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Crabs and barnacles (Crustacea: Decapoda & Cirripedia) from the late Pleistocene Port Morant Formation of southeast Jamaica

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Abstract

The fauna of crabs and barnacles from the siliciclastic Port Morant Formation (last interglacial, Sangamonian) of the parish of St. Thomas, southeast Jamaica, is comprised of seventeen species of crabs in fifteen genera and three of barnacles in two genera. One new callianassid, *Neocallichirus peraensis* sp. nov. and a new brachyuran, *Hepatus praecox* sp. nov., are described. Comparison with the coeval fauna of the raised reef of the Falmouth Formation, central north Jamaica, indicates that the crab and barnacle fauna of the Port Morant and Falmouth Formations were readily adaptable to the prevailing environmental conditions at the localities involved.

Key words: Crustacea, Decapoda, Cirripedia, Pleistocene, Jamaica.

Introduction

Palaeontological studies of marine Pleistocene successions in the Caribbean region have concentrated on raised reefs and other carbonate palaeoenvironments. Such studies have produced a wealth of taxonomic and palaeoecological data (for example, see Cerridwen & Jones, 1991 ; Gordon & Donovan, 1992 ; amongst others). However, in addition to carbonate palaeoenvironments, siliciclastic successions do occur, but have been somewhat ignored. Pleistocene siliciclastic successions offer the chance to compare biotas from a very different facies with those of raised reefs. In Jamaica, the best exposed, siliciclastic, Pleistocene succession is that which outcrops on the coast at Old Pera in the southeast corner of the island (Fig. 1). These rocks are highly fossiliferous and are the subject of ongoing research into the Jamaican, and wider Caribbean, Pleistocene fauna. The purpose of the present paper is to document the fauna of crabs and barnacles from these rocks, and to compare them with those from coeval reef environments. Despite its only moderate diversity, this is nevertheless one of the more diverse crab faunas known from the Cenozoic of the Antillean region.

Locality and Horizon

The specimens documented herein were collected from the late Pleistocene (Sangamonian, last interglacial) Port Morant Formation, exposed in a coastal section on the southeast side of Port Morant Bay, south of Old Pera, parish of St. Thomas, southeast Jamaica (Fig. 1 : between grid 11 references 221 354 to 222 354, Jamaican 1 : 50,000 topographic sheet 19

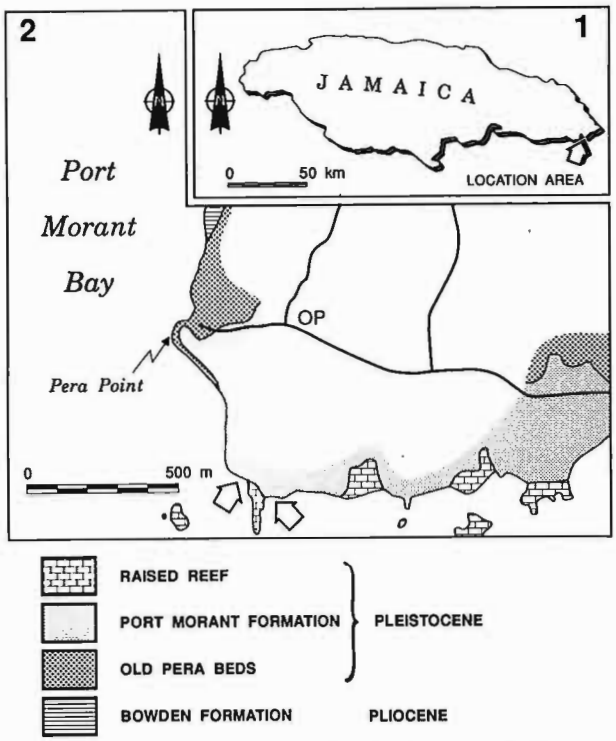


Fig. 1. After Donovan *et al.* (1994, fig. 1.) (1) Outline map of Jamaica, showing the position of the study area (arrowed): (2) Geological map of the Old Pera district, parish of St. Thomas, southeast Jamaica (based on the original field map of E. Robinson; note that the contact between the Old Pera Beds and the Port Morant Formation is incorrectly illustrated in Robinson (1969, fig. 5). Key: OP, Old Pera. Open arrows indicate the approximate outcrop of the crab- and barnacle rich-horizon, south of Pera Point.

"Morant Bay", metric (new) edition; about 76° 19′ 9″ W, 17° 53′ 0″ N). The Port Morant Formation discomformably overlies the early Pleistocene Old Pera Beds, both units forming part of the Upper Coastal Group (Robinson, 1969). The crabs and barnacles were collected from pebble conglomerates and shell-rich horizons in unit 10 of Donovan *et al.* (1994 ; Fig. 2 herein), particularly from near the base of this unit. Specimens were collected from a low cliff face and numerous large fallen blocks on the beach. These matrix-supported gritstones and pebble conglomerates with subangular to subrounded igneous clasts also include disseminated shells and shelly debris. The matrix is a straw-brown, medium- to coarse-grained, siliciclastic sand, often with abundant *Thalassinoides* sp. burrows. The fauna is dominated by scleractinian corals and, particularly, benthic molluscs. Many shells are fragile either because they are thin (particularly bivalves); they are partially decalcified and/or bored by clionid sponges (particularly gastropods); or they have been bored by bivalves such as *Gastrochaena* (both corals and larger molluscs). Gastropods include *Strombus gigas* Linné and *Bulla striata* Bruguiére, amongst others. Bivalves include oysters, *Pinna* sp., arks, scallops, lucinids and *Chione* sp. Bivalves are commonly, but not invariably, disarticulated and preserved concave side up. A single scaphopod, *Dentalium* sp., had been found. Shells may be encrusted by balanids and/or calcareous worm tubes, or may be bored by predatory gastropods. Scleractinians were hosts to *Ceratoconcha* barnacles. Rarer components of the fauna include a lunulate clypeasteroid, the spatangoid *Shizaster doederleini* (Chesher) (Donovan *et al.*, 1994) and teeth of the shark *Carcharhinus limbatus* (Valenciennes) (Purdy *et al.*, 1996).

Systematic Palaeontology

Order Decapoda Latreille, 1803
Infraorder Anomura H. Milne Edwards, 1832
Superfamily Thalassinoidea Latreille, 1831
Family Callianassidae Dana, 1852

Remarks: In a major reassessment of the Recent Callianassidae of North America, Manning & Felder (1991) introduced 7 subgenera and considered that, from the Recent point of view, the nominative genus was not represented in the Americas. This conclusion has far reaching repercussions among the numerous fossil species - ranging from the Cretaceous to Pleistocene of this region - previously assigned to *Callianassa sensu stricto*. Fortunately, of the two species recognised in the present collection, both can be referred to living subgenera and their new taxonomic position adopted. Unless similar recognition can be applied to other fossil callianassid species, however, it may be preferable to refer to them simply as "*Callianassa*" within Callianassidae *sensu lato*, without reference to a subfamily.

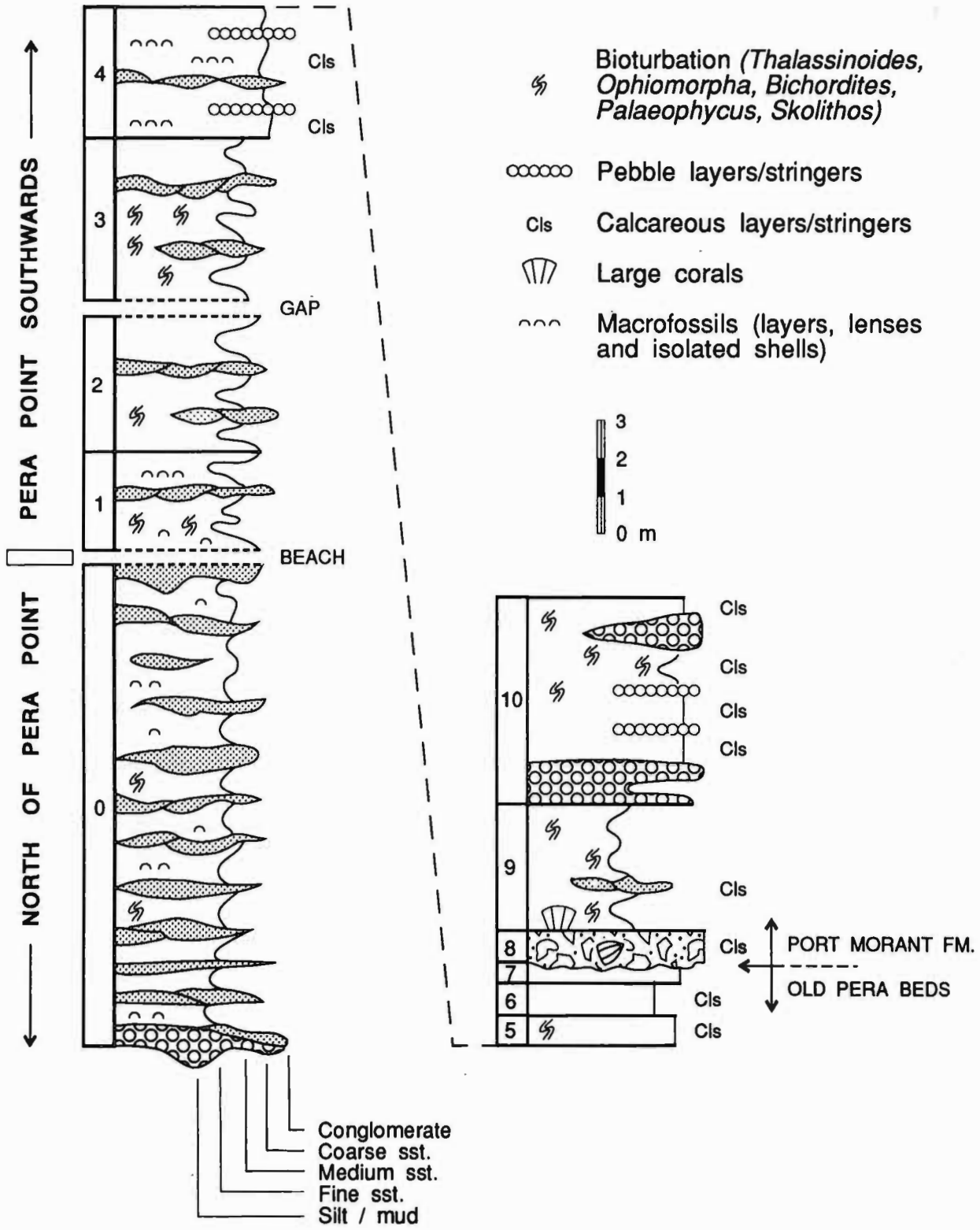


Fig. 2. Measured section of the late Pleistocene Port Morant Formation and junction with early Pleistocene Old Pera Beds exposed in coastal section near Old Pera, southeast Jamaica (after Donovan *et al.*, 1994, fig. 2). The crabs and barnacles documented herein come from the lower, more conglomeratic part of unit 10.

Subfamily Callichirinae Manning & Felder, 1991

Genus *Neocallichirus* Sakai, 1988

Type species: By original designation *Neocallichirus horneri* Sakai, 1988.

Neocallichirus peraensis sp. nov.
(Pl. 12, Figs. 3-6 ; Pl. 13, Fig. 5 ; Pl. 14, Fig. 1)

Derivation of name: With reference to the type locality, near Old Pera, parish of St. Tomas, Jamaica (but not to the Old Pera Beds).

Diagnosis: Propodus subquadrate in outline, fixed finger long, slender and in line with basal margin, a strong ridge on the inner surface embraces the interdigital margin and a spur off it reaches the occludent margin.

Material: Holotype, a left chela, BMNH IC 19 ; 9 paratypes, BM IC 20-28.

Description: The left and right chelae are subquadrate with much the same proportions and ornament. The distal height of the propodus is from about two thirds to three fourths of length. The edge of the gently curved upper margin is rounded to an abrupt, thin ridge on the inner surface. Lower margin convex, a little indented at the base of the fixed finger and finely and evenly serrated, the serrations - more prominent on the inner surface - extending a short distance onto the fixed finger. Outer surface moderately rounded to near the basal margin where it becomes concave. Inner surface flattened, hollowed at base of fixed finger; near the distal upper margin three large lunate (when unworn) pits each have their anterior border lower than the posterior. The carpal margin is straight, bounded by a narrow groove, its rounded upper angle a little incurved. The interdigital margin is almost vertical, its curved edge is lined with fine granules, shortly separated from others proximally on the fixed finger. The fixed finger is slender, almost as long as, and in line with the basal margin, inclined a little inwards and upturned at the tip, six elongate pits, deeper distally, line the basal edge. On the outer surface an obscure rounded ridge extends shortly onto the manus, a stronger ridge on the inner surface curves sharply to a groove bounding the interdigital margin and an excavation is enclosed by an oblique spur leading from it to the occludent margin. A row of, normally, ten linear pits extending along the inner basal margin originates from minute pits between each of the basal serrations; a pit occurs about the middle of the inner surface and another nearby proximally, there is one, median, near granules lining the interdigital margin which become coarser and more numerous basally, and may extend into the enclosed excavation. Occludent margin thinly ridged, sometimes straight, but normally arcuate medially.

Left and right dactyli similar: robust, inturned and strongly down-curved at the tip; the upper margin is slightly depressed and flattened near the articulation; there is a rectangular cusp before a somewhat shorter rectangular cavity on the occludent margin, after which the edge may be smooth or minutely granulated; six forwardly directed pits line the upper margin and another occurs lateral to the second one.

Discussion: The longer, slenderer fixed finger of *Neocallichirus peraensis* readily distinguishes that species from any of the six Recent American members included in the genus by Felder & Manning (1995), but in general outline and ornament of the chelae, *N. peraensis* has much in common with those of *Neocallichirus grandimana* (Gibbes, 1850). In this species, the manus is rather more quadrate, the basal margin is similarly serrate, 10 pores extend the length of the fixed finger and granules line the interdigital margin; however, the fixed finger lacks the ridge on the inner margin and there are two 'cutting' edges, the inner the lower. The upper margin of the dactylus is similarly porose, but the cusp on the opposing margin has a concave edge and there is a distinct triangular cusp distal to it.

Genus *Glypturus* Stimpson, 1866

Glypturus acanthochirus Stimpson, 1866
(Pl. 12, Fig. 1 ; Pl. 15, Figs. 1, 3, 4)

Material: 5 propodi, BM IC 29-32, 73 ; 1 dactylus BM IC 33.

Remarks: This species occurs less frequently than *Neocallichirus peraensis* in the ratio of about 1 : 3.

Superfamily Paguroidea Latreille, 1802

Family Paguridae Latreille, 1802
Genus *Petrochirus* Stimpson, 1859

Petrochirus bahamensis (Herbst, 1791)
(Pl. 14, Figs. 2-4 ; Pl. 16, Fig. 4)

Material: Chelae and fragments of fingers, BM IC 34-39, 73.

Remarks: All specimens agree well with descriptions (Rathbun, 1919 ; Provenzano, 1959) and specimens.

This, the largest of the Recent Caribbean hermit crabs, commonly occupies the shells of *Strombus gigas* and may be taken from shallow waters to as deep as c 35 m (Provenzano, 1959); remains of *S. gigas* are fairly common at Old Pera.

A worn chela from the Pleistocene of Brimstone Hill, St Kitts, in the Natural History Museum, London, tentatively identified as *Petrochirus bouvieri* Rathbun, 1919 has fan-shaped clusters of granules similar to those in the present collection, rather than 'round or nearly round' clusters (Rathbun, 1919) which typify *P. bouvieri*, and the chela could well be transferred to *P. bahamensis*.

Rathbun (1919) and other authors included *Petrochirus granulatus* (Olivier, 1811) in synonymies, but Provenzano (1959) preferred to keep an open mind until specimens outside the West Indian Region could be examined.

Infraorder Brachyura Latreille, 1803
Superfamily Calappoidea de Haan, 1833
Family Calappidae de Haan, 1833
Genus *Calappa* Weber, 1795

Calappa springeri Rathbun, 1931
(Pl. 13, Figs. 1, 2, 4; Pl. 17, Figs. 2, 4, 7; Pl. 7, Fig. 1)

Material: 8 carapace fragments and/or chelae. BM IC 40-47.

Remarks: Rathbun (1937) recorded no environmental conditions except for depths of c 8.5 m - c 33 m. *Calappa gallus* (Herbst, 1803), recorded by Morris (1993) from the Falmouth Formation of Rio Buena Harbour, occupies sandy, rocky and shelly bottoms as well as coral and extends to depths of c 130 m (Rathbun, 1937). *C. springeri*, apparently well established by Port Morant times, is not uncommon at Old Pera. Its Recent distribution appears to be confined to the Caribbean region.

Subfamily Matutinae MacLeay, 1838

Genus *Hepatus* Latreille, 1802
Type species: By original designation *Calappa angustata* Fabricius, 1798.

Hepatus praecox sp. nov.
(Pl. 13, Fig. 6)

Holotype: A carapace lacking frontal margin, BM IC 48.

Diagnosis: A *Hepatus* with steeply inclined, ridged posterolateral margins.

Description: The carapace lacks details of the front, but the length may be estimated as five sevenths of the width, widest a little before the bluntly rounded lateral angle. The anterolateral margin is divided into 13 more or less denticulate spines, denticulated on their margins; the lateral angle is about mid-length distant from the front. The posterolateral margins, sharply inclined towards the midline as far as the mesobranchial tubercles, are lined with rounded tubercles which, apart from a slightly larger one lateral to midlength, decrease in size posteriorly and continue above the posterior margin, which is bounded by a ridge. There is a row of three nodes composed of a cluster of small tubercles surrounding a larger one on the gastric region; one on each protogastric a little above one on the mesogastric lobe, and behind these a more prominent row is formed by a node on each mesobranchial lobe and one on the urogastric region. A curving line of 7 or 8 more or less even sized flattened tubercles extends from the midline halfway to the lateral angle.

Discussion: *H. praecox* has characters in common with the Atlantic region form, *Hepatus princeps* (Herbst, 1794), with its Pacific analogue *Hepatus kossmani* Neumann, 1878 and another Pacific coast species, *Hepatus lineatus* Rathbun, 1898. With *H.*

princeps, H. praecox shares the 13 tridentate spined anterolateral margin, but its posterolateral margins are more sharply inclined towards the midline and *H. praecox* lacks the 8 transverse rows of branchial granules. Instead, a row of tubercles extends backward and outward as in *H. kossmani*, although in that species rather more (11 - 14) tubercles extend further towards the lateral angle; the tubercle-clusters are similar in both species and to those of *H. lineatus. H. praecox* differs from *H. kossmani* in having more continuously dentate anterolateral margins, more transversely directed posterolateral margins and absence of branchial tubercles. The posterolateral margins of *H. lineatus* are less sharply concave and have a prominent tubercle near the posterior angle. The lateral angle of *H. praecox* is more distant from the front than any of the other three species considered.

Rathbun (1937) recorded *H. lineatus* from about the lowest tide levels, burrowing in sand, and the occurrence of *H. princeps* from Puerto Rico on coral; *H. kossmani*, on the other hand, has a preference for muddy bottoms at a depth ranging from c 4 m - 50 m.

Previous knowledge of fossil *Hepatus* species in the Caribbean Region has been limited to a single carapace of *Hepatus nodosus* Collins & Morris (1976) from the Middle Miocene Brasso Formation of Manzanilla Bay, Trinidad. It differs from *H. praecox* in having lobate anterolateral margins, the posterolateral margins are concave, but shorter and the posterior margin is comparatively wider.

Family Leucosiidae Samouelle 1819
Genus *Persephona* Leach, 1817

Persephona p. punctata (Linné, 1758)
(P1. 16, Fig. 1)

Material: Cheliped merus, BM IC 49.

Remarks: Whereas no coral associated specimens were recorded by Rathbun (1937) for the nominate species, *Persephona p. aquilonaris* Rathbun, 1933 occurs frequently with coral, but in this form the merus appears to be heavier and more coarsely tuberculate.

Superfamily Majoidea Samouelle, 1819
Family Majidae Samouelle, 1819
Subfamily Mithracinae Balss, 1829
Genus *Mithrax* Desmarest, 1823
Subgenus *Mithrax* Desmarest, 1823

Mithrax (*M.*) *hispidus* (Herbst, 1790)
(P1. 17, Fig. 5)

Material: Cheliped merus BM IC 50.

Remarks: Not before recorded as a fossil from Jamaica, but present in the Pleistocene, Coral Rock, of Barbados (Collins & Morris, 1976). This species presently ranges through the Caribbean as far south as Brazil; no bottom observations were recorded (Rathbun, 1925).

Mithrax (*M.*) *verrucosus* H. Milne Edwards, 1832
(P1. 17, Fig. 1)

Material: Chela. BM IC 51.

Remarks: Not before recorded as a fossil from Jamaica, but present in the Pleistocene, Coral Rock, of Barbados (Collins & Morris, 1976) ; these authors recorded the present distribution as from South Carolina to Fernando Norunha, Brazil. It is a nocturnal species living in holes in rocks.

Subfamily Maiinae Alcock, 1895
Genus *Pitho* Bell, 1836

Pitho anisodon (von Martins, 1872)
(P1. 13, Fig. 3)

Material: A carapace broken longitudinally along the midline, with the right side partially overlapping the left. BM IC 52.

Remarks: The carapace has an estimated width excluding spines of 20 mm, indicating a slightly junior moult-stage to those carapaces with a width of 24.2 mm - 25.0 mm recorded by Rathbun (1925).

One of three species of *Pitho* found in Jamaican waters, *P. anisodon*, not before recorded fossil, ranges from Florida to Columbia and Guadaloupe; it has been taken from a variety of bottoms, including coral.

Superfamily Portunoidea Rafinesque, 1815
Family Portunidae Rafinesque, 1815
Genus *Callinectes* Stimpson, 1860

Callinectes sp. cf. *C. toxodes* Ordway, 1863
(Pl. 18, Fig. 5)

Material: A left fixed finger. BM IC 53.

Remarks: The fixed finger corresponds more closely to this species which is the present Pacific analogue of *Callinectes bocourti* A. Milne Edwards, 1897. The fixed finger of the latter species differs in that the large teeth (each flanked by a small one) on the opposing margin are much narrower and without rectangular bases.

No bottom records were recorded for *C. toxodes* or *C. bocourti* by Rathbun (1930). The other four Jamaican species, *Callinectes danae* Smith, 1869, *Callinectes marginatus* (A. Milne Edwards, 1861), *Callinectes ornatus* Ordway, 1863 and *Callinectes sapidus* Rathbun, 1896, have, according to Rathbun (1930), been taken from a variety of bottoms from sticky mud to broken shell, but only two, *C. ornatus* and *C. marginatus*, included coral (the latter species elsewhere from Jamaica) (Rathbun, 1897, 1930). *C. bocourti* and *C. sapidus* have a preference for mud bottoms rather than sand, *C. ornatus* prefers sand, while *C. danae* occupies both bottoms. According to Catton (1989) degrees of salinity provide another factor governing the choice of habitat.

The present range of *C. bocourti*, the Atlantic analogue, extends from the West Indies to the State of Santa Catharina, Brazil (Rathbun, 1930).

Superfamily Xanthoidea MacLeay, 1838
Family Xanthidae MacLeay, 1838
Genus *Eurypanopeus* A. Milne Edwards, 1880

Eurypanopeus sp. cf. *E. depressus* (Smith, 1869)
(Pl. 16, Fig. 5)

Material: Chela. BM IC 54.

Remarks: Not recorded by Morris (1933), who listed *E. abbreviatus* (Stimpson, 1860) from the Falmouth Formation. Rathbun (1930) did not mention a coral habitat for *E. depressus*, but instead recorded specimens taken from under rocks, sponges and/or bryozoa and from muddy bottoms.

Genus *Eurytium* Stimpson, 1859

Eurytium sp. cf. *E. limosum* (Say, 1818)
(Pl. 16, Fig. 6)

Material: Associated propodus and carpus. BM IC 55.

Remarks: Found on a coral reef at Colon, Panama, and under stones or burrowing in sand at other localities (Rathbun, 1930).

Genus *Hexapanopeus* Rathbun, 1898

Hexapanopeus sp. cf. *H. caribbaeus* (Stimpson, 1871)
(Pl. 16, Figs. 2, 3)

Material: Chela. BM IC 56.

Remarks: Rathbun (1930) recorded Jamaican *Hexapanopeus* species among sponges and algae in brackish water. Elsewhere this species occurs among mangrove roots and a single specimen was taken from coral.

Genus *Panopeus* H. Milne Edwards, 1834

Panopeus sp. cf. *P. herbstii* H. Milne Edwards, 1834
(Pl. 18, Fig. 3)

Material: Chela. BM IC 57.

Panopeus sp. cf. *P. rugosus* A, Milne Edwards, 1880
(Pl. 18, Fig. 4)

Material: Chela. BM IC 58.

Remarks: *P. herbstii* occurs in the Falmouth Formation (Morris, 1993). Rathbun (1930) recorded it having been found among stones and mangroves, in sand and from under oysters. Much the same bottom conditions were also noted for *P. rugosus*.

Genus *Pilumnus* Leach, 1815

Pilumnus sp. cf. *P. sayi* Rathbun, 1897
(Pl. 15, Fig. 5)

Material: Chela. BM IC 59.

Remarks: This species appears to be as much at home on coral as most other bottoms (Rathbun, 1930).

Family Carpiliidae Ortmann, 1894
Genus *Carpilius* Desmarest, 1823

Carpilius corallinus Herbst, 1783
(Pl. 17, Fig. 6)

Material: Chela. BM IC 60.

Remarks: Found in sandy, stony and coral habitats (Rathbun, 1930).

Class Cirripedia Burmeister, 1834
Suborder Balanoidea Pilsbry, 1916
Family Balanidae Leach (Newman & Ross, 1976)
Genus *Balanus* Leach, 1817

Balanus eburneus Gould, 1841
(Pl. 12, Figs. 7, 9; Pl. 19, Figs. 1-5)

Material: 2 detached specimens; a small group on an oyster and an isolated compartment. BM IC 61-64.

Balanus improvisus Darwin, 1854
(Pl. 12, Figs. 7, 8; Pl. 19, Figs. 1-5)

Material: Several detached specimens; small groups on *Crassostrea virginica* and a pebble, BM IC 66-69.

Remarks: Both species occur in the Round Hills Beds, August Town Formation at Farquhar's Beach, Clarendon Parish (Bacon [pers comm.] *in* Littlewood & Donovan, 1988 ; Morris, 1993).

Pores with transverse septa visible on the rostrum of the detached *B. eburneus* readily distinguish this species from the small, round pores seen on broken plates of *B. improvisus* (Davadie, 1963), Unbroken specimens have the narrow, rounded radii similar to Pilsbry's (1916, fig. 16) figure illustrating differences of this character from that of *B. eburneus*.

At both of the recorded localities, *B. improvisus* is the commoner species. Zullo (1979) indicated the two species are often confused.

Family Pyrgomatidae Gray, 1825
Subfamily Ceratochonchinae Newman & Ross, 1976
Genus *Ceratoconcha* Kramberger-Gorjanović, 1889

Ceratoconcha sp. aff. *C. barbadensis* (Withers, 1926)
(Pl. 15, Fig. 2 ; Pl. 16, Fig. 3)

Material: 4 individuals on *Porites* sp. BM IC 70 - 73, 73a.

Remarks: Recorded by Morris (1993) from the Pleistocene raised reef near Round Hill Bluff west of Montego Bay, Hanover Parish.

Discussion

Morris (1993) described a crab fauna from the coeval Falmouth Formation of Jamaica's central north coast. However, unlike the Port Morant Formation, the Falmouth Formation represents a Sangamonian raised reef deposit. Crabs were only collected from poorly lithified limestones from one locality, representing either a patch reef or part of the reef crest, at east Rio Bueno Harbour. (locality 1 of Gordón & Donovan, 1992).

All the material from the Falmouth Formation studied by Morris (1993) was obtained from sieved residues from this poorly consolidated deposit. The Port Morant Formation succession as exposed at Old Pera offers no such opportunity; breakdown of the sediment would almost undoubtedly result in total loss of small specimens. Critical comparison, therefore, of the fossil crabs and barnacles of the Port Morant and Falmouth Formations remains speculative.

With the exception of *Neocallichirus peraensis* sp. nov. and *Hepatus praecox* sp. nov., all the species determined either by Morris (1993) or herein, are extant and, for the most part, insufficient data are recorded about them to provide adequate comparison of preferential habitats of the two crustacean commu-

Table 1. Fossil crabs from the late Pleistocene (Sangamonian) Port Morant Formation on southeast side of Port Morant Bay, south of Old Pera, parish of St. Thomas, southeast Jamaica (herein), and from the Falmouth Formation at east Rio Bueno Harbour, parish of St. Ann, central north Jamaica (after Morris, 1993).

Port Morant Formation	**Falmouth Formation**
Family Callianassidae Dana	
Glypturus acanthochirus Stimpson	*Callianassa sensu lato* sp. or spp.
Neocallichirus peraensis sp. nov.	
Family Paguridae Latreille	
Petrochirus bahamensis (Herbst)	*Petrochirus* sp.
Family Porcellanidae Haworth	
.....	*Petrolisthes* sp.
Family Albunidae Stimpson	
.....	*Albunea* sp.
Family Calappidae de Haan	
Calappa springeri Rathbun	*Calappa* sp. cf. *C. gallus* (Herbst)
Hepatus praecox sp. nov.	
Family Leucosiidae Samouelle	
Persephona p. punctata Linné	
.....	*Uhlias* sp. cf. *U. limbatus* Stimpson
Family Majidae Samouelle	
Mithrax (M.) hispidus Herbst	*Mithrax* sp. cf. *M. caribbaeus* Rathbun
M. (M.) verrucosus H. Milne Edwards	*M. spinosissimus* Lamarck
.....	*Mithraculus* sp. cf. *M. forceps* H. Milne Edwards
Pitho anisodon (von Martins)	
Family Grapsidae MacLeay	
.....	*Pachygrapsus* sp.
Family Ocypodidae Rafinesque	
.....	*Uca* sp.
Family Portunidae Rafinesque	
Callinectes sp. cf. *C. toxodes* Ordway	
Family Xanthidae Dana	
Carpilius corallinus Herbst	
Eurypanopeus sp. cf. *E. depressus* (Smith)	*Eurypanopeus abbreviatus* (Stimpson)
Eurytium sp. cf. *E. limosus* (Say)	
Hexapanopeus sp. cf. *H. caribbaeus* (Stimpson)	
Panopeus herbstii H. Milne Edwards	*Panopeus herbstii* H. Milne Edwards
P. sp. cf. *P. rugosus* H. Milne Edwards	
Pilumnus sp. cf. *P. sayi* Rathbun	
.....	*Micropanopeus* sp. cf. *M. polita* Rathbun
	M. sp. cf. *M. spinipes* A. Milne Edwards
.....	*Phymodius* sp. cf. *P. maculatus* (Stimpson)

nities, as known, from the Falmouth and Port Morant Formations.

Five genera and one species, *Petrochirus, Mithrax, Calappa, Eurypanopeus* and *Panopeus herbstii*, are common to both the Falmouth and Port Morant Formations (Table 1). Of the other Falmouth species recorded by Morris (1993), *Petrolithses* sp. belongs to a genus largely littoral in habitat, although species from the Caribbean region have been taken from depths extending to 215 fathoms (c 406 m) (Haig, 1956). *Phymodius maculatus* (Stimpson, 1860) is essentially a reef-dweller (Rathbun, 1930); *Calappa gallus, Micropanopeus polita*, and *Micropanopeus spinipes*, have been taken from a variety of bottoms (Rathbun, 1930), while no data are recorded for *Uhlias limbatus* Stimpson, 1871.

Regarding the Port Morant crab fauna, no data are available for *C. toxodes*, but *Callinectes* spp. have been taken from a variety of bottoms including coral, as have all the other extant species, considered herein, with the exception of *Persephona p. punctata* and *Panopeus rugosus*, to which Rathbun (1930, 1937) makes no reference to coral.

No cirripedes were recorded by Morris (1993) from the Falmouth Formation, but at least one species of balanid and *Ceratoconcha* sp. were found at Rio Bueno Harbour during the Geologists' Association 1993 Field Meeting to Jamaica (Donovan *et al.*, 1995). By and large, the coeval crab and barnacle fauna of the Port Morant and Falmouth Formations appears to have been readily adaptable to the diverse conditions under-which the deposits were laid down.

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Plate 12

Fig. 1. *Glypturus acanthochirus* Stimpson, BM IC 29, a small left propodus, inner surface, × 3.7.

Figs. 2, 8. *Balanus improvisus* Darwin.

Fig. 2. BM IC 65, lateral view of shell, × 3.5.

Fig. 8. BM IC 66, individuals encrusting a bivalve, × 2.4.

Figs. 3-6. *Neocallichirus peraensis* sp. nov.

Fig. 3. Paratype, BM IC 19, right propodus, inner surface, × 3.4.

Fig. 4. Holotype, BM IC 20, left chela, outer surface, × 3.7.

Fig. 5. Paratype, BM IC 21, right propodus, inner surface, × 3.5.

Fig. 6. Paratype, BM IC 22, left propodus, inner surface, × 3.6.

Figs. 7, 9. *Balanus eburneus* Gould.

Fig. 7. BM IC 61, lateral view, × 3.6.

Fig. 9. BM IC 62, individuals encrusting an oyster, × 3.7.

All specimens coated with ammonium chloride sublimate.


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Plate 13

Figs. 1, 2, 4. *Calappa springeri* Rathbun.

Fig. 1. BM IC 40, dorsal surface of carapace, × 3.

Fig. 2. BM IC 41, left propodus and dactylus, × 2.5.

Fig. 4. BM IC 42, posterior margin of carapace, × 2.1.

Fig. 3. *Pitho anisodon* (von Martins), BM IC 52, dorsal surface of carapace, × 3.6.

Fig. 5. *Neocallichirus peraensis* sp. nov. Paratype, BM IC 23, right propodus, outer surface, × 3.3.

Fig. 6. *Hepatus praecox* sp. nov. Holotype, BM IC 48, dorsal surface of carapace, × 3.0.

All specimens coated with ammonium chloride sublimate.

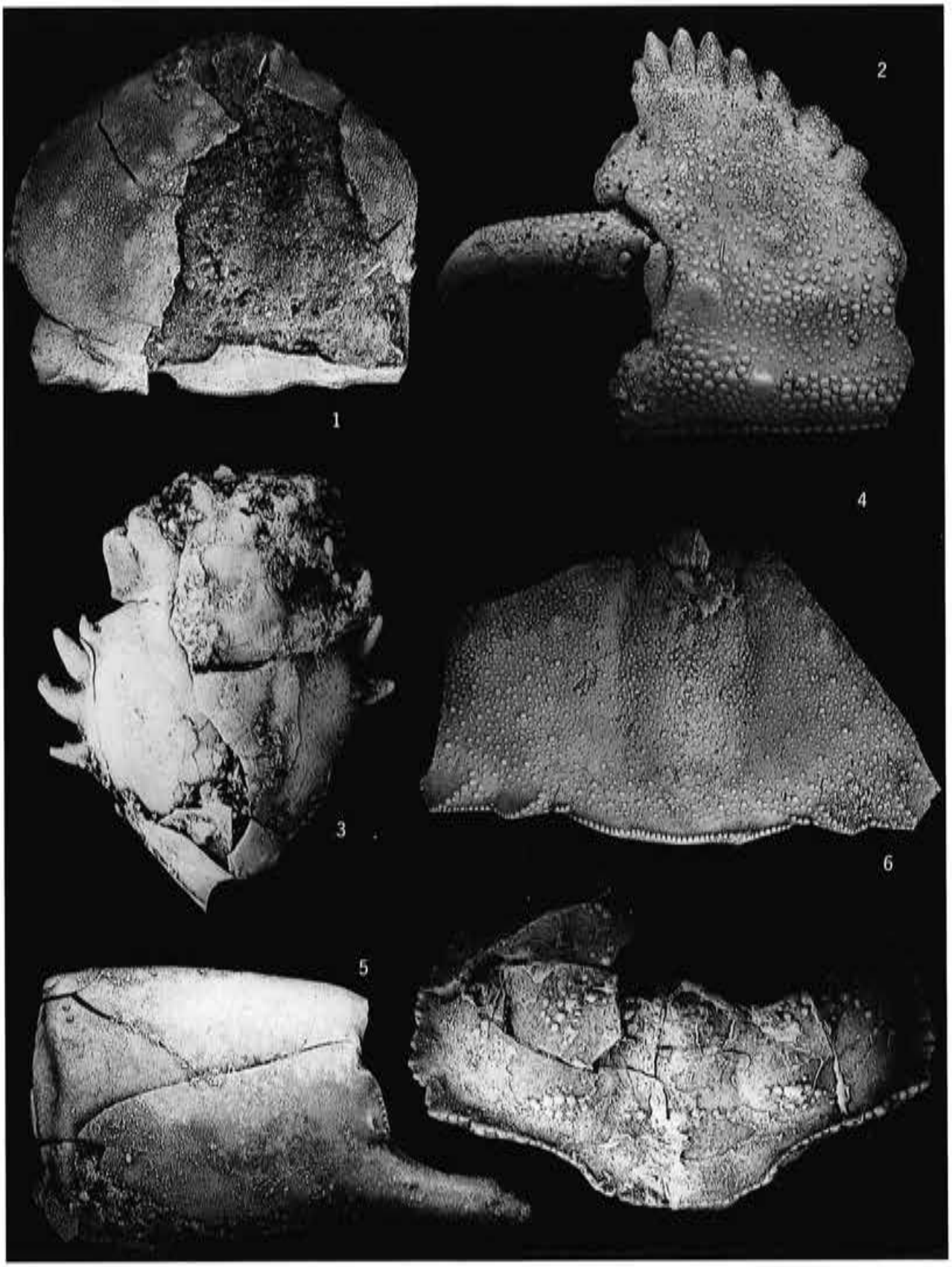

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Plate 14

Fig. 1. *Neocallichirus peraensis* sp. nov. Paratype, BM IC 24, left propodus, inner surface, × 3.5.
Figs. 2-4. *Petrochirus bahamensis* (Herbst).

Fig. 2. BM IC 34, left chela, outer surface, × 3.7.

Fig. 3. BM IC 35, left chela, inner surface, × 2.1.

Fig. 4. BM IC 36, right chela, inner surface, × 3.7.

All specimens coated with ammonium chloride sublimate.

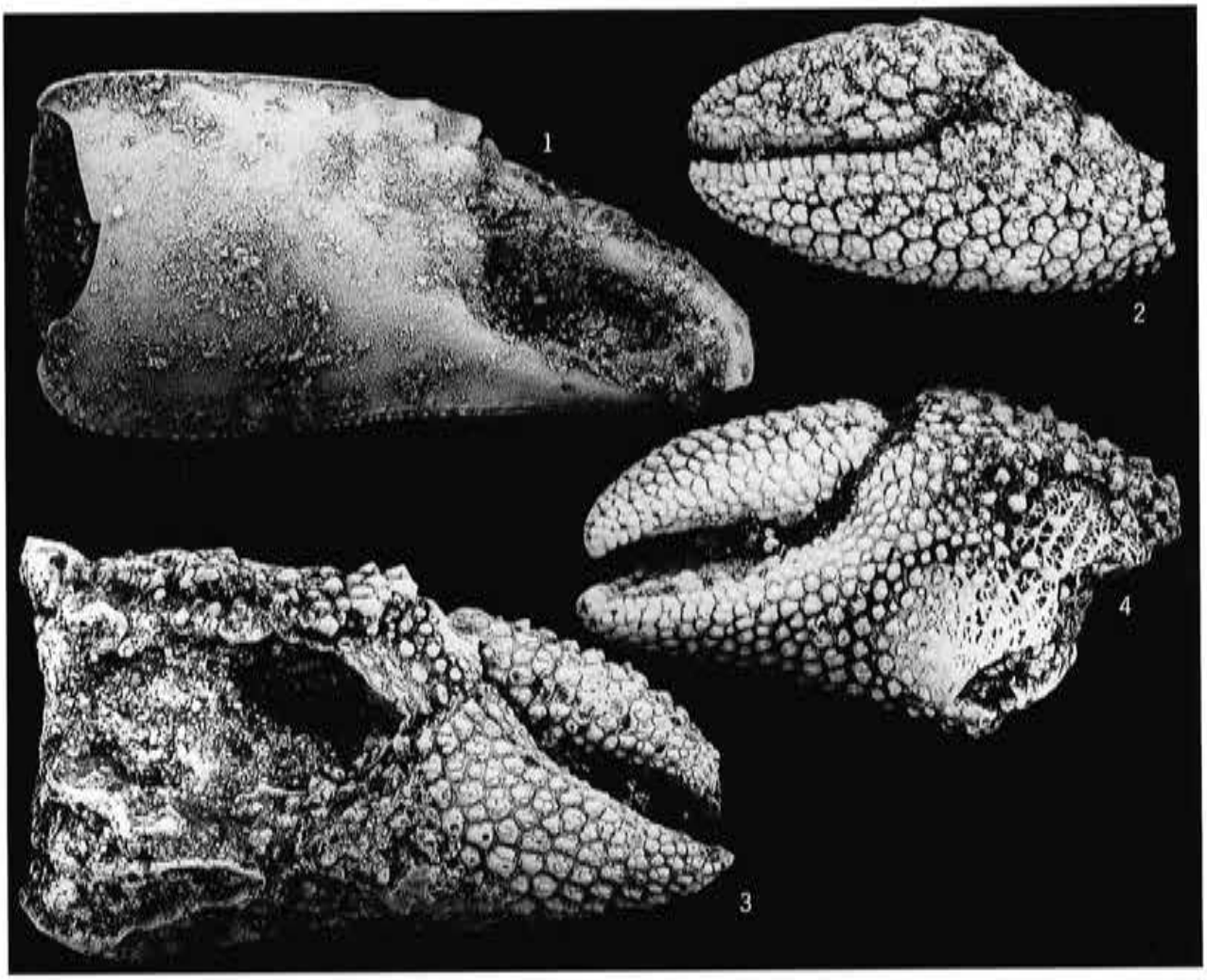

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Plate 15

Figs. 1, 3, 4. *Glypturus acanthochirus* Stimpson.

Fig. 1. BM IC 30, right propodus, oblique view of outer surface, × 8.

Fig. 3. BM IC 31, left propodus, oblique view of inner surface, × 9.

Fig. 4. BM IC 32, right dactylus, × 7.

Fig. 2. *Ceratoconcha* sp. cf. *C. barbadensis* (Withers). BM IC 70, apertural view, × 22.

Fig. 5. *Pilumnus* sp. cf. *P. sayi* Rathbun, BM IC 59, right chela, outer surface, × 9.

All scanning electron micrographs of specimens coated with 60% gold-palladium.


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Plate 16

Fig. 1. *Persephona p. punctata* Linné. BM IC 49, merus. × 9.

Figs. 2, 3. *Hexapanopeus* sp. cf. *H. caribbaeus* (Stimpson). BM IC 56, slightly oblique views of outer and inner surfaces respectively of right chela, both × 7.

Fig. 4. *Petrochirus bahamensis* (Herbst). BM IC 37, left fixed finger, × 9.

Fig. 5. *Eurypanopeus* sp. cf. *E. depressus* (Smith). BM IC 54, left propodus and articulated carpus, × 7.

Fig. 6. *Eurytium* sp. cf. *E. limosum* (Say). BM IC 55, right propodus, outer surface, × 8.

All scanning electron micrographs of specimens coated with 60 % gold-palladium.

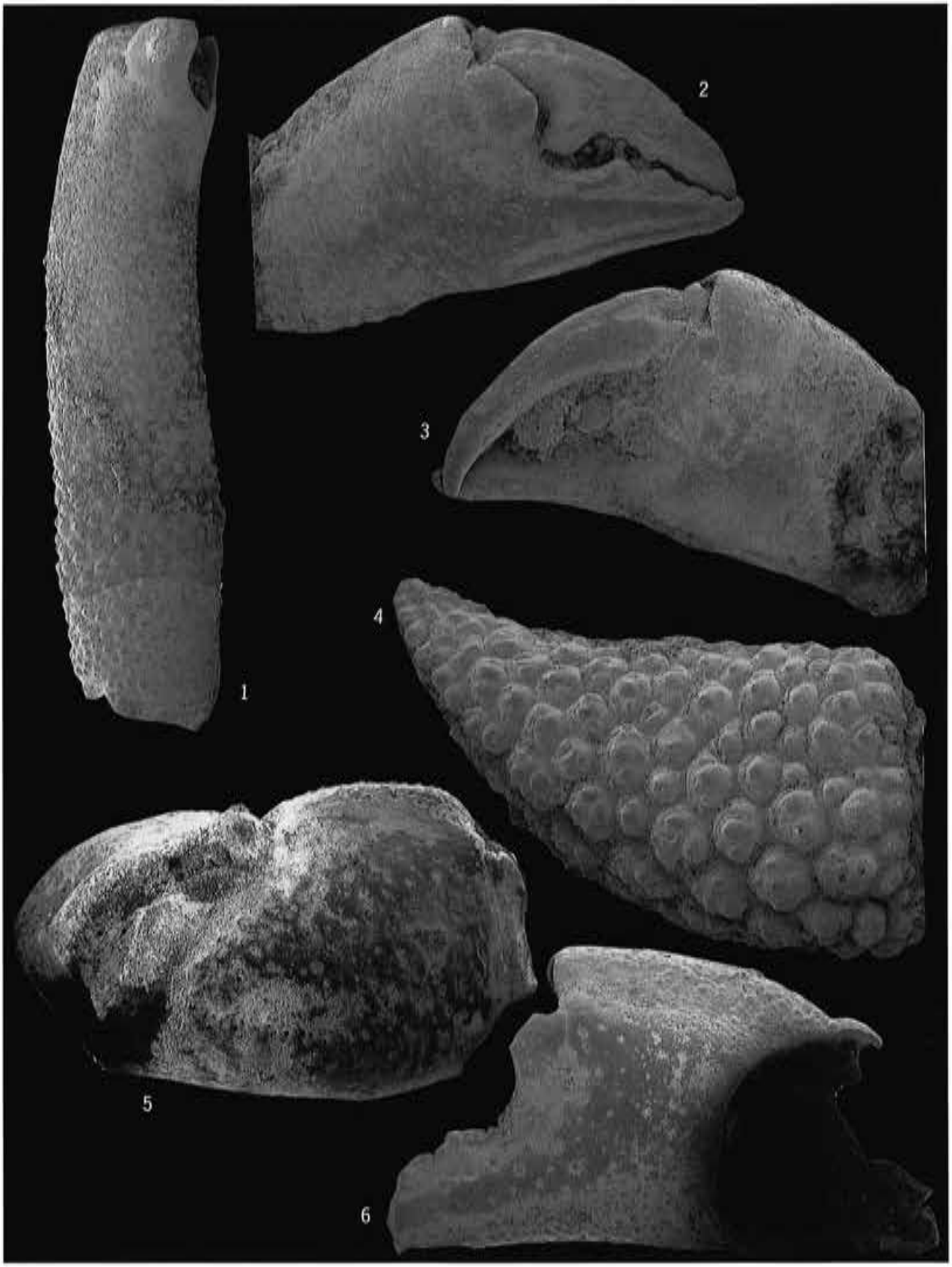

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Plate 17

Fig. 1. *Mithrax* (*Mithrax*) *verrucosus* H. Milne Edwards. BM IC 51, right chela, × 2.5.

Figs. 2, 4, 7. *Calappa springeri* Rathbun.

Fig. 2. BM IC 43, left chela, outer surface, × 3.

Fig. 4. BM IC 44, articulated propodus and carpus of left chela, × 2.8.

Fig. 7. BM IC 45, fragment of carapace, with posterior margin orientated to the right, × 2.5.

Fig. 3. *Ceratoconcha* sp. cf. *C. barbadensis* (Withers). BM IC 71, apertural view (left) and a broken specimen, × 3.6.

Fig. 5. *Mithrax* (*Mithrax*) *hispidus* (Herbst). BM IC 50, × 3. 6.

Fig. 6. *Carpilius corallinus* Herbst. BM IC 60, right chela, outer surface, × 4.

All specimens coated with ammonium chloride sublimate.

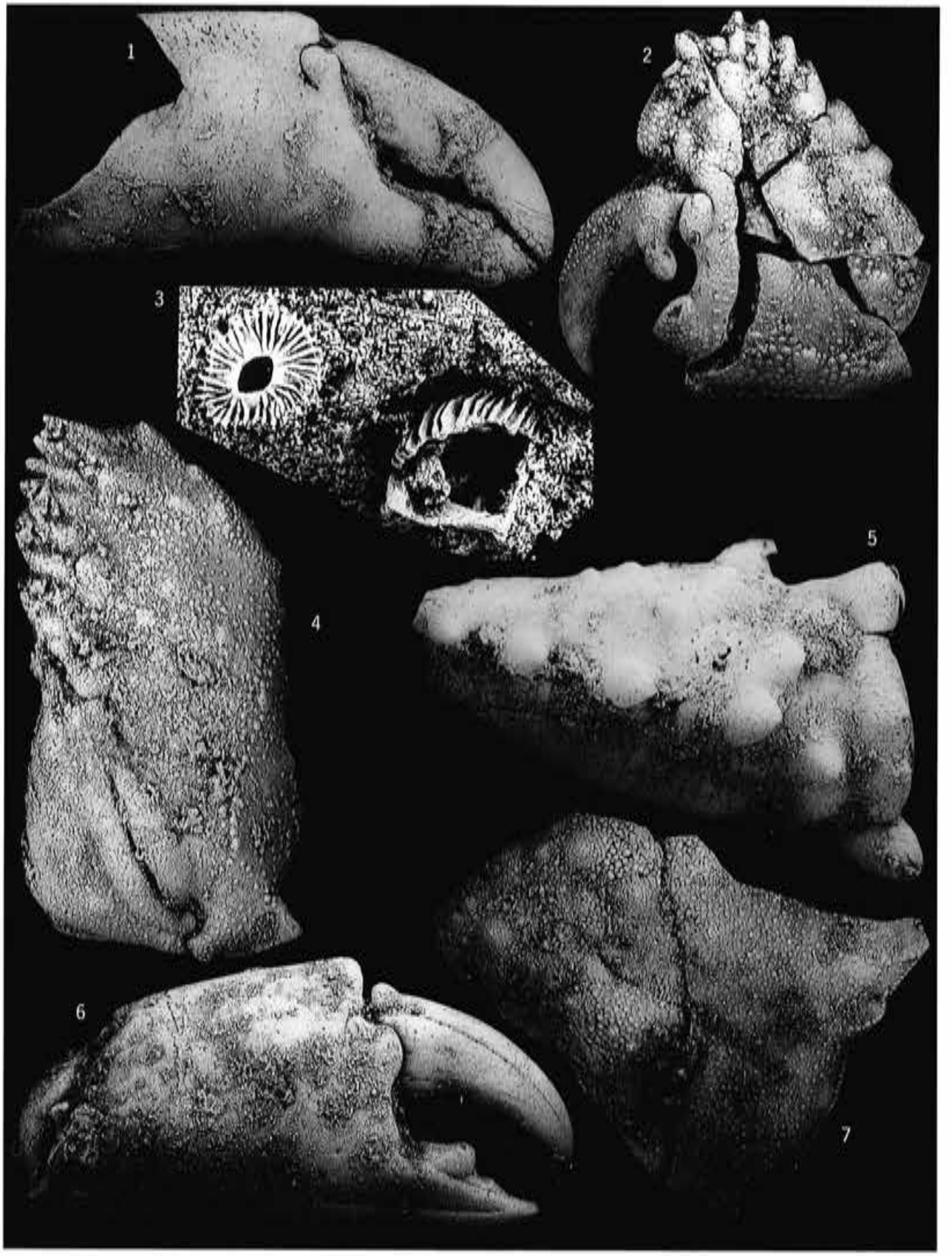

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Plate 18

Fig. 1. *Calappa springeri* Rathbun. BM IC 46, left dactylus, × 9.
Fig. 2. *Eurytium* sp. cf. *E. limosum* (Say). BM IC 55, left propodus, inner surface, × 8.
Fig. 3. *Panopeus* sp. cf. *P. herbstii* H. Milne Edwards. BM IC 57, right propodus, outer surface, × 8.
Fig. 4. *Panopeus* sp. cf. *P. rugosus* A. Milne Edwards. BM IC 58, right propodus, outer surface, × 8.
Fig. 5. *Callinectes* sp. cf. *C. toxodes* Ordway. BM IC 53, slightly oblique view of left fixed finger, × 6.

All scanning electron micrographs of specimens coated with 60% gold-palladium.


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Plate 19

Figs. 1–5. *Balanus eburneus* Gould.

Figs. 1–4. BM IC 63, 1, 2. Lateral views, carina towards centre of page, 3, 4, carinal and rostral views, all × 7.

Fig. 5. BM IC 64, inner surface of compartment, × 9.

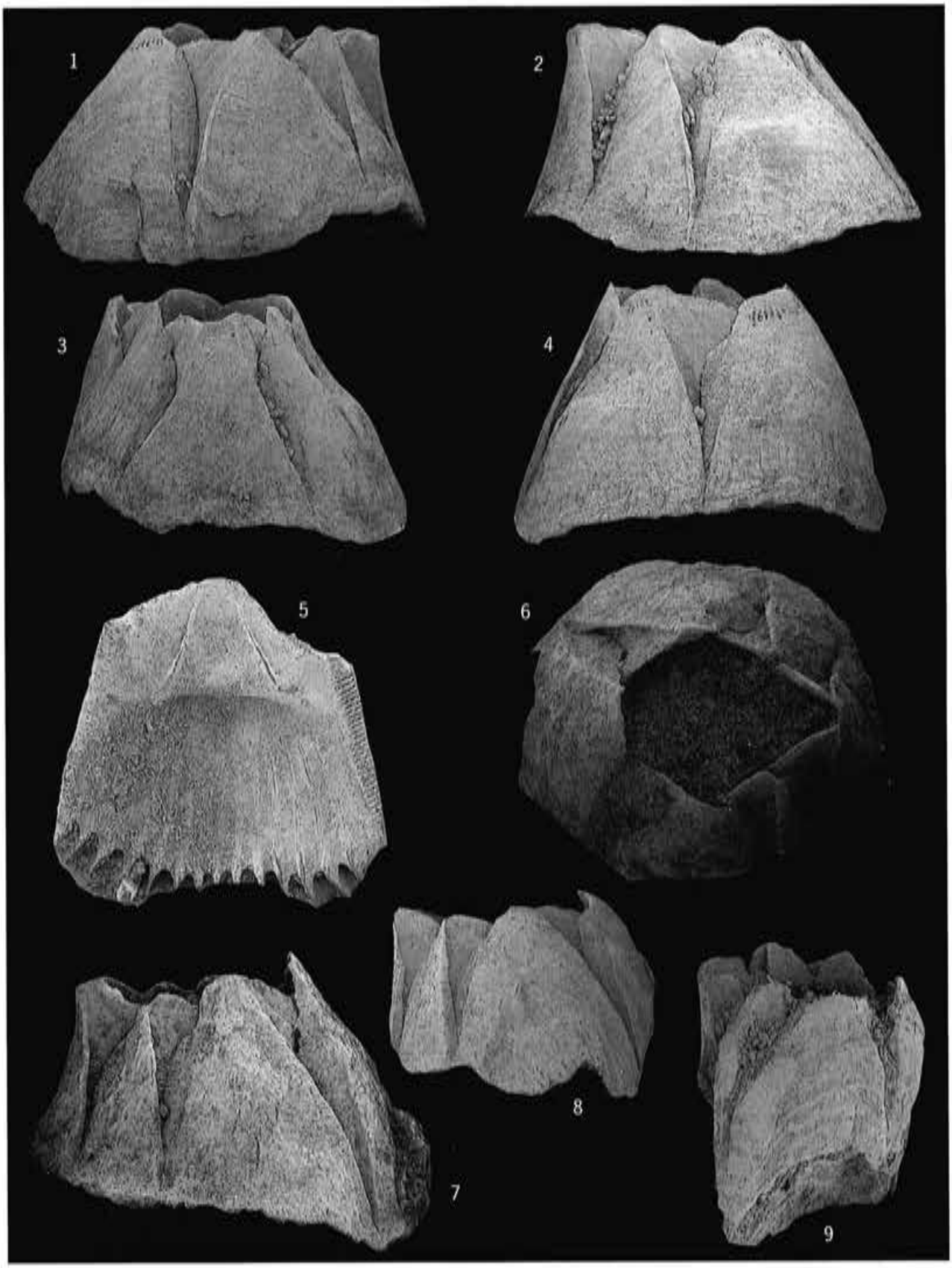
Figs. 6–9. *Balanus improvisus* Darwin.

Figs. 6, 7. BM IC 66, apertural and lateral views, both × 10.

Fig. 8. BM IC 67, lateral view, × 10.

Fig. 9. BM IC 68, rostral view, × 10.

All scanning micrographs of specimens coated with 60% gold-palladium.


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