

Species and Subspecies of the Genus *Aphanius* Nardo 1897 (Pisces: Cyprinodontidae) in Turkey

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Abstract: The Turkish species of the Cyprinodontiform genus *Aphanius* Nardo 1827 are described. The naming used follows Wildekamp (1993) (1) as the latest available revision. Information is given on morphology, sexual dimorphism, colouration and distribution, as well as remarks on taxonomy, nomenclature, distribution, variability and conservation. Comments are given on the Lazara (1995) (2) revalidation of *Lebias* as a distinct genus. It is shown that Valenciennes (1846) (3) is the first revisor of *Lebias*, and not Lazara, and that *Aphanius* should be maintained as a genus. The taxon *Aphanius chantrei* (Galliard 1895) is regarded as a junior synonym of *Aphanius danfordii* (Boulenger 1890), a lectotype for *A. danfordii* is designated and a more detailed type locality is given.

Key Words: Fish Systematics, Cyprinodontidae, *Aphanius*, Killifish.

Türkiye'deki *Aphanius* Nardo 1827 (Pisces: Cyprinodontiade) Genusunun Türleri ve Alttürleri

Özet: *Aphanius* Nardo 1827 (Pisces: Cyprinodontidae) cinsinin Türkiye'de dağılım gösteren türleri tanımlandı. İsimlendirmede Wildekamp (1993) (1)'in yapmış olduğu revizyondan yararlanıldı. Balıkların morfolojik özellikleri, seksüel farklılaşmaları, renklemeleri ve dağılımları belirlenerek; taksonomi, isimlendirme, dağılım, çeşitlenme ve korunmaları konusunda ayrıntılı bilgiler verildi. Lazara (1995) (2)'nin yeniden değerlendirmesine dayanılarak *Lebias* ayrı bir genus olarak yorumlandı. Literatür bilgilerine göre *Lebias*'ı ilk revize edenin Lazara değil Valenciennes (1846) (3) olduğu sonucuna varılmıştır. Bu nedenle çalışmada "*Aphanius*" genus olarak korunmuştur. *Aphanius chantrei* (Galliard 1895) *Aphanius danfordii* (Boulenger 1890)'nin sinonimi kabul edilerek, *Aphanius danfordii* (Boulenger 1890) için yeni bir lektotip seçilmiş ve ayrıntılı tip lokalitesi verilmiştir.

Anahtar Sözcükler: Balık Sistematiği, Cyprinodontidae, *Aphanius*, Dişli Sazancık.

Introduction

The Cyprinodontiform fishes of the genus *Aphanius*, extant as well as fossil, are widely distributed along the late-period Tethys Sea coast lines. Fossil finds are known from many locations between southern Germany and Kirchisiah. Their present-day distribution has also been influenced by glacial and interglacial differences in the Mediterranean sea level. Since the description of the first species by Valenciennes (4) the genus has been revised several times and its species have been the subject of various studies. Many of these publications describe scale reduction as being found in populations inhabiting the lakes on the Anatolian plateau. Initially, the studies on scale reduction led to the description of new genera and new species, but later analyses resulted in the view that no genetical differentiation exists between the

populations inhabiting these lakes and those living in rivers and springs. In Wildekamp (1), the results of these studies are compiled and conclusions are reached on the status of the species and subspecies of the genus *Aphanius*.

In this article, a key is given of the *Aphanius* species presently known from the Turkish territory, followed by a discussion on the nomenclature of the genus and on the status of the species as given in Wildekamp (1). Comments are included on the Lazara (2) revalidation of the genus *Lebias*, and the synonymisation of *A. chantrei* with *A. danfordii* is motivated. An overview of the major systematical literature is given. Data are included which were collected during fieldwork in Turkey in 1982, 1989 and 1992 by the first author, as well as information gathered in summer, 1996, by all the authors.

Key to the Turkish species of the genus *Aphanius*.

1. Teeth conical, no scalation *A. asquamatus*
Teeth tricuspid, bod scales present 2
2. Male pattern with distinct cross-bars 3
Mate pattern spotted, with indistinct cross-bars *A. mento*
3. Body completely scaled 4
Body with reduced scalation 5
4. Maximum size under 60 mm total length, male with 6–10 dark vertical bars *A. anatoliae anatoliae*
Maximum size over 60 mm total length, male with more than 9 vertical bars 6
5. Slender, body depth 3.9–5.1 times in standard length, endemic to Lakes Gölçük and Salda *A. anatoliae splendens*
Slender, body depth 3.5–4.2 times in standard length, endemic to Lake Burdur *A. anatoliae sureyanus*
Moderate slender, body depth 3.2–3.8 times in standard length endemic to springs around Lake Acı *A. anatoliae transgrediens*
6. Breeding male with yellow caudal fin, occasionally with one vertical sub-marginal bar *A. fasciatus*
Breeding male with more than one vertical bar in clear caudal fin *A. danfordii*

The genus *Aphanius* Nardo 1827

Type Species: *Aphanius nanus* Nardo 1827 (= *A. fasciatus*) (by subsequent designation of Jordan (5)).

Cyprinus non Linnaeus 1758; Forskål (6) (misidentification).

Lebias non *Lebia* Oken 1817 (7); Valenciennes (4); Garman (8) systematics; Myers (9) (synonym of *Cyprinodon*); Lazara (2) (revalidation).

Aphanius Nardo 1827 (10); Garman (8) (synonym of *Lebias*); Myers (9) (revalidation); Miller (11) (systematics, revalidation); Steinitz (12) (revision); Radda (13) (systematics); Tortonese (14) (systematics); Wildekamp (1) (systematics).

Poecilia non Bloch & Scheider 1801; Cuvier (15) (misidentification).

Cyprinodon non Lacépède 1803; Valenciennes (3) (systematics).

Tellia Gervais 1853 (16) (Type spec.: *Tellia apoda* Gervais 1853, by monotypy); Hoedeman (17) (synonym of *Aphanius*); Huber (18) subgenus).

Micromugil Gulia 1861 (19) (Type spec.: *Micromugil timidus* Gulia 1861 (= *A. fasciatus*) by original designation); Garman (8) (synonym of *Lebias*); Tortonese (14) (synonym of *Aphanius*); Villwock (20) (synonymy).

? *Alpismaris* Risso 1826 (21); Moreau (22); Wildekamp (1) (systematics).

Alpismaris non Risso 1826; Roule (23); Wildekamp (1) (systematics).

Kosswigichthys Sözer 1942 (24) (Type spec.: *Kosswigichthys asquamatus* Sözer 1942, by monotypy); Franz & Villwock (25) (synonym of *Aphanius*); Villwock (20) (Subgenus in *Aphanius*); Parenti (26) (distinct genus); Wildekamp (1) (synonym of *Aphanius*).

Anatolichthys Kosswig & Sözer 1945 (27) (Type spec.: *Anatolichthys splendens* Kosswig & Sözer 1945, by monotypy); Villwock (20) (synonym of *Aphanius*); Parenti (26) (synonym of *Kosswigichthys*); Huber (18) (subgenus).

Turkichthys Ermin 1946 (28) (Type spec.: *Turkichthys transgrediens* Ermin 1946 (= *A. anatoliae transgrediens* by monotypy); Villwock (20) (synonym of *Aphanius*); Lazara (29) (synonym of *Kosswigichthys*).

Aphaniops Hoedeman 1951 (17) (Type spec.: *Lebias dispar* Rüppel 1829, by original designation); Villwock (30) (synonym of *Aphanius*).

Description: Small Cyprinodontid fishes, rarely exceeding 80 mm TL; body of low to moderate lateral compression; pelvic fins may be absent; origin of dorsal fin slightly in front or over origin of anal fin; 1–2 unbranched dorsal rays, 7–13 branched dorsal rays; 1–2 unbranched anal rays, 7–14 branched anal rays; lateral line systems present on head only, consisting of a tubular system with pores; scalation may be reduced or occasionally absent; mouth superior, lower jaw occasionally vertically upturned; teeth on jaws usually tricuspid; 9–17 rakers on lower limb of first gill arch; low sexual dimorphism in size, males of equal size or slightly larger than females; males frequently with large dorsal and anal fins and brighter colouration.

Distribution: Presently the genus *Aphanius* consists of 12 known species, distributed in southern Europe, the

Levant, the Middle East as far east as Cutch in western India, north and east Africa, as far south as Somalia. Represented in Turkey by 5 species and 4 subspecies.

Remarks: Lazara (2) regards *Aphanius* as a junior synonym of *Lebias*. In Lazara (2) the genus *Lebias* is revalidated and its original description credited to Goldfuss (31). In Lazara's view, *Lebias* Goldfuss 1820 and *Lebia* Oken 1817, (preoccupied), are latinized names from the French vernacular "Les Lebias", as presented in Cuvier (32). According to Lazara (2), no type species for the genus *Lebias* was given. Therefore Lazara, while regarding himself as the first revisor, presented *Lebias fasciata* Valenciennes 1821 (in: Humboldt & Valenciennes) as the type species of the genus *Lebias*. This action automatically brought *Aphanius* Nardo 1827 into the synonymy of *Lebias* Goldfuss 1820. Lazara, however, overlooked or misinterpreted Valenciennes' (3) work, which must be regarded as the first revision of *Lebias*. In Valenciennes (3), the generic name *Lebias* was used as a vernacular name but also in its latinised form and a type species was designated. Valenciennes (3) clearly indicated that Cuvier's (32) "Les Lebias" was created for the same species as used by Lacépède (33) for the genus *Cyprinodon* and that this species (= *Cyprinodon variegatus* Lacépède 1803) was identical to *Lebias rhomboidalis* described in Valenciennes (4). From the above it can be concluded that Valenciennes (3) designated *Lebias rhomboidalis* as type species for the genus *Lebias*. Valenciennes (3) also indicated that *Lebias* is regarded as a synonym of *Cyprinodon* Lacépède 1803 and that both species described in Valenciennes (4). *Lebias fasciata* and *Lebias rhomboidalis*, were attributed to the genus *Cyprinodon*. Garman (8) was the first to make a generic separation between the "old world" and "new world" species of *Cyprinodon*, for which *Lebias* and *Cyprinodon* were used, respectively. This view was not shared by most subsequent authors (e.g., Günther (34); Boulenger (35); Pellegrin (36)) who persisted to use the name *Cyprinodon* for "new world", as well as "old world" Cyprinodontidae. Myers (9) confirmed the synonymy of *Lebias* with *Cyprinodon* and regarded all European forms, previously attributed to *Cyprinodon*, as *Aphanius*. This view was followed in Miller (11). For the reasons mentioned above, the generic name *Aphanius* is maintained here.

The Cyprinodont fishes found on the Anatolian plateau are regarded as being descended from a common ancestor that once lived in the ancient Tethys Sea. Pre-Pleistocene land risings caused the separation from the Tethys of a lake once covering a large part of present Anatolia. Ongoing land rising and changes of the climate divided this lake into three smaller subsystems, namely,

the eastern, central and western systems. The eastern system broke up again early in history, causing the separate evolution of *A. asquamatus*, restricted to Lake Hazer and, more to the west, *A. danfordii*. The central lake, of which the present lakes Tuz, Eğirdir and Beyşehir are remnants, offered evolutionary grounds for the populations of the present *A. anatoliae anatoliae*. For a longer period, the central and western lake systems had intermittent connections. Finally one lake, consisting of present day Lakes Burdur, Ak and Acı, became isolated. From that lake *A. anatoliae splendens*, *A. anatoliae transgrediens* and *A. anatoliae sureyanus* evolved.

In her revision of the Cyprinodontiform fishes, Parenti (26) used *kosswigichthys* as a distinct genus with *Anatolichthys* as a synonym. Both genera, *Kosswigichthys* and *Anatolichthys*, were originally defined primarily by the characteristic of reduction in scalation. Also, the conical teeth as described for *Kosswigichthys* were used as a distinguishing character for that genus, which was first thought to be a member of the subfamily Fundulinae.

The reduction of scalation in some populations of Anatolian Cyprinodontidae has been studied by various workers (Ermin (28); Akşiray (37, 38); Villwock (39, 40); Grimm (41, 42)). From the most recent of these studies, it can be concluded that, with two exceptions, reduction in scalation is not a stable characteristic. The two exceptions comprise the fully scaled members of all fluvial populations and the almost naked *Kosswigichthys asquamatus*. Grimm (41) demonstrated that reduction in scalation in the Anatolian killifishes does not represent a genetic adaptation to the high concentration of sodium sulfate, magnesium sulfate and magnesium carbonate in the lakes in which they live, nor is it caused by natural hybridisation. The reduction is caused by an unstable variation in the genes that is not favored or suppressed by genetic pressure. Thus, due to the lack of stabilizing selection, mutants with all variations in scalation may survive, leading to an increase in the variability of the scalation, indicative of the start of regressive evolution. For that reason, Grimm (41) regarded all populations having a reduction in scalation, with the exception of *A. asquamatus*, as identical to *A. anatoliae*.

The characteristic of the conical teeth in *Kosswigichthys* was shown also not to be a stable characteristic, as it has been reported, albeit rarely, from other Anatolian species. Franz & Villwock (25) have demonstrated that *Kosswigichthys* is a synonym of *Aphanius*, and in Villwock (20) *Anatolichthys* was also regarded as a synonym of *Aphanius*. These views were followed in Wildekamp (1) and are also retained here.

Aphanius anatoliae anatoliae (Leidenfrost 1912) (Fig. 1)

Type Locality: in the middle of the Lykaonic steppe, close to the village Jazla Jayla, in the vicinity of the Kradzsa Da mountain. (after Neu (43): "Yayla–yayla, summer village at the Karacadağ mountain±37°46'N; 33°43'E).

Cyprinodon sophiae (non Heckel in: Russegg 1846); Gaillard (44) (Yavlah near Boğazlıyan between Kayseri and Yozgat); Pellegrin (36) (partim, Eskişehir); Neu (43) (partim, Eskişehir).

Cyprinodon chantrei non Gaillard (1895); Hanko (45) (Karacadağ); Neu (43) (Yazla-Yayla, Salur at Karaca Dağ).

Cyprinodon anatoliae Leidenfrost 1912 (46) (original description).

Cyprinodon lykaonlensis Leidenfrost 1912 (46) (original description, Type Loc.: Jazla-Jayla); Pellegrin (36) (synonym of *C. anatoliae*); Wildekamp (1) (synonym of *A. anatoliae anatoliae*).

Aphanius sophiae (non Heckel in: Russegger 1846); Beccari (47) (Selçuk); Villwock (30) (Konya).

Aphanius chantrei venustus Kosswig & Sözer 1945 (27) (original description, TL: İnsuyu); Akşiray (37) (–description, İnsuyu, creek near Cihanbeyli (= present Inevi), at the west bank of Lake Tuz, 38°39'N; 32°56'E; Kırşehir, 39°09'N; 34°10'E); Radda (13) (synonym of *A. anatoliae*); Geldiay & Balık (48) (synonym of *A. chantrei*); Wildekamp (1) (synonym of *A. anatoliae anatoliae*).

Aphanius chantrei meandricus Akşiray 1948 (37) (original description, Type Loc.: Springs of the Büyük

Menderes River, near Işıklı (38°19'N; 29°50'E) and Karakuyu (±38°11'N; 29°55'E)); Radda (13) (synonym of *A. anatoliae*); Geldiay & Balık (48) (synonym of *A. chantrei*); Wildekamp (1) (synonym of *A. anatoliae anatoliae*).

Aphanius chantrei litoralis Akşiray 1948 (37) (original description, Type Loc.: Lake Bahçeözü (= present Lake Karataş (37°23'N; 29°57'E), near Tefenni in the Burdur district); Radda (13) (synonym of *A. anatoliae*); Geldiay & Balık (synonym of *A. chantrei*); Wildekamp (1) (synonym of *A. anatoliae anatoliae*).

Aphanius chantrei parvus Akşiray 1948 (37) (original description, Type loc.: Small streams near Lake Gölhisar (37°07'N; 29°36'E), south to Tefenni in the Burdur district); Radda (13) (synonym of *A. anatoliae*); Geldiay & Balık (48) (synonym of *A. chantrei*); Wildekamp (1) (synonym of *A. anatoliae anatoliae*).

Aphanius chantrei altus Akşiray 1948 (37) (original description, Type Loc.: Karapınar spring (37°32'N; 29°46'E), near Yeşilova in the Burdur district); Geldiay & Balık (48) (synonym of *A. chantrei*); Wildekamp (1) (synonym of *A. anatoliae anatoliae*).

Aphanius chantrei fontinalis Akşiray 1948 (37) (original description, Type Loc.: A spring near Lake Yarıklı (37°34'N; 29°53'E), southwest of Lake Burdur); Balık (49) Yarıklı Gölü); Geldiay & Balık (48) (synonym of *A. chantrei*); Wildekamp (1) (synonym of *A. anatoliae anatoliae*).

Aphanius chantrei obrukensis Akşiray 1948 (37) (original description, Type Loc.: Obruk (38°03'N; 33°06'E), from a small lake in the salt steppe, south of



Figure 1. *Aphanius anatoliae anatoliae*. Düger, DSI pump station.

Lake Tuz, central Turkey); Geldiay & Balık (48) (Synonym of *A. chantrei*); Wildekamp (1) (synonym of *A. anatoliae anatoliae*).

Aphanius chantrei flavianalis Akşiray 1948 (37) (original description, Type Loc.: İlica Pınarı (37°59'N; 34°46'E) and Akkaya Pınarı (37°56'N; 34°37'E), two small springs near Niğde); Geldiay & Balık (48) synonym of *A. chantrei*; Wildekamp (1) (synonym of *A. anatoliae anatoliae*).

Aphanius chantrei aksaranus Akşiray 1948 (37) (original description, Type Loc.: Eşmekaya Pınarı (38°46'N; 33°47'E), spring near Sultanhani and water sources near Aksaray (38°32'N; 34°02'E), southeast of Lake Tuz); Wildekamp (1) (synonym of *A. anatoliae anatoliae*).

Aphanius chantrei meridionalis Akşiray 1948 (37) (original description, Type Loc.: Lake Söğüt (37°04'N; 29°53'E) at the border between the districts of Burdur and Antalya); Geldiay & Balık (48) (synonym of *A. chantrei*); Wildekamp (1) (synonym of *A. anatoliae anatoliae*).

Aphanius burduricus iconii Akşiray 1948 (37) (Type Loc.: Kovada canal, outlet of Lake Eğirdir into Lake Kovada (37°50'N; 30°52'E) and Lake Beyşehir outlet into the Konya plains (37°43'N; 31°42'E)); Radda (13) (synonym of *A. anatoliae*); Wildekamp (1) (synonym of *A. anatoliae anatoliae*).

Aphanius anatoliae; Akşiray & Villwock (50) (Göhisar Gölü, Söğütlü); Scholl, Corzilius & Villwock (51) (electrophoresis); Grimm (52) (egg size); Grimm (41) (scalation); Grimm (53) (variability); Grimm (42) (scalation, Düğer köyü, Gelif); Grimm (54) (behaviour, Çavuşcu Gölü, Beyşehir Gölü, Düge köyü).

Aphanius anatolias (sic!); Kuru (55) (partim, Anatolia), Geldiay & Balık (48) (partim, Anatolia).

Aphanius chantrei (non Gaillard 1985); Geldiay & Balık (48) (partim, Anatolia).

Aphanius anatoliae anatoliae; Wildekamp (1) (systematics)

Sexual dimorphism and colouration: Subspecies of moderate variability. The colouration of males and females may vary on the population level.

Male: Body colour is light silver–grey. On the sides, from the back to the abdomen, 6–10 dark grey vertical bars are prominent, the number and width varying in different populations. When in breeding condition, males

have a black dorsal fin with a light grey band near its base. The anal fin is lemon yellow with a narrow black border, and small stripes or spots may also be present in the rear part of the fin. Some populations may have a wide terminal band at the anal fin. The caudal fin is colourless to pale yellow or white with two or three cross-bars.

Female: Pale silver–grey with dark grey spots on the sides, concentrated mainly along the mid-lateral line. A black spot is present in the middle of the caudal peduncle. All fins are colourless.

Distribution: (Fig. 11). The distribution includes a series of freshwater springs and small rivers around, and flowing into, the lakes Tuz (Great Salt Lake), Eğirdir, Beyşehir, and several rivers, pools and swamps around Konya and eastward to Niğde. It is also found in the spring area of the Menderes River (= Büyük Menderes Nehri) and in its lower drainage system near Selçuk, and in the upper Sakarya River around Eskişehir. Typical habitation is close to the shore in fresh to slightly brackish water.

Remarks: The original description by Leidenforst (46), including figures, clearly indicates that *Cyprinodon anatoliae* and *Cyprinodon lykaoniensis* were described on the basis of female and male specimens, respectively.

Several populations of *A. anatoliae anatoliae* around Lake Tuz and southwestern Anatolia are now considered extinct, or endangered due to pollution or disappearance of the water resulting from pumping for agricultural use. No specimens of any of the populations in the Lakes Ak, Yarıklı, Göhisar and Söğüt were found during surveys in 1992 (Wildekamp & Valkenburg, 57) and 1996, and it must be assumed that these are now extinct. According to information supplied by local people, Lake Söğüt, and its nearby swamps, were drained by a canal in 1959 and their beds released for agricultural use. Nevertheless, Lake Söğüt and its surrounding swamps still can be found on recently produced maps. The authors were able in summer 1996 to locate a surviving *Aphanius* population in irrigation canals at the northern edge of the Söğüt Plain, south of the village of Kırkpınar. Other populations on the northern and northeastern part of the Konya plains (e.g., Aksaray), previously separated from *A. mento*, are presently found to be sympatric with that species due to the construction of canals through the Konya plains for agricultural use. The effects of this unnatural sympatry are presently unknown (Wildekamp & Valkenburg, 57).

***Aphanius anatoliae splendens* (Kosswig & Sözer 1945) (Fig. 2).**

Type Locality: Lake Gölcük, west of Isparta. (37°44'N; 30°30'E)

Anatolichthys splendens Kosswig & Sözer 1945 (27) (original description); Ermin (58) (scalation, Gölcük Gölü); Ermin (28) (Scalation); Kosswig (59) (hybridisation, Gölcük Gölü); Öztan (56) (genetics, hybrids); Kosswig (60) (systematics, Gölcük Gölü); Villwock (30) (Gölcük-Gölü, springlake near Isparta; Salda Gölü); Kosswig (61) (Gölcük Gölü, Salda Gölü); Akşiray & Villwock (50) (systematics).

Anatolichthys splendens saldae Akşiray 1955 (62) (original description, Type Loc.: Lake Salda near Yeşilova (37°31'N; 29°39'E) in the Burdur district); Franz & Villwock (25) (synonym of *A. anatoliae splendens*).

Aphanius anatoliae splendens; Franz & Villwock (25) (synonymy); Wildekamp (1) (systematics).

Kosswigichthys splendens; Parenti (26) (systematics).

Kosswigichthys splendens splendens; Lazara (29) (systematics).

Kosswigichthys splendens saldae; Lazara (29) (systematics).

Aphanius anatoliae; Grimm (41) (scalation); Grimm (42) (scalation, Salda Gölü).

Aphanius anatoliae (sic!); Geldiay & Balık (48) Gölcük Gölü).

Aphanius (Anatolichthys) anatoliae splendens; Huber (18) (systematics).

Sexual dimorphism and colouration: Males variable on the specimen level, the width of the bark may differ in each individual specimen.

Male: Silver background body colour on which 8–11 irregular dark grey to almost black vertical bars are present. Commonly, there is also a series of small black spots on the back and the rear part of the head. The dorsal fin is colourless at the base with a wide black border. The anal fin is white to pale yellow with a narrow black border. The caudal fin is also colourless to white, usually with two black cross-bars.

Female: The sides have a beautiful silver sheen with large dark brown to almost black spots concentrated mainly along the mid-lateral line. All fins are colourless.

Distribution: (Fig 12). This subspecies was only known from two localities: Lake Gölcük, west of Isparta, where it is now regarded extinct, and Lake Salda, west of Yeşilova.

Remarks: *Aphanius anatoliae splendens* differs from the other *A. anatoliae* subspecies by having a very slender body and angular shape to the lower jaw, which rises almost vertically to the mouth. This characteristic, together with that of a reduction of body scales, motivated Kosswig & Sözer (27) to erect the genus *Anatolichthys*. Cytological studies and cross-breedings between different populations of Anatolian *Aphanius* showed that no genetic barriers exist, except for those populations with the largest geographical separation, i.e. *A. chantrei* and the western Anatolian populations (Grimm, 41, 42), and all were classified in the genus *Aphanius*. Parenti (26) was not aware of these



Figure 2. *Aphanius anatoliae splendens*, Lake Salda, Yeşilova-Burdur.

publications and classified *Anatolichthys* as a synonym of *Kosswigichthys*.

Both known localities of *Aphanius anatoliae splendens*, Lake Gölcük and Lake Salda, are fed by springs and are poor in planktonic fauna, although the benthic fauna is more abundant. Apart from some algae, submerged vegetation is lacking in Lake Salda, but Lake Gölcük used to have a dense aquatic vegetation near its littoral zone, which has now disappeared due to pollution. Both lakes have no outlet to the sea, although Lake Gölcük has some subsurface outlets. The lake water comes to the surface as springs in the surrounding terrain. In both lakes, *A. anatoliae splendens* lived in schools in the littoral zone. In Lake Gölcük *A. anatoliae splendens* lived sympatrically with *Hemigrammocapoeta kemali* (Hanko 1924) and it lives together with *Paraphoxinellus maeandri* (Ladiges 1960) in Lake Salda. Observations made by the authors indicated that, at least during the period. From 1989 to 1996, the water levels of Lake Gölcük and Lake Salda decreased dramatically. During surveys in 1989 and 1996, no specimens of *A. anatoliae splendens* were obtained from Lake Gölcük. Presently, the Gölcük population is regarded as extinct, as well as the sympatric *H. kemali*. Extinction was caused most probably by the introduction of *Stizostedion lucioperca* (Linnaeus 1758) (Pike-perch) and ongoing pollution.

In 1989 *A. anatoliae splendens* in Lake Salda was found to live in schools in the littoral zone, together with specimens of *P. maeandri*. In 1992 (Wildekamp & Valkenburg, 57) and 1996, only isolated specimens of both species could be found in the vicinity of underwater outlets of freshwater springs. This may indicate that the

lowering of the water level increased the salinity and that the fishes are seeking those parts of the habitat with a lower salt content. The dramatic decrease in the water levels of Lake Gölcük and Lake Salda are thought to be due to the nearby pumping of groundwater for irrigation purposes. In view of the apparent serious degradation of the habitat of *A. anatoliae splendens* and the introduction of Carp (*Cyprinus carpio* (Linnaeus 1758)) and Rainbow Trout (*Oncorhynchus mykiss* (Walbaum 1792)) in Lake Salda, this subspecies must be regarded as threatened (Wildekamp & Valkenburg, 57).

***Aphanius anatoliae sureyanus* (Neu 1937) (Fig. 3)**

Type Locality: Lake Burdur. (37°45'N; 30°15'E)

Cyprinodon sureyanus Neu 1937 (43) (original description); Akşiray (37) (nomen vanum); Battalgil (72) (Burdur Gölü).

Aphanius sureyanus; Sözer (24) (Burdur Gölü); Wildekamp (1) (systematics).

Anatolichthys burdurensis Ermin 1946 (28) (original description, Type Loc.: lake Burdur in the Burdur district); Akşiray (63) (hybridisation, Burdur Gölü); Balık (49) (Burdur Gölü); Wildekamp (1) (synonym of *A. anatoliae sureyanus*).

Aphanius burdurensis; Akşiray (37) (nomen nudum).

Aphanius burduricus Akşiray (37) (original description, Type Loc.: Lake Burdur, as well as in springs near its banks (37°45'N; 30°15'E)); Akşiray (38) (systematics); Akşiray (63) (hybridisation, Burdur Gölü); Kosswig (59) (synonym of *A. anatolia*); Villwock (39) (systematics, morphology, Burdur Gölü); Radda (13) (synonym of *A. anatoliae*); Kuru (55) (Burdur Gölü);



Figure 3. *Aphanius anatoliae sureyanus*. Lake Burdur, Burdur.

Geldiay & Balik (48) (Burdur Gölü); Wildekamp (1) (synonym of *A. anatoliae sureyanus*).

Aphanius dispar sureyanus; Berg (64) (systematics, misidentification).

Aphanius anatoliae transgrediens (non Ermin 1946); Villwock (20) (partim, Burdur Gölü); Wildekamp (65) (misidentification, Burdur Gölü).

Aphanius anatoliae; Grimm (66) (scalation); Grimm (52) (egg size); Grimm (41) (scalation); Grimm (53) (variability); Grimm (42) (scalation, Burdur Gölü); Grimm (54) (behaviour, Burdur Gölü).

Kosswigichthys burdurensis; Parenti (26) (systematics).

Aphanius anatoliae burduricus; Villwock (67) (systematics, Burdur Gölü).

Aphanius anatolias (sic!) Geldiay & Balik (48) (partim, Burdur Gölü).

Aphanius anatoliae sureyanus; Wildekamp (1) (systematics).

Aphanius (Anatolichthys) anatolia sureyanus; Huber (18) (systematics).

Sexual dimorphism and colouration: Vertical barring in males varying on the specimen level.

Male: Light silver–grey on the body, with irregular dark grey to almost black vertical bars, the number of which is highly variable. The dorsal and anal fins are similar, being light grey at the base, darkening progressively to a wide black border. The caudal fin is colourless to light grey with two dark vertical bars.

Female: Light silver with 6–8 large dark brown to dark grey spots on and above the mid–lateral line. All fins are colourless.

Distribution: (Fig. 12). Endemic to Lake Burdur. Can be found in schools near the shore. Males usually form territoria in the shore region near rocks with algal growth. It also inhabits springs near the shores of the lake in water that varies from relatively fresh to strongly brackish, and sometimes also sulfurous. With the exception of some algae, these habitats lack submerged vegetation.

Remarks: The subspecies name “*sureyanus*” is used here, in contrast to Villwock who, in earlier studies (20, 36), used the name *A. anatoliae transgrediens* for the Lake Burdur fish. Although the name *Cyprinodon sureyanus* has priority over all other names given to the “Burdur fishes”, this name was rejected by Akşiray (38) on the basis of “an unsatisfactory description”. However,

the female of this subspecies can be recognized on the basis of the Neu (43) description, and since no other cyprinodontiform fish is present in Lake Burdur, confusion with other species is not possible. Therefore, there is no longer any reason not to use the name “*sureyanus*” for this subspecies in Lake Burdur.

The population in Lake Burdur and its peripheral springs contains specimens with all possible gradations of scale reduction, ranging from fully scaled to almost nude. The fully scaled specimens were described as *A. burduricus* by Akşiray (37) and those with a reduced scalation in Ermin (28) as *Anatolichthys burdurensis*. In Villwock (67), the Lake Burdur population was regarded as distinct from those found in Lakes Gölcük, Salda and Acı, and was named *A. anatoliae burduricus*.

Aphanius anatoliae transgrediens (Ermin 1946) (Fig. 4)

Type Locality: Stream, fed by Acipınar spring at the western end of Lake Acı, Denizli district (37°49'N; 29°43'E)

Turkichthys transgrediens Ermin 1946 (28) (original description)

Anatolichthys transgrediens; Akşiray (37) (systematics, description, “Acı Tuz Göl”); Akşiray (38) (systematics); Akşiray (63) (hybridisation, Acıgöl); Kosswig (59) (hybridisation, Acıgöl); Öztan (56) (genetics); Villwock (30) (Akşiray, Acıgöl); Akşiray & Villwock (50) (systematics); Balik (49) (Acıgöl, Afyon).

Aphanius anatoliae transgrediens; Villwock (20) (Partim, Acıgöl springs); Villwock (67) (systematics, Acıgöl).

Aphanius anatoliae; Grimm (66) (scalation); Grimm (52) (egg size); Grimm (41) (scalation); Grimm (53) (variation); Grimm (42) (scalation; Acıgöl springs).

Kosswigichthys transgrediens; Parenti (26) (systematics).

Aphanius anatolias (sic!); Geldiay & Balik (48) (Acıgöl).

Aphanius (Anatolichthys) anatoliae transgrediens; Huber (18) (systematics).

Sexual dimorphism and colouration: Male colouration variable on the population level.

Male: Light silver–grey on the body with dark grey to black vertical bars, usually irregular, and 8–11 in number. A series of dark grey spots is usually present on the black. The dorsal and anal fins are colourless at the base with a black border. During breeding this border broadens and the entire fin may become black. The caudal fin is colourless to pale grey with two dark vertical bars.



Figure 4. *Aphanius anatoliae transgrediens*: Lake Aci, Gemiş.

Female: Silver with irregularly distributed dark brown to grey spots on the black and sides. A concentration of spots usually appears on the mid-lateral line. The fins are all colourless.

Distribution: (Fig. 12) Known only from a series of springs around Lake Aci in southern central Turkey. These springs produce fresh to slightly brackish water. The fishes generally do not inhabit the lake itself because of the high salinity of the lake waters and the periodic drying up during summer months to form a salt plain. In periods of heavy winter rainfall, the lake water may become fresh enough to allow populations from adjacent springs to migrate into the lake and intermingle with neighbouring populations, but distant populations never do.

Remarks: Scale reduction within populations of *A. anatoliae* subspecies has been studied by Grimm (41). He showed that this phenomenon is not a genetic adaptation to the high concentration of sodium sulfate, magnesium sulfate and magnesium carbonate in the lakes which they inhabit, but an unstable variation in the genes. The occasional gene flow between populations of *A. anatoliae transgrediens* led to a uniformity of scalation types in neighbouring populations.

The characteristics of scale reduction and a modified lower jaw, when compared with other *Aphanius* species, led Ermin (28) to erect the genus *Turkichthys*. This genus was not recognized by Akşiray (37, 38), who classified its only species, *Turkichthys transgrediens*, in *Anatolichthys*. On the basis of genetic studies carried out by Professor Villwock and co-workers, all Anatolian species and

populations included in *Turkichthys* and *Anatolichthys* were classified in *Aphanius* (Villwock, 20; Franz & Villwock, 25).

During a survey along the southern side of Lake Aci, conducted in 1989, *A. anatoliae transgrediens* was the only fish species observed in the springs which comprise the habitats for this subspecies. In September 1992, in a spring at the southwestern end of Lake Aci, the presence of the Poeciliid fish *Gambusia affinis* (Baird & Girard 1854) was observed together with notably limited numbers of *A. anatoliae transgrediens*. *Gambusia affinis*, introduced in various habitats for mosquito control, is known to be a threat to other fishes. It can thrive in the same environment as that occupied by *Aphanius* species, with the exception of hypersaline habitats, and may pose a threat to them by competitive exclusion and direct predation on fry. There is a strong possibility that *G. affinis* may spread to other springs during times of heavy rainfall when the water of Lake Aci is sufficiently fresh to permit migration. The presence of this introduced species should be regarded as a serious threat to populations of *A. anatoliae transgrediens* in the area (Wildekamp & Valkenburg, 57).

Aphanius asquamatus (Sözer 1942) (Fig. 5)

Type Locality: Lake Hazer, District of Elazığ (38°30'N; 39°25'E)

Kosswigichthys asquamatus Sözer 1942 (24) (original description); Akşiray (63) (scalation, Hazer Gölü); Kosswig (59) (Hazer Gölü); Öztan (56) (genetics); Özarslan (104) (morphology); Radda (13) (genetics); Kuru (55) (Hazer Gölü).



Figure 5. *Aphanius asquamatus*, Lake Hazer, Sivrice.

Aphanius asquamatus; Franz & Villwock (25) (systematics).

Aphanius (Kosswigichthys) asquamatus; Villwock (20) (systematics); Scholl, Corzilius & Villwock (51) (electrophoresis); Grimm (42) (scalation); Grimm (54) (behaviour).

Aphanius anatolias (sic!) (non Leidenfrost 1912); Geldiay & Balik (48) (synonymy).

Sexual dimorphism and colouration: Males somewhat variable in the barring on the sides.

Male: Silver–grey on the sides becoming darker grey on the back and silver on the belly. Eleven to fifteen dark vertical bars, comprising concentrations of small spots (melanophores), are present on the sides. Similar spots are also present on the head. The dorsal fin is grey, with a vertically elongated black patch in the frontal part. A silver, crescent-shaped submarginal band extends from this black patch to the anterior part of the fin. The central part of the dorsal fin is light grey, terminated by a darker grey band. The anal fin is grey with a dull darker band and narrow black border. The caudal fin is colourless to light grey, without markings. Breeding males become very dark to almost black.

Female: Body colour is grey, becoming darker towards the back and lighter towards the belly. On the sides, 13–18 irregular dark brown to dark grey spots which form irregular, discontinuous horizontal bands. All fins are colourless.

Distribution: (Fig. 13). Endemic to Lake Hazer, in eastern Turkey, where it lives in schools close to the

shore. Breeding males occupy territories around stones with bushes of algae.

Remarks: Based on its elongate body shape, almost complete scale reduction and the presence of three rows of conical teeth in the jaws, Sözer (24) erected the genus *Kosswigichthys* for this species, and classified it in the subfamily Fundulinae. Investigations into the relationships among Old World Cyprinodontidae, by Franz & Villwock (25), revealed that this species belongs to the genus *Aphanius*, with its relatives being the species of the western and central Anatolian plains.

Aphanius asquamatus was listed in the IUCN (68) Red Data Book as an endangered species. This was caused by habitat destruction due to a dramatic and sudden lowering of the lake water level by an unsuccessful drilling of a drain for irrigation (Villwock, pers. comm.). After stabilisation of the water level at a much lower level, the population recovered and the present situation can be regarded as stable. A great number of fishes can be observed from the shore (Wildekamp & Valkenburg, 57).

Aphanius danfordii (Boulenger 1890) (Fig. 6–7)

Type Locality: “Asia Minor at Albistan”. (see remarks)

Cyprinodon danfordii Boulenger 1890 (69) (original description); Garman (8) synonym of *Lebias sophiae*; (57) (synonymy).

Cyprinodon chantrei Gaillard 1895 (44) (original description, Type Loc.: Spring at Sandarémek or Sendiremeke, near Evérek ($\pm 38^{\circ}22'N 35^{\circ}30'E$)); Pellegrin (36) (Everek, Sandaramec); Neu (43) (Sandaremek near Everek).



Figure 6. *Alphanus danfordii*, Kanal 2, Soysali, Seyhan River system.



Figure 7. *Alphanus danfordii*, Lectotype, BMNH 1879.6.7.5.

Lebias sophiae non Heckel in: Russegger 1846; Garman (8) (systematics).

Cyprinodon fasciatus (non Valenciennes in: Humboldt & Valenciennes 1821); Boulenger (35) (Elbistan); Neu (43) (Elbistan).

Aphanius fasciatus (non Valenciennes in: Humboldt & Valenciennes 1821); Berg (70) (systematics); Sözer (24) (synonymy).

Aphanius chantrei; Sözer (24) (Karpuzatan, Kayseri); Ermin (58) (morphology); Ermin (28) (systematics); Akşiray (37) (Karpuzatan, Kayseri); Akşiray (63) (hybridisation, Karpuzatan, Samsun); Öztan (56) (genetics); Scholl, Corzillius & Villwock (51) (electrophoresis); Kuru (55) (partim, Anatolia); Grimm

(54) (behaviour); Geldiay & Balık (48) (synonymy, Anatolia).

Aphanius danfordi; Akşiray (37) (Elbistan).

Aphanius sophiae (non Heckel in: Russegger 1846); Berg (64) (synonymy); Kosswig (60) (synonymy); Villwock (30) (Samsun, Kızılırmak area).

Aphanius (Anatolichthys) chantrei; Huber (18) (systematics).

Sexual dimorphism and colouration: Male colour pattern slightly variable in respect to the barring on the sides, mainly on the population level.

Male: Light silver–grey on the sides, becoming grey on the back and silver on the underside. Nine to twelve dark

grey to black vertical bars appear on the sides of the body. The shape, size and number of these bars may vary in individual specimens. The caudal fin is colourless to faint white with dark vertical bars, usually three in number, but varying from one to four. Males in breeding condition show a black dorsal fin with some light spots at its base. The anal fin is pale yellow with 2–3 dark bars and a narrow black border.

Female: Silver–grey with a large number of dark grey to brown spots of variable size and shape, distributed in irregular longitudinal bands on the back and sides of the body. The largest and most distinct spot is always centered on the base of the caudal fin. The dorsal fin is pale brown while all other fins are usually colourless.

Distribution: (Fig. 13). Springs, small streams and creeks within the drainage system of the Kızılırmak River, from its middle reaches to the region of its mouth in the Black Sea. Also known from some localities in the drainage system of the upper Seyhan River, south of Kayseri in central Turkey. The full range of this species is not known.

Remarks: The identity of *Cyprinodon danfordii* has been obscure for a long period. In Garman (8) it was thought to be identical to *A. sophiae* and in Boulenger (35) regarded as *A. fasciatus*. The latter was followed by Berg (70) and Sözer (24).

In Boulenger's (69) original description, *A. danfordii* was reported to have been found together with *C. dispar*. The occurrence of that species in this part of Asia is highly unlikely. The closest known locality of *A. dispar* is the Dead Sea region of Jordan and Israel.

In Villwock (30) the remark in Kosswig (71) was repeated that *A. danfordii* might be identical to *A. chantrei* and both possibly identical to *A. sophiae*. In Kosswig (59), however, it was indicated that *A. danfordii* is identical to *A. chantrei*. Kosswig (59) based this suggestion on photographs of the type specimens received from Dr. Steinitz of Jerusalem. Unfortunately, Kosswig (59) did not bring *A. chantrei*, "for practical reasons", into the synonymy of *A. danfordii*.

Attempts to recollect *A. danfordii* from the type locality given in Boulenger (69) "Albistan" (= present Elbistan–Kahramanmaraş) have been unsuccessful. Akşiray (37) visited Elbistan and nearby Malatya, but only specimens of *A. mento* were found. Elbistan and its vicinity was visited by us in 1989 and 1992, with the same negative results. Elbistan is situated in the upper Seyhan River system in which only *A. mento* has been found (Wildekamp & Valkenburg, 57).

Research on the type specimens, housed in the collection of the Natural History Museum, London (BMNH 1879.6.7.5–12), which are in a good state of conservation, led us the conclusion that these are not distinguishable from the *A. chantrei* population living in the Sultan Swamps near Soysali. As discussed below, the Sultan Swamps are also the type locality of *A. chantrei*. For these reasons, *Cyprinodon chantrei* is here regarded as a junior synonym of *A. danfordii*. We hereby designate the largest male (37.2 mm standard length, 52 mm total length, BMNH 1879.6.7.5) as lectotypy. The type locality given in Boulenger (69), "Asia Minor at Albistan", is here regarded as "Elbistan District", in which the Sultan Swamps are situated.

The type locality of *A. chantrei*, Sandarémek near Evérek is, according to a map in Neu (43), in the drainage system of the Yeniceirmak River, a tributary to the Upper Seyhan River. Detailed maps of the area show that Senderemek is identical to present-day Çayırözü. The springs near that village are a part of the Sultan Swamps. Evérek is present-day Develi.

The Kızılırmak populations differ in some morphological aspects from those found in the system of the upper Seyhan River. This is most distinctly visible in the straight dorsal profile of the Seyhan River populations in contrast to the curved dorsal profile of the Kızılırmak River populations.

The construction of a canal between Soysali and the Kızılırmak River for irrigation, connected these distinct populations, which are presently known to hybridize in the canal. This most probably will lead to the loss of the specific characters of both population groups (Wildekamp & Valkenburg, 57).

***Aphanius fasciatus* (Valenciennes In: Humboldt & Valenciennes 1821) (Fig. 8)**

Type Locality: Not given (see remarks)

Lebias fasciata Valenciennes in: Humboldt & Valenciennes 1821 (4) (original description).

Aphanius nanus Nardo 1827 (10) (original description, Type loc.: Adriatic Sea); Garman (8) (synonym of *L. calaritana*); Boulenger (35) (synonym of *C. fasciatus*); Tortonese (14) (nomen nudum); Wildekamp (1) (synonymy).

Aphanius fasciatus; Nardo (10) (Adriatic Sea); Battalgil (72) (Küçük Çekmece Göl, İstanbul); Sözer (24) (Küçük Çekmece Gölü, İstanbul; İskenderun, Hatay); Villwock (30) (Küçükçekmece); Kuru (55) (Turkish Mediterranean coast); Scholl, Corzillius & Villwock (51) (electrophoresis).



Figure 8. *Alphanus fasciatus*, Marina di Modica, Sicily, Italy.

Lebias lineato-punctata Wagner 1828 (73) (original description, Type loc.: Cagliari, Sardinia); Garman (8) (synonym of *L. calaritana* var. *fasciata*); Boulenger (35) (synonym of *C. fasciatus*).

Lebias sarda Wagner 1828 (73) (original description, Type loc.: Cagliari, Sardinia); Garman (8) (synonym of *L. calaritana* var. *fasciata*); Boulenger (35) (synonym of *C. fasciatus*).

poecilia calaritana Bonelli 1829 (74) (original description, Type loc.: Cagliari, Sardinia); Boulenger (35) (synonym of *C. fasciatus*).

Lebias calaritana; Cuvier (15) (mention); Garman (8) (systematics).

Lebias flava Costa 1838 (75) (original description, Type loc.: Lake Varano, Italy, 41°54'N; 15°44'E); Garman (8) (synonym of *L. calaritana*); Boulenger (35) (synonym of *C. fasciatus*).

Lebias caleritana (sic!) Costa (75) (Italy).

Lebias nigropunctata Bonaparte 1846 (original description, Type loc.: Naples, 40°50'N; 14°16'E); Garman (8) (synonym of *L. calaritana* var. *fasciata*); Wildekamp (1) (synonym of *A. fasciatus*).

Cyprinodon hammonis Valenciennes in: Cuvier & Valenciennes 1846 (3) (original description, Type loc.: springs of the Oasis Jupiter Ammon (= present Siwa Oasis, Egypt, 29°12'N; 25°29'E)) and Syria. Note: The "Syrie" specimens represent *A. dispar richardsoni*; Garman (8) (synonym of *L. calaritana*); Boulenger (35) (synonym of *C. fasciatus*).

Cyprinodon fasciatus; Valenciennes (3) (Sardina, Italy); Boulenger (35) (systematics, Albistan); Pellegrin

(36) (vicinity of Izmir); Tok (77) (Çokça near Adana); Neu (43) (Izmir, Çokça near Adana, Mediterranean coast); Erazi (78) (Mediterranean Sea, Sea of Marmara).

Cyprinodon calaritanus; Valenciennes (3) (Sardinia, Italy).

Cyprinodon cyanogaster Guichenot 1859 (79) (original description, Type loc.: freshwaters of Biskra, Algeria, 34°52'N; 05°18'E), Garman (8) (synonym of *L. calaritana*); Boulenger (35) (synonym of *C. fasciatus*).

Cyprinodon doliatus Guichenot 1859 (79) (original description, Type loc.: Biskra, northeastern Algeria); Garman (8) (synonym of *L. calaritana*); Boulenger (35) (synonym of *C. fasciatus*).

Cyprinodon dispar (non Rüppel 1829); Günther (80) (Sidi Ohkbar, Tunisia).

Micromugil timidus Gulia 1861 (19) (original description, Type loc.: Island of Malta, 35°53'N; 14°19'E); Garman (8) (synonym of *L. calaritana*); Tortonese (14) (synonym of *A. fasciatus*).

Cyprinodon ammonis (sic!); Sauvage (81) (Siwa Oasis, Egypt).

Cyprinodon calaritanus var. *fasciatus*; Seeley (82).

? *Alpismaris marmoratus* Risso 1826 (21); Moreau (22) (possible synonym of *C. calaritanus*).

Lebias calaritana var. *fasciata*; Garman (8) (systematics).

Lebias lineo-punctata (sic!); Boulenger (35).

Alpismaris marmoratus Risso 1826 (21); Roule (23) (synonym of *C. marmoratus*); Wildekamp (1) (systematics).

Cyprinodon marmoratus; Roule (23); Wildekamp (1) (systematics).

Cyprinodon desioi Gianferrari 1932 (83) (original description, Type loc.: Sulfurous springs near Al Agheila, Libya, 30°11'N; 19°06'E), Smith (84) (synonym of *A. fasciatus*).

Aphanius sophiae similis (non Akşiray 1948); Geldiay & Kähnsbauer (86) (Ciğli civarı, İzmir); Balık (87) (Ciğli, İzmir).

Aphanius (Aphanius) fasciatus; Huber (18) (systematics).

Sexual dimorphism and colouration: Male colouration is variable on the population level. It is thought that western populations have fewer cross-bars than populations found in the eastern Mediterranean basin.

Male: Green to brown on the back with 8–15 dark blue–grey vertical bars on the sides and a silver background body colour. The dorsal fin is pale yellow–grey with some dark grey spots near the base. In the frontal part of this fin, a long vertical black patch is present, fading into a narrow dark grey border. The anal fin is faint white to light blue with some short dark streaks appearing anteriorly. The caudal fin is yellow to yellow–orange with, in some populations, a wide, dark submarginal band.

Female: Light grey to silver becoming darker on the back and almost white on the belly. Short, dark brown vertical bars are present along the mid–lateral line with a mottled pattern of dark brown spots above it. All fins are colourless.

Distribution: (Fig. 13). Inhabits coastal zones of rivers and creeks, in lagoons, but rarely encountered over sandy beaches. In brackish water, and occasionally entering freshwater or salinas. The eastern half of the Mediterranean basin; north Africa from Egypt to eastern Algeria; also in certain landlocked basins such as the Choods in northeastern Tunisia, the sulfur springs near Al Agheila in northern Libya, and the Siwa Oasis in northwestern Egypt where it occurs sympatrically with *A. dispar*, the Bitter Lakes in Egypt, to which it migrated through the Suez Canal; southern Europe from the islands of Corsica and Sardinia, the Rhone delta (Camargue) in southeastern France in the west, to southwest of Istanbul in western Turkey; and the Mediterranean coasts of the Asiatic parts of Turkey, Syria and western Israel.

Remarks: In the original description by Valenciennes (4), no type locality is given. However, type specimens

were designated by Valenciennes (3) that originated from: “freshwaters near Cape Cagliari (39°12'N; 09°04'E), Sardinia, Italy”. That locality thus can be regarded as the type locality.

Aphanius fasciatus is a fish that can be found in a variety of habitats. Usually it lives in the brackish waters of the mouths of rivers and creeks. Also frequently inhabited are lagoons and salinas only occasionally connected to the sea. It has not been found over the shallows and beaches of the Mediterranean Sea itself, where these bad swimmers are competed out. *Aphanius fasciatus* retreats to less favourable habitats where it usually is the only fish species present.

The distribution of *A. fasciatus* in Turkey is not fully known. Although the long stretches of rocky coast of the Turkish Mediterranean coast are not favoured by this species, several parts of it may contain potential localities for *A. fasciatus*. A direct survey to the occurrence of this species most probably will reveal its presence in more localities than presently known. The first author, for instance, was able to prove its existence in Lake Tuz, south of Adana in the delta of the Seyhan River and in a lagoon near Silifke (Wildekamp & Valkenburg, 57).

Aphanius mento (Heckel in: Russegger 1843) (Fig. 9, 10)

Type Locality: Mossul, northern Iraq. (36°18'N; 43°18'E)

Lebias mento Heckel in: Russegger 1843 (90) (original description).

Lebias Cypris Heckel in: Russegger 1843 (90) (original description, Type Loc.: Mossul); Garman (8) (synonym of *L. mento*).

Lebias Mento Heckel in: Russegger 1846 (91) (Mossul).

Cyprinodon mento: Valenciennes (3) (description after Heckel); Hanko (45) (Ak Göl near Ereğli).

Cyprinodon cypris; Bleeker (92), (mention); Pellegrin (93) (Syria Orontis); Pellegrin (36) (Ceyhan River, Adana); Neu (43) (Akgöl, Adana, Pekmes Möyök); Battalgil (94) (Kırkgöz); Kosswig & Battalgil (95) (Anatolian southcoast, Akgöl).

Cyprinodon sophiae (non Heckel in: Russegger 1846); Gaillard (44) (Yozgat); Pellegrin (93) (partim, Syria); Hanko (45) (partim, Akgöl, Ereğli); Neu (43) (Akgöl, Sakarya, Ereğli).

Aphanius cypris; Sözer (24) (Kırkgöz, Pınarbaşı); Battalgil (72) (Kırkgöz); Villowock (30) (Orontes, Iskenderun, Amik Gölü, Akgöl, Antalya, Malatya);



Figure 9. *Alphanus mento*. Elbistan. Ceyhan River system.



Figure 10. *Alphanus mento*. Kırkgöz. Antalya.

Kosswig (61) (Akgöl, Kırkgöz, Düdendere, Gölbaşı Adana, İskenderun, Amik Gölü); Villwock (39) (Malatya); Kosswig (96) (Akgöl); Villwock (40) İskenderun, Malatya, Ereğli, southern slope of Taurus); Krupp (97) (Orontes); Kuru (55) (southern Turkey); Krupp (98) (synonymy).

Alphanus aff. sophiae; Sözer (24) (Possible synonymy, Lake Amik).

Alphanus sophiae mentoides Akşiray 1948 (37) (original description, Type Loc.: "Kırk Göz, nortwest of Antalya" 37°06'N; 30°35'E); Wildekamp (65) (synonym of *A. mento*); Krupp (98) (synonym of *A. cypris*); Geldiay & Balık (48) (synonymy).

Alphanus sophiae similis Akşiray 1948 (37) (original description, Type Loc.: Akgöl, between Konya and Ereğli,

37°31'N; 33°45'E); Villwock (30) (synonym of *A. mento*); Kähsbauer (99) (Beşkonak, Bölgesi, Antalya district); Krupp (98) (synonym of *A. cypris*); Geldiay & Balık (48) (synonymy).

Alphanus cypris orontis Akşiray 1948 (37) (original description, Tupe Loc.: Small ditches near Lake Amik near Antakya 36°17'N; 36°20'E); Radda (13) (synonym of *A. cypris*); Krupp (98) (synonymy); Geldiay & Balık (48) (synonymy).

Alphanus cypris boulengeri Akşiray 1948 (37) (original description, Type Loc.: Lake Gölbaşı, in an area of three small lakes west of Beşni, Malatya district, 37°45'N; 37°35'E); Radda (13) (synonym of *A. cypris*); Krupp (98) (synonymy); Geldiay & Balık (48) (synonymy).

Aphanius cypris alexandri Akşiray 1948 (37) (original description, Type Loc.: Coastal creek near İskenderun, 36°35'N; 36°10'E); Radda (13) (synonym of *A. cypris*); Krupp (98) (synonymy).

Aphanius mento; Akşiray (37) (mention); Berg (64) (Asia Minor); Öztan (56) (genetics); Franz & Villwock (25) (Malatya, Kırkgöz, Düdendere, Akgöl, Adana, İskenderun, Amik Gölü); Scholl, Corzilius & Villwock (51) (electrophoresis); Lazara (100) (revalidation); Stibane (101) (osteology); Stibane (102) (osteology).

Aphanius cypris-sophiae; Steinitz (12).

Aphanius sophiae (non Heckel in: Russegger 1843); Sözer (24) (Amik Gölü); Kosswig (71).

(Kırkgöz); Kuru (55) (southern Turkey).

Aphanius cypris (sophiae); Kosswig (59) (Anatolia).

Aphanius sophiae-cypris; Steinitz (103) (Israel).

Aphanius sophiae orontis; Özarslan (104) (nomen nudum, anotomy).

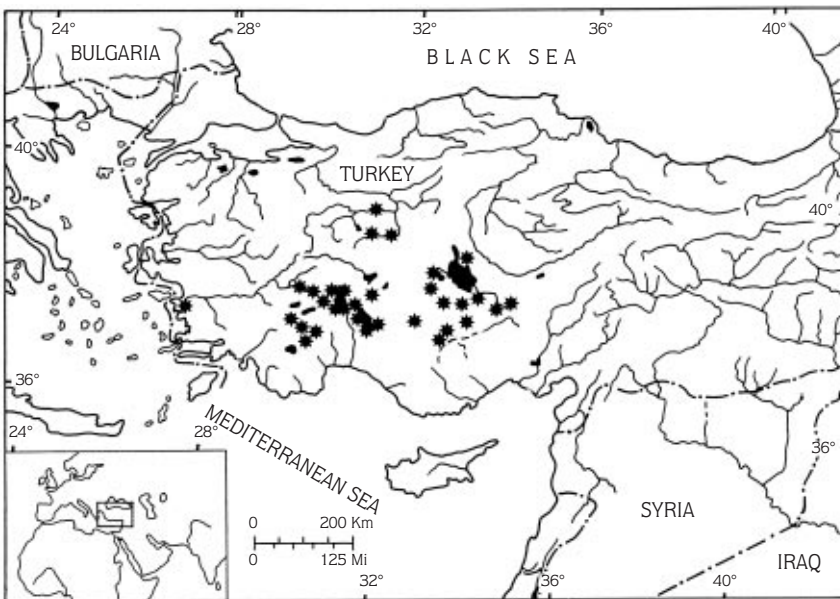


Figure 11. Distribution of *A. anatoliae anatoliae*.

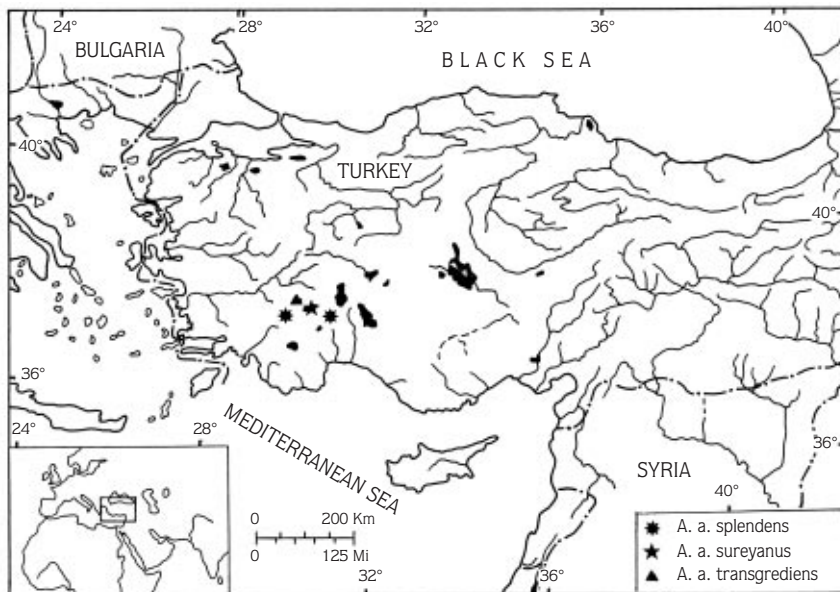


Figure 12. Distribution of *A. a. splendens*, *A. a. sureyanus*, *A. a. transgrediens*.

Aphanius sypris (sic!); Al-Hamed (105).

Cyprinodon striptus Lortet (106) (nomen nudum).

Aphanius mento mento; Goren (107) (Israel).

Aphanius mento striptus Goren 1974 (107) (original description, Type Loc.: Rosh Hanikra, springs near Amiḡam; W. Taninim; Gan Ha-Shlosha; Ein Hanaziv; Ein Moda, Ein Fahka, Israel and western Jordan); Wildekamp (108) (synonym of *A. mento*).

Aphanius mento mento; Goren (107).

"*Aphanius*" *mento*; Parenti (26) (osteology, systematics).

Aphanius (*Aphanius* ?) *mento*; Huber (18) (systematics).

Sexual dimorphism and colouration: The colour pattern is highly variable in both sexes.

Male: Breeding colours of the males differ from the normal colour pattern. Body colour is blue-black to very

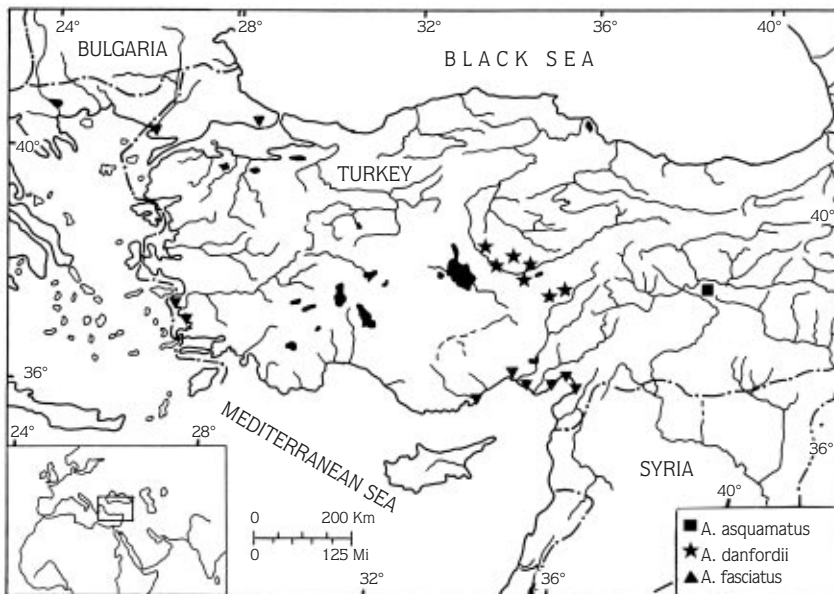


Figure 13. Distribution of *A. asquamatus*, *A. danfordii*, *A. fasciatus*.

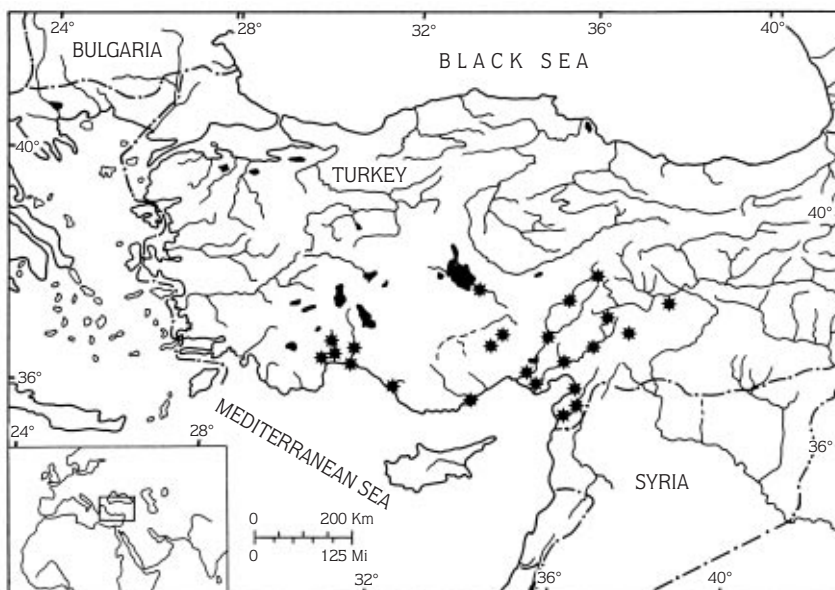


Figure 14. Distribution of *A. mento*.

dark brown, becoming paler on the abdomen. A large number of light blue to silver spots are present on the flanks and may form irregular vertical bars. The dorsal and anal fins are also blue–black to very dark brown in colour with curved lines of light spots. The caudal fin is of the same colour, also with curved lines of light spots, forming irregular bars. On the throat the edges of the gill covers are orange–red. Non–breeding males are grey–brown in colour, with a darker marbled pattern.

Female: Overall body colour is grey–brown, being darker on the back and lighter on the abdomen. Some scales on the sides may have a silver spot and some populations also show some black spots on the sides. The scales along the mid–lateral line usually have a relatively dark border. All fins are colourless.

Distribution: (Fig. 14). Inhabits fresh to lightly brackish water, in springs, creeks, rivers and small lakes, commonly near the banks. Usually found amongst or close to vegetation where males establish territories. Occurs in the entire Ceyhan River drainage in eastern central Turkey and in the Euphrates and Tigris River valleys in eastern Turkey and Iraq, and also in the Shat al Arab, which forms the border between southeastern Iraq and western Iran. Also found in Syria, Lebanon, and Israel in coastal river systems and through the Jordan valley to the Dead Sea, in western Jordan and Israel. Also in coastal southern Turkey from Syria to the area around Antalya, where the Taurus Mountains meet the Mediterranean Sea to form its western border. Some landlocked populations are present in central Turkey.

Remarks: In the past the name “*sophiae*” was frequently used for the species here regarded as *A. mento* (Pellegri (93); Sözer (24); Akşiray (37)). Villwock (109, 110), however, made clear that *A. sophiae* is a distinct and different species, not present in Turkey, but living in Iraq and Iran.

Also the name “*cypris*” was frequently used for this species. Krupp (98) concluded that *A. cypris* is the valid

name for this species. His vision was based on the assumption that Gaillard (44) was the first revisor, and a detailed synonymy was given. Lazara (100), however, concluded that Garman (8) was the first revisor and the name *A. mento* has priority over *A. cypris*.

For this species Parenti (26) placed the genus name *Aphanius* in parentheses because she noted deviations from “normal” *Aphanius* species with regard to the following characteristics: urohyal embedded in the fold of the branchiostegal membranes and a derived head pore pattern.

During September 1992 specimens of *A. mento* were collected by the first author, together with *A. anatoliae anatoliae*, immediately west of Aksaray, southeast of Lake Tuz. This locality was also studied in 1982, at which time only *A. anatoliae anatoliae* was found. The presence of *A. mento* at this locality was also not mentioned by Akşiray (37) when describing *A. chantrei aksaranus*, a synonym of *A. anatoliae anatoliae*. It is thought that the presence of *A. mento* at this locality is the result of a recent introduction through newly dug irrigation canals on the Konya plain. During the 1992 survey, *A. anatoliae anatoliae* was found in considerably smaller numbers than in 1981. Although not yet proven, natural hybridization between the two species seems possible (Wildekamp & Valkenburg, 57).

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