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Neotype designation of *Aphanius iconii*, first reviser action to stabilise the usage of *A. fontinalis* and *A. meridionalis* and comments on the family group names of fishes placed in Cyprinodontidae (Teleostei: Cyprinodontiformes)

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Abstract

As First Revisers, we give priority to *Aphanius fontinalis* over *A. altus* and *A. litoralis* and to *A. meridionalis* over *A. parvus.* A neotype is designated from Lake Eğirdir for *Aphanius iconii*. Family groups in the deeply polyphyletic fish family Cyprinodontidae are discussed. Aphaniidae, Cubanichthyidae and Orestiidae are proposed as distinct families, restricting the family Cyprinodontidae to the New World genera *Cualac*, *Cyprinodon*, *Floridichthys*, *Jordanella* and *Megupsilon.*

Key words: Biodiversity, killifish, freshwater fish, taxonomy

Introduction

Akşiray (1948) published the description of one new species and 15 new subspecies of *Aphanius* from Turkey. Villwock (1958, 1964) as well as Wildekamp (1993) and Wildekamp *et al*. (1999) did not accept any of these 16 taxa as valid. Wildekamp *et al.* (1999) placed *A. cypris alexandri*, *A. cypris boulengeri*, *A. cypris orontis*, *A. sophiae similis* and *A. sophiae mentoides* in the synonymy of *A. mento*. They also synonymized *A. burduricus iconii*, *A. chantrei aksaranus*, *A. chantrei altus*, *A. chantrei flavianalis*, *A. chantrei fontinalis*, *A. chantrei litoralis*, *A. chantrei maeandricus*, *A. chantrei meridionalis*, *A. chantrei obrukensis* and *A. chantrei parvus* with *A. anatoliae* and treated *A. burduricus burduricus* as a synonym of *A. anatoliae sureyanus*.

Hrbek *et al*. (2002) and Geiger *et al*. (2014) studied molecular characters in different Anatolian *Aphanius* species and found *A. anatoliae*, as understood by Wildekamp *et al.* (1999), to be highly polyphyletic. Geiger *et al*. (2014) therefore suggested treating *A. iconii*, *A. fontinalis*, *A. maeandricus* and *A. meridionalis* as valid species, a view accepted by Pfleiderer *et al*. (2014).

The type localities of *A. chantrei aksaranus*, *A. chantrei flavianalis* and *A. chantrei obrukensis* are all situated in the wider Lake Tuz basin and fishes from the respective type localities have been included by Hrbek *et al*. (2002) and/or Geiger *et al*. (2014) in their molecular studies, demonstrating that these names are indeed likely to be synonyms of *A. anatoliae*. Geiger *et al*. (2014) and Pfleiderer *et al*. (2014) identified fishes from Lake Işıklı basin and springs in Dinar as *A. maeandricus*, those from Lake Eğirdir as *A. iconii*, those from springs in former Lake Söğüt in the Taurus Mountains as *A. meridionalis,* and those from a spring near Lake Yarışlı near Burdur as *A. fontinalis*. The situation in *A. maeandricus* needs no discussion as it is the only name available for this species. But the situation is not as clear in the cases of *A. iconii*, *A. meridionalis* and *A. fontinalis.*

Akşiray (1948) described *A. burduricus iconii* based on a syntype series consisting of fishes from three different origins: from Lake Eğirdir, from the area of Çumra and from Hotamış Lake. The last two locations are situated in the Konya endorheic basin in Central Anatolia. All materials examined by Akşiray (1948) are lost. Hrbek *et al*. (2002) found the fishes from the Lake Eğirdir basin to be clearly distinguished from other Anatolian *Aphanius* but those from the Konya endorheic basin to be very similar to *A. anatoliae*.

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Akşiray (1948) described *A. chantrei meridionalis* from Lake Söğüt and *A. chantrei parvus* from the geographically close Lake Gölhisar basin. Hrbek *et al*. (2002) and Geiger *et al*. (2014) studied *A. meridionalis* from the Lake Söğüt basin and supported it status as a valid species but could not include specimens from Lake Gölhisar basin as these seemed to be extirpated. The molecular study by Hrbek *et al*. (2002) revealed another clade including fishes from the Lake Burdur and Lake Salda basins. Akşiray (1948) described *A. chantrei fontinalis* and *A. chantrei litoralis* (Lake Burdur basin) and *A. chantrei altus* (Lake Salda basin) in the same publication.

To stabilise the names in *Aphanius*, we act as First Revisers to give priority of *A. fontinalis* over *A. altus* and *A. litoralis* whenever the two latter names, either of them or both, are considered to be synonyms of *A. fontinalis*; and of *A. meridionalis* over *A. parvus* whenever the two names are considered to be synonyms; and we designate a neotype for *A. iconii*.

Working on *Aphanius*, we also reviewed the molecular studies on cyprinodontiform phylogeny and found strong disagreements between published family assignment and phylogenies of killifish and livebearers. While phylogenetic studies published in high-ranked journals do rarely commit to taxonomic conclusions, the revision of the family group Cyprinodontidae is more than overdue. Here we propose a new family structure for the killifishes previously placed in the family Cyprinodontidae.

Material and methods

After anaesthesia, fishes were fixed in 5% formaldehyde and stored in 70% ethanol or directly fixed in 99% ethanol. Measurements were made with a dial caliper and recorded to 1 mm. All measurements were made point-to-point, never by projections. Methods for counts and measurements follow Kottelat & Freyhof (2007). Standard length (SL) is measured from the tip of the snout to the posterior extremity of the hypural complex. The length of the caudal peduncle is measured from behind the base of the last anal-fin ray to the posterior extremity of the hypural complex, at mid-height of the caudal-fin base. The last two branched rays articulating on a single pterygiophore in the dorsal and anal fins are counted as "1½". Simple rays of dorsal and anal fins are not counted as they are deeply embedded. The neotype is included in the calculation of means and standard deviations (SD) of males.

Collection codes: FSJF, Fischsammlung J. Freyhof, Berlin; IUSHM, Istanbul University, Science Faculty, Hydrobiology Museum, İstanbul; ZMH, Zoologisches Museum Hamburg, Hamburg. Authors of species and family names are listed in Table 1.

First Reviser actions to stabilise the use of *A. fontinalis* and *A. meridionalis*

The First Reviser action is the principle that in cases of conflicts between simultaneously published names, the first subsequent author can decide which has precedence (ICZN 1999: Article 24.2). Akşiray (1948) published the description of one new species and 15 new subspecies of *Aphanius* from Turkey. Neither Villwock (1958, 1964), Wildekamp (1993), Wildekamp *et al*. (1999) or any later author accepted any of these 16 taxa as valid. Recently, Geiger *et al*. (2014) and Pfleiderer *et al*. (2014) accepted *A. fontinalis* and *A. meridionalis* as valid species but did not discuss the other available names for these species published by Akşiray (1948).

Akşiray (1948) described in the same publication *A. chantrei fontinalis* from a spring near Lake Yarışlı, *A. chantrei altus* from the spring Karapınar near Yeşilova, and *A. chantrei litoralis* from Lake Bahçeözü (Lake Karataş). Hrbek *et al*. (2002) include in their molecular study fishes from the spring Karapınar near Yeşilova (*A. chantrei altus*), Pınarbaşı near Kemer in Lake Karataş basin (*A. chantrei litoralis*), Lake Burdur (*A. sureyanus*) and Düger (a spring in Lake Burdur basin). In the trees shown by Hrbek *et al*. (2002), all these populations form one group of very closely related populations. Geiger *et al*. (2014) include also *A. sureyanus* and fish from a spring near Lake Yarışlı (*A. fontinalis*, Fig. 1) in their study, both being also very closely related. We see no reason to reject the results by Hrbek *et al*. (2002) and Geiger *et al*. (2014) and treat all these populations, except those from Lake Burdur, as conspecific. All these fish are distinguished by having a wide black anal-fin margin in males (vs. narrow in *A. anatoliae*, *A. maeandricus*, *A. meridionalis*, *A. danfordii*, *A. marassantensis* and *A. villwocki*) and the body being completely covered by scales (vs. scales reduced in *A. transgrediens*, *A. saldae*, *A. splendens* and *A. sureyanus*).

As First Revisers, we give precedence of *A. fontinalis* over *A. chantrei altus* and *A. chantrei litoralis*. *Aphanius sureyanus* is treated as distinct from *A. fontinalis* despite these two species sharing the molecular character states examined so far (Hrbek *et al*. 2002, Geiger *et al*. 2014). *Aphanius fontinalis* is distinguished from *A. sureyanus* by being completely covered by scales (vs. scales reduced in *A. sureyanus*). There is a large variability in scale patterns within *A. sureyanus* (Villwock, 1963). It cannot therefore be fully excluded that *A. fontinalis* might turn out to be a synonym of *A. sureyanus*; further studies are needed to clarify the situation.

Akşiray (1948) described in the same publication *A. chantrei meridionalis* from Lake Söğüt (Fig. 2) and *A. chantrei parvus* from the Lake Gölhisar basin (Fig. 3). Until now, only *A. meridionalis* has been accepted as a valid species, by Geiger *et al*. (2014). *Aphanius parvus* has not yet been studied for molecular characters as it has not been recorded in the last 25 years (Wildekamp *et al.* 1999) or perhaps even since 1957. It cannot be fully excluded that this population might be extirpated. We examined preserved material from Lake Gölhisar (Fig. 3) collected in 1957, including some captive-breed fishes from this stock, likely to have been preserved a few years later (ZMH 3502). As First Revisers, we give *A. meridionalis* precedence over *A. parvus*. These populations are considered conspecific as the adult males of both have a completely black dorsal fin (vs. dorsal fin with a white or hyaline base in *A. anatoliae*, *A. fontinalis*, *A. saldae*, *A. splendens*, *A. sureyanus* and *A. transgrediens*, dorsal fin with white or hyaline blotches or bands above the dorsal-fin base in *A. maeandricus*, *A. iconii*, *A. danfordii* and *A. marassantensis*) and a narrow black anal-fin margin (vs. wide margin or anal fin almost completely black in *A. fontinalis*, *A. saldae*, *A. splendens*, *A. sureyanus* and *A. transgrediens*). Field work is encouraged around Lake Gölhisar to clarify whether this population might still be present or has been extirpated. *Aphanius meridionalis*, however, might be more widespread. While Hrbek *et al*. (2002) and Geiger *et al.* (2014) found it also in the Lake Avlan basin, we identified as *A. meridionalis* a population (Fig. 4) from a small reservoir south of Yeşilova in the Lake Salda basin.

TABLE 1. Family names and species mentioned in this study, and their authors

Aphaniidae Hoedeman, 1949
Cubanichthyidae Parenti, 1981
Cyprinodontidae Wagner, 1828
Orestiidae Bleeker, 1859
Valenciidae Parenti, 1981
Aphanius anatoliae (Leidenfrost, 1912)
Aphanius burduricus Akşiray, 1948
Aphanius burduricus iconii Akşiray, 1948
Aphanius chantrei aksaranus Akşiray, 1948
Aphanius chantrei altus Akşiray, 1948
Aphanius chantrei flavianalis Akşiray, 1948
Aphanius chantrei fontinalis Akşiray, 1948
Aphanius chantrei litoralis Akşiray, 1948
Aphanius chantrei maeandricus Akşiray, 1948
Aphanius chantrei meridionalis Akşiray, 1948
Aphanius chantrei obrukensis Akşiray, 1948
Aphanius chantrei parvus Akşiray, 1948
Aphanius cypris alexandri Akşiray, 1948
Aphanius cypris boulengeri Akşiray, 1948
Aphanius cypris orontis Akşiray, 1948
Aphanius danfordii (Boulenger, 1890)
Aphanius marassantensis Pfleiderer, Geiger & Herder, 2014
Aphanius mento (Heckel, 1843)
Aphanius transgrediens (Ermin, 1946)
Aphanius saldae (Akşiray, 1955)
Aphanius sophiae mentoides Akşiray, 1948
Aphanius sophiae similis Akşiray, 1948
Aphanius splendens (Kosswig & Sözer, 1945)
Aphanius sureyanus (Neu, 1937)
Aphanius villwocki Hrbek & Wildekamp, 2003
Chriopeoides pengelleyi, Fowler, 1939
Yssolebias martae (Steindachner, 1875)

FIGURE 1. *Aphanius fontinalis*, FSJF 3456, male, 42 mm SL; Turkey: Yarışlı.

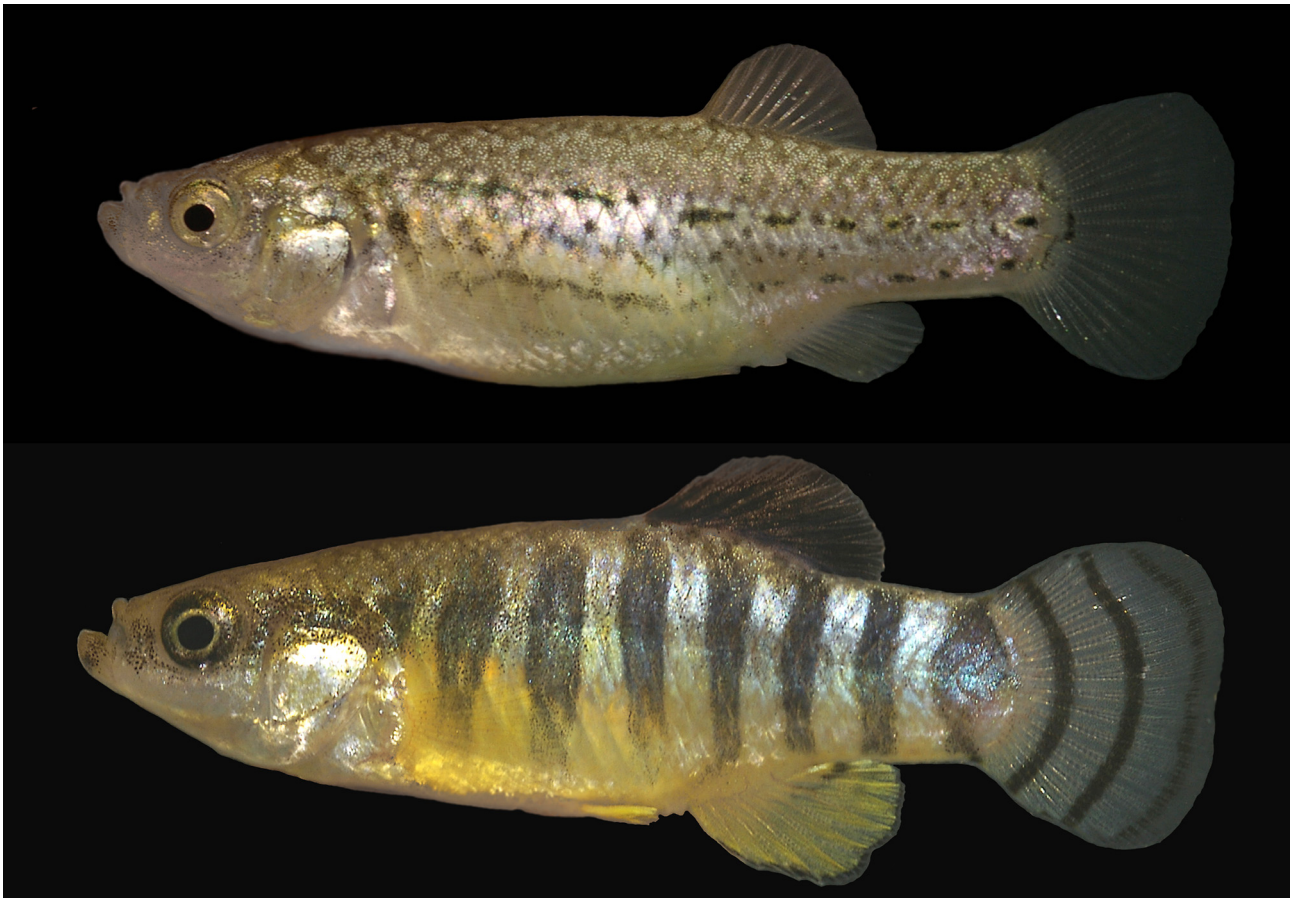

FIGURE 2. *Aphanius meridionalis*, FSJF 2460, female, 38 mm SL, male, 33 mm SL; Turkey: Söğüt.

FIGURE 3. *Aphanius meridionalis*, ZMH 3502, from the top, 39 mm SL, 28 mm SL, 27 mm SL, 25 mm SL; Lake Gölhisar.

FIGURE 4. *Aphanius meridionalis*, FSJF 3669, male, 29 mm SL; Turkey: reservoir south of Yeşilova.

Neotype designation for *Aphanius iconii* Akşiray, 1948

Akşiray (1948) figured nine syntypes of *Aphanius iconii*, of which five originate from Lake Eğirdir (Plate 3: 21–25) and four from the surroundings of Konya (Plate 4: 43–46). Because Akşiray (1948) did not explicitly mention a holotype in his original description of *A. iconii*, all nine specimens included by Akşiray (1948) become syntypes (ICZN, 1999: Art. 72.2 and Art. 73.4). Data presented by Hrbek *et al.* (2002) already indicate that two species are hidden under the name *A. iconii*. While the populations from the surroundings of Konya can be identified as *A. anatoliae*, the populations from the Lake Eğirdir basin represent a distinct species. We could examine preserved materials from both populations and also found specimens from a place between Konya and Çumra (ZMH 3495) identical to *A. anatoliae* and distinct from those from Lake Eğirdir. As two species are involved under the name *A. iconii*, a neotype designation is needed to secure the name *A. iconii* to one of the identified species. Following ICZN (1999; Art. 74.1), we designate here as lectotype the male specimen shown by Akşiray (1948) on plate 3 as number 23 (36 mm total length), which was collected in Lake Eğirdir. This male lectotype shows the diagnostic wide, white band above a black base in the dorsal fin. As this lectotype is lost, we designate the specimen IUSHM 2017-1272 as neotype of *A. iconii* (Fig. 5).

ICZN (1999: Art. 75.3) prescribes seven qualifying conditions to designate a neotype. Art. 75.3.1. requires a statement that the neotype is designated with the express purpose of clarifying the taxonomic status or the type locality of a nominal taxon. As two species are involved in the syntype series, the neotype designation clarifies the type locality and the taxonomic status of the species. Art. 75.3.2. requires a statement of the characters that the author regards as differentiating the species from its congeners. The diagnosis given below satisfies this requirement. Art. 75.3.3. requires data and description sufficient to ensure recognition of the specimen designated. The diagnosis and description given below satisfies this requirement. Art. 75.3.4. requires that the author's reasons for believing the name-bearing type specimen(s) to be lost or destroyed be stated, together with the steps taken to trace it or them. Akşiray (1948) is not known to have preserved any material and no museum material has ever been claimed to owe its provenance to Akşiray's (1948) descriptions of *Aphanius*. We also searched in ZMH and IUSHM again without success. Art. 75.3.5. requires evidence that the neotype is consistent with what is known of the former name-bearing type from the original description. The most important diagnostic character of the species (see below) is visible in the lectotype and in the neotype. Art. 75.3.6. requires that the neotype comes from a location as close as practicable to the original type locality (of the lectotype), meaning from Lake Eğirdir, which it does. Art. 75.3.7. requires a statement that the neotype is the property of a recognized scientific or educational institution, cited by name, that maintains a research collection, with proper facilities for preserving name-bearing types, and that makes them accessible for study. IUSHM fulfil this requirement.

The name *Aphanius iconii* is now definitively restricted to the species known from Lake Eğirdir and the use of the name stabilised. A description of the neotype and some individuals collected with the neotype is given below.

***Aphanius iconii* Akşiray, 1948**
(Figs. 5–7)

Neotype. IUSHM 2017-1272, male, 25 mm SL; Turkey: Isparta prov.: spring Karaot at shore of Lake Eğirdir, about 4 km north of Yenice, 38°08.094'N 30°54.443'E.

Additional material. FSJF 2325, 16, 25–32 mm SL; IUSHM 2017-1273, 10, 23–28 mm SL; same data as neotype.—FSJF 2476, 6, 28–39 mm SL; IUSHM 2017-1274, 13, 26–34 mm SL; Turkey: Isparta prov.: lower stream Çayköy at Koysazı bridge, southeast of Eğirdir, 37°50.488N 30°53.493'E.—FSJF 2271, 16, 18–35 mm SL; IUSHM 2017-1281, 7, 19–32 mm SL; Turkey: Konya prov.: spring Eflatun Pınarı at Sadıkhacı, 37°49.507'N 31°40.458'E.

Diagnosis. *Aphanius iconii* belongs to the *A. anatoliae* group in which the following species are recognised as valid: *A. anatoliae*, *A. fontinalis*, *A. maeandricus*, *A. meridionalis*, *A. danfordii*, *A. marassantensis*, *A. transgrediens*, *A. saldae*, *A. splendens*, *A. sureyanus* and *A. villwocki*. Adult male *A. iconii* are distinguished from adult males of all these species by having a black dorsal-fin base followed by a wide, white or hyaline band at about below the middle of the dorsal fin (vs. dorsal fin with a white or hyaline base or base and proximal part of dorsal fin hyaline in *A. anatoliae*, *A. fontinalis*, *A. saldae*, *A. splendens*, *A. sureyanus* and *A. transgrediens*, dorsal

fin with white or hyaline blotches shortly above the black dorsal-fin base in *A. maeandricus*, *A. danfordii* and *A. marassantensis*). Adult male *A. iconii* are also distinguished from adult male *A. fontinalis*, *A. saldae*, *A. splendens*, *A. sureyanus* and *A. transgrediens* by having a narrow black anal-fin margin (vs. margin wide or anal fin almost completely black).

Description. See Figures 5–7 for general appearance and Table 2 for morphometric data of neotype and 10 additional individuals. Dorsal head profile concave. Dorsal profile convex from nape shortly behind head to end of dorsal-fin base or to mid-height of back. Ventral profile gently convex or almost straight from breast to anal-fin origin. Profile straight along caudal peduncle. Body compressed. Body deepest at about dorsal-fin origin. Greatest body width at pectoral-fin base. Lower jaw sharply upturned, oriented nearly perpendicular to body axis. Caudal peduncle compressed laterally, 1.6 times longer than deep in neotype, 1.4–1.7 in males 1.7–2.0 in females. No axillary lobe at base of pelvic fin. Pectoral fin rounded, reaching 80–90% of distance between pectoral- and pelvic-fin bases. Pelvic-fin origin four predorsal scales in front of vertical of dorsal-fin origin. Pelvic fin not reaching or reaching to anus. One large scale between pelvic-fin bases. Anus situated slightly in front of anal-fin origin, tissue around genital papillae swollen in nuptial female. Anal fin with convex posterior margin. Dorsal fin roundish in females, reaching to vertical of middle of last anal-fin ray, elongated in males, reaching to of vertical of tip of anal fin. Extremity of dorsal fin rounded in both sexes. Caudal fin rounded to truncate. Largest individual examined 39 mm SL.

TABLE 2. Morphometric data of *Aphanius iconii* (neotype IUSHM 2017-1272, IUSHM 2017-1273, n=5 males and 5 females). Means, range and SD of males include neotype.

	neotype	other individuals					
	male	males (5)			females (5)		
		mean	range	SD	mean	range	SD
Standard length (mm)	26		28–29			23–29	
In percent of standard length							
Head length	30.5	30.2	29.1–30.9	0.6	30.3	28.4–32.5	1.5
Body depth at anal-fin origin	26.4	25.5	23.6–26.4	1.0	21.6	20.8–23.0	1.0
Predorsal length	58.1	56.8	55.4–58.1	1.0	57.3	56.5–58.1	0.7
Preanal length	65.7	65.1	64.0–66.1	0.9	67.3	65.5–69.1	1.5
Prepelvic length	51.0	49.4	48.2–51.0	1.0	50.4	48.4–52.0	1.5
Distance between pectoral and pelvic-fin origins	20.4	19.5	17.9–20.4	1.0	19.9	18.9–20.8	0.9
Distance between pelvic and anal-fin origins	16.4	17.4	16.4–18.0	0.6	17.8	16.0–18.9	1.4
Depth of caudal peduncle	16.5	15.7	14.8–16.6	0.9	14.0	12.9–15.6	1.0
Length of caudal peduncle	25.9	24.6	23.2–26.1	1.2	25.4	23.2–26.8	1.4
Dorsal-fin base length	19.3	20.0	17.6–22.8	1.9	17.2	15.1–20.3	2.0
Anal-fin base length	12.7	13.5	12.1–15.0	1.0	10.9	10.2–11.3	0.4
Pectoral-fin length	18.0	17.4	16.4–18.5	0.9	17.4	15.5–19.9	1.7
Pelvic-fin length	14.1	14.4	14.0–15.4	0.5	13.5	13.0–14.0	0.4
In percent of head length							
Head depth at eye	56	57.1	55–59	1.4	55.4	28–32	2.8
Snout length	25	26.3	24–29	1.8	25.5	21–23	1.5
Eye diameter	37	35.1	33–37	1.5	35.6	56–58	1.7
Postorbital distance	46	46.6	45–51	2.2	46.0	65–69	1.1
Maximum head width	59	60.6	58–64	2.4	58.1	48–52	2.0
Interorbital width	34	34.7	31–37	1.9	33.5	19–21	1.7

Dorsal fin with 10½ (8), 11½ (4), branched rays. Anal fin with 9½ (9)–10½ (3) branched rays. Caudal fin with 7+7 (8), 7+6 (1), 7+8 (1) or 8+8 (2) branched rays. Pectoral fin with 13 (3), 14 (9) and pelvic fin with 6 rays. Scales

large and cycloid. Trunk and head entirely scaled. One scale row on upper part of opercule. Flank with 27 (8), 28 (8), 29 (1) scales along lateral series. Two (15) or three (2) rows of small scales on anterior caudal-fin base. Lateral line incomplete, with 4–13 pores, scales pored mostly behind vertical of pelvic-fin origin. Teeth tricuspid, median cusp longer than laterals.

FIGURE 5. *Aphanius iconii*, IUSHM 2017-1272, 25 mm SL, neotype; Turkey: Karaot.

FIGURE 6. *Aphanius iconii*, FSJF 2325, female, 30 mm SL; Turkey: Karaot; FSJF 2476, male, 25 mm SL; Turkey: Çayköy.

FIGURE 7. *Aphanius iconii*, FSJF 2271, 30 mm SL; Turkey: spring Eflatun Pınarı.

Coloration. See Figures 5–7 for general appearance. Males in life: Head and flank silvery or yellowish brown. Cheek, breast and belly whitish or pale yellow. Many small black spots on head and flank. Flank with 7–11 wide, brown or yellowish-brown bars confluent with brown back. Interspaces silvery, much narrower than bars. Scales on back with silvery or yellowish margin. Top of head pale brown. Pectoral fin hyaline or yellow. Pelvic fin hyaline or yellow with narrow black margin. Anal fin hyaline or yellow with narrow black margin, absent in some individuals and in juveniles, and few black blotches on posterior part in most individuals. Dorsal fin black with a black base and a wide, hyaline or white band below middle of fin. Dorsal fin grey distally in some individuals. Caudal fin hyaline or yellow with 1–2 bold black bands. Yellow colour faded in preserved fish.

In life and in preserved females: Body pale grey. Ventral part of head and belly silvery. Head and flank with numerous, small, dark-brown or black blotches, usually horizontally elongates, irregularly set and shaped. Paired fins hyaline, unpaired fins with dark-brown or black blotches, irregularly set and shaped, at base.

Distribution. *Aphanius iconii* is widely distributed in Lake Eğirdir basin and is known also from Lake Kovada, which is close to Lake Eğirdir.

Remarks. Hrbek *et al.* (2002) as well as Geiger *et al.* (2014) included an *Aphanius* population from Eflatun Pınarı in Lake Beyşehir basin in their analyses. In the study by Hrbek *et al.* (2002), these fish cluster with *A. anatoliae*. They form a group slightly differentiated but closely related to *A. anatoliae* in the tree shown by Geiger *et al.* (2014). We identify the *Aphanius* population from Eflatun Pınarı as *A. iconii* as they show the diagnostic wide hyaline band above a black base in the dorsal fin in males (Fig. 7). It is beyond the aims of this study to analyse this population further to resolve the disagreement between the molecular placement of these fishes and their male colour pattern. We speculate, that introgressive hybridisation of *A. anatoliae* into *A. iconii* might have had occurred in the Lake Beyşehir basin. An in-depth study of the *Aphanius* of Lake Beyşehir basin might help to resolve this question in the future.

Aphaniidae as a valid family name for Western Palaearctic killifishes

While working on the *Aphanius* species discussed above we questioned the retention of this group of fishes in the otherwise American family Cyprinodontidae. Recent phylogenetic studies place *Aphanius* outside of Cyprinodontidae and more close to Valenciidae and Poeciliidae (Pohl *et al.* 2015, Helmstetter *et al.* 2016, Reznick *et al.* 2017). The killifishes of the Western Palaearctic are usually placed in two families, Valenciidae and Cyprinodontidae (Myers 1928, Parenti 1981, Kottelat & Freyhof 2007, Van der Laan *et al.* 2014). While the family Valenciidae is well accepted as a distinct family endemic to Europe, Parenti (1981) and Van der Laan *et al.* (2014) included four quite distinct groups of fishes in the family Cyprionodontidae. These are five related genera (*Cualac*,

Cyprinodon, *Floridichthys*, *Jordanella*, *Megupsilon*) from North, Central and northern South America, one genus (*Aphanius*) from the Western Palaearctic and North to East Africa, one genus from the high Andes (*Orestias*), one genus from the Caribbean and Colombia (*Cubanichthys*). Parenti (1981) opposed the allocation of *Cubanichthys* to a separate subfamily (*Cubanichthyinae*) as distinct from the other genera (Cyprionodontinae), distinguished two tribes in Cyprionodontinae (Cyprionodontini, Orestinii) and joined *Aphanius* and *Orestias* in the tribe Orestinii, which is diagnosed by an "extremely robust lower jaw caused by a median extension of the lower dentary": Parenti (1981:521).

Recently, Pohl *et al.* (2015), Helmstetter *et al.* (2016), and Reznick *et al.* (2017), published comprehensive, multigene phylogenetic analyses of cyprinodontiform fishes, demonstrating that the family Cyprinodontidae, as proposed by Parenti (1981), is clearly polyphyletic. As the family structure of cyprinodontiform fishes was not the focus of these molecular studies, they did not draw any taxonomic conclusions. All three molecular studies found *Aphanius* to be more closely related to *Valencia*, the livebearers of the families Anablepidae and Poeciliidae, and the African lampeyes (*Aplocheilichthys* and related genera), than to other genera in Cyprinodontidae. We thus see no argument to retain *Aphanius* in Cyprinodontidae. The New World genera of the family Cyprinodontidae are related to the killifish families Fundulidae, Profundulidae, and the livebearers of the Mexican family Goodeiidae. Also, the genera *Cubanichthys* and *Orestias* are highly isolated and there is no indication that they belong to Cyprinodontidae.

Pohl *et al.* (2015) and Helmstetter *et al.* (2016) recovered *Aphanius* as a sister group to *Valencia* and suggested that they might be included in the family *Valenciidae*. Parenti (1981:500) diagnosed Valenciidae by having a unique, very long, attenuate dorsal process of the maxillary (vs. dorsal process rounded or absent in *Aphanius* and other families discussed here). The divergence between *Valencia* and *Aphanius* is postulated to have occurred in the Late Eocene (Helmstetter *et al.* 2016) and both are here accepted as separate families, Valenciidae and Aphaniidae. *Aphanius* was previously placed in the tribe Orestinii (Parenti 1981) or treated as contained in a separate tribe (Aphaniini) in the cyprinodontid subfamily Cyprinodontinae (Van der Laan *et al.* 2014). Moreover, we propose that the two Neotropical killifish genera *Cubanichthys* and *Orestias* be allocated to their own families, Cubanichthyidae and Orestiidae, respectively.

Cubanichthyidae, previously treated as a subfamily of Cyprinodontidae (Parenti 1981, Van der Laan *et al.* 2014), was well diagnosed by Parenti (1981). We follow Costa (2015) and Reis *et al.* (2003) in accepting *Yssolebias martae* and *Chriopeoides pengelleyi* as species of *Cubanichthys*.

We cannot avoid to discussion of the stem of *Orestias* (see Van der Laan *et al.* 2014 for details). Maurice Kottelat was consulted to help us in this case (M. Kottelat, pers. comm.). Gill (1896:224) used Orestiad-, Jordan & Evermann (1896:631) used Oresti- and Myers (1931) used Orestiat- as a stem of *Orestias*. *Orestias* is a feminine word in classical Greek (a mountain nymph). The genitive singular is orestiados and the stem is orestiad-. Thus, the family name should be Orestiadidae, as already observed by Gill (1896: 224). But ICZN art 29.5 says "if a spelling of a family-group name was not formed in accordance with article 29.3 but is in prevailing usage, that spelling is to be maintained, whether or not it is the original spelling [...]". (prevailing usage: Oresti-idae; original spelling Orestias-idae; according to 29.3: Orestiad-idae). It is far beyond the aim of this study to count how often different stems have been used, but it is evident that all have been used several times. It seems that the stem *Oresti-* is in prevailing usage, as used by Parenti (1981); many other widely accepted publications too, use this name (Reis *et al.* 2003, Nelson *et al*. 2016, just to name few). Therefore, we use Orestiidae as the family name of the fishes of the genus *Orestias*.

Following the concept proposed here, all five family groups discussed are monophyletic. The extant genera included and the diagnostic characters derived mostly from Parenti (1981) are given below.

Aphaniidae: *Aphanius*

Based on osteological data presented by Parenti (1981:521), Aphaniidae is distinguished from Orestiidae by having a vomer (vs. absent), a cartilaginous mesethmoid (vs. ossified) and an ossified interhyal (not ossified). The generic diagnosis is valid also as a family level diagnosis.

Cubanichthyidae: *Cubanichthys*

Parenti (1981:519) diagnosed the family Cubanichthyidae (as Cubanichthyinae) by its possession of several rows of teeth in the upper and lower jaw, an enlarged supraoccipital crest, an elongate dorsal process of the autopalatine, a supraorbital sensory-pore pattern consisting of a large third pore, and lacking an ossified ventral limb of the posttemporal. The subfamily-level diagnosis is valid also as a family level diagnosis.

Cyprinodontidae: *Cualac*, *Cyprinodon*, *Floridichthys*, *Jordanella* and *Megupsilon*

Parenti (1981:526) diagnosed the family Cyprinodontidae (as Cyprinidontini) by its having a derived form of the attachment of the first vertebra to the skull and the pharyngobranchial teeth being organised in discrete rows. The tribe-level diagnosis is valid as a family-level diagnosis.

Orestiidae: *Orestias*

Parenti (1981:526) diagnosed the genus *Orestias* by its lacking the vomer and the first postcleithrum. The generic diagnosis is valid also as a family-level diagnosis.

Valenciidae: *Valencia*

Parenti (1981:500) diagnosed Valenciidae as a distinct family against all other groups in Cyprionodontiform fishes by possession of a very long, attenuate dorsal process of the maxillary.

Comparative material

***Aphanius anatoliae*:** FSJF 2483, 15, 19–36 mm SL; IUSHM 2017-1280, 48, 10–30 mm SL; Turkey: Aksaray prov.: spring in Köşk Park within Sultanhanı, 38°14'29"N 33°32'45"E.—FSJF 2485, 38, 25–45 mm SL; IUSHM 2017-1282, 30, 21–40 mm SL; Turkey: Konya prov.: Meyil Lake , about 3 km southwest of Esentepe, 37°59'10"N 33°21'5"E.—FSJF 2527, 9, 21–30 mm SL; IUSHM 2017-1283, 25, 16–31 mm SL; Turkey: Konya prov.: stream north of Sarıyayla, draining to former Lake Samsam, 39°7'8"N 32°45'33"E.—FSJF 2610, 4, 21–38 mm SL; IUSHM 2017-1279, 21, 12–46 mm SL; Turkey: Konya prov.: stream at Gölyazı at road from Eskil to Cihanbeyli, 38°33'9"N 33°12'3"E.—ZMH 3489, 10, 27–37 mm SL; Turkey: Niğde prov.: Niğde.—ZMH 3495, 28, 28–39 mm SL; Turkey: Konya prov.: stream 20 km north of Çumra.—ZMH 3490, 10, 34–45 mm SL, Turkey: Konya prov.: Aksaray.

***Aphanius danfordii*:** FSJF 2601, 16, 23–42 mm SL; IUSHM 2017-1276, 30, 16–45 mm SL; Turkey: Kayseri prov.: Spring Soysallı west of Soysallı, west of Develi, 38°23'25"N 35°21'56"E.—ZMH 3473, 1, 29 mm SL; ZMH 3474, 1, 32 mm SL; ZMH 3475, 8, 19–27 mm SL; Turkey: Kayseri prov.: Çayırözü, about 15 km northwest of Develi, 38°25'2''N 35°17'22''E.—ZMH 3476, 21, 19–36 mm SL; Turkey: Kayseri prov.: Soysallı, 38°20'28''N 35°21'47''E.—ZMH 3477, 33, 19–43 mm SL; ZMH 3478; 1, 40.1 mm SL; ZMH 3479, 1, 46 mm SL; Turkey: Kayseri prov.: Develi, İlipınar.

***Aphanius fontinalis*:** FSJF 3456, 20, 22–38 mm SL; Turkey: Burdur prov.: spring in Lake Yarışlı basin, 37°34'50''N 29°56'50"E.

***Aphanius maeandricus*:** FSJF 1876, 37, 16–40 mm SL; FSJF 3027, 9, 27–40 mm SL; IUSHM 2017-1278, 9, 28–41 mm SL; Turkey: Denizli prov.: Işıklı spring at Işıklı, 38°19'17"N 29°51'4"E.—FSJF 2470, 5, 26–38 mm SL; IUSHM 2017-1277, 3, 25–27 mm SL; Turkey: Afyonkarahisar prov.: Spring Düden, 5 km east of Dinar, 38°3'7"N 30°10' 32"E.

***Aphanius marassantensis*:** FSJF 3455, 29, 28–43 mm SL; Turkey: Ankara prov.: Hirfanlı Reservoir, 39°09'09"N 33°38'12"E.—ZMH 3480, 86, 19–55 mm SL; ZMH 3484, 1, 33 mm SL; ZMH 3485, 1, 40 mm SL; Turkey: Kayseri prov.: Kayseri, Karpuzatan, 38°46'25"N 35°27'11"E.—ZMH 3481, 33, 18–28 mm SL; ZMH 26068, 18, 23–35 mm SL; Turkey: Kırşehir prov.: Kırşehir: springs in Kırşehir.—ZMH 3482, 20, 17–35 mm SL; Turkey: Samsun prov.: Lake Balık about 12 km east of Bafra, 41°34'45"N 36°5'00"E.

***Aphanius meridionalis*:** FSJF 2460, 7, 21–36 mm SL; IUSHM 2017-1275, 22, 20–39 mm SL; Turkey: Antalya prov.: small field canal south of Kırkpınar, north of Kızılcadağ, 37°8'21"N 29°55'5"E.—FSJF 3669, 3, 27–29 mm SL; Turkey: Turkey: Burdur prov.: reservoir south of Yeşilova, 37.490766 29.743290.—ZMH 3502, 17, 23–39 mm SL; Turkey: Lake Gölhisar.

***Aphanius saldae*:** ZMH 3507, 40, 32–38 mm SL; Turkey: Burdur prov.: Lake Salda.

***Aphanius splendens*:** ZMH 3505, lectotype, 31 mm SL; ZMH 3506, 1, 38 mm SL; Turkey: Isparta prov.: Lake Gölcük.

***Aphanius sureyanus*:** ZMH 7850, 40, 16–34 mm SL; Turkey: Burdur prov.: shore of Lake Burdur at road from Burdur to Yeşilova.

***Aphanius transgrediens*:** ZMH 3509, 52, 23–33 mm SL; Turkey: Afyonkarahisar prov.: spring system of Acıgöl, 37°49'N 29°55'E.

***Aphanius villwocki*:** FSJF 2626, 4, 31–55 mm SL; IUSHM 2017-1285, 6, 24-48 mm SL; Turkey:

Afyonkarahisar prov.: spring about 11 km east of Emirdağ, 39°02'53"N 31°19'38"E.—FSJF 3091, 12, 20–35 mm SL; Turkey: Konya prov.: Ilgın Lake, 38.32075N 31.89029E.

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