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Nebalia troncosoi sp. nov., a new species of leptostracan (Crustacea: Phyllocarida: Leptostraca) from Galicia, Iberian Peninsula (north-east Atlantic)

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A new species of leptostracan (Crustacea: Phyllocarida: Leptostraca) belonging to the genus *Nebalia*, *N. troncosoi* sp. nov., is described from specimens collected off the Galician coast (Iberian Peninsula, north-east Atlantic). The new species is relatively common in sandy bottoms. It is characterized by having a long rostrum, an eye with small distal lobes, an antennular flagellum with up to seven articles, the exopod of the second maxilla longer than the first article of the endopod, and acute denticles along the posterior dorsal border of pleonites 6–7.

INTRODUCTION

In recent years, the number of new described taxa belonging to Leptostraca (Crustacea: Phyllocarida) has increased greatly (Kazmi & Tirmizi, 1989; Modlin, 1991; Escobar-Briones & Villalobos-Hiriart, 1995; Vetter, 1996; Martin et al., 1996; Walker-Smith, 1998; Olesen, 1999; Haney & Martin, 2000; Walker-Smith, 2000; Haney et al., 2001), mainly after the revision of Dahl (1985) devoted to the European shelf species, in which a model for the description of leptostracans was established. However, records of leptostracans from the Iberian Peninsula (north-east Atlantic) are scarce (Dahl, 1985; Cunha et al., 1997), most of them having been attributed to *Nebalia bipes* (Fabricius, 1780), a species regarded by Dahl (1985) as having a northern distribution. A careful examination of several leptostracan specimens collected along the coast of Galicia (north-west Spain) has revealed the presence of an undescribed species belonging to the genus *Nebalia* Leach, 1814, which is described in this paper as *N. troncosoi* sp. nov.

MATERIALS AND METHODS

Specimens were collected between the years 1995 and 1997 during several ecological investigations of the benthic communities in several locations off the Galician coast (north-west Spain). Samples were taken by means of a Van Veen dredge. Specimens were sorted from the sediment, fixed in 10% buffered formalin, and then transferred to 70% ethanol. At each sampling point an additional sample was taken to provide sediment for granulometric and physico-chemical analysis.

About 15 females were dissected and temporary mounts of appendages were used for drawings. Line drawings were prepared using a camera lucida connected to an Olympus BX40 light microscope. Several specimens were subjected to scanning electron microscope (SEM) analysis, after being dehydrated via a graded ethanol series, liquid-CO_2-critical-point-dried, and sputter coated with gold. These specimens were examined with a Philips SEM XL30 at CACTI (Centro de Apoyo Científico y Tecnológico a la Investigación, University of Vigo). Descriptions of the new species are of females, following the model of Dahl (1985) and other recent works (Martin et al., 1996; Olesen, 1999). Total length (TL) was measured from the articulation of the rostrum and carapace to the posterior end of the caudal rami, excluding setation; dorsal carapace length (DCL) was considered as the distance between the articulation of the rostrum and the margin of the posterodorsal cleft; lateral carapace length (LCL) was considered as the distance along lateral surface between the anteriormost margin and the posteriormost margin; rostrum length (RL) was measured along the midline. The type series is deposited in the Museo Nacional de Ciencias Naturales, Madrid (MNCN), and Zoological Museum Hamburg (ZMH), while remaining specimens are kept in the collection of first author (J.M.).

SYSTEMATICS

Family NEBALIIDAE Samouelle, 1819
Genus *Nebalia* Leach, 1814
Nebalia troncosoi sp. nov.
Figures 1–8

Type series

Holotype: ovigerous female, MNCN 20.04/5335, Ensenada de Baiona (Galicia, north-west Spain), 42°7′30″N 8°50′15″W, December 1995, 7 m, muddy sand, RL 0.75 mm, DCL 1.2 mm, LCL 1.8 mm, TL 3.55 mm.

Allotype: male, MNCN 20.04/5336, Ensenada de Baiona, 42°8′50″N 8°50′15″W, December 1995, 7 m, muddy sand with *Zostera marina* L., RL 0.8 mm, DCL 1.75 mm, LCL 2.5 mm, TL 5.35 mm.

Paratypes: ovigerous female, MNCN 20.04/5337, Ensenada de Baiona, 42°7′50″N 8°49′13″W, April 1996, 4 m, fine sand; female, MNCN 20.04/5338, Ensenada de Baiona, 42°7′50″N 8°49′13″W, December 1995, 4 m, fine sand; female, MNCN 20.04/5339a, Ensenada de Baiona, 42°8′50″N 8°50′15″W, July 1996, 7 m, muddy sand with

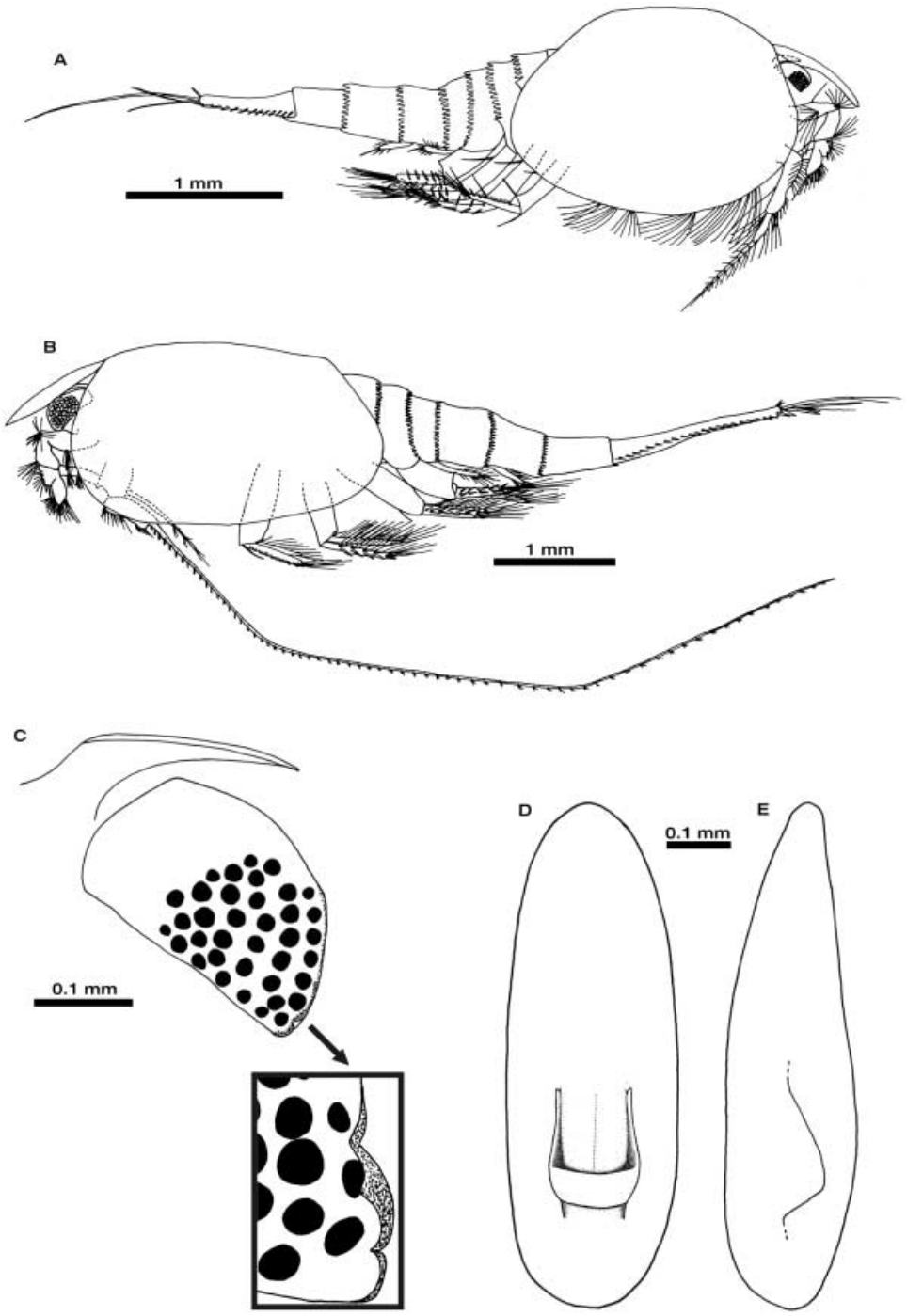

Figure 1. *Nebalia troncosoi* sp. nov.: (A) ovigerous female, lateral view; (B) male allotype, lateral view; (C) eye, lateral view (box: detail of distal lobes); (D) rostrum, ventral view; (E) rostrum, lateral view. D–E: same scale bar.

Z. marina; subadult male, MNCN 20.04/5339b, Ensenada de Baiona, 42°8′50″N 8°50′15″W, July 1996, 7 m, muddy sand with *Z. marina*; female, MNCN 20.04/5340, Ensenada de Baiona, 42°8′30″N 8°49′13″W, December 1995, 3 m, fine sand; ovigerous female, ZMH: K-40200, Ensenada de Baiona, 42°7′30″N 8°50′15″W, March 1996, 7 m, muddy sand; female, ZMH: K-40201, Ensenada de Baiona, 42°7′30″N 8°50′15″W, April 1996, 7 m, muddy sand; male, ZMH: K-40202, Ensenada de Baiona, 42°7′30″N 8°50′ 15″W, July 1996, 7 m, muddy sand; subadult male, ZMH: 40203, Ensenada de Baiona, 42°7′30″N 8°50′15″W, Dec 1996, 7 m, muddy sand; female, ZMH: K-40204, Ensenada de Baiona, 42°7′30″N 8°50′15″W, December 1996, 7 m, muddy sand.

Additional material examined (non-paratypic)

Ensenada de Baiona, 42°8′50″N 8°50′15″W, 7 m, muddy sand with *Z. marina*: December 1995, 18 females, 13 juveniles; February 1996, 2 juveniles; March 1996, 1 subadult male, 3 juveniles; April 1996, 3 females; May 1996, 1 juvenile; June 1996, 1 female, 2 juveniles; July 1996, 4 females, 2 subadult males, 3 juveniles; September 1996, 2 females, 2 juveniles; October 1996, 2 juveniles; November 1996, 1 female, 3 juveniles; December 1996, 7 females, 7 juveniles;

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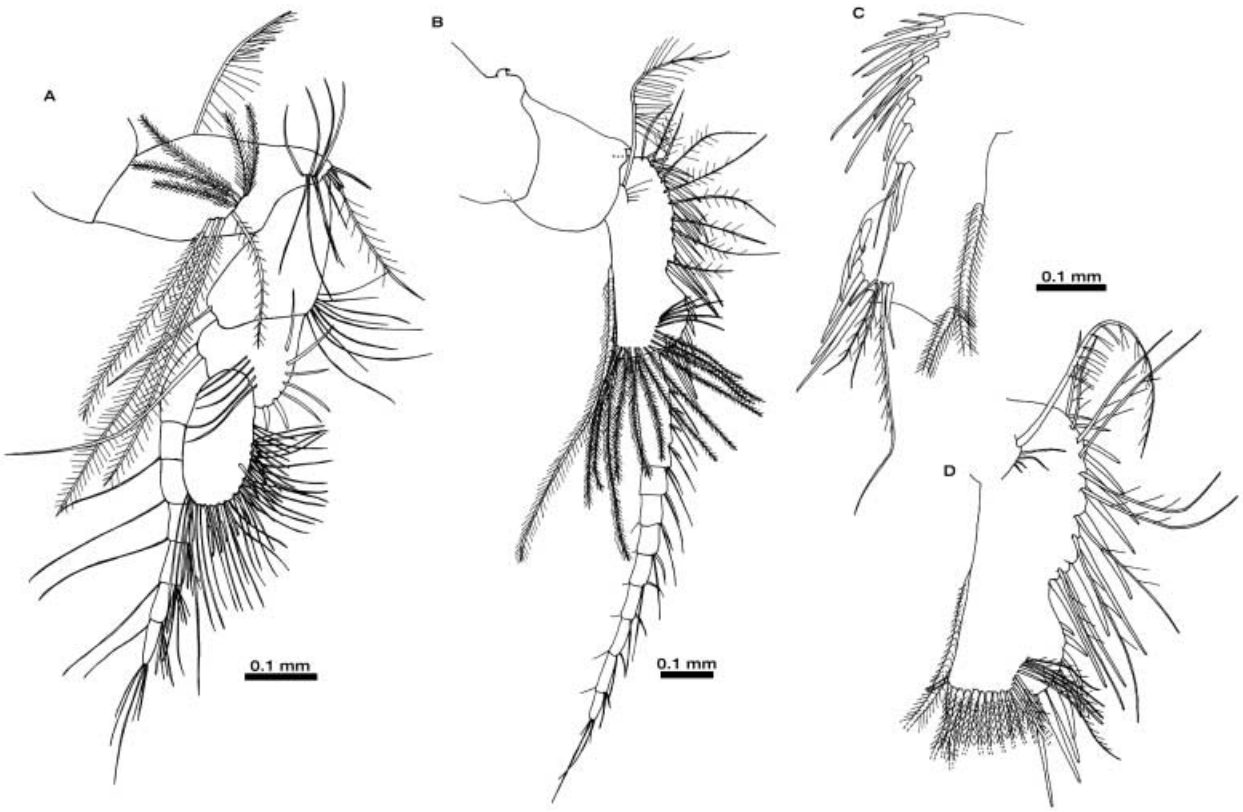

Figure 2. *Nebalia troncosoi* sp. nov.: (A) antennule, lateral view; (B) antenna, lateral view; (C) antenna, third article, left side, lateral view; (D) antenna, third article, right side, lateral view. C–D: same scale bar.

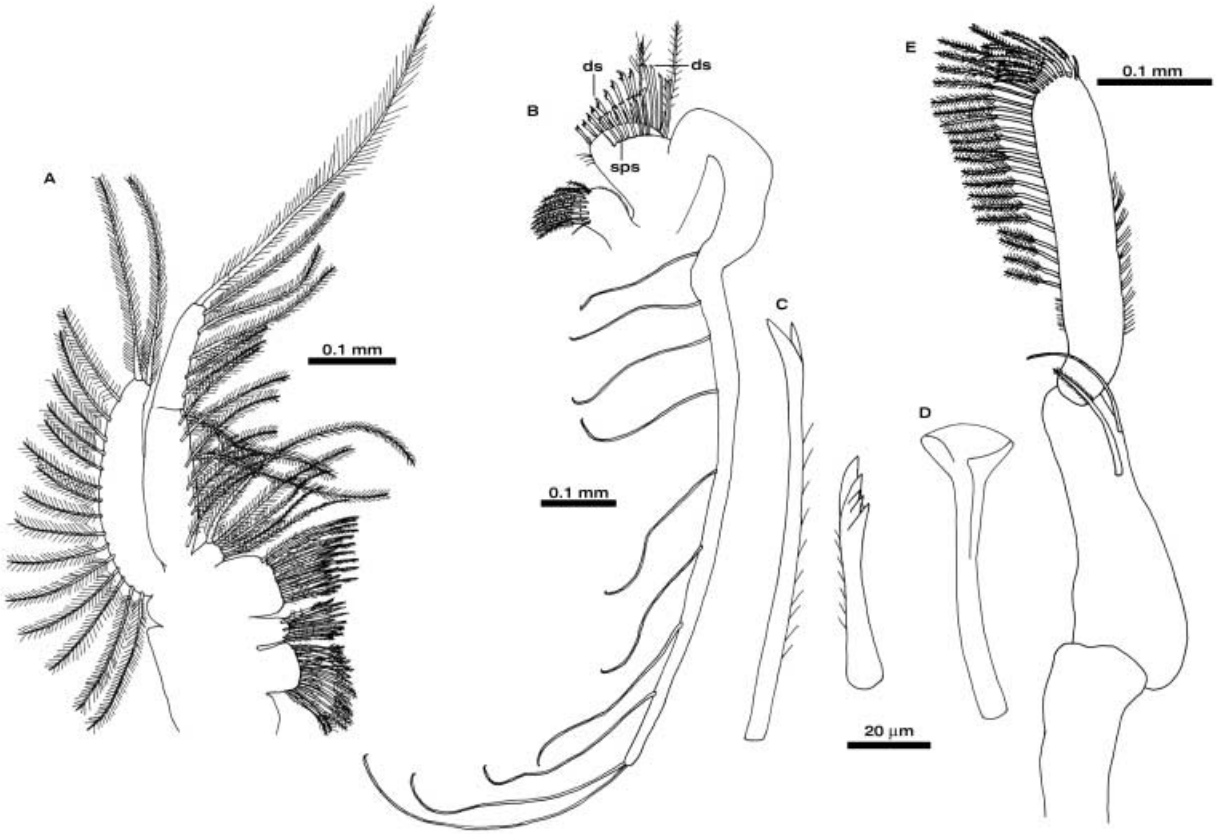

Figure 3. *Nebalia troncosoi* sp. nov.: (A) second maxilla; (B) first maxilla; (C) first maxilla, denticulate setae of distal endite; (D) first maxilla, spatulate setae of distal endite; (E) mandibular palp. C–D: same scale bar. ds, denticulate setae; sps, spatulate setae.

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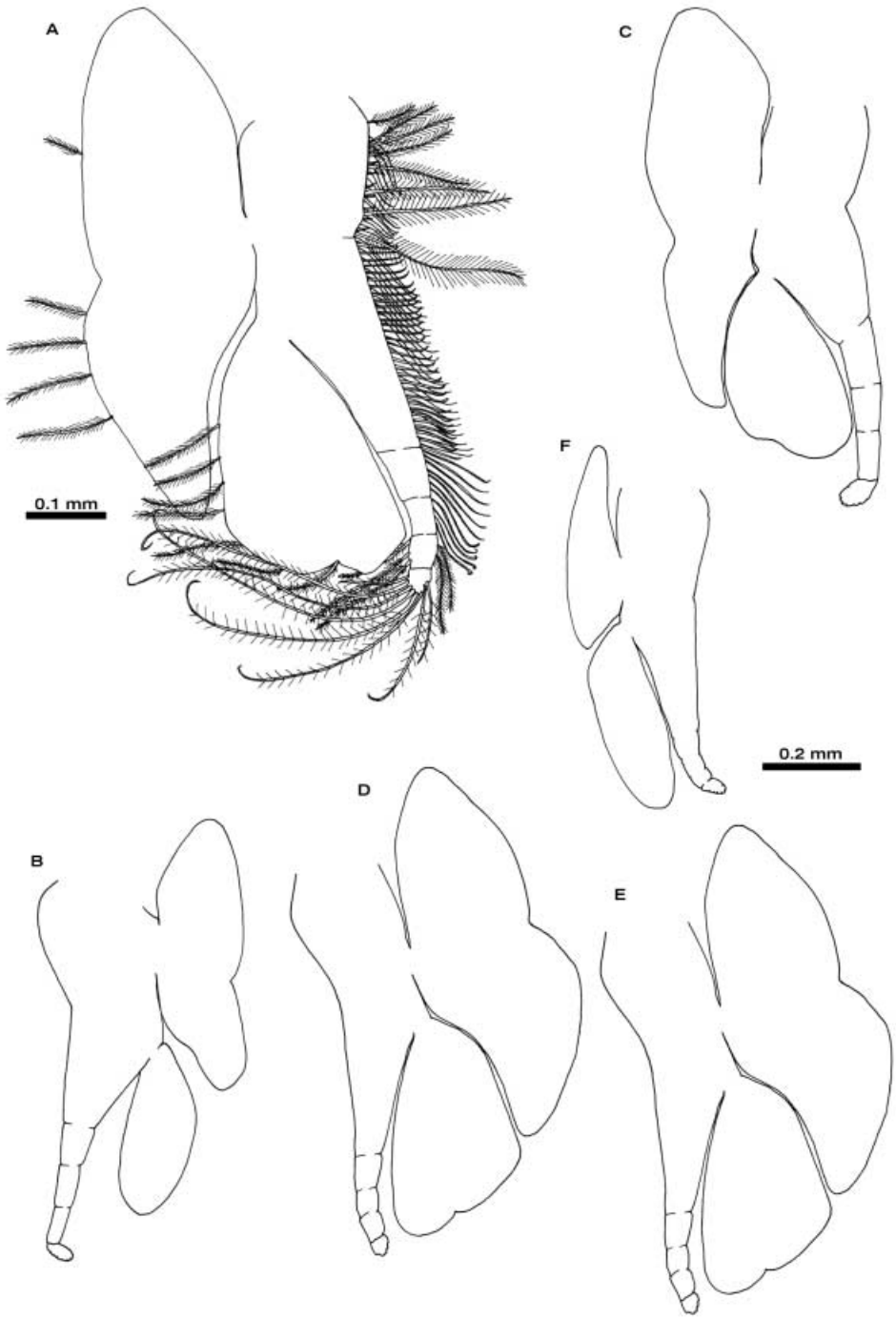

Figure 4. *Nebalia troncosoi* sp. nov.: (A) thoracopod 5, showing setation; (B) thoracopod 1; (C) thoracopod 2; (D) thoracopod 3; (E) thoracopod 7; (F) thoracopod 8. B–F: same scale bar.

January 1997, 4 females, 7 juveniles; February 1997, 4 juveniles. Ensenada de Baiona, 42°8′50″N 8°49′44″W, 4 m, muddy sand, December 1995: 5 females, 1 subadult male, 10 juveniles. Ensenada de Baiona, 42°8′30″N 8°50′15″W, 11 m, muddy sand, December 1995: 8 females, 1 subadult male, 19 juveniles. Ensenada de Baiona, 42°8′30″N 8°49′44″W, 7 m, muddy sand, December 1995: 2 subadult males, 5 juveniles. Ensenada de Baiona, 42°8′30″N 8°49′13″W, 3 m, fine sand, December 1995: 6 females, 4 subadult males, 11 juveniles. Ensenada de Baiona, 42°8′10″N 8°49′44″W, 8 m, muddy sand, December 1995: 5 females, 2 subadult males, 5 juveniles. Ensenada de Baiona, 42°8′10″N 8°49′13″W, 3 m, muddy sand, December 1995: 10 females, 1 subadult male, 13 juveniles. Ensenada de Baiona, 42°7′50″N 8°49′44″W, 9 m, medium sand, December 1995: 2 juveniles. Ensenada de Baiona, 42°7′50″N 8°49′13″W, 4 m, fine sand: December 1995, 9 females, 3 subadult males; February 1996, 1 juvenile; March 1996, 3 juveniles; April 1996, 1 postovigerous female, 3 juveniles; May 1996, 1 juvenile; October 1996, 5 females, 1 subadult male, 5 juveniles; January 1997, 8 females, 9 juveniles. Ensenada de Baiona, 42°7′30″N 8°50′15″W, 7 m, muddy sand: December 1995, 2 juveniles; February 1996, 5 females, 3 juveniles; March 1996, 3 females, 4 juveniles; April 1996, 5 juveniles; May 1996, 1 male; June 1996, 1 female; July 1996, 10 juveniles; September 1996, 1 female, 3 juveniles; November 1996, 2

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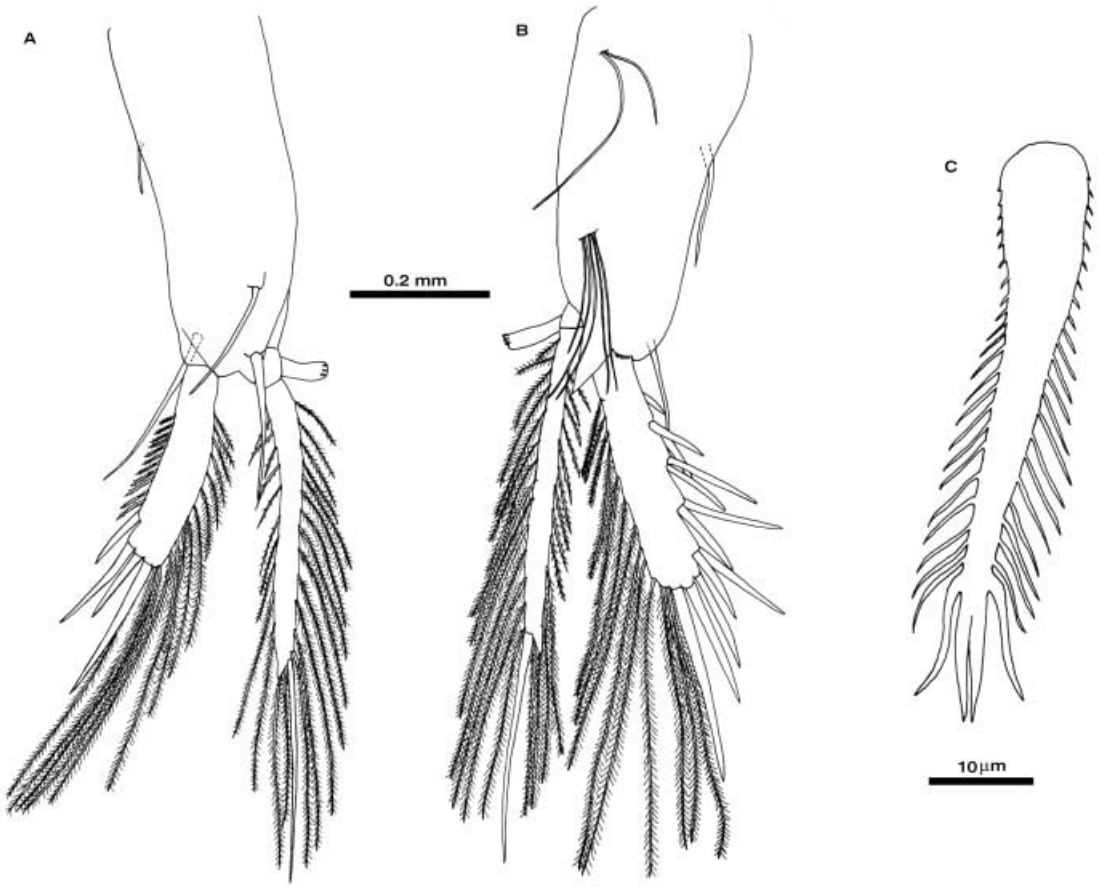

Figure 5. *Nebalia troncosoi* sp. nov.: (A) first pleopod, ventral view; (B) second pleopod, ventral view; (C) first pleopod, serrate spine. A–B: same scale bar.

females, 2 juveniles; December 1996, 2 subadult males, 2 juveniles; January 1997, 2 juveniles. Ensenada de Baiona, 42°7′30″N 8°49′44″W, 8 m, fine sand, December 1995: 5 females, 1 juvenile. Ensenada de Baiona, 42°7′10″N 8° 49′44″W, 3 m, sandy mud, December 1995: 2 juveniles. Ensenada do Grove (Galicia, north-west Spain), 42°29′ 45″N 8°50′15″W, 8 m, muddy sand with *Z. marina*, December 1996: 22 females, 1 subadult male, 34 juveniles.

Type locality

Ensenada de Baiona (Galicia, north-west Spain), 42°7′30″N 8°50′15″W, 7 m, muddy sand (Q_{50}: 0.24), % silt–clay: 6.2, % carbonates: 72.9, % organic matter: 3.17.

Diagnosis of female

Eye oval, tapering slightly distally, with 2–3 small distal lobes; ommatidia present at least in distal half; supraorbital plate covering proximal half of eye dorsally. Rostrum long, about 2.7–2.9 times as long as wide. Antennular flagellum with up to seven segments. Exopod of second maxilla longer than first article of the endopod. Postero-lateral border of fourth pleonite with rounded denticles; postero-lateral corner acute. Protopod of fourth pleopod with several crenulations along posterior border, ending in acute tooth at postero-lateral corner. Pleonites 6–7 with distally acute denticles along dorsal posterior borders. Pleopods 5–6 with four large disto-lateral spines. Caudal furca equal to or slightly shorter than telson and pleonite 7 combined.

Description of female

Largest female 4.6 mm TL, 1.6 mm DCL, 2.3 mm LCL and 0.75 mm RL. Carapace oval or with a rounded shape, covering neither dorsally nor laterally fourth pleonite (Figure 1A).

Rostrum: long, about 2.7–2.9 times as long as wide, tapering slightly distally (Figure 7A); ventral keel with slightly protruding anterolateral borders and anterior depression where supraorbital plates fit in (Figure 1D,E).

Compound eye: oval, with 2–3 small distal lobes protruding from eye surface, more conspicuous in immature specimens (Figure 1C); ommatidia present at least in distal half; supraorbital plate with acute tip, extending to approximately half length of eye.

Antennule: peduncle four-segmented (Figure 2A). Second article widest at midpoint, about 2.3 times as long as wide, with plumose seta dorsally at midpoint, cluster of lateral plumose setae, and several plumose and smooth setae distally. Third article shorter than second, widest distally, with dorsal cluster of setae distally and isolated ventral long seta placed distally. Fourth segment shorter

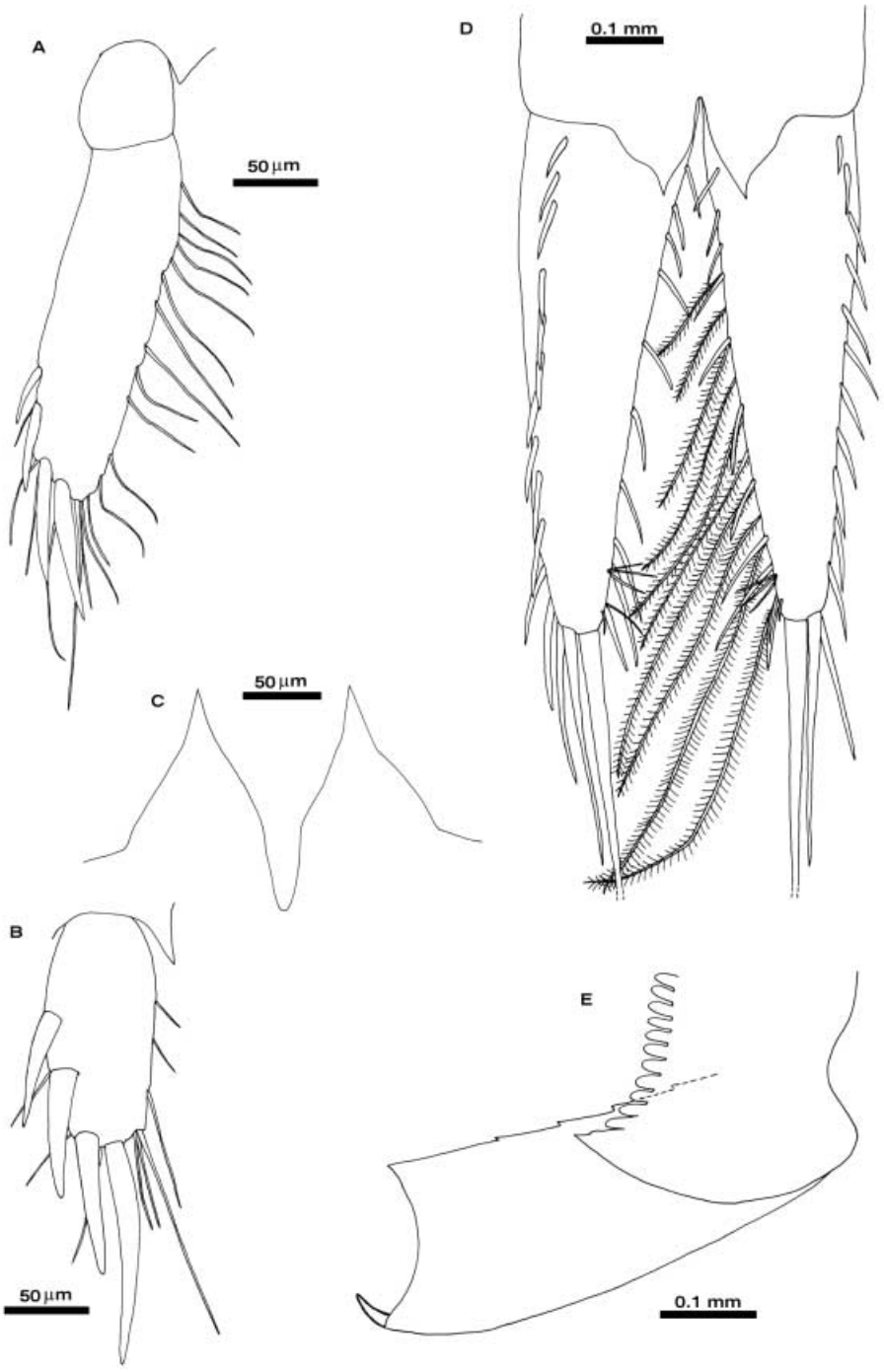

Figure 6. *Nebalia troncosoi* sp. nov.: (A) fifth pleopod, ventral view; (B) sixth pleopod, ventral view; (C) anal scales; (D) caudal furca, ventral view (plumose setae not figured in right ramus); (E) fourth pleopod, protopod, lateral view.

than third, with two clusters of dorsal and lateral setae including 1–2 stout spines distally, and additional long ventral seta placed distally. Antennular scale oval, about twice as long as wide, with several rows of setae along dorsal margin: long naked setae, stout serrate setae with coarse teeth, and thinner setae with sharp teeth (Figure 7B). Flagellum short, about half length of peduncle, with up to seven articles in mature females (of a series of N=25 of the largest females), each article with several aesthetascs and distal setae.

Antenna: peduncle three-segmented (Figure 2B). First article with small dorsal tooth placed distally. Second article with a dorsal tooth, larger than that of first article. Third article longer than second, about three times as long as wide; with several spines and smooth and plumose setae along dorsal margin; plumose seta placed proximally on lateral margin, long ventral plumose seta subdistally, and row of about 12–14 plumose setae distally (Figure 2C,D). Flagellum well-developed, as long as peduncle; with about nine articles in mature females, each article with several distal setae and spine-like setae (Figure 7C).

Mandible: palp well-developed, three-segmented (Figure 3E). First article shorter than second. Second article with two setae in distal third, distal seta smooth and proximal

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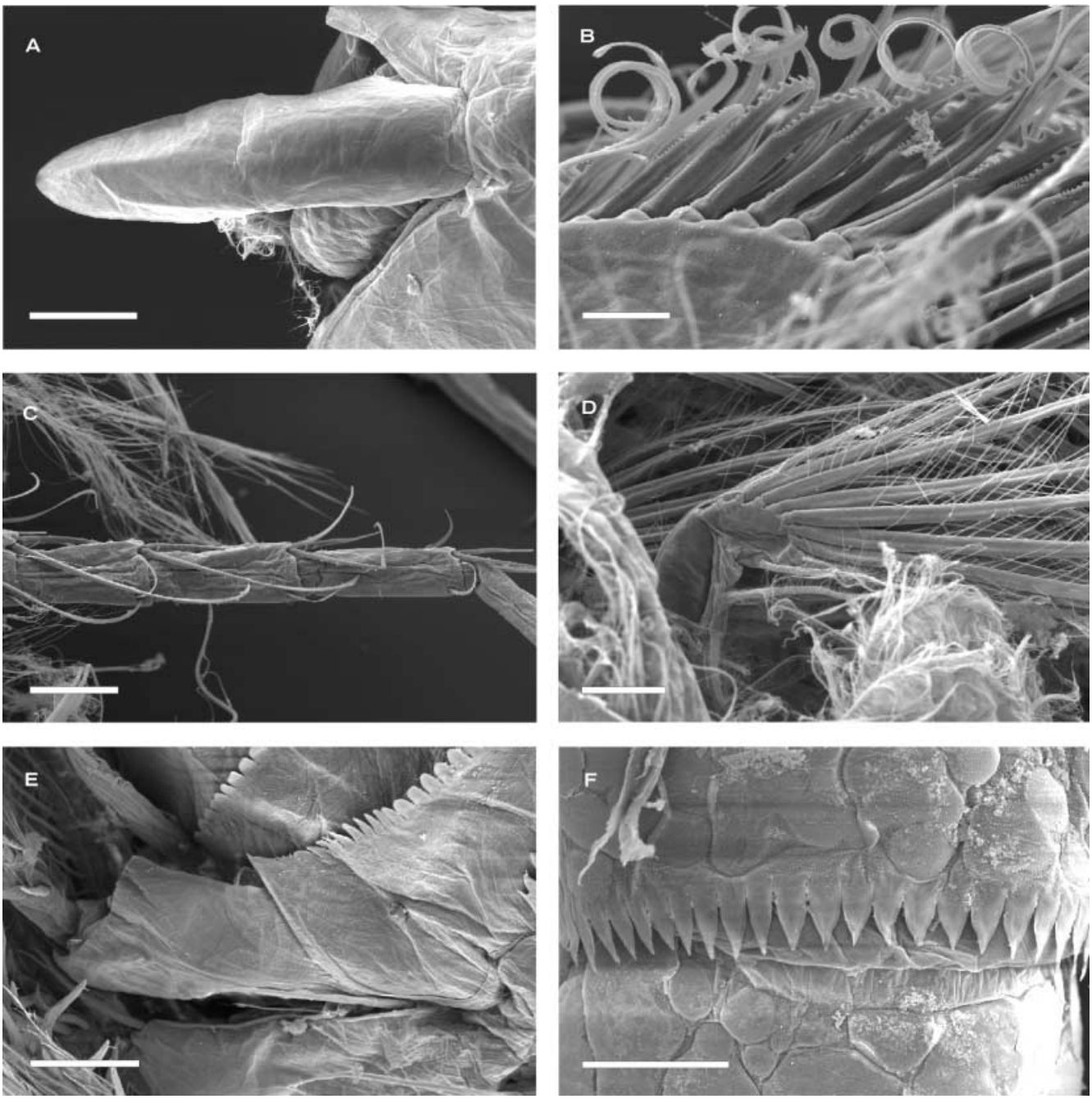

Figure 7. *Nebalia troncosoi* sp. nov., scanning electron microscope micrographs: (A) rostrum, dorsal view; (B) antennular scale, serrate setae; (C) antennular flagellum, detail; (D) thoracopod, distal end of endopod; (E) fourth pleonite, postero-lateral border; (F) pleonite 7, dorsal denticles. Scale bars: A, 0.2 mm; B, 20 μm; C–D, 50 μm; E–F, 0.1 mm.

setulose. Third article equal to or slightly longer than second, with parallel margins, not expanding distally; with marginal row of setae bearing lanceolate setules, begining at the end of proximal third and extending to tip; distal border with shorter row of stouter setae with lateral serrulations.

First maxilla: protopod with two endites (Figure 3B); first endite with plumose setae; second endite larger than first, with setae arranged in two rows comprising about two setulose, seven spatulate and 14 distally denticulate setae (Figure 3C,D). Palp well-developed, about five times the length of protopod, with long and spaced setae.

Second maxilla: protopod with four endites bearing setulose setae, endites one and three the largest (Figure 3A). Endopod longer than exopod, two-segmented, the proximal article about 1.5 times as long as distal one; exopod clearly surpassing the articulation between the two articles of endopod. All endites, exopod and endopod with plumose setae. Terminal seta of distal segment of endopod longer than the entire ramus.

Thoracopods (Figure 4): endopod slightly longer than exopod, weakly segmented in the last third, distal segment with long plumose setae (Figure 7D). Exopod with some plumose setae along ventral and lateral margins. Epipod

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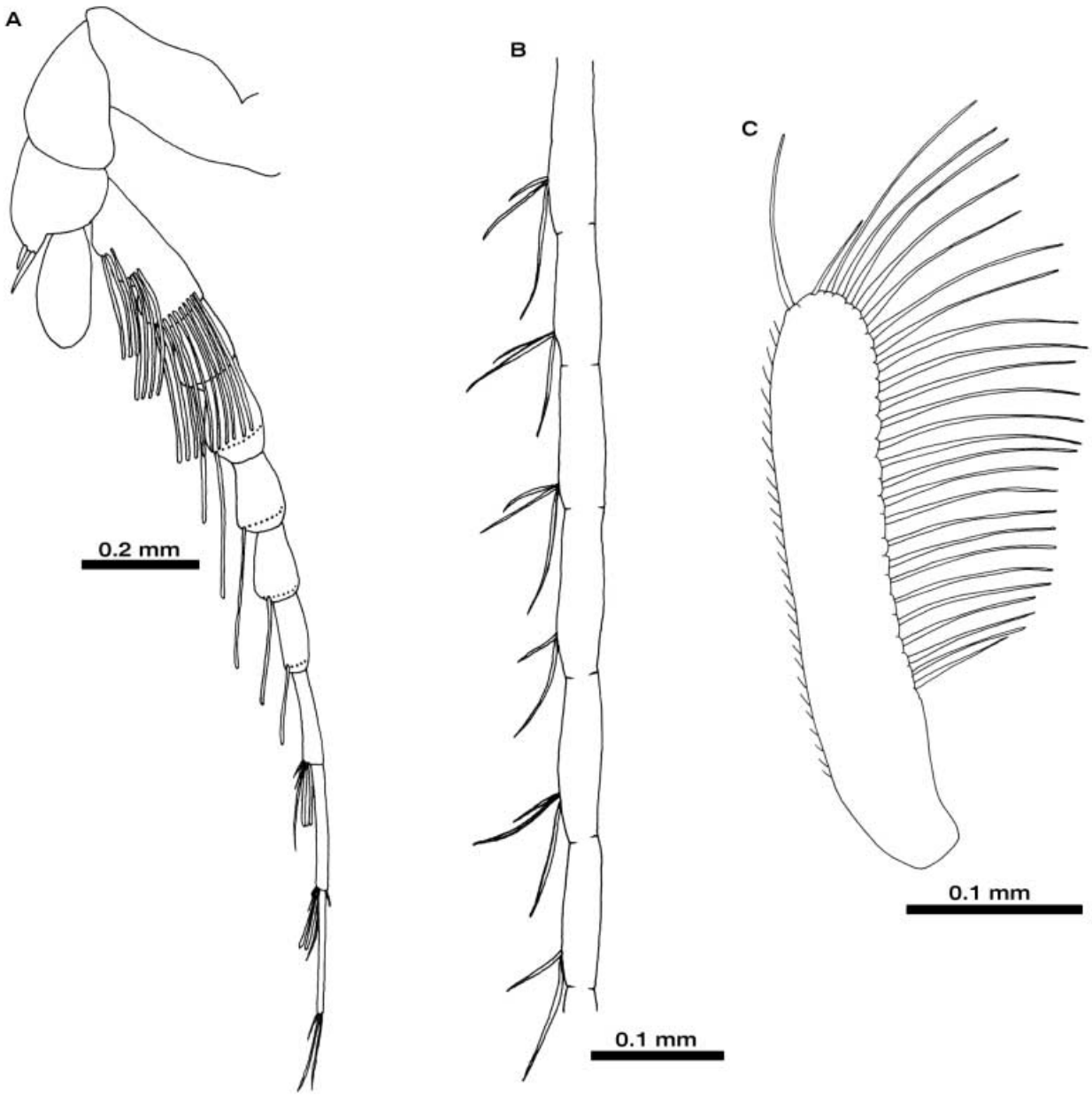

Figure 8. *Nebalia troncosoi* sp. nov., male allotype: (A) antennular flagellum (only part of setation and aesthetascs figured); (B) antennal flagellum, detail; (C) mandibular palp, third article (setules not figured).

more or less bilobed, except that of thoracopod 8 which is also reduced in size.

Pleonites: posterior border of first pleonite lacking denticles. Second pleonite bearing distally rounded denticles along postero-dorsal border. Third pleonite with distally rounded denticles along dorsal and lateral posterior border. Fourth pleonite with distally rounded denticles along postero-lateral border, postero-lateral corner acute (Figures 6E & 7E). Pleonite 5 with distally rounded denticles along posterior border; some specimens with distally acute denticles on postero-dorsal border. Pleonites 6–7 with distally acute denticles on postero-dorsal border, becoming rounded along lateral and ventral posterior border (Figure 7F).

First pleopod (Figure 5A): exopod about 0.6 times as long as protopod, with row of about 9–15 short serrate spines along lateral border (Figure 5C), four stout smooth spines on disto-lateral border, and long plumose setae along medial margin. Endopod two-segmented, longer than exopod; distal segment with plumose setae along lateral and medial margins and long terminal spine; basal segment with appendix interna. Protopod with three basal spines: long spine located subdistally, thicker spine between the two rami, and long spine near the base of exopod, almost reaching the distal end of spine row of exopod; posterior margin even.

Second pleopod (Figure 5B): protopod with several lateral and subdistal setae, acute triangular process between exopod and endopod, and spine next to exopod base; posterior

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margin even. Exopod without row of stout spines, instead with row of spine pairs, each pair consisting of one long and one shorter spine; medial margin with long plumose setae, three distal spines, the terminal one the longest. Endopod longer than exopod, two-segmented; distal segment with plumose setae along lateral and medial borders, ending in long spine.

Pleopods 3–4: similar to second pleopod. Protopod of third pleopod with posterior margin even; protopod of fourth pleopod with posterior margin crenate (Figure 6E).

Fifth pleopod (Figure 6A): uniramous, two-segmented; distal article 3.6 times as long as wide, with four stout spines along disto-lateral and terminal border, increasing in length distally, and with several simple setae along medial and distal border. Acute triangular process between both pleopods.

Sixth pleopod (Figure 6B): uniramous, one-segmented; with four stout spines along disto-lateral and terminal border, increasing in length distally, and with several setae along medial, lateral and terminal borders. Acute triangular process between both pleopods.

Telson, anal scales and furca: anal scales acutely pointed, with no distinct lateral 'shoulder' (Figure 6C). Telson as long as pleonite 7. Furcal rami tapering distally (Figure 6D), approximately equal to or shorter than telson and pleonite 7 combined, bearing 10–15 acute spines along lateral margin and 8–10 along medial margin, with plumose setae on medial margins; distally two long spines, the terminal one twice the length of the furcal rami.

Colour: fixed animals are whitish or more or less transparent, with dark pigment in eye.

Male

Males are relatively common in samples obtained during the month of December (Figure 1B). Adult male has a longer antennule than that of the female, with up to nine articles bearing longer aesthetascs (Figure 8A). Antennal flagellum long, with more than 60 articles, and surpassing the tip of furcal rami (Figures 1B & 8B). Both eye and furcal rami are comparatively longer than those of the female, the latter being clearly longer than pleonite 7 and telson combined. The carapace is less rounded than in female (Figure 1B) and dorsally covers second pleonite and laterally part of third and fourth pleonites. The third article of mandibular palp lacks the distal row of stout setae with lateral serrulations present in females (Figure 8C).

Habitat

The new species is relatively common in muddy sand and fine sand bottoms (Q_{50}: 0.096–0.24), in some localities with sea grass *Zostera marina* L., at depths of between 3 and 11 m. In these bottoms, the percentage of the silt–clay fraction ranges from 3.0 to 15.5, the carbonate content from 18.4 to 75.3%, and the organic matter content from 1.45 to 3.7%. The benthic community is characterized by the presence of the following species: the polychaetes *Spiophanes bombyx* (Claparède, 1870), *Spio decoratus* Bobretzky, 1871, *Prionospio fallax* Söderström, 1920, *Galathowenia oculata* (Zaks, 1922), *Euclymene oerstedii* (Claparède, 1863), and *Chaetozone* cf. *setosa* Malmgren, 1867, the bivalves *Angulus tenuis* (da Costa, 1778), *Fabulina fabula* (Gronovius, 1781) and *Mysella bidentata* (Montagu, 1803), and the amphipod *Perioculodes longimanus* (Bate & Westwood, 1868). Several specimens of the new species have also been collected in medium sand (Q_{50}: 0.032; % silt–clay: 3.16; % carbonates: 80.35; % organic matter: 2.18) and sandy mud bottoms (Q_{50}: 0.064; % silt–clay: 49.2; % carbonates: 4.36; % organic matter: 2.82).

Distribution

To date, *Nebalia troncosoi* sp. nov. is only known from the Galician coast (Ensenada de Baiona, Ensenada do Grove).

Etymology

We are pleased to name the new species after Dr Jesús S. Troncoso, director of our research group and eminent malacologist, who gave us the opportunity to research in the field of marine biology.

Remarks

To date, five species belonging to the genus *Nebalia* have been recorded from the European coasts (Dahl, 1985): *N. bipes* (Fabricius, 1780), *N. borealis* Dahl, 1985, *N. herbstii* Leach, 1814, *N. strausi* Risso, 1826, and *N. clausi* Dahl, 1985. *Nebalia troncosoi* sp. nov. differs from *N. bipes*, *N. herbstii* and *N. clausi* in having acute denticles along the postero-dorsal border of pleonites 6–7 rather than having rounded ones. Mature females of *N. borealis* and *N. strausi* have a longer antennular flagellum which bears up to 11–12 articles unlike mature females of *N. troncosoi* sp. nov., which bear up to seven articles. Additionally, *N. borealis* has a nearly triangular rostrum, wider basally than that of *N. troncosoi* sp. nov, and *N. strausi* has a second maxilla with an exopod slightly longer than the first article of the endopod, while in *N. troncosoi* sp. nov. the exopod of the second maxilla is clearly longer than the first article of the endopod.

Nebalia daytoni Vetter, 1996, from California has a similar external body appearance as *N. troncosoi* sp. nov., a long rostrum, a short antennular flagellum with up to six articles, acute denticles on pleonites 6–7, and anal scales without distinct lateral 'shoulder', but differs from *N. troncosoi* sp. nov. in having a different eye shape, a supraorbital plate longer than the eye, a long plumose seta on the second article of the mandibular palp, and a second maxilla with an exopod not surpassing the articulation between the two articles of endopod. *Nebalia marerubri* Wägele, 1983, from the Red Sea, *N. antarctica* Dahl, 1990, from Antarctica, *N. lagartensis* Escobar-Briones & Villalobos-Hiriart, 1995, from Yucatán, *N. hessleri* Martin, Vetter & Cash-Clark, 1996, and *N. gerkenae* Haney & Martin, 2000, from California, and *N. brucei* Olesen, 1999, from Zanzibar, also possess acute denticles on pleonites 6–7, but all these species have an antennular flagellum that bears ten or more articles. *Nebalia longicornis* Thomson, 1879, *N. capensis* Barnard, 1914, *N. ilheoensis* Kensley, 1976, *N. cannoni* Dahl, 1990, *N. falklandensis* Dahl, 1990, and *N. patagonica* Dahl, 1990, from the Southern Hemisphere, differ from *N. troncosoi* sp. nov. in having distally blunt denticles on pleonites 6–7. Besides, *N. longicornis*, *N. cannoni*, *N. falklandensis* and *N. patagonica* possess an eye dorsal papilla which is not present in *N. troncosoi* sp. nov.

The recently described *N. schizophthalma* Haney, Hessler & Martin, 2001, from deep waters off the east coast of the USA, also possesses a short antennular flagellum and acute denticles on pleonites 6–7 like *N. troncosoi* sp. nov., but the former can be distinguished from any known member of the genus in having the distal margin of the eye invaginated medially, giving it a bilobed appearance.

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