

Family Aphaniidae

Eurasian killifishes

The family comprises approximately 45 species, distinguished by the absence of ossified rays in the dorsal, a short and stout body, and sexually dimorphic colour patterns. The males typically exhibit prominent black or brown bars on the flank, while the females display a mottled or spotted colour pattern, with short black or brown lateral bars in some species. This resulted in numerous instances of dual descriptions of males and females as different species during the 19th century when scientists were unaware of this sexual dimorphism. Extensive research was conducted on Aphaniids previously classified within the American family Cyprinodontidae. The definition, limits, and contents of the family Cyprinodontidae have undergone significant changes over the past 30 years. Aphaniidae is treated as its own family related to Valenciidae, which is endemic to Europe and African lamp-eyes (Procatopodidae). Aphaniidae has been subdivided into eight genera, with six of which (excluding *Tellia* and *Apricaphanius*) are included in the coverage of this book. Aphaniids have a long fossil record, with the oldest *Aphanius*-like otoliths deriving from Miocene deposits almost 21 million years old. At which times, Aphaniids also occurred in Central Europe and the Caucasus region, and it is possible that they vanished from these regions due to climatic changes. The biology of most Aphaniids remains unknown in the field. However, they have been extensively studied in captivity. During

the spawning period, which extends throughout spring and summer, year-round in some species, males establish territories along the shores, usually in dense vegetation but also between rocks, which they defend against rival males. Females spawn with one male, typically in algae or other vegetation close to the water surface or into gravel bottoms. If population densities are high, several males may sneak in to join the spawning pair. One or a few eggs are laid into the spawning substrate during a single spawning act. Individual females may spawn several egg clutches during a day and then typically pause for a few days before spawning again. Eggs possess filamentous structures to attach to the substrate. The larvae usually hatch after 7–15 days, with the timing dependent on temperature. Young Aphaniids exhibit rapid growth, with some reaching maturity within the same or the following year. Most species feed on algae, detritus, and small invertebrates. Several Aphaniids have very limited distribution ranges, with some species facing a high risk of extinction. One species is currently extinct. *Ex situ* populations of numerous species have been established within the aquarium hobby, yet they are poorly managed and typically based on a very small founder broodstock. **Further reading.** Parenti 1981 (phylogeny); Kottelat & Wheeler 2001 (nomenclature); Hrbek & Meyer 2003 (phylogeny, biogeography); ICZN 2003 (nomenclature); Freyhof et al. 2017b (family concept); Freyhof & Yoğurtçuoğlu 2020 (generic structure of Aphaniidae); Kärst et al. 2020 (reproduction, *ex situ* maintenance).

Key to the genera of Aphaniidae in West Asia

The bars mentioned in the keys and the accompanying text are dark brown or black. The silvery white bars are referred to as interspaces. The key is largely based on the colour pattern of adult, nuptial individuals. It may be challenging to differentiate between immature individuals and those outside the spawning season.

1a - Head canals present, anterior supraorbital canal with 2–3 pores, posterior supraorbital canal with 2 pores, preopercular-mandibular canal with 6–7 pores.

.....2

1b - Head canals absent, cephalic sensory pores reduced to a series of neuromasts in small depressions, not connected to canals.

.....3

2a - Caudal in male hyaline or white, often with yellow margin, with three wide, bold black bars, first bar situated on caudal base, shortly behind end of hypural complex, often faded (no bars in *A. furcatus*); in nuptial female no dermal sheath around anterior anal rays.

.....*Aphaniops*

2b - Caudal in male pale- or deep-yellow or orange, clearly distinct from silvery interspaces of flank bars; caudal with 0–2, often faint bars, no bar behind end of hypural complex; in nuptial female, dermal sheath, present around first few anal rays.

.....*Aphanius*

3a - Teeth conical, in three rows; caudal peduncle very narrow, its depth 2.5–3.2 times in its length; body without scales.

.....*Kosswigichthys*

3b - Teeth tricuspid, in one row; caudal peduncle deep, its depth 1.2–2.0 times in its length; body covered by scales, but reduced or absent in some species.

.....4

4a - Flank in male bluish, grey, or almost black with often irregular set and shaped, iridescent blue-white to silvery spots or bars often forming narrow vertical rows; male with very narrow, blue-white or silvery rows of spots or small blotches forming bands on black or blue caudal; female without diamond-shaped or roundish bold black blotch at mid-height of caudal base.

.....*Paraphanius*

4b - Flank in male silvery with very regular set and shaped, rarely irregular, brown or black bars, overlaid with iridescent silvery spots in some species; male with bold, black or brown bars or with narrow brown bands on hyaline, white or yellow caudal, or caudal hyaline, with white margin in some species; female with diamond-shaped or roundish bold black blotch at mid-height of caudal base.

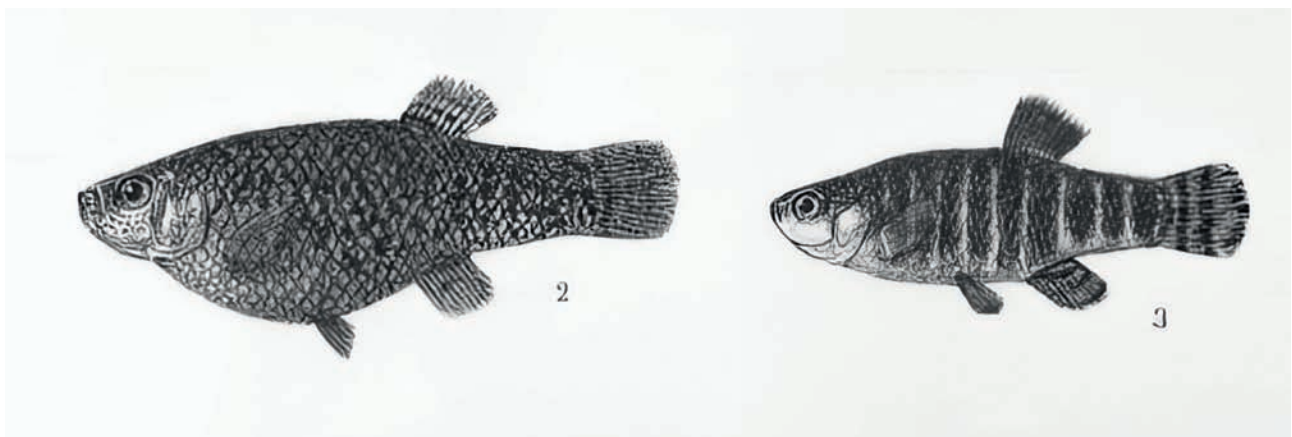
.....5

5a - Caudal in male without bars or rows of spots, with 1–5 indistinct vertical rows of small brown spots on proximal portion of caudal in some species; dorsal margin white, caudal and anal margins often white; if dorsal and anal margins black (*E. isfahanensis*) caudal without rows of spots or bars.

.....*Esmaeilius*

5b - Caudal in male with 1–4 bold black bars or numerous vertical rows of small black or brown spots (4–14 in *A. villwocki*); dorsal- and usually anal with margin black.

.....*Anatolichthys*



An unidentified species of *Anatolichthys* was known from Syria in the early 20th century (from Pellegrin 1923).

Anatolichthys

Anatolichthys is the largest genus of Eurasian killifishes, with all (except one) species occurring in Central Anatolia. They often have restricted distribution ranges in relatively small habitat patches. Two species are found in the Black Sea basin. *Anatolichthys* is related to *Kosswigichthys*. All *Anatolichthys* inhabit inland waters, including springs, lakes, and the shores of rivers. They also inhabit reservoirs. All species mature within a few months after hatching, usually late in the year of birth. Males establish territories along the banks, usually in dense vegetation, but also between rocks, which they defend against rivals. Females spawn with one or more males, usually in algae or other vegetation near the water surface or on gravel bottoms. Few eggs are deposited in the substrate during a spawning event. Individual females produce several clutches of eggs in one day. All species feed on algae, detritus, and small invertebrates. Many springs previously inhabited by *Anatolichthys* dried out in the late 20th century, and non-native species now dominated many others. Due to the deteriorating ecological conditions in

Central Anatolia, many populations of *Anatolichthys* will vanish in the future. One species, *A. splendens*, became extinct after introducing non-native species for fisheries. An additional, potentially extinct species is known from early 20th-century records in the Damascus and Jordan basins. This species is similar to *A. marassantensis*, and it is necessary to determine whether it represents an undescribed species or was introduced to the region. Three species of *Anatolichthys* are notable for their pelagic habitat and reduced scale coverage, which are adaptations to predator-free, lacustrine environments. However, two of these species are now on the brink of extinction and largely restricted to springs at lake shores, as the ecological conditions in the lakes no longer allow fish to exist there permanently. **Further reading.** Pellegrin 1923 (unidentified species from Syria); Hrbek et al. 2002 (biogeography); Hrbek & Meyer 2003 (phylogeny, biogeography); Geiger et al. 2014 (phylogeny); Yoğurtçuoğlu & Freyhof 2018 (identification of species); Freyhof & Yoğurtçuoğlu 2020b (generic structure of Aphaniidae); Freyhof & Yoğurtçuoğlu 2020 (distribution).

Key to species of *Anatolichthys*

1a - Scales on back and belly usually absent, scales absent or few on flank in one species; usually 1–3 lines of large, not or only slightly overlapping scales on mid-lateral flank.

.....2

1b - Body completely covered with overlapping scales.

.....5

2a - Lateral-head profile almost quadratic, lower jaw large, directing upward; body depth 4.0–5.3 times in standard length.

.....3

2b - Lateral-head profile triangular or rounded, lower jaw small, directing forward; body depth 3.2–4.2 times in standard length.

.....4

3a - No or few isolated scales on flank; black bars wider at dorsal part in male, narrower in ventral region.

.....*A. saldae*

3b - 38–46 total, overlapping scales along lateral series; male with black bars regularly shaped, not wider at dorsal part.

.....*A. splendens*

4a - Caudal peduncle depth 11–14 % SL; head depth at nape 61–69 % SL; head width at nape 51–60 % SL; nuptial male with grey dorsal base.

.....*A. sureyanus*

4b - Caudal peduncle depth 16–18 % SL; head depth at nape 68–75 % SL; head width at nape 62–74 % SL; nuptial male with completely black dorsal.

.....*A. transgrediens*

5a - Male with irregularly set and shaped, dark-brown bars, bars with white spots or vermiculate pattern, some large individuals' plain dark-grey with some yellow blotches.

.....*A. irregularis*

5b - Male with regularly set and shaped dark-brown or black bars, without white spots in bars.

.....6

6a - Male with a completely black anal or anal white with a wide black margin, with irregularly set and shaped black bands and/or blotches.

.....*A. fontinalis*

6b - Male with yellow or white anal with a narrow black margin, usually with 1–5 black bands or rows of blotches.

.....7

7a - Male with 4–14 vertical rows of small black or brown spots on caudal; male with 13–25 narrow brown bars on body; female larger than 40 mm SL usually without back spots or blotches on flank except for one bold black blotch at middle of hypural.

.....*A. villwocki*

7b - Male with 1–4 bold black vertical bars on caudal; male with 5–14 black bars on body; female with bold back spots or/and blotches on flank.

.....8

8a - Male with black dorsal base; dorsal with black distal margin and white proximal band or with a proximal row of white spots or blotches distinctly or slightly above dorsal base.

.....9

8b - Male with brown, hyaline, or white dorsal base; dorsal completely black or with greyish or black distal margin and a white line or row of white spots at dorsal base or very slightly above.

.....10

9a - Male with wide, white proximal band in black dorsal; last lateral bar in male regularly shaped, not fused with penultimate bar.

.....*A. iconii*

9b - Male with a row of white spots or blotches along or distinctly above dorsal base; last dark-brown bar irregularly or diamond-shaped, usually fused with pre-last bar.

.....*A. maeandricus*

10a - Male with rhomboid body shape, dorsal profile straight until vertical of pelvic origin; male with dark-brown bars on caudal peduncle being 2.3–4.0 times as wide as interspaces.

.....*A. danfordii*

10b - Body shape ovoid, rarely rhomboid, dorsal profile convex; male with dark-brown bars on caudal peduncle being 0.3–1.8 times as wide as interspaces.

.....11

11a - Male with a completely black dorsal; usually with 6–8 black or dark-brown lateral bars on flank, brown bars in front of dorsal origin narrower than whitish interspaces.

.....*A. meridionalis*

11b - Male with a white dorsal base or a white line or row of spots at base of black dorsal; usually with 8–13 brown lateral bars on flank, brown bars wider than whitish interspaces.

.....12

12a - Male with a white line or row of white spots at or very slightly above dorsal base; brown bars as wide as or slightly wider than interspaces.

.....*A. marassantensis*

12b - Male usually with grey or whitish dorsal base and a black mid-dorsal band and a hyaline or pale-grey distal dorsal margin, except base, dorsal completely black in some populations; brown bars much wider than interspaces.

.....*A. anatoliae*

Anatolichthys anatoliae

Common name. Lake Tuz killifish.

Diagnosis. Distinguished from other species of *Anatolichthys* by: ○ male usually with grey or whitish dorsal base and a black mid-dorsal band and a hyaline or grey distal dorsal margin / ○ except base, dorsal completely black in some populations / ○ body shape ovoid / ○ male with 8–10 wide, regularly set, yellowish dark-bars / ○ third-last bar anterior to caudal base 2.1–4.3 times wider

than anterior white interspace / ○ male with yellow anal with narrow black margin / ○ male with 1–4 bold black vertical bars on caudal / ○ male with flank bars in front of dorsal origin wider than interspaces / ○ male with dark-brown bars on caudal peduncle being 0.3–1.8 times as wide as interspaces / ○ female with numerous black spots or blotches on flank not organised in bars or a midlateral row / ○ body completely covered with overlapping scales. Size up to about 45 mm SL.



Anatolichthys anatoliae; Lake Meyil, Türkiye; female, 43 mm SL.



Anatolichthys anatoliae; Lake Meyil, Türkiye; male, 40 mm SL.

Distribution. Lakes Tuz, Beyşehir, and Suğla basins, around Konya and eastward to Niğde.

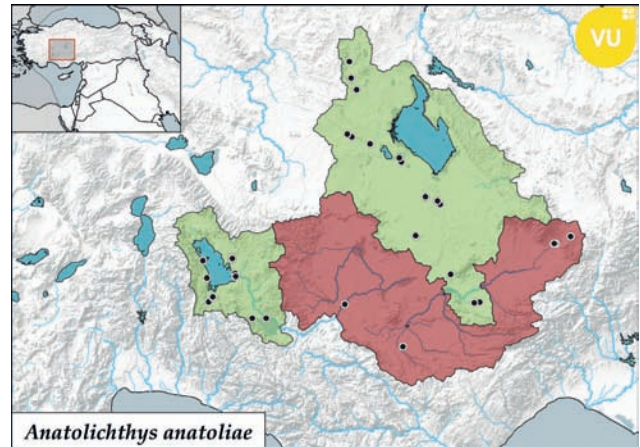
Habitat. Springs and streams with dense underwater vegetation.

Biology. Live up to 4 years; biology as described in genus section.

Conservation status. VU; habitats have been lost continuously for many years.

Remarks. *Aphanius lykaoniensis*, *A. venustus*, *A. flavianalis*, *A. obrukensis* and *A. aksaranus* are synonyms.

Further reading. Wildekamp et al. 1999 (distribution); Yöğürçuoğlu & Freyhof 2018 (distribution, identification).



Vanishing Lake Tuz. Lake Tuz in Central Anatolia was once the second-largest lake in Türkiye. It was a popular destination for flamingos, who flocked there to feed and nest. People also visited to witness the lake's seasonal colour changes and to bathe in the mineral-rich water, mud, and salt. Lake Tuz is fed by groundwater that originates in the Northern Taurus and passes through the Konya Plain and Obruk Plateau, which bubbles up into Lake Tuz via springs. Other water sources include two major streams and rain that primarily falls in springtime. Water in the region has become increasingly scarce, with more frequent and intense droughts. The region is a significant climate change hotspot, warming more than the global average since the pre-industrial period. Before 2000, Lake Tuz generally contained sufficient water in August to be considered permanent. From 1985 through 2000, the lake's water level exceeded 20 % of the current shoreline in all years except 1992 and 1994. During the most humid years, 1988 and 1996, the lake reached its fullest extent, with 93 % and 58 % of the lake covered by water, respectively. Notwithstanding the drought conditions that prevailed in 1992, water still managed to cover 16 % of the lakebed. However, a distinct shift occurred after the year 2000. Between 2001 and 2016, water spanned less than 20 % of the lake every August (except for 2015) as droughts became more frequent and intense. In 2008 and 2016, the lake completely dried up. Research indicates that an extraordinary meteorological drought has devastated Lake Tuz since 2019. In July 2021, the lake's water levels were at an all-time low, resulting in the mass death of flamingos. The decline of Lake Tuz coincided with the excessive use of groundwater and surface-water resources, which were used to irrigate agriculture and meet the water needs of the surrounding provinces. Furthermore, as surface water dwindled during the intense drought, people turned to the groundwater that historically fed the springs. In the event of further drought conditions, water extraction will likely continue at current levels, resulting in the disappearance of lakes, springs, and streams in Central Anatolia. **Further reading.** Aydın et al. 2020 (Lake Tuz); MedECC 2020 (climate change in Mediterranean).





Anatolichthys danfordii; Soysallı, Türkiye; female, 43 mm SL.



Anatolichthys danfordii; Soysallı, Türkiye; male, 38 mm SL.

Anatolichthys danfordii

Common name. Sultan killifish.

Diagnosis. Distinguished from other species of *Anatolichthys* by: ● male with rhomboid dorsal profile, straight up to a vertical line through pelvic origin / ○ male with 8–14 black bars / ○ male with bars behind dorsal origin wider than interspaces / ○ third-last bar anterior to caudal base 2.3–4.0 times wider than anterior white interspace in male larger than 26 mm SL / ○ male with 1–4 bold black vertical bars on caudal / ○ male with completely grey or black dorsal often with grey margin / ○ dorsal base hyaline or with a narrow white line / ○ male with yellow or white anal, with narrow black margin and 1–4 narrow, black, concentric bands / ○ female with numerous bold black spots and/or blotches on flank not organised in bars or a midlateral row / ○ female without spots or blotches on caudal and/or anal / ○ body completely covered with overlapping scales. Size up to 46 mm SL.

Distribution. Türkiye: Sultan marshes in Develi depression.

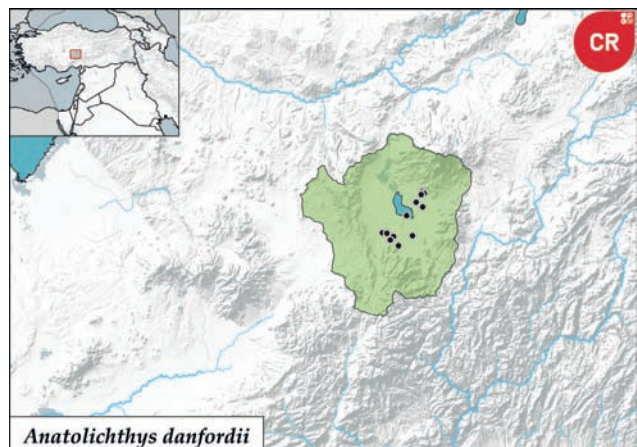
Habitat. Springs, spring-fed streams, and canals with or without dense underwater vegetation.

Biology. Live up to 3 years; biology as described in genus section.

Conservation status. CR; see comments under *Pseudopoxinus elizavetae*.

Remarks. *Cyprinodon chantrei* is a synonym.

Further reading. Wildekamp et al. 1999 (identification); Pflieger et al. 2014 (*C. chantrei*); Yoğurtcuoğlu & Freyhof 2018 (identification).





Anatolichthys fontinalis; Yarışlı, Türkiye; female, 32 mm SL.



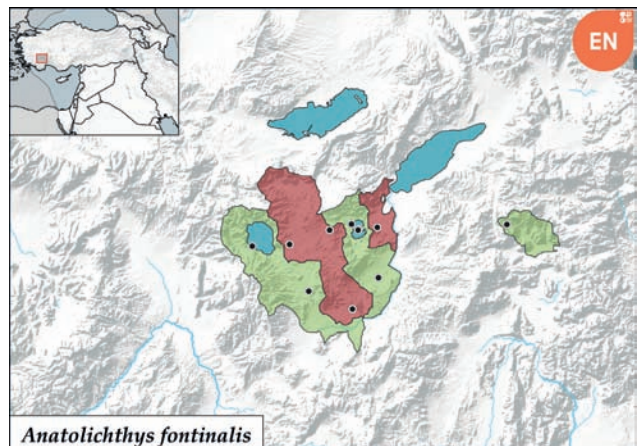
Anatolichthys fontinalis; Yarışlı, Türkiye; male, 35 mm SL.

Anatolichthys fontinalis

Common name. Yarışlı killifish.

Diagnosis. Distinguished from other species of *Anatolichthys* by: ○ male with a completely black anal or anal white with a wide black margin, with irregularly set and shaped black bands and/or blotches / ○ body completely covered with overlapping scales / ○ male with regularly set and shaped dark-brown or black bars, without white spots in bars / ○ dorsal completely black or with white or hyaline base / ○ flank bars behind dorsal origin wider than interspaces / ○ female with numerous black spots or blotches on flank often organised in midlateral rows. Size up to about 50 mm SL.

Distribution. Türkiye: Karapınar spring near Yeşilova, Düğer spring near Lake Yarışlı southwest of Lake Burdur, springs in former Lake Karaevli southeast of Lake Burdur and Lakes Karataş and Salda basins.



Habitat. Streams, springs, and lake shores, with or without vegetation, also common on rocky shores.

Biology. Live up to 3 years; batch spawning, spawns synchronously with *A. saldae* from April to September in Lake Salda.

Conservation status. EN; appears to be declining within its very small range. Extirpated from Karapınar and Düğür spring and Lake Karataş basin.

Remarks. Potentially introduced to Lake Salda, where it hybridises with *A. saldae*. *Aphanius altus* from Karapınar and *A. litoralis* from Lake Karataş are synonyms.

Further reading. Akşiray 1948 (description); Geiger et al. 2014 (phylogeny); Yoğurtçuoğlu & Freyhof 2018 (identification); Yoğurtçuoğlu 2019 (reproduction).

Anatolichthys iconii

Common name. Eğirdir killifish.

Diagnosis. Distinguished from other species of *Anatolichthys* by: ● male with black dorsal, with a wide, hyaline or white, proximal band / ○ male with black dorsal base / ○ last lateral bar in male regularly shaped, not fused with penultimate bar / ○ female with bold back spots or/and blotches on flank / ○ male with yellow or white anal with a narrow black margin / ○ male with 1–4 bold black vertical bars on caudal / ○ body completely covered with overlapping scales. Size up to about 50 mm SL.

Distribution. Lake Eğirdir and Kovada basins. Also in two springs in upper Köprüçay and Aksu.



Anatolichthys iconii; Lake Eğirdir basin, Türkiye; female, 30 mm SL.



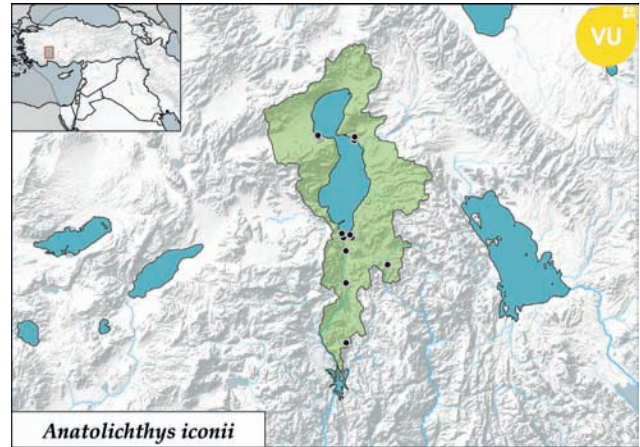
Anatolichthys iconii; Lake Eğirdir basin, Türkiye; male, 25 mm SL.

Habitat. Lakeshores, springs, and streams, usually with dense vegetation.

Biology. Live up to 4 years; feeds mainly on aquatic insect larvae, amphipods and diatoms. Population size in Eğirdir fluctuates in parallel with *Atherina* population.

Conservation status. VU; had declined sharply in Lake Eğirdir before about 2006 but has increased since then, presumably following the disappearance of predation by *Sander lucioperca* due to overfishing. It is now declining again as the lake level is falling.

Further reading. Akşiray 1948 (description); Küçük et al. 2009b (population increase); Geiger et al. 2014 (phylogeny); Freyhof et al. 2017b (Neotype designation); Yoğurtçuoğlu & Freyhof 2018 (identification); Güçlü 2012 (biology; as *Aphanius anatoliae*).



Anatolichthys irregularis; Kaklık spring, Türkiye; female, 52 mm SL.



Anatolichthys irregularis; Kaklık spring, Türkiye; male, 35 mm SL.

Anatolichthys irregularis

Common name. Kaklık killifish.

Diagnosis. Distinguished from other species of *Anatolichthys* by: ● male with irregularly set and shaped, dark-brown bars, bars with white spots or vermiculate pattern, some large individuals plain, dark-grey with some yellow blotches / ○ male with yellow or white anal with narrow black margin / ○ female with numerous black, irregularly shaped stripes and vermiculate blotches on flank organised in midlateral rows / ○ body completely covered with overlapping scales. Size up to about 52 mm SL.

Distribution. Türkiye: Spring near Kaklık in Büyük Menderes drainage.

Habitat. Springs with dense vegetation and associated streams.

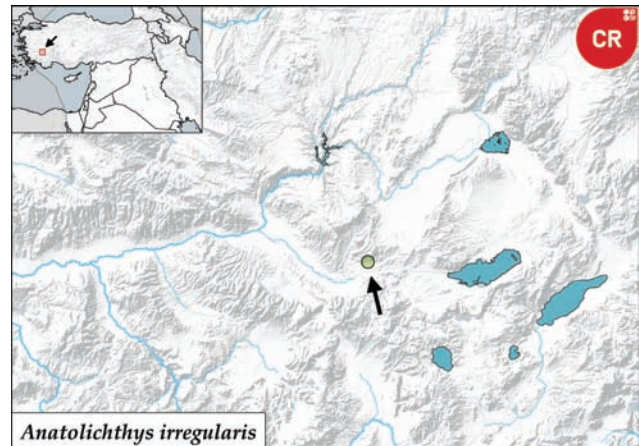
Biology. Live up to 3 years; biology as described in genus section.

Conservation status. CR; known only from a very small spring area, vulnerable to climate change, recreational activities, non-native species and desiccation.

Remarks. *Anatolichthys irregularis* is very closely related to *A. maeandricus*, but the colour pattern of male and

female can easily distinguish both species. It is likely that *A. irregularis* was recently isolated and has adapted to the gypsum springs where it lives.

Further reading. Yoğurtcuoğlu & Freyhof 2018 (description).



Spots or bars? Or even more open questions for Kaklık killifish. The colour patterns of fish have long fascinated evolutionary biologists due to their striking diversity and how they are influenced by sexual and environmental selection. Much of the data on the cellular and developmental mechanisms underlying colour-pattern formation, such as stripes, spots, or regular and irregular colour patterns, comes from zebrafish (*Danio rerio*). However, there is still much to be discovered about how these mechanisms are linked to the behaviour, ecology, and natural selection in the wild. Several cases, including recently evolved groups such as East African cichlids, have provided insights into the evolution of pigment patterns and triggered various hypotheses for testing. *Anatolichthys irregularis* is a young species worthy of future attention in this respect. It is unique in that its irregularly set and shaped spots and bars in the male (vs. regular bars in other *Anatolichthys*). It was initially assumed that this significant difference in colour pattern, the dissociation of regular bars into an irregular and spotted pattern, must have been merely a phenotypic plasticity response to its extreme habitat (high sulfur concentration, high temperature, and oxygen-poor conditions). However, captive generations bred under different conditions have proven the colour patterns stable, as other *Anatolichthys* have demonstrated. Consequently, several open hypotheses have been formulated, including the evolution of isolated peripheral populations under strong selection and genetic drift due to limited population size. This phenomenon has already been demonstrated in zebrafish, where a change in pattern may be driven by a single mutation in a single gene, which is prone to selection through pleiotropic effects. **Further reading.** Parichy 2003, Gante 2018 (stripe evolution).



Anatolichthys maeandricus; Işıklı spring, Türkiye; female, 40 mm SL.

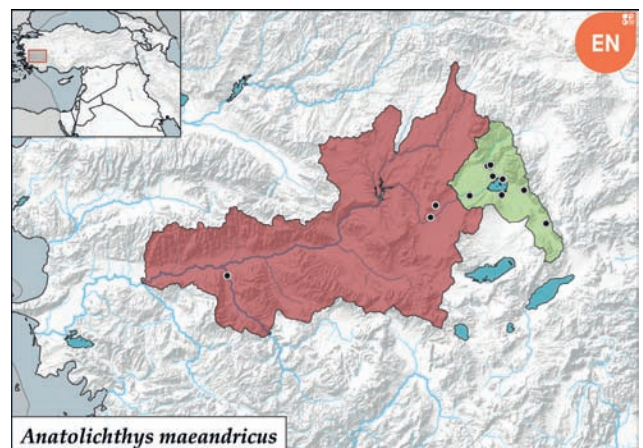


Anatolichthys maeandricus; Işıklı spring, Türkiye; male, 30 mm SL.

Anatolichthys maeandricus

Common name. Büyük Menderes killifish.

Diagnosis. Distinguished from other species of *Anatolichthys* by: ● male with a white line or a row of white spots or blotches along or distinctly above black dorsal base / ○ dorsal completely black or with grey distal margin / ○ last dark-brown bar irregularly or diamond-shaped, usually fused with pre-last bar / ○ male with bright yellow anal with narrow black margin / ○ male with 1–4 bold black vertical bars on caudal / ○ male with flank bars behind dorsal origin wider than interspaces / ○ female with numerous black spots not organised in midlateral rows / ○ body completely covered with overlapping scales. Size up to 45 mm SL.



Distribution. Türkiye: Springs of Büyük Menderes near Işıklı, Pınarbaşı spring near Karakuyu and Düden Pınarı at Dinar.

Habitat. Springs with dense underwater vegetation.

Biology. Live up to 3 years; biology as described in genus section.

Conservation status. EN; appears to be declining within its very small range.

Remarks. Several records of *Anatolichthys* from the middle and lower Büyük Menderes drainage exist, none of which have been confirmed in recent decades.

Further reading. Akşiray 1948 (description); Geiger et al. 2014 (phylogeny); Yoğurtçuoğlu & Freyhof 2018 (identification).

Anatolichthys marassantensis

Common name. Kızılırmak killifish.

Diagnosis. Distinguished from other species of *Anatolichthys* by: ○ adult male with completely black dorsal, or with white or grey base and a narrow white line or row of white spots along dorsal base / ○ male with bright yellow or white anal with narrow black margin and 1–4 narrow, black, concentric bands / ○ male with 8–13 dark-brown bars, third-last bar anterior to caudal base 0.9–1.8 times wider than anterior white interspace / ○ male with ovoid dorsal profile in individuals larger than 26 mm SL / ○ female without spots on caudal / ○ female larger than 28 mm SL with 1–3 lateral rows of large black spots on flank behind dorsal base / ○ body shape ovoid, rarely rhomboid, dorsal profile convex / ○ body completely covered with overlapping scales. Size up to 57 mm SL.



Anatolichthys marassantensis; Kayseri, Türkiye; female, 40 mm SL.



Anatolichthys marassantensis; Kayseri, Türkiye; male, 36 mm SL.

Distribution. Türkiye: Kızılırmak drainage and lower and middle Yeşilirmak drainage; also in adjacent coastal wetlands west of Sinop.

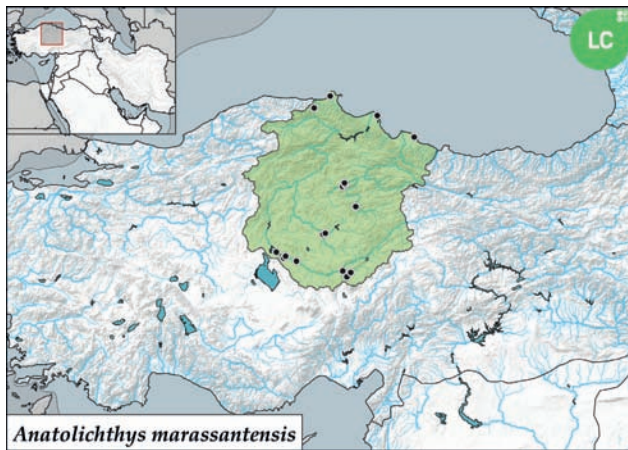
Habitat. Springs, small streams to marshes, and large reservoirs.

Biology. Live up to 5 years; spawns May-September. Feeds mainly on zooplankton (especially cladocerans and copepods), plants (diatoms and algae) and some other invertebrate groups (especially amphipods and gastropods). Similar to *A. iconii* in Lake Eğirdir, its population fluctuates in a similar pattern to that of *Atherina* in Hirfanlı Reservoir.

Conservation status. LC.

Remarks. This species is usually identified as *A. chantrei*, a synonym of *A. danfordii*. Similar fish occurred in upper Jordan drainage and the Damascus basin in Syria until the early 20th century but have not been found since. These have been identified as *A. marassantensis*, which may have been introduced in this area, but this needs to be confirmed.

Further reading. Krupp 1985d (Syrian records); Geiger et al. 2014 (phylogeny); Pfleiderer et al. 2014 (description); Yoğurtçuoğlu & Ekmekçi 2013 (life-history); Yoğurtçuoğlu & Ekmekçi 2017 (distribution in Yeşilirmak); Yoğurtçuoğlu et al. 2018b (feeding).



Anatolichthys meridionalis

Common name. Lycian killifish.

Diagnosis. Distinguished from other species of *Anatolichthys* by: ● male with 6–8 dark-brown bars on flank / ● male with flank bars behind dorsal origin narrower than interspaces / ○ adult male with completely black dorsal or with brown base / ○ body shape ovoid / ○ male with bright yellow anal with narrow black margin / ○ male with 1–4 bold black vertical bars on caudal / ○ female with numerous black spots or blotches on flank often organised in midlateral rows / ○ body completely covered with overlapping scales. Size up to 55 mm SL.

Distribution. Türkiye: Upper Eşen drainage and Lake Söğüt, Avlan, and Gölhisar basins. Also in a small reservoir in Lake Salda basin (potentially introduced).

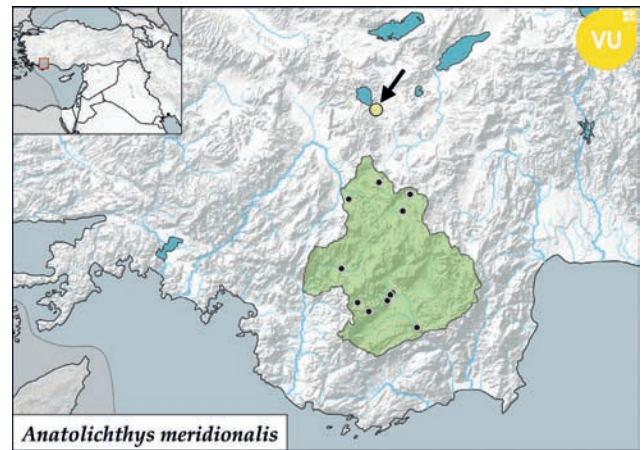
Habitat. River and stream margins, lakeshores, springs, and spring-fed canals and streams.

Biology. Live up to 4 years, mature at age I; spawns July-September.

Conservation status. VU; found in fewer than 10 independent populations, some of which are declining.

Remarks. *Anatolichthys parvus*, from small streams near Lake Gölhisar, is a synonym.

Further reading. Akşiray 1948 (description); Yoğurtçuoğlu & Freyhof 2018 (identification); Güçlü 2022 (biology).



Anatolichthys meridionalis; Söğüt, Türkiye; female, 38 mm SL.



Anatolichthys meridionalis; Söğüt, Türkiye; male, 33 mm SL.



Lake Salda in Türkiye is the only habitat of *Anatolichthys saldae*.



Anatolichthys saldae; Salda, Türkiye; female, ~50 mm SL.



Anatolichthys saldae; Salda, Türkiye; male, ~40 mm SL.

Anatolichthys saldae

Common name. Salda killifish.

Diagnosis. Distinguished from other species of *Anatolichthys* by ○ 1–3 lines of large, usually not or only slightly overlapping scales on midlateral flank / ● usually no or few isolated scales on flank, up to 47–52 total, not or very slightly overlapping scales along lateral series / ● male with black bars wider at dorsal part, narrower at ventral part / ○ no or few isolated scales on flank except midlateral row / ○ scales on back and belly absent / ○ lateral head profile almost quadratic, lower jaw large, directing upward / ○ body depth 4.0–5.3 times in standard length. Size up to 50 mm SL.

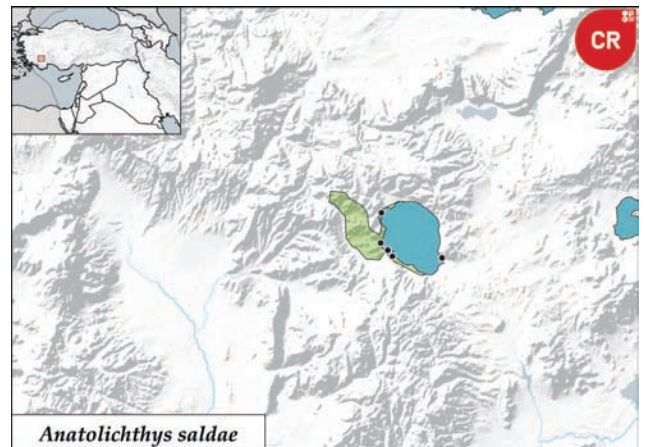
Distribution. Türkiye: Lake Salda.

Habitat. Lacustrine. Forages in open water; spawns on gravel beds near shore. Overwinters in deeper parts of lake. Lake Salda is oligotrophic with a very high concentration of magnesium carbonate (MgCO_3).

Biology. Live up to 3 years, mature within a year. Pelagic and offshore, outside spawning season. Non-nuptial males and females form large schools, even during spawning season spawns April to September. Males establish territories along shore, usually between gravel and rocks, which

they defend against rivals. Female spawn with one or more males on gravel bottoms. Few eggs are laid in the substrate during a spawning event. Individual females may produce several clutches in a single day. Feeds on small benthic and planktonic invertebrates.

Conservation status. CR; Water abstraction and reduced rainfall due to climate change are critical threats to salinity levels in Lake Salda and could lead to its rapid extinction in the near future.



Remarks. Often treated as a synonym of *A. splendens*.

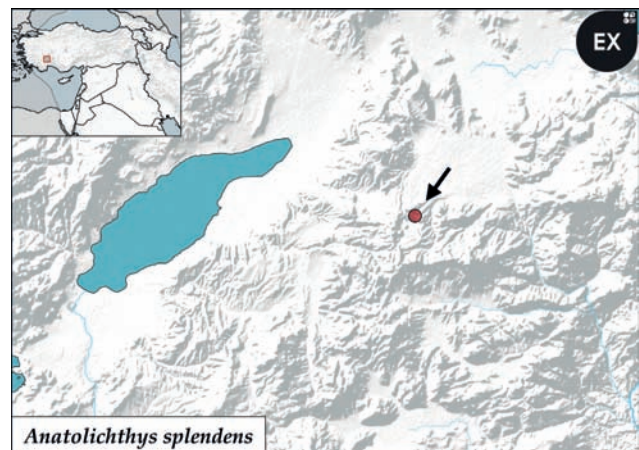
Further reading. Akşiray 1955 (description); Geiger et al. 2014 (phylogeny); Yoğurtçuoğlu & Freyhof 2018 (identification); Yoğurtçuoğlu 2019 (reproduction).

Scale reduction in *Anatolichthys* and *Kosswigichthys*. The presence of scales on fish is a protective mechanism that safeguards the integumentary system from injury. However, this adaptation comes at a cost in terms of energy expenditure. This is evidenced by the observation that many cavefish, which inhabit environments with reduced levels of light, have reduced scales. Similarly, pelagic Aphaniids that inhabit mineral-rich lakes appear relatively safe from predators and flooding hazards. Consequently, they have also reduced their scales. The reduction of scales in *Anatolichthys* and *Kosswigichthys* is not a genetic adaptation to the high concentration of sodium sulfate, magnesium sulfate, and magnesium carbonate in the lakes in which they live. There was no difference in the salt tolerance of scale-reduced fish and normally scaled fish observed in experiments. The reduction is a consequence of the absence of stabilizing selection. Mutants exhibiting all variations in squamation survive, increasing the variability of the squamation. This may lead to the complete loss of scales, potentially saving energy by not developing and maintaining scales. **Further reading.** Grimm 1980 (scale reduction).

Anatolichthys splendens

Common name. Gölcük killifish.

Diagnosis. Distinguished from other species of *Anatolichthys* by: ○ 1–3 lines of large, usually not or only slightly overlapping scales on midlateral flank / ● usually 38–46 total, overlapping scales along lateral series / ● male with black bars equally shaped, not wider at dorsal part / ○ scales on back and belly absent / ○ lateral head profile almost quadratic, lower jaw large, directing upward / ○ body depth 4.0–5.3 times in standard length / ○ male with white anal with wide, black margin or completely black. Size up to 38 mm SL.



Anatolichthys splendens; Lake Gölcük, Türkiye; female, 38 mm SL; male, 31 mm SL.

Distribution. Türkiye: Lake Gölçük west of Isparta.

Habitat. Lacustrine.

Biology. No data. Expected to be similar to other *Anatolichthys*. In laboratory, larvae hatch after 12 days at an incubation temperature of 24°C.

Conservation status. Extinct; invasive *Sander lucioperca*, *Cyprinus carpio* and *Carassius auratus* caused the extinction of this species in the early 1980.

Remarks. *Anatolichthys saldae*, a species endemic to Lake Salda, is often treated as a population of *A. splendens*.

Further reading. Kosswig & Sözer 1945 (description); Yoğurtçuoğlu & Freyhof 2018 (identification).

Anatolichthys sureyanus

Common name. Burdur killifish.

Diagnosis. Distinguished from other species of *Anatolichthys* by: ○ usually scales on back and belly absent / ○ usually 1–3 lines of large, usually not or only slightly overlapping

scales on midlateral flank / ○ lateral head profile triangular or rounded, lower jaw small, directing forward / ○ body depth 3.2–4.2 times in standard length / ○ caudal peduncle depth 11–14 % SL / ○ head depth at nape 61–69 % SL / ○ head width at nape 51–60 % SL / ○ nuptial male with grey dorsal base / ○ male with white anal and wide, black margin or completely black. Size up to 45 mm SL.

Distribution. Türkiye: Lake Burdur.

Habitat. Lacustrine along shores also found in mouths of inflowing streams and springs on lakeshores. Lake Burdur has very high sodium sulfate (Na_2SO_4) concentrations and alkalinity (pH 8.9–9.5).

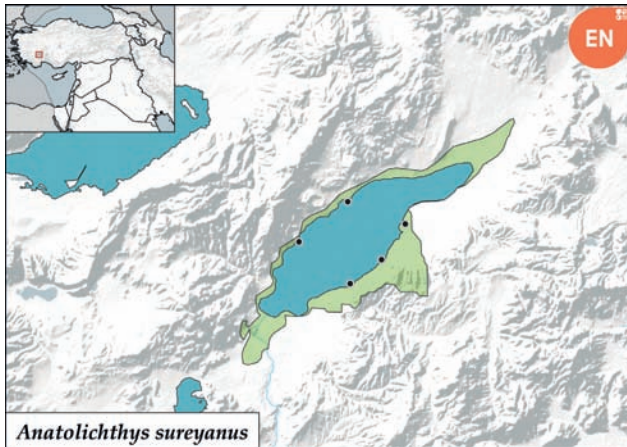
Biology. Live up to 4 years, mature in 100–120 days. Starts spawning at end of March. Incubation period 7–8 days at 22–24°C water temperature. Non-nuptial males and females form large schools. *Arctodiaptomus burduricus* and *Brachionus plicatilis* are major food items.



Anatolichthys sureyanus; Lake Burdur, Türkiye; female, 38 mm SL.



Anatolichthys sureyanus; Lake Burdur, Türkiye; male, ~30 mm SL. © M. Sağdıç



Conservation status. EN; appears to be declining within its small range. The main threats are drying up of Lake Burdur and increasing salinity and pollution, which are continuing. Lake Burdur has lost about 30 % of its surface area since the 1980s due to water abstraction and retention. Reduced inflow has led to increased salinity and pollutant concentrations. Between 2016 and 2019, the species disappeared from the lake after massive fish kills. It was confined to springs and tributaries, suffering from competition and predation from non-native *Gambusia holbrooki*. In 2000, it was found in the lake again after much rain and fewer algal blooms. Lake Burdur is a Ramsar site, a “Protected Area of First-Degree Importance”, and a “Wildlife Development Zone” under national law.

Remarks. In the past, *Anatolichthys* from Lake Burdur showed a wide range of squamation patterns. Fish with a partially bare body and reduced, non-overlapping scales on the flank coexisted with fish with a body completely

covered by overlapping scales. Early authors placed a high value on scale patterns and placed fish with full-scale coverage in genus *Aphanius* and those with reduced scales in genus *Anatolichthys*. Later, authors treated all fishes as one variable species, mostly based on inconclusive hybridisation experiments and intermediate fishes in the lake. Fish from Lake Burdur were described as *A. sureyanus* without giving details of scale patterns, *A. burdurensis* based on fish with reduced scales and a slender body, and *A. burduricus* based on fish with full-scale coverage and a deep body. Today, *Anatolichthys* show reduced scale patterns or no scales at all. Molecular studies (cytochrome b, cytochrome c oxidase 1) have yet to provide evidence to distinguish fish from Lake Burdur (without detail in scale patterns) from fish inhabiting springs and lakes in the wider Lake Burdur basin, identified here as *A. fontinalis*.

Further reading. Akşiray 1955 (description); Yoğurtçuoğlu 2018 (conservation status); Yoğurtçuoğlu & Freyhof 2018 (identification); Güçlü et al. 2007 (biology).

Anatolichthys transgrediens

Common name. Acıgöl killifish.

Diagnosis. Distinguished from other species of *Anatolichthys* by: ○ scales on back and belly usually absent / ○ usually 1–3 lines of large, not or only slightly overlapping scales on midlateral flank / ○ lateral head profile triangular or rounded, lower jaw small, directing forward / ○ body depth 3.2–4.2 times in standard length / ○ caudal peduncle depth 16–18 % SL / ○ head depth at nape 68–75 % SL / ○ head width at nape 62–74 % SL / ○ nuptial male with completely black dorsal / ○ male with white anal and wide, black margin or anal completely black. Size up to 40 mm SL.



Anatolichthys transgrediens; Acıgöl, Türkiye; female, 30 mm SL.



Anatolichthys transgrediens; Acıgöl, Türkiye; male, 25 mm SL.

Distribution. Türkiye: Lake Acıgöl basin.

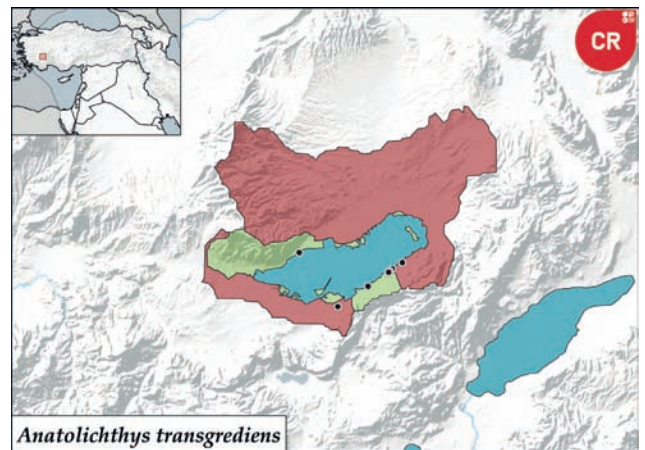
Habitat. Springs and small spring-fed streams. Also found in Acıgöl when there is sufficient water.

Biology. Live up to 2 years, mature with 5-7 months. Spawns February to May and again July to August in channels of brine ponds. Several males gather to chase females during spawning. Few eggs are laid on vegetation during a spawning event. Feeds on benthos and detritus in *Gambusia* dominated springs, otherwise insect larvae, zooplankton and plant material.

Conservation status. CR; once abundant in Acıgöl and its tributaries. Now, only in one spring field. Springs on western, eastern and northern shores of Acıgöl have dried up. In late 20th century, it was reported to be more abundant, and the last spring field was much larger.

Remarks. There is a large variation in scale reduction in *A. transgrediens*.

Further reading. Ermin 1946 (description); Yoğurtçuoğlu & Freyhof 2018 (identification); Yoğurtçuoğlu et al. 2020c (reproduction).



Spring-feed streams running to hypersaline Lake Acıgöl in Türkiye are the habitat of *Anatolichthys transgrediens*.



Anatolichthys villwocki; Sakarya drainage, Türkiye; female, 35 mm SL.



Anatolichthys villwocki; Sakarya drainage, Türkiye; male, 40 mm SL.

Anatolichthys villwocki

Common name. Sakarya killifish.

Diagnosis. Distinguished from other species of *Anatolichthys* by: ● male with 4–14 vertical rows of small black or brown spots on caudal / ● male with 13–25 narrow brown bars on body / ● female larger than 40 mm SL usually without back spots or blotches on flank except one bold black blotch at middle posterior most caudal peduncle / ○ male with regularly set and shaped dark-brown or black bars, without white spots in bars / ○ male with bright yellow anal with narrow black margin / ○ male with flank bars behind dorsal origin wider than interspaces / ○ body completely covered with overlapping scales. Size up to 60 mm SL.

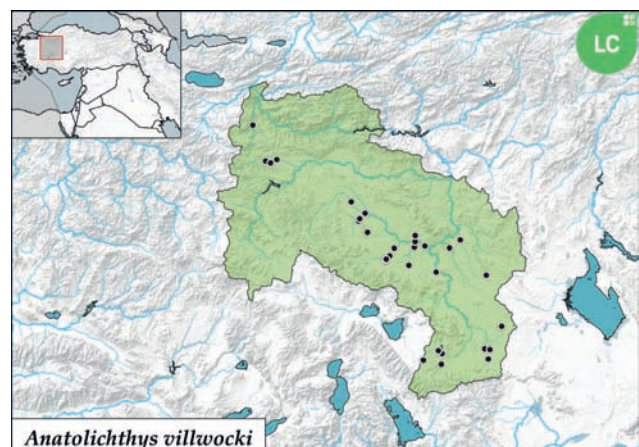
Distribution. Türkiye: Lake Ilgın and upper Sakarya drainage downstream to about confluent of Sakarya and Porsuk.

Habitat. Lakes, springs, and slow-flowing streams with dense vegetation.

Biology. Male live up to 4 years, females up to 5 years; batch spawning from late of March to July.

Conservation status. LC.

Further reading. Hrbek & Wildekamp 2003 (description).



Aphaniops

Aphaniops are a group of eight species of killifishes known to inhabit the south-easternmost Mediterranean basin, extending along the coasts of the Red Sea from south to Ethiopia and across the Persian Gulf basin to Gujarat in India. Except for one species, all *Aphaniops* occur in West Asia. *Aphaniops stiassnyae* is endemic to Lake Afdera in the Danakil Depression of northern Ethiopia, and several

undescribed species might exist in East Africa. *Aphaniops* cannot survive water temperatures below 10°C for an extended period. Low water temperatures during the winter months in the Mediterranean basin may limit their distribution. **Further reading.** Getahun & Lazara 2001 (*A. stiassnyae*); Chiozzi et al. 2017 (diversity in East Africa); Freyhof et al. 2017b (molecular data, distribution); Esmaeili et al. 2020b (generic concept).

Key to species of *Aphaniops* in West Asia

1a - Body without scales; caudal slightly emarginate, male without bold bars on caudal.

.....*A. furcatus*

1b - Body covered by scales; caudal truncate, or slightly rounded, male with 2–3 bold, crescent-shaped black bars on caudal.

.....2

2a - Female with a midlateral row of roundish, black spots, often with additional black spots on flank; male with a wide, black dorsal margin; anal yellow, with or without a narrow black margin and 0–2 short black bars on middle of fin.

.....*A. sirhani*

2b - Female with a midlateral row of vertically elongated black, grey or dark-brown blotches or narrow bars; male without black dorsal margin, anal yellow anteriorly, with 3–8 narrow black or brown bars on posterior part of fin.

.....3

3a - Male with silvery vermiculation on grey background on flank.

.....*A. richardsoni*

3b - Male with dark-grey bars on silvery background or with roundish or ovoid silvery spots or blotches, sometimes with short vermiculation, on a grey, greenish or bluish background, often with spots in front of anal origin and bars on caudal peduncle.

.....4

4a - Male with 9–19 brown or grey bars on flank between pectoral and caudal bases.

.....5

4b - Male with roundish or ovoid silvery spots or blotches, sometimes with short vermiculation, on a grey, greenish or bluish background, often with spots in front of anal origin and bars on caudal peduncle.

.....7

5a - 5 branched dorsal rays, ½ ray absent.

.....*A. ginaonis*

5b - 6–8½ branched dorsal rays, several individuals have 7 rays and no ½ ray; male with 9–17 brown or grey bars on flank.

.....6

6a - Female with a diamond-shaped or slightly vertically elongate black or dark-brown blotch at caudal base; male with 9–14 brown bars on flank.

.....*A. kruppi*

6b - Female with a narrow and long bar at caudal base; male with 12–17 brown bars on flank.

.....*A. teimorii*

7a - Male with roundish or ovoid silvery spots or blotches on flank, sometimes with short vermiculation, on a grey, greenish or bluish background, usually without bars on caudal peduncle; tip of dorsal reaching to three scales in front of end of hypural complex in nuptial male larger than 40 mm SL; female with a midlateral series of wide bars or irregularly shaped and set, vertically elongated, lateral blotches.

.....*A. dispar*

7b - Male usually with wide grey or brown bars at posterior flank and caudal peduncle, with roundish or ovoid silvery spots or blotches on flank anterior to dorsal base or caudal peduncle; tip of dorsal reaching to end of hypural complex in nuptial male larger than 40 mm SL; female with a midlateral series of narrow bars, not much wider in upper part.

.....*A. stoliczkanus*



Aphaniops dispar; salt marshes at Atlit, Israel; female, 43 mm SL.



Aphaniops dispar; salt marshes at Atlit, Israel; male, 37 mm SL.

Aphaniops dispar

Common name. Red Sea killifish.

Diagnosis. Distinguished from other species of *Aphaniops* in West Asia by: ● male with roundish or ovoid silvery spots or blotches on flank, sometimes with short vermiculation, on a grey, greenish or bluish background, usually without bars on caudal peduncle / ● tip of dorsal reaching to three scales in front of end of hypural complex in male larger than 40 mm SL / ○ female with a midlateral series of wide bars or irregularly shaped and set, vertically elongated, lateral blotches / ○ female with a narrow and long bar at caudal base / ○ male with 2–3 bold, crescent-shaped black bars on caudal / ○ body covered by overlapping scales / ○ caudal truncate or slightly rounded / ○ 6–8½ branched dorsal rays. Size up to 56 mm SL.

Distribution. Red Sea coast south to Gulf of Aden, Socotra and south to Ethiopia. In Suez Canal, Bitter and Timsach Lakes. Also along northern Nile Delta and Sinai coast, and

on Israeli Mediterranean coast at Atlit and Siwa Oasis in western Egypt. Introduced in fish farms around Khartoum with salt from Port Sudan area.

Habitat. Euryhaline, coastal habitats with dense vegetation or rocky bottoms. Also found in coral reefs in Red Sea. Very rarely reported from freshwater habitats.

Biology. Live up to 3 years, mature in a few months, usually late in year of birth. Males establish territories along shore, usually in dense vegetation but also between rocks, which they defend against rival males. Spawns March–September, with a peak in July–August on Mediterranean coast of Egypt. Spawns throughout year on Arabian Peninsula. Females spawn with one or more males, usually on gravel, rocks, algae, or other vegetation. Few eggs are laid in substrate during a spawning event. Individual females may produce several clutches in a single day. Feeds on algae, detritus, and small invertebrates. Produces sterile hybrids with *Aphanius fasciatus* along Egyptian coast.



Aphaniops cf. *dispar*; Jeddah, Saudi Arabia; female, 40 mm SL.



Aphaniops cf. *dispar*; Jeddah, Saudi Arabia; male, 35 mm SL.



Aphaniops cf. *dispar*; Shukaray, Eritrea; male, 45 mm SL.

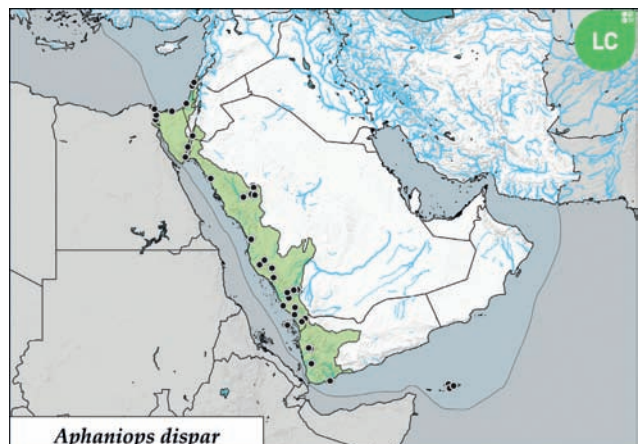


Aphaniops cf. *dispar*; Lake Abbe, Djibouti; male, ~50 mm SL. © H. Wischmann.

Conservation status. LC.

Remarks. Populations in Socotra and western Yemen are thought to belong to this species. In the Nile, reports are from the delta area, but records upstream of the delta, south of Cairo, are unconfirmed and doubtful. At least two species are included in *A. dispar*, both found in the Red Sea, and there may be other unrecognised species in the area. It remains to be seen which species was originally described as *A. dispar*.

Further reading. Villwock et al. 1983 (distribution); Al-Kahem et al. 2008 (Saudi Arabia); Freyhof et al. 2017b (molecular data, distribution); Freyhof et al. 2020 (distribution).





Aphaniops furcatus; Shur drainage; Iran; female, 30 mm SL.



Aphaniops furcatus; Shur drainage; Iran; male, 21 mm SL.

Aphaniops furcatus

Common name. Scaleless Hormuzgan killifish.

Diagnosis. Distinguished from other species of *Aphaniops* in West Asia by: ● caudal slightly emarginate / ● caudal without bars in male / ● body completely scaleless / ● teeth bicuspid. Size up to 33 mm SL.

Distribution. Iran: Kol and Mehran drainages including Khurgu and Faryab hot sulfuric springs close to Bandar Abbas. Also, Shur drainage in Makran region.

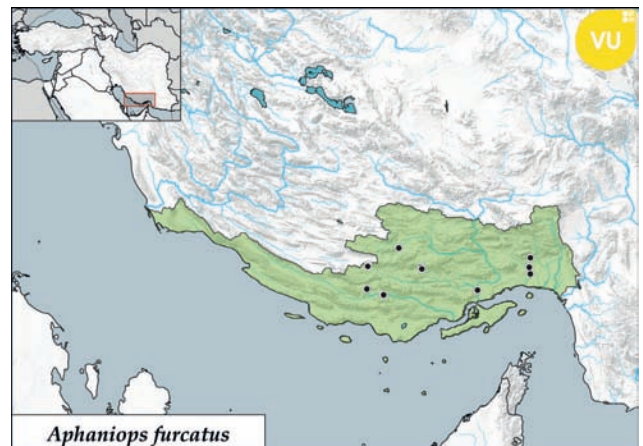
Habitat. Saline rivers and hot sulfur springs with salinities around 30 ‰. Usually along banks.

Biology. No data.

Conservation status. VU; habitats are under threat due to severe drought, pollution, and habitat destruction.

Remarks. Occurs in sympatry with *Aphaniops teimorii*, which is usually much more abundant.

Further reading. Teimori et al. 2014 (description); Teimori et al. 2019 (distribution and habitats).





Aphaniops ginaonis; Genow spring, Iran; female, 32 mm SL.



Aphaniops ginaonis; Genow spring, Iran; male, 35 mm SL.

Aphaniops ginaonis

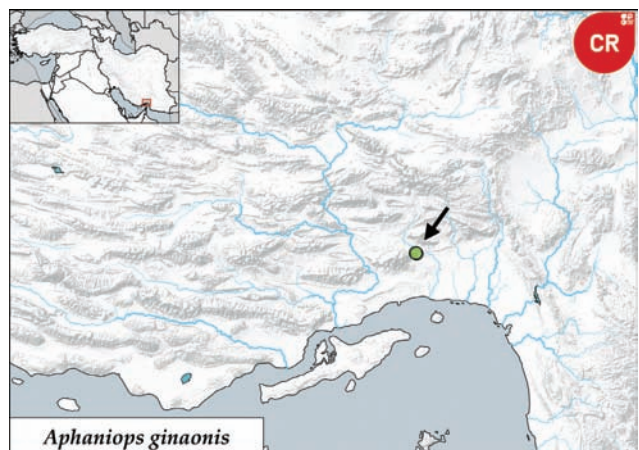
Common name. Genow killifish.

Diagnosis. Distinguished from other species of *Aphaniops* in West Asia by: ● 5 branched dorsal rays, $\frac{1}{2}$ ray absent / ○ male with 13–19 brown bars on flank / ○ male with 2–3 crescent-shaped black bars on caudal / ○ female with a midlateral row of vertically elongated black, grey or dark-brown blotches or narrow bars / ○ male without black dorsal margin, anal yellow anteriorly, with 3–8 narrow black or brown bands on posterior part of fin / ○ anal and dorsal not reaching to caudal base / ○ body covered by overlapping scales / ○ caudal truncate or slightly rounded. Size up to 40 mm SL.

Distribution. Iran: Genow hot sulfuric spring.

Habitat. A very small hot sulfur spring with 37–40°C water temperatures, bottom of stones and pebbles covered with cyanobacteria.

Biology. Lives up to 6 (female) or 5 (male) years. Matures at 2 years. Spawns probably all year round. Feeds on algae and insect larvae.



Conservation status. CR; declined sharply after the construction of bathing facilities in the spring of the early 21st century. Since then, population has stabilised at a very low level.

Remarks. This species occurs adjacent to the range of *A. teimorii* that inhabits the outflow of Genow spring below

a small waterfall. Both species are well differentiated morphologically, but morphological differences may result from recent adaptations to the extreme conditions of the habitat.

Further reading. Reichenbacher et al. 2009 (habitat, otolith morphology); Golmoradzadeh et al. 2012 (life history).



Only a small part of Genow spring in Iran is inhabited by endemic *Aphaniops ginaonis*.



Aphaniops kruppi; Wadi Bani Khalid, Oman; female, 45 mm SL.



Aphaniops kruppi; Wadi Bani Khalid, Oman; male, 34 mm SL.

Aphaniops kruppi

Common name. Omani killifish.

Diagnosis. Distinguished from other species of *Aphaniops* in West Asia by: ● male with 9–14 brown or grey flank bars between pectoral, pelvic, and caudal bases, often dissociated into blotches in front of pelvic base / ● female with a diamond-shaped or vertically elongate black or dark-brown blotch at caudal base / ○ female with a midlateral row of vertically elongated black, grey or dark-brown blotches or narrow bars / ○ male without black dorsal margin, anal yellow anteriorly, with 3–8 narrow black or brown bands on posterior part of fin / ○ male with 2–3 bold, crescent-shaped black bars on caudal / ○ body covered by overlapping scales / ○ caudal truncate or slightly rounded / ○ 6–7½ branched dorsal rays. Size up to 52 mm SL.

Distribution. Oman: Coast of Dhofar northeast to Wadi Bani Khalid drainage. Wadi Bani Khalid is far inland. In small springs and falaj systems, for example, in the towns of Bani Bu Ali and Al Mudayrib. Populations in eastern Yemen are likely to belong to this species.

Habitat. Coastal wetlands, wadis, springs, falaj systems, and spring-fed streams.

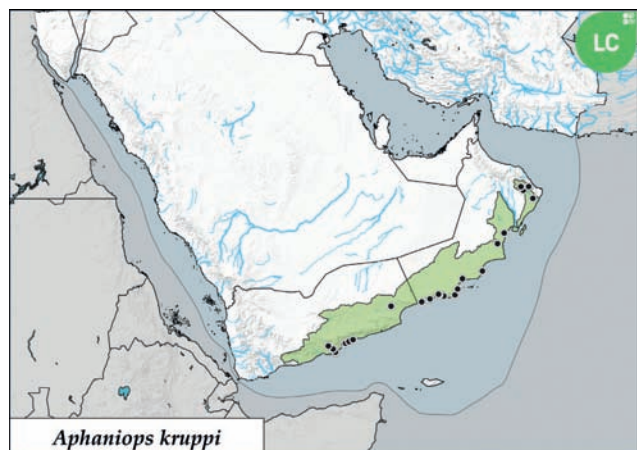
Biology. Live up to 2 years, mature in a few months, usually late in year of birth. Males establish territories along banks, usually in dense vegetation but also between rocks, which they defend against rival males. Spawns throughout year. Females spawn with one or more males, usually in algae or other vegetation near the surface or on gravel beds. Few

eggs are laid in substrate during a spawning event. Individual females produce several clutches of eggs in one day. Feeds on algae, detritus, and small invertebrates.

Conservation status. LC.

Remarks. Molecular data show that *A. kruppi* is distinct from coastal populations of *A. stoliczkanus*. *Aphaniops* from many inland drainages north of Buraimi on the UAE-Oman border (e.g., Wadi Dayqah, Al-Hoota, Al Juwayf, Wadi Hatta, and Wadi Sayfam) are very similar to *A. kruppi* in colour pattern, but have mtDNA of *A. stoliczkanus*. They are thought to be hybrids and often non-native populations.

Further reading. Freyhof et al. 2017b (description).





Aphaniops richardsoni; Neot HaKikar, Israel; female, ~50 mm SL. © B. Nicca.

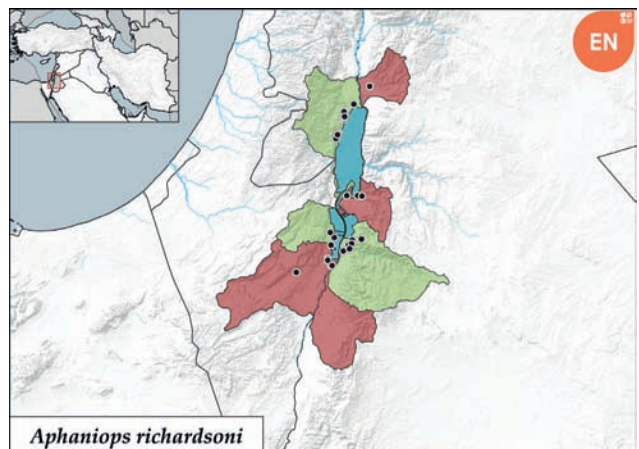


Aphaniops richardsoni; Neot HaKikar, Israel; males, ~50 mm SL. © B. Nicca.

Aphaniops richardsoni

Common name. Dead Sea killifish.

Diagnosis. Distinguished from other species of *Aphaniops* in West Asia by: ● male with silvery vermiculation on grey background on flank / ○ bars absent on flank or restricted to caudal peduncle in male / ○ female with a midlateral row of vertically elongated black, grey or dark-brown blotches or narrow bars / ○ male without black dorsal margin, anal yellow anteriorly, with 3–8 narrow black or brown bands on posterior part of fin / ○ dorsal in male only slightly longer than in females, not reaching caudal base in male larger than 30 mm SL / ○ male with 2–3 bold, crescent-shaped black bars on caudal / ○ body covered by overlapping scales / ○ caudal truncate or slightly rounded. Size up to 50 mm SL.



Distribution. Jordan and Israel: Springs in Dead Sea basin.
Habitat. Springs and headwater streams, usually with fresh or brackish water.

Biology. Live up to 3 years, mature in a few months, usually late in the year of birth. Biology similar to other Aphaniidae. Feeds on algae, detritus and small invertebrates.

Conservation status. EN; appears to be declining within its very small range. In Jordan, extirpated from the northern Dead Sea basin and now restricted to the southern part.

Further reading. Freyhof et al. 2017b (molecular data, distribution); Kärst et al. 2020 (distribution, reproduction).

Aphaniops sirhani

Common name. Azraq killifish.

Diagnosis. Distinguished from other species of *Aphaniops* in West Asia by: ● female with a midlateral row of roundish, black spots, often with additional black spots on flank / ● male with a wide, black dorsal margin / ● dorsal and anal yellow, with or without a narrow black margin and 0–2 short black bands on middle of fin / ○ male with 8–11 distinct bold black or dark-brown lateral bars on flank between head and caudal peduncle / ○ female with a series of dark-grey blotches along midlateral body / ○ male with 1–3 bold, crescent-shaped black bars on caudal / ○ body covered by overlapping scales / ○ caudal truncate or slightly rounded. Size up to 45 mm SL.

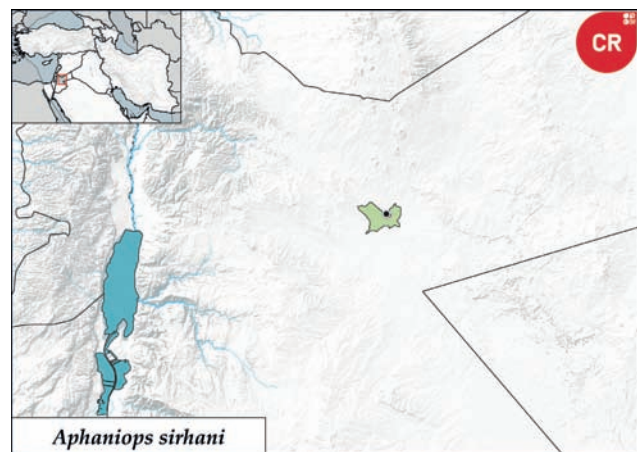
Distribution. Jordan: Azraq marsh.

Habitat. Shallow oases, lakes and springs.

Biology. Live up to 3 years, mature in a few months, usually late in the year of birth. Biology similar to other Aphaniidae.

Conservation status. CR; Azraq marshes almost completely dried up in 1992. Species survived in wetland and had been maintained in Azraq Reserve and outside by captive breeding. Since 1994, 8 % of the marshes (based on their 1960s extent) have been restored. However, the species remains dependent on conservation, as water has to be pumped into the wetland due to a very low water table resulting from increasing water abstraction. Non-native species threaten the restored reserve.

Further reading. Villwock et al. 1983 (description); Freyhof et al. 2017b (molecular data, distribution).



Aphaniops sirhani; Azraq, Jordan; female, ~45 mm SL. © N. A. Hamidan.



Aphaniops sirhani; Azraq, Jordan; male, ~40 mm SL. © N. A. Hamidan.



Aphaniops sirhani is endemic to Azraq wetland in Jordan, which depends on water bought for conservation.



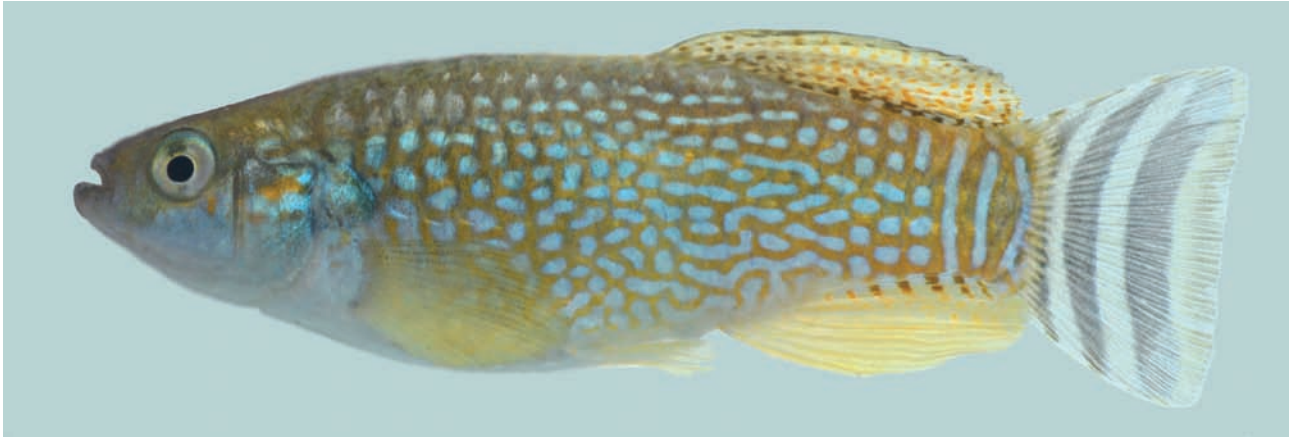
Aphaniops stoliczkanus; Narara-Salt Pans, India; female, 30 mm SL.



Aphaniops stoliczkanus; Narara-Salt Pans, India; male, 30 mm SL.



Aphaniops stoliczkanus; Wadi Fanja, Oman; female, 40 mm SL.



Aphaniops stoliczkanus; Wadi Fanja, Oman; male, 44 mm SL.

Aphaniops stoliczkanus

Common name. Rajasthan killifish.

Diagnosis. Distinguished from other species of *Aphaniops* in West Asia by: ● male usually with wide grey or brown bars at caudal peduncle, often anterior to dorsal base, with roundish or ovoid silvery spots or blotches on flank anterior to dorsal base or caudal peduncle / ● tip of dorsal reaching to end of hypural complex in nuptial male larger than 40 mm SL / ● female with a midlateral series of narrow bars, not much wider in upper part / ○ female with a narrow and long bar at caudal base / ○ male with 2–3 bold, crescent-shaped black bars on caudal / ○ male without black dorsal margin / ○ body covered by overlapping scales / ○ caudal truncate or slightly rounded / ○ 6–8½ branched dorsal rays. Size up to 53 mm SL.

Distribution. Shatt al Arab/Arvand and its tributaries, recorded from Hammar Marsh, Fallujah, Lake Razzazah and Badrah on Iran/Iraq border east of Baghdad. Also along coasts of Persian Gulf basin in Kuwait, Iraq, Iran, Saudi Arabia, and Oman, except coast of Hormuzgan, and east along Indian Ocean coast to Rajasthan (north-west India). *Aphaniops* found as far inland as south of Riyadh in Saudi Arabia may belong to this species.

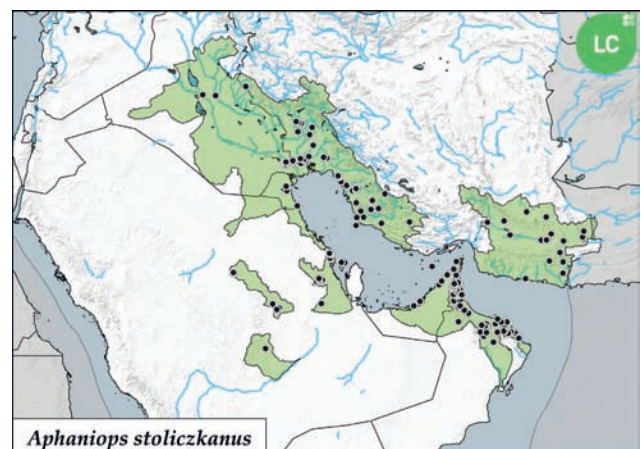
Habitat. Euryhaline; widespread in lagoons and estuaries, lower parts of rivers, streams, and all types of inland waters, especially when brackish or saline. In and around Hajar Mountains, very common in freshwater habitats, natural and artificial (including water tanks and cisterns), with or without significant vegetation.

Biology. May mature within five months, depending on temperature and food availability. Females mature at about 25 mm SL, males smaller. Males grow larger than females. Live up to 3 years. Males territorial during spawning season defending spawning sites against other males. Spawns in pairs. In Oman and UAE, spawning occurs at

all times of day and throughout the year. In southern Iraq, spawning peaks April–July. Several eggs are laid in each spawning event, and several spawning events occur daily. Eggs are attached to the spawning substrate by sticky filaments. Larvae hatch after about 14 days (25°C). Females, juveniles, and non-reproductive males form schools in open water. Salinities up to 14.5 ‰ are tolerated, and salinities up to 25.0 ‰ are briefly survived. Feeds on a wide variety of aquatic and terrestrial invertebrates, algae, and detritus are usually main components.

Conservation status. LC.

Remarks. *Aphaniops teimorii*, *A. kruppi*, and *A. ginaonis* are other superficially similar species. *Aphaniops stoliczkanus* has been widely introduced for mosquito control in UAE and Oman, and many, if not all, inland populations may be non-native. In northern Oman, inland populations sometimes show colour patterns similar to *A. kruppi*, and hybridisation between the two species cannot be excluded. **Further reading.** Haas 1982 (biology); Teimori et al. 2012 (diversity in Persian Gulf basin); Freyhof et al. 2017b (molecular data, distribution).





Aphaniops teimorii; Govdar, Iran; female, ~55 mm SL.

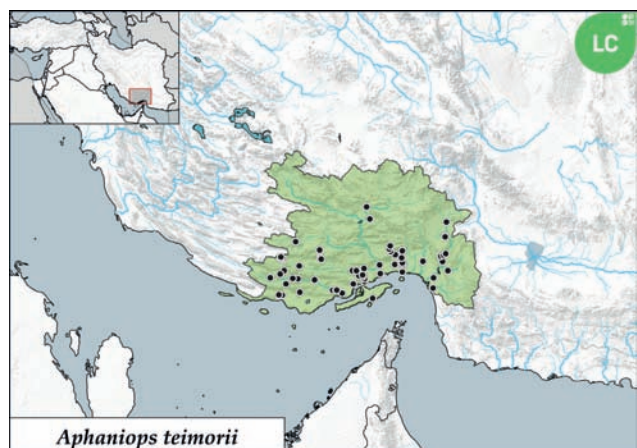


Aphaniops teimorii; Govdar, Iran; male, 33 mm SL.

Aphaniops teimorii

Common name. Hormuz killifish.

Diagnosis. Distinguished from other species of *Aphaniops* in West Asia. ○ female with a narrow and long bar at caudal base / ○ male with 12–17 brown bars on flank / ○ male with 2–3 bold, crescent shaped black bars on caudal / ○ female with a midlateral row of vertically elongated black, grey or dark-brown blotches or narrow bars / ○ male with grey bars on silvery background or with roundish or ovoid silvery spots or blotches, sometimes with short vermiculation, on a grey greenish or bluish background, often with spots in front of anal origin and bars on caudal peduncle / ○ body covered by overlapping scales / ○ caudal truncate, or slightly rounded / ○ 7–8½ branched dorsal rays. Size up to about 55 mm SL.



Distribution. Iran: Mond to Minab drainages as well as Qeshm Island.

Habitat. Lakes, rivers, and streams with high salinity.

Biology. Live up to 3 years, mature in a few months, usually late in year of birth. Males establish territories along banks, usually in dense vegetation but also between rocks, which they defend against rival males. Females spawn with one or more males, usually in algae or other vegetation near surface or in gravel bottoms. Few eggs are deposited in substrate during a spawning event. Individual females may produce several clutches of eggs in 1 day. Feeds on algae, detritus, and small invertebrates.

Conservation status. LC.

Remarks. *Aphaniops teimorii* was previously described as *A. hormuzensis*, and this name is still in use, although it is not available (*nomen nudum*) due to a formal error in the description.

Further reading. Teimori et al. 2018 (invalid description of *A. hormuzensis*); Freyhof & Yoğurtçuoğlu 2020 (description); Teimori et al. 2020 (invalid attempt to re-establish *A. hormuzensis*).

Aphanius

The two species of the genus *Aphanius* are found along the coasts of the Mediterranean, where they inhabit a wide range of brackish waters and are rarely seen in pure freshwaters or the sea. Inland water habitats are usually associated with very high mineral concentrations. *Aphanius* inhabit mostly shores with dense submerged vegetation and resist pollution and high water temperatures. Notably, nuptial males are territorial, whereas non-nuptial males and females often shoal and may be pelagic.

Further reading. Kottelat et al. 2007 (species diversity); Triantafyllidis et al. 2007 (phylogeny); Valdesalici et al. 2019 (distribution).



Heavily polluted outflow of a thermal spring in Tuzla, Türkiye. Habitat of many thousands of *Aphanius almirensis*.



Aphanius almirensis; Tuzla, Türkiye; female, ~35 mm SL.



Aphanis almiriensis; Tuzla, Türkiye; male, ~25 mm SL.

Aphanis almiriensis

Common name. Almiri killifish.

Diagnosis. Distinguished from *Aphanis fasciatus* by:

- female with dark, roundish blotches on flank, more or less connected by an irregular dark-grey midlateral stripe /
- dorsal and anal not reaching caudal base in male. Size up to about 38 mm SL.

Distribution. Aegean basin in Türkiye and Greece: Tuzla estuary, Lake Bafa and coastal lagoons around İzmir (Homa lagoon), springs near Almiri and Meligou (Peloponnese) and coastal lagoons on islands of Lesbos and Kos and near cities of Thessaloniki and Kavala. Likely more widespread. Also at Palude del Capitano in Puglia, Italy.

Habitat. Slow-flowing streams, lagoons and lakes. In fresh and brackish water, up to 23 ‰ salinity.

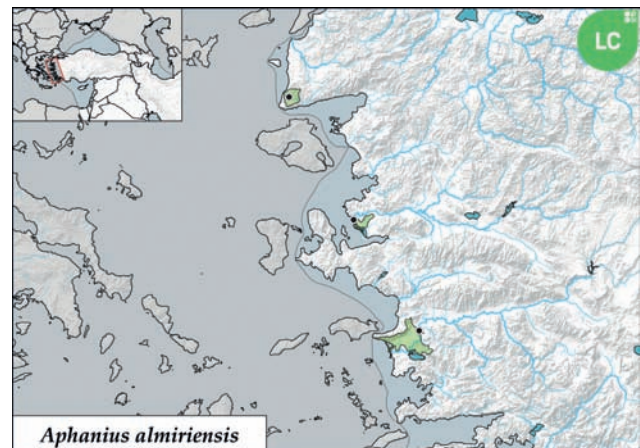
Biology. Live up to 3 years, mature in a few months, usually late in year of birth. Males establish territories along banks, usually in dense vegetation but also between rocks, which they defend against rival males. Females spawn with one or more males, usually in algae or other vegetation near surface or in gravel beds. Few eggs are deposited in substrate during a spawning event. Individual females may produce several clutches in one day. Feeds mainly on algae and detritus and, to a lesser extent, on planktonic invertebrates and anflug.

Conservation status. LC.

Remarks. This species was considered restricted to two localities in Greece but appears widespread throughout the

Aegean basin. The distribution of *A. almiriensis* and *A. fasciatus* in the eastern Mediterranean is poorly understood, and a population from the island of Evia (Greece) and possibly several others in Aegean belong to *A. fasciatus*. Both species may hybridise, but this has not been investigated. It cannot be completely excluded that the Italian population was accidentally introduced during Roman times, possibly from the island of Kos (Greece).

Further reading. Kottelat et al. 2007 (description); Triantafyllidis et al. 2007 (distribution); Valdesalici et al. 2019 (distribution, first record in Italy); Saç et al. 2025 (biology).



When the Aegean was a lake. The biogeography of *Aphanius* is fascinating. *Aphanius fasciatus* is widely distributed throughout the Mediterranean, from Morocco to Syria and Egypt. The relatively shallow genetic differences between populations suggest gene exchange has occurred, likely facilitated by migration along the coast. However, the Aegean Sea has remained unimpacted by this migration, allowing *A. almiriensis* to evolve independently. The Northern Aegean region evolved as a restricted landlocked basin during the Miocene, with small temporary connections to the Paratethys (today's Black Sea) and the Mediterranean. In the Tortonian (11.6–7.2 million years ago), the Aegean showed scattered lakes predominantly fed by local rivers and short-lived Paratethys connections. The first persisting marine conditions, alternating with brackish Paratethyan environments, indicate a late Maeotian age (6.9–6.1 million years ago) when the region formed a semi-isolated (Egamar) sea with multiple marine influxes. The cessation of marine conditions is well documented by a marked paleoenvironmental change to the brackish water environments, which correlates to the Maeotian/Pontian boundary (6.1 million years ago) in the Eastern Paratethys. During the Messinian Salinity Crisis (5.97–5.33 million years ago), the Northern Aegean was a brackish water system (Lake Egemar) that formed a passageway for Paratethyan overspill waters toward the Mediterranean. It is hypothesised that *A. almiriensis* had been isolated from the Mediterranean, *A. fasciatus* during these times, the latest during the Messinian Salinity Crisis. Nevertheless, while the isolation of the Aegean from the Mediterranean may have contributed to the isolation and speciation of both *Aphanius*, the last 5 million years should have been sufficient time for both species to invade each other's ranges. The only documented instances of such an invasion are the records of *A. fasciatus* from Evia (Greece) and *A. almiriensis* from Italy. Indeed, the dispersal ability of *Aphanius* appears to be relatively limited. Several molecular studies of *A. fasciatus* populations demonstrate a shallow but notable genetic structure within its large range. These studies indicate no rapid and unrestricted gene flow within the Mediterranean. The environmental factors limiting the recent distribution of *A. fasciatus* and *A. almiriensis* may have similarly constrained their range expansion since the Messinian. However, there is a possibility that both species compete strongly with each other if they come into contact or form hybrid populations. This remains highly speculative and requires further research. **Further reading.** Ferrito et al. 2013; Geiger et al. 2014; Buj et al. 2015; Cavraro et al. 2017 (phylogeography); Krijgsman et al. 2020 (Geology of the Aegean Sea).



Aphanius fasciatus; Pag, Croatia; female, 35 mm SL.



Aphanius fasciatus; Qued Zahzah, Tunisia; male, 35 mm SL.

Aphanius fasciatus

Common name. Mediterranean killifish.

Diagnosis. Distinguished from *A. almiriensis* by: ● female with narrow, isolated, dark-grey or brown bars on flank / ● dorsal and anal reaching caudal base in male. Size up to about 60 mm SL.

Distribution. Deltaic areas of Köyceğiz, Göksu, Seyhan, and Ceyhan, in a stream near Iskenderun, lowermost Susurluk in Marmara basin, and perhaps elsewhere in southern Türkiye. Mediterranean coast from Moulouya estuary (Morocco) east to Egypt, Cyprus, and Syria; in tributaries of Chott el Gharsa and Lake Keliba in Tunisia and Chott Melrhir and Touggourt oasis in Algeria. Entering Bitter Lakes in Egypt via Suez Canal. Locally along Syrian and Israeli coasts (Haifa, now extirpated), in Siwas and Fayum Oasis in Egypt. In Nile Delta and adjacent coastal lagoons. Largely absent from Aegean basin, but recorded from island of Evia (Greece). In Europe, from Camargue (France) east to western Greece, including Corsica, Sardinia, Sicily and Malta. In Spain, recently appeared in Ebro Delta, which was thought to have been released by aquarists, but population seems to have disappeared.

Habitat. Coastal lagoons in fresh (with high mineral content), brackish, and even hypersaline waters. Often in shallow, still or slow-flowing brackish waters, especially at estuaries.

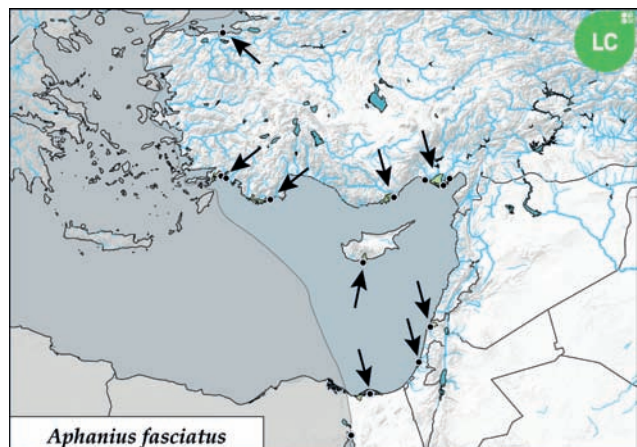
Biology. Live up to 3 years, spawns for the first time at 7–12 months. Spawns March–June in Italy, April–July in Greece, April–September in Corsica. Males establish territories along shore, usually in dense vegetation but also between rocks, which they defend against rivals. Females spawn with one or more males, usually in seaweed or other vegetation close to surface or in gravel beds. Few eggs are laid in

substrate during a spawning event. Individual females may produce several clutches in one day. Eggs hatch in 10–14 days. Juveniles form large schools, and non-nuptial males and females swarm and are often pelagic. Feeds on small benthic or planktonic invertebrates, anflug and algae.

Conservation status. LC.

Remarks. There appear to be no current records of this species from the Egyptian Bitter Lakes and the northern Red Sea, and the species may be no longer found here. The distribution of *A. fasciatus* in the eastern Mediterranean has yet to be fully understood. The distribution limits with similar *A. almiriensis* along the Aegean coast of Türkiye are still unclear but seem to lie between Köyceğiz and Bafa.

Further reading. Tigano & Ferrito 1985 (osteology); Gandolfi et al. 1991 (biology); Wildekamp 1993 (description); Leonardos & Sinis 1998 (reproduction); Kottelat et al. 2007 (systematics); Valdesalici et al. 2019 (distribution).





Coastal lagoons are the typical habitat of both *Aphanius* species, as here in the Gediz delta in Türkiye, where *A. almiriensis* is common.

Esmaeilius

Persian killifish is a genus of six species widespread in Iran and the lower Shatt al Arab in Iraq. All species inhabit inland habitats, such as the shores of rivers, streams, and springs. Many populations, often largely isolated, indicate a much wider distribution range in the recent geological past, and many populations might have become isolated only a few thousand years ago. The distribution of these fishes reflects the interesting geological history of the Zagros Mountains. Some geographically distantly isolated populations were described as

separate species during their discovery. However, subsequent analysis revealed that many of these are very closely related, morphologically indistinguishable and that those previously identified as *E. arakensis*, *E. kavirensis*, *E. mesopotamicus*, or *E. pluristriatus* are now considered synonymous with *E. sophiae*. Many populations have been lost recently due to the unsustainable exploitation of freshwater resources and the increasing aridity of Central Iran, which is also a consequence of climate change. **Further reading.** Freyhof & Yoğurtcuoğlu 2020 (description, species diversity).

Key to species of *Esmaeilius*

1a - Male with black dorsal, pelvic, and anal margins.

.....*E. isfahanensis*

1b - Male with white dorsal, pelvic, and anal margins.

.....2

2a - Female with distinct, short, brown bars along lateral midline.

.....*E. persicus*

2b - Female with irregular set brown or dark-grey spots and blotches, blotches sometimes slightly vertically elongated.

.....3

3a - 36–47 total scales in lateral series; female without bold black spot at middle caudal base.

.....*E. vladikovii*

3b - 23–32 total scales in lateral series; female with bold black spot at middle caudal base, absent or very small in *E. shirini*.

.....4

4a - Male usually with 7–10 wide flank bars.

.....*E. shirini*

4b - Male with 10–19, usually 11–16, narrow flank bars.

.....5

5a - Female with a midlateral series of short, slightly vertically elongated blotches.

.....*E. darabensis*

5b - Female with a pattern of spots and irregularly shaped blotches not organised in a midlateral series.

.....*E. sophiae*



Esmaeilius darabensis; Golabi spring, Kol drainage, Iran; female, ~30 mm SL.



Esmaeilius darabensis; Golabi spring, Kol drainage, Iran; male, ~25 mm SL.

Esmaeilius darabensis

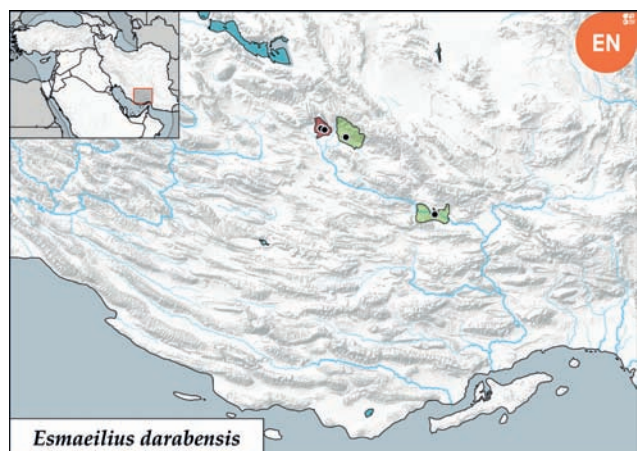
Common name. Darab killifish.

Diagnosis. Distinguished from other species of *Esmaeilius* by: ● female with a midlateral series of short, slightly vertically elongated blotches / ○ male with narrow white dorsal and pelvic margin / ○ anal margin white, hyaline or greyish / ○ 10–19 dark-brown bars on flank wider than interspaces / ○ female with a distinctive black spot at caudal base / ○ 23–28 scales in lateral series. Size up to 34 mm SL.

Distribution. Iran: Korsiash Banaki and Golabi springs and Dasht-e Konar wetland in upper Kol drainage.

Habitat. Springs and spring-fed streams.

Biology. No data. Expected to be similar to other *Esmaeilius*.



Conservation status. EN; appears to be declining within its very small range. Extirpated from Korsiah Banaki. (not shown on the map).

Remarks. This species is related to *E. persicus* but superficially resembles *E. sophiae*. Both species are distinguished mainly by molecular characters, and the morphological differences given may be quite vague.

Further reading. Esmaeili et al. 2014a, b (description, biogeography); Esmaeili et al. 2020b (molecular data and distribution); Freyhof & Yöğurtçuoğlu 2020 (generic position).

Esmailius isfahanensis

Common name. Esfahan killifish.

Diagnosis. Distinguished from other species of *Esmailius* by: ● male with black dorsal, pelvic and anal margins / ●

female mottled with many large blotches or narrow bars on flank, usually fused into a midlateral, wide, dark-brown band / ○ 25–29 total scales along lateral series / ○ female with a distinctive black spot at caudal base. Size up to 45 mm SL.

Distribution. Iran: Lower Zayandeh drainage (e.g., Hasan Abad, Malvajerd qanats).

Habitat. Springs and spring-fed streams.

Biology. Live up to 3 years, mature in a few months at about 25 mm SL, usually late in year of birth. Males establish territories along banks, usually in dense vegetation but also between rocks, which they defend against rival males. Spawns April–July. Females spawn with one or more males, usually in algae or other vegetation near surface or in gravel beds. Few eggs are laid in the substrate during a spawning event. Individual females may produce several clutches in one day. Feeds on algae, detritus, and small invertebrates.



Esmailius isfahanensis; Zayandeh, Iran; female, 35 mm SL.

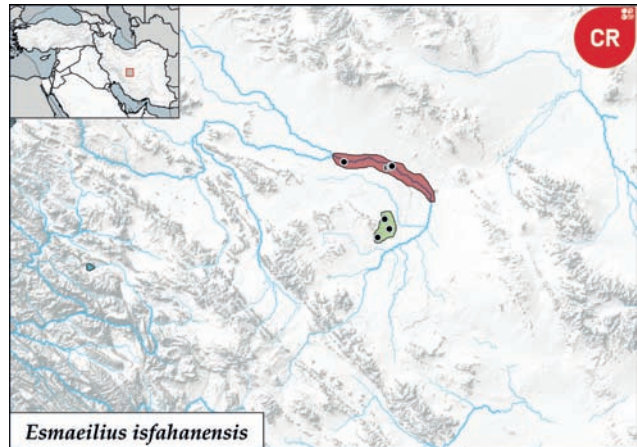


Esmailius isfahanensis; Zayandeh, Iran; male, 32 mm SL.

Conservation status. CR; appears to be declining within its very small range. May have disappeared from Varzaneh.

Remarks. *Esmaeilius sophiae* inhabits Gavkhoni marshes in very lower Zayandeh drainage. The black spot at the caudal base in the female is much more pronounced in small individuals and fades in large adults of more than 25 mm SL.

Further reading. Hrbek et al. 2006 (description); Keivany 2013 (biology); Esmaeili et al. 2020b (molecular data and distribution); Freyhof & Yoğurtçuoğlu 2020 (generic position).



Isolation of endorheic Kor basin. In West Asia, numerous rivers do not reach the sea but terminate in lakes or marshes that are often hypersaline. These rivers are known as endorheic rivers and endorheic basins, in contrast to exorheic rivers that flow to the sea. One of the many endorheic rivers in Iran is the Kor, which has been the subject of considerable study. During the Quaternary period, the Palaeo-Kor drained to the Persian Gulf via the Mond River. From the late Quaternary (20,000 years ago) until the Holocene (2000 years ago), the exorheic drainage was closed due to the tectonic uplift of the Zagros Mountains. This resulted in the Kor becoming endorheic and isolated from the exorheic Mond. Unsurprisingly, most species currently found in the endorheic Kor are the same as those found in the Mond and other adjacent tributaries of the Persian Gulf. The isolation of the Kor occurred relatively recently. However, this may be a partial story. While two endemic fish species, *Esmaeilius shirini* and *Oxynoemacheilus tongiorgii*, are present in the Kor, several species found in the Mond are absent in the Kor, including *Capoeta mandica*, and *Garra rufa*. Conversely, *Chondrostoma regium* occurs in the Kor but is absent in the Mond. Clearly, the biogeography of the Kor is far more complex and its connection to the Lake Maharlo basin (home to the endemic *E. persicus*) also requires further investigation. **Further reading.** Gholami et al. 2014 (geology).



Esmaeilius persicus; Pirbanoo spring, Iran; female, ~30 mm SL.



Esmaeilius persicus; Pirbanoo spring, Iran; male, ~30 mm SL.

Esmaeilius persicus

Common name. Maharlo killifish.

Diagnosis. Distinguished from other species of *Esmaeilius* by: ● female with distinct, brown bars along lateral midline / ○ male with narrow white anal, dorsal, and pelvic margin / ○ female with a distinctive black spot at caudal base / ○ 24–29 total scales along lateral series. Size up to 35 mm SL.

Distribution. Iran: Lake Maharlo basin.

Habitat. Small freshwater or brackish springs and pools, usually without vegetation.

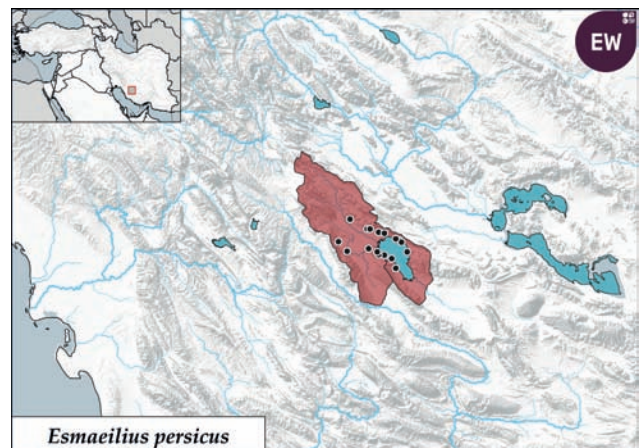
Biology. Live up to 4 years, mature in a few months, usually late in year of birth. Males establish territories along banks, usually in dense vegetation, but also between rocks, which they defend against rivals. Spawns April–November (Barm-e Shur spring). Females spawn with one or more males, usually in vegetation near surface or in gravel beds. Few eggs are laid in substrate during a spawning event. Individual females may produce several clutches in one day. Feeds on algae, detritus and small invertebrates.

Conservation status. Extinct in the wild; found only in one spring in 2013 but seems to have disappeared from nature since. Water abstraction, habitat destruction, pollution, introduction of non-native species and reduced

rainfall due to climate change have caused all populations to vanish and springs to dry up.

Remarks. Very few female *E. persicus* lack the diagnostic narrow brown bars on the flanks but have a mottled pattern. This species was called *Aphanius farsicus* between 2011 and 2020.

Further reading. Monsefi et al. 2009 (reproduction); Teimori et al. 2011 (*A. farsicus*); Esmaeili et al. 2020b (molecular data and distribution); Freyhof & Yöğurtçuoğlu 2020 (generic position, discussion of *Brachylebias*, *E. persicus*).



***Aphanius persicus*: Forward and back again.** *Aphanius persicus* (Jenkins, 1910) was previously known as the scientific name of the Maharlo killifish. When Gaudant (2011) studied the fossil killifish *Brachylebias persicus* Priem, 1908, he concluded that this must be a species of *Aphanius* and thus transferred *B. persicus* to *Aphanius*. Consequently, *A. persicus* (Jenkins, 1910) became a junior secondary homonym of *A. persicus* (Priem, 1908). As the name *A. persicus* was no longer available for the Maharlo killifish, it was redescribed as *A. farsicus*. However, upon the separation of the phylogenetic groups of *Aphanius* into different genera, *Brachylebias* was considered *incertae sedis*, as there were no arguments to place it in one of the recognised genera, and it could not be excluded that it represents a distinct (extinct) evolutionary lineage. As it is highly unlikely that *Brachylebias* might have been a species of *Esmailius*, it was transferred back to *Brachylebias*. As a result of this reclassification, *Aphanius farsicus* became a junior synonym of *A. persicus* (Jenkins, 1910), and the latter name is once again available for the Maharlo killifish. This species was then transferred to the new genus *Esmailius*. **Further reading.** Freyhof & Yöğurtçuoğlu 2020 (*A. persicus* and *Brachylebias*).



Water is extracted from springs everywhere in West Asia, such as in Pirbanoo in Iran. The picture was taken a few weeks before the spring dried out and one of the last populations of *Esmailius persicus* vanished in 2007.



Esmaeilius shirini; Khosroshirin spring, Iran; female, ~35 mm SL.



Esmaeilius shirini; Khosroshirin spring, Iran; male, ~30 mm SL.

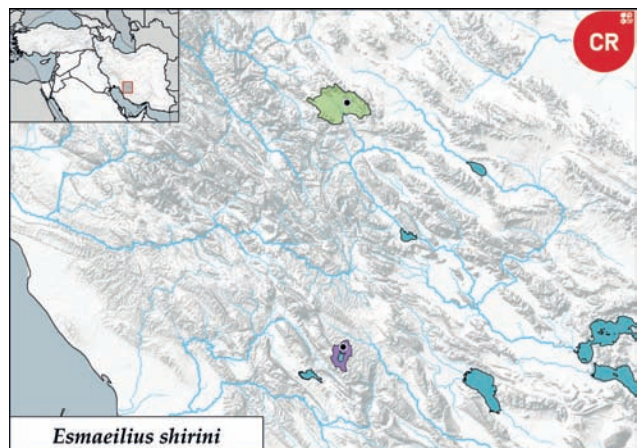
Esmaeilius shirini

Common name. Shirin killifish.

Diagnosis. Distinguished from other species of *Esmaeilius* by: ● male usually with 7–11 wide, brown bars on flank / ○ male with wide and white dorsal margin / ○ female with irregular set brown or dark-grey spots and blotches / ○ female without or with a very small black spot at caudal base / ○ 25–31 total scales along lateral series. Size up to 36 mm SL.

Distribution. Iran: Khosroshirin, a headwater spring-stream system in upper Kor drainage and Arjan wetland in Helleh drainage (introduced).

Habitat. Streams and springs with low to moderate current, gravel and mud substrate covered with dense filamentous algae.



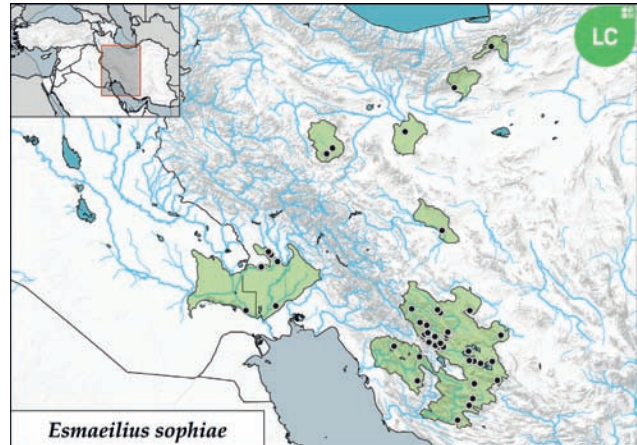
Biology. No data. Expected to be similar to other *Esmaeilius*.
Conservation status. CR; has declined sharply in its last native habitat and may be on the verge of extinction, occurring in only one non-native habitat.

Further reading. Gholami et al. 2014 (description, biogeography); Esmaeili et al. 2020b (molecular data and distribution); Freyhof & Yoğurtcuoğlu 2020 (generic position).

Esmaeilius sophiae

Common name. Persian killifish.

Diagnosis. Distinguished from other species of *Esmaeilius* by: ○ male with narrow white anal, dorsal and pelvic margin / ○ male with 8–19, usually 11–16 brown bars on



Esmaeilius sophiae; Cheshmeh Ali spring, Iran; female, 32 mm SL.



Esmaeilius sophiae; Gavkhoni marsh, Iran; male, 26 mm SL.

flank / ○ female with irregular set brown or dark-grey spots and blotches / ○ female with a distinctive black spot at caudal base / ○ 25–31 total scales along lateral series. Size up to 42 mm SL.

Distribution. Iraq: Shatt al-Arab, north of Basra. Iran: Springs in Lake Namak basin, lower Karkheh and Karun drainage, Helleh drainage, and springs in Mond drainage, possibly in a qanat near Jahrom. Endorheic basins of Kor, Esfahan, and Sirjan, Western Kavir (Cheshmeh Ali spring), and Gavkhoni marsh in the very lower Zayandeh drainage.

Habitat. Rivers, streams, springs and qanats with stagnant or slowly flowing water, usually with dense submerged vegetation, but also with little or no vegetation and small gravel and pebble substrates.

Biology. Lives up to 4 years, maturing in a few months, usually late in the year of birth. Males establish territories along banks, usually in dense vegetation but also between rocks, which they defend against rivals. Females spawn with one or more males, usually in algae or other vegetation near surface or in gravel beds. Few eggs are laid in substrate during a spawning event. Individual females may produce several clutches in one day. Feeds on algae, detritus and small invertebrates.

Conservation status. LC; one population in Mond drainage extirpated due to introduction of *Xiphophorus hellerii* and *Gambusia holbrooki*.

Remarks. *Esmaeilius arakensis*, *E. mesopotamicus*, *E. pluristriatus*, and *E. kavirensis* are synonyms.

Further reading. Coad 1996 (distribution); Coad 2009a (description as *E. mesopotamicus*); Esmaeili et al. 2012 (description as *A. pluristriatus*); Keivany et al. 2012 (rediscovery as *E. mesopotamicus*); Teimori et al. 2012 (description

of *E. akarensis*); Keivany & Esmaeili 2013 (*A. mesopotamicus*, conservation); Esmaeili et al. 2014b (description as *A. kavirensis*); Gholami et al. 2014 (biogeography); Esmaeili et al. 2020b (molecular data and distribution); Freyhof & Yöğurtçuoğlu 2020 (species diversity).

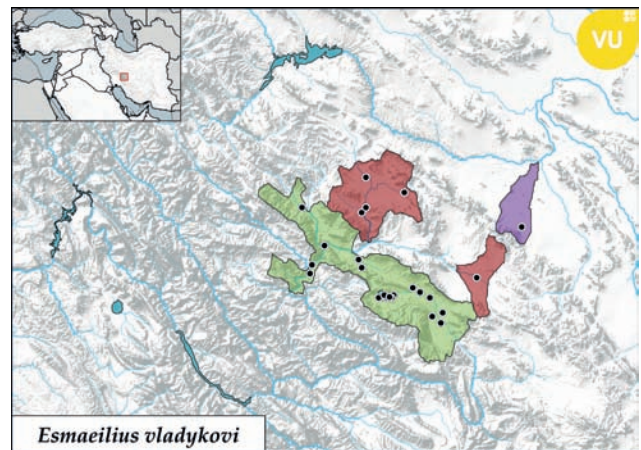
Esmaeilius vladykovi

Common name. Chaghakhor killifish.

Diagnosis. Distinguished from other species of *Esmaeilius* by: ● 36–47 scales in lateral series / ○ female without distinctive black spot at caudal base / ○ female with irregular set brown or dark-grey spots and blotches, blotches sometimes slightly vertically elongated / ○ male with 9–14 brown bars on flank / ○ male with wide white anal, and dorsal margin. Size up to 65 mm SL.

Distribution. Iran: Upper Karun drainage. Introduced to Hozmahi spring in Zayandeh drainage.

Habitat. High-altitude wetlands in the Zagros Mountains (at about 2400 m). In springs, ponds, streams, and marshes.



Esmaeilius vladykovi; Boldaji, Iran; female, ~30 mm SL.



Esmailius vladykovi; Boldaji, Iran; male, ~35 mm SL.

Biology. Live up to 4 years, mature in a few months, usually late in year of birth. Males establish territories along banks, usually in dense vegetation, but also between rocks, which they defend against rivals. Spawning peaks in early April but lasts much longer. Females spawn with one or more males, usually in algae or other vegetation close to surface or in gravel beds. Adhesive eggs attached to plants in batches of 3–30 eggs hatch in 9–13 days at 21–22°C. Individual females may produce several clutches in one day. Feeds on algae, detritus, and small invertebrates.

Conservation status. VU; originally present at 10 sites, but has disappeared from four sites in the last 10 years.

Further reading. Coad 1988 (description); Pazooki et al. 2008 (food); Keivany & Soofiani 2004 (reproduction); Esmaeili et al. 2020b (molecular data, distribution); Freyhof & Yoğurtçuoğlu 2020 (generic position).

Kosswigichthys

The only species in this genus is a highly specialised pelagic killifish endemic to a single ancient lake in Eastern Anatolia. *Kosswigichthys* is related to *Anatolichthys*, but both genera are long and well-separated. *Kosswigichthys* is one of West Asia's few phylogenetically isolated and

highly adapted lacustrine fish species. Its only habitat, Lake Hazar, is a rift lake situated at the border of the Anatolian and Arabian plates within the East Anatolian Fault Zone (EAFZ). This is one of the most significant active continental transform fault zones globally. Lake Hazar may be the oldest lake in West Asia, having possibly commenced development in the late Miocene or early Pliocene. However, some studies suggest a quite recent age for the lake, of about 150–180,000 years. Molecular data demonstrate that *Kosswigichthys* is isolated from *Anatolichthys* for longer than the late Miocene and that its ancestors may have inhabited the area much longer. It is possible that they found refuge in Lake Hazar, adapting to lacustrine conditions when the lake was formed. Their adaptations to lacustrine environments are similar to those of *Anatolichthys saldae* and *A. splendens*, which also show a lack of or reduced scales, a slender body, and a strongly upturned mouth. However, these species inhabit relatively young lakes and might have separated from their riverine ancestors only during the late Pleistocene. At present, *K. asquamatus* is the sole representative of the Aphaniidae in the upper Mesopotamian drainage system. **Further reading.** Freyhof & Yoğurtçuoğlu 2020 (generic structure of Aphaniidae).



Kosswigichthys asquamatus; Hazar Lake, Türkiye; female, ~33 mm SL.



Kosswigichthys asquamatus; Hazar Lake, Türkiye; male, ~30 mm SL.

Kosswigichthys asquamatus

Common name. Hazar killifish.

Diagnosis. Distinguished from other species of Aphaniidae by: ● teeth conical, in three rows / ○ body without scales / ○ no black bars in caudal in male. Size up to 36 mm SL.

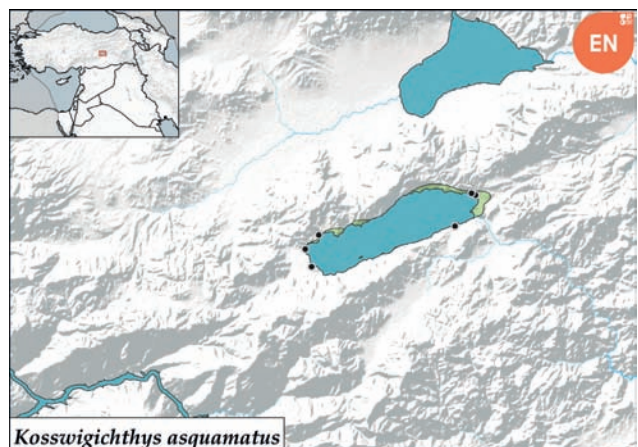
Distribution. Türkiye: Lake Hazar.

Habitat. Pelagic come to shores in spring and summer to spawn. Feeds on algae, invertebrates, and plankton.

Biology. No data.

Conservation status. EN; appears to be declining within its very small range.

Further reading. Sözer 1942 (description); Freyhof & Yoğurtçuoğlu 2020 (distribution, morphology, generic position).





Lake Hazar, the only habitat of *Kosswigichthys asquamatus*, is a deep, ancient, tectonic lake in West Asia.

Paraphanius

Paraphanius comprises seven species, plus one undescribed, that are all superficially similar but well distinguished by molecular characters. *Paraphanius* species are particularly diverse in the Eastern Mediterranean, especially in the Levant. One species, *P. mento*, is distributed across the Levant,

the upper Euphrates and Tigris, where it appears to have a localised distribution pattern. Further studies are required to determine whether this species represents a complex of closely related species. **Further reading.** Esmaeili et al. 2020b (description of *Paraphanius*); Freyhof & Yoğurtçuoğlu 2020 (generic structure of Aphaniidae).

Key to species of *Paraphanius*

The key is only suitable for adult fishes, ideally nuptial females and males, larger than 30 mm SL.

1a - Adult male with silvery, very narrow, vertical lines on flank.

.....2

1b - Adult male with silvery spots on flank, often organised in fuzzy, vertical series but not in lines (juvenile males of all species often with lines).

.....3

2a - Adults very large, often more than 60 mm SL; lower jaw strongly upturned; in male, silvery lines irregularly shaped, often interrupted; background colour greenish, greyish or dark-blue in male, upper part of head and back, not orange.

.....*P. mentoides*

2b - Adults small, rarely more than 40 mm SL; lower jaw slightly upturned; silvery lines regularly shaped, rarely interrupted in male; background colour bright blue in male, with an orange upper part of head and anterior back.

.....*P. striptus*

3a - Female without midlateral stripe or pale-brown marbled pattern on flank.

.....4

3b - Female with pale-brown marbled pattern on flank and a midlateral, pale-brown stripe between vertical of dorsal base and caudal base.

.....5

4a - Silvery scales on caudal peduncle not in regular lines in female; silvery spots organised in vertical rows in male.

.....*P. similis*

4b - Silvery scales on caudal peduncle in regular lines in female; silvery spots not organised in vertical rows in male (characters poorly known and very different in different populations).

.....*P. mento*

5a - Silvery spots distinct, well isolated from each other, not organised in vertical rows in adult male (in rows in juveniles).

.....*P. orontis*

5b - Silvery spots often fused and usually organised in vertical rows in juvenile and adult male.

.....6

6a - Female without marbled pattern on back; usually with single pale-brown dots in middle of scales.

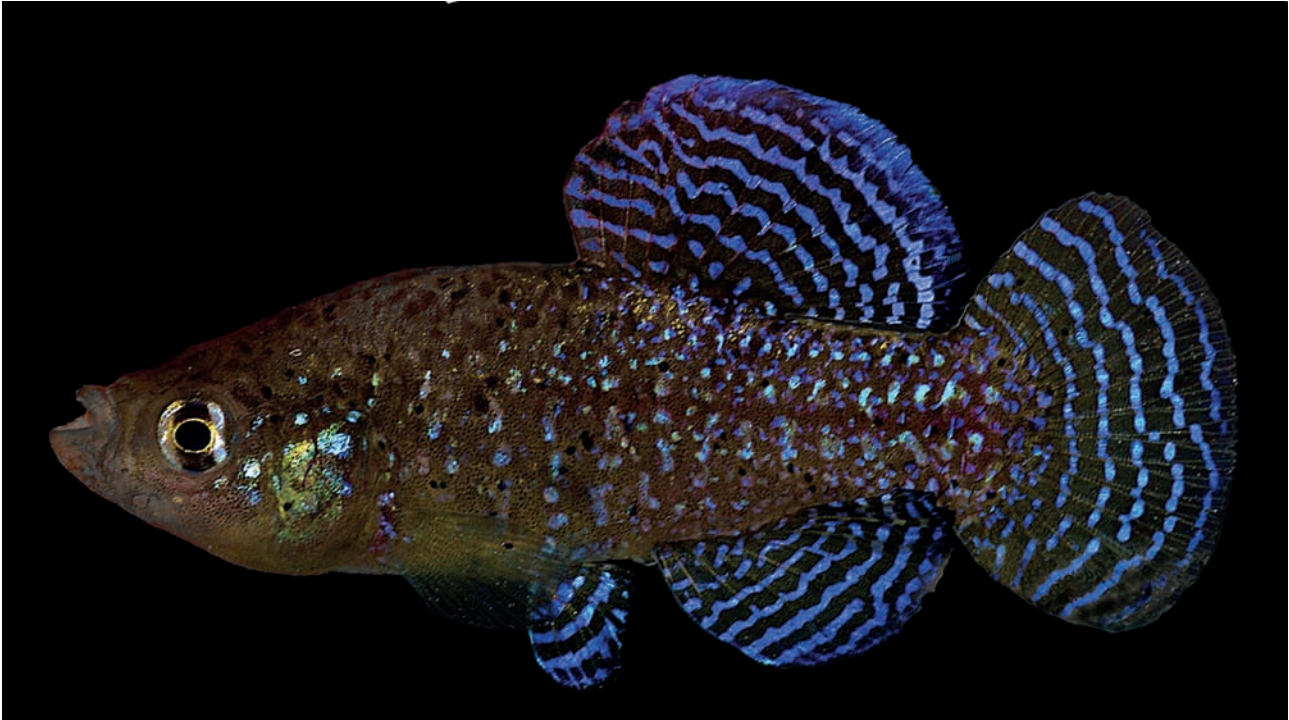
.....*P. alexandri*

6b - Female with marbled pattern on back; usually without pale-brown dots in middle of scales.

.....*P. boulengeri*



Paraphanius alexandri; Elbistan, Ceyhan drainage, Türkiye; female, 33 mm SL.



Paraphanius alexandri; Ceyhan drainage, Türkiye; male, 45 mm SL.

Paraphanius alexandri

Common name. İskenderun killifish.

Diagnosis. Distinguished from other species of *Paraphanius* by: ○ male bluish, black or dusty grey with roundish or elongated silvery spots on flank organised in vertical series / ○ silvery spots indistinct, overlaid by many fine, powder-like dots / ○ pelvic reaching to anal origin in adult male / ○ pre-dorsal distance 57–60 % SL / ○ pre-anal distance 63–70 % SL / ○ interorbital distance 36–45 % HL female with pale-brown marbled pattern on flank / ○ female with pale-brown stripe between vertical of dorsal-base and caudal base / ○ female with silvery scales above and below stripe on caudal peduncle / ○ female without marbled pattern on back, often with single pale-brown dots in middle of scales. Size up to 46 mm SL.

Distribution. Türkiye: Middle and upper Ceyhan drainage, Erzin drainage, and small coastal streams in Hatay south to Arsuz. Introduced in warm springs in upper Tohma drainage (Euphrates).

Habitat. Springs, lakes and slow-flowing streams.

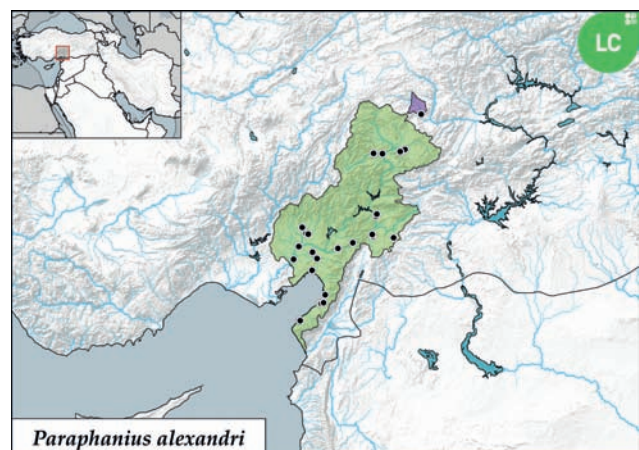
Biology. Live up to 4 years, mature in a few months, usually late in year of birth. Males establish territories along banks, usually in dense vegetation, defending against rivals.

Females spawn with one or more males, usually in vegetation close to surface. Individual females produce several clutches in 1 day. Feeds on algae, detritus and small invertebrates.

Conservation status. LC.

Remarks. Appears to be absent from the lower Ceyhan drainage.

Further reading. Akşiray 1948 (description).





Paraphanius boulengeri; Gölbaşı, Ceyhan drainage, Türkiye; female, 40 mm SL.

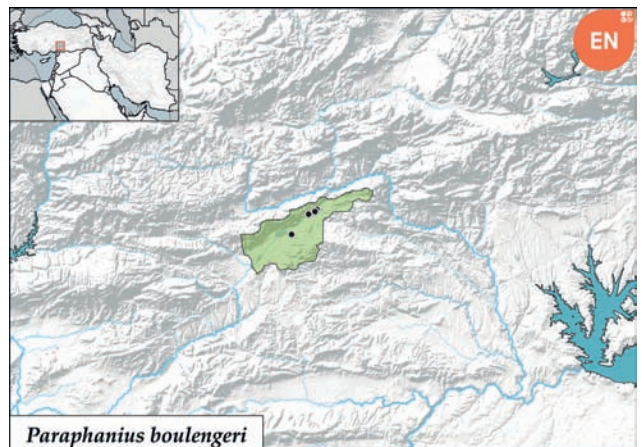


Paraphanius boulengeri; Gölbaşı, Ceyhan drainage, Türkiye; male, 37 mm SL.

Paraphanius boulengeri

Common name. Gölbaşı killifish.

Diagnosis. Distinguished from other species of *Paraphanius* by: ○ male bluish, black or dusty grey with roundish or elongated silvery spots on flank organised in vertical series / ○ silvery spots indistinct, overlaid by many fine, powder-like dots / ○ pelvic reaching to anal origin in adult male / ○ pre-dorsal distance 55–62 % SL / ○ pre-anal distance 62–64 % SL / ○ interorbital distance 33–40 % HL / ○ female with pale-brown marbled pattern on flank / ○ female with pale-brown stripe between vertical of dorsal-base and caudal base / ○ female with silvery scales above and below stripe on caudal peduncle / ○ female with marbled pattern on back. Size up to 40 mm SL.



Distribution. Türkiye: Gölbaşı lakes in Adıyaman.

Habitat. Lakes and canals with or without dense underwater vegetation.

Biology. Live up to 4 years, mature in a few months, usually late in year of birth. Males establish territories along banks, usually in dense vegetation, defending against rivals. Females spawn with one or more males, usually in

vegetation close to surface. Individual females produce several clutches in one day. Feeds on algae, detritus, and small invertebrates.

Conservation status. EN; appears to be declining within its very small range. Its only habitat has been dominated by invasive *Gambusia holbrooki*.

Further reading. Akşiray 1948 (description).



Paraphanius boulengeri is endemic to Gölbaşı lakes in Ceyhan drainage, a small endemism hotspot in the region.



Paraphanius mento; Orontes drainage, Syria; female, ~40 mm SL.



Paraphanius mento; Orontes drainage, Syria; male, ~45 mm SL.



Paraphanius mento; Spring of Barada, Syria; male, ~50 mm SL.



Paraphanius cf. *mento*; Shatt al Arab, Iraq; female, 32 mm SL; male, 31 mm SL. © A. Ali.



Paraphanius cf. *mento*; Ein Feshkha, Israel; male, ~40 mm SL.

Paraphanius mento

Common name. Iridescent killifish.

Diagnosis. Distinguished from other species of *Paraphanius* by: ○ male bluish, black or dusty grey with roundish or elongated silvery spots on flank, spots might be organised in vertical series or in longitudinal rows (with whitish bars in lower Mesopotamia) / ○ silvery spots distinct, not overlaid by many fine, powder-like dots / ○ female with silvery spots on each flank-scale (female with whitish blotches in lower Mesopotamia) / ○ female without midlateral stripe or pale-brown marbled pattern on flank / ○ pelvic not reaching to anal origin in adult male. Diagnostic character blurred as several species seemed to be involved. Size up to 52 mm SL.

Distribution. Tigris downstream of Mosul and common in marshes along Shatt al-Arab/Arvand. Upper Nahr al Khābūr in Syria, Damascus basin, Litani and Jordan drainages, and Dead Sea basin (Ein Feshkha spring). Also, one record in Qweiq and in very upper Orontes in Syria, downstream to Homs.

Habitat. Slow-flowing rivers, lakes, and marshes usually associated with dense aquatic vegetation.

Biology. Live up to 3 years, mature in a few months, usually late in year of birth. Spawns April to July in southern Iraq. Males establish territories along banks, usually in dense vegetation, defending against rivals. Females spawn with one or more males, usually in vegetation close to surface. Individual females produce several clutches in one day. Feeds on algae, detritus and small invertebrates.

Conservation status. LC; extirpated from Qweiq and seems to have disappeared from Iranian part of Mesopotamian marshes.

Remarks. There is a considerable population diversity within *P. mento*, as recognised here. *Paraphanius mento* occurs in sympatry with *P. striptus* in the northern Dead

Sea basin and possibly elsewhere in Jordan drainage. Both species have also hybridised extensively in the region. *Paraphanius mento* was described from Tigris at Mosul based on individuals with isolated iridescent spots. Fish from the lower Tigris show a barred pattern in males (similar to *P. striptus*) and a marmorated pattern in females (vs. plain in *P. striptus* and other populations of *P. mento*). These might not be conspecific with *P. mento*. Molecular characters and details in colour pattern of fish from Mosul have not yet been studied. Molecular analyses place fish from the Litani and upper Orontes, lowermost Tigris, Jordan, Damascus basin, and middle Orontes in three distinct clades, with *P. striptus* nested in between in some analyses. The diversity of *P. mento* will have to be re-examined when material from Mosul becomes available.

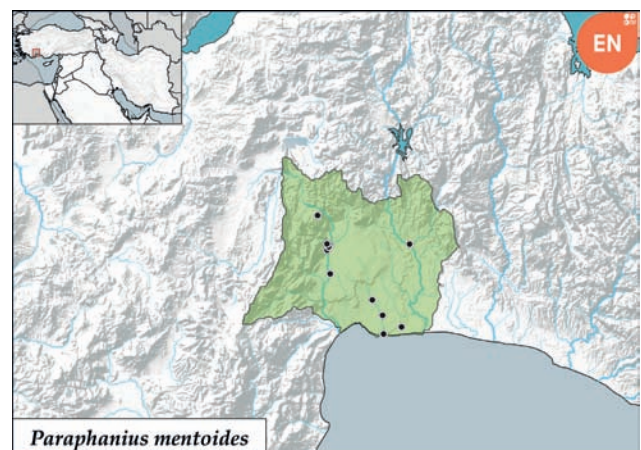
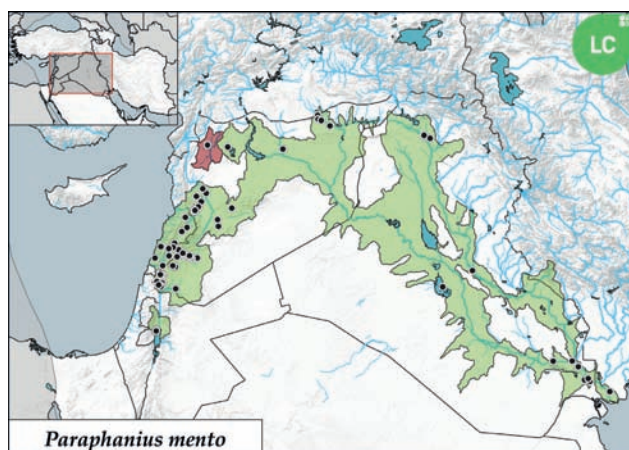
Further reading. Al-Daham et al. 1977 (biology).

Paraphanius mentoides

Common name. Kirkgöz killifish.

Diagnosis. Distinguished from other species of *Paraphanius* by: ○ adults very large, often more than 60 mm SL / ○ pre-dorsal distance 62–66 % SL / ○ pre-anal distance 67–72 % SL / ○ interorbital distance 32–33 % HL / ○ male bluish, black or dusty grey with roundish or elongated silvery spots on flank, organised in vertical lines / ○ silvery lines distinct, not overlaid by many fine, powder-like dots / ○ lower jaw strongly upturned / ○ background colour greenish, greyish or dark-blue in male, upper part of head and back not orange / ○ female without silvery scales and without brown stripe along lateral midline. Size up to 66 mm SL.

Distribution. Türkiye: Yamansaz marsh, Düden spring in Antalya, Kirkgöz spring and outflowing stream Yediarıklar. Introduced in Lake Nemrut, a volcano crater lake in East Anatolia (not shown on map).





Paraphanius mentoides; Kırkgöz spring, Türkiye; female, 60 mm SL.



Paraphanius mentoides; Kırkgöz spring, Türkiye; male, 58 mm SL.

Habitat. Lakeshores, springs, and spring-fed streams.

Biology. Live up to 7 years, mature after first winter. Spawns May–July. Males establish territories along banks, usually in dense vegetation, defending against rivals. Females spawn with one or more males, usually in vegetation close to surface. Individual females produce several

clutches in one day. Feeds on algae, detritus, and small invertebrates.

Conservation status. EN; appears to be declining within its very small range.

Further reading. Akşiray 1948 (description); Güçlü & Küçük 2011 (reproduction, as *Aphanius mento*).



Nemrut Crater Lake is the habitat of a non-native population of *Paraphanius mentoides*.



Paraphanius orontis; Lake Gölbaşı, Orontes drainage, Türkiye; female, 38 mm SL.



Paraphanius orontis; Lake Gölbaşı, Orontes drainage, Türkiye; male, 39 mm SL.

Paraphanius orontis

Common name. Asi killifish.

Diagnosis. Distinguished from other species of *Paraphanius* by: ○ male black or dusty grey with roundish silvery spots on flank not organised in vertical series / ○ silvery spots large, distinct, well isolated from each other, without or with few fine, powder-like dots / ○ female with pale-brown marbled pattern on flank / ○ female with pale-brown stripe between vertical of dorsal-base and caudal base / ○ female with a line of silvery scales above and below stripe on caudal peduncle / ○ pelvic reaching to anal origin in adult male / ○ pre-dorsal distance 57–61 % SL / ○ pre-anal distance 62–65 % SL / ○ interorbital distance 39–45 % HL. Size up to 43 mm SL.

Distribution. Türkiye: Lower Orontes drainage downstream to former Lake Amik. Introduced to lower Manavgat drainage east of Antalya (not shown in map).

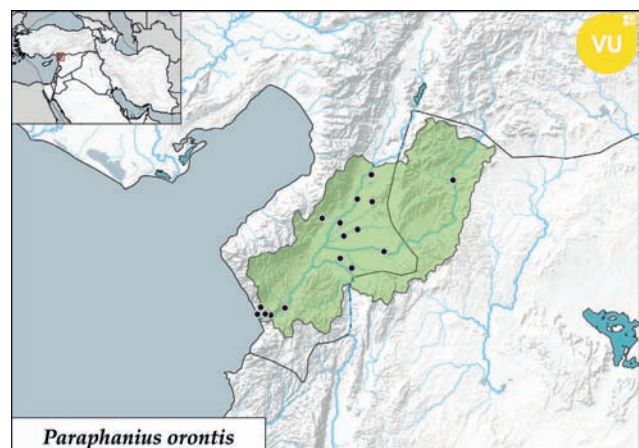
Habitat. Lakes, slow-flowing rivers, and canals.

Biology. Live up to 3 years, mature in a few months, usually late in year of birth. Males establish territories along banks, usually in dense vegetation, defending against rivals.

Females spawn with one or more males, usually in vegetation close to surface. Individual females produce several clutches in one day. Feeds on algae, detritus, and small invertebrates.

Conservation status. VU; found in fewer than 10 independent populations, some of which are declining.

Further reading. Akşiray 1948 (description).



The Orontes, a composite river. Tectonic activities significantly modify the river system of the Levant. The Jordan, the Litani, and the Orontes have a particularly troubled history, repeatedly ending in endorheic, terminal lakes. These rivers were connected and disconnected from each other and the Euphrates or drained into the Mediterranean through short, temporary outlets in the coastal mountain ranges. The Orontes is the longest river in the Levant, with a length of 600 km. It has its source in the Ayn az-Zarqa spring in the Lebanese city of Baalbek, from where it

flows north through Syria to Türkiye and into the Mediterranean. Two major tributaries, the Afrin and the Karasu, originate in Türkiye and flow south to meet the Orontes at the former Lake Amik. The history of the Orontes is as interesting as it is complicated. During the Upper Miocene and early Pliocene, the current-day lower Orontes was the only river flowing into the Mediterranean. The upper and middle parts of the Orontes flowed independently to the Euphrates. The current-day endorheic Qweiq was a tributary of the middle Orontes when it was still connected to the Euphrates. During the Lower Pleistocene, the al-Ghab Valley, which was formed during the Miocene, subsided, uplifting the Gabal az-Zawiyah Mountains. The uplifting of Gabal az-Zawiyah, which extended toward the Palmyra fold belt, severed the connections between the Proto-Orontes and the Euphrates. Nevertheless, the connection between the Qweiq and the Euphrates remained intact and only dried out in the early Holocene. At that time, the present Orontes consisted of three independent rivers separated from each other by mountain plateaus.

The upper river originated in Lebanon and discharged into the current-day Nahr al Kebir South. The middle sector, represented by the al-Ghab basin at the time, had its outflow in the Nahr Marqīyah, today one of Syria's small coastal rivers. There is evidence that it was also connected to the Nahr al-Kabir North, another coastal river of the present day, via the Nahr al-Abyad, whose upper reaches were at that time a source of the Nahr al-Kabir North. The lower course, which opened to the Mediterranean following a tectonic subsidence, allowed the coastal Küçük Orontes to flow to Lake Amik. All three parts had been endorheic for some time and formed large lakes before being connected. The water of the huge spring areas in today's lower Orontes and the Afrin and Karasu flows drained into the large Lake Amik, forming an endorheic basin. The waters of the Middle sector formed extensive terminal lakes and marshes of al-Ghab and Aharne following the disconnection of this area from the Nahr al Kabir north. The upper sector of the Orontes formed Lake Homs following the disconnection of this area from the Nahr al Kabir south. The basaltic extrusions that erupted during the Quaternary separated the Orontes from the coastal rivers. The confluence of the three formerly separated segments of the Orontes is relatively recent, around 6000 years ago. It was caused by retrogressive erosion.

The recent joining of the different sectors of the Orontes is still reflected in its faunal composition. For example, *Garra variabilis* is only known from the middle and upper sectors. The northern sector is restricted to the Nahr al-Kabir South, *Alburnus magnificus*, *Oxynoemacheilus hamwii*, *O. amanos*, and *Pseudophoxinus turani* are endemic to this sector. In contrast, *Oxynoemacheilus shehabi* is limited to the southernmost Orontes. In the widely distributed and ubiquitous *Paraphanius* killifishes, three distinct mtDNA lineages have been identified, corresponding to *P. orontis* in the northern Orontes, *P. mento* in the southern Orontes, and a potentially undescribed species in between, as well as in some adjacent coastal streams. **Further reading.** Alwan 2010 (geology and biogeography).



Paraphanius similis; Ereğli, Türkiye; female, 31 mm SL.



Paraphanius similis; Ereğli, Türkiye; male; 28 mm SL.



Paraphanius similis; lower Seyhan; Türkiye; female, ~25 mm SL.



Paraphanius similis; Zengen, Türkiye; male, ~30 mm SL.

Paraphanius similis

Common name. Adana killifish.

Diagnosis. Distinguished from other species of *Paraphanius* by: ○ male bluish, black or dusty grey with roundish or elongated silvery spots on flank organised in vertical series / ○ silvery spots distinct, without or with few fine, powder-like dots / ○ female with many silvery spots on flank, not organised as continuous rows on caudal peduncle / ○ female without midlateral stripe or pale-brown marbled pattern on flank / ○ pelvic reaching to anal origin in adult male / ○ pre-dorsal distance 57–60 % SL / ○ pre-anal distance 63–68 % SL / ○ interorbital distance 36–41 % HL / ○ Size up to 40 mm SL.

Distribution. Türkiye: Lower Tarsus, Seyhan and Ceyhan. Also, in springs in Ereğli marshes.

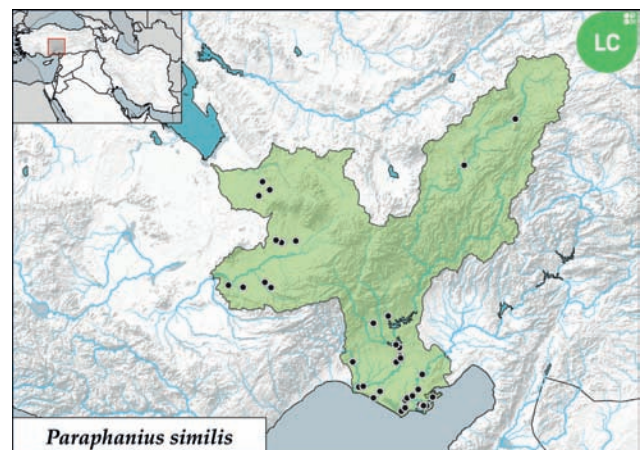
Habitat. Lakes, slow-flowing rivers and coastal marshes with fresh or brackish water. Also, in canals, large reservoirs and many heavily polluted and artificial habitats.

Biology. Live up to 3 years, mature in a few months, usually late in year of birth. Males establish territories along banks, usually in dense vegetation, defending against rivals.

Females spawn with one or more males, usually in vegetation close to surface. Individual females produce several clutches in one day. Feeds on algae, detritus and small invertebrates.

Conservation status. LC.

Further reading. Akşiray 1948 (description).





Paraphanius striptus; Einot Timsach, Israel; female, ~32 mm SL.



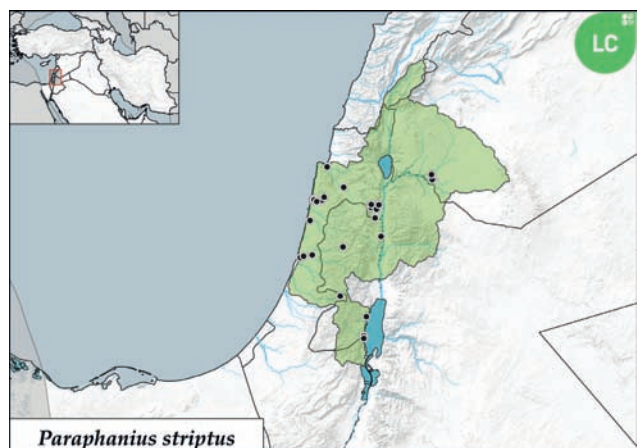
Paraphanius striptus; Einot Timsach, Israel; male, ~35 mm SL.

Paraphanius striptus

Common name. Palestinian killifish.

Diagnosis. Distinguished from other species of *Paraphanius* by: ○ adults small, rarely more than 40 mm SL / ○ lower jaw slightly upturned / ○ background colour bright blue in male, with an orange upper part of head and anterior back / ○ male with silvery lines, regularly shaped, rarely interrupted / ○ female with few silvery spots on flank, not organised as continuous rows on caudal peduncle / ○ female without brown stripe along lateral midline. Size up to 40 mm SL.

Distribution. Israel and Syria: Jordan drainage south of Lake Tiberias, locally in Jarmuk drainage, and in several coastal spring-stream systems.





Paraphanius sp.; Orontes drainage, Syria; immature male, 32 mm SL.

Habitat. Springs and streams with dense underwater vegetation.

Biology. Live up to 3 years, mature in a few months, usually late in year of birth. Males establish territories along banks, usually in dense vegetation, defending against rivals. Females spawn with one or more males, usually in vegetation close to surface. Individual females produce several clutches in one day. Feeds on algae, detritus, and small invertebrates.

Conservation status. LC.

Remarks. Occurs in sympatry with *P. mento* in northern Dead Sea basin and possibly elsewhere in Jordan drainage. Here, both species hybridise, at least locally.

Further reading. Goren 1974 (description).

***Paraphanius* sp.**

Common name. Syrian killifish.

Diagnosis. The characters distinguishing this species from other *Paraphanius* have yet to be worked out. Size up to 46 mm SL.

Distribution. Syria: Nahr al Sanawbar, Nahr al-Hawaiz, and middle reaches of Orontes.

Habitat. Springs, rivers, and streams.

Biology. No data.

Conservation status. NE

