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A new species of smirnovipinid copepod (Copepoda: Cyclopoida: Smirnovipinidae) from an anchialine cave in Italian coastal waters, with a replacement name for the genus *Ginesia* Jaume and Boxshall, 1997

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Abstract
A new smirnovipinid copepod has been found in a shallow coastal cave located between the villages of Bagnara and Palmi on the Calabria coast. The new species belongs to genus *Ginesia* Jaume and Boxshall, but this name is already taken by *Ginesia* Fernández Yépez, a genus of freshwater fish from South America. The name *Costanzoia* is proposed as replacement and *Costanzoia longicaudata,* new combination, is the type of species by original designation. The new species *Costanzoia longiseta* is characterized by the extraordinary length of the apical seta on the fifth leg, which extends as far as the distal margin of third urosomal somite of the female, and by the length of seta II on the caudal rami. *C. longiseta* sp. nov. is very similar to shallow water hyperbenthic forms such as *Cyclopinoides, Oromiina,* and *Smirnovipina*, which also belong to family Smirnovipinidae. The discovery of *C. longiseta* sp. nov. confirms the presence and spread of this genus in anchialine caves of the Central Mediterranean Sea. In the cave the new species co-occurred with other cyclopoid species such as *Euryte longicauda* and *Eupolymniphilus* sp.

Keywords: *Taxonomy, Copepoda,* Ginesia, Costanzoia, *Mediterranean Sea*

Introduction

Ginesia Jaume and Boxshall, 1997 was established as a monotypic genus of cyclopoid copepod on the basis of material collected from a flooded karstic cave on the island of Mallorca in the Mediterranean Sea (Jaume & Boxshall 1997). The genus name *Ginesia* is already taken by *Ginesia* Fernández Yépez, 1951, a genus of freshwater fish (family Pimelodidae) from South America. Although *Ginesia* Fernández Yépez, 1951 is now considered a synonym of *Brachyplatystoma* Bleeker, 1862 (see Froese & Pauly 2012), the name is taken. *Costanzoia* is proposed here as a replacement name and *Ginesia longicaudata* Jaume & Boxshall, 1997 is designated as the type of species, that becomes *Costanzoia longicaudata* (Jaume & Boxshall 1997) new combination.

Four genera formerly placed in the paraphyletic family Cyclopinidae (Boxshall & Halsey 2004) have been recorded from anchialine caves: *Muceddina* Jaume and Boxshall, 1996a, *Trogocyclopina* Jaume & Boxshal, 1996a, *Costanzoia* nom. nov. and *Oromiina* Jaume & Boxshall, 1997 (Jaume & Boxshall 1996a, 1997). These are currently placed in three distinct families created from the former Cyclopinidae. *Costanzoia* nom. nov. and *Oromiina* are currently placed in the Smirnovipinidae, *Muceddina* in the Schminkepinellidae and *Troglocyclopina* remains in the Cyclopinidae (Walter 2011).

The cyclopoid family Smirnovipinidae is widely distributed in the marine environment from polar to tropical seas, its genera commonly inhabit brackish coastal and marine waters and hyperbenthic environments (Pesce 2010). They represent an important group among the marine epibenthic or meiobenthic (Martínez Arbizu 1997) and interstitial fauna. They are frequently found on beaches and in the sublittoral and subtidal sandy bottom (Chang 2011), and in karstic anchialine caves (Jaume & Boxshall 1997).

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In this paper we describe a new species of *Costanzoia* nom. nov. collected in an anchialine cave on the Southern Italian coast (Central Mediterranean).

Materials and methods

Samples were collected on 20 October 2011 from an anchialine cave (Figure 1) located on the southernmost coast of the Tyrrhenian Sea, using a hand-held plankton net (180 μm mesh). The cave is located in close proximity to the shore, about 30 m inland, between the villages of Bagnara and Palmi in the Calabria Region of Southern Italy. The cave has a maximum depth of 28 m and is significantly influenced by the marine environment.

Samples were fixed in 4% formaldehyde/seawater solution. Only one *Costanzoia* specimen was sorted out from the original samples. The specimen was dissected with glass needles in distilled water and the body and appendages were observed under a light microscope. Drawings were made using a Reichert Visopan projection microscope. The morphological terminology follows Huys and Boxshall (1991).

Taxonomic accounts

Class MAXILLOPODA Dahl, 1956
Subclass COPEPODA Milne Edwards, 1830
Order CYCLOPOIDA Burmeister, 1834
Family SMIRNOVIPINIDAE Martínez Arbizu, 1997
Genus *Costanzoia* nom. nov.
Costanzoia longiseta sp. nov.
(Figures 2–5)

Material examined

Holotype adult female, dissected, appendages were mounted on glass slides in Reyne's fluid (series of 11 slides containing the appendages (ZMC reg. n° 2011. 5625) and the body of the female (ZMC reg. n° 2011. 5626) preserved in 4% formaldehyde/seawater solution, are deposited in the Zoological Museum "Cambria" (ZMC)-Department of Animal Biology and Marine Ecology, Messina, Italy.

Description

Adult female (holotype), body length 0.70 mm, cyclopiform (Figure 2A). Nauplius eye absent. Rostrum well developed. Prosome: 5-segments, comprising cephalosome plus four free pedigerous somites. First pedigerous somite concealed beneath carapace-like extension of dorsal cephalothoracic shield. Cephalosome and free pedigerous somites

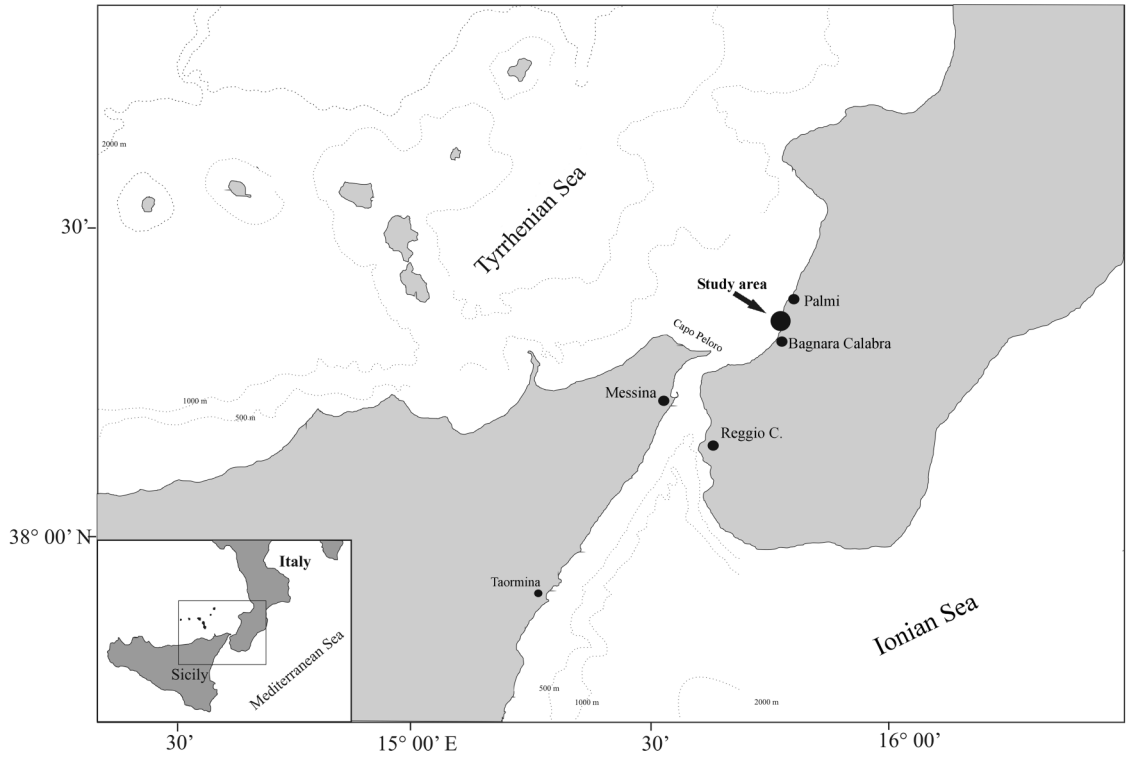

Figure 1. Study area.

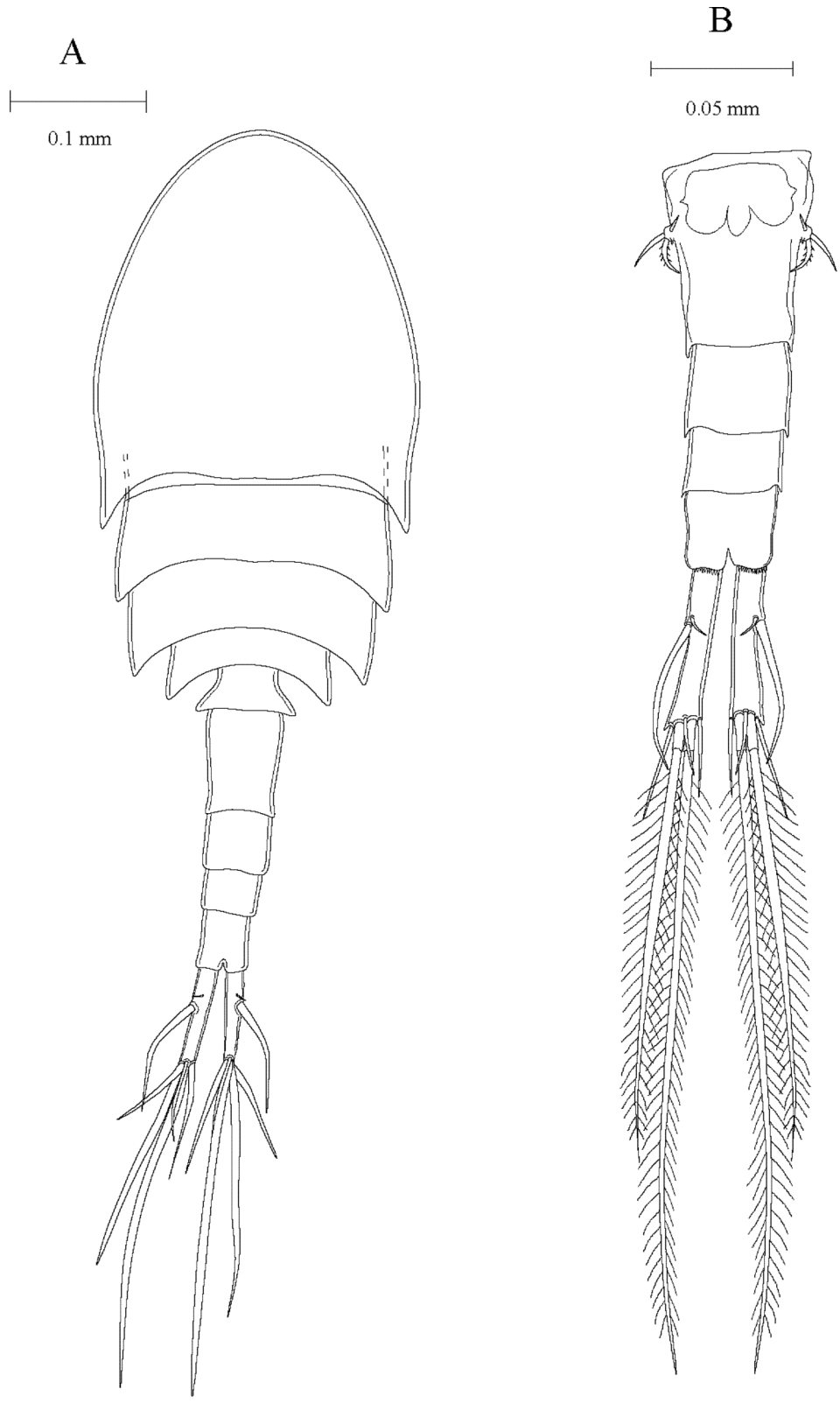

Figure 2. *Costanzoia longiseta* sp. nov.: adult female. A, habitus, dorsal; B, urosome.

two to four with well developed epimeral plates, with pointed posterolateral corners.

Urosome: 5-segments (Figure 2B). Fifth pedigerous somite symmetrical, with posterolateral pointed corners. Genital and first abdominal somites fused to form genital double somite. Genital double- somite symmetrical, longer than wide, and slightly expanded anteriorly. Gonopores covered by opercula derived from the sixth legs, each armed with three setae, dorsalmost seta very short, lateral and ventralmost setae longer, similar in length, and with former bearing setules. Anal somite ornamented with row of spinules along distal margin. Caudal rami symmetrical, elongate, long about 5.5 times as wide, armed with seven setae; seta I and II located near middle of lateral margin, seta II very long extending beyond caudal rami.

Antennules (Figure 3A) symmetrical, 18-segmented, with segment six showing traces of subdivision. Armature elements are as follows: segment 1 (I-II), three setae; segment 2 (III-V), five setae; segment 3 (VI-IX), eight setae; segments 4 and 5 (X and XI), two setae each; segment 6 (XII-XIV), six setae; segments 7 to 10 (XV and XVIII), one seta each; segment 11 (XIX), naked; segments 12 and 13 (XX and XXI), one seta each; segment 14 (XXII), naked; segment 15 (XXIII), one seta; segments 16 and 17 (XXIV and XXV), two setae each; segment 18 (XXVI-XXVIII), seven setae + aesthetasc.

Antenna (Figure 3B) uniramous, 4-segmented; coxa and basis fused, bearing one inner basal seta distally and two outer setae representing exopod. Endopod 3-segmented; first segment with one inner medial seta, second segment with five setae and third segment with six distal setae.

Mandible (Figure 3C) with the cutting edge of gnathobase bearing seven cuspidate teeth and one thin dorsal seta. Palp biramous; basis with one plumose single seta and five thin setules on inner surface. Endopod 2-segmented, first segment with three, second with six setae. Exopod 4-segmented, setal formula 1, 1, 1, 2.

Maxillule (Figure 4A,B) praecoxal arthrite bearing seven strong and three thin setae; coxal epipodite represented by two setae; coxal endite with one seta (Figure 4A). Proximal and distal endites of basis armed with three and two plumose setae, respectively. Endopod with seven setae. Exopod ornamented with row of setules on inner margin, and bearing four distal setae.

Maxilla (Figure 4C) 5-segmented, praecoxa and coxa fused, endite setal formula 4, 1, 3, 3. Basis with one stout claw and two unequal setae. Endopod 3-segmented, first segment double, bearing four setae, second segment with two setae, third segment with four setae.

Maxilliped (Figure 4D) 7-segmented; praecoxa and coxa completely fused, endites setal formula 1, 3, 2. Basis ornamented with a row of setules along medial margin and armed with two unequal distal setae. Endopod 5-segmented, segments 1–4 each bearing one seta, segment 5 with four setae.

Swimming legs one to four (Figure 5A-D) biramous with 3-segmented rami. Spine and seta formula as follows:

	Coxa	Basis	Exopodal segments	Endopodal segments
Leg 1	0-1	1-I	I-1; I-1; III,I,4	0-1; 0-1; 1,2,3
Leg 2	0-1	1-0	I-1; I-1; III,I,5	0-1; 0-2; 1,2,3
Leg 3	0-1	1-0	I-1; I-1; III,I,5	0-1; 0-2; 1,2,3
Leg 4	0-1	1-0	I-1; I-1; I,I+1,5	0-1; 0-2; 1,2,2

Inner spine on basis of leg 1 serrate along distal 2/3 on both margins, and ornamented with rows of long slender spinules proximally.

Outer basal seta of leg 3 remarkably elongate, reaching tip of exopod.

Leg 4 characterised by stout spiniform seta on inner margin of first endopodal segment; third exopodal segment with one serrate spine and one slender seta distally, seta offset, originating on anterior surface of segment.

Leg 5 (Figure 5E) uniramous, 3-segmented. Coxa and basis distinctly separated, coxa naked, basis bearing one outer seta. Exopod with two outer setae, one subdistal short inner seta, and one very long apical seta, reaching as far as distal margin of third urosomal somite.

Etymology

We replace the genus name *Ginesia* (Jaume & Boxshall 1997) with *Costanzoia* as a tribute to Prof. Costanzo, our mentor in the study of copepod taxonomy; the specific name *longiseta* of the new species refers to the extraordinary length of the apical seta on the exopod of the fifth legs, and of seta II on the caudal rami.

Remarks

Costanzoia longiseta sp. nov. displays the ancestral state for the Cyclopoida in some characters such as the carapace-like posterior extension of the dorsal cephalic shield overlying the free first pedigerous somite, not fused to cephalosome; the caudal rami with an armature consisting of seven setae; the

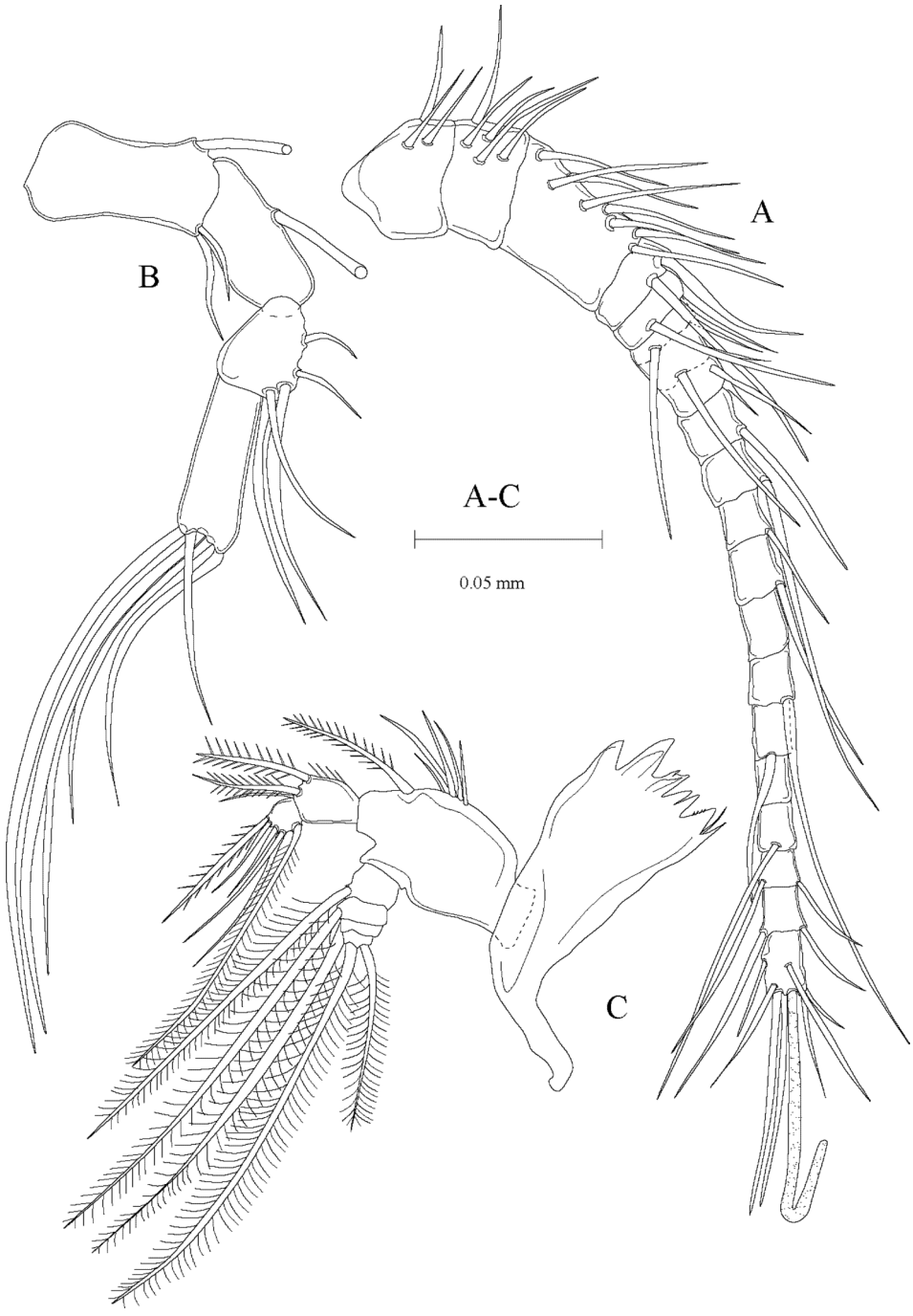

Figure 3. *Costanzoia longiseta* sp. nov.: adult female. A, antennule; B, antenna; C, mandible.

setation of the maxilla; the 5-segmented endopod of the maxilliped; and the 3-segmented female fifth legs.

Costanzoia longiseta sp. nov. is the second species of the genus *Costanzoia* nom. nov. and is easily distinguishable from *C. longicaudata* (Jaume & Boxshall 1997) in the following characters (the characters of *C. longiseta* in parentheses): (1) Dorsal and lateral surfaces of prosomal somites ornamented with rounded integumental tubercles (absent); (2) total body length, 0.48 mm vs. (0.70 mm); (3) the proportions of the caudal rami: length/width ratio 15:1 vs. (about 5.5:1); (4) greater relative length of the apical seta of the fifth legs: apical seta/exopodal segment length ratio is 3.7:1 vs. (5.0:1); (5) the length of seta II on the caudal rami does not extend beyond tip of caudal rami (extend beyond tip of caudal rami).

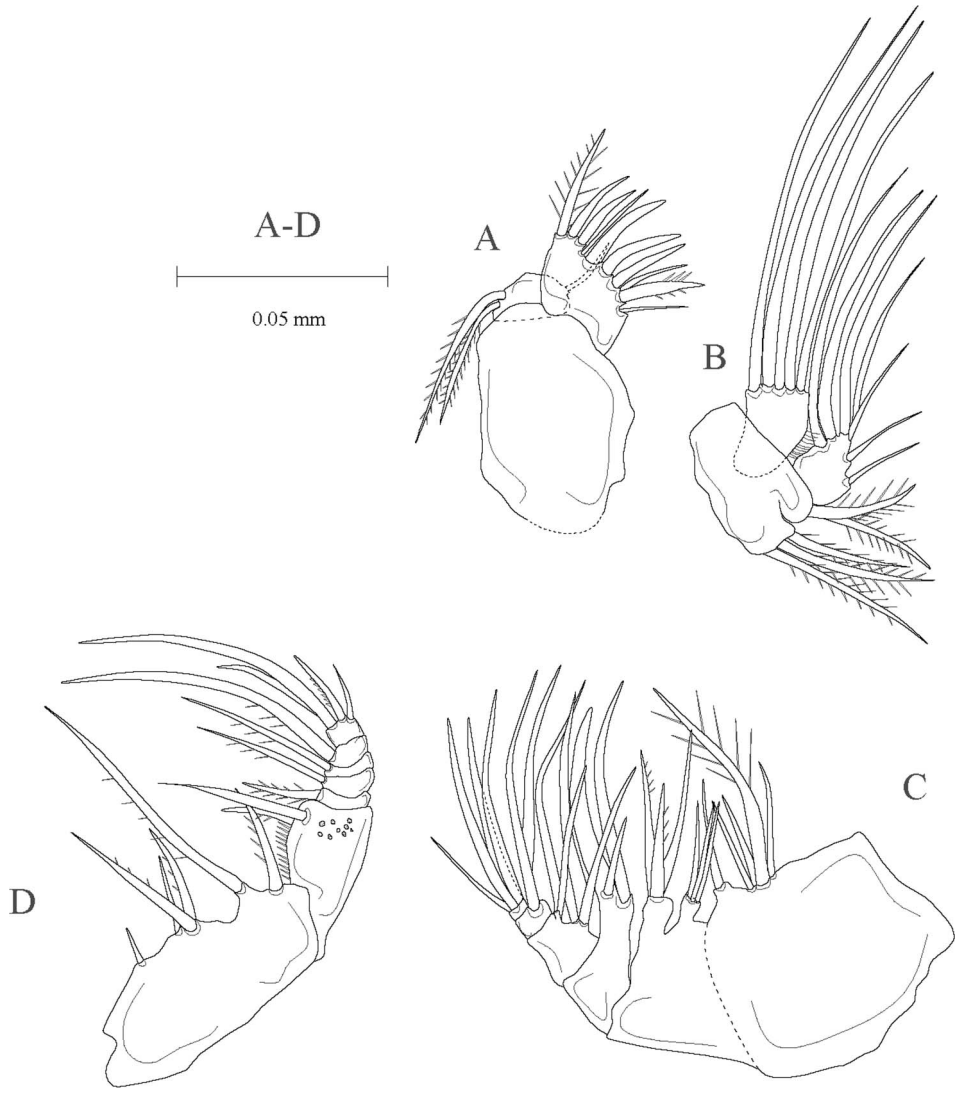

Figure 4. *Costanzoia longiseta* sp. nov.: adult female. A, maxillule praecoxa and coxa; B, maxillule basis and rami; C, maxilla; D, maxilliped.

Costanzoia longiseta sp. nov., within the Smirnovipinidae is very similar to the genera *Cyclopinoides, Oromiina* and *Smirnovipina*. Comparisons among these three genera and *Costanzoia* nom. nov. show that they are easily distinguishable because the female antennule of *Oromiina* and *Smirnovipina* consist of 17 and 19 segments, respectively, vs. (18), the caudal rami of *Oromiina* lack seta I (retain seta I), and the setation formula of the maxilliped endopod is 1, 2, 2, 1, 4 in *Cyclopinoides* and *Oromiina*, compared with 1, 2, 2, 1, 3 in *Smirnovipina* (1, 1, 1, 1, 4).

Distribution and habitat

The known distribution of species of the genus comprises the Balearic Basin (Mallorca, Balearic Islands, Western Mediterranean) and the Tyrrhenian Sea, Italy (Central Mediterranean). The habitat of *Costanzoia longiseta* sp. nov. is the muddy bottom of the cave at 28 m depth, located 30 m inland and subjected to significant marine influence. The occurrence of this new taxon and of other species, such as *Euryte longicauda* and *Eupolymniphilus sp.* (Zagami pers. comm.) in the same cave of Tyrrhenian Sea, provides further evidence of the existence of a rich assemblage of cyclopoid copepods in an anchialine environment. This copepod assemblage has only recently been discovered by the pioneering studies of Rocha & Iliffe (1991, 1993, 1994) and Jaume & Boxshall (1996a, 1997). In the Mediterranean region, together with cyclopoid assemblage, the cave-living copepod community is characterized by hyperbenthic calanoids (Jaume & Boxshall 1995;

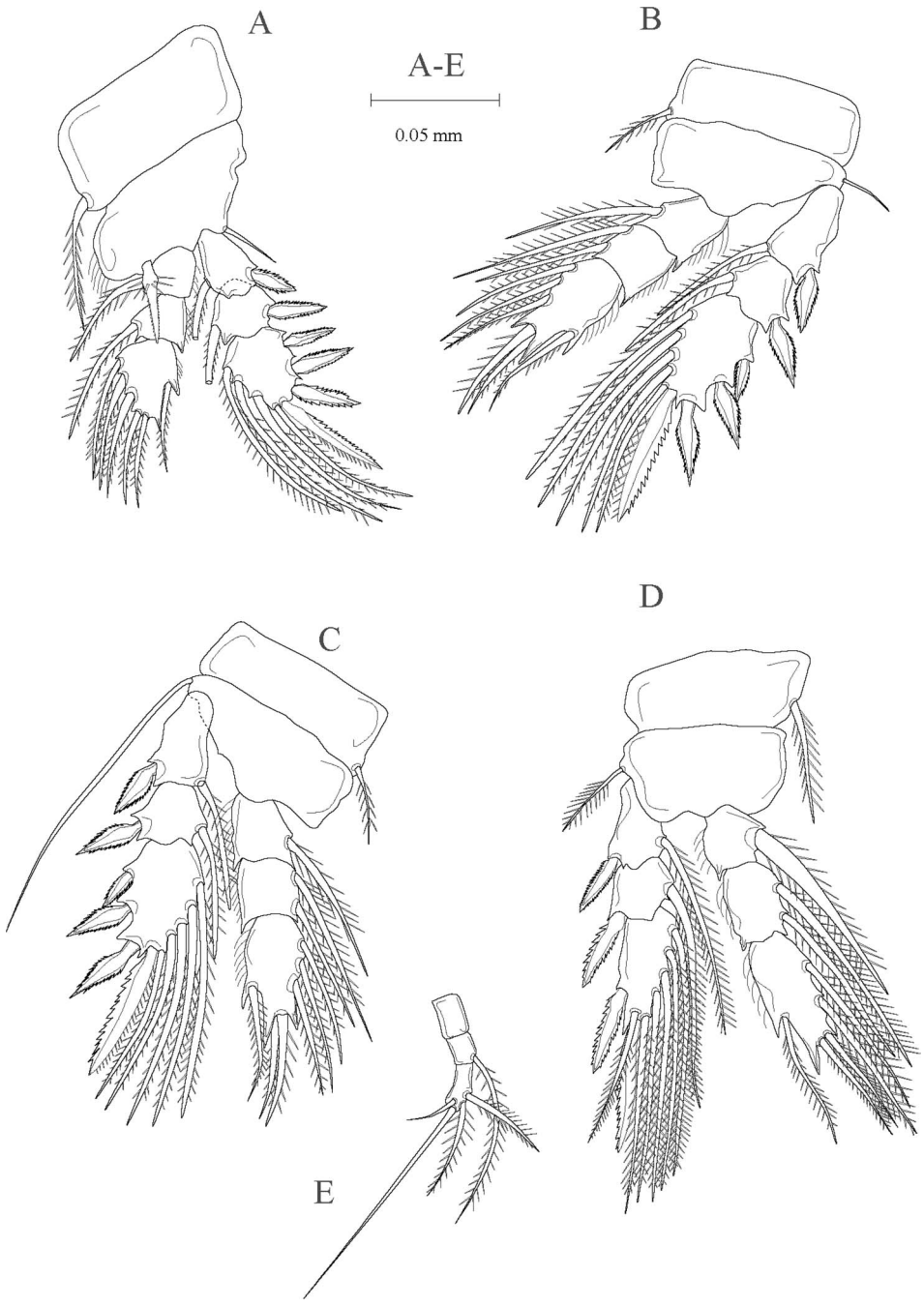

Figure 5. *Costanzoia longiseta* sp. nov.: adult female. A to D, swimming legs 1 to 4; E, fifth leg.

Kršinic 2005), harpacticoids (Galassi et al. 1997) and misophrioids (Jaume & Boxshall 1996b), but the true species diversity has yet to be completely revealed. These cave environments are common along the Mediterranean coasts and provide a rich source of new species, worthy to be sampled and described (e.g. Messana & Ruffo 2001; Berera & Cottarelli 2003).

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