

Ghost Crabs of Oman (Crustacea: Brachyura: Ocypodidae)

David A. Clayton

Biology Department, College of Science, Sultan Qaboos University,
PO Box 36, Al Khod 123, Muscat, Sultanate of Oman

خلاصة : ان الشواطئ الرملية للسواحل العمانية تضم خمسة انواع من سرطان الشبح : نوع *Ocypode cordimanus* , يتواجد بالكثبان الرملية بالمنطقة الفوق الشاطئية (أعلى من مستوى المد والجزر) بينما تتواجد الانواع *O. saratan* , *O. platytarsis* و *O. rotundata* بالشواطئ المفتوحة . أما نوع *O. jousseaumei* فيتواجد في الاخوار . هذه البيئات تُعد امتدادا للبيئات المعروفة لهذه الانواع الخمس . ويُعد تواجدها مجموعات من الانواع المختلفة من ال *Ocypode* بتقسيم البيئة في عمان أمرا فريدا ومختلفا عن تواجدها مثل هذه الانواع بشرق افريقيا او الهند . ويختص هذا البحث بوصف هذه الانواع الخمس وبعرض الخصائص المميزة لكل نوع .

ABSTRACT: The sandy beaches of the coasts of Oman support five species of *Ocypode* ghost crabs. *Ocypode cordimanus* is found on supra-littoral sand dunes while *O. saratan*, *O. rotundata*, and *O. platytarsis* occur on the open beaches. *O. jousseaumei* is largely restricted to marine inlets or khawrs. The present records represent range extensions for all five species. The species composition of the *Ocypode* assemblages of Oman is unique and clearly distinct from that of either East Africa or India. A description of the species, including a key for their identification is provided.

Brachyuran decapods of the Indo-Pacific are one of the better studied groups of marine invertebrates (Serène 1965; Dai and Yang 1991) and information about those of the western Indian Ocean in general has been well documented by Barnard (1950), Hartnoll (1975), Vannini and Valmori (1981a, 1981b) Serène (1984) and Crosnier (1965, 1984), Galil and Vannini (1990) for East Africa and by Henderson (1893) and Alcock (1895, 1896, 1898, 1899, 1900 reprinted 1968), Chhapgar (1957a, 1957b, 1958, 1961, 1968), Tirmizi (1980) and Tirmizi and Kazmi (1983) for the Indian subcontinent. Similarly the Red Sea (Nobili 1906a; Laurie 1915; Guinot 1962, 1967; Holthuis 1958, 1977; Zarenkov 1971; Lewinsohn 1977; Serène 1984; Galil 1989), and the Arabian Gulf (Nobili 1906b; Stephensen 1945; Pretzmann, 1971, 1975; Titgen 1982) are equally well known. The decapods found in the waters bordering the rest of the Arabian Peninsula, from the Gulf of Oman to the Gulf of Aden, however, remain largely unknown. Only the work of Hogarth (1988, 1989, 1994) and Holthuis (1986) on the crustacea of the southern Dhofar region of Oman and Ismail and Ahmed (1993) on Khor Kalba in the north of Oman specifically relate to this area.

The aim of this paper is somewhat modest in that it is restricted to the consideration of a single genus. Ghost crabs of the genus *Ocypode* are conspicuous and often dominant elements of Indo-Pacific sandy habitats and as such should be well documented and readily identified. However, until recently only one species, *Ocypode*

saratan, was considered to be dominant on the shores of the Arabian Peninsula. The records for this species from the Red Sea to the Arabian Gulf have recently been shown to be incorrect. Vannini and Valmori (1981b), Titgen (1982) and Apel and Türkay (1992) have indicated that the very similar *O. rotundata* was misidentified (as *O. saratan*) by previous workers in the Arabian Gulf (Stephensen 1945, Basson *et al.* 1977; Jones 1986).

Thus as part of the revision of the ghost crabs of the world, Türkay *et al.* (1996) list four species as being found on the sandy beaches of Arabia. These include *O. saratan* which is found on the coasts of the Red Sea and the Gulf of Aden and *O. rotundata* in the Arabian Gulf and the Gulf of Oman as far South-West as Salalah. *O. cordimanus*, a more terrestrial species than other members of the genus and common on all Indo-Pacific supralittoral sand dunes, is only reported from the shores of the Red Sea and the Gulf of Aden and is then absent until it reappears on the Indian subcontinent. *O. jousseaumei* is only known from a few specimens collected from Jibouti and Yemen close to the entrance of the Red Sea from the western Indian Ocean (Türkay *et al.* 1996).

Using material exclusively collected in Oman, this paper confirms the presence of these four species in the Sultanate, but significantly alters their distributional ranges and additionally reports on the presence of a fifth species, *O. platytarsis*, previously only recorded from India.

Methods

Individuals were collected from five main sites at Khawr Al-Milh (S) (Barr Al-Hikman: 20° 23' N 58° 17' E), Al-Ashkarah (21° 48' N 59° 32' E), Qurm (23° 37' N 58° 17' E), Suwadi (23° 46' N 57° 47' E) and Sohar (Ra's Sallan: 24° 24' N 56° 43' E) (Figure 1). Only a few animals were excavated from their burrows and most were caught while active on the surface. Other collections were made in the southern region around Salalah (17° 02' N 54° 24' E to 16° 52' N 53° 46' E) and along northern shores around Muscat (23° 38' N 58° 29' E to 23° 24' N 58° 48' E) and Quriyat (23° 15' N 58° 56' E to 23° 10.5' N 58° 59.5' E) (Figure 1). At these minor sites many individuals were also caught, but once their identity was established, most were released.

Sand beaches backed by supralittoral vegetated sand dunes dominate the coastline of the Sultanate of Oman (Salm, 1991). As detailed below, some collections were made along these open beaches, but more effort was devoted to those that were adjacent to, or fronted tidal inlets or khawrs. Khawrs and sharems (the Red Sea equivalent; Fishelson, 1983) are the seaward end of

surface-water drainage channels. They are of a variable size and some remain permanently open to the sea and additionally may support stands of the black mangrove, *Avicennia marina*. Typically only a narrow channel through the coastal dunes connects the sea to the khawr, but beyond it may expand and flood areas of sabkha on the low-lying coastal plain. Ghost crabs were sought from all these areas. Khawr Al-Milh (S) (Barr Al-Hikman) is more correctly described as a tidal lagoon, delimited by sand-spit development, but Mughsayl, Zaitra'a, Taqah, Khawr Al-Milh (N), Yiti, Qurm, Suwadi and Sohar are all khawrs (Figure 1).

The collection of 271 individuals is deposited in the Department of Biology at Sultan Qaboos University (SQU) except for voucher specimens of each species which have been deposited in the Oman Natural History Museum (ONHM) and the Natural History Museum in London (BNHM). Dimensions are given in millimetres: width x length. Type specimens were not seen and species identification was based on descriptions from the available literature as listed below for each species.

Systematic Account

Ocypode saratan Forskål, 1775 (Plate 1a, 2a, 3a)

Ocypode saratan Forskål 1775, p87.

Ocypoda aegyptiaca -- Miers 1882, p381 Plate XVII, Figs 3, 3a respectively: external orbital angle and stridulating ridge on major chela. Laurie 1915, p467 Fig 4, dorsal view of carapace.

Ocypode saratan -- Holthuis 1958, p 52. Crosnier 1965, p 95, Figs 153, 161, 169, 170, plates VIII Fig 2, X Fig 5, respectively: dactylus of 1st walking leg, 1st pleopod, full animal, stridulating ridge. George & Knott 1965, p19, Figs 3A, B, C respectively growth changes of external orbital angle. Lewinsohn 1977; Vannini & Valmori 1981b, p 205, Figs 1B, 2B₁, 2B₂, 3B, 4B, respectively: full animal, ♂ & ♀ stridulating ridge on major chela, dactyl and propodus of 1st & 2nd walking legs, pleopod.

Material: 56 individuals ranging in size from 36.4/30.9 to 57.6/51.5 of which 23 had the major chela on the right including 40♂♂ and 16♀♀. 3♂♂ Salalah (17° N 54° 06' E), 11 May 1995; 1♀ Khawr Taqah (17° 02' N 54° 24' E), 11 May 1995; 1♂, 1♀ Raaha Bay (=Hoons Bay, 16° 57' N 54° 47' E), 1 February 1987; 1♂, 2♀♀ Dugm (19° 41' N 57° 41' E) (ONHM 01573.01); 2♂♂ Filim (20° 37' N 58° 12' E), 2 December 1994; 30♂♂, 11♀♀ Khawr Al-Milh (S), 31 May 1995, 1 June 1995; 1♂ Sifah (23° 24' N 58° 48' E), 9 July 1996; 2♂♂, 1♀ Seeb (23° 13' N 58° 57' E), 29 May 1995.

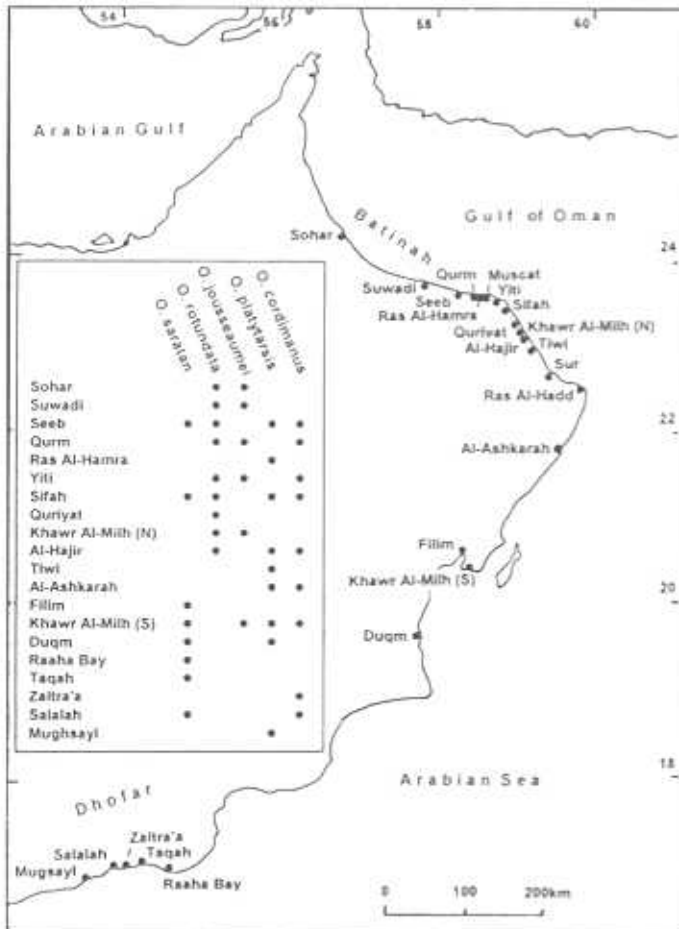


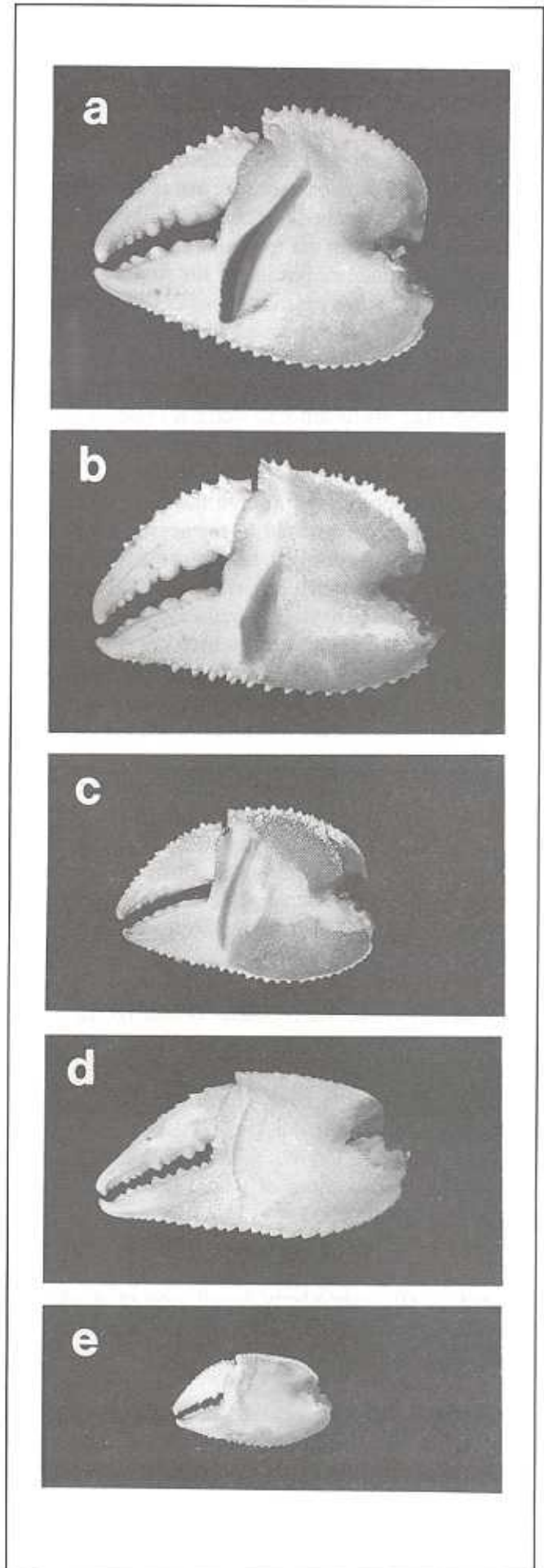
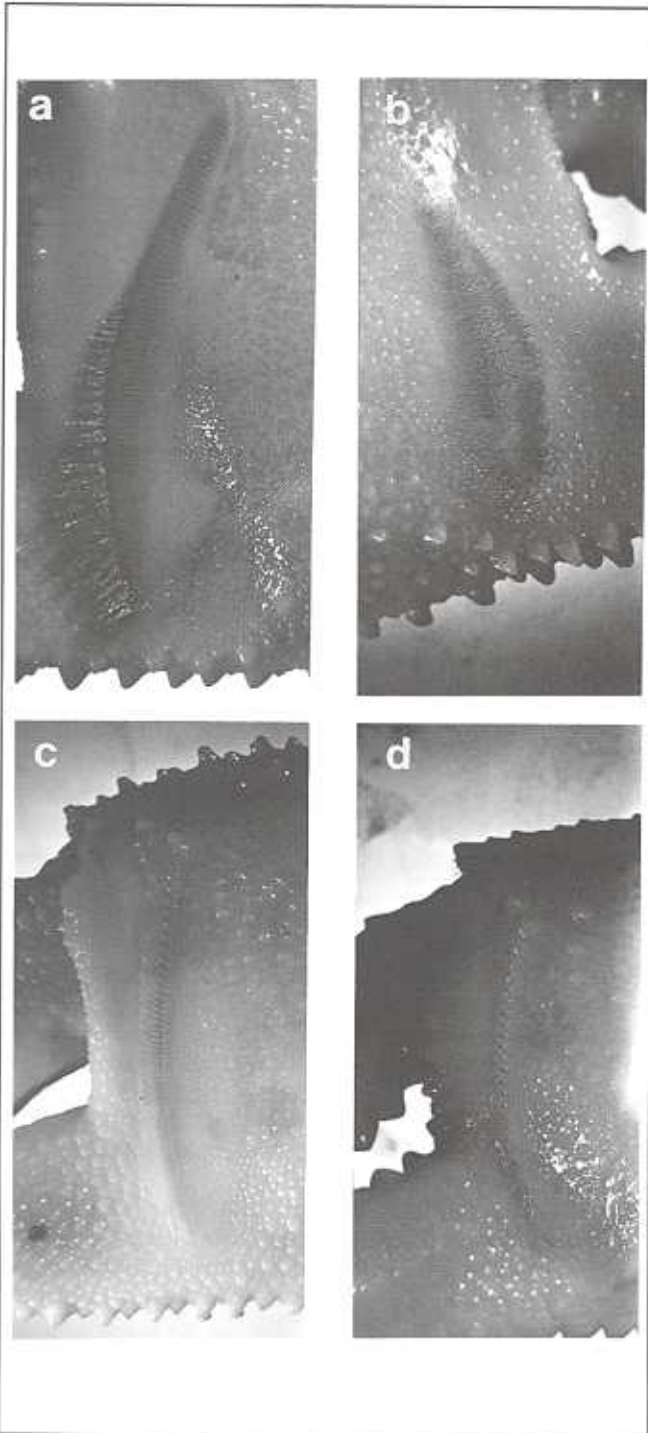
Figure 1. Ghost crab collection sites on the coast of Oman. Species composition at each site is indicated by the inset table.

Plate 2. (below) Detail of stridulating ridge of males. The ridge of females of an equivalent carapace width is less well developed than that of males.

- a *Ocypode saratan*, fine striae throughout length.
- b *Ocypode rotundata*, widely spaced, granulated striae.
- c *Ocypode jousseaumei*, dorsally tubercles, ventrally striae.
- d *Ocypode platytarsis*, tubercles throughout length.

Plate 3. (to the right) Inner face of the major claw of males. Measurements are given for chela length and height in mm.

- a *Ocypode saratan*, 41.5 x 30.2.
- b *Ocypode rotundata*, 41.85 x 26.85
- c *Ocypode jousseaumei*, 31.3 x 21.25.
- d *Ocypode platytarsis*, 37.4 x 19.75.
- e *Ocypode cordimanus*, 19.35 x 11.7.



GHOST CRABS OF OMAN (CRUSTACEA: BRACHYURA: OCYPODIDAE)

Voucher specimens have been lodged in Oman and Britain with the following numbers: 1♀ ONHM 2494.03, 1♂ ONHM 2494.04, Khawr Al-Milh (S). 1♂, 1♀ BNHM 1995.1700 & 1995.1703, Khawr Al-Milh (S).

MORPHOLOGICAL REMARKS: The anterolateral borders of the carapace of *Ocypode saratan* are rounded and may occasionally be notched. There is a slender, curved styliform processes on the eyestalks and a thick patch of hairs along the anterior portion of the first walking legs. The stridulating ridge extends about 2/3 of the height of the cheliped and is composed of 65-90 fine, closely-spaced striae throughout its length. In males a brush of setae occurs along the anterior edge of the lower half of the ridge. The brush is not so well developed in females.

DISTRIBUTION AND ECOLOGY: The burrows of *Ocypode saratan* are concentrated around the high water mark. Sand pyramids, constructed to the seaward side of the burrows, form a conspicuous feature of the beaches inhabited by these crabs. Individuals at Khawr Al-Milh (S), including large, pyramid-building males, however, also occur in the sand dunes where *O. cordimanus* is found. On remote beaches, such as the oceanic side of Khawr Al-Milh (S), individuals were active at all times of the day. Thus, on the evening of 31st May 1995, 14 were captured and at dawn the following day 22 more were caught. This is in contrast to the apparent nocturnal behaviour of *O. platytarsis* as during the same period 21 were caught at night, but none at dawn. *O. saratan* is found predominantly in the southern part of the country, but as four specimens were caught at Sifah and Seeb, its distribution clearly extends to the northern Batinah coast of Oman.

Ocypode rotundata Miers, 1882. (Plate 1b, 2b, 3b)

Ocypoda rotundata -- Miers 1882, p 378, 382, Plate XVII Figs 4, 4a respectively: external orbital angle and stridulating ridge on major chela. Alcock 1900, p 345, 348. Chhagar 1957b, p508, Plate 13 g, h, i, respectively dorsal view of whole crab and 1st male pleopod and its tip.

Ocypode rotundata -- Pretzmann 1971, p 480, Plate 4 Figs 8, 9, 10, respectively dorsal view of whole crab, front and stridulating ridge of major chela. Titgen 1982, p152; Apel and Türkay 1992, p189.

Material: 92 individuals ranging in size from 21.7/17.7 to 59.6/50.2 of which 44 had the major chela on the right including 53 ♂♂ and 39 ♀♀. 3 ♂♂, 1 ♀ Al-Hajir (23° 10.5'N 58° 59.5'E), 3 November 1995; 3 ♂♂, 1 ♀, Khawr Al-Milh (N), 23° 13'N 58° 57'E), 3

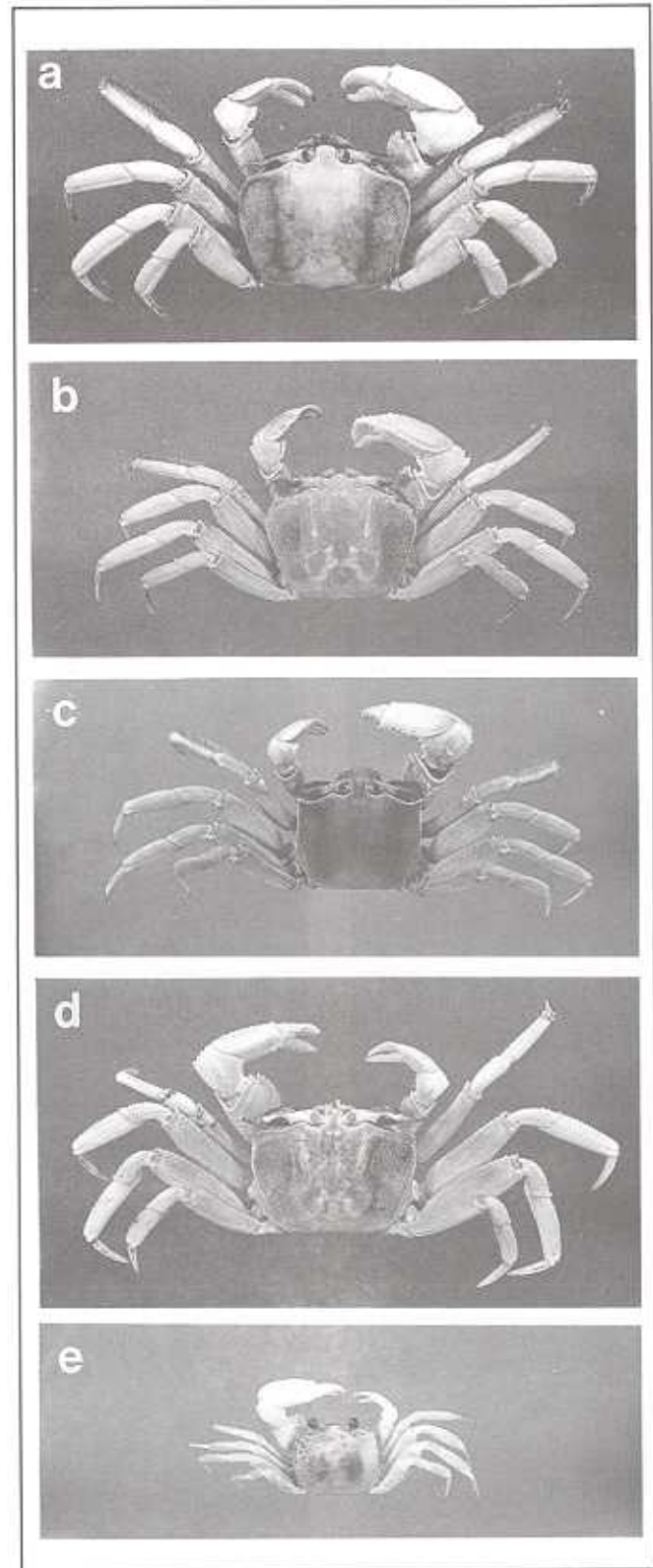


Plate 1. Dorsal view. Note that the carapace patterning is not necessarily typical of live specimens.

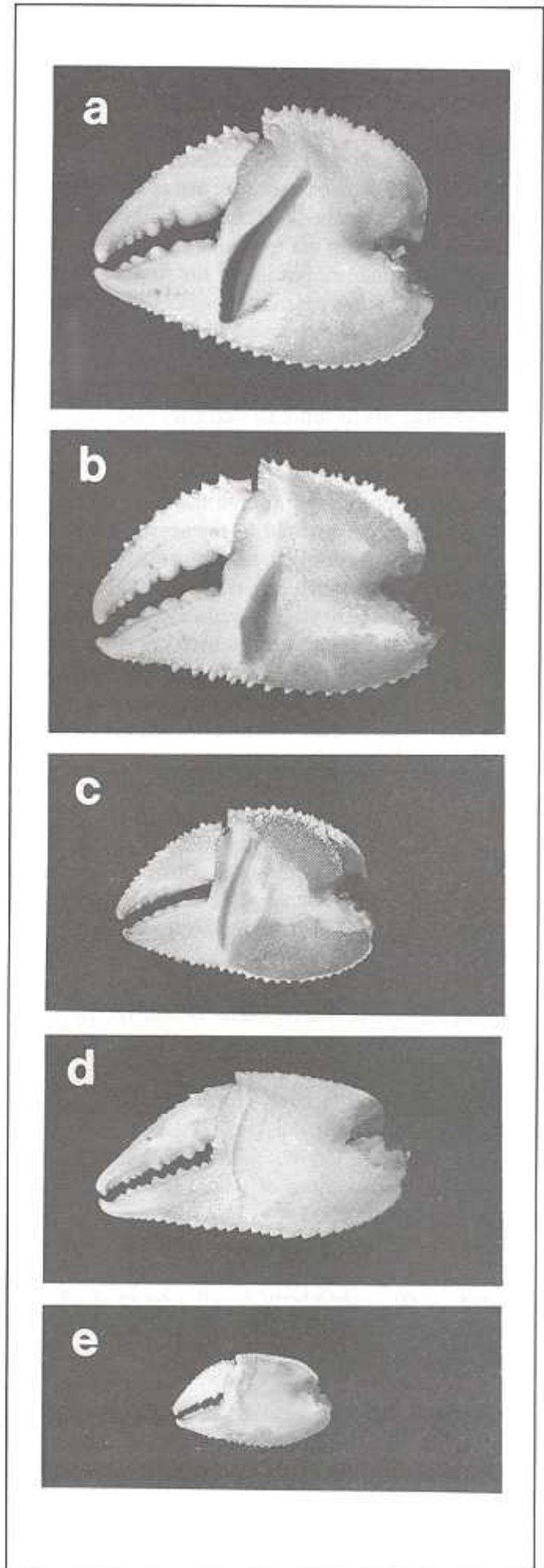
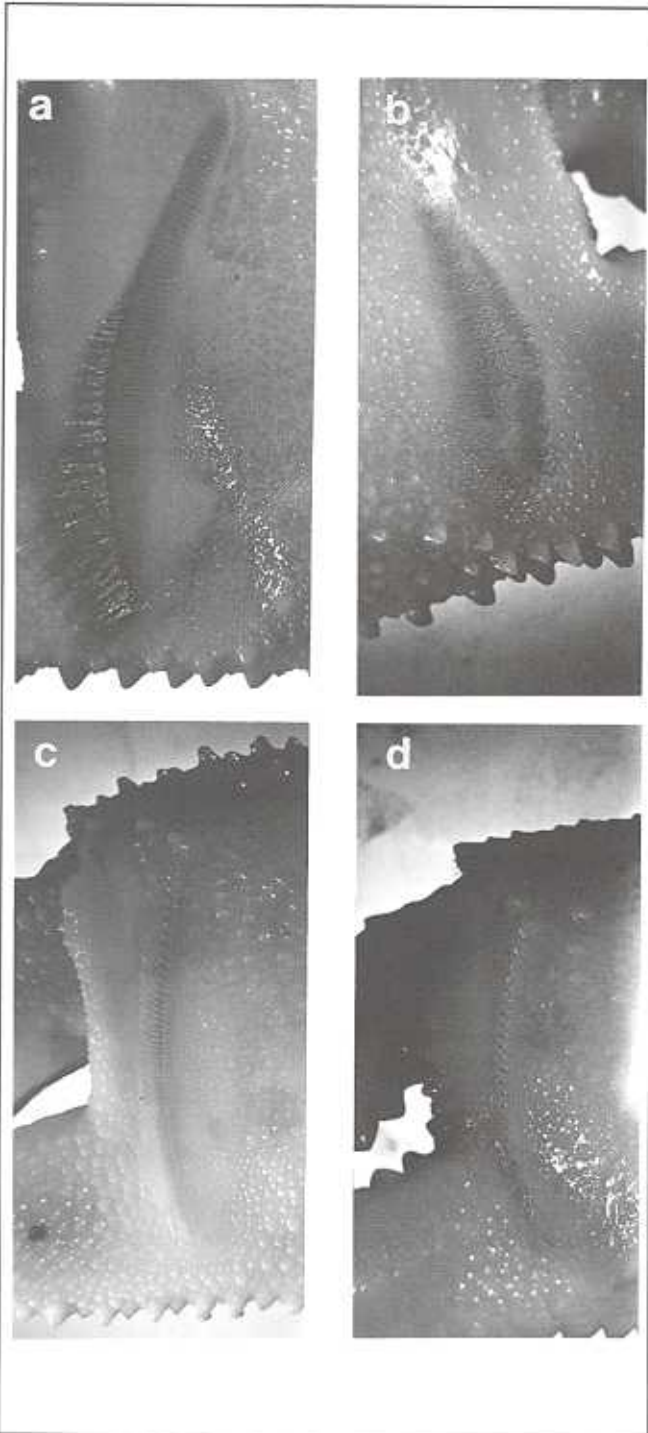
- a *Ocypode saratan* (Forskål 1775). 50.3x44.9. Bar Al-Hikman (S)
- b *Ocypode rotundata* Miers, 1882. 46.3x39.45. Seeb
- c *Ocypode jousseaumei* Nobili, 1905. 37.2x35.55. Khawr Suwadi
- d *Ocypode platytarsis* Milne Edwards, 1852. 52.3x40.25. Bar Al-Hikman (S)
- e *Ocypode cordimanus* Latreille, 1818. 26.35x22.45. Bar Al-Hikman (S)

Plate 2. (below) Detail of stridulating ridge of males. The ridge of females of an equivalent carapace width is less well developed than that of males.

- a *Ocypode saratan*, fine striae throughout length.
- b *Ocypode rotundata*, widely spaced, granulated striae.
- c *Ocypode jousseaumei*, dorsally tubercles, ventrally striae.
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Plate 3. (to the right) Inner face of the major claw of males. Measurements are given for chela length and height in mm.

- a *Ocypode saratan*, 41.5 x 30.2.
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- e *Ocypode cordimanus*, 19.35 x 11.7.



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November 1995; 3 ♂♂, 1 ♀ Quriyat (23° 15' N 58° 56' E), 3 November 1995; 1 ♀ Sifah, 13 February 1987; 2 ♂♂ Yiti, (23° 32' N 58° 40' E), 17 October 1995; 20 ♂♂, 3 ♀♀ Qurm (23° 37' N 58° 17' E), 26 & 28 May 1995; 2 ♂♂, 1 ♀ Seeb, 29 May 1995; 5 ♂♂, 6 ♀♀ Suwadi, 26 May 1995; 15 ♂♂, 25 ♀♀ Sohar, 19 October 1995.

Voucher specimens have been lodged with the following numbers: 1 ♀ ONHM 2494.08, 1 ♂ ONHM 2494.09, Suwadi. 1 ♂, 1 ♀ BNHM 1995.1696 & 1995.1702, Seeb.

MORPHOLOGICAL REMARKS: *Ocypode rotundata* is very similar to *O. saratan* also having rounded, and sometimes notched, anterolateral angles to the carapace. There is also a thick patch of hairs along the anterior portion of the first walking legs. While it has more robust curved, styliform processes on the eyestalks than *O. saratan* of a similar size, the clearest distinguishing character is the stridulating ridge. The stridulating ridge extends only about 2/5 of the height of the cheliped and is composed of 10-14 widely-spaced striae. The striae are made up of a series of granules which decrease in number in the more dorsal striae. A brush of hairs occurs along the whole length of the ridge and is well-developed in males and less so in females.

DISTRIBUTION AND ECOLOGY: The ecology of *Ocypode rotundata* appears to be very similar to that of *O. saratan* with high shore burrows and sand pyramids being indicative of its presence. While *O. rotundata* is a species of open beaches, smaller individuals occur along the edges of khawrs as at Khawr Al-Milh (N). Specimens could be caught at both dawn and dusk as for example at Suwadi. So far this species has not been caught further south than Al-Hajir (23° 10.5' N 58° 59.5' E).

Ocypode jousseaumei Nobili, 1905 (Plate 1c, 2c, 3c)

Ocypoda Jousseaumei Nobili 1905, 233-235, fig 2

Ocypode jousseaumei -- Crosnier 1965, p 99, Figs 156, 163, 173, 174, plate X Figs 1 & 6, respectively: dactylus of 1st walking leg, 1st pleopod, full animal, stridulating ridge.

Material: 37 individuals of which 18 had the major chela on the right including 27 ♂♂ and 10 ♀♀ ranging in size from 11.1/5.2 to 37.2/35.55. 1 ♀ Khawr Al-Milh (S), 31 May 1995; 1 ♂, 1 ♀ Khawr Al-Milh (N), 3 November 1995; 4 ♂♂, 1 ♀ Yiti (23° 32' N 58° 40' E), 18 February & 17 October 1995; 4 ♂♂ Qurm, 26 & 28 May 1995; 18 ♂♂, 6 ♀♀ Suwadi, 10 February 1995, 26 May 1995; 1 ♀ Sohar, 19 October 1995.

Voucher specimens have been lodged in Oman and Britain with the following numbers: 1 ♀ ONHM 2494.05, 1 ♂ ONHM 2494.06, Suwadi. 1 ♂, 1 ♀ BNHM 1995.1699 & BNHM 1995.1701, Khawr Suwadi.

MORPHOLOGICAL REMARKS: The anterolateral angle is triangular with its apex protruding laterally. The eyestalk does not extend beyond the cornea. There is a brush of hairs along the anterior surface of the propodus of the first pair of walking legs. The stridulating ridge on the major chela is composed of finely-spaced striae at its base that grade into more widely-spaced tubercles in the upper third of the ridge. The number of elements vary between 45 and 74.

DISTRIBUTION AND ECOLOGY: *Ocypode jousseaumei* is usually restricted to the inner reaches of khawrs. Like all ghost crabs, the species is very active and it is therefore not surprising that they are occasionally found on oceanic beaches that front the khawr as at Qurm and Khawr Al Milh (S). Some, however, have been found in burrows on beaches adjacent to those of *O. rotundata*, as at Yiti. *O. jousseaumei* appears to be restricted to open habitats, for at Qurm, the only site reported here that has stands of mangrove trees (*Avicennia marina*), no *O. jousseaumei* were found in them. Where they occur, the burrows are very abundant. They are found in the soft damp sand at the edge of the high tide line round the edge of khawrs. They are not found in muddy areas. At Suwadi where the inlet is surrounded by low-lying sabkha flats, abandoned burrows and shallow excavations can be found a considerable distance inland at the height of the highest spring tides. At Qurm and Yiti where mountains limit the extent of such areas of sabkha, the distribution of crabs and burrows is more closely restricted. At Khawr Al-Milh (S), their distribution away from the lagoon is limited by sand dunes. As for *O. platytarsis*, there are no sand pyramids associated with the burrows. It is not clear how permanent the burrows are, but the above observations suggests that their location, like that of the species on open beaches, may change with the tidal cycle as reported for other species (Vannini 1976).

Ocypode platytarsis Milne Edwards, 1852 (Plate 1d, 2d, 3d)

Ocypoda platytarsis -- Miers 1882, p 378, 383, Plate XVII figs 5, 5a respectively: external orbital angle and stridulating ridge on major chela. Alcock 1900, p 345, 348. Gravely 1927, p 148, Plate XXI Fig 19, major chela showing the stridulating ridge.

Material: 62 individuals of which 26 had the major chela on the right including 50 ♂♂ and 12 ♀♀ ranging in

size from 15.2/12.6 to 60.9/59.1♂, 1♀ Mughsayl (16° 52' N 53° 46' E); 7♂ Dugm (ONHM 01573.02); 18♂♂, 3♀♀ Khawr Al-Milh (S), 31 May 1995; 13♂♂, 6♀♀ Al-Ashkarah, 1 June 1995; 4♂♂ Makalla Wabar, Tiwi, (22° 53' N 59° 13' E) 26 October 1995; 1♂ Al-Hajir, 3 November 1995; 5♂♂, 1♀ Sifah, 9 July 1996; 1♀ Ras Al-Hamra (23° 38' N 58° 29' E), 13 February 1995; 1♂ Seeb, 29 May 1995.

Voucher specimens have been lodged in Oman and Britain with the following numbers: 1♀ ONHM 2494.09, 1♂ ONHM 2494.010, Khawr Al-Milh (S). 1♂, 1♀ BNHM 1995.1694 & 1995.1695, Khawr Al-Milh (S) and Al-Ashkarah, respectively.

MORPHOLOGICAL REMARKS: In *Ocypode platytarsis* the upper orbital margin is strongly curved upwards and the anterolateral angle is nearly right-angled. The styliform process on the eyestalk is straight. While the relative height of the major chela is less than that of either *O. saratan* or *O. rotundata* of a similar size, the meri of the walking legs are relatively much broader. There is no brush of hairs on any of the walking legs. The stridulating ridge is also without hair and consists of a row of 20-30 small widely-spaced tubercles or papillae, the centres of which may be pitted in larger specimens.

DISTRIBUTION AND ECOLOGY: This species occurs on the same oceanic beaches as *O. saratan* (as at Khawr Al-Milh (S)) and *O. rotundata* (as at Seeb) and also occupies some beaches (as at Al-Ashkarah) where these two species appear to be absent. *O. platytarsis* does not build sand pyramids. The Al-Ashkarah beach is frequented by many fishermen which may explain the absence of any wandering animals during daylight hours including dawn. This explanation, however, could not be applied to the more remote situation at Khawr Al-Milh (S). The major populations of *O. platytarsis* at Khawr Al-Milh (S) and Al-Ashkarah were only sampled at low tide, but in India the activity of this species appears to centre around high tide (Naidu, 1951).

Ocypode cordimanus Latreille, 1818 (Plate 1e, 2e)

Ocypode cordimanus Latreille 1818, p198.

Ocypoda cordimana -- Miers 1882, p 379, 387, Plate XVII Figs 9, 9a, respectively: external orbital angle and stridulating ridge on major chela. Alcock 1900, p345, 349. Chhapgar 1957b, p507, Plate 13 d, e, f, respectively dorsal view of whole crab and 1st male pleopod and its tip.

Ocypode cordimanus -- Barnard 1950, p 84, Fig 17 a, b, respectively: front of carapace and dactylus of 1st

walking leg. Crosnier 1965, p 92, 96, Figs 154, 162, 171, 172, Plate VIII Fig 3, respectively: dactylus of 1st walking leg, 1st pleopod, full animal, stridulating ridge.

Ocypode cordimana -- Vannini and Valmori 1981b, p 205, Figs 1B, 2B₁, 2B₂, 3B, 4B, respectively: full animal, and stridulating ridge on major chela, dactyl and propodus of 1st & 2nd walking legs, pleopod.

Material: 24 individuals of which 11 had the major chela on the right including 11♂♂ and 13♀♀ ranging in size from 17.4/14.4 to 27.3/23.7. 2♂♂ Salalah, 11 May 1995; 1♂ Zaitra'a (17° 02' N 54° 20' E), 5 March 1992; 3♂♂, 2♀♀ Khawr Al-Milh (S), 31 May 1995; 2♀♀ Al-Ashkarah, 1 June 1995; 1♀ Al-Hajir, 3 November 1995; 1♂ and 2♀♀ Sifah, 9 July 1996; 1♂ Yiti, 17 October 1995; 2♂♂, 6♀♀ Qurm, 28 May 1995; 1♂ Seeb, 29 May 1995.

Voucher specimens have been lodged in Oman and Britain with the following numbers: 1♀ ONHM 2494.02, Qurm; 1♂ ONHM 2494.01, Khawr Al-Milh (S). 1♂, 1♀ BNHM 1995.1697 & 1995.1698, Khawr Al-Milh (S).

MORPHOLOGICAL REMARKS: The anterolateral angle is triangular with its apex pointing forwards. The eyestalk does not extend beyond the cornea. There is a brush of hairs along the anterior surface of the propodus of the first pair of walking legs. There is no stridulating ridge on the major chela.

DISTRIBUTION AND ECOLOGY: *Ocypode cordimanus* is much less common than other species, but appears to be found along the whole coastline. It was collected from the dune systems backing the oceanic beaches except at Sifah where the crabs were foraging in the intertidal. Burrows were widely-spaced at intervals of between 10 and 30m and usually occurred on sloping sand adjacent to vegetation as at Salalah, Al-Ashkarah, Khawr Al-Milh (S) and Seeb. This was also the case in the outer dunes at Qurm, but in the inner dunes in front of the mangrove trees where spring tide flooding occurred, a greater density was encountered. Excavation of these burrows confirmed that they were not those of *O. jousseaumiei*.

KEY FOR THE IDENTIFICATION OF ADULT *OCYPODE* GHOST CRABS OF OMAN:

- 1 No stridulating ridge on the inner palm of the major chela *cordimanus*
- 1a Stridulating ridge present 2
- 2 Stridulating ridge less than half the height of the palm *rotundata*

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- 2a Stridulating ridge greater than half the height of the palm 3
- 3 Eyestalks not prolonged beyond end of cornea *jousseaumei*
- 3a Eyestalks prolonged beyond end of cornea 4
- 4 Prolonged eyestalk curved, ridge composed of fine striae *saratan*
- 4b Prolonged eyestalks straight, ridge composed of tubercles *platytarsis*

Remarks on Zoogeography

Oman borders the Arabian Sea, a region that contains a discrete subset of the fauna found in the Indian Ocean with which it is contiguous (Sheppard et al. 1992). As with the terrestrial fauna of Arabia, marine intertidal fauna (Smythe 1980, Price 1982) has affinities with both the African and Indian faunas which is also reflected in the distribution of the species of *Ocypode* reported here.

Characteristic *Ocypode* assemblages are a feature of these shores such that one species is extralittoral and one or more eulittoral (Vannini 1976). In Africa north of the equator, the Somalian shores are inhabited by the terrestrial species, *O. cordimanus* and the beach species on exposed sandy shores is commonly *O. ryderi*. This latter species also co-exists with *O. ceratophthalmus* on more sheltered sandy shores such as those bordering mangroves (Vannini & Valmori 1981b). The northern extent of the distribution of *O. ceratophthalmus* ends somewhere in this region (4° - 8° N) and while *O. ryderi* is found further north, it does not enter the Red Sea (Vannini and Valmori 1981b). *O. cordimanus* is also found along the coasts of Pakistan and India where the co-occurring beach species is *O. platytarsis* (Rao 1968; Rajabai 1972; Paulraj et al. 1982). Additionally, *O. ceratophthalmus* (Vannini 1976; Titgen 1982) and *O. macrocera* are also recorded from east Indian shores, the latter also in association with *O. cordimanus* (Rao 1968; Rajabai 1972).

Between these two faunas is that of the Arabian Peninsula coast from the Red Sea to the Arabian/Persian Gulf. The presence of *O. cordimanus* on the shores of Oman is to be expected as this species occurs both to the east and west of the Arabian Sea. In the Red Sea *O. cordimanus* co-exists with *O. saratan* (Lewinsohn 1977), an association that continues on African shores, where *O. saratan* is distributed southward to between 8° - 4° N (Vannini and Valmori 1981b).

The extent of the eastward distribution of *Ocypode saratan*, reaching the northern Batinah coast of Oman, is less expected, if only because of the presumed separation of the coastal waters of Oman into two provinces: the

Arabian Sea including the southern coastal marine current system (that is affected by upwelling) and the more northern Gulf of Oman coastal system (Glynn 1992, Stirm 1995). Although monsoonal effects may reach Sur (24° 34' N 59° 32' E), the separation is generally presumed to occur round Ras Al-Hadd (22° 32' N 59° 48' E) (Stirm 1995) (Figure 1). Nevertheless, while *O. saratan* is the dominant species on the southern shores of Oman, *O. rotundata* is the dominant one to the north. The south-western limit of the distribution of *O. rotundata* remains to be established, but to the east this species is found in the Arabian/Persian Gulf and extends along the Pakistan coast at Pasni, Sonmiani and Manora (Tirmizi 1980; pers. comm) and as far as Okha, India (Chhappgar 1957b).

O. jousseaumei has previously only been reported from the general locality of the mouth of the Red Sea (Türkay et al. 1996) and its discovery in Oman significantly extends its distribution and also explains the paucity of information about its ecology. This species appears to be restricted to the relatively rare habitat of inner khawrs, perhaps occupying the 'sheltered shore' habitat as described by Vannini and Valmori (1981b) for *O. ceratophthalmus*.

O. platytarsis is reported from Arabia for the first time, and has a distribution extending as far as Mughsayl, a considerable distance to the South and beyond the point of separation of the two marine provinces of Oman.

In Oman the *Ocypode* assemblage is at its simplest where there are just two species: the supra-littoral *O. cordimanus* and the eulittoral species *O. saratan* as at Salalah or *O. platytarsis* as at Al-Ashkarah (Figure 1). Three species can be found at the site of khawrs where *O. jousseaumei* appears, as at Yiti and Qurm. The most complex arrangement occurs at Khawr Al-Milh (S) where *O. cordimanus*, *O. jousseaumei*, *O. saratan* and *O. platytarsis* are found; the latter two species inhabiting the eulittoral environment. At Sifah and Seeb, the extra-littoral *O. cordimanus* is found with a eulittoral assemblage of *O. rotundata*, *O. saratan* and *O. platytarsis*. Although *O. rotundata* is the numerically dominant species at Seeb, the presence of two other eulittoral species presents an interesting opportunity to investigate competition. As most species of *Ocypode* appear to be active around low tide (Vannini 1976), the high tide activity of *O. platytarsis* (Naidu, 1951) suggests that one way of avoiding competition could be through a temporal separation of the species.

Acknowledgements

I thank Michael Gallagher and Samira Al-Lawatia of the Oman Natural History Museum for their assistance; Paul Clark and Steven Head for help in literature

searches and Michael Robinson and Daniel Clayton for help in specimen collection.

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Received 16 December 1995

Accepted 14 July 1996