# *Nitocrella longa* n. sp. (Crustacea, Copepoda, Harpacticoida) from Subterranean Waters of Montenegro (SE Europe)

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With 25 figures

## Abstract

A new species of the genus *Nitocrella* Chappuis, 1924 is described. *N. longa* n. sp. was collected in three caves in the central and southern part of Montenegro, and belongs to the "*hirta*"-group. It is remarkably similar to *N. tirolensis* Kiefer, 1963 comb. n., but there are clear distinguishing features.

**Key words:** Taxonomy, Copepoda, *Nitocrella*, Montenegro, Balkan Peninsula.

## Introduction

Chappuis (1924) established the genus *Nitocrella* from both sexes of *N. hirta*, which he described from two different localities in Serbia. The first revision of that genus was made by Lang (1965), when three new genera were established: *Paraleptomesochra*, *Pseudoleptomesochrella*, and *Parapseudoleptomesochra*. After that Petkovski (1976) reviewed the systematics of the genus *Nitocrella* Chappuis s.l., and two new genera were separated: *Stygonitocrella* and *Nitocrellopsis*. In that review he divided the genus *Nitocrella* Chappuis s. str. into the following groups, according to the setation of the terminal segment of the P4 exopodite: the "*vasconica*"-group (with 6 setae), the "*chappuisi*"-group (with 5 setae), and the "*hirta*"-group (with 3 or 4 setae on the terminal segment of P4 exopodite).

The "*hirta*"-group is the smallest one, and quite homogeneous, both from a systematic and biogeographical point of view. Petkovski (1976) cited eight species and subspecies in the "*hirta*"-group, although he did not recognize (we think correctly) two subspecies of *N. hirta* which were described earlier (*N. h. bucarestiensis* Damian & Botosaneanu, 1954, and *N. h. caucasica* Borutzky, 1967). The "*hirta*"-group now includes 17 species, all from south and central Europe, and from the Caucasus. At the end of this paper there is a key for its determination.

During an investigation of the copepod fauna in Montenegro, one undescribed species of the genus *Nitocrella* was identified. This new species, which belongs to the "*hirta*"-group of species, is herein described as *N. longa* n. sp.

## Methods

Samples were collected with different types of hand-nets and little rubber pumps. The material was preserved by adding several drops of 36% formaldehyde, and washing it very soon after that, and copepods were separated and removed into 70% ethanol. Specimens were dissected in a mixture of distilled water and glycerol (1:1), with fine entomological needles. All drawings have been prepared using a drawing attachment on a Leica DMLS brightfield microscope with C-PLAN achromat objectives. Dissected appendages were preserved in Faure's medium which is prepared following the old procedure, recently discussed by Stock & Vaupel-Klein (1996). Non-dissected specimens were, after examination, again preserved in 70% ethanol.

Abbreviations used in the text, key, and figures are: GS – genital somite; Fu – furca; A1 – antennula; A2 – antenna; Md – mandible; Mxl – maxillula; Mx – maxilla; Mxp – maxilliped; P1 – first leg; P2 – second leg; ... P6 – sixth leg; Enp – endopodite; Exp – exopodite; Enp2P3 – second endopodite article of the third leg.

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Received November 1998, accepted March 1999

## Systematics

### *Nitocrella longa* n. sp.

Material examined. 1) Holotype (female, 0.886 mm), allotype (male, 0.81 mm), and 18 paratypes (5 females, 6 males, and 7 copepodids) from the Sutimska Jama cave (type locality) near the town of Podgorica, Montenegro, coll. T. Karanovic, 18 September 1997. Another 17 topotypes (6 females, 7 males, and 4 copepodids) from the same locality, coll. T. Karanovic, 3 February 1997.

2) One male from the Ivanina Spilja cave near the village Donja Seoca on the mountain Rumija, south Montenegro, coll. T. Karanovic, 4 February 1997.

3) One female from the Sopot cave near the village Risan on Adriatic Coast, Montenegro, coll. T. Karanovic, 8 June 1997.

Holotype, allotype, and two paratypes (male and female) are deposited in the Museum für Naturkunde in Berlin. All other specimens are deposited in the author's collection in Kotor, Montenegro.

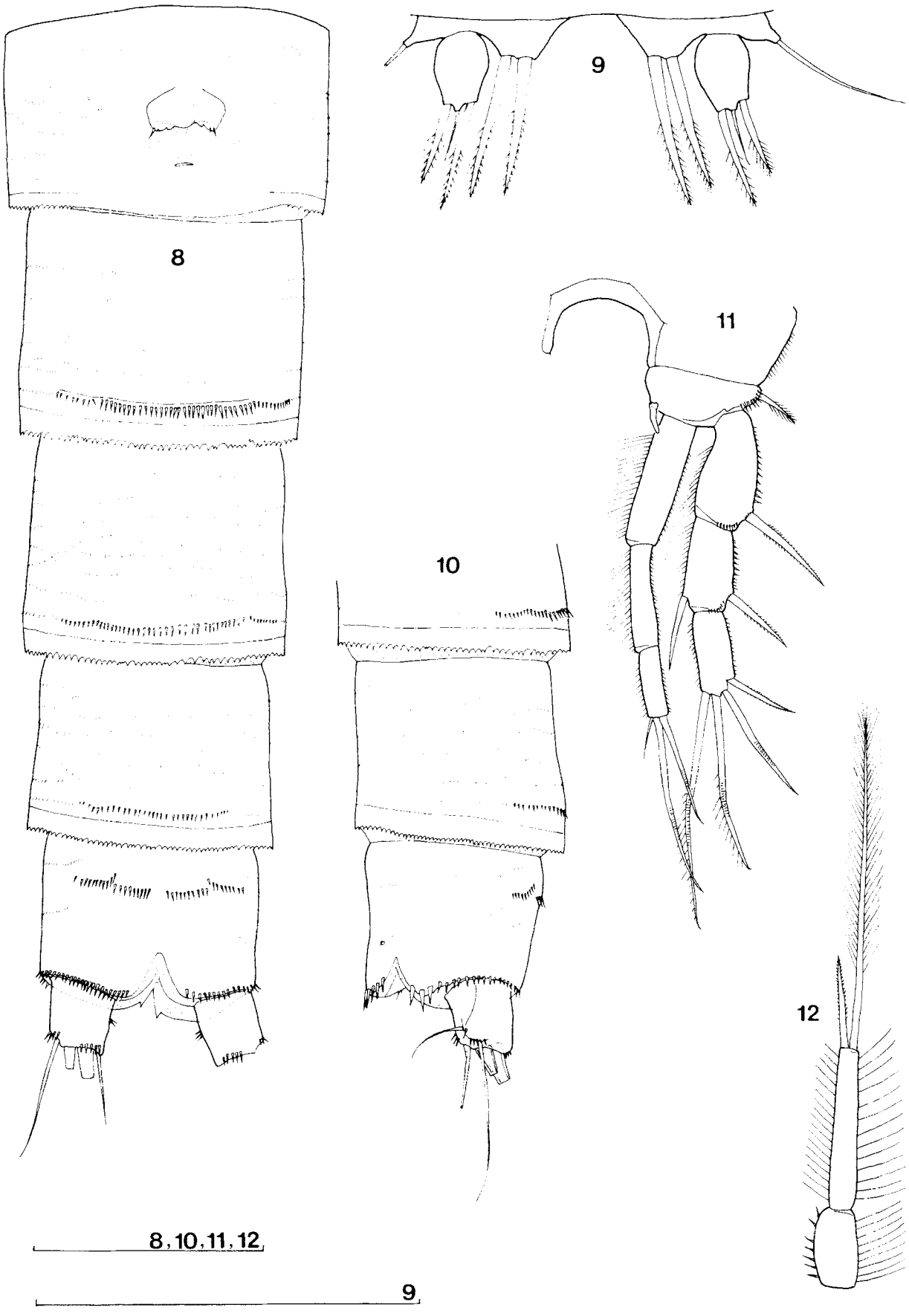
Description. **Female (holotype).** Body length, including furcal rami (but excluding furcal setae), is 0.886 mm. Body elongated, subcylindrical (cephalothorax is almost twice the width of the abdomen), colourless, and without nauplius eye (Fig. 2). Hind margins of cephalothorax and thoracic somites are smooth. Hind margins of abdominal somites clearly serrated both on ventral and dorsal surfaces. Each abdominal somite with many rows of small hairy spinules (Figs 8, 10). GS is about 1.6 times wider than long, without a transverse row of spines ventrally, and with characteristic genital field (Fig. 8). Second, third, and fourth abdominal somites with transverse rows of spines ventrally on the distal part. Anal somite with interrupted row of cuticular spines ventrally on the proximal part, and at the base of the furcal rami. Anal operculum concave, with 12 strong spines on its margin, and it does not reach beyond distal margin of anal somite (Fig. 1). Caudal rami divergent, as long as wide, with 1 oblique row of spines on the inner margin, and with complete armature (2 lateral, 3 apical, and 1 dorsal seta). Dorsal seta is attached almost at the end, and it is very long (about 1.5 times longer than anal somite and Fu together). There are 4 cuticular spines at its base. Inner apical seta is a little longer than caudal ramus, while middle and outer apical setae are very long and strong. Distal lateral seta is situated almost subapically, and there are 3 spines at its base. Proximal larteral seta is moved to the dorsal side, with 1 spine at the base (Fig. 1). A1 is 8-segmented, with aesthetasc on fourth segment, reaching beyond the top of the distal segment for more than a length of penultimate and terminal segments together (Fig. 7). Its fourth segment is almost 2.5 times longer than wide. A2 is very elongated, with 1-segmented exopodite, which is armed with 1 apical and 2 subapical setae (Fig. 4). The inner seta is plumose; other 2 are naked. Basipodite and first endopodite segments of A2 without armature, and with only a few hairs on the outer margins. Md with very elongated praecoxa, and 2-segmented palp, armed with 1 very strong subapical seta on the first segment, and four apical setae on the second (Fig. 6). Syncoxa of Mx with 2 endites of which proximal bearing 2, while distal bearing 3 setae; basipodite with 1 strong seta; endopodite reduced to a tubercule with two apical setae (Fig. 5). Basipodite of Mxp with 1 plumose seta on distal-inner corner; first endopodite segment with row of spinules and 3 hairs on the outer margin; second segment with a strong, recurved thorn and 1 smooth seta (Fig. 3). All swimming legs with 3-segmented exopodites, as well as endopodite of P1, while endopodites of P2, P3, and P4 are 2-segmented. Spine and setal formula on exo- and endopodites P1–P4 (legend: inner/outer spine or seta; inner/terminal/outer):

| | Exp | | | Enp | | |
|---|---|---|---|---|---|---|
| Segments | 1 | 2 | 3 | 1 | 2 | 3 |
| P1 | 0/1 | 1/1 | 0/2/2 | 0/0 | 0/0 | 1/2/0 |
| P2 | 0/1 | 1/1 | 0/2/2 | 0/0 | 0/2/0 | – |
| P3 | 0/1 | 1/1 | 0/2/2 | 0/0 | 0/2/0 | – |
| P4 | 0/1 | 1/1 | 0/2/2 | 0/0 | 0/2/0 | – |

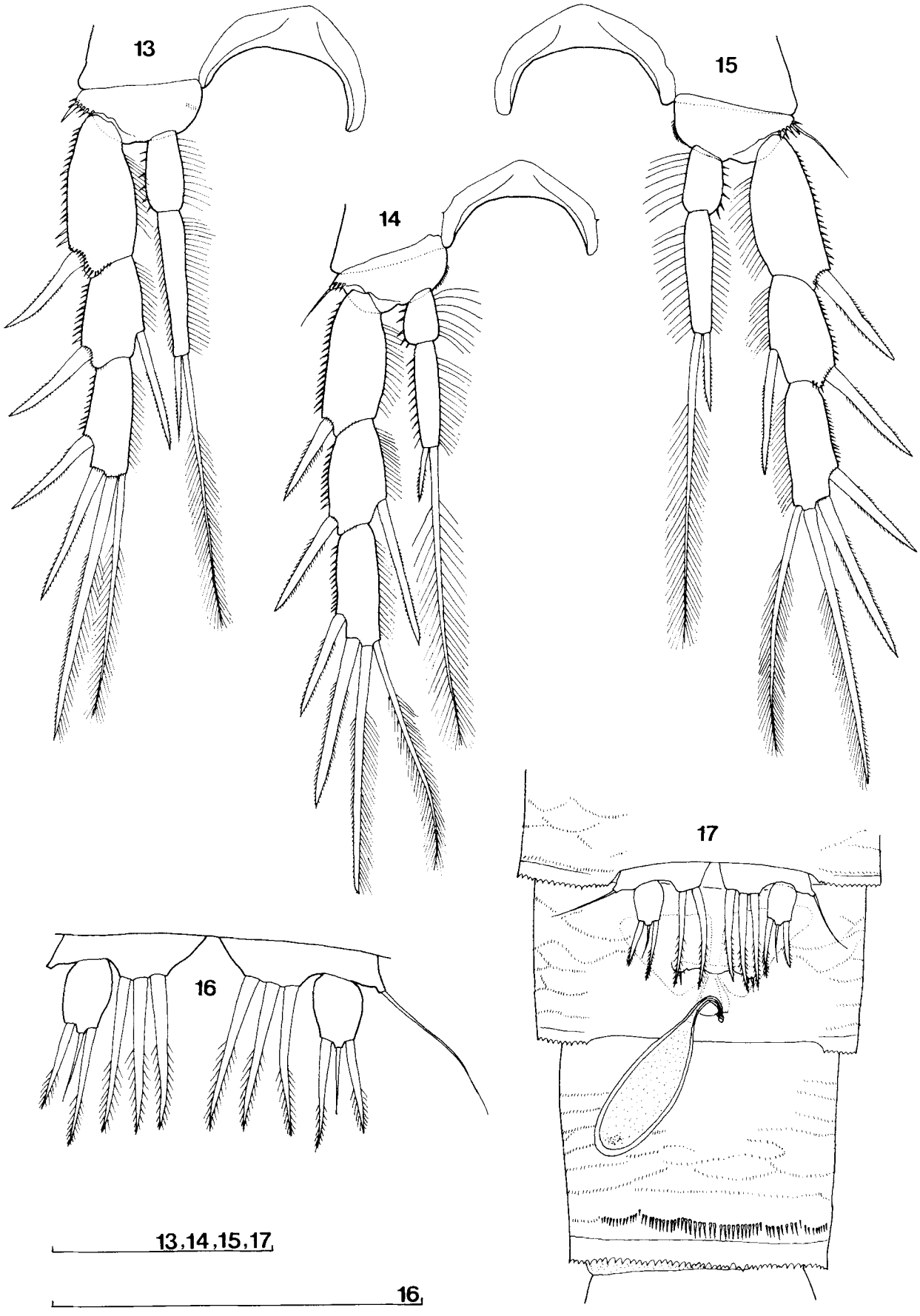
Basipodite of P1 with 1 short and obtuse spine on inner-distal corner, as well as 1 plumose spine on outer margin (Fig. 11). Endopodite is longer than exopodite, and very slender (first endopodite segment is 3.3 times longer than wide; second one even 4 times). Endopodite of P2 reaches to the end of the second exopodite article, and it is very slender (Fig. 13). Second endopodite segment is twice as long as the first one, and almost 5.5 times as long as wide. Endopodites of P3 and P4 reach to the middle of the second exopodite segments (Fig. 14 and 15). Also, their second endopodite segment is twice as long as the first one. Intercoxal plates of all swimming legs are convex and smooth. Basiendopodite of P5 protrudes only slightly, bearing 2 strong and plumose setae (Fig. 9). Exopodite oviform, bearing 3 apical setae, of which the middle one is short, thin, and naked, while the other 2 are strong and plumose.

**Male (allotype).** Body length is 0.81 mm. Body similar to female in general appearance, slightly slender (Fig. 21). Hind margins of fifth


Figs 1–7. *Nitocrella longa* n. sp., holotype (female, 0.886 mm): 1 – last abdominal somite and furcal rami, dorsal view; 2 – dorsal view; 3 – Mxp; 4 – A2; 5 – Mx; 6 – Md; 7 – A1. Scales = 0.1 mm.




Figs 8–12. *Nitocrella longa* n. sp., 8–11. holotype (female, 0.886 mm); 12. paratype (female, 0.892); 8 – abdomen, ventral view; 9 – P5; 10 – abdomen, lateral view; 11 – P1; 12 – EnpP2. Scales = 0.1 mm.




Figs 13–17. *Nitocrella longa* n. sp., 13–15, holotype (female, 0.886 mm); 16, paratype (female, 0.915 mm); 17, paratype (female, 0.892 mm): 13 – P2; 14 – P4; 15 – P3; 16 – P5; 17 – first two abdominal somites with P5 and attached spermatophore. Scales = 0.1 mm.

thoracic, and all abdominal segments (except anal) are clearly serrated, except on the position of P5 and P6 (Fig. 18). Armature of abdominal somites, anal operculum and Fu are similar to that of female (anal operculum also with 12 spines). A1 prehensile, 8-segmented, and with very long aesthetasc on fourth segment (Fig. 19). All setae on A1 are naked, except small, plumose, and spine-like one on inner margin of the fourth segment. A2, Md, Mxl, Mx, Mxp, P2–P4 are very similar to those of the female. Spine on inner side of basipodite of P1 is hooked and stronger than female's (Fig. 22). Endopodite of P2 reaches to the end of the second exopodite segment, and it is very similar to female's (Fig. 23). Basiendopodite of P5 is the same as in the female. Exopodite of that leg also bearing 3 setae, but they are different compared to the female (Fig. 24). Inner apical seta on the exopodite is the longest, and plumose; middle seta is about 4 times shorter, plumose, and spine-like; outer seta is as long as middle one, but naked and very thin. P6 consisting of a chitinous lamella, which bears 1 small outer spine, and 1 small inner seta (Fig. 20).

Variability. Eleven specimens (5 females and 6 males) of *Nitocrella longa* n. sp. from the type locality were completely dissected and studied, as well as 1 male from the Ivanina Spilja cave. Body length of females ranges from 0.885 mm to 0.923 mm (average 0.9 mm), while in males it ranges from 0.792 mm to 0.923 (average 0.862). Basiendopodite of female's P5 bearing 2 or 3 setae (Figs 9, 16, and 17), but exopodite is consistant in shape. Shape of male's P5 are very similar in all studied specimens, just 1 paratype male has an abnormal exopodite, with 4 setae (Fig. 25). The number of spines on anal operculum ranges from 11 to 15, but in most cases it is 12.

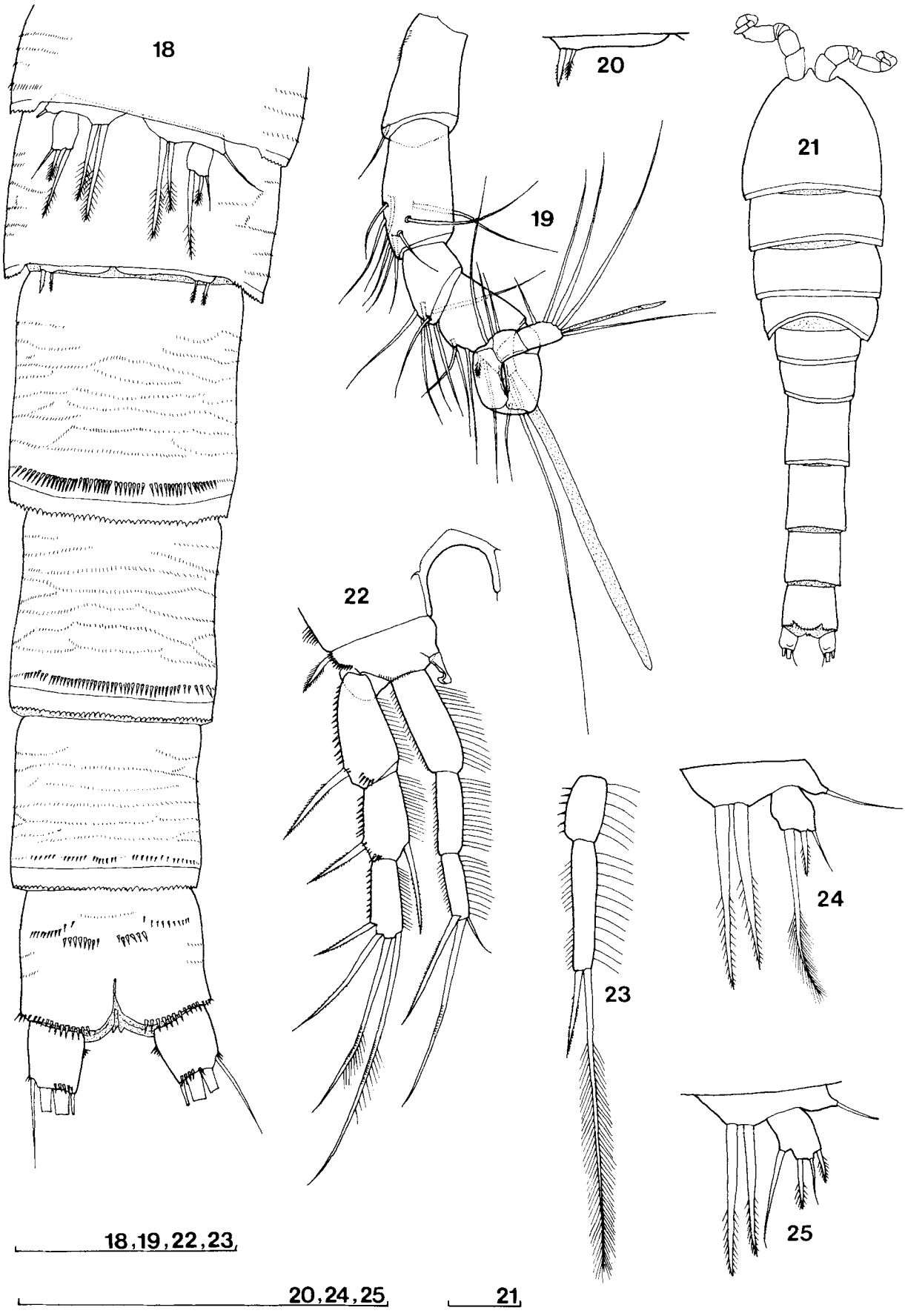
Distribution. At present, *N. longa* n. sp. is found only in three localities in the central and southern part of Montenegro. We suppose that it inhabits wide area of south Dinaric Alps.

Etymology. The specific name is from the Latin adjective *longus*, what means long, agreeing in gender with the (feminine) generic name. This name refer to species's very long body (*N. longa* is the largest species in the genus).

Remarks and affinities. *Nitocrella longa* n. sp. belongs to the "*hirta*"-group, that was created by Petkovski (1976). It is perhaps the most similar to *N. tirolensis* Kiefer, 1963 comb. n., which was described from 3 females from Innsbruck (Austria), as a new subspecies of *N. hirta*. Shape of P1–P4 are very similar in both species, only *N. longa* has slightly slender endopodites (it is especially noticable in the shape of EnpP2, which reaches to the end of the second exopodite article in *N. longa*, while in *N. tirolensis* it reaches to the middle of that article). Exopodite of P5 in *N. tirolensis* also bears 3 setae, but only the inner one is plumose, while in *N. longa* inner and outer setae are plumose. *N. tirolensis* is evidently distinguishable from *N. longa* by the combination of the following characters: 1) A1 with very stocky articles; its fourth segment is almost as long as wide (about 2.5 times longer than wide in *N. longa*); 2) each seta on ExpA2 is plumose (just inner one in *N. longa*); 3) first segment of Md palp is without setae (in *N. longa* with one very strong subapical seta, and that article is much larger than second one); 4) anal operculum is armed with 4 spines (from 11 to 15 in *N. longa*); 5) dorsal seta on Fu is very short (very long in *N. longa*); 6) proximal lateral seta is situated on the outer margin (it is moved to the dorsal side in *N. longa*). Unfortunately, only females of *N. tirolensis* were found. We think that *N. tirolensis* Kiefer, 1963 comb. n. is separate species (not subspecies of *N. hirta*) because it is more similar to *N. longa* n. sp., than to *N. hirta*, while the area of *N. hirta* is between areas of *N. tirolensis* and *N. longa*. It is hard to imagine two similar subspecies in two opposite parts of the area of the nominate subspecies.

*N. longa* n. sp. is also similar to *N. hirta* Chappuis, 1924, which is distributed in Slovenia, Bosnia and Hercegovina, Hungary, Serbia, Romania, Macedonia, Bulgaria, and Russia (north-west from Caucasus) (Chappuis 1924, Damian & Botosaneanu 1954, 1955, Petkovski 1959, Michailova-Neikova 1962, Borutzky 1967, Apostolov 1991). The abnormal ExpP5 in one male of *N. longa* (Fig. 25), which resembles that of *N. hirta*, is probably an atavism that points to their common origin. These two species differ by the appearance of Fu, EnpP2, and P5 in both sexes.

Based on the shape of the female's P5 *N. longa* is similar to *N. juturna* Cottarelli, 1975, *N. stochi* Pesce & Galassi, 1986, and to *N. fedelitae* Pesce, 1985 (all from Italy), but they are distinguishable by many features. All other species from "*hirta*"-group are distinguishable from *N. longa* by the shape of P5, and many other characteristics.




Figs 18–25. *Nitocrella longa* n. sp., 18–24, allotype (male, 0.81); 25, paratype (male, 0.904 mm): 18 – abdomen, ventral view; 19 – A1; 20 – P6; 21 – dorsal view; 22 – P1; 23 – EnpP2; 24 – P5; 25 – P5. Scales = 0.1 mm.

## Key to the species of "*hirta*"-group of the genus *Nitocrella* This key is mostly based on the females morphology

1. Exp3P4 with 4 setae or spines ..... 2
– Exp3P4 with 3 setae or spines ..... ***N. tonsa* Michailova-Neikova, 1965**
2. Enp2P4 with 1 or 2 setae ..... 3
– Enp2P4 with 3 setae ..... ***N. hofmilleri* Brehm, 1953**
3. EnpP2 with 2 setae ..... 4
– EnpP2 with 1 seta ..... ***N. maggii* Pesce, 1983**
4. Enp2P3 with 2 setae ..... 5
– Enp2P3 with 1 seta ..... ***N. calcaripes* Damian & Botosaneanu, 1954**
5. Enp2P1 with inner seta ..... 6
– Enp2P1 without inner seta ..... 7
6. Dorsal seta on Fu is 3 times longer than inner apical one ..... ***N. fedelitae* Pesce, 1985***
– It is less than twice longer than apical seta ..... ***N. juturna* Cottarelli, 1975**
7. ExpP5 with more than 2 setae ..... 8
– ExpP5 with 2 setae ..... ***N. pescei* Galassi & Laurentiis, 1997**
8. Enp1P1 with inner seta ..... 9
– Enp1P1 without inner seta ..... 13
9. Exp2P4 with inner seta ..... 10
– Exp2P4 without inner seta ..... ***N. kunzi* Galassi & Laurentiis, 1997**
10. Anal operculum armed with spines ..... 11
– Anal operculum naked ..... ***N. slovenica* Petkovski, 1959**
11. Exp2P1 with inner seta ..... 12
– Exp2P1 without inner seta ..... ***N. skyrensis* Pesce, 1982**
12. Male's ExpP5 with 4 setae ..... ***N. psammophila* Chappuis, 1954**
– Male's ExpP5 with 5 setae ..... ***N. morettii* Pesce, 1984**
13. Anal operculum armed with spines ..... 14
– Anal operculum unarmed ..... ***N. stochi* Pesce & Galassi, 1986**
14. Female's ExpP5 with 5 setae ..... 15
– Female's ExpP5 with less than 5 setae ..... 16
15. Basiendopodite of female's P5 with 4 setae ..... ***N. omega* Hertzog, 1936 (*fide* Kiefer, 1957)**
– Basiendopodite of females's P5 with 2 setae ..... ***N. spinulosa* Apostolov, 1991**
16. ExpP5 with 3 setae ..... 17
– ExpP5 with 4 setae ..... ***N. hirta* Chappuis, 1924**
17. Proximal segment of Md palp with strong seta ..... ***N. longa* n. sp.**
– Proximal segment of Md palp is naked ..... ***N. tirolensis* Kiefer, 1963 comb. n.**

* In original description of *N. fedelitae* Pesce, 1985 the Enp2P1 is drawn without inner seta, but the reexamination of the type material (Galassi & Laurentiis 1997) revealed the presence of that seta.

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