Hydrobiologia 148: 103–114 (1987)

New or rare species of *Diacyclops* Kiefer, 1927 (Copepoda, Cyclopoida) from different groundwater habitats in Italy(*)(**)

Giuseppe L. Pesce & Diana P. Galassi
Dipartimento di Scienze Ambientali-University of L'Aquila, Italy

Keywords: taxonomy, groundwater crustaceans, Copepoda, *Diacyclops*, Palaeartic Region, Italy

Abstract

Diacyclops paralanguidoides sp.n., *Diacyclops paolae* sp.n., *Diacyclops maggii* sp.n. and *Diacyclops sardous* sp.n., all belonging to the '*languidoides*-group' of species, are described from groundwaters (wells, hyporheic habitats) in Italy.

New localities are reported, from the same country, for other remarkable species of the genus, viz. *Diacyclops clandestinus* (Kiefer) and *Diacyclops zschokkei* (Graeter).

The absence of a vestigial exopod and the armature of the basipodite of the antenna are considered as useful diagnostic characters for species demarcations.

Introduction

Recent stygobiological research on groundwaters (springs, wells and hyporheic habitats) in Italy by the 'Dipartimento di Scienze Ambientali' of the University of L'Aquila, Italy [Pesce, 1980, 1983, 1984, in press; Pesce & Galassi, 1983; Pesce & Tetè, 1985] have yielded large numbers of cyclopoid copepods of the '*Diacyclops languidoides*-group'. Among these, noteworthy species, such as *Diacyclops clandestinus* (Kiefer) and *Diacyclops zschokkei* (Graeter) were identified; four taxa, viz. *Diacyclops paralanguidoides* sp.n., *Diacyclops paolae* sp.n., *Diacyclops maggii* sp.n. and *Diacyclops sardous* sp.n. are described as new.

These new finds greatly enlarge the number of known groundwater species of *Diacyclops* in Italy, suggesting that this genus is more widespread in that country than previously thought.

So far, the following species and subspecies have been recorded in groundwaters of Italy: *D. languidoides languidoides* (Lilljeborg), widely distributed in epigean and underground waters of the Alpine and Apennine provinces [*sensu* Pesce, 1985]; *D. hypnicola* (Gurney), from epigean and groundwaters of northern Italy (Veneto); *D. clandestinus* (Kiefer), widely distributed in subterranean waters of the northern and central Apennines; *D. languidoides italianus* (Kiefer), from cave habitats of the Alpine province; *D. zschokkei* (Graeter), from caves and phreatic habitats of the north-central Apennines; *D. languidoides aprutinus* Pesce & Fabrizi, endemic to central Italy (Abruzzo); *D. languidoides nagysalloensis* Kiefer, from the phreatic network of south Italy; *D. nuragicus* Pesce & Galassi, from phreatic waters of Sardinia; *D. ichnusae* Pesce & Galassi, from hyporheic waters of Sardinia; *D. lindae* Pesce, from phreatic waters of Basilicata, southern Italy; *D. paralanguidoides* sp.n., *D. paolae* sp.n., *D. maggii* sp.n. and *D. sardous* sp.n. (present data).

* Research supported by a M.P.I. 60% grant. 'Gruppo Nazionale C.N.R.-Biologia Naturalistica'.

** Contribution to the knowledge of the underground water fauna in central and southern Italy: XXXVIII.

Among these, seven (*D. clandestinus, D. nuragicus, D. ichnusae, D. lindae, D. paralanguidoides* sp.n., *D. paolae* sp.n., *D. sardous* sp.n.) are true stygobionts; three (*D. languidoides aprutinus, D. languidoides nagysalloensis, D. maggii* sp.n.) are eustygophiles, showing characteristic morphological adaptations to life in subterranean waters, while the remainder (*D. languidoides languidoides, D. languidoides italianus, D. hypnicola, D. zschokkei*) are stygophiles or stygoxenes.

Rylov [1948], and later Pesce [1985], mentioned also *D. languidoides goticus* (Kiefer) from groundwaters of northern Italy, but this record is still doubtful.

Material and methods

Samples were taken with a modified [Cvetkov, 1969] plankton net with nylon gauze 120 HD, and fixed with 4% formaline. Copepods were sorted using a M8 Wild stereo-microscope; specimens for study were dissected in polyvinil lactophenol or in Faure's medium.

The following abbreviations are used throughout the text and figures: A_1 = antennulae; A_2 = antennae; $P_1 - P_5$ = legs 1 to 5; Ti = inner apical, furcal seta; Te = outer apical furcal seta; DSAA = 'Dipartimento di Scienze Ambientali', University of L'Aquila (Italy), senior Author's collection.

Body length measurements are along the mid-dorsal line, from the frontal margin, excluding antennulae, to the end of the furcal rami, furcal setae excluded.

CYCLOPIDAE

Diacyclops Kiefer, 1927
Diacyclops paralanguidoides sp.n.

Type material. Holotype (1 female, DSAA, ER.66/1) and allotype (1 male, DSAA, ER.66/2) from a fresh-water well at Raiale (Bologna, central Apennine) (type-locality), 26 July 1985, coll. P. Marchegiani & L. Polidori. Paratypes: 4 females and 1 male from the same station (DSAA, ER.66/3–7); 1 female, fresh-water well at Forlimpopoli (Forli, central Apennine) (DSAA, ER.25/1), 7 August 1984, coll. P. Marchegiani & L. Polidori; 3 females, fresh-water well at Rimini (Forli) (DSAA, ER.56/1–3), 13 August 1984, coll. P. Marchegiani & L. Polidori; 5 females, fresh-water well, Castel Maggiore (Bologna) (DSAA, ER.69/1–5), 27 July 1985, coll. P. Marchegiani & L. Polidori; 2 females, fresh-water well, Castello d'Argile (Bologna) (DSAA, ER.75/1–2), 27 July 1985, coll. P. Marchegiani & L. Polidori; 1 female, fresh-water well at Capracotta (Isernia, Molise, south Apennine (DSAA, MO.73/1), 7 December 1985, coll. E. Vitelli & F. Palmucci; 3 females, fresh-water well, valle del Baccano (Roma, Latium) (DSAA, LA.38/1–3), 2 December 1985, coll. M. C. Curia & A. Canossi; 2 females, fresh-water well, Numana (Ancona, Marche) (DSAA, MA.24/1–2), 27 December 1978, coll. G. Baldoni; 2 females, fresh-water well at Senigallia (Pesaro, Marche (DSAA, MA.58/1–2), 20 March 1979, coll. G. L. Pesce & D. Maggi.

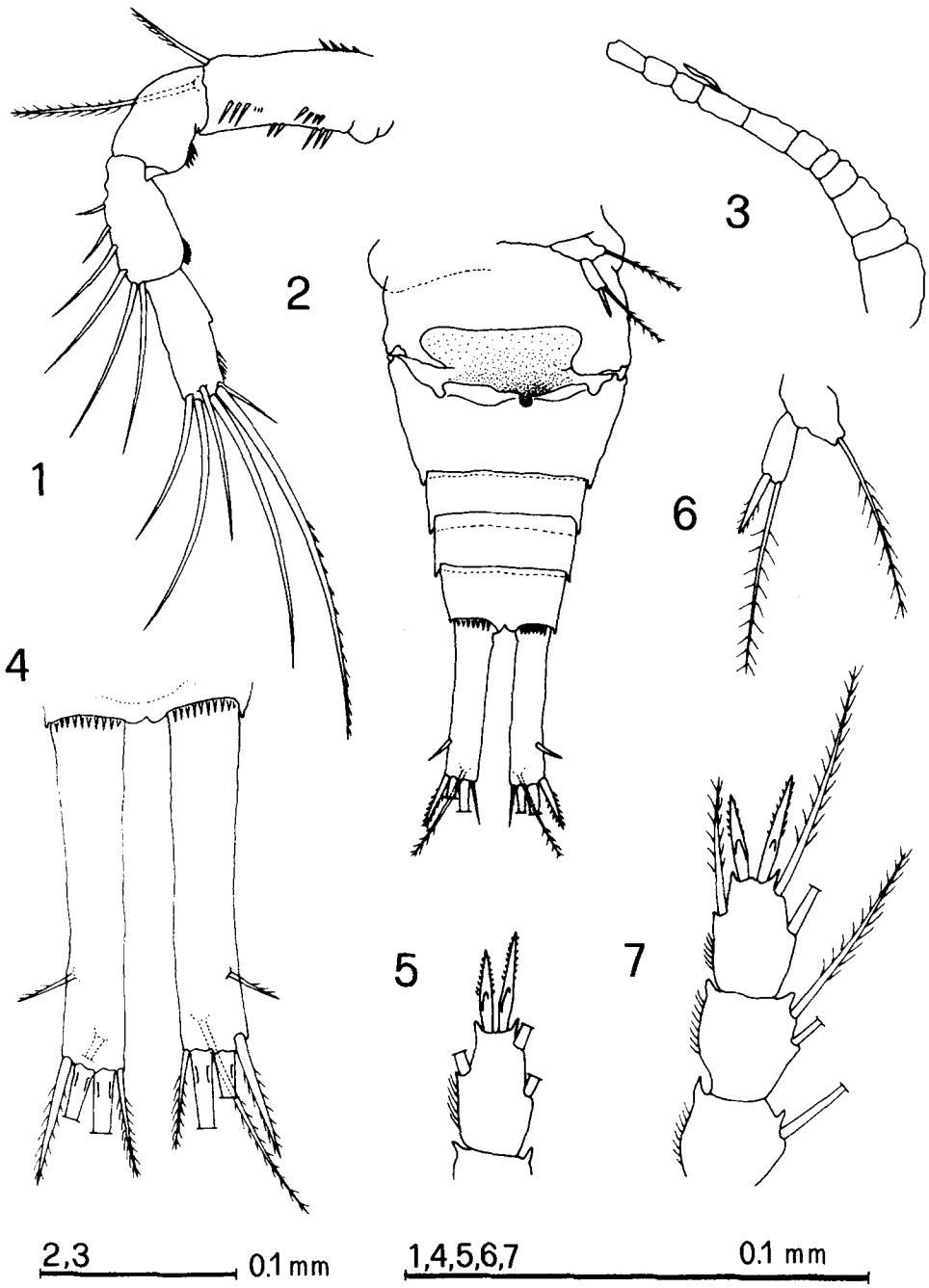
Description

Female. Total length 590–630 μm, holotype 596 μm. Genital segment nearly as broad as long in the proximal third. Furcal rami longer than wide (length/width ratio: 5.10–6.10); outer and inner, apical setae shorter than each furcal ramus; Ti shorter than Te (Figs. 2–4); dorsal seta shorter than ramus and longer than both the outer and the inner apical setae.

A_1: 11-jointed, reaching to about the middle of the cephalothorax. A_2: 4-jointed, without exopod; basipodite with reduced armature (Fig. 1).

Both rami of P_1 2 jointed, those of P_3 and P_4 3-jointed; exopod of P_2 3-jointed, endopod 2-jointed. Spinae and setae formula of the distal joint of exopods of $P_1 - P_4$, respectively: 3333 and 5444.

Distal joint of endopod of P_4 elongated (length/width ratio: 1.40–1.55); inner, apical spine shorter than the joint and longer than the outer one. Terminal joint of P_5 about twice longer than wide, distal spine as long as the joint.



Figs. 1–7. Diacyclops paralanguidoides sp.n. Female 1. A_2; 2. abdomen and furcal rami, ventral view; 3. A_1; 4. furcal rami, ventral view; 5. endopod of P_4, distal joint; 6. P_5; 7. endopod of P_4.

Male. Total length 545–595 μm, allotype 560 μm. P_6: inner spine and middle seta of equal length, outer seta about twice as long as spine. Other characteristics as in the females.

Etymology. The specific name '*paralanguidoides*' refers to the similarity of this species with *D. languidoides* s.str.

Habitat. The species occurred in groundwater (phreatic network) of the central Apennines (Emilia Romagna, Latium, Marche) (water level at 8.5–9.0 m; depth of interstitial water: 5.2–6.5 m; pH and temperature ranges 6.9–7.1 and 14.9–15.5 °C, respectively; bottom sediment composed of sandstone detritus and clay). *D. paralanguidoides* sp.n. lives together with other stygobionts, such as cyclopid copepods (*Diacyclops paolae* sp.n., *Diacyclops clandestinus*), harpacticoid copepods (*Elaphoidella phreatica* Chappuis), asellid isopods (*Proasellus adriaticus* Argano & Pesce), amphipods (*Niphargus orcinus* Joseph), gastropods (*Arganiella pescei* Giusti & Pezzoli), ostracods and water mites.

Differential diagnosis. According to the structure and ornamentation of the antenna, recently Pesce & Galassi [1985] suggested the subdivision of the species and subspecies of *D. languidoides* s.l. in two morphological and ecological groups, including respectively stygobiont, groundwater species lacking an exopod on the antenna and with reduced or absent armature on the relative basipodite, and stygophilic, mainly epigean species with exopod and well developed armature on the basipodite of the antenna.

According to the above proposal, *D. paralanguidoides* n.sp. fits into the first group, owing to its peculiar ecology, the absence of an exopod on the antenna and the reduced armature on the basipodite of the antenna. The new species differs from other species of the same group (*D. clandestinus, D. insularis* Monchenko, *D. nuragicus, D. ichnusae, D. paolae* sp.n., *D. sardous* sp.n., *D. lindae*) by the peculiar armature of the basipodite of the antenna (spines on frontal and inner sides only) and the length of the furcal rami (length/width ratio: 5.10–6.20 in *D. paralanguidoides*; 3.50–3.83 in *D. clandestinus*; 3.30–4.10 in *D. insularis*; 3.70–3.92 in *D. nuragicus*; 2.01–2.15 in *D. ichnusae*; 3.10–3.30 in *D. paolae* sp.n.; 3.30–3.41 in *D. sardous* sp.n.; 3.61–3.82 in *D. lindae*).

Diacyclops paolae sp.n.

Type material. Holotype (1 female, DSAA, ER.1/1) from a fresh-water well at Brisighella (Forli), 4 August 1984, coll. P. Marchegiani & L. Polidori. Paratypes: 1 female (DSAA, ER.27/1), fresh-water well at Villanova (Forli), 7 August 1984, coll. P. Marchegiani & L. Polidori; 1 female (DSAA, ER.30/1), fresh-water well at Forli, 1 August 1984, coll. P. Marchegiani & L. Polidori; 1 female (DSAA, ER.66/1), fresh-water well at Raiale (Bologna), 2 July 1985, coll. P. Marchegiani & L. Polidori; 2 females (DSAA, ER.94/1–2), fresh-water well at Marrana (Ferrara, Emilia, central Apennine), 27 July 1985, coll. P. Marchegiani & L. Polidori.

Description. Total length 410–418 μm, holotype 412 μm. Genital segment about as long as wide. Furcal rami short (length/width ratio: 3.1–3.3); outer and inner, apical setae shorter than furcal ramus and subequal in length; dorsal seta about as long as furcal ramus (Figs. 10–11).

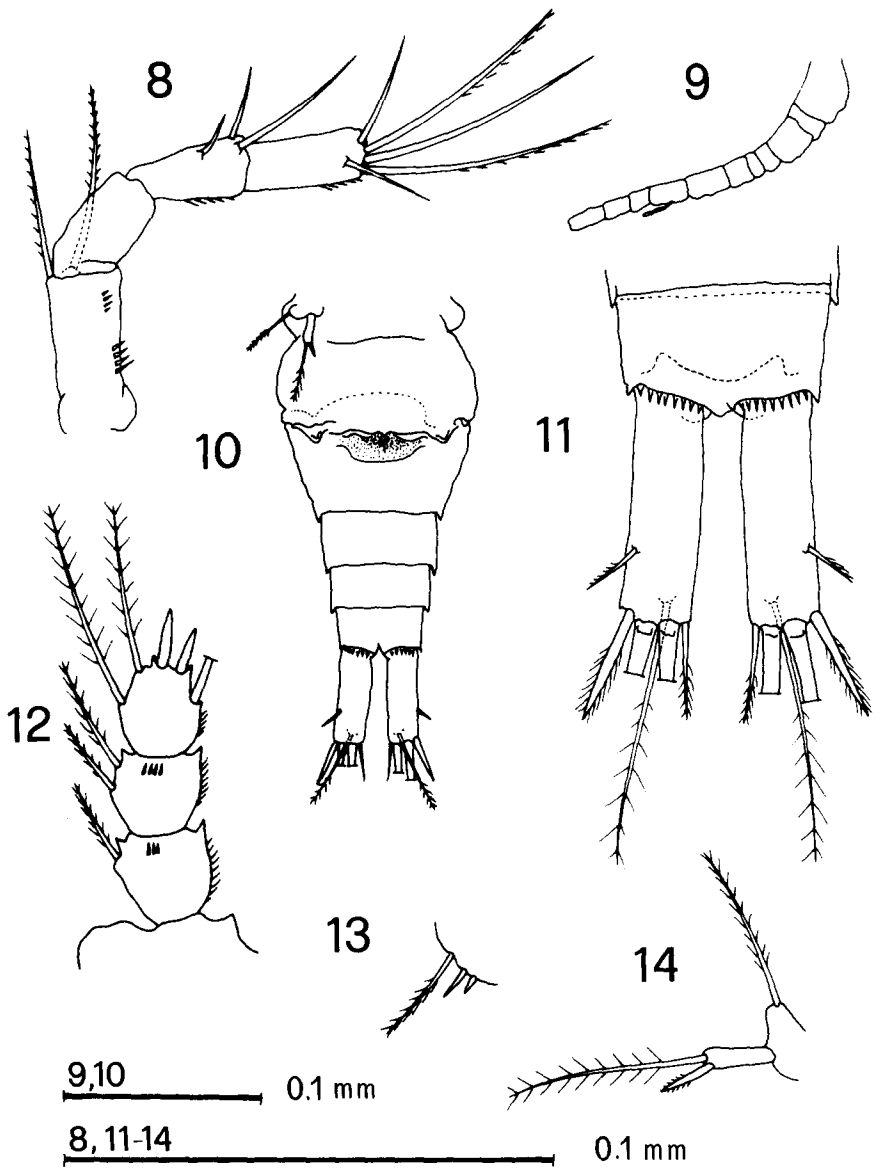
A_1, 11-jointed, overreaching the middle of cephalothorax. A_2, 4-jointed, without exopod; armature of the basipodite consisting of two rows of 3–4 spines along the outer, ventral margin (Fig. 8).

Both rami of P_1 2-jointed, those of P_3 and P_4 3-jointed; exopod of P_2, 3-jointed, endopod of the same leg 2-jointed. Spinal and setal formula of the distal joint of exopods P_1–P_4, respectively: 3333 and 5444. Enp. 3 of P_4 rounded, about as long as wide (length/width ratio: 1.04–1.05); both apical spines shorter than the joint, the inner slightly longer than the outer one (Fig. 12). Terminal joint of P_5 about 3 times longer than wide, distal spine shorter than the joint (Fig. 14).

Male unknown.

Etymology. Specific name after miss Paola Marchegiani who collected the new species.

Habitat. The new species has been collected in phreatic waters (wells) of the central Apennines (Emilia Romagna) (water level from the soil surface: 11.5–12.3 m; water depth: 8.2–8.5 m; pH and temperature ranges 6.7–7.1 and 14.5–15.7 °C, respectively; bottom sediment composed of sandstone detritus). *D. paolae* sp.n. occurs in the same



Figs. 8–14. Diacyclops paolae sp.n. Female 8. A_2; 9. A_1; 10. abdomen and furcal rami, ventral view; 11. furcal rami, ventral view; 12. endopod of P_4; 13. P_6; 14. P_5.

biocoenoses as *D. paralanguidoides* sp.n. and *D. clandestinus*, and the cohabitation of these animals allows us to rank them at the specific rather than the subspecific level.

Other stygobionts living in the same biocoenoses are the cyclopid *Diacyclops antrincola* Kiefer, the harpacticoid copepods *Elaphoidella elaphoides* (Chappuis) and *Nitocrella morettii* Pesce, ostracods and water mites.

Taxonomic remarks. D. paolae sp.n. belongs to the same group as *D. paralanguidoides* sp.n., resembling *D. clandestinus* in the morphology and armature of the furcal rami and in the construction of P_5; the main differences are in the shape of the genital segment (about as long as wide in *D. paolae* sp.n., wider than long in *D. clandestinus*) and in the morphology and armature of the distal joint of the endopod of P_4 (length/width ratio: 1.04–1.05 in

D. paolae sp.n., 1.25–1.30 in *D. clandestinus*; inner apical spine much shorter than the width of the joint in *D. paolae* sp.n., subequal to the width of the joint in *D. clandestinus*).

Diacyclops maggii sp.n.

Type material. Holotype (1 female, DSAA, PU.84/1) and allotype (1 male, in alcohol 60°, DSAA, PU.84/2) from a brackish-water well at Lesina (Foggia, south Italy), 23 June 1976, coll. G. L. Pesce & G. Silverii. Paratypes: 3 females and 1 male (in alcohol 60°) from the same locality (DSAA, PU.84/3–6); 2 females and 1 male (DSAA, PU.143/1–3), brackish-water well at Mola di Bari (Bari, south Italy), 12 July 1979, coll. G. L. Pesce, G. Silverii and D. Maggi; 2 females (DSAA, U.71/1–2), fresh-water well at Marsciano (Perugia, Umbria, central Italy), 3 September 1985, coll. B. Di Francescantonio.

Description.

Female. Total length 480–505 μm, holotype 491 μm. Genital segment nearly as broad as long (Fig. 20).

Furcal rami (Figs. 18, 20) longer than wide (length/width ratio: 3.01–3.20); inner and outer terminal setae subequal in length, or the inner a little longer than the outer one (Ti/Te = 1.15–1.31); dorsal seta longer than ramus.

A_1, 11-jointed, overreaching the middle of cephalothorax. A_2, 4-jointed, with well developed exopod, overreaching the distal joint; basipodite, armature as in Fig. 16.

Both rami of P_1 2-jointed, those of P_3 and P_4, 3-jointed; exopod of P_2, 3-jointed, endopod 2-jointed. Spinal and setal formula of the distal joint of exopods P_1–P_4, respectively: 3333 and 5444. Distal joint of the P_4 endopod elongated (length/width ratio: 1.56–1.68); inner apical spines slender, divaricate, the inner longer than the outer and than the joint (spine length/joint length=1.10; spine length/joint width=1.75–1.93); the outer spine about as long as the joint (Figs. 19, 21). Terminal joint of P_5 twice longer than wide, distal spine as long as the joint.

Male. Total length 460–472 μm; allotype 480 μm. P_6: inner spine and middle seta of equal length, outer seta longer than spine. Other characteristics as in the female.

Etymology. Specific name after Dr. Domenico Maggi who participated in the fieldwork and collected the new species.

Habitat. The new species lives in slightly brackish and fresh ground-waters of Apulia (south Italy) and Umbria (central Italy), respectively (water level at 5.4–6.2 m; depth of the interstitial water: 2.5–3.0 m; salinity and temperature ranges 0.9–1.2‰ and 14.5–15.5 °C, respectively; pH: 6.7–6.9; bottom sediment composed of organic sandstone detritus).

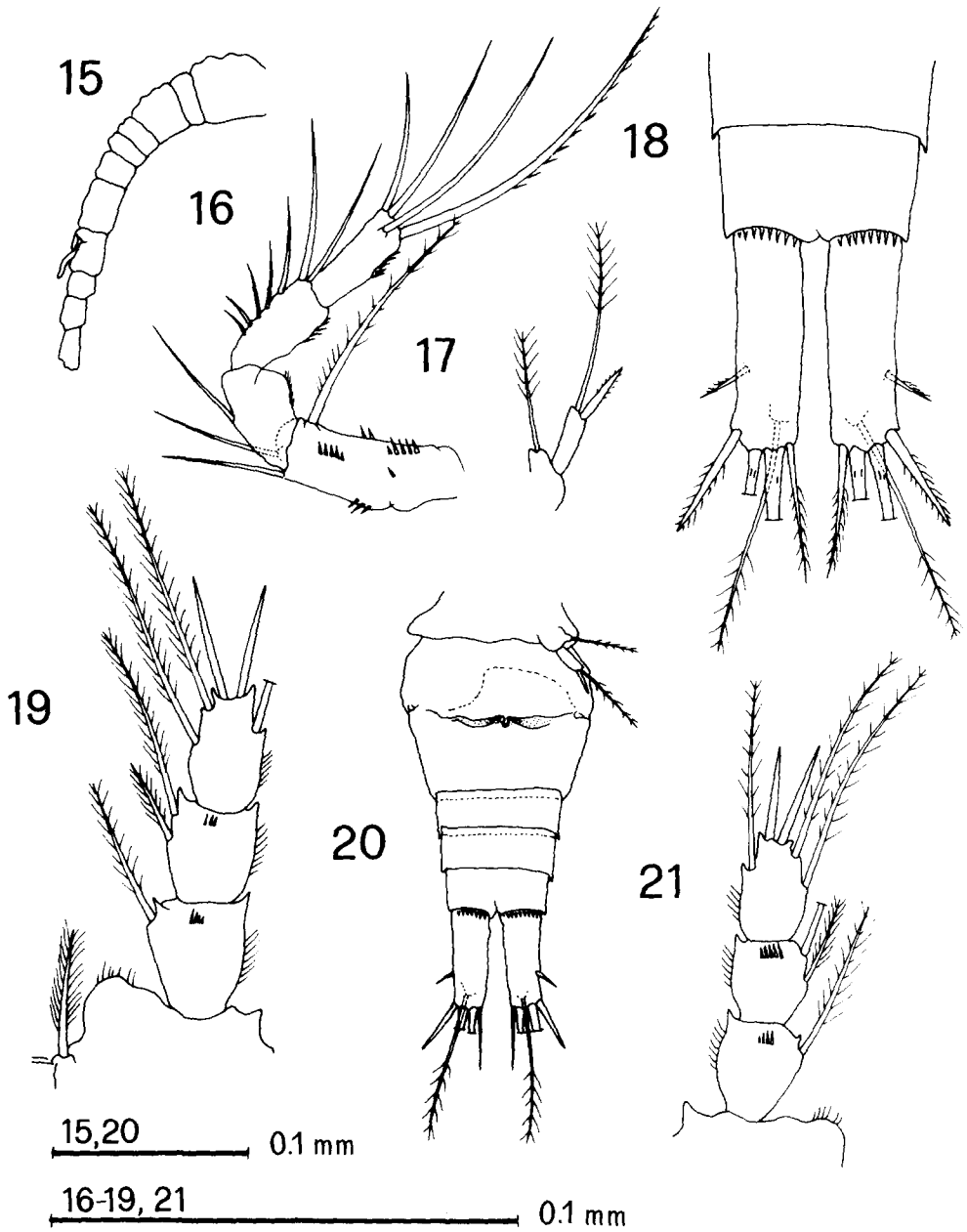
D. maggii sp.n. lives in association with other remarkable stygobionts, such as cyclopid copepods (*Diacyclops clandestinus, Metacyclops subdolus* Kiefer, *Diacyclops antrincola* Kiefer), harpacticoid copepods (*Nitocrella stammeri* Chappuis), mysidaceans (*Spelaeomysis bottazzii* Caroli, *Stygiomysis hydruntina* Caroli), amphipods (*Niphargus orcinus*), ostracods, oligochaetes, and water mites.

Taxonomic remarks. D. maggii sp.n., owing to its ecology and the presence of a well developed exopod on the antenna, is placed in the group of stygophilic species of *D. languidoides* s.l.

Within this group it is close to *D. cohabitatus* Monchenko, from cave waters of the Ukraine, and to *D. languidoides* s.str., widely distributed in the Palaeartic area. However, the small size, the remarkable length of the apical spines on the P_4 endopod (inner spine length/joint length=1.10–1.15 in *D. maggii* sp.n.; 0.68–0.75 in *D. cohabitatus*; 0.72–0.86 in *D. languidoides* s.str.) and the length ratio between the inner and outer apical furcal setae (Ti/Te=1.09–1.31 in *D. maggii* sp.n.; 0.67–0.92 in *D. languidoides* s.str.; 1.52–1.81 in *D. cohabitatus*) differentiate the new species from its close relatives as well as from all other representatives of the same group.

Diacyclops sardous sp.n.

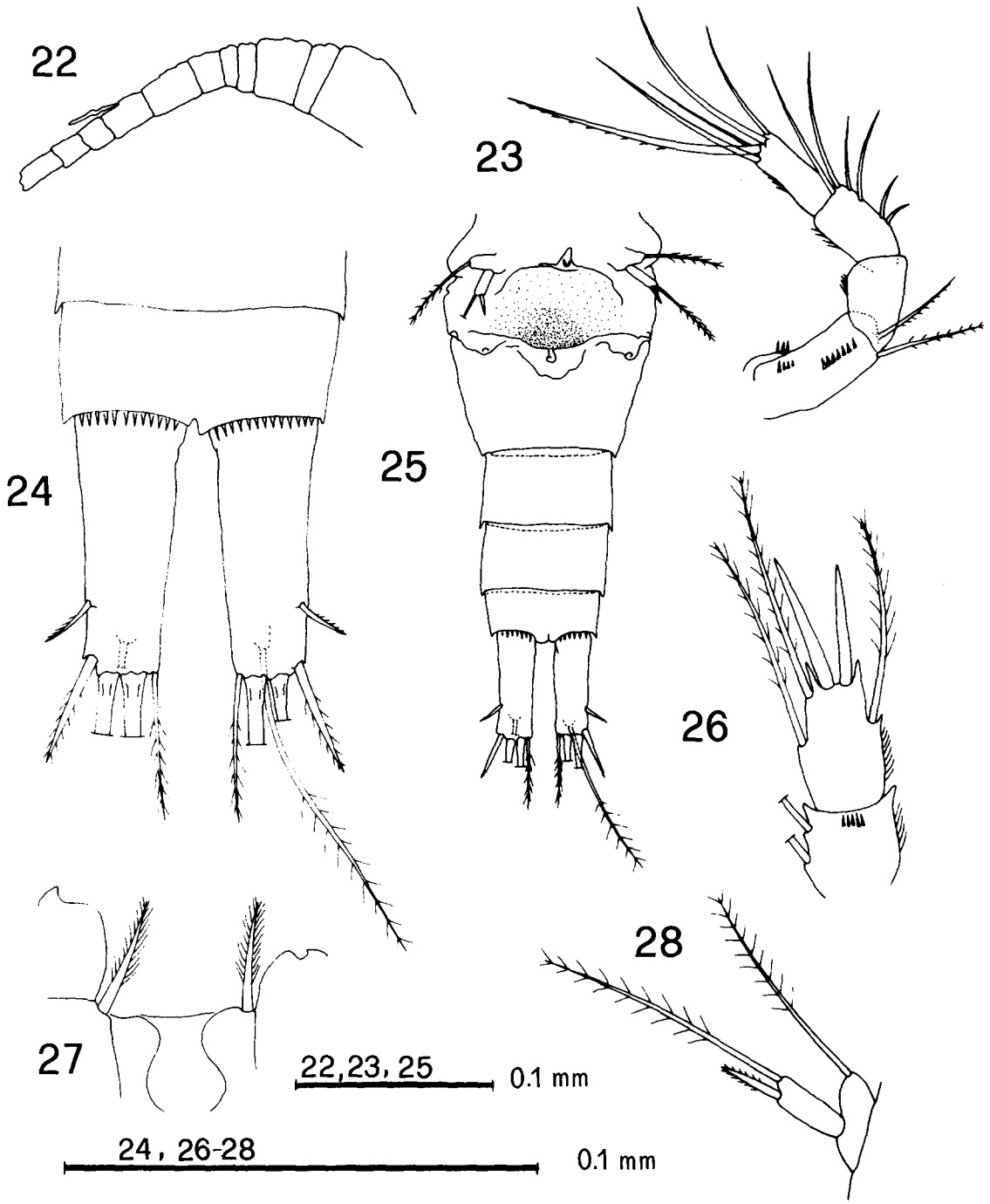
Type material. Holotype (1 female, DSAA,



Figs. 15–21. Diacyclops maggii sp.n. Female 15. A_1; 16. A_2; 17. P_5; 18. furcal rami, ventral view; 19. endopod of P_4 (holotype); 20. abdomen and furcal rami, ventral view; 21. endopod of P_4 (paratype).

SA./38/1), from a brackish-water well at Capo Spartivento, Cagliari (Sardinia), 3 November 1979, coll. G. L. Pesce, D. Maggi and G. Silverii. Paratypes: 3 females, same locality (DSAA, SA.38/2–4).

Description. Total length 520–590 μm, holotype 538 μm. Posterior borders of thoracic and abdominal segments smooth. Genital segment (Fig. 25) nearly as broad as long in the proximal third. Anal segment with denticles only ventrally, at the base of furcal rami.



Figs. 22–28. Diacyclops sardous sp.n. Female 22. A_1; 23. A_2; 24. furcal rami, ventral view; 25. abdomen and furcal rami, ventral view; 26. distal joint of P_4 endopod; 27. coxal plate of P_4; 28. P_5.

Furcal rami (Figs. 24, 25) 3.3–3.4 times longer than wide; inner apical seta about 1.4 times longer than the outer; dorsal seta much longer than furcal ramus.

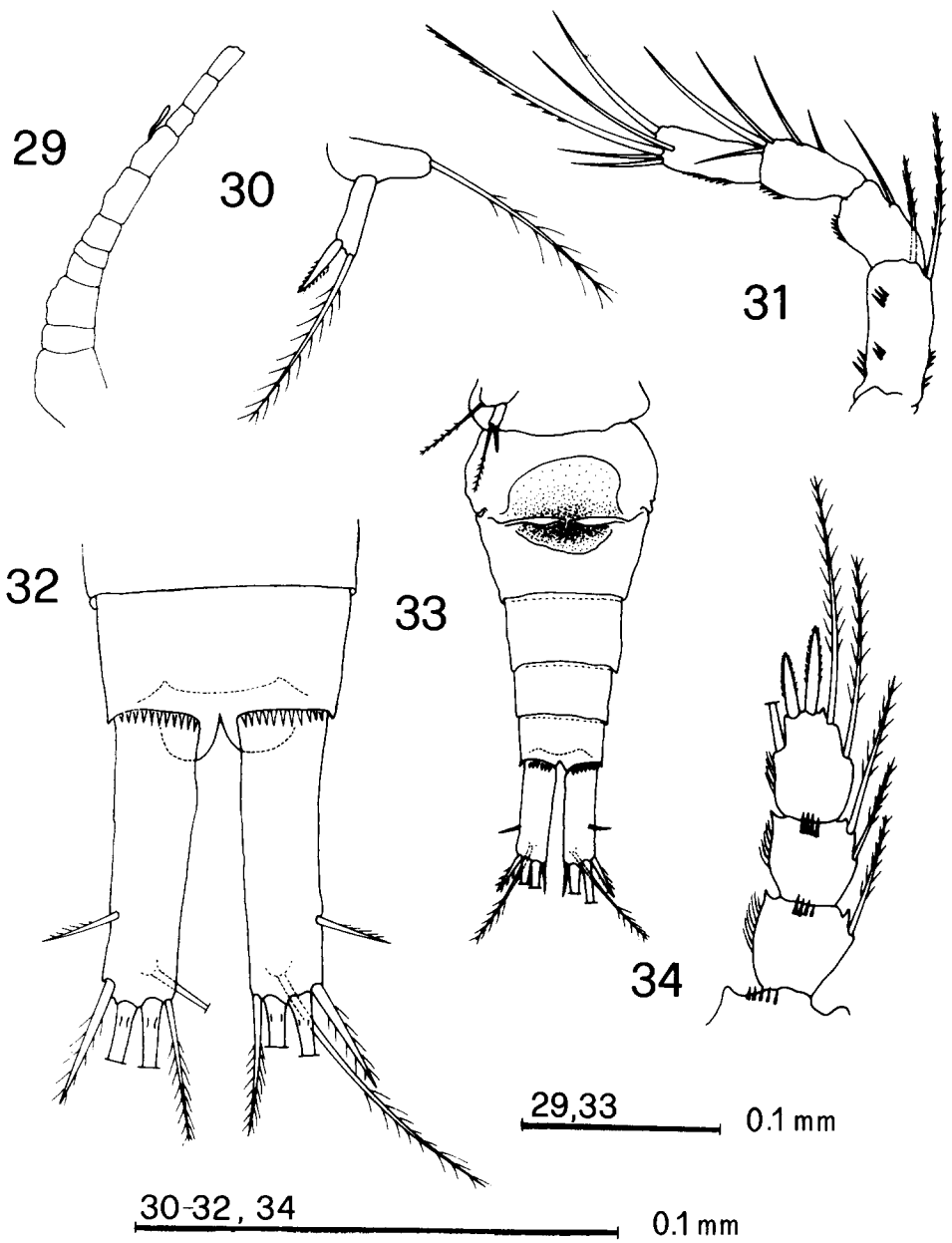
A_1, 11-jointed, reaching about middle of cephalothorax. A_2, 4-jointed, without exopod; basipodite with reduced armature (Fig. 23).

Both rami of P_1 2-jointed, those of P_3 and P_4

3-jointed; exopod of P_2 3-jointed, endopod of the same leg, 2-jointed. Spinae and setae formula of the distal joint of exopod of P_1-P_4, respectively: 3333 and 5444. Distal joint of endopod of P_4 about 1.5 times longer than wide; inner apical spine longer than the outer and the joint (Fig. 26). Terminal joint of P_5 elongated, about 3 times longer than wide, distal spine shorter than the joint.

Male unknown.

Habitat. This species occurred in a brackish-water well near the sea (water level from the soil surface:

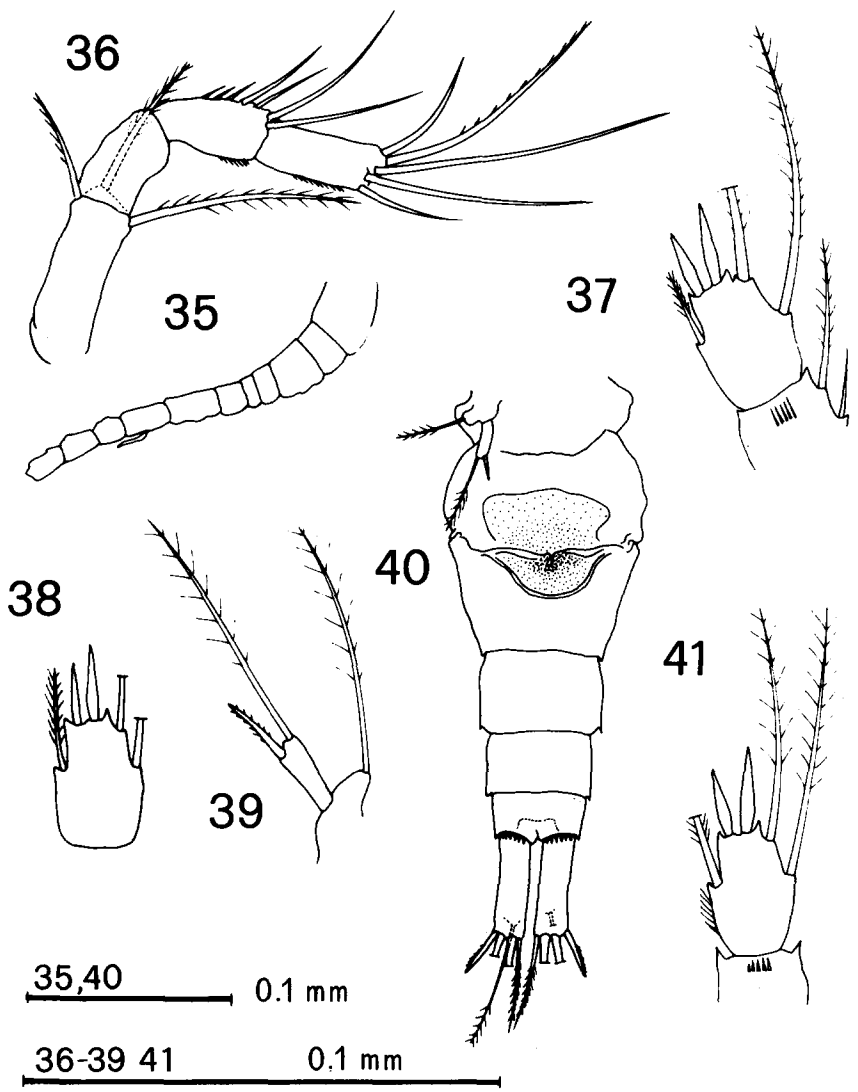


Figs. 29–34. Diacyclops clandestinus [Kiefer]. Female 29. A_1; 30. P_5; 31. A_2; 32. furcal rami, venral view; 33. abdomen and furcal rami, ventral view; 34. endopod of P_4.

6.5 m; water depth: 2.5 m; salinity and temperature respectively 0.9‰ and 16.2 °C; bottom sediment composed of thin sandstone detritus). The new species lives in association with other stygobionts, such as harpacticoid copepods (*Nitocrella stammeri* Chappuis), asellid isopods (*Proasellus* sp.), stenasellid isopods (*Stenasellus nuragicus* Argano), amphipods (*Bogidiella silverii* Pesce), ostracods, gastropods, and water mites.

Differential diagnosis. D. sardous sp.n., owing to the absence of an exopod on the antenna, the length of dorsal furcal setae and the length ratio between inner and outer, apical furcal setae, closely resembles *D. ichnusae*, also from Sardinia. From this species, *D. sardous* sp.n. differs by the different armature of the basipodite of the antenna, the length of furcal rami (length/width ratio = 3.30–3.40 in *D. sardous* sp.n.; 2.09–2.10 in *D. ichnusae*) and the length of P_4 endopod (length/width ratio = 1.49–1.52 in *D. sardous* sp.n.; 1.19–1.20 in *D. ichnusae*).

Five other species in the *languidoides*-group [(*D. maggii* sp.n., *D. balearicus* Lescher-Moutoué, *D.*



Figs. 35–41.Diacyclops zschokkei [Graeter]. Female 35. A_1; 36. A_2; 37. 38. 41. distal joint of P_4 endopod; 39. P_5; 40. abdomen and furcal rami, ventral view.

nanus (Sars), *D. slovenicus* Petkovski, *D. neglectus* Flossner)] have an elongated endopod 3 of P_4 and apical spines longer than the joint, but all these species have an exopod on the antenna. Moreover, they are mainly stygophiles.

Diacyclops clandestinus [Kiefer, 1926]

(Figs. 29–34)

Diacyclops languidoides clandestinus, Kiefer, 1936:11
Diacyclops clandestinus, Petkovski, 1984:36

Material. 18 females, 3 males (DSAA, U.71/1–21), fresh-water well at Marsciano, Perugia (central Italy), 3 September 1984, coll. B. Di Francescantonio; 3 females, 1 male (DSAA, A/1–4), fresh-water well at Torretta, L'Aquila (Abruzzo, central Italy), 2 July 1979, coll. G. L. Pesce; 1 female (DSAA, T/43.1), fresh-water well at Chiusi (Tuscany, central Italy), 24 September, coll. P. Bianchi; 3 females, 1 male (DSAA, ER.44/1–3), fresh-water well at S. Maria Palmense, Ascoli Piceno (Marche, central Italy), 30 August 1978, coll. G. Baldoni; 2 females, 1 male (DSAA, ER.44/1 + 3), fresh-water well at Savignano (Emilia-Romagna, central Italy), 28 July 1985, coll. P. Marchegiani.

D. clandestinus is a stygobiont, widely distributed in phreatic and underflow waters of the Palaeartic (Europe, Turkey, Ukraine, Syria, Lebanon) and Indo-Australian (Japan) regions.

This species has been previously recorded from different localities (wells and hyporheic habitats) of the northern and central Apennines and from Sardinia. It seems to be the most widely distributed cyclopoid copepod in the groundwaters of Italy.

Diacyclops zschokkei [Graeter, 1910)

(Figs. 35–41)

Diacyclops languidoides zschokkei, Kiefer, 1929:63
Diacyclops languidoides japonicus, Ito, 1952:118
Diacyclops languidoides putealis, Lescher-Moutoué, 1974:345
Diacyclops zschokkei, Petkovski, 1984:35

Material. 5 females, 2 males (DSAA, T.26/1–7), fresh-water well at Casalguidi, Pistoia (Tuscany, central Italy), 17 September 1984, coll. P. Bianchi.

D. zschokkei is a stygophilic species, which shows a wide distribution both in epigean and underground (phreatic and hyporheic network) waters of the Palaeartic area (Balkan Peninsula, Italy, France, Turkey, Czecho-Slovakia, Germany, Switserland), Ukraine and Japan.

The present record is the first reliable one from Italy. Earlier ones [Pesce & Fabrizi, 1979, for central Italy; Franciscolo, 1955, for north-west Italy] are doubtfull.

References

Cvetkov, L., 1969. Un filet phréatobiologique. Bull. Inst. Mus. Sofia 27: 215–219.

Franciscolo, M. E., 1955. Fauna cavernicola del Savonese. Ann. Mus. civ. St. nat., Genova 67: 1–223.

Kiefer, F., 1929. Das Tierreich 53. II. Cyclopoida Gnathostoma. Berlin, pp. 1–102.

Ito, T., 1952. Four new Copepods from subterranean waters of Japan. Rep. Fac. Fish. Prefect. Univ. Mie 1: 113–120.

Lescher-Moutoué, F., 1974. Recherches sur les eaux souterraines. 23:Cyclopides des eaux souterraines de l'Ain et de l'Isère (France). Ann. Spéleol. 29: 335–349.

Pesce, G. L., 1980. Richerche faunistiche in acque freatiche delle Marche e stato attuale delle conoscenze sulla fauna interstiziale italiana. Contributo alla conoscenza della fauna delle acque sotterranee dell'Italia centro-meridionale: XIII. Riv. Idrobiol. 19: 547–590.

Pesce, G. L., 1983. Contributo alla conoscenza degli Arpacticoidi delle acque sotterranee della regione pugliese (Crustacea:Copepoda). Contributo alla conoscenza della fauna delle acque sotterranee dell'Italia centro-meridionale: XXII. Thalassia Salentina 12–13: 62–81.

Pesce, G. L., 1984. *Diacyclops languidoides nagysalloensis* Kiefer, ciclopoide nuovo per la fauna Italiana, e note sullo status tassonomico del complesso '*languidoides*' in Italia (Crustacea Copepoda:Cyclopidae). Contributo alla conoscenza della fauna delle acque sotterranee dell'Italia centro-meridionale: XXVIII. Boll. Mus. civ. St. nat. Verona 11: 333–337.

Pesce, G. L., 1985. The groundwater fauna of Italy: a synthesis. Stygologia 1: 129–159.

Pesce, G. L., in press. Ciclopidi ed Arpacticoidi di acque sotterranee freatiche della Basilicata (Crustacea:Copepoda). Contributo alla conoscenza della fauna delle acque sotterranee dell'Italia centro-meridionale: XXXVII. Lav. Soc. It. Biogeograf., nuova serie.

Pesce, G. L. & R. Fabrizi, 1979. Ciclopidi delle acque sotterranee d'Abruzzo (Crustacea:Copepoda). Contributo alla conoscenza della fauna delle acque sotterranee dell'Italia centro-meridionale: VII. Nature 70: 55–75.

Pesce, G. L. & D. P. Galassi, 1983. Ciclopidi ed Arpacticoidi di acque sotterranee freatiche dell'Umbria e descrizione di *Elaphoidella tiberina* n.sp. (Crustacea:Copepoda). Contributo alla conoscenza della fauna della acque sotterranee dell'Italia centro-meridionale: XXX. Riv. Idrobiol. 22: 101–154.

Pesce, G. L. & D. P. Galassi, 1985. Due nuovi *Diacyclops* del complesso '*languidoides*' (Copepoda:Cyclopidae) di acque sotterranee di Sardegna e considerazioni sul significato evolutivo dell'antenna nei copepodi stigobionti. Boll. Mus. civ. St. nat. Verona: 12: 411–418.

Pesce, G. L. & P. Teté, 1985. Stato attuale delle conoscenze sulla stigofauna dell'Umbria. Contributo alla conoscenza della fauna delle acque sotterranee dell'Italia centro-meridionale: XXXIII. Incontro Naz. Biospeleol. Città di Castello, Perugia: 121–134.

Petkovski, T. K., 1984. Bemerkenswerte Cyclopiden (Crustacea:Copepoda) aus den subterranen Gewässern sloweniens. Acta Mus. Mac. sc. nat. 17: 23–52.

Rylov, V. M., 1948. Crustacea, Freshwater Cyclopoida. fauna Rossii, n.s. 35, pp. 1–318.

Received 16 June 1986; in revised form 17 September 1986; accepted 10 November 1986.