A New Species of *Parapetulus* (Copepoda: Caligidae) Parasitic on the Samson Fish, *Seriola hippos* from Australia and Its Similarity with *Caligus spinosus*

By

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With Text-figures 1–3

Abstract *Parapetulus spinosus*, new species, was recovered from the gill arches of the samson fish *Seriola hippos* Gunther. The female of this species, although grossly different in its genital complex and abdomen, is otherwise virtually identical with *Caligus spinosus* Yamaguti, which was found on the same host. Also, the male of the new species appears to be identical in every detail with the males described from *C. spinosus*. The similarities are explained by divergent evolution on one host species. A proposal to relagate *Caligus kurochkini* Kazatchenko to the genus *Parapetulus* is given, bringing the Australian records of the genus to three species.

In December of 1983 a study was initiated in the Coffs Harbour area on the Australian east coast of the ectoparasite fauna of the samson fish (*Seriola hippos*). Two copepod species were recorded, and although they belong to different genera of the same family (Caligidae), they are remarkably similar in most morphological characters.

Fish were caught by rod and reel, from Coffs Harbour, New South Wales, They were pithed, their heads cut off and placed in 10% formalin. The external surface, mouth cavity, nares, gills and gill arches as well as sediment from fish samples were examined by Dr. Chris Donovan. Copepods were excised and washed in sea water prior to fixation in 70% alcohol. Specimens were cleared and dissected in lactic acid. Measurements of male and female copepods are based on ten specimens each. Measurements are given in micrometers (μm) as mean (range), length width. Drawings were made using a camera lucida.

Parapetulus spinosus sp. nov.

Material examined. Holotype female (222993), allotype male (222994), 5 female paratypes (222995) and 2 male paratypes (222996) deposited in the National Museum of Natural History, Smithsonian Institution; 3 female paratypes (1985. 341–343) and 3 male paratypes (1985. 344–346) deposited in the British Museum of Natural History.

Host: *Seriola hippos* Gunther, 1876. Site: Gill Arches. Locality: Coffs Harbour, New South Wales, Australia.

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Female. Total length 4300 (3470–4900). Dorsal shield circular, (Fig. 1–A) 1880 (1590–2040) × 1940 (1590–2120) with thoracic zone just extending further posteriorly than tips of lateral zones. Well developed frontal plate, only slightly larger than half entire width of shield; lunules round and protruding. First antennae projecting nearly to lateral borders. Latter fringed with transparent marginal membrane. Fourth leg-bearing segment indistinctly separated from genital complex. Genital complex very large 1650 (1290–1900) × 1080 (900–1220), with large posterolateral lobes. Lobes (Fig. 1–D, E) with a number of small spines along margins and 2 rounded lobes posteromedial on genital segment ventral to abdomen. Division between genital complex and abdomen indistinct. Abdomen 820 (570–920) × 800 (590–920), one-segmented, longer than, and as wide as thoracic zone of dorsal shield, with large rounded posterolateral lobes which extend to posterior margins of the caudal rami. Caudal ramus small, subquadrangular, as long as wide, armed with 6 small setae.

Second antenna (Fig. 2–C) with long, sharply curved claw with usual 2 setae; posterior process of second segment with flange. Postantennary process (Fig. 1–G) consisting of curved claw, at base of which there is a large spine and 2 hair-bearing papillae, similar third papilla present some distance from base of claw.

Dentiform process of first maxilla (Fig. 1–F) with broad subtriangular base curving towards tip which is rimmed by membrane; short inner branch at about half entire length; base with conical papilla tipped by 3 setae. Mandible typical of family.

Maxilliped (Fig. 2–D) robust; corpus with smooth medial margin and striated protuberance near middle; claw of subchela long and curved, seta near base of claw less than half its length. Second maxilla with unusually long flabellum.

Sternal furca (Fig. 2–B) with almost square, flattened box, lobe on each lateral margin; tines diverge before converging near tips; each tip blunt and provided with flange.

First leg (Fig. 2–G) with patch of small denticles on basal segment. Exopod of leg 1 (Fig. 2–H) with 1 terminal seta and 3 spines; central 2 bifid, others simple. Spine 1 (anteriormost) armed with row of fine denticles, longer than spines 2 and 3, about same length as spine 4 which is naked. Spines 2 and 3 about same length, armed on posterior margins with row of denticles; each with large, naked secondary processes arising from posterior half of each seta (nearly half length of seta). Posterior margin of same segment with 3 short pinnate setae. Basal segment of second leg (Fig. 1–C) with conical papilla which is apically armed with recurved spines. First endopod segment of leg 2 (Fig. 1–B) with first segment armed with row of sharp spines followed by more proximal row of fine setules; lateral margins of second and third segments with fine setules.

Third leg (Fig. 2–A) with basal apron bearing a ventral protuberance surmounted by a several sturdy spines located just lateral to the submedian longitudinal rib which curves ventrally and bifurcates. Additional field of small spines lateral to round protuberance and adhesive pad near margin. Fourth leg (Fig. 2–E) with

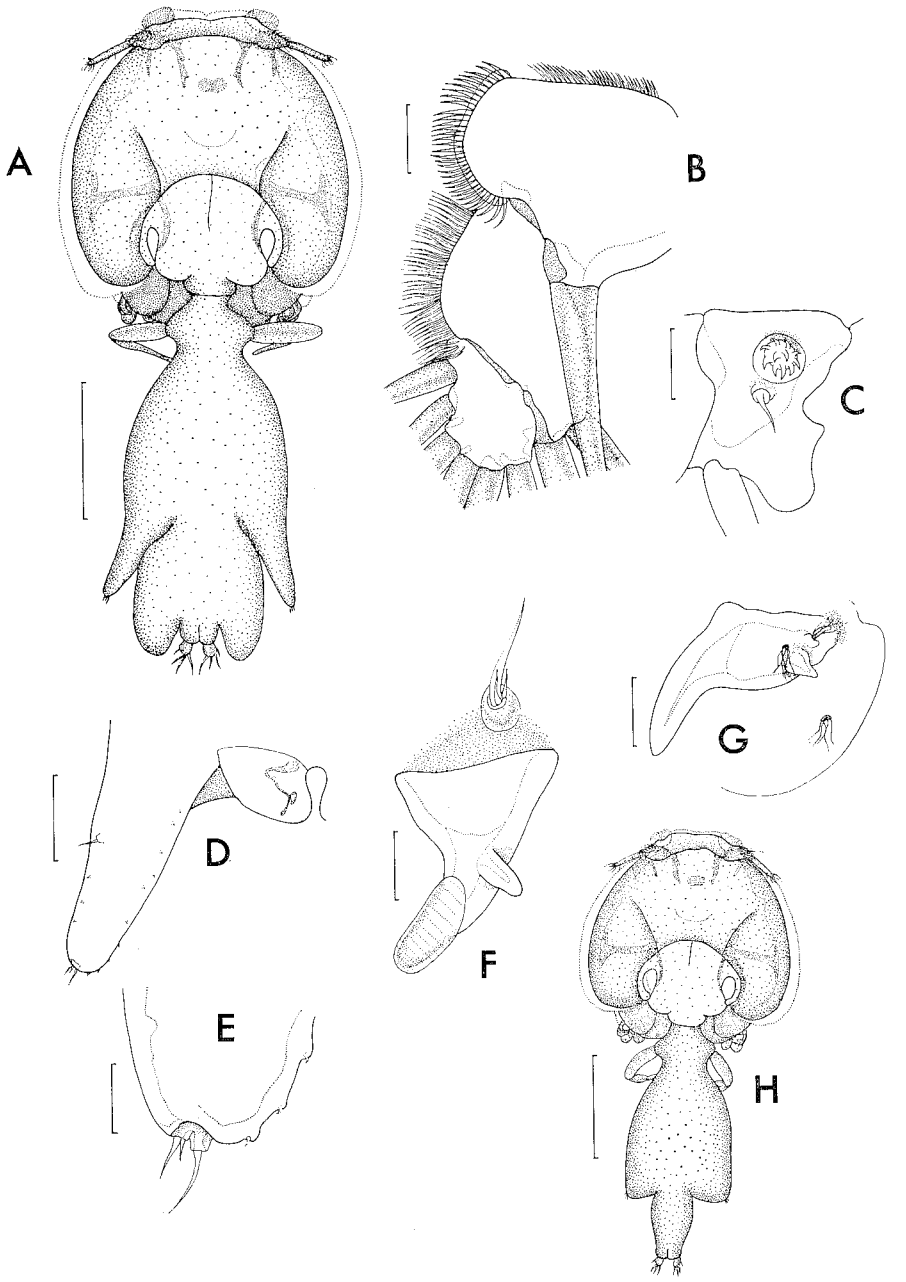

Fig. 1. *Parapetulus spinosus* sp. nov. A. Female, dorsal; B. Second endopod, ventral; C. Basal segment of second leg, ventral; D. Posterior section of genital complex, ventral; E. Posterolateral tip of genital complex, ventral; F. First maxilla, ventral; G. Postantennary process, ventral; H. *Caligus spinosus*, female, dorsal. Scale lines: A, H, 1000 μm; B, C, F, G, 50 μm; D, 75 μm; E, 25 μm.

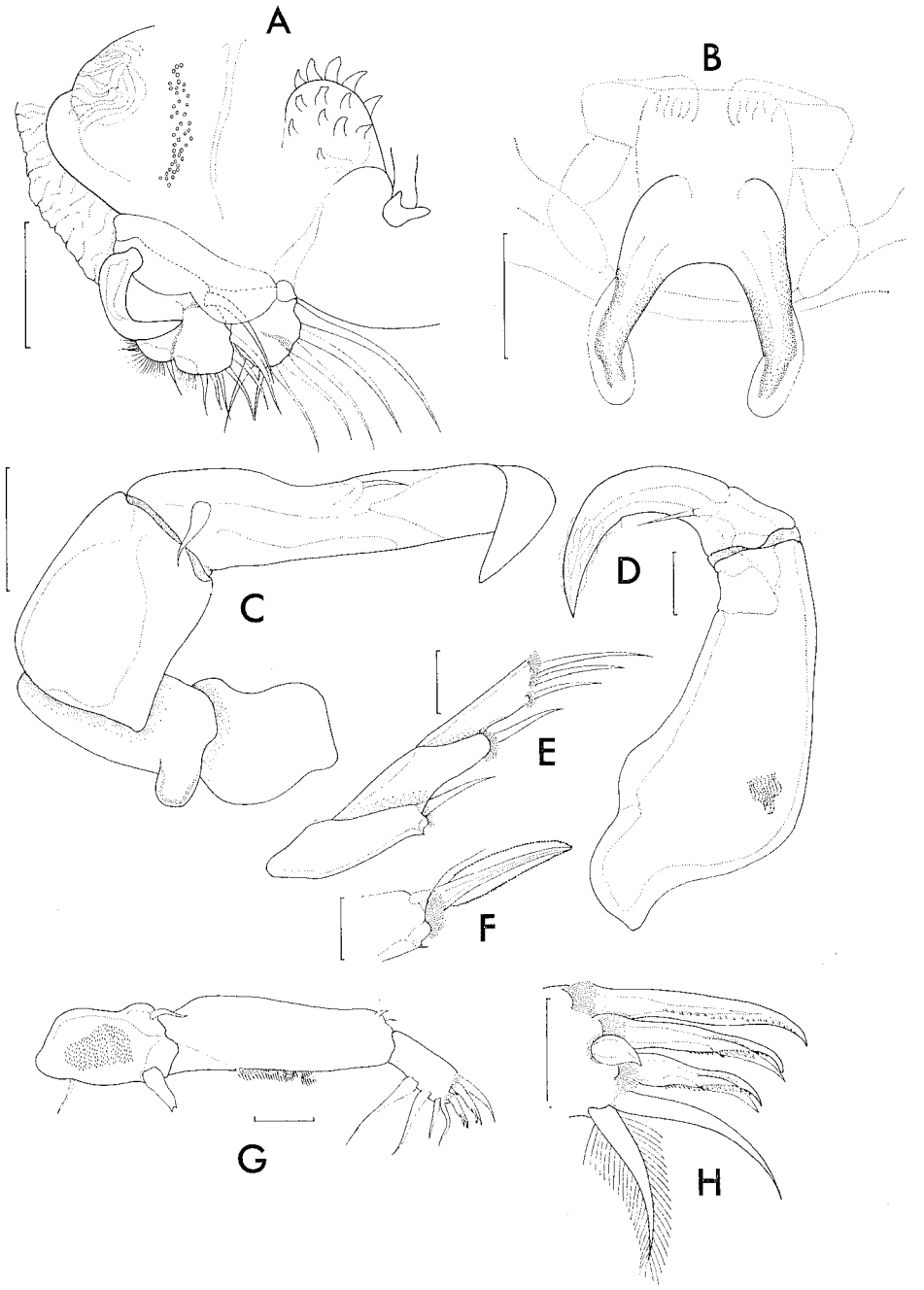

Fig. 2. *Parapetulus spinosus* sp. nov. A. Third leg, ventral; B. Sternal furca, ventral; C. Second antenna, ventral; D. Maxilliped, ventral; E. Distal half of fourth leg, ventral; F. Seta of first exopod segment of fourth leg, ventral; G. First leg, ventral; H. Distal tip of first exopod, ventral. Scale lines: A–E, G, 100 μm; F, H, 50 μm.

distal tip of sympod bearing one pinnate seta; exopod three-segmented, distal segment armed with 3 apical spines. One apical spine on other two exopod segments; spine of basal section (Fig. 2–E) ventrally overlapped at base by following segment and with small spine near its base. All spines armed with strips of serrated membrane on two margins and with pectens at bases.

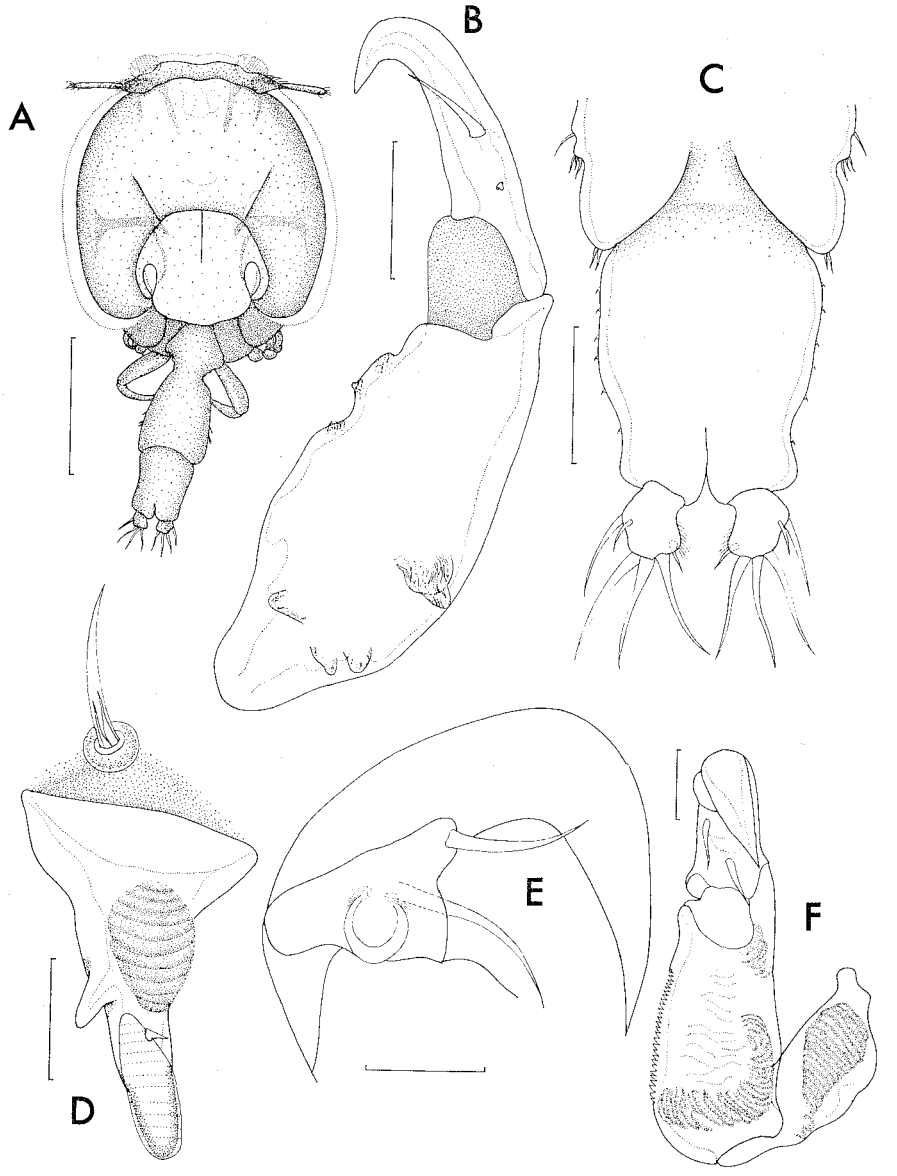

Fig. 3. *Parapetulus spinosus* sp. nov. A. Male, dorsal; B. Maxilliped, ventral; C. Genital complex to caudal rami, ventral; D. First maxilla, ventral; E. Claw of second antenna, ventral; F. Second antenna, ventral. Scale lines: A, 1000 μm; B, 100 μm; C, 200 μm; D–F, 50 μm.

Fifth leg (Figs. 1–D, E) consisting of 1 small, lateral setule and 3 small terminal setules of unequal length.

Male. Total length 3140 (2860–3510). Dorsal shield (Fig. 3–A) similar to that of female, 1760 (1630–2040) × 1690 (1490–1940). Fourth leg-bearing segment indistinctly separated from genital complex. Latter complex 610 (530–710) × 450 (390–510), about one third as long as dorsal shield, trapezoid in shape; posterior border concave and distinctly separated from abdomen. Abdomen (Fig. 3–C) one-segmented, not as long as previous segment, 450 (410–510) × 350 (310–410), tapering slightly posteriorly, posteromedially incised. Caudal ramus (Fig. 3–C) similar to that of female.

First antennae extend beyond lateral margins of dorsal shield. Second antenna (Fig. 3–F) with terminal claw (Fig. 3–E) in form of simple, curved hamulus, rounded protuberance (perhaps a secondary tine) and 2 spines near base. First and second segments with adhesive pads.

Dentiform process of first maxilla (Fig. 3–D) similar to that of female except for additional small blunt spine proximal to barbel.

Fifth leg (Fig. 3–C) consisting of 4 setules, 1 a short distance anterior to other 3, all on small projections anterior to posterolateral corner of genital complex. Sixth leg (Fig. 3–C) consisting of 2 setules on posterolateral corner of genital complex.

Etymology. The name *spinosus* refers to the similarity with *Caligus spinosus* Yamaguti, 1939.

Remarks. The new species is most similar to *Caligus kurochkini* Kazachenko, 1975 parasitic on the carangid, *Usacaranx georgianus* (Cuv. et Val.), from the Great Australian Bight. This species, because of its large genital complex and abdomen, is transferred to the genus *Parapetulus.* Although the new species and *P. kurochkini* have similar dorsal shields and third legs, they can easily be distinguished by the size and shape of the genital complex and fourth leg-bearing segment, as well as the armature of the first leg. The genital complex of *P. spinosus* is relatively shorter with large posterolateral lobes, whereas *P. kurochkini* has no lobes. The fourth leg-bearing segment of the new species is less than one quarter the length of its dorsal shield, while that of *P. kurochkini* is more than two-thirds its shield length. The setae on the posterior margin of the exopod of leg 1 are twice as long in the new species.

Parapetulus gunteri Pearse, 1957 is the only other record of this genus from Australian waters; it was recorded by Kabata (1966) from the gills of *Rachycentron canadus* (L.) at Moreton Bay, Queensland.

Other Observations. The female of the new species, aside from obvious differences posterior of the dorsal shield (see Figs. 1–A, H), is virtually identical with *Caligus spinosus* Yamaguti, 1939. *Caligus spinosus* is clearly a parasite which is specific to *Seriola* spp. It has been recorded by Yamaguti (1939) from the gill filaments of *Seriola quinqueradiata* Temm. et Schleg in Japan and by Shiino (1960) from *S. aureorittata* Temm. et Schleg in Japan. It has also been recorded in Australian waters

on the gill arches of *S. grandis* Castlenau by Rohde (1978) and in the debris of *S. hippos* Gunther by me.

A large number of female and male *Parapetulus* specimens (some *in copula*) were collected from the gill arches of the host while only 5 female *Caligus spinosus* were found in the debris of the same host. I assume that all males found in my study belong to *Parapetulus* and not *Caligus* since males, like females, were found on the gill arches and are all identical with those attached to female *Parapetulus* specimens.

However, I have examined male specimens of *Caligus spinosus* from *Seriola grandis* and found them to be morphologically identical with *Parapetulus* males. So, although the males are seemingly identical, they belong to different genera.

Both *Parapetulus* and *Caligus* specimens have egg sacs ruling out any hypothesis of post-mating metamorphosis. Similarities between copepods infecting the same or similar hosts have also been observed by Pillai (1970). For example, he noticed that *Caligus coufusus* Pillai, 1961, *C. platurus* Kirstinghe, 1964, *C. cordyla* Pillai, 1963, and many other species found on carangid fishes all over the world show general similarities such as a four-segmented fourth leg, and long second segment of the first antenna. Pillai considered these as cases of convergent evolution. I cannot, however, accept this explanation for the similarities between *Parapetulus spinosus* and *Caligus spinosus*. It would imply that the parasites of different genera have secondarily acquired nearly identical morphology as a result of adapting to a particular niche on their common host. This explanation is contradicted by the observation that these two species usually inhabit different sites on the host: *Parapetulus spinosus* is found only on the gill arches and *Caligus spinosus* on the gill filaments of its hosts, with the notable exception of *Seriola grandis*, where it is found on the gill arches (Rohde, 1978). In addition, caligids have no specialized attachment organs which restrict them to a particular site on their hosts. Hence it seems highly unlikely that selective pressures have lead to the remarkable similarities between these two parasites, even if there were some overlap in their host sites.

The similarities between *Parapetulus spinosus* and *Caligus spinosus* can best be explained by conservation of morphological features during divergent evolution from a common ancestor.

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