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Short Paper

Redescription of *Ephemeroporus barroisi* (Richard, 1894) (Cladocera, Chydoridae) on the Basis of Material from Mediterranean Anatolia (Turkey)

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Abstract

Ephemeroporus barroisi, accepted as nomen dubium though there are many reports to date, is redescribed on the basis of parthenogenetic female, ephippial female and male collected from Mediterranean Anatolia, Turkey. It is decided that Anatolian specimens represent the species described by Richard. On the basis of nineteen diagnostic characters that were widely used in the description and diagnosis of the species in the previous studies, *Ephemeroporus barroisi* is the most similar first to *E. epiaphantoii* and next to *E. margalefi*. It is concluded that the *E. barroisi* group can not be defined by a single outomorphy, but by the character combination of the presence of four labral teeth and that of the denticles on the posterior angle of valves. Finally, an account on the distribution of species from the *E. barroisi* group is presented and it has been postulated that the species of the E. barroisi group may have been derived from an ancestral stock that was present in the old Mediterranean.

Keywords: Cladocera, Chydoridae, *Ephemeroporus barroisi*, Anatolia.

Akdeniz Bölgesinden (Türkiye) Toplanan Örnekler ile *Ephemeroporus barroisi* (Richard, 1894)'nin Yeniden Tanımlanması

Özet

Birçok çalışmada ismine yer verilmiş olmasına karşın nomen dubium (şüpheli tür) olarak kabul edilen *Ephemeroporus barroisi*'nin Akdeniz bölgesinden toplanan partenogenetik ve efipial dişi ile erkek bireylere dayalı yeniden tanımlanmıştır. Tarafımızdan toplanan Anadolu örneklerinin Richard tarafından tanımlanan türü temsil ettiği belirlenmiştir. Önceki çalışmalarda grup içerisindeki türlerin tanım ve ayırdımında yaygın olarak kullanılan 19 karaktere göre *E. barroisi* en fazla *E. epiaphantoii* ile ve sonra *E. margalefi* benzerlik göstermektedir. Ayrıca, *E. barroisi* tür grubunun tek bir otomorfi ile değil, labral plakadaki dört diş ve valvlerin arka köşesindeki dentiküllerin kombinasyonu ile tanımlanabileceği sonucuna varılmıştır. *E. barroisi* grubuna ait türlerin yayılışları ile ilgili bilgiler verilmiş ve bu türlerin eski Akdeniz'de mevcut olan atasal stokdan türemiş olabileceği kanısına varıldı.

Anahtar Kelimeler: Cladocera, Chydoridae, *Ephemeroporus barroisi*, Anadolu.

Introduction

The genus *Ephemeroporus* was established by Frey (1982) to include seven species of the "*barroisi*-complex" (*Pleuroxus barroisi* Richard, 1894 = *Chydorus barroisi* (Richard) Sars, 1895): *Ephemeroporus hybridius* Daday, 1905; *E. tridentatus* Bergamin, 1939; *E. phintonicus* Margaritora, 1969; *E. acanthodes* Frey, 1982, *E. archboldi* Frey, 1982. Number of valid species in the genus has risen to seven with the descriptions of *E. margalefi* and *E. epiaphantoii* by Alonso (1987) since there are neither available specimens of *E. barroisi* from original collection nor later collected topotypes. Frey (1982) considered *Ephemeroporus barroisi* to be a *nomen dubium*, though it has been reported from some additional worldwide localities (Bromley, 1993; Samraoui *et al.*, 1998; Sinev and Hollwedel, 2002). However, Smirnov (1996), in his review on the Chydorinae, does not agree with Frey and suggests *Ephemeroporus barroisi* Richard, 1894 to be a valid species because of the presence of figures in the original description.

Frey (1982) did not clearly define species groups

within the genus *Ephemeroporus*, but he considered previous records of *Chydorus barroisi* within the *barroisi*-group presenting a detailed discussion on the taxonomic status of the *E. barroisi* s. str. using the Richard's description and figures. Alonso (1987) recognised *barroisi*-group on the basis of two characters; presence of 4 teeth on the labral keel and that of the denticle(s) on the posterior angle of valves though the species constituting the group were not listed. However, the *barroisi*-group species can be identified only by combination of these two characters.

E. barroisi has been reported from different locality world-wide (Smirnov, 1971, 1996; Frey, 1982; Alonso, 1987; Bromley, 1993; Samraoui *et al*., 1998; Sinev and Hollwedel, 2001), but at present, the taxonomy and range are still not known properly. Although the pattern is more clear for the new world (Frey, 1982; 1995), it is too blurry for the rest of the world, where includes the type locality (Eastern Mediterranean-Syria). Unfortunately, there are no existing specimens from the origin collection and there are no available topotypes since the pool of the village Abadi (type locality) dried (Frey, 1982). Thus, the taxonomic debate on this species can only be resolved using specimens from close surrounding.

The only record of this species around Mediterranean is by Fiers (1978) from Anatolia on the basis of specimens collected by I. Minor. In the checklist of Anatolian Cladocera (Gündüz, 1997; Ustaoğlu, 2004), *E. barroisi* (as *Chydorus barroisi*) is included based on the reference of Fiers (1978). After that, the species has not been reported from Anatolia until recently. Recent sampling of some freshwaters in the western part of Mediterranean Anatolia provided the facility of a more detailed study of *Ephemeroporus barroisi*. The examination of specimens from different water bodies revealed that the southern Anatolian population belongs to *Ephemeroporus barroisi* and provided the opportunity of redescription of this poorly known species

In this study, we aimed at (i) redescribing the *E. barroisi* on the base of specimens from southern Anatolia, which is geographically close to type locality (ii) preparing a detailed diagnosis for *E. barroisi* together with other species of the genus (iii) giving a detailed list of the diagnostic characters for the *barroisi* species group and (iv) briefly evaluating the present data on taxonomy and biogeography of the genus.

Materials and Methods

One lake (Lake Titreyen) and streams (Köprü, Karpuz and Kargı), located in southern Anatolia, were sampled on several occasions between 2001 and 2008 (see material examined). These water bodies are located either just next to the Mediterranean Sea, or have a connection with it. Samples were taken mainly from slow-running and vegetation rich parts of the streams and lake. Specimens were collected using plankton net with 55 µm mesh, and fixed in formaldehyde 5% immediately after collection.

In the laboratory, the specimens were dissected in glycerol under a stereomicroscope. Figures were drawn by means of a compound microscope equipped with a camera lucida. Five specimens were freeze dried, mounted on an aluminium stub, coated with gold, and examined under a scanning electron microscope (Zeiss, Leo 130).

Results

Materials Examined

Parthenogenetic female, Turkey: Antalya, Manavgat, Lake Titreyen, 01.09.2002, nineteen parthenogenetic females, and eleven parthenogenetic females, Turkey: Antalya, Manavgat, Titreyen Lake, 31.07.2001, 01.09.2002, B. Yalim (AUZM: Akdeniz University Zoology Museum), four parthenogenetic females Turkey: Antalya, Manavgat, Karpuz Stream, 01.09.2002, B. Yalim (AUZM), two parthenogenetic females Turkey: Antalya, Manavgat, Köprü Stream, 31.07.2001, B. Yalim (AUZM), two parthenogenetic females Turkey: Antalya, Alanya, Kargı Stream, 31.07.2001, B. Yalim (AUZM). Four ephippial females Turkey: Antalya, Manavgat, Lake Titreyen, 23.12.2007, B. Yalim, two ephippial females Turkey: Antalya, Manavgat, Titreyen Lake, 20.01 2008, B. Yalim, three males Turkey: Antalya, Manavgat, Titreyen Lake, 20.02 2008, B. Yalim.

Parthenogenetic Female

Body 1.22-1.24 times longer than wide, its dorsal margin regularly convex, ventral margin obtusely concave, with a distinct bulge about in the middle part; posterior-dorsal angle prominent (Figures 1A-B, 2A).

Head. Headshield slightly longer than wide (Figure 1C); surface smooth, without ornamentation rostrum short, tapered to a blunt tip (Figures 1A-C); ocellus almost as large as eye; in adults no head pores.

Antennules short, not reach to the tip of the rostrum and provided with 9 aesthetascs of different lengths; antennular sensory seta longer than the aesthetascs, inserted submedially (Figure 1E).

Antenna typical of the genus and seemingly undifferentiated from other species of genus; terminal spines on distal segments of the two branches very short, spine on basal segment of the dorsal branch either very short or not visible; seta arising from mid segment of ventral branch longer than terminal seta, antennal formula of the female 0(1)-0-3/0-1-3(1) (Figure 1F).

Labrum elongated, with four pairs of distinct teeth inserted along outer margin, lacking brusque narrowing under the inferior denticle and its distal tip rounded; its posterior region expanded laterally

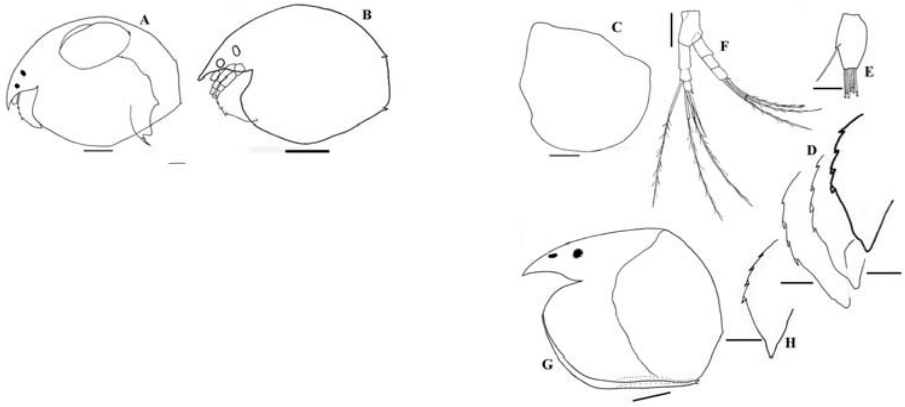

Figure 1. *Ephemeroporus barroisi*, A-L adult parthenogenetic female: (A)-(B) lateral view, (C) headshield, (D) labrum, (E) antennula, (F) antennae, (G-H); ephippial female. (G) Lateral view, (H) labrum. Scale bars denote 0.1 mm for (A), 0.05 mm for (B), (E) and 0.02 mm for (C), (D) and (F-H).

(Figure 1D).

Valves. Anterior-ventral margin with 8-10 setae which followed by 6-8 prominent brush-like structures; posterior ventral margin with 32-33 setae from ventral bulge to the postereo-ventral corner, length of which reached maximum in the midway, where the insertion is submarginal (Figures 3C-D). Ventral margin with a pronounced ventral bulge¸ there are tooth-like expansions in the anterior of ventral bulge (Figures 3C, I); postereo-ventral angle bordered with 1-2 denticles (Figures 3E-H), their number may be different between the two valves of the same specimen (1-1, 1-2); denticle(s) with a short and wide basis, it usually grows posteriorly at the angle formed between the ventral and posterior margins. The postereo-ventral angle covered first with rather prominent 6-9 small setae and followed by a row of shorter setae submarginally; the short setae are hardly visible or invisible under ligth microscobe. Roughly anterior 1/3 of the valves with hexagonal cells that produce 6-8 irregularly curved rows roughly running parallel to the anterior margin; medial 1/3 of valves with 8-11 sinuous lines parallel to the postereo-ventral margin, there are almost no transverse connections between the ventral most 4-5 parallel sinuous lines and those produced long polygons; remaining polygons have few indistinct transverse lines; the long polygons located in the medial 1/3 of the valves covered with indistinct few rows of the hexagonal cells on dorsal and posterior sides (Figure 3A). Whole surface of the valves (both in ornamented lateral and unornamented dorsal sides) bears fine pits (Figures 2B-C, 3B).

Postabdomen short, 2.4 times longer than wide, pre-anal margin pronounced, post-anal margin provided with 8-10 thin and sharp denticles (Figures 3J-N), proximal 2-3 denticles distinctly longer than others; the denticle in intermediate position is almost in the same length as of the remaining distal ones. The anal groove provided with 3-5 marginal clusters of spines, lateral spinulation made up of clusters diminutive setae that found along the whole of the post-anal region. Clusters of lateral seta more dense anteriorly and rare posteriorly (Figures 3J-L). Postabdominal claw with two slender and curved basal spines, proximal one very short and delicate than distal one; its concave surface provided with very fine setules throughout claw that separated into two groups, those of basal group being somewhat more robust; long flagellum- like structures arising pre-apically located on convex (ventral) side and extend far beyond tip of claw (Figures 3J-M, O).

Thoracic Limbs: Five Pairs

Limb I of moderate size (Figures 4A-B). Epipodite oval. Outer distal lobe with one long seta; inner distal lobe with 3 setae, the inner hook-shaped seta 1.7 times longer than the second outer one. The second seta bearing a row of pronounced subequal spinules. The third seta roughly as thick as the second but longer than it and with more slender spinules. The inner branch of the endite with 12 setae; the anterior lobule of the inner branch of endite consists of 4 setae of similar length, the first of which is feathery. The posterior lobule of the inner branch of the endite with 8 setae and an additional accessory seta.

Limb II triangularly rounded (Figure 4C). Exopodite with one slender seta; endopodite with 8 setae, first 5 seta slender than others, remaining 3 setae of the same size and with thin setules in distal parts; gnathobase provided with 8 filter setae of similar length.

Limb III with an oval epipodite (Figure 4D); exopodite subrectangular, with 7 setae; distal endite with 2 setae, basal endite with 5 stiff and feathered setae. Filter plate with 8 setae.

Limb IV with an oval epipodite, with finger-like projection (Figures 4E-F). Exopodite sub-rectangular, with 7 setae the first being shortest, slender and naked. Second seta long, slender and with weak setulae. Seta 3 slightly shorter than others. Setae 4-7 subequal in length. Of the seven setae the 3.-7. plumose. Inner portion of limb IV with 4 setae. Scraping seta long, slender with denticles in distal part; first flaming-torch seta broader than the other

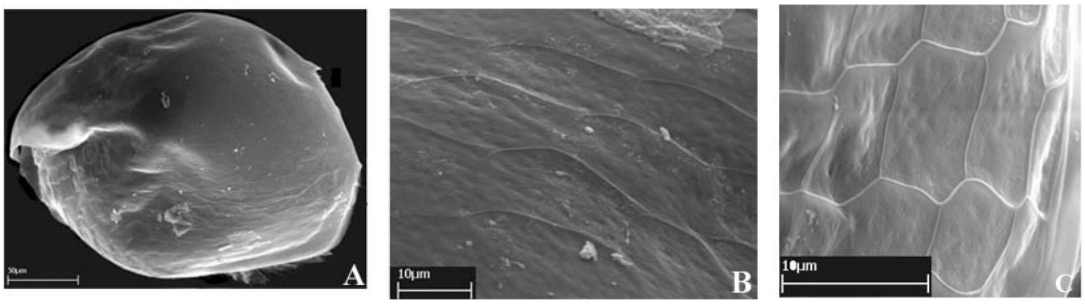

Figure 2. *Ephemeroporus barroisi*, A-C adult parthenogenetic female: Scanning electron micrographs of (A) Lateral view, (B) anterior shell sculpturing, (C) posterior shell sculpturing. Scale bars denote 0.05 mm for (A), 0.01 mm for (B), (C).

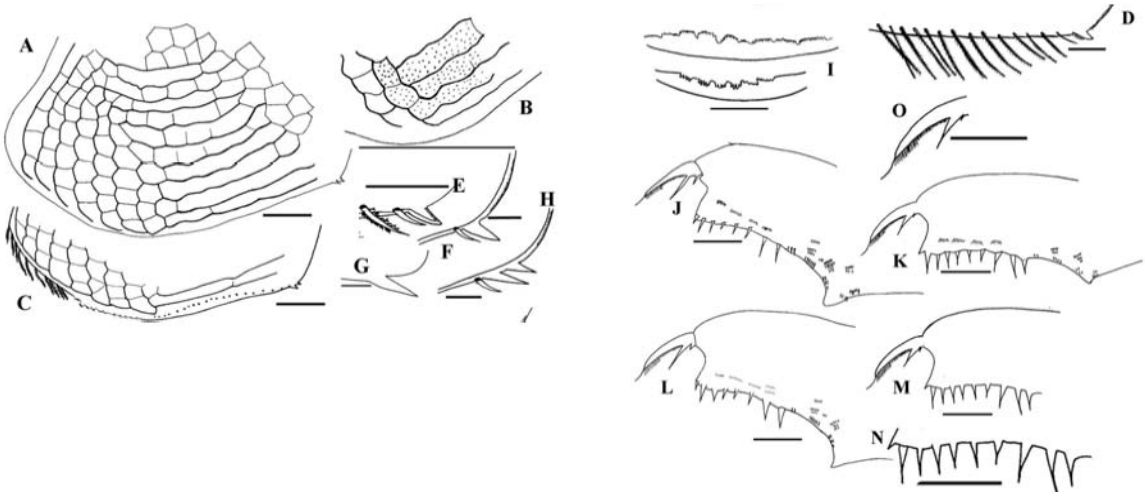

Figure 3. *Ephemeroporus barroisi*, A-O adult parthenogenetic female: (A) Shell ornamentation, (B) anterior and posterior shell sculpturing, (C) ventral margin of shell, (D) posterior ventral margin of shell, (E-H) posterior ventral angle of shell, (I) serrate expanded seta bases of anterior to ventral bulge, (J-N) postabdomen, (O) postabdominal claw. Scale bars denote 0.05 mm for (A), (C), (D)- (F) and (H), 0.02 mm for (B), (G) and for (I)-(O).

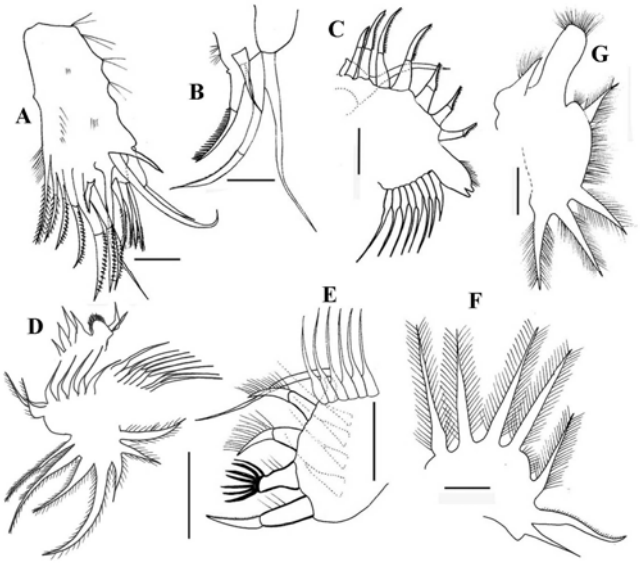

Figure 4. *Ephemeroporus barroisi*, A-G adult parthenogenetic female: (A) Trunk limb I, (B) inner and outer distal lobes of trunk limb I, (C) trunk limb II (D) trunk limb III, (E) inner portion of Limb IV, (F) exopodite of Limb IV, (G) trunk limbV. Scale bars denote 0.02 mm for (A)-(G).

two and with 7-8 strong setules; remaining two flaming-torch setae slender and with thin setules. Four soft setae gradually increase in size toward apex. Gnathobase with a long 2-segmented seta.

Limb V with elliptical epipodite; exopodite oval, lateral group of setae with 3 somewhat long and densely setulated setae, there is a single short seta distally (Figure 4G).

Maximum length: 284 µm, minimum length: 261 µm, maximum height: 230 µm, minumum height: 190 µm, average length: 276 µm, average length/height: 1.22-1.24 (elongated).

Ephippial female

Basically similar to parthenogenetic female, but, differently with a higher and shorter body; dorsal margin of valves highly arched. Ephippium dark brown (Figures 1G-H).

Male

Body more elongate than parthenogenetic female, body height/body length 0,72; its dorsal margin almost regular, ventral margin obtusely concave, with a distinct bulge about in the middle part; posterior-dorsal angle prominent (Figures 5A, C). Ocellus of same size as in female; rostrum short, tapered to a blunt tip. Labral teeth more prominent than that in parthenogenetic female, posterior region of labral keels expanded laterally (Figure 5B). Antennules shorter and broader than that in female, not reach to the tip of the rostrum. Anterior-ventral margin of valves with 5-6 setae which followed by 4-5 prominent brush-like structures; ventro-posterior margin with 36-38 setae from ventral bulge to the postereo-ventral corner length of which reach maximum in the midway where the insertion is submarginal; postereo-ventral angle with a single short and wide denticle (Figure 5D). The posterior margin with a row of diminutive setae located submarginally. Surface ornemantation of the valves similar to that of female.

Limb I with U shaped copulatory hook, its free arm longer and slender than the basal one and with 2 small notches at the tip; the copulatory brush well-developed (Figure 5E). The outer branch of endite of the first thoracic limb with 3 setae of roughly same length (Figure 5F).

Postabdomen sligthly shorter than that of female, 2.2-2.4 times longer than wide (Figure 5G-I). Both pre-anal and post-anal angles not pronounced. Post-anal margin with 8-9 sharp denticles proximal 2-3 of which distinctly longer than others. The anal groove provided with 3-5 marginal clusters of spines, lateral spinulation made up of clusters diminutive setae that found along the whole of the post-anal region. Clusters of lateral seta more dense anteriorly and rare posteriorly. Postabdominal claw with 2 slender and curved basal spines; the longer basal spine of the claw is roughly half of the claw itself in length. The sperm-duct opening located on ventral side of postabdomen near base of claw.

Differential diagnosis of *E. barroisi* (Richard, 1894) and Discussion

The data obtained during this study can be evaluated in different ways. First, data can be used to make decision if the Anatolian population is belonging to the species described by Richard. Following this decision, it will be plausible to discuss the species composition of *barroisi*-group and to conclude the relationship within the group using invariable detailed characters (Table 1). Finally, some remarks for the biogeography of group will be presented.

Recognition of *E. barroisi* (Richard, 1894)

A list of the diagnostic characters (Table 1) for the species of *E. barroisi*- group is miscellany from the previous studies (Frey, 1982; Alonso, 1987). It is worth nothing that these characters are invariable or

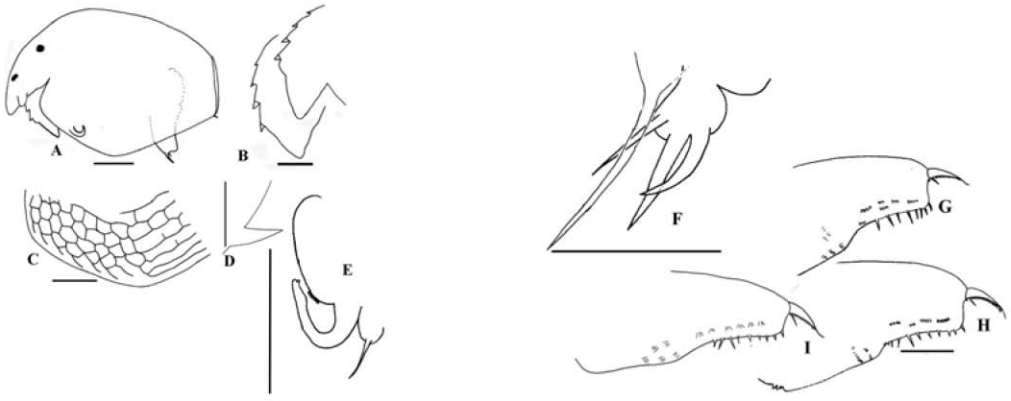

Figure 5. *Ephemeroporus barroisi*, A-I adult male: (A) lateral view, (B) labrum, (C) shell ornemantation, (D) posterior ventral angle of shell, (E) copulatory hook, (F) inner and outer distal lobes of trunk limb I, (G)-(I) postabdomen Scale bars denote 0.02 mm for (A)-(I).

Table 1. List of the diagnostic characters for *barroisi* group.

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
E.barroisi Richard's description	+	+	+	+	?	?	?	+	+	+	?	+	+	+	?	?	?	+	+
E.barroisi Anatolian population	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
E.epiaphantoii	+	-	+	-	+	+	-	-	+	+	+	+	-	-	+	-	-	-	+
E. margalefi	-	+	-	+	-	-	+		-	-	-	-	+	+	-	+	-	+	-
Iran population	+	-	+	-	+	+	?	+	+	+	?	?	-	+	+	-	+	-	+

1-Labrum: (+) without a brusque narrowing below the inferior denticle; (-) with a brusque narrowing below the inferior denticle.
2-Tip of labrum: (+) rounded; (-) pointed. 3-Rostrum: (+) short; (-) elongated. 4 Apex of rostrum: (+) blunt; (-) sharp.
5-Shape of cells in postereo-ventral one-third of the valves: (+) elongate; (-) hexagonal
6-Pattern of cells on the postereo-ventral one-third of the valves: (+) ordered in the rows, with roughly straight margins; (-) not ordered in the rows, without straight margins. 7-Surface of cells in the postereo-ventral one-third of the valves: (+) punctuated; (-) striated.
8-Number of brush-like expansions on the ventral bulge of valves anteriorly: (+) 6-8; (-) 12-14.
9-Tooth-like projections on the ventral bulge: (+) well developed; (-) weekly developed
10-Base of the denticle on the postereo-ventral corner: (+) thick; (-) thin.
11-Aesthetascs on antennula (A1): (+) not in the same length; (-) roughly in the same length.
12-Lateral setae of antennula (A1): (+) medial or submedial; (-) submarginal.
13-One or two of the middle denticles on the dorsal margin of postabdomen: (+) somewhat shorter than previous other; (-) shorter than previous others; 14-Marginal denticles of postabdomen: (+) proximal two-three denticles distinctly longer than remaining distal ones; (-) roughly all in the same length; 15-Number of the antereo- ventral setae of the valve: (+) 8-10; (-) 15-17.
16-Number of the postereo-ventral setae of the valves: (+) 30-33; (-) 25-28.
17-Outer branch of the endite of leg I: (+) with slender spinules; (-) with pronounced spinules
18-Length/height of the body: (+) >1 (1.20-1.40); (-) ~1. 19-Postereo-dorsal angle of the valves: (+) distinct; (-) indistinct.

variations limits are species specific, thus, allow us to provide a comparison of present population both with the original description and with other species in the group. It was not possible to determine some character states in the description and figures by Richard (see in Frey 1982), but, others still provide inclusive data to decide if present specimens represent the species described by Richard. There was no information for 7 of 19 characters given in original description. Of these, especially character 7 seems a typical autapomorphy of the specimens collected from Anatolia, though it is not described by Richard. Of the unknown characters of the original description, 5 and 6 are related to ornamentation of valve's surface, and are similar in *E. epiaphontoii,* Anatolian and Iranian populations of *E. barroisi*-complex. On the contrary, *E. margalefi* has hexagonal cells throughout the surface. Again, length of aesthetascs on antennula (Character 11), number of the antereo-ventral setae of the valves (Character 15) exhibit a similar case as in two characters mentioned in previous sentences. Another character which is unknown from original description is number of postereo-ventral setae of valves seems to diagnose *E. epiaphontoii* from others. Of the remaining two unknown characters, the presence of spinules on outer branch of endite limb I may be considered a detailed and unimportant character for the group. However, the punctuated surface of elongated cells (on posterio-ventral 1/3 of valves) seems to be a prominent character and may be of use to determine consensus of present material with original description and to distinguish this species from others. However, 12 characters other than 7 unknown provide a considerable support to the desicion that Anatolian specimens are belonging to *E. barroisi* (Richard, 1894). Among these 12 characters there is some doubt about the Character 14. According to Richard (1894), the denticles are about the same length while they are in different length in presently described specimens. However, features of present specimens well fit to original description, and the only difference can be considered a variation or insufficiently mentioning in the original description (Frey, 1982). In conclusion, above statements indicate that there is a considerable aggrement between traits of the material collected from Anatolia and Richardson's description on the basis of the characters used in the other studies on the genus *Ephemeroporus* (Smirnov, 1971; Frey, 1982; Alonso, 1987). Thus, we assume that this material represent the species described by Richards, *Ephemeroporus* (=*Chydorus*) *barroisi*.

E. barroisi has been recorded from different geographies world-wide in the studies previous to the establishment of the genus by Frey (1982) as *Chydorus barroisi*. Of these records, the new world populations were considered to be distinct different species and the other records from the remaining parts of the world to be a species complex (Frey, 1982). Although further new species were described from the Old World (Alonso, 1987), still there were numerous other records given within *E. barroisi*-complex. Smirnov (1996) in his review on Chydoridae mentioned to the range of this species as "Syria, Iran, India, Sri Lanka, Australia, Africa, Nicaragua and North America" though Frey (1982) considered American specimens to be separate species. Unfortunately, there are no comprehensive data about each of these specimens to allow a thorough comparison if they belong to this species or not. For this purpose the characters listed in Table 1 are also coded as far as available from the descriptions/figures

by Frey (1982) and Alonso (1987). As can be seen in the matrix below, the character list data is not sufficient for a comparison (Table 1) and a decision for these population requires examination further material representing each of the records.

The only population relatively well described is that from Iran (Alonso, 1987). However, there are some differences between Iranian and Anatolian population, and between Iranian population and the description by Richard. Although the accuracy of the characters diagnosing taxa of this group can be questioned (Smirnov, 1996), these dissimilarities of Iranian population suggest that Anatolian population are a better representative of the Richard's species. Thus, the Iranian population either may be a subset of *E. barroisi* or another species in the group. Since the data related to other populations of E*. barroisi* (Table 1) are very poor, a decision for them will be very premature at this stage.

The *E. barroisi* Group and Relationships Within the Group

As mentioned by Alonso (1987), presences of the teeth on the labral keel are a prominent synapomorphy of the *E. barroisi* species group. Alonso (1987) also considered the presence of denticles on postereo-ventral corner of the valves as an additional synapomorphy shared by these species. However, each of these characters constitutes different groups, since they were not shared congruently. When the group is defined on the basis of presence of four labral teeth, it includes *E. epiaphantoii, E. margalefi* and *E. phintonicus* and *E. barroisi*. On the contrary, grouping according to the presence of denticle(s) on postereo-ventral angle excludes *E. phintonicus*. Though world-wide distribution and taxonomy pattern of the *barroisi*-group is still unclear, it seems more plausible to define the *barroisi*-group according to presence of four labral teeth for two reasons: (i) variation in the number of denticles on the postereo-ventral corner of the valve (e.g. 7-8 in *E. archboldi,* 1-2 in *E. margalefi*, *E. epiaphantoii* and *E. barroisi*) and (ii) all Mediterranean plus south-eastern Asian species will be in the same group leaving apart all the valid New World species. The number of the labral teeth is less than 4 in the New World species of the genus, except *E. tridentatus* (Frey, 1982; Smirnov, 1996). In general, *E. tridentatus* has three teeth (as indicated in the species name) and if there is a fourth, it is more weekly developed. But other three species in *E. barroisi* group always have four well-developed teeth.

E. barroisi shows close affinities with *E. epiaphantoii* among the species of the *barroisi*-group. The labrum without a brusque narrowing below the inferior denticle, the short rostrum, the elongated cells on the postereo-ventral one-third of the valves, the basely thick denticle of the postereo- ventral corner, the aesthetascs of the antennules that are not in the same length, the submedial lateral seta of the antennules, presence of the 8-10 setae on the antereo-ventral margin of the valves, striae running parallel to the anterior margin and presence of the well developed brush-like expansions on the ventral bulge are shared by these two species. However, the *E. barroisi* differs from *E. epiaphantoii* by the following characters; the blunt tips of labrum and of rostrum, the pitted (in form of small depression) surface of the elongated cells in the postereo-ventral one-third of the valves, the presence of the 30-33 setae on the postereo-ventral margin of the valves, the marginal sixth denticle (from distal) of postabdomen that is longer than previous five denticles and the conspicuous proximal two-three marginal denticles of postabdomen. Of three species in the group, *E. epiaphantoii* and *E. barroisi* seem to be more close relatives sharing presence of the distinctly elongated cells on postereo-ventral one-third of the valves. Importantly, these elongated cells filled with fine striae in *E. epiaphantoii* while it is filled with numerous fine punctuations in *E. barroisi*. It seems that there is a correlation between presence of elongated polygons and fine striae in the cells since there are other species of *Ephemeroporus* species have both elongated polygons, and striae in these polygons. In respect to this character, *E. epiaphantoii* (Alonso, 1987) is similar to *E. hybridius* and that *E. acanthodes* (Frey, 1982). However, *E. barroisi* shows a contrary case: shell is with elongated polygons but with punctation (without striae) within these polygons as in the hexagonal cells.

The other species are considered to be in the *barroisi*-group, *E. margalefi*, shares less similarity with *E. barroisi*. The rounded distal tip of the labrum, the distinctly longer proximal two-three marginal denticles of the postabdomen, the presence of the 30-33 postereo-ventral setae of the valves, elongated body and the presence of more than one postereo-ventral denticle (their number can be different between the two valves of the same specimen as in *E. archboldi*) are common characteristics of *E. margalefi* and *E. barroisi*; but these two species differ in many other characters; the labrum with a brusque narrowing below the inferior denticle, the elongated rostrum, the hexagonal cells on postero-ventral one- third of the valves and the striae within these cells, the presence of weakly developed brush-like expansions on the ventral bulge, the basely thin denticle of the postero-ventral corner, aesthetascs of antennula that are roughly in the same length, the submarginal lateral seta of the antennula, and the presence of 15-17 setae on the antero-ventral margin of the valves (Table 1).

E. barroisi males are similar to *E. epiaphantoii* among the species of the *barroisi*-group. The labrum without a brusque narrowing below the inferior denticle, distal tip of the labrum rounded, the short rostrum, the elongated cells on the postereo-ventral one-third of the valves, striae running parallel to the anterior margin of the valves and presence of the well

developed brush-like expansions on the ventral bulge are shared by these two species. However, the *E. barroisi* differs from *E. epiaphantoii* by the conspicuous proximal 1-2 marginal denticles of postabdomen.

Remarks on Biogeography of the *E. barroisi* Group

Redescription of *E. barroisi* from Mediterranean Anatolia will contribute to the completion of the phylogenetic and distributional patterns of the genus *Ephemeroporus*. Smirnov (1996) suggested that *E. epiaphantoii* is defined on minute characters by Alonso (1987). Although *E. epiaphantoii* is more similar to *E. barroisi* morphologically, if determinated differences are accepted to be insignificant minute characters or variations, these two populations should be in the same species. Importantly, it also supports Frey (1995) in suggesting that the chydorid species previously accepted to be cosmopolitan are in fact groups of the related species. Thus, it is quite possible that clear definition of other insufficiently known records of the *Ephemeroporus* will provide further supports to Frey's hypothesis.

On the other hand, records of *Ephemeroporus* around Mediterranean and south-eastern Asia (genus is insufficiently known for south Asia) may be biogeographically sensible. There are many records of the genus *Ephemeroporus* around Mediterranean and Red Sea. All of the above records (the *barroisi*-group) share the presence of four labral teeth and seem to constitute a distinct lineage within the genus. Distribution pattern of the *barroisi* group provides opportunity of further developing of the Frey's (1995) assumption that the genus *Ephemeroporus* has a Gondwanian origin. Because the localities of the species within *barroisi*-group are in/around the Tethys Sea, the origin and distribution of this lineage can be correlated with tectonic evolution of the area. Especially, because there was a water connection between Indian Ocean and Tethys Sea over Mesopotamia in the Miocene in Tertiary (Rögl, 1999; Bozkurt, 2001), it is plausible to assume an ancestral stock of this date and a subsequent evolution of this stock in the area as suggested for killifishes by Hrbek and Meyer (2003). Although still there are many unknown taxonomical and distributional aspects of the *Ephemeroporus*, above assumption is also congruent with Frey's (1995) suggestion that speciation within chydorid groups has occurred predominantly by the vicariance. Inferring from distribution of the *barroisi* species group, vicariant speciation within the genus *Ephemeroporus* is not only by separations of the continents but also by occurrence of more local barriers, such as closing of Tethys or regressive/transgressive cycles in the Mediterranean area. However, this working hypothesis needs much more data on the *Ephemeroporus* from North Africa and South Asia.

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