, and by the tables in which the central and peripheral holes are similar in size, whereas in the other species the peripheral holes are much smaller than central one. In addition to, the tables of *H. impatiens* are particularly large and smooth looking than those found in other species.

Subgenus: *Platyperona* Rowe, 1969

Holothuria (Platyperona) crosnieri Cherbonnier, 1988

Holothuria (Platyperona) crosnieri Cherbonnier, 1988: 103-106, Fig. 42, A-Q.

Materials examined: One specimen was examined from Gulf of Aden.

Habitats: *Holothuria crosnieri* can live only in the subtidal zone among dead and live coral patches. It is also live in sandy substrate at depths ranging between 20 and 25 meter deep (Cherbonnier, 1988).

Status: Rare species.

Distribution: *Holothuria crosnieri* was recorded only from East Africa and Madagascar Islands by Cherbonnier (1988) and from the Red Sea by Hasan (2001) and Hellal *et al.* (2007).

Remarks:

Cherbonnier described *Holothuria (Platyperona) crosnieri* for the first time in 1988, from Madagascar Island. However, in the present work, the characters of the single specimen collected from Gulf of Aden are very similar with the description given by Cherbonnier (1988). Thus, it is a new record from southern Red Sea. The presence of *H. (Platyperona) crosnieri* in the studied area and the previous record by Hasan (2001) and Hellal *et al*. (2007) from the northern Red Sea is considered to be extension in their distribution in all Red Sea.

Subgenus: *Mertensiothuria* Deichmann, 1958

Holothuria (Mertensiothuria) albofusca Cherbonnier, 1988

Holothuria (Mertensiothuria) albofusca Cherbonnier, 1988: 114-116, Fig. 46, A-O.

Materials examined: Three specimens were examined from Bab El-Mandab and El-Makha.

Habitats: This species usually found in sand and sandy patches or conceal under rocks at the intertidal and subtidal zones. It prefers to live in the shallow depths ranged between 0.5 and 3 meters deep.

Status: Rare species.

Distribution: *H. albofusca* was recorded only from Madagascar Island (Cherbonnier, 1988) and the northern Red Sea (Hasan, 2001; Hellal *et al.*, 2002, 2007).

Remarks:

Cherbonnier described *H. (Mertensiothuria) albofusca* from Madagascar for the first time in 1988. The characters of the examined materials in the present study are in full agreement with the description given by Cherbonnier (1988). Thus, the presence of such species in the Bab El-Mandab area considered to be a new record in the southern Red Sea holothurian fauna.

Holothuria (Mertensiothuria) leucospilota Brandt, 1835

Synonyms:

Holothuria (Gymnochirota) leucospilota Brandt, 1835: 51

Holothuria vagabunda**:** Selenka, 1867: 343, Pl.19, Fig. 75-76

Holothuria leucospilota: Ludwig, 1881: 959

Holothuria oxurropa**:** Sluiter, 1888: 109, Pl.1, fig. 3-5

Holothuria (Mertensiothuria) leucospilota: Rowe, 1969: 148, Fig. 14; Clark and Rowe, 1971: 176, Pl. 28, fig. 19; Tortonese, 1980: 108; Price, 1983: 87, fig. 49; Cherbonnier and Feral, 1985: 682, fig. 11; Cherbonnier, 1988, 112-114, fig. 45 a-

p.

Materials examined: Ten specimens were examined from all studied areas.

Habitats: *H. (Mertensiothuria) leucospilota* exists on the soft substrates at sandy patches and lagoons and seagrass areas.

Status: Abundant species.

Distribution: *H. (Mertensiothuria) leucospilota* is a cosmopolitan species.

Remarks:

Characters of the collected specimens are in general accordance with the descriptions and/or illustrations of *Holothuria (Mertensiothuria) leucospilota* given by the previous workers (e.g. Rowe, 1969; Rowe and Doty, 1977; Price, 1983 and Cherbonnier, 1988). However, very few buttons among the spicules in the collected specimens have more than 3 pairs of holes. *H. (Mertensiothuria) pervicax* has also been recorded in Southeast Arabia and the Red Sea by some authors (Clark and Rowe, 1971; Price, 1982, 1983; Cherbonnier, 1988; Hasan, 2001) and is distinguished from *H. leucospilota* by the mottled colouration and buttons which are mostly incomplete (Rowe and Doty, 1977). By contrast, specimens in the present study (10) are uniformly coloured and the spicules contain many well-developed buttons. So *H. (Mertensiothuria) pervicax* was therefore rejected as a possible valid species for the Red Sea holothuroid fauna. These findings are in full agreement with the findings given by Hasan (2001) and Hellal *et al.* (2007). Also, *H. (Mertensiothuria) leucospilota* can be easily distinguished from the two local species *H. (Halodeima) atra and H. (Halodeima) edulis*, which are superficially rather similar, by the presence of buttons and by the cluster of 8 to 12 spinelets crowing the spire of the tables. In addition, in the latter two species buttons are lacking and the spire of tables ends in a Maltese cross when viewed from above.

Holothuria (Mertensiothuria) papillifera Heding, 1938

Holothuria (Mertensiothuria) papillifera Heding, 1938: 57, Pl. 19, fig. 32; Rowe, 1969:148, fig., 16.

Materials examined: Two specimens were examined from El-Khokhah.

Habitats: *H. (Mertensiothuria) papillifera* is occupied the soft substrate, in sand, and seagrass areas and never found at the reef slope or reef crest.

Status: Rare species.

Distribution: *H. (Mertensiothuria) papillifera* was considered to be endemic to the Red Sea.

Remarks:

Holothuria (Mertensiothuria) papillifera has a very limit distribution in the Red Sea and recorded only from the Marine Biology Station, Hurgada, at the northern part of the Red Sea by Hasan (2001) and from Nuweiba area at the Gulf of Aqaba by Hasan and Hasan (2004). The presence of *H. papillifera* at El-Khokhah area (most southern part of the Red Sea) indicating that there is a southern extension in their distribution. Hence, it is considered to be a new record in such area for the first time.

Subgenus: *Cystipus* Haacke, 1880

Holothuria (Cystipus) sucosa (Erwe, 1919)

Synonyms:

Holothuria Sucosa Erwe, 1919: 120, Pl. 19, fig 12

Cucumaria kurtmeyeri: Helfer, 1923: 340 Fig. 12

Holothuria ocellata: Tortonese, 1954: 65, Fig. 5

Holothuria (Cystipus) sucosa: Cherbonnier, 1964: 215

Materials examined: Four specimens were examined from Bab El-Mandab area.

Habitats: *H. (Cystipus) sucosa* lives in the subtidal area (fore-reef) mainly among living corals. It also occupies the dead coral zones and rocky patches.

Status: Rare species.

Distribution: *Holothuria sucosa* is endemic to the Red Sea.

Remarks:

H. (Cystipus) jousseaumei Cherbonnier, 1955, *H. (C.) remollescens* Lampert, 1885, and *H. (C.) rigida* Selenka, 1867, in addition to *H. (C.) sucosa* Erwe, 1919, were recorded from the Red Sea by some authors (Cherbonnier, 1955 b; Deichmann, 1958; Rowe, 1969; Clark and Rowe, 1971; Price, 1982). In his discussion for the species of the subgenus *Cystipus*, Rowe (1969) considered *H. (C.) remollescens* Lampert, 1885 was consubgeneric with *H. (Thymiosycia) impatiens* Forskaal, 1775 by Deichmann (1958) and *H. (C.) jousseaumei* Cherbonnier, 1955 was conspecific with *H. (C.) rigida* Selenka, 1867. Also, Rowe (1969) mentioned that the three nominal species are only ones, which have hollow fenestrated spheres in addition to the knobbed buttons and unmodified tables, under name *H. (C.) rigida* Selenka, 1867 which have the priority.

In the present study, the materials collected from the Bab El-Mandab and other specimens from the Red Sea by other workers (Clark and Rowe, 1971; Hasan, 2001; Hellal *et al.*, 2002) having tables with 8-10 peripheral holes to the disc, the spire apparently terminating in a ring of irregular spines and the knobbed buttons having

4-5 pairs of holes. By the comparison of these characters with the descriptions and/or illustration given by Cherbonnier (1955 b), Rowe (1969), Clark and Rowe (1971), and Cherbonnier (1988) putting these materials under the name *H. (C.) sucosa*, which appears to be distinct from other species included in subgenus *Cystipus*. It seems most closely allied to *H. (C.) rigida* but again differs in lacking fenestrated spheres like those in *H. (C.) rigida*. Therefore, *H. (Cystipus) sucosa* is considered to be a valid species for the Red Sea holothurian fauna. *Holothuria sucosa* has a very limit distribution in the Red Sea and recorded only from Gulf of Suez by Hasan (2001) and from Gulf of Aqaba by Hasan and Hasan (2004). The presence of *H. sucosa* for the first time at Bab El-Mandab area (the entrance of the Red Sea), indicating that there is a southern extension in their distribution.

Subgenus: *Metriatyla* Rowe, 1969

Holothuria (Metriatyla) scabra Jaeger, 1833

Synonyms:

Holothuria scabra Jaeger, 1833: 234; Cherbonnier, 1955 b: 145, Pl. 32, fig. a-c; Domantay, 1962: 86, fig. a-d; James and Pears, 1969: 61.

Holothuria (Metriatyla) scabra: Rowe, 1969: 160, Fig. 60; Clark and Rowe, 1971: 178, fig. 87, Pl. 15, fig. 15; Price, 1982: 6.

Materials examined: Four specimens were examined from Bab El-Mandab and El-Khokhah.

Habitats: *Holothuria scabra* usually found in the coral mainly on reef edge and reef slope at depths from 4 to 25 meters. It is occupies also sand patches and sand lagoons in the reef flat.

Status: Rare species.

Distribution: *Holothuria scabra* is present in many areas and well distributed in the Indo-West Pacific regions.

Remarks:

Holothuria scabra recorded for the first time from central Red Sea by Cherbonnier (1955 b). After that Clark and Rowe (1971), Price (1982) and Cherbonnier (1988) recorded the same species from the Red Sea but they did not mentioned the specific locality and they have doubtful on the presence of this species in the Red Sea. However, this species was included in the list given by Price (1982) from the Gulf of Suez and the same author mentioned that the record of *H. scabra* from this area needs more confirmation. In their studies, Hasan (2001) and

Hasan and Hasan (2004) recorded *H. scabra* from northern Red Sea and The Gulf of Aqaba respectively. In the present work, *Holothuria scabra* is recorded for the first time from the most southern Red Sea (Bab El-Mandab), hence, it is considered that *H. scabra* to be proved among the Red Sea holothurian fauna.

Subgenus: *Theelothuria* Deichmann, 1958

Holothuria (Theelothuria) spinifera Theel, 1886

Synonyms:

Holothuria spinifera Theel, 1886: 175, Pl. 8, Fig. 1; Panning, 1935, Pl. 101, fig. 93; Mortensen, 1937, Pl. 60, fig. 50-52, Pl. XIII, fig. 5.

Holothuria (Theelothuria) spinifera: Mortensen, 1937: 60, Fig. 5; Price, 1982: 6.

Materials examined: Two specimens were examined from Bab El-Mandab and El-Khokhah.

Habitats: *Holothuria spinifera* usually found in subtidal zone lives in sand and seagrass patches and never recorded in the intertidal zone. It also occupy the rocky substrates and the dead and live corals but in very small densities (Cherbonnier, 1988; Hasan, 2001).

Status: Rare species.

Distribution: *Holothuria spinifera* is restricted in their distribution. It was recorded only from Red Sea, East Indies, Philippine Islands and South Pacific.

Family: Stichopodidae

Genus: *Stichopus* Brandt, 1835

Stichopus horrens Selenka, 1867

Synonyms:

Stichopus horrens Selenka, 1867: 316, Pl. 18, Fig. 27-29; Panning, 1944: 35; Tokioka, 1953: 147, Pl. 7, fig. 8-11; Cherbonnier, 1955 a: 323; Clark and Rowe, 1971: 178, 201, Pl. 27, fig. 19; Rowe and Doty, 1977: 227, fig, 2d, 6 b; Cherbonnier, 1980: 649, fig. 17, a-q.

Stichopus godeffroyi variegatus Semper, 1868: 24 b

Stichopus godeffroyi Semper, 1868: 75, Pl. 20, Fig. 4

Stichopus variegatus pygmaeus Semper, 1868: 75

Stichopus tropicalis**:** Fisher, 1907: 676, Pl. 70, Fig. 1 a-i

Materials examined: 4 specimens were examined from Bab-El- Mandab and El-Khokhah.

Habitats: *Stichopus horrens* occupy a variety of habitats beginning with sand

substrates in sand lagoons and seagrass patches to live corals and coral patches. This species live in the subtidal zone. It occupies the mid reef and fore reef it also found in the reef slope and sand slopes.

Status: Rare species.

Distribution: *Stichopus horrens* is well distributed in the Indo-Pacific regions.

Remarks:

Stichopus horrens was recorded by Clark and Rowe (1971) from north Australia and South Pacific, and by Cherbonnier (1988) from East Africa. After that Hasan (2001) recorded this species from the Red Sea and indicated that *S. horrens* considered to be a new recorded in the Red Sea for the first time. There is no any record of this species from southern part of the Red Sea. However, the specimens collected in the present study are in full agreement with the description given by Clark and Rowe (1971) and Cherbonnier (1988). Therefore, *Stichopus horrens* is considered to be a new recorded in the southern part of the Red Sea.

Stichopus variegatus Semper, 1868

Synonyms:

Stichopus variegatus hermanni Semper, 1868: 73, Pl. 16 & Pl. 30.

Stichopus naso Haacke, 1880: 46

Stichopus levis Sluiter, 1888: 198, Pl. 1, Fig. 6

Stichopus vastus Sluiter, 1888: 198, Pl.2, Fig. 46 & 48

Stichopus hirota Mitsukuri, 1912: 161, Fig. 28

Stichopus obshimae: Mitsukuri, 1912: 171, Fig. 30

Stichopus variegatus trepangi: Domantay, 1936: 12, Pl. 1, Fig. 26.

Stichopus variegatus pallidus: H.L. Clark, 1938: 514

Stichopus variegatus: Koehler and Vaney, 1908: 23; Clark and Rowe, 1971: 178, Pl. 27, fig. 20; Price, 1983: 86, 95, fig. 53; Cherbonnier and Feral, 1985: 367, fig. 17 A-M.

Materials examined: Nine specimens were examined from Bab El-Mandab, El-Khokhah and El-Makha areas.

Habitats: *Stichopus variegatus* is well adapted to live in different kinds of habitats at different depths (between 3 to 35 meters). It is appear to be more abundant in sand patches, seagrass areas and sand lagoons at the reef flat, but it is very rare in rocky areas.

Status: Abundant species.

Distribution: *Stichopus variegatus* is a cosmopolitan species and found in all the Indo-west-Pacific regions with high degree of abundance.

Remarks:

Stichopus variegatus can be distinguished from the other holothurian species by the large flattened body, and the presence of large C-shaped rods among their spicules. Spicules of the collected materials in the present study, including the characteristic C-shaped rods, which are very closely resemble to those illustrated for *S. variegatus* by Clark and Rowe (1971). Price (1983) and Clark and Rowe (1971) mentioned that *S. monotuberculatus* and *S. chloronotus* are widely distributed in the Indo-Pacific regions and they are closely related species to *S. variegates*. But *S. chloronotus* has a distinctive dark green appearance (Rowe and Doty, 1977) with which *S. monotuberculatus* is very similar externally (Cherbonnier, 1952). Both species were, therefore, precluded as possible species represented in the present collection and need more confirmation.

Order: Apodida

Family: Synaptidae

Genus: *Polyplectana* Selenka, 1867

Polyplectana kefersteini (Selenka, 1867)

Synonyms:

Synapta kefersteini Selenka, 1867: 360, Pl. 20, Fig. 120 &1

Synapta kallipeplos Sluiter, 1888: 217, Pl. 2, Fig. 41-43

Mondrocloea kefersteini Ostergen, 1898:114

Polyplectana kefersteini: H. L. Clark, 1908: 143, Fig. 11 (9 & 10); Domantay, 1933: 88, Pl. 2, fig. 8; Clark and Rowe, 1971: 186, Pl. 31, fig. 1; Liao, 1975: 222, fig. 25; Price, 1982: 6; Guille *et al*., 1986.

Materials examined: One specimen was examined from El-Khokhah area.

Habitats: *Polyplectana kefersteini* mainly occupy the sandy lagoons and sand patches in the reef flat. It also exists in the seagrass patches, at the subtidal areas.

Status: Rare species.

Distribution: *Polyplectana kefersteini* was restricted in their distribution and recorded from the Red Sea, North Australia, Philippine Islands, South Pacific Islands and Hawaiian Islands.

Remarks:

Polyplectana kefersteini was previously recorded from the Red Sea and Gulf of

Aqaba by Clark and Rowe (1971) and Price (1982) and from Gulf of Suez by Hasan (2001). In the present work *Polyplectana kefersteini* was recorded for the first time from the southern part of the Red Sea.

Genus: *Synapta* Eschscholtz, 1829

Synapta maculata (Chamisso and Eysenhardt, 1821)

Synonyms:

Holothuria maculata Chamisso and Eysenhardt, 1821: 325, Pl. 25; Clark, 1952: 204; Cherbonnier, 1955 b: 170, Pl.47, fig. a-d; Clark and Spencer Davis, 1966: 603; Clark and Rowe, 1971: 186, Pl. 30, fig. 9.

Synapta beselii Semper, 1868: 11, Pl. 1, Fig. 5-7 & 10

Chondrocloea beselii: Koehler and Vaney, 1908: 46

Synapta maculata endreae: Heding, 1928: 115, Fig. 2 (9-11)

Synapta maculata sundaensis: Heding, 1928: 116, Fig. 3-5

Synapta maculata: Heding, 1928: 113, Fig. 2

Materials examined: Two specimens were examined from Bab-El-Mandab area.

Habitats: *Synapta maculata* mainly occupy the sandy lagoons and seagrass patches. This species lives in the subtidal zone.

Status: Common species.

Distribution: *Synapta maculata* is widely distributed species found in many places in the Indo-West Pacific region.

Genus: Synaptula Orsted, 1849

Synaptula reciprocans (Forskal, 1775)

Synonyms:

Chondrocloea reciprocans Forskal, 1775**:** 121; James and Pearse, 1969: 109.

Synapta reciprocans**:** Selenka, 1867: 364

Synaptula reciprocans**:** Mortensen, 1926: 117; Cherbonnier, 1955 b: 173; Price, 1982: 12.

Materials examined: Five specimens were examined from Bab-El-Mandab area.

Habitats: *Synaptula reciprocans* mainly occupy the sandy area in both intertidal and subtidal zones.

Status: Common species.

Distribution: *Synaptula reciprocans* known only from the Red Sea and Suez Canal.

Order: Dendrochirotida

Family: Phyllophoridae

Genus: ***Ohshimella*** Heding and Panning, 1954

Ohshimella ehernbergi (Selenka, 1868)

Synonyms:

Urodemas ehernbergi Selenka, 1868: 114

Phyllophorus ehernbergi Theel, 1886: 151; Cherbonnier, 1955 b: 169

Phyllophorus frauenfeldi Theel, 1886: 151; H.L.Clark, 1923: 417

Cucumaria turbinate Pearson, 1903: 189

***Ohshimella ehernbergi*:** Clark and Spincer-Davies, 1966: 603; Cherbonnier, 1967: 57; James and Pearse, 1969: 101-102; James, 1979: 60; Price, 1982: 12

Materials examined: Three specimens were examined from Bab-El-Mandab area.

Habitats: *Ohshimella ehernbergi* mainly occupy the rocky and dead coral areas in both intertidal and subtidal zones as well as live corals. The specimens of this small holothuroid were found under rocks at depth about 3 meters on the outer edge of reef.

Status: Rare species.

Distribution: *Ohshimella ehernbergi* is very restricted in their distribution and recorded from the Red Sea, South Africa, Maldives and Ceylon.

II- Bab El-Mandab holothuroid fauna

1- Faunal composition and species status

A complete systematic list of the recorded holothuroid species from the five sites at Bab El-Mandab area is given in Table (1). The list comprises 28 species belonging to 9 genera, 4 families and 3 orders. Order Aspidochirotida is the most dominant order not only in the number of species but also in number of individuals. It has the highest number of species recorded in study area, being 24 species (85.7 %) belonging to 5 genera (55.6 %) and 2 families (50 %). Most of holothuroids are belonging to the family Holothuriidae 22 species (78.6 %) (Table, 1). All other families, Synaptidae, Stichopodidae and Phyllophoridae, are represented by 6 species (21.4 %). Genus *Holothuria* comprises the largest number of species, being 13 species (46.4%), followed by genera *Bohadschia*, *Actinopyga* and *Stichopus* which represented by 5, 3, 2 species respectively. The other 5 genera represented by only one species for each (Table, 1).

The distribution of holothuroid species among different areas is given in Table (1) and Figure (1 A). Results showed that Bab El-Mandab was accommodated by highest number of species, being 22 species (78.6 %) belonging to 8 genera and 4 families. Followed by El-Khokhah which had 15 species (53.6 %) belonging to 5 genera and 3 families. While mangrove site had the lowest number of species, being 3 species (10.7 %) belonging to 2 genera and one family (Table, 1 and Fig. 1 A).

Among the recorded 28 holothuroid species, *Bohadschia mitsioensis*, *Holothuria atra* and *H. leucospilota* were found to be the most abundant species and recorded from all studied sites. Also, *Actinopyga echinites*, *A. mauritiana*, *Holothuria edulis* and *Stichopus variegatus* were common and recorded from three sites. On the other hand, the most of the remaining 21 species were rare species and recorded from one or two sites only (Table 1). The status of the recorded sea cucumber species from different sites are given in Table (1) and Figure (1 C). It was noticed that 4 species (14.3 %) belonging to 3 genera are abundant. While, 12 species (42.9 %) belonging to 5 genera are common and the same number of species are found to be rare.

2- Species diversity and density

The diversity and density of holothuroid species in the studied sites at the vicinity of Bab El-Mandab are shown in Table (2) and Figure (2 A & B). The survey revealed that Bab El-Mandab site comes in the first category and has the highest species diversity represented by 22 species (78.6 %) and 4.4 diversity index. Followed by El-Khokhah and El-Makha sites in the second category (moderate species diversity) and comprised 15 species (53.6 %), 11 species (39.3 %) and 3.15 and 2.67 diversity indices respectively. The remaining two sites, Gulf of Aden and mangrove have low species diversity and contained 7 species (25 %), 3 species (10.7 %) and 1.68 and 0.8 diversity indices (Table, 2).

With respect to species density, *Holothuria atra*, *H. leucospilota* and *Actinopyga mauritiana* recorded the highest densities among all surveyed species. *H. atra* was recorded in all surveyed sites with a density varied from 4.9 $\pm$ 3.5 individuals / 25 m^2 (Mangrove site) to 14.3 $\pm$ 3.08 individuals / 25 m^2 (Bab El-Mandab). Similarly, *H. leucospilota* was recorded in all sites and its density varied between 1.7 $\pm$ 1.16 individuals / 25 m^2 (Gulf of Aden) and 8.3 $\pm$ 4.35 individuals / 25 m^2 (Bab El-Mandab). While, *A. mauritiana* was recorded in 4 sites out of 5 surveyed sites, with a density fluctuated between 4.2 $\pm$ 1.7 individuals/25m^2 (Gulf of Aden) and 15.3 $\pm$ 1.15 individuals / 25 m^2 (Bab El-Mandab). Among the recorded species, *H. scabra* which has high commercial value was recorded in two sites (Bab El-Mandab and El-Khokhah) with low density, being 2.3 $\pm$ 0.71 and 1.3 $\pm$ 0.97 individuals / 25 m^2 respectively. On the other hand, there are three species, *H. crosnieri*, *H. papillifera* and *Polyplectana kefersteini*, recorded from one sites with very low species density, being 0.4, 0.8 and 0.4 individuals / 25 m^2 (Table, 2 and Fig. 2 A & B).

3- Habitat distribution

The distribution of holothuroid species among different biotopes at Bab El-

Mandab area is given in Table (3) and Figure (1B). The results showed that 27 species (96.4 %) belonging to all genera and families were found in the subtidal zone. While, 10 species (35.7%) belonging to 7 genera and 4 families were found in the intertidal zone (Table, 3). The sandy flat was inhabited by 22 species (78.6 %) belonging to 8 genera and 2 orders. The most common species are those belonging to the genera, *Actinopyga*, *Bohadschia*, *Holothuria* and *Stichopus*. Live corals, dead corals and sea grasses habitats were inhabited by 15 species (53.6%), 16 (57.1 %) and 15 species (53.6 %). Members of genera, *Actinopyga*, *Bohadschia*, *Holothuria* and *Synapta* dominated such biotopes. While, 13 species (46.4 %) belonging to genera *Bohadschia*, *Labidodemas*, *Holothuria* and *Stichopus* were dominated rocky or fossilized reef flat (Table, 3 and Fig. 1B). It is clear that each biotope has its specific holothuroid fauna, however, only one species, *Holothuria atra*, was inhabited all types of biotopes, *Holothuria spinifera* and *Stichopus variegatus* were inhabited 5 types of biotopes except muddy habitat. On the other hand, only three holothuroid species, *Bohadschia steinitzi*, *Holothuria albofusca* and *Synaptula reciprocans* were inhabited one specific habitat and 4 species belonging to genera *Actinopyga*, *Holothuria* and *Synapta* were found in two biotopes. The remaining species (18 species) were found to be inhabited three or four habitats (Table, 3).

Discussion

Recently holothuroid fauna from the different regions of the Red Sea had been studied by some investigators such as Rowe (1969), Clark and Rowe (1971), Price (1982), Cherbonnier (1988), Hasan (2001), Hellal *et al.*, (2002, 2007) and Hasan and Hasan (2004). The results of these works revealed that the total number of holothuroid species was 101 species belonging to 26 genera, 6 families lies in 3 orders. However, some notes must be taken in consideration on the results obtained by the above mentioned authors. These notes well discussed by Hasan (2001) and resulting in the total number of valid holothuroid species in the Red Sea is 86 species. The present study revealed that Bab El-Mandab area comprises 28 holothuroid species. This number is higher than that recorded by Hasan (2001) (20 species), Hasan and Hasan (2004) (25 species) from Gulf of Aqaba and Hasan (2001) (7 species from the northern Red Sea. In contrast, this number is lower than that recorded by Price (1982) (39 species) however, Price did not give the specific locality (i.e. north or south).

Out of the 28 recorded species from the Bab El-Mandab area, Red Sea, there are four cosmopolitan species (14.3 %) known everywhere; these are *Holothuria (Mertensiothuria) leucospilota, H. (Halodeima) atra, H. (Thymiosycia) hilla* and

Stichopus variegatus. On the other hand, there are seven species (25 %) were restricted in their distribution to certain places in the Indo-Pacific region including the Red Sea. Whereas five species (17.9 %) were endemic to the Red Sea; these are *Bohadschia cousteaui*, *B. steinitzi*, *Holothuria (Mertensiothuria) papillifera*, *H. (Cystipus) sucosa*, and *Synaptula reciprocans*. The remaining 12 species (42.8%) were considered to be world wide in their distribution. In a similar study made by Thandar (1989) on the zoogeography of South African echinoderms, he found that out of 400 echinoderm species 47.0 % were endemic, 37.0 % were restricted and only 3.0 % were cosmopolitan in their distribution. Also, in his study on the Red Sea ophiuroid fauna (brittle stars) from the Red Sea, Hellal (1990) found that only 2.0 % of such fauna were cosmopolitan species, 14.3 % were restricted species in their distribution and 83.7 % were world wide distribution

The obtained data have shown that the species diversity and density varied from site to site. The higher diversity and density were found when both suitable environmental conditions and low/or no human impacts were achieved in one site. For example, Bab El-Mandab area (22 species) and El-Khokhah (15 species) which recorded the highest species diversity and density. Both have excellent environmental conditions (suitable substrate, high food availability, high variety of niches and very low predators), in addition to having no any human impacts. These are due to both sites are very well protected areas and there is no any attractable to commercial collectors. Also, the present study indicated that *Actinopyga mauritiana*, *Holothuria atra* and *Holothuria leucospilota* recorded the highest densities among all species in all sites (Tables, 1 & 2). These findings are in full agreement with some workers such as Kerr *et al*. (1993) from Guam Island, Mezali (2001) from Algeria, Hasan (2003), Hasan and Hasan (2004) from the Gulf of Aqaba, Red Sea.

None of the previous works mentioned any record of holothuroids from the most southerly part of the Red Sea particularly Bab-El-Mandab area. The present study revealed that 12 holothuroid species are recorded for the first time from such area (Table, 1). Several factors affected the presence of newly recorded species in the present study. **(1)** other workers in East Africa and/or one or more region of the Indo-west Pacific areas had recorded those new records and/or described new species. The larvae of these species were transported to the Red Sea by the currents which known to carry large number of larvae, then it found the suitable substrate in the Red Sea and settled in it; **(2)** these larvae managed to adapt to the physical and chemical characters of the water of the Red Sea and metamorphosis occur to reach the adult; **(3)** the adults found enough food and suitable habitats to exist and flourished in the Red Sea and **(4)** it is well known that faunal patterns can be a

strong reflection of sampling thoroughness and the collecting method used (Price, 1982).

The referred habitats and the feeding habits were found to be the major reasons for the choice of subtidal habitat. As revealed in the present study, except for *Holothuria papillifera* all recorded species occupied the subtidal zone. Among them *Actinopyga mauritiana*, *Bohadschia mitsioensis*, *Holothuria conusalba* and *H. crosnieri* were surf zone species and mainly found on the reef crest. The same results were arrived by Conand (1990) and Shelly (1981) for *A. mauritiana*, and reported that, this species fed on plankton and prefer the frequent strong wave action on and behind reef crest. On the other hand, some species such as *Actinopyga echinites*, *Holothuria spinifera* and *Holothuria sucosa* live in deep water and shallow water. These results are in full agreement with the findings by Rowe and Dotty (1977), Roberts (1979) for *Actinopyga echinites* and Preston and Lokani (1990) for *Holothuria fuscogilva.*

The Red Sea has diverse habitats especially in the subtidal area (Head, 1987). The data given in Table (3) showed that sandy habitat is the richest holothuroid fauna and contains 22 species, followed by the live coral habitat (16 species), then dead coral and seagrass habitats (15 species / each). While, both rocky and mangrove habitats have the lowest number of recorded holothuroid species, being 13 and only 3 species respectively. This is due to the different ecological factors, which affecting the distribution of the holothuroid species. Nowadays, factors affecting distribution of sea cucumbers include substrate type (Roberts, 1979; Mercier *et al*., 1999; Hasan and Hasan, 2004), availability of food (Wiedemeyer, 1992; 1994), variety of niches and natural predators (Boffi, 1972; Guille and Ribes, 1981; Mezali, 2001; Hasan, 2001; Hellal *et al*., 2007), depth (Price, 1982; Lokani *et al*., 1996), abundance of larvae in the water column and larval habitat selection (Thorson, 1966) and human impacts (Hasan, 2003; Hasan and Hasan, 2004). The sandy habitat is considered to be the most favorable substrate for most holothuroid species because most of species prefer to live in burrows in the sand also the availability of food for such detritus feeder holothuroids. Among them *Holothuria atra*, *H. leucospilota*, *H. conusalba*, *H. albofusca* and *Stichopus variegatus* are the most abundant species in such habitat. This is in full agreement with results obtained by Massin and Doumen (1986) in New Guinea; Kerr *et al*., (1993) in Guam; and Kerr (1994) in Caroline Island. They found that *H. atra* represented by about 92 % of all collected specimens. Dead coral habitat provide the holothuroid a vast range of niches and holes for hiding, also this habitat is rich with filamentous algae which

consider an important food source for the holothuroids. Seagrass habitat is considered a rich food source for holothuroids due to the seagrass itself, algae and other foods found in this habitat, in addition to the high organic matter trapped between the seagrass. While rocks are the most unfavorable substrate for holothuroids due to the lack of food and suitable ecological niches, also such habitat considered an exposed habitat for many predators. The present study indicated that some species confined to one or two kind of habitats. While other species such as *Holothuria atra*, *Holothuria spinifera* and *Stichopus variegatus* were occupy all kinds of habitats. Holothuroid species prefer sheltered habitats to avoid the predators and harsh environmental factors which affect the abundance and diversity of species. In the present study, field observations showed that most holothuroid species were found in well sheltered habitat such as Bab El-Mandab (22 species) and El-Khokhah (15 species). Sloan *et al*. (1979), Kerr *et al*. (1993) and Hasan and Hasan, (2004) obtained the same results from Aldabra Island, Guam and Gulf of Aqaba, Red Sea respectively. The same authors reported that the exposed habitats leading to less species diversity. This was evident in the present study, where the exposed habitat such as Gulf of Aden and El-Makha areas include the lowest number of holothuroid species, being 7 and 11 species respectively.

Concerning the ecological distribution of holothuroids and based on the spicule types, tentacles and body shape, Deichmann (1958) classified holothuroids into three categories. Holothuroid species belonging to the genera *Actinopyga* and *Bohadschia* were found to be a surf zone species (first Deichmann category) (Rowe, 1969; Hasan, 2001) which mostly found clinging on hard substrates, the tables were absent and their spicules were represented by only rods and rosettes, tentacles were bushy for capture of plankton. While most of the recorded species in genus *Holothuria* were fugitive species (second category) (Rowe, 1969; Hasan, 2001). They live partially concealed under coral fragments, sand, rocks …etc. Species belonging to the subgenera *Stauropora*, *Platyperona*, *Mertensiothuria* and *Thymiosycia* were from that division, they have tables, smooth buttons never knobbed, also sometimes have rods and rosettes and tentacles (peltate form) were terminally or ventrally placed. The third Deichmann's division was the fossorial species, those capable of burrowing or digging in sand and found buried more or less completely in the substrate (Rowe, 1969; Hasan, 2001). The species belonging to the subgenera *Cystipus*, *Theelothuria* and *Metriatyla* lies under such division. These species have relatively small, terminally or ventrally placed peltate tentacles; their spicules comprised knobbed buttons and tables, either kind of spicules becoming elaborated into fenestrated ellipsoidal or spherical bodies.

Table (1): A systematic list, distribution and status of sea cucumber inhabiting different sites at Bab El-Mandab, Red Sea.

No	Order	Family	Species	BM	KH	MA	GA	MG
1	Aspidochirotida	Holothuriidae	*Actinopyga crassa*	++				
2			*Actinopyga echinites*	++	++	+		
3			*Actinopyga mauritiana*	+++	+++	++	++	
4			* *Bohadschia cousteaui*		++			
5			* *Bohadschia mitsioensis*	+++	++	++	++	+
6			*Bohadschia steinitzi*	++	++			
7			*Bohadschia tenuissima*	+				
8			* *Bohadschia vitiensis*	++		+		
9			*Labidodemas rugosum*	+				
10			*Holothuria (Halodeima) atra*	+++	+++	+++	+++	+++
11			*Holothuria (Halodeima) edulis*	+++		++	++	
12			*Holothuria (Thymiosycia) arenicola*		++	+		
13			* *H.(Thymiosycia) conusalba*	+				
14			*Holothuria (Thymiosycia) hilla*		++		++	
15			*Holothuria (Thymiosycia) impatiens*	++		++		
16			* *Holothuria (Platyperona) crosnieri*				+	
17			**Holothuria (Mertensiothuria) albofusca*	+		+		
18			*Holothuria (Mertensiothuria) leucospilota*	+++	+++	+++	+	++
19			* *Holothuria (Mertensiothuria) papillifera*		+			
20			* *Holothuria (Cystipus) sucosa*	+				
21			*Holothuria (Metriatyla) scabra*	+	+			
22			* *Holothuria (Theelothuria) spinifera*	+	+			
23		Stichopodidae	*Stichopus horrens*	+	+			
24			*Stichopus variegatus*	+++	+++	++		
25	Apodida	Synaptidae	* *Polyplectana kefersteini*		+			
26			*Synapta maculata*	++				
27			* *Synaptula reciprocans*	++				
28	Dendrochirotida	Phyllophoridae	* *Ohshimella ehernbergi*	+				
Total	3	4	28 (9 genera)	22	15	11	7	3
Percentage				78.6	53.6	39.3	25.0	10.7

BM = Bab El-Mandab; KH = El-Khokhah; MA = El-Makha; GA = Gulf of Aden;

MG = Mangrove; +++ = Abundant; ++ = Common; + = Rare.

* = Species recorded for the first time in the study area.

Table (2). Diversity and density (number of individuals / 25 m^2) of holothuroid species recorded from different sites at the vicinity of Bab El-Mandab.

Species	Distribution				
	Bab El-Mandab	El-Khokhah	El-Makha	Gulf of Aden	Mangrove
Actinopyga crassa	6.3 ± 0.95	0	0	0	0
Actinopyga echinites	8.0 ± 1.41	3.1 ± 1.55	2.3 ± 1.52	0	0
Actinopyga mauritiana	15.3 ± 1.15	11.3 ± 4.6	4.6 ± 2.31	4.2 ± 1.70	0
Bohadschia cousteaui	0	5.3 ± 2.08	0	0	0
Bohadschia mitsioensis	6.7 ± 2.10	4.7 ± 2.18	5.1 ±1.11	3.2 ± 1.64	1.8 ± 0.89
Bohadschia steinitzi	5.8 ± 1.26	3.7 ± 0.58	0	0	0
Bohadschia tenuissima	1.3 ± 0.61	0	0	0	0
Bohadschia vitiensis	3.8 ± 2.90	0	1.7 ± 0.53	0	0
Labidodemas rugosum	1.5 ± 0.71	0	0	0	0
Holothuria atra	14.3 ± 3.08	9.3 ± 1.52	7.1 ± 2.11	6.2 ± 1.17	4.9 ± 3.50
Holothuria edulis	6.3 ± 0.61	0	2.9 ± 1.11	2.5 ± 0.98	0
Holothuria arenicola	0	5.5 ± 0.71	1.3 ± 0.47	0	0
Holothuria conusalba	1.3 ± 0.51	0	0	0	0
Holothuria hilla	0	3.7 ± 0.61	0	2.6 ± 1.31	0
Holothuria impatiens	3.1 ± 2.56	0	2.3 ± 1.50	0	0
Holothuria crosnieri	0	0	0	0.4 ± 0.36	0
Holothuria albofusca	1.5 ± 1.29	0	0.8 ± 0.76	0	0
Holothuria leucospilota	8.3 ± 4.35	5.2 ± 4.24	4.5 ± 3.23	1.7 ± 1.16	3.5 ± 2.01
Holothuria papillifera	0	0.8 ± 0.51	0	0	0
Holothuria sucosa	2.5 ± 2.12		0	0	0
Holothuria scabra	2.3 ± 0.71	1.3 ± 0.97	0	0	0
Holothuria spinifera	1.3 ± 0.97	0.7 ± 0.46	0	0	0
Stichopus horrens	1.2 ± 0.86	0.8 ± 0.69	0	0	0
Stichopus variegatus	6.3 ± 2.75	4.2 ± 3.03	3.8 ± 3.01	0	0
Polyplectana kefersteini	0	0.4 ± 0.35	0	0	0
Synapta maculata	1.7 ± 0.58	0	0	0	0
Synaptula reciprocans	4.5 ± 3.42	0	0	0	0
Ohshimella ehernbergi	1.4 ± 1.01	0	0	0	0
Species diversity	4.4	3.15	2.67	1.86	0.8

Table (3). Distribution of holothuroid species in different biotopes at Bab El-Mandab.

Species	Habitat type			Zone
	Soft substrates		Coral	

	Sea grass	Muddy area	Sandy area	Rocky area	Live	Dead	Subtidal	Intertidal
Actinopyga crassa	+		+				+	
Actinopyga echinites	+		+		+	+	+	+
Actinopyga mauritiana	+		+				+	
Bohadschia cousteaui				+	+	+	+	+
Bohadschia mitsioensis	+		+	+		+	+	
Bohadschia steinitzi			+				+	
Bohadschia tenuissima	+		+		+		+	
Bohadschia vitiensis	+		+		+		+	
Labidodemas rugosum			+	+		+	+	+
Holothuria (Halodeima) atra	+	+	+	+	+	+	+	+
Holothuria (Halodeima) edulis				+	+	+	+	
Holothuria (Thymiosycia) arenicola			+	+	+	+	+	
Holothuria (Thymiosycia) conusalba	+	+	+				+	
Holothuria (Thymiosycia) hilla			+	+	+	+	+	+
Holothuria (Thymiosycia) impatiens				+	+	+	+	
Holothuria (Platyperona) crosnieri			+		+	+	+	
Holothuria (Mertensiothuria) albofusca			+				+	+
Holothuria (Mertensiothuria) leucospilota	+	+	+				+	
Holothuria (Mertensiothuria) papillifera	+	+	+					+
Holothuria (Cystipus) sucosa				+	+	+	+	
Holothuria (Metriatyla) scabra	+				+		+	
Holothuria (Theelothuria) spinifera	+		+	+	+	+	+	
Stichopus horrens			+	+	+	+	+	
Stichopus variegatus	+		+	+	+	+	+	+
Polyplectana kefersteini	+	+	+				+	
Synapta maculata	+		+				+	
Synaptula reciprocans			+				+	+
Ohshimella ehernbergi				+	+	+	+	+
Number of species	15	5	22	13	16	15	27	10
Percentage	53.6	17.9	78.6	46.4	57.1	53.6	96.4	35.7

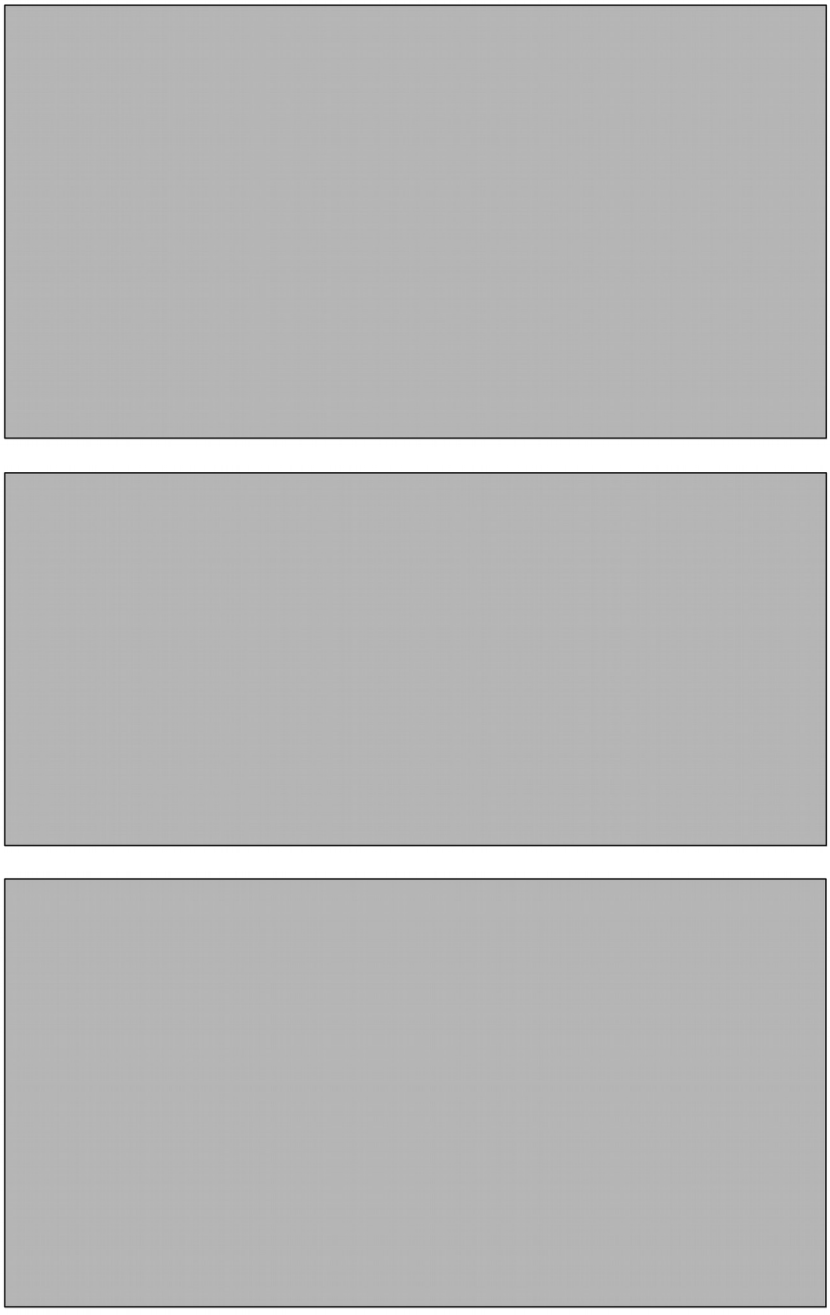
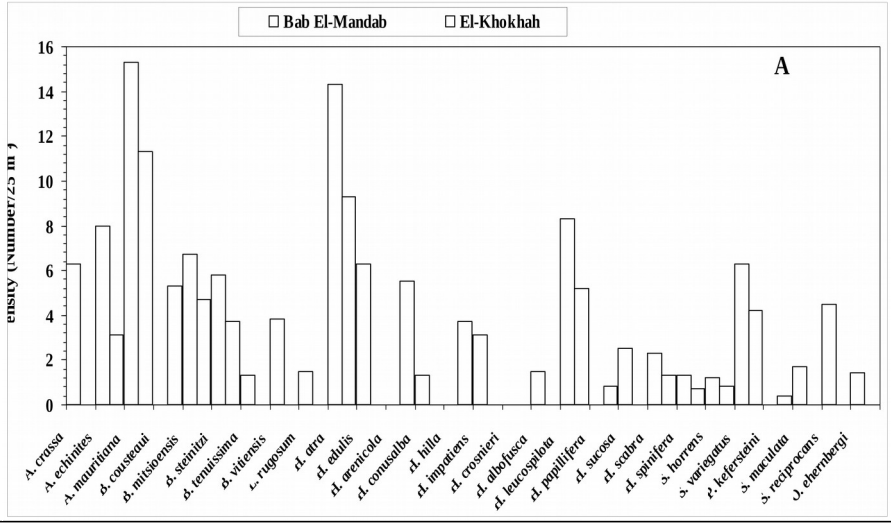


Fig. (1): Showing distribution of holothuroid species in different sites (A); different biotopes (B) and holothurian status (C) at Bab El-Mandab.


Bab El-Mandab
El-Khokhah
A
16
14
12
10
8
6
4
2
0
A. crassa
A. echinites
A. mauritiana
B. cousteaui
B. mitsioensis
B. steinitzi
B. tenuissima
B. vitiensis
L. rugosum
H. atra
H. edulis
H. arenicola
H. conusalba
H. hilla
H. impatiens
H. crosnieri
H. albofusca
H. leucospilota
H. papillifera
H. sucosa
H. scabra
H. spinifera
S. horrens
S. variegatus
H. keferstini
S. maculata
S. reciprocans
O. ehrenbergi

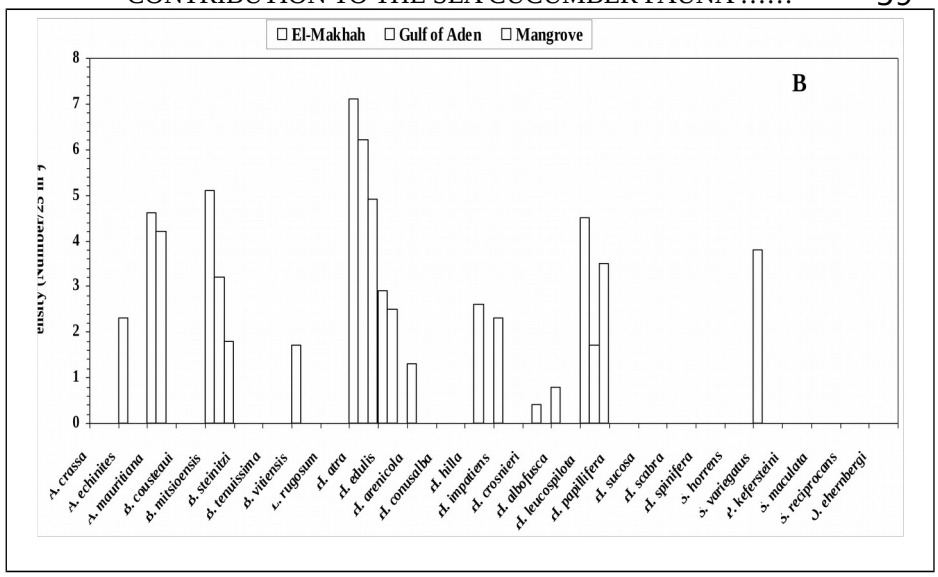


Fig. (2): showing variations in diversity and density of holothuroid species at Bab El-Mandab and El-Khokhah (A) and El-Makha, Gulf of Aden and Mangrove (B).

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مساهمة فى فونة خيار البحر (شوكيات الجلد: الخياريات) من منطقة مضيق باب المندب – البحر الأحمر – اليمن

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الملخص العربى

يهتم هـــذا العمل بدراسة فونة خيـــار البحر (holothuroids) فى منطقة بـــاب المندب والمناطق المجاورة لها عند مدخل البحر الأحمر باليمن. تم جمع حيوانـات خيار البحر من خمسة مواقع هى : باب المندب والخوخة وميناء المخا وخليج عـدن ومنطقة المانجروف (نباتات الشورى mangrove). وأوضحت النتائج أن إجمالى عدد الأنواع المسجلة فى هـذه الدراسة هو 28 نوعا ينتمـون إلى ثلاثة رتب وأربعة عوائل وتسعة أجناس. وكانت منطقة بـاب المنـدب أعلى المنـاطق تنوعا وإحتـوت على 22 نوعا تمثل 78.6 ٪ من إجمـالى عـدد الأنـواع المسـجلة ، تليها منطقة الخوخة 15 نوعا (53.6٪)، ثم منطقة ميناء المخا 11 نوعا (39.3٪). أما منطقة المانجروف فكانت أقل المناطق تنوعا وإحتوت على ثلاثة أنواع (10.7 ٪).

وبينت الدراسة أن جنس *Holothuria* يحتوى على أكبر عدد من الأنواع بلغ 13 نوعا بنسبة 46.4 ٪ وأن هناك خمسة أجناس مثل كل منها بنوعا واحدا. وأشـارت نتائج هذه الدراسة والدراسات السابقة أن هنـاك 12 نوعا تم تسـجيلهم لأول مـرة من منطقة الدراسة. ومن بين الأنـواع المسـجلة في مواقع هـذه الدراسة هنـاك 5 أنواع (17.9 ٪) تعتبر مستوطنة في البحر الأحمر. وبينت دراسة توزيع الأنـواع فى الموائل (habitats) المختلفة أن الموائل الرملية إحتوت على أكبر عدد من الأنـواع ، 22 نوعا بنسـبة 78.6 ٪ ، تليها الموائل المرجانية (الشـعاب المرجانية الميتة والحيـة) 18 نوعا (64.3 ٪)، ثم سـرير الأعشـاب البحرية 15 نوعا (53.6 ٪) وأخـيرا الموائل الصـخرية بنسـبة 46.4 ٪. وتم تسـجيل ملاحظـات على التنـوع والوضع القائم للأنواع المسجلة وكثافاتها ، وكذلك موائلها وتوزيعها الجغرافى.