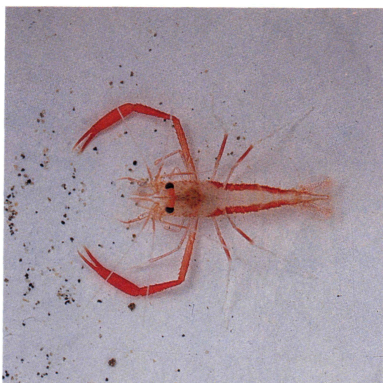
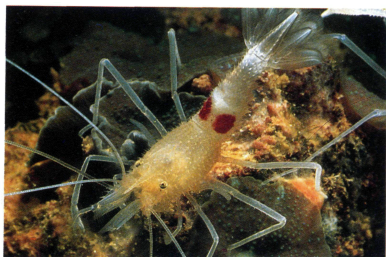


A. Holotype of *Stenopus devaneyi*, Nuku Hiva, Marquesas Islands. Photo by John E. Randall.



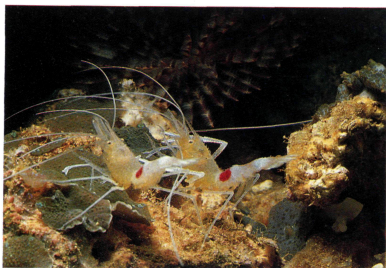
B. Holotype of *Stenopus earlei*, O'ahu, Hawaiian Islands. Photo by John L. Earle.



C. *Stenopus devaneyi*, Sri Lanka. Aquarium photo by Helmut Debelius.



D. *Stenopus earlei*, O'ahu, Hawaiian Islands. Underwater photo at night by Scott Johnson.



E. A pair of *Stenopus devaneyi*, Sri Lanka. Aquarium photo by Helmut Debelius.



F. *Stenopus devaneyi* and the moray *Gymnothorax breedeni*, Tahuata, Marquesas Islands. Underwater photo by John E. Randall.

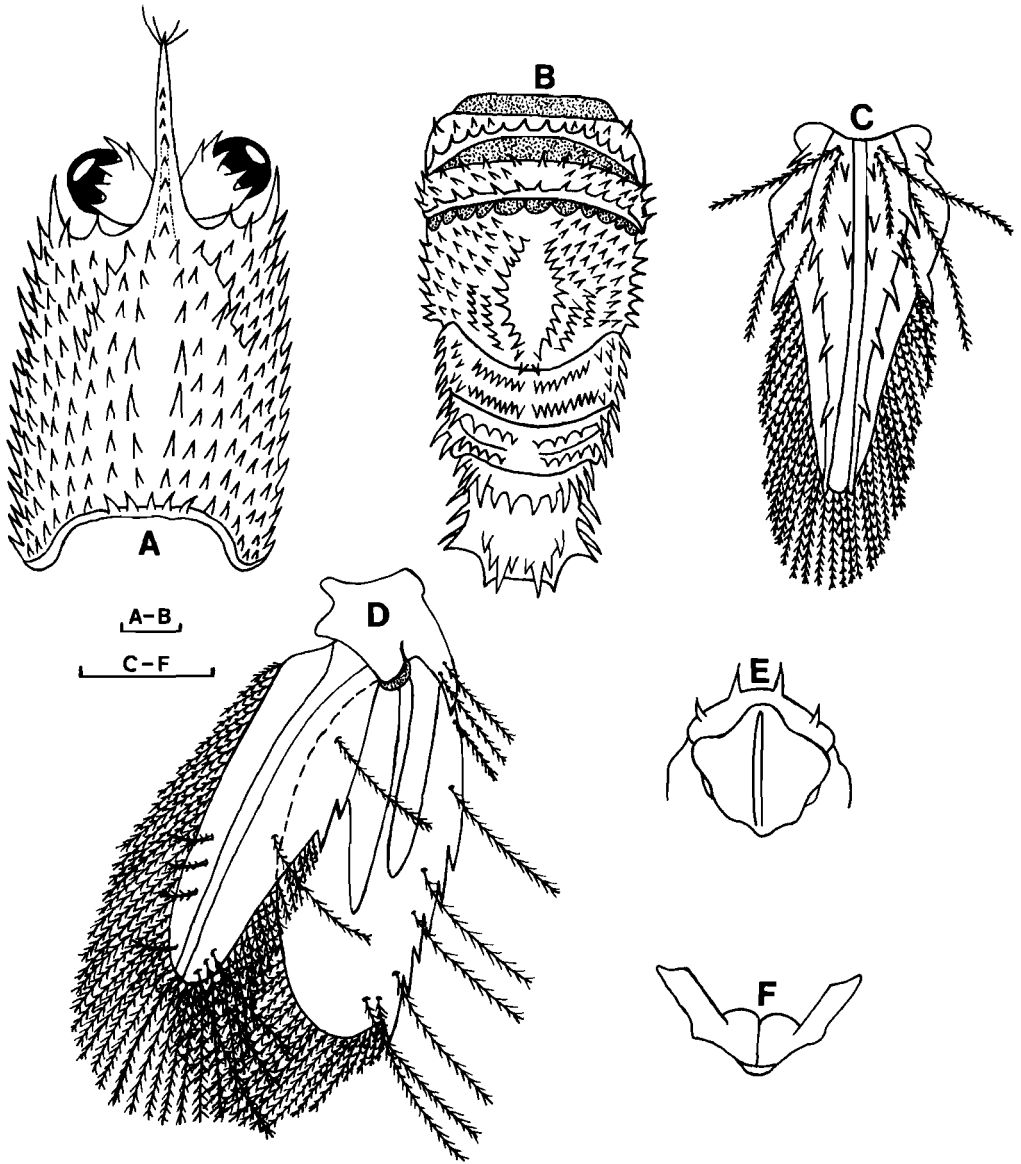


Fig. 6. *Stenopus earlei*, holotype, ♂: **A**, carapace, dorsal view; **B**, abdominal somites, dorsal view; **C**, telson; **D**, uropods; **E**, epistome and labrum, ventral view; **F**, paragnath. Scale bars represent 1.0 mm.

as upper. Articles of both flagella with delicate short setae placed on all sides along entire length.

Antenna (Fig. 7C) with strong basal segment bearing 2 strong ventral, 1 ventrolateral spines. Scaphocerite well developed, reaching about $\frac{1}{2}\times$ beyond tip of rostrum. Outer margin moderately concave proximally with 2 small spines; distal part bearing 9 stronger teeth equally spaced to tip. Dorsal surface with 2 distinct longitudinal carinae, without spinulation. Inner margin with long plumose setae. Ventral surface without spinules but with widely spaced long setae. Antennal flagellum well developed, extending beyond tip

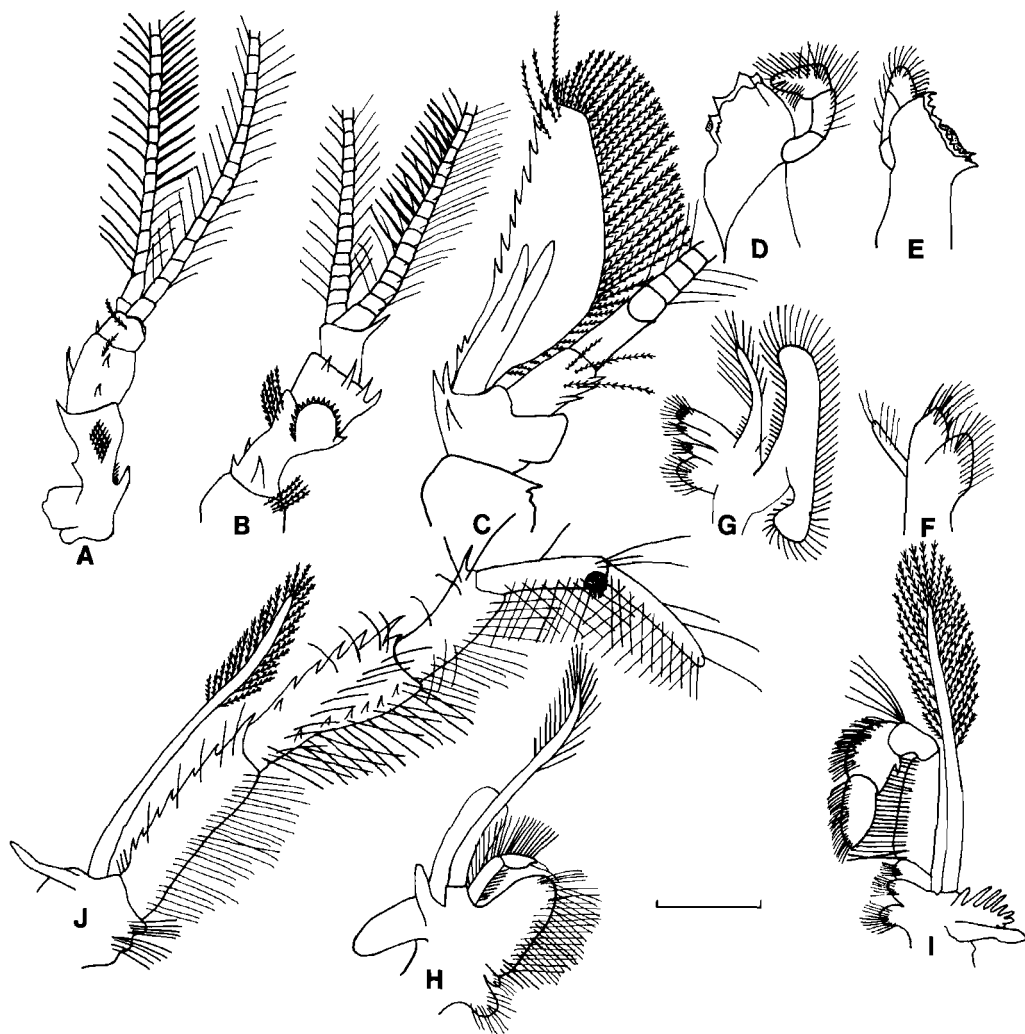


Fig. 7. *Stenopus earlei*, holotype, ♂: **A**, left antennule and antennular peduncle, dorsal view; **B**, right antennule and antennular peduncle, ventral view; **C**, antenna and scaphocerite, dorsal view; **D**, right mandible, ventral view; **E**, left mandible, dorsal view; **F**, maxillule; **G**, maxilla; **H**, 1st maxilliped; **I**, 2nd maxilliped; **J**, 3rd maxilliped. Scale bar represents 1.0 mm. Setules on some plumose setae not shown for clarity.

of telson; basal segment with 3 dorsal spines, 1 larger spine distoventrally; all flagellar articles with delicate setae around entire length of flagellum.

Mandibles (Fig. 7D,E) robust with short, fused molar and incisor processes. Molar surface nearly smooth, incisor bearing 10 minute medial teeth. Palp well developed, 3-segmented; proximal segment lacking setae; middle segment more than 2× as broad as proximal segment, setose on outer surface; distal segment broad, flattened, setose along edges and outer surface.

Maxillule (Fig. 7F) with slender, undivided endopodite bearing 4 plumose setae laterally, 2 distally. Proximal endite moderately broad, slightly broader distally than proximally with 1 slender seta laterally, about 15 robust simple setae in more than 1 row distally, fringing

slender setae on inner edge. Distal endite slightly broader, tapering distally, simple setae dense.

Maxilla (Fig. 7G) with following setation on coxal and basal endites: 11 on proximal lobe, 5 on distal lobe of coxal endite; 5 on proximal lobe, 9 on distal lobe of basal endite. Endopodite long, slender, exceeding anterior margin of scaphognathite, with 5 small simple setae on basal portion of inner margin, 15 long plumose setae around distal $\frac{1}{2}$. Scaphognathite long, narrow, little more than $4 \times$ longer than breadth at center with plumose setae along margin.

First maxilliped (Fig. 7H) with 3-segmented endopodite. Proximal segment longer than broad, with 10 long plumose setae laterally along outer margin, 9 shorter setae on inner margin. Middle segment about $\frac{1}{2}$ length of proximal segment, with 11 long plumose setae along outer margin. Distal segment slender, tapering, slightly less than $\frac{1}{2}$ length of middle segment, with minute simple terminal seta. Basipodite large, auriculiform, with straight outer border bearing dense fringe of long simple setae. Coxopodite bilobed, each lobe bearing numerous short setae. Exopodite well developed, flagellum with 22 long plumose distolateral setae. Large epipod with proximal lobe distinctly longer, larger than distal lobe.

Second maxilliped (Fig. 7I) with 5-jointed endopodite. Dactylus suboval, $1\frac{2}{3} \times$ longer than greatest breadth, dense fringe of short setae along distodorsal margin. Propodus equal to length of dactylus but broader, densely setose on dorsal margin, ventral margin bearing stout proximal tooth. Carpus short, almost as long as propodus, with 5 long simple setae at distodorsal angle, several shorter setae on upper surface. Merus about $2 \times$ length of dactylus, $2\frac{1}{2} \times$ longer than broad; outer border compressed, slightly convex, with many long simple setae. Ischium and basis not fused, each with dense fringe of mesial setae as for coxa, ventral aspect of ischio-basis bearing small setose knob. Exopodite long, slender, undivided in distal $\frac{1}{2}$, bearing 28 long plumose setae. Small, elongate epipod present; arthrobranch and podobranch also present.

Third maxilliped (Fig. 7J) endopodite strongly developed, 5-segmented, with coxa and basis fused. Dactylus slender, tapering, about $6\frac{1}{2} \times$ longer than basal width, with 3 simple setae on outer margin, 10–11 simple setae in mesial row and 11 along inner margin. Propodus same length as dactylus but about $5 \times$ longer than broad, with 4 simple setae on outer margin; setiferous organ reduced to 10 stout short setae distally, row of 8 long simple setae mesially and row of 6 on inner margin. Carpus slightly shorter than propodus, about $4 \times$ longer than broad, with large distodorsal spine, 4 setae on outer margin; numerous long setae mesially on inner margin. Merus long, slightly robust distally, about $1\frac{1}{3} \times$ longer than carpus, with 6 dorsal spines increasing in size distally, 4 simple setae on outer margin; row of 6 low, curved, small spines subdorsally along proximal $\frac{3}{4}$ of segment, above numerous long simple setae medially and mesially on inner margin. Ischium long, slender, about $\frac{1}{3} \times$ longer than merus, with 7 spines, 8 setae on outer margin; dense fringe of long setae on inner margin and row of simple setae on central part of medial side together with some scattered setae.

First pereopod (Fig. 8A) small, when stretched almost reaching past scaphocerite, all segments glabrous. Dactylus equal to $\frac{1}{2}$ length of propodus. Fingers slightly compressed, having somewhat hooked tips. Cutting edges distinct, both propodus and dactylus bearing small, stout, peglike teeth separated by rectangular chitinous lamellae. Dactylus with few scattered simple setae, tufts of longer setae around distal part; propodus with few scattered short simple setae, pair of long setae (branched towards their tips) on distodorsal extremity, tufts of long setae around distoventral area. Distoventral part of carpus and proximoventral part of propodus with setiferous organ. Carpus longest segment about $2 \times$ longer than palm, narrowing slightly proximally, bearing scattered long and short simple setae. Merus

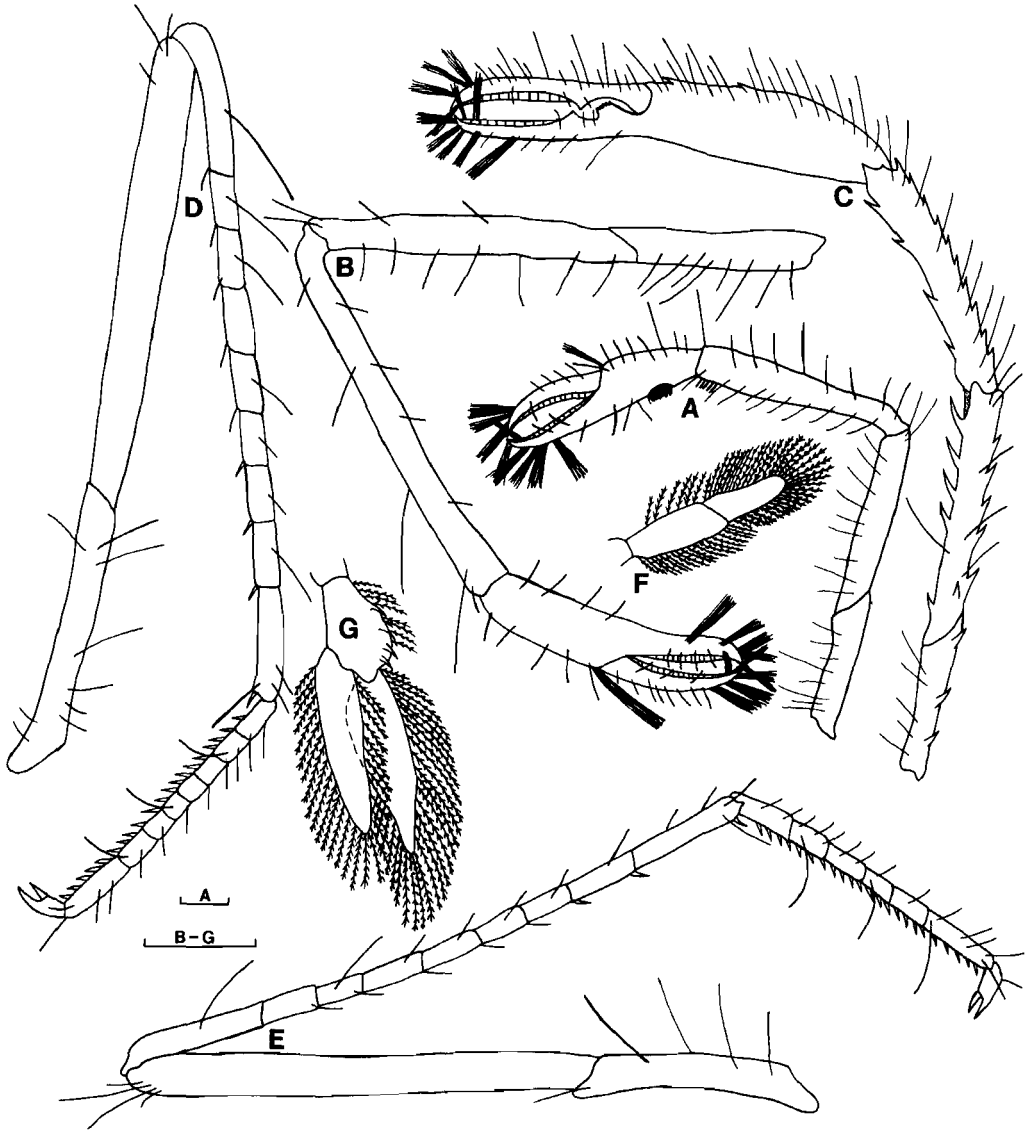


Fig. 8. *Stenopus earlei*, holotype, ♂: A, 1st pereiopod; B, 2nd pereiopod; C, 3rd pereiopod; D, 4th pereiopod; E, 5th pereiopod; F, 1st pleopod; G, 2nd pleopod. Scale bars represent 1.0 mm.

almost equal to carpal length, with numerous long and short simple setae, especially on ventral margin. Ischium about $\frac{1}{3} \times$ shorter than merus, with few long simple setae on ventral margin. Basis short, with few simple setae on inner margin. Coxa short, with few simple setae on inner margin, laterally small epipod.

Second pereiopod (Fig. 8B) built similarly to 1st but longer, stronger, all segments glabrous. No setiferous organ present. Finger tips more strongly hooked than those of 1st, cutting edges with small, stout, peglike teeth separated by rectangular chitinous lamellae. Fingers and distodorsal extremity of palm bearing small tufts of long setae; outer dactylar margin with 8 simple setae. Widely scattered short to medium simple setae over surface of palm, pair of long fused setae at distodorsal extremity. Carpus longest segment just over

3× longer than palm, with several long and short simple setae on margins. Merus about 2× longer than ischium, with few long and short simple setae, especially on ventral margin. Basis and coxa unarmed, coxa with small epipod.

Third pereopod (Fig. 8C) largest, strongest, longer than entire length of body, extending beyond scaphocerite by length of carpus and chela. Palm of chela equal in length to carpus, with 2 small spines centrally on outer dorsal surface together with long simple setae along dorsal margin of entire propodus. Fingers elongate, with sharp hooked crossing tips. Dactylus with numerous long and short dorsal simple setae; cutting edge bearing proximal large sharp tooth, distal row of 10 stout peglike teeth separated by rectangular chitinous lamellae. Cutting edge of propodus with proximal large rounded projection dorsally, with 4 denticles followed by acute tooth merging into row of 10 stout peglike teeth separated by chitinous lamellae. Fingers distally bearing small tufts of long setae. Carpus about ½ length of propodus. Dorsal margin with 10 forwardly directed spines increasing in size proximally, 9 long simple setae; ventral margin with 4–6 smaller spines; dorsomesial edge produced into blunt spinelike process. Merus equal to length of carpus; 5 small spines, 5 long simple setae on dorsal margin; distomesial edge produced into large rounded knob; ventral margin with 5–6 spines increasing in size distally. Ischium about ½× shorter than merus, with 2 or 3 curved dorsal marginal spines along proximal ½ of segment, most proximal spine largest, 0–1 smaller spine and scattered simple setae on ventral margin. Basis and coxa short, coxa bearing few simple setae, small epipod.

Fourth and 5th pereopods (Fig. 8D,E) long, slender, very similar. Dactylus of 4th biunguiculate with unguis long, curved, not clearly separated from dactylar corpus; accessory spine about ⅔ length of unguis. Propodus subdivided into 8 segments bearing 20 movable spines, 3 long setae ventrally; numerous shorter dorsal setae, except only 1 long seta at distodorsal extremity. Carpus slender, straight, longest segment of pereopod slightly more than 2× meral length, subdivided into 9 smaller segments with 4 small spines on distoventral margin of distal 4 segments, other 5 segments bearing short simple seta distoventrally; dorsal margin with 9 long simple setae. Merus slender, elongate, about ½× length of carpus, unarmed except for 3 long simple setae distodorsally. Ischium, basis, coxa unarmed except for few long setae. Fifth pereopod with dactylus similar to 4th, slightly more slender. Propodus subdivided into 6 segments bearing 23 movable spines; 3 long setae ventrally; 13 shorter dorsal setae and several on inner margin. Carpus slightly more than 2× propodal length, subdivided into 9 segments, all other segments except proximal bearing short simple seta distoventrally; dorsal margin with 9 long simple setae. Merus slender, ⅔× length of carpus, unarmed except for 4 long simple setae distoventrally. Ischium, basis, coxa unarmed except for few long setae.

First pleopod (Fig. 8F) uniramous, 2nd (Fig. 8G) to 5th biramous, all lacking appendices. First pleopod smallest, with exopodite slightly shorter than basipodite. Ventral margin of basipodite with long plumose setae; dorsal margin with 6 long plumose setae; exopodite with plumose marginal setae. Ventral margin of 2nd pleopod basipodite bearing 4 spines, 8 plumose setae; dorsal margin unarmed; rami lanceolate, about 2× length of basipodite. Exopodite and endopodite with plumose marginal setae. Third to 5th pleopods generally similar, except 3rd with only 3 spines on ventral margin, decreasing in size, setation posteriorly.

Branchial formula. Same as for *S. devaneyi* given above.

Measurements. Measurements of the holotype are included in Table 1 and compared with other specimens examined.

Coloration. Dorsal and lateral surfaces of carapace with numerous tiny, diffuse, reddish-

Table 1. Meristic data and comparison between carapace, 3rd pereopod, and total length in *Stenopus earlei* (measurements in mm).

Lengths	Specimen					
	BPBM S10012a	BPBM S10012b	BPBM S10007 (holotype)	CAS 030069	CAS 031662	BPBM S8573
Total (T)	15.7	16.5	17.2	19.2	20.2	22.5
Rostral carapace (RC)	6.0	5.8	7.1	8.6	8.2	8.7
Postorbital carapace (PC)	4.2	4.0	4.0	4.8	4.7	5.3
Chela of 3rd pereopod (C)	5.0	5.4	8.1	—	—	10.0
3rd pereopod (P)	14.3	14.0	18.5	—	—	27.0
Ratios P/PC	3.4:1	3.5:1	4.6:1	—	—	5.1:1
P/RC	2.4:1	2.4:1	2.6:1	—	—	3.1:1
P/T	0.9:1	0.8:1	1.1:1	—	—	1.2:1
T/RC	2.6:1	2.8:1	2.4:1	2.2:1	2.5:1	2.6:1

orange chromatophores; many spines in this area red from base to tip; concentrated dark red spot at posteriolateral edge of carapace; anterior to this and medially, clear area with spines unpigmented. Rostrum, eyestalks light red. Edges of antennal and antennular peduncle, scaphocerite, ischium and merus of 3rd maxillipeds outlined in red. Carpus, propodus, dactylus of 3rd maxillipeds reddish. Flagella of antennule, antenna reddish proximally but white for greater part of their length. Lateral red stripe on each side of abdomen converging and narrowing distally, merging at telson, but abdominal pleura and dorsal region mainly white. First and 2nd pereopods with light reddish ischia, meri, and carpi; chelae white. Third pereopods reddish except tips of chelae white. Fourth and 5th pereopods with red meri and reddish ischia; carpi, propodi, and dactyli white. Pleopods with reddish basipodites, rami outlined in light red. Telson reddish, only central area somewhat lighter anteriorly. Uropods with endopodite outlined in red becoming more diffuse centrally; exopodite reddish on outer edge, clear elsewhere. (See color plate IB.) Paratypes similar in coloration of holotype, except carpi, propodi and dactyli of 3rd pereopods whitish. (See color plate ID.)

Paratypes. The new species is variable in the number of body and appendage spines. Rostrum with 5–7 dorsal, 1–5 ventral spines. Scaphocerite with 1–2 proximal spines, 7–9 distal spines on outer margin. Ischium of 3rd maxilliped with 2–7 dorsal spines; merus with 4–6 dorsal spines. One specimen with 5 dorsal meral spines, 6 dorsal carpal spines on 2nd pereopod. Spination on 3rd pereopod very variable: ischium bearing 4–5 dorsal spines; merus with 5–10 dorsal, 5–7 ventral spines; carpus with 10–14 dorsal, 1–5 dorsomesial, and 4–8 ventral spines; and propodus bearing 2–13 dorsal spines. Ventral surface of 6th abdominal somite sparsely covered with spinules in some specimens. Outer margin of uropodal endopodite with 2–3 teeth; outer margin of uropodal exopodite with 6–10 teeth. We could not find any correlation between the number of spines and the size or sex of the animals, but some of these differences may reflect allometric growth changes and normal variation in the species.

Material examined. HAWAIIAN IS: O'AHU I: off Mākua, depth 36.5 m, 12.IV.1981 (John Earle) (BPBM S10007, ♂ holotype); off Mākua, depth 39.6 m, under flat slab nr reef dropoff, VII.1979 (Earle) (BPBM S8573, ♀ paratype); KAUA'I I: off Lāwa'i, depth 15.2 m, under *Porites* slab, 4.X.1981 (Earle) (BPBM S10012, ♂, ♀ paratypes). INDIAN OCEAN: GRAND COMORO I: Mozambique Channel, N of Hotel Itsandra in front of Coelacanth Grotto, depth 20–30 m, 20.II.1975 (McCosker et al.) (CAS 031662, ♀ paratype; CAS 030069, ♂ paratype).

Type-locality. Hawaiian Is: O'ahu I, off Mākua.

Habitat. Most of the specimens were taken under ledges on well-developed coral reef systems in depths greater than 20 m. The new species has long, prominent, white antennal flagella, and even though it was not found in association with any fishes, it may enter into cleaning symbiosis with cooperating fishes, much like its congeners in the genus *Stenopus*.

Etymology. This new species is named for Mr. John Earle, who first drew our attention to the animal. He not only provided the holotype and some of the paratypes but also provided color slides of these specimens. This enabled us to give an extensive morphological, as well as color, description of the species.

Key to the Described Indo-West Pacific Species of *Stenopus*

1. Lateral marginal spines absent on telson; carapace and abdomen white in life; antennal flagella white; abdominal somites with broad middorsal red stripe
..... **S. pyronotus** Goy & Devaney, 1980
- Lateral marginal spine present on telson; abdominal somites otherwise pigmented 2
2. Rostrum not exceeding middle segment of antennular peduncle in length; without ventral spines; with 1 or more lateral spines 3
- Rostrum exceeding middle segment of antennular peduncle; with 1 to 5 ventral spines, but no lateral spines 4
3. Third abdominal somite without bare area posterodorsally; carapace white in life; antennal flagella white; abdomen with red transverse bands on 3rd and 6th somites
..... **S. hispidus** (Olivier, 1811)
- Third abdominal somite with bare area posterodorsally; carapace golden yellow in life; antennal flagella red; abdomen with oval red patches on sides of 2nd and 5th somites
..... **S. zanzibaricus** Bruce, 1976
4. Outer margin of scaphocerite serrate up to final (terminal) tooth; carapace reddish white in life; antennal flagella white; lateral red stripes extending from posterior of carapace along sides of abdomen, converging at telson; 3rd pereopods reddish white except finger tips
..... **S. earlei** Goy & Randall, 1984
- Outer margin of scaphocerite with considerable nonserrate space before final (terminal) tooth; rostrum exceeding antennular peduncle, with both ventral and lateral spines; carapace and abdomen otherwise pigmented; 3rd pereopods banded in red, white, and orange 5
5. Distoventral carpal extremity of 4th and 5th pereopods with 2 to 6 acute movable spines; carapace yellow-brown in life; antennal flagella white; abdomen with bilobed red spot on 2nd and 3rd somites **S. devaneyi** Goy & Randall, 1984
- Distoventral carpal extremity of 4th and 5th pereopods without movable spines; carapace purplish blue in life; antennal flagella white; abdomen with red transverse bands on 3rd and 5th somites **S. tenuirostris** DeMan, 1888

DISCUSSION

Both *Stenopus devaneyi* and *S. earlei* closely follow the definition of the genus *Stenopus* given by Holthuis (1946). *Stenopus devaneyi* is generally more robust than other members of the genus, especially in having stouter appendages. In this regard, it is most closely related to *S. tenuirostris*, but differs in color and in being less spinous on the carapace, abdomen, and appendages. *Stenopus earlei* has squamous spinules on the abdominal somites in contrast to the usually erect spinules in other members of the genus. It is most closely related to *S. scutellatus* from the Western Atlantic, but differs in color and in the spination of the rostrum, scaphocerite, and 3rd maxilliped.

The only stenopodidean shrimp collected from the Marquesas Is is *S. devaneyi*, but *S. tenuirostris* has been photographed at Nuka Hiva I (BPBM photo #188, D.M. Devaney).

Also, both *S. hispidus* (Olivier, 1811) and *S. tenuirostris* have been recorded from other islands of French Polynesia (Holthuis 1946). *Stenopus hispidus* has been the only stenopodid besides *S. devaneyi* reported from Sri Lanka (Müller 1887).

Four species of stenopodidean shrimps have been reported from the Hawaiian Is: *Stenopus hispidus* (Rathbun 1906; McNeil & Ward 1930; Edmondson 1946; Tinker 1965; Hobson & Chave 1972; Titcomb 1979); *Spongicola henshawi* (Rathbun 1906); *Stenopus pyrsonotus* (Goy & Devaney 1980); and *Spongicoloides hawaiiensis* (Baba 1983). *Stenopus earlei* becomes the 5th stenopodid species collected in the Hawaiian Is. It is also reported herein from Grand Comoro I in the Indian Ocean. *Stenopus hispidus* collected from Grand Comoro I has been examined by one of us (JWG) (CAS 03-0067, CAS 030070, CAS 030071, and CAS 030073). A large (70.7 mm total length) *Stenopus pyrsonotus* (CAS 030068) also was found from Grand Comoro I. *Stenopus earlei* was photographed near Kilifi, Kenya, under a boulder inside a cave at a depth of 16 m (H. Debelius, IKAN photograph collection).

The Indo-West Pacific region occupies a large geographic area extending longitudinally more than halfway around the world and latitudinally through about 60° (Briggs 1974). In the east, this region's farthest outposts are the Hawaiian Is, the Marquesas Is, and the Tuamotu Archipelago, while in the west, the east coast of Africa provides a natural boundary (Ekman 1953). It is very interesting zoogeographically that 3 recently discovered species in the genus *Stenopus* (*S. pyrsonotus*, *S. devaneyi*, and *S. earlei*) have been found in these outposts. More extensive sampling in the Indo-West Pacific region will probably lead to records of these species and other stenopodidean shrimps from other localities throughout this tropical marine region.

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