On the synonymy of Delamarella Chappuis and Latiremus Božić (Copepoda, Harpacticoida, Latiremidae), including the description of D. obscura sp. nov. from the Black Sea

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A new species of Delamarella Chappuis, 1954 (Copepoda, Harpacticoida, Latiremidae), D. obscura sp. nov., is described from sandy beaches along the western Black Sea coast of Turkey, using both light and scanning electron microscopy. Additional morphological observations of the closely related D. galateae Cottarelli, 1971 are presented, based on topotype material from Sardinia and newly collected specimens from mainland Italy. Previous records of D. karamani Petkovski, 1957 from the Bulgarian Black Sea coast are based on misidentifications and should be attributed to D. obscura sp. nov. All three species are morphologically similar, and criteria based on meristic and ornamentation characters are provided to distinguish them. Examination of copepodid V L₅₀₄₈₉ intermoult stages provided new insights into the morphology of the highly transformed P₄ exopod of the adult male and its homology with reference to the female. A reassessment of the generic distinctiveness of Delamarella and the monotypic genus Latiremus Božić, 1969 revealed that morphological criteria, traditionally employed to separate both genera, are all essentially unsound and based on erroneous reports in the literature. Consequently, Latiremus is relegated to a junior synonym of the type genus, leaving Delamarella and Arbutifera Huys & Kunz, 1988 as the only remaining valid genera in the family. © 2005 The Linnean Society of London, Zoological Journal of the Linnean Society, 2005, 145, 263–281.

Bodin (1976a, b) and Kunz (1977) considered them congeneric and re-allocated *L. eximius* to the genus *Delamarella*. This course of action was also supported by Božič (1978) who made a careful comparison of the segmental patterns of the antennules, P1 exopod and P4 endopod, the presence/absence of foliaceous spines on the P5, and the ornamentation of the anal operculum. Kunz (1984) further expanded the generic boundaries of *Delamarella* by including the Namibian species *D. phyllostosota*.

Itô (1974) established a new genus *Protolatiremus* for a single species *P. sakaguchii* Itô, 1974, which he assigned to the Thalestridae. However, Itô’s (1974) unfortunate choice of the generic name in conjunction with his dubious supposition of a ‘...a rough evolutionary line arising from *Protolatiremus* to *Latiremus* and further to *Delamarella...’ led Bodin (1976a, b, 1979, 1988) to cite this genus persistently as a member of the Latiremidae. Any relationship between *Protolatiremus* and the latiremid genera has been refuted by various authors (Božič, 1978; Kunz, 1984; Huys & Kunz, 1988). Huys & Kunz (1988) suggested that *Protolatiremus* could well represent a distinct unrelated family but Bodin (1997) continued to include it in the Latiremidae, this time as genus incertae sedis. Recently, Willen (2000) identified *Protolatiremus* as the sistergroup of the Thalestridimorpha, a taxon uniting the Langian families Thalestridae, Diosacidae, Parastenheliidae and Miraciidae.

Huys & Kunz (1988) reviewed the generic distinctiveness of *Delamarella* and *Latiremus*, reinstated the latter and transferred *D. phyllostosota* to a new genus *Arbutifera*. They recognized a sistergroup relationship between *Latiremus* and *Arbutifera*, and placed this clade in apposition to *Delamarella*. The discovery of new *Delamarella* material from the Turkish Black Sea coast, described herein as a new species, has prompted us to reconsider the generic distinctiveness of *Delamarella* and *Latiremus*.

**MATERIAL AND METHODS**

Harpacticoids were collected using the Karaman–Chappuis method (Delamare Deboutteville, 1954). Specimens were dissected in lactic acid and the parts mounted on slides in lactophenol mounting medium. Glass fibres were added to prevent the animal and appendages from being compressed by the coverslip and to facilitate rotation and manipulation, allowing observation from all angles. Preparations were sealed with transparent nail varnish. All drawings have been prepared using a camera lucida on an Olympus BX-50 differential interference contrast microscope. Measurements were made with an ocular micrometer. Body length was measured from the base of the rostrum to the posterior edge of the caudal rami.

Males and females of *Delamarella obscura* sp. nov. were examined with a Philips XL30 scanning electron microscope. Specimens were prepared by dehydration through graded acetone, critical point dried, mounted on stubs and sputter-coated with gold–palladium alloy. The descriptive terminology is adopted from Huys et al. (1996). Abbreviations used in the text are: ae, aesthetasc; P1–P6, first to sixth thoraco-abdominal segments; exp (enp)-1 (2, 3) to denote the proximal (middle, distal) segment of a ramus. Scale bars in illustrations and SEM micrographs are in micrometres. Type and other material is deposited in the collections of the Natural History Museum, London (NHM) and Balıkesir University (BU). Attempts to trace the types of *Latiremus eximius*, *Delamarella arenicola* and *D. karamani* failed (cf. Huys & Kunz, 1988).

**RESULTS**

**FAMILY LATIREMIDAE** Božič, 1969

**GENUS DELAMARELLA CHAPPUIS, 1954**

**DELAMARELLA OBSCURA SP. NOV.**

**Synonym:** Delamarella karamani Petkovski, 1957

**Type locality:** Filyos beach, Hisarönü, Zonguldak province (station 14) (Turkey).

**Type material:** Holotype adult ♀ dissected on 3 slides (deposited in NHM, reg. no. 2005.167). Paratypes are (1) 1 adult ♂ dissected on 5 slides (deposited in NHM, reg. no. 2005.168), (2) 4 Cop V ♀♀, 1 Cop IV ♀ and 2 Cop V ♂♂ preserved in alcohol; and 1 adult ♀ dissected on 4 slides (deposited in BU). Collected on 7 July 2001 from type locality; leg. S. Karaytuğ and S. Sak.

**Other material:** (1) From Gobü beach, Hisarönü, Zonguldak province (station 12), Turkey (leg. S. Karaytuğ and S. Sak; 7 July 2001): 4 adult ♀♀ and 1 adult ♂ preserved in alcohol (deposited in NHM, reg. no. 2005.169–173); 3 adult ♀♀, 1 adult ♂, 6 Cop V ♀♀, 2 Cop IV ♀♀, 1 Cop V ♂♂ all preserved in alcohol, 1 ♂ dissected on 1 slide (deposited in BU); (2) from Türkali beach, Hisarönü, Zonguldak province (station 13), Turkey (leg. S. Karaytuğ and S. Sak; 7 July 2001): 2 adult ♀♀, 1 adult ♂, 3 Cop V ♀♀ and 1 Cop V ♂♂ preserved in alcohol (deposited in NHM, reg. no. 2005.174–180); (3) from Kapsuyu beach, Kurusacile, Bartin province (station 17), Turkey (leg. S. Karaytuğ and S. Sak; 8 July 2001): 4 ♀♀ preserved in alcohol (deposited in NHM, reg. no. 2005.181–185); (4) from Inebolu beach, Inebolu, Kastamonu province, Turkey (leg. S. Karaytuğ and S. Sak; 8 July 2001): various specimens (deposited in BU).
**Description**

**Female:** Total body length: 420–520 µm (mean = 487 µm; N = 10). Maximum width measured at cephalothorax. P1-bearing somite completely incorporated in cephalosome forming a cephalothorax (Fig. 1A, B). P2-bearing somite separated from cephalothorax by large intersomitic membranous zone. Posterior margin of cephalothorax and pedigerous somites with plain hyaline frill (Fig. 1A, B); hyaline frill of urosomites with denticulate hyaline frill dorsally and ventrally (Figs 2B, 3A). Rostrum (Fig. 1A) very small, fused to cephalic shield; with 2 delicate sensillae.

Genital somite (Figs 1A, B, 2B) completely free from first abdominal somite. Genital field (Figs 3C, G, 11A) small, positioned far anteriorly on midventral surface of genital somite, flanked by 2 pairs of secretory pores; consisting of 2 closely set crescent-shaped opercula derived from P6 and closing off paired genital apertures, without armature; copulatory pore internal (arrowed in Fig. 3G). All postgenital somites with transverse spinular rows as illustrated in Figure 2B; no distinct ornamentation dorsally. Anal operculum spinulose, with 20–30 small spinules (Figs 3A, 7A); anal frill deeply serrated, setulose, largely covered by anal operculum (Fig. 3A).

Caudal rami (Figs 2B, 3A, 7A) slightly divergent; partly concealed beneath anal operculum; longer than wide; ventral surface with pore near proximal margin and tube-pore subdistally; inner margin with row of fine long setules running on to dorsal surface; dorsal surface with oblique row of strong spinules, increasing in size abaxially; posterior margin smooth dorsally, with strong spinules ventrally. Ramus with 7 setae: seta I relatively well developed; setae II and III spiniform and finely pinnate, with subapical flagellate extension; setae IV and V well developed, bipinnate, with fracture planes; seta VI short and bare; seta VII plumose and tri-articulate at base.

Antennule (Fig. 3F) consisting of coxa, basis, 1-segmented exopod and 2-segmented endopod; basis and proximal endopod segment incompletely separated. Coxa with spinules along distal margin. Basis and proximal endopod segment incompletely fused, original boundary being represented by surface furrow (Fig. 8B) but not by functional articulation; each segment with bipinnate seta. Free endopod with spinules along abepodial margin; lateral armature consisting of 2 pinnate spines and 1 seta (Fig. 3F: inset); distal armature consisting of 1 simple and 4 geniculate setae, longest one of which fused basally to long sparsely pinnate seta. Exopod 1-segmented; with 3 curved unipinnate spines laterally and 1 strong pinnate spine apically.

Mandible (Figs 4A, 9A) with well-developed gnathobase provided with series of small, curved teeth and pinnate seta at dorsal corner. Palp uniramous, consisting of basis and endopod. Basis with 1 naked and 2 pinnate setae. Endopod 1-segmented, with 2 lateral and 6 terminal setae.

Labrum well developed, with transverse spinule row along free ventral margin and median tuft of setules on anterior surface (Fig. 8C).

Maxillule (Fig. 4B). Praecoxal arthrite with 2 tube-setae on anterior surface; distal margin with 8 strong spines. Coxal endite with 2 naked setae and 1 geniculate spine. Basis with 2 geniculate, 2 bipinnate and 3 naked setae. Endopod and exopod defined at base, with 3 naked setae each.

Maxilla (Figs 4C–D, 9B). Syncoxa with 3 endites and 2 spinular rows; proximal endite with 4 setae, middle endite with 2 setae and large backwardly directed unipinnate spine, distal endite with 1 naked and 2 pinnate setae; posterior surface with slit-like opening of maxillary gland (arrowed in Fig. 9B). Allobasis with 2 naked setae and 2 serrate spines. Endopod 2-segmented; enp-1 with 2 serrate spines; enp-2 with 1 serrate spine and 3 naked setae.

Maxilliped (Figs 4E, 9C) prehensile, comprising syncoxa, basis and 1-segmented endopod. Syncoxa with 3 spinular rows and 1 pinnate seta. Palmar margin of basis with row of strong spines anteriorly, row of finer spines posteriorly and 2 setae (smaller one with tubular extension; arrowed in Fig. 4E). Endopod with small sclerite at base; drawn out into strong, curved claw bearing 3 accessory setae.

P1 (Figs 5A, 9D, 10A, B). Protopod with accessory sclerite positioned dorsally to praecoxa (arrowed in Fig. 9D). Praecoxa represented by a well-developed sclerite with spinular row on anterior surface. Coxa with spinular row anteriorly and posteriorly as figured. Intercoxal sclerite with fine spinular rows anteriorly. Basis with pinnate spine (with subapical flagellate extension) at outer distal corner and inner unipinnate spine; anterior surface with strong spinules around distal margin. Exopod 3-segmented; exp-1 and -2 with outer unipinnate spine and covered with coarse spinules around outer and distal margins; exp-3 small, with 2 unipinnate geniculate spines and 2 long bare setae; boundary between exp-2 and -3 not always clearly defined (Fig. 10B) but more clearly expressed when exp-3 withdrawn into exp-2 (Fig. 10A). Endopod 2-segmented; enp-1 elongate, about twice longer than wide, with serrate inner seta, outer and distal margins spinulose; enp-2 very small, with geniculate claw and very long naked seta apically.
Figure 1. *Delamarella obscura* sp. nov. A, habitus ♂, dorsal; B, habitus ♀, lateral; C, habitus ♂, dorsal.
Figure 2. *Delamarella obscura* sp. nov. A, urosome ♂, ventral; B, urosome ♀, ventral.
Figure 3. Delamarella obscura sp. nov. A, anal somite and caudal rami ♀, dorsal; B, anal operculum and caudal rami ♂, dorsal; C, fifth legs and genital apertures ♀, ventral; D, left caudal ramus ♂, lateral; E, antennule ♀, ventral; F, antenna [inset: medial view of distal endopod segment]; G, genital field ♀.
Figure 4. *Delamarella obscura* sp. nov. Female. A, mandible; B, maxillule, anterior [inset: armature of coxal endite]; C, maxilla, anterior; D, maxillary allobasis, posterior; E, maxilliped, anterior [posterior palmar seta on basis arrowed].
Figure 5. *Delamarella obscura* sp. nov. Female. A, P1, anterior; B, P2, anterior; C, P3, anterior; D, P4, anterior.
P2–P4 (Fig. 5B–D) with 3-segmented exopods and endopods. Intercoxal sclerites with concave ventral margin, without surface ornamentation. Praecoxa represented by well-developed sclerite with anterior spinular row. Coxà with spinular row on posterior surface. Basis with pinnate outer seta (P3–P4) or flagellate outer spine (P2). Exopods longer than endopods. Exopodal segments with coarse spinules along outer and distal margins and without spinules/setules along inner margin. Endopodal segments with coarse spinules along outer (enp-1,2) and distal (enp-1,2,3) margins. P2–P3 (Fig. 5B, C) with serrate inner seta on enp-1 and -2; distal margin of enp-3 with outer pinnate spine and inner plumose seta. P4 enp-1 (Fig. 5D) expanded, with robust unipinnate spine at inner sub-distal corner; enp-2 without any spines or setae; enp-3 with 2 pinnate spines apically.

P1–P4 armature formula:

<table>
<thead>
<tr>
<th>Exopod</th>
<th>Endopod</th>
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</thead>
<tbody>
<tr>
<td>P1 0.0.022</td>
<td>1.020</td>
</tr>
<tr>
<td>P2 0.1.022</td>
<td>1.1.020</td>
</tr>
<tr>
<td>P3 0.1.022</td>
<td>1.1.020</td>
</tr>
<tr>
<td>P4 0.0.022 [modified in ♀]</td>
<td>1.0.020</td>
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</table>

P5 (Figs 2B, 3C). Fifth pair of legs fused mediially; baseoendopod and exopod forming a common plate; basal seta plumose, arising from a prominent setophore. Exopodal lobe with 2 long biserrate spines, 1 short spinulose spine and 1 bare seta; endopodal lobe with a strong serrate spine medially and 2 short spinulose spines.

**Male**: Total body length: 440–500 µm (mean = 471 µm; N = 4). Sexual dimorphism in antennule, caudal rami and P4–P6.

Antennule (Figs 6A–C, 8D) haplocer with 5 segments distal to geniculation; indistinctly 13-segmented; boundaries between segments 11 and 13 expressed only dorsally (Fig. 6A), completely fused ventrally (Fig. 8D). Segment 5 small, represented by small U-shaped sclerite. Segment 6 with long aesthetasc fused basally to seta. Segment 8 with denticulate anteriodorsal margin, 1 naked seta, 1 basally fused pinnate seta (with tubular extension) and 1 modified element. Segment 9 with 3 modified elements. Segments 11–13 forming claw-like compound segment with most setae arranged around posterior margin (Fig. 8D). Armature formula 1-[1 pinnate], 2-[1], 3-[8], 4-[6], 5-[1 + 1 pinnate] 6-[4 + 1 pinnate + (1 + ae)], 7-[2], 8-[1 + 1 pinnate + 1 modified], 9-[3 modified], 10-[1], 11-[2], 12-[2], 13-[5 + (2 + ae)]. Modified elements on segments 8 and 9 with longitudinally ribbed surface and fused basally to segment (Fig. 8D).

Caudal rami (Figs 2A, 3D) with large cup-shaped pore ventrally halfway along ramus length (arrowed in Fig. 3D).

P4 (Figs 6D, 10C) with strongly modified exopod; exp-1 and -2 expanded, exp-3 reduced forming claw-like segment. Exp-1 rectangular, about 1.4 times as long as maximum width, with long unipinnate outer spine; distal margin and outer distal corner with strong spinules. Exp-2 forming central socket for exp-3; outer distal corner produced into lobate process (B) and spiniform outgrowth (D); outer spine strongly reduced, represented by small triangular element arising from posterior surface (A). Exp-3 outwardly recurved (C), forming functional grasping device with exp-2; with 3 setiform elements arranged around the inner margin. Endopod relatively longer and more slender than in ♀ exp-1 not expanded as in ♀ and lacking inner spine; outer distal spine on exp-3 comparatively longer than in ♀.

P5 (Figs 2A, 6E, 7D, 10D, 11B) essentially as in ♀ except middle endopodal spine relatively longer and with smaller hyaline flanges.

Sixth pair of legs (Figs 2A, 11B) strongly asymmetrical, with both members fused to genital somite and bearing 1 short bare and 1 long plumose seta; largest member functional one, inner portion rounded and with denticulate free margin. Spermatophore moderately large, about 80 µm.

**Etymology.** The specific epithet alludes to the small differences between the new species and its mediterranean congeners.

**Delamarella galateae Cottarelli, 1971**

Originally described from Sardinia (Cottarelli, 1971), the species has now also been found on mainland Italy (Sorrento area).

**Type locality:** Italy, Sardinia, north coast, beach near mouth of Rio de li Saldi, 200 m upstream.

**Material examined:** (1) From type locality: 1 ♀ dissected on slide; leg. V. Cottarelli, 25 February 1999; deposited in NHM, reg. no. 2005.186; (2) south of Salerno, mouth of Torrente Asa, near the village of Pontecagnano Faiano: 2 ♀♀ on slide, 1 ♀ and 1 ♂ on slide, 4 ♂♂ each on 1 slide; all specimens mounted in toto; leg. V. Cottarelli, 20 November 1972; deposited in NHM, reg. nos. 2005.187–194; (3) several specimens from rivermouth of Rio Posada, Nuoro Province, western Sardinia; leg. V. Cottarelli.

**Additional observations**

**Female:** Anal operculum spinulose, with 7–10 large spinules (Fig. 7B). Caudal ramus with dorsal spinules at inner distal corner and around base of seta VII; the oblique ventral setule row figured by Cottarelli (1971: Tav. I-3, left ramus only) is absent but some fine long
Figure 6. *Delamarella obscura* sp. nov. Male. A, antennule, dorsal [for complete armature pattern see B and C]; B, antennulary segments 1–10, anterior; C, antennulary segments 7–10, anterior; D, P4, anterior; E, fifth legs, ventral.
Figure 7. Delamarella obscura sp. nov. A, anal operculum and left caudal ramus ♀, dorsal; D, right fifth leg ♂, ventral; F, P4 copepodid V ♂, intermoult stage, anterior; G, P4 exopod ♂, developing inside copepodid V ♀ intermoult stage. Delamarella galateae Cottarelli, 1971; B, anal operculum and left caudal ramus ♀, dorsal; C, antenna (except free endopod) ♀; E, right fifth leg ♂, ventral.

Figure 8. *Delamarella obscura* sp. nov. SEM micrographs. A, distal portion of antennule ♀, ventral [surface sutures separating apical segments arrowed; ae, aesthetasc]; B, antenna ♀ [surface suture separating basis and proximal endopod segment arrowed]; C, labrum [anterior setular tuft arrowed]; D, distal portion of antennule ♂, anterior [modified elements around geniculation arrowed].

Figure 9. Delamarella obscura sp. nov. SEM micrographs. Female. A, mandibular palp; B, maxilla, posterior [opening of maxillary gland arrowed]; C, maxilliped [palmar setae on basis arrowed]; D, P1 protopod, anterior [supplementary sclerite arrowed; b, basis; c, coxa; ics, intercoxal sclerite; pc, praecoxa].
Figure 10. Delamarella obscura sp. nov. SEM micrographs. A, P1 exopod, anterior, showing exp-3 partly withdrawn in exp-2 (arrowed); B, P1 exopod, anterior, showing exp-3 fully exposed [surface suture arrowed]; C, P4 exopod ♂, anterior; D, P5 ♂, anterior [secretory tube-pores arrowed].
setules are present along the inner margin; ventral surface with pore near proximal margin and tube-pore substistally; ramus with 7 setae as in *D. obscura*.

Antennule clearly 9-segmented; armature formula as in *D. obscura*.

Antenna (Fig. 7C). Basis and proximal endopod segment incompletely separated; abexopodal seta of proximal endopod segment much shorter than that on basis; armature of distal endopod segment as in *D. obscura*.

Mandibular endopod with 6 apical setae instead of 5 as figured by Cottarelli (1971: Tav. II-2).

Maxillule and maxilla as in *D. obscura*.

Maxilliped less slender than figured by Cottarelli (1971: Tav. II-8); basis with additional seta on palmar margin and spinele row on posterior surface; endopodal claw more elongate than in original description.

P1 exopod 3-segmented; exp-1 and -2 with outer unipinnate spine and covered with coarse spinules around outer and distal margins; exp-3 small, with 2 unipinnate geniculate spines and 2 long bare setae; boundary between exp-2 and -3 not always clearly defined. Endopod 2-segmented; enp-1 with serrate inner seta [overlooked in Cottarelli (1971: Tav. III-1,4)].

P2–P3 exp-2 with plumose inner seta [overlooked in Cottarelli (1971: Tav. III-2,6)].

P1–P4 armature formula and detailed morphology of P5 as in *D. obscura*.

Male: Caudal rami with large cup-shaped pore ventrally halfway along ramus length.

Antennule haplocer with 5 segments distal to geniculation; indistinctly 13-segmented; boundaries between segments 11 and 13 expressed only dorsally, completely fused ventrally. Segment 5 small, represented by small U-shaped sclerite. Segment 6 with long aesthetasc fused basally to seta. Armature formula as in *D. obscura*.

P4 closely resembling condition in *D. obscura* but distal seta on exp-3 shorter.

P5 (Fig. 7E) essentially as in *D. obscura* except that exopodal spines are longer and more slender, and mid-

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**Figure 11. Delamarella obscura** sp. nov. SEM micrographs. A, endopodal lobes of fifth legs and genital apertures (arrowed) of ♀; B, P5 and genital opercula of ♂.
dle endopodal spine has long spinules instead of being denticulate.

Sixth pair of legs strongly asymmetrical, with both members fused to genital somite and bearing 1 short bare and 1 long plumose seta; largest member functional one, inner portion rounded and with denticulate free margin.

**DISCUSSION**

**VALIDITY OF **Latiremus** Božić, 1969**

Chappuis (1954a) established the genus Delamarella in a preliminary note, presenting a detailed text description of the type species *D. arenicola*. In a later report, Chappuis (1954b) supplemented this description by providing additional drawings and a discussion of potential relationships; however, having been unable to place the new genus with confidence in any existing family, he preferred to consider it incertae sedis (see also Chappuis, 1954c). This uncertain taxonomic position remained unchanged when Petkovski (1957) and Cottarelli (1971) added two more mediterranean species to the genus, *D. karamani* Petkovski, 1957 from Croatia, and *D. galateae* Cottarelli, 1971 from Sardinia.

Božić (1969) described a new genus and species, *Latiremus eximius*, from La Réunion, and considered it the type of a new family Latiremidae. As pointed out by himself (Božić, 1978), he unfortunately overlooked the close affinity between Delamarella and Latiremus, a relationship first recognized by Itô (1974) and subsequently confirmed by various other authors (Bodin, 1976a, b; Wells, 1976, 1978; Kunz, 1977). Most authorities considered the differences insufficient to maintain generic distinction and relegated *Latiremus* to a junior subjective synonym of the latter (Apostolov & Marinov, 1988; Bodin, 1976a, b; Kunz, 1977, 1984; Božić, 1978). This resulted in the family name being based on an invalid generic name, but as this course of action occurred after 1960, the validity of the family name and the designation of Delamarella as the type genus remained unaffected (ICZN: Art. 40). Wells (1976) preferred to treat them as distinct genera, an option also favoured by Huys & Kunz (1988) who redefined the generic boundaries within the Latiremidae. They reinstated *Latiremus* as a valid genus, moved *Delamarella phyllosetosa* Kunz, 1984 to a new genus *Arbutifera*, and restricted Delamarella to the three mediterranean species *D. arenicola*, *D. karamani* and *D. galateae*.

Huys & Kunz (1988) justified the separate generic status of *Latiremus* on the basis of the following characters: P1-bearing somite completely incorporated in cephalosome forming cephalothorax; genital and first abdominal somites completely free in female; seminal receptacles clearly separated; anal operculum with setulose frill but without spinules; caudal ramus setae II–III bearing subapical flagella; antennule 8- or 9-segmented; antennary basis and proximal endopod segment not fused; P1-exopod 2-segmented; P1 enp-1 without inner subdistal seta; P4 exopod 3-segmented; 3 bipinnate setae in abdominal somites; anal operculum with 10–15 spinules; genital and first abdominal somites fused dorsally in *D. arenicola* and 3 bipinnate spines in *D. karamani*. The following character states were used to diagnose Delamarella: P1-bearing somite partially incorporated in cephalosome; genital and first abdominal somites fused dorsally in *D. arenicola*; seminal receptacles closely set; anal operculum with 10–15 spinules; caudal ramus setae II–III without subapical flagella; antennule 8- or 9-segmented; antennary basis and proximal endopod segment fused forming allobasis; P1-exopod 2-segmented; P1 enp-1 without inner subdistal seta; P4 exopod 3-segmented; at least 2 strong blunt processes; P5 middle somite of endopodal lobe with strips of serrate membrane, endopodal lobe with 3 bipinnate spine plus seta in both sexes.

Our re-examination of *D. galateae* and description of *D. obscura* revealed that the characters used by Huys & Kunz (1988) to separate Delamarella and *Latiremus* are all essentially unsound and based on erroneous reports in the literature. Petkovski (1957) stated that the P1-bearing somite is only partly fused to the cephalosome in *D. karamani* and Cottarelli's (1971) illustration of the male habitus of *D. galateae* appears to substantiate this. It now appears that both authors have wrongly interpreted the extensive intersomitic membrane separating the cephalothorax from the P2-bearing somite. It is conceivable that Kunz (1984) made the same observational error in his description of *Arbutifera phyllosetosa* and that consequently all latiremids possess a genuine cephalothorax. Similarly, Huys & Kunz (1988) extrapolated Petkovski's (1957) observation of a dorsally fused (but ventrally separated) genital double-somite in *D. karamani* to all Delamarella species. This is contradicted by our observations of *D. galateae* and *D. obscura*; in these species the genital and first abdominal somites are completely separated as in *Latiremus* and *Arbutifera*. Generic distinction based on seminal receptacle position has also proven unreliable as the structures illustrated by Cottarelli (1971) in reality refer to the crescent-shaped genital apertures (Fig. 11A) and this is probably also the case for Božić's (1969: fig. 4a) figure of the female genital field in *L. eximius*.

The ornamentation of the anal operculum in *D. obscura* is intermediate between the finely serrate condition displayed by *L. eximius* and the more spinulose state found in *D. arenicola* and *D. galateae*, indicating that this character has no significance at generic level. Caudal ramus setae II and III have a subapical flagella in *D. galateae* and *D. obscura*.
L. eximius (1988) remarked that the 8-segmented conditions in D. obscura (compare Figs 3E, 8A). Huys & Kunz (1988) remarked that the 8-segmented conditions in L. eximius and D. arenicola may not be homologous; however, given the generally weakly defined boundaries of the apical segments, this claim requires confirmation before it can be attributed taxonomic significance. A similarly overemphasized character is the presence/absence of an antennary allobasis. All published descriptions of Delamarella species invariably state that the basis is fused to the proximal endopod segment, forming an allobasis. Our observations confirmed the presence of a transverse surface suture (Fig. 8B) in both D. obscura and D. galateae which resembles the faint articulation drawn by Božič (1969) in his description of L. eximius.

The 2-segmented P1 exopod reported by Chappuis (1954a, b), Petkovski (1957) and Cottarelli (1971) was considered by Huys & Kunz (1988) as one of six autapomorphies defining the genus Delamarella. We observed that in D. obscura and D. galateae the P1 exopod is in reality 3-segmented although the segment boundary between exp-2 and exp-3 is not always clearly discernible. Unlike the articulation between exp-1 and exp-2, the joint between exp-2 and exp-3 is telescopic in nature and does not display the usual condylar reinforcements. The middle and distal segments are connected by a membranous intersegmental zone (arrowed in Fig. 10B) which enables the latter to be partly withdrawn in the former (Fig. 10B). When exp-3 is fully exposed, the telescopic boundary is hardly discernible, creating the false impression that the ramus is 2-segmented (Fig. 10B). Although the inner seta on P1 endp-1 in A. phyllosetosa and L. eximius has consistently been claimed to be absent in previous Delamarella descriptions, we have shown it to be present in at least D. galateae and D. obscura. As this element typically arises from the posterior surface of the segment, we suspect that it may have been overlooked in D. arenicola and D. karamani.

The most striking apomorphy of latiremids is displayed by the complex morphology of the male P4 exopod. The different processes and elements of the distal part of the ramus cannot readily be homologized with their equivalents in the adult female. Prior to the final moult the P4 is essentially the same in both sexes, except that the proximal and middle exopod segments are already expanded in the male (Fig. 7F). Examination of a copepodid V 

tain *Latiremus* as a distinct genus it is formally synonymized with *Delamarella* and, consequently, its type species is transferred as *D. eximia* (Božić, 1969) comb. nov. Based on published records the genus appears to assume a ponto-mediterranean distribution with one outlier in the Western Indian Ocean (Božić, 1969); however, one of us (V.C.) recently discovered another morphologically close congener from the Philippines, suggesting that *Delamarella* is probably Tethyan in distribution. Most mediterranean species are found interstitially in beach sands influenced by freshwater, i.e. at or near the mouth of rivers and streams. This low salinity preference probably enabled the genus to colonize other habitats in the oligohaline Black Sea.

**Species discrimination in Delamarella**

Delamarella species are generally small (about 0.5 mm) and the morphological stasis in the genus makes it extremely difficult to separate congeners unambiguously. Most species belonging to the ponto-mediterranean species complex can only be differentiated by either morphometric characters and/or features related to ornamentation of body and appendages. In addition, characters traditionally applied to separate species are no longer valid. For example, Cottarelli (1971) identified the following characters as diagnostic for *D. galateae*: (1) oblique row of fine spinules on dorsal surface of caudal ramus, (2) caudal ramus sexual dimorphism (with ‘tubercle’ in ♂) (3) denticulate somitic frills, (4) distinct ventral spinulation of abdominal somites, (5) inner margin of P2–P3 exp-2 [lapsus calami in Cottarelli (1971): read exp-2] without seta, and (6) detailed morphology of ♂ P4 endopod. Characters (1)–(4) are also displayed by *D. obscura* and are conceivably present in all Delamarella species, being inadequately figured in previous descriptions. Character (5) is based on an observational error given that our re-examination of *D. galateae* revealed the presence of an inner seta on P2–P3 exp-2 as in all other congeners. Finally, given the deficiencies in earlier descriptions (see above) the morphology of the male P4 endopod is of limited usefulness in species discrimination. Cottarelli (1971) remarked that females of both *D. galateae* and *D. karamani* differ from those of the type species *D. arenicola* in the 8-segmented antennule and the P4 endopod which is not only 2-segmented but also distinctly shorter than in its congeners.

The differences between the remaining mediterranean species are less pronounced. *D. obscura* differs from *D. galateae* primarily in the spinulation of the anal operculum (20–30 small spinules vs. 7–10 large spinules; Fig. 7A, B), the length of the distal abexopodal seta on the antenna (much shorter than the proximal one in *D. galateae*; Figs 3F, 7C) and the detailed morphology of the male P5 (exopodal spines longer and ornamentation of middle endopodal spine more pronounced in *D. obscura*; Fig. 7D, E). Despite the conciseness of Petkovski’s (1957) description of *D. karamani*, his illustrations provide sufficient information to distinguish this species from *D. obscura*: (1) the anal operculum is less ornate, (2) the P3 endopod is as long as the exopod (distinctly shorter in *D. obscura*: Fig. 5C) and (3) the exopodal spines on the male P5 are markedly longer and more slender.

Apostolov (1969) recorded numerous females and males from coastal groundwater (‘Küstengrundwasser’) at Cape Galata in the Bay of Varna (Bulgarian Black Sea coast), which he attributed to *D. karamani*. The author claimed his specimens differed from Petkovski’s (1957) Croatian type material in the caudal ramus (presence of an oblique dorsal spinule row and two short marginal spinules between setae II and III; the latter form obviously part of the posteroventral spinule row found in other species, e.g. Fig. 2B), the size of the anal somite (reaching halfway along the caudal ramus length) and the anal operculum (with 21–25 spinules). This last character suggests Apostolov’s (1969) material and his six females from a sandy beach near the Veleka River (Apostolov, 1971) are conspecific with *D. obscura*, indicating the species has an almost continuous distribution on either side of the Bosporus, from the Bay of Varna in northern Bulgaria to at least the Kastamonu province in north-western Turkey. It should also be remarked that the illustrations of *D. karamani* in Apostolov & Marinov’s (1988) Fauna Bulgarica are based on Petkovski (1957), not on Apostolov (1969).

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**REFERENCES**


SYNONYM OF LATIREMUS AND DELAMARELLA


