

# Seven new species of *Hatschekia* Poche, 1902 (Copepoda: Siphonostomatoida: Hatschekiidae) parasitic on fishes of New Caledonia, and a redescription of *H. cadenati* Nunes-Ruivo, 1954

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## ABSTRACT

Members of the genus *Hatschekia* Poche, 1902 (Copepoda: Siphonostomatoida: Hatschekiidae) are gill parasites found on eight orders of marine actinopterygian fishes: Anguilliformes, Aulopiformes, Beryciformes, Ophidiiformes, Perciformes, Pleuronectiformes, Scorpaeniformes, and Tetraodontiformes. The genus *Hatschekia* is particularly species rich in tropical and subtropical regions. Eight species of *Hatschekia* are described from the gill filaments of seven perciform fish hosts (four serranids, two lutjanids and a lethrinid) collected off New Caledonia. Seven of them are newly described: *Hatschekia maculatus* n. sp. from *Epinephelus maculatus* (Bloch, 1790), *Hatschekia cyanopodus* n. sp. from *Epinephelus cyanopodus* (Richardson, 1846), *Hatschekia louti* n. sp. from *Variola louti* (Forsskål, 1775), *Hatschekia euanus* n. sp. from *Gymnocranius euanus* (Günther, 1879), *Hatschekia eteliscicola* n. sp. from *Etelis carbunculus* (Cuvier, 1828) and *Etelis coruscans* Valenciennes, 1862, *Hatschekia fuscoguttatus* n. sp. from *Epinephelus fuscoguttatus* (Forsskål, 1775), and *Hatschekia niger* n. sp. from *Macolor niger* (Forsskål, 1775). The widely distributed species *Hatschekia cadenati* Nunes-Ruivo, 1954 is

**KEY WORDS**

*Hatschekia*,  
Siphonostomatoidea,  
barcode,  
New Caledonia,  
fish hosts.

redescribed based on material from *Epinephelus cyanopodus* and was also newly recorded from another five species of *Epinephelus* Bloch, 1793 and two species of *Variola* Swainson, 1839 (all members of the serranid subfamily Epinephelinae Bleeker, 1875). Partial sequences of the mitochondrial gene COI (cytochrome c oxidase subunit I) of *Hatschekia maculatus* n. sp., *H. cyanopodus* n. sp. and *H. cadenati* were obtained and submitted to GenBank.

**RÉSUMÉ**

*Description de sept espèces nouvelles de Hatschekia Poche, 1902 (Copepoda : Siphonostomatoidea : Hatschekiidae) parasites de poissons de Nouvelle-Calédonie, et redescription de H. cadenati Nunes-Ruivo, 1954.*

Les copépodes du genre *Hatschekia* Poche, 1902 (Copepoda : Siphonostomatoidea : Hatschekiidae) sont des parasites trouvés sur huit ordres de poissons actinoptériens marins : Anguilliformes, Aulopiformes, Beryciformes, Ophidiiformes, Perciformes, Pleuronectiformes, Scorpaeniformes, et Tétrodontiformes, chez qui ils se fixent sur les branchies. Le genre *Hatschekia* est particulièrement riche en espèces dans les régions tropicales et subtropicales. Huit espèces d'*Hatschekia* sont décrites ici des filaments branchiaux de sept poissons perciformes hôtes (quatre serranides, deux lutjanides et un lethrinide) collectés au large de la Nouvelle-Calédonie. Sept d'entre elles sont nouvellement décrites : *Hatschekia maculatus* n. sp. sur *Epinephelus maculatus* (Boch, 1790), *Hatschekia cyanopodus* n. sp. sur *Epinephelus cyanopodus* (Richardson, 1846), *Hatschekia louti* n. sp. sur *Variola louti* (Forsskål, 1775), *Hatschekia euanus* n. sp. sur *Gymnocranius euanus* (Günther, 1879), *Hatschekia eteliscicola* n. sp. sur *Etelis carbunculus* (Cuvier, 1828) et *Etelis coruscans* Valenciennes, 1862, *Hatschekia fuscoguttatus* n. sp. sur *Epinephelus fuscoguttatus* (Forsskål, 1775), et *Hatschekia niger* n. sp. sur *Macolor niger* (Forsskål, 1775). L'espèce à vaste répartition *Hatschekia cadenati* Nunes-Ruivo, 1954 est redécrite à partir de matériel trouvé sur *Epinephelus cyanopodus* ; elle a été également trouvée pour la première fois sur cinq autres espèces d'*Epinephelus* Bloch, 1793 et deux espèces de *Variola* Swainson, 1839 (toutes membres de la sous-famille Epinephelinae Bleeker, 1875 des serranides). Des séquences partielles du gène COI (cytochrome c oxydase sous unité I) de *H. maculatus* n. sp., *H. cyanopodus* n. sp. et *H. cadenati* ont été obtenues et déposées sur GenBank.

**MOTS CLÉS**

*Hatschekia*,  
Siphonostomatoidea,  
barcode,  
Nouvelle-Calédonie,  
fish hosts.

**INTRODUCTION**

Poche (1902) established the genus *Hatschekia* Poche, 1902 for some parasitic copepod species that had previously been placed in the genus *Clavella* Oken, 1815, a member of a different family, the Lernaepodidae Milne Edwards, 1840. Members of the genus *Hatschekia* are all gill parasites of marine actinopterygian fishes (Boxshall & Halsey 2004). Kabata (1979) removed *Hatschekia* from the heterogeneous family Dichelethiidae Milne

Edwards, 1840 and established it as the type of a new family, the Hatschekiidae. Many new species were described in the early to middle twentieth century, often inadequately, and by the 1980s the genus was in urgent need of revision. Jones (1985) undertook a major revision, considering 68 species as valid and recognizing ten species as synonyms. In a note added in proof Jones (1985) commented on a report that he had just found in which Uma Devi & Shyamasundari (1980) described three additional species: *H. argyrops* Uma Devi & Shyamasundari,

1980; *H. flatti* Uma Devi & Shyamasundari, 1980, and *H. sigani* Uma Devi & Shyamasundari, 1980. Since the 1985 revision (Jones 1985) 43 new species have been added to the genus (Pillai 1985; Romero & Kuroki 1986; Villalba 1986; Jones & Cabral 1990; Kabata 1991; Ho & Kim 2001; Uyeno & Nagasawa 2009b, 2010a-c, 2012; El-Rashidy & Boxshall 2011), raising the total number of known species to 114.

Species of *Hatschekia* have been reported from eight orders of actinopterygian hosts: Anguilliformes, Aulopiformes, Beryciformes, Ophidiiformes, Perciformes, Pleuronectiformes, Scorpaeniformes, and Tetraodontiformes (Uma Devi & Shyamasundari 1980; Jones 1985; Pillai 1985; Romero & Kuroki 1986; Villalba 1986; Jones & Cabral 1990; Kabata 1991; Ho & Kim 2001; Uyeno & Nagasawa 2009a, b, 2010a-c, 2012; El-Rashidy & Boxshall 2011). 69 species are known from perciform fishes, of which nine species occur in New Caledonia. The majority of *Hatschekia* species are known from hosts that live in tropical and subtropical regions (Kabata 1979).

Most *Hatschekia* species were inadequately described, at least in part because they often have rather featureless bodies and small vestigial appendages. In addition to body form, taxonomically useful interspecific differences have been found in the segmentation and armature formula of the antennule, mandible and maxillule, and in the structure and ornamentation of the legs. However, the structure of the maxilla and the number of teeth on the mandible are rarely mentioned or illustrated (Jones 1985).

Morphometric characters have been used. Capart (1959) was one of the first authors to employ morphometrics when distinguishing *H. epinepheli* Capart, 1959 from *H. cernae* Goggio, 1905 based on body size. This was an inauspicious start, however, because these two species were subsequently synonymised by Jones (1985). Hewitt (1969) used the proportions of the different body regions to compare related species, but this proved to be unreliable in distinguishing species. Jones (1985) himself expressed doubts about the validity of these morphometric characters by demonstrating that differences in measurements could be due to intraspecific variation. Nevertheless, Kabata (1991) used the cephalothorax:trunk length ratio and the

cephalothorax length: width ratio as characteristics of his new species. More recently, Uyeno & Nagasawa (2009a, b; 2010a-c; 2012) re-assessed the taxonomic value of a number of morphometric characters, and recommended including proportional measurements of the female body and of some appendages in species descriptions.

The present study describes seven new species from hosts caught off New Caledonia and redescribes one inadequately known species, *H. cadenati* Nunes-Ruivo, 1954. Four of the new parasite species are from groupers (Serranidae Swainson, 1839: Epinephelinae Bleeker, 1875), two are from snappers (Lutjanidae Gill, 1862) and one is from large eye bream (Lethrinidae Bonaparte, 1831: Monotaxinae Greenwood, Rosen, Weitzman & Myers, 1966).

## MATERIAL AND METHODS

Perciform fishes were collected, generally by line fishing, or sometimes by spear-fishing in New Caledonia waters, or were occasionally purchased at the fish market of Nouméa during the period from October 2003 to June 2008. The gills of the fish were removed by using the "gill method" of Justine *et al.* (2010a). Copepods were extracted with fine forceps or with the help of a fine needle from the gill filaments of the host under a binocular microscope, and were usually fixed immediately in 99% ethanol. Individual fish were given a JNC collection number. Specimens are deposited in the collections of the Muséum national d'Histoire naturelle (MNHN) in Paris, the Natural History Muséum (NHMUK) in London and the Marine Biodiversity Institute of Korea (MABIK).

The specimens were cleared in lactic acid for 3-4 hours and then dissected in a cavity slide using tungsten needles. The dissected body parts were mounted separately on slides in lactophenol. All drawings were made using a drawing tube on a Leica DM2500 interference microscope.

Specimens of some species were also examined using scanning electron microscopy (SEM). Each specimen for SEM was dehydrated through a graded ethanol series (70%, 80%, 90%, 95%, 100%) for 30 minutes, then transferred to Isoamyl acetate for

20 minutes and finally dried in a critical-point dryer (Hitachi E-1010). Dried specimens were mounted and coated with gold using a sputter coater to a thickness of 15-30 nm. Coated specimens were examined and photographed in a Hitachi S-2380N scanning electron microscope.

Length measurements of body parts follow Uyeno & Nagasawa (2009a). The descriptive terminology follows Huys & Boxshall (1991).

#### DNA BARCODING

Specimens were removed from the gill filaments of the host and were immediately fixed in 99% ethanol. They were washed in sterile distilled water and homogenized by pestle in 1.5 ml microcentrifuge tubes. PCR premix (BiONEER Co., Korea) was added to 20 µl containing homogenized tissues and 1 µl each Mitochondrial Cytochrome Oxidase c subunit I (mt COI) primer (LCO-1490: 5' – GGT CAA CAA ATC ATA AAG ATA TTG G – 3'; HCO-2198: 5' – TAA ACT TCA GGG TGA CCA AAA AAT CA – 3'). The polymerase chain reaction (PCR) (TP600, TAKARA) conditions were as follows: an initial denaturation at 94°C for 5 min, followed by 40 cycles of denaturation at 94°C for 1 min, annealing at 46°C for 2 min and extension at 72°C for 3 min, a final extension at 72°C for 10 min, finally decreasing to 4°C (Folmer *et al.* 1994). Electrophoresis of PCR products was on a 1% agarose gel and they were visualized with ethidium bromide under ultraviolet light. The required band was excised from the gel and purified with a LaboPass™ GEL extraction Kit (COSMO Co. Ltd, Korea), or without excising band PCR products were purified with a LaboPass™ PCR purification Kit (COSMO Co. Ltd, Korea) and sequenced in both directions using an ABI 3730xl DNA Analyzer (COSMO Co. Ltd, Korea).

#### ABBREVIATIONS

##### *Morphology*

ae aesthetasc;  
enp endopod;  
exp exopod;  
enp (exp)-1 to denote the proximal segment of a two-segmented ramus;  
enp (exp)-2 to denote the distal segment of a two-segmented ramus;

fp flap-like process;  
pp posterior margin process;  
tp tuberculate process.

#### *Institutions*

MNHN Muséum national d'Histoire naturelle, Paris;  
NHMUK Natural History Museum, London;  
MABIK Marine Biodiversity Institute of Korea.

#### SYSTEMATICS

Order SIPHONSTOMATOIDA  
Burmeister, 1835

Family HATSCHEKIIDAE Kabata, 1979

Genus *Hatschekia* Poche, 1902

*Hatschekia maculatus* n. sp.

*Hatschekia* sp. 10 – Justine *et al.* 2010a: fig. 1E.

TYPE HOST. — *Epinephelus maculatus* (Bloch, 1790) (Perciformes: Serranidae).

TYPE LOCALITY. — Récif Toombo, New Caledonia (22°32'59"S, 166°28'59"E).

ETYMOLOGY. — The specific name of the new species, *maculatus*, is treated as a noun in apposition and is derived from its host fish.

MATERIAL EXAMINED. — Holotype female (MNHN-IU-2013-4001) dissected on 14 slides. Paratype female (NHMUK 2012.263) dissected on 5 slides. 89 ♀♀ undissected paratypes (2 ♀♀ used for SEM) from *E. maculatus* [JNC1907]; Récif Toombo, New Caledonia (22°32'59"S, 166°28'60"E), coll. J.-L. Justine, 18.VII.2006. 40 ♀♀ undissected in MNHN-IU-2013-4002), 27 ♀♀ undissected in NHMUK 2012.264-273, 20 ♀♀ undissected in MABIK CR00179889-CR00179908.

ADDITIONAL MATERIAL. — 1 ♀ from *E. maculatus* [JNC1522]; Récif Aboré, New Caledonia (22°21'20"S, 166°15'30"E), coll. J.-L. Justine, 21.IV.2005. (NHMUK 2012.274);

21 ♀♀ from *E. maculatus* [JNC1523]; Récif Aboré, New Caledonia (22°21'20"S, 166°15'30"E), coll. J.-L. Justine, 21.IV.2005. (MNHN-IU-2013-4003);

5 ♀♀ from *E. maculatus* [JNC1524]; Récif Aboré, New Caledonia (22°21'20"S, 166°15'30"E), coll. J.-L. Justine, 21.IV.2005. (NHMUK 2012.286-290);

39 ♀♀ from *E. maculatus* [JNC 1908]; Récif Toombo, New Caledonia (22°32'59"S, 166°28'60"E), coll. J.-L. Justine, 18.VII.2006. (NHMUK 2012.275-284);

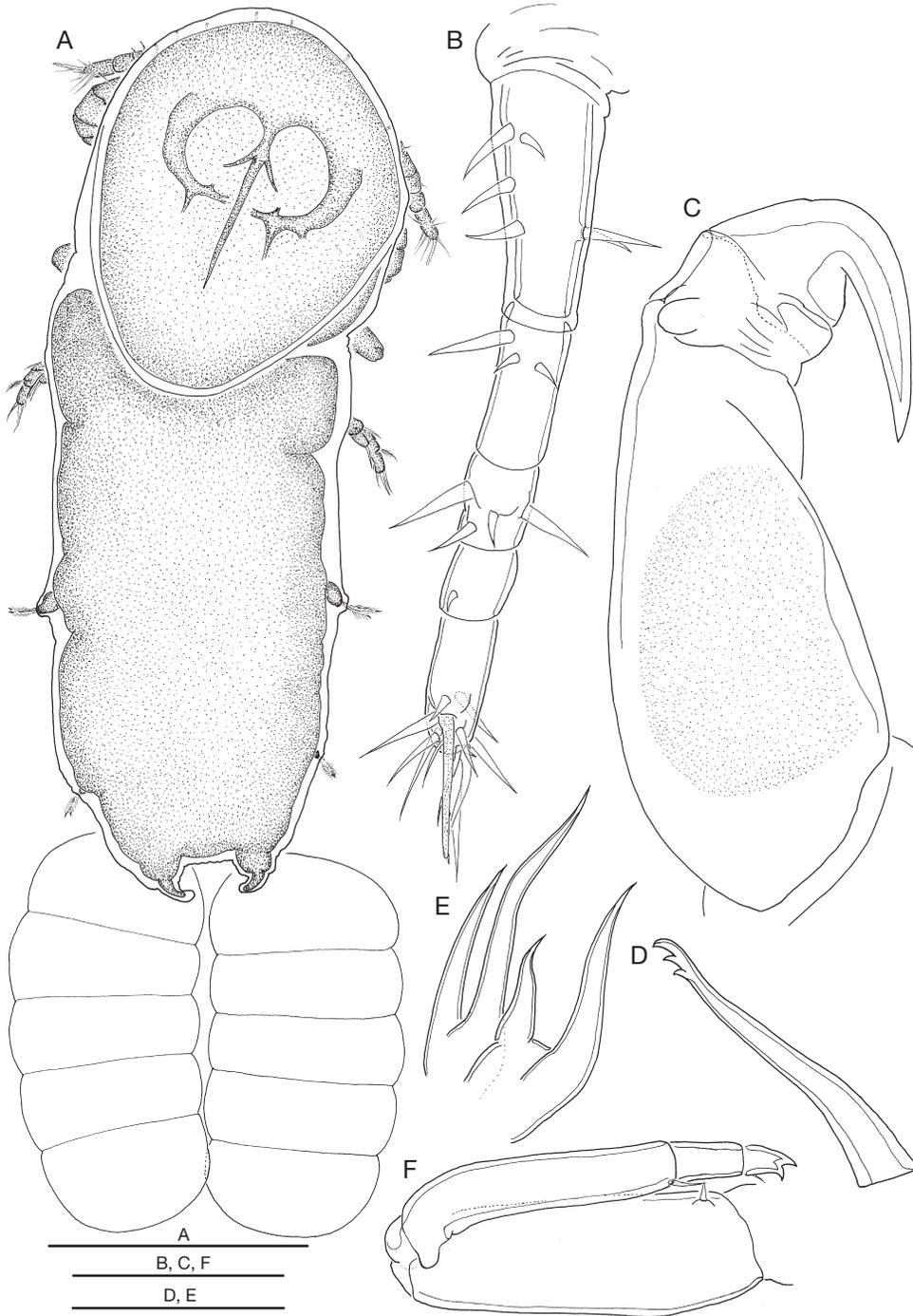


FIG. 1. — *Hatschekia maculatus* n. sp. female: **A**, habitus, dorsal; **B**, antennule; **C**, antenna; **D**, mandible; **E**, maxillule; **F**, maxilla. Scale bars: A, 250 µm; B, C, F, 50 µm; D, E, 25 µm.

DNA-barcode (mtCOI) sequences and traces were submitted to GenBank (accession number: JQ664005).

## DESCRIPTION

### *Female*

Total body length 790–892  $\mu\text{m}$  ( $n = 12$ , mean = 836  $\mu\text{m}$ ) excluding caudal rami. Body (Fig. 1A) dorsoventrally depressed, with integument separated by gap from internal body tissues. Cephalothorax (Fig. 1A) oval, longer than wide (377  $\times$  304  $\mu\text{m}$ ), widest in anterior third and narrowing posteriorly towards strongly convex posterior margin; dorsal surface with distinct chitinous markings in form of “m-shape”, bar in mid-line extending well beyond branched posterior tips of curved lateral bars; bar in mid-line with short oblique lateral branches near base. Trunk (Fig. 1A) rectangular, longer than wide (515  $\times$  292  $\mu\text{m}$ ), with irregularly parallel lateral margins narrowing in posterior fifth to posterior margin bearing paired postero-lateral processes; each process comprising wider proximal part and narrow, conical distal part, all with wrinkled cuticle (Fig. 1A). Urosome (Fig. 2E) tapering posteriorly, shorter than wide (74  $\times$  95  $\mu\text{m}$ ), unsegmented comprising fused genital complex and abdomen (Fig. 2E). Caudal ramus (Fig. 2E) elongate, elliptical, longer than wide (53  $\times$  19  $\mu\text{m}$ ), with five naked distal setae and one plumose lateral seta. Egg sacs shorter than trunk, mean of 4.0 eggs per sac, range from three to seven eggs per sac.

Rostrum absent. Antennule (Fig. 1B) 5-segmented; length 164  $\mu\text{m}$ ; armature formula: 6, 3, 4, 1, 12 + ae; first segment with integument separated from internal tissues. Antenna (Fig. 1C) 3-segmented; proximal segment unarmed (not figured); middle segment (basis) swollen, tapering distally, ornamented with surface pits; terminal claw lacking ornamentation; total length 196  $\mu\text{m}$ ; middle segment length 140  $\mu\text{m}$ ; terminal claw length 56  $\mu\text{m}$ . Parabasal papilla (Fig. 3A) tapering, hook-like knob, with wrinkled surface. Oral cone robust. Mandible (Fig. 1D) slender, tapering distally, with three sharp teeth distally. Maxillule (Fig. 1E) bilobate; both lobes armed with two sharp tapering processes. Maxilla (Fig. 1F) 4-segmented; proximal segment unarmed; second segment swollen, with one proximal seta on medial margin; third segment rod-like, elongated,

with one distal seta; terminal segment small, with one small seta and bifid claw. Maxilliped absent.

Leg 1 (Fig. 2A) biramous; protopod fused with trunk, bearing one inner fine spine and one outer seta; exopod indistinctly 2-segmented, exp-1 with one outer seta, exp-2 with two distal setae; endopod 1-segmented, with one distal seta; protopod length 36  $\mu\text{m}$ ; exopod length 26  $\mu\text{m}$ ; endopod length 15  $\mu\text{m}$ . Leg 2 (Fig. 2B) biramous; protopod fused with trunk, bearing one plumose outer seta; exopod indistinctly 2-segmented, exp-1 with one outer seta ornamented with fine hairs, exp-2 with one inner and three distal setae; endopod 1-segmented, with two distal setae; protopod length 31  $\mu\text{m}$ ; exopod length 44  $\mu\text{m}$ ; endopod length 20  $\mu\text{m}$ . No variation noted in setation of legs 1 and 2. Protopod and rami of legs 1 and 2 (Fig. 2A, B) ornamented with crescentic rows of blunt spinules on surface. Intercoxal sclerites of both legs incorporated into body. Leg 3 (Fig. 2C) represented by two plumose setae carried on cylindrical process laterally at mid-length. Leg 4 (Fig. 2D) comprising two plumose setae arising from subsurface papilla located 20% of length from end of trunk, respectively.

### *Male*

Unknown.

## REMARKS

*Hatschekia maculatus* n. sp. is characterized by the possession of well-developed posterolateral lobes on the trunk, and by having a cephalothorax and trunk of very similar width, as in *H. cernae*, a widely distributed species on epinepheline hosts (groupers) (Nunes-Ruivo 1954; Shiino 1957; Capart 1959; Jones 1985). In addition to the similar body shape, these two species also show a clear space separating the integument over the body surface from the underlying internal tissues, as in several other species such as *H. flatti* Uma Devi & Shyamasundari, 1980, and both have caudal rami that are distinctly longer than wide (Shiino 1957). They differ in many details such as the segmentation of the antennules which were described as indistinctly-segmented by Nunes-Ruivo (1954) but as 4-segmented by Shiino (1957), compared to 5-segmented in *H. maculatus* n. sp. Differences in legs 1 and 2 include: the endopod of

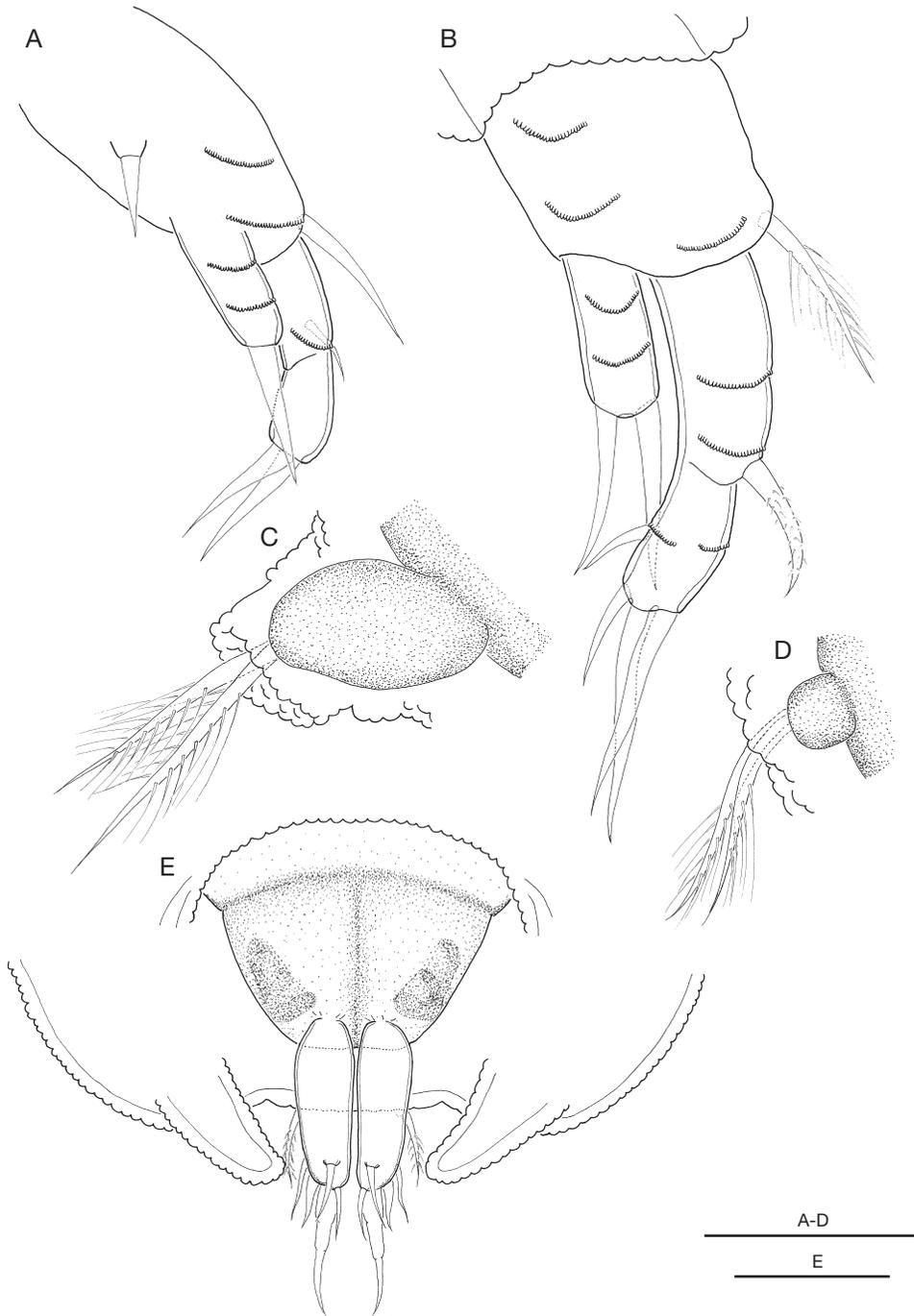


FIG. 2. — *Hatschekia maculatus* n. sp. female: **A**, leg 1; **B**, leg 2; **C**, leg 3; **D**, leg 4; **E**, posterior part of trunk, ventral. Scale bars: A-D, 25 µm; E, 50 µm.

leg 1 in the new species is 1-segmented and carries a single apical seta, whereas it is 2-segmented and bears 2 apical setae in *H. cernae*; the exopod of leg 2 carries 4 setal elements on the distal segment in the new species compared to only 2 in *H. cernae* (Nunes-Ruivo 1954; Shiino 1957). The form of the posterolateral processes on the rear margin of the trunk is very distinctive – no other *Hatschekia* species has processes of this form, with a wider basal part carrying a narrow conical distal part with wrinkled cuticular surface.

### *Hatschekia cyanopodus* n. sp.

*Hatschekia* sp. 11 – Justine *et al.* 2010a: fig. 1C.

TYPE HOST. — *Epinephelus cyanopodus* (Richardson, 1846) (Speckled blue grouper) (Perciformes: Serranidae).

TYPE LOCALITY. — Off Ouen Toro, Nouméa, New Caledonia (22°18'47"S, 166°26'55"E).

ETYMOLOGY. — The specific name of the new species, *cyanopodus*, is treated as a noun in apposition and is named after its host.

MATERIAL EXAMINED. — Holotype female (MNHN-IU-2013-4004) dissected on 14 slides. Paratype female (NHMUK 2012.285) dissected on 6 slides. 12 ♀♀ undisseminated paratypes (2 ♀♀ for SEM): from *E. cyanopodus* [JNC 1530C], off Ouen Toro, Nouméa, New Caledonia (22°18'47"S, 166°26'55"E), coll. J.-L. Justine, 10.V.2005. 5 ♀♀ undisseminated in MNHN-IU-2013-4005, 2 ♀♀ undisseminated in MABIK CR00179909-CR00179910.

ADDITIONAL MATERIAL. — 40 ♀♀ from *E. cyanopodus* [JNC1625], Passe de Dumbéa, New Caledonia, coll. J.-L. Justine, 25.X.2005. (MNHN-IU-2013-4006);

14 ♀♀ from *E. cyanopodus* [JNC1626], Passe de Dumbéa, New Caledonia, coll. J.-L. Justine, 25.X.2005. (MNHN-IU-2013-4007);

6 ♀♀ from *E. cyanopodus* [JNC1661], Passe de Dumbéa, New Caledonia, coll. J.-L. Justine, 25.XI.2005. (NHMUK 2012.291-296);

10 ♀♀ from *E. cyanopodus* [JNC1659], Passe de Dumbéa, New Caledonia, coll. J.-L. Justine, 25.XI.2005. (NHMUK 2012.1271-1280);

6 ♀♀ from *E. cyanopodus* [JNC1718], Passe de Dumbéa, New Caledonia, coll. J.-L. Justine, 16.I.2006. (NHMUK 2012.1281-1286);

1 ♀ from *E. cyanopodus* [JNC1888]; Récif Aboré, New Caledonia, Coll. J.-L. Justine, 2.VII.2006. (NHMUK 2012.1287);

29 ♀♀ from *E. cyanopodus* [JNC1901]; Récif Snark, New Caledonia, Coll. J.-L. Justine, 8.VII.2006. (MABIK CR00179911-CR00179939);

15 ♀♀ from *E. cyanopodus* [JNC1902]; Récif Snark, New Caledonia, Coll. J.-L. Justine, 8.VII.2006. (NHMUK 2012.1288-1297);

DNA-barcode (mtCOI) sequences and traces were submitted to GenBank (accession number: JQ664006).

### DESCRIPTION

#### *Female*

Total body length 1040-1330  $\mu\text{m}$  ( $n = 12$ , mean = 1150  $\mu\text{m}$ ) excluding caudal rami. Body (Fig. 4A) dorsoventrally flattened; with integument separated from internal body tissues by space; body surface ornamented with tiny pores. Cephalothorax (Fig. 4A) hexagonal, slightly longer than wide (396  $\times$  371  $\mu\text{m}$ ), dorsal surface with distinct subsurface chitinous markings in form of "m-shape", bar in mid-line slender, lacking side branches, extending well beyond branched posterior tips of curved lateral bars; posterior margin of cephalothorax with rounded extension in posterior midline. Trunk (Fig. 4A) longer than wide (783  $\times$  458  $\mu\text{m}$ ), with rounded lateral margins and greatest width just anterior to level of insertion of fourth legs; posterior margin with widely spaced pair of small processes (Fig. 5E [pp]), each tapering distally and with wrinkled surface cuticle, pair of smooth flap-like processes (fp) located medial and ventral to posterior processes. Surface of trunk finely tuberculate (Figs 3C, D; 5E). Urosome (Fig. 5E) excluding caudal ramus shorter than wide (72  $\times$  89  $\mu\text{m}$ ), unsegmented and fused to trunk, comprising genital complex and abdomen fused; pair of tuberculate processes (arrowed in Figs 3D; 5E [tp]) present in immediate area of genital apertures, with ornamentation of long setules between, but detail obscured by adhering debris (Figs 3C, D; 5E). Caudal ramus (Fig. 5E) elongate, longer than wide (68  $\times$  23  $\mu\text{m}$ ), indistinctly subdivided by transverse markings, with five naked setae, innermost two each with swollen base and slender tip, and one plumose lateral seta. Egg sacs with mean of 14.7 eggs per sac, range from 13 to 17 eggs per sac.

Rostrum absent. Antennule (Fig. 4B) 5-segmented; length 204  $\mu\text{m}$ ; armature formula: 5, 3, 4, 1, 13 + ae; first segment with integument

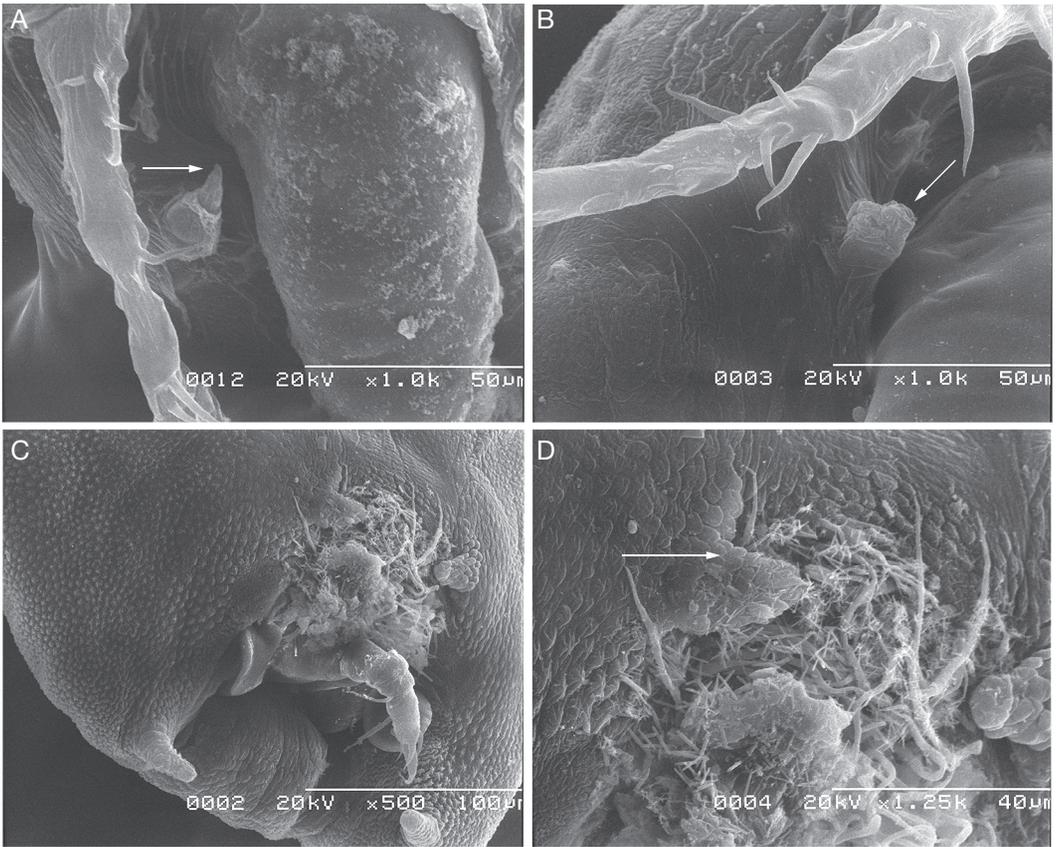


FIG. 3. — **A**, *Hatschekia maculatus* n. sp. parbasal papilla, ventral (arrowed); **B**, **C**, *Hatschekia cyanopodus* n. sp.; **B**, parbasal papilla, ventral (arrowed); **C**, genital complex and abdomen, ventral; **D**, detail showing paired tuberculate processes (arrowed), ventral. SEM micrographs.

separated from internal tissues. Antenna (Fig. 4C) 3-segmented; proximal segment unarmed (not figured); middle segment (basis) swollen and tapering distally, ornamented with surface pits; terminal claw subdivided by incomplete suture; without armature; total length 212  $\mu\text{m}$ ; middle segment length 149  $\mu\text{m}$ ; terminal claw length 63  $\mu\text{m}$ . Parbasal papilla (Fig. 3B) blunt, thumb-like knob, with wrinkled surface. Oral cone robust. Mandible (Fig. 4D) slender, tapering distally, with five small teeth. Maxillule (Fig. 4E) bilobate, both lobes armed with two sharp tapering processes. Maxilla (Fig. 4F) 4-segmented; proximal segment unarmed; second segment swollen, with one basal seta; third segment rod-like, elongate, with one

distal seta; terminal segment small with one small seta and bifid claw. Maxilliped absent.

Leg 1 (Fig. 5A) biramous; protopod fused with trunk, bearing one inner and one outer seta; exopod indistinctly 2-segmented, exp-1 with one outer seta, exp-2 with one outer and two distal setae; endopod 1-segmented, with one distal seta; protopod length 23  $\mu\text{m}$ ; exopod length 36  $\mu\text{m}$ ; endopod length 23  $\mu\text{m}$ . Leg 2 (Fig. 5B) biramous; protopod fused with trunk and bearing one plumose outer seta; exopod indistinctly 2-segmented, exp-1 with one outer seta ornamented with fine hairs, exp-2 with one inner and three distal setae; endopod 1-segmented, with two distal setae; protopod length 19  $\mu\text{m}$ ; exopod length 49  $\mu\text{m}$ ; endopod length 21  $\mu\text{m}$ . Protopod

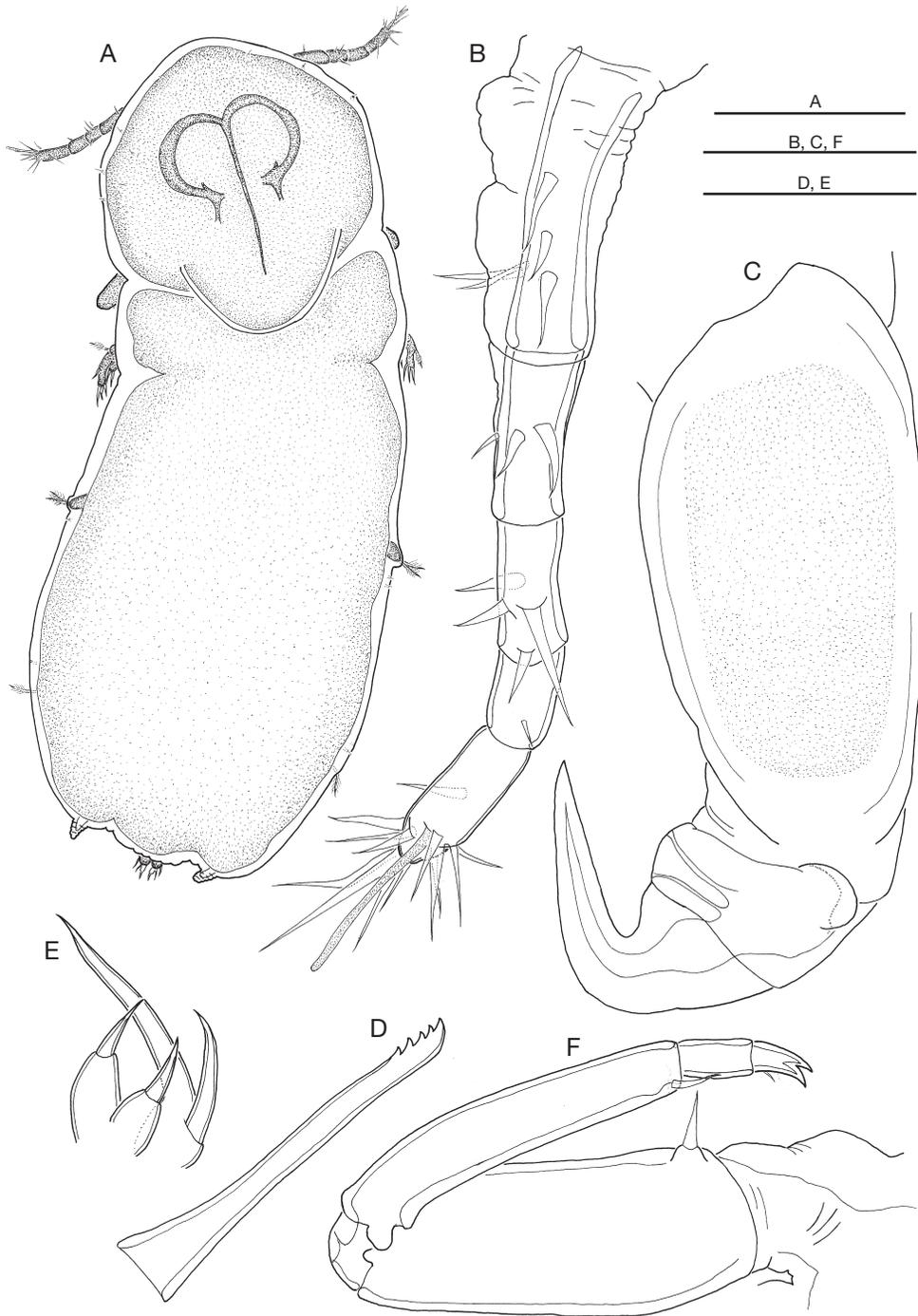


FIG. 4. — *Hatschekia cyanopodus* n. sp. female: **A**, habitus, dorsal; **B**, antennule; **C**, antenna; **D**, mandible; **E**, maxillule; **F**, maxilla. Scale bars: A, 250 µm; B, C, F, 50 µm; D, E, 25 µm.

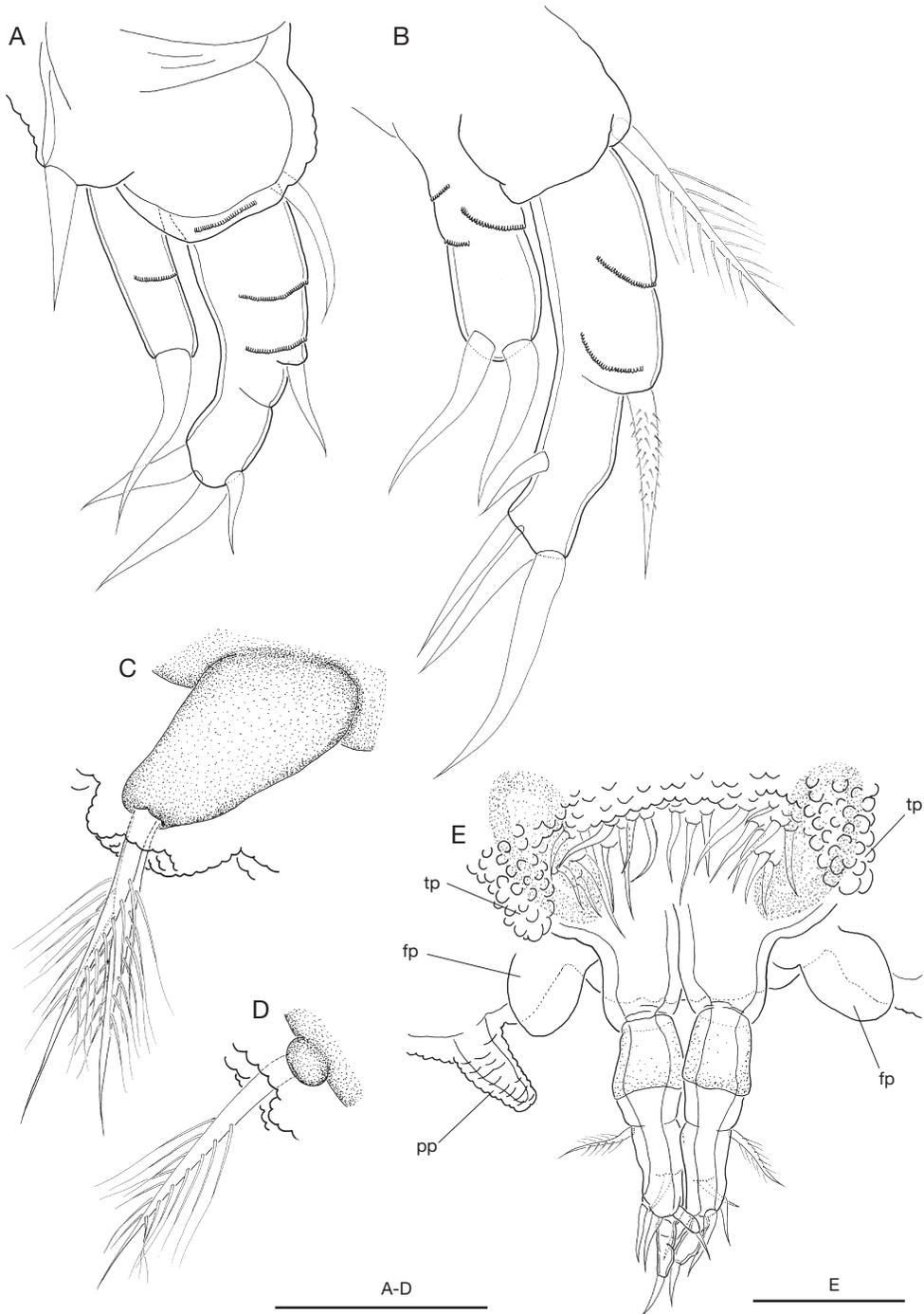


FIG. 5. — *Hatschekia cyanopodus* n. sp. female: **A**, leg 1; **B**, leg 2; **C**, leg 3; **D**, leg 4; **E**, posterior part of trunk, ventral. Scale bars: A-D, 25  $\mu$ m; E, 50  $\mu$ m.

and rami of legs 1 and 2 (Fig. 5A, B) ornamented with crescentic rows of blunt spinules on surface. Intercoxal sclerites of both legs incorporated into body. Leg 3 (Fig. 5C) represented by two plumose setae on lobe located laterally in middle of trunk. Leg 4 (Fig. 5D) represented by one small plumose seta arising from subsurface papilla, located laterally at three quarters of trunk length.

#### Male

Unknown.

#### REMARKS

*Hatschekia cyanopodus* n. sp. is very closely related to *H. maculatus* n. sp. Both species have a similar shaped cephalothorax which extends posteriorly in the dorsal midline, have a clear intervening space between the integument covering the body surface and the underlying internal tissues, and possess posterior lobes on the trunk. However, the lobes are smaller and more widely spaced on the rear margin of the trunk in *H. cyanopodus* n. sp. than in *H. maculatus* n. sp. In addition, *H. cyanopodus* n. sp. possesses paired flap-like lobes just medial and ventral to the posterior processes, plus the paired tuberculate processes (Figs 3D; 5E) located near the genital apertures. This combination of processes is unique within the genus. The pattern of subsurface chitinous markings on the cephalothorax is similar in *H. maculatus* n. sp. and *H. cyanopodus* n. sp., but the latter lacks the side branches located proximally on the bar in the mid-line present in the former.

In both species the body shape is also similar to that of *H. cernae*, with little perceptible difference in width between the cephalothorax and trunk. *Hatschekia cyanopodus* n. sp. has the same setal formula for leg 2 as *H. maculatus* n. sp. but they differ in the setation of leg 1 which has an additional setal element on the distal exopodal segment in *H. cyanopodus* n. sp. Leg 4 is represented by 2 setae in *H. maculatus* n. sp. but only a single seta in *H. cyanopodus* n. sp. The number of mandibular teeth also differs between these two species. The parbasal papilla is tapering in *H. maculatus* n. sp. but blunt in *H. cyanopodus* n. sp.

The ventral surface of the trunk in the vicinity of the genital apertures has very unusual ornamenta-

tion in *H. cyanopodus* n. sp. The whole surface of the trunk is finely tuberculate (Figs 3C, D; 5E) but in the immediate area of the genital apertures there are long setules present, to which debris adheres obscuring precise details. We did not observe such setular ornamentation in any other species and are uncertain both of its origin and its functional significance. The egg sacs of *H. cyanopodus* n. sp. contain a mean of 14.7 eggs per sac, whereas those of *H. maculatus* n. sp. contain a mean of only 4.0 eggs per sac.

#### *Hatschekia louti* n. sp.

*Hatschekia* sp. 8 – Justine *et al.* 2010a: fig. 1G.

TYPE HOST. — *Variola louti* (Forsskål, 1775) (Perciformes: Serranidae).

ADDITIONAL HOST. — *Variola albimarginata* Baissac, 1952 (Perciformes: Serranidae).

TYPE LOCALITY. — Récif Le Sournois, off coast of Nouméa, New Caledonia (22°19'32"S, 166°27'37"E).

ETYMOLOGY. — The specific name of the new species, *louti*, is treated as a noun in apposition and is based on its host.

MATERIAL EXAMINED. — Holotype female (MNHN-IU-2013-4008) dissected on 9 slides. 16 ♀♀ undissected paratypes, from *Variola louti* [JNC 1208B], Récif Le Sournois, off coast of Nouméa, New Caledonia (22°19'32"S, 166°27'37"E), coll. J.-L. Justine, 27.VII.2004. 6 ♀♀ undissected in MNHN-IU-2013-4009, 1 ♀ undissected in NHMUK 2012.1298, 2 ♀♀ undissected in MABIK CR00179940-CR00179941.

ADDITIONAL MATERIAL. — 1 ♀ from *Variola albimarginata* [JNC1209A], Récif Le Sournois, off coast of Nouméa, New Caledonia (22°19'32"S, 166°27'37"E), coll. J.-L. Justine, 27.VII.2004. (NHMUK 2012.1299); 4 ♀♀ from *V. albimarginata* [JNC1247B], Récif Le Sournois, off coast of Nouméa, New Caledonia (22°19'32"S, 166°27'37"E), coll. J.-L. Justine, 15.IX.2004. (NHMUK 2012.297-300); 3 ♀♀ from *V. louti* [JNC1353B], Passe de Dumbéa, New Caledonia, coll. J.-L. Justine, 28.IX.2004. (MNHN-IU-2013-4010).

#### DESCRIPTION

##### Female

Total body length 570–660 µm (n = 8, mean = 620 µm) excluding caudal rami. Cephalothorax

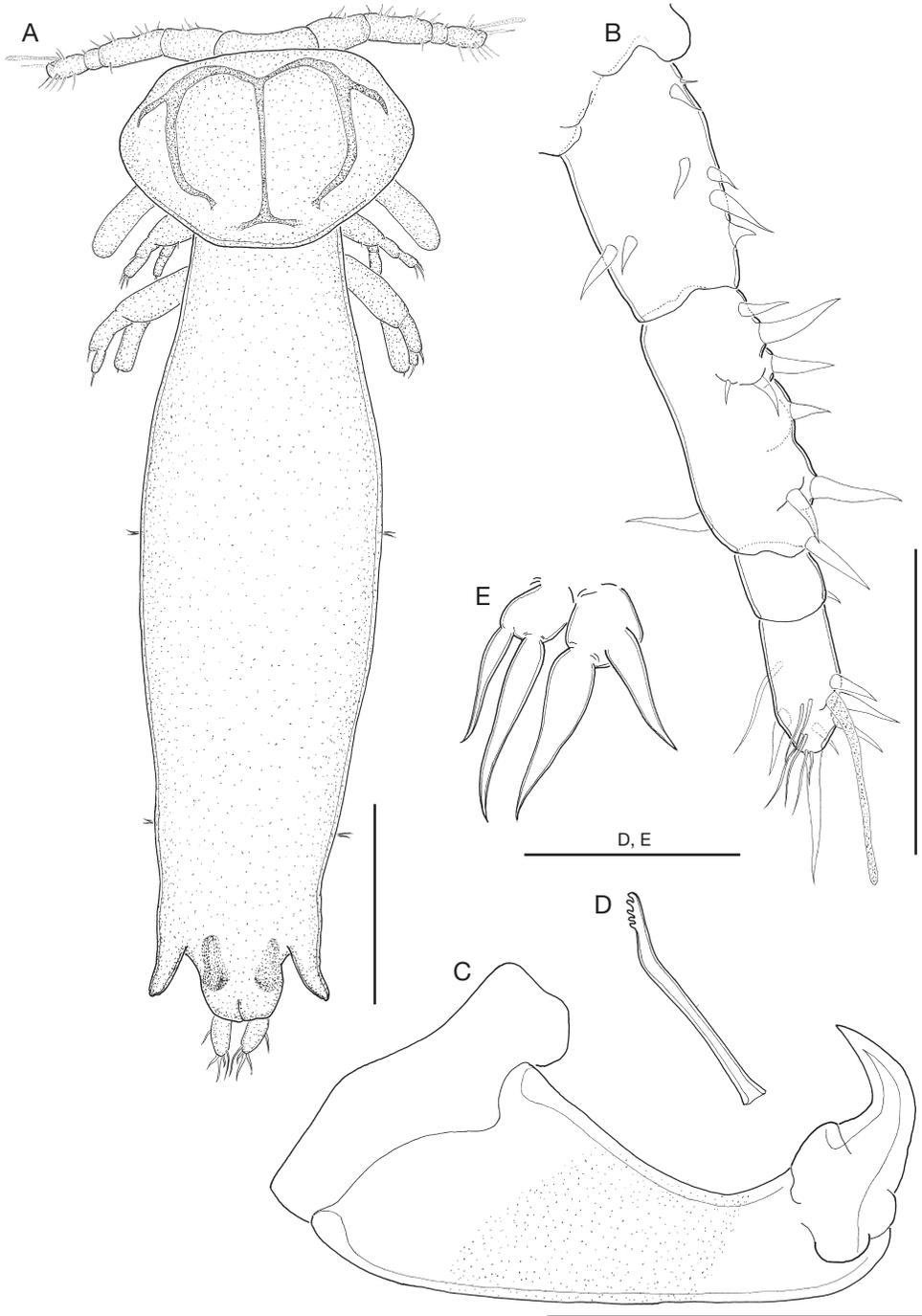


FIG. 6. — *Hatschekia louti* n. sp. female: **A**, habitus, dorsal; **B**, antennule; **C**, antenna; **D**, mandible; **E**, maxillule. Scale bars: A-C, 50 µm; D, E, 25 µm.

(Fig. 6A) wider than long ( $125 \times 188 \mu\text{m}$ ), with straight frontal margin, protruding lateral margins and rounded posterior margin; dorsal surface with distinct chitinous markings in form of “m-shape”, bar in mid-line extending beyond posterior tips of curved lateral bars and divided at posterior end; curved lateral bars with anterior side branch near antero-lateral angle of cephalothorax. Trunk (Fig. 6A) fusiform, longer than wide ( $498 \times 155 \mu\text{m}$ ), with greatest width about at level of insertion of third legs; trunk bearing conspicuous paired tapering processes at posterolateral corners, each slightly outwardly curved and terminating in rounded knob-like tip (Fig. 7F). Urosome (Fig. 7F) excluding caudal ramus shorter than wide ( $41 \times 63 \mu\text{m}$ ), comprising fused genital complex and abdomen (Fig. 7F). Caudal ramus (Fig. 7F) elongate, longer than wide ( $27 \times 13 \mu\text{m}$ ), with five naked setae.

Rostrum absent. Antennule (Fig. 6B) 4-segmented; length  $121 \mu\text{m}$ ; armature formula: 8, 10, 1, 13 + ae. Antenna (Fig. 6C) 3-segmented; proximal segment unarmed; middle segment (basis) swollen, tapering distally, ornamented with surface pits; terminal claw small, without armature; total length  $97 \mu\text{m}$ ; middle segment length  $81 \mu\text{m}$ ; terminal claw length  $17 \mu\text{m}$ . Parabasal papilla shrivelled, carrying apical process. Oral cone robust. Mandible (Fig. 6D) slender, rod-like, with five small blunt teeth. Maxillule (Fig. 6E) bilobate; both lobes armed with two sharp tapering processes. Maxilla (Fig. 7A) 4-segmented; proximal segment unarmed; second segment swollen, with one basal seta; third segment rod-like, elongated, with one distal seta; terminal segment small, with one small seta and bifid claw. Maxilliped absent.

Leg 1 (Fig. 7B) biramous; protopod bearing one inner spine and one fine outer seta; exopod indistinctly 2-segmented, exp-1 with one outer seta, exp-2 with three distal setae; endopod 2-segmented, enp-1 unarmed, enp-2 with one distal seta; protopod length  $36 \mu\text{m}$ ; exopod length  $26 \mu\text{m}$ ; endopod length  $19 \mu\text{m}$ . Leg 2 (Fig. 7C) biramous; exopod 2-segmented, exp-1 with one outer seta, exp-2 with one seta; endopod 1-segmented, with one distally small seta; protopod length  $51 \mu\text{m}$ ; exopod length  $30 \mu\text{m}$ ; endopod length  $34 \mu\text{m}$ . Protopod and rami of legs 1 and 2 (Fig. 7B, C) elongate and unornamented. Intercostal sclerites of both legs

elongate, unornamented and unmodified. Legs 3 and 4 (Fig. 7D, E) each represented by small lobe tipped with two simple setae, located laterally in middle and at three quarters length of trunk.

#### Male

Unknown.

#### REMARKS

*Hatschekia louti* n. sp. shares the possession of conspicuous paired processes at the posterolateral corners of the trunk with *H. conifera* Yamaguti, 1939, although the processes have a shallower conical shape in the latter compared with the slender, slightly outward curving processes (terminating in a rounded, knob-like tip) of the new species. *Hatschekia conifera* was originally described on the basis of Japanese material taken from the host *Pampus argenteus* (Euphrasen, 1788) (as *Stromateoides argenteus*) (Yamaguti 1939). It was redescribed by Cressey (1968) who also described the male for the first time: his material was from *Cubiceps caeruleus* Regan, 1914 caught off Chile. Kabata (1981) examined material of *H. conifera* from *Brama japonica* Hilgendorf, 1878 and relegated *H. acuta* Barnard, 1948 to synonymy with *H. conifera*. Jones (1985) confirmed this synonymy after re-examination of Barnard's type material of *H. acuta* from *Brama brama* (Bonnaterre, 1788) (as *Brama raii* Bloch & Schneider, 1801) taken in South African waters, and after study of new material from *Brama brama* from New Zealand. So *H. conifera* is widely distributed in the Indo-Pacific and occurs on a variety of different hosts but it is well characterized and we found that *H. louti* n. sp. differs significantly from *H. conifera* in body shape, in the armature formula of the antennule, in the number of teeth on the mandible, and most obviously in the form of legs 1 and 2 and the armature formula of legs.

*Hatschekia louti* n. sp. has a very modified endopod on leg 2. In *H. conifera* the endopods of legs 1 and 2 are 2-segmented and carry six setal elements (Cressey 1968) whereas in the new species leg 1 has a 2-segmented endopod with just a single apical seta while leg 2 has an enlarged unsegmented lobate endopod bearing a single minute seta. A similar enlarged endopod is present in leg 2 of *H. becuni*

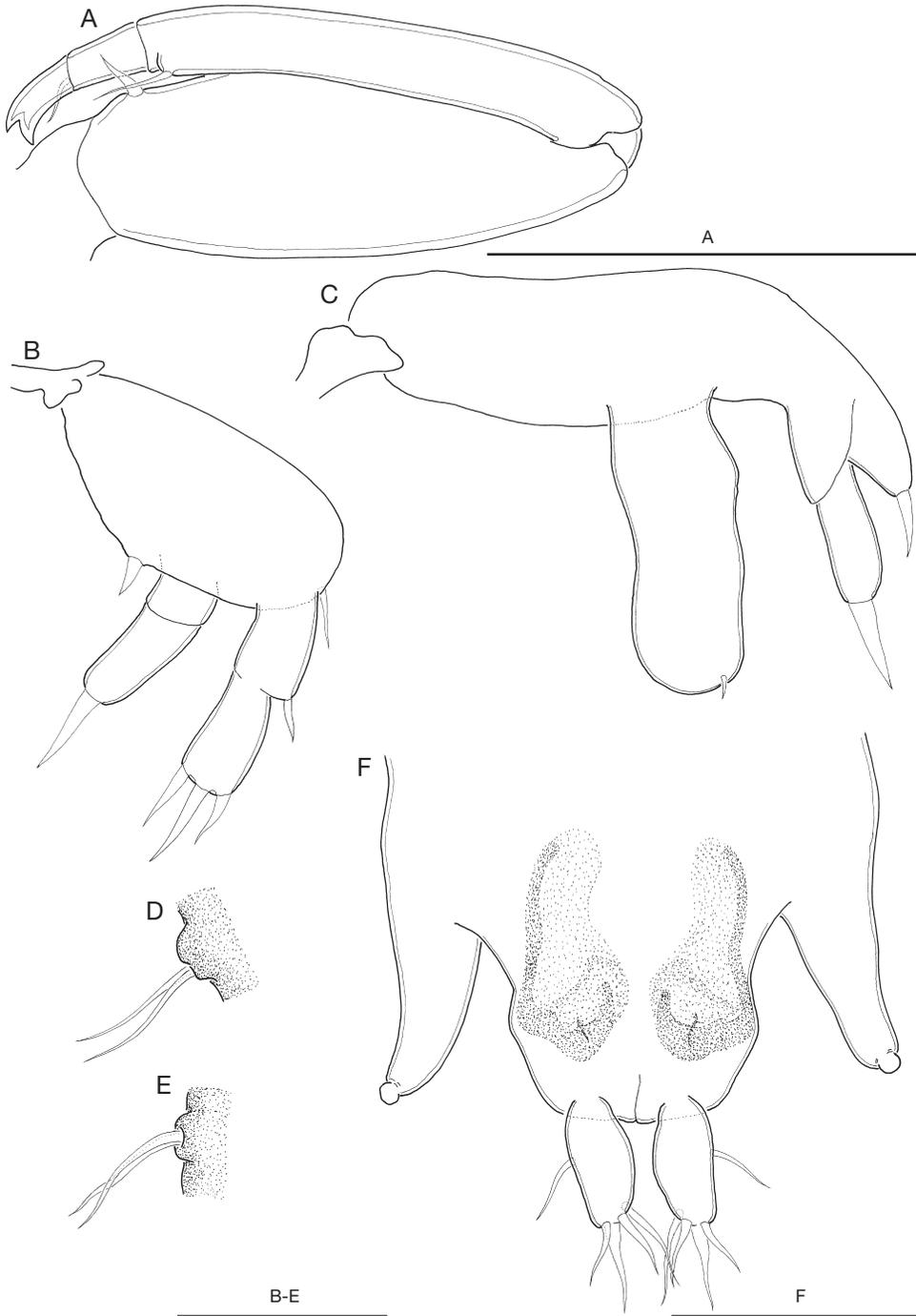


FIG. 7. — *Hatschekia louti* n. sp. female: **A**, maxilla; **B**, leg 1; **C**, leg 2; **D**, leg 3; **E**, leg 4; **F**, posterior part of trunk, ventral. Scale bars: A, F, 50 µm; B-E, 25 µm.

Jones & Cabral, 1990 but this species differs from *H. louti* n. sp. in lacking any processes on the trunk. The endopod is also broad in *H. jonesi* Uyeno & Nagasawa, 2010 but this ramus is 2-segmented and retains four setae in *H. jonesi*.

### *Hatschekia euanus* n. sp.

*Hatschekia* sp. 12 – Justine *et al.* 2010b: fig. 1B.

TYPE HOST. — *Gymnocranius euanus* (Günther, 1879) (Perciformes: Lethrinidae).

TYPE LOCALITY. — New Caledonia.

ETYMOLOGY. — The specific name of the new species, *euanus*, is treated as a noun in apposition and is based on its host.

MATERIAL EXAMINED. — Holotype female (MNHN-IU-2013-4011) dissected on 9 slides. 3 ♀♀ undissected paratypes (1 ♀ for SEM) from *G. euanus* [JNC1788], external slope of barrier reef, off wreck of ship *Ever Prosperity*, New Caledonia, coll. J.-L. Justine, 26.IV.2006. 2 ♀♀ undissected in MABIK CR00179942-CR00179943. 2 ♀♀ paratypes from *G. euanus* [JNC1852], Récif Le Sournois, New Caledonia, coll. J.-L. Justine, 6.VI.2006. (NHMUK 2012.1300-1301);

1 ♀ paratype from *G. euanus* [JNC1855]; Récif Aboré, New Caledonia, coll. J.-L. Justine, 2.VII.2006. (MABIK CR00179944);

2 ♀♀ paratypes from *G. euanus?* [JNC1725 – identification not confirmed, see table 2 in Justine *et al.* 2010b], near Récif Toombo, New Caledonia, coll. J.-L. Justine, 19.I.2006. (MNHN-IU-2013-4012).

### DESCRIPTION

#### *Female*

Total body length 750 – 870 µm (n = 5, mean = 830 µm) excluding caudal rami. Cephalothorax (Fig. 8A) trapezoidal, wider than long (228 × 169 µm) and widest near posterior margin, lateral margins very slightly concave, with slight processes at anterolateral angles and larger processes at postero-lateral angles; posterior margin evenly convex; dorsal surface with distinct chitinous markings in form of “m-shape”, bar in mid-line about to level of posterior tips of curved lateral bars; bars without side branches. Trunk (Fig. 8A) fusiform, longer than wide (612 × 235 µm); with narrow anterior “neck” region, broadening out sharply to maximum width about at level of

anteriorly-located third legs, narrowing gradually posteriorly; lacking posterolateral lobes or processes. Urosome (Fig. 9E) excluding caudal ramus shorter than wide (28 × 62 µm), comprising fused genital complex and abdomen (Fig. 9E). Caudal ramus (Fig. 9E) elongate, with a transverse marking at level of lateral seta, longer than wide (28 × 15 µm), with six naked setae, five distal, one lateral.

Rostrum concealed beneath frontal projections of dorsal cephalic shield, comprising two pairs of humplike processes (Fig. 8B), visible in ventral view (Fig. 10B). Antennule (Fig. 8B) 4-segmented; length 119 µm; armature formula: 11, 7, 1, 11 + ae. Antenna (Fig. 8C) 3-segmented; proximal segment unarmed; middle segment (basis) slightly tapering, ornamented with minute surface pits; terminal claw bearing one small spine proximally; total length 159 µm; middle segment length 96 µm; terminal claw length 63 µm. Parabasal papilla small. Oral cone robust. Mandible (Fig. 8D) styliform, with simple pointed apex. Maxillule (Fig. 8E) bilobate; both lobes armed with two sharp tapering processes. Maxilla (Fig. 8F) 4-segmented; proximal segment unarmed; second segment swollen, with one proximal seta on medial margin; third segment rod-like, elongate, with one distal seta; terminal segment small, with one small seta and bifid claw. Maxilliped absent.

Leg 1 (Fig. 9A) biramous; protopod bearing one outer seta and inner spine; exopod 2-segmented, exp-1 with one outer seta, exp-2 with six setae; endopod 2-segmented, enp-1 unarmed, enp-2 with two inner and three distal setae; protopod length 50 µm; exopod length 28 µm; endopod length 25 µm. Leg 2 (Fig. 9B) biramous; protopod bearing one small outer seta and, in one specimen, fine inner setule; exopod indistinctly 2-segmented, exp-1 one outer seta, exp-2 with two inner and three terminal setae; endopod 2-segmented, enp-1 with one inner seta, enp-2 with one inner and three terminal setae; protopod length 56 µm; exopod length 33 µm; endopod length 33 µm. Protopods and rami of legs 1 and 2 (Fig. 9A, B) ornamented with crescentic rows of blunt spinules on surface; protopod of leg 2 with large inner setule in one specimen, absent in other examined specimens. Intercoxal sclerites of both legs elongate, unornamented and unmodified. Legs 3 and

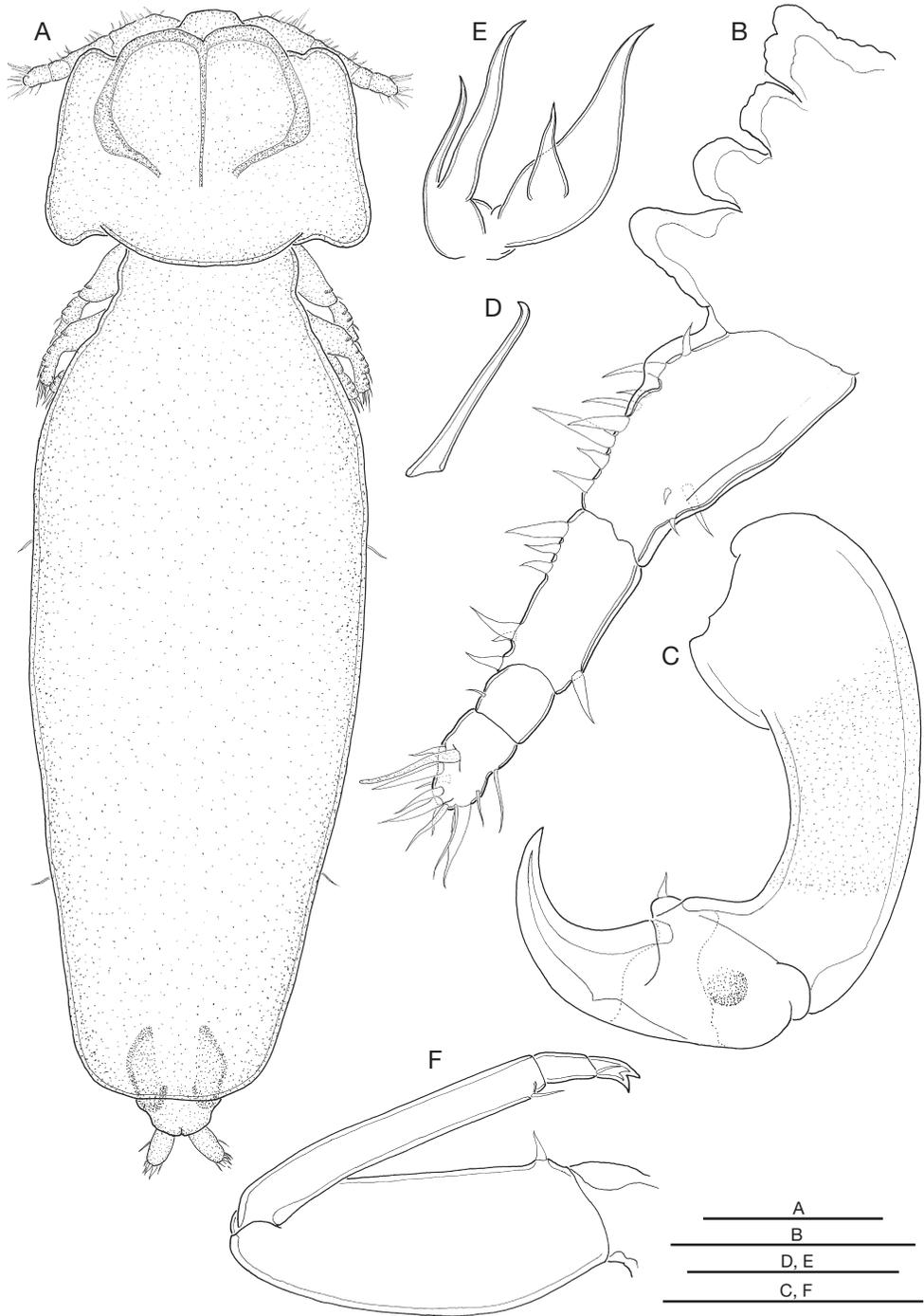


FIG. 8. — *Hatschekia euanus* n. sp. female: A, habitus, dorsal; B, antennule; C, antenna; D, mandible; E, maxillule; F, maxilla. Scale bars: A, C, F, 250 µm; B, 50 µm; D, E, 25 µm.

4 (Fig. 9C, D) each represented by small lobe tipped with one simple seta located laterally at about one third and two thirds of length of trunk, respectively.

#### Male

Unknown.

#### REMARKS

The shape of the cephalothorax of *Hatschekia euanus* n. sp. is very distinctive: it has very slightly concave lateral margins, which diverge posteriorly and there are defined swellings (weak processes) at both the anterolateral and the posterolateral corners of the dorsal cephalothoracic shield. Posterolateral swellings are present on the cephalothorax of *H. uncata* Wilson, 1913, but the lateral margins of this species are strongly convex and the shape of its trunk, which bears paired hemispherical protuberances on its posterior margin, is entirely different. Anteriorly *H. uncata* lacks the four-partite frontal process which is present on the antero-ventral margin of the cephalothorax of *H. euanus* n. sp. The form of this structure is unique within the genus.

### *Hatschekia eteliscola* n. sp.

*Hatschekia* sp. 21 – Justine *et al.* 2012: fig. 2A

TYPE HOST. — *Etelis carbunculus* (Cuvier, 1828) (Perciformes: Lutjanidae).

ADDITIONAL HOST. — *Etelis coruscans* Valenciennes, 1862 (Perciformes: Lutjanidae).

TYPE LOCALITY. — Deep water, off Passe de Dumbéa, New Caledonia (22°25'S, 166°10'E).

ETYMOLOGY. — The specific name of the new species, *eteliscola*, is based on the generic name of the host combined with *-icola*, meaning inhabitant.

MATERIAL EXAMINED. — Holotype female (MNHN-IU-2013-4013) dissected on 12 slides. Paratype female (NHMUK 2012.1302) dissected on 3 slides. 5 ♀♀ undissected paratypes (1 ♀ for SEM) from *Etelis carbunculus* [JNC2459]: deep water, off Passe de Dumbéa, New Caledonia (22°25'S, 166°10'E), coll. J.-L. Justine, 26.VI.2008. 4 ♀♀ undissected in MABIK CR00179945-CR00179948.

ADDITIONAL MATERIAL. — 3 ♀♀ from *Etelis coruscans* [JNC113D]; CHONDRICAL PAL10, New Caledonia

(23°01'06"S, 166°55'83"E), depth 467–489 m, coll. J.-L. Justine, 1.II.2002. (NHMUK 2012. 1303-1305); 10 ♀♀ from *E. coruscans* [JNC114D]; CHONDRICAL PAL10, New Caledonia (23°01'06"S, 166°55'83"E), depth 467–489 m, coll. J.-L. Justine, 1.II.2002. (NHMUK 2012. 1306-1315); 1 ♀ from *E. coruscans* [JNC116D]; CHONDRICAL PAL10, New Caledonia (23°01'06"S, 166°55'83"E), depth 467–489 m, coll. J.-L. Justine, 1.II.2002. (MNHN-IU-2013-4014); 5 ♀♀ from *E. coruscans* [JNC117D]; CHONDRICAL PAL10, New Caledonia (23°01'06"S, 166°55'83"E), depth 467–489 m, coll. J.-L. Justine, 1.II.2002. (MABIK CR00179949-CR00179953); 16 ♀♀ from *E. coruscans* [JNC2616]; off Barrier reef near Passe de Dumbéa, New Caledonia (22°19.67'S, 166°12.899'E), coll. J.-L. Justine, 3.VII.2008. (MNHN-IU-2013-4015).

#### DESCRIPTION

##### Female

Total body length 3000–3520 µm (n = 10, mean = 3120 µm) excluding caudal rami. Cephalothorax (Fig. 11A) subtriangular (322 × 427 µm), widest near slightly curved posterior margin; dorsal surface with distinct 3-branched chitinous markings, bar in mid-line simple, extending beyond posterior tips of lateral bars; lateral bars following margin of cephalothorax with irregular posterior edge bearing traces of side branches. Trunk (Fig. 11A) cylindrical, much longer than wide (2798 × 484 µm); anterior half consistently broader than posterior half; posterior part bearing legs 3 and 4, narrower than anterior, but with slight constrictions in some specimens; lacking posterior processes. Urosome (Fig. 12E) excluding caudal ramus small, shorter than wide (49 × 109 µm) comprising fused genital complex and abdomen (Fig. 12E). Caudal ramus (Fig. 12E) longer than wide (35 × 21 µm), with six naked setae clustered near apex. Egg sacs with mean of 31.5 eggs per sac, range from 27 to 36 eggs per sac.

Rostrum absent. Antennule (Fig. 11B) 4-segmented; length 179 µm; armature formula: 10, 10, 1, 11 + ae. Antenna (Fig. 11C) 3-segmented; proximal segment unarmed (not figured); middle segment (basis) elongate, slightly tapering distally, ornamented with surface pits; terminal claw small, subdivided by incomplete suture; without ornamentation; total length 213 µm; middle segment length 163 µm; terminal claw length 50 µm. Parabasal papilla not observed.

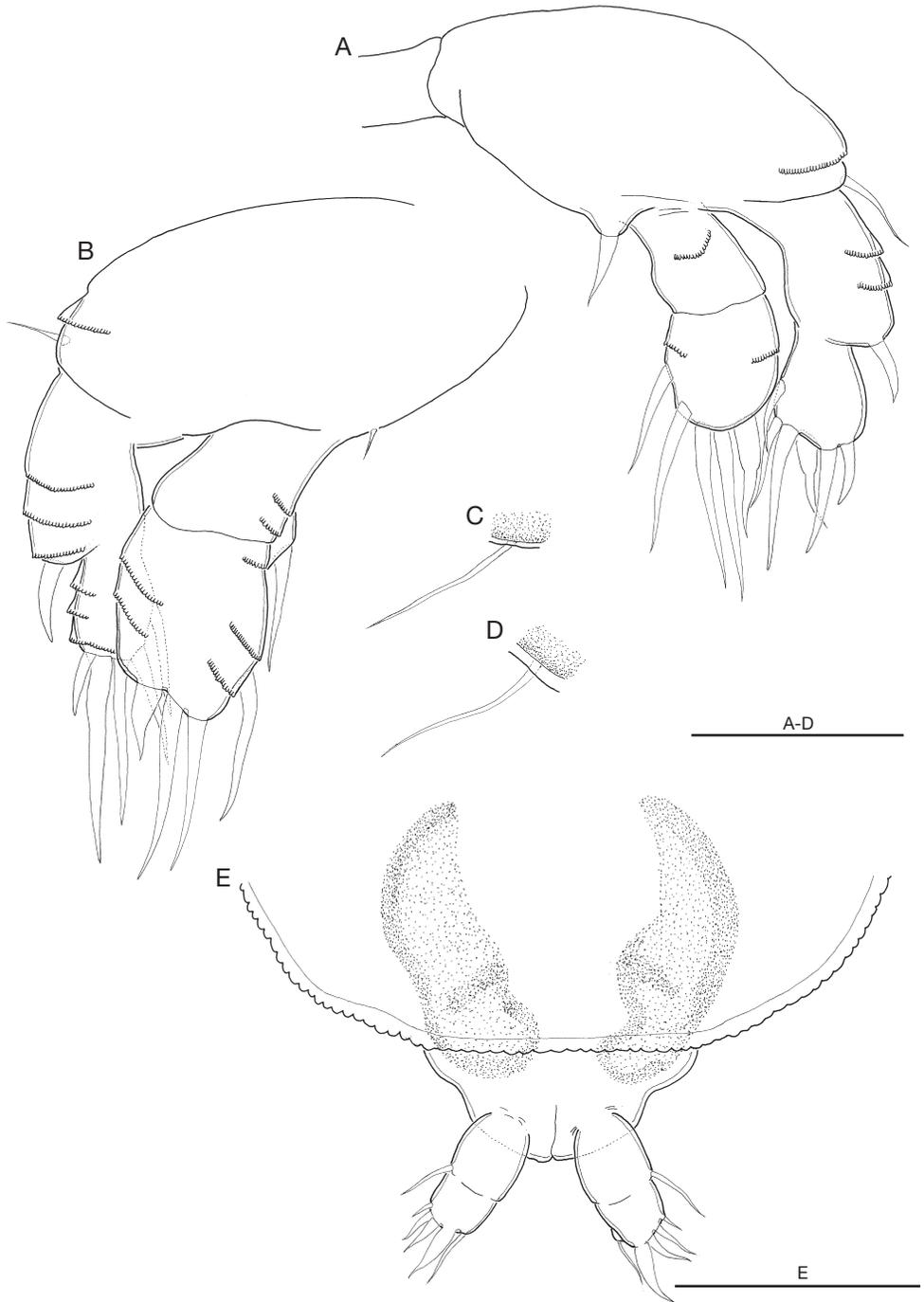


FIG. 9. — *Hatschekia euanus* n. sp. female: **A**, leg 1; **B**, leg 2; **C**, leg 3; **D**, leg 4; **E**, posterior part of trunk, ventral. Scale bars: A-D, 25 µm; E, 50 µm.

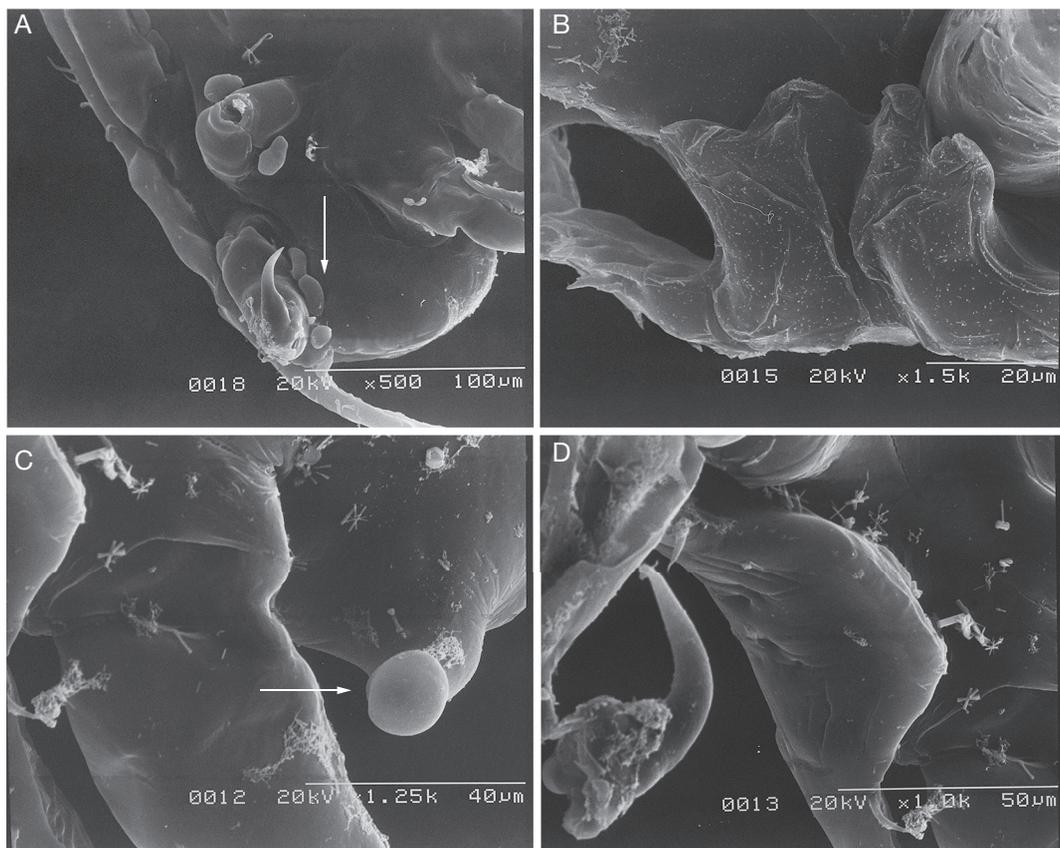


FIG. 10. — *Hatschekia cadenati* Nunes-Ruivo, 1954: **A**, cephalothorax, ventral view of anterior region showing parbasal papilla (arrowed). *Hatschekia euanus* n. sp.; **B**, rostrum, ventral. *Hatschekia fuscoguttatus* n. sp.; **C**, parbasal papilla (arrowed); **D**, rostrum. SEM micrographs.

Oral cone robust. Mandible (Fig. 11D) slender, rod-like, with five small blunt teeth. Maxillule (Fig. 11E) bilobate; both lobes armed with two stout tapering processes. Maxilla (Fig. 11F) 4-segmented; proximal segment unarmed; second segment elongate, with one basal seta; third segment rod-like, elongate, with one distal seta; terminal segment small, with one small seta and bifid claw. Maxilliped absent.

Leg 1 (Fig. 12A) biramous; protopod bearing one fine inner spine and one outer seta; exopod indistinctly 2-segmented, exp-1 with one outer seta, exp-2 with three inner and three distal setae; endopod 1-segmented, with three inner setae, two distal setae, and one outer seta; protopod length 61  $\mu$ m; exopod length 45  $\mu$ m; endopod length

31  $\mu$ m. Leg 2 (Fig. 12B) biramous; exopod indistinctly 2-segmented, exp-1 with one outer seta, exp-2 with five setae; endopod indistinctly 2-segmented, enp-1 with one inner seta, enp-2 with one inner seta, three terminal setae, and one outer seta; outer protopodal seta missing in figured specimen, present in other specimens; protopod length 84  $\mu$ m; exopod length 53  $\mu$ m; endopod length 40  $\mu$ m. Protopod and rami of legs 1 and 2 (Fig. 12A, B) ornamented with crescentic rows of blunt spinules on surface. Intercoxal sclerites of both legs elongate, unornamented and unmodified. Legs 3 and 4 (Fig. 12C, D) each represented by small laterally located lobe tipped with one simple plumose seta and positioned at two thirds and  $\frac{7}{8}$  of length of trunk.

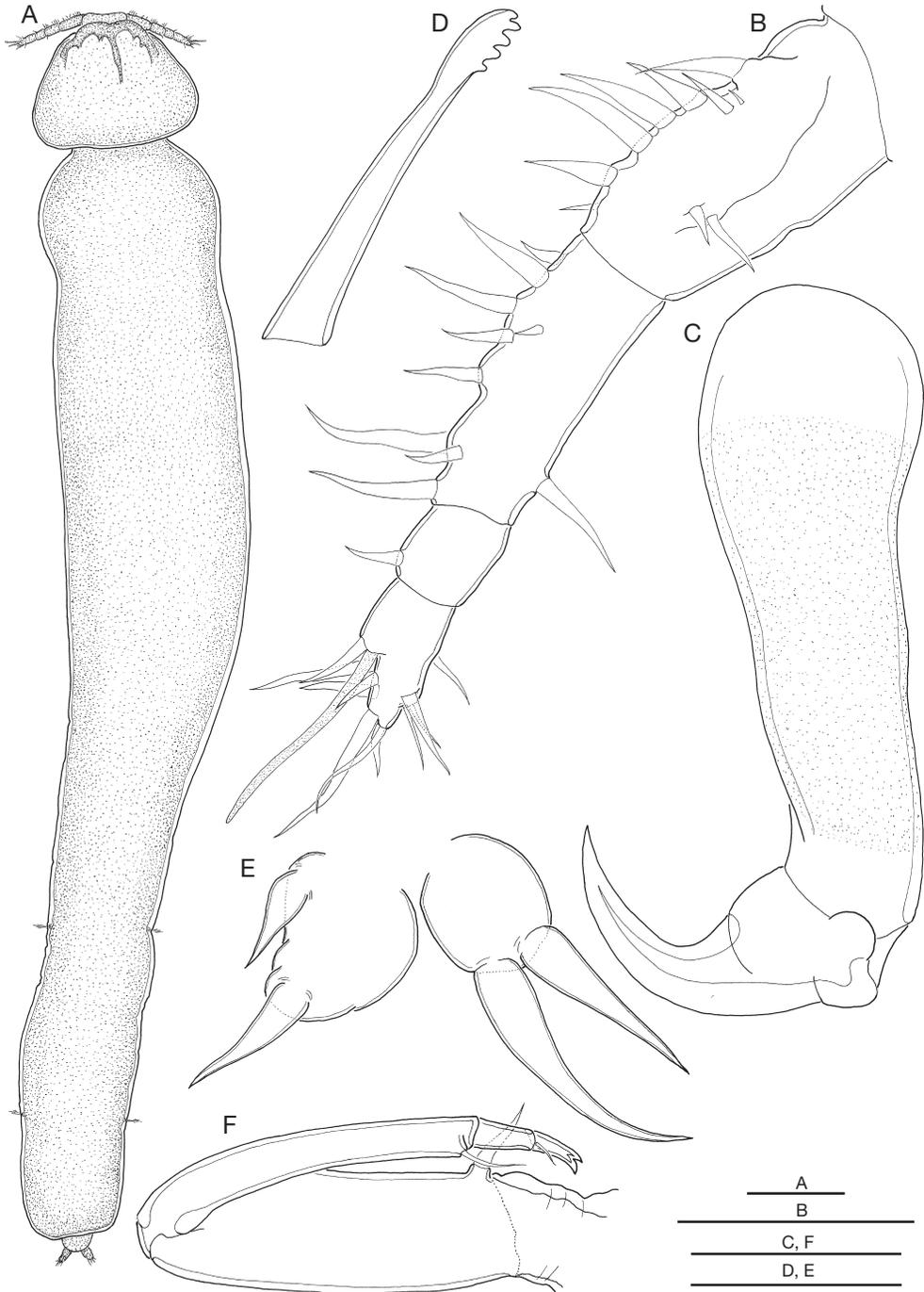


FIG. 11. — *Hatschekia eteliscola* n. sp. female: **A**, habitus, dorsal; **B**, antennule; **C**, antenna; **D**, mandible; **E**, maxillule; **F**, maxilla. Scale bars: A, 250  $\mu$ m; B, C, F, 50  $\mu$ m; D, E, 25  $\mu$ m.

*Male*

Unknown.

## REMARKS

*Hatschekia eteliscola* n. sp. is distinctive in having a very long trunk and, judging from the posterior location of vestigial legs 3 and 4, this length comes particularly from elongation of the first two pedigerous somites in the trunk. The trunk is about 5.8 times longer than wide and it narrows distinctly in the posterior half. The division into broader anterior and narrow posterior parts is a consistent feature, irrespective of the state of fixation and preservation of the specimen. Relatively few other species have a trunk more than 5 times longer than wide. These are *H. tenuis* (Heller, 1865), *H. sargi* (Brian, 1902), *H. linearis* Wilson, 1913, *H. pagrosomi* Yamaguti, 1939, *H. gracilis* Yamaguti, 1954, *H. longibrachium* Yamaguti, 1954, *H. atagonel* Jones, 1985, *H. manea* Jones & Cabral, 1990, *H. clava* Kabata, 1991, *H. squamigera* Kabata, 1991, and *H. tanysona* Ho & Kim, 2001. None of these has a trunk showing marked division into broader anterior and narrow posterior parts.

The new species differs from both *H. clava* and *H. tanysona* in the position of leg 3 – which is located just anterior to the mid-length of the trunk in both species, but well within the posterior third of the trunk in the new species. *Hatschekia tanysona* and *H. clava* also possess minute posterolateral processes on the trunk which *H. eteliscola* n. sp. does not. *Hatschekia squamigera* has an elongate cephalothorax (1.35 times longer than wide) and has distinct posterolateral processes on the trunk. In contrast the cephalothorax of *H. eteliscola* n. sp. is wider than long and it lacks processes on the trunk. The new species differs from *H. atagonel* which has a well defined transverse welt in its neck region and has a cephalothorax that is widest anteriorly. *Hatschekia manea* has a 3-segmented antennule compared to 4-segmented in *H. eteliscola* n. sp. and this species has fewer setal elements on both rami of both legs 1 and 2 than the new species.

*Hatschekia tenuis* has a very elongate trunk, over 8 times longer than wide, which is widest in its posterior half. This is different in form from the new species but trunk shape can vary with reproductive state. According to Jones (1985), *H. tenuis* also has

a distinctive conical projection at the base of the hook on the antenna, which is lacking in the new species. *Hatschekia pagrosomi* is also an extremely elongate form but differs in having markedly fewer setation elements on the exopods of legs 1 and 2 than in *H. eteliscola* n. sp.

*Hatschekia sargi* has a linear trunk and has smoothly convex lateral margins to the cephalothorax. In contrast the trunk of the new species is narrower posteriorly and the cephalothorax is distinctly triangular in shape from dorsal view, with its lateral margins tapering anteriorly from its widest point near its rear margin.

The trunk of *H. longibrachium* is much wider posteriorly than anteriorly and also differs from the new species in having a cephalothorax which is widest in the middle compared to widest posteriorly as in the new species. *Hatschekia linearis* has a distinctive shape as it has swellings marking the origins of legs 1 and 2, and also differs from *H. eteliscola* n. sp. in having a 3-segmented antennule (cf. 4-segmented) and in having many fewer setal elements on both rami of legs 1 and 2. *Hatschekia gracilis* is another elongate species with a trunk that is much wider posteriorly than anteriorly. It has a distinctive pattern of chitinous markings on the dorsal surface of the cephalothorax with an additional pair of branched bars located between the usual lateral bars and the mid-line bar. The new species has relatively reduced chitinous markings and no additional branched bars are present.

The significant differences between *H. eteliscola* n. sp. and all these other species that share an elongate trunk justify the establishment of the new species.

*Hatschekia fuscoguttatus* n. sp.

*Hatschekia* sp. 5 – Justine *et al.* 2010a: fig. 1D.

TYPE HOST. — *Epinephelus fuscoguttatus* (Forsskål, 1775) (Perciformes: Serranidae).

TYPE LOCALITY. — Passe de Dumbéa, New Caledonia (22°21'59"S, 166°14'59"E).

ETYMOLOGY. — The specific name of the new species, *fuscoguttatus*, is treated as a noun in apposition and is based on its host.



FIG. 12. — *Hatschekia eteliscicola* n. sp. female: A, leg 1; B, leg 2; C, leg 3; D, leg 4; E, posterior part of trunk, ventral. Scale bars: A-D, 25 µm; E, 50 µm.

MATERIAL EXAMINED. — Holotype female (MNHN-IU-2013-4016) dissected on 11 slides. Paratype female (NHMUK 2012.1316) dissected on 5 slides. 7 ♀♀ undissected paratypes (1 ♀ used for SEM): from *E. fuscoguttatus* [JNC 2120], Passe de Dumbéa, New Caledonia, coll. J.-L. Justine, 5.XII.2006. 1 ♀ in MNHN-IU-2013-4017, 5 ♀♀ undissected in MABIK CR00179954-CR00179958); 7 ♀♀ undissected paratypes from *E. fuscoguttatus* [JNC1379], Passe de Dumbéa, New Caledonia, coll. J.-L. Justine, 24.IX.2004. 4 ♀♀ in MNHN-IU-2013-4018, 3 ♀♀ in NHMUK 2012.1317-1319.

## DESCRIPTION

### Female

Total body length 910-1037  $\mu\text{m}$  ( $n = 9$ , mean = 982  $\mu\text{m}$ ) excluding caudal rami. Cephalothorax (Fig. 13A) much wider than long, with angular expansions in middle of lateral margins, not projecting frontally, with truncate, transverse posterior margin (196  $\times$  307  $\mu\text{m}$ ); dorsal surface with distinct chitinous markings, subdivided by bar along mid-line almost joining tips of lateral bars; bar in mid-line with right-angled side branches near bifid tip. Lateral bars defining sub-rectangular shape. Trunk (Fig. 13A) fusiform, longer than wide (709  $\times$  234  $\mu\text{m}$ ), exhibiting slight constriction posterior to second legs; trunk narrowing posteriorly. Urosome (Fig. 14F) comprising fused genital complex and abdomen constricted near base, longer than wide (50  $\times$  77  $\mu\text{m}$ ) (excluding caudal ramus). Caudal ramus (Fig. 14F) longer than wide (39  $\times$  17  $\mu\text{m}$ ), with seven naked setae, longest seta partly fused to ramus at base. Egg sacs shorter than trunk, each egg sac with two elongate eggs.

Rostrum trapezoidal in ventral view (Fig. 10D). Antennule (Fig. 13B) 4-segmented; length 252  $\mu\text{m}$ ; armature formula: 9, 10, 1, 13 + ae. Antenna (Fig. 13C) 3-segmented; proximal segment unarmed (not figured); middle segment (basis) small, tapering slightly distally, ornamented with minute surface pits; terminal claw small without ornamentation, subdivided by incomplete suture; total length 160  $\mu\text{m}$ ; middle segment length 113  $\mu\text{m}$ ; terminal claw length 47  $\mu\text{m}$ . Parabasal papilla large, with rounded knob-like tip (arrowed in Fig. 10C), extending beyond lateral margin. Oral cone robust. Mandible (Fig. 13D) slender, short, rod-like, with three small blunt teeth. Maxillule (Fig. 13E) bilobate;

both lobes armed with two long, tapering, acute processes. Maxilla (Fig. 13A) 4-segmented; proximal segment unarmed; second segment swollen with one basal seta; third segment rod-like, elongate, with one distal seta; terminal segment small, with one small seta and bifid claw. Maxilliped absent.

Leg 1 (Fig. 14B) biramous; protopod bearing one fine inner spine, and one long outer seta ornamented with single setule distally; exopod indistinctly 2-segmented, exp-1 with one outer seta, exp-2 with four setae (innermost seta minute); endopod 2-segmented, enp-1 unarmed, enp-2 with three setae (one minute seta on inner margin, one long and one short seta distally); protopod length 68  $\mu\text{m}$ ; exopod length 58  $\mu\text{m}$ ; endopod length 26  $\mu\text{m}$ . Leg 2 (Fig. 14C) biramous; protopod bearing long outer seta, ornamented with single setule; exopod 2-segmented, exp-1 with one plumose outer seta, exp-2 with two long coiled distal setae; endopod 2-segmented, enp-1 unarmed, enp-2 with two elongate setae and minute distal seta; protopod length 119  $\mu\text{m}$ ; exopod length 115  $\mu\text{m}$ ; endopod length 84  $\mu\text{m}$ . Rami of leg 2 (Fig. 14C) ornamented with crescentic rows of blunt spinules on surface. Intercostal sclerites of both legs elongate, unornamented and unmodified. Leg 3 (Fig. 14D) represented by small lobe tipped with two plumose setae at mid-length of trunk. Leg 4 (Fig. 14E) represented by one plumose seta located at three quarters length of trunk.

### Male

Unknown.

## REMARKS

*Hatschekia fuscoguttatus* n. sp. exhibits a unique feature in the presence of very long apical setae on both rami of leg 2. These setae are about twice as long as the entire exopod and are sufficient to distinguish the new species from all its congeners. There are two of these setae on the tip of each ramus and they are loosely coiled in fixed specimens. The setae on the rami of leg 1 are more normal in length. In many other respects the new species resembles *H. cadenati* Nunes-Ruivo, 1954 which is redescribed below in the present study, based on new material from New Caledonia. They are similar in characters such as general body shape,

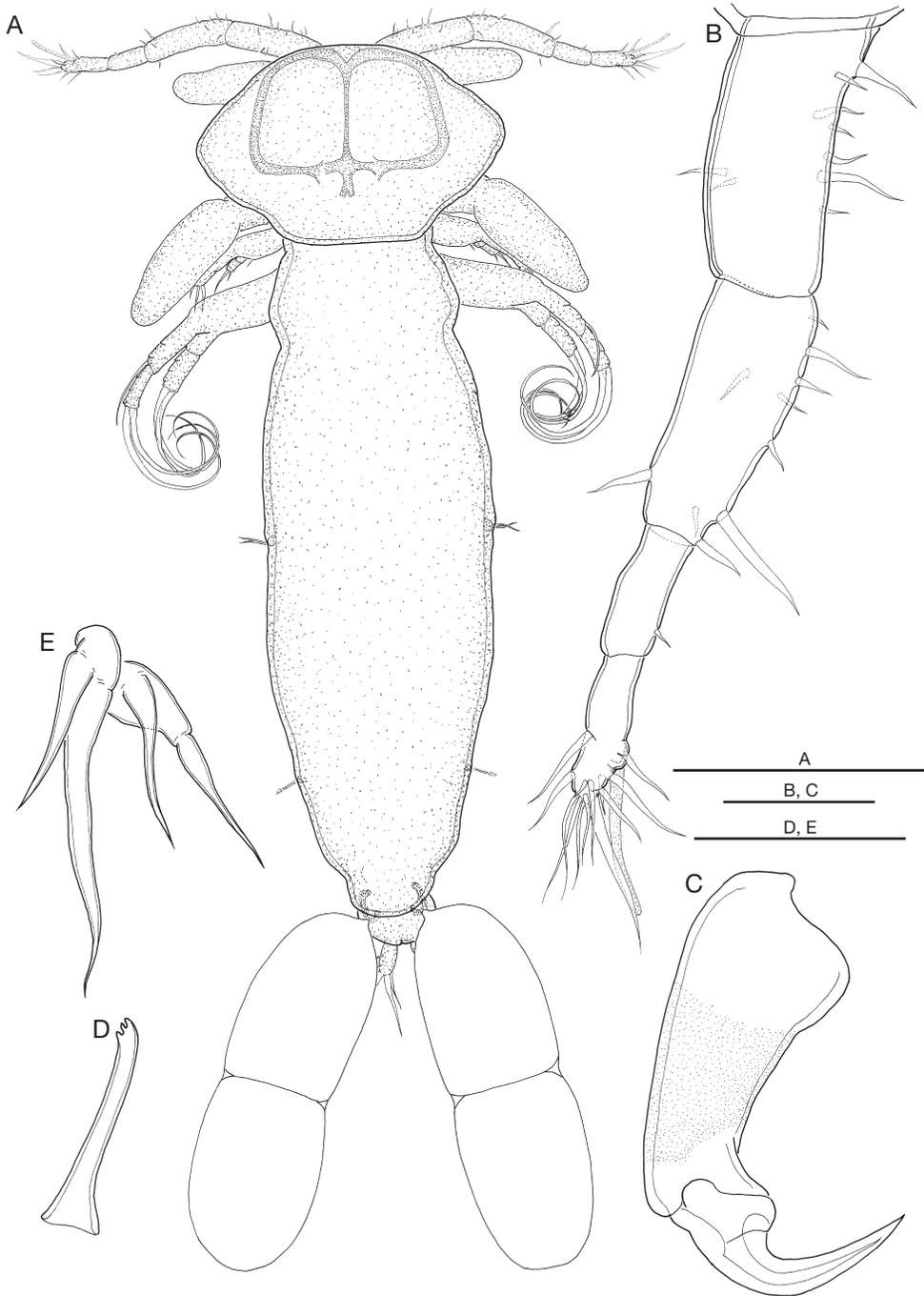


FIG. 13. — *Hatschekia fuscoguttatus* n. sp. female: A, habitus, dorsal; B, antennule; C, antenna; D, mandible; E, maxillule. Scale bars: A, 250 µm; B, C, 50 µm; D, E, 25 µm.

antennular segmentation, form of the antenna, and in the possession of egg sacs containing just two eggs each. Additional differences can be found in the antennule armature formula which is 9, 10, 1, 13 + ae in the new species, compared with 5, 8, 1, 13 + ae in *H. cadenati*. So, the new species has four and two additional setae on the first and second antennular segments respectively. The armature of the distal two segments is the same. These species also differ in the number of teeth on the mandible. The form of the parabasal papilla is different: in the new species it is a large process with a rounded knob-like tip that extends beyond the lateral margin of the cephalothorax, whereas in *H. cadenati* it comprises four or five thumb-like or oval processes.

### *Hatschekia niger* n. sp.

*Hatschekia* sp. 18 – Justine *et al.* 2012: fig. 2B.

TYPE HOST. — *Macolor niger* (Forsskål, 1775) (Perciformes: Lutjanidae).

TYPE LOCALITY. — New Caledonia.

ETYMOLOGY. — The specific name of the new species, *niger*, is treated as a noun in apposition and is based on its host.

MATERIAL EXAMINED. — Holotype female (MNHN-IU-2013-4019) dissected on 10 slides. Paratype female (NHMUK 2012.1320) dissected on 10 slides. 39 ♀♀ undissected paratypes: from *Macolor niger* [JNC 1716B], Passe de Dumbéa, New Caledonia, coll. J.-L. Justine, 16.I.2006. 10 ♀♀ undissected in MNHN Cp. 0000, 17 ♀♀ undissected in NHMUK 2012.1321-1330, 12 ♀♀ undissected in MABIK CR00179959-CR00179968.

ADDITIONAL MATERIAL. — 1 ♀ from *M. niger* [JNC1717]; Passe de Dumbéa, New Caledonia, coll. J.-L. Justine, 16.I.2006. (NHMUK 2012.1331).

#### DESCRIPTION

##### *Female*

Total body length 1190-1500 µm (n = 10, mean = 1330 µm) excluding caudal rami. Body (Fig. 15A) elongate. Cephalothorax (Fig. 15A) wider than long (218 × 259 µm), convex angular lateral margins and straight posterior margin; dorsal surface with distinct chitinous markings in form of “m-shape”,

bar in mid-line extending beyond posterior tips of curved, undivided lateral bars, with short side branches at about 60% of length, and divided at posterior end. Trunk (Fig. 15A) cylindrical, longer than wide (1230 × 286 µm), with natter neck region anteriorly; lateral margins straight to slightly convex; widest about in middle; posterior margin with three or four nodules on either side, situated dorsal to urosome (Fig. 16E), and with paired minute bifid processes located ventrally at posterolateral corners of trunk (Fig. 16F). Urosome (Fig. 16E, F) excluding caudal ramus shorter than wide (58 × 102 µm), comprising fused genital complex and abdomen. Caudal ramus (Fig. 16E, F) widest distal to mid-level, longer than wide (28 × 16 µm), with six naked setae. Egg sac containing ten eggs (single specimen with egg sacs).

Rostrum absent. Antennule (Fig. 15B) 5-segmented; length 207 µm; armature formula: 9, 4, 1, 11 + ae. Antenna (Fig. 15C) 3-segmented; proximal segment unarmed; middle segment (basis) swollen, slightly tapering, ornamented with surface pits; terminal claw small without ornamentation, subdivided by incomplete suture; total length 223 µm; middle segment length 178 µm; terminal claw length 45 µm. Parabasal papilla not observed. Oral cone robust. Mandible (Fig. 15D) styliform, apparently unarmed. Maxillule (Fig. 15E) bilobate; both lobes armed with two stout processes. Maxilla (Fig. 15F) 4-segmented; proximal segment unarmed; second segment swollen with one proximal seta on medial margin; third segment rod-like, elongate, with one distal seta; terminal segment small, with one small seta and bifid claw. Maxilliped absent.

Leg 1 (Fig. 16A) biramous; protopod bearing one inner and one fine outer seta; exopod indistinctly 2-segmented, exp-1 with one outer seta, exp-2 with four setae ornamented with fine hairs; endopod 2-segmented, enp-1 unarmed, enp-2 with two distal and three inner setae ornamented with fine hairs; protopod length 85 µm; exopod length 63 µm; endopod length 51 µm. Leg 2 (Fig. 16B) biramous; protopod elongate, laterally-directed, lacking outer seta; exopod indistinctly 2-segmented, exp-1 with one outer seta, exp-2 with three distal setae ornamented with fine hairs and two naked inner setae; endopod 2-segmented, enp-1 slender,

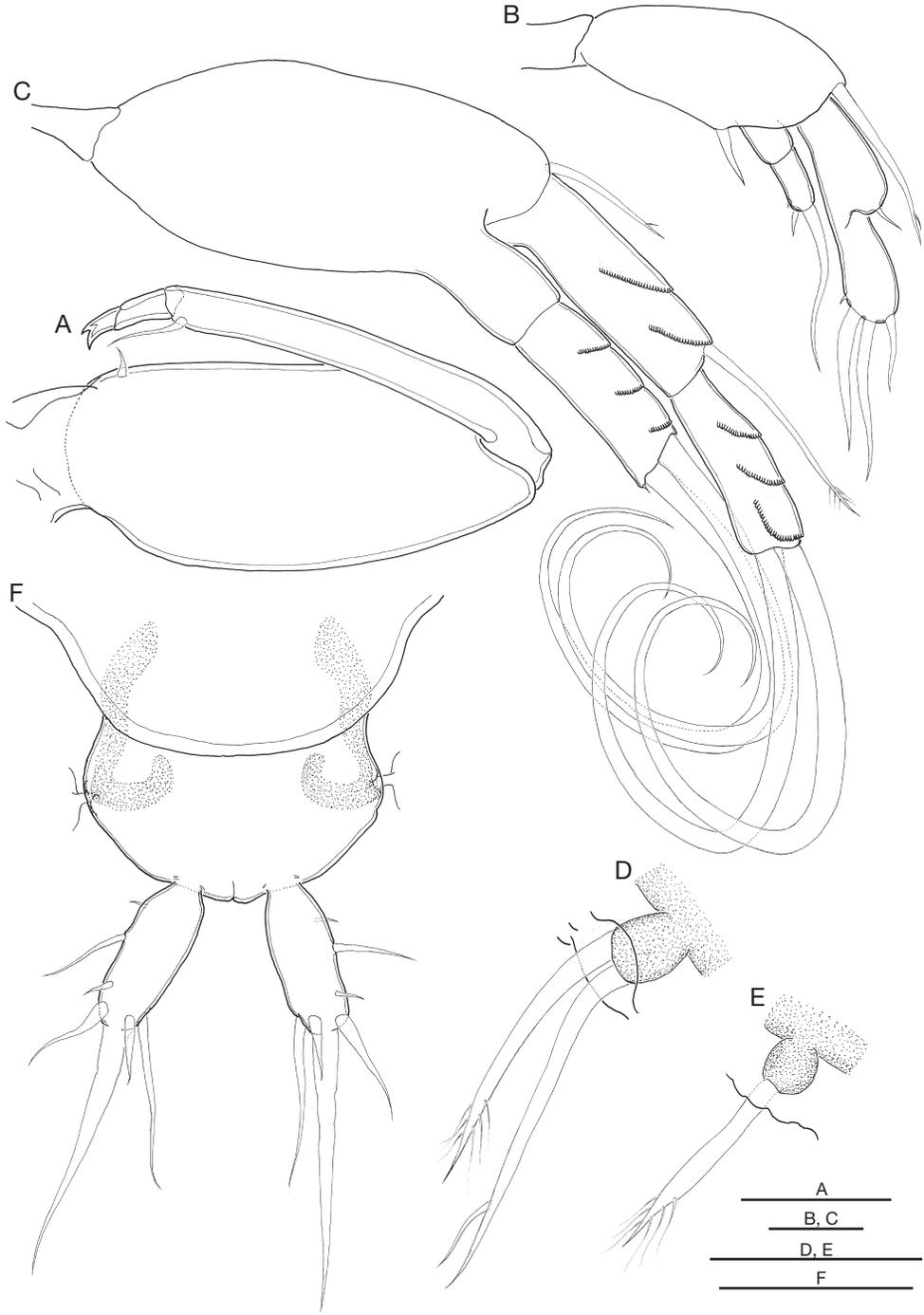


FIG. 14. — *Hatschekia fuscoguttatus* n. sp. female: **A**, maxilla; **B**, leg 1; **C**, leg 2; **D**, leg 3; **E**, leg 4; **F**, posterior part of trunk, ventral. Scale bars: A, F, 50 µm, B-E, 25 µm.



FIG. 15. — *Hatschekia niger* n. sp. female: **A**, habitus, dorsal; **B**, antennule; **C**, antenna; **D**, mandible; **E**, maxillule; **F**, maxilla. Scale bars: A, 250  $\mu$ m; B, C, F, 50  $\mu$ m; D, E, 25  $\mu$ m.

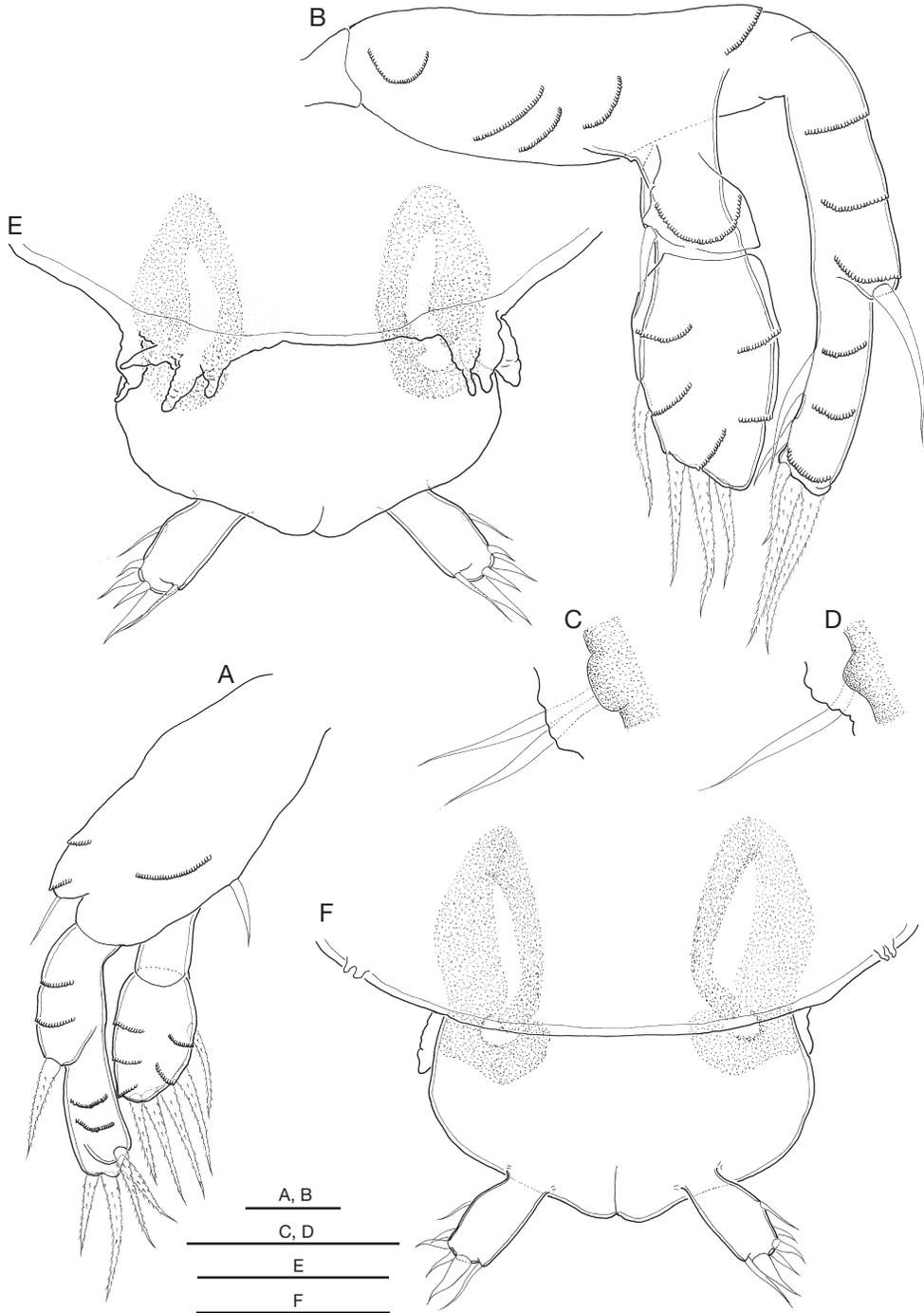


FIG. 16. — *Hatschekia niger* n. sp. female: **A**, leg 1; **B**, leg 2; **C**, leg 3; **D**, leg 4; **E**, posterior part of trunk, dorsal; **F**, posterior part of trunk, ventral. Scale bars: A-D, 25 µm; E, F, 50 µm.

with inner seta; enp-2 with one inner and three distal setae ornamented with fine hairs; protopod length 120  $\mu\text{m}$ ; exopod length 120  $\mu\text{m}$ ; endopod length 102  $\mu\text{m}$ . Protopod and rami of legs 1 and 2 (Fig. 16A, B) ornamented with crescentic rows of blunt spinules on surface. Intercoxal sclerites of both legs elongate, unornamented and unmodified. Leg 3 (Fig. 16C) represented by small laterally-located lobe with two naked setae just anterior to mid-length of trunk. Leg 4 (Fig. 16D) represented by small lobe with one naked seta located at three quarters length of trunk.

#### Male

Unknown.

#### REMARKS

*Hatschekia niger* n. sp. shares the possession of nodules on the posterior margin of the trunk with *H. nodosa* Ho & Kim, 2001. These nodules may be derived from modified posterior trunk processes but their position dorsal to the urosome might indicate that they are novel structures. Both species occur on the gills of lutjanid hosts and share other characters such as the pattern of chitinous markings on the dorsal surface of the cephalothorax. They are undoubtedly closely related but there are several differences between the new species and *H. nodosa*. In the new species the setal formula of the antennule is 9, 4, 4, 1, 11 + ae, whereas in *H. nodosa* it is 9, 5, 4, 3 + ae, 11, according to Ho & Kim (2001). The apparent difference in antennular segmentation needs confirmation: the configuration of the two distal segments shown by Ho & Kim (2001) is probably erroneous since the aesthetasc is shown as carried on the subapical segment in their drawings but it is always found on the apical segment in *Hatschekia*. The antenna of *H. nodosa* carries an inner seta on the coxobasis of the antenna which, as Ho & Kim (2001) pointed out, is an unusual feature for the genus. No such seta was present in the new species. The mandible of *H. nodosa* has six small teeth whereas in *H. niger* n. sp. the mandible tapers to a curved pointed tip without additional teeth. The exopod of leg 1 is armed with five setae in *H. nodosa* but only four in the new species and the setae on the exopod of leg 2 differ in relative

lengths: in the new species there are two apical setae of similar length compared to a short outer seta and long inner seta on the apex in *H. nodosa*. No variation was detected in the number of setae present on the exopod of leg 1 in the new species. The curved lateral bars on the cephalothorax of *H. nodosa* have anterolateral side branches (Ho & Kim, 2001: Fig. 2B) which are absent in *H. niger* n. sp. Finally these two species also differ slightly in the shape of the urosome, which is relatively wider compared to its length in the new species. Taken together, we consider that these morphological differences are sufficient to justify the recognition of the new species, although we know little about variability in this genus and it would be advisable to test the separation of these two species using molecular data.

#### *Hatschekia cadenati* Nunes-Ruivo, 1954

*Hatschekia* sp. 1 – Justine *et al.* 2010a: fig. 1B.

MATERIAL EXAMINED. — 3 ♀♀ from *E. cyanopodus* [JNC 945A], outer side of Récif Kué, off coast of Nouméa, New Caledonia (22°35'59"S, 166°32'00"E), coll. J.-L. Justine on 28.X.2003. Female (NHMUK 2013.1360) dissected on 11 slides. 2 ♀♀ used for SEM; 12 ♀♀ from *Variola albimarginata* [JNC1209A], Récif Le Sournois, New Caledonia, coll. J.-L. Justine, 27.VII.2004. (MABIK CR00179969-CR00179980); 5 ♀♀ from *V. albimarginata* [JNC1247B], Récif Le Sournois, off coast of Nouméa, New Caledonia (22°19'32"S, 166°27'37"E), coll. J.-L. Justine, 15.IX.2004. (NHMUK 2012. 1332-1336); 1 ♀ from *V. albimarginata* [JNC1353B], Passe de Dumbéa, New Caledonia, coll. J.-L. Justine, 28.IX.2004. (specimen lost); 31 ♀♀ from *E. coeruleopunctatus* [JNC1905], Fausse Passe de Uitoé, New Caledonia, coll. J.-L. Justine, 10.VII.2006. (MNHN-IU-2013-4021); 18 ♀♀, 1 ♂ from *E. polyphkadion* [JNC1911], Récif Tabou, New Caledonia, coll. J.-L. Justine, 20.VII.2006. (NHMUK 2012. 1337-1346); 6 ♀♀ from *E. polyphkadion* [JNC1915], Récif Tabou, New Caledonia, coll. J.-L. Justine, 20.VII.2006. (MNHN-IU-2013-4022); 1 ♀, 1 ♂ from *E. fasciatus* [JNC1936], Récif To, New Caledonia, coll. J.-L. Justine, 5.IX.2006. (NHMUK 2012. 1347-1348); 1 ♀ from *E. rivulatus* [JNC1873], Récif Le Sournois, New Caledonia, coll. J.-L. Justine, 20.VI.2006. (NHMUK 2012. 1349);

10 ♀♀ from *E. maculatus* [JNC2157], Off Ever Prosperity, New Caledonia, coll. J.-L. Justine, 17.IV.2007. (NHMUK 2012. 1350-1359); DNA-barcode (mtCOI) sequences and traces were submitted to GenBank (accession numbers: JQ664007).

#### REDESCRIPTION

##### *Female*

Total body length 625-880  $\mu\text{m}$  ( $n = 12$ , mean = 712  $\mu\text{m}$ ) excluding caudal rami. Cephalothorax (Fig. 17A) elliptical with expanded, rounded lateral margins, slightly shorter than wide (172  $\times$  271  $\mu\text{m}$ ), dorsal surface with distinct chitinous markings in form of "m-shape", bar in mid-line, without side branches, extending only as far as branched posterior tips of curved lateral bars; lateral bars each with short, anterior side branch near anterolateral angles. Trunk (Fig. 17A) longer than wide (620  $\times$  256  $\mu\text{m}$ ), widest at level between third and fourth legs; tapering anteriorly to narrow zone resembling neck region; convex lateral margins converging posteriorly to narrow border with urosome; trunk lacking posterior processes. Urosome excluding caudal ramus shorter than wide (43  $\times$  78  $\mu\text{m}$ ) comprising fused genital complex and abdomen (Fig. 18E). Caudal ramus (Fig. 18E) elongate, longer than wide (31  $\times$  13  $\mu\text{m}$ ), with six naked setae and one plumose mid-lateral seta. Egg sacs shorter than trunk, each containing two elongate eggs.

Rostrum absent. Antennule (Fig. 17B) 4-segmented; length 213  $\mu\text{m}$ ; armature formula: 5, 8, 1, 13 + ae. Antenna (Fig. 17C) 3-segmented; proximal segment unarmed, fused with cephalosome; middle segment (basis) swollen and tapering distally, ornamented with surface pits; terminal claw without armature, subdivided by suture; total length 131  $\mu\text{m}$ ; middle segment length 95  $\mu\text{m}$ ; terminal claw length 37  $\mu\text{m}$ . Parbasal papilla (Fig. 10A) four or five thumb-like or oval processes. Oral cone robust. Mandible (Fig. 17D) slender, tapering distally, with two small distal teeth. Maxillule (Fig. 17E) bilobate; both lobes armed with two sharp tapering processes. Maxilla (Fig. 17F) 4-segmented; proximal segment unarmed; second segment swollen with one basal seta; third segment rod-like, elongate, with one distal seta; terminal segment small, with one small seta and bifid claw. Maxilliped absent.

Leg 1 (Fig. 18A) biramous; protopod bearing one fine inner spine and one outer seta; exopod indistinctly 2-segmented, exp-1 one outer seta, exp-2 with one distal seta and three inner setae (innermost seta minute); endopod 2-segmented, enp-1 unarmed, enp-2 with two distal setae; protopod length 53  $\mu\text{m}$ ; exopod length 55  $\mu\text{m}$ ; endopod length 21  $\mu\text{m}$ . Leg 2 (Fig. 18B) biramous; protopod bearing one plumose outer seta; exopod 2-segmented, exp-1 with one outer seta, exp-2 with two distal setae (inner seta minute); endopod 2-segmented, enp-1 unarmed, enp-2 with two distal setae; protopod length 75  $\mu\text{m}$ ; exopod length 73  $\mu\text{m}$ ; endopod length 44  $\mu\text{m}$ . Protopods and rami of legs 1 and 2 (Fig. 18A, B) ornamented with crescentic rows of blunt spinules on surface. Intercoxal sclerites of both legs elongated, unornamented and unmodified. Leg 3 (Fig. 18C) represented by two simple plumose setae arising from subsurface papilla, at mid-level of trunk. Leg 4 (Fig. 18D) one small plumose seta arising from subsurface papilla located laterally at three quarters length of trunk.

#### REMARKS

*Hatschekia cadenati* had not been adequately characterized and was in need of redescription according to Jones (1985), however, certain details were apparent from the original description by Nunes-Ruivo (1954) that allowed us to positively identify this species. Leg 1 exhibits an unusual setation feature that is unique in our experience, namely that the exopod carries two large setae set very closely together on the inner margin just distal to the articulation between the first and second segments (Fig. 18B). Nunes-Ruivo (1954) figured these setae and our material has two large setae and a minute (and easily-overlooked), vestigial element in the same position. In view of additional similarities in overall body shape, size, form of egg sacs with two eggs, defined urosome and elongate caudal rami, we identify our material as *H. cadenati*. This material was mistakenly treated as representing an undescribed species by Boxshall (*in* Justine *et al.* 2010a). All *Hatschekia* species recorded from serranid hosts are listed in Table 1 and *H. cadenati* is now reported from a total of 11 different hosts.

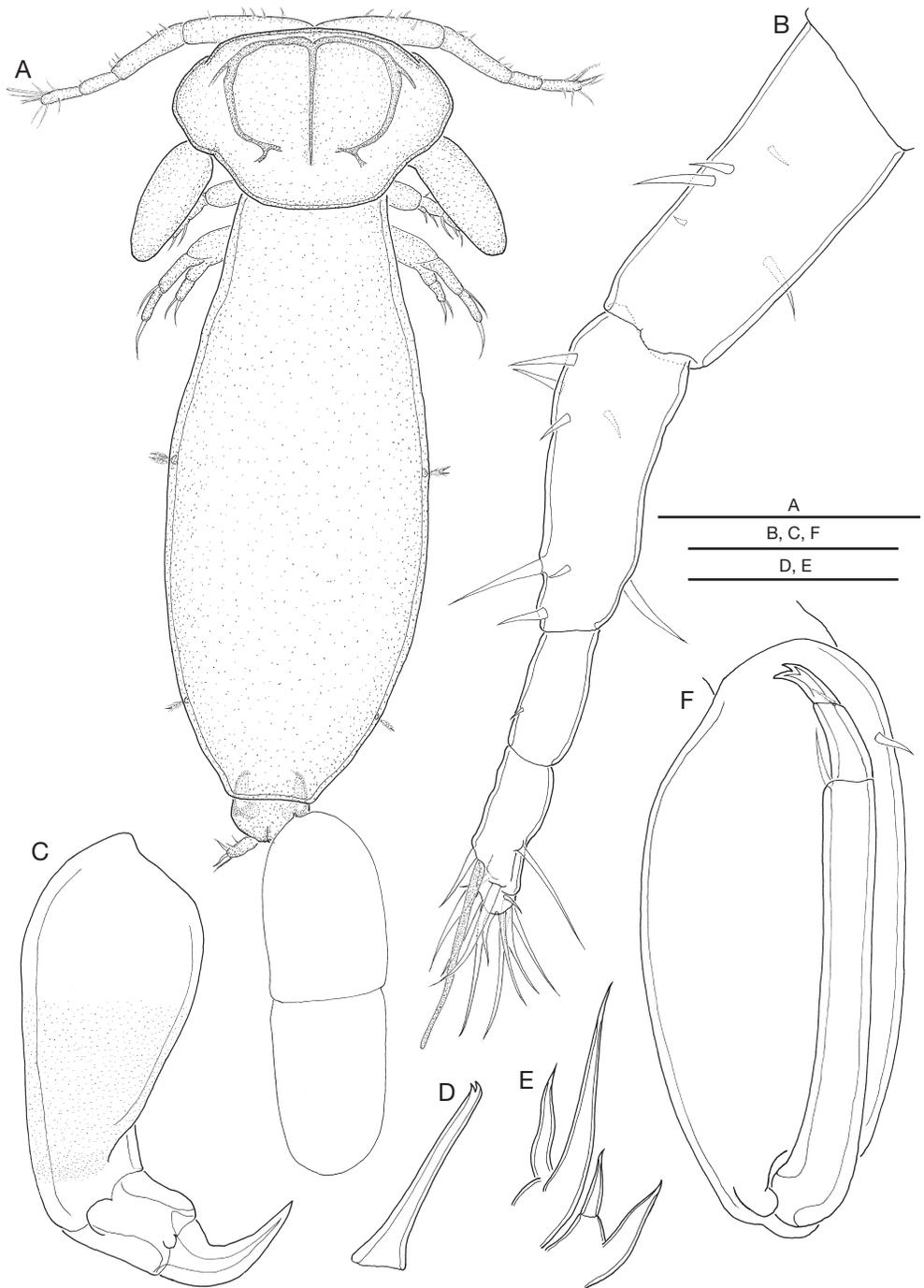


FIG. 17. — *Hatschekia cadenati* Nunes-Ruivo, 1954 female: **A**, habitus, dorsal; **B**, antennule; **C**, antenna; **D**, mandible; **E**, maxillule; **F**, maxilla. Scale bars: A, 250 µm; B, C, F, 50 µm; D, E, 25 µm.

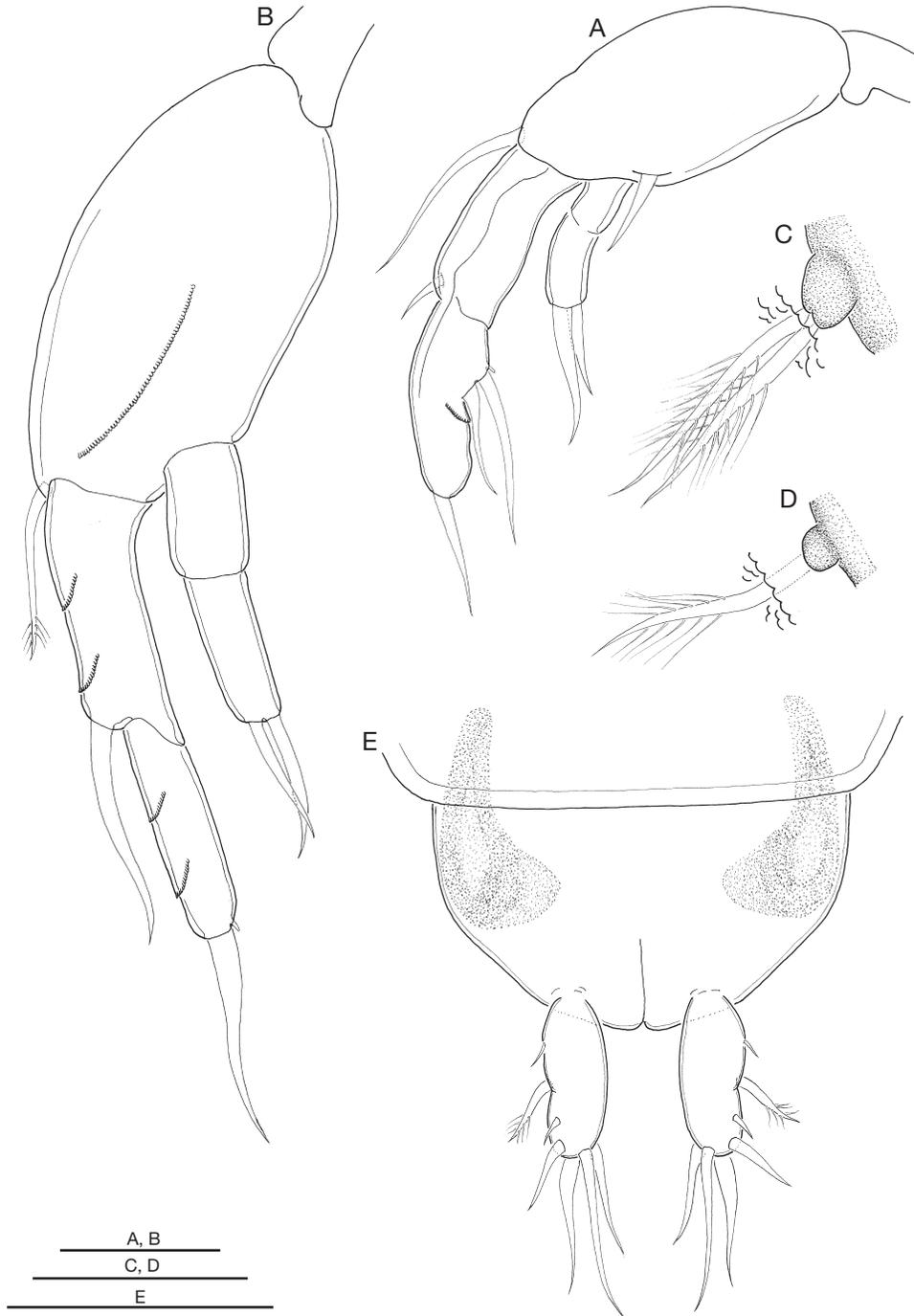


FIG. 18. — *Hatschekia cadenati* Nunes-Ruivo, 1954 female: **A**, leg 1; **B**, leg 2; **C**, leg 3; **D**, leg 4; **E**, posterior part of trunk, ventral. Scale bars: A-D, 25 µm; E, 50 µm.

TABLE 1. — Species of *Hatschekia* reported from host fish belonging to the Serranidae Swainson, 1839.

Copepod Species	Host species	Reference
<i>H. albirubra</i> Wilson, 1913	<i>Paralabrax clathratus</i> (Giard, 1854)	Wilson 1913
<i>H. amphiprocesa</i> Romero & Kuroki, 1986	<i>Paralabrax humeralis</i> (Valenciennes, 1828)	Romero & Kuroki 1986
<i>H. bifurcata</i> Yamaguti & Yamasu, 1959	<i>Diploprion bifasciatus</i> Cuvier, 1828	Yamaguti & Yamasu 1959
<i>H. cadenati</i> Nunes-Ruivo, 1954	<i>Epinephelus aeneus</i> (Geoffroy Saint-Hilaire, 1817)	Nunes-Ruivo 1954
	<i>Cephalopholis taeniops</i> (Valenciennes, 1828) [as <i>Epinephelus taeniops</i> ]	Nunes-Ruivo 1954
	<i>Epinephelus fasciatus</i> (Forsskål, 1775) [as <i>Epinephelus alexandrinus</i> ]	Nunes-Ruivo 1954
	<i>Epinephelus coeruleopunctatus</i> (Bloch, 1790)	present account
	<i>Epinephelus cyanopodus</i> (Richardson, 1846)	present account
	<i>Epinephelus fasciatus</i> (Forsskål, 1775)	present account
	<i>Epinephelus marginatus</i> (Lowe, 1834) [as <i>Epinephelus gigas</i> ]	Delamare Deboutteville & Nunes-Ruivo, 1958
	<i>Epinephelus maculatus</i> (Bloch, 1790)	present account
	<i>Epinephelus polyphkadion</i> (Bleeker, 1849)	present account
	<i>Epinephelus rivulatus</i> (Valenciennes, 1830) <i>Variola albimarginata</i> Baissac, 1953	present account present account
<i>H. cernae</i> Goggio, 1905	<i>Epinephelus aeneus</i> (Geoffroy Saint-Hilaire, 1817) [as <i>Cerna aenea</i> ]	Goggio 1905
	<i>Epinephelus fasciatus</i> (Forsskål, 1775) [as <i>Epinephelus alexandrinus</i> ]	Nunes-Ruivo 1954
	<i>Epinephelus marginatus</i> (Lowe, 1834) [as <i>Cerna gigas</i> or <i>Epinephelus gigas</i> ]	Goggio 1905, Rose & Vassière 1952, Nunes-Ruivo 1954, Capart 1959
	<i>Epinephelus tauvina</i> (Forsskål, 1775)	Ho & Sey 1996
	<i>Epinephelus morrhua</i> (Valenciennes, 1833)	Justine <i>et al.</i> 2010a
	<i>Epinephelus</i> sp.	Shiino 1957
<i>H. cyanopodus</i> n. sp.	<i>Epinephelus cyanopodus</i> (Richardson, 1846)	present account
<i>H. delamarei</i> Nunes-Ruivo, 1954	<i>Mycteroperca rubra</i> (Bloch, 1793)	Nunes-Ruivo 1954
<i>H. fuscoguttatus</i> n. sp.	<i>Epinephelus fuscoguttatus</i> (Forsskål, 1775)	present account
<i>H. insolita</i> Wilson, 1913	<i>Epinephelus adscensionis</i> (Osbeck, 1765)	Wilson 1913, Pearse 1951
	<i>Epinephelus morio</i> (Valenciennes, 1828)	Jones 1985
	<i>Mycteroperca bonaci</i> (Poey, 1860)	Jones 1985
	<i>Mycteroperca</i> sp.	Jones 1985
<i>H. louti</i> n. sp.	<i>Variola louti</i> (Forsskål, 1775)	present account
	<i>Variola albimarginata</i> Baissac, 1952	present account
<i>H. maculatus</i> n. sp.	<i>Epinephelus maculatus</i> (Bloch, 1790)	present account
<i>H. ovalis</i> (Bassett-Smith, 1898)	<i>Serranus</i> sp.	Bassett-Smith 1898
<i>H. pacifica</i> Cressey, 1970	<i>Paralabrax nebulifer</i> (Giard, 1854)	Cressey 1970
<i>H. petiti</i> Nunes-Ruivo, 1954	<i>Epinephelus aeneus</i> (Geoffroy Saint-Hilaire, 1817)	Nunes-Ruivo 1954
<i>H. plectropomi</i> Ho & Dojiri, 1978	<i>Plectropomus leopardus</i> (Lacepède, 1802)	Ho & Dojiri 1978
	<i>Plectropomus maculatus</i> (Bloch, 1790)	Kabata 1991
	<i>Plectropomus laevis</i> (Lacepède, 1801)	Justine <i>et al.</i> 2010a
<i>H. uncata</i> Wilson, 1913	<i>Epinephelus adscensionis</i> (Osbeck, 1765)	Wilson 1913

## DISCUSSION

All of these new species have been reported previously (Justine *et al.* 2010a, b, 2012) but have remained undescribed until now. Recent studies by Uyeno & Nagasawa (2009a, b, 2010a-c) have shown that the diversity of *Hatschekia* on tetraodontiform fishes in the Pacific is much higher than previously thought. Surveys of epinepheline serranids (Justine *et al.* 2010a), lethrinids (Justine *et al.* 2010b) and lutjanids (Justine *et al.* 2012) have revealed similar lack of knowledge on the true levels of species richness of *Hatschekia* on these families also.

Parasitic monogeneans were also common on the gills of the groupers of New Caledonia (Justine *et al.* 2010a). However, their distribution across host taxa was different from that of *Hatschekia*. The diversity of diplectanids of the genus *Pseudorhabdosynochus* Yamaguti, 1958 in particular, was much higher than for *Hatschekia* on the same host species. Justine (2007) found that *Epinephelus maculatus* was host to eight species of *Pseudorhabdosynochus*, while *E. malabaricus* was host to seven (Justine & Sigura 2007) and *E. cyanopodus* was host to six (Sigura & Justine 2008). No one species occurred on all three hosts, but two species were found on both *E. maculatus* and *E. cyanopodus* (Sigura & Justine 2008). All other species were strictly host specific. Comparison with the distribution of *Hatschekia* species found on the epinepheline serranids reveals significant differences: *H. cadenati* appears to be a generalist species reported from eleven different host species (Table 1). There appears to be no equivalent generalist species of the monogenean *Pseudorhabdosynochus*. The other new species described here from epinepheline hosts are more host specific: each occurs on just a single host species, or on two congeneric species, in the case of *H. louti* n. sp. on *Variola louti* and *V. albimarginata*. However, *H. cernae* has been reported from five different host species and both *H. insolita* Wilson, 1913 and *H. plectropomi* Ho & Dojiri, 1978 are known from three hosts (Table 1). Simple comparison between these two gill-inhabiting genera shows that the levels of host specificity in *Pseudorhabdosynochus* are significantly higher than in *Hatschekia*.

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