

A New Hawaiian Hermit Crab of the Genus *Trizopagurus* (Crustacea, Decapoda, Diogenidae), with Notes on its Behavior¹

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ABSTRACT: A new deep-water Hawaiian hermit crab, *Trizopagurus hawaiiensis* n. sp., is described and illustrated. Observations on its behavior, feeding habits, and growth rates have been obtained from a specimen kept in the laboratory for more than a year.

THE SUPERFICIAL SIMILARITIES in the genera *Aniculus* Dana, *Dardanus* Paulson, and *Clibanarius* Dana have been the source of many carcinological problems. During a study of pagurids from the Belgian Oceanographic Expedition to the south Atlantic, Forest (1952a) encountered a specimen which he could not adequately assign to any of the known pagurid genera. In many ways this specimen resembled both *Aniculus* and *Clibanarius*, but differed from both in several significant characters. Comparative studies of species assigned to these genera showed that several species, variously assigned to *Aniculus*, *Clibanarius*, and *Dardanus* (as *Pagurus* sensu Dana, cf. Rathbun 1903, Hemming 1957) by earlier carcinologists, agreed better in all diagnostic characters with his new taxon than with the genera to which they had been assigned. Consequently, Forest (1952a) erected the new genus, *Trizopagurus* Forest, for these species. In addition to his new species, *Trizopagurus caparti* Forest, he included *Clibanarius strigimanus* (White), *C. magnificus* Bouvier, *C. melitai* Chevreux & Bouvier, *Aniculus strigatus* (Herbst), and *A. tenebrarum* Alcock. At that time he also

cited, without description, a second new species, *Trizopagurus krempfi*, which he described subsequently in a more complete review of the genus (Forest 1952b). An eighth species, *Trizopagurus shebae* Lewinsohn, recently has been described from the Red Sea (Lewinsohn 1969).

Heretofore, in the Hawaiian fauna, *Trizopagurus* has been known only from *T. strigatus* (cf. Edmondson 1925, 1946, 1952, as *Aniculus strigatus*). From the collections of the Bernice P. Bishop Museum and the National Marine Fisheries Service (NMFS) research vessel *Townsend Cromwell* (TC), a second, and new, species has been discovered. A living specimen, collected during one of the NMFS cruises, was given to one of the authors (JHB) who was able to maintain it in the laboratory for 21 months, during which time observations on feeding habits and molting frequencies were made.

The holotype and female paratype have been deposited in the collections of the National Museum of Natural History, Smithsonian Institution (USNM). Additional paratypes have been deposited in the collections of the Bernice P. Bishop Museum (BPBM), Honolulu, Hawaii, and the Allan Hancock Foundation (AHF), University of Southern California.

Trizopagurus hawaiiensis new species

Figures 1-3

Holotype

Male (SL = 4.8 mm), NMFS station TC 61-119, 21°01.8' N, 156°06.5' W, 2 November 1972, 172-230 m, USNM.

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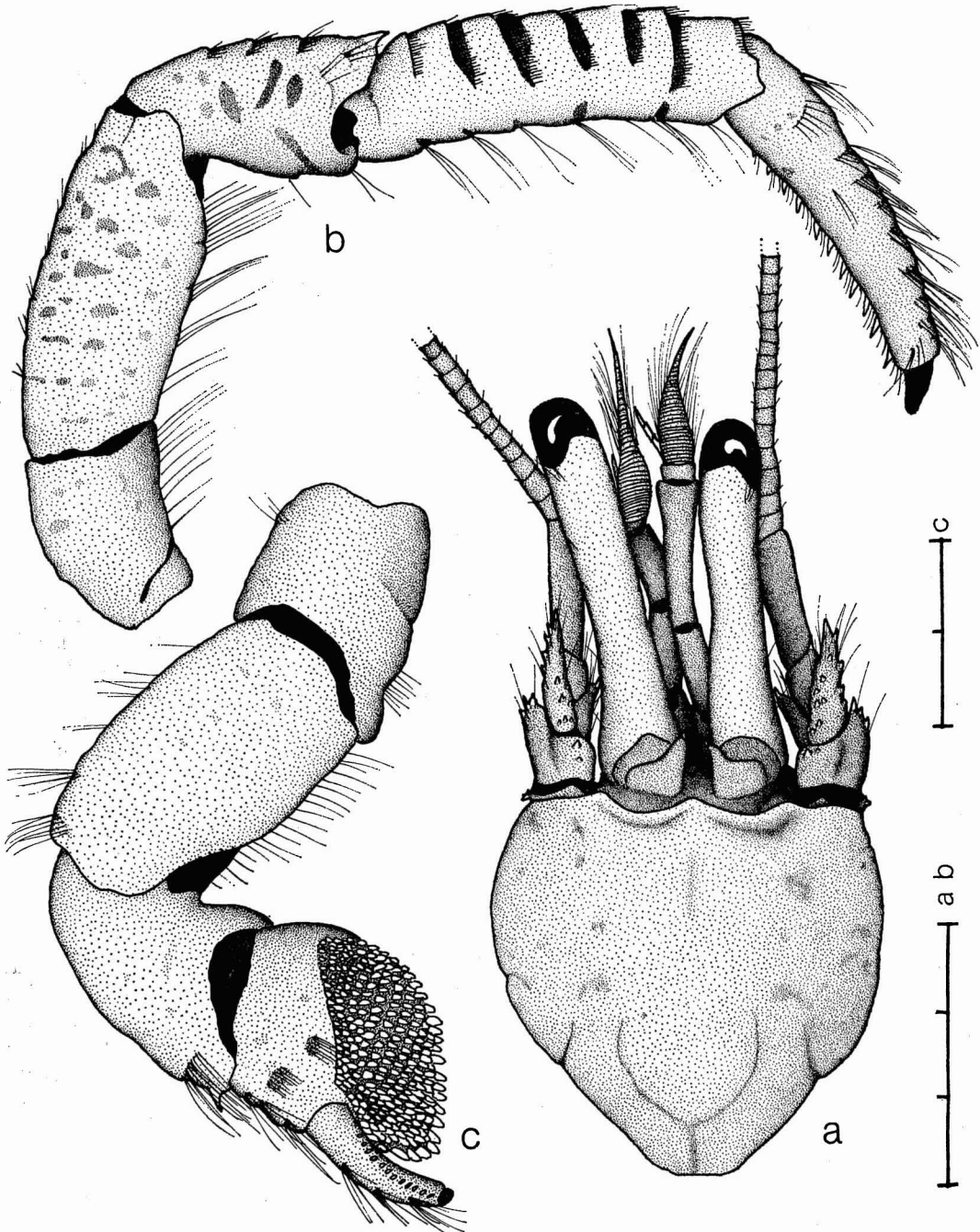


FIGURE 1. *Trizopagurus hawaiiensis* n. sp., male (SL = 4.6 mm). *a*, shield and cephalic appendages; *b*, 3rd right pereiopod (lateral view); *c*, 4th left pereiopod (lateral view). Scales equal 3 mm (*a*, *b*) and 1 mm (*c*).

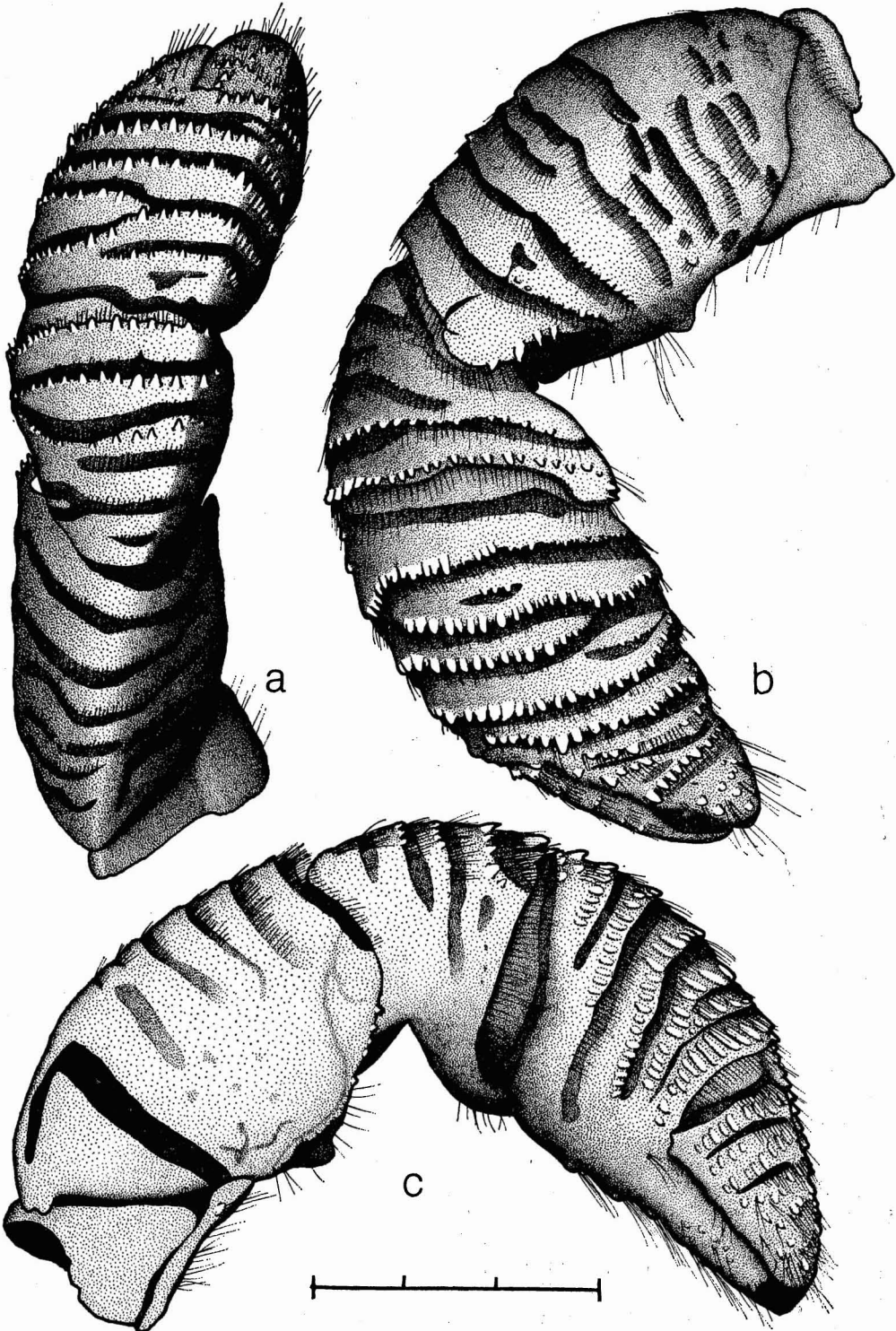


FIGURE 2. *Trizopagurus hawaiiensis* n. sp., male (SL = 4.6 mm). Left cheliped: *a*, dorsal view; *b*, lateral view; *c*, mesial view. Scale equals 3 mm.

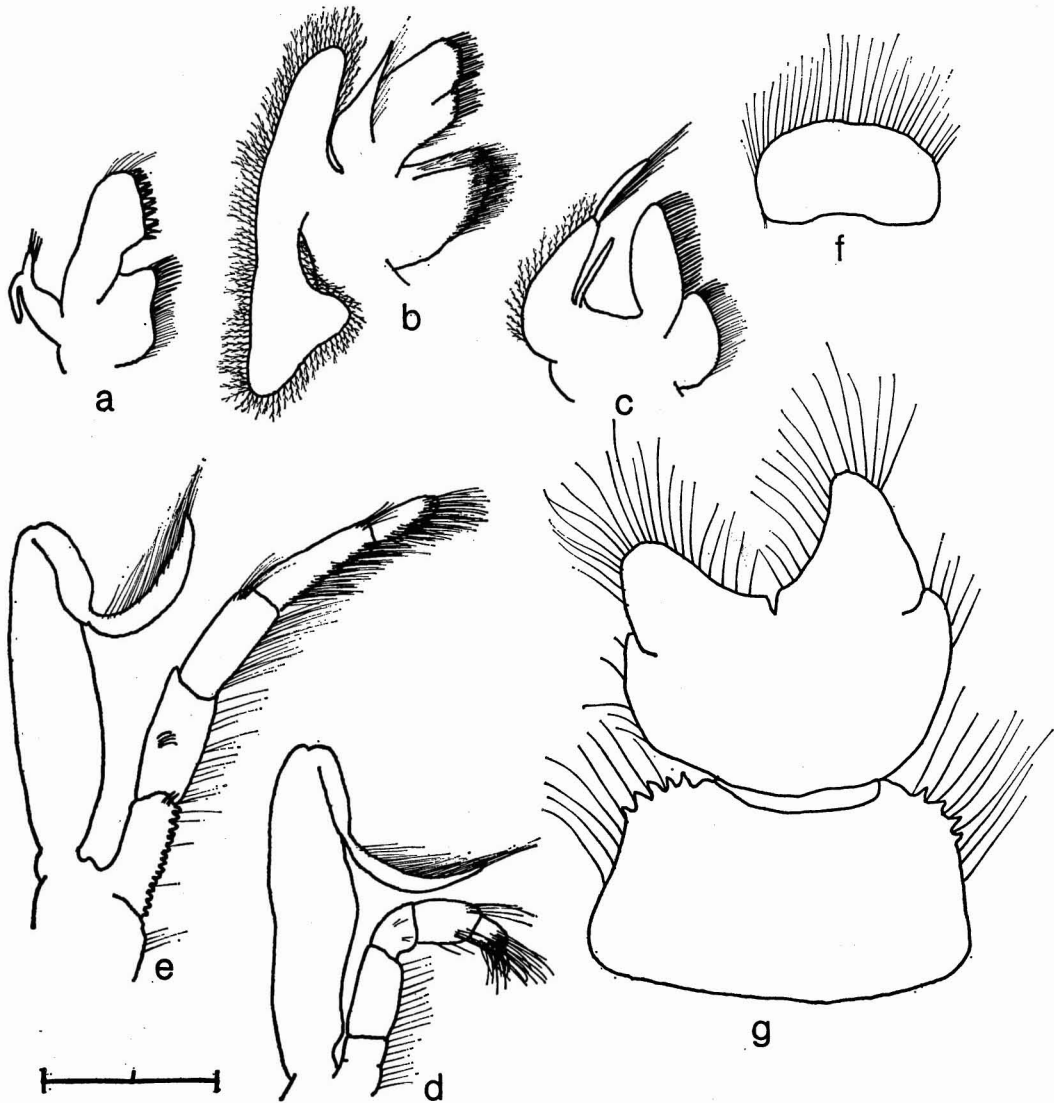


FIGURE 3. *Trizopagurus hawaiiensis* n. sp. *a-e*, mouthparts (left, internal view): *a*, maxillule; *b*, maxilla; *c*, mxp₁; *d*, mxp₂; *e*, mxp₃. *f*, sternite of 3rd pereopods. *g*, 6th abdominal segment and telson. Scale equals 1 mm.

Paratypes

1 male (SL = 5.6 mm), 1 female (SL = 4.7 mm), NMFS station TC 61-119, 21°01.8' N, 156°06.5' W, 2 November 1972, 172-230 m, AHF, USNM; 1 male (SL = 4.6 mm), off Oahu, 23 September 1971, 382 m, BPBM; 1 male (SL = 4.9 mm), off Haleiwa, Oahu, Hawaii, 20 June 1970, T. Clarke collector, 382 m, BPBM S-8400.

Type Locality

Hawaii, 21°01.8' N, 156°06.5' W.

Diagnosis

Chelae and carpi of both chelipeds with transverse rows of small spines dorsally and laterally. Meri of second ambulatory legs each with row of small spines on ventral margin.

Description

Shield usually slightly longer than broad; anterolateral margins sloping, anterior margin between rostrum and lateral projections straight or somewhat concave; posterior margin truncate or roundly truncate; dorsal surface with incomplete subovate demarcation posteriorly (Figure 1*a*) and with few scattered tufts of setae; degree of dorsoventral flattening contingent upon habitat (see remarks). Rostrum short, not exceeding lateral projections; terminating acutely or subacutely and with small spine or spinule. Lateral projections obtusely triangular, each with small submarginal spine.

Ocular peduncles long, exceeding length of shield, cylindrical, slightly inflated basally and very slightly dilated in corneal region; dorsal and dorsomesial faces usually with few tufts or longitudinal row of fine short setae. Ocular acicles narrowly triangular, mesial margins usually straight, lateral margins sloping; terminating acutely and with small marginal or submarginal spine; separated basally by one-half to two-thirds basal width of one acicle.

Antennular peduncles moderately long, usually reaching to base of corneae; ultimate and penultimate segments each usually with few scattered setae; basal segment with small spine at ventrodorsal margin, laterodorsal margin with one–five strong acute spines, lateral face dorsally occasionally with small spinule.

Antennal peduncles moderately short, one-third to two-thirds length of ocular peduncles; with supernumerary segmentation (cf. McLaughlin 1974). Fifth segment with few scattered tufts of short setae. Fourth segment with small spine at dorsodorsal margin. Third segment with strong acute spine at ventrodorsal margin and few tufts of moderately long setae. Second segment with dorsolateral distal angle produced, terminating in moderately strong, simple or bifid spine, lateral margin with one–three small spines and few moderately long setae, mesial margin unarmed or with one or two small spines; dorsomesial distal angle usually with very small spinule or with one or two adjacent small spines, mesial margin with tufts of setae and occasionally with one or two adjacent small spines. First segment with small spine on lateral face distally; ventral margin

produced, with row of small spines or spinules laterally. Antennal acicle short, reaching proximal third of ultimate peduncular segment; terminating in acute, simple or bifid spine; dorsomesial face with two–seven small spinules, lateral margin with one–four moderately strong spines. Antennal flagella long, considerably overreaching chelipeds; usually each article with one or two minute bristles.

Mandible without distinguishing characters. Maxillule (Figure 3*a*) with three or four stiff bristles on moderately well-developed internal lobe, external lobe extremely well developed, recurved; proximal endite subquadrate, superodistal angle slightly produced. Maxilla (Figure 3*b*) with broad, tapering endopodite slightly exceeding scaphognathite in distal extension. First maxilliped (Figure 3*c*) with basal segment of exopodite moderately slender. Second maxilliped (Figure 3*d*) with basis-ischium fusion incomplete. Third maxilliped (Figure 3*e*) with basis-ischium fusion incomplete; basis unarmed; ischium with crista dentata well developed, without accessory tooth; merus and carpus unarmed.

Chelipeds (Figure 2*a–c*) equal or slightly subequal, short; similar in armature and ornamentation. Dactyls moderately short, slightly shorter than or equal to length of palms; cutting edge each with one or two prominent calcareous teeth proximally, few corneous teeth medianly, and terminating in very strong, elongate corneous claw; dorsomesial margins not markedly delimited, dorsal and mesial faces each with one–four irregular, shallow, transverse furrows and irregular rows of low, often corneous-tipped, tuberculate spines proximally, scattered, corneous-tipped small spines distally partially obscured by tufts of long stiff setae; ventral surface with few tufts of stiff setae or bristles. Palms moderately long, usually exceeding length of carpus; dorsolateral margins not delimited, dorsal, lateral, and mesial faces each marked by shallow transverse furrows; dorsally and laterally, each furrow usually bounded proximally by row of moderately strong, often corneous-tipped spines or spinulose tubercles interspersed with very short fine setae; fixed finger distally with scattered spines partially obscured by tufts of long stiff setae; furrows of mesial face bounded

proximally by transverse rows of corneous-tipped rods forming stridulating apparatus; ventral surfaces each with few transverse furrows mesially and laterally, and scattered tufts of long setae. Carpi moderately short, one-half to two-thirds length of meri; subtriangular; dorsal, lateral, and mesial faces each with several shallow transverse furrows, dorsally and laterally each usually bounded proximally by row of small spines or spinules interspersed with fine short setae; distal margin dorsally and laterally with row of moderately strong, occasionally corneous-tipped spines and row of short fine setae. Meri subtriangular; dorsal margins, lateral and to lesser extent mesial faces each with shallow transverse furrows, bounded proximally by rows of short fine setae and occasionally by a row of small spines or spinules; dorsal margin also usually with few spines most prominent distally; ventral surface often with prominent large tubercle, ventromesial and ventrolateral margins usually with short row of spines distally. Ischia each with row of short setae and occasionally one or two small spines on ventromesial margin. Coxae each with tuft of long setae at ventromesial distal angle and row of setae on ventromesial margin.

Ambulatory legs moderately long, usually overreaching chelipeds by full length of dactyls of P_2 ; generally similar in armament and ornamentation. Dactyls moderately long, equaling or slightly exceeding length of propodi; in lateral view, straight or slightly curved ventrally; in dorsal view, straight; dorsal surfaces each with irregular rows of tufts of long stiff setae, often arising from low protuberances; lateral and mesial faces each with irregular rows of shallow depressions and tufts of long setae; ventral surfaces each with row of moderately strong corneous spines, increasing in size distally and partially obscured by tufts of long setae. Propodi moderately long, one-fourth to one-third longer than carpi; each with series of prominent ridges (Figure 1*b*) and rows of short fine setae circumscribing segment, more irregular and somewhat interrupted on P_3 ; dorsal surfaces also with additional tufts of long setae. Carpi moderately short, one-third to two-thirds length of meri; dorsal and lateral, and less frequently, mesial surfaces each with series

of short transverse ridges and rows of short fine setae, dorsally also armed with few small spines or spinules (P_2) or unarmed (P_3), dorsodistal margins each with strong spine. Meri moderately long, laterally compressed; dorsal surfaces each with row of low transverse ridges and short setae, extending laterally and mesially in distal half; ventral margins each with single or double row of small spines (P_2) or unarmed (P_3) and with row of tufts of short setae. Ischia each with row of setae on ventral margin. Coxae each with rows of tufts of setae on ventromesial and ventrolateral margins. Sternite of third pereopods roundly rectangular, anterior margin with long, moderately fine setae (Figure 3*f*).

Fourth pereopods (Figure 1*c*) subchelate; dactyls apparently without preungual process; propodal rasp very well developed, encompassing approximately one-half to two-thirds of lateral face; carpi each with small spine at dorsodistal margin.

Fifth pereopods chelate.

Males with four biramous unpaired pleopods, with external rami moderately well developed, internal rami reduced. Females with four biramous unpaired pleopods, with both rami multisegmented and well developed.

Uropods generally symmetrical. Posterolateral angles of sixth abdominal segment each with one-five small spines (Figure 3*g*). Telson with posterior lobes broadly subtriangular, symmetrical or slightly asymmetrical, with moderately shallow median cleft; posterolateral angles acutely or broadly rounded, terminal margins with long setae.

COLOR IN PRESERVATIVE (ethanol): Shield generally light orange with darker mottling of reddish orange laterally; rostral point dark red-orange. Ocular peduncles and acicles dark to light reddish orange. Antennular and antennal peduncles colorless, except for antennal acicles and second peduncular segments, which appear mottled orange. Chelipeds with furrowed areas cream-colored, remaining surfaces reddish orange to orange, flecked with white or cream. Ambulatory legs generally mottled orange and cream; dactyls more uniformly dark reddish orange with cream-colored depressions and tips; propodi white or cream distally. All color

fading in time to white or straw-color. In specimens lacking color, the shallow furrows of the chelipeds are often difficult to discern.

COLOR IN LIFE: An overall red-orange color, of brighter tones than the preserved specimen. The shallow furrows of the chelipeds and the apical tips of the antennules are bright yellow.

Distribution

At present known only from the Hawaiian Islands; 172–382 meters.

Affinities

Trizopagurus hawaiiensis appears most closely allied to *T. tenebrarum* from the Indian Ocean and the Gulf of Aden. However, the prominent shallow furrows and stronger spination of the chelipeds and the armature of the carpi and meri of the second pereopods of *T. hawaiiensis* immediately distinguish this species from the former. The presence of spines on the chelipeds also distinguishes *T. hawaiiensis* from *T. strigatus*, the only other representative of the genus known from Hawaiian waters. A superficial similarity also exists between *T. hawaiiensis* and the Hawaiian *Aniculus maximus* Edmondson and the Indo-Pacific *Aniculus aniculus* Fabricius; however, the generic characters which distinguish *Trizopagurus* from *Aniculus* clearly confirm the distinction of *Trizopagurus hawaiiensis*.

Remarks

Forest (1952*b*), in his characterization of *Trizopagurus*, did not mention the rather unusual multisegmented condition of the female pleopods. This segmentation is very pronounced in *T. hawaiiensis*. In the three other species of *Trizopagurus* available to the authors, varying degrees of segmentation were observed. In both *T. strigatus* and *T. magnificus*, segmentation of the rami was incomplete; in *T. tenebrarum*, segmentation was distinct.

As previously indicated, a male specimen of

T. hawaiiensis was maintained in the laboratory for a period of 21 months. At the time of its capture, this specimen occupied a shell of *Terebra gouldii* Deshayes. Shortly after the demise of a hermit crab, which occupied a shell of *Xenophora tenuis* Fulton and which shared the aquarium with *Trizopagurus hawaiiensis*, the latter took up residence in the *Xenophora tenuis* shell. As is common with hermit crabs, this "house swapping" occurred more than once. *T. hawaiiensis* eventually took up permanent residence in the lighter and less cumbersome *Terebra gouldii* shell. Examination of this specimen after its preservation revealed no dorsoventral flattening of the carapace. In contrast, specimens of this species collected and preserved in their shells of *Xenophora tenuis* did exhibit varying degrees of dorsoventral compression. These observations lend support to Forest's (1952*a*) proposition that the marked degree of carapace compression seen in some species of *Trizopagurus* is more a function of habitat than a genetic trait.

Although the specimen of *T. hawaiiensis* was maintained on a diet of fish chunks, during its first few days in the aquarium it eagerly ate the serpulid worms encrusting the shells of *Xenophora tenuis* and *Terebra gouldii*. While inhabiting the *Xenophora tenuis* shell, the crab simply picked the worms from the tubes attached to the shell of *Terebra gouldii*. However, after returning to the more elongate *T. gouldii* shell, *Trizopagurus hawaiiensis* would balance against the *Xenophora tenuis* shell, using the ambulatory legs and the apex of its shell as a tripod, and pick the worms from their tubes with its chelae.

During the 21 months in the aquarium, the specimen molted four times, the first molt occurring 4.5 weeks after capture (late October). Although growth measurements were not taken with successive molts, the specimen increased from a shield length of 3.1 mm at the time of the first molt to a shield length of 4.6 mm at the time of its preservation, or an average of slightly less than 0.4 mm increase in shield length per molt.

The specific name of this species is derived from the type locality, Hawaii.

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LITERATURE CITED

- EDMONDSON, C. H. 1925. Crustacea. Pages 3-69 in C. H. Edmondson, W. K. Fisher, H. L. Clark, A. L. Treadwell, and J. A. Cushman. Marine zoology of tropical central Pacific. Bull. Bernice P. Bishop Mus. 27. 148 pp.
- . 1946. Reef and shore fauna of Hawaii. Spec. Publ. Bernice P. Bishop Mus. 22. iii + 381 pp.
- . 1952. Additional central Pacific crustaceans. Occ. Pap. Bernice P. Bishop Mus. 21(6): 67-86.
- FOREST, J. 1952a. Sur *Trizopagurus caparti* gen. et sp. nov., paguride de la côte occidentale d'Afrique. Bull. Inst. R. Sci. Nat. Belg. 28: 1-8.
- . 1952b. Contributions à la revision des crustacés Paguridae. I. Le genre *Trizopagurus*. Mém. Mus. Nat. Hist. Nat., sér. A, Zool. 5: 1-40.
- HEMMING, F., ed. 1957. Opinion 472. Addition to the official list of generic names in zoology of the generic name *Pagurus* Fabricius, 1775, with *Cancer bernhardus* Linnaeus, 1758, as type species (class Crustacea, order Decapoda). Opinions and Declarations of the International Commission for Zoological Nomenclature 16: 213-276.
- LEWINSOHN, C. 1969. Die Anomuren des Roten Meeres (Crustacea Decapoda: Paguridea, Galatheidea, Hippidea). Zool. Verh. Rijksmus. Nat. Hist. Leiden 104. 213 pp.
- MCLAUGHLIN, P. A. 1974. The hermit crabs (Crustacea Decapoda, Paguridea) of north-western North America. Zool. Verh. Rijksmus. Nat. Hist. Leiden 130. 396 pp.
- RATHBUN, M. J. 1903. Japanese stalk-eyed crustaceans. Proc. U.S. Nat. Mus. 26: 23-55.