A NEW SPECIES OF *EXUMELLA* (COPEPODA: CALANOIDA: RIDGEWAYIIDAE) FROM ANCHIHALINE CAVES IN THE MEDITERRANEAN

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Exumella mediterranea n. sp., the first representative of the genus outside the Caribbean region, is described. It is a bottom-living inhabitant of anchihaline caves on the Balearic Islands and Sardinia (W Mediterranean). It is a raptorial, opportunistic feeder. Main diagnostic characters separating the new taxon and the other species of the genus are provided by the morphology of the male fifth legs.

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INTRODUCTION

Calanoid copepods are among the most characteristic inhabitants of anchihaline caves worldwide. Within these special environments many representatives have been found of the otherwise mainly hyperbenthic families Ridgewayiidae WILSON, Pseudocyclopiidae SARS, Pseudocyclopidae GIESBRECHT, Arietellidae SARS, Epacteriscidae FOSSHAGEN, and Stephidae SARS (ESTERLY 1911; FOSSHAGEN & ILIFFE 1985; 1991; OHTSUKA & al. 1993; BARR 1984; BOXSHALL & al. 1990; BOWMAN 1976; YEATMAN 1980). The two known representatives of the primitive family Boholiniidae (FOSSHAGEN & ILIFFE 1989) are restricted to anchihaline habitats in the Indo-Pacific.

In contrast to this general pattern of occurrence, the anchihaline caves of the Mediterranean seemed devoid of stygobiont calanoids (BOWMAN 1986). None had been recorded previously, with the exception of *Stephos margalefi* VIVES, RIERA & GILI, known only from the deeper parts of a marine cave on Mallorca, Balearic Islands (RIERA & al. 1991). This cave might be suspected to be anchihaline, i.e., subjected to terrestrial influences (STOCK & al. 1986), although nothing was mentioned in the original description.

The present paper is the first in a series dealing with the taxonomy of anchihaline copepod assemblages of the Mediterranean region. Material was collected during the last four years by one of us (D.J.) from coastal caves around Sardinia and the Balearic Islands. Sampling was undertaken as part of a biogeographical study of marine-anchihaline cave taxa (i.e., taxa with low potential for dispersal) belonging to primitive lineages.

In this framework, a Mediterranean ridgewayiid, belonging to the genus *Exumella* FOSSHAGEN, is described

below. The new taxon was captured in several caves in the Balearic archipelago, and also on Sardinia. This constitutes the first record of this shallow water, tropical genus in the Mediterranean. The two existing representatives of the genus are known from the Exuma Cays, Bahamas (FOSSHAGEN 1970), and from Kingston Harbour, Jamaica (GRAHAME 1979). Recently, unnamed *Exumella* have been reported from an anchihaline cave in Belize (FOSSHAGEN & ILIFFE 1991) and also from similar environments in Bermuda (A. Fosshagen, pers. commn).

MATERIAL AND METHODS

Material examined. *Exumella mediterranea*, n. sp. Mallorca (Balearic Islands): Cova de na Barxa (Capdepera). UTM coordinates: 539,30; 4393,10. Topographic profile of the cave published by ANDREWS & al. (1989): fossil coastal cave excavated in Triassic fissured limestone, 10 m from shoreline, with a subaerial entrance at 3 m above sea level (a.s.l.). Anchihaline lake reaching a maximum depth of 1.5 m. Holotype: male 0.90 mm (MNCM 246). Allotype: female 1.06 mm (MNCM 247). Paratypes: 10 males and 10 females (BM(NH) Reg. no. 1994.5875-5884) and several hundreds of individuals belonging to both sexes (MNCM 248). Collected by D. Jaume, 17 July 1994. - Cova del Dimoni (Manacor). Coordinates: 529,67; 4377,18. Fossil coastal cave excavated in upper Miocene porous calcarenite, 3 m from shoreline, with subaerial entrance at 3 m above sea level (a.s.l.). Elongated marine water lake, 2.5 m maximum depth, connected directly with the sea via a submarine tunnel opening at one of its extremities. 1 female (MNCM 251), collected by D. Jaume, 23 April 1994. - Cabrera Archipelago (Balearic Islands): Cova de sa Llumeta (Illa dels Conills). Coordinates: 496,60; 4337,35. Topographic profile of the cave published by TRIAS (1993): fossil coastal cave excavated in Jurassic fissured limestone, 5 m from shoreline, with subaerial entrance at 25 m a.s.l. Anchihaline lake reaching 3 m maximum depth, although an impassable shaft appears to continue downwards. Collected by D.

Jaume, 10 August 1993 (20 specimens, both sexes, MNCM 249), and 17 June 1994 (19 specimens, both sexes, MNCM 250). - Sardinia: Dasterru de la Dragunara (Capo Caccia, Alguero). UTM coordinates: 610,725; 4492,93. Topographic profile of the cave published by MUCEDDA (1983): fossil coastal cave excavated in Cretaceous limestone 200 m from shoreline, with subaerial entrance at 23 m a.s.l. Anchihaline lake reaching up to 45 m depth occupying the bottom. 25 specimens, of both sexes (MNCM 252), collected by D. Jaume and G. Pons, 19 June 1991.

Comparative material examined. *E. tuberculata* GRAHAME, Kingston harbour, Jamaica (West Indies). Several dozens of male and female paratypes (BM(NH) Reg. no. 1985.455-464). Collected by J. Grahame, Sept., Nov. and Dec. 1971. *E. polyarthra* FOSSHAGEN, off Harvey Cay Light, Exuma Cays (Bahamas). 2 males and 1 female topotypes. Collected by A. Fosshagen, 1 May 1967.

Samples were taken using meat-baited traps placed at different depths in the cave lakes and left for several days, and also using a hand-held plankton net with an extensible (to 3 m) handle. Salinity profiles were determined with a salinometer ANDERA-3017.

The terminology used in descriptions follows HUYS & BOXSHALL (1991). Material is deposited both in the Museu de la Naturalesa de les Illes Balears, Palma de Mallorca (MNCM), and in The Natural History Museum, London (BM (NH)).

TAXONOMIC PART

Family Ridgewayiidae WILSON, 1958

Genus *Exumella* FOSSHAGEN, 1970

Exumella mediterranea sp. n.
(Figs 1-5; 6A, B, D; 7)

Adult female. Body (Fig. 1A, B) almost colourless, robust, up to 1.06 mm long. Eyes absent. Prosome vaulted in lateral view, about 2.8 times longer than urosome. Rostrum (Fig. 1B, C) present, directed posteroventrally, rounded, with pair of slender distal filaments; rostral sensory complex composed of 2 raindrop shaped vesicles each opening via a small pore, 2 sensilla, and pair of minute pores between sensilla. First pedigerous somite integrated into cephalosome, although weak, incomplete transverse suture visible dorsally between it and posterior margin of cephalosome. Remaining pedigerous somites free, fifth asymmetrical, showing traces of a dorsal lobe on right side of posterior margin; 2 longitudinal rows of sensilla implanted along both sides of pedigerous somites 2-4. Urosome 3-segmented. Genital double-somite (Figs 1A, B; 6A, B) asymmetrical, produced on the right side, with single gonopore opening ventrolaterally on right side; operculum subcircular; 2 sensilla positioned anterodorsally and posteroventrally to operculum. Anal

somite (Fig. 1D, E) bearing striated distal hyaline frill forming 2 big triangular teeth on dorsal margin, and 2 smaller on ventral margin. Caudal rami (Figs. 1D, E) symmetrical, about 1.7 times as long as wide, armed with 1 short subdistal dorsal seta (seta VII of HUYS & BOXSHALL, 1991) and 5 distal setae (II-VI of HUYS & BOXSHALL); row of setules along medial margin of each ramus.

Antennules (Figs 1A, B; 3A): symmetrical, 27 segmented, not reaching distal end of prosome. First segment fringed ventrally with transverse row of setules along distal margin. Segments II, III and IV partially fused. Segment X narrower on dorsal side than on ventral. Armature elements as follows: I, 1 seta + aesthetasc; II, 2 setae; III, 2 + aesthetasc; IV, 1 seta; V to VII, 1 + aesthetasc; VIII to XVIII, 2 + aesthetasc; XIX and XX, 2 setae; XXI, 2 + aesthetasc; XXII and XXIII, 1 seta; XXIV, 2 setae; XXV, 2 + aesthetasc; XXVI, 2 setae; apical segment (corresponding to fused ancestral segments XXVII and XXVIII), 6 + aesthetasc.

Antenna biramous (Fig. 2A). Coxa and basis armed with 1 seta and 2 subdistal setae on inner margin respectively. Endopod 2-segmented, with segments about same size, elongated; proximal armed with 2 setae implanted about halfway along inner margin; distal with no trace of inner lobe, bearing 4 setae along proximal half of inner margin, 6 distal setae, and 2 brush-like scales on outer margin (Fig. 7A, B). Scales resembling simple setae when using light microscopy. Exopod 7-segmented, longer than endopod, with segments 2 and 6 about same size as endopod segments; segment 7 reduced; setal formula: 0, 2, 1, 1, 1, 1, 3.

Mandible (Fig. 2B): coxal gnathobase stout, cutting blade well developed, with 3 deeply incised irregular teeth on outer margin, some shallower blades on medial portion, and slender spine on inner margin. Mandibular palp: basis large, unarmed; endopod reduced, bisegmented, first segment unarmed, second bearing 6 distal setae, 1 reduced; 4-segmented exopod less than half length of basis, with setal formula: 1, 1, 1, 3; setae diminishing in size and length from proximal to distal segments; distal segment derived from fusion of ancestral segments 4 and 5.

Maxillule (Fig. 2C, D) with well defined praecoxa produced medially into arthrite bearing 10 stout, pectinate spines along medial margin, submarginal row of 4 setae on ventral side, and isolated dorsal seta. Coxa with epipodite armed with 9 setae, and endite with 4. Basis fused with exopod and endopod; proximal basal endite discrete, armed with 4 setae; distal incorporated into segment, armed with 5 setae. Endopod fully incorporated to basis, formed by 3 indistinctly fused lobes, perhaps remnants of 3 ancestral segments, with setal formula: 2, 4, 5. Exopod bearing 10 marginal setae.
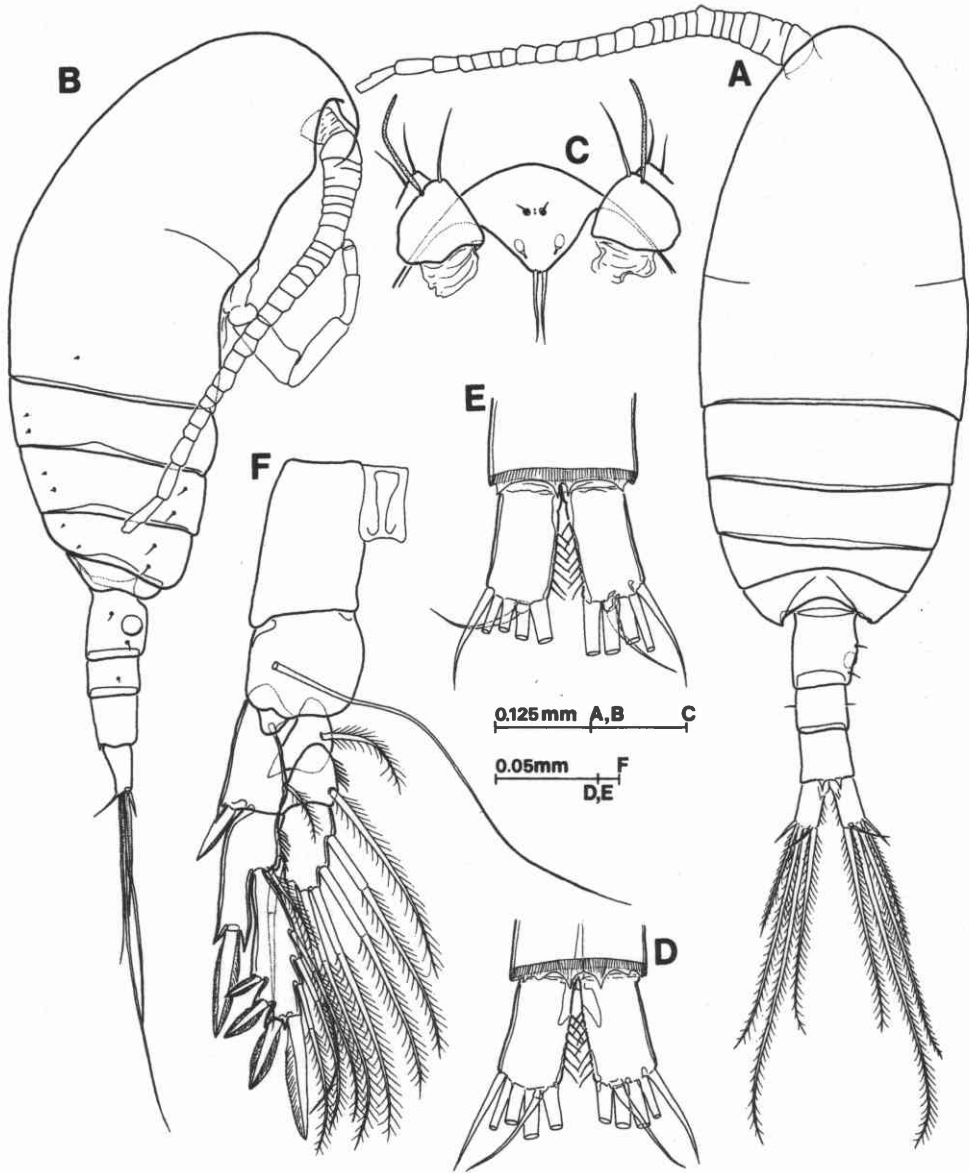
Fig. 1. *Exumella mediterranea* n.sp., female paratype. A. Habitus, dorsal view. B. Habitus, lateral. C. Rostrum, frontal. D. Anal somite and caudal rami, dorsal; E. Anal somite and caudal rami, ventral. F. Fifth leg, posterior.

Maxilla (Fig. 3B, C) comprising completely fused praecoxa and coxa, each armed with 2 endites, allobasis, and 3-segmented endopod. Proximal praecoxal endite with 4 long, stout setae, and 1 slender, somewhat shorter seta; distal with 3 stout setae, 1 longer than others. Both coxal endites armed with 3 setae: 2 long and stout, 1 slender and reduced on proximal endite; 3 unequal, with 1 very stout, on distal endite. Proximal allobasis endite well developed, swollen, armed with 4 stout unequal setae; distal bearing 3 unequal setae, 1 very reduced in size. Free endopod setal formula: 3, 2, 2; 1 of setae on proximal segment very reduced, and another very thick
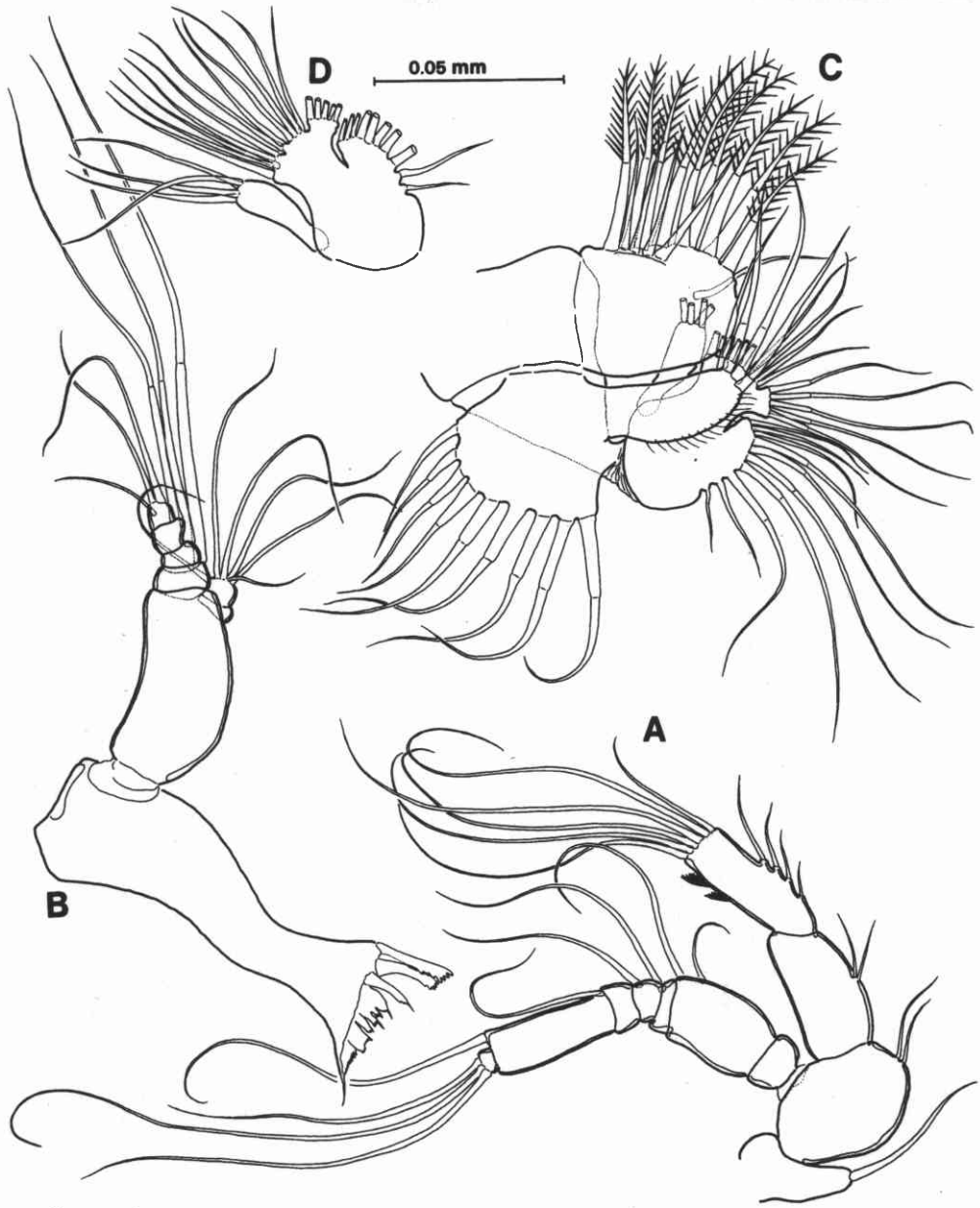
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Fig. 2. *Exumella mediterranea* n.sp., female paratype. A. Antenna. B. Mandible. C. Maxillule. D. Detail of maxillulary basis, exopod and endopod.

and stout; 1 on distal segment shorter than other.

Maxilliped (Figs 1B; 3D) powerfully developed, 6-segmented and reflexed distally. Syncoxa armed with 7 setae distributed in 4 groups along medial margin: 1, 1, 2, 3; small lobe protruding on distal part of medial margin; row of short setules on distal margin of segment.

Basis plus fused first endopodal segment armed with 3 basal and 2 endopodal setae distally on medial margin; row of short setules (not shown in figures) along proximal portion of medial margin. Free endopod 4-segmented; first and second segments each with 4 setae on distal portion of medial margin; row of short setules
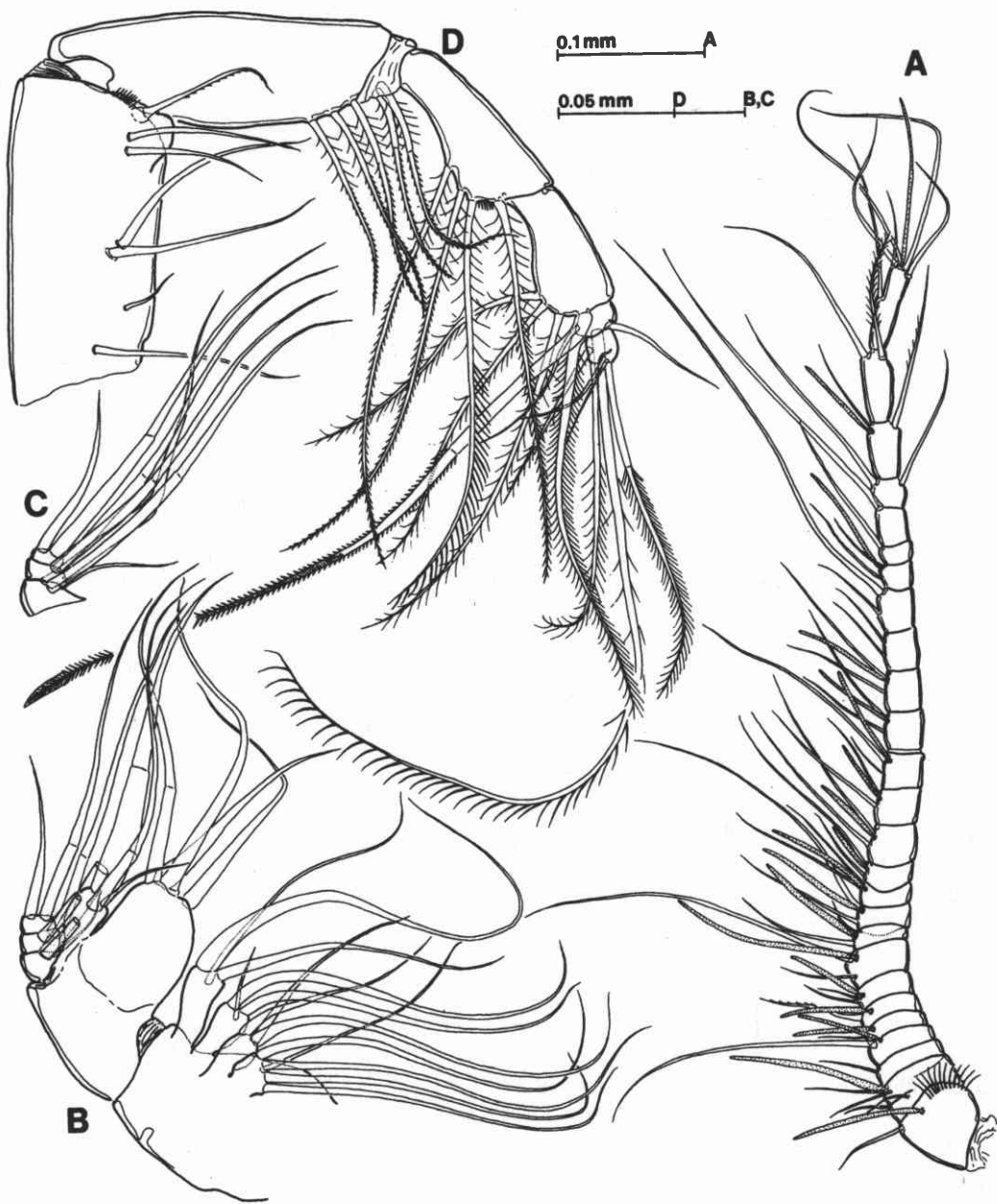
Fig. 3. *Exumella mediterranea* n.sp., female paratype. A. Right antennule, ventral. B. Maxilla. C. Detail of endopod of Maxilla. D. Maxilliped.

along medial margin of first segment between 3rd and 4th setae; 4th seta on 2nd segment very long and stout, articulate, bearing specialized ornamentation: short and stout spinules along both margins after articulation, produced distally into hyaline flange; seta faintly striated in distal half. Endopod segments 3 and 4 reduced; 3rd

bearing 4 unequal setae; 4th formed by fusion of ancestral segments 5 and 6 (as indicated by presence of outer margin seta on this segment), with armature of 5 unequal setae.

Swimming legs (Figs 1F; 4) increasing in size from 1 to 3, and then decreasing from 3 to 5; each with 3-

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segmented rami; exopods longer than endopods. Spine and seta formula as follows:

	Coxa	Basis	Exopod	Endopod
Leg 1	0-1	0-1	I-1; I-1; II,I,4	0-1; 0-2; 1,2,3
Leg 2	0-1	0-0	I-1; I-1; II,I,5	0-1; 0-2; 2,2,4
Leg 3	0-1	0-0	I-1; I-1; III,I,5	0-1; 0-2; 2,2,4
Leg 4	0-1	0-1	I-1; I-1; III,I,5	0-1; 0-2; 2,2,3
Leg 5	0-0	0-1	I-1; I-1; III,I,3	0-1; 0-1; 2,2,2

Swimming leg 1 (Fig. 4A) reduced, with small sclerite (remnant of praecoxa) located laterally round base of coxa; first endopod segment with lateral margin produced into distal lobe. Leg 3 (Fig. 4c) with some short spinules on lateral margin of basis. Leg 5 (Fig. 1F) with elongated coxa. Seta on basis very long, implanted submarginally on posterior side of segment. Endopod about 0.6 times length of exopod, reaching slightly beyond insertion of 3rd exopod segment; lateral margin of segments 1 and 2 produced into pointed distal lobe. Setae on exopod segments 1 and 2 reduced, implanted about halfway along medial margin; spines on segments flanged, those of segment 3 increasing in size distally.

Adult male. Somewhat smaller and more slender than female. Body (Fig. 5A) up to 0.94 mm long, with prosome 2.6 times longer than urosome. Prosome as in female; 5th pedigerous somite symmetrical. Urosome 4-segmented. Genital somite asymmetrical, slightly produced and extended backwards on left side; single gonopore (Fig. 6D) opening ventrolaterally on left side close to posterior margin of segment; operculum not so clearly defined as in female genital double somite, forming narrow bulge dorsal to gonopore. Anal somite and caudal rami as in female. Antennules asymmetrical, left as in female; right (Fig. 5B) geniculate, 24 segmented, with segments II, III and IV, X and XI, and XII, XIII and XIV partially fused; articulation between segments XIX and XX supplied with much more extensive arthrodial membrane than articulation between segments XX and XXI, both articulations forming part of geniculation mechanism; armature as follows: I, 1 seta + aesthetasc; II, 2 setae; III, 2 + aesthetasc; IV, 2 setae; V to XI, 2 + aesthetasc; XII, 2 + aesthetasc; XIII, 1 + aesthetasc; XIV to XVIII, 2 + aesthetasc; XIX and XX, 1 seta; segment 21 (fused ancestral segments XXI to XXIII), 2 + aesthetasc; segment 22 (fused ancestral segments XXIV and XXV), 4 + aesthetasc; segment 23 (ancestral segment XXVI), 2 setae; segment 24 (fused ancestral segments XXVII and XXVIII), 6 + aesthetasc. Other mouthparts and swimming legs 1 to 4 as in female in segmentation and setation.

Fifth legs (Fig. 5C) large, asymmetrical, both biramous, with coxa, basis, 3-segmented endopod and 2-segmented exopod. Coxae unarmed, left longer than right. Both bases about same size, each with long submarginal seta implanted posteriorly; seta on left basis longer. Endopods symmetrical; segment 1 with lateral margin produced into pointed distal lobe; setal formula: 0-0; 0-1; 2,2,2. Left exopod segment 1 longer and wider than corresponding right, armed with stout, straight, distolateral, denticulate spine as long as segment; right segment 1 armed with homologous, short spine. Left segment 2 (Figs 5D; 7E) about same length as segment 1, more slender, bearing 3 distal processes: first consisting of smooth, regularly tapering, straight spine implanted laterally; second consisting of central, chair-shaped process, with medial margin of proximal half expanded to form subrectangular flap fringed with short marginal setules; distal half slender, broadening distally, ornamented with row of minute marginal denticles, and with long spine implanted proximally and running parallel to medial margin; third process hyaline, implanted apically and becoming broader distally. Right segment 2 (Figs 5E; 7C, D) more than half length of segment 1, bearing 3 spines: 1 short and stout, implanted distolaterally, armed with row of short spinules; 1 long, curved, flanged, implanted distomedially; 1 distal, the longest, 2.1 times longer than corresponding segment, with distal half somewhat flattened and fringed with long spinules along lateral margin.

Etymology. The specific name refers to the distribution of the species, in the Mediterranean Basin.

Taxonomic remarks. The availability of type material of the other 2 species of the genus has allowed us to make comparisons and to establish the diagnostic differences between the species. It has also permitted us to check the status of some characters not clearly resolved in the original descriptions. The new species from the Mediterranean is easily distinguished from *E. tuberculata* GRAHAME by: the absence of a protruding bilobed process on the right margin of the last prosomal segment of the female, the presence of 2 setae instead of only 1 on the antennal endopod segment 1, the somewhat larger maxilliped, the shape of the female genital operculum, circular versus bilobed in *E. tuberculata* (Fig. 6C), the shape of the hyaline frill along the distal margin of anal somite, bearing 2 ventral pointed processes which are absent in *E. tuberculata* (Figs 8A, B), and also by some detailed characters of the distal portion of male leg 5. As FOSSHAGEN (1970) stated, the most modified part in ridgewayiids is the apex of male left exopod of leg 5, and this holds true for *Exumella*. Thus, the armature of this part in the Mediterranean species differs from that of *E. tuberculata* (Fig. 8C) in the shape of the distolateral spine, distally tapering instead being
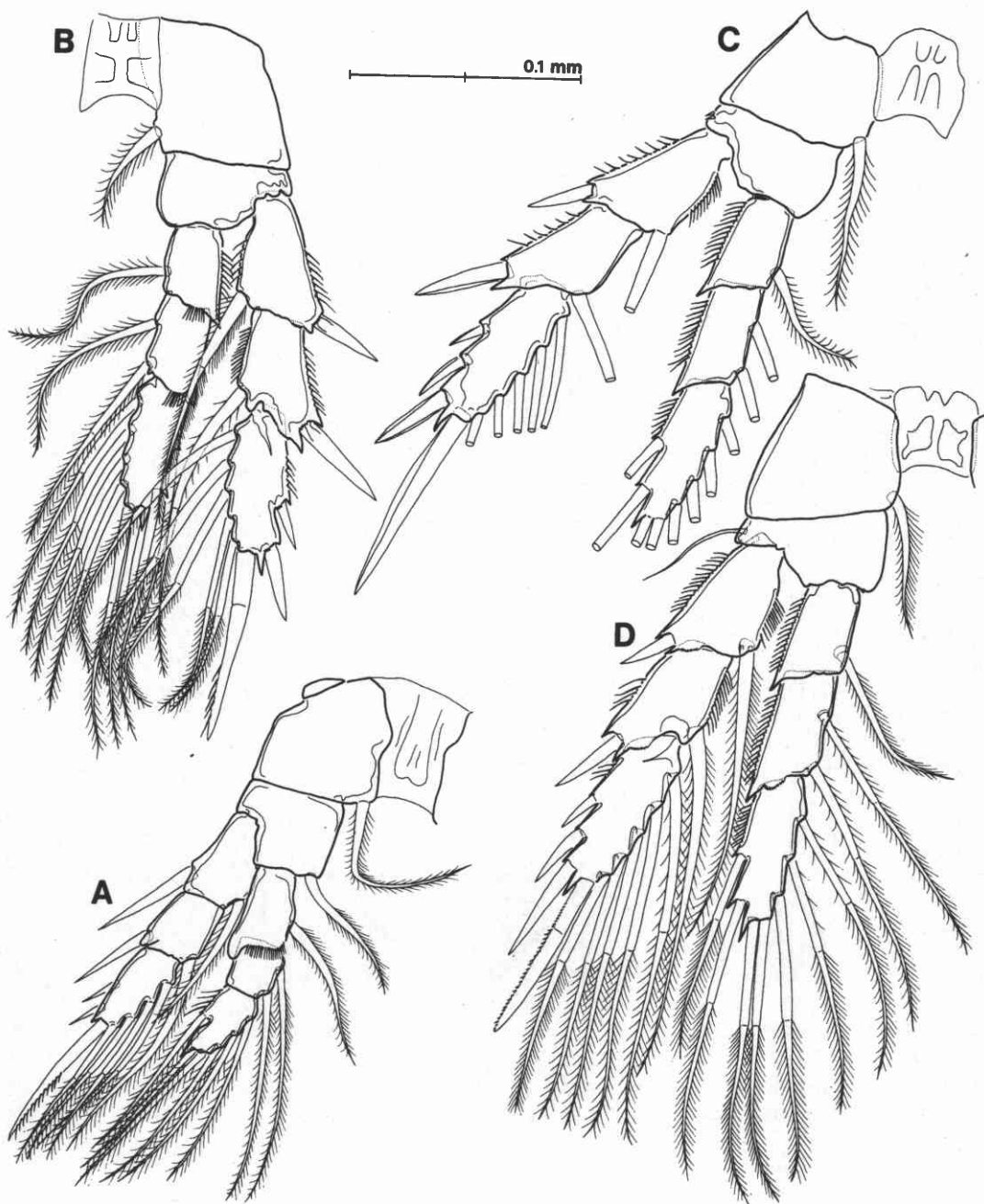
Fig. 4. *Exumella mediterranea* n.sp., female paratype. A. Leg 1, anterior. Leg 2, anterior. Leg 3, anterior. Leg 4, anterior.

spear-shaped, and in the shape of the central process, swollen basally and not bearing a row of long marginal setules. Besides, the distal half of this process becomes broader distally instead of narrower. Another diagnos-

tic difference is the relative length of the distal spine on right endopod segment 2: in the Mediterranean species, it is considerably shorter, attaining only 2.1 times the length of the corresponding segment; in *E. tuberculata*,
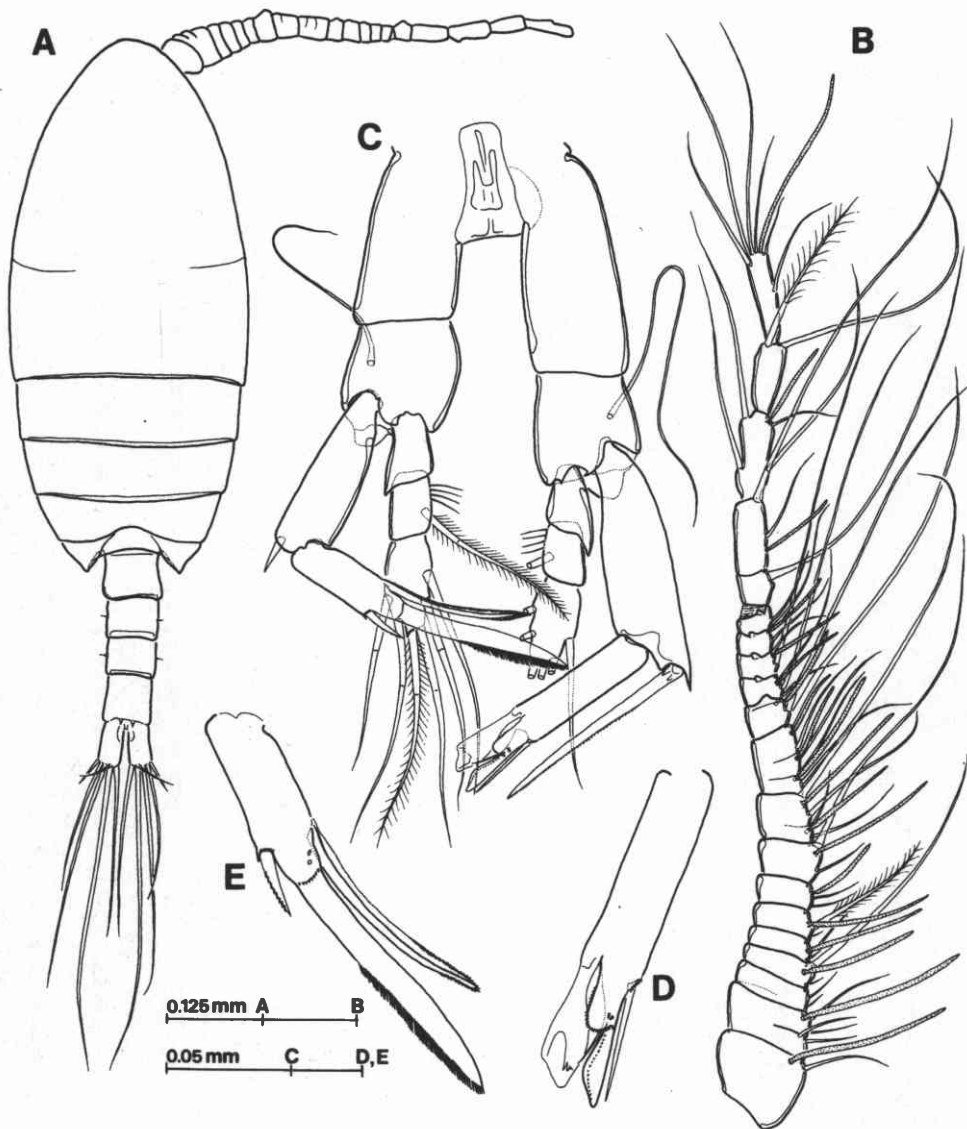
Fig. 5. *Exumella mediterranea* n.sp., male paratype. A. Habitus, dorsal. B. Right antennule, ventral. C. Leg 5, anterior. D. Detail of left exopod segment 2 of leg 5. E. Detail of right exopod segment 2 of leg 5.

this spine is 3.3 times longer than the corresponding segment (Fig. 8D). The armature of all remaining limbs is identical in both species.

Differences between the new species and *E. polyarthra* are more subtle and lie in the minute details of the armature of the non-geniculate antennule and antenna, and in the distal portion of male leg 5. The aesthetasc on the distal segment of antennule is longer than the segment in the new species whereas in *E. polyarthra* it is shorter. The proximal segment of endopod of the antenna bears 2 setae in the Mediterranean species, instead of only 1 in *E. polyarthra*. Differences between distal portion of male leg 5 of both species are the same as those listed above between the
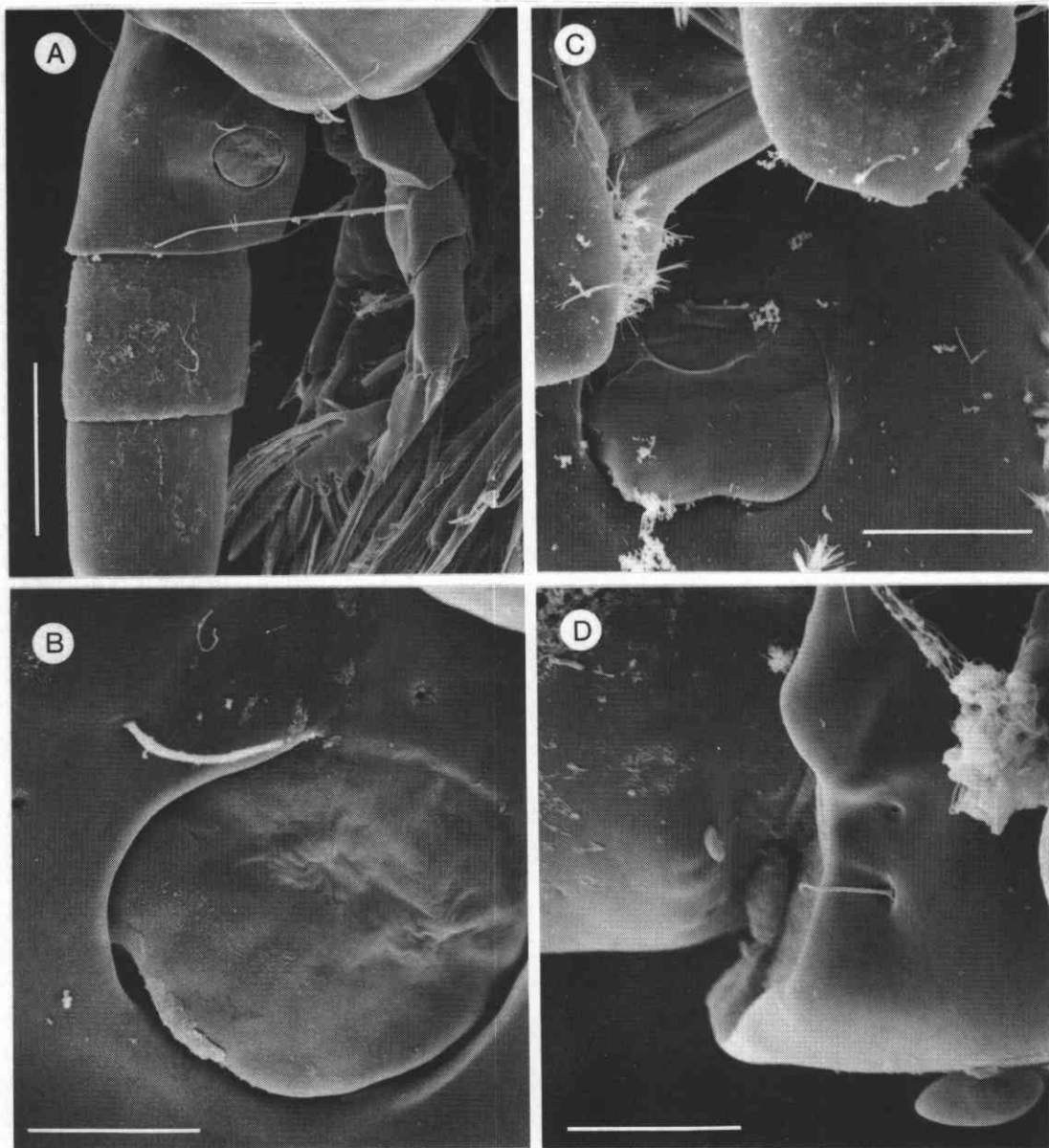
Fig. 6. *Exumella mediterranea* n.sp., female paratype (A, B), and male paratype (D); *Exumella tuberculata* GRAHAME, female paratype (C). A. female genital double-somite, right lateral (scale bar: 60 μm). B. Detail of female operculum and gonopore (scale bar: 10 μm). C. Detail of female operculum and gonopore (scale bar: 15 μm). D. Detail of male operculum and gonopore (scale bar: 10 μm).

new species and *E. tuberculata* (Figs 8E, F), although the distal spine of right exopod segment 3 is not as long in *E. polyarthra* (only 2.8 times longer than the corresponding segment). The armature of remaining limbs is identical in both species. We note here that the illustrations of the antennules of both sexes and the maxilliped of *E. polyarthra* presented by HUYS & BOXSHALL (1991), although reflecting the correct segmentation pattern, contained errors in setation. After re-checking the original material it is apparent that the incongruencies between the antennulary setation pattern presented by HUYS & BOXSHALL (fig. 2.2.2 A, p.55; fig.2.2.5 A, p.58) and those of the other 2 species are related to damaged segments in the *E. polyarthra* material. Similarly, the po-
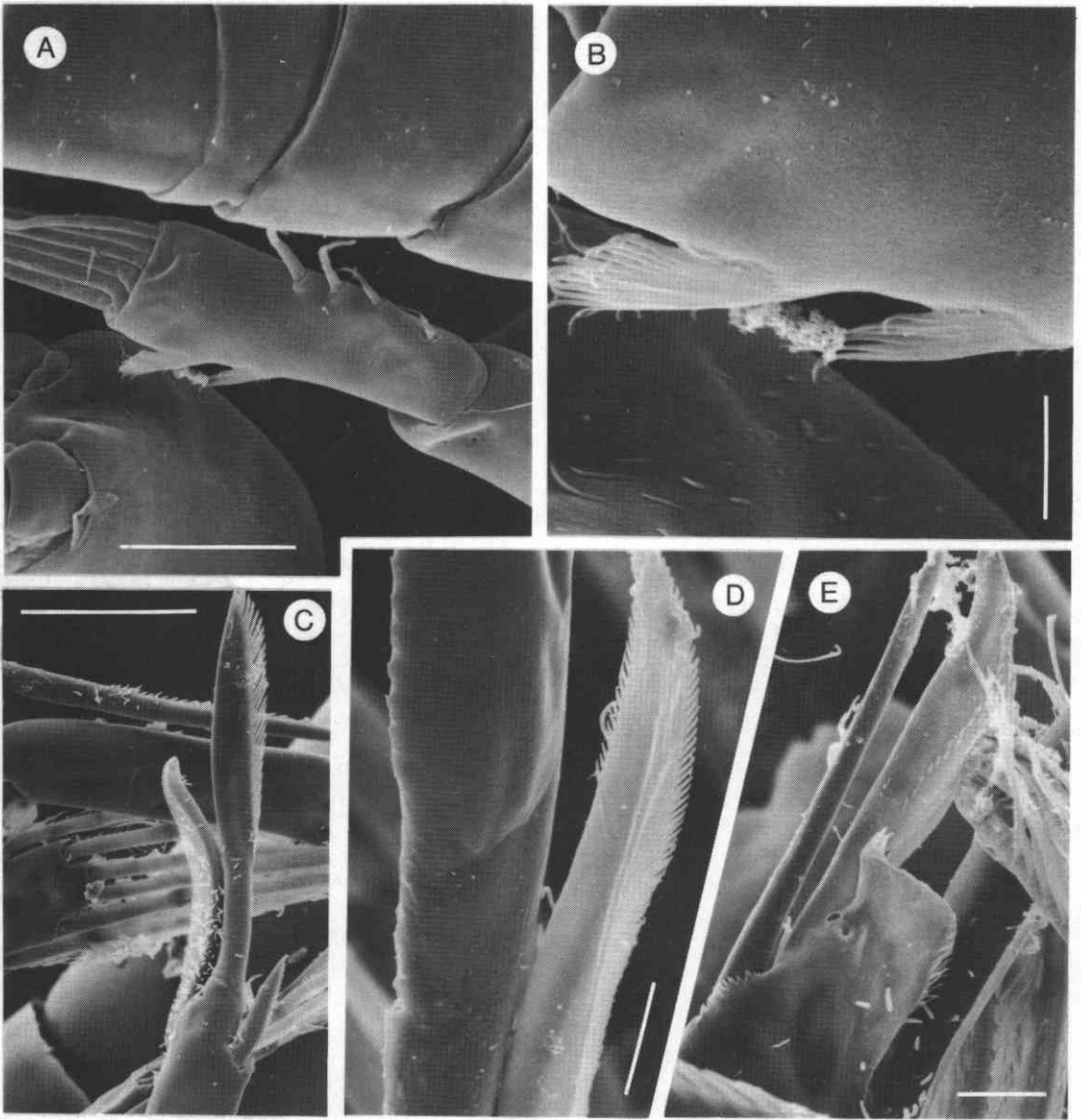
Fig. 7. *Exumella mediterranea* n. sp., female paratype (A, B), and male paratype (C-E). A. Detail of antennal endopod segment 2 (scale bar: 15 μm). B. Detail of brush-like scales on antennal endopod segment 2 (scale bar: 3 μm). C. Detail of right exopod segment 2 of leg 5, anterior view (scale bar: 25 μm). D. Detail of distomedial and distal spines on right exopod segment 2 of leg 5, posterior (scale bar: 5 μm). E. Detail of distomedial spine and "chair-shaped" process on left exopod segment 2 of leg 5 (scale bar: 5 μm).

sition of the long, distally flanged seta of the maxilliped, which is shown as the 4th element on the 5th segment in HUYS & BOXSHALL (fig. 2.2.24 D, p. 77), should be the 4th element on the 4th segment.

DISCUSSION

Large numbers of *Exumella mediterranea* n. sp. were captured using meat-baited traps placed for several days on the bottom of anchihaline cave lakes. This provides evidence for a raptorial, opportunistic feeding mode rather than a specialized diet. The species also main-
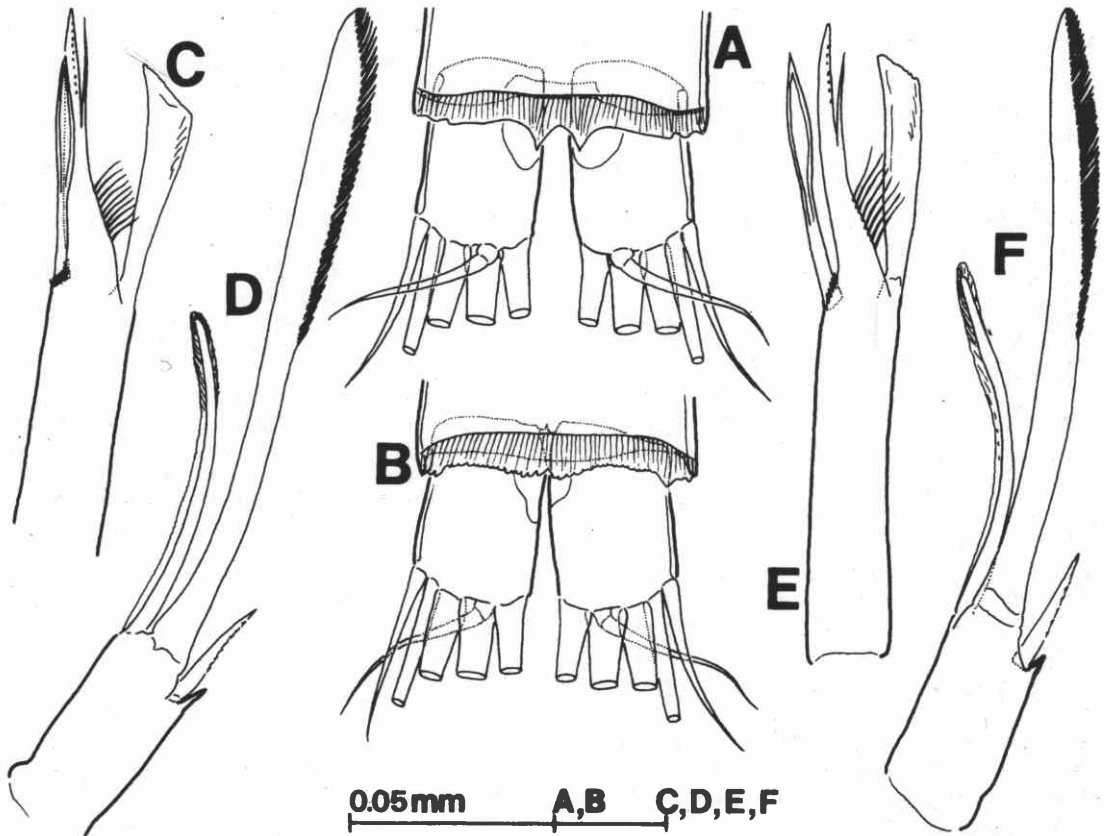
Fig. 8. *Exumella tuberculata* GRAHAME, male paratype (A-D); *Exumella polyarthra* FOSSHAGEN, male topotype (E, F). A. Anal somite and caudal rami, dorsal. B, Anal somite and caudal rami, ventral. C. Leg 5, detail of left exopod segment 2. D. Leg 5, detail of right exopod segment 2. E. Leg 5, detail of left exopod segment 2. F. Leg 5, detail of right exopod segment 2.

tains a close proximity to the substrate: in the lake of Cova de na Barxa, which is only 1.5 m deep, hundreds of individuals were captured with traps but none was caught in a hand-held plankton net in the water column. No egg-carrying females have been seen and it is probable that eggs are released on the bottom as laid.

Only scattered data are available concerning the range of salinity tolerance of the new species. It seems to be absent from the more freshwater influenced anchihaline lakes located further inland. Thus, in Cova de sa Llumeta on 10 August 1993, salinity ranged from 13 % at the surface to 34.5 % at the bottom; the *Exumella* population was moderately high, and the accompanying fauna consisted of a new genus and species of stygobiont janirid isopod and some epigean marine taxa such as *Palaemon serratus* (PENNANT), *Heteromysis* cf. *formosa* SMITH, and various copepods. In Cova de na Barxa, PRETUS (1989) measured 7045 µS/cm on 19 June 1987, and 7070 µS/cm on 1 February 1988; no chemical analy-

sis of water was performed during our visit, but it was clearly fresher and warmer than the neighbouring sea. Here the accompanying fauna consisted of the stygobiont amphipods *Pseudoniphargus mercadali* PRETUS and *Metacrangonyx longipes* CHEVREUX, other oculate amphipods, the new janirid cited above, *Jaera italica* KESSELYAK, copepods, and an oculate *Heteromysis* (*Gnathomysis*). No chemical data are available for the remaining 2 stations, although prevalence of marine conditions was clear in Cova del Dimoni, where swell and an undeniably epigean marine accompanying fauna (viz., *Palaemon serratus*, *Cumella pygmaea* SARS, oculate Mysidacea and Amphipoda, Chaetognatha) was recorded with the single individual captured; this station also provided a single male of the stygobiont calanoid *Stephos margalefi*. In Dasterru de la Dragunara, the upper water layers have been exploited for human consumption from ancient times (MUCEDDA 1983), but the bottom water layers are probably of near marine

salinities, according to the depth of the lake and its proximity to the sea. Captured at 6 m depth were moderately high numbers of specimens, but no specimens were taken in surface waters, either using traps or a hand-held net.

The other two species of *Exumella* are shallow water taxa (recorded from 7-15 m depths), living in close vicinity to the bottom (hyperbenthic environment) (FOSSHAGEN 1970; GRAHAME 1979). One of them, *E. tuberculata*, was captured in the water column over an oligoxic muddy sediment. Living close to a macroporous substratum and resistance to low oxygen conditions have been claimed as important preadaptations for the colonization of the inland subterranean environment (STOCK 1986). The ability of members of the genus *Exumella* to colonize anchihaline habitats, which frequently have a restricted exchange of water with the open sea and oligoxic conditions, may therefore be enhanced by these characteristics. In Balearic anchihaline caves, oligoxic waters have been recorded occasionally (D.J., pers. obs.), but not in Cova de sa Llumeta, the only station rendering *Exumella* from which data on oxygen concentration are available: here it never falls below 30 %.

The taxonomic status of the Sardinian population deserves a comment. We have been unable to find any major morphological differences between the Sardinian and the Balearic populations. This is interesting since the populations are isolated from each other by about 400 km of open sea with a depth in excess of 2000 m. However, similar wide distributions are known among other anchihaline Mediterranean crustaceans (viz., the amphipod *Salentinella angelieri* RUFFO, the copepods *Halicyclops troglodytes* KIEFER and *Metacyclops subdolus* KIEFER). In addition, the amphipod *Pseudoniphargus mercadali*, which was thought to be endemic from Menorca and Mallorca (where the only known population lives in Cova de na Barxa), has recently been found on Sardinia in a salty well close to the sea, North of Capo Caccia (D.J., pers. obs.).

ACKNOWLEDGEMENTS

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