Egypt. J. Exp. Biol. (Zool.), 13(2): 300– 308 (2017)
DOI: 10.5455/egysebz.20171113105752

RESEARCH ARTICLE

Samia H. Eissa
Nahla E. Omran
Hoda K. Salem
Amal K. Kabbash
Manar A. Kandeil

Surveillance study on the most common sea-cucumbers in some Egyptian coasts

ABSTRACT:

Sea cucumbers depletion has become a threat to Egypt because of the extreme harvesting and utility of sea cucumbers for their direct value as food and as source for bioactive products. Therefore, it is necessary to have an updated overview about the current available species in Egyptian fauna, including distribution, anatomy and morphological analysis. Six species of sea-cucumbers were collected from Egyptian coasts (Mediterranean and Red Seas). One of these species, namely *Holothuria polii* is collected from Mediterranean Sea coasts (Abu-Qir and Miami regions, Alexandria) while, the other five species were found in Hurghada shores. The collected species were identified and separated according to morphometric analysis. The variation of morphological characters between collected samples and their distribution along Egyptian coasts were discussed. The obtained results revealed that *Holothuria leucospilota*, *Holothuria edulis*, *Bohadschia marmorata* and *Actinopyga mauritiana* can emit fine sticky mass named Cuvierian tubules from their anus while, *Holothuria atra* and *Holothuria polii* lack this tubule. In addition, there is a significant difference between *Actinopyga mauritiana* and other genera in the presence of five distinct teeth around the anus.

KEY WORDS:

Sea-cucumbers, *Holothuria*, *Bohadschia, Actinopyga* sp., Egypt, Mediterranean Sea, Red Sea.

CORRESPONDENCE:

Manar A. Kandeil

Pharmacognosy Department, Faculty of Pharmacy, Tanta University, Egypt

E-mail: manarkandeil@yahoo.com

Samia H. Eissa
Nahla E. Omran
Hoda K. Salem
Amal K. Kabbash

Zoology Department, Faculty of Science, Tanta University, Egypt

ARTICLE CODE: 32.01.17

INTRODUCTION:

Marine species are valuable sources of nourishing foods due to the rich oceanic biodiversity. Most of naturally occurring sources are derived from them (Malve, 2016; Mashjoor and Yousefzadi, 2016). Sea-cucumbers are marine invertebrates which have high value for humans as they have been used as food in several parts of the world particularly in some parts of Asia since the 18th century. They are consumed either raw or after very simple preparation (Taiyeb-Ali *et al*., 2003; Lovatelli, 2004; Bordbar, *et al*., 2011; Purcell *et al*., 2012; Omran, 2013). The commercial value of a species is commonly determined by its size and the thickness of the body wall (Conand, 1990; Omran, 2013). Chinese studies revealed that sea-cucumbers contain saponin glycosides. These compounds have a structure like the active component of ginseng, ganoderma, and other famous tonic herbs. Previous studies indicated anticancer, antifungal and antimicrobial activities of both the sea-cucumber saponins and polysaccharides (Jiansan and Jiaxin, 2001; Mashjoor and Yousefzadi, 2016).

They tend to live on the benthic areas of deep seas (Conand, 1990; Bordbar *et al*., 2011; Purcell *et al*., 2012). They feed using buccal tentacles which varies morphologically according to the systematic of the orders within the class. Another diagnostic feature of

the Holothuroidea is the reduction of the skeleton to microscopic calcareous spicules (ossicles) that have mesodermal origin. It has been demonstrated that the spicules of sea-cucumber consist of a single crystal of calcite (Ahmed, 2009). The family Holothuriidae represents 11% of the total diversity of the class Holothuroidea. It includes about 185 species which classified into five genera. *Holothuria* comprises about 148 species classified into 18 subgenera (Samyn *et al.*, 2005).

The identification of all genera and species of sea-cucumbers depend almost entirely on the general body morphology and anatomical features. The main characters used for identifying and classifying holothuroids are the fine morphology of the calcareous ring, number of tufts of gonad, shape, size, distribution, abundance and position of microscopic spicules (Deichmann, 1958; Clark and Rowe, 1971; Ahmed, 2009). The spicules can take widely different shapes, such as rosettes, C-shaped rods, buttons, and plates (Hickman, 1998). The previous study of Gilliland (1993) stressed that a single species contains several different types of ossicles.

Some species that belong to the family Holothuriidae possess defense system called the Cuvierian tubules that located in the posterior part of the animal (Hamel and Mercier, 2000). When sea-cucumber attacked by foreign predators, it expels tubules that lengthen into sticky white threads to entangle them (Bingham and Braithwaite 1986; Hamel and Mercier, 2000).

Holothuria polii is a common holothurian echinoderm that inhabits the Mediterranean Sea shore of Abu-Qir and Miami, Alexandria, Egypt (Eissa, 1986). Other species of *Holothuria* inhibit the red sea coasts and Gulf of Aqaba (Ahmed, 2006). *Holthuria atra* is a common reef species in the Red Sea and Gulf of Aqaba. It has a wide range of habitat preferences including coral reef; seagrass beds and sandy habitats (Samyn, 2003; Ahmed, 2006). The species also has a wide range of depth preferences ranging from 0 to 25 m deep (Conand, 2001; Lawrence *et al*., 2004). *Actinopyga mauritiana* is one of the commercial sea-cucumber species and has a wide range of distribution. It also has a wide range of habitat preferences in coral reef and seagrass (Massin, 1996; lane *et al*., 2000; Samyn, 2003). In addition, it has depth preferences in shallow and deep water (Conand and Byrne, 1993; Massin, 1996; Lane *et al*., 2000; Samyn, 2003).

In 1955, Cherbonnier recorded 16 genera and 44 species of holothurians inhibit Red Sea belonging to three orders. Cherbonnier (1979) added 15 species of holothuroids from the Gulf of Aqaba with detailed description of three species, *Bohadschia steinitzi*, *Holothuria kurti* and *Psendocnus echinatus* which was recorded for the first times this area. In 1971, Clark and Rowe studied the Indo-West Pacific echinoderms including those from the Red Sea. They recorded 66 species of holothuroids from the Red Sea, distributed within 5 families. They recorded 46 species of Holothuriidae among them *Holothuria* (*Stauropora) olivacea*, 11 species of Synaptidae, 4 species of Cucumariidae, 3 species of Phyllophoridae and finally two species belonging to family Stichopodidae.

Because of the overexploitation of several sea cucumber species in Egyptian fauna, the goal of this work is to have an updated overview and re-description of the available recent species there.

MATERIAL AND METHODS:

Samples collection:

Specimens of sea-cucumbers were collected from some localities in Egyptian coasts (Fig. 1). *Holothuria polii* were collected from the intertidal region at Abu-Qir and Miami coasts (Mediterranean Sea) during summer (June 2014). Collected specimens were transported in an icebox to the laboratory for subsequent investigations.

Other specimens were collected in January, February and March (2015) from Hurghada shores of the Red Sea by SCUBA diving from deep water (35 m maximum depth) and by snorkelling and hand collection from shallow reef flat areas.

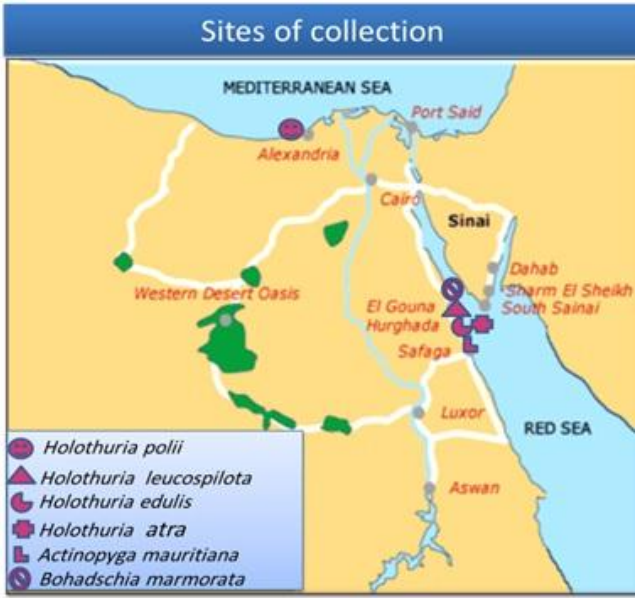

Fig. 1. Map of Egypt shows the sites of collection and the collected species.

Preservation and identification:

For taxonomic examination, specimens were preserved in 10% (v/v) formalin buffered with sea water. Identification of the sea-cucumber was undertaken using morphological characters and types of spicules (Clark and Rowe, 1971; Cannon and

Silver, 1986). The average of sample length, width, weight and body wall thickness were determined after relaxation and ejection of internal organs. The morphological characters, include dorsal and ventral surface colours, tentacle types, respiratory trees and gonads, were immediately recorded after collection.

Spicules preparation:

A sample tissue was taken from the tegument of each sample (2 × 2 mm^2) then was placed in the centre of a slide, on a flat surface free from dust and drafts. A large drop of neat bleach Clorox (5.25% sodium hypochloride) was then added over the sample with a pipette and left for 5 – 15 min to dissolve soft tissue (depending on the thickness of the tissue and strength of the bleach). The slide was then washed carefully with distilled water to remove the bleach and examined under the optical microscope accompanied by digital camera (Olympus microscope CX31).

All morphometric analyses were repeated three times and the obtained results were expressed as mean values ± standard deviation (SD) using a statistical analysis system (SPSS Version 17).

RESULTS:

Six species of sea-cucumbers, belonging to family Holothuriidae from three different genera were collected during this work.

Classification of the collected species:

Phylum: Echinodermata

Class: Holothuroidea

1. Order: Aspidochirotida (Grube, 1980)

Members of this order have radial canals, numerous podia, small leaf-shaped tentacles and respiratory trees. Also, they possess numerous ventral tube-feet for locomotion while, the dorsal tube-feet are modified into warts, papillae or elongated processes.

1.1. Family: Holothuriidae (Ludwig, 1894)

Members of this family are characterized by ventrally located mouth. The body is flattened ventrally to form a creeping sole. The spicules have the form of tables, rods and perforated plates.

1.1.1. Genus: Holothuria (Linnaeus, 1767)

1.1.1.1. species: *polii, atra, leucospilota and edulis*

1.1.2. Genus: *Bohadschia* (Jaeger, 1833)

1.1.2.1. species: *marmorata*

1.1.3. Genus: *Actinopyga* (Bronn, 1860)

1.1.3.1. species: *mauritiana*

Morphological characteristics and taxonomic examination of the collected species will be discussed in the following sections.

***Holothuria polii* (DelleChiaje, 1823)** (Fig. 2)

Re-description:

It is a common holothurian existed on soft bottoms in Abu-Qir and Miami coasts of Alexandria among sea grasses. It has a cylindrical dark brown coloured body and spotted with dark brown spots (Fig. 2). The recorded mean length of the body was 15.83 ± 2.17 cm, the mean width was 5 ± 1.8 cm and the mean weight was 151.57 g. The retractile podia are present only on the ventral surface while, the dorsal surface is devoid of podia. The five radii running longitudinally from mouth to anus are two dorsal and one median ventral and two lateral ventral. The mouth is somewhat ventral and surrounded by retractile tentacles (buccal tentacles). The anus is terminal situated at the posterior pole of the animal. It lacks Cuvierian organ. Integument is thick with internal microscopic calcareous spicules belong to button type of different shapes and sizes (Fig. 3).

Fig. 2. External feature of *Holothuria polii.*

Fig. 3. Dermal ossicles of *Holothuria polii* (buttons).

Distribution and habitat:

H. polii lives in Mediterranean Sea and Atlantic Ocean east. It lives in all backgrounds but prefers those detrital and grasslands of seagrass. It furrows from the surface about twenty meters deep, sometimes more (Göthel, 1992).

***Holothuria atra* (Pearson in 1914)** (Fig. 4)

Re-description:

It is commonly known as the black sea-cucumber or lolly fish. The body is a sausage-shaped cylindrical, elongated, with rounded ends and smooth tegument **(**Fig. 4). The

recorded mean length was 23.3±7.6cm, the mean width was 7.5 ± 3.1 cm and the mean weight was 368.67 ± 199.6 g. The mouth is ventral surrounded by 20 black tentacles, long, leafy shape, with collar of papillae around the base of the tentacles. The tube feet consist of numerous pedicles crowded on the ventral surface. Gonads are in a single tuft and consist of simple tubes with numerous branches. The anus is terminal and without anal papillae. *H. atra* emits red fluid when its skin is rubbed or damaged. It hasn't Cuvierian tubules, so when attacked it extrudes its internal organs through the anus.

Ossicles:

Body wall with tables. Each table with large and more spinose disc and has high spire ending in a Maltese cross (Fig. 5a). Also, it has numerous simple rosettes (Fig. 5b) and perforated disc with four central and four peripheral holes (Fig. 5c).

Fig. 4. External feature of *Holothuria atra*.

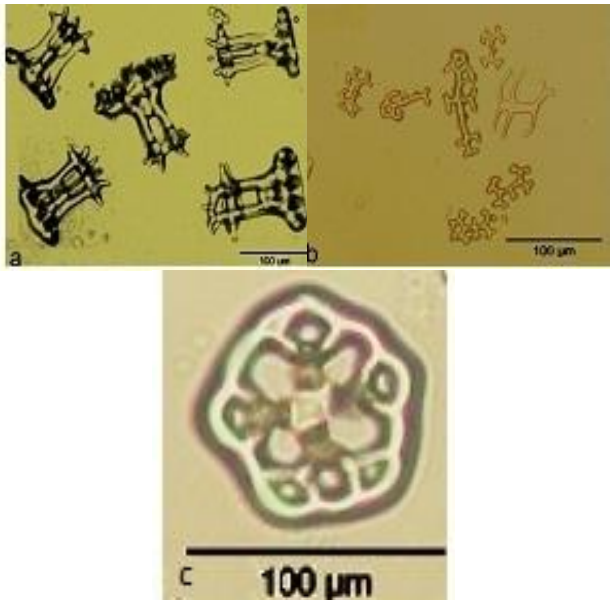

Fig. 5. Dermal ossicles of *H. atra*. a. tables, b. rosettes, c. Table disc perforated by four central and four peripheral holes, with high spire ending in a Maltese cross.

Local distribution and habitat:

The species considered to be one of the most common shallow water species in all habitats along the Red Sea coasts of Egypt. It was rarely found in depths more than 20 m. *H. atra* is abundant on all type of habitats such as coral reefs, sea grasses and sand (Ahmed, 2009).

World distribution:

Holothuria atra is a cosmopolitan species widely distributed along the tropical Indo-Pacific area. It extends from the Red Sea and East Africa to Australia. It is found on the seabed, in shallow waters on reefs and sand flats and in seagrass meadows at depths of up to 20 metres (Paulay, 2010a; Purcell *et al*., 2012).

***Holothuria leucospilota* (Brandt, 1835)** (Fig. 6)

Re-description:

It is commonly known as the black sea-cucumber as the body colour is entirely black. It is roughly cylindrical, tapering towards the posterior end and its tegument is very smooth. The body is very elongate, narrower anteriorly than posteriorly **(**Fig. 6). The recorded mean length was 35 ± 5 cm; the mean width was 4 ± 1 cm, the mean live weight was 316.6 ± 79.29 g and the mean body wall thickness is 0.73 ± 0.25 cm. The mouth is ventral surrounded by 20 black tentacles, sometimes brown; leafy shape with no collar of papillae around its base. Their Podia and papillae are randomly distributed on the dorsal surface. The anus is sub-dorsal in position. Gonads consist of simple tubes with numerous branches forming a single tuft. It can emit a mass of fine sticky Cuvierian tubules from its anus which ensnares the potential predator allowing the sea-cucumber to escape.

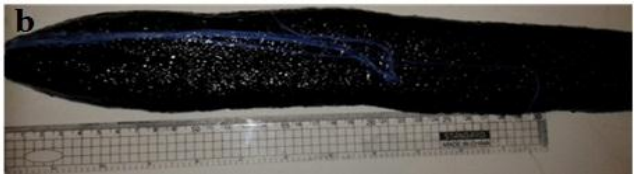

Fig. 6. External feature of *Holothuria leucospilota*.

Ossicles:

Body wall with tables and buttons (Fig. 7 a & b). Tables are numerous, their disc perforated by 4 large central holes and 4 - 15 small peripheral holes. The rim of the disc is provided with spines. There are 4 short pillars forming a spire united by one cross beam and ending in a crown of sharp spines and a large central hole (Fig. 7a). Buttons are few with mostly 3 pairs of holes (Fig. 7b).

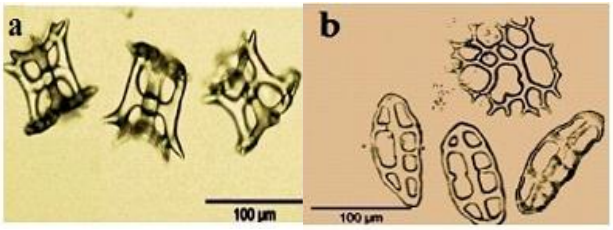

Fig. 7. Dermal ossicles of *Holothuria leucospilota*; a. tables, b. buttons with 3 pairs of holes, c. rosettes.

Local distribution and habitat:

The species is widely distributed along the Red Sea and Gulf of Aqaba. It was recorded in 102 sites along the Egyptian coast of the Red Sea. It was rarely to be found in depth more than 20 m; mostly on outer and inner reef flats, black reefs, and shallow coastal lagoons, abundant in sea grass beds, sandy-muddy grounds with rubble or coral patches where it hides the posterior part of body (Ahmed, 2009; Purcell *et al*., 2012).

World distribution:

This species is widespread throughout the Indo-Pacific and the Red Sea. It can be found from South Africa to India, China to Australia, Hawaii, Polynesia, and east to Central America from Mexico to Peru (Conand *et al*., 2013).

***Holothuria edulis* (Lesson, 1830)** (Fig. 8).

Re-description:

It is commonly known as the edible sea-cucumber or the pink and black sea-cucumber. The body is stout approximately cylindrical in shape but with somewhat flattened ventral sole. This sea-cucumber has usually a dark reddish-black colour on its upper side (Fig. 8a) and a pinkish-mauve colour below. The recorded mean length is 23 ± 7.75 cm; mean width was 5.75 ± 1.7 cm; mean live weight was 224.3 ± 123.36 g and mean body wall thickness was 0.73 ± 0.25 cm. The mouth is ventral surrounded by 20 grey big tentacles and have collar of papillae around their bases (Fig. 8b). It has a posterior tapering vermiform end**.** The podia are cylindrical, scattered ventrally on the radius and inter-radius. The anus is usually devoid of anal papillae and sub-terminal in their position. Gonads are composed of simple tubes with numerous branches forming a single tuft.

Fig. 8. External feature of *Holothuria edulis*.

Ossicles:

Body wall with button-like rosettes (Fig. 9 a & b) and tables (Fig. 9 c) that are similar in both dorsal and ventral body wall.

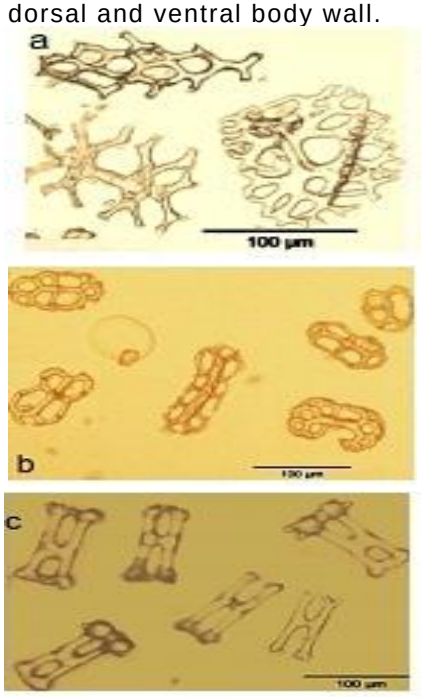

Fig. 9. Dermal ossicles of *H. edulis*. A & b, button-like rosettes and c, tables.

Local distribution and habitat:

It is a very rare species along the Egyptian coast of the Red Sea and Gulf of Aqaba. It was rarely found in depths of more than 20m; mostly in inner and outer flats of costal reefs, back reefs, or shallow coastal lagoons (Ahmed, 2009; Purcell *et al*., 2012).

World distribution:

Holothuria edulis is a common and widespread species in the western Indo-Pacific Ocean. It lives on the seabed at depths down to 20 meters. It extends from the Red Sea and East African coast to Sri Lanka, Japan, China and Indonesia. It is found in many different habitats such as sandy, muddy substrates, coral and sea grass meadows (Paulay, 2010b).

***Bohadschia marmorata* (Jaeger, 1833)** (Fig. 10).

Re-description:

Its body is cylindrical in cross-section. It has generally light yellowish ventral colour (Fig. 10a) and brownish dorsally **(**Fig. 10b). The body wall is thick, tough and leathery and has a rough texture due to its calcareous spicules. The recorded mean thickness of it was 1.2 ± 0.65 cm. The recorded mean length of the body was 15.83 ± 1.8 cm, the mean width was 7.6 ± 2.1 cm and the mean weight was 264.5 ± 106.35 g. The anterior end of the body is somewhat narrowed and has a mouth surrounded by a ring of retractile tentacles. The posterior end is rounded and has an anal opening which is terminal, relatively large, surrounded by a brown line**.** It has defensive

white sticky threads of the Cuvierian tubes which may be ejected through the cloaca when the animal is stressed.

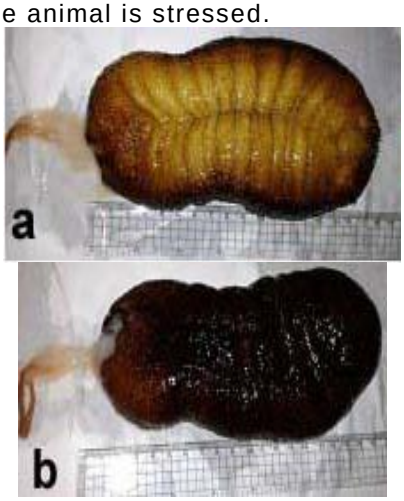

Fig. 10. External feature of *Bohadschia marmorata*; A, Ventral view and B, dorsal view.

Ossicles:

Body wall with rosettes and grains of various forms that can be perforated or not (Fig. 11).

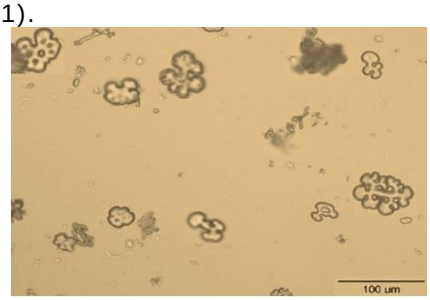

Fig. 11. Dermal ossicles of *B. marmorata* (rosettes and grains).

Local distribution and habitat:

The species is widely distributed along the Red Sea coast of Egypt and Gulf of Aqaba. It was usually found in shallow water, rarely in depths more than 20 m; mostly in coastal lagoons and inner reef flats; abundant in sandy-muddy sediments where it burrows most of the time (Ahmed, 2009; Purcell *et al*., 2012).

World distribution:

Bohadschia marmorata is found in the Indo-Pacific Ocean. It extends from the Red Sea and east coast of Africa to Japan, the Philippines and Australia. It lives on the sandy or gravelly bottoms of shallow water areas and seagrass meadows at depths down to about 36 metres (Paulay, 2010c).

***Actinopyga mauritiana* (Quay and Gaimard 1833)** (Fig. 12)

Re-description:

Its body is very thick, muscular, cylindrical in shape, elongated, arched dorsally and flattened ventrally. It has very variable colour on both sides in which the ventral body wall is pink in colour but sometimes is white (Fig. 12a). Dorsal side is black with numerous light brown conical papillae and sometimes wrinkled, wider in the middle and tapering towards both ends**.** The anus is armed with five distinct calcified teeth. Body size is moderate to large. The recorded mean length was 36 ± 4.97cm; mean width was 9.67 ±1.53 cm; mean weight was 800 ± 180.28 g and the mean thickness of the body wall is 1.5 ± 0.5 cm. Mouth is ventral surrounded by 25 black short, leafy shaped and stout tentacles (Fig. 12b). Their Tube feet are arranged in 8 to 12 rows at the ventral side, while in the dorsal side decreased to 5 or 6 rows. Papillae are small and cylindrical. Pedicles are numerous and small. The gonad is long and form very fine tubes with numerous small branches forming a single tuft.

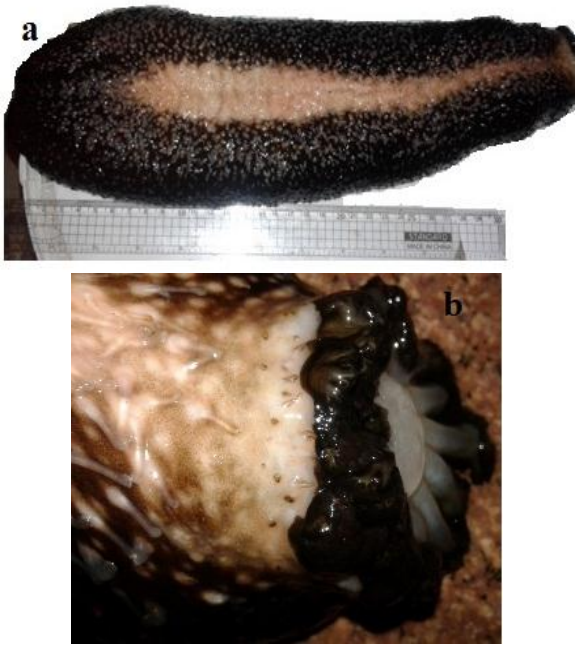

Fig. 12. External feature of *Actinopyga mauritiana*, a. ventral side and b. enlarged anterior part of *Actinopyga mauritiana* showing buccal tentacles.

Ossicles:

body wall is provided with spiny or smooth rods and simple, very small rosettes (Fig. 13a), small and elongated grains (Fig. 13b). Also, it has plates like dermal ossicles (Fig. 13c).

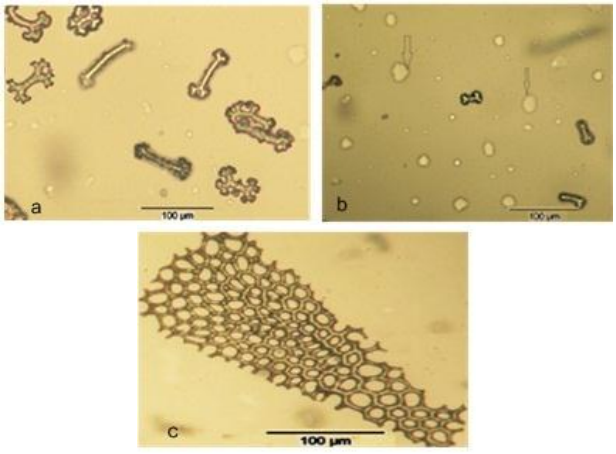

Fig. 13. Dermal ossicles of *A. mauritiana*;

Local distribution and habitat:

The species is widely distributed along the Red Sea coast and the Gulf of Aqaba. It was found in sub-tidal and intertidal areas. It is very abundant in sandy areas, sea grasses, and sandy lagoons and on corals (Ahmed, 2009).

World distribution:

This species is found in islands of West Indian Ocean, East Africa, East Indies, North Australia, Philippine Island, China, south Japan, south Pacific Island and Hawaiian Islands. moreover, they are widely distributed in the tropical Indo-Pacific; from the Red Sea to Hawaii (Tortonese, 1980; Rowe and Gates, 1995).

DISCUSSION:

The present work re-described the most common sea cucumbers in Egypt by using shape, body wall colour, thickness and spicules, tube feet, papillae and presence or absence of Cuvierian gland. Typically, these characters are used for identification and classification of species (Clark and Rowe, 1971; Cherbonnier 1980; Conand, 1990; Uthicke *et al*., 2004). Other anatomical character such as the presence or absence of Cuvierian tubules is used as a taxonomic character by Uthicke *et al*. (2004). Additional previous method has been used in attempt to identify the different species of sea-cucumber while live or fresh such as molecular phylogeny (Uthicke and Benzie 2003; Uthicke *et al*., 2004; Ahmed, 2009). These methods have been useful in most cases.

The recent survey resulted on the identification of one species (*Holothuria polii*) collected from Mediterranean Sea (Abu Qir and Miami regions) and five different sea-cucumber species collected from the Hurghada coasts. These species were *H. atra*, *H. leucospilota*, *H. edulis*, *Bohadschia marmorata* and *Actinopyga mauritiana*. All the species were identified using the available keys for sea-cucumber identification provided by Clark and Rowe (1971) and Cannon and Silver (1986). Previous study of Ahmed (2009) recorded 18 different species of sea cucumber from the Red Sea coast of Egypt and Gulf of Aqaba. He collected three different species of the genus *Actinopyga* in which two morphotypes from the species *A. mauritiana* and *A. crassa*. Moreover, three species from the genus *Bohadchia*, one species of the genus *Pearsonthuria* and eight species from the genus *Holothuria* were also collected and described by the same author.

In current study, the description of tested sea-cucumber *Holothuria polii* which lacks Cuvierian tubules is coincident with that of Shoukr *et al*. (1984), Eissa (1986), and Omran and Khedr (2012).

The findings showed that *Holothuria leucospilota* can emit fine sticky mass named Cuvierian tubules from its anus which ensnare the potential predator allowing the sea-cucumber to escape, while, *Holothuria atra* lacks this tubule. This result agrees with the previous study of Flammang *et al*. (2002) and Ahmed (2009).

Holthuria atra is a common reef species in the Red Sea and Gulf of Aqaba. In the present study the collected *H. atra* from Hurghada coasts is easy to identify because it characterized by dark black body which is very thin and usually releases red stain when handed and without Cuvierian tubules. The Morphological and spicule examination results showed no differences between specimens collected from the Red Sea, and specimens collected from different habitats recorded in the previous studies of Conand (2001), Lawrence *et al*. (2004), and Ahmed (2009).

Concerning *Holothuria edulis* which collected in this study, it has a dark reddish-black colour on its upper side and a pinkish-mauve colour below. It can retract and expand its body and adopt different shapes. The obtained morphological characters come in accordance with that described before by Ahmed (2009). The same author mentioned that *H. edulis* is a very rare species along the Egyptian coast of the Red Sea and Gulf of Aqaba. It was rarely found in depths of more than 30m; mostly in inner and outer flats of costal reefs, back reefs, or shallow coastal lagoons.

The results showed that the spicule differences between *Actinopyga* and *Bohadchia* are very little and they are almost similar in both species while, morphologically there are clear difference between the two genera that is represented by the presence of anal hard teeth in the case of *Actinopyga* which replaced by anal soft papillia in the case of *Bohadchia*. These results agreed with Samyn (2003) and Ahmed (2009).

In this survey, Egyptian *B. marmorata* has generally light yellowish ventral colour and brownish dorsally and this is dissimilar with Purcell *et al*. (2012) who mentioned that *B. marmorata* has large brown blotches on the dorsal surface and white to cream colour ventral surface. The morphological examination results showed great differences between *Actinopyga mauritiana* and other genera. This species is one of the commercial sea- cucumber species and has a wide range of habitat preferences (coral reef and sea grass) and depth preferences (shallow and deep water). The investigated species is characterized by dark black dorsal surface with numerous light brown conical papillae and white-pink ventral surface. On the other hand, in the Western Indian Ocean, the colouration is marbled greenish to brownish with white patches dorsally (Purcell *et al*., 2012). Thus, the habitats affect the morphology of species. The spicule examination of herein *A. mauritiana* is rods

and rosettes that matching the spicules description of this species in the literature (Conand and Byrne, 1993; Lane *et al*., 2000; Samyn, 2003). *A. mauritiana* has an additional type of spicules (plates) that has been mentioned only in this study.

In conclusion, the taxonomy of sea-cucumbers depends on the variation of morphological characters between the different kinds of species. The results showed significant differences between *Actinopyga mauritiana* and other genera in the presence of five distinct calcified teeth around the anus. Further researches based on their chemotaxonomy and bioactivities are currently underway in our laboratory.

ACKNOWLEDGMENTS:

The authors are grateful to the Department of Zoology, Tanta University for providing necessary laboratory facilities.

REFERENCES:

Ahmed MI. 2006. Taxonomic and fishery stock status of sea-cucumber in the Egyptian Red Sea. MPhil Thesis, University of Hull, UK.

Ahmed MI. 2009. Morphological, ecological and molecular examination of the sea-cucumber species along the Red Sea coast of Egypt and Gulf of Aqaba: with the investigation of the possibility of using DNA barcoding technique as a standard method for sea-cucumber ID. PhD Thesis, University of Hull, UK.

Bingham BL, Braithwaite LF. 1986. Defense adaptations of the dendrochirote holothurians *Psolus chitonoides* Clark. J. Exp. Mar. Biol. Ecol., 98(3): 311–322.

Bordbar S, Anwar F, Saari N. 2011. High-value components and bioactives from Sea Cucumbers for functional foods - A review. Mar. Drugs, 9(10): 1761-1805.

Cannon LRG, Silver H. 1986. Sea-cucumbers of Northern Australia. South Brisbane, Australia: Queensland Mus., pp. 60.

Cherbonnier G. 1955. The holothurians from the Red Sea [Les holothuries de la mer Rouge]. Ann. Inst. Océanogr. Paris (Nouv. Sér.) 30: 129-183.

Cherbonnier G. 1979. Description d'Actinopyga flammea nov. sp., et données nouvelles sur deux espèces connues d'Holothuries Aspidochirotes (Echinodermes). Bull. Mus. Hist. Nat., Paris, 4(1): 3-12.

Cherbonnier G. 1980. Holothuries de Nouvelle-Calédonie. B. Mus. Nat. Hist. Paris, 2(A3): 659-700.

Clark AM., Rowe FWE. 1971. Holothuroidea. In: Monograph of shallow-water Indo-West Pacific echinoderms, London Trustees Brit. Mus. Nat. Hist., pp. 171–210.

Conand C. 1990. The fishery resources of Pacific island countries. Part 2: Holothurians. FAO Fish. Tech. Pap., Rome, FAO. 272.2, pp.143.

Conand C. 2001. Overview of sea-cucumbers fisheries over the last decade - what possibilities for a durable management? In: "Echinoderm 2000. (Barker MF., Ed)". Swets & Zeitlinger, Lisse, pp. 339–344.

Conand C, Byrne M. 1993. A review of recent developments in the world sea cucumber fisheries. Mar. Fish. Rev., 55: 1-13.

Conand C, Purcell S, Gamboa R. 2013. *Holothuria leucospilota.* The IUCN Red List of Threatened Species. Version 2014.3.IUCNRedList.org.

Deichmann E. 1958. The Holothurioidea collected by the Velero III and IV during the years 1932 to 1954. Part II. Aspidochirota. Allan Hancock Pacif. Exped., 11: 249-349.

Eissa SHH. 1986. Taxonomical, histological and histochemical studied on sea-cucumber *Holothuria* in Egypt water. MSc Thesis, Fac. Sci., Tanta Univ. Egypt.

Flammang P, Ribesse J, Jangoux M. 2002. Biomechanics of Adhesion in Sea Cucumber Cuvierian Tubules (Echinodermata, Holothuroidea). Integr. Comp. Biol., 42(6): 1107–1115.

Gilliland PM. 1993. The skeletal morphology, systematics and evolutionary history of holothurians. Palaeontological Assoc., pp. 147.

Göthel, H. 1992 Guide de la faune sous-marine: La Méditerranée. Invertébrés marins et poissons. Eygen Ulmer GmbH & Co., pp. 318.

Hamel JF, Mercier A. 2000. Cuvierian tubules in tropical holothurian: usefulness and efficiency as a defence mechanism. Mar. Freshw. Behav. Physiol., 33(2): 115–139.

Hickman CJ. 1998. A field guide to sea stars and other echinoderms of Galapagos (Galapagos Marine Life Series). Sugar Spring Press., pp. 83.

Jiansan J, Jiaxin C. 2001. Sea farming and sea ranching in China. FAO Fish. Tech. Pap. No. 418, pp. 43–46.

Lane D, Marsh L M, VandenSpiegel D, Rowe, F W E. 2000. Echinoderm fauna of the South China Sea: an inventory and analysis of distribution patterns. Raffles B. Zool., 8: S459-S493.

Lawrence AJ, Ahmed M, Hanafy M, Gabr H, Ibrahim A, Gab-Alla A. 2004. Status of the sea-cucumber fishery in the Red Sea – The Egyptian experience. In: 'Advances in sea-cucumber aquaculture and management. (Lovatelli A, Conand C, Purcell S, Uthicke S, Hamel JF, Mercier A. Eds)'. FAO Fish. Tech. Pap. No. 463, pp. 457.

Lovatelli A. 2004. Advances in sea cucumber aquaculture and management. FAO Fish. Tech. Pap. No. 463, pp. 440.

Malve H. 2016. Exploring the ocean for new drug developments: Marine pharmacology. J. Pharm. Bioallied. Sci. 8(2): 83–91.

Mashjoor S, Yousefzadi M. 2016. Holothurians antifungal and antibacterial activity to human pathogens in the Persian Gulf. J. Mycol. Med., 27(1): 46-56.

Massin C. 1996. Results of the Rumphius Biohistorical Expedition to Ambon (1990). Part 4. The Holothuroidea (Echinodermata) collected at Ambon during the Rumphius Biohistorical Expedition. Zool. Zool. Verh. Leiden, 307(1): 1–53.

Omran NE. 2013. Nutritional Value of Some Egyptian Sea Cucumber. Afr. J. Biotechnol., 12(35): 5466–5472.

Omran NE, Khedr AM. 2012. Structure elucidation, protein profile and the antitumor effect of the biological active substance extracted from sea-cucumber *Holothuria polii*. Toxicol. Ind. Health, 31(1): 1–8.

Paulay G. 2010a. *Holothuria (Halodeima) atra* Jaeger, 1833. Accessed through: World Register of Marine Species at http://www.marinespecies.org/aphia.php?p=taxdetails&id=148748 on 2017-11-23.

Paulay G. 2010b. *Holothuria (Halodeima) edulis* Lesson, 1830. Accessed through: World Register of Marine Species at http://www.marinespecies.org/aphia.php?p=taxdetails&id=210882 on 2017-11-23.

Paulay G. 2010c. *Bohadschia marmorata* Jaeger, 1833. Accessed through: World Register of Marine Species at http://marinespecies.org/aphia.php/aphia.php?p=taxdetails&id=210762 on 2017-11-23.

Purcell SW, Samyn Y, Conand C. 2012. Commercially important sea cucumbers of the world. FAO Species Catalogue for Fishery Purposes No. 6, FAO, Rome.

Rowe FWE, Gates J. 1995. Echinodermata. In: "Zoological Catalogue of Australia, (Wells A. Ed.)", CSIRO, Canberra, Australia, Vol. 33, pp. 510.

Samyn Y, Appeltans W, Kerr AM. 2005. Phylogeny of *Labidodemas* and the Holothuriidae (Holothuroidea: Aspidochirotida) as inferred from morphology. Zool. J. Linn. Soc., 144(1): 103-120.

Samyn Y. 2003. Towards an understanding of the shallow-water holothuroid fauna (Echnodermata: holothuroidea) of the western Indian Ocean. PhD Thesis Vrije. Univ. Brussel., pp. 384.

Shoukr FA, Mona MH, Abdel-Hamid ME. 1984. Holothurians (Echinodermata: Holothuroidea) from some Egyptian shores. B. Fac. Sci. Zagazig Univ., 6: 662–682.

Taiyeb-Ali TB, Zainuddin SLA, Swaminathan D, Yaacob H. 2003. Efficacy of "Gamadent" toothpaste on the healing of gingival tissues: a preliminary report. J. Oral Sci., 45(3): 153–159.

Tortonese E. 1980. Researches on the coast of Somalia. Littoral Echinodermata. Ital. J. Zool., Supplemento, 13(1): 99-139.

Uthicke S, Benzie JA. 2003. Gene flow and population history in high dispersal marine invertebrates: mitochondrial DNA analysis of *Holothuria nobilis* (Echinodermata: Holothuroidea) populations from the Indo-Pacific. Mol. Ecol., 12(10): 2635-2648.

Uthicke S, Welch D, Benzie JA. 2004. Slow growth and lack of recovery in overfished holothurians on the Great Barrier Reef: Evidence from DNA fingerprints and repeated large-scale surveys. Conserv. Biol., 18(5): 1395-1404.

دراسة حصرية لأنواع خياريات البحر المختلفة في الشواطْئ المصرية

سامية هانم حميم عيسى، نهله السيد عمران، هدى كمال سالم، أمل كمال كباش*، منار عباس قنديل

قسم علم الحيوان، كلية العلوم، جامعة طنطا، مصر

* قسم العقاقير، كلية الصيدلة، جامعة طنطا، مصر

الإفراط في صيد خيار البحر من الشواطئ المصرية، نظراً لفوائده الغذائية والصحية العظيمة، أصبح يهدد التنوع البيولوجي البحري لدرجة اختفاء بعض الأنواع الأمر الذي أدى إلى إغلاق المصايد في عده مناطق. وبناء عليه هدفت هذه الدراسة لعمل فحص حديث لأنواع خياريات البحر المتاحة الآن على السواحل المصرية من حيث التوزيع والتشريح والشكل الظاهري. اشتملت الدراسة على تجميع ستة أنواع مختلفة من أنواع خياريات البحر من السواحل المصرية (البحر الأبيض المتوسط والبحر الأحمر). أحد هذه الأنواع، كان هولوثوريا بولاي، وهو فريدا من نوعه على سواحل البحر الأبيض المتوسط حيث تم جمعه من منطقتي أبو قير وميامي بينما تم العثور على الأنواع الخمسة الأخرى من شواطئ الغردقة. تم تصنيف هذه الأنواع وفصلها وفقا لتحليلها المورفومتري (كشكل الجسم واللون والطول والعرض والوزن). أيضاً تم اعتمد تحديد الأنواع بشكل كلي على أنواع وأشكال ووفرة الشويكات المجهرية التي هي مكونات الهيكل العظمي في جدار الجسم لجميع خياريات البحر. وأظهرت النتائج أن الاختلافات بين أكتينوبيجا وبوهادشيا قليلة جدا وأنهما تقريبا يحتويا على أنواع مماثلة من الشويكات المجهرية، بينما من الناحية الشكلية هناك اختلافات واضحة بين النوعين الذي يمثله وجود الأسنان الصلبة الشرجية في حالة أكتينوبيجا التي يتم استبدالها بحلمات شرجية لينة في حالة بوهادشيا. ومن ناحية أخرى تم استخدام الجانب التشريحي مثل وجود أو عدم وجود انيبيات كوفريان كصفة تصنيفية، وهي كتلة من الخيوط اللزجة والتي تندفع من فتحة الشرج أثناء الهجوم. وأظهرت النتائج المتحصل عليها أن هولوثوريا ليوكوسبيلوتا، هولوثوريا إدوليس، بوهادشيا مارموراتا، وأكتينوبيجا موريتيانا تحتوي علي هذه الأنابيب، بينما هولوثوريا أترا وهولوثوريا بولي تفتقر إلى هذه الأنيبية.