

Family Oxudercidae

Sand gobies and mudskippers

Oxudercid gobies constitute a large group of fishes, comprising approximately 110 genera and 745 species. They are found predominantly in coastal and brackish waters, as well as in freshwater habitats. Their previous family name was Gobionellidae. However, it is now considered a junior synonym of Oxudercidae. In the freshwaters of West Asia, Oxudercidae is represented by the amphidromous genus *Awaous*, the sand gobies of the genus *Knipowitschia*, non-native *Rhinogobius*, and three mudskippers (*Boleophthalmus dussumieri*, *Periophthalmus waltoni*, *Scartelaos tenuis*). Mudskippers are found often

associated with mud flats and mangroves in the Persian Gulf and around the Arabian Peninsula. They may also be occasionally found in freshwater, particularly following heavy rainfall, but they do not occur regularly in freshwater; instead, they are only found in brackish waters and the sea. Some mudskippers are occasionally seen at considerable distances up in brackish rivers, as *B. dussumieri* in the upper Shur (Iran), 55 km upriver from the coast. The key includes *Periophthalmus* and *Scartelaos* but excludes them from the list of freshwater fishes of West Asia. **Further reading.** Agorreta et al. 2013 (phylogeny); Thacker 2013 (phylogeny); Nelson et al. 2016 (diversity).



Periophthalmus waltoni; Kuwait; ~100 mm SL. © M. Pope.



Scartelaos tenuis; Bandar Khamir, Hormozgan, Iran; ~140 m SL. © G. Polgar.



Awaous jayakari; Wadi Shab, Oman; 75 mm SL.



Awaous jayakari; Wadi Masila, Yemen; 84 mm SL. © F. Krupp.

Awaous jayakari

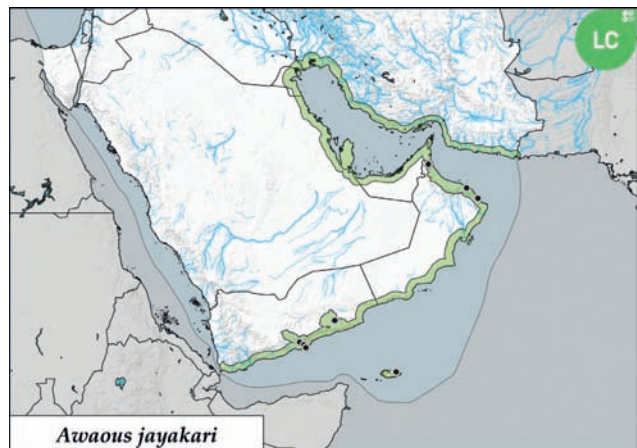
Common name. Arabian freshwater goby.

Diagnosis. Distinguished from sympatric *Glossogobius* by:
 ● upper lip projecting beyond lower lip / ● caudal rounded.
 Size up to 200 mm SL.

Distribution. Oman, UAE, Yemen, southern Iran, and Pakistan.

Habitat. Lower and middle parts of streams that flow into sea at least once every few years. Occupies soft bottoms with sand, silt or organic material. Also on soft sea bottoms, in estuaries, mangroves and coastal lagoons.

Biology. No data. Other species in this genus are amphidromous and spawn in freshwater. Male guard eggs. Larvae are pelagic and must drift into estuaries or ocean. Juveniles migrate to freshwater to grow into adults and spawn. No resident freshwater populations known, but individuals can live for many years, and larvae may only reach sea in years of heavy flooding. Individuals often bury themselves in soft sediment. Marine and brackish water-only populations are expected to occur along coastlines.



Conservation status. LC.

Remarks. Previously identified as *Awaous aeneofuscus*, a species known from the East African coast, possibly as far north as Socotra (Yemen). The distribution boundary between the two species is unknown, but individuals from Wadi Masila in Hadhramaut are identified as



Wadi Shab in Oman is the habitat of *Awaous jayakari* and *Glossogobius tenuiformis*.

A. jayakari. Individuals from Socotra have yet to be identified and are provisionally included under *A. jayakari*. *Awaous jayakari* differs from *A. aeneofuscus* in having a pectoral base that is scaleless or has only 1–3 scales

in adults (vs. pectoral base that is usually completely covered with scales).

Further reading. Esmaeili et al. 2020c (record from Iran); Freyhof et al. 2020 (Arabian Peninsula).

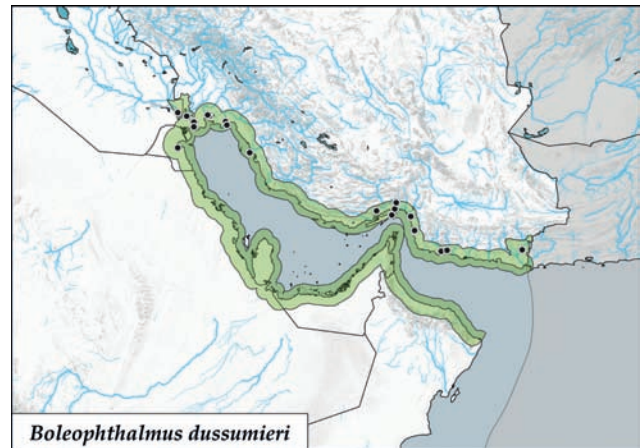
Boleophthalmus dussumieri

Common name. Gel Khorok mudskipper.

Diagnosis. Distinguished from other freshwater gobies in the Persian Gulf basin and the Arabian Peninsula by: ● one large canine tooth behind jaw symphysis and behind row of teeth in lower jaw / ○ no barbels on ventral side of head / ● eye strongly elevated from head profile / ● usually only one row of teeth in lower jaw / ○ 103–185 scales in lateral series / ○ 48–56 predorsal scales. Size up to 187 mm SL.

Distribution. Persian Gulf basin to western India. Upper Shur (Iran) found 55 km upstream from coast and expected to occur in other brackish rivers.

Habitat. Intertidal mudflats. Also, mudflats of brackish rivers far inland.



Boleophthalmus dussumieri; Kuwait; ~120 mm SL. © M. Pope.

Biology. Lives up to 6–7 years, usually spawns for a single season and then dies. Spawns first time at 2 years, in April–August. Digs U-shaped vertical burrows to a depth of about 1 m with mud dams around entries. Mud dams usually pentagonal, rarely hexagonal or square, shape varies between populations. Mud dams help to keep water in burrow at low tide. Hides in burrow at high tide, low winter, and very high summer temperatures and when threatened. Active between 13 and 40°C. Muscular pectoral fin aid movement on land. Keeps water under gill cover to maintain a moist atmosphere for gills. Usually remains within mud walls of its territory, submerged in water or wet mud. Emerges from burrows at 10°C, often coming out of burrows to test temperatures. Basks to raise body temperature to 14°C. Keeps itself wet by regular immersion in pools and burrows and cool by evaporative loss of body fluids. Even at 40°C air temperature, body temperature does not exceed 33°C. Mucous cells prevent dehydration. Gas exchange in air and water occurs through gills, inner operculum, nasal, body, and outer operculum skin. Spawns in male burrow. Male guard eggs. Larvae emerge mid-July, usually in August. Male compete for females during courtship. A male usually has five neighbors, half of which are females. Male identify and attract female by raising fins and jumping with about two-thirds of body above ground. Pectoral fin waves, lateral tail beats, and quivers are other signals. On coast, feeds mainly

on diatoms, blue-green algae, and filamentous algae, using polygonal enclosure between mud walls as a ‘farm’ for diatom growth.

Conservation status. LC.

Remarks. Records of this species from the east coast of India refer to *Boleophthalmus boddarti*.

Further reading. Clayton & Vaughan 1982; Clayton & Wright 1989 (behaviour, habitat); Murdy 1989 (description); Polgar et al. 2013 (revision).

Knipowitschia

Dwarf gobies of the genus *Knipowitschia* are a widespread species in lower parts of slowly flowing rivers and lakes in the Black, Caspian, and Mediterranean basins, from Italy to the Aegean coast in Türkiye. All species are very small gobies that inhabit standing or slowly flowing waters, usually with dense submerged vegetation. They might be very abundant, especially in lakes close to the coast. All species of *Knipowitschia* have a lifespan of no more than two years with adults absent in late summer. Currently, seven species are known from West Asia, with one, *K. iljini*, being strictly marine in the Caspian Sea and included in the key only. Notably, *K. iljini* has not been recorded for several decades. *Knipowitschia* is superficially similar to sand gobies of the *Pomatoschistus*, only found in the sea and in brackish parts of estuaries. **Further reading.** Geiger et al. 2014 (generic placements).

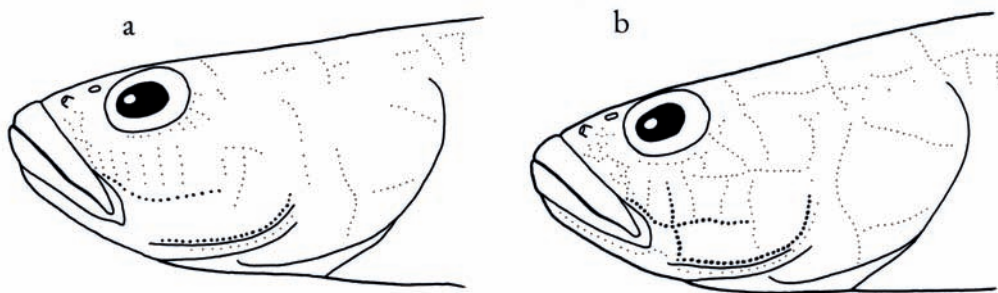


Figure 63. Sensory papillae on side of head: **a**, without vertical row on cheek between rows *d* and *e* in most *Knipowitschia* species; **b**, with vertical row on cheek between rows *d* and *e* in *K. bergi* (from Kottelat & Freyhof 2007, **a**, after Ahnelt 1991, **b**, after Iljin 1928, and Miller 2004).

Key to species of *Knipowitschia* entering freshwaters in West Asia

1a - Otic transverse row *tra* of papillae on cheek extending downward from anterior oculoscapular canal almost to row *b*; a second transverse row of papillae on cheek extending downward through row *d* and almost reaching row *e* (Fig. 63).

.....*K. bergi*

1b - Otic transverse row *tra* of papillae on cheek not reaching to row *b*; no transverse row of papillae on cheek through row *d*.

.....2

2a - Squamation incomplete, scales present under pectoral, on caudal peduncle, and rarely in one series along mid-lateral line.

.....3

2b - Flank and caudal peduncle covered by scales, with more than one series along lateral midline, head, nape, breast, and back naked in front of origin of second dorsal.

.....4

3a - Head canals absent.

.....*K. ricasolii*

3b - Head canals present, often reduced.

.....*K. byblisia*

4a - Anterior oculoscapular canals usually separate or very closely set in midline of posterior interorbital space, with two pores λ (Fig. 64).

.....*K. mermere*

4b - Anterior oculoscapular canals usually fused in posterior interorbital space, with a single pore λ (Fig. 64), rarely canals not extending to interorbital space.

.....5

5a - Caudal asymmetric.

.....*K. longecaudata*

5b - Caudal symmetric.

.....6

6a - Posterior oculoscapular canal usually present (pores ρ^1 – ρ^2 ; as in Fig. 64).

.....*K. caucasica*

6b - Posterior oculoscapular canal always absent (Fig. 64).

.....*K. caunosi*

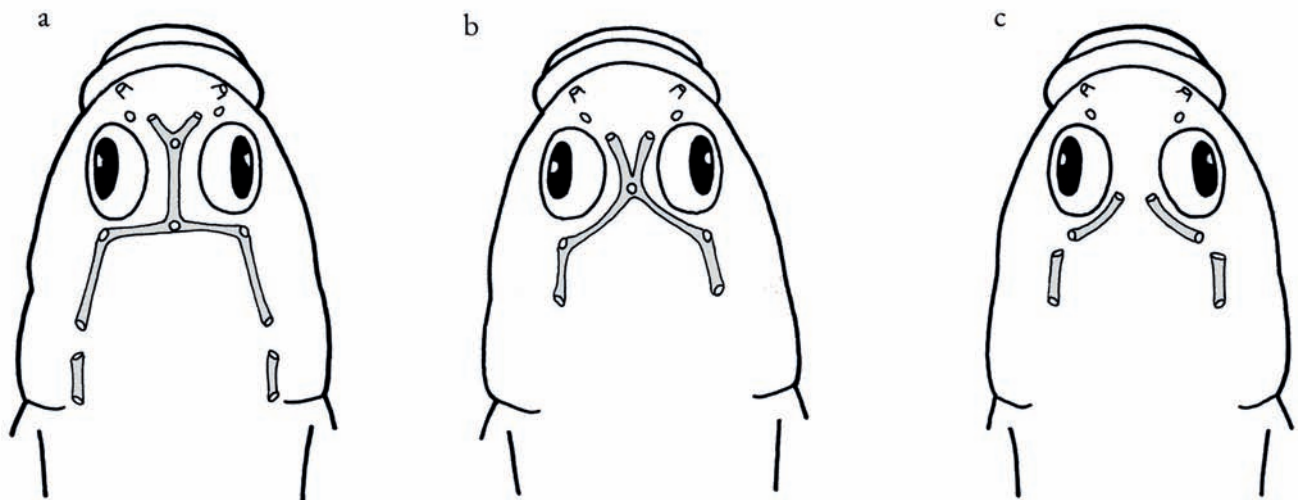
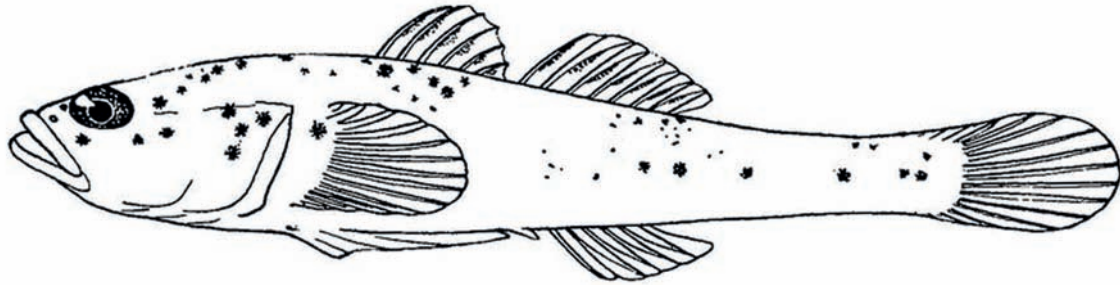


Figure 64. Anterior oculoscapular canal ending: **a**, on snout (pore σ) in *Pomatoschistus* species; **b**, in front of middle of eye (pore λ) in some *Knipowitschia* species; **c**, behind middle of eye (pore K) in some *Knipowitschia* species.



Knipowitschia bergi; Caspian Sea; ~30 mm SL. (from Iljin 1928).

Knipowitschia bergi

Common name. Volga dwarf goby.

Diagnosis. Distinguished from other species of *Knipowitschia* in Caspian basin by: ● otic transverse row *tra* of papillae on cheek extending downward from anterior oculoscapular canal almost to row *b* / ● a second transverse row of papillae on cheek extending downward through row *d* and almost reaching row *e* / ○ flank and caudal peduncle covered by scales, with more than one series along lateral midline / ○ about 30 total scales in midlateral series / ○ caudal symmetric. Size up to 32 mm SL.

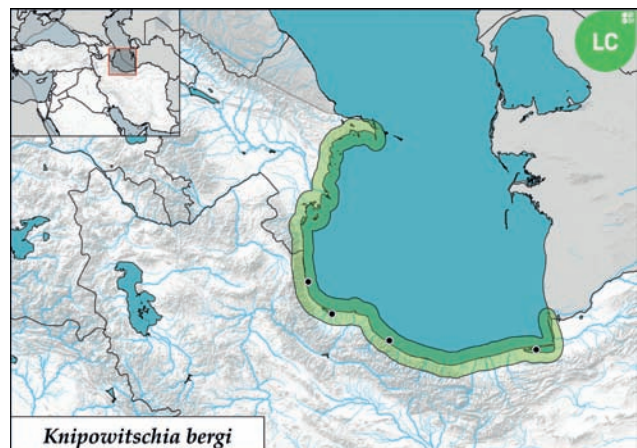
Distribution. Northern and south-eastern Caspian Sea, deltas of Ural and Volga, along west coast south to Iran. Mostly at sea, but was recorded from a river in Gonbad City (Iran).

Habitat. A near-pelagic coastal, marine species found in areas of varying salinity, including freshwater.

Biology. Lives 1 year. Matures at 18–20 mm SL. Spawns after first winter, in May–July, at depths of 2–7 m. Female lay 2–3 portions of eggs (0.4 × 1.0 mm) attached inside a mollusc shell. Adults probably die shortly after spawning. Feeds on small crustaceans.

Conservation status. LC.

Remarks. *Knipowitschia bergi* is poorly known and has been reported from coastal, freshwater or slightly brackish



lagoons in the Caspian basin. It is thought to be common in northern the Caspian Sea in Kazakhstan, where it mainly inhabits fresher parts of the sea. *Knipowitschia bergi* has been placed in a separate genus, *Hyrcanogobius*, by some authors based on a slightly different organisation of cephalic sensory pores. Its phylogenetic position should be investigated in future.

Further reading. Iljin 1928 (description); Miller & Pinchuk 2004 (biology, distribution).



Knipowitschia byblisia; lower Dalaman, Türkiye; ~20 mm SL.

Knipowitschia byblisia

Common name. Köyceğiz dwarf goby.

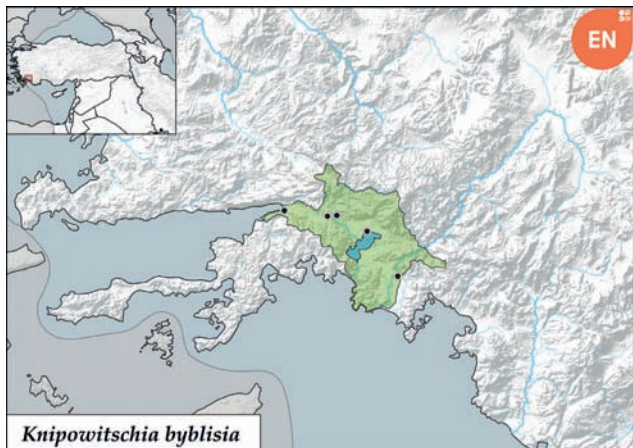
Diagnosis. Distinguished from other species of *Knipowitschia* in Anatolia by: ○ squamation incomplete, scales in two patches: in axillary area and on caudal region, often with a narrow naked zone behind tip of pectoral, rarely in one series along midlateral line / ○ head canals usually reduced to two short postorbital canals, anterior oculo-scapular canal present in few individuals / ○ otic transverse row *tra* of papillae on cheek not reaching to row *b* / ○ no transverse row of papillae on cheek through row *d* / ○ caudal symmetric. Size up to 28 mm SL.

Distribution. Türkiye: Lake Köyceğiz basin, a small stream flowing to Gökova Bay and lower Dalaman drainage.

Habitat. Fresh to brackish waters of coastal lakes and tributaries.

Biology. No data.

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



Remarks. *Knipowitschia byblisia* is much more abundant than *K. caunosi* in Lake Köyceğiz. These two species represent a molecular cluster (COI) well separated from other *Knipowitschia*. Within this cluster, syntopic subgroups are slightly different from each other. Fish from these subgroups all agree with the original description of *K. byblisia*.

Further reading. Ahnelt 2011 (description); Ahnelt 2016 (record from Marmaris).

Knipowitschia caucasica

Common name. Caucasian dwarf goby.

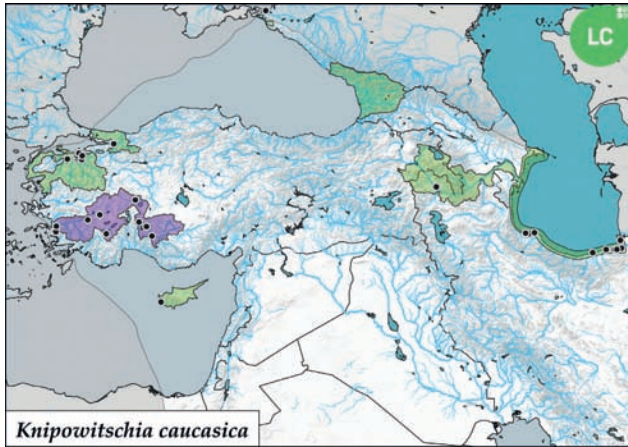
Diagnosis. Distinguished from other species of *Knipowitschia* in West Asia by: ● head canals usually complete, rarely posterior oculoscapular reduced / ○ anterior oculoscapular canals usually fused in posterior interorbital space, with a single pore λ / ○ flank and caudal peduncle covered by scales, with more than one series along lateral midline / ○ anterior extremity of anterior oculoscapular canal in front of middle of eye (pore λ) (Fig. 64) / ○ otic transverse row *tra* of papillae on cheek not reaching to row *b* / ○ no transverse row of papillae on cheek through row *d* / ○ caudal symmetric. Size up to 50 mm SL.

Distribution. Coasts of Black, Azov, Caspian, and Marmara Seas. Also, along northern Aegean west to Aliakmon drainage (Greece). Introduced in Karamanlı Reservoir, Lakes Beyşehir, Eğirdir and Eber basins, Büyük Menderes drainage and some places around Antalya (Türkiye). Also introduced to Aral Sea (now extirpated). Invasive in lower Rhine (North Sea basin).

Habitat. Fresh to hypersaline waters (salinity up to 55 ‰) of lakes, estuaries, and lagoons. Most common in shallow, well-vegetated habitats.



Knipowitschia caucasica; Lake Beyşehir basin, Türkiye; ~35 mm SL.



Biology. Lives <2 years. Spawns after first winter in March–July at 20–23 mm SL, releasing up to four portions of eggs. Eggs are attached to roof of a burrow under stones, plant material or shells, defended by male. Postlarvae pelagic. Feeds on small invertebrates.

Conservation status. LC.

Remarks. The origin of introduced populations in Türkiye appears to be the Maritza drainage in European Türkiye, as fish farms in this region were a major source of carp stocked throughout Anatolia. Molecular data also support this hypothesis. Within *K. caucasica*, several molecular groups differ slightly from each other.

Further reading. Economidis & Miller 1990 (systematics); Daoulas et al. 1993 (reproduction); Economou et al. 1994 (reproduction, Trichonis population); Bianco & Ahnelt et al. 1995 (distribution, systematics); Vasil'eva & Kuga 2001 (osteology, systematics); Vasil'eva et al. 2004 (biology); Küçük et al. 2009b (introduction in Eğirdir); Ahnelt 2011 (introduction to Central Anatolia); Tarkan et al. 2015 (distribution).

Knipowitschia caunosi

Common name. Kaunos dwarf goby.

Diagnosis. Distinguished from other species of *Knipowitschia* in West Asia by: ○ head canals present / ○ posterior oculoscapular canal absent / ○ anterior oculoscapular canals usually fused in posterior interorbital space, with a single pore λ, rarely canals not extending to interorbital space / ○ flank and caudal peduncle covered by scales, with more than one series along lateral midline / ○ anterior extremity of anterior oculoscapular canal in front of middle of eye (pore λ) (Fig. 64) / ○ otic transverse row *tra* of papillae on cheek not reaching to row *b* / ○ no transverse row of papillae on cheek through row *d* / ○ caudal symmetric. Size up to 30 mm SL.

Distribution. Türkiye: Lake Köyceğiz basin.

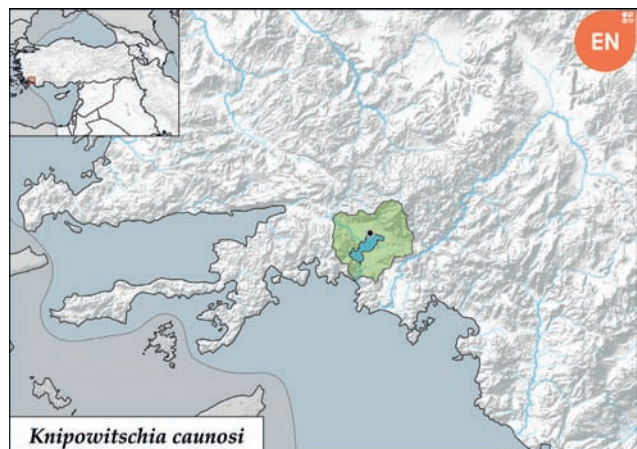
Habitat. Fresh to brackish waters of coastal lakes and rivers.

Biology. No data.

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

Remarks. *Knipowitschia caunosi* is much rarer than *K. byblisia* and seems to be endemic to Lake Köyceğiz.

Further reading. Ahnelt 2011 (description).



Knipowitschia caunosi; Lake Köyceğiz, Türkiye; ~20 mm SL.



Knipowitschia longecaudata; Kura, Azerbaijan; female, ~35 mm SL.



Knipowitschia longecaudata; Lake Sinoe, Romania; male, ~30 mm SL.

Knipowitschia longecaudata

Common name. Longtail dwarf goby.

Diagnosis. Distinguished from other species of *Knipowitschia* entering freshwater by: ● caudal asymmetric, upper part longer than lower part / ○ anterior extremity of anterior oculoscapular canal in front of middle of eye (pore σ) / ○ anterior oculoscapular canals usually fused in posterior interorbital space, with a single pore λ, rarely canals not extending to interorbital space / ○ flank and caudal peduncle covered by scales, with more than one series along lateral midline / ○ otic transverse row *tra* of papillae on cheek not reaching to row *b* / ○ no transverse row of papillae on cheek through row *d* / ○ posterior oculoscapular canal absent / ○ back naked in front of origin of second dorsal / ○ body with 4–8 dark bars in live nuptial male / ○ 33–40 total scales in midlateral series. Size up to 40 mm SL.

Distribution. Caspian, Azov, northern and western Black Sea basins.

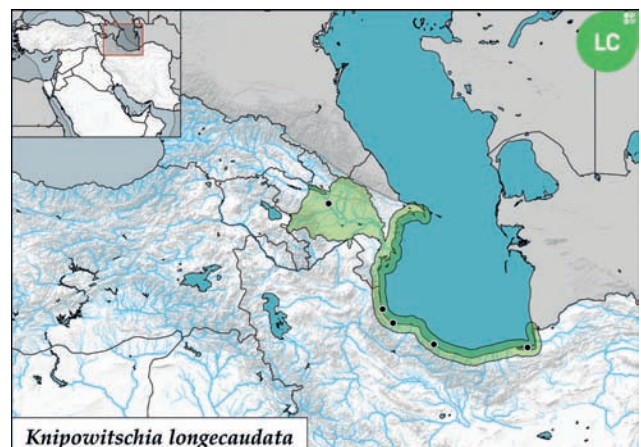
Habitat. Fresh to salt waters of coastal lakes, reservoirs, estuaries, and lagoons in shallow, well-vegetated habitats. Rarely in large rivers where it might occur far upstream.

Biology. Lives <2 years. Spawns after first winter, at 20 mm SL, March–July. Female may spawn several times in a season. Male defend eggs in cavities under stones, plant material, or mollusc shells. Feeds on small invertebrates.

Conservation status. LC.

Remarks. This species has not been found along the Black Sea coast of Türkiye, Russia, and Georgia and may be absent from the Asian Black Sea basin. Fish identified as this species from the Danube delta and the lower Don share their COI DNA sequences with *K. caucasica*, and no *K. longecaudata* has been positively identified by molecular methods. This suggests that *K. caucasica* may have introgressed at least parts of populations.

Further reading. Miller 2004 (description, biology); Zarei et al. 2022a (records from Iran).





Knipowitschia mermere; Gediz drainage, Türkiye; 25 mm SL.

Knipowitschia mermere

Common name. Gediz dwarf goby.

Diagnosis. Distinguished from other species of *Knipowitschia* in Anatolia by: ● anterior oculoscapular canals usually separate or very closely set in midline of posterior interorbital space, with two pores λ / ○ flank and caudal peduncle covered by scales, with more than one series along lateral midline / ○ head canals present, often reduced / ○ posterior oculoscapular canal absent / ○ otic transverse row *tra* of papillae on cheek not reaching to row *b* / ○ no transverse row of papillae on cheek through row *d* / ○ caudal symmetric. Size up to 30 mm SL.

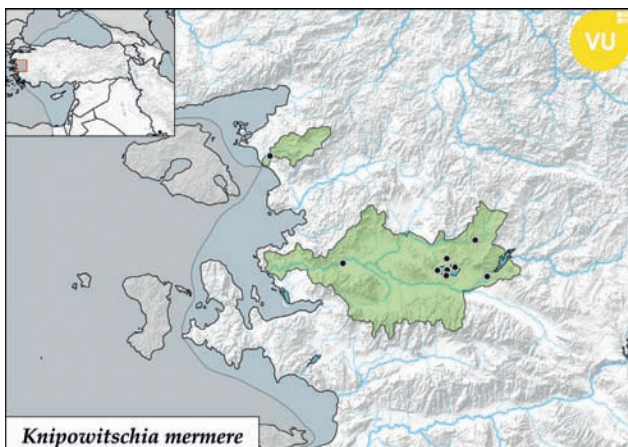
Distribution. Türkiye: Lower Gediz and Madra drainages, probably more widespread in northern and central Aegean rivers in Anatolia.

Habitat. Fresh to brackish water of coastal lakes.

Biology. No data.

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

Further reading. Ahnelt 1995 (description).



Knipowitschia ricasolii

Common name. Ephesus dwarf goby.

Diagnosis. Distinguished from other species of *Knipowitschia* in Anatolia by: ● head canals absent / ○ squamation incomplete, scales in two patches: in axillary area and on caudal region, rarely in one series along midlateral line / ○ otic transverse row *tra* of papillae on cheek not reaching to row *b* / ○ no transverse row of papillae on cheek through row *d* / ○ caudal symmetric. Size up to 26 mm SL.

Distribution. Türkiye: Lakes Gebekirse and Kocagöz basins and Eleman marshes in lower Küçük Menderes drainage.

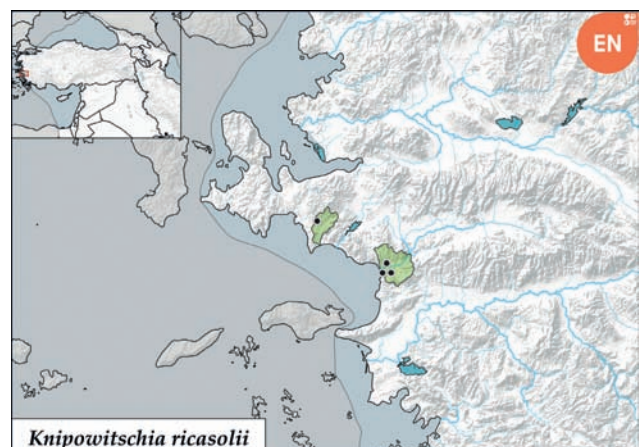
Habitat. Fresh to brackish water of coastal lakes.

Biology. No data.

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

Remarks. Gobies in Kavakdere reservoir (Aegean basin) may belong to this species. *Knipowitschia ephesi* is a synonym. *Knipowitschia ricasolii* is closely related to *K. caucasica*.

Further reading. Ahnelt 1995 (description); Çiçek et al. 2019 (*Gobius ricasolii*).





Before it dried out, Lake Marmara was the habitat of a very large population of *Knipowitschia mermere*.



Knipowitschia ricasolii; Lake Zeytinkoy, Türkiye; 25 mm SL.

Rhinogobius

Rhinogobius is a large group of small gobies widely distributed in East and Southeast Asia. It is estimated that there are around 112 species in the genus, with many more yet to be described. Stream gobies exhibit a wide range of life history traits, with some species inhabiting coastal rivers and streams, being amphidromous and producing many eggs and small pelagic larvae. These species often have large distribution areas. Others inhabit headwater streams and lay few eggs from which large benthic larvae hatch. A significant proportion of these species are endemic to

a single or few rivers, and only a small proportion have likely been described. Consequently, the identification of *Rhinogobius* species is challenging, as only a few regional faunas have been extensively studied, while *Rhinogobius* from China, Russia, and Vietnam remain largely unstudied. One *Rhinogobius* species is non-native in West Asia, and it is believed to have been introduced from Central Asia to Iran as a contaminant of commercially cultivated fishes such as Chinese carps (*Ctenopharyngodon*, *Hypophthalmichthys*). It is thought to originate from the Russian Amur, from where it was introduced to Central Asia during Soviet

times. Chinese carps have also been introduced to Central Asia from China (e.g., from Wuhan, Yangtze). It cannot be excluded that the non-native *Rhinogobius* originate from outside the Amur. These *Rhinogobius* have been identified as *R. similis*, *R. lindbergi*, or *R. cheni*. Still, identification of the species is based only on the assumption that it has been introduced from the Amur drainage and that these are the only similar species in the Amur. *Rhinogobius* is a very speciose genus, and many undescribed species are expected to occur in China and the Russian part of the Amur drainage. A comprehensive identification of non-native *Rhinogobius* is only possible when the diversity of Chinese *Rhinogobius* species is better understood. The species has expanded its range in the western Caspian basin and Iran. It has recently also reached the Rioni in the Georgian Black Sea basin, opening the door for a westward invasion. As it continues to be introduced as a weed with commercial fish, it could virtually be found everywhere, especially in areas where carps are stocked. In addition to the species discussed here, *R. brunneus* or a similar species, has been recorded

from the Persian Gulf but has not been confirmed recently. **Further reading.** Endruweit 2018; Huang et al. 2016; Chen et al. 2002; Chen & Shao 1996; Shibukawa 2020 (diversity, life history); Vasil'eva 2007 (Central Asia).

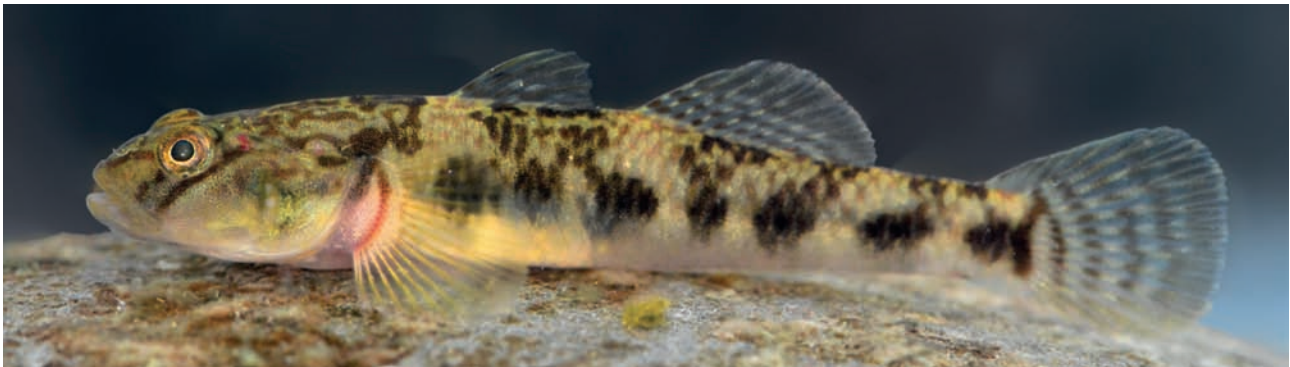
Rhinogobius sp.

Common name. Stream goby.

Diagnosis. Distinguished from other gobies in West Asia by:

● first dorsal with bluish-iridescent, small blotches on 1–2nd dorsal membrane in male / ● orange spot on gill-membrane in male / ○ 5–6 rays in first dorsal / ○ lower lip very slightly projecting beyond upper lip / ○ caudal roundish / ○ flank mottled or marbled, or with 6–8 irregularly shaped bars or blotches / ○ cheek without rows of pores. Size up to 52 mm SL.

Distribution. Introduced and invasive in southern Caspian basin from Kura east to Gorgan. Also in Rioni (Black Sea basin), Lakes Urmia and Namak basins, Iranian Tigris drainage, and Hari. Was introduced in Columbia drainage of western United States, Central Asia, and parts of Russia and China, where it is not native. Believed to be native to Amur drainage.



Rhinogobius sp.; Lake Urmia basin, Iran; female, ~40 mm SL.



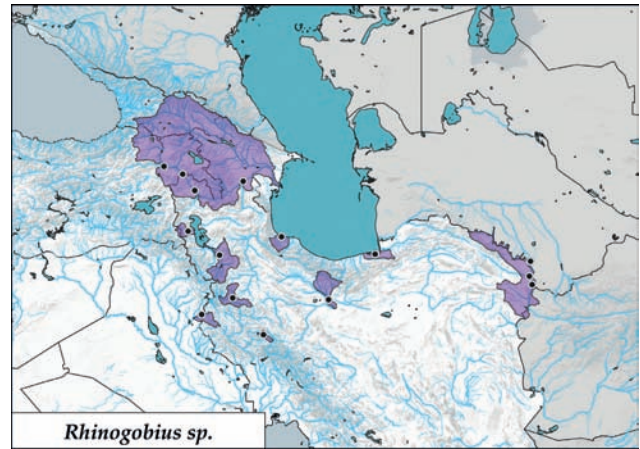
Rhinogobius sp.; Amur Darja drainage, Uzbekistan; male, ~40 mm SL.

Habitat. A wide range of rivers, streams, and coastal wetlands, also in Caspian Sea. Often found in habitats with submerged vegetation.

Biology. Poorly known. Lives one year and spawns first spring. Eggs laid under or between stones, plants or shells. Feeds on small invertebrates.

Conservation status. Non-native; introduced as a weed with carp and/or Chinese carps.

Further reading. Al-Hassan & Miller 1987 (record of *R. brunneus*); Coad & Abdoli 2000 (records from Iran as *R. similis*); Bogutskaya et al. 2008 (colour pattern from Amur); Vasil'eva & Kuga 2008 (identification as *R. cheni* in Central Asia); Eagderi & Moradi 2017 (records from Urmia); Eagderi et al. 2018a (records from Tigris); Sadeghi et al. 2018 (identification as *R. lindbergi*).



Coastal wetlands are major habitats of Gobies, pipefishes, silversides, and killifish, as here in Oman.