VIE ET MILIEU - LIFE AND ENVIRONMENT, 2008, 58 (3/4): 263-275

AN INTRIGUING NEW TAXON OF INTERSTITIAL LAOPHONTIDAE FROM THE INDO-PACIFIC: *AEQUINOCTIELLA* GEN. NOV. (COPEPODA: HARPACTICOIDA).

V. COTTARELLI, M. C. BRUNO, R. BERERA*

Dipartimento di Scienze Ambientali, Università della Tuscia, Largo dell'Università. 01100 Viterbo, Italy
** Corresponding author: mcbruno@unitus.it*

LAOPHONTIDAE
INTERSTITIAL HARPACTICOIDS
INDONESIA
PHILIPPINES
AEQUINOCTIELLA
KLIEONYCHOCAMPTOIDES

ABSTRACT. – A new genus of the harpacticoid family Laophontidae T. Scott, 1905 is described here. *Aequinoctiella* gen. nov. includes two species: *A. cavallettii* sp. nov., collected from the interstitial habitat of a beach on Tomea Island (Kepulauan Archipelago, southwest of Sulawesi), and *A. sagarum* sp. nov. collected from the interstitial habitat of a beach on Siquijor Island (Philippines, Mindanao Sea). The new genus lacks the sexually dimorphic P3, and the females show a partially-merged genital double-somite. The two new species have a similar habitus, integumental ornamentation, and chaetotaxy of the swimming legs, but they differ in the morphology of A1, mouthparts, male P5, and degree of reduction of P3 and P4 endopods in both sexes. A third species, collected with only female specimens from the interstitial habitat at several locations in the Philippines and Japan (Okinawa Island), is reported here as *Aequinoctiella* sp. Thus, the new genus appears to have a wide distribution in the Indo-Pacific, ranging from Japan, to the Philippines and Indonesia. The closest affinities of *Aequinoctiella* gen. nov. are with the genus *Klieonychocamptoides* Noodt, 1958.

INTRODUCTION

Marine and continental interstitial harpacticoids of southeastern Asia have been investigated by our research group for several years (e.g. Bruno & Cottarelli 1999, Cottarelli & Mura 1980, 1981, Cottarelli *et al*. 2006 a, b). During a research expedition to Indonesia in 1996, we collected interstitial harpacticoids from the northern sandy beach of Tomea (a small island of the Kepulauan Tukang Besi, an archipelago southwest of Sulawesi). The specimens belong to the family Laophontidae, subfamily Laophontinae *sensu* Huys and Lee 2000, and are herein described as the type species of a new genus: *Aequinoctiella cavallettii* gen. nov. sp. nov. Re-examination of other specimens in our collection, collected from the interstitial habitat on the island of Siqujior (Philippines), allows us to describe a second new species within the same genus, *Aequinoctiella sagarum* sp. nov.

The females of the two new species are very similar to those of the genus *Klieonychocamptoides* Noodt, 1958, which is reported from the interstitial habitat of warm seas. However, the males of *A. cavallettii* sp. nov. and *A. sagarum* sp. nov. do not have the characteristic transformed endopod P3 of *Klieonychocamptoides* and some other genera within the Laophontidae. The lack of a transformed P3 endopod, combined with other features, and their similar ecological characteristics (both highly specialized for life in interstitial habitats, being distributed over a wide geographical area but with similar climatic characteristics), led us to establish the new genus *Aequinoctiella*.

MATERIALS AND METHODS

Specimens were collected using the Karaman-Chappuis method (Delamare-Deboutteville 1960), fixed in 5 % buffered formalin solution, sorted and mounted in Faure's medium between two coverslips, to allow observation from two sides. Once Faure's medium was dry, the coverslips were fixed to a microscope slide with pieces of adhesive tape. To avoid deformation of non-dissected specimens, they were mounted between two coverslips with fragments of human hair (Karanovic 2005). Drawings were made at a magnification of 1,250 X, using a drawing tube mounted on a Zeiss Axioskop® phase-contrast microscope.

Two females of *Aequinoctiella cavallettii* sp. nov. were prepared for scanning electron microscopy. They were fixed for 24 h in 10 % formalin solution, washed twice in cacodylate buffer (pH 7.2), post-fixed in 1 % osmium tetraoxide in the same buffer, dehydrated in a graded ethanol series, critical-point-dried in a Balzers Union® CPD 020 apparatus, and coated with gold in a Balzers Union® MED 010 sputter coater. Observations were performed with a 1200 JEOL JEM® EX II scanning electron microscope.

The following abbreviations are used throughout the text and figures: Enp = endopod; Exp = exopod; A1 = antennule; A2 = antenna; P1-P5 = first to fifth thoracic appendages. The nomenclature and descriptive terminology follow Huys & Boxshall (1991).

Specimens are deposited at the Natural History Museum, London (NHM), and at the senior author's collection at the Department of Environmental Sciences, "della Tuscia" University, Viterbo (DSAUT). The stubs prepared for SEM are deposited at the Interdepartmental Center for Electron Microscopy, Tuscia University (CIME).

An image analysis was developed to test for morphological differences which would discriminate between females of the genera *Klieonychocamptoides* and *Aequinoctiella* gen. nov. We measured the following morphometric variables: 1) FemL: Length abdomen + caudal ramus (measured from posterior margin of cephalothorax to distal margin of caudal ramus); 2) FemlenCPT: cephalothorax length (measured from tip of rostrum to posterior margin of cephalothorax); 3) FemTL: total length (FemL + FemlenCPT); 4) FemwidCPT: cephalothorax width; 5) CPTwidlen: FemwidCPT / FemlenCPT; 6) CPTTL: FemlenCPT / FemTL. We tested for significant differences with a non parametric Mann-Whitney U-test. Analyses were run using SPSS (SPSS Inc. 1999-2001). Measurements were taken under a Zeiss Axioscop 2 plus compound microscope, with a 20x NEOFLUAR Zeiss objective, connected to an Axiocam photocamera. Images were acquired and measured using the Zeiss Axiovision 4 software.

FAMILY LAOPHONTIDAE T. SCOTT, 1905

Subfamily Laophontinae T. Scott, 1905 *sensu* Huys & Lee, 2000

Genus *Aequinoctiella* gen. nov.

Diagnosis – Body cylindrical, slightly tapering distally, unpigmented, eyeless. Rostrum prominent, with two sensilla and one dorsal tube pore. Integument of cephalothorax slightly pitted. Cephalothorax and certain somites with dorsal sensilla and pores. Genital somite and abdominal somites with ventral sensilla and pores. Genital somite and first abdominal somite of female divided dorsally; partially merged ventrally, trace of separation represented by chitinous band. Distal margin of anal operculum convex, with minute denticles. Caudal rami short, subquadrangular, without dorsal processes, with seven setae, inner terminal seta longest. Sexual dimorphism in antennule, P4, P5, and genital segmentation; male smaller than female. Antennule six-segmented in both sexes. Male antennule with one segment after geniculation. Antenna with allobasis; exopod one-segmented with four setae. Syncoxa of maxilla with two endites. P1 with one-segmented exopod and two-segmented endopod, P2-P4 with one-segmented exopod in both sexes. P2 without endopod in both sexes. P3-P4 with endopod vestigial or missing. P4 exopod sexually dimorphic, with apical spiniform seta very long and strong, slightly curved, and pinnate in the male. P3 endopod not transformed in males. P5 of male coalescent, exopod carrying four setae and merged with baseoendopod which carries two endopodal setae. P5 of female not coalescent, exopod carrying four setae, not fused with baseoendopod, which carries three endopodal setae. P6 reduced in both sexes, carrying two setae of different lengths.

Type species – *Aequinoctiella cavallettii* gen. nov., sp. nov.

Other species – *Aequinoctiella sagarum* sp. nov.

Etymology – The generic name is derived from the Latin *aequus* (equal) and *nox* (night) = equinox (gender: feminine), and refers to the geographical distribution of the new genus, collected near the equator.

Aequinoctiella cavallettii sp. nov.

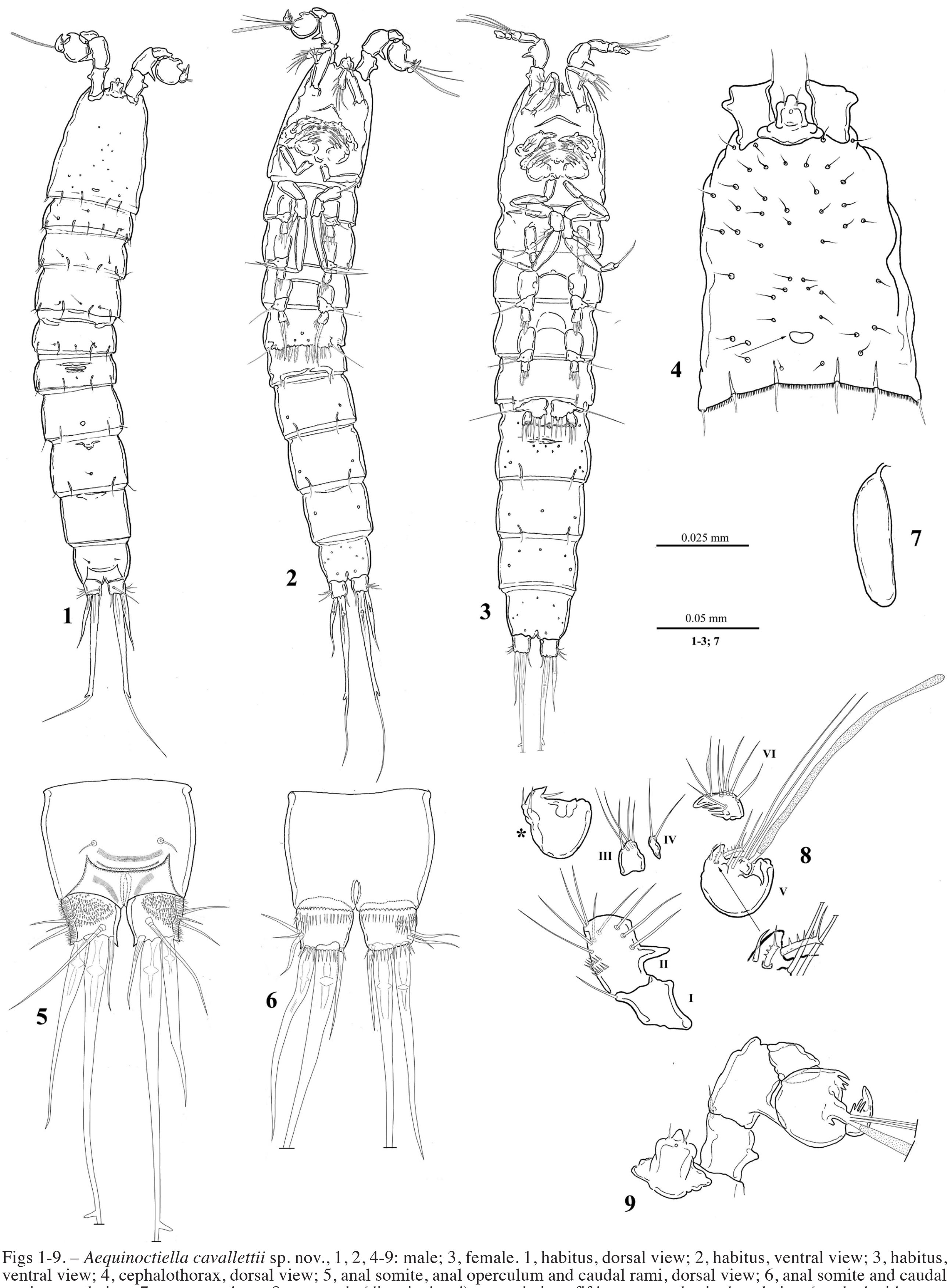
Type locality – Interstitial habitat of coral sandy beach, North side of Tomea Island, Kepulauan Tukang Besi (i.e. Kepulauan Archipelago), south-west of Sulawesi (Indonesia) (5° 43' 29.65" N; 123° 56' 42.25" E).

Material – Holotype male, mounted on slide labeled: "*Aequinoctiella cavallettii* holotype: male, Tomea Island, Indonesia, 12 Feb 1996" (NHM 2008.3502). Allotype female, mounted on slide labeled: "*Aequinoctiella cavallettii* allotype: female, Tomea Island, Indonesia, 12 Feb 1996" (NHM 2008.3503). 2 male paratypes, mounted each on a slide labeled: "*Aequinoctiella cavallettii* male paratype, Tomea Island, Indonesia, 12 Feb 1996" (DSAUT); 4 female paratypes, mounted each on a slide labeled: "*Aequinoctiella cavallettii* female paratype, Tomea Island, Indonesia, 12 Feb 1996" (NHM 2008.3504, DSAUT). Two female paratypes, prepared for scanning electron microscopy, on one stub labeled: *Aequinoctiella cavallettii* Tomea Island, Indonesia (CIME).

All material collected by V Cottarelli and M C Bruno.

Male – Body cylindrical, slightly tapering distally, unpigmented, eyeless, habitus as in Figs. 1, 2. Length, measured from anterior margin of rostrum to posterior margin of caudal rami: 410 µm (n = 3; mean = 412 µm). Cephalothorax as long as the following three thoracic somites. Posterior margin of cephalothorax with one dorsal spinular row interspersed with six sensilla; dorsal surface of cephalothorax with 44 sensilla and one small hyaline window arrowed in Fig. 4. Thoracic somites 1-3 with posterior margin carrying dorsally six sensilla, and three sensilla just in front of the posterior margin (Fig. 1). Fourth thoracic somite with seven dorsal sensilla; five pores on the ventral distal margin (Fig. 2). Genital somite with four sensilla, one pore, and three elliptic hyaline surfaces on dorsal surface (Fig. 1); following two abdominal somites with four dorsal sensilla and one pore, and two pores and two sensilla on the ventral distal margin; dorsal surface of third abdominal somite bare and ventral surface with two pores (Fig. 1, 2). Hyaline frills of all abdominal somites smooth (Fig. 1, 2). Anal somite with 10 pores on ventral surface (Fig. 2). Distal margin of anal operculum convex, with row of small denticles, flanked by one pair of sensilla; and with transversal row of spinules (Fig. 5). Caudal rami (Figs. 5, 6) approximately quadrangular**,** much shorter than anal somite, length to width ratio: 1.2, carrying seven setae. Anterolateral (II) and posterolateral (III) setae of same length, slightly longer than caudal ramus; anterolateral accessory (I) seta short; dorsal seta (VII) composite, 2.4 times as long as caudal ramus, inserted at about 2/3 of the caudal ramus. Inner terminal seta (V) proximally enlarged, outer terminal seta (IV) smooth, 1.5 times longer than anal somite. Terminal accessory seta (VI) 1.65 times as long as caudal ramus. Caudal rami with ventral spinular row near the terminal setae insertions, transversal row of hair-like spinules along the proximal margin, and two more sub-proximal transversal rows of hair-like spinules on lateral margin. Several rows of very short spinules on dorsal surface, and longitudinal rows of hair-like spinules along lateral margin. Spermatophore as in Fig. 7.

Rostrum (Fig. 4, 9): not merged with cephalothorax, quadrangular, with round tip carrying one pore flanked by two sensilla.



Figs 1-9. – *Aequinoctiella cavallettii* sp. nov., 1, 2, 4-9: male; 3, female. 1, habitus, dorsal view; 2, habitus, ventral view; 3, habitus, ventral view; 4, cephalothorax, dorsal view; 5, anal somite, anal operculum and caudal rami, dorsal view; 6, anal somite and caudal rami, ventral view; 7, spermatophore; 8, antennule (disarticulated), ventral view; fifth segment also in dorsal view (marked with asterisk); 9, rostrum and antennular segments, without ornamentation.

Antennule (Figs. 8, 9): six-segmented, subchirocer; first segment distally with short medial seta and laterally with rounded process. Second segment with lateral long, pointed hook, two dorsal, five ventral, two medial distal setae; two transversal spinular rows along medial margin. Third segment with three marginal setae of same length, and one ventral and one dorsal longer seta; fourth segment reduced to one small sclerite, with two setae of same length. Fifth segment enlarged and rounded; ventrally: process with two setae of same length and one very long aesthetasc; two normal shorter setae; distomedial corner with pointed expansion carrying two transformed setae (arrowed in Fig. 8), and one short curved seta. Dorsally with three short spiniform setae. Sixth segment with three thin and pointed projections, ending in pointed tip with seven normal setae and one slender aesthetasc. Armature formula: 1-[1 bare], 2-[9 bare], 3-[5 bare], 4-[2 bare], 5-[5 bare + 2 transformed + 1 spiniform + ae], 6-[7 bare + ae].

Antenna (Fig. 10): coxa small, with one transversal spinular row. Allobasis with one small pinnate seta at midlength of abexopodal margin and two transversal spinular rows. Exopod one-segmented, with four subequal distal pinnate setae. Endopod apically with one claw-like spine, one unipinnate and three geniculate setae, subapically with one bare medial seta and one lateral spiniform pinnate seta.

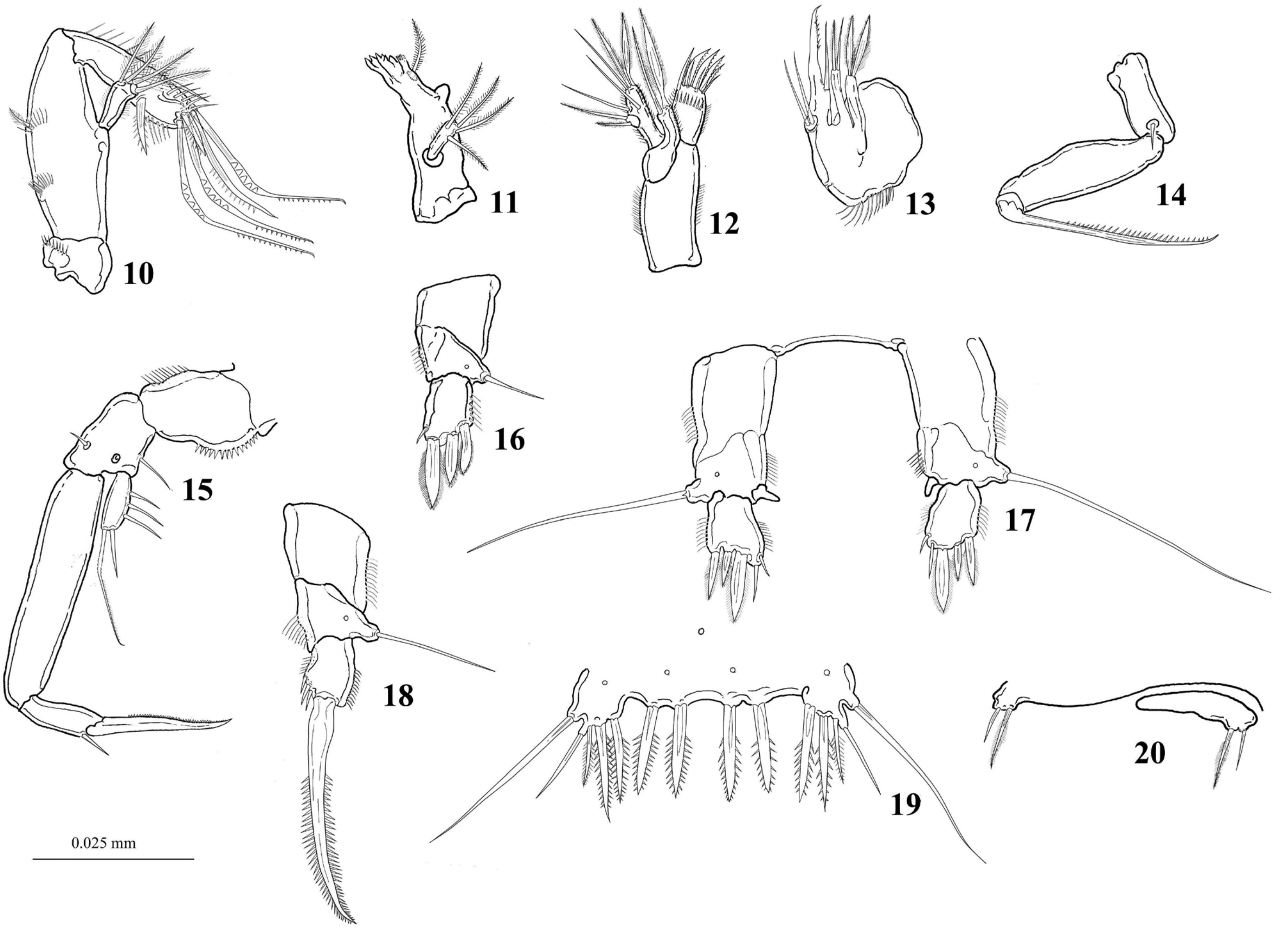
Mandible (Fig. 11): palp small, one-segmented, bearing two apical and two sub-apical pinnate setae; gnathobase with several bifid blunt teeth and one pinnate seta.

Maxillule (Fig. 12): praecoxa with longitudinal spinular rows; arthrite with dorsal spinular row, four strong distal spiniform curved setae interspersed with three thin setae and one subapical seta. Coxal endite cylindrical, with longitudinal spinular row, bearing two pinnate setae, the longest one leaf-like; basal endite with one bare and two leaf-like, pinnate apical setae; exopod one-segmented, with two apical setae of different lengths; endopod reduced to two setae.

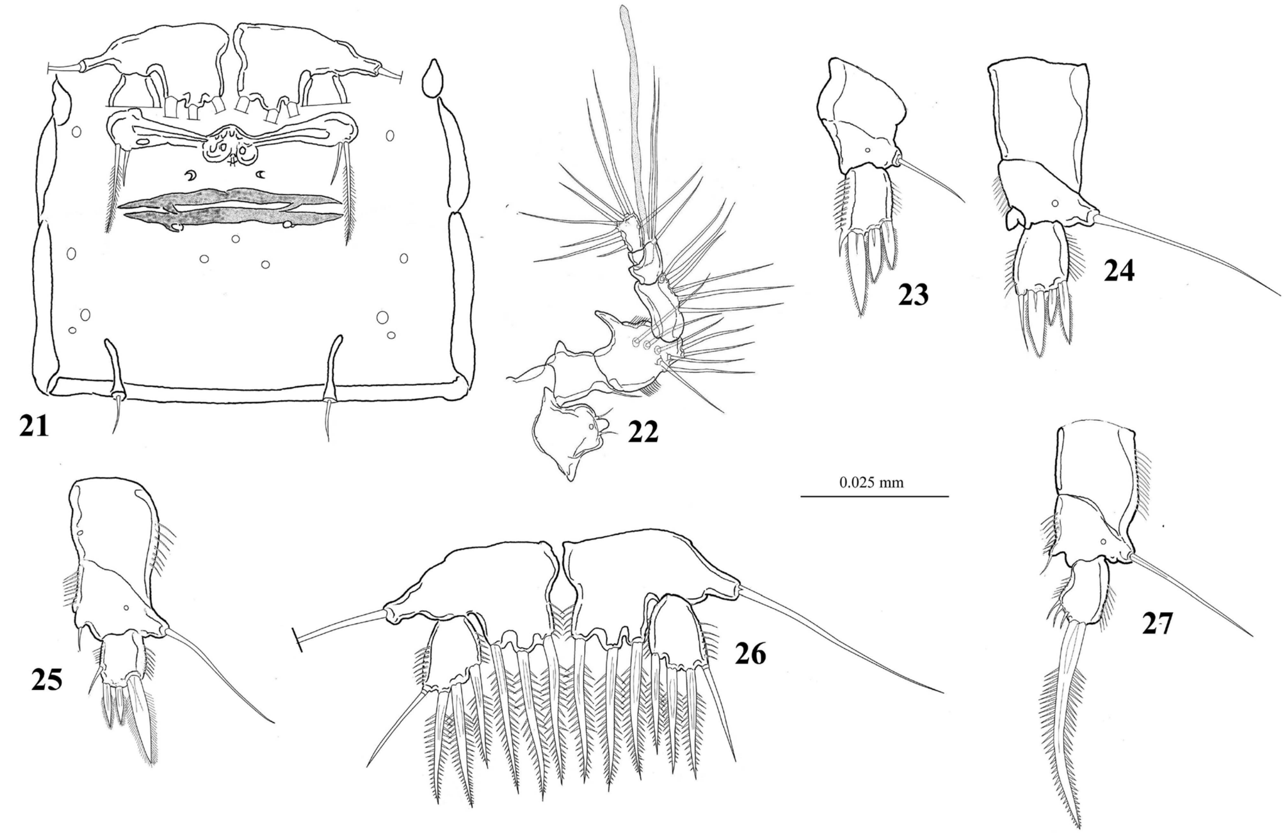
Maxilla (Fig. 13): syncoxa with one lateral longitudinal row of long spinules, bearing two endites: proximal endite with two enlarged pinnate setae, distal endite with one pinnate and one bare apical seta. Allobasis ending in strong, distally pinnate, slightly curved claw, with one lateral seta. Endopod reduced to small tubercle with two apical bare setae of same length.

Maxilliped (Fig. 14): syncoxa bearing one small subapical seta. Basis strong, bare; endopod prolonged in slender, apically curved, unipinnate claw, longer than basis.

P1 (Fig. 15): coxa cylindrical with one medial and one lateral longitudinal spinular row. Basis with one small sub-distal medial seta and one longer seta at about the middle of the lateral margin. Exopod small, one-segmented with three subequal medial



Figs 10-20. – *Aequinoctiella cavallettii* sp. nov., male. 10, antenna; 11, mandible; 12, maxillule; 13, maxilla; 14, maxilliped; 15, P1; 16, P2; 17, P3; 18, P4; 19, P5; 20, P6.



Figs 21-27. – *Aequinoctiella cavallettii* sp. nov., 21-26, female; 27, male (variability). 21, P6, genital double-somite and genital field, ventral view; 22, rostrum and antennule, dorsal view; 23, P2; 24, P3; 25, P4; 26, P5; 27, P4.

setae, and two apical setae of different lengths, medialmost geniculate. First segment of endopod quite strong, bare, about 5.0 times longer than wide; second segment short, slightly longer than exopod, with one strong distal unipinnate claw and one short distal seta.

P2-P4 basis: with one pore.

P2 (fig. 16): reduced. Coxa unarmed. Basis with lateral seta and medial spinular row. Exopod one-segmented, nearly quadrangular with three distal pinnate spiniform setae, the middle one longest; one small subdistal spiniform seta on the medial margin and row of small spinules along the lateral margin. Endopod absent.

P3 (fig. 17): reduced. Coxa with lateral longitudinal spinular row. Basis with one pore near lateral seta and medial longitudinal spinular row. Exopod one-segmented, nearly quadrangular, with three apical pinnate spiniform setae, medial one longest and middle one shortest; distal medial corner with one apical and one subapical thin bare seta. Spinular row on both lateral and medial margins. Endopod reduced to small pointed tubercle.

P4 (Fig. 18): reduced. Coxa with lateral, longitudinal spinular row. Basis with one pore near lateral seta and medial longitudinal spinular row. Exopod one-segmented, three very short, curved, spiniform setae on distomedial margin; apical spiniform seta very long and strong, slightly curved, and pinnate. Spinular row on both lateral and medial margins. Endopod absent.

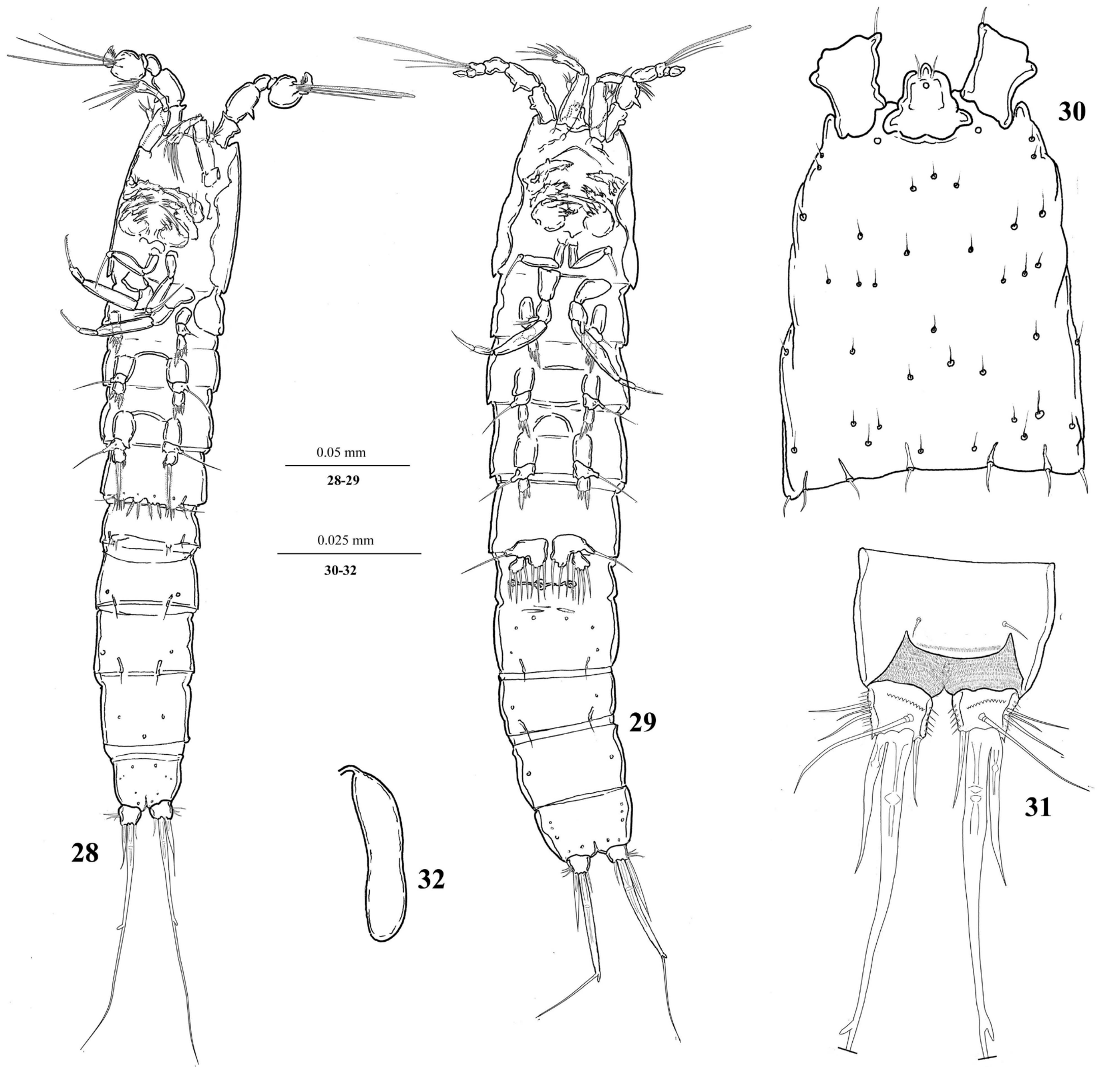
P5 (Fig. 19): baseoendopod and exopod fused together and to somite; with five transversal pores. Exopod, from distomedial to distolateral corner: two pinnate setae of subequal lengths, one shorter pinnate seta, one small tubercle with one naked seta. Baseoendopod with two pinnate endopodal setae of same length.

P6 (Fig. 20): Two small, asymmetrical plates with two distal setae, medial one long and pinnate.

Female – Habitus, as in Fig. 3. Length (measured as in male): 461 µm (n = 5; mean = 440 µm). Genital double somite fused only ventrally (Fig. 21), with 15 pores and two sensilla on the ventral side. Dorsal integumental ornamentation of cephalothorax and somites as in male. First abdominal somite with three pores and two sensilla on ventral distal margin; second abdominal somite with five pores ventrally; anal somite with nine pores ventrally (Fig. 3).

Rostrum (Fig. 22), A2 (Fig. 59), mouth parts (Fig. 60), P1 (Fig. 61), anal operculum and caudal rami as in male.

A1 (Fig. 22, 58): six-segmented. First segment with mediodistal seta and lateral pointed process; second segment strong, with mid-lateral long, pointed hook, three ventral, two dorsal, two subapical, one lateral setae, and two longitudinal spinular rows. Third segment with six medial setae; fourth segment with distomedial tubercle carrying two setae and one long aesthetasc. Fifth segment with distal seta. Sixth segment with nine setae. Armature formula: 1-[1 bare], 2-[8 bare], 3-[6 bare], 4-[2 bare + ae], 5-[1 bare], 6-[9 bare].



Figs 28-32. – *Aequinoctiella sagarum* sp. nov., 28, 30-33: male; 29, female. 28, habitus, ventral view; 29, habitus, ventral view; 30, cephalothorax, dorsal view; 31, anal somite, anal operculum and caudal rami, dorsal view; 32, spermatophore.

P2 (Figs 23, 62): similar to that in male, but small spiniform seta on medial distal corner of exopodite merged with the segment.

P3 (Fig. 24, 63): coxa bare; basis similar to that in male, exopod narrower and longer than in male, without subapical medial seta. Endopod represented by one tubercle, larger and squatter than in male.

P4 (Fig. 25, 64): coxa with lateral spinular row. Basis similar to that in male. Exopod one-segmented, with one long distolateral pinnate spiniform, and two apical shorter subequal setae. One short thin seta on medial margin. Endopod represented by one tubercle merged with basis, carrying one small distal seta.

P5 (Fig. 26, 65): with separate baseoendopod and exopod. Baseoendopod with two pores (arrowed in Fig. 65), with three subequal pinnate setae; exopod with three subequal apical pinnate setae and one thinner, bare seta on the distolateral corner. Additional ornamentation as in figure.

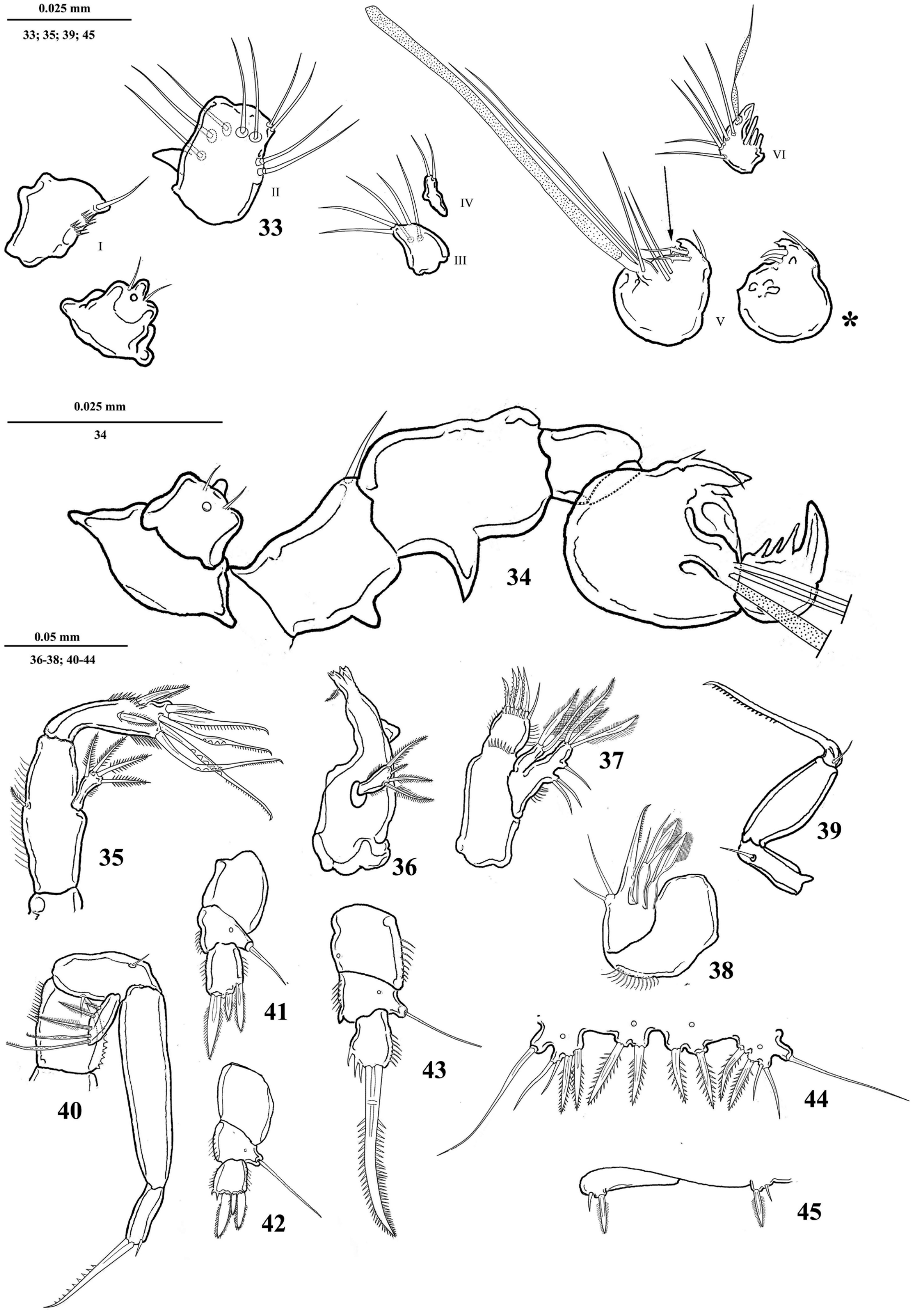
P6 (Fig. 21): two reduced plates, each with two setae of different lengths, lateral one longer and pinnate.

Variability – One paratype male has the endopod of the left P4 reduced to a tubercle with one short seta (Fig. 27), whereas the other P4 is normal.

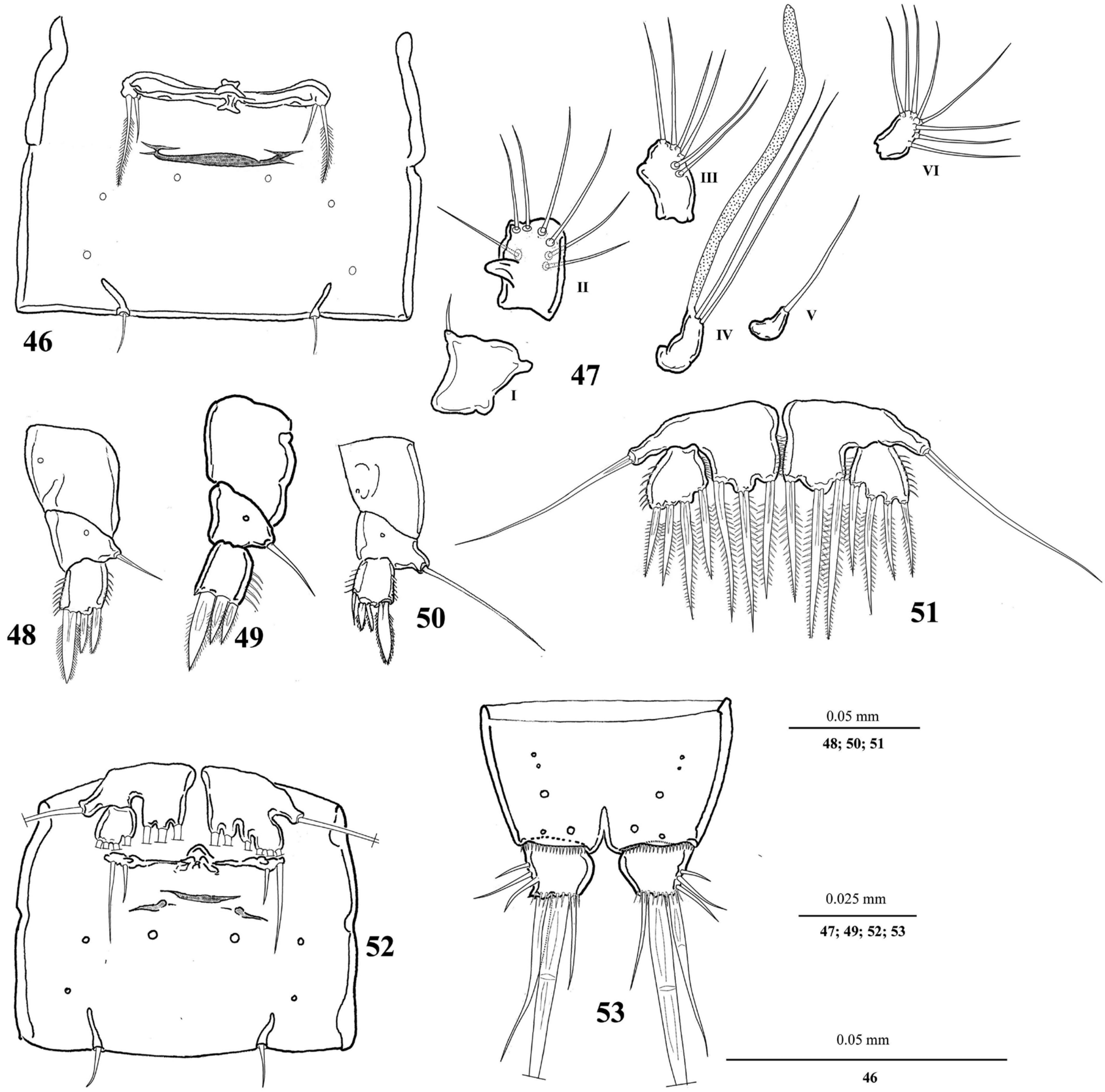
Etymology – The new species is named after our friend Alessandro Cavalletti, ship-owner and skipper of the schooner Arawa, where we sailed from Sulawesi to Ambon (Moluccan Islands) for the scientific expedition in which we collected the material. Specific epithet in singular masculine genitive.

Aequinoctiella sagarum sp. nov.

Type locality – Interstitial habitat of coral sandy beach, Salag



Figs 33-45. – *Aequinoctiella sagarum* sp. nov., male. 33, rostrum; antennule (disarticulated) in ventral view; fifth segment also in dorsal view (marked with asterisk); 34, rostrum and antennular segments, without ornamentation; 35, antenna; 36, mandible; 37, maxillule; 38, maxilla; 39, maxilliped; 40, P1; 41, P2; 42, P3; 43, P4; 44, P5; 45, P6.



Figs 46-53. – *Aequinoctiella sagarum* sp. nov., female. 46, P6, genital double-somite and genital field, ventral view; 47, antennule (disarticulated), ventral view; 48, P2; 49, P3; 50, P4; 51, P5, 52, P5, P6 and genital double-somite, ventral view (variability); 53, anal somite and caudal rami, ventral view (variability).

Do-Ong beach, Siquijor Island, Central Visayas region, Philippines, (9° 12' 47.46" N; 123° 40' 59.64" E).

Material – Holotype male, mounted on slide labeled: "*Aequinoctiella sagarum* holotype: male, Siquijor Island, Philippines, 16 Jan 1985" (NHM 2008.3505). Allotype female, mounted on slide labeled: "*Aequinoctiella sagarum* allotype female, Siquijor Island, Philippines, 16 Jan 1985" (NHM 2008.3506). Three female paratypes, one dissected, mounted on slides labeled: "*Aequinoctiella sagarum* female paratype, Siquijor Island, Philippines, 2 February 2005" (DSAUT).

All material collected by V Cottarelli.

Male –Body cylindrical, slightly tapering distally, unpigmented, eyeless, habitus as in Fig. 28. Length, from rostrum to tip of caudal ramus: 367 µm. Cephalothorax as long as the following three thoracic somites together. Distal margin of cephalothorax with six sensilla; dorsal surface of cephalothorax with 40 sensilla (Fig. 30). Thoracic somites 1-3 with posterior margins each carrying six dorsal sensilla; three pores and two more sensilla present dorsally on first and third free thoracic somites; second free thoracic somite with one additional pore. Fourth free thoracic somite with six sensilla and three pores on dorsal posterior margin, and four sensilla and two pores on ventral margin. Genital somite with six sensilla and one pore on dorsal posterior margin, and two sensilla on the ventral posterior margin; first and second abdominal somites with four dorsal sensilla and one pore, and two pores and two sensilla on ventral posterior margin; dorsal surface of third abdominal somite bare and ventral surface with three pores. Hyaline frills of all abdominal somites smooth (Fig. 28). Anal somite with 10 pores on ventral surface; dorsal surface partly covered with spinular rows (Fig. 28, 31). Anal operculum:

smooth, with convex distal margin, flanked by a pair of sensilla and transversal row of distal spinules (Fig. 31). Caudal rami (Fig. 31) approximately quadrangular, much shorter than anal somite; length to width ratio: 0.7; carrying seven setae. Anterolateral (II) and posterolateral (III) setae of same length, slightly longer than caudal ramus; anterolateral accessory (I) seta short; dorsal seta (VII) composite, 2.8 times as long as caudal ramus, inserted at about 2/3 of caudal ramus. Inner terminal seta, (V) proximally enlarged, outer terminal seta (IV) smooth, 1.25 times longer than anal somite, and basally fused with inner terminal seta. Terminal accessory seta (VI) 1.7 times as long as caudal ramus. Spinular row along lateral and medial margins. One transversal spinular row on dorsal margin, proximally from dorsal seta. Spermatophore as in Fig. 32.

Rostrum (Fig. 33): not merged with cephalothorax, quadrangular, with round tip carrying one pore flanked by two sensilla.

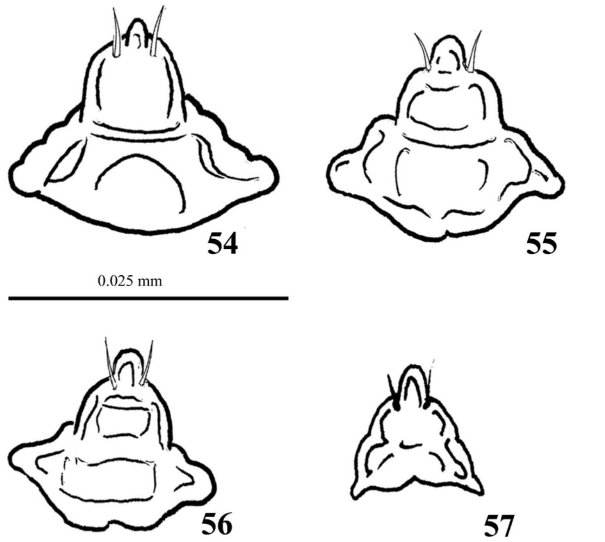
Antennule (Figs 33, 34): six-segmented, subchirocer; first segment with short medio-distal seta, two transversal spinular rows on medial margin and small lateral rounded process. Second segment with lateral long, pointed hook, three dorsal, two ventral, two medial, two distomedial setae. Third segment with three marginal seta of same length and one ventral and one dorsal longer seta. Fourth segment reduced to one sclerite, with two short setae of same length. Fifth segment enlarged and rounded, ventrally: process with two apical setae of same length and one very long aesthetasc and one subapical shorter seta; two normal setae at base of process, distomedial corner with pointed expansion carrying two transformed setae (arrowed in Fig. 33), and one short curved seta. Dorsally with two short spiniform setae. Sixth segment with three small digitiform teeth, segment ending in a sharp tip, with six setae and one subapical aesthetasc. Armature formula: 1-[1 bare], 2-[9 bare], 3-[5 bare], 4-[2 bare], 5-[6 bare + 2 transformed + 2 spiniform + ae], 6-[6 bare + ae].

Antenna (Fig. 35): coxa small, unarmed; allobasis with one small pinnate seta at midlength of abexopodal margin and spinular rows on same margin. Exopod one-segmented, with three apical and one subapical pinnate setae. Endopod apically with one claw-like spine, one unipinnate and three geniculate setae, and subapically with two spiniform pinnate setae.

Mandible (Fig. 36): palp small, one-segmented, bearing two apical and two sub-apical pinnate setae, one apical seta very short. Gnathobase with three bifid blunt teeth and one pinnate seta.

Maxillule (Fig. 37): praecoxa naked, arthrite with four spiniform, slightly curved setae and one normal distal seta, proximal and distal transversal spinular rows, and longitudinal spinular row on medial and on lateral margins. Coxa with cylindrical endite bearing two subequal pinnate setae, one is leaf-like; basal endite with three apical pinnate setae, the medialmost shortest, remaining two leaf-like. Exopod reduced to small tubercle merged with basis carrying two apical bare setae; endopod reduced to a tubercle merged with basis, carrying one apical bare seta.

Maxilla (Fig. 38): syncoxa with lateral spinular row, two endites, each with one normal and one leaf-like pinnate seta. Allobasis ending in strong pinnate claw, with one proximal seta.



Figs 54-57. – *Klieonychocamptoides* sp. 54, male; 55-57, female. 54, rostrum, dorsal view, Maldive Islands; 55, rostrum, dorsal view, Chagos Islands; 56, rostrum, dorsal view, Chagos Islands; 57, rostrum, dorsal view, Cuba.

Endopod reduced to small tubercle with two apical bare setae.

Maxilliped (Fig. 39): syncoxa bearing small apical seta. Basis strong, without ornamentation; endopod projecting into long claw-like process, with curved and pointed apex, and short seta at base.

P1 (Fig. 40): coxa with longitudinal medial spinular row and lateral row of small denticles. Basis with one lateral and one medial short seta. Exopod one-segmented with three pinnate spines on medial margin and two apical unipinnate, geniculate setae of different lengths. First segment of endopod long and without ornamentation; second segment short, with one strong distal claw and one short distal seta.

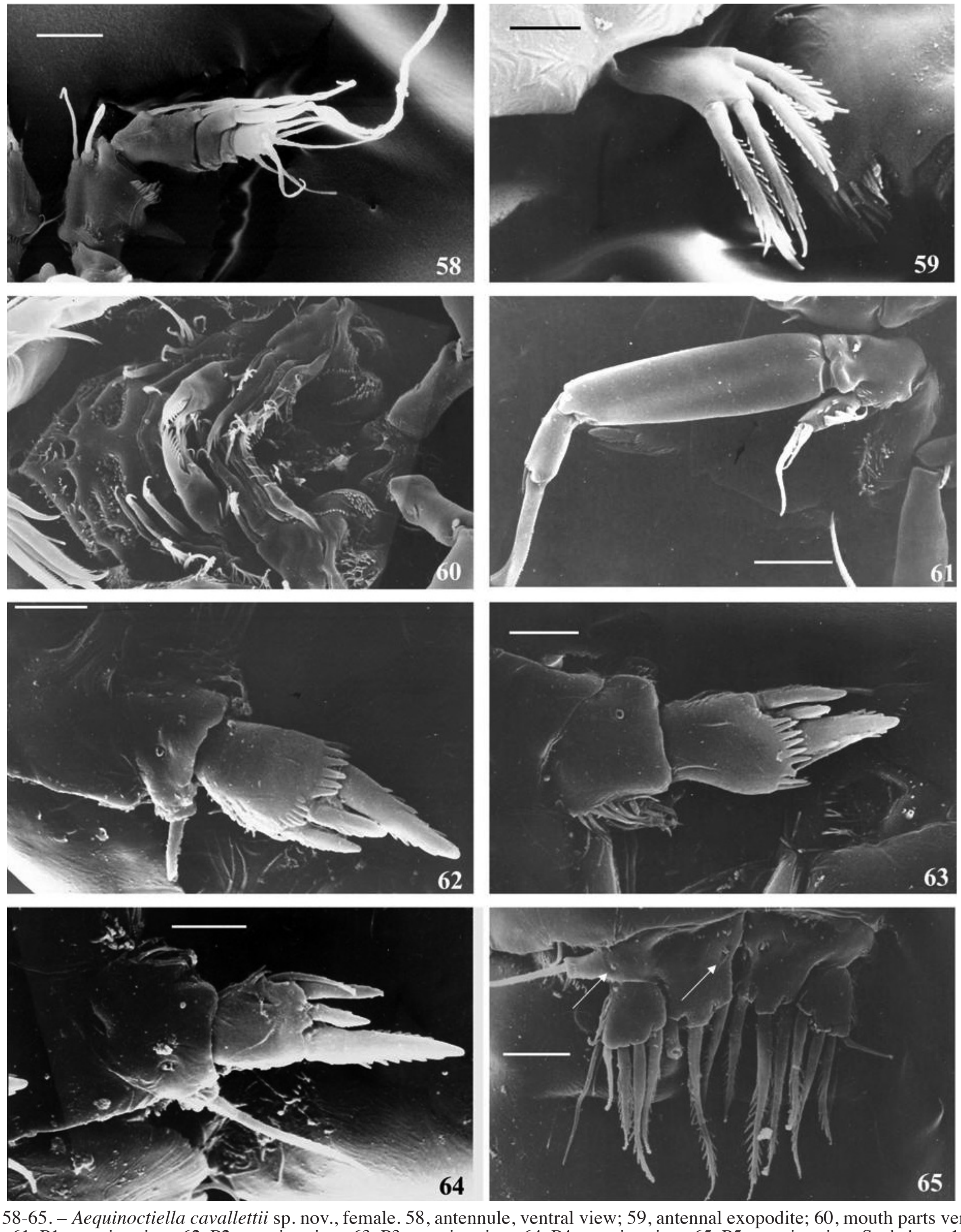
P2-P4 basis: with one pore.

P2 (Fig. 41): reduced. Coxa unarmed, stronger than basis; basis with lateral seta and medial longitudinal spinular row. Exopod one-segmented, rectangular, with three distal pinnate spiniform setae of different lengths, middle one longest. Spinular row along lateral and medial margins. Endopod absent.

P3 (Fig. 42): reduced. Basis with lateral seta and medial longitudinal spinular row. Exopod one-segmented, nearly quadrangular, with two very short curved spiniform setae fused to segment on distomedial corner and three distal pinnate spiniform setae of different lengths, the middle one shortest. Spinular row along lateral and medial margins. Endopod absent.

P4 (Fig. 43): reduced. Coxa with medial pore and lateral longitudinal spinular row. Basis with pore, lateral seta and medial longitudinal spinular row. Exopod one-segmented, three short setae fused with distomedial margin; apical spiniform seta very long and strong, slightly curved, and pinnate. Row of small spines on lateral margin. Endopod reduced to very small process.

P5 (Fig. 44): baseoendopod and exopod fused together and to somite; with four pores on surface. Exopod, from distomedial to distolateral corner: two pinnate setae of subequal length, small tubercle with two bare apical setae of different lengths. Baseoendopod with two pinnate endopodal setae of subequal



Figs 58-65. – *Aequinoctiella cavallettii* sp. nov., female. 58, antennule, ventral view; 59, antennal exopodite; 60, mouth parts ventral, view; 61, P1, anterior view; 62, P2, anterior view; 63, P3, anterior view; 64, P4, anterior view; 65, P5, anterior view. Scale bars: 10 µm in Figs 58, 60, 61; 5 μm in Figs 59, 62-65.

lengths and lateral basal seta on tubercle.

P6 (Fig. 45): Two small, asymmetric plates with two distal setae, medial one long and pinnate.

Female – Habitus, as in Fig. 29. Length (measured as in male): 392 µm (n = 4; mean =383 µm). Dorsal integumental ornamentation of cephalothorax and somites as in male. Genital double-somite fused only ventrally; on the ventral surface six pores and two sensilla on posterior margin (Fig. 46). Following two abdominal somites each with two ventral pores; anal somite (Fig. 29) with 10 ventral pores.

Rostrum, A2, mouth appendages, P1, anal operculum and caudal rami as in male.

A1 (Fig. 47): six-segmented. First segment with medio-distal seta and small, lateral blunt process. Second segment with mid-lateral long, pointed process and seven setae, three of which dorsal. Third segment with six medial setae; fourth segment with distomedial tubercle carrying two setae and one long aesthetasc. Fifth segment with distal seta. Sixth segment with 8 setae. Armature formula: 1-[1 bare], 2-[7 bare], 3-[6 bare], 4-[2 bare + ae], 5-[1 bare], 6-[8 bare].

P2 (Fig. 48): similar to that in male but the middle spiniform seta longer than in male, coxa with one pore.

P3 (Fig. 49): exopod longer and more slender than in male, with three distal setae, two lateralmost subequal in length. Endopod absent.

P4 (Fig. 50): exopod one-segmented, with three apical pinnate spiniform setae, the lateral one long, the remaining two short and subequal in length. One thin and naked seta on distomedial corner. Endopod absent.

P5 (Fig. 51): with separate baseoendopod and exopod. Baseoendopod with three subequal spiniform setae; exopod with four subequal apical pinnate setae, next-to-medialmost longest, other three subequal in length. Remaining ornamentation as in figure.

P6 (Fig. 46): two reduced plates, each with two setae of different lengths, lateral one longer and pinnate.

Variability – All the morphological features appeared to be constant in the type-series except for one P5 exopod of one female paratype which was merged with baseoendopod, whereas the other P5 was normal (Fig. 52), and another female paratype with inner terminal seta (V) and outer terminal seta (IV) of both caudal rami not basally fused (Fig. 53)

Etymology – The specific name is derived from the Latin name *saga* = witch: it alludes to the "magic" practices performed on Siquijor Island by Filipinos. Specific epithet in plural feminine genitive.

DISCUSSION

The great evolutionary success of the family Laophontidae is demonstrated by their presence in a wide variety of marine habitats, mostly in warm seas. They also occur in association with other marine invertebrates (Cottarelli *et al*. 2006b, Fiers 1992) and some genera colonized brackish and freshwater habitats (i.e. *Troglophonte* Huys & Lee 1944, *Heterolaophonte* Lang 1944, *Pseudonychocamptus* Lang 1944, *Paronychocamptus* Lang 1948, *Onychocamptus* Daday 1903, *Laophonte* Philippi 1840, *Folioquinpes* Fiers & Rutledge 1990). The subfamily Laophontinae T. Scott, 1905 *sensu* Huys & Lee 2000 includes, besides the 55 genera listed in Boxshall and Halsey (2004), the following genera: *Apistophonte* Gheerardyn *et al*. 2006, *Carcinocaris* Cottarelli, Bruno & Berera 2006, *Carraroenia* McCormack 2006, *Peltidiphonte* Gheerardyn *et al*. 2006, *Propephonte* Gheerardyn & Fiers 2006, and *Spiniferaphonte* Gheerardyn & Fiers 2007. Tropical marine habitats are those "which could host the highest number of taxonomic novelties among Laophontidae", as stated by Gheerardyn *et al*. (2007), and shown by this work as well. The new genus is placed in the subfamily Laophontinae based on the following characteristics as defined by Huys & Lee (2000): male antennule with up to three segments distal to geniculation, mandible uniramous, maxilliped with maximum two setae on syncoxa, P1 enp-1 without inner seta, outer setae of female P5 exopod with distinctly separated insertion sites and absence of cup-shaped transformed pores on legs or somites. As stated by Huys (1990), the presence of a sexually dimorphic P3 endopod is a particularly robust character of several Laophontidae. The male apophysis is the homologue of the female outer spine on the distal endopodal segment of P3. Moreover, as a consequence of the loss of the P3 endopod in the species of *Aequinoctiella* gen. nov., this dimorphism is absent in the genus. In several lineages of Laophontidae, the loss of a sexually dimorphic P3 has occurred independently, e.g. in *Echinolaophonte tetracheir* Mielke, 1981, *Lipomelum* Fiers, 1986, *Loureirophonte* Jakobi, 1953, *Paralaophonte aenigmaticum* Wells, Hicks and Coull, 1982, *Peltidiphonte, Apistophonte*, and *Propephonte*.

Aequinoctiella gen. nov. is highly specialized to the interstitial habitat, as shown by the reduced size, the cylindrical and distally tapering body and the extreme reduction of P2-P4 and the P1 exopod. The new genus has very strong affinities with the genus *Klieonychocamptoides* Noodt 1958, which includes four species, all from the littoral interstitial, and three of which are described from tropical areas. Some of these affinities can be explained by convergence (body shape and size, some of the leg reductions), but several other features (such as certain features of the antennule, P1 and P5 morphology, ornamentation and shape of caudal rami and anal operculum) could define the two genera as "sibling-genera", i.e. they derived from a common ancestor but are still diverging morphologically (as shown, for instance, by the male P4 which is identical in the two genera). *Klieonychocamptoides* belongs to the group of genera represented by *Laophontina* Norman & Scott T. 1905, *Pseudolaophonte* A. Scott 1896, *Afrolaophonte* Chappuis 1960, and *Mexicolaophonte* Cottarelli 1977, which are all characterized by the "strongly reduced legs and the curious sexual dimorphism in the third leg of the male" (Fiers 1986). The disappearance of the transformed P3 endopod represents the autapomorphy supporting the establishment of a new genus for the two species described herein. This feature separates the evolutionary lineage of *Aequinoctiella* gen. nov. and that of *Klieonychocamptoides*. A detailed comparison of the new species of *Aequinoctiella* gen. nov. with the descriptions of *K. arenicola* (Chappuis & Delamare Deboutteville 1956), *K. remanei* Noodt 1958, *K. itoi* Mielke 1981 and with specimens of *K. arganoi* Cottarelli & Mura 1980 and species of *Klieonychocamptoides* from our collection, allowed us identifying the following dif-

Table I. – Morphometric measurements of female specimens. 1) FemL: Length abdomen + caudal ramus (measured from posterior margin of cephalothorax to distal margin of caudal ramus); 2) FemTL: total length (FemL + FemlenCPT); 3) FemlenCPT: cephalothorax length (measured from tip of rostrum to posterior margin of cephalothorax); 4) FemwidCPT: cephalothorax width; 5) CPTwidlen: FemwidCPT / FemlenCPT; 6) CPTTL: cephalothorax length/ FemTL.

Genus	Species	Location	FemL (µm)	FemTL (µm)	Fem lenCPT (µm)	Fem widCPT (µm)	CPT widie (µm)	CPTTL (µm)
Aequinoctiella	*cavallettii*	Tomea Island (Indonesia)	319.96	407.51	87.55	70.87	0.81	0.21
Aequinoctiella	*cavallettii*	Tomea Island (Indonesia)	314.10	410.15	96.05	75.72	0.79	0.23
Aequinoctiella	*cavallettii*	Tomea Island (Indonesia)	367.53	461.24	93.71	80.58	0.86	0.20
Aequinoctiella	*cavallettii*	Tomea Island (Indonesia)	342.20	444.39	102.19	82.71	0.81	0.23
Aequinoctiella	*cavallettii*	Tomea Island (Indonesia)	351.13	457.05	105.92	88.93	0.84	0.23
Aequinoctiella	*sagarum*	Siqujior Island (Philippines)	315.00	405.00	90.00	68.75	0.76	0.22
Aequinoctiella	*sagarum*	Siqujior Island(Philippines)	295.32	392.32	97.00			0.25
Aequinoctiella	*sagarum*	Siqujior Island (Philippines)	252.81	329.11	76.30	67.23	0.88	0.23
Aequinoctiella	sp.	Verde Island (Philippines)	335.40	423.02	87.62	75.67	0.86	0.21
Aequinoctiella	sp.	Apo Island (Philippines)	286.78	382.92	96.14	73.37	0.76	0.25
Aequinoctiella	sp.	Okinawa Island	299.41	397.41	98.00	84.86	0.87	0.25
Aequinoctiella	sp.	Okinawa Island	306.92	395.63	88.71	78.13	0.88	0.22
MEAN VALUE			315.55	408.81	93.27	76.98	0.83	0.23
Klieonychocamptoides	sp.	Apo Island (Philippines)	189.34	267.83	78.49	61.42	0.78	0.29
Klieonychocamptoides	sp.	Maldive-Baros Atoll	287.32	399.75	112.43			0.28
Klieonychocamptoides	sp.	Maldive-Bandos Atoll	306.00	405.87	99.87	86.77	0.87	0.251
Klieonychocamptoides	sp.	Chagos-Salomon Atoll	281.88	382.16	100.28	88.09	0.88	0.26
Klieonychocamptoides	sp.	Messico.Cozumel: Palancan	243.96	341.75	97.79	85.30	0.87	0.29
Klieonychocamptoides	sp.	Cuba	255.00	351.92	96.92	84.02	0.87	0.28
Klieonychocamptoides	sp.	Cuba	266.31	367.30	100.99	83.66	0.83	0.27
MEAN VALUE			261.40	359.51	98.11	81.54	0.83	0.27

ferences between the two genera: male A1 with one segment distally from the geniculation in *Aequinoctiella* gen. nov. and with two segments in *Klieonychocamptoides*; rostrum of both sexes quadrangular in *Aequinoctiella* gen. nov., round in *Klieonychocamptoides*, and always smaller in the latter (Figs. 8, 22, 33, 54-57).

At first examination, females of the two genera appear very similar, so that they apparently can not be identified unless males are collected as well. Moreover, the sex-ratio in both genera is biased towards females, and we often collected only female specimens. Therefore, we analyzed morphometrically all females of *Klieonychocamptoides* from our collection (Table I) and compared them with those of *Aequinoctiella* gen. nov. The two genera differed significantly in the following variables (Table I): FemL ($p = 0.004$), FemTL ($p = 0.022$), CPTTL ($p < 0.001$). Thus, females of the genus *Aequinoctiella* are on average longer than those of *Klieonychocamptoides* (408.81 mm *vs* 359.51 mm total length, 315.55 *vs* 261.40 abdomen length) with a proportionally shorter cephalothorax (0.23 *vs* 0.27 cephalothorax length/total length). Other differences can be detected in the genital double-somite and the position of the genital field: in both genera the double-somite is fused only ventrally, with a double transversal chitinous band indicating the original segmentation (Figs 21, 46), but in *Aequinoctiella* gen. nov. the genital double somite is more elongated (length/width=1) than in all the examined *Klieonychocamptoides* species (length/width = 0.64). The genital field is located in the posterior half of the (partly fused) genital somite, below the P5 (Figs 21, 65) in *Aequinoctiella* gen. nov., whereas the genital field is located in the anterior half of the genital somite in all species of *Klieonychocamptoides*, beneath the P5, which covers it completely.

Aequinoctiella cavallettii sp. nov. and *A. sagarum* sp. nov. are quite similar in appearance. However, they can be distinguished by the smaller size of the latter species (average values of females total length = 436.1 mm in *A. cavallettii* sp. nov., and 375.5 mm in *A. sagarum* sp. nov., $p = 0.036$), and by the different shape and size of caudal rami, which are longer and narrower in the former species. Additional differences are represented by: 1) the shape of the genital double-somite of the females (with 15 pores, two sensilla, and a large and strong chitinous band in *A. cavallettii* sp. nov.; six pores, no sensilla, and a thinner chitinous band, in *A. sagarum* sp. nov.); 2) the ornamentation of P6 of the females (with the medial seta slightly shorter than the lateral one in *A. cavallettii* sp. nov.; and slightly longer in *A. sagarum* sp. nov.); 3) the ornamentation of the mandibular palp of both sexes (which carries three subequal setae and a shorter and thinner one in *A. sagarum* sp. nov. and four subequal setae in *A. cavallettii* sp. nov.); 4) the morphology and ornamentation of P5 exopod of females (which is narrower and longer in *A. cavallettii* sp. nov., and carries four distal setae, three of which pinnate and the outer one thin and naked, whereas in *A. sagarum* sp. nov. all four apical setae are pinnate); 5) the morphology and ornamentation of the male P5 (the exopod is narrower and longer in *A. cavallettii* sp. nov., and carries 4 pinnate setae and one tubercle with one normal seta, whereas it carries two pinnate setae, and one tubercle with two naked seta in *A. sagarum* sp. nov.; the baseoendopod has two setae of the same length in the former, and of different lengths in the latter species); 6) the endopods of P3-P4 are absent in *A. sagarum* sp. nov., reduced but present in *A. cavallettii* sp. nov.; 7) the different number and distribution of pores and sensilla. Thus, it appears that these two new species, which show geographical ranges very distant from each other, are morphologically very similar and can be distinguished specifically by microcharacters. This condition occurs also for species of the closely related genus *Klieonychocamptoides*.

Detailed examination of all specimens of the two genera in our collection yielded females of a species of *Aequinoctiella* from three more stations (Okinawa in the Pacific Ocean, Isla Verde in the Southern Chinese Sea, Chagos Islands in the Indian Ocean). It will be possible to attribute these specimens to one of the two new species, or to a third new species, once we will collect more specimens from the same locations. Nonetheless, these records give information on the geographical distribution of the genus. The distribution range of *Aequinoctiella* appears to be very wide, and related to the presence of tropical coral sandy beaches, extending from North to South from the Pacific Ocean (Okinawa) to the Southern Chinese Sea (Siquijor, Verde Island, Apo Island), the Indian Ocean (Chagos islands) and the Banda Sea (Tomea Island). These tropical sandy beaches are also the typical habitat of two other genera of Laophontidae, namely *Klieonychocamptoides* and *Afrolaophonte*. In fact, we collected on Apo Island a female of *Aequinoctiella sp*. together with females of *Klieonychocamptoides* sp. and several males and females of *Afrolaophonte* sp.. Furthermore, specimens of *Afrolaophonte* sp. were collected on Tomea Island and Siquijor Island as well. It is likely that more research will define a wide intertropical distribution in coral sands for *Aequinoctiella* gen. nov., as it occurs for the genera *Klieonychocamptoide*s and *Afrolaophonte* (Fiers 1990, Cottarelli unpublished data).

ACKNOWLEDGEMENTS.- We want to thank Dr A Taddei (Interdepartmental Center for Electron Microscopy, DISA) for assistance with the Scanning Electron Microscope, and Dr E Catalani (DISA) for assistance with Image Analysis. Two referees greatly improved the manuscript with their comments. This research was in part supported with funds MURST-COFIN and ex MIUR 60 %.

REFERENCES

Boxshall GA, SH Halsey 2004. An introduction to copepod diversity. Ray Society, London, 966 p.

Bruno MC, Cottarelli V 1999. Harpacticoids from groundwaters in the Philippines: *Parastenocaris mangyans*, new species, *Epactophanes philippinus*, new species, and redescription of *Phyllognathopus bassoti* (Copepoda). *J Crust Biol* 19(3): 510-529.

Cottarelli V, Mura G 1980. *Klieonychocamptoides arganoi*, n. sp., arpacticoide di acque interstiziali litorali delle isole Maldive. *Cah Biol Mar* XXI: 358-361.

Cottarelli V, Mura G 1981. Remarks on the Genus *Afrolaophonte* (Crustacea, Copepoda, Harpacticoida): Description of three new species. *Vie Milieu* 31(2): 153-161.

Cottarelli V, Bruno MC, Berera R 2006a. A new freshwater harpacticoid from Philippines: *Parastenocaris distincta* sp. nov. (Copepoda, Harpacticoida). *Zootaxa* 1368: 57-68.

Cottarelli V, Bruno MC, Berera R 2006b. Variazioni sul tema number 1: Description of *Carcinocaris serrichelata*, new genus, new species associated with xanthid crabs and new data on distribution of *Xanthilaophonte trispinosa* (Sewell) (Copepoda: Harpacticoida). *Vie Milieu* 56(3): 203-213.

Delamare-Deboutteville C 1960. Biologie des eaux souterraines littorales et continentales. Hermann, Paris, 740 p.

Fiers F 1986. Harpacticoid copepods from the West Indian Islands: Laophontidae (Copepoda, Harpacticoida). Amsterdam Expedition to the West Indian Islands, Report 48. *Bijdr Dierkd* 56(1): 132-164.

Fiers F 1990. Zoogeography of the laophontid genus *Afrolaophonte* (Copepoda, Harpacticoida), with description of *A. stocki* n. sp. from Guadeloupe. *Beaufortia* 41(9): 55-65.

Fiers F 1992. *Robustunguis* gen. nov., a genus of decapod associated laophontids (Copepoda: Harpacticoida). *Zool Meded* 66: 399-412.

Gheerardyn H, Fiers F, Vincx M, De Troch M 2007. *Spiniferaphonte*, a new genus of Laophontidae (Copepoda: Harpacticoida), with notes on the occurrence of processes on the caudal rami. *J Crustacean Biol* 27(2): 309-318.

Huys R 1990. Amsterdam Expeditions to the West Indian Islands, Report 64. A new family of harpacticoid copepods and an analysis of the phylogenetic relationships within the Laophontoidea T. Scott. *Bijdr Dierkd* 60(2): 79-120.

Huys R, Boxshall GA 1991. Copepod Evolution. Ray Society, London, 468 p.

Huys R, Lee W 2000. Basal resolution of laophontid phylogeny and the paraphyly of *Esola* Edwards. *Bull Nat Hist Mus Lond, Zool* 66: 49-107.

Karanovic T 2005. Two new subterranean Parastenocarididae (Crustacea, Copepoda, Harpacticoida) from Western Australia. *Rec West Aust Mus* 22(4): 353-374.

SPSS Inc. 1999-2001. SPSS for Windows Student Version release 11.0.0.

Received February 27, 2008
Accepted June 2, 2008
Associate editor: O Verneau