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Ichnusella improvisa sp. nov. from subterranean waters of Sardinia (Italy) and remarks on *Itunella intermedia* and *Itunella muelleri* (Copepoda, Harpacticoida)

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Ichnusella improvisa sp. nov. from subterranean waters of Sardinia (Italy) and remarks on *Itunella intermedia* and *Itunella muelleri* (Copepoda, Harpacticoida)

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INTRODUCTION

A new harpacticoid belonging to the genus *Ichnusella* Cottarelli, 1971 was collected during extensive research on groundwater habitats in Sardinia. The genus *Ichnusella* has been, until now, endemic for Italy, with all species being collected exclusively in Latium and Sardinia. The taxon is characteristic of interstitial river-mouth communities, as confirmed by the new record.

Itunella intermedia Apostolov, 1975, an uncommon species, known only for the Black Sea, and so new for Italian fauna, was collected in the rivermouth of the Liscia River and Vignola Stream (Sassari Province, Sardinia). The species is redescribed, completing the original description with new morphological features. New data are also provided on *Itunella muelleri* (Gagern, 1922), collected in the interstitial habitat of the island of Ischia (Naples, Italy) and on that of Kythira (Greece).

MATERIALS AND METHODS

Specimens were collected using the Karaman-Chappuis method (Delamare Deboutteville, 1960), fixed in 5% buffered formalin and mounted on permanent slides with Faure's medium. They were drawn at 1250 ×, with an oil immersion lens, using a drawing tube mounted on a Zeiss Axioskop® phase contrast microscope. All scale bars represented in the figures correspond to 0.025 mm.

For scanning electron microscopy, some specimens were fixed for 24 h in 10% formalin, washed twice in cacodylate buffer (pH 7.2), post-fixed in 1% osmium tetroxide in the same buffer, dehydrated in a graded ethanol series, critical-point-dried in a Balzers Union® CPD 020 apparatus, and coated with gold in a Balzers Union® MED 010 sputter coater. Observations were performed with a 1200 JEOL JEM® EX II scanning electron microscope.

The following abbreviations are used, when required, throughout the text and figures: A1, antennule; A2, antenna; Enp, endopod; Exp, exopod; Md, mandible; Mxl, maxillule; Mx, maxilla; Mxp, maxilliped; P1-P5, thoracic appendages; R, rostrum.

The nomenclature and descriptive terminology follow Huys *et al.* (1996).

The holotype and one female paratype will be deposited in the collection of the Museo Civico di Storia Naturale G. Doria, Genova (Italy); the remaining material of the type series is deposited at the Dipartimento di Scienze Ambientali, Università della Tuscia, Viterbo (senior Author's collection).

Latitude and longitude were determined using a Garmin GPS (Global Position System) 38™.

TAXONOMIC ACCOUNT

Family LEPTOPONTIIDAE Lang, 1948

Genus *Ichnusella* Cottarelli, 1971

Ichnusella improvisa sp. nov.

Material – Holotype: 1 male, V. Cottarelli and R. Berera coll., 18.02.1998, rivermouth of Rio Ciuchesu (Sassari Province, Sardinia; 41°10.480' N, 9°10.338' E), 2 m from the right river shoreline, 150 m from the sea; dissected and mounted on a slide labelled: Sardegna,

ABSTRACT

Data are presented on interstitial harpacticoids collected at the estuaries of some rivers and streams in Sardinia. *Ichnusella improvisa* sp. nov., from the interstitial habitat of Ciuchesu Stream (Sassari Province, Sardinia), is described and discussed. A new key to the five species is presented, as well as observations on the genus ecology. New data on the morphology and ecology of *Itunella intermedia*, collected in the interstitial habitat of the Liscia River and Vignola Stream (Sassari Province, Sardinia) are given. This record extends the distribution of the species, which was previously recorded only from the Black Sea. Brief information on ecology and distribution of *Itunella muelleri* is also presented.

KEY WORDS: Psammopsyllinae - Canthocamptidae - Interstitial fauna - *Ichnusella*.

ACKNOWLEDGEMENTS

This work was supported by grants from the Italian Ministero dell'Università e della Ricerca Scientifica e Tecnologica (M.U.R.S.T., funds 60%). We wish to thank the two anonymous referees whose comments usefully improved the manuscript.

Rio Ciuchesu Stream - *Ichnusella improvisa* holotype. Allotype: 1 ovigerous female V. Cottarelli and R. Berera coll., same date and place as holotype, mounted on a slide labelled: Sardegna, Rio Ciuchesu Stream - *Ichnusella improvisa* allotype. Paratypes: 7 males, 5 females and 2 ovigerous female, V. Cottarelli and R. Berera coll., same date and place as holotype, mounted on slides labelled: Sardegna, Rio Ciuchesu Stream - *Ichnusella improvisa* paratype.

Description of the holotype – Body cylindrical and elongate, pitted, unpigmented, eyeless; length from rostrum to distal apex of caudal rami: 0.364 mm. Cephalothorax and anal somite respectively with one dorsal and one ventral hyaline integumental window (Fig. 1E).

Anal operculum (Fig. 1E): distal margin smooth and straight, with a curved, spiniform expansion on right side, left side aberrant.

Caudal rami (Fig. 1E): as long as the anal somite, of approximately conical shape; length to width ratio: 3.5. Armature consisting of: a long anterolateral seta, a posterolateral seta, an outer terminal seta, a long and strong inner terminal seta, a short terminal accessory seta near the inner terminal corner, a dorsal composite seta with a small spine close to it; produced dorsally into a long curved apical tip.

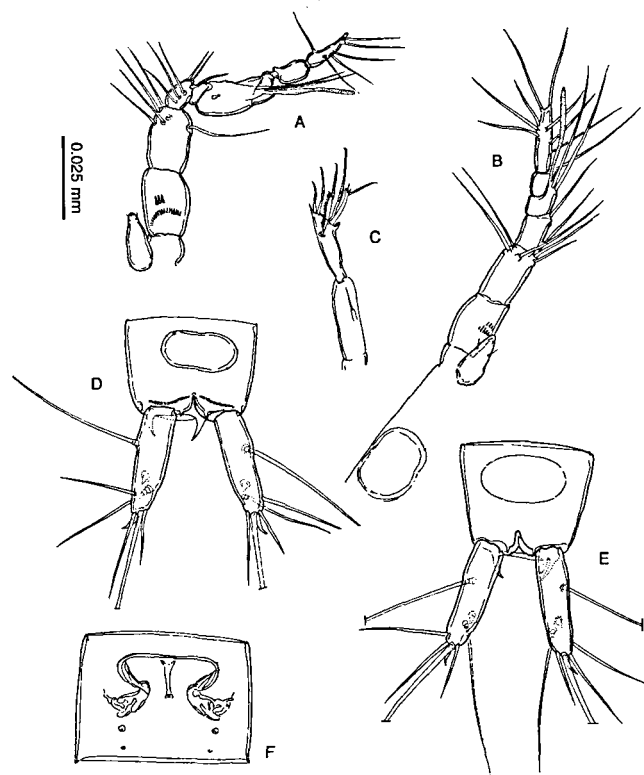


Fig. 1 - *Ichnusella improvisa* sp. nov. Holotype: A, antennule and rostrum; C, antenna; E, caudal rami and anal operculum, ventral view, and abdominal somite with ventral window. Allotype female: B, antennule and rostrum; D, caudal rami and anal operculum, ventral view, and abdominal somite with ventral window.

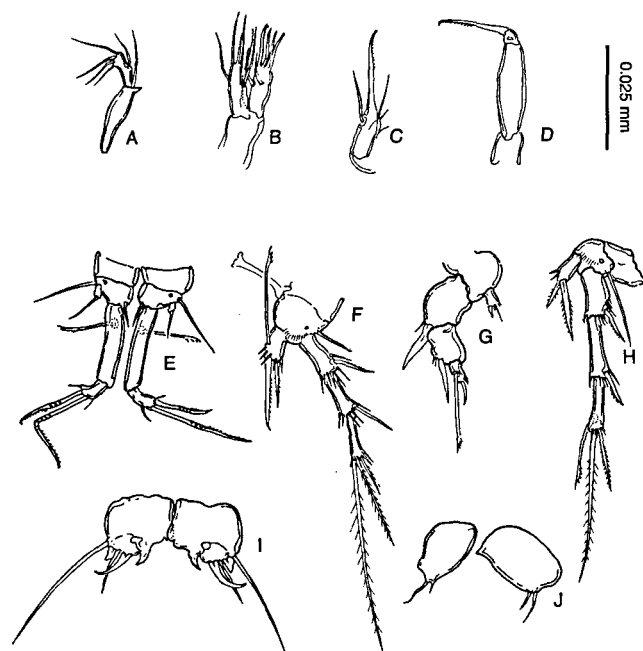


Fig. 2 - *Ichnusella improvisa* sp. nov.: holotype. A, mandible; B, maxillule; C, maxilla; D, maxilliped; E-J, thoracic appendages: E, P1; F, P2; G, P3; H, P4; I, P5; J, P6.

Rostrum and antennule (Fig. 1A): rostrum as in the Figure A1: eight-segmented. First segment with two rows of transverse spinules; second segment with five distal setae. Third segment with three subapical setae and two apical ones; fourth segment with one seta. Fifth segment with a strong apical tubercle bearing two long setae and an aesthetasc; sixth segment bare, with enlarged proximal part. Seventh segment bare, with a tooth-like expansion on the proximal part; last segment long and narrow, with six setae.

Antenna (Fig. 1C): one-segmented exopod with an apical seta, allobasis bare. Endopod bearing distally three geniculate, one normal, one pinnate, and one transformed setae.

Mandible (Fig. 2A): two-segmented palp; basis with one seta on the distal margin, endopod with four apical and one subapical setae.

Maxillule (Fig. 2B): praecoxal arthrite with four apical spines of same length, two curved setae are inserted at about half length of arthrite. Coxal endite with two distal setae; basis with three apical setae; exopod (?) reduced to a long seta.

Maxilla (Fig. 2C): syncoxa with one endite bearing two setae of different length. Basis prolonged in an apical curved tip; endopod represented by a long seta.

Maxilliped (Fig. 2D): slim and elongate; syncoxa and basis unarmed, endopod represented by a long, pinnate, apical claw.

P1-P4 basis with a pore and a seta near the exopod insertion.

P1 (Fig. 2E): an inner seta near the endopod insertion. Exopod 1-segmented and small, with an apical seta. Endo-

pod two-segmented, Enp-1 about 3.5 times as long as Enp-2, with a transformed proximal inner seta. Enp-2 bearing two geniculate apical setae of different length, one vestigial inner subapical seta, and one subapical spinule.

P2 (Fig. 2F): exopod three-segmented, armature shown in the figure. Endopod 1-segmented, shorter than Exp-1, with two apical normal setae and one transformed subapical one.

P3 (Fig. 2G): transformed; exopod three-segmented, enlarged and curved inwards; Exp-1 very enlarged with one distal outer strong seta; Exp-2 with one outer seta. Last segment very small, with one subapical long and transformed seta and one apical spine. Endopod represented by a cylindrical short segment, with two apical spinules and short subapical ones.

P4 (Fig. 2H): exopod three-segmented, last segment with a subapical transformed seta and two apical normal ones of different length. Endopod as long as half of Exp-1, with two apical pinnate setae of different length.

P5 (Fig. 2I): an almost rectangular plate, with two distal lobes; the inner lobe with a sinuous inner margin and a curved spine. On the outer lobe, from the inner to the outer corner, a strong curved spine, one seta, a shorter strong spine, one long seta.

P6 (Fig. 2J): two asymmetrical rectangular plates, both of them with a short spinule and a seta on the distal margin.

Description of the male paratype – Some of the features described for the holotype have been checked in two male paratypes with SEM. Habitus as in Figure 4A. A2 as in Figure 4B. Mouth parts as in Figure 4C.

P3 (Fig. 4D): basis with one pore and a long seta on the outer surface and two rows of spinules on the inner margin.

Description of the female allotype – Length: 0.354 mm. R (Fig. 1B), A2, Md, Mxl, Mx, Mxp, P1 basis (Fig. 3A), P2 (Fig. 3B), P4 (Fig. 3D), cephalic (Fig. 1B) and abdominal (Fig. 1D) window as in the male.

Caudal rami (Fig. 1D): resembling those of the male but a little shorter, longer than the last abdominal somite. Length to width ratio: 3.4.

Antennule (Fig. 1B): six-segmented, first segment with two transverse rows of spinules, second segment with six distal setae. Third segment with one seta; fourth segment with a tubercle bearing two setae and an aesthetasc. Fifth segment with a distal seta, last segment with eight setae.

P1 (Fig. 3A): dimorphic, end-1 with a long proximal, inner, not transformed seta.

P3 (Fig. 3C): basis with outer seta and pore. Exopod three-segmented, Exp-3 with two apical setae and a subapical transformed one; remaining ornamentation as in the figure. Endopod represented by a cylindrical segment, shorter than Exp-1, with one strong apical seta.

P5 (Fig. 3E): two plates of almost triangular shape bearing, along the distal margin from the inner to the

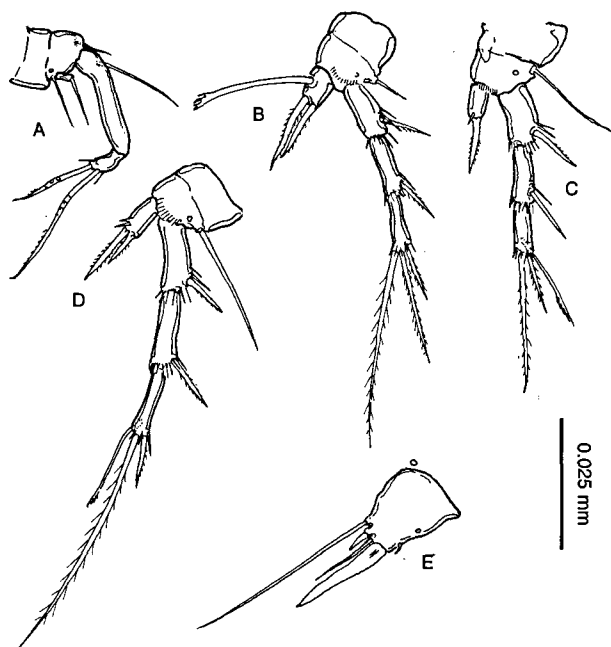


Fig. 3 - *Ichnusella improvisa* sp. nov.: allotype female, thoracic appendages. A, P1; B, P2; C, P3; D, P4; E, P5.

outer corner: a pore, a short spine, a very strong and long spine, a seta, a short spine, a very long seta.

Genital field as in Figure 1F.

Derivatio nominis – The species name derives from the Latin adjective 'improvisa', meaning 'unexpected'.

Family CANTHOCAMPTIDAE Sars, 1906 (part.),
Monard, 1927 (part.), Lang, 1948

Genus *Itunella* Brady, 1896

Itunella intermedia Apostolov, 1975

Material – Two males and 4 females collected on 25-02-1999 in the interstitial habitat of Liscia River (V. Cottarelli & R. Berera leg.); 1 male and 2 females collected on 27-02-1999 in groundwater habitat of Vignola Stream (V. Cottarelli & R. Berera leg.) (Sassari Province, Sardinia).

Description of female – Anal operculum (Fig. 6A): convex, with a row of spinules along the margin.

Caudal rami (Fig. 6A): shorter than anal somite of approximately elliptical shape, distal margin with a row of spinules; length to width ratio 1.8. Armature consisting of: a anterolateral seta, a posterolateral seta, a dorsal seta, an inner terminal seta reduced to a stout hump, outer terminal and terminal accessory setae short, of equal length.

Rostrum and antennule (Fig. 5A): rostrum as in the Figure A1: seven-segmented. First segment with one

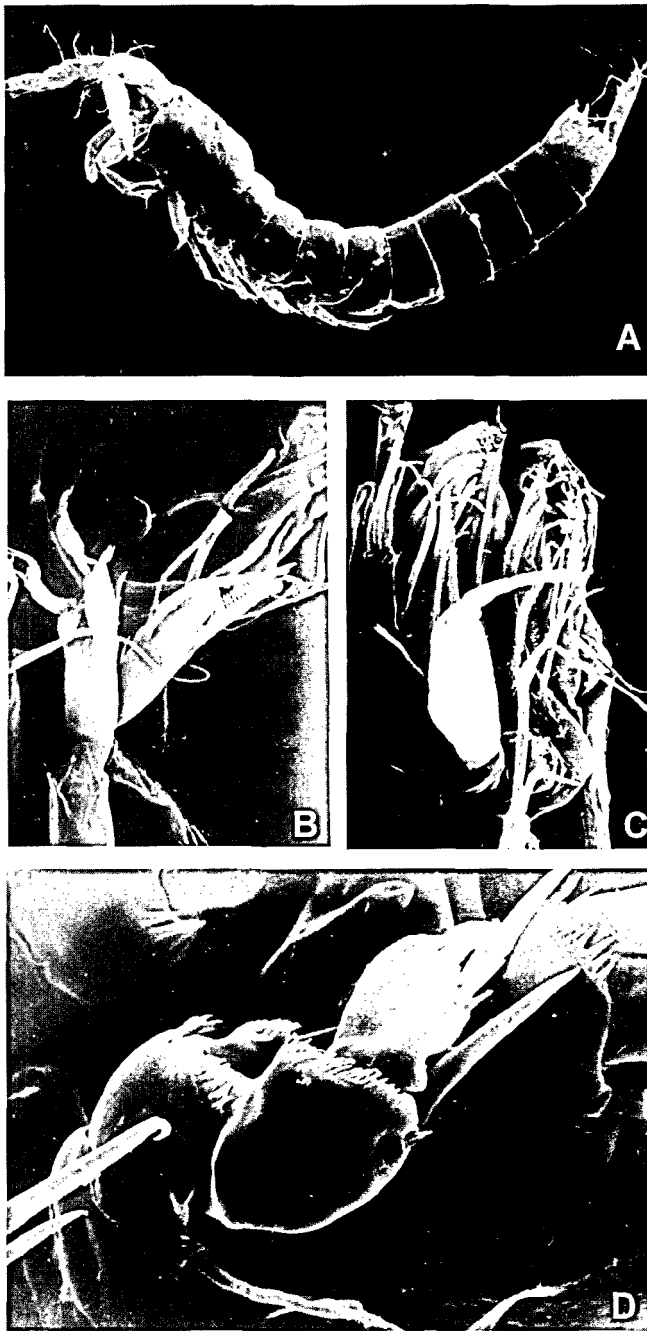


Fig. 4 - *Ichnusella improvisa* sp. nov.: paratype male. A, habitus ($\times 500$); B, antenna ($\times 3500$); C, mouth parts ($\times 2000$); D, P3 ($\times 3500$).

pinnate seta; second segment with nine setae. Third segment with seven setae; fourth segment with two setae and an aesthetasc. Fifth and sixth segment with an apical seta; last segment bearing eight setae and an aesthetasc.

Antenna (Fig. 5C): exopod one-segmented with one subapical pinnate seta and three apical setae, allobasis bare. Endopod bearing two rows of strong spinules on outer margin and a row of spinules on distal and inner margin; apical armature of five distal setae, two of which falciform and serrate and three plumose.

Mandible (Fig. 5D): 1-segmented palp, endopod with three apical setae.

Maxillule (Fig. 5E): arthrite of the praecoxa with five apical denticulate spines of same length; two setae inserted at about half length of arthrite. Coxal endite with two distal setae of which the outermost is pinnate; basis with two apical and four lateral (one pinnate) setae.

Maxilla (Fig. 5F): syncoxa with two endites each bearing two distal setae. Basis drawn out into strong, slightly curved minutely denticulate claw, accessory armature consisting of two naked setae; endopod represented by two naked setae and one spine.

Maxilliped (Fig. 5G): prehensile; syncoxa with two surface rows of spinules, outer margin with tiny spinules and distal margin with long pinnate seta. Basis with a double surface row of spinules along inner margin, endopodal claw bearing microspinules.

Swimming legs: exopods three-segmented; setal formula of exopods: P1, 0.1.121; P2, 0.1.221; P3, 0.1.221; P4, 0.1.221.

P1 (Fig. 7A, B): Exp-2 with one inner seta with a comb-like distal border; endopod two-segmented, Enp-2 bearing two long apical setae and one slender plumose inner seta.

P2 (Fig. 7C): Exp-2 and Exp-3 with one inner seta with a comb-like distal border; endopod one-segment-

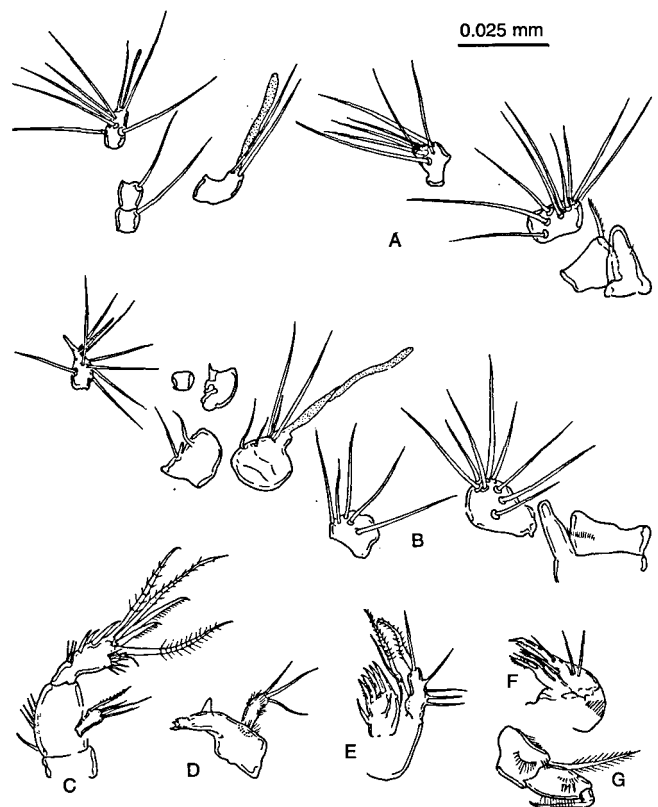


Fig. 5 - *Itunella intermedia*. Female: A, antennule and rostrum; C, antenna; D, mandible; E, maxillule; F, maxilla; G, maxilliped. Male: B, antennule.

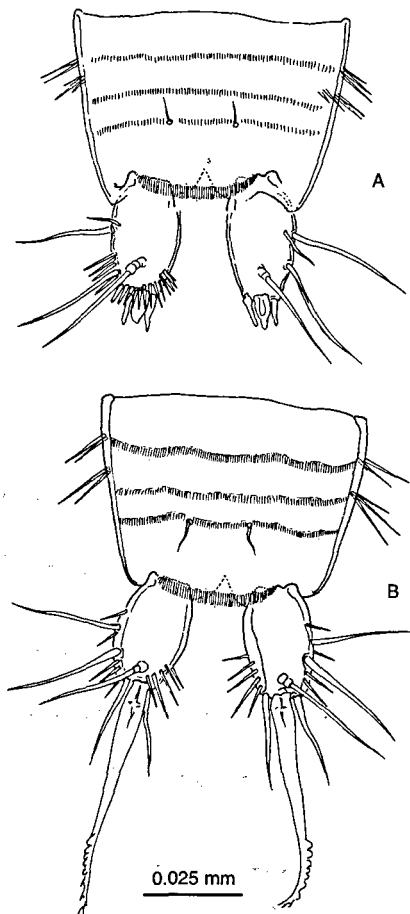


Fig. 6 - *Itunella intermedia*. Female: A, caudal rami and anal operculum. Male: B, caudal rami and anal operculum.

ed, as long as Exp-1, with two spiniform setae and one subapical seta.

P3 (Fig. 7D): endopod one-segmented, longer than Exp-1, bearing three spiniform setae of different length.

P4 (Fig. 7E): endopod one-segmented, bearing three spiniform setae of different length and one inner spine.

P5 (Fig. 7F): baseoendopod with four pinnate spines; exopod with three spiniform setae and two tiny outer setae.

Genital somite (Fig. 7G): almost as wide as long; genital field with separate genital apertures covered by a vestigial P6, each bearing two short and smooth setae, copulatory pore situated medially.

Description of male – Anal operculum (Fig. 6B): as in the female. Caudal rami (Fig. 6B): slightly shorter than female; length to width ratio: 1.7. Armature consisting of an anterolateral seta, a posterolateral seta, a dorsal seta, an outer terminal seta, a long and transformed inner seta and a terminal accessory seta. Outer and inner margin of caudal rami bearing some spinules of different length.

Rostrum and antennule (Fig. 5B): rostrum as in the Figure A1: eight-segmented. First segment with a row of

spinules; second segment with eight setae. Third segment with five setae; fourth segment with two long and three short setae and an aesthetasc. Fifth with two setae; sixth and seventh segment unarmed. Last segment bearing eight setae and an aesthetasc.

P1 (Fig. 8A): endopod as in female.

P2 (Fig. 8B): exopod as in female. Endopod shorter than Exp-1 bearing two pinnate setae of different length and two short setae.

P3 (Fig. 8C): exopod as in female; endopod two-segmented, segment 1 with two outer spines; segment 2 with a pore, and a spiniform process.

P4 (Fig. 8D): exopod as in female; endopod two-segmented; segment 1 unarmed, segment 2 ending in a spiniform process and bearing one inner and one outer setae.

P5 (Fig. 8E): baseoendopod with one pore near the insertion of the exopod, with two pinnate setae. Exopod armed with four setae and two spines.

P6 (Fig. 8F): rudimentary with two setae of different length.

Itunella muelleri (Gagern, 1922)

Material – Ten males and 13 females collected on 12-12-1986 from interstitial habitat on the island of Ischia (Naples Province, Italy) (V. Cottarelli & S. Bascherini leg.); 4 males and 3 females collected on 3-04-1996

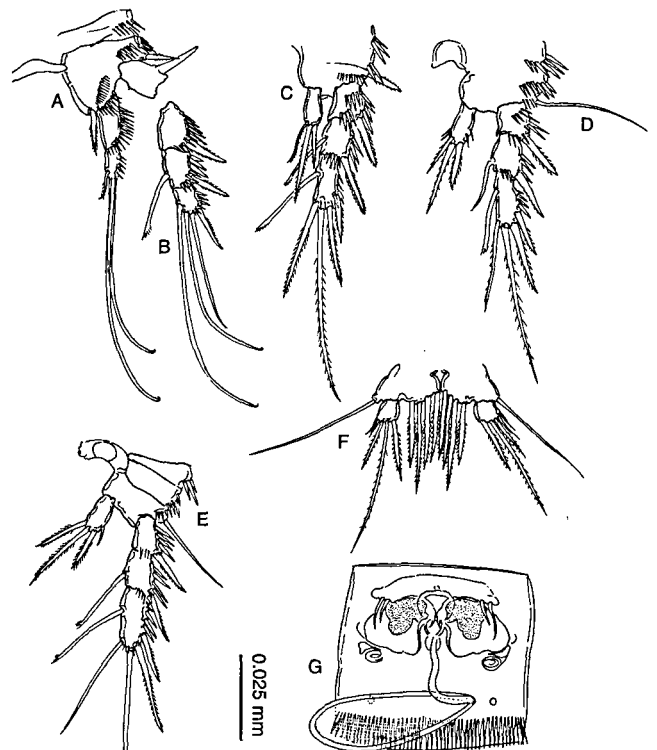


Fig. 7 - *Itunella intermedia*. Female: A, endopod P1; B, exopod P1; C, P2; D, P3; E, P4; F, P5; G, genital field.

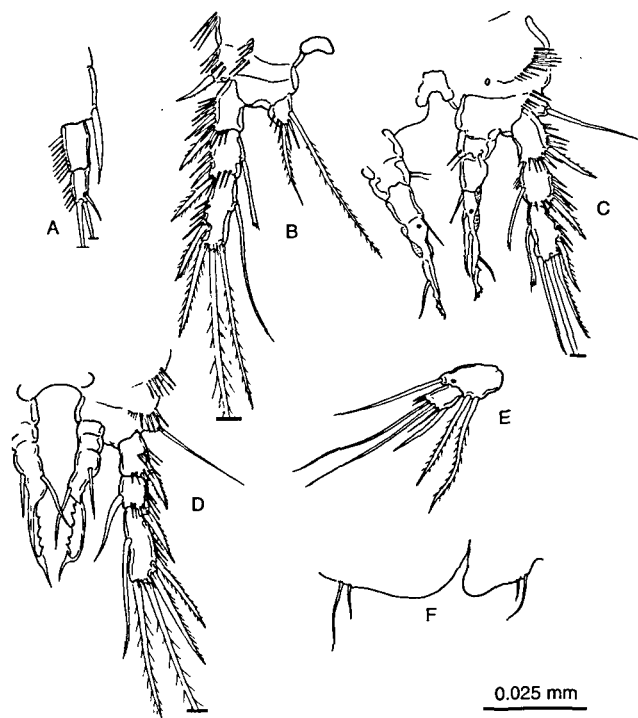


Fig. 8 - *Itunella intermedia*. Male: A, endopod P1; B, P2; C, P3; D, P4; E, P5; F, P6.

from hyporheic water of a small stream mouth on Kas-traki beach on the island of Kythira (Greece) (V. Cottarelli & M. C. Bruno leg.).

Complementary description of the male – We present the description of some morphological features of this taxon in order to make the comparison with *Itunella intermedia* easier.

P2 (Fig. 9A): endopod almost as long as Exp-1, represented by a rectangular segment with four distally setae. P3 (Fig. 9B): last segment of endopod ending in a stout spinous process, its tip extending beyond distal end of Exp-3, with two bipennate setae on the outer margin. P4 (Fig. 9C): Enp-2 bearing distally one bipennate seta and a transformed spine and two stout spines on the inner margin. A2 exopod (Fig. 9D): armed with five setae. Mandibular palp (Fig. 9E): bearing two apical and two subapical bipennate setae. Mx1 (Fig. 9F): basis with two apical and three distal setae. Mx (Fig. 9G): as in the Figure.

Remarks on the ecology and distribution

Ichnusella improvisa sp. nov. was collected in the interstitial habitat of a rivermouth and has colonized freshwater, as all the other species belonging to the genus. The species were collected at different locations: *Ichnusella eione* Cottarelli, 1971 from the mouths of the Cedrino (Nuoro Province, Sardinia) and Coghinas (Sassari Province, Sardinia) Rivers, in an area between 200 and 2700 m from the coastal line (Cottarelli, 1971;

Cottarelli *et al.*, 1999). *Ichnusella tertia* Cottarelli, Bruno and Berera, 1999 was initially collected in the river-mouth of the Fiora River and Valfragida Stream (Viterbo Province, Latium) in two sites located at 55 m and 40 m from the sea respectively (Cottarelli *et al.*, 1999), and lately on the Fiora River at 130 m from the sea (Cottarelli V., unpubl. data). *Ichnusella longifurca* Cottarelli, Bruno and Berera, 1999 was collected on the De Li Saldi Stream (Sassari Province, Sardinia), 30 m from the shoreline (Cottarelli *et al.*, 1999), but the rivermouth of De Li Saldi is in a small and protected bay, and probably the subterranean seawater intrusion does not reach far from the shoreline. We lately collected several specimens of *I. longifurca* in the interstitial habitat of the Vignola Stream (Sassari Province, Sardinia) and Coghinas River always in freshwater. *Ichnusella pasquinii* (Cottarelli, 1969) was first collected in a small stream at 40 m from the mouth; one female specimen was lately collected at about 90 m from the shoreline (Bruno M. C., unpubl. data). *Ichnusella improvisa* sp. nov., was collected in the interstitial habitat of the Ciuchesu Stream at 120 and 180 m from the sea, in winter and in summer (when the stream was dry), respectively. The copepod community was composed, during the winter, of the following species: *Parastenocaris oligoalina* Cottarelli, Bruno and Venanzetti, 1994; *Schizopera* sp.; *Nitocrella beatrix* Cottarelli and Bruno, 1994; *Psammopsyllus maricae* Cottarelli, Saporito and Puccetti, 1983.

During all the research mentioned above, we never collected more than two species of *Ichnusella* in the same river or stream, with the exception of *I. eione* and *I. longifurca* in the Coghinas River. This is a large river, and has a wide estuary with sandbanks; however, the two species of *Ichnusella* were never collected at the same site. A similar phenomenon was detected for the *Para-*

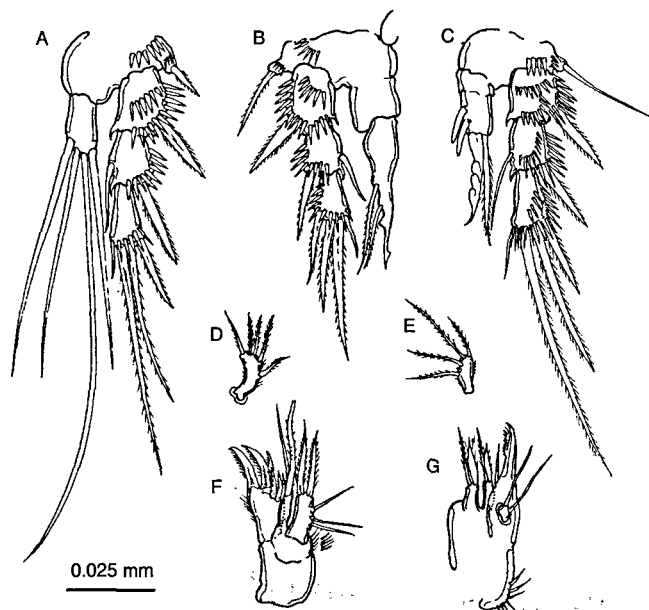


Fig. 9 - *Itunella muelleri*. Male: A, P2; B, P3; C, P4; D, antenna exopod; E, mandibular palp; F, maxillule; G, maxilla.

stenocaris species of the *minuta*-group Lang 1948, that live in the rivermouth interstitial habitat and have peculiar morphological affinities (Cottarelli & Bruno, 1997). These species were collected from rivers geographically close to each other, but never from the same watercourse.

Ichnusella improvisa sp. nov. was collected in an intermittent river, which dries up completely in summer. In July 2000, specimens were collected in a hole excavated in the centre of the riverbed, reaching the water table at about 1.5 m depth. On the other hand, on the same date no specimens were found in the sampling sites near the coastline (10 and 95 m from the sea) in brackish waters. This datum suggests that, when the river dries, the species, which can not live in brackish water, disperses following the lowering of the water table level. Therefore, the populations of *I. improvisa* sp. nov. are probably patchy in summer, with consequent bottlenecks and genetic drift phenomena.

As regards *I. intermedia*, the present data widen the distribution of the taxon. *Itunella intermedia* had been previously collected (Apostolov, 1975) with three specimens (one male and two females) only once, from an interstitial habitat near the mouth of the Vélékà River, on the Bulgarian shore of the Black Sea. The specimens collected in the interstitial habitat of the Liscia River and Vignola Stream represent the second record of the species and the first for Italy.

The genus *Itunella* is one of the few of the family Canthocamptidae living in brackish and fresh waters and was considered exclusive of the northern European seas. Only three species belong to the genus: *I. tenuiremis* (T. Scott 1893) the species-type, *I. muelleri* and *I. intermedia*. *Itunella tenuiremis* is known from brackish and marine waters in Scotland and Sweden (Lang, 1948; Dussart & Defaye, 1990). *Itunella muelleri* was collected on the coast of Germany (Lang, 1948), in Ireland (Roe, 1958), on the German Helgoland Island (Noodt, 1954; Kiefer, 1960), on the Carelian (Russia) coasts of the White Sea (Chislenko, 1967), in Finland (Noodt, 1970) and in the Scilly Islands (Wells, 1961). The southern limit of the species distribution was the Bulgarian coast of Black Sea where the taxon was collected and described by Chappuis & Serban (1953) as *I. bacescui*. Other records for the Black Sea are by Marinov (1971), Apostolov (1969), Apostolov & Marinov (1988). In the Mediterranean Sea, *I. muelleri* was signalled for the first time in 1954 by Chappuis near Banyuls-sur-Mer; in 1986 in the island of Ischia (Naples Province, Italy) (Bascherini S., unpubl. data; Argano *et al.*, 1995) and in 1996 on the island of Kythira (Cottarelli V. & Bruno M. C., unpubl. data), first record for Greece. *Itunella muelleri* lives not only in the cold Atlantic-Boreal region (*sensu* Lang, 1948), but also in temperate regions such as on the coasts of the Black Sea and Mediterranean Sea. Therefore, the species has a European chorotype (*sensu* Vigna Taglianti *et al.*, 1999).

Itunella muelleri was first collected in benthonic habitats; nonetheless the species can colonise the interstitial

habitat with abundant populations and has also been collected in brackish waters (Bascherini S., unpublished data). In Ischia this taxon was collected in brackish and marine waters (Cetara beach) and in fresh waters (small rivermouth in Maronti beach). In Kythira the species was found in the hyporheic water of a small stream on Kastraki beach, where it shares the same ecological niche with *Parastenocaris aphroditis* Cottarelli & Bruno, 1997; *Elaphoidella* sp.; *Nitocrella* sp. *hirta*-group.

Itunella tenuiremis is a benthonic species which lives in brackish waters (Lang, 1948). *Itunella intermedia* was known only for a rivermouth interstitial habitat in Vélékà (Bulgaria) "par 1 m de la nappe phréatique de la plage près de la rivière" (Apostolov, 1975). In Sardinia, we collected this species in interstitial fresh water near the mouth of the Liscia River at about 500 m from the sea and also near the mouth of the Vignola River at about 70 m from the sea. In the Liscia River, *I. intermedia* was collected together with *Schizopera* sp.; *Nitocrella beatrix*; *Delamarella galatae* Cottarelli, 1971; *Psammopsyllus maricae*; *Epactophanes richardi* Mrázek, 1893. In the Vignola Stream, the species was collected with *Ichnusella longifurca*, *Parastenocaris oligoalina* and *Psammopsyllus maricae*.

DISCUSSION

Ichnusella improvisa sp. nov. has one curved apical tip on the caudal rami like *I. tertia* and *I. pasquinii*. The affinities with *I. tertia* also regard the morphology of the mouth parts, since the two species have the same ornamentation of Mx1, and the Mx differ only for one more spine in *I. tertia*.

The male of *I. improvisa* sp. nov., has a rectangular P3-Exp2, which in *I. tertia* has a strong tip on the distal inner corner, and in *I. pasquinii* seems to be less modified than in the other species of the genus. The male P5 is very similar to that of *I. longifurca*, but it should be emphasised that the latter species is characterised by longer caudal rami.

The peculiar feature of *I. improvisa* sp. nov. is the dimorphic P1: in the male, the End-1 bears a transformed seta which is normal in the female. The same seta is not transformed in both sexes of all the other *Ichnusella*.

On the basis of the morphology of the new species, we provide a new key for the genus:

- 1 - Caudal rami distinctly longer than anal somite in both sexes. 2
- Caudal rami shorter than, or as long as, anal somite in both sexes. 3
- 2 - Apex of caudal rami with two curved spines in both sexes. *I. eione*
- Apex of caudal rami with one curved spine in both sexes. *I. longifurca*
- 3 - Male P3 Exp-2 not very enlarged; innermost lobe of male P5 with only one curved spine; distal margin of

- female P5 with four setae of different length
 *I. pasquinii*
 - Male P3 Exp-2 enlarged and prolonged in a strong
 tip on the distal inner corner; innermost lobe of
 male P5 with two spines; female P5 with one very
 strong spiniform seta, one long seta, two spines . . .
 *I. tertia*
 - P1 End-1 of the male bearing a transformed seta; P3
 Exp-2 of the male enlarged but not prolonged in a
 strong tip on the distal inner corner; P5 innermost
 lobe of the male with one spine
 *I. improvisa* sp. nov.

The collection of a new species of *Ichnusella* amends the diagnosis of the genus regarding the number of antennular segments given in Cottarelli *et al.*, 1999. New observations of specimens of all five species allow us to recognize an eight-segmented A1 in the male, and to confirm a six-segmented A1 in the female. It is useful to recall here that this feature is not exclusive for *Ichnusella* because we observed the same antennular segmentation in other genera belonging to the subfamily Psammöpsyllinae Krishnaswamy, 1956 and in particular in *Psammöpsyllus maricae* (Cottarelli V. & Berera R., unpubl. data).

As regards *Itunella intermedia*, this species is reminiscent of *I. muelleri* but, as emphasised by Apostolov (1975), the two species differ in the ornamentation and the morphology of P2 and P4 exopods of both sexes. In this work, we presented the male P2-P4 (Fig. 9A-C), in order to compare also the endopods which were not discussed by Apostolov (1975). These rami, in fact, show different shape and ornamentation. The male P2 Exp-2 and the P3 Exp-2 and Exp-3 of *I. intermedia* bear a transformed seta on the inner margin, whereas this seta is normal in the other species. Other peculiar features not reported by Apostolov (1975), that distinguish the two species, are: the abdominal somite distal margin is strongly denticulated in *I. muelleri* and smooth in *I. intermedia*; the different chaetotaxy of A2 exopod (Fig. 9D), of the mandibular palp (Fig. 9E), and of the Mx1 basis (Fig. 9F). Finally, Mx endopod is still present, although reduced, in *I. muelleri* (Fig. 9G), whereas it is lacking in *I. intermedia*.

REFERENCES

- Apostolov A., 1969 - Harpacticoiden (Crustacea Copepoda) von der bulgarischen Küste. Zool. Anz., 183: 259-267.
 Apostolov A., 1975 - Les harpacticoides marins de la Mer Noire. Description de quelques formes nouvelles. Vie Milieu, 25: 165-178.

- Apostolov A., Marinov T., 1988 - Copepoda, Harpacticoida. Fauna Bulgarica, vol. 18. In Aedibus Acad. Sci. Bulgaricae, Sofia, 384 pp.
 Argano R., Bruno M. C., Ceccherelli V. U., Cottarelli V., Mariniello L., Mazzocchi M. G., Pesce G. L., Principato M., Relini G., Stella E., 1995 - Crustacea Maxillopoda, Pentastomida. In: A. Minelli, S. Ruffo & S. La Posta (eds), Checklist delle specie della fauna italiana, vol. 28. Calderini, Bologna, 57 pp.
 Chappuis P. A., 1954 - Recherches sur les crustacés souterrains. IV - Copépodes psammiques des plages du Roussillon. Arch. Zool. exp. gén., 91: 35-50.
 Chappuis P. A., Serban M., 1953 - Copépodes de la nappe phréatique de la plage d'Agigea près Constanza. Notes biospéol., 8: 91-102.
 Chislenko L. L., 1967 - Garpaktitsidy (Copepoda Harpacticoida) Karelskogo pobezeh'ya Belogo morya (Copepoda Harpacticoida of the Karelian coast of the White Sea. Gidrobiol. Issled. na Karel'skom poberezh'e Belogo morya (Issled. Fauny Morey), 7: 48-198.
 Cottarelli V., 1971 - *Ichnusella eione* n. gen. sp. nov. (Copepoda, Harpacticoida), nuovo crostaceo di acque interstiziali italiane. Ist. Lombardo Accad. Sci. Lett. B, 105: 57-70.
 Cottarelli V., Bruno M. C., 1997 - First record of Parastenocarididae (Crustacea, Copepoda: Harpacticoida) from subterranean waters of insular Greece and description of two new species. Int. J. Speleol., 25 (1996): 43-57.
 Cottarelli V., Bruno M. C., Berera R., 1999 - Remarks on the genus *Ichnusella* (Crustacea, Copepoda, Harpacticoida) and description of *Ichnusella tertia* sp. nov. and *Ichnusella longifurca* sp. nov. from interstitial habitat of rivermouths in Latium and Sardinia, Italy. Vie Milieu, 49: 129-143.
 Delamare Deboutteville C., 1960 - Biologie des eaux souterraines littorales et continentales. Hermann, Paris, pp. 740.
 Dussart B. H., Defaye D., 1990 - Répertoire mondial de crustacés copépodes des eaux intérieures. III. Harpacticoides. Crustaceana, 16 (suppl.): 1-384.
 Huys R., Gee J. M., Moore C. G., Hamond R., 1996 - Marine and brackish water harpacticoid copepods, 1. Synop. Br. Fauna new Ser., 51: 1-352.
 Kiefer F., 1960 - Psammobionte Ruderfusskrebse (Crust. Cop.) aus dem Gebiet der Unterweser und von der Insel Helgoland. Zool. Anz., 165: 30-26.
 Lang K., 1948 - Monographie der Harpacticiden. Nordiska Bøkhandeln, Stockholm, 1682 pp.
 Marinov T. M., 1971 - Kharpatikoidi ot b'lgarskoto kraibrezhnie na Chernom more (Harpacticoides of the Bulgarian Black Sea coast). Izv. Inst. Okeanogr. Rib. Stop. Varna, 11: 43-87.
 Noodt W., 1954 - Sandstrand - Copepoden von der Schwedischen Ostküste. Kungl. Fysiograph. Sällskap i Lund Förhandl., 24: 1-8.
 Noodt W., 1970 - Zur Ökologie der Copepoda Harpacticoida des Küstengebietes von Tvärminne (Finnland). Acta zool. Fenn., 128: 1-35.
 Roe K. M., 1958 - The littoral harpacticids of the Dalkey (Co. Dublin) area with descriptions of six new species. Proc. R. Ir. Acad. B, 59: 221-255.
 Vigna Taglianti A., Audisio P. A., Biondi M., Bologna M. A., Carpaneto G. M., De Biase A., Fattorini S., Piattella E., Sindaco R., Venchi A., Zapparoli M., 1999 - A proposal for a chorotype classification of the Near East fauna, in the framework of the Western Palearctic region. Biogeographia, 20: 31-59.
 Wells J. B. J., 1961 - Interstitial copepods from the Isles of Scilly. Crustaceana, 2: 262-274.