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The genus *Diaphanosoma* (Ctenopoda: Sididae) in Spain

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Abstract

During a 1987–88 extensive limnological study of Spanish reservoirs, euplanktonic cladocerans were sampled all around the country. Two species of *Diaphanosoma* Fischer, 1850 were recorded, viz *D. mongolianum* Uéno, 1938 and *D. brachyurum* (Liévin, 1848). Morphological descriptions of both species are presented, especially of the thoracic limbs, together with notes on their ecology. Both species present a clear allopatric distribution, *D. brachyurum* inhabiting waters with a low Total Dissolved Salt (TDS) content, which equilibrated relative ionic composition, characteristic of a narrow strip in the northern part of the Iberian Peninsula; on the contrary, *D. mongolianum* inhabits waters with high TDS values and high content of sulphate or chloride, characteristic of the central and southern regions.

Introduction

The euplanktonic crustacean fauna of the Iberian Peninsula is very scanty, mainly as a result of the scarcity of true limnetic habitats; there are only two important natural lakes (Sanabria, 108 hm^3; Banyoles, 17 hm^3). Nevertheless, more than 700 reservoirs have been constructed during 1940–70 (Dirección General de Obras Hidráulicas, 1973), and an up-to-date census would probably yield and estimate of about 900. This has given the chance for colonization, and a checklist of the crustaceans of the Spanish reservoirs (Armengol, 1978), which can be considered the first extensive survey of true limnetic habitats carried out in Spain, reported 28 euplanktonic species – 15 cladocerans and 13 copepods. This represent only 2/3 of the expected number of species found in European lakes (Margalef, 1983), an impoverishment which is more a result of the youth and environmental fluctuations of reservoirs than of a deficient habitat prospection.

The existence of a very rich steppic cladoceran fauna, with a high degree of endemism (Alonso, 1985) has switched the attention of local taxonomists far from such euplanktonic groups as *Diaphanosoma* Fischer, 1850, *Daphnia* s. gen. *Daphnia* (O.F. Müller, 1776) Johnson, 1952, and *Bosmina* Baird, 1845. These genera are composed of species with a high phenogenetic plasticity, which require accurate morphological characterization and delimitation of variability in order to elucidate their taxonomic status.

The aim of this paper is to present accurate morphological descriptions and to study the variability of the *Diaphanosoma* species inhabiting the Iberian Peninsula, in order to relate them to some extensive works on the genus (Kořinek, 1987; Korovchinsky, 1987). Some previous references concerning the genus in Spain are limited to the enumeration of localities from which the genus has been reported (Margalef, 1953; Miracle, 1976; Armengol, 1978; Toja, 1981). The pattern used has been to refer all the representatives of the

genus in Spain to *D. brachyurum* (Liévin, 1948) (Armengol, 1978; Toja, 1981). Nevertheless, Alonso (1985) distinguished between *D. brachyurum* and *D. birgei* Kořinek, 1981 in his work on Cladocera of Spain. Korovchinsky (1987) studied two populations from Spain and assigned them to *D. mongolianum* Uéno, 1938. Our own collections have confirmed the presence of two *Diaphanosoma* species in the Iberian Peninsula, viz *D. brachyurum* and one representative of the *D. mongolianum* group, with an allopatric distribution determined mainly by ecological factors.

Materials and methods

Material were collected mainly during an extensive limnological study of the Spanish reservoirs carried out during 1987–88. 104 reservoirs were visited two times during this period, corresponding to the maximum stratification and mixture of the water column. Samples from small natural lakes and ponds deposited in Dr M. Alonso's collection (Barcelona, Spain) were also used. Samples were taken with a Nytal net of 200 μm mesh size and 25 cm diameter, and fixed with 4% formalin. Camera lucida drawings were made with a BH-T Olympus microscope. Measurements were made by means of an eyepiece micrometer, the scale factor of which was determined by a stage micrometer, and following Korovchinsky (1978). All measurements and observations were done on adult parthenogenetic females and adult males.

Results

Diaphanosoma mongolianum Uéno, 1938 emend. Korovchinsky, 1987

Synonymy:
Diaphanosoma brachyurum (non Liévin, 1848) Armengol, 1978; Toja, 1981.
Diaphanosoma birgei (non Kořinek, 1981) Alonso, 1985.

Material examined:
Reservoirs (code numbers as in Armengol (1978 : 4) and in Fig. 6): 26 (2.8.88), 27 (13.12.87; 1.8.88), 33 (18.12.87; 15.7.88), 34 (19.12.87; 16.7.88), 35 (16.7.88), 36 (14.6.88), 37 (14.6.88), 39 (15.6.88), 44 (21.6.88), 45 (21.6.88), 46 (14.2.88; 22.6.88), 48 (16.2.88); 23.6.88), 49 (23.6.88), 50 (13.2.88), 53 (11.2.88; 9.6.88), 55 (24.6.88), 56 (13.6.88), 57 (2.1.88), 61 (1.9.88), 63 (1.9.88), 64 (25.5.88; 3.9.88), 65 (3.9.88), 66 (27.2.88; 4.9.88), 67 (29.11.88; 6.9.88), 68 (29.2.88; 6.9.88), 70 (14.9.88), 71 (16.9.88), 72 (15.9.88), 73 (11.3.88; 17.9.88), 75 (13.3.88; 25.6.88), 76 (25.6.88), 77 (19.9.88), 82 (1.3.88; 8.9.88), 83 (3.3.88; 3.3.88), 84 (10.9.88), 85 (10.9.88), 86 (11.9.88), 87 (12.9.88), 88 (6.3.88; 12.9.88), 89 (6.3.88; 13.9.88), 90 (28.2.88; 5.9.88), 96 (24.11.87), 98 (1.8.88), 100 (17.7.88), 101 (22.6.88), 102 (14.9.88), 103 (9.3.88; 15.9.88), 104 (3.2.88; 12.6.88).

Lakes and lagoons (materials deposited in the collection of Dr M. Alonso, Barcelona, Spain): Laguna Chica de Villafranca (La Mancha, 26.7.84).

Description

Parthenogenetic female

Head large (38.32% in terms of body length; see Table 1) with a more or less protruded dorsal part, varying in appearance from conical to more or less roundish rectangular (Fig. 1a, b). Ventral side of head with depression (Fig. 1a). Antennules with flagellum twice as long as basal segment; one individual bearing an abnormal thin seta halfway on the margin (Fig. 1e). Labrum reaching anterior margin of valves (Fig. 1b, d). First maxilla with 6 curved biarticulated setae, bearing bristles only on their distal segment, and one triangular spine fringed with a row of bristles (Fig. 1f). Swimming antennae massive (84% in terms of body length), never reaching the posterior margin of the valves (Fig. 1a, 2a), its basipodite longer than the biarticulated branch, with a long seta inserted on the inner side of its flexible basis, and distally with one small subapical feathered seta on inner side

Table 1. Biometrical data (lengths, mm) of 5 spanish populations of *Diaphanosoma mongolianum* Uéno, 1938 (see also Fig. 6 for place localities).

Locality	45 (21.6.88)	73 (17.9.88)	100 (17.7.88)	103 (15.9.88)	MANCHA (26.7.84)
Body length (x ± 1 S.E.) (variation)	1.07 ± 0.18 (0.95–1.23) (*n* = 37)	1.11 ± 0.02 (1.00–1.23) (*n* = 30)	1.19 ± 0.02 (0.98–1.40) (*n* = 49)	1.08 ± 0.12 (0.78–1.23) (*n* = 49)	0.88 ± 0.04 (0.80–1.02) (*n* = 9)
Head length: body length (%)	38.15 ± 0.61 (*n* = 37)	38.17 ± 0.48 (*n* = 31)	38.59 ± 0.30 (*n* = 49)	37.72 ± 0.27 (*n* = 49)	38.97 ± 1.32 (*n* = 9)
Head height: body length (%)	22.73 ± 0.84 (*n* = 10)	23.97 ± 1.05 (*n* = 11)	24.12 ± 0.51 (*n* = 28)	22.65 ± 0.41 (*n* = 29)	22.44 ± 0.84 (*n* = 9)
Shell denticles	21–38 (*n* = 37)	30–39 (*n* = 30)	19–39 (*n* = 30)	21–34 (*n* = 30)	18–26 (*n* = 9)

and one spine on outer side (Fig. 2a, b). Distal part of proximal segment of biarticulated antennal branch with one spine and one rounded prominence (Fig. 2c); distal part of distal segment with one spine, 2 rounded and one pointed prominences (Fig. 2d). One subapical spine on distal part of the intermediate segment of triarticulated branch; 2 spines, one of them very small, on distal segment (Fig. 2e). Formula of setae: 4-8/0-1-4. Carapace convex in the middle part of dorsal side, with a laterally protruding brood chamber, but narrower in its posterior part (Fig. 1a, c). Infero-posterior margin of valves merging smoothly with the flap-like ventral margin of valves (Fig. 1a, g); up to 39 denticles implanted on the infero-posterior margin of valves, in groups of 3–4 denticles with one thin seta implanted between adjacent groups (Fig. 1g); this row of denticles extends somewhat into the posterior margin of the valves. 12(-14) long feathered setae implanted on the edge of the ventral flap, the 3 proximal ones smaller and implanted on the inner side of the valves; the distalmost seta is shortened also, and implanted in the fist group of denticles of the infero-posterior margin of valves (Fig. 1g). There are 7–8 small setules between successive long setae (Fig. 1h). Posterior margin of valves with a row of marginal cilia on inner side, the ventralmost ones thicker; one small and thick spine implanted on the inner side of the supra-posterior margin of the valves (Fig. 1i).

Postabdomen with 7–8 groups of small denticles and two rows of small setules above them on the lateral side. Proximal basal spine of claw smaller than the other two (Fig. 1j). Inner ventral side of claw with 5–8 regularly distributed flat denticles; 2 rows of spinules on its outer lateral side, one of them implanted over basal claw spines (Fig. 1j).

First thoracic limb (Fig. 3a) with exopodite narrowed distally, and bearing 5 apical and 5 laterally implanted feathered setae, the proximal one with its basis thicker than the rest, and directed proximally. Endopodite of the same length as exopodite and subdivided into 4 not very distinct segments; the subterminal one bears a row of biarticulate filtering setae and one shorter, nonarticulate feathered stout seta like those of the exopodite; outer basal side of endopodite with a lobe having as many as 13 unfeathered, spine-like setae (Fig. 3b). Margin of gnathobasic prominence (Fig. 3b) with one long and stout biarticulate seta, one nonsegmented feathered seta, not surpassing the proximal segment of the former, and one biarticulated seta of the same size as the last one described; on the outside of these

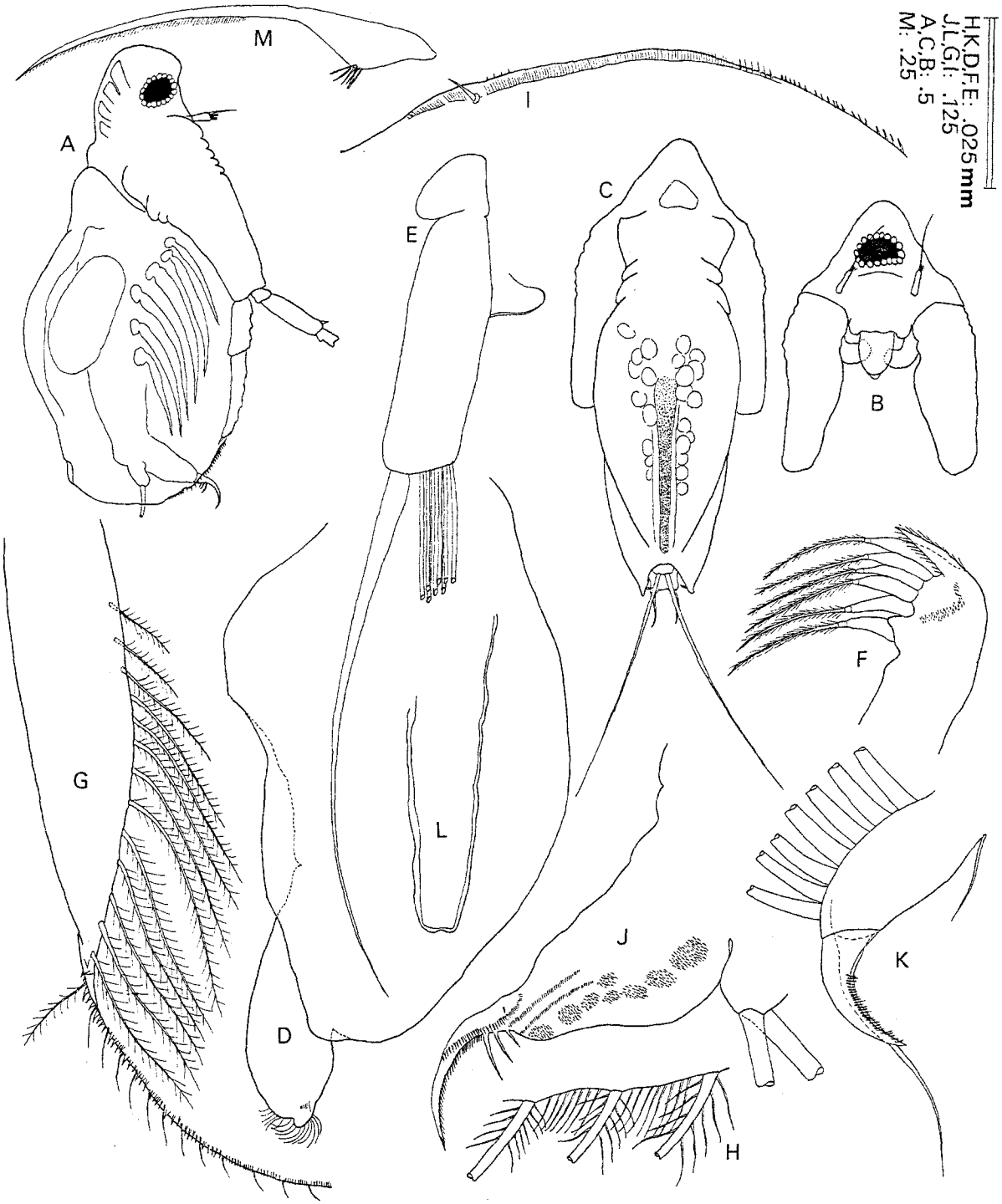

Fig. 1. Diaphanosoma mongolianum Uéno, 1938 from Iznájar reservoir (73). Female: *a*, lateral view of parthenogenetic individual; *b*, frontal view of head; *c*, dorsal view of an individual without embryos in the egg chamber; *d*, lateral view of labrum; *e*, antennula with an abnormal seta halfway on the basis margin; *f*, first maxilla; *g*, ventral margin of valve; *h*, detail of the setulation between feathered setae of the ventral margin; *i*, posterior margin of valve; *j*, postabdomen. Male from La Tranquera reservoir (33): *k*, apical part of endopodite of first thoracic limb; *l*, penis; *m*, antennula.

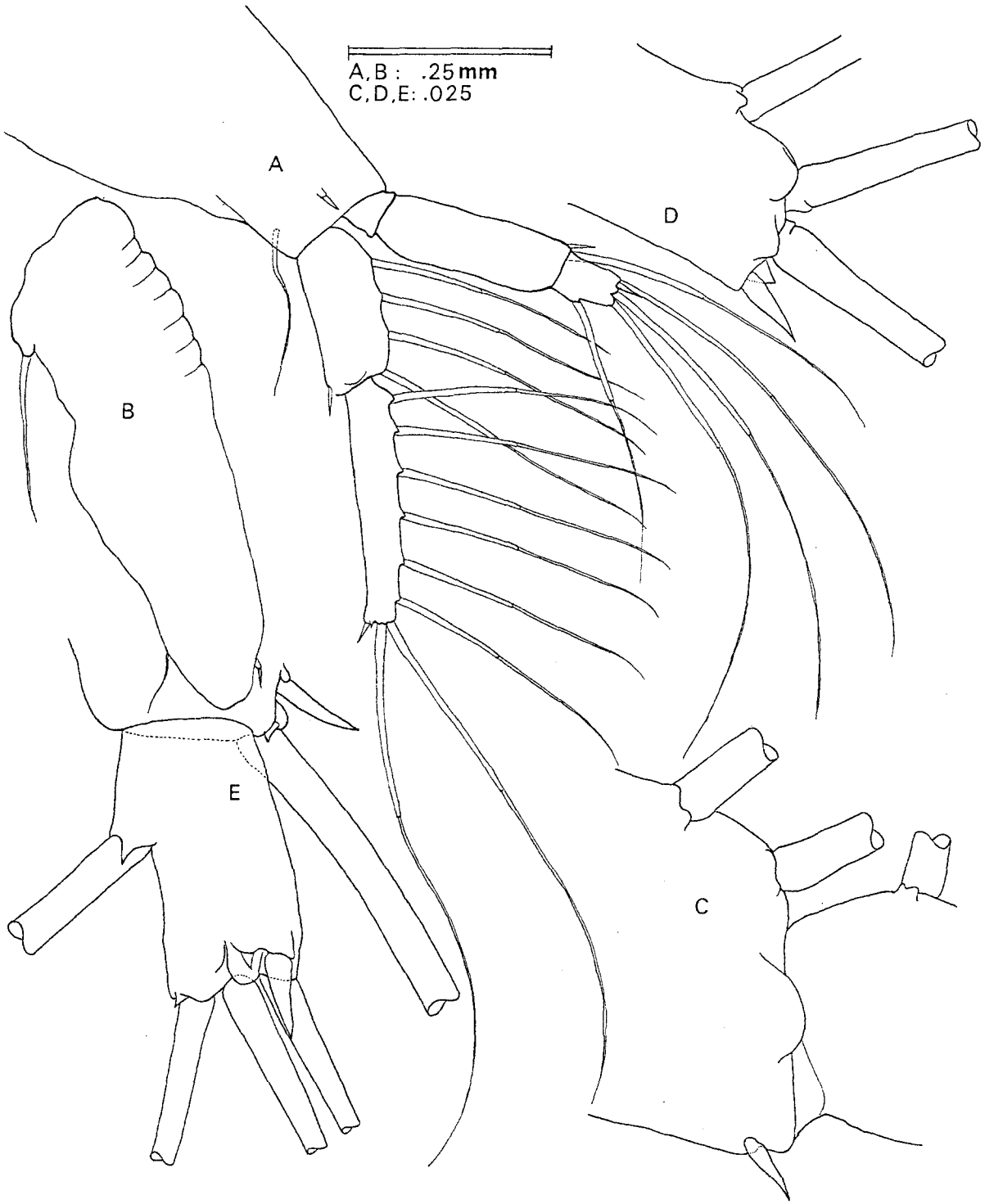

Fig. 2. Diaphanosoma mongolianum Uéno, 1938 from Iznájar reservoir (73): *a*, lateral view of antenna; *b*, frontal view of basipodite of antenna; *c*, detail of distal part of proximal segment of the biarticulated antennal branch; *d*, distal part of terminal segment of the biarticulated antennal branch; *e*, terminal segment of the triarticulated antennal branch.

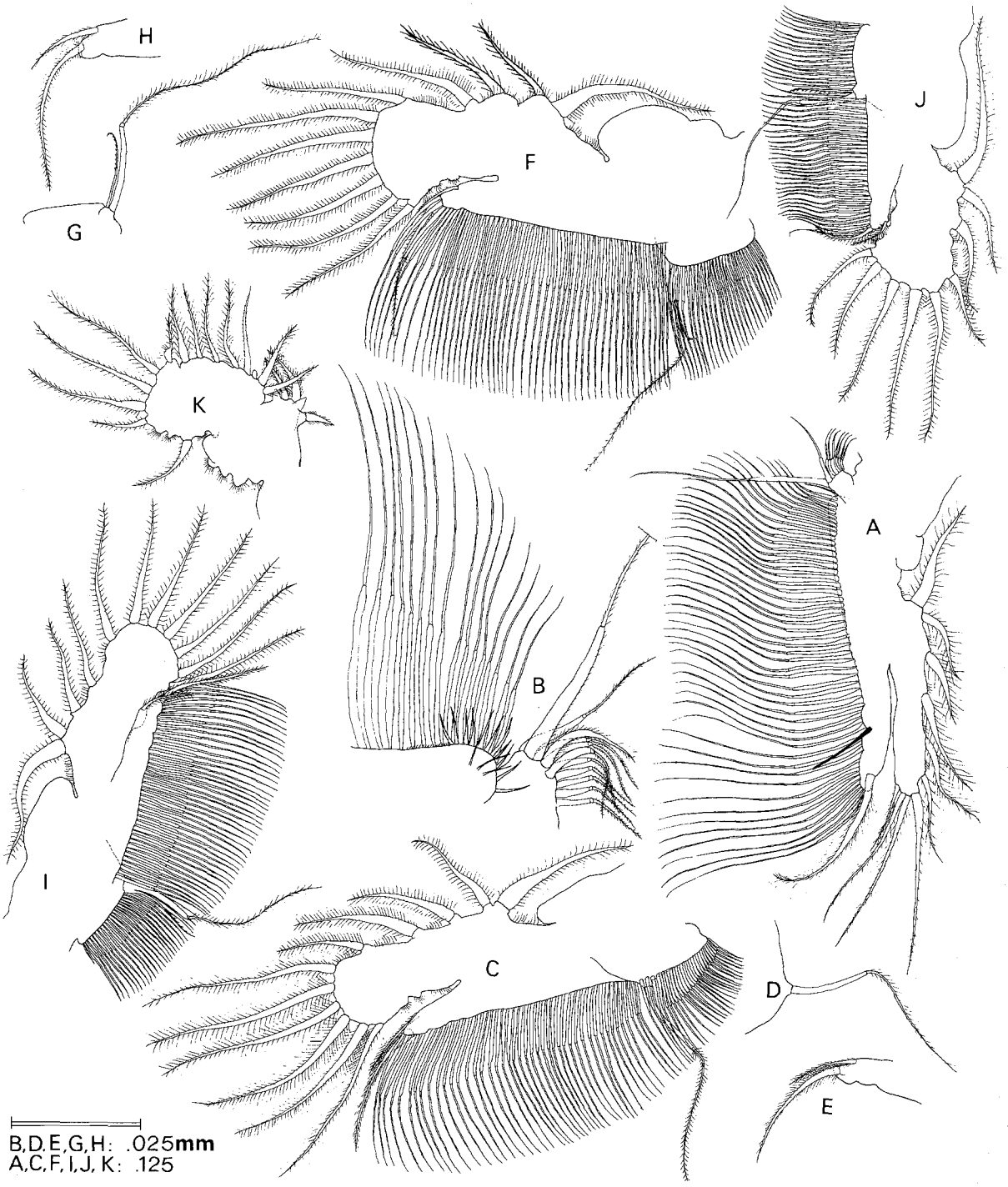

Fig. 3. Diaphanosoma mongolianum Uéno, 1938 from Iznájar reservoir (73). Thoracic limbs of female: *a*, first limb; *b*, gnathobasic prominence of first limb; *c*, second limb; *d*, detail of gnathobasic prominence of second limb; *e*, detail of apical part of endopodite of second limb; *f*, third limb; *g*, gnathobasic prominence of third limb; *h*, detail of apical part of endopodite of third limb; *l*, fourth limb; *j*, fifth limb; *k*, sixth limb (rows of filtering setae not represented in d, e, g and h).

there is a row of 8 small biarticulate setae, only feathered on their distal part, the first one slightly thicker and longer than the rest.

Second thoracic limb (Fig. 3c) with exopodite expanded distally; 7 terminal setae, roughly of the same size, and 4 lateral setae of the same size also, shorter than the former; the proximal lateral seta has its basis thicker than the rest of the setae, and is directed proximally. Endopodite shorter than exopodite; distal segment with a row of biarticulate filtering setae and one thick nonarticulate feathered seta (Fig. 3c), roughly of the same length as the biarticulate ones; second segment with a row of biarticulate setae and one feathered nonarticulate seta (Fig. 3e), thinner and shorter than that of the distal segment. Margin of gnathobasic prominence bearing a long and thick biarticulate seta (Fig. 3d) and a row of up to 30 biarticulate filtering setae (Fig. 3c).

Third thoracic limb (Fig. 3f) with terminal part of exopodite more broadly expanded than that of the second thoracic limb, and bearing 7 long, feathered, unsegmented setae, all of them roughly the same size; 4 lateral setae, similar to those of the distal part, but the proximal one with a thicker basis, and directed proximally. Endopodite shorter than exopodite, with structure resembling that of the second thoracic limb (Fig. 3h). Gnathobasic prominence bearing a long biarticulate seta resembling that of the second thoracic limb, a small unsegmented seta shorter than the basal segment of the biarticulate one, bearing some denticles on its distal part (Fig. 3g), and a row of biarticulate filtering setae (Fig. 3f).

Fourth thoracic limb (Fig. 3l) resembling the third one, but smaller.

Fifth thoracic limb (Fig. 3j) with general structure resembling those of the third and fourth ones, but smaller and bearing 6 setae on the terminal part of the exopodite and 3 on its lateral side.

Sixth thoracic limb (Fig. 3k) very small. Exopodite with 5 setae on terminal plate and a lateral seta. Endopodite reduced to an unsegmented, broad plate with 7 nonarticulate feathered setae of the same size, and one small prominence inserted between the third and second proximal setae. Gnathobasic prominence with 2 nonarticulate feathered setae, 2 prominences, and one thick lateral feathered seta.

Gamogenetic female

Identical to the parthenogenetic female. One resting egg, brownish, oval, with a smooth cuticle.

Male

Diagnostic features as in female. Antennae surpassing the posterior margin of valves. Antennules long, with flagellum covered by minute setules, and olfactory setae inserted halfway on basis (Fig. 1m). Hook of first thoracic limb endopodite with minute setules along its distal half (Fig. 1k). Tube-like copulatory appendage (penis) narrower towards end (Fig. 1l).

Remarks

Korovchinsky (1987) has presented an emended redescription of two *Diaphanosoma* species, viz *D. mongolianum* Uéno, 1938 and *D. lacustris* Kořinek, 1981. Both are essentially Palearctic species, very similar in morphology, and constitute the so-called 'mongolian' group. The diagnostic character for their correct assignment are mainly biometrical (length and height of head in terms of body length, number of denticles on the infero-posterior margin of valves), and also morphological (shape of postero-dorsal margin of valves). The Spanish populations can be assigned to *D. mongolianum* s.st., in accordance with the morphological and biometrical data recorded (Table 1). Nevertheless, some peculiarities have been detected: The ratio head length: body length falls in the lower range recorded for *D. mongolianum* (Table 1) (Korovchinsky, 1987), as is also evident comparing our drawings (Fig. 1a) with those presented by Korovchinsky, loc.cit.; nevertheless, Korovchinsky had noted this characteristic in one of the two populations he studied from Spain, namely, the one roughly assigned to the province La Mancha. A sample from the same locality, i.e. Laguna Chica de Villafranca, a temporary athalassohaline pool, was kindly offered to me by Dr M. Alonso. Only

9 well-preserved, mature parthenogenetic females were found, the biometrical data of which appear in Table 1. Head length : body length mean values of the latter population and those from reservoirs 45, 73, 100 and 103 (Table 1) were subjected to One Factor ANOVA in order to test the biometrical homogeneity of Spanish populations; no significative differences were found (F = 1.571, N.S). Hence, Spanish populations are characterized by a small head, a feature also reported from the population inhabiting Lake Issyk-Kul (Kirghizia, USSR) (Korovchinsky, 1987).

Some meristic characters have presented a wider range of variation than that previously reported. The number of denticles of the infero-posterior margin of valves can be up to 39 (maximum reported by Korovchinsky (1987) was 36). The number of feathered setae along the ventral margin of the valves can be up to 14 (up to 12 in Korovchinsky (1987), who considers this feature characteristic of the 'mongolian' group). Both these results are probably a consequence of big individuals involved in our measurements. The thin lateral seta of the female's antennule has not been reported in previous works on the 'mongolian' group (Korínek, 1981; 1987; Korovchinsky, 1987). We have observed a small, hyaline, spine-like prominence on the distal part of distal segment of the triarticulated antennal branch (Fig. 2e). The natatory antennae do not surpassed the posterior margin of the valves in all the females examined; in males, on the contrary, the length of the antennae has always surpassed the posterior margin of valves with the exception of males from La Tranquera reservoir (33). The first maxilla has 6 curved setae (only 5 reported by Kořinek, 1987).

Spanish reservoirs' populations of *D. mongolianum* differ from others studied elsewhere (Korovchinsky, 1987) by producing males in early winter (males are known from 27(13.12.87), 33(18.12.87) and 96(24.11.87)) instead than in summer; this is perhaps related to the midl autumn conditions. In Laguna Chica de Villafranca, on the contrary, males are known from April 1985 (Korovchinsky, 1987) and 26.7.84; Korovchinsky (in litt.) considers this population as peculiar because of its small head, the nature of the habitat (temporary athalassohaline pool), and the occurrence of gamogenesis in spring. No differences, either morphological or biometrical (Table 1), have been detected in comparison with other Spanish populations. Moreover, the variability in time of gamogenesis perhaps is related to the unpredictability of the wet period.

Diaphanosoma brachyurum (Liévin, 1848)

Material examined:
Reservoirs (code numbers as in Armengol (1978 : 4) and in Fig. 6):
1 (27.11.87), 6 (9.7.88), 10 (4.12.87; 22.7.88), 11 (4.12.87; 21.7.88), 12 (4.12.87; 23.7.88), 13 (21.7.88), 14 (23.7.88), 16 (7.12.87; 25.7.88), 17 (9.12.87), 18 (8.12.87; 25.7.88), 19 (8.12.87; 26.7.88), 20 (10.12.87; 28.7.88), 21 (9.12.87; 27.7.88), 22 (11.12.87; 30.7.88), 24 (12.12.87; 31.7.88), 32 (15.7.88), 95 (25.11.87), 97 (28.7.88), 99 (30.7.88).

Lakes and lagoons (materials deposited in the collection of Dr M. Alonso, Barcelona, Spain): Laguna de Navalhornos, Laguna de Matisalvador (Cantalejo, Segovia, July 1980); Laguna de Guardafuegos (Marzagón, Huelva, 15.4.79); Lago de Isoba (León, July 1982); Lago Ubales (Asturias, 18.9.89); Llac de Banyoles (Girona, July 1983).

Description

Parthenogenetic female
General profile more slender than that of *D. mongolianum*; head without protruded dorsal part (Figs. 4a, b). Antennae never reaching posterior margin of valves, and bearing the same setation as in *D. mongolianum*; there is no spine on the distal part of proximal segment of the biarticulated antennal branch (Figs. 4a, b).

Ventral margin of valves with a row of long, feathered setae with minute setules intercalated between them (Fig. 4c). Infero-posterior margin

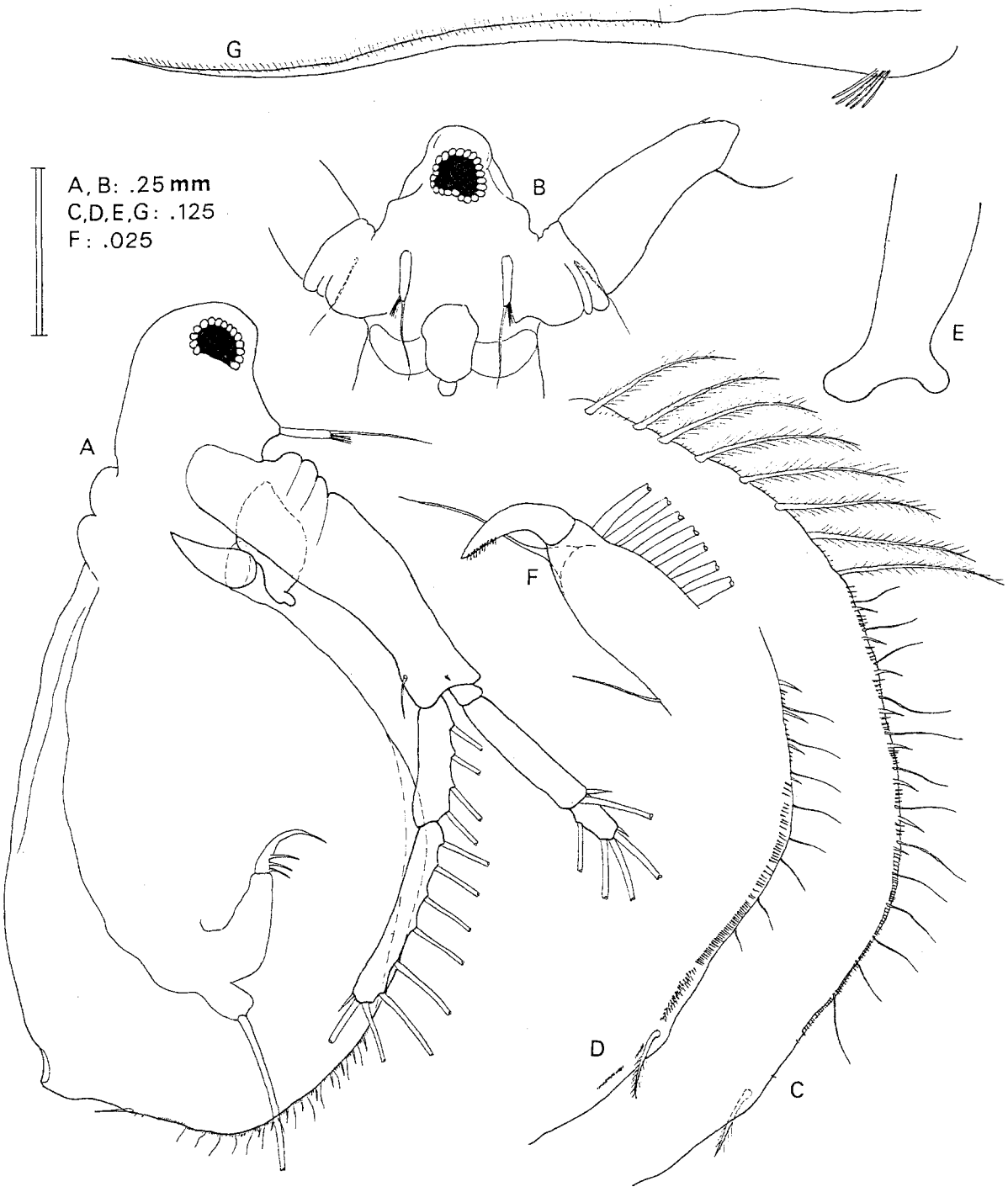

Fig. 4. Diaphanosoma brachyurum (Liévin, 1848) female from Belesar reservoir (18): *a*, lateral view; *b*, frontal view of head; *c*, posterior margin of valves, outer side; *d*, posterior margin of valves, inner side. Male from las Conchas reservoir (20): *e*, distal part of penis; *f*, detail of distal part of first limb endopodite; *g*, antennula.

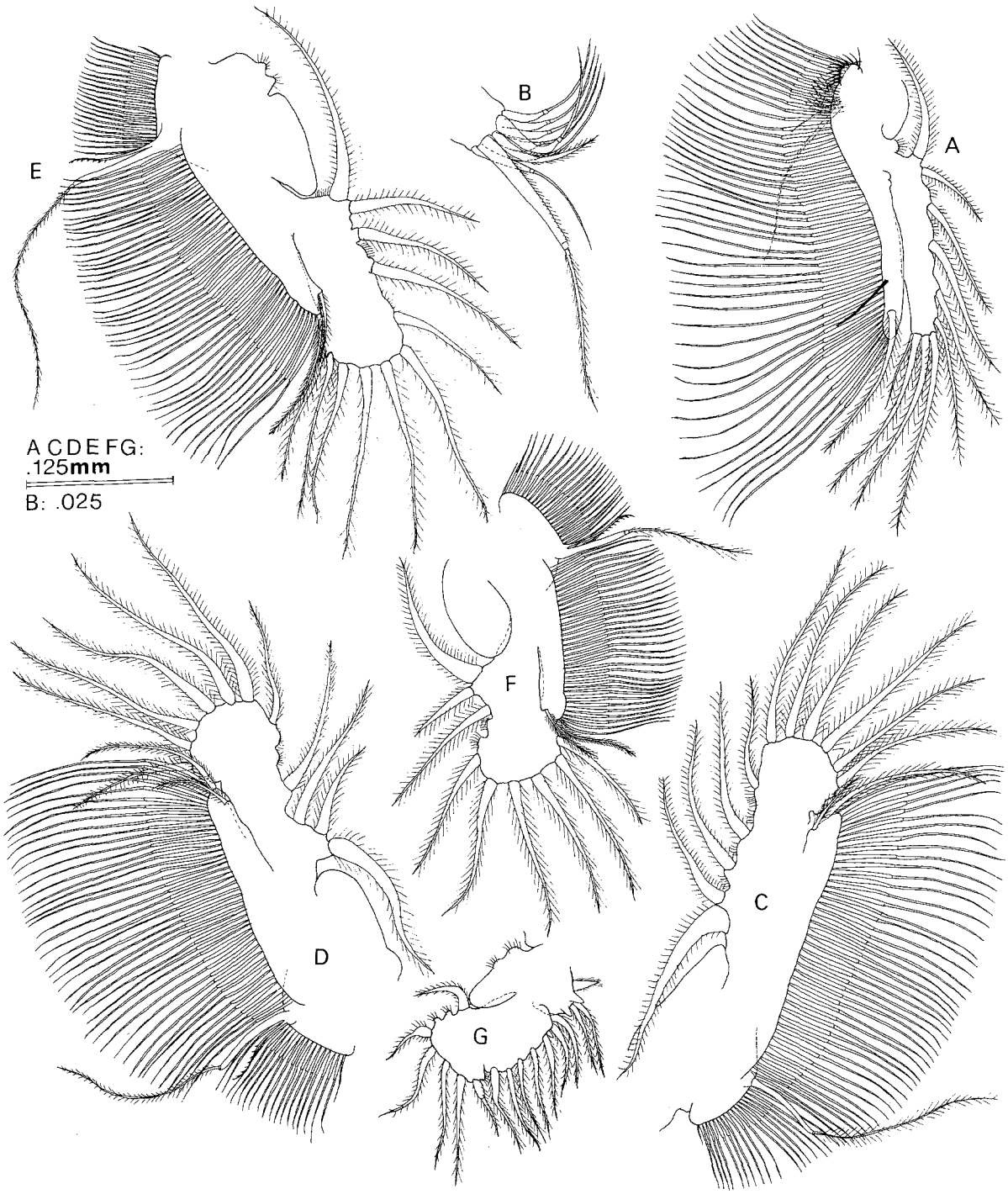

Fig. 5. Diaphanosoma brachyurum (Liévin, 1848), thoracic limbs of female from Belesar reservoir (18): *a*, first limb; *b*, gnathobasic prominence of first limb (row of filtering setae not represented); *c*, second limb; *d*, third limb; *e*, fourth limb; *f*, fifth limb; *g*, sixth limb.

with a row of 7–8 marginal spines, with groups of 3–5 small spinules and one hair in between them (Fig. 4c). Posterior margin of valves with a row of marginal cilia and one plumose, thick spine on inner side (Fig. 4d), and 4–5 groups of 10–11 cilia and one long hair on outer side (Fig. 4c).

Thoracic limbs somewhat smaller than in *D. mongolianum* but resembling them in general

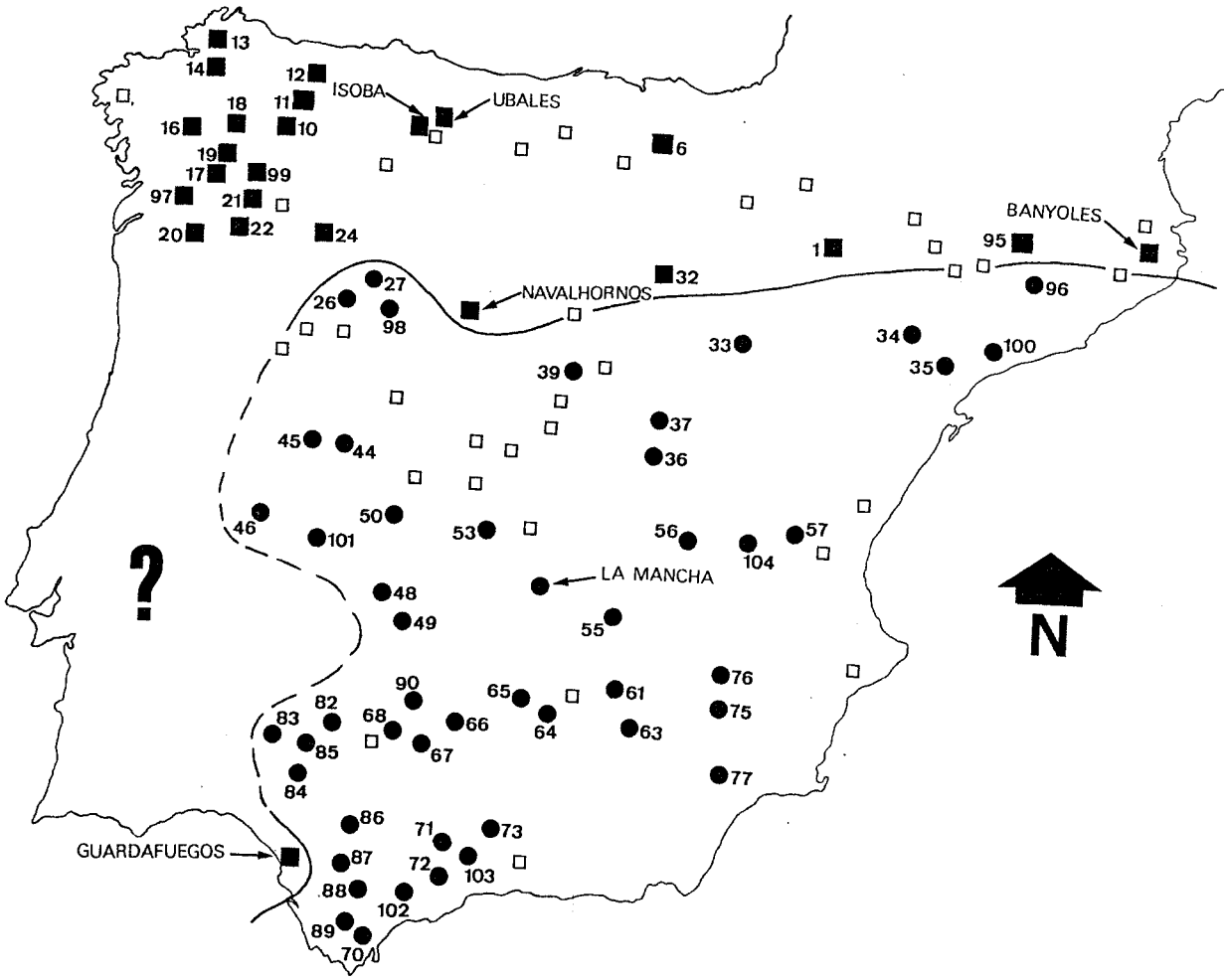

Fig. 6. Distribution of the genus *Diaphanosoma* Fischer, 1850 in the Iberic peninsula. Dark squares represent localities where *D. brachyurum* (Liévin, 1848) has been recorded, dark circles those for *D. mongolianum* Uéno, 1938. Open squares represent reservoirs without *Diaphanosoma*. Reservoirs are, 1 : Sotonera (Huesca); 6 : Ebro (Santander); 10 : Salime, 11 : Doiras, 12 : Arbón (Asturias); 13 : Forcadas, 14 : Ribeira, 16 : Portodemouros (Coruña); 17 : Velle (Orense); 18 : Belesar, 19 : Peares (Lugo); 20 : Conchas, 21 : San Esteban, 22 : Chandreja (Orense); 24 : Cernadilla; 26 : Villalcampo; 27 : Ricobayo (Zamora); 32 : Cuerda del Pozo (Soria); 33 : Tranquera, 34 : Mequinenza (Zargoza); 35 : Flix (Tarragona); 36 : Buendía, 37 : Entrepeñas (Guadalajara); 39 : El Atazar (Madrid); 44 : Gabriel y Galán (Cáceres); 45 : Borbollón, 46 : Alcántara (Cáceres); 48 : Orellana, 49 : Zújar (Badajoz); 50 : Valdecañas (Cáceres); 53 : Guajaraz, 55 : Peñarroya (Ciudad Real); 56 : Alarcón (Cuenca); 57 : Benaixebe (Valencia); 61 : Guadalmena, 63 : Tranco de Beas, 64 : Rumblar, 65 : Jándula (Jaén); 66 : Guadalmellato, 67 : Breña, 68 : Bembézar (Córdoba); 70 : Guadarranque (Cádiz); 71 : Guadalteba; 72 : Conde Guadalhorce (Málaga); 73 : Iznájar (Granada); 75 : Cenajo; 76 : Talave (Albacete); 77 : Puentes (Murcia); 82 : Pintado (Sevilla); 83 : Aracena (Huelva); 84 : Minilla, 85 : Cala, 86 : Torre del Aguila (Sevilla); 87 : Bornos; 88: Guadalcacín, 89 : Celemín (Cádiz); 90 : Puente Nuevo (Córdoba); 95: Oliana, 96 : Sant Ponç (Lleida); 97 : Frieira (Orense); 98 : San Román (Zamora); 99: Mao (Orense); 100 : Riudecanyes (Tarragona); 101 : Guadiloba (Cáceres); 102 : Concepción, 103 : Guadalhorce (Málaga); 104 : Contreras (Valencia).

structure and setation (Fig. 5); minor differences occur in the row of small biarticulate setae on the outside of the gnathobasic prominence of the first thoracic limb (Fig. 4b), which is composed by (6)-7 setae instead of the 8 in *D. mongolianum*. No gamogenetic females were found in the populations studied.

Male

Diagnostic features as in female. Copulatory appendages with characteristic bilobated distal part (Fig. 4e). Hook of first thoracic limb endopodite with minute denticles along its distal third (Fig. 4f). Antennula long, with olfactory setae inserted on proximal third part of basis (Fig. 4g).

Remarks

Some differences in morphology and denticulation of the hook of the male first thoracic limb endopodite are appreciable in comparison with that of a Czechoslovakian male represented in Kořinek (1984). Nevertheless, *Diaphanosoma brachyurum* probably constitutes a group of closely related species as does the 'mongolian' group, and is now under revision (Korovchinsky, pers.com.).

Ecology and distribution

The euplanktonic preferences of both *Diaphanosoma* species in the Iberian Peninsula are clearly manifested by their extensive distribution along reservoirs, and their absence from shallower water bodies (Alonso, 1985).

Both species are characteristic of warm waters, and are preponderant elements of the summer zooplankton communities of Spanish reservoirs. Nevertheless, as has already been pointed out by Alonso (1985), *D. brachyurum* is less thermophilic than *D. mongolianum*: it is not rare in the winter plankton of the northern reservoirs, but occurs at low densities. Both species are absent from the high altitude lakes of the Pyrenees (Miracle, 1978) and Sierra Nevada (Cruz, 1981).

D. mongolianum and *D. brachyurum* present a clearly allopatric pattern of distribution in the Iberian Peninsula (Fig. 6). This seems ecological in nature: *D. brachyurum* inhabits waters in the NW part of the Peninsula with low levels of Total Dissolved Salts (TDS < 250 mg l^{-1}) and a relative ionic composition of $CO3^{2-} > Cl^{-} = SO4^{2-}$, and a group of reservoirs in rivers draining the Cantabrian mountains and the Pyrenees having bicarbonate waters ($CO3^{2-} > SO4^{2-} > Cl^{-}$) and intermediate TDS values (150–450 mg l^{-1}). *D. mongolianum* inhabits the central and southern parts of the Iberian Peninsula, in waters characterized by preponderance of sulphate or chloride, and high TDS value (Armengol *et al.*, in press).

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