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Calappa pokipoki, a new species of box crab (Crustacea: Decapoda: Brachyura: Calappidae) from Hawaii

Peter K. L. Ng

Department of Biological Sciences, National University of Singapore, Kent Ridge, Singapore 119260, Republic of Singapore

Abstract.—A new species of box crab, *Calappa pokipoki*, is described from Hawaii. This new species resembles *C. gallus* (Herbst), but can easily be distinguished by several carapace features as well as color pattern. *Calappa pokipoki* also resembles *C. bicornis* (Miers), *C. matsuzawa* Galil, *C. sebastieni* Galil and *C. yamasitae* Sakai, but can be separated from these by a suite of distinctive carapace characters.

At present, seven species of calappids are known from Hawaii, *Calappa calappa* (Linnaeus 1758), *C. gallus* (Herbst 1803), *C. hepatica* (Linnaeus 1758), *C. biconis* (Miers 1884), *Cycloes marierubri* Galil & Clark, 1996, *Mursia hawaiiensis* Rathbun, 1893, and *M. spinimanus* Rathbun, 1906 (Rathbun 1906, Tinker 1965, Galil 1993, 1997; Galil & Clark 1996). Studies of the brachyuran collections in the Barrice P. Bishop Museum showed that Tinker's (1965) record of *C. bicornis* is erroneous, and the specimens which have been referred to this species actually represent a new species, described herein. This new species, while most similar to *C. gallus*, differs from this species in several distinct characters.

Specimens examined during this study are deposited in the Bernice P. Bishop Museum, Honolulu, Hawaii (BPBM); Zoologisk Museum, University of Copenhagen (ZMUC); and the Zoological Reference Collection of the Raffles Museum, National University of Singapore (ZRC). Numerous specimens of *C. gallus*, *C. bicornis* and *C. galloides* from BPBM, ZMUC and ZRC have also been examined for the present comparisons. Measurements provided are listed as the carapace width by length. The abbreviations G1 and G2 are used for the male first and second pleopods respectively.

Taxonomic Account

Family Calappidae

Calappa pokipoki, new species
(Figs. 1, 2, 3a, 4a, 5a–g, 6)

Calappa bicornis.—Tinker, 1965: 74 (not *Calappa bicornis* Miers, 1884)

Material examined.—Holotype female (87.8 by 64.5 mm) (BPBM 12073), Kona, Hawaii, coll. research vessel *Townsend Cromwell*, TC 81-01 station 34, 16 Feb 1981.

Paratypes: 1 female (78.8 by 58.8 mm) (ZRC 2000.516), same data as holotype; 1 male (43.5 by 33.5 mm) (BPBM S11259), TC 40 station 2, Penguin Banks, Molokai, 21°09.9′–21°09.8′N, 157°24.1′–157°29.8′W, Hawaii, 182 m, coll. R/V *Townsend Cromwell*, trawl, 6–7 Nov 1968; 1 juvenile (25.3 by 20.0 mm) (BPBM S11255), TC 36 station 33, Penguin Banks, Molokai, 21°02.9′–21°01.6′N, 157°25.9′–157°26.0′W, Hawaii, coll. R/V *Townsend Cromwell*, trawl, 5 Jun 1968; 1 female (46.4 by 36.2 mm) (BPBM S11271), Barber's Point, Oahu, 30 m, Hawaii, coll. 1963; 1 juvenile (13.3 by 11.0 mm) (BPBM S11146), Northwest End, Penguin Banks, Molokai, 21°02.8′N, 157°40.5′W, 182 m, Hawaii, coll. HURL 82–111, *Makalii* submersible, 20 Sep 1982; 1 male (42.4 by

31.6 mm) (ZRC 2000.1798), Molokai, Hawaii, coll. 14 Jun 1959; 1 female (right part of carapace damaged) (BPBM S6688), Hawaii, no other data; 1 male (49.6 by 36.4 mm) (BPBM S5422), 400 yards off Mokulua, Oahu, 36 m, Hawaii, coll. Brock, 14 Apr 1949.

Diagnosis.—Carapace dorsal surface covered with relatively large, low, rounded, submammillate granules on anterior half; posterior half with numerous oblique to transverse raised strise; hepatic region strongly depressed; from posterior view, gastric region is highest point, with branchial regions gradually sloping towards margins; frontal margin quadridentate; anterolateral margin with 11 or 12 well marked teeth; clypeiform extension well developed, margin with numerous long, stiff yellow setae which almost completely obscure margin; basal antennal segment with distal margin gently concave; outer surface of manus with well spaced granules; G1 with distal ¼ slightly sinuous; G2 subequal in length to G1, distal segment relatively short, tip of flange between distal and basal segments faintly tricuspid.

Description.—Carapace subtriangular in shape; dorsal surface distinctly convex; anterior half covered with relatively large, low, rounded, submammillate granules which are closely appressed basally; posterior half with numerous oblique to transverse raised striae which are longer towards lateral margins; striae near margins more prominent, beaded, appearing almost serrated. Hepatic region strongly depressed. Epigastric region with 2 distinct transverse tubercles. Gastric region strongly raised, median part especially high. Gastric and cardiac regions separated from branchial regions by deep longitudinal groove. Suborbital region with 2 large transverse granules, rest of surface finely granulated. Frontal margin thickened, quadridentate, median part prominently produced anteriorly, median teeth separated by distinct U-shaped sulcus. Supraorbital margin with small but distinct inner tooth; inner half of margin prominently swollen; outer part with 2 deep narrow fissures. Eyes folding obliquely. External orbital tooth very low, rounded. Anterolateral margin arcuate, clearly demarcated from posterolateral margin by distinct cleft, lined with scattered long, stiff yellow setae which partially obscure margin; first tooth (subhepatic tooth) large, low, conical; subsequent 5 teeth small but clearly discernible, with bicuspid tips, lateral margins with minute denticles; last 6 teeth ca. twice as large as preceding teeth, with sharp tips, lateral margins distinctly denticulate. Posterolateral clypeiform extension well developed, lined with numerous long, stiff yellow setae which almost completely obscure margin; anterior part with 3 broadly triangular teeth (larger posteriorly), each tooth with denticulate margins and median ridge; posterior part with 3 low, broadly triangular teeth, first tooth longest, second tooth slightly shorter than first, third tooth (nearest posterior carapace margin) ca. 0.5 times length of second tooth; each tooth with strongly denticulated margins and median ridge, margin appearing prominently serrated; margins lined with long, stiff yellow setae which almost obscure margin. Posterior carapace margin convex, margin distinctly denticulated, appears serrated, lateral parts lined with long, stiff yellow setae. Basal antennal segment subtriangular, surface finely granulated, distal margin gently concave. Longitudinal endostomial septum with shallow concavity on anterior border, edge just visible when first maxillipeds closed.

Minor left chela (without cutting tooth) with prominent dorsal crest, with 6 lamelliform teeth, first bilobed, low, next 5 high, acutely triangular; outer surface of manus granulated, granules not arranged in distinct rows; upper half with several large granules; lower ⅓ surface with numerous subsquamose granules, becoming smaller towards tip of pollex; subsquamiform granules on proximal lower surface of manus becoming larger and fewer towards carpus; ventral outer margin lined with row of laterally directed granules, appears distinctly

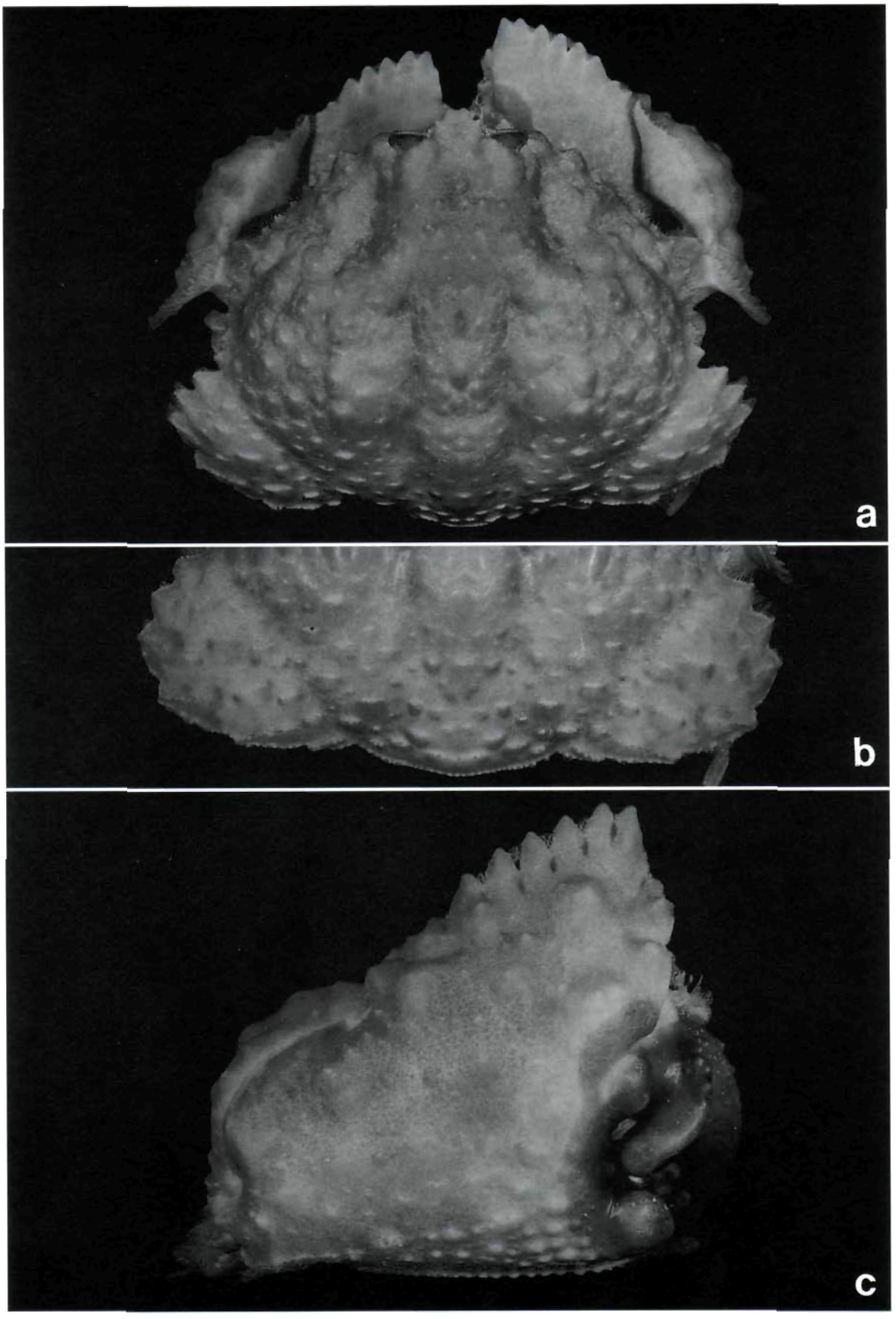

Fig. 1. *Calappa pokipoki*, new species, holotype female (87.8 by 64.5 mm) (BPBM S5422). a, dorsal view; b, posterior carapace margin (dorsal view); c, right chela (outer view).

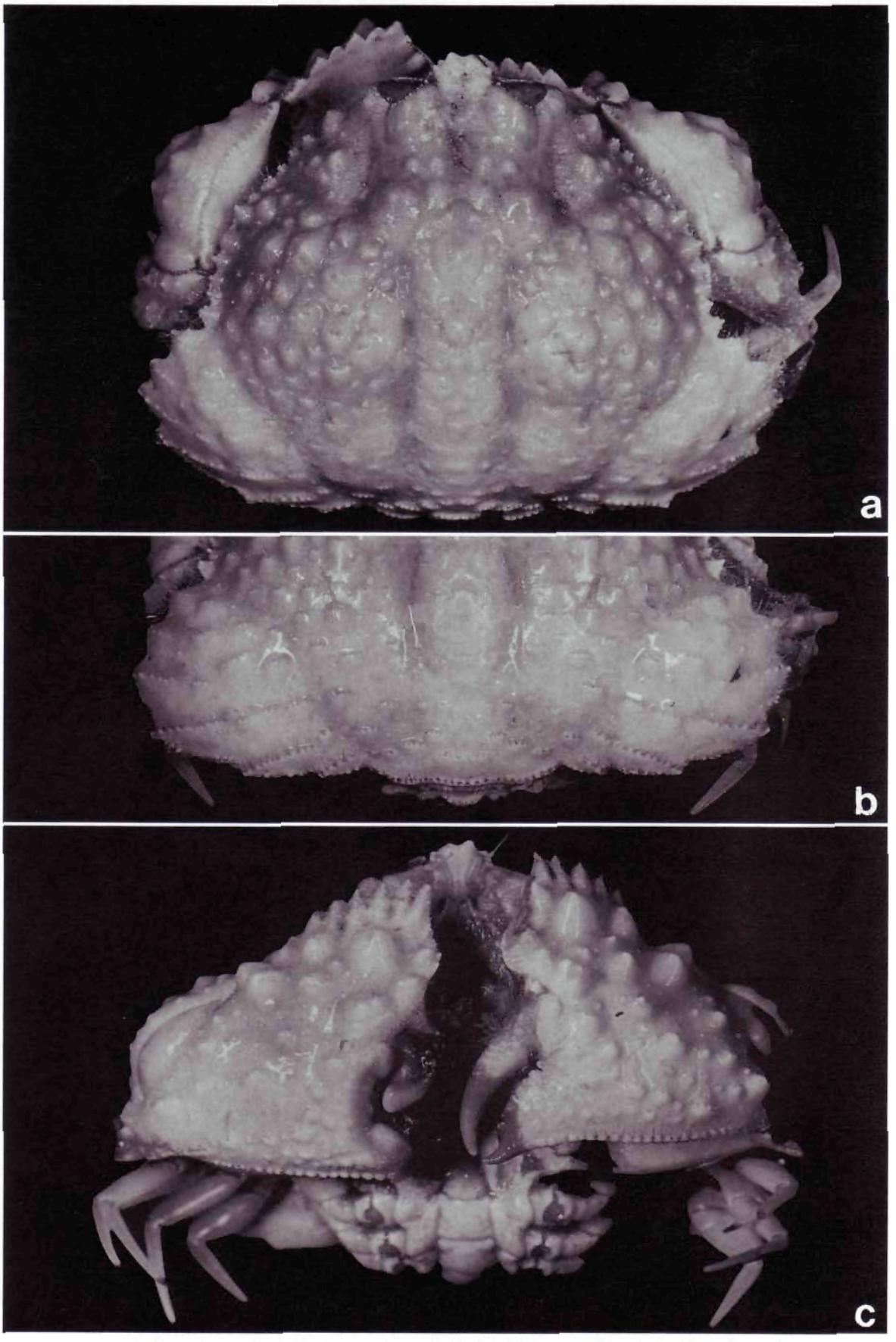

Fig. 2. *Calappa pokipoki*, new species, paratype male (42.4 by 31.6 mm) (ZRC 2000.1798). a, dorsal view; b, posterior carapace margin (dorsal view); c, chelipeds (outer view).

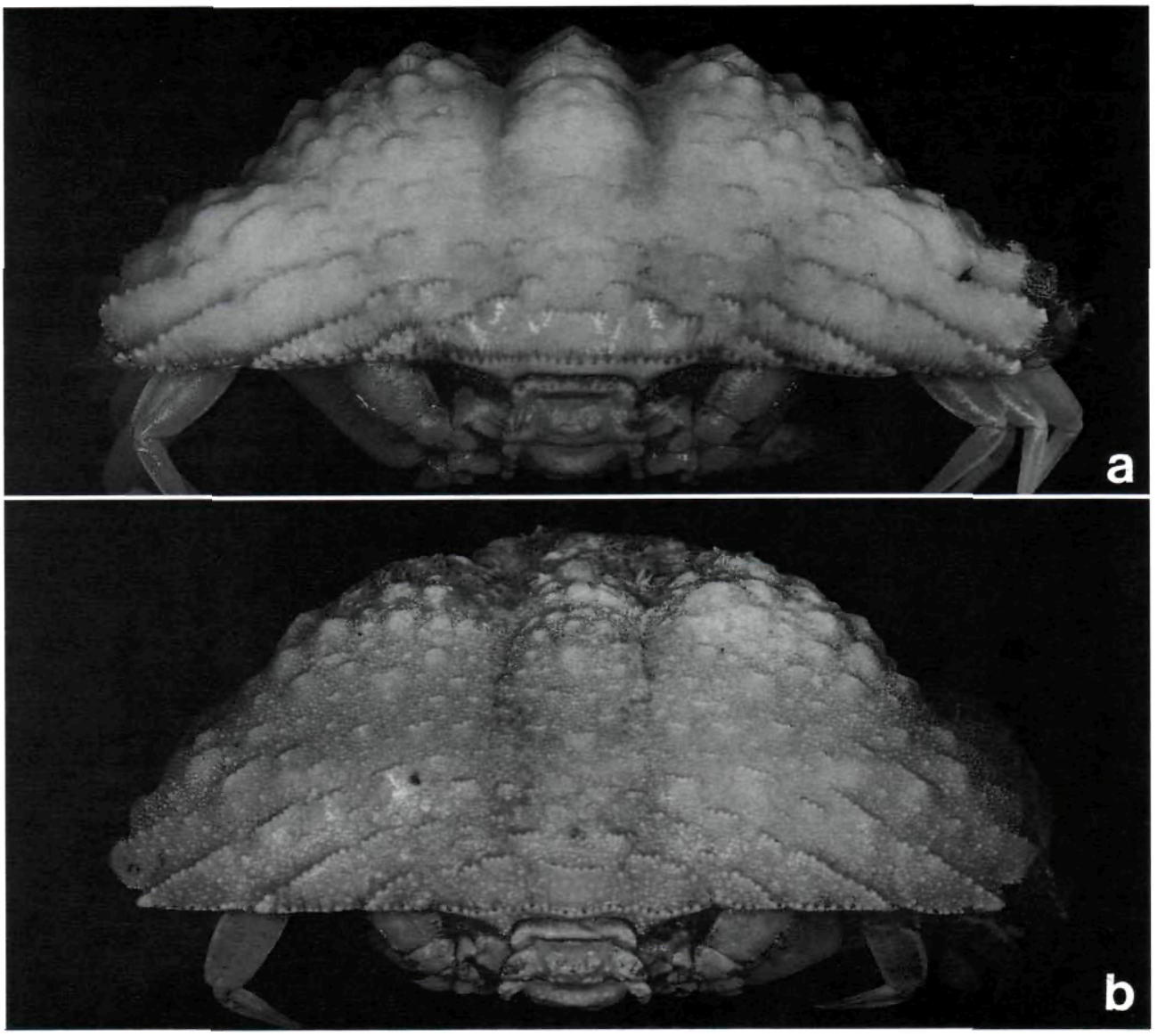

Fig. 3. Carapace showing degree of convexity (posterior view). a, *Calappa pokipoki*, new species, paratype male (42.4 by 31.6 mm) (ZRC 2000.1798); b, *C. gallus*, male (48.4 by 36.4 mm) (ZRC).

serrated, tooth adjacent to carpus low but distinct, subtruncate, sublamelliform; dactylus very slender, recurved, distal half pigmented, smooth; proximal part of dactylus granulated. Major right chela (with special cutting tooth) similar in shape and features to minor chela, but dorsal crest, with 7 lamelliform teeth, first bilobed, low, next 6 high, acutely triangular; entire dactylus pigmented, proximal surface granulated, with subtruncate tooth proximally.

Ambulatory legs relatively slender, unarmed, smooth; second pair longest. Dactylus very slender, styliform, gently curved. Last leg with subdistal part of ventral margin of fused basis-ischium with tuft of long stiff setae; subproximal part of ventral margin of merus with short row of long stiff setae.

Abdomen narrowly triangular. First segment with proximal margin lined with submedian low granules, appearing gently serrated, with long, stiff yellow setae, outermost parts smooth, glabrous. Second segment with distinct granules on outer and median parts, lined with long, stiff yellow setae, intermediate areas unarmed, glabrous. Third to fifth segments fused, but lateral clefts separating segments still discernible; third segment subrectangular, outer submarginal part with scalloped features, fourth segment trapezoidal, lateral margins

Fig. 4. Posterior carapace margin, first two male abdominal segments and base of last pair of ambulatory legs. a, *Calappa pokipoki*, new species, paratype male (42.4 by 31.6 mm) (ZRC 2000.1798); b, *C. gallus*, male (48.4 by 36.4 mm) (ZRC).

deeply concave; fifth segment almost squarish, with deeply concave lateral margins; sixth segment slightly elongate, lateral margin sinuous. Telson acutely triangular, lateral margin gently concave to almost straight.

G1 relatively stout, almost straight, distal ¼ slightly sinuous, more slender than median part; tip truncate; distal surfaces lined with numerous small posteriorly directed spinules. G2 subequal in length to G1, gently curved; distal segment relatively short, tip rounded; junction between basal and distal segments with short flange, tip of flange faintly tricuspid; inner margin of base of basal segment bilobed.

Variation.—The specimens do not vary substantially in morphology, with the non-sexual characters relatively constant. The setation on the carapace margin, ambulatory legs and abdomen is less dense in small specimens (less than 30 mm carapace width). The chela is also relatively higher in larger specimens, regardless of sex. One paratype female (78.8 by 58.8 mm, ZRC 2000.516) is very unusual in that the special cutting tooth is on the left chela rather than the right. In all known specimens of all other species of *Calappa* Weber, 1795, as well as all the other specimens of *C. pokipoki*, the special cutting tooth is on the right chela and is adapted to peel right-apertured gastropods (see Ng & Tan 1984, 1985).

Color (in preservative).—In adult specimens, anterior half of carapace orange; posterior ⅓ dirty white with scattered uneven brown spots; zone where 2 color zones meet uneven but well marked. Despite the age of the present specimens, most of them still show the pattern described above quite clearly.

Etymology.—The species name is derived from the Hawaiian name for *Calappa*, "Poki-poki." The name is used here as a noun in apposition.

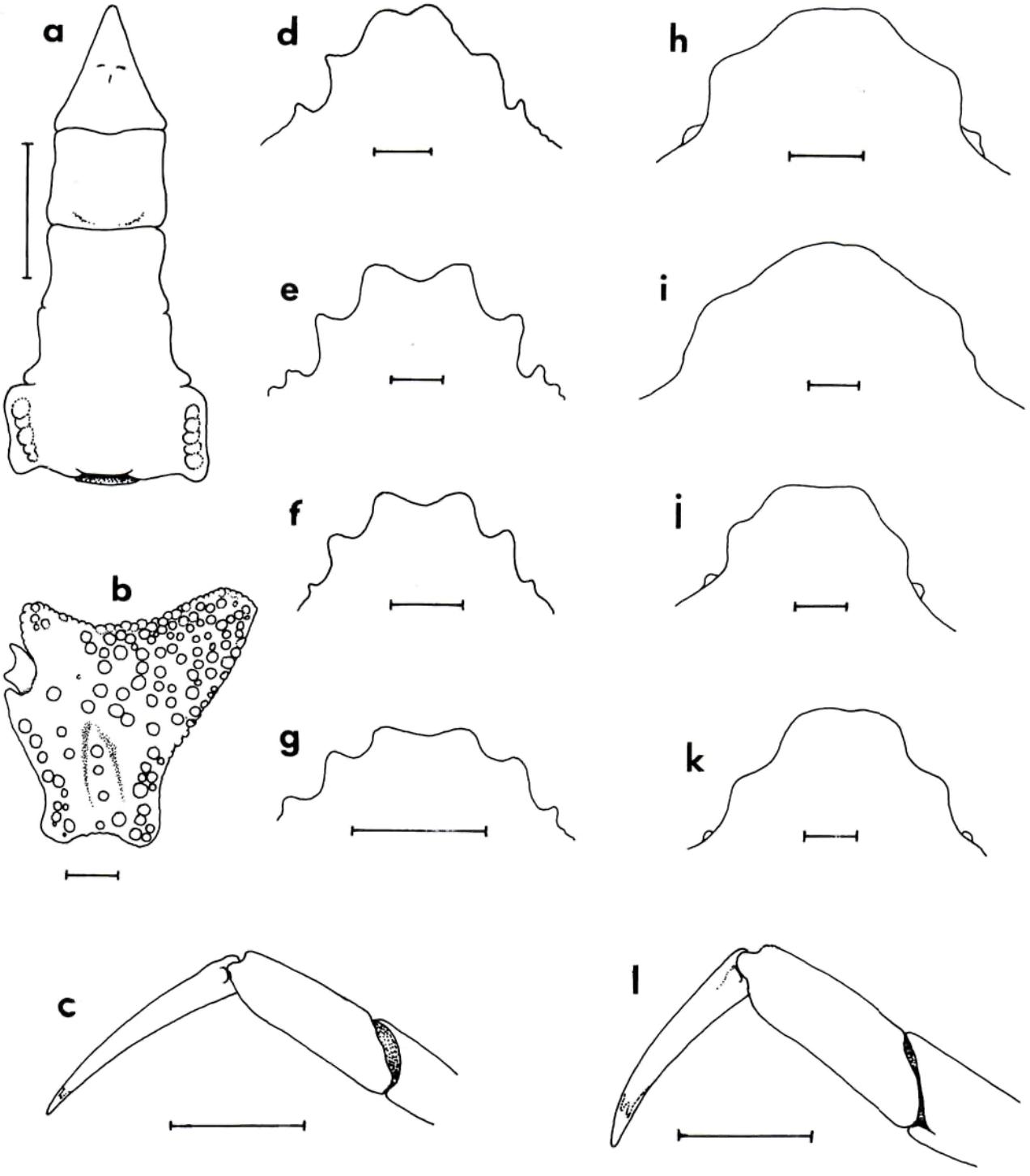

Fig. 5. a–g, *Calappa pokipoki*, new species: a, male abdomen; b, left basal antennal segment; c, l, left second ambulatory leg (dactylus and propodus); d–k, frontal margins; a, b, c, d, holotype female (87.8 by 64.5 mm) (BPBM S5422); e, male (43.5 by 33.5 mm) (BPBM S11259); f, juvenile (25.3 by 20.0 mm) (BPBM S11255); g, juvenile (13.3 by 11.0 mm) (BPBM S11146); h–l, *C. gallus*; h, female (47.2 by 36.2 mm) (BPBM 5078); i, female (46.2 by 35.8 mm) (BPBM 967); j, male (33.2 by 25.5 mm) (BPBM 3303); k, female (46.8 by 37.8 mm) (BPBM 1303). Scales: a, c, l = 5.0 mm; b, d–k = 1.0 mm.

Remarks.—Calappa pokipoki, new species, is most similar to *C. gallus* (Herbst 1803), a common species in Hawaii, but the two can easily be distinguished by the frontal margin and carapace physiognomy. The BPBM has a good series of specimens of *C. gallus* which allows for a very thorough competition of the two species to be made. The frontal margin of *C. pokipoki* (irrespective of sex or size) is more produced,

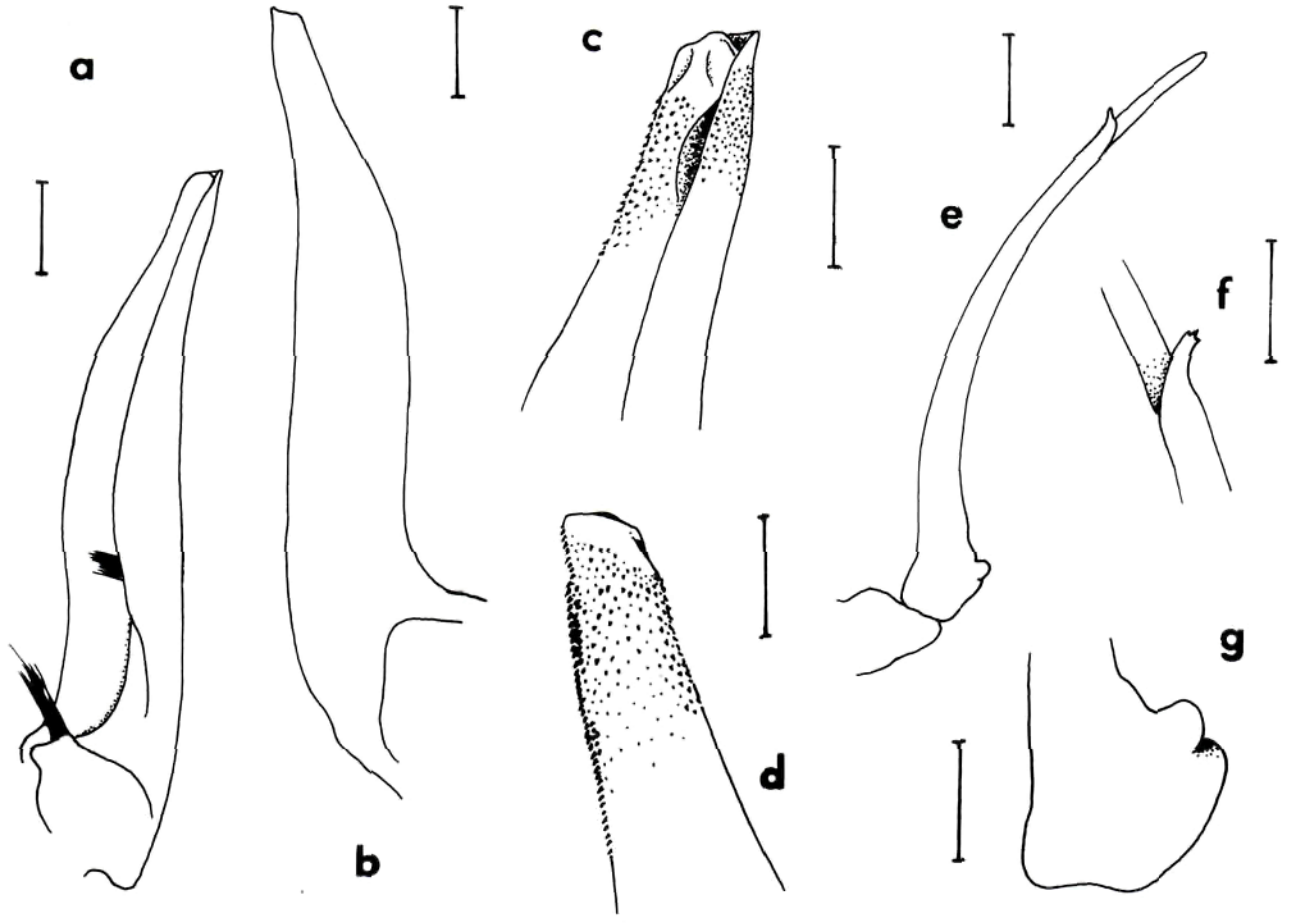

Fig. 6. *Calappa pokipoki*, new species, paratype male (49.6 by 36.4 mm) (BPBM S5422). a, left G1 (dorsal view); b, left G1 (ventral view) (setae not drawn); c, distal part of left G1 (dorsal view); d, distal part of left G1 (ventral view); e, left G2 (ventral view); f, flange at junction of basal and distal segments of G2; g, G2 basal segment. Scales: a, b, e = 1.0 mm; c, d, f, g = 0.5 mm.

with four well defined teeth, the two median ones projecting anteriorly from the lateral ones and are separated by a distinct cleft (Fig. 5d–g). In *C. gallus*, however, the frontal margin is subquadrate, and although the lateral parts may appear stepped, it never develops even a trace of a tooth (Fig. 5h–k). The carapace of *C. pokipoki* is distinctly less swollen compared to that of *C. gallus*. Observed frontally or from the posterior, the branchial regions of *C. pokipoki* in particular, are prominently lower and gradually slope towards the lateral margins from the gastric region which is the highest point of the carapace (Fig. 3a). For *C. gallus*, the gastric and branchial regions are equally high (Fig. 3b, see also Galil 1997, Sakai 1999).

In addition, several more subtle characters can also be used to distinguish the two species. Specimens of *C. pokipoki* larger than 40 mm carapace width can also easily be distinguished from *C. gallus* by the much denser and longer setae lining the posterolateral margins and chelipedal meral lobe which almost completely obscure the margins (Fig. 4a) from the dorsal view. In *C. gallus*, these setae are much less dense even in large specimens, and never completely obscure the margins (Fig. 4b). The ambulatory dactyli of *C. pokipoki* is also relatively more slender and somewhat longer (Fig. 5c) compared to those of *C. gallus* (Fig. 5l). The second male abdominal segment is also distinctly more granulose in *C. gallus* (Fig. 4b vs. 4a). In contrast, the posterolateral margin of *C. pokipoki* has more widely spaced granules (Figs. 3a, 4a vs. 3b, 4b). In *C. gallus*, the setose parts of the basis-ischium and merus of the last ambu-

latory leg have gentle but distinctly scalloped granules (Fig. 4b), but in *C. pokipoki* these parts are almost smooth (Fig. 4a).

There also appear to be color differences between *C. pokipoki* and *C. gallus*. *Calappa pokipoki* clearly has a "bicolored" carapace when adult, with the anterior half of the carapace darker colored and the posterior part white with scattered brown spots, with the two zones more or less clearly demarcated. This color pattern is similar to that reported for species like *C. undulata* Dai & Yang, 1991, and *C. bicornis* Miers, 1884 (see Miyake 1983, Chen 1993, Ng et al. 2000).

In the form of the frontal margin (and general color pattern), *C. pokipoki* certainly resembles *C. bicornis*, and it is not surprising that Tinker (1965) referred it to this species. Tinker's (1965) material is in the BPBM and his figure is probably based on one of the specimens listed above. *Calappa bicornis*, however, can easily be distinguished from *C. pokipoki* by the dorsal carapace surface of *C. bicornis* having larger and/or more mammillate tubercles, less expanded clypeiform process, relatively much deeper cleft on the frontal margin, deeply clefted anterior margin of the basal antennal segment which appears bidentate (vs. gently concave), serrated supra- and suborbital margins (vs. smooth), proportionately more slender ambulatory meri and much longer dactyli, with the legs appearing banded in life (vs. uniformly colored and patterned) and the distal segment relatively more podlike (vs. evenly cylindrical with a rounded tip) (present specimens, see also Galil 1997, Ng et al. 2000).

In the morphology and sculpture of the carapace, *C. pokipoki* also resembles *C. matsuzawa* Galil, 1997, described and known only from Japan thus far. The clypeiform process of *C. matsuzawa*, however, is relatively less expanded, the anterior part of the anterolateral margin has no well marked teeth (vs. with 6 distinct teeth in *C. pokipoki*), and the front is less well developed (Galil 1997:304, Fig. 17b). In the form of the frontal margin, relatively more expanded clypeiform process, granulation features of the suiter surface of the chela and structure of the G1, *C. pokipoki* closely resembles *C. sebastieni* Galil, 1997, known only from the Marquesas. *Calappa sebastieni* can easily be separated from *C. pokipoki* by its less broad carapace (length to width ratio 1.6 vs. 1.3) and much smoother dorsal carapace surface which does not have any prominent large granules on the anterior part of the carapace (Galil 1997: 312, fig. 17f). In the form of its dorsal carapace sculpture, *C. pokipoki* superficially resembles *C. yamasitae* Sakai, 1980, known only from Japan, but the latter species can be separated by its proportionately broader carapace (width to length ratio 1.6 vs. 1.3), bidentate (vs. quadridentate) frontal margin and the dorsal crest of larger chela having more teeth (9–10 vs. 6–7) (cf. Sakai 1980: 5, frontispiece fig. 2).

Calappa pokipoki also bears a close resemblance to the Atlantic species previously referred to "*Calappa gallus*" (see Monod 1956, Manning & Holthuis 1981). Manning & Chace (1990) referred the old records of "*Calappa gallus*" (nec Herbst 1803) from the Atlantic to *C. galloides* Stimpson, 1859. I have examined specimens from various parts of the Atlantic and there appears to be at least two species referrable to "*C. galloides*" from there; one with a prominently quadridentate frontal margin and less inflated carapace (*C. galloides* s. str.); and another with a more rounded frontal margin and strongly inflated carapace. In addition, there is one more supposed junior synonym of *C. galloides*, *C. squamosa* Desbonne *in* Desbonne & Schramm, 1867, described from Guadeloupe. Although the resolution of the taxonomy of taxonomy of these Attantic taxa is well outside the scope of the present paper, it is nevertheless useful to note that *C. pokipoki* is very unlikely to be conspecific with any of the above taxa. *Calappa pokipoki* can be separated from *C. galloides* (and *C. squamosa*) by its relatively more

expanded clypeiform extension, more rounded posterior carapace margin and much higher dorsal crest of the chela.

Calappa pokipoki is known only from the Hawaiian islands and its vicinity thus far. All the type specimens have been collected from sublittoral waters. *Calappa gallus* on the other hand, has a very wide Indo-West Pacific distribution and is common from intertidal to deeper waters.

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Literature Cited

Chen, H.-L. 1933. The Calappidae (Crustacea: Brachyura) of Chinese waters. Pp. 675–704 *in* B. Morton, ed., Marine biology of the South China Sea, Proceedings of the First International Conference on Marine Biology, Hong Kong, South China Sea, Hong Kong University Press.

Dai, A.-Y., & S.-L. Yang. 1991. Crabs of China Seas. Pp. 21+682, figs. 1–295, pls. 1–74. China Ocean Press, Beijing & Springer-Verlag, Berlin.

Desbonne I., & A. Schramm. 1867. Brachyures. *In* Crustacés de la Guadeloupe, d'après un manuscrit du Doctaur Isis Desbonne comparé avec les echantillons de Crustacés de sa collection et les dernières publications de MM. Henri de Saussure et William Stimpson, 1re partie, Basse-Terre. 60 pp, 8 pls.

Fabricius, J. C. 1793. Entomologia systematica emendata et aucta secundum classes, ordines, genera, species adjectis synonimis, locis, observationibus descriptionibus. Hafniae 2:i–viii, 1–519.

Galil, B. 1993. Crustacea Decapoda: A revision of the genus *Mursia* Desmarest, 1823 (Calappidae). *In* A. Crosnier, ed., Résultats des Campagnes MUSORSTOM, vol. 10.—Mémoires du Muséum national dHistoire Naturelle, Paris 156:347–379.

———. 1997. Crustacea Decapoda: A revision of the Indo-Pacific species of genus *Calappa* Weber, 1795 (Calappidae) *In* A. Crosnier, ed., Résultats des Campagnes MUSORSTOM, vol. 18.—Mémoires du Muséum national d'Histoire Naturelle, Paris 176:271–335.

———, & P. F. Clark. 1996. A revision of *Cryptosoma* Brullé, 1837 and *Cycloes* de Haan, 1837 (Crustacea brachyura: Calappidae).—Zoological Journal of the Linnaean Society 117:176–204.

Herbst, J. F. W. 1782–1804. Versuch einer Naturgeschichte der Krabben und Krebse, nebst einer systematischen Beschreibung ihrer verschiedenen Arten. vol. 1–3, 515 pp., 62 pls.

Linnaeus, C. 1758. Systema Naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis specierum, synonymis, locis. 10th edition, 1:i–iii, 1–824 pp.

Manning, R. B., & L. B. Holthuis. 1981. West African brachyuran crabs (Crustacea: Decapoda).—Smithsonian Contributions to Zoology 306:1–379.

———, & F. A. Chace, Jr. 1990. Decapod and stomatopod Crustacea from Ascension Island, South Atlantic Ocean.—Smithsonian Contributions to Zoology 503:1–91.

Miers, E. J. 1884. Crustacea. Pp. 1178–1322 *in* Report on the zoological collections made in the Indo-Pacific Ocean during the voyage of H.M.S. 'Alert' 1881–2. British Museum, London.

Miyake, S. 1983. Brachyura (Crabs). Japanese crustacean decapods and stomatopods in Color, 2:277 pp., pls. 1–64, unnumbered fig. 1st edition. Hoikusha, Osaka. [In Japanese]

Monod, T. 1956. Hippidea et Brachyura ouest-africains.—Mémoires Institut français d'Africa Noire 45:1674.

Ng, P. K. L., J. C. Y. Lai, & C. Aungtonya. 2000. The box and moon crabs of Thailand, with description of a new species of *Culappa* (Crustacea: Brachyura: Calappidae, Matutidae).—Research Bulletin of the Phuket Marine Biological Center, Thailand, (in press).

———, & L. W. H. Tan. 1984. The 'shell peeling' structure of the box crab *Calappa philargius* (L.) and other crabs in relation to mollusc shell architecture.—Journal of the Singapore National Academy of Science 13:195–199.

———, & ———. 1985. 'Right Handedness' in heterochelous calappoid and xanthoid crabs—suggestion for a functional advantage.—Crustaceana 49:98–100.

Rathbun, M. J. 1893. Descriptions of new genera and species of crabs from the West Coast of North America and Sandwich Islands. *In* Scientific Results of Exploration by the U.S. Fish Commission 'Albatross.' No. XXIX.—Proceedings of the U.S. National Museum 16(933):223–260.

———. 1906. The Brachyura and Macrura of the Hawaiian Islands.—Bulletin of the United States Fish Commission 23:827–930, pls. 1–24.

Sakai, K. 1999. J. F. W. Herbst-Collection of decapod Crustacea of the Berlin Zoological Museum, with remarks on certain species.—Naturalists,

Tokushima Biological Laboratory 6:1–45, pls. 1–21.

Sakai, T. 1980. New species of crabs of the families Lithodidae and Calappidae.—Researches on Crustacea, Tokyo 10:1–11, frontispiece, pl. 1.

Stimpson, W. 1959. Notes on North American Crustacea, No. 1.—Annals of the Lyceum of Natural History of New York 7:49–93, pl. 1.

Tinker, S. W. 1965. Pacific Crustacea. An illustrated handbook on the reef-dwelling Crustacea of Hawaii and the South Seas. C. E. Tuttle, Tokyo 134 pp., 52 pls.

Weber, F. 1795. Nomenciator entomologicus secundum Entomologiam systematicam ill. Fabrict adjects speciebus recens detectis et varietatibus, i–viii, 1–171.