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Description of a new species (*Eucypris dorlionensis* n. sp.) (Ostracoda, Crustacea) from Türkiye and a cladistic analysis of the genus *Eucypris*

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Abstract: This is the first clustering analysis of the 53 species of the genus *Eucypris* where we used 28 plesiomorphic and apomorphic character states in the Winclada/NONA program. Accordingly, *Eucypris dorlionensis* n. sp. was clustered within Group 2, in which the new species was clearly separated from the other species of the genus based on the shape of the carapace, presence of fine hair-like setae on the carapace surface, the position of the maximum height of the carapace, and length ratio of terminal claws of the second antenna. *Eucypris dorlionensis* n. sp. was collected from a trough in Eskişehir province in Türkiye where this is the first new species description of the genus that the number of species of the genus has now increased to 10. Besides, the genus is of cosmopolitan distribution known from a variety of aquatic bodies in the world. Including the new species, the number of the species has now raised to 56.

Keywords: Ostracoda, *Eucypris*, new species, clustering analyses, distribution

1. Introduction

Ostracods are small aquatic crustaceans that can be found in a variety of aquatic habitats from marine, and brackish to freshwater (Meisch, 2000). They are considered one of the most diverse invertebrates in the world after insects (Balian et al., 2008) due to their wide dispersion ability. On the other hand, they are probably the only group with the highest elevational range from about 9300 m depth in the ocean (Brandão et al., 2019) to the high altitudinal lakes located at 6000 m above sea level (Pinto, 2013), completing more than 15,000 m of elevational range.

The estimated number of living freshwater ostracod species in the world is more than 2300 species (Meisch et al., 2019). These authors emphasized the presence of more than 799 nonmarine ostracod species in the Palearctic region, underlining that 634 of them are endemic to the region. Among countries, Türkiye has a considerable number of ostracod species. Kulköylüoğlu et al. (2015) reported about 143 nonmarine ostracod species in Türkiye. Most recently, this number has been increased to 160 (and more) but is also considered an underestimation (Kulköylüoğlu, pers. comm.).

The genus *Eucypris* with a wide diversity throughout the world has mostly been reported in the Palearctic region. A total of 57 members of the genus are listed in

the literature so far (Meisch et al., 2019). Recently, two species were also redescribed (*Eucypris cecryphalium* renewed as *Cypridopsis silvestris* (see Perez et al., 2019) and *E. mareotica* redescribed as *Arctocypris mareotica* (see details in Peng et al., 2021)) and excluded from the genus *Eucypris*. Hereby the species list has decreased to 55 species and more than half of them (ca. 30 species) are found in the Palearctic region. *Eucypris* species diversity (9 species known so far) of Türkiye (Kulköylüoğlu et al. 2015) is highest when compared with the other countries in the Palearctic region; for instance, 8 species are known from Italy (Pieri et al., 2015) and Britain (Griffiths and Evans, 1995), and 4 and 1 species are known from Spain (Baltanás et al., 1996) and Portugal (Martins et al., 2010), respectively.

Türkiye is considered as an important geographical bridge between Asia and Europe and serves as a natural corridor which may be considered as a relict area for the species. This is probably why we see a high diversity of organisms in the area (Çıplak et al., 1993). This perspective also includes the ostracod species. Reporting a new species in the present study supports high ostracod diversity in Türkiye. The aim of the present study is to describe a new species of the genus *Eucypris* from Eskişehir province (Türkiye) along with the first usage of a supportive clustering analysis on the genus.

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2. Material and methods

2.1. Study area and sampling

Materials were collected from an old stone-made trough (39°27'16"N, 30°35'35.4"E; Figures 1 and 2) situated in Yukarısöğüt village in Seyitgazi County of Eskişehir province on July 16, 2020. A standard sized hand net (150 µm mesh size) was used for sampling. Collected material was fixed with 70% of ethanol in a 250 mL plastic bottle in situ. Geographical data (elevation (m), latitude, and longitude) was recorded with GARMIN Etrex Vista H global positioning system (Garmin Ltd., Kansas, USA). A testo 410-2 model anemometer was used to measure the air temperature (Ta, °C), moisture (Moist, %), and wind speed (Wind, m s⁻¹). Ecological variables (dissolved oxygen concentration (DO, mg L⁻¹), percent oxygen saturation (%DO), pH, electrical conductivity (EC, µS cm⁻¹), specific EC (µS cm⁻¹), salinity (Sal., ppt), water temperature (Tw, °C), total dissolved solid (TDS, mg L⁻¹), atmospheric pressure (Atm, mmHg), oxidation-reduction potential (ORP, mV) were recorded with the aid of a YSI-Professional Plus multiprobe at the sampling site. About 100 mL of water fixed with Nitric (65%) and Hydrochloric acid (37%) solutions was collected from each sampling site and kept in a cooler for the analyses of the major anion and cations. These analyses were done at the Limnology Laboratory, Department of Biology, Bursa Uludağ University, Türkiye. Biological Oxygen Demand (BOD₅) was basically run with the water samples taken in 500 mL plastic containers and stored in a dark bottle at an average temperature of 20 °C in the laboratory. BOD₅ values were

recorded by taking the difference between the first and last oxygen saturation values. The turbidity (NTU) of the water was read 10 times with a turbidity meter (WPA Turbidity Meter TU1100) and then the average was taken. Sediments were washed up and filtered through four different-sized sieves (0.5: 1.0: 1.5: 2.0 mm mesh size) and then kept in 70% ethanol. Ostracod specimens were separated from the sediment under a stereomicroscope (Olympus ACH-1X).

2.2. Morphological analyses

Dissection of the adult specimens was done with fine entomological needles when soft body parts were separated and mounted on a slide in lactophenol solution for identification. This procedure was achieved under the Olympus SZX7 stereomicroscope. Soft body parts were covered with cover slip, numbered, and kept in the laboratory while carapaces were kept in the micropaleontological slides. Drawings of the soft body parts were prepared with a camera lucida (Olympus U-DA) attached to an Olympus BX-51 microscope. Then all drawings were digitized using the Adobe Illustrator CC 2015 program. Illustrations of valves and carapaces were obtained with the aid of scanning electron microscopy (SEM, Carl Zeiss EVO-50 type SEM-EDX) at the Department of Geological Engineering, Hacettepe University, Türkiye. Proper taxonomic keys (Bronstein, 1947; Meisch, 2000; Karanovic, 2012) were followed for the chaetotaxy of the limbs and the taxonomic identification of specimens. All materials and slides are lodged in the Limnology laboratory of Bolu Abant İzzet Baysal University, Bolu, Türkiye.

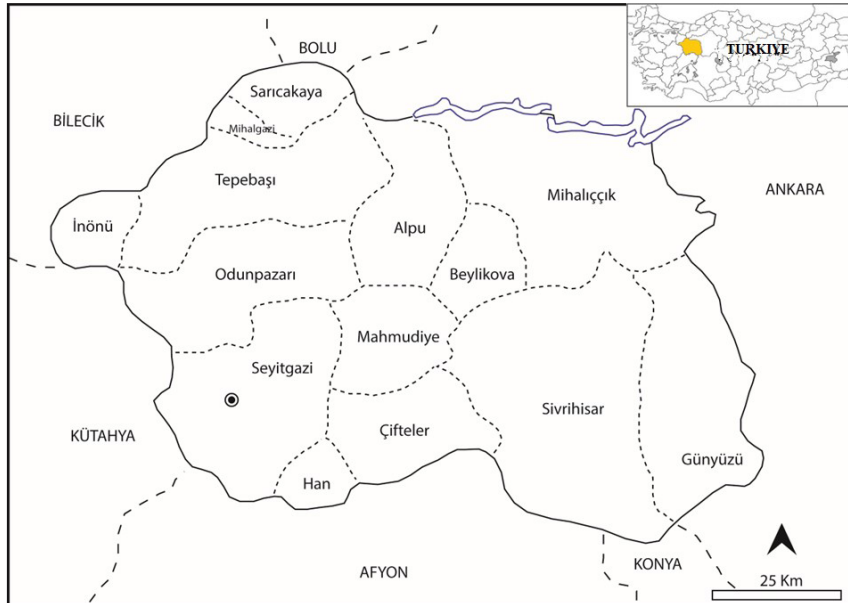


Figure 1. Type locality of the *Eucypris dorlionensis* n. sp., Yukarısöğüt village in Seyitgazi County of Eskişehir province. Location of sampling site pointed on the map.



Figure 2. Photographs of the trough, the type locality. A) closer view of trough, B) southwest view of trough, C) south view of trough.

2.3. Cladistic analysis

A total of 28 morphologic characters (Table 1) of the genus were used to provide a data matrix (Table 2). Accordingly, “0” and “1” represent plesiomorphic and apomorphic character states, respectively. Along with the binary data, we also used character states (e.g., 2, 3) whenever needed. Some multistate characters were given in the relative number. Unknown or missing values were coded with “?” in the matrix. We utilized this data matrix (Table 2) to construct a phylogenetic tree based on the morphological differences among the species of genus *Eucypris* with the aid of Winclada/NONA (Golobof, 1999; Nixon, 1999) statistical programs. The characters (e.g., numbered in Table 1 as 2, 3, 10, 13, and 16) diagnostic for the genus were weighted by 2, and all others were 1. In order to provide the best tree showing the best clustering relationships among the species, we repeated a tree bisection and reconnection (TBR+TBR) method of branch-swapping. During which, if a tree is divided into two, the branches left are reconnected to construct a tree. All 28 characters used here were orderly coded and weighted in the computation of consistency (Ci) and retention (Ri) indices. A heuristic search with the variables of the Ratchet Island Hopper application was used to obtain phylogenetic trees. Accordingly, the program runs with 200 replications, one tree to hold-iteration, three characters to sample, 10 random constraint levels and amb-poly (i.e. amb) command is used how orderly a branch of tree is collapsed; poly command means to indicate trees collapsed are treated (Golobof 1999, Nixon 1999, Karanovic 2007, Külköylüoğlu et al., 2019, 2023). During the analysis, a total of 52 species of the genus *Eucypris* along with *Eucypris dorlionensis* n. sp. were used. Of which, *E. fabaeformis*, *E. lateraria* and *E. rishtanica* were excluded from the analyses due to lack of descriptive

information about them. To evaluate our data better, *Cypris pubera* was used as an outgroup in the analysis because of its close relationship to the genus *Eucypris*.

Abbreviations used in text and figures

A1: Antennula, A2: Antenna, Md: Mandibula, Mxl: Maxillula, T1: First thoracic leg, T2: Second thoracic leg or walking leg, T3: Third thoracic leg or cleaning leg, UR: Uropod.

3. Results

3.1. Systematics

Class Ostracoda Latreille, 1802
 Order Podocopida Sars, 1866
 Family Cyprididae Baird, 1845
 Subfamily Eucypridinae Bronshtein, 1947
 Genus *Eucypris* Vávra, 1891

Type species

Eucypris virens (Jurine, 1820)

3.2. Taxonomy

Eucypris dorlionensis n. sp.

[http://zoobank.org/urn:lsid:zoobank.org:pub: E8058723-1F65-4F06-8D79-97DB13C86728](http://zoobank.org/urn:lsid:zoobank.org:pub:E8058723-1F65-4F06-8D79-97DB13C86728)

Figures 3-7

3.2.1. Diagnosis of the new species

A medium sized species. Carapace elliptical. Valves almost straight with slightly rising on the dorsal side, and concave on the ventral side. Valve margin without denticles. In external view, valve margin with small, pitted area anteriorly and posteriorly. Presences of fine hair-like setae on the carapace surface. Porenwarzen absent. Left valve larger than right valve on the anterior side. In dorsal view, anterior end of the valves thinner with a slightly beak-shape, and posterior end rounded. The greatest

Table 1. A total of 28 morphological characters and character states used in cladistic analyses. References used for the characters include a, Meisch (2000); b, Karanovic (2012); c, Bronstein (1947); d, this study.

No	Characters
1 ^d	Ornamentation: absent, smooth (0), reticulated (1), pitted (2), punctuated (3)
2 ^{a,b,c}	Porenwarzen: known (0), not known (1)
3 ^b	Valves: RV > LV (0); LV > RV (1); LV = RV (2)
4 ^b	Difference between size of the valves: on the anterior side (0), on the posterior side (1), both side (2)
5 ^b	Shell surface: without surface hairs (0), with fine hairs (1), with thick setae-like hairs (2)
6 ^{b,c}	Dorsal margin: straight (0), slightly rounded (1), highly arched (triangular) (2)
7 ^b	Ventral margin: straight (0), concave (1)
8 ^b	Anterior margin of the valves: straight on the mouth area (0), enlargement (lip-like) around mouth area (1)
9 ^b	Dorsally, valve margins: parallel (0), not parallel, ovoid appearance (1)
10 ^{b,c}	Ventral margin: a rounded expansion like a pouch (lobe): absent (0), present (1)
11 ^{b,c}	Lateral view: max. H, on the middle (0), on the frontal side of the middle (1), behind the middle (2)
12 ^{b,c}	Maximum width: < half of the length (0), = half of the length (1), > half of the length (2)
13 ^d	Selvage: absent (0), present (1)
14 ^c	Carapace marginal denticles: absent (0), present (1)
15 ^d	Numbers of central muscle scars: more than > 4, (0); maximum 4, (1)
16 ^{a,b,c}	Beak-shape: absent (0), anterior (1), posterior (2), both side (3)
17 ^d	Pore canals: simple (0), sieved (1), marginal (2)
18 ^{a,b,c}	A2 Natatory Setae: Long (0), intermediate (barely reaches to the terminal claws) (1), short (do not reach to terminal segment) (2)
19 ^d	A2, terminal claws G1, G2, G3: almost equal size (0), different size (1)
20 ^d	First thoracic leg, h-setae: one long two short setae (0), three unidentical setae (1), two long one short setae (2)
21 ^d	Subterminal segment (penultimate segment) of walking leg is divided (5-segmented) (0), undivided (4-segmented) (1)
22 ^c	Maxillary spines (teeth bristles): smooth (0), toothed (1)
23 ^c	Uropod: long and slender (0), short and thick (1)
24 ^d	Uropodal ramus: straight (0), curved (1)
25 ^b	Uropod posterior claw: equal or < half of the anterior claw (0), > half of the anterior claw (1)
26 ^{a,b,c}	Uropod anterior claw to ramus size: anterior claw shorter than 1/3 to ramus size (0), anterior claw to ramus size between 1/3 to 2/3 ratio (1), anterior claw longer than 2/3 of ramus size (2)
27 ^d	Spines on claws of uropod: absent (0), present (1)
28 ^b	Furcal rami: both similar (0), different in size, shape, or one of them with missing seta (1)

height of carapace on the frontal side of the middle point. Calcareous inner lamella (CIL) of both valves broad and have vertical lines. Selvage peripheral. Simple pores are present. Hinge adont. Antenna (A2) with short swimming (natatory) setae, the longest one barely reaching the middle of penultimate segment. Maxillular palp of distal segment cylindrical and slightly curved, teeth on the third segment smooth. Walking leg (T2) terminal claw (h2) as long as the last three segments. Uropodal attachment long and slender with broad basal segment. Anterior claws slightly serrated.

3.2.2. Etymology

The species is named after the former name (Dorlion) of Eskişehir province.

3.2.3. Type locality

A trough (39°27'16"N, 30°35'35.4"E) in Yukarısöğüt village, Seyitgazi county of Eskişehir province, Türkiye. Collected from the type locality by Mehmet Yavuzatmaca, Filiz Batmaz and Çağatay Çapraz.

3.2.4. Holotype

One female with soft body parts dissected in lactophenol solution and sealed in a slide and valves kept dry in micropaleontological slides for SEM illustrations (slide no: OK-TR-ES:01).

3.2.5. Paratype

Four females dissected (slide no: OK-TR-ES 02-05) and valves stored dry in micropaleontological slides. Total of 19 individuals and 30 carapaces collected from type locality kept in a vial in 70% ethanol.

3.3. Description

Carapace (Figure 3): Female: mean L = 1.18 mm, mean H = 0.57 mm, mean W = 0.63 mm, (n = 5). Elliptical carapace with slightly rounded in front of the middle point (Figures 3C–3F). LV overlaps RV. Maximum width behind the middle point (Figure 3A, 3B). Anterior margin beak shaped in dorsal view, and narrower than the posterior margin. Posterior end rounded. Ventral margin concave

Table 2. Data matrix obtained from the morphological characters given in the Table 1 of the species of the genus *Eucypris* and of the outgroup species, *Cypris pubera*. *The sources of the information about species: ¹⁰Karanovic, 2012; ¹¹Hartmann, 1964; ¹²Meisch, 2000; ³Furtos, 1936; ⁴Daday, 1905; ⁵Tressler, 1937; ⁶Deb, 1984; ⁷Victor&Michael, 1975; ⁸Petkovski, 1959; ⁹Roen, 1956; ¹⁰Deb, 1983; ¹¹Henry, 1923; ¹²Löffler, 1963; ¹³Stephanides, 1937; ¹⁴Diebel&Pietrzeniuk, 1978; ¹⁵Klie, 1936; ¹⁶Petkovski&Keyser, 1995; ¹⁷Akatova, 1950; ¹⁸Gutentag&Benson, 1962; ¹⁹Daday, 1908; ²⁰Kiss, 1959; ²¹Hartmann, 1965; ²²Margalef, 1961; ²³Schäfer, 1952; ²⁴Klie, 1937; ²⁵Danielopol, 1965; ²⁶Eagar, 1970; ²⁷Furtos, 1933; ²⁸Anichini, 1963; ²⁹Chapman, 1963; ³⁰Sywula, 1967; ³¹Hartmann, 1962; ³²Moniez, 1891.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
<i>Eucypris dorianensis</i> n. sp.	0	1	1	0	1	0	1	0	1	0	1	1	1	0	1	1	0	2	1	1	0	0	0	0	1	2	0	0
^{10,11} <i>E. afganistanensis</i>	0	1	1	2	1	1	1	0	0	1	0	1	0	0	0	2	2	2	?	?	0	0	1	0	1	2	0	0
² <i>E. anglica</i>	2	0	1	1	0	2	1	1	0	1	2	0	?	0	0	3	0	2	0	?	?	0	0	0	1	1	1	?
¹ <i>E. angulata</i>	2	1	1	1	1	2	1	0	0	1	0	1	1	0	0	0	0	1	?	?	?	0	1	0	1	2	1	0
³ <i>E. arcadiae</i>	0	1	1	2	0	1	0	1	0	0	1	2	1	0	1	2	2	0	?	?	?	0	0	0	0	1	0	0
⁴ <i>E. areguensis</i>	0	?	2	2	1	1	1	0	0	0	0	?	0	0	0	?	?	0	?	?	?	0	0	0	0	1	0	0
⁵ <i>E. bayensis</i>	3	?	1	1	0	0	0	0	0	0	0	1	0	?	0	0	0	0	?	?	?	1	1	1	1	2	1	0
⁶ <i>E. biharensis</i>	0	?	1	0	0	1	1	0	0	0	1	0	1	0	?	0	0	0	?	?	?	0	1	0	1	1	1	0
⁷ <i>E. bispinosa</i>	1	?	1	1	0	0	0	0	0	0	0	0	?	0	?	0	?	0	?	?	?	0	0	0	1	1	1	0
⁸ <i>E. bronsteini</i>	0	0	1	2	1	1	1	0	1	0	1	0	1	0	?	1	1	2	?	?	0	0	1	1	1	1	0	0
⁹ <i>E. cameronensis</i>	0	?	2	2	1	0	0	0	0	0	0	?	?	?	?	0	0	1	?	?	0	?	0	1	1	1	0	0
¹⁰ <i>E. compressa</i>	2	?	0	0	1	1	1	1	0	0	2	?	?	0	?	1	0	0	0	0	0	0	0	1	1	1	1	1
² <i>E. crassa</i>	2	1	1	0	0	1	1	0	0	1	1	?	0	0	0	3	0	0	0	?	?	0	0	1	1	1	0	?
¹² <i>E. crinita</i>	0	?	1	2	0	2	1	?	?	0	1	?	?	?	?	?	?	0	?	?	?	?	?	?	?	?	?	?
¹³ <i>E. domestica</i>	0	?	1	2	1	2	0	0	1	0	1	0	?	0	0	2	0	2	0	?	?	0	0	0	1	1	1	0
² <i>E. elliptica</i>	0	0	1	2	0	1	0	1	0	1	1	2	?	0	0	1	2	0	0	?	?	0	0	1	1	2	0	?
¹⁰ <i>E. ellipticals</i>	0	?	1	0	0	0	1	0	0	0	0	2	?	0	?	0	0	0	0	0	0	0	0	1	1	1	1	1
^{10,14} <i>E. elongata</i>	0	0	1	1	1	1	1	0	0	1	0	0	?	0	0	1	2	?	?	?	?	1	0	0	1	1	1	0
¹⁰ <i>E. gombi</i>	0	1	0	0	1	1	0	1	1	0	2	2	?	0	?	1	1	0	0	?	?	0	1	1	1	2	0	?
^{10,1} <i>E. hamadanensis</i>	0	0	2	2	0	1	1	0	0	1	1	1	1	0	0	0	0	1	?	?	?	0	1	0	1	1	1	0
^{10,14} <i>E. heinrichi</i>	0	0	1	2	0	2	1	1	0	0	1	2	1	0	0	3	?	0	0	?	?	0	0	0	1	2	1	0
¹⁰ <i>E. himani</i>	2	?	1	0	1	1	0	0	0	0	0	1	?	0	?	0	0	1	0	1	0	1	0	0	1	0	1	0
¹⁵ <i>E. illyrica</i>	0	?	0	0	1	2	0	0	0	0	1	0	1	?	?	1	0	0	?	?	?	0	1	0	1	1	1	0
¹⁰ <i>E. indica</i>	2	?	1	0	2	2	0	1	0	0	0	2	?	0	?	0	?	0	0	0	0	1	0	1	1	2	1	?
¹⁰ <i>E. inequalis</i>	2	?	1	0	0	2	0	0	0	0	1	2	?	0	?	0	0	0	0	?	?	1	1	1	1	2	1	?
² <i>E. kerkynensis</i>	0	0	0	2	0	1	0	0	0	0	0	2	?	0	0	1	0	0	?	?	?	0	0	0	1	1	1	?
¹⁶ <i>E. kurt-diebeli</i>	?	0	1	2	1	2	0	0	?	0	1	0	1	0	0	?	?	1	1	2	0	0	0	0	1	1	1	0
² <i>E. liljeborgi</i>	0	0	1	2	0	2	0	0	0	0	0	?	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	?
¹⁷ <i>E. lineata</i>	1	?	1	0	1	1	0	1	0	1	2	1	?	0	0	?	0	?	0	?	?	?	0	0	1	1	0	?
^{10,18} <i>E. meadensis</i>	3	1	1	2	0	2	1	0	0	1	0	0	1	0	0	?	?	?	?	?	?	?	?	?	?	?	?	?
^{10,19} <i>E. minuta</i>	0	0	2	2	1	0	0	1	0	0	1	0	1	0	?	0	0	0	1	?	?	1	1	1	0	1	0	0
²⁰ <i>E. montelgoni</i>	0	1	2	2	1	2	1	0	0	0	1	?	0	1	0	?	0	?	0	1	?	0	0	0	1	1	0	0
² <i>E. moravica</i>	0	0	2	2	0	1	0	1	0	1	1	?	0	0	1	0	1	0	1	0	0	0	0	0	1	1	0	0
¹⁰ <i>E. munita</i>	0	1	0	0	1	2	0	1	0	0	0	?	0	0	1	2	0	0	0	?	?	0	1	1	1	1	0	0
^{10,21} <i>E. noodti</i>	0	0	1	2	1	2	0	1	0	1	0	?	1	0	?	0	0	?	?	?	?	?	1	1	1	2	0	0
²² <i>E. opulenta</i>	0	?	?	?	0	1	0	0	?	0	0	?	?	0	?	0	?	?	1	?	?	0	0	1	1	1	0	0

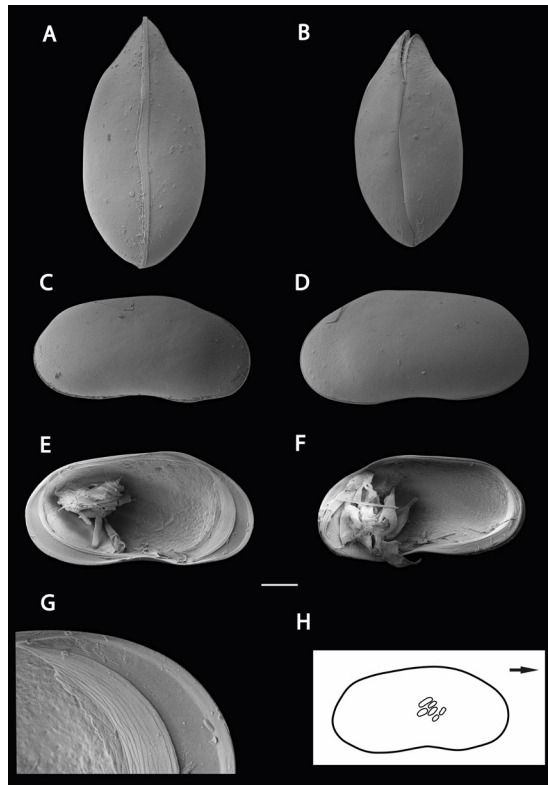


Figure 3. *Eucypris dorlionensis* n. sp., Female, A: Ventral view, B: Dorsal view, C: Right Valve (RV) external view, D: Left Valve (LV) external view, E: LV internal view, F: RV internal view, G: LV closer view; CIL, H: Line-drawings of the muscle scars; RV, external view. Scale bars: 182 μm for A; 200 μm for B, C, D, E, and F; 57 μm for G.

with a small and rounded expansion antero-ventral. Valve surface smooth with sparse, fine hair without porenwarzen anteriorly. Muscle scars typical to the genus (Figure 3H). Calcareous inner lamella broader on anterior side than the posterior side with radial lines horizontally.

A1 (Figure 4A): Seven segmented. The first segment with two long smooth ventral setae, one short and one long serrated mid-dorsal setae. Rome organ not seen. The second segment broaden with a smooth short dorso-apical seta. The third segment longer than the fourth segment, bearing a medium-sized smooth apical seta and a short ventral apical seta, both smooth. The fourth segment with four apical setae, two dorso-apical setae long extending the tips of the terminal segment, and one long and a short ventral seta. The fifth segment bearing four long apical setae (two dorsal and two ventral), dorsal setae longer than the length of the ventral setae. The sixth segment with four unequally long, smooth setae. Terminal segment with two long natatory smooth setae, one shorter seta, and an aesthetasc Ya.

A2 (Figure 4B): Four segmented. The first segment with no setae. Exopodial plate with one long and two unequally short smooth setae. Y aesthetasc short and two segmented, slightly broaden on the tip. The second segment with one long serrated apico-ventral seta reaching to the tip of the terminal segment and distally five equally long natatory setae, slightly reaching the middle of the penultimate segment. Penultimate segment with two unequally long dorsal setae, four unequally long t-setae inserted mid-ventrally, three unequally long z-setae (length ratio $z1 > z2 > z3$), z1 seta reaching to the tips of the G1 claw. G2 claw slightly longer than G1 and G3 claws. Terminal segment with a claw-like GM and one short Gm claw and an aesthetasc y3. y2 aesthetasc not seen.

Md (Figure 5A): Md-palp four segmented. Md-coxa elongated with distally inserted ca 7 teeth, 8 setae in the interstitial spaces, and a short plumosed subapical seta. The basal segment with a respiratory plate bearing six short plumose setae ventro-distally one long smooth seta, two setose s-setae (S1 and S2) and a short α seta. The

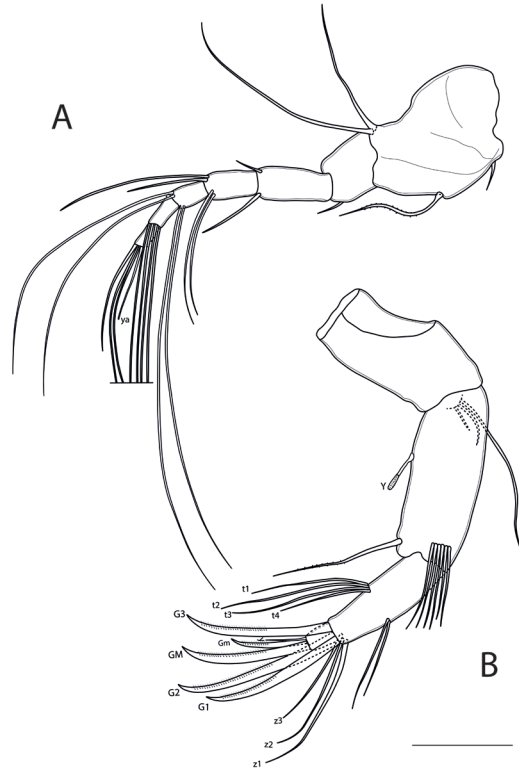


Figure 4. *Eucypris dorklionensis* n. sp. Female A) A1, B) A2. Scale: 25 μ m.

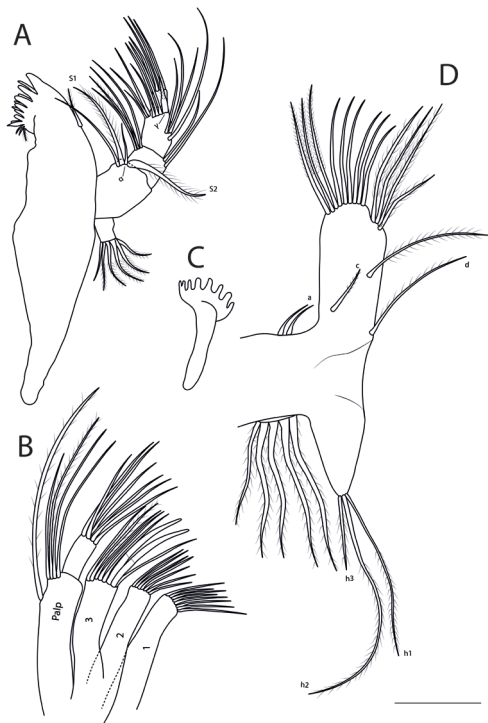


Figure 5. *Eucypris dorklionensis* n. sp. Female. A) Md, B) Mxl, C) Rake like organ, D) T1. Scale: 50 μ m.

second segment with two unequally long smooth dorso-apical setae, a group of unequally long four setae and, one plumose and 3 smooth ventral setae, β -seta not seen. The third segment with a group of unequally long four smooth setae inserted mid-dorsally, three smooth ventro-apical setae (two long and one short), a row of four apical setae and one slightly stout plumose γ -seta. Terminal segment with four thin and smooth setae, three long and one shorter than others.

Mxl (Figure 5B): Bearing a two-segmented palp, three endites and a vibratory plate with six plumose setae. First palp segment consisting of four apical setae, one longer (plumose) than the three smooth thin setae (one shorter than others), and a long setose subapical seta. Second palp slightly elongated and cylindrical, with 7 smooth setae; two of them longer than the others. Third endite with two smooth setae ("Zahnbürsten").

Rake-Like Organ (Figure 5C): Small and with moderately narrow rod and distally inserted ca eight blunt teeth.

T1 (Figure 5D): With a small palp, bearing three apical setae ($h_2 > h_1 > h_3$). Respiratory plate with four long and one short plumose setae. Protopodite with two short equally long a setae, b and d setae equally long and plumose, c seta slightly plumose and short about 1/3 seta b, and distally with eight apical setae unequally long (three slightly plumose, five smooth) and four subapically inserted plumose setae with different length.

T2 (Figure 6A): First segment with a long d1 seta. Length of d1 seta ca 2x long d2 seta. The second segment with a distally located plumose e seta reaching about the middle of the third segment. The third segment with an apically inserted plumose f seta reaching about the tip of the subterminal segment. Subterminal segment carrying an apically short g seta about size of the next segment. The terminal segment with a very long h2 claw and two almost equally long plumose h1 and smooth h3 setae.

T3 (Figure 6B): Three segmented. First segment with 3 unequally long and smooth d setae ($d_p > d_2 > d_1$). Second segment elongated and distally long setose e seta, extending half of the next segment. Terminal segment, with a medially inserted setose f seta, reaching to the end of the segment, h2 seta pincer-like, and h3 seta long about the length of the segment.

Genital Organ (Figure 6C): Smooth and subrectangular in shape, slightly tapering.

Uropod (Figure 6D): Well developed. Anterior claw (Ga) slightly serrated and equal to about 1/2 length of ramus. Dorsal margin smooth. Ga approximately twice the posterior claw (Gp). Anterior (Sa) and posterior (Sp) setae smooth and equally long. Uropodal attachment with a single narrow and proximally branched ramus.

Males not known.

3.4. Winclada/NONA

The numbers on nodes correspond to the individual characters (chr) from the list (see Table 1). Nona analysis along with the Winclada program (Figure 7) displayed the dendrogram with six distinct clustering groups among the species of the genus. The most repeated characters effective on the separation of the species are found as the maximum height from the lateral view (chr 11), the state of the dorsal margin (chr 6) and, the maximum width and its position to the length (chr 12). The outgroup *C. pubera* was clearly separated from the rest of the *Eucypris* species.

The first species (*E. lineata*) was separated from the other species in the beginning. Having selvage (chr 13) on the carapace, beak-shape occurrence (chr 16) and the ratio between anterior claw to the ratio between anterior claw to uropodal ramus (chr 26) also important characters represented with the black dots in the cladogram.

Character 16 (beak-shape) was responsible for separating the first group from the others. Also, the length difference of right or left valve (chr 3), and uropodal ramus (chr 24) seems to be important to dividing the Group 1 (*E. gomti*, *E. munia*, *E. illyrica*, *E. compressa*, *E. sonia*, *E. indica*, *E. inequalis*, *E. rava*, *E. himani*, *E. angulate*, *E. orca*, *E. bayensis*, *E. bispinosa*).

The shape of the ventral margin from the lateral view (chr 7), natatory setae length on the A2 (chr 18), and uropod shape (chr 23) were found effective to separate Group 2 (*E. trajani*, *E. bronsteini*, *E. afganistanensis*, *E. pigra*, *E. dorlionensis* n. sp.) from other groups. As seen, the new species belongs to this group. *Eucypris dorlionensis* n. sp. shares similar features (pore canals type (chr 17), and uropod shape (chr 23)) with *E. pigra* in this group. Another closer species to the new species was *E. afganistanensis* and share one similar character (the ratio between anterior claw to uropodal ramus (chr 26)) with the new species. However, the new species differs from others because of the shape of the carapace, length of the valves on the anterior side (chr 4), relatively straight dorsal margin (chr 6), valve margins appearance in dorsal view (chr 9) and numbers of the muscle scars (chr 15).

At first glance, the difference between the size of the valves (chr 4) and ventral margin's state (chr 7) seems to affect separation of Group 3 which includes 4 species (*E. elongata*, *E. stephanidesi*, *E. pagasti*, *E. persica*).

Division of Group 4 with ten species (*E. kerkyrensis*, *E. domestica*, *E. kurtdiebeli*, *E. heinrichi*, *E. crinite*, *E. salina*, *E. thomsoni*, *E. crassa*, *E. anglica*, *E. meadensis*) from the others can be characterized based on the spines on the uropod claws (chr 27).

The difference between the size of the valves (chr 4), and ventral margin's state (chr 7) appeared to be effective for separation of the Group 5 (*E. unguolata*, *E. pratensis*, *E. biharensis*, *E. petkovskii*, *E. ellipticalis*, *E. trapezoides*) from others.

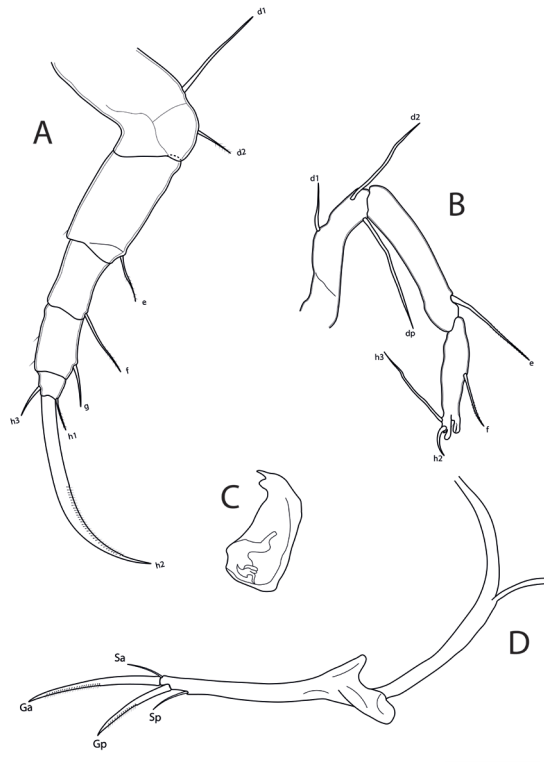


Figure 6. *Eucypris dorlionensis* n. sp. Female. A) T2, B) T3, C) Genital organ, D) Uropod and uropodal attachment. Scale: 25 μ m.

The last clustering group (Group 6) (*E. noodti*, *E. virens*, *E. opulenta*, *E. hamadanensis*, *E. tarentina*, *E. areguensis*, *E. montelgoni*, *E. cameronensis*, *E. minuta*, *E. tibetana*) is basically separated from the others with the uropod shape (chr 23), and the valve size difference (chr 3).

3.5. Ecology and distribution

The species was encountered in an old man-made trough located at 1100 m asl. found in a meadow area with intensive animal husbandry. Table 3 portrays the physio-chemical values of the trough where we collected the new species *Eucypris dorlionensis* n. sp.. As far as we know, the type locality of no species belonging to the genus is a trough.

4. Discussion

As stated above the recent Ostracoda checklist of Meisch et al. (2019) covers 57 species recorded worldwide. Lately, two species were redescribed (*Eucypris cecryphalum* renamed as *Cypridopsis silvestris* (Perez et al., 2019) and *E. mareotica* redescribed as *Arctocypris mareotica* (Peng et al., 2021)) and excluded from the group. Hereby the list now includes 55 species. Unfortunately, as stated by Karanovic (2012), descriptive information about some of these species are not available for those important characters.

Indeed, during the present study, we encountered that there are at least 6 species (*E. fabaeformis* (see Moniez 1891), *E. meadensis* (Gutentag and Benson, 1962), *E. rischtanica* (Schneider, 1963) (Mandelstam and Schneider 1963), *E. ungulata* (cf. Daday 1900, Gauthier 1928.), *E. lateraria*, and *E. rischtanica*) with inadequate descriptions (i.e. line drawings). Similarly, we were not able to find proper morphological and taxonomic description about *E. cameronensis* whose general characteristics seem to be not belong to the genus *Eucypris* (C. Meisch pers. comm.).

As stated above, four species (*E. bronsteini*, *E. afganistanensis*, *E. pigra*, and *E. trajani*) clustered in the same Group 2 (Figure 7) seem to be closer with *E. dorlionensis* n. sp. Karanovic (2012) mentioned that *E. afganistanensis* should be replaced in the Herpetocypridinae subfamily due to its short claw-like posterior seta (Sp) being very close to posterior claw (Gp) on uropod. In our detailed search on the figures and descriptions of Hartmann (1964, see Figure 17e), posterior seta is not a claw-like, rather it is a relatively long (ca. $\frac{1}{2}$ of Ga) well developed seta. In contrast, this seta in our species is shorter, thin, and smooth. *Eucypris bronsteini* is another similar species with *Eucypris dorlionensis* n. sp. They both have smooth carapace, LV > RV, fine hairs on the shell surface, concave

Table 3. Physico-chemical values of the water measured at the sampling site. Abbreviations and Units: DO: Dissolved oxygen (mg L⁻¹), Salinity (ppt), EC: Electrical conductivity (µS cm⁻¹), Spe. EC: Specific EC (µS cm⁻¹), T water: Water temperature (°C), T air: Air temperature (°C), ATM: Atmospheric pressure (mm Hg), TDS: Total dissolved solid (mg L⁻¹), BOD₅: Biological oxygen demand (mg L⁻¹), Moisture (%), Wind (m s⁻¹), EL: Elevation (m). Ca²⁺: Calcium (mg L⁻¹), Mg²⁺: Magnesium (mg L⁻¹), NO₂-N: Nitrite nitrogen (mg L⁻¹), NO₃-N: Nitrate nitrogen (mg L⁻¹), NO₂: Nitrite (mg L⁻¹), NO₃: Nitrate (mg L⁻¹), Total N: Total Nitrogen (mg L⁻¹), PO₄-P: Orthophosphate as phosphorus (mg L⁻¹), PO₄: Phosphorus (mg L⁻¹), Total P: Total Phosphate (mg L⁻¹), Total Hardness (mgCaCO₃ L⁻¹).

pH	DO	%DO	Salinity	EC	Spe. EC	T water	T air	ATM
7.4	6.6	73	0.39	714	787	20.1	20	663.6
TDS	Turbidity	BOD ₅	Moisture	Wind	EL	Ca ²⁺	Mg ²⁺	ORP
513.5	1.83	2.54	58	3.8	1100	182.364	76.608	-17.8
NO ₂ -N	NO ₃ -N	NO ₂	NO ₃	Total N	PO ₄ -P	PO ₄	Total P	Total Hardness
0.015	2.869	0.049	12.701	9.461	0.064	0.196	0.081	581.252

ventral margin, and ovoid dorsal side valve margin. In addition, *E. bronsteini* and *E. dorlionensis* n. sp. also have a slightly beak shape on the anterior side, and short natatory setae on the second antenna. However, there are some important differences between them. For example, *E. bronsteini* has porenwarzen on the anterior side of valves like most of the *Eucypris* species but these structures are absent in *Eucypris dorlionensis* n. sp. Left valve (LV) is longer than right valve (RV) both anteriorly and posteriorly for *E. bronsteini*. In contrast, LV is anteriorly longer than RV in *E. dorlionensis* n. sp. Another important difference between these two species is the location of the maximum width. It is located on the anterior side of the middle point in *E. bronsteini* but found about the middle point of *E. dorlionensis* n. sp..

Eucypris pigra is also under the subject of discussion that this species bears some morphological similarities with *E. dorlionensis* n. sp. but differences between both species are also distinctive. For example, the dorsal margin of *E. pigra* is highly arched (triangular) but it is slightly rounded in *E. dorlionensis* n. sp.. RV and LV of *E. pigra* are in almost equal length, while LV is anteriorly longer than RV in *E. dorlionensis* n. sp. Also, in dorsal view, marginal line is straight in *E. pigra*, but ovoid for *E. dorlionensis* n. sp.. However, *E. trajani* appeared close to the new species on the NONA results, this species does not look so similar with the new species. Having highly arched dorsal margin on the lateral view and the length of the left valve both anterior and posterior margins separate these two species each other easily.

Among the species of the genus *Eucypris*, carapace shapes are mostly elliptical and elongated dorsally. The new species' carapace shape is elliptical but slightly elongated on the anterior (Figure 3). Most of the *Eucypris* species (*E. virens*, *E. persica*, *E. bronsteini*, *E. kurtdiebeli* and some others) have porenwarzen anteriorly but the present species does not. Ventral margin with a rounded expansion is close to mouth area. The anterior end has a beak shape, but posterior end rounded. Among the species

of the genus, reticulated (e.g., *E. lineata*), pitted (e.g., *E. orca*), and smooth (e.g., *E. virens*) carapace surface can be seen. The new species has a smooth carapace with sparse, fine hairs and simple pores.

The first antennula (Figure 4A) is almost the same for all species in the genus. However, the second antenna (Figure 4B) has differences amid some species of the genus. Unlike *E. virens*, the new species has short natatory setae like those of *E. petkovskii*, and *E. bronsteini*. The claws of the terminal segment of A2 are almost equal in length in the new species but they are unequally long in *E. sonia*, and *E. kurtdiebeli*.

Two bristles on the third masticatory lobe (Figure 5B) are smooth on new species like *E. bronsteini*, but these bristles are serrated in *E. biharensis*, *E. elongata*, and some others. The new species has three unidentical endopodial h setae (length ratio: h2 > h1 > h3) on the maxilliped while *E. compressa* has one long and two short setae, and some species (*E. kurtdiebeli*) has two long and one short setae.

Walking leg (Figure 6A) is 5 segmented and has a long and curved terminal claw (h2). Basal segment bears a longer d1 seta than d2 like most of the species in the genus. The ratio of these setae shows differences from species to species, on the new species this ratio is almost two times longer than several of the other species.

The setae (e and f setae) of T3 of the new species are slightly reticulated (Figure 6B) but smooth on the other species.

The new species has long and slender uropod (Figure 6D) like *E. persica*, *E. opulenta* but some species have short and thick uropod like *E. stephanidesi*, *E. virens*, and *E. bronsteini*. Some species of the genus has curved uropod (e.g., *E. sonia*, *E. minuta*, *E. bronsteini*) but *E. gordioni* has straight uropod (like *E. kurtdiebeli*, *E. salina*, *E. domestica*, etc.). Some of the species's uropod posterior claw length is equal or shorter than the half of the anterior claw (*E. areguensis*, *E. minuta*, etc.) but uropod posterior claw is longer than ½ anterior claw for the new species. In some species of the genus, uropod pairs display differences from each other (*E. compressa*, *E. ellipticalis*) but same on the new species.

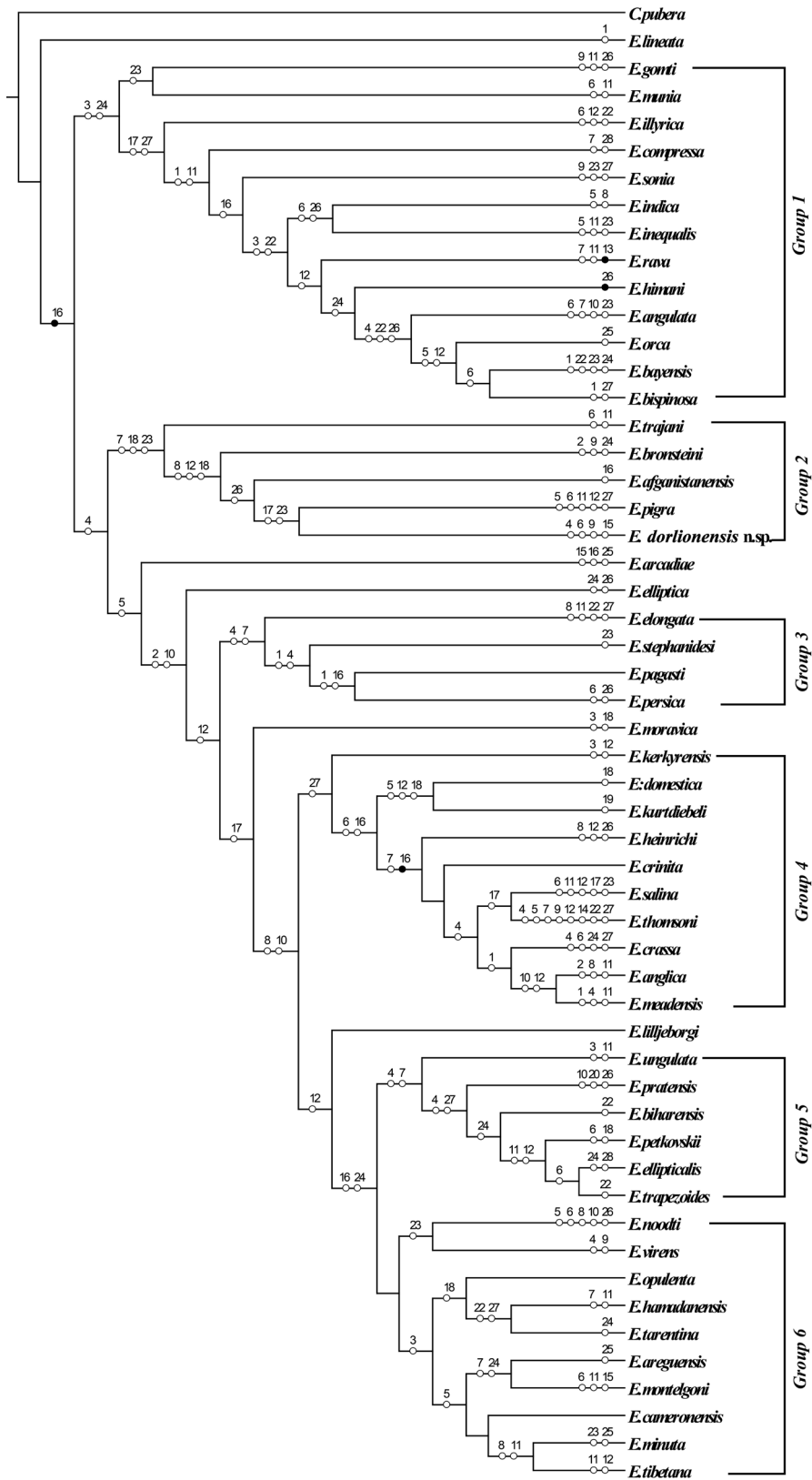


Figure 7. Six clustering groups of the genus *Eucypris* with 53 species and *Eucypris dorlionensis* n. sp. with the outgroup *C. pubera*. Nodes represent effective characters for division.

5. Conclusion

After detailed morphological and cladistic comparative analyses described above, we conclude that *Eucypris dorlionensis* n. sp. is proposed as a new species of the genus *Eucypris*. Accordingly, members of the genus *Eucypris* raised to 56 species. However, considering the complex taxonomic issues mentioned above, we strongly recommend a revision of the genus *Eucypris* along with the redescription of most of the species (if not all).

Conflict of interest

The authors declare that they have no conflict of interest, financial or other, exists in this study.

Nomenclatural acts: This work and the nomenclatural acts it contains have been registered in ZooBank. The ZooBank Life Science Identifier (LSID) for this publication

is: <http://zoobank.org/urn:lsid:zoobank.org:pub:E8058723-1F65-4F06-8D79-97DB13C86728>

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