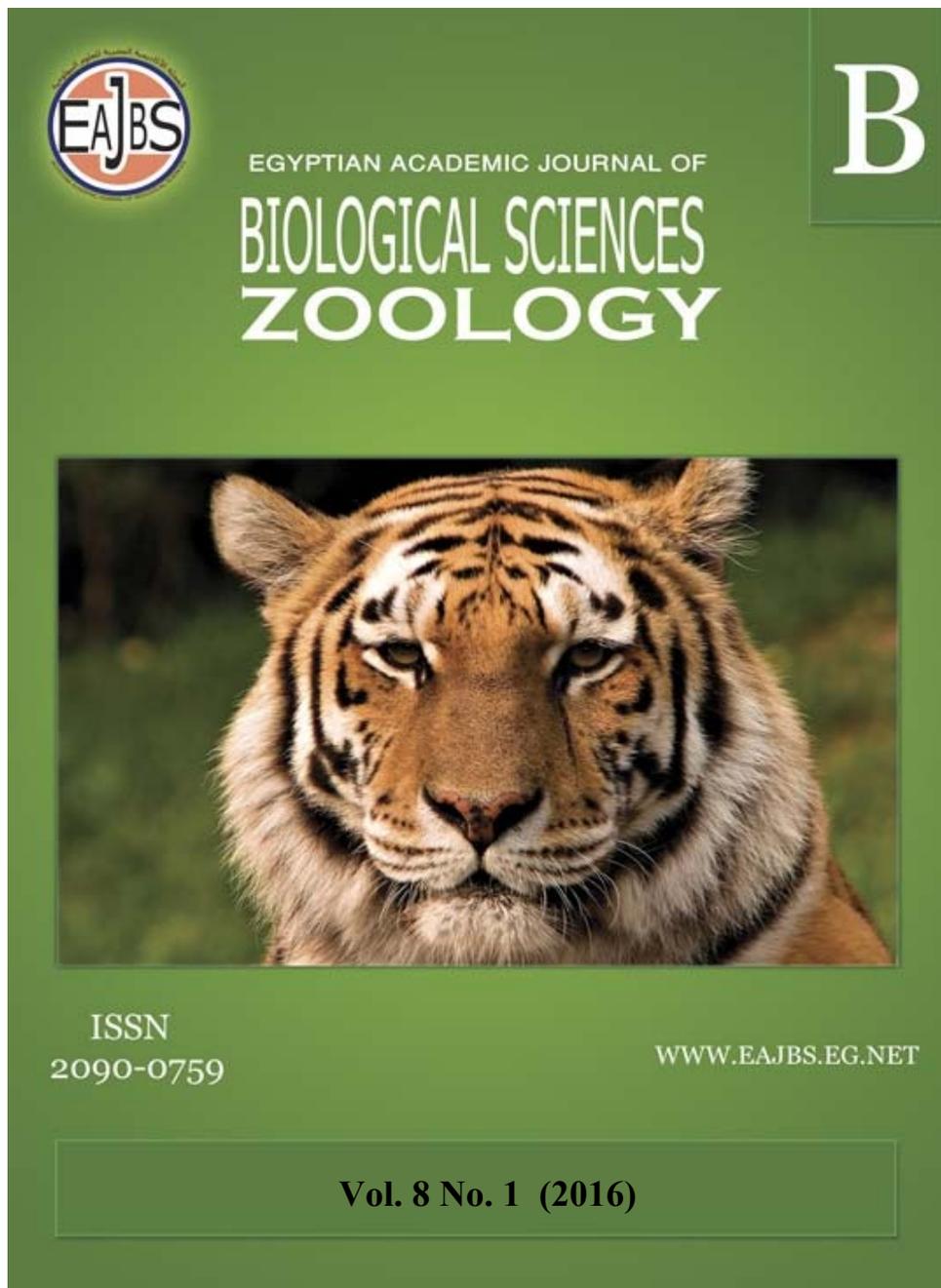
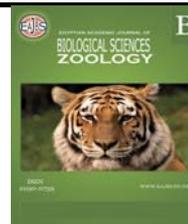


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Revision of family Ocypodidae (Brachyura: Crustacea) from the Egyptian Red Sea and Mediterranean Coasts

El-Sayed, A. A.M.¹; Nasef, A.M.¹; Khalifa, M.A.¹; Sarhan, M.²; and Abdal khalek, A.M.¹

1-Zoology Department, Faculty of Science, Al-Azhar University, Cairo;

2- Zoology Department, Faculty of Science, Al-Azhar University, Assuit Branch.

E. Mail: awaad_am@hotmail.com

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ABSTRACT

The present study revised taxonomy and occurrence of the ghost crabs (genus *Ocypode*) and fiddler crabs (genus *Uca*), belonging to family Ocypodidae collected from different localities of the Egyptian Red Sea and Mediterranean Sea coasts. A total of six species were collected, comprised three species of ghost crabs, represented by *Ocypode cordimanus*, *O. cursor*, and *O. saratan* and three species of fiddler crabs, including *Uca albimana*, *U. inversa*, and *U. tetragonon*. With the exception of *Ocypode cursor* which was only recorded from the Mediterranean Sea, all other five species were collected from the Red Sea. All species of *Ocypode* construct permanent burrows in the supralittoral sandy shores, while *Uca* species live in permanent burrows in the upper intertidal zone of mud-flats and sandy mud areas around and within mangrove swamps only. The present results showed also that, the fiddler crab, *Uca albimana*, was recorded for the first time from South Sinai mangroves at Nabq (Gulf of Aqaba) and Ras Mohammed (northern Red Sea), increased ocypodid fauna at the most northern portions of the Red Sea and Gulf of Aqaba. These results denote to the northward distribution of this species and recommend re-investigating all *Uca* species collected previously from South Sinai, particularly *U. inversa*, deposited in all National Museum of Natural History of the world. Notes on habitats, color, size and geographical distribution, in addition to keys for identification were also given.

INTRODUCTION

Members of ocypodids are frequently occurring in the coastal intertidal and supralittoral zones of tropical, subtropical and to somewhat temperate regions around the world (Guinot, 1967; Holthuis, 1958, 1975; Lewinsohn, 1977). They are characterized by well-defined wide orbits, occupied large size of front, with long stalked eyes, can move freely upper and lower in its orbits; therefore they called the ghost or stalked- eyed crabs.

Mature males are sexually differentiated from female by enlarged chelae which are mostly heterogenetic, with right and left dissimilar chelae in most species particularly in genus *Uca* (Barnard, 1950; Crane, 1975; Warner, 1977). The majority species of this super family occurs in sand or sandy mud habitats, as well as associated with mangroves, constructed permanent or temporarily burrows, being prominent during breeding season and reach more than 50 cm or more during winter (Fishelson, 1971; Por *et al.*, 1977; Vine, 1986; Jones *et al.* 1987; Sallam, 1993, 2005; El-Sayed, 1996 a &b, 2003; Hellal *et al.*, 1997; Fouda *et al.*, 2002).

Along the Red Sea coasts, several studies had been carried out on the occurrence of ocypodids either at sandy shores or within and around mangroves (Fishelson, 1971; Por *et al.*, 1977; Price *et al.*, 1987; Vine, 1986; Jones *et al.* 1987; El-Sayed, 1996 a &b, 2003; Hellal *et al.*, 1997; Fouda *et al.*, 2002). While detailed studies on biology and ecology of ocypodids from mangroves of South Sinai (Nabq Protected Area) were treated by Sallam (1993, 2005) and El-Serahy *et al.* (1994).

However, the taxonomical studies on the Red Sea ocypodids are rare. The only intensive studies on taxonomy of Red Sea ocypodids were carried out by Lewinsohn (1977) based on specimens collected from South Sinai and Dahlak Archipelago from Eritrean waters in addition to species from the natural history museums in Europe. He recorded 12 species; two belong to genus *Ocypode*, three to *Uca*, 5 to *Macrophthalmus* and one from each *Dotilla* and *Paracleistostoma*. With exception of *U. annulipes* which was recorded only from Dahlak Archipelago and southern Red Sea regions, all other species were recorded from South Sinai and other localities from the Egyptian coasts. On the eastern Red Sea coasts, Turkay *et al.* (1996) revised species of genus *Ocypode* from the Red Sea among those collected from Arabian Gulf, Gulf of Oman and Gulf of Aden. They recorded *Ocypode saratan* and *O. cordimanus* from the Red Sea. However, Naderloo, *et al.* (2010) recorded *Uca albimana* from Safaga, south Hurghada (25° N), indicating to the northward distribution for *Uca albimana* along the Egyptian coasts to Safaga.

On contrast, along the Egyptian Mediterranean coasts, Ocypodids are represented by only *Ocypode cursor*, which is very frequent along the intertidal sandy beaches and widely distributed in all Mediterranean regions (Manning & Holthuis, 1981; Ziese, 1985; Glaubrecht, 1992). Along the Egyptian coasts, no detailed taxonomical studies were done on this species, but it was recorded by Ramadan and Dowidar (1972) as well as by Atta (1991) among all brachyuran lists in the two studies. The occurrence of this species was noticed at several localities along the Egyptian Mediterranean coasts from Alexandria to Port Said (Ramadan and Dowidar, 1972; Atta, 1991).

The systematic of some ocypodids still has some problems. There are some species which have overlapping characters, or with restricted distribution for which little material is available. Another problem is the identification of juveniles which are often confused as they look very similar and do not show the adult characters.

Consequently, this study aims at revise the taxonomy of super family Ocypodoidea collected from the Egyptian coasts of the Red Sea and Mediterranean Sea, and gives information on geographical distribution, and general habitats for each species.

MATERIALS AND METHODS

A total of 75 specimens (55 males, 19 females and one only juvenile) of *Ocypode* and *Uca* species, family Ocypodidae deposited at Al-Azhar University Reference Collection, in addition to recently collected specimens were investigated.

All specimens were collected from different localities and variable habitats of the Egyptian coasts of the Red Sea and Mediterranean Sea during the period from April, 1982 to May 2015. The Red Sea areas comprised several sites of sandy and mangrove swamps extending along the coastline from 20 km North Hurghada to Abu Ramad, south Shalateen, in addition to Ras Mohammad Protected area at South Sinai (northern Red Sea). Other specimens were collected from Gulf of Aqaba, comprised Nabq and Abu Gallom Protected areas, and other separate sandy sites from Taba to Nueiba. While specimens of Gulf of Suez were collected from Adabya, Ain Sukhna, Abu-El-Darg Light house and Km 85 South Suez City at the western coast and from Ras Suder at the Eastern coast. For the Mediterranean Sea, specimens were collected from sandy coasts of Alexandria and Al Arish during the period from 2013 to 2014.

The crabs of the present study were collected from the supralittoral and intertidal zones either by hand during low tide or by hand net and plastic traps, especially for those of highly movable and nocturnal species. Burrowing species were dug out and separated from sand granules using sieves with mesh 0.5 mm. The subtidal species were collected by hand during snorkeling. All available information on types of habitats, date of collection, tidal regime, and color of live specimens were recorded. The collected specimens were kept in labeled jars and immersed with 10% formalin solution and transferred to the laboratory for further investigation.

At the laboratory, the specimens were sorted, sexed, and all available morphometric measurements were taken to the nearest centimeters using Caliper vernier according to Crane (1975), Naderloo, *et al.* (2010). All terminology comprising: carapace length (C.L), carapace width (C.W), front width (F.W), orbital width (O.W), chelae length (Ch. L), and fingers length (F.L), were used in the present work follow those mentioned by Crane (1975). While NIOF is the abbreviation for the National Institute of Oceanography and Fisheries, Red Sea Branch (Hurghada). The median and lateral gastric teeth of the gastric mill were described according to Sakai and Turkay (2013) and Naderloo, *et al.* (2010). All examined specimens were identified for the specific levels according keys of Barnard (1950), Crane (1975), Turkay *et al.* (1996), Edmonson (1962), Naderloo *et al.*, (2010) and Sakai and Turkay (2013), in addition to other available literature including Monod (1938), Lewinsohn (1977), Ng *et al.* (2008), and Mechie, *et al.* (2015) were also used.

Microscopic investigation and photographed of fine details of body regions for small species were carried out using a binocular microscope (Model OPTICA, SZM-1), fitted by Micro cam (PHD-5 MP). The dorsal and ventral surfaces, as well as, fine structure of carapace regions, granules, eyes, front, pleopods, gonopods, third maxillipeds, and appendages with their bristles, granules, and spines were examined and photographed, if necessary, using a portable camera (Samsung HD1080). Dendrogram for morphological characters was constructed using MINITAP 14.

RESULTS

Systematic account

Order Decapoda Latreille, 1802

Suborder Pleocyemata Burkenroad, 1963

Infraorder Brachyura Linnaeus, 1758

Section Eubrachyura de Saint Laurent, 1980

Super family Ocypodoidea Rafinesque, 1815

Family: Ocypodidae Rafinesque, 1815

Subfamily: Ocypodinae Rafinesque, 1815

Genus: *Ocypode* Weber, 1795
***Ocypode cordimanus* Latreille, 1818**
Plates (1&2)

Synonyms:

Ocypode cordimanus Latreille, 1818: p. 11; Nouv. Dict. Hist. Nat: 198; Crosnier, 1965: 96-98; Turkay, Sakai, & Apel, 1996: 100-102; Sakai and Turkay, 2013: 696- 702, Figs. 12& 34.

Ocypode cordimana, Kossmann 1877: 55; Laurie 1915: 416; Stella 1953: 66; Lewinsohn 1977:54.

Ocypoda cordimana, Nobili 1906 a: 310.

Ocybode aegyptiaca, Balss, 1924 (part.).

Material examined: 5 (3 males and 2 females).

Localities:

- **Red Sea:** Hurghada (NIOF): One ♀, 2.05×2.3 cm, April, 1992; 9Km North Marsa Alam: One ♂, 2.1×2.4 cm, 19/4/1996; Mangrove Safaga: One ♀, 1.3×1.9 cm, July, 2014; Mangrove Al-Hamraween, North Qusier: One ♂, 1.25×1.6 cm, 13 May, 2015.

- **Gulf of Aqaba:** Nabq: Protected Area: One ♂, 1.1×1.33Cm, July 1994.

General characters:

Carapace has squarish-shaped; with parallel lateral margins have broadly triangular and clearly protruding exorbital tooth (Plate, 1a&b). Front narrow, varies from 0.25-0.35cm. Orbit wide; approaches half-length of carapace width; varies from 0.60-1.00cm. Eystalks not extended beyond cornea (Plate, 2a).

Chelae are slightly dissimilar; inner surface of major chela palm without stridulating ridge (Plate, 2 d). Small chelae have pointed fingers; large and small chelae vary from 0.90-1.50cm. Outer and inner surface of finger and thumb have two transverse ridges convergent at tips; finger varies from 0.50-1.00cm.

Anterior face of propodus of second pereopods has a little row of hairs along median line (Plate, 2g), but the same joint is naked in third pereopods (Plate, 2j).

First male pleopods are abruptly narrowed distally, with distal part slightly bents laterally; palp is short and angular, its distance to pleopod tip much longer than palp length (Plate, 2 m). Opercle of female genital duct is knob-shaped, distally rounded, and protruding mesially; vulva-opening is oblique with respect to median line of sternum.

Size: Carapace: 1.10 cm to 2.10 cm in CL, and 1.30 to 2.40 cm in CW.

Color: Carapace, chelipeds, all walking legs and fingertips are whitish yellow or light yellow color.

Habitat: This species is rare, and digs its burrows in the upper intertidal and lower borders of the supralittoral sandy zones.

Distribution:

- **Local:** Gulf of Aqaba and Red Sea (Nobili 1906a; Laurie 1915; Balss, 1924; Stella 1953; Lewinsohn 1977; Vine, 1986; El-Sayed, 1995, 1996a,b, 2002; Hellal *et al.*, 1997; Fouda *et al.*, 2003).

- **World:** Indo-West Pacific from South Africa to Madagascar, Seychelles and Mauritius (Crosnier, 1965; Guinot, 1967; Turkay, *et al.*, 1996; Sakai and Turkay, 2013).

Remarks: The identity of this species faced some problems as the original description included more than one species. The present description agrees well with Lewinsohn (1977), Turkay *et al.* (1996) and Sakai and Turkay (2013). However, the posterior face of propodus of the 2nd and 3rd pereopods has a row of hairs; while both of the

anterior and posterior face of dactyls of the same pereopods has a row of hairs, in contrast to the dactylus of the 4th and 5th pereopods, which has a row of hairs on anterior face only. Inner and outer face of chelipeds has 2 keels.

Ocypode cursor (Linnaeus, 1758)

Plates (1& 2)

Synonyms:

- Cancer cursor* Linnaeus, 1758: 625; Sakai and Turkay, 2013: 702- 706.
Cancer anomalus Hasselquist, 1762: 474.
Ocypode ippeus Olivier, 1804a: 235; 1804b: 52.
Ocypode chevalier, Latreille, 1817: 16.
Ocypode rhombea, Audouin, 1826: 80.
Ocypode (Ocypode) cursor, De Haan, 1835: 29.
Ocypoda cursor, Herklots, 1851: 22; Odhner, 1923: 23; Monod, 1956: 391; Guinot & Ribeiro, 1962: 66.
Ocypode cursor, H. Milne Edwards, 1852: 142; Barnard, 1950: 88; Holthuis & Gottlieb, 1958: 99; Holthuis, 1961: 58; Manning & Holthuis, 1981: 219; Turkay, 1989: 186; Ng, Guinot & Davie, 2008: 240.
Ocypoda hippeus, Ortmann, 1897: 368; Nobili, 1906c: 317; Bouvier, 1906a: 187; Balss, 1914: 79; Monod, 1927: 609.
Ocypode ceratophthalma, Pesta, 1911: 88: 54 [in part, material from Fernandes].
Ocypoda aegypticae, Monod, 1937: 18.
Ocypoda cordimana, Bodenheimer, 1937: 281.
Ocypode hypeus [sic!], Sourie, 1954: 22.

Material examined: 10 (9 males and only one female).

Locality:

- **Mediterranean Sea:** Alexandria: 5 km West of Marakea: 4♂, 2.01-2.20 (C.L), 2.54-2.78 (C.W), 12/7/1993; Al Arish: Western Cost of Al Masaed: 3♂, 1♀, 2.77-3.46 (C.L), 3.38-4.14 (C.W), 6/6/2013; Eastern cost of Al Resa: 2♂, 2.83-3.40 (C.L), 3.44-4.10 (C.W), 7/6/2013.

General characters:

Carapace is squarish-shaped (Plate, 1 c & d), has indistinct regions. Front is narrow and varies from 0.30-0.60cm. Orbit is wide, reaches half carapace width; varies from 1.04-2.00cm. Lateral half of orbital margin almost straight. Exorbital angle is acute, triangular and protruding outward (Plate, 1c). Eyestalks not prolonged distally beyond cornea, but bearing a brush at distal end of cornea (Plate, 2b).

Chelae are dissimilar, have stridulating ridge composes of 69-96 tubercles with striae (Plate, 2 e). Outer and inner surface of finger and thumb with two transverse ridges convergent at its tips (distinct in small chela than large one); finger varies from 0.80-1.70cm. Large and small chela vary from 1.30-3.00cm. Anterior surface of 2nd and 3rd propodus of walking legs are naked (Plate, 2 h a & k).

First male pleopod is curved laterally at distal end, lacking a palp (Plate, 2 n). Female genital opening has lateral rim continuous lengthwise to elongate operculum, which is directed antero-mesially under median rim (Plate, 2 p).

Size: Carapace: 2.01- 3.40 cm in CL and 2.54- 4.10 cm in CW.

Color: Carapace, chelipeds, all walking legs and fingertips are pale to light yellow color, but ventral surface of walking legs is white.

Habitat: This species is common and digs its burrows at the upper intertidal and supralittoral sandy zones.

Distribution:

- **Local:** Mediterranean Sea from Alexandria to Al Arish (Monod, 1938; Ramadan and Dwoidar, 1972; Atta, 1991).
- **World:** This species is distributed from Mauritania to Namibia in Atlantic Ocean, and in all Mediterranean to Turkey and southern Greece (Barnard, 1950; Holthuis & Gottlieb, 1958; Ng *et al.*, 2008; Sakai and Turkey, 2013).

Remarks: *Ocypode cursor* was described firstly under the name of *Cancer cursor* Linnaeus, 1758. But Hasselquist (1762) described it as *Cancer anomalus*, while Olivier (1811) listed it under *Ocypode ippeus*, attributing *O. cursor* to *O. ceratophthalma*. However, all these names are synonyms for *O. cursor*, because they have the following characters in common: eyestalks bear a brush at the distal end of the cornea; the stridulating ridge composes of 69-96 closely pressed tubercles with striae and curved in its dorsal third; and the 2nd and 3rd propodus are naked and provided with spiniform tubercles, both on the anterior surface and on the ventral margin. The present specimens are in well agreement with these characters, and in full agreement with those mentioned by Sakai and Turkey (2013).

Ocypode saratan* (Forsk., 1775)*Plates (1 & 2)****Synonyms:**

Cancer saratan Forskal, 1775: Descr. anim.: 87.

Ocypode saratan, Olivier, 1811: 414,416; Crosneir, 1965: 95; Serene 1968:97; Lewinsohn 1977: 48; Turkey, Sakai, & Apel, 1996: 107- 111 Figs. 9-10, 12, Plates 4-6; Sakai and Turkey, 2013: 741- 7044, figs.5 c, 27, 49.

Ocypode aegyptiaca Gerstaecker, 1856, Arch. Naturg. 22 (1): 134; Heller 1861: 361, 292; Ortmann 1894: 762,769; Ortmann 1897: 360,366.

Ocypode cordimana Heller 1861:361,292 [nec *Ocypode cordimana* Latreille, 1818].

Ocypode aegypticus, (sic) Serene 1968: 97.

Material examined: 21 (13 males and 8 females).

Localities:

Red Sea: Hurghada: Pollution Trip: 3♂, 3.34-3.81 (CL), 3.85-4.28(CW), 1983; Al Yasmen Tourist Village: One♂, 2.9×3.4, 27/1/1993; 18Km South of Marsa Alam: 2♂, 2.9-3.4 (CL), 3.3-3.7 (CW), 8/4/1996; Sharm Loly: One ♂, 2.25×2.67, 16/4/1996; Wadi Al Gemal: 2♂, one ♀ 3.84-4.2 (CL), 4.31-4.6 (CW), 17/4/1996; Mangrove Safaga: one♂, one♀, 2.32-2.35 (CL), 2.67-2.76(CW),5/4/2008; Hurghada: 2♂, 1.91-2.90(CL), 2.11-3.40(CW), 4/2009; Mangrove Safaga: 2♀, 3.20-3.90 (CL), 3.70-4.30 (CW), July, 2014; Hurghada (NIOF): one♀, 3.4×3.8, 8 April, 2015; one ♀, 3.77×4.04 cm, Mangrove Safaga, 14/02/2014.

Gulf of Aqaba: Abu Gallom: One ♀, 3.65×4.00, 28/11/1994; Nabq (Mangroves Abu Zabad): One ♂ juvenile, 1.6×1.9, 24/5/1995.

Gulf of Suez: Adabea (18 km South Suez City): one ♀, 4.2×4.6, 28/3/2013.

General characters:

Carapace is squarish-shaped; regions indistinct; lateral margins are parallel (Plate, 1 e & f). Front is narrow, varies from 0.50-1.10 cm. Orbits are wide, approaches half carapace width, varies from 1.00-2.30cm. Eyestalks extend beyond cornea (Plate, 2 c); exorbital corner is shortly protruding (Plate, 1e).

Chelae are dissimilar; vary from 1.20 to 2.80cm. The inner surface of palm of major chela has stridulating ridge composes of 67-87 striae (Plate, 2f). Tips of finger

and thumb of minor chela are pointed. Outer and inner surface of fingers and thumb have two transverse ridges convergent at its tips, being distinct in small chela than larger one; large and small finger varies from 0.80-2.20cm.

The anterior face of propodus of second pereopods has a broad row of hairs along median line (Plate, 2 i), while the third pereopods of the same joint is naked (Plate, 2 l).

First male pleopod is clearly broadened; its distal part bends laterally. Palp has long and slender tip, its distance to pleopod tip is slightly more than palp length (Plate, 2 o). Opercle of female genital duct is distally rounded, and protruding mesially; valve-opening being oblique with respect to median line of sternum (Plate, 2 q).

Size: Carapace: 1.90- 4.20 cm in CL and 2.10 -4.60 cm in CW.

Color: Dorsal and ventral surface of carapace, chelipeds, all walking legs and fingertips are yellow color. Tips of major chela white color but minor chela brown color.

Habitat: This species is common on the shores of the Red Sea and associated gulfs (Aqaba and Suez). It burrows in sandy supralittoral shores; where males construct permanent burrows reach about half meters or more, with characteristic mounds around openings of male's burrows up to 15 cm high in breeding season.

Distribution:

- **Local:** Southern portion of Suez Canal (Monod, 1938;), Gulf of Suez, Gulf of Aqaba and Red Sea (Forsk. 1775; Lewinsohn 1977; Ramadan, 1936; Monod, 1938; Holthuis, 1956, 1958; Fishelson, 1981; Vine, 1986; Jones, *et al.*, 1987; El-Sayed, 1996 a, b, 2002; Turkay, *et al.*, 1996; Foud *et al.*, 2003).
- **World:** It is widely distributed in the Arabian Gulf and Western regions of the Indian Ocean from East Africa to Madagascar extending to Al Mukalla (Serene 1968; Crosnier, 1965; Ginout, 1967; Holthuis, 1985; Turkay, *et al.*, 1996; Sakai and Turkay, 2013).

Remarks: The present species is common on the shores of the Red Sea and Gulfs of Suez and Aqaba. Turkay *et al.* (1996) have mentioned that, all other records of other species, especially *O. ceratophthalma*, from this area proved to belong to *Ocypode saratan*. It was also recorded several times from outside the Red Sea and the Gulf of Aden. All dactylus of legs has hairs on upper surface, and tips of joints of propodus on all legs except cheliped with hairs which agree well with those mentioned by Turkay *et al.* (1996) and Sakai and Turkay (2013).

For all *Ocypode* species, the dendrogram based on closeness characters presented in Table (1) is shown in Figure (1). It demonstrates the overlapping and distinct characters for each *O. cordimanus*, *O. cursor*, and *O. saratan*.

Subfamily: Ucinae Dana, 1851

Genus: *Uca* Leach, 1814

Subgenus: *Uca (Austruca)*

Uca (Austruca) albimana (Kossmann, 1877)

Plates 3&4

Synonyms:

Gelasimus annulipes var. *albimana* Kossmann, 1877: 53-54.

Uca annulipes, Nobili, 1906a: 150-151; 1906b: 311(in key), 312; Laurie, 1915 (in list): 416; Balss, 1924: 15; Hornby, 1997: 15.

Uca (Celuca) lacteal annulipes Crane, 1975: 299, 301, 611. [part.: Red Sea material].

Uca (Celuca) lacteal albimana, Lewinsohn, 1977: 61-63.

Uca lacteal Hogarth, 1989: 114-115; Ismail & Ahmed, 1993: 158 (in list).

Uca lacteal annulipes, Hywel-Davies, 1994: 37, 48.

Uca annulipes albimana, Apel & Turkey, 1999: 133; Apel, 2001: 114.

Uca albimana, Shih *et al.*, 2009: 377.

Material examined: 16 (12 males and 4 females).

Localities:

- **Gulf of Aqaba:** Nabq, mangrove Abu Zabad: Only one ♂, 0.85×1.5, 26/11/1994.
- **Red Sea:** South Sinai- Red Sea, mangrove Ras Mohamed: One ♂ and one ♀, 0.76-0.83(CL), 1.28-1.4(CW), 2/5/1995; Mangrove 17 km South Safaga: 4♂, 3♀, 0.61-1.50(CL), 1.00-2.30 (CW), 14/2/2014; 6♂, 0.60-0.76 (CL), 1.00-1.42 (CW), July, 2014.

General characters:

Carapace lateral margins are convergent behind; antero-lateral angles are directed obliquely outwards; exorbital angles are acutely triangular, directed forwards (Plate, 3a & b). Front moderately broad, varies from 0.30 to 0.80 cm. Orbit is more than half of carapace breadth and varies from 0.60 to 1.30 cm (Plate, 3 a).

Male chelae are unequal; small chela has spoon-shaped tip; chelae are equal in females, both with spoon-shaped tips; lower margin of inner surface of chela with triangular tubercles; lower margin of palm of major chela is not straight (Plate, 4 d), outer surface of thumb is swollen near lower margin; large chela varies from 1.50 to 3.33 cm; small chela varies from 0.40 to 0.80 cm (Plate, 4 d). Finger of major chela is longer than thumb, dual on latter; cutting-edge with 3-4 teeth, thumb tip with prominent sub apical tooth (Plate, 3 a); large finger varies from 1.20 to 3.00 cm; small finger varies from 0.30-0.75 cm.

First male pleopod has distally digit form process on inner margin with stem slightly bent in postero-lateral direction; palp doesn't reach to base of horny end piece; apex is flattened and rather broadly spatulas; lateral margin of pleopod has feather-shaped setae along; seminal channel opening sub apically on the ventral (convex) side (Plate,4 g).

Gastric mill has median tooth plate with 7 nearly similar teeth but different in size (Plate, 4 j).

Size: Carapace: 0.60 - 1.50 cm in CL and 1.00 - 2.40 cm in CW.

Color: Carapace is black with white patches, chelipeds and all walking legs and fingertips are yellow or whitish yellow.

Habitat: This species lives in sandy muddy and mudflat upper intertidal areas around mangroves.

Distribution:

-**Local:** This is the first record from South Sinai including Gulf of Aqaba and represents the maximum northward distribution in the Red Sea. However, it was recorded from the southern Red Sea by Lewinsohn (1977) and from Safaga south Hurghada by Naderloo, *et al.* (2010).

-**World:** This species was recorded from Gulf of Aden, Socotra, Arabian Sea, Oman (Dhofar), South Gulf of Oman and South-eastern Persian Gulf by Naderloo, *et al.* (2010).

Remarks: The present specimens are in agreement with those described by Naderloo *et al.*, (2010). *Uca albimana* was differentiated from *U. inversa* by color of carapace

which is distinct black in *U. albimana* and white with black patches in *U. inversa*. Major chela in most cases at left side, and there are 4 large teeth parallel.

Subgenus: *Uca (Cranuca)* Beinlich & von Hagen, 2006

Uca (Cranuca) inversa (Hoffmann, 1874)

Plates (3&4)

Synonyms:

Gelasimus inversa Hoffmann, 1874, p. 19, pl. 4.

Uca inversa, Nobili, 1906a: 312-313; Laurie, 1915:416; Balss, 1924: 15; Holthuis, 1958: 53; Guinot, 1967: 281; Fishelson, 1971: 119,128; Vine, 1986, ; El-Sayed, 1996 a, b, 2002; Fouda, *et al.*, 2003).

Austruca inversa, Bott, 1973: 320.

Uca (Amphiuca) inversa inversa Crane, 1975: 105-108; Lewinsohn, 1977:63-64.

Material examined: 8 (7 males, and only one female).

Localities:

- **Gulf of Aqaba:** Nabq, St.18 Al-Gharqana: only one ♂, 1.05×1.75, 28/7/1994; Nabq, Al-Rewaissia: only one ♂, 1.3×2.2, 29/7/1994; Nabq, Abu Zabad, only one ♂, 0.9×1.4, 3/5/1995; Nabq, Al-Rewaissia: only one ♂, 1.4×2.3, 3/5/1995.
- **Red Sea:** South of Sinai: Ras Mohamed. St.5:♀, 0.7×1.1; Mangrove 17 km South Safaga: 3♂, 0.6-0.8 (CL), 1.0-1.3(CW), July, 2014.

General characters:

Carapace lateral margins convergent behind, antero-lateral angles directed obliquely outwards (Plate, 3 c & d). Front is moderately broad, varies from 0.20 to 0.70 cm (Plate, 3 b). Orbit is half of carapace breadth; varies from 0.55-1.20 cm (Plate, 3 c).

Male chelae are unequal, small chela with spoon-shaped chela tips; female chelae are equal with spoon-shaped tips; lower margin of inner surface of chela without triangular tubercles; lower margin of palm of major chela is straight and not oblique; outer surface of thumb has a clear pit near lower margin; large chela varies from 1.40-3.20 cm; small chela varies from 0.35-0.76 cm (Plate, 3 e). Finger of major chela is longer than thumb, with large two teeth on finger and thumbs; fingertip with prominent sub apical tooth; large finger varies from 1.11-2.85 cm; small finger varies from 0.30-0.70 cm (Plate, 3 e).

First male pleopod has broad flanges; flanking the pore with setae at its tip (Plate, 3 h).

The gastric mill has median tooth plate with 3 teeth nearly similar different in size (Plate, 3 k).

Size: Carapace: 0.60 - 1.30 cm in CL and 1.00 - 2.20 cm in CW.

Color: Carapace is light black with large white patches, chelipeds and fingertips are yellow or whitish yellow, all walking legs are yellow with brown patches.

Habitat: This species lives in sand mud and mud flats of the upper intertidal zones around mangrove swamps.

Distribution:

- **Local:** Gulf of Aqaba and Red sea (Nobili, 1906, 1906a; Laurie, 1915; Balss, 1924; Holthuis, 1958; Guinot, 1967; Fishelson, 1971; Vine, 1986; El-Sayed, 1996 a, b, 2002; Fouda *et al.*, 2003 Guinot, 1967).
- **World:** Indian Ocean and western regions including East Africa, South Africa, Madagascar, and Pakistan (Bott, 1973; Crane, 1975; Holthuis, 1975; Lewinsohn, 1977).

Remarks: The present specimens are in good agreement with those mentioned by Barnard (1950), Crosnier (1965), Crane (1975) and Lewinsohn (1977). However, all

legs are naked without hairs; finger is blunt and longer than thumb of large chela. It can be easily distinguished from *U. albimana* which is the more closely species in the same localities by absence of triangular tubercles on the lower margin of inner surface of major chela palm, and straight outline of chela which is tuberculated and oblique in *U. albimana*. Thumb has groove near lower margin on outer surface in *U. inversa* but without groove in *U. albimana*. Also, the gastric mill has 7 teeth on median too- plate in *U. albimana* and only 3 in *U. inversa*.

Subgenus: *Uca (Gelasimus)* Latreille, 1817
***Uca (Gelasimus) tetragonon* (Herbst, 1790)**
Plates (3& 4)

Synonyms:

- Cancer tetragonon* Herbst, 1790: p. 197-200, fig. 187.
Goneplax tetragonon Latreille, 1817: 17.
Gelasimus tetragonon, Ruppell, 1830: 25; Heller, 1861: 17; Paulson, 1875: 26.
Ocypode (Gelasimus) tetragonon Herklots, 1861: 14.
Uca tetragonon Nobili, 1906a: 313; Laurie, 1915: 416; Balss, 1924: 15; Holthuis, 1958: 52; Guinot, 1967: 281; Fishelson, 1971: 119; Vine, 1986, ; El-Sayed, 1996 a, b, 2002; Fouda, *et al.*, 2003).
Mesuca (Mesuca) tetragonon, Bott, 1973: 320.
Uca (Thalassuca) tetragonon Crane, 1975: 77- 82.
Uca (Gelasimus) tetragonon Ng, Guinot and Davie, 2008: 240.

Material examined: 15 (12 males and 3 females).

Localities:

- **Red Sea:** Mangrove Hamata: 2♂, 0.75-1.40 cm (CL), 1.14-2.30 cm (CW), 15/4/1996; Mangroves 17 km South Safaga, one ♂, ♀, 2.10-2.26 cm (CL), 3.23-3.25 cm (CW), 5/4/2008; only one ♀, 2.0×2.75 cm, one ♀, 1.9×2.65 cm, 9/4/2010; 3♂, 1.60×2.30 cm (CL), 2.30×3.25 cm (CW), 14/02/2014; 4♂, 1.6-2.0 cm (CL), 2.3-2.9 cm (CW), July, 2014. Mangrove El-Hamraween (36 km north Qusier): Only one ♂, 1.6×2.3 cm, 14 May, 2015.
- **Gulf of Aqaba:** Nabq: Al Monkateaa: Only one ♂, 1.5×2.3 cm, 3/5/1995.

General characters:

Carapace regions are ill-defined; lateral margins are convergent behind, antero-lateral angles are directed obliquely outwards (Plate, 3 e & f). Front is narrow; varies from 0.15 to 0.40 cm (Plate, 3 c). Orbit is wide, reaches half of carapace breadth and varies from 0.50 to 1.40 cm (Plate, 3 e).

Male chelae are conspicuously unequal; small chela with spoon-shaped tip; in females, chelae are equal, both has spoon-shaped tips (Plate, 4f); large chela varies from 1.50 to 4.40 cm; and small chela varies from 0.5-3.00 cm. Finger of major chela is shorter than thumb; large finger varies from 1.10-2.70 cm; while small finger varies from 0.80-1.70 cm (Plate, 4 e).

Major pollex and dactyli are normally rounded; oblique ridge on inner side of palm is indistinct, without enlarged tubercles (Plate, 4 f); major merus with a large sharp tooth at distal end of its antero-dorsal margin (Plate, 3 e).

First male pleopod is slender; hairy at its tip and side (Plate, 4 i).

The gastric mill has median tooth plate with 4 nearly similar teeth, different in size (Plate, 4 l).

Size: Carapace: 0.75 - 2.30 cm in CL and 1.14 - 3.20 cm in CW.

Color: Carapace, chelipeds, all walking legs and fingertips are light brown.

Habitat: This species lives in sandy and muddy flats at the upper intertidal zones around mangrove swamps.

Distribution:

- **Local:** Gulf of Aqaba and Red Sea at mangrove swamps (Paulson, 1875; Nobili, 1906a; Laurie, 1915; Balss, 1924; Holthuis, 1958; Fishelson, 1971; Lewinson, 1977; Vine, 1986; El-Sayed, 1996 a, b, 2002; Fouda, *et al.*, 2003).
- World:** Indo-West Pacific, from Zanzibar, Madagascar to Mauritius (Ginout, 1967; Crane, 1975; Holthuis, 1975).

Remarks:

The characters of present specimens are in agreement with those mentioned by Crosnier (1965), Crane (1975) and Lewinson (1977). However, the inner and outer surface of dactyli of 2nd, 3rd and 4th legs are hairy in males and females; but the inner surface only of 5th leg dactyli is hairy in the sexes, while other joints are hairless. This species is easily distinguished from other *Uca* species by remarkably narrow front and presence of 4 teeth in the gastric mill median tooth plate, compared with 7 and 3 in *U. albimana* and *U. inversa*, respectively. The dendrogram for all *Uca* species in the present study based on closeness characters presented in Table (1) is shown in Figure (1), and demonstrates the overlapping and distinct characters.

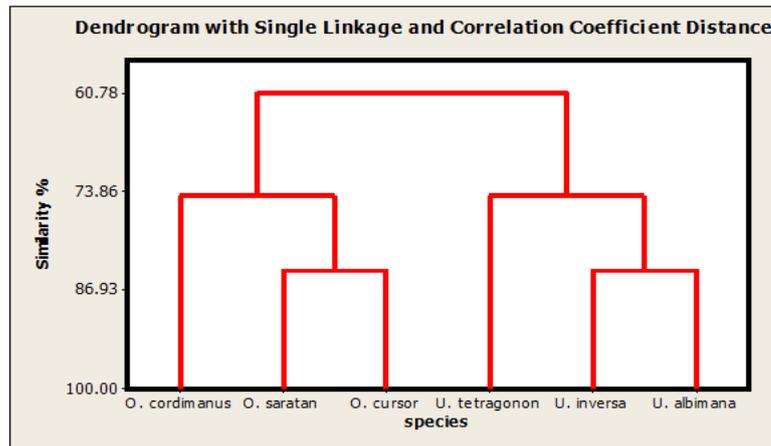


Fig. 1: Dendrogram for cluster analysis showing closeness between *Ocypode* and *Uca* species during the present study.

Table 1: Cluster analysis for variables characters of *Ocypode* and *Uca* species showing correlation coefficient distance, and single linkage amalgamation steps during the present study.

Step	Number of clusters	Similarity level	Distance level	Clusters joined	New cluster	Number of obs. in new cluster
1	5	84.3750	0.312500	2 3	2	2
2	4	84.3750	0.312500	5 6	5	2
3	3	74.5049	0.509902	1 2	1	3
4	2	74.5049	0.509902	4 5	4	3
5	1	60.7843	0.784314	1 4	1	6

Keys for the present recorded ocypodids

Key for superfamily Ocypodoidea:

- 1- A cavity between bases of 3rd and 4th legs **Ocypodidae**
 - No cavity between legs **2**
- 2- Body deep, more or less globose. Membranous spaces on 4th joints of the legs..... **Dotillidae (*D. sulcata*)**
 - Body shallow, broader than long. No membranous spaces on legs **3**
- 3- Mxp.3 meeting in middle line, 4th joint as long as or longer than 3rd **Camptandriidae (*Paracleistostoma leachii*)**
 - Mxp.3 not meeting, leaving a lozenge-shaped gap between them, 4th joint shorter than 3rd **Macrophthalmida**

Key for genera of family Ocypodidae:

- 1- Carapace sub quadrangular. Chelipeds unequal in both sexes. Cornea very large, occupying greater part of ventral surface of eye-stalk ***Ocypode***
 - Carapace broader than long. Chelipeds in ♀ small and subequal, in ♂ one vastly larger than..... ***Uca***

Key for species of genus *Ocypode*:

- 1 - No stridulating ridge on palm. Eye-stalk not prolonged beyond cornea.....***Ocypode cordimanus***
 - Stridulating ridge present **2**
- 2- Eye-stalks prolonged in a horn (at least in adult, not developed in juvenile). Stridulating ridge extending across greater part of width of palm, composed of tubercles above and striae below ***O. saratan***
 - Eye-stalks prolonged in a short conical process bearing a brush of hairs. Stridulating ridge extending across the palm, composed of striae ***O. cursor***

Key for species of genus *Uca*:

- 1 - Front narrow, narrowest between eyestalk bases, its minimum breadth subequal to, rarely 1.5 times, basal breadth of erected eyestalk ***Uca tetragonon***
 - Front broad, narrowest below eyestalk bases, its breadth between them twice or more basal breadth of erected eyestalk..... **2**
- 2- Finger of large chela with prominent sub apical tooth, oblique ridge on lower part of palm of large chela absent, major chela depressed, 2 large cutting teeth on finger and thumb, lower part of inner surface of palm without triangular ridge..... ***U. inversa***
 - Thumb of large chela with prominent sub apical tooth, oblique ridge on lower part of palm of large chela present, major chela swollen, 4 large cutting teeth on finger and thumb, lower part of inner surface of palm with triangular ridge ***U. albimana***

DISCUSSION

The present results indicate to successful occurrence and distribution of ocypodids along the Egyptian Red Sea and Mediterranean coasts. However, due to fast extensive areas of coral reefs and mangrove swamps surrounded by characteristic mud flats, in addition to sandy and sandy mud shores at the Red Sea, which provide ideal and available habitats for most ocypodids, particularly species of genus *Uca*, 5 species were recorded, compared with only one species (*Ocypode cursor*) from the Mediterranean Sea.

The obtained results are in well agreement with the previous studies along the Egyptian coasts particularly Holthuis (1958, 1965), Lewinsohn (1977), Por *et al.* (1977), El-Sayed (1996 a&b, 2002), Hellal *et al.* (1997), Fouda *et al.* (2003) and Nadelroo, *et al.* (2010) on the Red Sea, and Ramadan and Dowidar (1972) and Atta (1991) on the Mediterranean coasts.

However, the present results indicated that, the distribution of fiddler crab, *Uca albimana* was restricted to the southern and mid regions of the Red Sea, particularly from Eritrean waters (Lewinsohn, 1977), and the maximum northern distribution was recorded by Naderloo *et al.* (2010) at Safaga (25° N). Therefore, this is the first record for this species from the maximum northern limits of the Red Sea and Gulf of Aqaba and increased the ocypodids fauna of these regions. All individuals were collected from mangrove swamps at Nabq (Gulf of Aqaba) and Ras Mohammed Protected areas at South Sinai. They construct their characteristic burrows at upper intertidal mud flats around and within mangroves, while other ocypodids. On the other hand, *Ocypode cordimanus*, *O. cursor*, and *O. saratan* refuge in permanent burrows at the supralittoral sandy shores (Fihelson, 1971; Por *et al.*, 1977; Price, *et al.*, 1977; Vine, 1986; Jones *et al.*, 1987; El-Sayed, 1996 a)).

The present study and those of the previous ones denote to frequency occurrence of several species of fiddler crabs belong to genus *Uca* at the mud flats and sandy- muddy zones around mangroves swamps stretched along the Egyptian coasts of the Red Sea. They are characterized by their waving signals and small pyramids at the entrances of their burrows. The occurrence of these crabs was well documented in early and recent works comprised Monod, 1938; Holthuis, 1958; Fihelson, 1971; Lewinsohn, 1977; Por *et al.*, 1977; Jones *et al.*, 1984; 1987; Vine, 1986; Price, *et al.*, 1987; El-Sayed, 1996a,b, 2003; Hellal, *et al.*, 1997; Fouda *et al.*, 2002; Naderloo, *et al.*, 2010).

Crosnier (1965) in her catalogue about brachyuran species and genera in the Red Sea and adjacent Indian Oceans waters recoded 40 species of Ocypodidae belong to 7 genera comprised *Ocypode* (7 species), *Uca* (10 species), *Dotilla* (2 species), *Macrophthalmus* (15 species), *Cleistostoma* (2 species), *Paracleistostoma* (2 species) and *Tylodiplax* (2 species). With exception *Cleistostoma* and *Tylodiplax* which were completely absent from the Red Sea, all other four genera were represented in the Red Sea with variable number of species varied from only one for *Dotilla* and *Paracleistostoma* to 4 for *Ocypode*, 5 for *Uca* and 8 for *Macrophthalmus*.

It was obvious that, Crosnier's records overestimated Red Sea ocypodid into 19 species. However, several species were recorded within in Crosniers records based either on synonyms for certain species or included the entrance of the Red Sea specimens among those recorded from the entire region.

According Crosnier (1965), members of genus *Uca* came in the second order after *Macrophthalmus*, and was represented by 10 species in the Indian Ocean and adjacent waters of them 5 species were recorded in the Red Sea, comprising *U. tetragonon* (Herbst, 1790), *U. marions marions* (Desmarest, 1823), *U. annulipes* (H. Milne Edwards, 1852), *U. inversa* (Hoffmann, 1877), and *U. marions excise* Nobili, 1906. It was also overestimated and based on specimens collected from Gulf of Aden and East African coasts.

Crane (1975) recorded four species of *Uca* in the Red Sea of them *U. tetragonon* and *U. inversa* were well distributed all over the eastern and western coasts, while *U. annulipes* and *U. albimana* were restricted to the southern limits and well distributed along the East African coasts. On the other hand, Holthuis (1975) in his

studied on garpsidae and Ocypodidae from Tanzanian coasts recorded 16 of species of ocypodids of them 8 were belonging to genus *Uca*.

On the other hand, Vine (1986) mentioned only *U. inversa* and *U. albimana*, which was previously recorded by Holthuis (1958) from south Sinai. However, Lewinsohn (1977) added *U. annulipes* from the Dahlak Archipelago to the previous recorded species. Other records for the first two species by Fishelson, (1971) and Por *et al.* (1977) were added. During the last decades of the twentieth century, the occurrence of *U. tetragonon* and *U. inversa* were documented on the sandy and muddy flats around the mangrove swamps along the Egyptian coasts by El-Sayed (1996 a & b, 2003), Hellal *et al.* (1997) and Fouda *et al.* (2002)

Recently, Naderloo *et al.* (2010), in his study on *Uca* species from the Arabian Sea, Persian Gulf and Red Sea including Gulf of Aden recorded *U. albimana* from the different localities of the northern and southern Red sea coasts till Safaga along the Egyptian coasts, which represents the maximum northward distribution till 25° 30' lat. along the western Red Sea coasts.

The present study showed that, the three species of *Uca* comprised *U. tetragonon*, *U. inversa* and *U. albimana* are occurring along the Egyptian coasts and at the northern Red Sea limits and south Sinai. The last species (*U. albimana*) is recorded for the first time from the entire northern limits of the Red Sea beyond than 25° 30' lat. recorded previously by Naderloo *et al.*, (2010) which increased the Red Sea *Uca* species as well as ocypodids species at the northern limits.

It is worth to mention that, this study recommends to be re-examined carefully all *Uca* species collected from the northern Red Sea and Gulf of Aqaba deposited at the Natural History Museums around the world, and a further molecular investigations for all *Uca* species at the northern Red Sea must be carried out.

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(A)



(B)



(C)



(D)



(E)



(F)

Plate 1: Dorsal and ventral view of *Ocypode cordimanus* (A & B), *O. cursor* (C &D) and *O. saratan* (E&F).

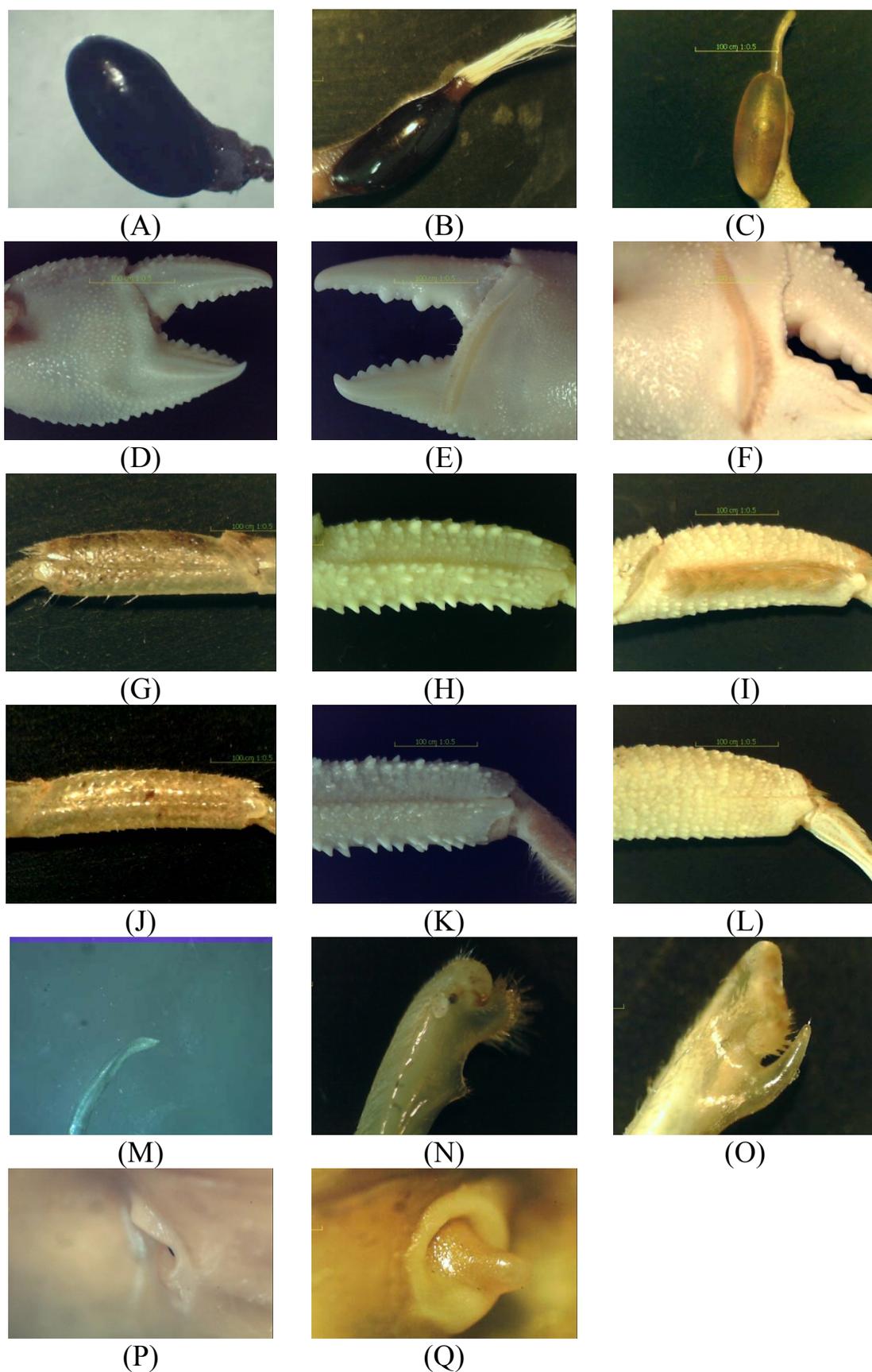


Plate 2: Show eyestalk (A- C); stridulating ridge (D-F); propodus of 2nd pereiopod (G-I); propodus of 3rd pereiopod (J- L); first male pleopod (M-O) of *Ocypode cordimanus*, *O. cursor* and *O. saratan*, and female genital openings of *O. cursor* and *O. saratan* (P&Q), respectively



(A)



(B)



(C)



(D)



(E)



(F)

Plate 3: Dorsal and ventral view of *Uca albimana* (A & b), *U. inversa* C & D) and *U. Tetragonon* (E&F), respectively.

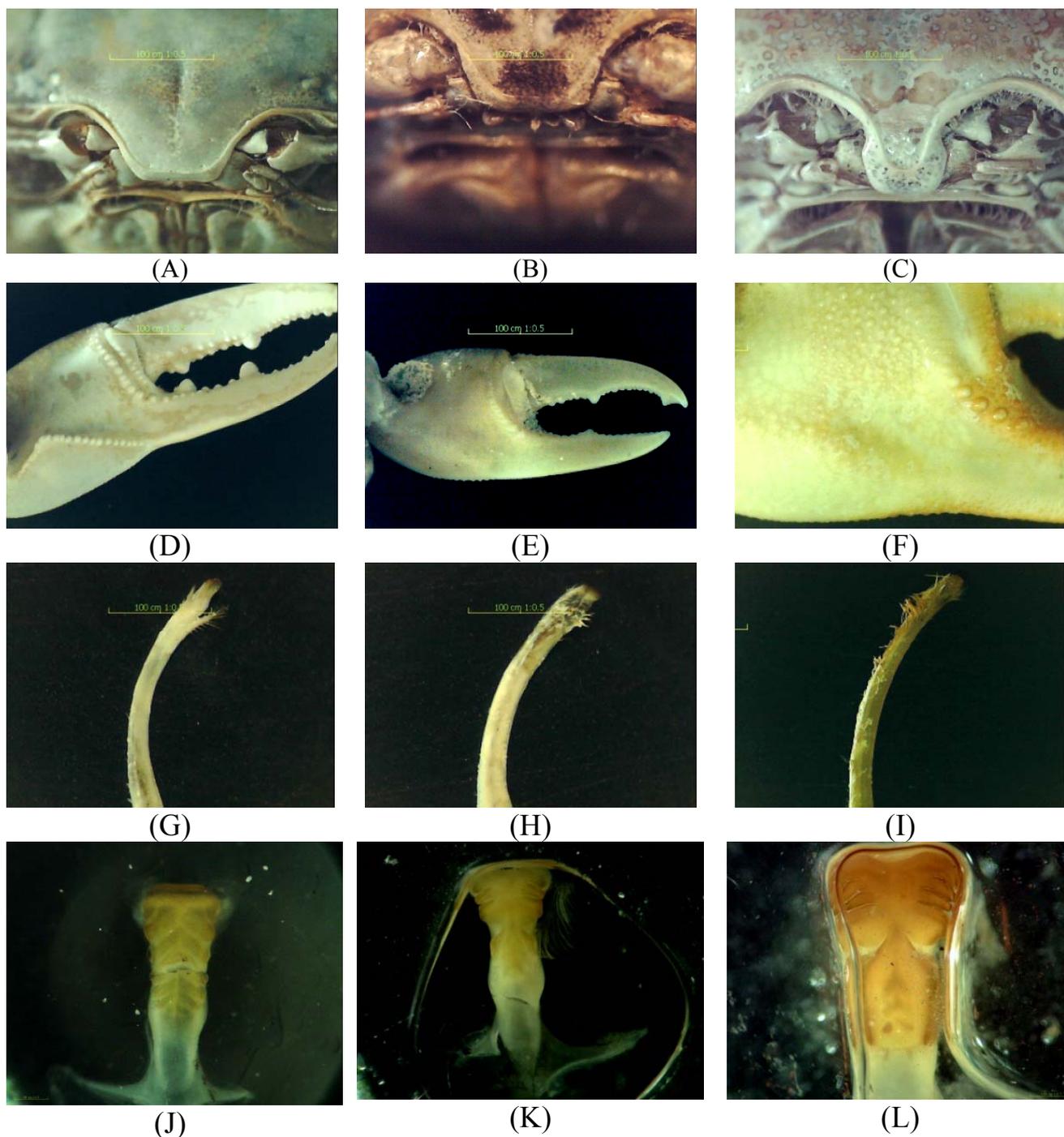


Plate 4: Front (A-C); inner surface of major chela (D-F); first male pleopods (G-I); and median tooth plate of the gastric mill (J-L) for *U. albimana*, *U. inversa* and *U. tetragono*, respectively.

ARABIC SUMMERY

مراجعة أنواع سرطانات الأوسبوديدي (القشريات قصيرة الذنب) من الشواطئ المصرية للبحرين الأحمر والمتوسط

عواد عبده محمد السيد¹، عمرو محمد ناصف¹، محمود أمين خليفة¹، مصطفى سرحان²،
عبد الله محمد عبد الخالق¹

1- قسم علم الحيوان كلية العلوم بنين، جامعة الأزهر بالقاهرة
2- قسم علم الحيوان كلية العلوم بنين، جامعة الأزهر فرع أسيوط

أسفرت الدراسة الحالية عن تسجيل ستة أنواع من سرطانات الأوسبوديدي من الشواطئ المصرية للبحرين الأحمر والمتوسط، تنتمي إلى جنسين، هما جنس الأوسبيود ويشتمل على أسيبود كورديمانس وأسيبود كورسور وأسوبود سرطان، و جنس اليوكا الذي يضم يوكا البيمانا ويوكا انفرسا ويوكا تتراجون، ولقد اتضح من النتائج انتشار خمسة أنواع بالبحر الأحمر واقتصر انتشار نوع الأسيبود كورسور على البحر المتوسط، كما وضحت النتائج تسجيل نوع يوكا البيمانا لأول مرة من شواطئ جنوب سيناء المطل على خليج العقبة وشمال البحر الأحمر من مناطق المانجروف، مما يؤدي إلى وجوب مراجعة وإعادة فحص العينات التي تنتمي إلى نوع يوكا انفرسا المجمع من جنوب سيناء بمتاحف التاريخ الطبيعي على مستوى العالم، كما اتضح من النتائج تنوع السرطان بالبحر الأحمر نظرا لتنوع البيئات والموائل الفطرية خاصة تجمعات وأيكات نبات الشورة (المانجروف) وبيئة الشعاب المرجانية التي لا توجد بالبحر المتوسط. ولقد تم عمل مفاتيح للتعرف وذكر نبذة عن البيئات الفطرية وأحجام العينات المجمعمة والتوزيع الجغرافي لكل نوع.