Zootaxa 2746: 1–19 (2011)
www.mapress.com/zootaxa/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

Redescription of *Callianassa jousseaumei* Nobili, 1904, a junior subjective synonym of *Callianassa indica* de Man, 1905 with description of a new species of *Neocallichirus* (Decapoda: Axiidea: Callianassidae)

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Abstract

Investigation of newly collected material from the Philippines during the Panglao Marine Biodiversity Project 2004, together with re-examination of the type material of *Callianassa jousseaumei* Nobili, 1904 and numerous specimens identified as *Neocallichirus indicus* (de Man, 1905), revealed that the latter is identical with the former and has to be considered a junior synonym of *Callianassa jousseaumei*. A redescription of this species is presented together with notes on its morphological variability and its ecology. A new species of *Neocallichirus*, *N. vaugelasi*, is described for specimens from Aqaba, previously attributed erroneously to *C.* (or *N.*) *jousseaumei*, and *N. natalensis* Barnard, 1947 is removed from the synonymy of the latter. This is the first record of this species for the Philippines and Thailand.

Key words: *Callianassa jousseaumei*, *Callianassa indica*, *Callianassa natalensis*, *Neocallichirus*, the Philippines, synonymisation

Introduction

Nobili (1904) briefly described *Callianassa jousseaumei* based on material from "mer Rouge", "Djibouti et Périm" (M. Jousseaume), "Djibouti" (M. Coutière) and "golfe de Tadjourah" (M. Faurot). Nobili (1906) was more specific, provided figures and also provided information on sex and numbers: Djibouti et Périm (M. Jousseaume) 10 males and 9 females; mer Rouge (M. Jousseaume) 2 females; Djibouti (M. Coutière) 4 males and 3 females; golfe de Tadjourah (M. Faurot) 1 male and 1 female.

De Man (1905) described *Callianassa indica* based on a single male from Kangeang, Indonesia, lacking the major cheliped. Later, Edmondson (1944) described *Callianassa variabilis* from Hawaii, which he considered very similar to *C. jousseaumei* and *C. indica*. Subsequent records of *C. indica* were from Mauritius (Kensley 1976) and Okinawa (Sakai 1987). De Saint Laurent & LeLoeuff (1979) placed both *C. jousseaumei* and *C. indica* in the genus *Callichirus* Stimpson, 1866.

In the 1980s, Jean de Vaugelas (Univ. Nice, France) studied the ecology of callianassids at Aqaba, Red Sea. He developed a method for collecting deep-burrowing shrimps, the "weighted line" method (de Vaugelas 1985). One species collected from subtidal sandy bottoms was new and described as *Callichirus* (currently *Glypturus*) *laurae* de Saint Laurent, 1984 (in de Vaugelas & de Saint Laurent 1984). The other species was tentatively identified as *Callichirus jousseaumei* Nobili, 1904 by M. de Saint Laurent. De Vaugelas (1984) used this name when describing the burrows. Later, de Vaugelas (1990) in an unpublished thesis mentioned that M. de Saint Laurent had doubt about the identity as *C. jousseaumei* after she had received additional material from Aqaba. She communicated to de Vaugelas that his material is a new species different from *C. jousseaumei*. Dworschak (1992), who had received one of the specimens collected by de Vaugelas uncritically attributed it to *C. jousseaumei* and provided some figures. Sakai (1999) based his account on the very same female specimen (NHMW 6980) and placed it into *Neocallichirus* Sakai, 1988. In the diagnosis, he mentioned that the male second pleopod lacks both appendix masculina and appendix interna, referring to fig. 22g, which is actually from SMF 4959, a specimen not listed under "Material examined" for *N. jousseaumei*, but for *N. indicus* (see Sakai 1999: 99). Sakai (1999) studied the holotype of *C. indica*, but not the type material of *C. jousseaumei*, which is stored in Paris and Turin. In addition, he synonymised

Accepted by S. Ahyong: 22 Dec. 2010; published: 21 Jan. 2011

several species with *N. indicus*. Later, *N. indicus* was reported from Socotra Island by Sakai & Apel (2002), with some speculations about the shape of the male major cheliped of this species based on findings of a large detached cheliped in the Persian-Arabian Gulf.

The study of the type material of *Callianassa jousseaumei*, together with newly collected material from the Philippines and Thailand, show that all the material attributed to *N. indicus* should be referred to *N. jousseaumei*. In addition, the specimens from the Red Sea, erroneously attributed to *N. jousseaumei* by Dworschak (1992) and Sakai (1999), are described as a new species of *Neocallichirus*. Finally, *N. natalensis* as well as *N. variabilis* are removed from the synonymy of *N. indicus*.

Material and methods

Specimens from intertidal sediments were extracted with a stainless steel yabby pump (Emro, Caloundra, QLD) or with an improvised PVC pump of similar design. Shrimp were chilled on ice before they were fixed in 75% ethanol or 99% propylenglycol.

Material is deposited in the following museums: Muséum National d'Histoire Naturelle, Paris, France (MNHN); Museo Regionale di Scienze Naturali, Torino, Italy (MRSN); Naturhistorisches Museum Wien, Austria (NHMW); National Museum of the Philippines, Manila (NMCR); Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt a.M., Germany (SMF); University of Louisiana at Lafayette, Zoological Collection, USA (ULLZ); Zoological Reference Collection, Raffles Museum of Biodiversity Research, Singapore (ZRC).

Size is expressed as total length (tl in mm) from the tip of the rostrum to the end of the telson and as carapace length (cl in mm) from the tip of the rostrum to the posterior median edge of the carapace. Other abbreviations used include: A1, first antenna (antennule); A2, second antenna; Mxp3, third maxilliped; P1, first pereopod; P3, third pereopod; Plp1, first pleopod; Plp2, second pleopod; plma, palm length major cheliped; calma, carpus length major cheliped; plmi, palm length minor cheliped; calmi, carpus length minor cheliped; coll., collector.

Neocallichirus jousseaumei (Nobili, 1904)

(Figs 1–4, 6F–H)

Callianassa (*Cheramus*) *Jousseaumei* Nobili, 1904: 236; 1906: 101, pl. 6 fig. 2; de Man, 1928: 26, 97, 100 (key), pl. 18 fig. 27–27a.

Callianassa (*Cheramus*) *indica* de Man, 1905: 605; 1928: 26, 100, 159, 160, pl. 17 fig. 26–26g [Type locality: Station 16, Lat. 6°59'S long. 115°24.7' E, Bay of Kankamaraän, S. coast of Kangeang, reef].

Callianassa indica. — Kensley, 1976: 50, fig. 2A–E; Sakai, 1987: 302, 306.

Callichirus indicus. — de Saint Laurent & LeLoeuff, 1979: 97.

Callichirus jousseaumei. — de Saint Laurent & LeLoeuff, 1979: 97.

Neocallichirus taiaro Ngoc-Ho, 1995: 212, figs. 1–2. [Type locality: Taiaro atoll, Tuamotu Island, French Polynesia]; Tudge *et al.*, 2000: 144.

Neocallichirus indicus. — Sakai, 1999: 99, fig. 23a, b, d, e (not *Neocallichirus indicus*; Sakai, 1999: 99, 100, fig. 23c; 2005: 178 [part, holotype of *C. natalensis*]); Sakai & Apel, 2002: 277, fig. 2; Robles *et al.*, 2009: 314 (tree), 317 (list).

Neocallichirus jousseaumei. — Sakai, 1999: fig. 22g.

Neocallichirus indica. — Tudge *et al.*, 2000: 144 (list).

Not *Callichirus jousseaumei*. — de Vaugelas, 1984: 529 [misindentification = *N. vaugelasi* **sp. n.**].

Not *Callianassa jousseaumei*. — Dworschak, 1992: 198, fig. 5a–d, 6a–c [misindentification = *N. vaugelasi* **sp. n.**].

Not *Neocallichirus jousseaumei*. — Sakai, 1999: 100, fig. 22e, f; 2005: 179; Tudge *et al.*, 2000: 144 (list) [misindentification = *N. vaugelasi* **sp. n.**]

Type material. "Djibouti et Perim, Dr. Jousseaume coll.", 1 male (tl 57, cl 15.4, figured) LECTOTYPE (here designated to fix the concept of *Callianassa jousseaumei* Nobili, 1904 and to ensure the universal and consistent interpretation of the same); PARALECTOTYPES, 1 female (tl 61, cl 15, figured), 1 female (tl 61, cl 15.7, minor P1 missing, figured), 1 male (tl 56, cl 14.9), 1 female (tl 45, cl 12, minor P1 missing), 1 female (cl 10), 1 male (tl 54, cl 14.4, major P1 missing), 1 female (cl 14, both P1 missing), 1 female (cl 11, both P1 missing), 1 female (cl 13.5, both P1 missing), 1 male (damaged), 1 male (tl 46, cl 12), 1 male (tl 40, cl 10.8, both P1 missing), 1 male (tl 31, cl 8.1), 1 female (tl 40, cl 10.6, both P1 missing), 1 female (tl 38, cl 10.8, both P1 missing), 1 male (tl 48, cl 12.4, both P1 missing), 1 male (tl 34, cl 8.6, both P1 missing), 1 male (tl 19, cl 5.0, major P1 missing, figured) MNHN Th-83.

—"mer Rouge, M. Jousseaume coll. 1897, auct. det.", 2 females (not measured) MNHN Th-81. — "golf de Tadjourah, M. Faurot coll. 242.95", 1 male, 1 female (not measured) MNHN Th-82. — "Museum Paris Djibouti, H. Coutière, 109-97", 1 male (cl 8, major P1 missing, minor P1 detached), 1 female (cl 9.5, major P1 detached) MRSN Cr.460 (ex 2295).

Non-type material. "Djibouti (Somalia) Det. Auch. 1905", 1 male (tl 60, cl 16.3, both P1 missing), 1 female (cl 14.6, broken in 2 parts), 1 male (tl 40, cl 11.7, both P1 missing), 1 male (tl 37, cl 9.4, both P1 missing), 1 male (tl 31, cl 8.3, both P1 missing), 1 vial with dissected appendages and one minor P1, MRSN Cr.467. — Red Sea, coll. E. Rüppell 1827, 1 male (tl 36, cl 10.4) SMF 4959. — Yemen, Socotra, E of Hadibo, N-coast, SOC/IT-178a (12°39.740'N 054°02.630'E) under stones in shallow water, M. Apel coll. 14 April 1999, 1 female (tl 40, cl 12.4) SMF 26515. — United Arab Emirates, Fujairah, Sandy Beach Hotel, Al Aqqa, between mainland and small island at reef near small island, UAE95-28 (25°30.000'N 056°22.000'E), 3–4 m, in sand under stone, M. Apel coll. 4 July 1995, 1 male (tl 28, cl 9.2) SMF 26516. — Philippines, Bohol, Panglao I., Alona Beach (M1: 09°32.9'N, 123°46.6'E), intertidal: coll. June 2004, 1 male (tl 34 cl 10.2) ZRC 2010.0396; 1 female (tl 28 cl 8) NHMW 25032; –P.K.L. Ng coll 3 June 2004, 1 male (tl 35 cl 10.2) ZRC 2010.0385 (Photo sp.2); –P. Dworschak coll. 5 June 2004, 1 female (tl 74 cl 21.3) NHMW 21942 (PD030); –P. Dworschak coll. 6 June 2004, 1 male (tl 76 cl 21.4) NMCR 39021, (PD032/1); 1 female (tl 66 cl 17.7) ZRC 2010.0391 (PD032/2); 1 female (tl 59 cl 16) MNHN Th-1608 (PD032/3); 1 female (tl 51 cl 14.2) ZRC 2010.0392 (PD032/4); 1 male (tl 46 cl 12) MNHN Th-1609 (PD032/5); –P. Dworschak coll. 8 June 2004, 1 female (tl 70 cl 19) MNHN Th-1611; –P. Dworschak coll. 15 June 2004, 1 male (tl 83 cl 23.5), NHMW 25036 (PD109); 1 female (tl 73 cl 21), NMCR 39024 (PD110); 1 male (tl 66 cl 17.7), ZRC 2010.0397 (PD111); 1 male (tl 85 cl 22.8), NHMW 25033 (PD112); 1 male (tl 70 cl 18.5) ZRC 2010.0395 (PD113); 1 female (tl 58 cl 15.7) MNHN Th-1613 (PD114); 1 female (damaged tl ca 48), MNHN Th-1614 (PD115); 1 male (tl 61 cl 17), MNHN Th-1615 (PD116); 1 male (tl 65 cl 18.2); NHMW 25034 (PD117); 1 female (tl 53 cl 16), NMCR 39023 (PD118); –Joelle Lai coll. 16 June 2004, 1 male (tl 85 cl 24.4), NHMW 25041 (JL010); 1 female (tl 73 cl 20.2) NMCR 39027 (JL011); 1 female (damaged, cl 20) NMCR 39022 (JL012); 1 female (tl 55 cl 15.8) ZRC 2010.0390 (JL013); 1 female (tl 56 cl 15.9) NHMW 25031 (JL014); 1 male (damaged, cl 12.6) NMCR 39025 (JL015); –P. Dworschak coll. 18 June 2004, 1 male (tl 70 cl 20.7), 1 female (tl 35 cl 11), NHMW 25035 (PD144); –P.K.L. Ng coll. 3 July 2004, 1 female (tl 49 cl 13.5) ZRC 2010.0386 (3.7./01); 1 female (tl 50 cl 13.1) NMCR 39029 (3.7./02); 1 female (tl 60 cl 17) MNHN Th-1604 (3.7./03); 1 female (tl 75 cl 20.7) NMCR 39026 (3.7./04); 1 male (tl 52 cl 15) NHMW 25027 (3.7./05); 1 male (58 cl 16.3) MNHN Th-1605 (3.7./06); 1 female (tl 69 cl 18.6) ZRC 2010.0387 (3.7./07); 1 male (tl 57 cl 16.6) NHMW 25039 (3.7./08); 1 female (tl 55 cl 15.1) ZRC 2010.0388 (3.7./09); 1 female (tl 80 cl 22.5) NHMW 25038 (3.7./10); 1 male (tl 63 cl 16.7) NHMW 25028 (3.7./11); 1 male (tl 61 cl 16.6) NHMW 25040 (3.7./12); 1 female (tl 75 cl 20.8) ZRC 2010.0389 (3.7./13); 1 female (tl 63 cl 17.5) MNHN Th-1606 (3.7./14); 1 male (tl 50 cl 13.8) NHMW 25029 (3.7./15); 1 male (tl 36 cl 10.6) NHMW 25030 (3.7./16); 1 female (tl 39 cl 12) MNHN Th-1607 (3.7./17). – Philippines, Bohol, Panglao I., Sungcolan Bay (M11: 09°38.3'N, 123°49.6'E), intertidal sand, P. Dworschak coll. 7 Jun.2004, 1 female (tl 75 cl 20) ZRC 2010.0393 (PD041); 1 female (tl 83 cl 22.2) NHMW 25037 (PD042); –P. Dworschak coll. 8 June 2004, 1 male (tl 62 cl 17.2) MNHN Th-1610 (PD051); 1 female (tl 66 cl 18.3) ZRC 2010.0394 (PD052); 1 male (tl 74 cl 21.3) MNHN Th-1612 (PD054); 1 male (tl 84 cl 24.5) NMCR 39028 (PD055); 1 ovigerous female (tl 75 cl 23.2) NMCR 39030 (PD056). — Thailand, Andaman Sea, Phangnga, Laem Pakarang [8° 44'06"N 98°13'18"E], intertidal, in muddy sand at transition from beach to coral rubble, coll. July 2007: 1 female (carapace damaged) NHMW 21952; 1 female (tl 44 cl 12) NHMW 21953; 1 male (tl 37 cl 10.2) NHMW 21954; 1 female (tl 38 cl 11) NHMW 21955. – Thailand, Andaman Sea, Phangnga, Khao Lak, Sunset Beach [8°37'41" N 98°14'26" E], small beach, sand between boulders, intertidal, coll. July 2007: 1 male (tl 42 cl 12.2) NHMW 21956; 1 male (tl 57 cl 16) NHMW 21957.

Redescription. Dorsally, carapace as long as abdominal somites 1 and 2 combined, ca 1/4 of total length. Frontal margin of carapace with three anterior prominences, lateral prominences obtusely angular, sometimes appearing uncalcified; median prominence reaching beyond laterals, forming short, broadly rounded rostrum (Figs 1A, B, 2A, B, 3A, B, 4A, B). Carapace lacking cardiac prominence and dorsal carina, with distinct linea thalassinica; dorsal oval distinctly marked posteriorly by deep transverse cardiac furrow, the latter extending anteroventrally to either side above linea thalassinica as shallow groove marking posterior half of dorsal oval. Frontal margin of carapace continued ventrolaterally beyond intersection with linea thalassinica as thickened oblique ridge ending anteriorly at prominent hepatic boss (Fig. 3B). Sclerotised ridge along anterodorsal margin of anterior branchiostegal lobe articulating at junction of oblique ridge and linea thalassinica. Subantennular region of epistome bearing dense tuft of long setae.

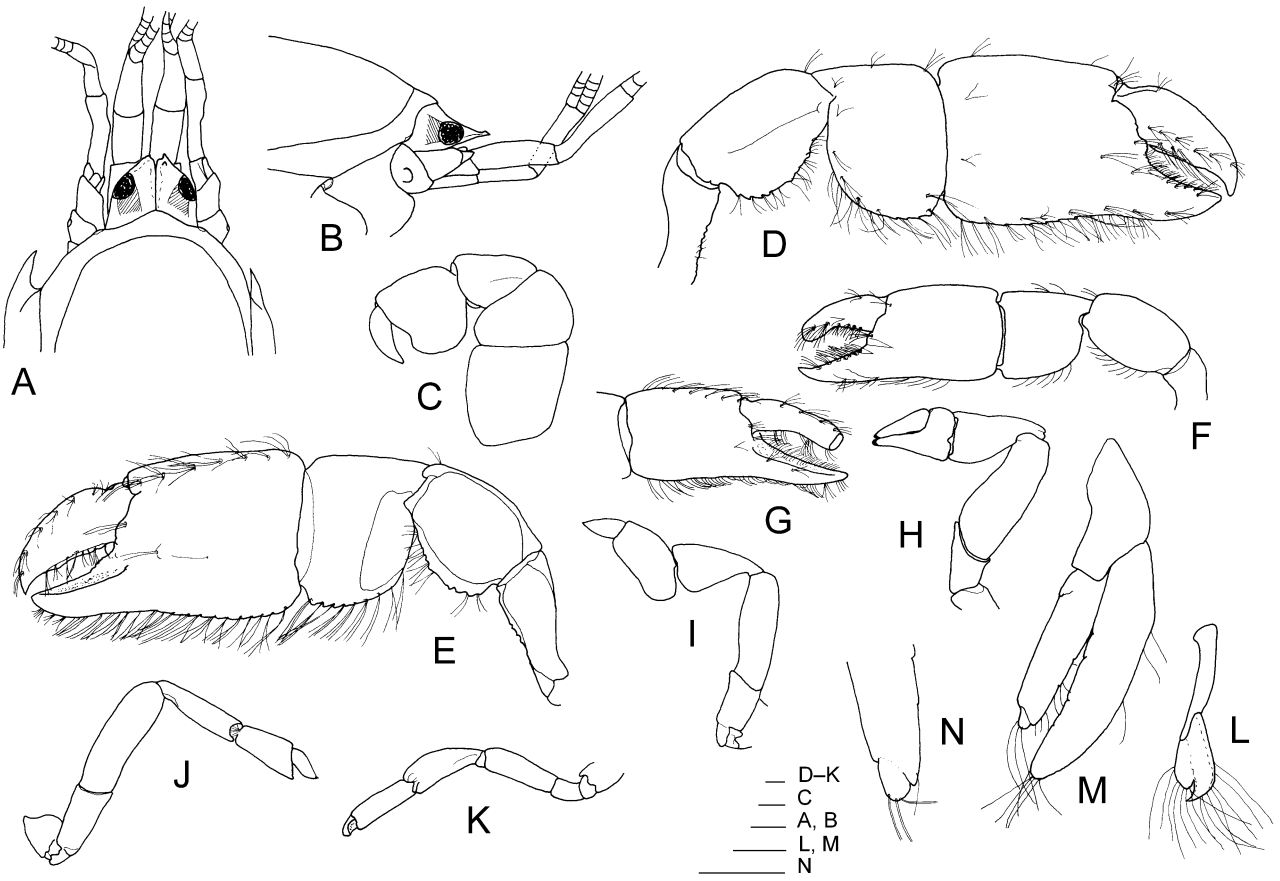

FIGURE 1. *Neocallichirus jousseaumei* (Nobili, 1904), lectotype of *Callianassa jousseaumei* Nobili, 1904, MNHN Th 83, male (tl 57, cl 15.4, telson damaged): A, front in dorsal view; B, front in lateral view; C, third maxilliped in lateral view (setae omitted); major cheliped in lateral (D) and mesial (E) view; F, minor cheliped in lateral view (in situ); G, propodus and dactylus of minor cheliped in mesial view; H, second pereopod (setae omitted); I, third pereopod (setae omitted); J, fourth pereopod (setae omitted); K, fifth pereopod (setae omitted); L, first left pleopod in lateral view; M, second left pleopod in anterior view; N, same, detail of endopod. Scale is 1 mm.

Eyestalks reaching to or beyond basal antennular article, ca 1.5 times as long as broad; outer margins convex, terminating in a dorsoventrally flattened rounded lobe bearing one to several tubercles distally (Figs 1A, B, 2 A, B, M, N, 3A–D, 4A, B). Cornea black, situated dorsolaterally in distal 1/2 of eyestalk, ca 1/3 to 1/2 width of eyestalk. Black pigment filling eyestalk to variable extent proximal to cornea (extracorneal pigment) (Figs 2M, N, 3C, D).

Antennular peduncle (Fig. 2O) thicker, but shorter than antennal peduncle; second article slightly shorter than basal article; terminal article 1.5 times as long as second.

Antennal peduncle (Fig. 2P) with basal article with dorsolateral carina forming lip above excretory pore; second article longer than first, third article short, visible in lateral view as short triangle ventral to second article and vestigial antennal scale; fourth article elongate, as long as basal, second and third article combined; fifth article narrower, as long as fourth article.

Mouthparts as figured (Fig. 3E–K), typical for genus. Mandible with toothed molar process (Fig. 3E). Third maxilliped (Figs 1C, 2C, Q, 3K, J, 4C) without exopod; endopodal ischium 1.1 times as long as broad (lectotype), mesial surface with row of teeth (crista dentata); merus triangular, 1.3 times as broad as long; carpus triangular, longer than broad; propodus large, ovoid, 1.1 times as broader as long; dactylus narrow, arcuate.

Major cheliped massive, (Figs 1D, E, 2D, R, 3L, M, 4E, F) located on either right or left side of body (Panglao: 28 left, 22 right), shape not sexually dimorphic (see below). Ischium slender, inferior margin with row of teeth; merus with toothed blade on inferior margin, widest proximally; carpus slightly shorter than merus, with straight superior and convex inferior margin; propodus much longer than carpus (see Table 1) with low keel in proximal half of superior margin, inferior margin of palm serrated; fixed finger slightly curved, cutting edge smooth or with low tubercles proximally, dactylus curved, broad, longer than fixed finger, cutting edge variable (see below).

Minor cheliped massive (Figs 1F, G, 2H, 3N), about 0.7 times as long and 0.5 times as high as major cheliped, sparsely armed, ischium with row of minute denticles proximally on inferior margin; merus unarmed, with rounded superior and inferior margins; carpus as long as high; palm of propodus slightly longer than carpus (see Table 1), fixed finger shorter than palm, triangular; dactylus slightly curved; cutting edges of fixed finger and dactylus smooth. Tips of both fixed fingers and dactylus corneous.

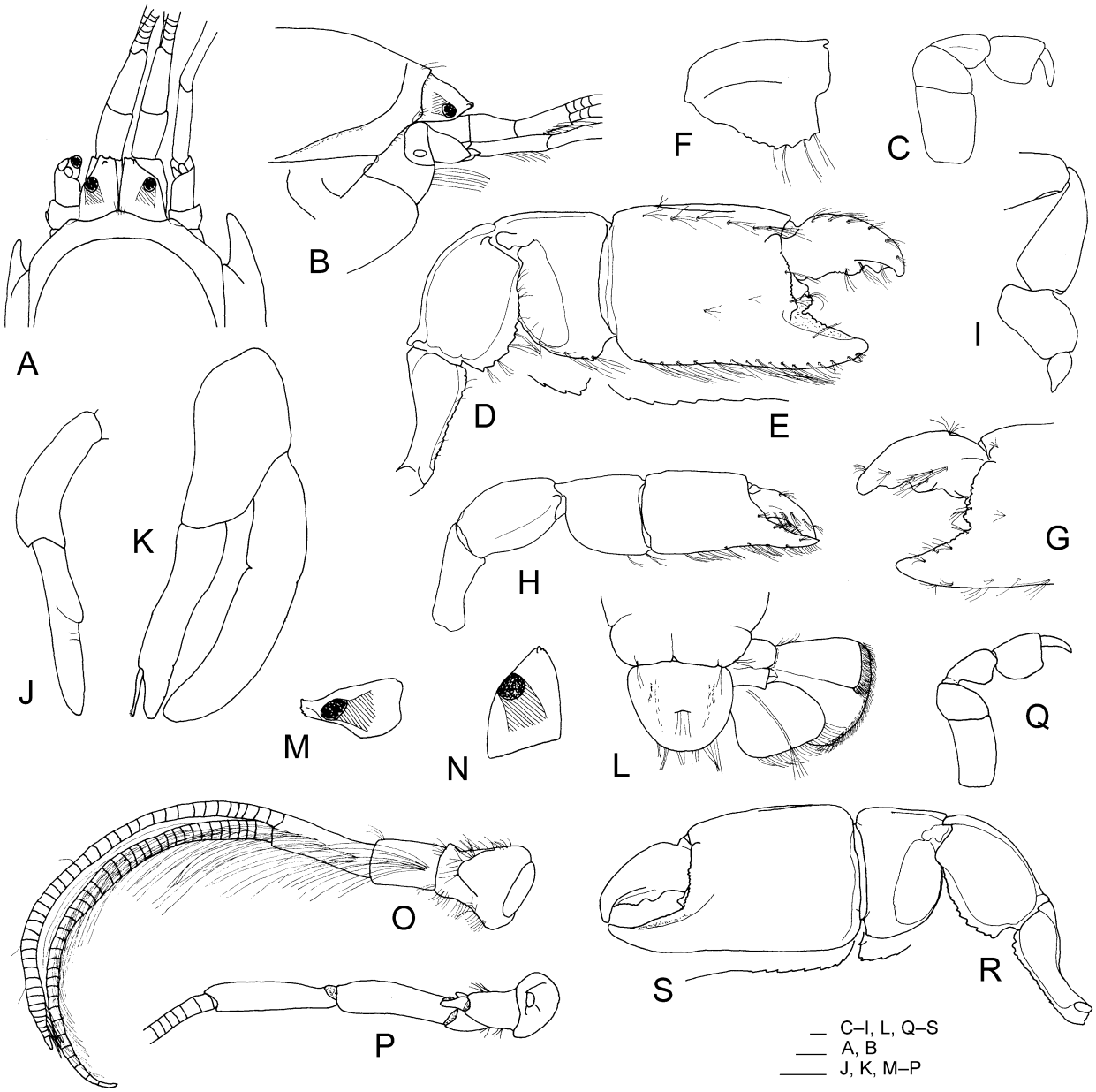

FIGURE 2. *Neocallichirus jousseaumei* (Nobili, 1904), paralectotypes, MNHN Th 83, A–L, female (tl 61, cl 15); M–S, female (tl 61, cl 15.7). A, front in dorsal view; B, front in lateral view; C, third maxilliped in lateral view (setae omitted); D, major cheliped in mesial view; E, same, lower border of carpus and propodus in dorsomesial view; F, same, carpus in lateral view; G, dactylus and fixed finger of major cheliped in lateral view; H, minor cheliped in lateral view; I, distal articles of left third pereopod (setae omitted); J, first right pleopod in lateral view (setae omitted); K, second right pleopod in posterior view (setae omitted); L, telson and right uropod in dorsal view; eyestalk in dorsal (M) and lateral (N) view; left antennula (O) and antenna (P) in lateral view; Q, third maxilliped in lateral view (setae omitted), R, major cheliped in mesial view (setae omitted); S, same, lower border of carpus and propodus in dorsomesial view. Scale is 1 mm.

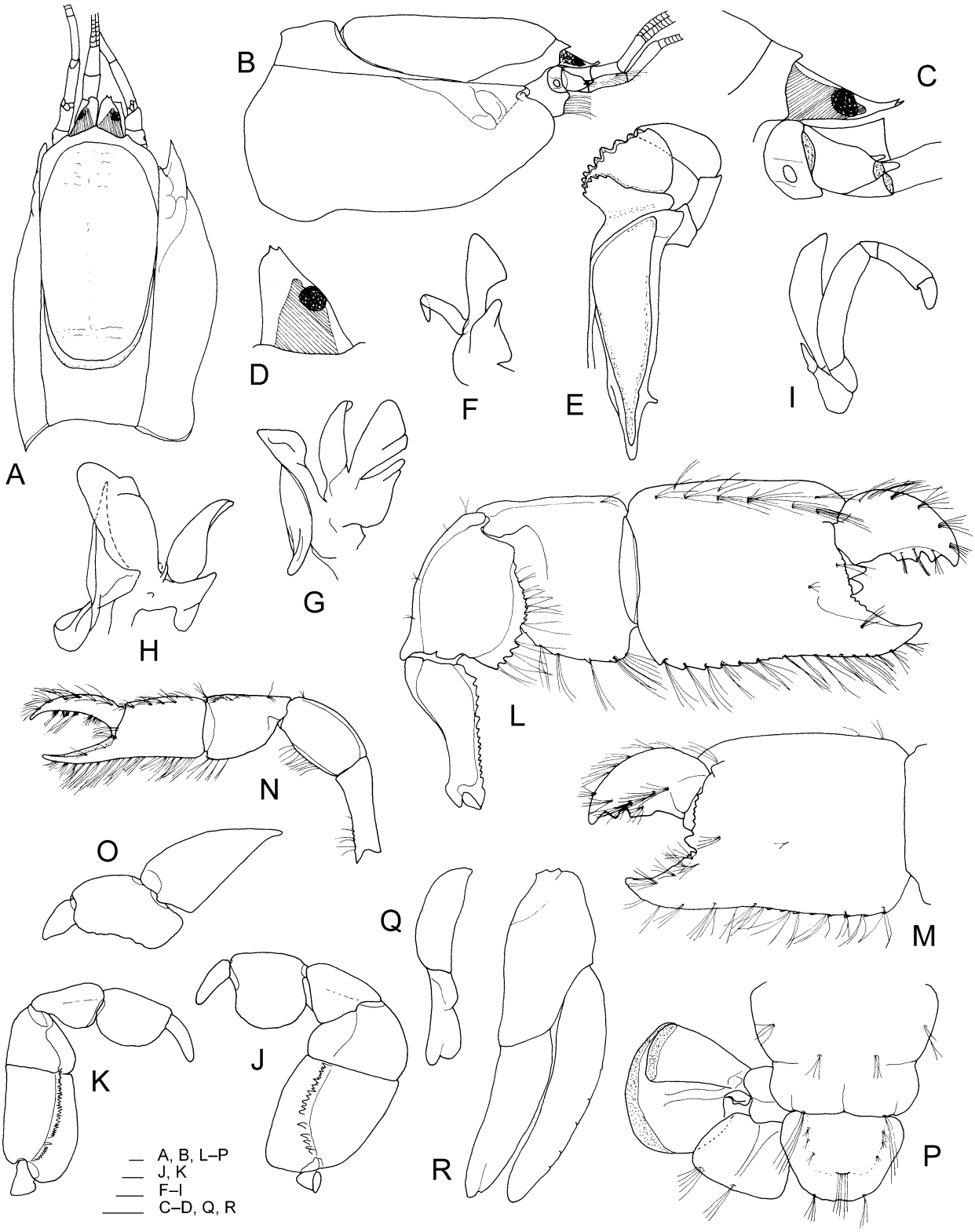

FIGURE 3. *Neocallichirus jousseaumei* (Nobili, 1904), NMCR 39021, male (tl 76 cl 21.4). Carapace in dorsal (A) and lateral (B) aspect; C, detail of front in lateral view; D, eyestalk in dorsal view; E, right mandible; F, right first maxilla; G, right second maxilla; H, right first maxilliped; I, right second maxilliped; right (J) and left (K) third maxilliped; L, major cheliped in mesial view; M, same, propodus and dactylus in lateral view; N, minor cheliped in mesial view; O, distal segments of third pereopod; P, telson and left uropod; right first (Q) and second (R) pleopod in posterior view. All setae omitted except for L, M, N, P. Scale is 1 mm.

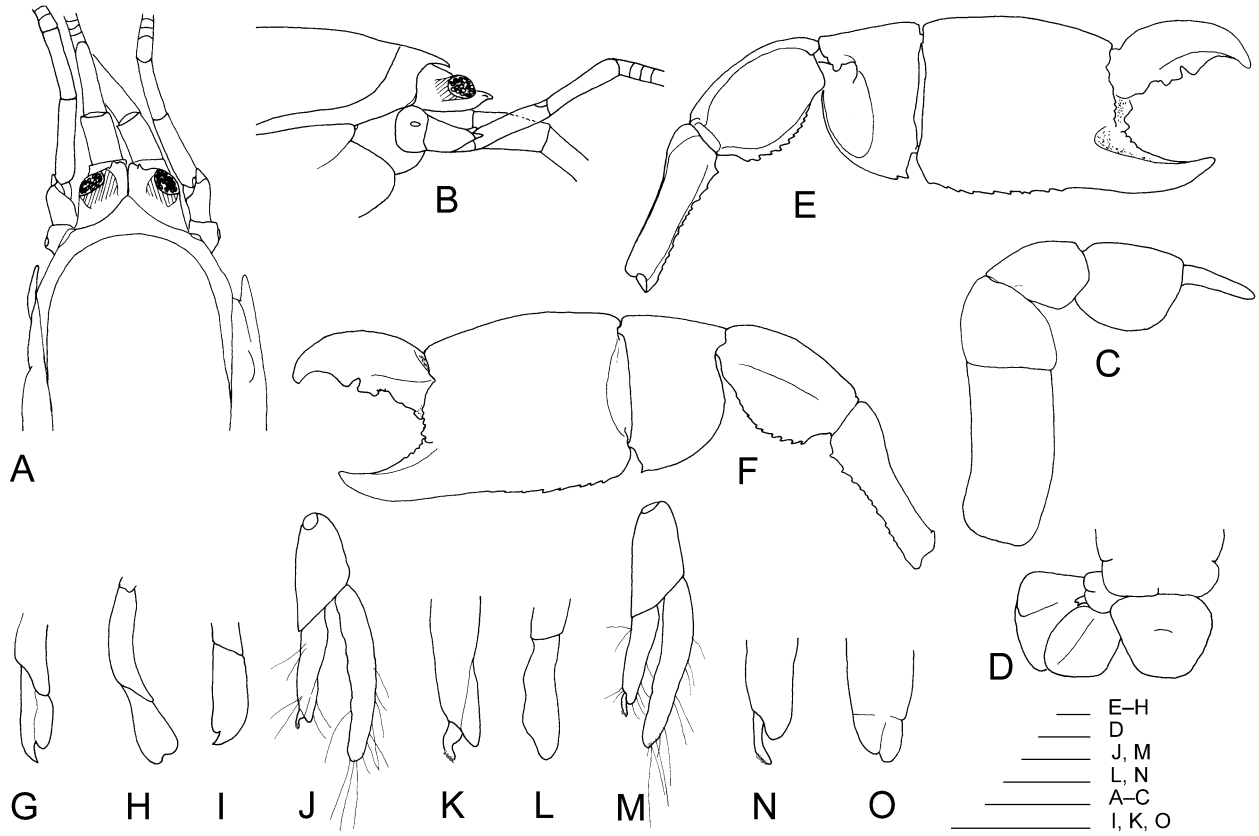

FIGURE 4. *Neocallichirus jousseaumei* (Nobili, 1904). A–D, paralectotype, MNHN Th-83, male (tl 19, cl 5.0); E, F, I–K, ZRC 2010.0396 (tl 34 cl 10.2); G, NHMW 25033 (tl 85 cl 22.8); H, NHMW 25039 (tl 57 cl 16.6); L–N, NHMW 25030 (tl 36 cl 10.6); O, NHMW 25027 (tl 52 cl 15). Front in dorsal (A) and lateral (B) view; C, right third maxilliped; D, telson and left uropod; major cheliped in mesial (E) and lateral (F) view; F, H, right first pleopod, lateral view; I, L, left first pleopod, lateral view; J, M, left second pleopod, anterior view; K, N, same, detail of appendix interna; O, left second pleopod, distal part of endopod, posterior view. Scale is 1 mm.

TABLE 1. Ratios (mean and ranges) of propodus and carpus measurements.

	N. jousseaumei type material	*N. jousseaumei* Panglao	*N. jousseaumei* Khao Lak	*N. vaugelasi* **sp. n.** Aqaba	*N. natalensis* Malindi
plma/calma	1.7 (1.35–2.07)	1.8 (1.33–2.36)	1.9 (1.45–2.22)	1.6 (1.42–1.82)	1.0
plmi/calmi	1.5 (1.27–1.74)	1.14 (0.8–1.9)	1.1 (0.89–1.52)	0.68 (0.61–0.85)	0.64

Second to fifth pereopod as figured (Figs 1H–K), typical for genus. Third pereopod (Figs. 1I, 2I, 3O) propodus rhomboidal with proximally-directed lobe of inferior margin not reaching beyond broadest part of carpus (not heeled).

Abdomen long (Figs. 6F–H); dorsal length ratio (along midline) of first to sixth abdominal somites 1.0: 1.47: 1.18: 1.05: 1.15: 1.57 (lectotype).

Male first pleopod consisting of two articles (Figs 1L, 3Q, 4G–I, L); second article same length as first, bilobed or with rounded lobe and acute hooked tip distally (see Variations below). Female first pleopod simple (Fig. 2J), consisting of two articles; terminal article with shoulder at midlength.

Male second pleopod (Figs 1M, N, 3R, 4J, K, M–O) biramous, variable with respect to shape and demarcation of appendix masculina and appendix interna (see below). Female second pleopod biramous (Fig. 2K), endopod with appendix interna.

Third to fifth pleopods with appendix interna embedded into mesial margin of endopod.

Telson ca 1.2 times as broad as long, broadest proximally, lateral and posterior margins convex. Uropodal endopod slightly longer than telson, rhomboidal, about as long as wide. Uropodal exopod longer than endopod, with anterodorsal plate (Figs 2L, 3P, 4D).

Variations. The shape of Mxp3 is variable, ischium-merus length to width ratio ranged from 1.7 to 2.5 (mean 2.1) in the specimens from Panglao; the Mxp3 differed between left and right in two specimens (see Fig. 3J, K). The tuberculation on the eyestalks varies also, there is at least one tubercle on the distal corner, additional tubercles may be present mesiodistally. The male first pleopods, irrespective of size, may have two rounded lobes (Figs 3Q, 4H) (5 in type series, 7 from Panglao) or be hooked (Figs 1L, 4G, I) (6 in type series, 8 from Panglao); one male had an intermediate form, another one (NHMW 25030, tl 36) a simple Plp1 terminus (Fig. 4L). The latter showed also an appendix interna on the endopod of Plp2 (Figs 4M, N). Another male (ZRC 2010.0396, tl 34) has a hooked Plp1 and an appendix interna on Plp2 (Figs 4I–K). An appendix interna on the left side only was observed in another small male from the type series (MNHN Th-83, tl 19), whereas all the larger males have no appendix interna and show a weakly demarcated appendix masculina (Figs 1N, 3R, 4O). The major chelipeds show no obvious sexual dimorphism in shape, but chelipeds become slightly larger in males (plma = 0.8276 cl - 2.6583, n = 22, r = 0.90) than in females (plma = 0.5652 cl + 0.5113, n = 29, r = 0.88) from Panglao. Slight variations exist in the cutting edge of the dactylus, which may be entire (8 specimens, e.g. as in the lectotype, Figs 1D, E) or show a distal triangular and an indented proximal rectangular tooth (41 specimens, e.g. as in PD32/1, Figs 3L, M, 4E, F).
At Panglao, 28 specimens had the major cheliped on the left side, 23 had it on the right side, sex ratio (males : females) was 22 : 30 for Panglao and 16 : 14 for the type material, only one (tl 75) out of 30 females from Panglao was ovigerous. Embryo diameter is 714–785 µm

Size. For Panglao, tl 28–85 mm, cl 8–24.5 mm.

Colour. Transparent with a touch of pink on the dorsal abdomen and chelipeds (Fig. 6F) to brightly pink (Fig. 6G, H).

Commensals. At Panglao, many specimens had numerous clausidiid copepods on their body surface.

Habitat. Lower intertidal in coral rubble covered by fine sand or fine sand between boulders (see Figs 6A–C).

Distribution. Djibouti, Perim, Gulf of Tadjourah, Red Sea (type locality); Socotra, Persian-Arabian Gulf (Sakai & Apel 2002); Indonesia (type locality of *C. indica* de Man, 1905); Thailand, the Philippines (this study); French Polynesia (type locality of *N. taiaro* Ngoc-Ho, 1995).

Remarks. Present in the Muséum national d'Histoire Naturelle, Paris (as of May 2007) are the specimens from Djibouti et Perim (MNHN Th-83 collected by Jousseaume in 1891), Mer Rouge (MNHN Th-81 collected by Jousseaume in 1897) and golfe de Tadjourah (MNHN Th-82 collected by Faurot). The number of specimens agrees with that given by Nobili (1906). The seven specimens from Djibouti collected by Coutière remained in Torino, where Nobili worked; some (5 specimens) were later sent on loan to J. G. de Man. Parenti (1971) lists two lots of *C. jousseaumei*: MRSN Cr.460 (2 specimens) and MRSN Cr.467 (5 specimens), none indicated as type material. Both lots were found at the MRSN in September 2008; only the former is indicated as type on the label. The sizes given by de Man agree well with the two larger specimens from MRSN Cr.467, the sexes given by Nobili (1906) – 4 males, 3 females – and those found in 2008 – 5 males, 2 females – do not. The "Det. Auch. 1905" on the label, however, seems to indicate that the specimens came to the collection later. It is unknown what "Det. Auch." might mean (L. Levi, C. Froglia pers. comm. Sep. 2008), but it could be a misinterpretation of "auct. det", which can be found on the label of MNHN Th-81, meaning that the author of the species (G. Nobili) identified the specimens. The specimens of MRSN Cr.467 are here not considered as syntypes and therefore do not become paralectotypes.
The type material both in MNHN and MRSN is in fairly good condition, but fewer than half of the specimens had the major cheliped still attached.

De Man (1928) compared *C. indica* with material of *C. jousseaumei* he received on loan from Turin (probably MRSN Cr.460, see above). He concluded that there are two differences, one in the shape of the male Plp1, the other in the length relation of Mxp3 ischium and merus. Edmondson (1944), in his description of *C. variabilis*, concluded that "Structural features selected by De Man to distinguish *C. indica* from *C. jousseaumei* are found in the Hawaiian form to have wide ranges of variation, which suggest that if sufficient material had been available de Man might have found the species from the Red Sea and Kangean to be identical". He finally gave, as a very constant character in which *indica/jousseaumei* and *variabilis* differ, the presence of a distinct anteroventral lobe on the Mxp3 propodus in the latter. The "lobe" on the Mxp3 propodus, however, was also figured for the type material of *C. jousseaumei* by de Man (1928: pl. 18 fig. 27). In the type series as well as in the material from Panglao, this lobe is recognisable in most specimens (Panglao: no lobe 20, with lobe 29).

According to Art.23.9.1 (International Code on Zoological Nomenclature, 1999), the use of a junior synonym is to be conserved when it has been used in 25 works by 10 different authors in the past 50 years. This is not appli-

cable here because *indicus* has been published in that period in only 12 papers by 7 authors (see synonymy). Therefore, *jousseaumei* takes precedence over *indicus*.

The specimen attributed to *C. jousseaumei* by Dworschak (1992), subsequently by Sakai (1999) and mentioned in Tudge *et al.* (2000), is different from this species (see below).

Sakai (1999) synonymised several taxa with *N. indicus*:

1) *Callianassa* (*Cheramus*) *variabilis* Edmondson, 1944 from Hawaii, Hanauma Bay, Oahu, in gravel bed of the intertidal zone. As mentioned above, no essential morphological difference exists between this species and *N. jousseaumei*. Study of recently collected material from Hawaii (ULLZ) confirmed this (pers. obs. June 2008). Molecular studies, however, indicate that *N. variabilis* is sufficiently different from *N. jousseaumei* (as *N. indicus*) (R. Robles & D.L. Felder, pers. comm. 2009). *Neocallichirus variabilis* is therefore considered a separate species here.

2) *Callianassa natalensis* Barnard, 1947 based on a single female specimen of tl 100 mm collected from the stomach of Rock Cod at the Natal coast, South Africa. Barnard (1947, 1950) mentioned that it resembles *C. indica*, yet without giving further details. *Neocallichirus natalensis* is considered different from *N. jousseaumei* here. Further details are given below.

3) *Neocallichirus manningi* Kazmi & Kazmi, 1992 known from two females with tl 35 and 22 mm collected in the lower intertidal region at Sandpit, Karachi, Pakistan. Sakai (2005) removed this species from synonymy with *N. indicus*, but still lists the locality among the latter's distribution. *Neocallichirus manningi* differs from *N. jousseaumei* by i) the shape of the telson, which has a median terminal spine, ii) the lower border of the major cheliped is smooth (denticulated blade in *N. jousseaumei*, always present even in small specimens both from the type series and Panglao). In addition, the carpus of both major and minor P1 is much longer than the palm.

Neocallichirus natalensis (Barnard, 1947)

(Figs 5, 6I)

Callianassa natalensis Barnard, 1947: 379; 1950: 511, fig. 95 f–h; Kensley, 1974: 277 [Type locality: from stomach of Rock Cod, Natal coast]

Neocallichirus indicus. — Sakai 1999: 99, 100, fig. 23c; 2005: 178 (part, holotype of *C. natalensis*) (not *Neocallichirus indicus* = *N. jousseaumei*)

Neocallichirus natalensis. — Tudge *et al.*, 2000: 144 (list).

Material. NHMW 24900, Indian Ocean, Kenya, Malindi [3°12'11.68"S 40°07'23.02"E], beach, intertidal, coll. August 2008, 1 female (tl 117, cl 24.4).

Size. Total length 100 to 117 mm.

Colour. Transparent; chelipeds white, except for a tint of pink on dorsal face of merus; carapace dorsal oval and cardiac region and antennal peduncles pink; orange hepatopancreas and red ovary shining through tergites of first two abdominal somites; posterior abdominal somites and dorsal faces of tailfan pink.

Commensals. The specimen from Malindi had numerous clausidiid copepods on its body surface (see Fig. 6I)

Distribution. Natal (type locality), Kenya (this study).

Remarks. Barnard (1950) provided figures of the third maxilliped, major cheliped and tailfan. Sakai (1999: fig. 23c, as *N. indicus*) published another figure of the holotype's major cheliped. From the description and figures, *N. natalensis* differs from *N. jousseaumei* by 1) the third article of antennular peduncle is as long as the second (Fig. 5A, B) (second much shorter than third in *N. jousseaumei*); 2) the merus of major P1 is widest at midlength (denticulated blade widest proximally in *N. jousseaumei*) and tuberculated proximally at the upper border (smooth in *N. jousseaumei*); and 3) the carpus of major P1 is almost as long as the palm (Fig. 5D, E) (always shorter in *N. jousseaumei*). The ratio plma/calma from fig. 95g in Barnard (1950) is 1.07, from Sakai (1999) 1.03; the specimen from Kenya has a ratio of 1.0 (see Table 1), 4) the carpus of minor P1 is much longer than the palm (Fig. 5G) (always shorter than palm in *N. jousseaumei*) and 5) dactylus and fixed fingers of the minor cheliped are longer than the palm (Fig. 5G, H) (always much shorter in *N. jousseaumei*) (*N. jousseaumei* Panglao 1.33–2.3, mean: 1.8). The specimen from Malindi differs also from all *N. jousseaumei* studied by having the third pereopod propodus slightly heeled (compare Fig. 5I with Figs 1I, 2I, 3O).

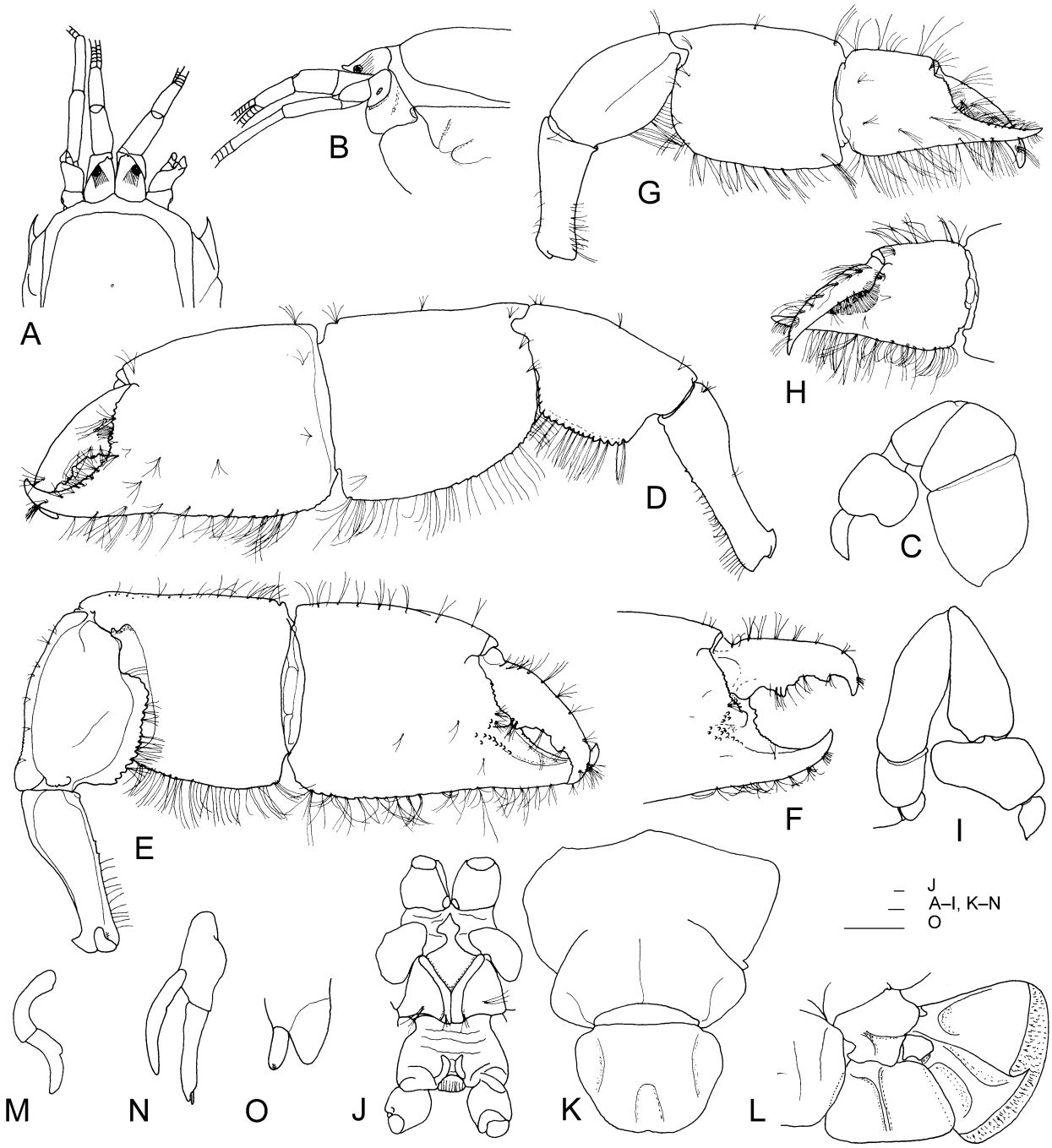

FIGURE 5. *Neocallichirus natalensis* (Barnard, 1947), NHMW 24900, female (tl 117, cl 24.4). Front in dorsal (A) and lateral (B) aspect; C, left third maxilliped (in situ); major cheliped in lateral (D) and mesial (E) view; F, same, with fingers opened; G, minor cheliped, lateral view; H, same, propodus and dactylus in mesial view; I, right third pereopod (in situ); J, sternites 6 to 8, ventral view; K, sixth abdominal somite and telson, dorsal view; L, right uropod, dorsal view; first (M) and second (N) pleopod, posterior view; O, same, detail of appendix interna. All setae omitted except in D–H. Scale is 1 mm.

***Neocallichirus vaugelasi* sp. n.**

(Figs 7–10)

Callichirus jousseaumei. — de Vaugelas, 1984: 529.
[*Callichirus* sp. aff. *jousseaumei*. — de Vaugelas, 1990: 40]
Callianassa jousseaumei. — Dworschak, 1992: 198, figs. 5a–d, 6a–c.
Neocallichirus jousseaumei. — Sakai, 1999: 100, fig. 22e, f [not fig. 22g]; 2005: 179; Tudge *et al.*, 2000: 144 (list).
Not *Callianassa Jousseaumei* Nobili, 1904 (see above).

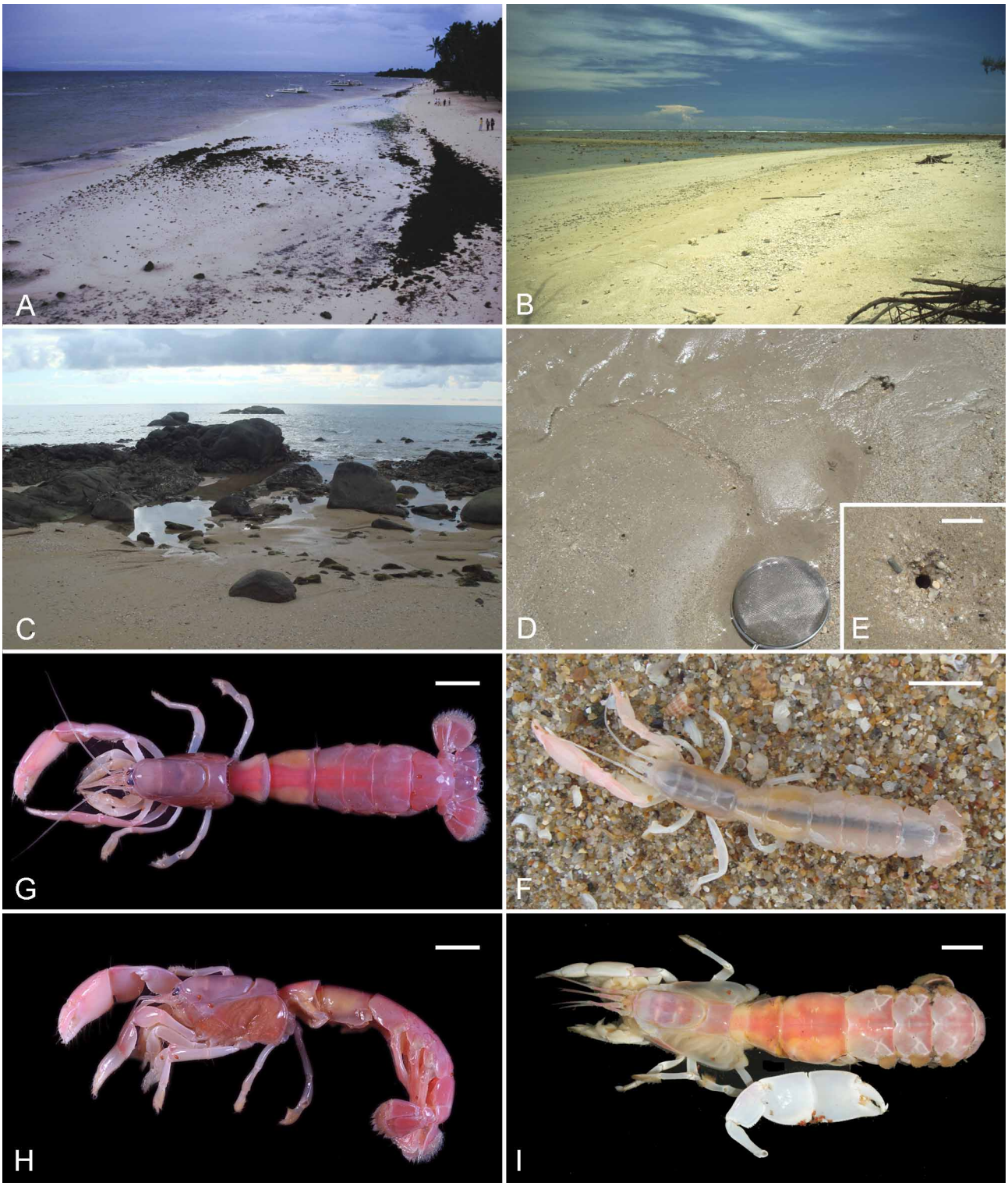

FIGURE 6. *Neocallichirus jousseaumei* (Nobili, 1904). Habitats: Alona Beach on Panglao, the Philippines at low tide (A); in Thailand, Leam Pakarang (B) and Sunset Beach (C); D, detail of sediment surface with burrow openings (diameter of sieve 20 cm); E, detail of one burrow opening with faecal pellets; F, male specimen NHMW 21956, (tl 42 cl 12.2) from Sunset Beach; female specimen NHMW 21942 (tl 74 cl 21.3) in dorsal (G) and lateral (H) view from Alona Beach (Photos: Tin-Yam Chan and Chia-Wei Lin). I, *Neocallichirus natalensis* (Barnard, 1947), female specimen NHMW 24900; major cheliped detached. Note associated red copepods on body surface in G–I. Scale is 1 cm.

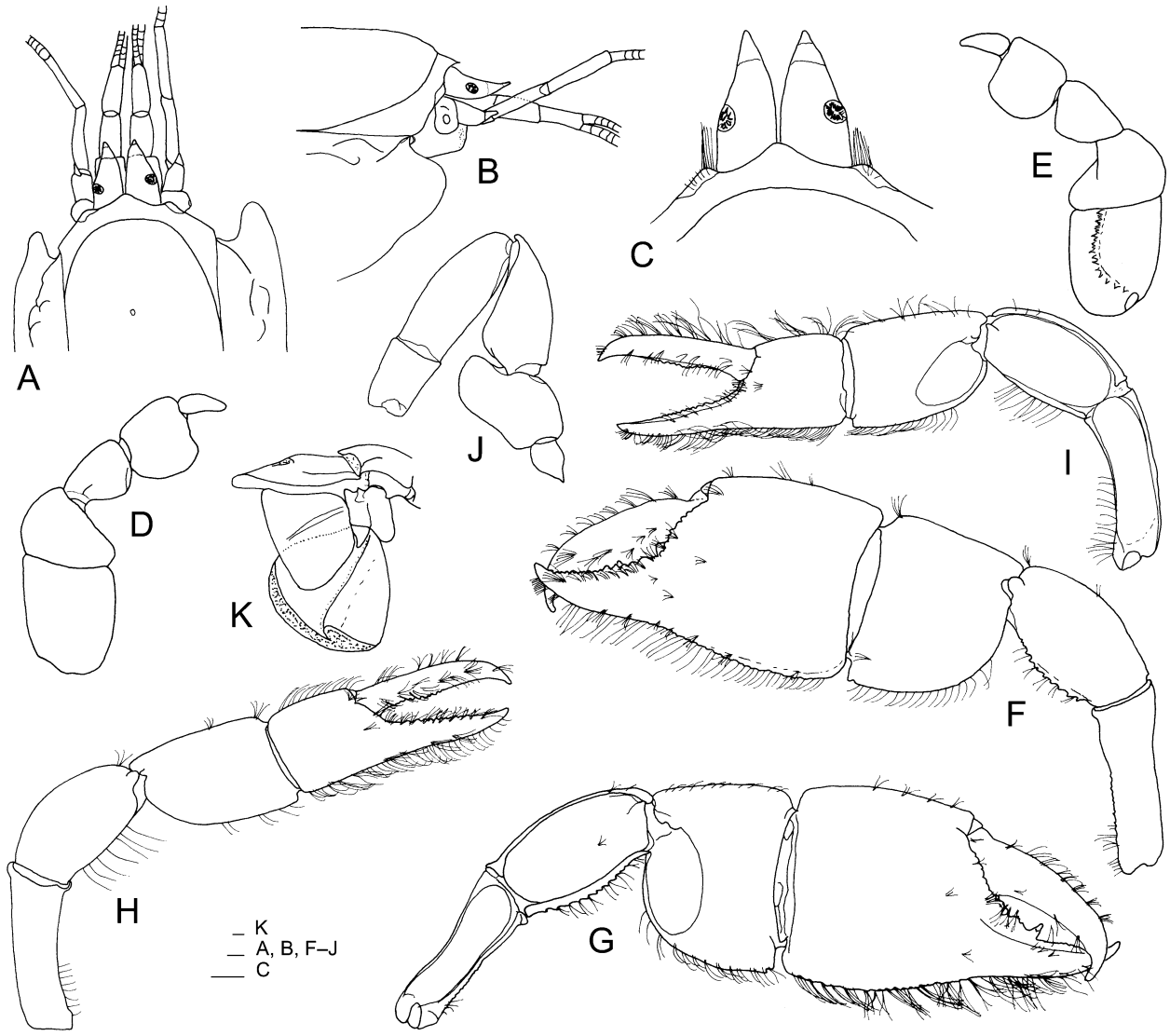

FIGURE 7. *Neocallichirus vaugelasi* **sp. n.**, female holotype (ovigerous, tl 118, cl 23.5), NHMW 6980. Front in dorsal (A) and lateral (B) view; C, detail of front and eyestalks; third maxilliped in mesial (D) and lateral (E) view (setae omitted); major cheliped in lateral (F) and mesial (G) view; minor cheliped in mesial (H) and lateral (I) view; J, third pereopod in mesial view (setae omitted); K, right uropod in lateral view (flat, setae omitted). Scale is 1 mm.

Type material. Red Sea, Aqaba, J. de Vaugelas coll. with weighted line: HOLOTYPE, ovigerous female (tl 118, cl 23.5), 29 June 1984, NHMW 6980. PARATYPES, 1 male (tl 89, cl 23, left major cheliped missing), 1 female (tl 139, cl 29.8, left major cheliped missing), 1 detached left P1, 4 June 1983, MNHN Th-651; 1 male (tl 105, cl 27.2, right major cheliped and both Mxp3 missing), 18 June 1983, MNHN Th-930; 1 female (cl 24.8, 6th pleomere and tailfan broken off) 4 December 1983, MNHN Th-931; 1 female (tl 108, cl 28, both chelipeds and Mxp3 missing, still entangled in line), (1), 14 April 1984, MNHN Th-932; 1 female (tl 93, cl 25.4, major left cheliped detached, minor attached, 1 additional left cheliped), 14 May 1984, MNHN Th-933; 1 ovigerous female (tl 96, cl 24.9, right major cheliped missing), 11 July 1984 "Aqaba, Hotel, oefs incubateur" MNHN Th-934; 1 detached right major cheliped, MNHN Th-1616.

Description. Carapace ca 0.25 of total length; frontal margin (Figs 7A, C, 8A, C, 9B) with three anterior prominences, lateral of which are obtusely angular, appearing uncalcified, overlying inner margins of antennal peduncles; median prominence reaching slightly beyond laterals, forming short obtusely angular rostrum, not extending to cornea.

Carapace lacking rostral carina, with distinct linea thalassinica, and with defined dorsal oval marked posteriorly by deep transverse cardiac furrow, latter extending anteroventrally to either side above linea thalassinica as

shallow groove demarcating posterior half of dorsal oval. Frontal margin of carapace continued ventrolaterally beyond intersection with linea thalassinica and onto branchiostegite as thickened oblique ridge terminating at anterior end of prominent rounded hepatic boss. Sclerotised ridge along anterodorsal margin of anterior branchiostegal lobe articulating at junction of oblique ridge and linea thalassinica. Subantennular region of epistome bearing dense tuft of long setae.

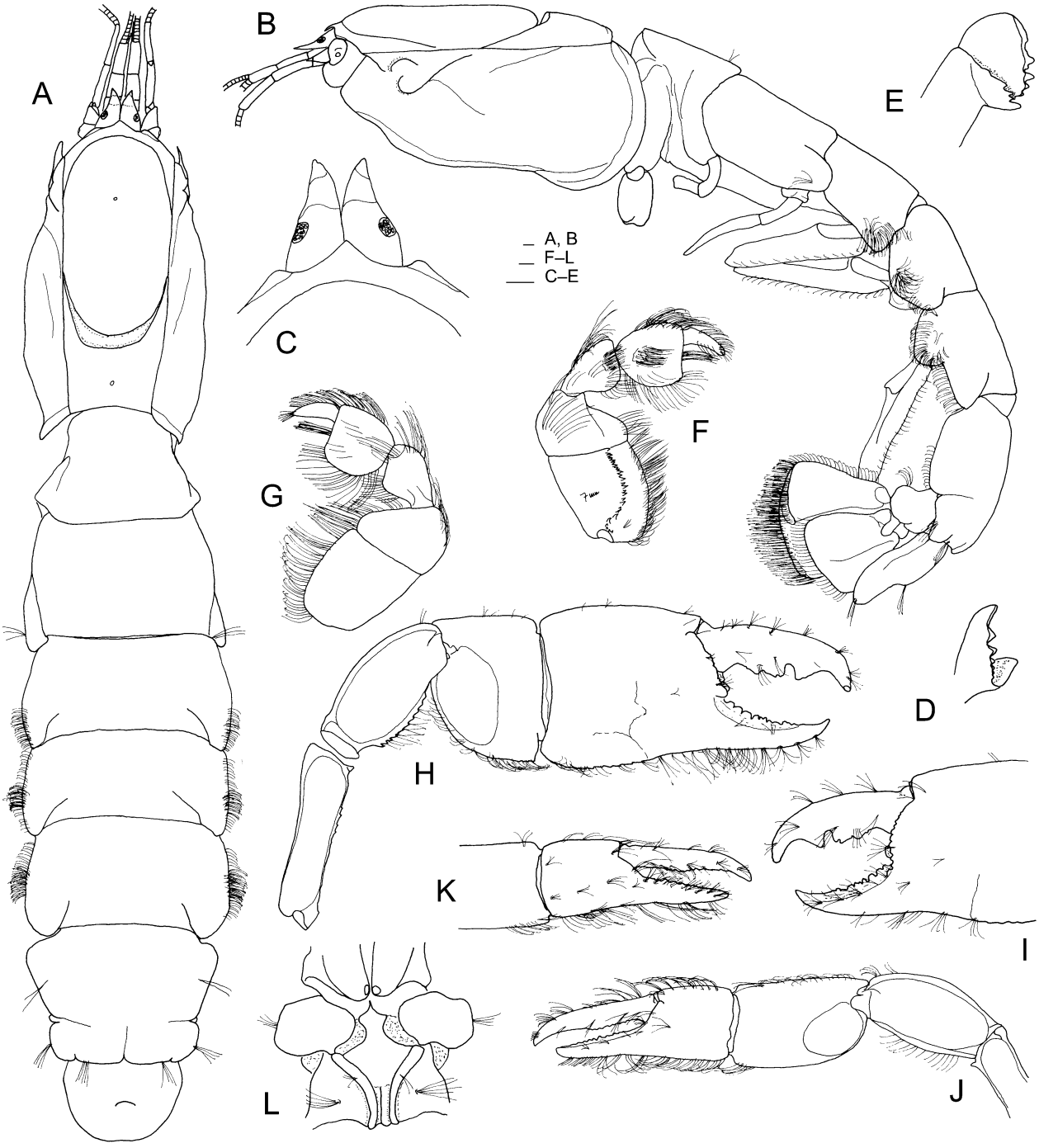

FIGURE 8. *Neocallichirus vaugelasi* **sp. n.**, A–D, F–L, female paratype (tl 93, cl 25.4), MNHN Th-933. E, female paratype (tl 108, cl 28), MNHN Th-932. Habitus in dorsal (A) and lateral (B) view; C, detail of front and eyestalks; distal part of right (D) and left (E) mandible; third maxilliped in mesial (E) and lateral (F) view; G, major cheliped in mesial view; H, same, fingers in lateral view; I, minor cheliped in mesial view; J, same, propodus and dactylus in lateral view; K, sternite 7 in ventral view. Scale is 1 mm.

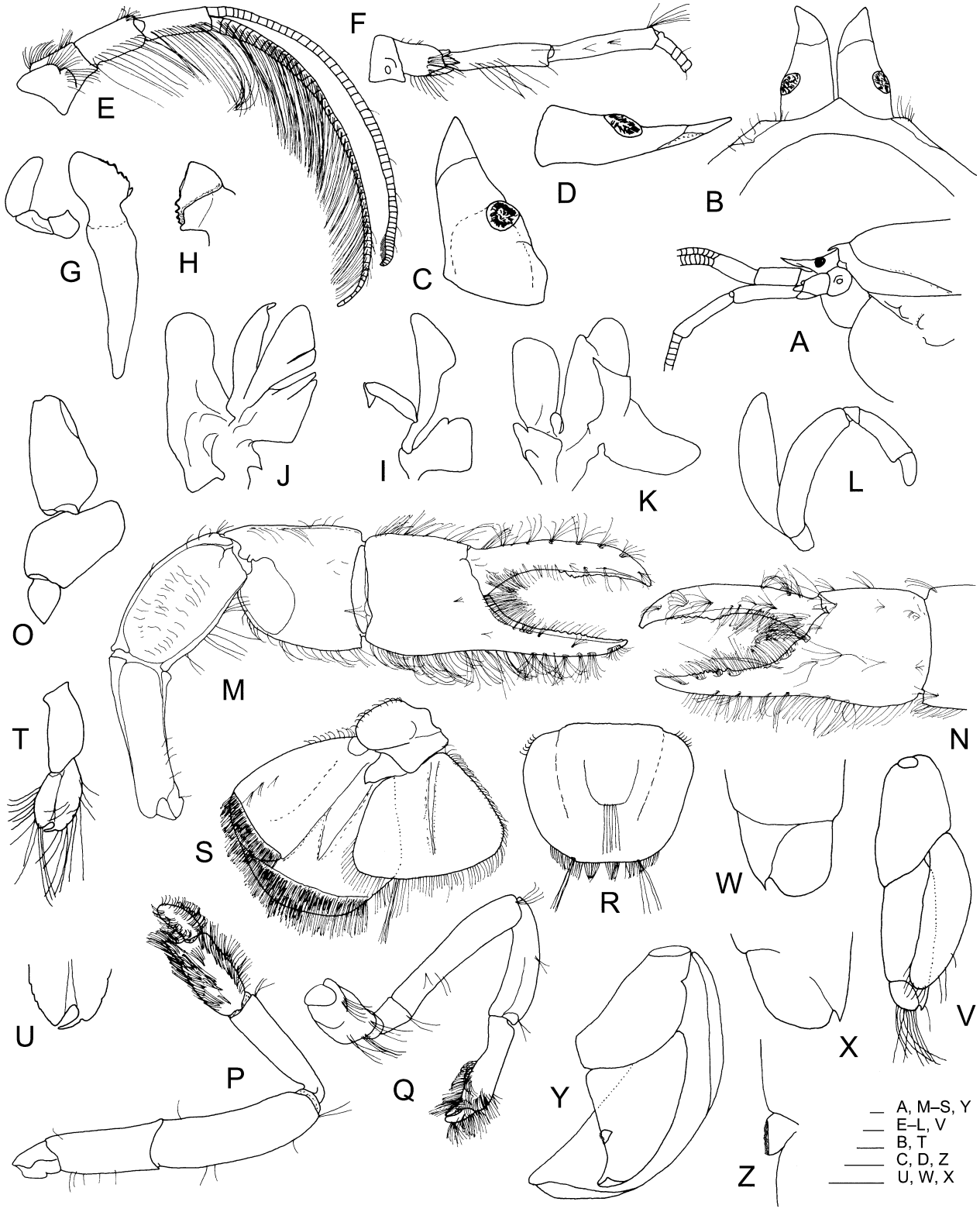

FIGURE 9. *Neocallichirus vaugelasi* **sp. n.**, male paratype (tl 105, cl 27.2), MNHN Th-930. A, front in lateral view; B, detail of front and eyestalks in dorsal view; eyestalk in dorsal (C) and lateral (D) view; right antennule (E) and antenna (F); mandible in lateral (G) and mesial (H) view; I, right maxillule; J, right maxilla; K, right first maxilliped; L, right second maxilliped; minor cheliped in mesial (M) and fingers in lateral (N) view; O, distal part of third pereopod, mesial face; left fourth (P) and left fifth (Q) pereopod; R, telson; S, left uropod; T, first left pleopod, lateral view; U, same detail of terminus; V, second left pleopod, anterior view; same, distal part of endopod in posterior (W) and anterior (X) view; Y, right third pleopod; Z, same, appendix interna. Setae omitted in A, G–L, O, U, X–Z. Scale is 1 mm.

Eyestalks (Figs 7C, 8C, 9B–D) elongated, triangular, strongly diverging distally, transparent in distal part; cornea dorsolateral in proximal half, small, occupying less then half eyestalk width in dorsal view. Length of exposed eyestalk in dorsal view two times basal width, tips overreaching distal end of basal antennal article.

Antennular peduncle (9E) shorter and heavier than antennal peduncle, terminal article about as long as penultimate and not exceeding midlength of terminal article of antennal peduncle; penultimate and terminal articles of peduncle with ventromesial and ventrolateral rows of long setae; rows of setae continued onto ventral ramus of flagellum; ventral ramus of flagellum slightly exceeding dorsal one, six times length of terminal article of peduncle; dorsal ramus with sparse setae in proximal third, distal fifth comprising tapered tip with dense line of ventral aesthetascs.

Antennal peduncle (Fig. 9F) with terminal article slightly longer than penultimate article; short basal article forming slightly produced, setose lip above laterally produced excretory pore; second article longer than first, third article short, visible in lateral view as short triangle ventral to second article and vestigial antennal scale; fourth article elongate, as long as basal, second and third article combined; fifth article narrower, as long as fourth article.

Mandibles (Figs 8D, E, 9G, H) with large, three-segmented palp, elongated third article of palp slightly tapered and terminally rounded, concave on external surface, long setae distally on second article and on proximal extensor surface of third, field of short. weakly hooked setae on most of extensor surface of third article, setae heavier and less hooked terminally; incisor process with well defined, terminally corneous teeth on cutting margin, teeth largest on proximal half of cutting margin, internal surface with lip giving rise to molar process proximal to incisor teeth, molar process smooth (Figs 8D, 9H) or with about four to five small marginal teeth (Fig. 8E), one of which may be spaced proximally on internal margin apart from others.

First maxilla (Fig. 9I) with endopodal palp long, narrow, terminal article deflected proximally at articulation and narrowed to terminal tip; proximal endite with very dense fine setation on most of lower mesial margin, terminal lobe with field of large, terminally bifurcate setae; distal endite elongate, proximally narrow, broadening terminally where armed with short stiff bristles; exopodite low, truncate and setose.

Second maxilla (Fig. 9J) with endopod acute distally, first and second endites each longitudinally subdivided and densely setose terminally; first endite with low arcuate setose crest across external surface of lower lobe, internal surface fused to broad, rounded, plate bearing long marginal setae; exopod forming large, broad, scaphognathite.

First maxilliped (Fig. 9K) with proximal endite narrowly produced, dentiform, marginally setose; distal endite robust, rectangular, mesial half of external surface and margins heavily setose, long dense setae of outer surface overreaching and obscuring stout bifurcate bristles on mesial margin, longest setae terminal, internal surface concave; exopod ovoid, divided by transverse suture marking notch on mesial margin, longest setae in field on external surface and mesial margin proximal to notch; epipod large, posterior lobe broad, anterior end tapered to narrow terminus.

Second maxilliped (Fig. 9L) with long, narrow endopod; endopodal merus length about five times width, flexor margin with dense fringe of long, close-set setae; carpus short; propodus slightly arcuate, heaviest distally, greatest width about 1/2 length; dactylus half length of propodus, with terminal brush of stiff bristles; exopod narrow, arcuate, distally overreaching end of endopodal merus, marginally fringed by long setae; epipod small, partial suture subdividing angular terminal lobe (not shown); arthrobranch (not shown) rudimentary.

Third maxilliped (Figs 7D, E, 8F, G) without exopod; endopod with long setation on mesial margin, terminal three articles also with long setation on extensor margins; length of endopodal ischiomerus two times width; ischium subrectangular, distinctly longer than broad, proximomesial margin rounded, not strongly produced, internal surface with well defined, longitudinally oriented elevation bearing curved row of sharp denticles (crista dentata); merus subtriangular, slightly broader than long; carpus heavy and subtriangular, with setose lobe on flexor margin, internal surface with dense field of fine setae distally; propodus large, subquadrate, slightly longer than high, internal surface with median field of fine, dense setae; dactylus narrow, slightly arcuate, shorter than height of propodus, terminally with small brush of stiff bristles.

Branchial formula including exopods and epipods as described for first and second maxillipeds above; branchiae limited to single rudimentary arthrobranch on second maxilliped, pair of arthrobranchs on third maxilliped, and pair of arthrobranchs on each of first through fourth pereopods.

First pereopods forming dissimilar chelipeds. Sexual dimorphism not obvious (only one male with attached major cheliped known). Major cheliped (Figs 7F, G, 8H, I, 10B, C, H, I) heavy, located on either right (5 specimens) or left (4 specimens) side of body; ischium slender, superior margin sinuous, inferior (flexor) margin with

minute denticles in proximal half; merus about two times as long as high, superior margin arcuate, regularly rounded in outline and armed with small denticles; carpus shorter than high, much shorter than palm, superior margin weakly arcuate, proximoinferior margin regularly rounded and with mesially directed denticles in distal half, propodus heavy, length (including fixed finger) distinctly less than twice height, latter greatest proximally, superior margin of palm forming unserrated keel in proximal half, proximal inferior margin lined on internal side by line of submarginal denticles extending onto base of fixed finger; fixed finger with prehensile margin armed with sharp triangular teeth becoming smaller distally; dactylus as long as palm, opposable margin with bilobed subrectangular tooth in proximal half, separated by deep cleft from broad subtriangular tooth distally, terminally with acute hooked tip.

Minor cheliped (Figs 7H, I, 8J, K, 9M, N, 10F, G, J, K) well calcified but more slender, less than half as high as major; ischium narrow, unarmed on inferior margin, as long as merus; merus elongately ovoid, twice as long as high, inferior margin unarmed; carpus large, as long as merus, 1.3 times as long as high, markedly exceeding height and length of palm; chela (including fixed finger) narrower than and exceeding length of carpus; palm rectangular, longer than high; fixed finger longer than palm, cutting edge serrated; gape slightly setose; dactylus much longer than palm, cutting edge with low, broad weakly serrated tooth at midlength.

Second pereopod (Fig. 10L) chelate, long setae sparsely distributed on inferior margin of ischium, more closely set over most of flexor margin on merus and both margins of carpus, those of superior margin of carpus set in a series of tufts, inferior margin of propodus with similar long setae proximally, progressively reduced in length and stiffened distally, subterminally becoming dense patch of short, stiff bristles; prehensile margins of both fingers corneous, graded from finely micropectinate proximally to smooth distally in both, that of fixed finger obscured by conspicuous tuft of arched bristles on external side near midlength, margins terminated distally in thickened corneous tips of fingers; superior margin of dactylus nearly straight, with long marginal setation proximally, dense patch of short stiff setae and bristles distally; external surface of carpus, propodus and dactylus with scattered patches of short setae.

Third pereopod (Figs 7J, 9O) merus broadest at midlength, length three times height; carpus broadest distally, length less than two times height, terminally with patches of long setae overreaching propodus; propodus with proximally-directed lobe of inferior margin not reaching beyond broadest part of carpus, lobe terminally with long distally-directed setae, inferodistal margin with spaced tufts of slightly shorter setae, superior margin with fields of long setae grading to small, patterned tufts of thinner, shorter setae on outer face of article; dactylus tear-shaped, densely setose on external surface, terminating in corneous tip hooked toward external side.

Fourth pereopod (Fig. 9P) with merus thicker and longer than carpus; subchelate, inferodistal corner of propodus produced into short fixed finger bearing heavy microserrate setae on external side and short bristles at tip; soft dense setation on outer surface of propodus and dactylus, that of propodus divided into upper and lower fields, densest in lower field where continued onto lower half of internal surface; dactylus terminating in narrow tip hooked toward external side.

Fifth pereopod (Fig. 9Q) minutely chelate, opposable surfaces of propodus and minute dactylus excavate, spooned, terminally rounded, forming beak-like chela obscured by dense fields of setation on distal half of propodus and superior surface of dactylus; corneous prehensile lip on fixed finger of chela pectinate.

Abdomen long (Figs. 8A, B); dorsal length ratio (along midline) of first to sixth abdominal somites 1 : 1.05 : 0.9 : 0.9 : 1 : 1.24 (MNHN Th-933). Abdominal somites smooth, glabrous dorsally; first somite narrowed anteriorly, pleuron triangular; second somite with straight anterior margin, posterior margin expanded posterolaterally, with one setal tuft near the posterior margin; third to fifth somites each distinctly shorter than second somite, posterior margins slightly expanded posterolaterally; pleura each with row of plumose setae midlaterally; sixth tergite with fine marginal setation laterally and distinct transverse, posteriorly-facing groove above telson.

Male first pleopod consisting of two articles (Figs 9T, U, 10D); second article same length as first, subdivided into two lobes by weak longitudinal furrow, anterior lobe terminally rounded, posterior lobe terminally acute. Female first pleopod simple (Fig. 10J), consisting of two articles; terminal article with shoulder at midlength.

Male second pleopod biramous, endopod with small appendix interna and a weakly demarcated appendix masculina (MNHN Th-651, Fig. 10E) or with no sign of an appendix interna with cincinnuli, the endopod demarcated distally with sutures in a broadly rounded mesial part (appendix masculina?) and a shorter acutely tipped lateral part (MNHN Th-930, Figs 9V–X). Female second pleopod biramous (Fig. 10N, O), endopod with appendix interna.

Third to fifth pleopods (Fig. 9Y) forming large, posteriorly cupped fans when coupled at mesial margins of endopods; endopod of each subtriangular, short, stubby appendix interna embedded into mesial margin of endopod (Fig. 9Z).

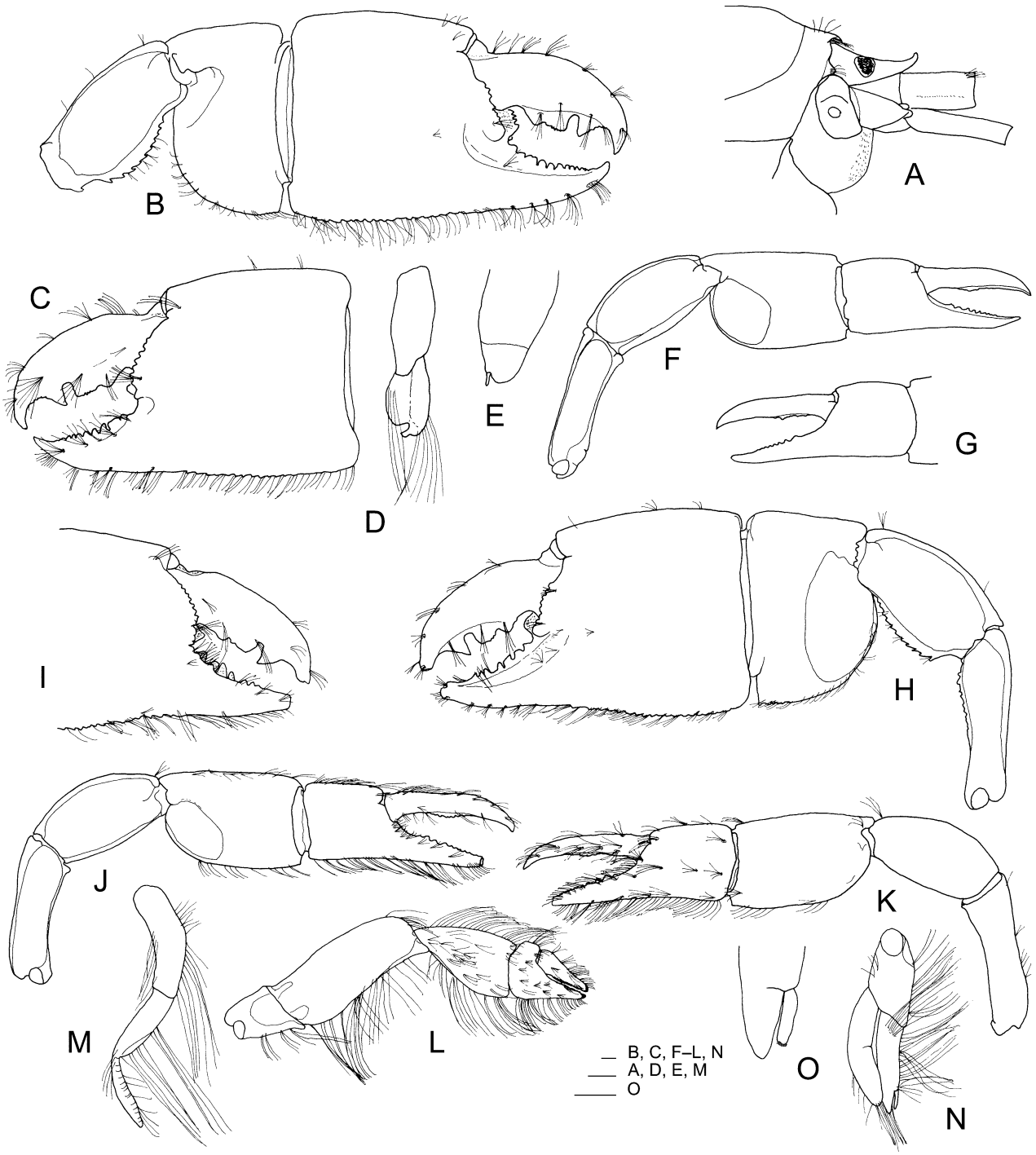

FIGURE 10. *Neocallichirus vaugelasi* **sp. n.**, A–E, paratype male (tl 89, cl 23), MNHN Th-651; F, G, paratype female (ovigerous, tl 96, cl 24.9), MNHN Th-934; H–O, female paratype (broken, cl 24.8), MNHN Th-931. A, front in lateral view; B, H, major cheliped in mesial view; C, I, same, fingers in lateral view; F, J, minor cheliped in mesial view; G, K, same, lateral view; L, left second pereopod; D, right first pleopod in lateral view; E, second pleopod, distal part of endopod in posterior view; M, first left pleopod, posterior view; second left pleopod in posterior view; O, same, detail of appendix interna. Setae omitted in E–G, O. Scale is 1 mm.

Telson (Figs 8A, 9R) 1.2 times as broad as long, broadest at lateral lobes in anterior third, posteriorly truncate to weakly sinuous, posterolateral corners broadly rounded, each bearing tuft of long setae; dorsal surface anteromedially elevated, with shallow sulci on lateral lobes to either side and short transverse line of setae directed posteriorly.

Uropod with angular, posterolaterally-directed lobe of protopod slightly overreaching anterior margin of endopod; endopod broad, rhomboidal, slightly broader than long, posterior margin truncate, nearly straight, dorsal surface with longitudinal carina and small tuft of long setae near posterolateral corner; exopod with anterodorsal plate falling well short of distal endopod margin, distal edge of plate lined with short, thick spiniform setae grading to thinner longer setae of exopod margin; dorsal surface of exopod below plate concave, distal margin with dense fringe of setation, fringe diminished and supplemented by row of short spiniform setae on posterior margin.

Embryos had a diameter between 712 and 785 µm.

Type locality. Aqaba, Red Sea

Etymology. The epithet is dedicated to Jean de Vaugelas (University of Nice, France), who collected the specimens.

Size. Total lengths from 89 to 118 mm, cl 24.8 to 28 mm.

Colour. Not recorded.

Distribution. Red Sea, Aqaba (type locality), Safaga (Dworschak, 1992).

Habitat. Sublittoral clean sands (down to 10 m water depth), often close to patch reefs. Burrow openings are characterised by mounds (10–15 cm diameter at base, 5–10 cm high)(de Vaugelas, 1984).

Remarks. *Neocallichirus vaugelasi* **sp. n.** is morphologically similar to *N. jousseaumei* in the shape of the tailfan and the shape of the third pereopod propodus. The new species differs from *N. jousseaumei* in 1) the shape of the eyestalks, which are elongated, have no tubercles and a very small cornea and show no extracorneal pigment; 2) the shape of the major chelipeds, which are a) generally more slender and less massive than in *N. jousseaumei* and have b) the merus with concave lower denticulate border widest at the midlength (denticulated blade widest proximally in *N. jousssseaumei*) c) a much longer dactylus, about as long as the dorsal border of the propodus (0.75 as long in *N. jousseaumei*), d) sharp triangular teeth on the cutting edge of fixed finger (smooth or with low tubercles proximally in *N. jousseaumei*); 3) the shape of the minor cheliped which a) tapers proximally and has b) a much longer carpus than palm (plmi/calmi 0.85–0.61, mean 0.68) [this ratio is 1.27–1.74 (mean 1.5) in the type material (n = 7) and 0.8–1.9 (mean 1.5) in Panglao material (n = 38) of *N. jousseaumei*, respectively (see Table 1)], c) both cutting edges have denticles (unarmed in *N. jousseaumei*) and d) the dactylus is much longer than the palm (dactylus much shorter than palm in *N. jousseaumei*).

Note that the male second pleopod figured by Sakai (1999: fig. 22c) was not that of "*N. jousseaumei*" (= *N. vaugelasi* **sp. n.**) because SMF 6780 is listed among the material of *N. indicus* (= *N. jousseaumei*).

Acknowledgements

Part of the material described herein was collected during the Panglao Biodiversity Project 2004, which was enabled through grants from the Total Foundation, the French Ministry of Foreign Affairs, and the ASEAN Regional Centre for Biodiversity Conservation. The Philippines Bureau of Fisheries and Aquatic Resources (BFAR) is acknowledged for issuing a research permit. The author thanks the Principal Investigators, Drs Philippe Bouchet (Muséum National d'Histoire Naturelle, Paris, France) and Danilo Largo (University of San Carlos, Cebu, Philippines) for the invitation to participate in the field work. The author is grateful to Drs Peter K. L. Ng and Swee-Hee Tan (Department of Biological Sciences, National University of Singapore, Singapore) for the opportunity to study the thalassinidean shrimps collected during the Panglao project. For loan of material I thank Nguyen Ngoc-Ho, Régis Cleva (MNHN) and Michael Türkay (SMF); for information and access to the collections of G. Nobili in Turin I thank Lisa Levi (MRSN) and Carlo Froglia (Ancona).

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