

The terrestrial crabs *Sesarma* (*Sesarmops*) *impressum* and *Geograpsus crinipes* (Brachyura, Grapsidae, Sesarminae) recorded from the Fiji Is.

C.L. McLay* and P.A. Ryan**

Two terrestrial brachyuran grapsid crabs are recorded from the Taveuni Is. in the Fiji group: *Sesarma* (*Sesarmops*) *impressum*, and *Geograpsus crinipes*. These new records, plus previous records of grapsid crabs (*S. (Parasesarma) lenzii*, *S. (P.) leptosoma*, *S. (Labuanium) rotundatum*, *S. (Neosarmatium) smithii*, *S. (Labuanium) trapezoideum*, *S. (Perisesarma) bidens*, *Geograpsus grayi*, *Varuna litterata*) and the gecarcinid crabs (*Cardisoma longipes*, *C. carnifex*, *C. hirtipes* and *Gecarcoidea lalandii*), bring the total known Fiji fauna to fourteen species. Further collecting is likely to reveal many more species.

Keywords: Land crabs, Grapsidae, biogeography, terrestrial adaptations, distribution, rainforest fauna.

INTRODUCTION

Few published papers deal specifically with the brachyuran crabs of the Fiji Is. Crabs recorded from Fiji can be found only in regional reviews (e.g. Forest and Guinot, 1962) or in reviews of particular families (e.g. Türkay, 1974) although a recent book on the natural history of Fiji (Ryan, 1988) lists a few species and includes colour photographs. This paper reports the presence of *Sesarma* (*Sesarmops*) *impressum* H. Milne Edwards, 1837 and *Geograpsus crinipes* (Dana, 1851), both members of the Family Grapsidae, on Taveuni, a small island south-east of Vanua Levu.

The status and structure within the genus *Sesarma* Say, 1817 sensu largo is a shambles. There have been several attempts to introduce some order into the chaos and sort out the relationships between the present 130 'species'. De Man (1887, 1895) recognized four sub-genera, whose names were subsequently changed by Rathbun (1897, 1909) and incorporated into a very detailed review by Tesch (1917), who also provided a key. In his review of the Grapsidae of Madagascar, Crosnier (1965) also followed this system. More recently Serène and Soh (1970) elevated the sub-genera to generic status. He erected ten new genera, and argued that *Sesarma* Say, 1817 sensu stricto is not represented in the Indo-Pacific region, but is restricted to the Atlantic. Manning and Holthuis (1981) corrected several of the sub-generic names. Little attempt has been made to sort out which species are synonymous, but there are probably around 100 Indo-Pacific species of *Sesarma* sensu largo. The generic name *Sesarma* is used in this paper in the sense of De Man and Tesch, but the generic divisions of Serène and Soh are used as sub-genera (following Yaldwyn and Wodzicki, 1979). Since *S. (S.) impressum* is a poorly known species, a detailed description is provided. By contrast the genus *Geograpsus* Stimpson, 1858 does not suffer the same confusion, and has recently been well reviewed by Banerjee (1960). There are only four species in that genus, three from the Indo-Pacific (mentioned herein) and *G. lividus* (H. Milne Edwards, 1853) from the Atlantic. Consequently only the important features are mentioned. Since both

* Department of Zoology, University of Canterbury, Christchurch

** Department of Biology, University of the South Pacific, Suva, Fiji. Present address: Westland Catchment Board, P.O. Box 66, Greymouth.

crabs are terrestrial species with different solutions to the problem of conserving moisture, we include a comparison of their morphological adaptations.

DESCRIPTIONS

Sesarma (Sesarmops) impressum H. Milne Edwards, 1837, Fig. 1 A-G

Synonymy

Sesarma impressa H. Milne Edwards, 1837, p74; *Sesarma atrorubens* Hess, 1865, pp149-150, pl.6, fig.12; *Sesarma similis* Hess, 1865, p150; *Sesarma frontale* A. Milne Edwards, 1869, p27; *Sesarma atrorubens* de Man, 1890, p95; *Sesarma atrorubens* Ortmann, 1894; *Sesarma nodulifera* Lenz, 1910, p562; ?*Sesarma impressa* Lenz, 1910, p561; *Sesarma (Sesarma) impressa* Tesch, 1917, (key); *Sesarma (Sesarma) impressa* Sakai, 1939, pp685-686, pl.110, fig.1; *Sesarma (Sesarma) impressum* Crosnier, 1965, p63, figs 82,92,104; *Sesarmops impressum* Serène and Soh, 1970, p406, pl.7A,B; *Sesarmops frontalis* Serène and Soh, 1970, p406; *Sesarmops similis* Serène and Soh, 1970, p406; *Sesarmops atrorubens* Serène and Soh, 1970, p406. (A more detailed list of references can be found in Tesch, 1917, under *S. (S.) atrorubens*, *S. (S.) impressa* and *S. (S.) nodulifera*.)

Material examined

One female (CW 40.5mm) collected near Wainisari Creek, 1.5km from sea, altitude 100m, Taveuni Is, Fiji, 19/7/88, P.A. Ryan. Second walking legs missing and left third leg has a limb bud.

Description

Carapace mostly smooth, sparsely covered in short hairs, broader than long (ratio 1.07), greatest width near of base of third walking leg, outline oblong with margins diverging posteriorly (Fig.1A). Frontal area, between the eyes, deeply excavated with upper and lower margins projecting forward. Lower margin developed as a lobed shelf overhanging the antennules and antennae, folded beneath and extending around the base of the eye to the dorsal margin as the supraorbital margin. Upper margin divided into four lobes separated by deep grooves, especially the central lobes. These are more than twice as wide as the lateral lobes, which meet the supraorbital margin. Anterior borders of lobes faintly tuberculate and there is a small tubercle beneath each of the central lobes in the excavated area. Behind the lateral lobe is a raised ridge separated by a groove which extends posterolaterally behind the eye. Supraorbital margin smooth, curved, ending in a strong blunt external spine (or first anterolateral tooth). This is followed by a second prominent anterolateral tooth, directed almost vertically, and by a faint third tooth a similar distance behind. Carapace margin diverges slightly and combines with the fringe of short setae bordering the pterygostomial region below. Posterolateral margins eroded and posterior margin straight. Mesogastric region of the carapace well marked by a deep oval-shaped groove which is extended forward between the central superior frontal lobes. At the anterolateral borders of the mesogastric groove are large, shallow opaque pits. The highest points on the carapace are on the shoulders (lateral mesogastric-hepatic regions), and the lowest points are at the posterolateral corners of the branchial region where the surface is faintly striated. Pterygostomial regions densely reticulated by a pattern of tiny tubercles which create a series of narrow diagonal channels leading along the leading along the sides of the carapace towards the oral area (Fig.1G). Each tubercle has a flattened, erect seta which bears a fine, curved horizontal tip directed at approx. 45° to the direction of the adjacent channel. Outer maxillipeds deeply grooved. This is part of the mechanism for recycling water over the gills. Chelipeds (in the female) shorter than walking legs, merus trigonal, borders with small, blunt tubercles, inner face curved and bearing on its border a distinct brush of long anteriorly directed setae which are probably used to clear the pterygostomial setae of debris (Fig.1D). Cheliped carpus with finely tuberculate upper surface and margins, propodus upper surface also finely tuberculate, outer

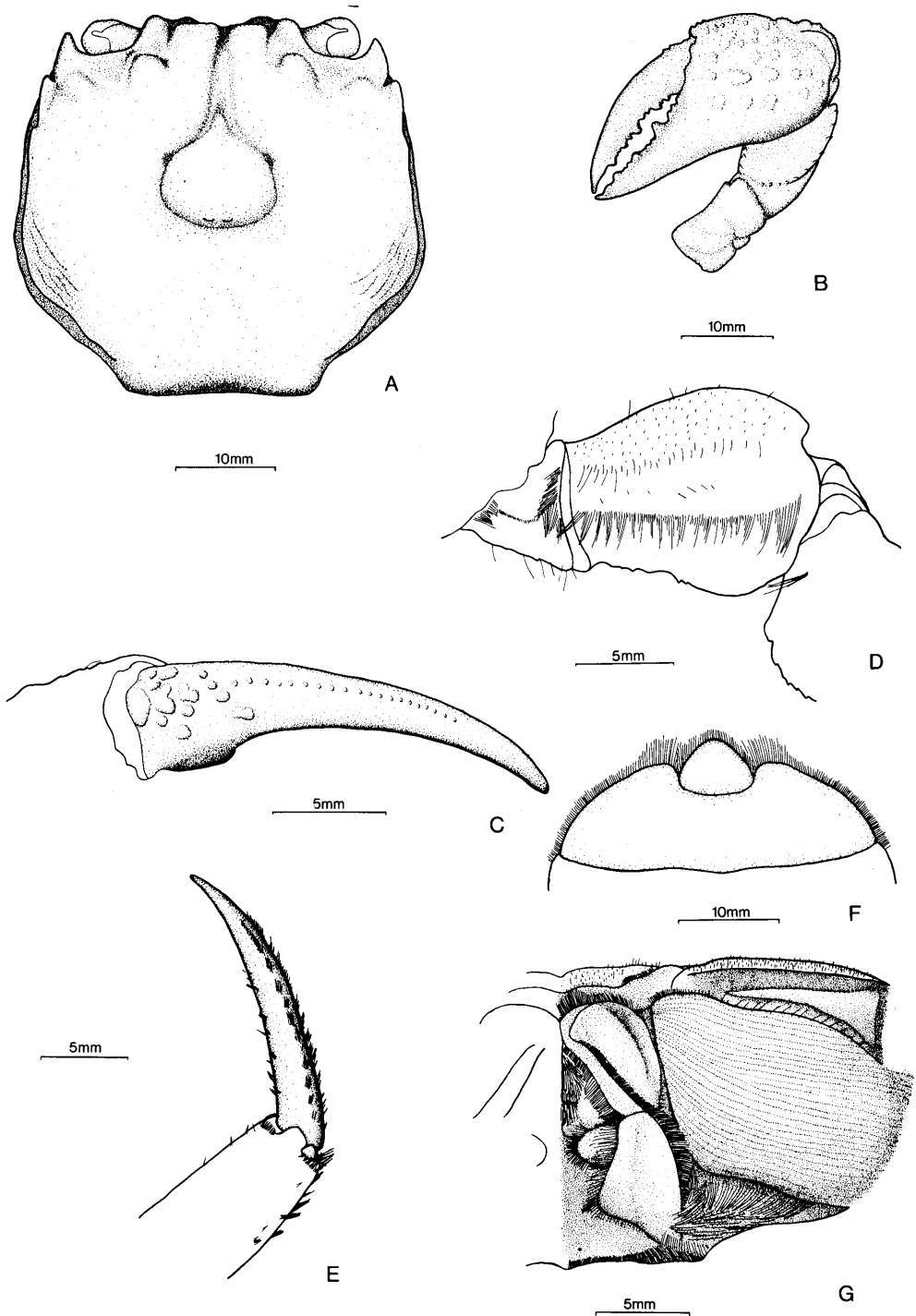


Fig. 1 – *Sesarma (Sesarmops) impressum* female. A - dorsal view of carapace; B - frontal view left cheliped; C - postero-dorsal view of left cheliped dactyl; D - inner face of left cheliped merus; E - ventral view of dactyl of fourth walking leg; F - ventral view penultimate segment of abdomen and telson; G - ventral view of left pterygostomial region.

face ornamented with large, low tubercles and lower surface smooth. Base of movable finger tuberculate, upper border with a single ridge of attenuated tubercles (Fig.1C). Fingers curved inward, gaping, meeting only at the tips which are sharply pointed. Cutting edge of movable finger (Fig.1B) ornamented with about ten blunt teeth (only four are prominent), edge of fixed finger with about eleven blunt teeth (only three are prominent). Subterminal borders of both fingers developed into a narrow ridge which may function in a scissor-like manner. Walking legs well-developed (third pair longest), dense bunches of setae between bases of all walking legs (including cheliped and first leg); meri flattened, borders subparallel, with an anterior, subterminal sharp spine; anterior margins of remaining segments fringed with thick setae; dactyls long, curved and sharply pointed. Posterior terminal margin of propodus armed with axially directed, short, stout spines against which the dactyl can close (Fig.1E). These may assist the crab to grasp vegetation. Dactyli approximately same length as propodi. Female abdomen occupying the entire ventral surface of the thorax, outer surface smooth, fringed with short setae, first two segments very narrow, fifth segment broadest, telson small with a broadly rounded margin (Fig.1F).

Measurements (female)

Carapace width 40.5mm. Carapace length 38.0mm. Max. abdomen width 34.5mm. Cheliped propodus length (ventral margin) 27mm. Max. propodus depth 13.8mm. Length of third leg 76mm.

Colour

Dorsal surface of carapace and limbs dark purple, ventral surface pale creamy yellow. Fingers and tubercles on outer face of cheliped propodus pale yellow against a dark purple background.

Remarks

Crosnier (1965) synonymized *S. frontale* A. Milne Edwards, 1869 and *S. nodulifera* Lenz, 1910 with *S. (Sesarma) impressum* H. Milne Edwards, 1837. An examination of the description of *S. atrorubens* Hess, 1865, probably collected from Sydney, Australia, shows that this species should also be synonymized with *S. (S.) impressum* H. Milne Edwards, 1837. The frontal regions, deeply incised mesogastric grooves, chelipeds, walking legs and colour are almost identical in the two species (see pl.6, fig.12 of Hess, 1865). Serène and Soh (1970) suggested that *S. similis* Hess, 1865 was the same as *S. impressum* (probably following Tesch, 1917) but strangely they did not include *S. atrorubens* despite Hess' comment that *S. similis* may well just be the female of *S. atrorubens*. Thus the six species listed by Serène and Soh (1970) in their new genus *Sesarmops* can be reduced to five (*S. impressum* H. Milne Edwards, 1837; *S. mindanaoensis* Rathbun, 1915; *S. weberi* (De Man, 1892); *S. intermedium* (De Haan, 1835); *S. sinensis* (H. Milne Edwards, 1853)). The use of *Sesarmops* as a generic name is not followed here because its proper status remains to be established.

This crab is known locally as the 'blue' land crab and the present specimen came from a dried creek bed, 1.5km from the sea at an altitude of approx. 100m. Here a crab was observed during the day sitting on a boulder in among mosses and ferns. On a previous occasion one of us (P.A.R.) observed a cast exoskeleton of *S. (S.) impressum* in a creek bed in Taveuni rainforest at an altitude of approx. 1200m. Clearly this crab is capable of living far from the sea.

Distribution

S. (S.) impressum has been recorded from the Fiji Islands, as *Sesarma atrorubens*, by De Man (1890) and Ortmann (1894). According to Tesch (1917) the specimens mentioned by De Man are in Leiden Museum. By combining the localities for *S. (S.) impressum* and all its synonyms the distribution of this species becomes as follows: Zanzibar, Madagascar, Sumatra, Java, Timor, Celebes, Moluccas, Philippines, Formosa, Japan, Australia, Fiji and Samoa.

Clearly *S. (S.) impressum* is a widespread Indo-West Pacific species. A total of 18 species of *Sesarma* Say, 1817 belonging to 9 subgenera, has been recorded from Pacific islands (Table 1) and of these species seven have been recorded from the Fiji Is. These species represent five sub-genera: *Perisesarma*, *Sesarmops*, *Parasesarma* (2 spp.), *Neosarmatium* and *Labuanium*

Table 1 – *Sesarma* species recorded from the South Pacific Islands. Based mainly on Tesch (1917) but using the subgenera of Serène and Soh (1970).

Species	Localities	Reference
<i>S. (Geosesarma) angustifrons</i> A. Milne Edwards, 1869	Tahiti	De Man, 1889
<i>S. (Perisesarma) bidens</i> (De Haan, 1835)	Fiji	Dana, 1852
<i>S. (Sarmatium) crassum</i> Dana, 1851	New Caledonia	Serène, 1973
<i>S. (Nanosesarma) edamensis</i> De Man, 1887	New Caledonia	Serène, 1973
<i>S. (Labuanium) gardineri</i> * Borradaile, 1900	Ellice Is., Rotuma Tokelau Is.	Borradaile, 1900 Yaldwyn & Wodzicki, 1979
<i>S. (Labuanium) gracilipes</i> H. Milne Edwards, 1853	Tonga Tahiti	Milne Edwards, 1853 Ortmann, 1894
<i>S. (Sesarmops) impressum</i> H. Milne Edwards, 1837	Fiji Is. Samoa	De Man, 1890; Ortmann, 1894 Ortmann, 1894
<i>S. (Parasesarma) lenzii</i> De Man, 1889	Fiji Is.	De Man, 1889
<i>S. (Parasesarma) leptosoma</i> Hilgendorf, 1869	Fiji Is.	De Man, 1889; Ortmann, 1894
<i>S. (Perisesarma) livida</i> A. Milne Edwards, 1869	New Caledonia	Milne Edwards, 1869
<i>S. (Neosarmatium) fourmanoiri</i> Serene, 1973	New Caledonia	A. Milne Edwards, 1873
<i>S. (Chirromantes) obtusifrons</i> Dana, 1851	Niue	Rathbun, 1907
<i>S. (Parasesarma) plicata</i> (Latreille, 1806)	New Caledonia	A. Milne Edwards, 1873
<i>S. (Labuanium) rotundatum</i> * Hess, 1865	Samoa Fiji Is., Nairai	A. Milne Edwards, 1869 Miers, 1877
<i>S. (Neosarmatium) rotundifrons</i> A. Milne Edwards, 1869	Samoa	Milne Edwards, 1869
<i>S. (Neosarmatium) smithii</i> H. Milne Edwards, 1853	Fiji Is. New Caledonia	De Man, 1889, 1890; Ortmann, 1894 A. Milne Edwards, 1873
<i>S. (Labuanium) trapezoideum</i> H. Milne Edwards, 1837	Fiji Is. Tahiti	De Man, 1889, 1890 Rathbun, 1907; Forest & Guinot, 1961
<i>S. (Chirromantes) villosa</i> A. Milne Edwards, 1869	Samoa	Milne Edwards, 1869

* *S. (L.) gardineri* and *S. (L.) rotundatum* may be synonyms; see Rathbun (1907) and Yaldwyn and Wodzicki (1979).

(2 spp.). All species are widely distributed, either in the Indo-Pacific (*S. (P.) bidens*, *S. (S.) impressum*, *S. (P.) leptosoma*, *S. (L.) rotundatum*, *S. (N.) smithii*) or Pacific (*S. (P.) lenzii*, *S. (L.) trapezoideum*) regions. How many of these specific names are valid is uncertain, as the *Sesarma* genus is in serious need of revision. However Fiji may well have quite a diverse fauna, including species ranging from coastal habitats to high in the rainforest.

***Geograpsus crinipes* (Dana, 1851), Fig.2A-G**

Synonymy

Grapsus crinipes Dana, 1851, p249; *Geograpsus crinipes* Stimpson, 1858, p101; *Geograpsus crinipes* Alcock, 1900, p396; *Geograpsus crinipes* Borradaile, 1901; *Geograpsus crinipes* Rathbun, 1906, p839; *Geograpsus crinipes* Edmondson, 1923, p10; *Geograpsus crinipes* Sakai, 1939, p652, pl.107, fig.2; *Geograpsus antelmei* Ward, 1942, p105, pl.6, fig.7; *Geograpsus crinipes* Holthuis, 1953, p29; *Geograpsus crinipes* Edmondson, 1959, p162, fig.4a,5a; *Geograpsus crinipes* Banerjee, 1960, p163, figs 1e,3q,r,4a-c; *Geograpsus crinipes* Yaldwyn and Wodzicki, 1979, p16.

Material examined

One male (CW 46.4mm) collected near Lavena Village, Taveuni Is., Fiji, 19/7/88, P.A. Ryan. Left cheliped missing, also right second and third walking legs.

Description

Carapace wider than long (ratio 1.15), sides parallel, surface smooth except for subparallel striae especially in branchial area and across the frontal lobes (Fig.2A). Gastro-cardiac groove distinct. Frontal margin deflexed, entire, faintly denticulate, orbits deeply set, corner marked by a blunt external spine (first anterolateral tooth) which is followed by a second, smaller, acute anterolateral tooth. Lower orbital margin finely denticulate. Behind the frontal margin is a deep median groove which separates two small blunt lobes and these, in turn, are separated by shallow grooves from similar lobes bordering the inner orbital margin. Male cheliped (Fig.2B,C) well developed, striated, merus trigonal, inner margin produced as a serrated flange, carpus with a well developed spine on inner, dorsal margin. Upper surface of carpus and propodus slightly tuberculate. Fingers curved inward, fixed finger with a deep proximal notch armed with small teeth, distal half of finger armed with two larger teeth separated by smaller teeth. Movable finger serrated along its entire length, four larger teeth separated by smaller teeth. Walking legs well developed, second pair longest, meri flattened, surface transversely striated, posterior margin produced as a flange, dactyli longer than propodi, both segments armed with marginal spines and sparse, long setae (Fig.2D). Pterygostomial areas in the vicinity of the buccal frame covered in short setae. Posterior margin of base of second walking leg fringed with long (4-5mm) dense setae which are adjacent to a similar fringe of setae on the anterior margin of the base of the third walking leg (Fig.2E). This fringe of setae extends upward between the leg bases as far as the posterolateral corner of the carapace. This is part of the mechanism whereby the crab absorbs moisture into its gill pouches. Male telson triangular, blunt, length about equal to basal width (Fig.2F). Male first pleopod, short, stout, setose at apex (Fig.2G).

Measurements (male)

Carapace width 46.4mm Carapace length 40.6mm. Cheliped propodus length (ventral margin) 37mm. Max. propodus depth 19.3mm. Length of second walking leg 66.7mm.

Colour

Dorsal surface yellowish brown, ventral surface yellowish white. Spines on walking legs dark brown.

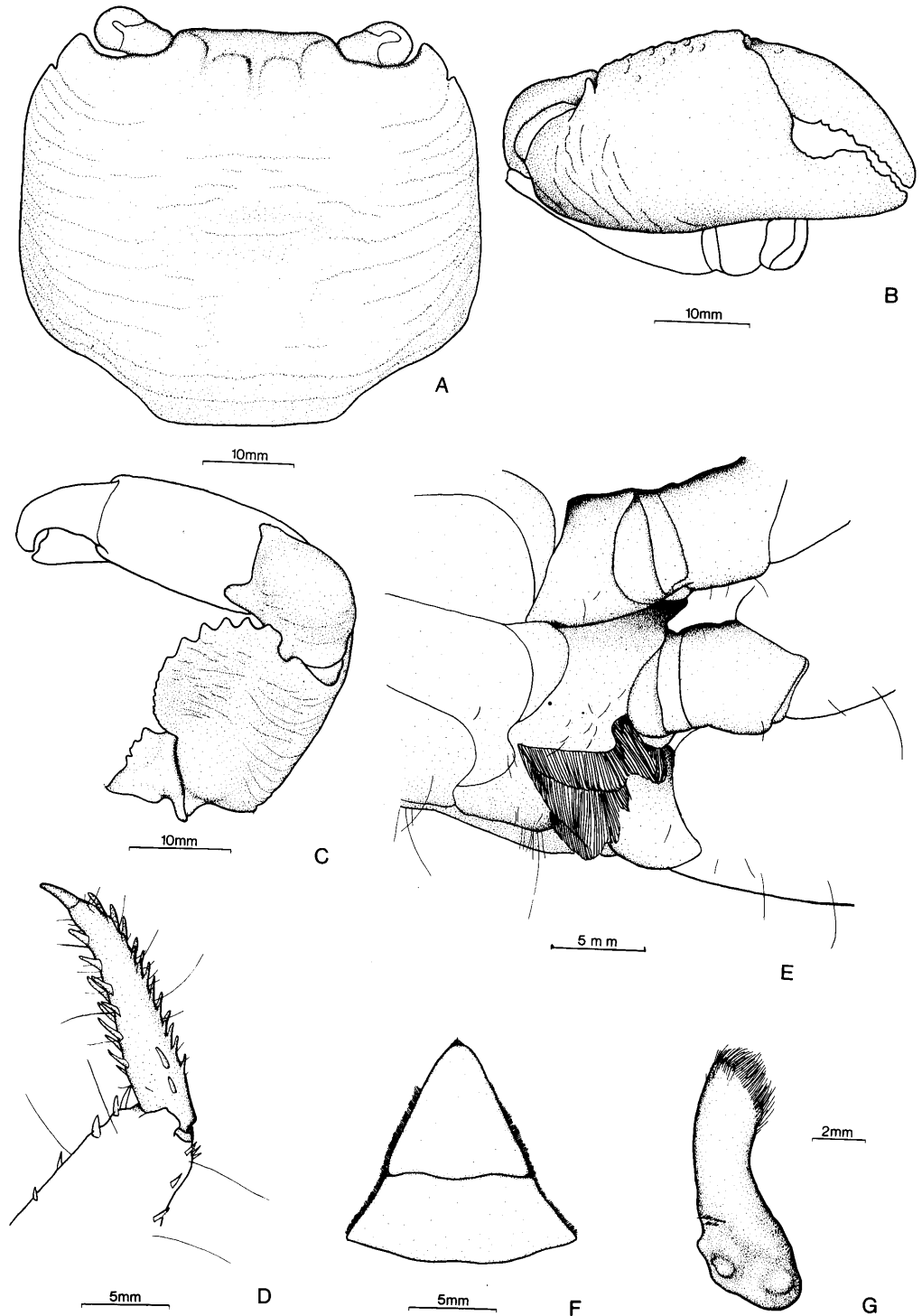


Fig. 2—*Geograpsus crinipes* male. A -dorsal view of carapace; B -frontal view of right cheliped; C -dorsal view of right cheliped merus and carpus; D - ventral view of dactyl of fourth walking leg; E - ventral view of bases of first three walking legs; F - ventral view of penultimate segment of abdomen and telson; G - ventral view of first male pleopod.

Remarks

This appears to be the first record of *Geograpsus crinipes* from the Fiji Is. It is referred to locally as the 'brown' tree-climbing crab. Colour seems to be very variable: Yaldwyn and Wodzicki (1979) recorded three different colour patterns, unrelated to sex or size, while Banerjee (1960) found that colour could vary from bright red, orange or orange-yellow, to grey or brown. The present specimen was collected near Lavena Village where crab burrows are common in the ground. The habitat of *G. crinipes* ranges from rocky and sandy shores above high tide level, the floor of *Pisonia* groves where it burrows, under loose bark on rotten coconut logs, to rainforest where it climbs trees.

Distribution

A widely distributed Indo-Pacific species, *G. crinipes* has been recorded from the Red Sea, from islands in the Indian Ocean and in the Indonesian Archipelago. In the Pacific it has been recorded from the Marshall Islands, Ellis Islands, Line Islands, Hawaiian Islands, Easter Island, Tahiti and the Tuamotu Archipelago, Tokelau Islands and now from Fiji. The other two Indo-West Pacific species from this genus include *G. grayi* (H. Milne Edwards, 1853) collected by *H.M.S. Challenger* from Kandavu, south of Viti Levu, and *G. stormi* De Man, 1895 which has not yet been recorded from Fiji (Banerjee, 1960). *G. grayi* and *G. crinipes* co-exist in the same habitat on the Tokelau Islands (Yaldwyn and Wodzicki, 1979, and elsewhere, see Holthuis, 1953, Hicks *et al.*, 1984) and the same may well be true in Fiji.

COMPARISON OF TERRESTRIAL ADAPTATIONS

One of the distinctive characteristics of sesarimid crabs is the reticulated pterygostomial regions on the ventral surface of the carapace. In *Sesarma (S.) impressum* a series of small channels, created by rows of tiny tubercles, extend from the margins of the buccal frame, around the undersurface of the carapace above the legs. Each tubercle is accompanied by a geniculated hair, and collectively they form a fine net or 'hair-sieve' (Rathbun, 1918). Water, emerging from the branchial chamber near the mouth, passes along a deep suborbital channel on to the reticulated surface, where it gains oxygen from the air before being directed by the hairs towards the leg bases where it re-enters the branchial chamber (Cott, 1929). The reticulated surface is kept clean by use of the brush-border on the inner surface of the cheliped merus. The reticulated surface appears to function as a re-oxygenation system which recycles and conserves water and may also collect water from the environment. Oxygen is taken up by the gills in the branchial chamber. By contrast, *Geograpsus crinipes* lacks the reticulated surface, but instead has a specialized means of gaining water from the environment. Dense bunches of setae between the bases of the second and third walking legs are long enough to make contact with the substrate when the crab sits back on its haunches, and in this way water can be taken up into the gill chambers by capillary action (see Bliss, 1979, for other examples). A narrow channel between the leg bases conducts water up into the rear of the branchial chamber at the posterolateral corner of the carapace. *G. crinipes* has a mechanism which allows it to obtain water from the substrate, but has no means of recycling this water. Thus we would expect this crab to be more limited to proximity to water than *S. (S.) impressum*. On Taveuni *S. (S.) impressum* is known to live from coastal areas to an altitude of approx. 1200m; *G. crinipes* is limited to the coastal fringe, where it lives in burrows and shelters under logs but also ventures up into the vegetation to feed. *G. crinipes* females migrate to the sea to release their eggs (Hicks *et al.*, 1984). The habits of *S. (S.) impressum* are less well known, and it is not clear whether this species is also a burrower and tree-climber (Tesch, 1917, gives no habitat information); but other species of *Sesarma* are known to have these habits. On nearby Tokelau Is. *S. (L.) gardineri* climbs kanavu trees (*Cordia subcordata*) and coconut trees (Yaldwyn and Wodzicki, 1979), while *S. (Neosarmatium) fourmanoiri*, native to New Caledonia, lives in burrows (observations made in Africa by Cott, 1929). Other *Sesarma* species also live far from the sea. *S. (H.) obtusifrons*

on Christmas I. lives high on the sea cliffs (Hicks *et al.*, 1984); *S. (L.) trapezoideum* is recorded from Tahiti at an altitude of 500m (Forest and Guinot, 1961); and *S. (Sesarma) bidentatum* from Jamaica lives in rivers and streams to approx 1400m (Rathbun, 1918; Hartnoll, 1964). Similarly, *S. (S.) jarvisi* and *S. (S.) cookei*, unique to Jamaica, have evolved terrestrial habits (Hartnoll, 1971). These observations suggest that *Sesarma* species have been more successful than *Geograpsus* species in invading the terrestrial habitat, and this may have resulted from their greater ability to conserve moisture.

DISCUSSION

A recent book on Christmas Island crabs (Hicks *et al.*, 1984) records five grapsid land crabs (including *Sesarma (C.) obtusifrons*, *S. (Sesarmoides) jacksoni*, *Geograpsus grayi*, *G. crinipes*) and two gecarcinid crabs (*Gecarcoidea natalis* and *Cardisoma hirtipes*). The best review of brachyuran land crabs in the South Pacific can be found in the paper on the fauna of the Tokelau Islands by Yaldwyn and Wodzicki (1979). From these three small atolls, six species belonging to the families Grapsidae and Gecarcinidae were recorded: *Geograpsus grayi*, *G. crinipes*, *Metopograpsus thukar*, *Sesarma (Labuanium) ?gardineri*, *Cardisoma carnifex* and *C. rotundum*. These land crabs are all nocturnally active scavengers that eat any available organic material, and where they live at high densities they make an important contribution to the breakdown of litter on the forest floor.

The land crabs recorded from the Fiji Is. are listed in Table 2, including the species of *Geograpsus* and *Sesarma*, *Varuna litterata* (Ryan and Choy, in press) and the gecarcinids *Cardisoma carnifex*, *C. hirtipes*, *C. longipes* and *Gecarcoidea lalandii* (Türkay, 1974). This gives a total of fourteen land crabs from Fiji Is. Ryan (1988) also records *C. rotundum* from Fiji, but this needs to be verified by further collecting.

Very little is known about the habitats from which the *Sesarma* species came, and the extent of adaptation to a terrestrial existence remains to be established. Some of them may be restricted to coastal mangroves. An important factor affecting the distribution and/or numbers of land crabs on the Fijian Is. is likely to be the introduced Indian mongoose, *Herpestes auropunctatus*, which eats crabs (Ryan, pers. obs.). Because the Fiji group has more islands and totals a greater area than the Tokelan group, it might be expected that many of the species recorded from the Tokelau Is. would also be found in Fiji. With further collecting from Fiji and clarification of *Sesarma* taxonomy, the land crab fauna may well reach 15-20 species and may include species of *Metasesarma*. Particular attention should be paid to streams and caves to see whether there has been any parallel evolution of the sub-genera in these specialized

Table 2 – List of brachyuran land crabs recorded from the Fiji Islands.

Grapsidae

- Varuna litterata*
- Geograpsus crinipes*
- G. grayi*
- Sesarma (Parasesarma) lenzii*
- S. (Sesarmops) impressum*
- S. (P.) leptosoma*
- S. (Labuanium) rotundatum*
- S. (L.) trapezoideum*
- S. (Neosarmatium) smithii*
- S. (Perisesarma) bidens*

Gecarcinidae

- Cardisoma longipes*
 - C. carnifex*
 - C. hirtipes*
 - Gecarcoidea lalandii*
-

habitats, such as is found elsewhere. For example, crabs belonging to one *Sesarma* sub-genus in Jamaica complete their entire life history in freshwater (Hartnoll, 1971); and crabs of the *Sesarmoides* sub-genus on Christmas Island, *S. (S.) jacksoni*, live in caves (Hicks *et al.*, 1984).

ACKNOWLEDGEMENTS

We wish gratefully to acknowledge the help of Peter McLay, who skillfully prepared the illustrations, and Barbara Schakau who did some German translations.

REFERENCES

- Alcock A., 1900. Materials for a carcinological fauna of India. No. 6. The Brachyura Catometopa, or Grapsoidea. *Journal of the Asiatic Society Bengal* 69: 249-456.
- Banerjee S.K., 1960. Biological results of the Snellius Expedition. XVIII. The genera *Grapsus*, *Geograpsus* and *Metopograpsus* (Crustacea Brachyura). *Temminckia* 10: 132-199.
- Bliss D.E., 1979. From sea to tree: saga of a land crab. *American Zoologist* 19: 385-410.
- Borradaile L.A., 1900. On some crustaceans from the South Pacific. Part IV. The Crabs. *Proceedings of the Zoological Society, London* 1900: 568-596.
- 1901. Land Crustaceans. *The Fauna and Geography of the Maldive and Laccadive Archipelagoes* 1: 64-100.
- Cott H.B., 1929. The Zoological Society's Expedition to the Zambesi, 1927: No. 2. Observations on the National History of the land-crab *Sesarma meinerti*, from Beira, with special reference to the theory of warning colours. *Proceedings of the Zoological Society, London* 1929: 679-692.
- Crosnier A., 1965. Crustaces Decapodes Grapsidae et Ocypodidae. *Faune De Madagascar* 18: 1-143.
- Dana J.D., 1851. Conspectus crustaceorum quae in orbis terrarum circumnavigatione, Carolo Wilkes e Classe Reipublicae Foederatae duce, lexit et descripsit. Catometopa or Grapsoidea. *Proceedings of the Academy of Natural Science Philadelphia* 5: 247-254.
- 1852. United States Exploring Expedition during the years 1838, 1839, 1840, 1841, 1842 under the command of Charles Wilkes, U.S.N. vol. 13, part 1, Crustacea. Text 1393pp. Atlas (1835) 27pp., 96 pls.
- Edmondson C.H., 1923. Crustacea from Palmyra and Fanning Islands. *Bulletin of the Bernice P. Bishop Museum* 5: 1-43.
- 1959. Hawaiian Grapsidae. *Occasional Papers of the Bernice P. Bishop Museum* 22(10): 153-202.
- Forest J., and Guinot D., 1961. Crustaces Decapodes Brachyours de Tahiti et des Tuamotu. *Expedition française sur les récifs coralliens de la Nouvelle-Calédonie* 1960-62, vol. prelim., 195pp.
- 1962. Remarques biogéographiques sur les crabes des Archipels De La Société et des Tuamotu. *Cahiers du Pacifique* 4: 41-75.
- Haan W. De, 1833-1850. Crustacea. In P.F. de Siebold (Ed): *Fauna Japonica*, 1-244pp.
- Hartnoll R.G., 1964. The freshwater grapsid crabs of Jamaica. *Proceedings of the Linnean Society London* 75: 145-169.
- 1971. *Sesarma cookei* N.sp., a grapsid crab from Jamaica (Decapoda, Brachyura). *Crustaceana* 20(3): 257-262.
- Hess W., 1865. Beiträge zur Kenntniss der Decapoden-Krebse Ost-Australiens. *Archiv für Naturgeschichte* 31: 127-173.
- Hicks J., Rumpff H., and Yorkston H., 1984. Christmas Crabs. Christmas Island Natural History Association.
- Hilgendorf F., 1869. Crustaceen. In Baron Carl Claus von der Decken (Ed): *Reisen in Ost-Afrika in den Jahren 1859-1865*, vol. 3(1) pp. 67-116, 147, pls 1-6.
- Holthuis L.B., 1953. Enumeration of the decapod and stomatopod Crustacea from Pacific coral islands. *Atoll Research Bulletin* 24: 1-66.
- Latreille P.A., 1806. Genera Crustaceorum et Insectorum..... 1 p i-xvii, 1-302, 16pl.
- Lenz H., 1910. Crustaceen von Madagaskar, Ostafrika und Ceylon. Reise in Ostafrika in den Jahren 1903-1905. In A. Voeltzkow (Ed): *Wissenschaftliche Ergebnisse. Stuttgart*, vol. 2, p.539-576.
- Man J.G. De, 1887. Uebersicht der Indo-Pacifischen Arten der Gattung *Sesarma* Say nebst einer Kritik der von W. Hess und E. Nauck in den Jahren 1865 und 1880 beschriebenen Decapoden. *Zoologische Jahrbucher. Abtheilung für Systematik, Geographie und Biologie der Thiere* 2(3,4): 639-722.

- 1889. Ueber einige neue oder seltene Indopacifische Brachyuren. *Zoologische Jahrbucher, Abtheilung fur System atik, Geographie und Biologie der Thiere* 4: 409-452.
- 1890. Carcinological studies in the Leyden Museum. No. 4. *Notes Leyden Museum* 12(13): 49-126.
- 1892. Decapoden des Indischen Archipels. In Weber's (Ed): *Zoologische Ergebnisse einer Reise in Niederlandisch Ost-Indien*, Leiden. 2:265-527.
- 1895. Bericht uber die von Hern Schiffscapitan Storm zu Atjeh, an den west-lichen Kusten von Malaka, Borneo und Celebes sowie in der Java-See gesammelten Decapoden und Stomatopoden. Zweiter Theil. *Zoologische Jahrbucher, Abtheilung fur System atik, Geographie und Biologie der Thiere* 9: 75-218.
- Manning R.B., and Holthuis L.B., 1981. West African brachyuran crabs (Crustacea: Decapoda). *Smithsonian Contributions to Zoology* 306: 379pp, 88 figs.
- Miers E.J., 1877. On a collection of Crustacea made by the Rev. G. Brown, C.M.Z.S., on Duke-of-York Island. *Proceedings of the Zoological Society London* 1877: 133-138.
- Milne Edwards A., 1869. Note sur quelques nouvelles especes du genre *Sesarma* (Say). *Nouvelles Archives du Museum d'Histoire naturelle Paris* 5 (Bulletin): 25-31.
- 1873. Recherches sur la faune carcinologique de la Nouvelle-Caledonie. *Nouvelles Archives du Museum d'Histoire naturelle Paris* 9: 156-332.
- 1837. Histoire naturelle des Crustaces, Paris. II, 531p., pl.1-28.
- 1853. Memoire sur la famille des Ocypodiens. *Annales des Sciences Naturelles* (3), vol. 20: 163-228, pls. 6-11.
- Ortmann A., 1894. Die Decapoden-Krebse des Strassburger Museums, mit besonderer Berücksichtigung der von Herrn Dr. Doderlein bei Japan und bei den Liu-kiu Inseln gesammelten und zur Zeit im Strassburger Museum aufbewahrten Formen, VIII. *Zoologische Jahrbucher, Abtheilung fur System atik, Geographie und Biologie der Thiere* 7: 683-772.
- Rathbun M.J., 1897. A revision of the nomenclature of the Brachyura. *Proceedings of the Biological Society Washington* 11: 153-167.
- 1906. The Brachyura and Macrura of the Hawaiian Islands. *Bulletin of the United States Fisheries Commission* 23(3): 827-930, text figs. 1-79, pls. 3-24.
- 1907. Reports on the scientific results of the expedition to the tropical Pacific... by U.S. Fish Commission steamer "Albatross". IX, X The Brachyura. *Memoirs of the Museum of Comparative Zoology Cambridge* 35(2): 23-74.
- 1909. New crabs from Gulf of Siam. *Proceedings of the Biological Society Washington* 22: 102-116.
- 1915. New species of crabs of the families Grapsidae and Ocypodidae. *Proceedings of the United States National Museum* 47: 69-85.
- 1918. The grapsoid crabs of America. *Bulletin of the United States National Museum* 97: 1-461.
- Ryan P.A., 1988. Fiji's Natural Heritage. Southwestern Publishing Co. Ltd.
- Ryan P.A., and Choy S.C. (in press). Some observations on the mass upstream migration of *Varuna litterata* (Fabricius) megalopae (Crustacea: Brachyura: Grapsidae) in Fiji. *Crustaceana*.
- Sakai T., 1939. Brachygnatha, Brachyrhyncha. Studies on the Crabs of Japan. 4: 365-741 (Yokendo Ltd, Tokyo).
- Say T., 1817. An account of the Crustacea of the United States. *Journal of the Academy of Natural Science Philadelphia* 1: 57-80.
- Serène R., 1973. Notes sur quelques espèces de brachyours de Nouvelle-Calédonie. *Cahiers du Pacifique* 17: 119-161.
- Serène R., and Soh C.L., 1970. New Indo-Pacific genera allied to *Sesarma* Say 1817 (Brachyura, Decapoda, Crustacea). *Treubia* 27(4): 387-416.
- Stimpson W., 1858. Prodrum descriptionis animalium evertibratorum, quae in Expeditione ad Oceanum Pacificum Septentrionalem, a Republica Federata missa, Cadwaladro Ringgold et Johanne Rodgers Ducibus, observavit et descripsit. *Proceedings of the Academy of Natural Science Philadelphia* 10: 93-110.
- Tesch J.J., 1917. Synopsis of the genera *Sesarma*, *Metasesarma*, *Sarmatium* and *Clistocaeloma*, with a key to the determination of the Indo-Pacific species. *Zoologische Mededeelingen uitgegeuen vanwege's Rijks Museum van Natuurlijke Historie te Leiden* 3(2-3): 127-260.
- Türkay M., 1974. Die Gecarcinidae Asiens und Ozeaniens (Crustacea, Decapoda). *Senckenbergiana biologica* 55(4-6): 223-259.

- Ward M., 1942. Notes on the Crustacea of the Desjardins Museum, Mauritius Institute with descriptions of new genera and species. *Mauritius Institute Bulletin* 2(2): 49-108.
- Yaldwyn J.C., and Wodzicki K., 1979. Systematics and ecology of the land crabs (Decapoda: Coenobitidae, Grapsidae and Gecarcinidae) of the Tokelau Islands, Central Pacific. *Atoll Research Bulletin* 235, 53 pp.