An early Pleistocene decapod crustacean fauna from Zululand

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The early Pleistocene Port Durnford Formation has yielded the first substantial fossil decapod crustacean fauna to be recorded from southern Africa. The fauna is clearly of warm-water Indo-West Pacific origin, and is dominated by the portunid crab Scylla serrata *(Forskal), with fewer* Podophthalmus vigil *(Fabricius) and* Myra fugax *(Fabricius). In addition, there are two xanthid crabs of* Atergatis-Atergatopsis *type, a single example of a portunid identified as* Charybdis (Goniohellenus) *cf.* hoplites *var.* longicollis *Leene, and thalassinidean burrows assigned to the ichnogenus* Ophiomorpha.

The Port Durnford Formation is a coastal sequence exposed in eroding sea-cliffs along the Zululand littoral, from Cape St Lucia to the Mlalazi estuary. The succession was first described by Anderson[1] and, although best known for its fossil vertebrates, has also yielded a diverse invertebrate fauna indicating normal marine salinities.[2] It is a back-barrier lagoonal sequence,[3] laid down when sea levels were higher than at present.[3-5] Where best known, at Gabhagabha 7 km north of Richards Bay, the formation rests disconformably on mid-Tertiary carbonates of the Uloa Formation and is disconformably overlain, with a rubified palaeosol, by unconsolidated ilmenite-rich aeolianites of the Kwambonambi Formation. At this locality, a fourfold subdivision of the Port Durnford Formation is evident:

iv) At least 20 m of poorly consolidated, pale yellowish-green to orange aeolianites displaying large-scale dune cross-bedding and with lignitic lenses near the base. The upper part is rubified and capped by a chocolate-brown palaeosol.

iii) Up to a metre of well-lithified, secondarily ferruginized, orange, cross-bedded sandstone with thin cross-cutting seams of ironstone. Occasional comminuted shell material is encountered.

ii) Greenish-grey, slightly calcareous mudstones and siltstones with a basal lag characterized by terrestrial vertebrate remains and internal moulds of oysters. The upper part is well bedded but essentially devoid of macrofossils.

i) A laterally impersistent, channel-fill sequence of greenish-grey to dark greenish-black sandy mudstones with *Solen cylindraceus* and *Dosinia hepatica* in life position, together with abundant barnacle debris and fragments of *Fulvia* and other bivalves.

The fauna to be described here, comprising several hundred more or less fragmentary individuals, represents by far the best-preserved and most complete decapod fauna to come from South African rocks. The decapods are preserved in hard, indurated, greenish-grey mudstone, lithologically similar to unit (ii) of the above succession, thrown up as storm debris onto the modern beaches immediately north of Richards Bay. Since (a) the Port Durnford Formation rests disconformably on sandy limestones, presently to be correlated with the Uloa Formation, (b) coastal erosion along the beaches on which the fauna was found is currently cutting into the Port Durnford Formation, and (c) the lower part of the Port Durnford Formation comprises the only recorded lithology from the Neogene succession of Zululand which resembles the decapod matrix closely, it seems reasonable to assume the fauna derives from offshore exposures of the Port Durnford Formation. The fact that a similar fauna has not yet been discovered in the onshore exposures suggests substantial facies variation.

The sparse fossil record of southern African decapod Crustacea was outlined by Kensley,[6] who remarked that '... from such slender records, no useful conclusions can be drawn' (p.14). Consequently, the fossil decapod fauna to be described here is of considerable biogeographical significance.

Systematic palaeontology

All the material described herein is housed in the palaeontological collections of the Durban Museum.

Subtribe Brachyrhyncha Borradaile, 1903
Family Portunidae Dana, 1852
Subfamily Portuninae Dana, 1852
Genus Scylla *de Haan, 1833*

Scylla serrata (Forskal, 1755)

Material. Numerous specimens, including DM-PQPD314, 325, 330–334, and 336–338 (Figs 1, 2.6).

Occurrence. This widespread Indo-Pacific species[6-9] frequents muddy lagoons, mangrove swamps, and low-salinity estuaries, often under brackish conditions, as well as extending to shallow infratidal depths offshore.[6] It ranges from Japan (to 15 m depth), through the Phillipines to Vietnam, New Caledonia, Australia and the east coast of Africa where it reaches as far south as the Knysna Lagoon. The present record extends its time range in southern Africa back to the early Pleistocene.

Genus Charybdis *de Haan, 1833*

Charybdis (Goniohellenus) cf. *hoplites* var. *longicollis* Leene, 1938

Material. A single specimen, DM-PQPD3262 (Fig. 3.1).

Discussion. The specimen agrees most closely with *C. (Goniohellenus) hoplites* var. *longicollis* Leene, as described by Crosnier,[7] especially in the shape of the anterolateral carapace teeth, the fairly coarse granulation to the dorsal surface of the carapace, and the transverse lines.

Occurrence. This species is known only from the Red Sea and Madagascar, where it inhabits sandy substrates at 10–55 depth. However, since the Port Durnford fossil is in argillaceous matrix, the species is not restricted to such substrates.

Subfamily Podophthalminae Borradaile, 1907
Genus Podophthalmus *Lamarck, 1801*

Podophthalmus vigil (Fabricius, 1798)

Material. Many specimens, including DM-PQPD324, 326–329, 335 and 339 (Figs 2. 1–5, 7–9).

Occurrence. A shallow infratidal species, extending down to 42 m depth,[6-7] but sometimes also found swimming at the surface. It is widely distributed in the Indo-Pacific,[6-7,9-10] ranging from Japan and Formosa to the Philippines (to 42 m depth), Thailand, New Guinea, Australia, Society Island (18–22 m depth), Hawaii, the Red Sea. Madagascar, and the east coast of Africa as far south as Natal.

Subtribe Oxystomata de Haan, 1841
Family Leucosiidae Dana, 1852
Subfamily Illinae Stimpson, 1871
Genus Myra *Leach, 1817*

Myra fugax (Fabricius 1798)

Material. Five specimens (Figs 2.10–13), DM-PQPD318–319, 321–323, and 3265.

Occurrence. A widely distributed, estuarine to intertidal Indo-Pacific species[6,9] ranging from Japan, through China, the Phillipines (to 71 m depth), Singapore (at 3.5–7 m), Thailand (to 18 m), India, Cargados Carajos (to 55 m), the Iranian Gulf and, via the Suez Canal, into the eastern Mediterranean (Israel). In addition, it extends down the east coast of Africa as far as Mozambique. The present fossil occurrence represents the most southerly record of the species, and also its first record from South Africa.

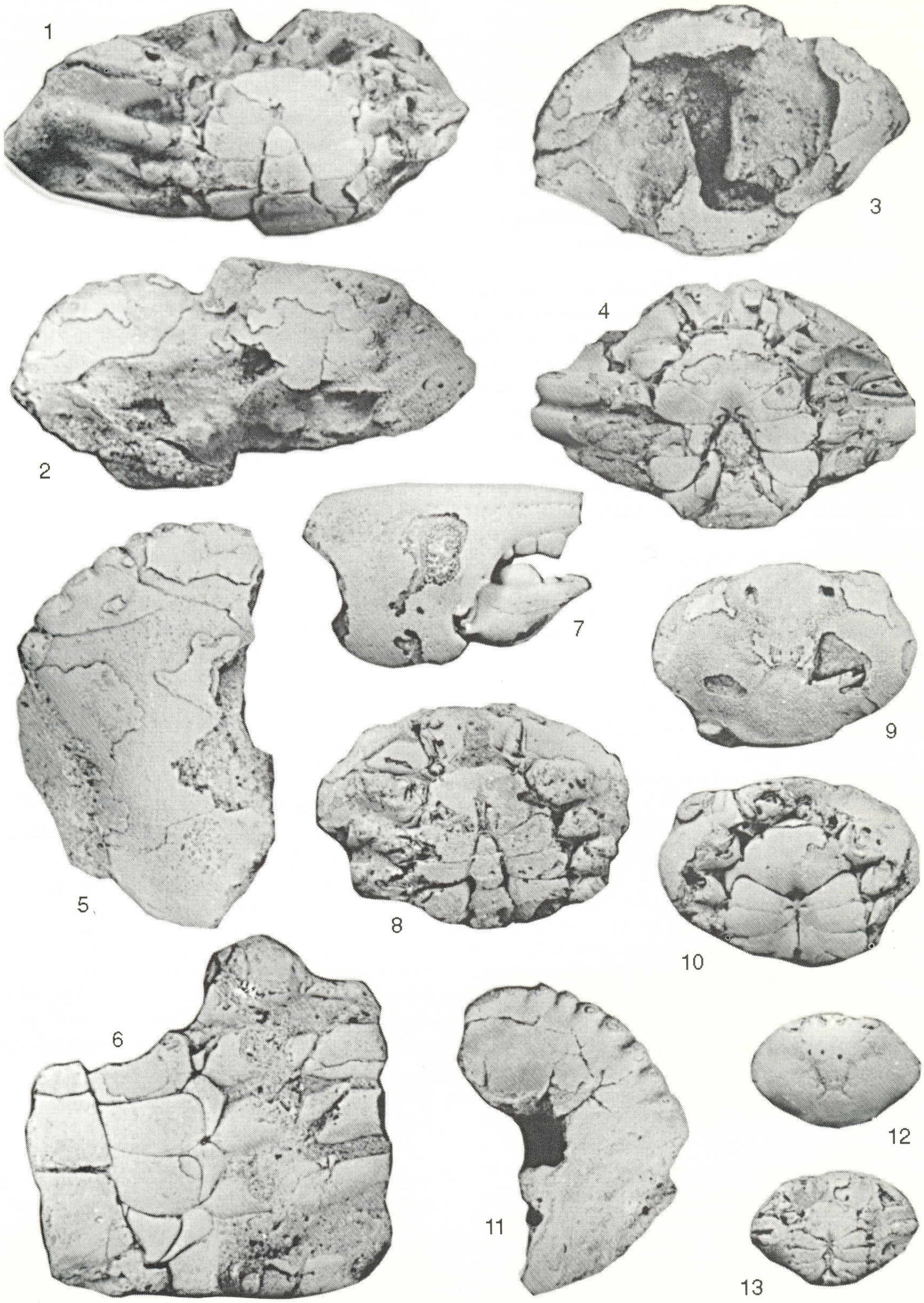

Fig. 1. *Scylla serrata* (Forskal). 1–2, Abdominal and dorsal views of DM-PQPD333, × 0.8. 3–4 Dorsal and abdominal views of DM-PQPD340, a female, × 0.53. 5–6, Dorsal and abdominal views of DM-PQPD337, × 0.53. 7, Part of a cheliped, DM-PQPD314, × 0.8. 8, Abdominal view of DM-PQPD330, a male, × 0.8. 9–10, Dorsal and abdominal views of DM-PQPD332, a male, × 0.8. 11, Dorsal view of DM-PQPD338, × 0.8. 12–13, Dorsal and abdominal views of DM-PQPD334, a juvenile, × 0.8.

Family Xanthidae Dana, 1851

cf. *Atergatis-Atergatopsis*

Material. Two specimens, DM-PQPD3263 and 3264 (Figs 3.2–3)

Material. This is a small broad species (carapace width c. 22 mm), with granular chelipeds of equal size, and characteristically white-tipped fixed fingers and dactyli. It is dorsally smooth and strongly convex, not demarcated into regions and with undemarcated lateral lobes. There are a few small marginal tubercles.

Occurrence. This group of genera are all subtropical/tropical in distribution.

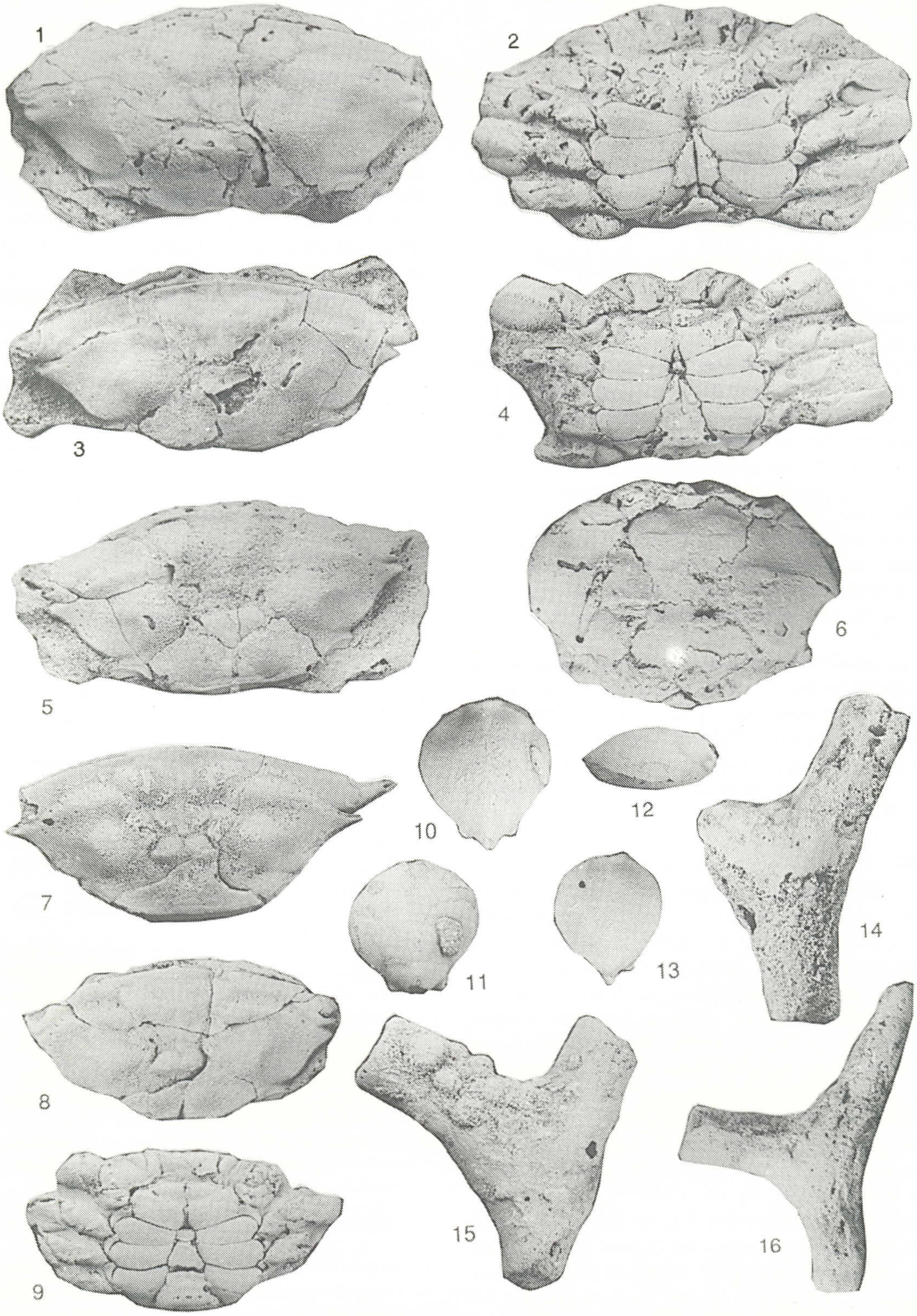

Fig. 2. 1–5,7–9. *Podophthalmus vigil* (Fabricius), × 0.8. 1–2, Dorsal and ventral views of DM-PQPD329. 3–4, Dorsal and ventral views of DM-PQPD339. 5, Dorsal view of DM-PQPD326. 7, Dorsal view of DM-PQPD324. 8–9, Dorsal and ventral views of DM-PQPD-PQPD328. 6, *Scylla serrata* (Forskal), × 0.8. Dorsal view of DM-PQPD330. 10–13, *Myra fugax* (Fabricius), × 0.8. 10, Dorsal view of DM-PQPD321. 11–12, Lateral and dorsal views of DM-PQPD313. 13, Dorsal view of DM-PQPD319. 14–16, *Ophiomorpha* cf. *nodosa* Lundgren, × 0.8. 14, Lateral view of DM-PQFD316. 15, Lateral view of DM-PQPD315; note size and shape of mud pellets. 16, Lateral view of DM-PQPD317; note scratch-like marks.

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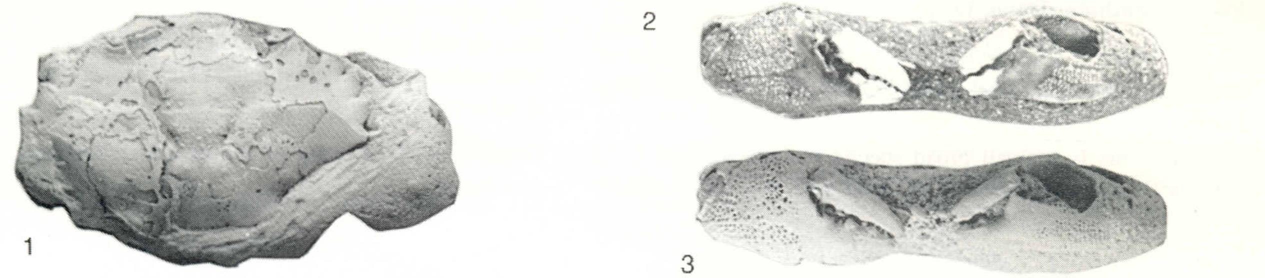

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Fig. 3. 1, *Charybdis* cf. *hoplites* var. *longicollis* Leene, × 0.8. Dorsal view of DM-PQPD3262. 2–3, Xanthid crab, × 1.2. Anterior view of DM-PQPD3263 (2) uncoated to show white-tipped fixed finger and dactylus, and (3) coated with ammonium chloride to show granulated surface of chelipeds.

Superfamily Thalassinoidea Latreille, 1831
Ichnogenus Ophiomorpha *Lundgren, 1891*

Ophiomorpha cf. *nodosa* Lundgren, 1891.

Material. Several specimens, including DM-PQPD315–317 (Figs 2.14–16).

Discussion. The present material closely resembles *Ophiomorpha nodosa*,[11,12] with some individuals (Fig. 2.14) showing a mammillate surface, resulting from lining of the burrow with mud pellets, whereas the surface of others (Fig. 2.16) appears to display scratch marks. However, the present material differs from the diagnosis given for *Ophiomorpha nodosa* by Kennedy and Macdougall[11] in that maximum diameter of the burrows is 16.5 mm, burrow cross-section is elliptical (minor diameter/major diameter 0.94), and the single mud pellets used to line the burrow walls are relatively large (6–10 mm diameter) and rounded (rather than elliptical). This suggests a different (?new) ichnospecies may be involved. Earlier records of *O. nodosa* from the Port Durnford Formation[3] should be assigned here.

It has been shown[13–15] convincingly that *Ophiomorpha nodosa* represents the burrows of callianassid and upogebiid mud-prawns, and these also constituted part of the Port Durnford fauna. However, since Kensley[6] reports four living species each of *Callianassa* and *Upogebia* from the same zoogeographic region, it is uncertain as to which species is involved.

Palaeoecology

The decapod fauna documented here supplements sedimentological[3] and molluscan evidence[2] for the depositional environment of the Port Durnford lagoon. The presence of *Podophthalmus vigil* and the xanthid crab indicates normal marine salinities, and the occurrence of *Myra fugax* and *Charybdis* cf. *hoplites* suggests affinities with the warmer water Indo-West Pacific faunas to the north. Therefore, the tropical Indo-West Pacific decapod fauna of the east coast does not represent a relatively recent incursion[6] but already was well established in the early Pleistocene.

The present-day depth distribution of the Port Durnford Decapoda[6] provides ambiguous information regarding water depths in the Port Durnford lagoon. However, the overwhelming abundance of *Scylla serrata* favours depths shallower than about 15 m. This is of some significance regarding the sea-level rise responsible for Port Durnford sedimentation. Maud[4] postulated a +30-m rise in sea level to account for deposition of the Port Durnford Formation, whereas Davies[5] correlated it with both his +45-m and +30-m transgressive events. On the other hand, Hobday and Orme[3] regarded an 8-m rise in sea level sufficient to deposit the lagoonal sediments of the Port Durnford Formation. Since the base of the Port Durnford Formation is within a few metres of present-day sea level, the estimate of Hobday and Orme[3] is perhaps better favoured by the decapod evidence.

Although burrows of *Ophiomorpha* are considered diagnostic of nearshore, littoral and shallow neritic environments,[13–15] southern African callianassids range to depths of 180 m and upogebiids to 80 m.[6] The burrows, therefore, do not offer a precise depth for the Port Durnford lagoon.

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