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Anablepsoides lineasoppilatae, a new killifish (Teleostei: Rivulidae) from south-eastern Peru

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Abstract

Anablepsoides lineasoppilatae, spec. nov. from south-eastern Peru (Departamento Puno and Madre de Dios) is here described. It is a member of the *A. limoncochae* group and differs from all the other species of this assemblage in its unique colour pattern. In *A. lineasoppilatae*, the red striped pattern on the flank reaches only to the posterior area of the pectoral fin (versus stripes reaching to the humeral region). Further it distinguished by a grey anal fin (versus yellow), by an inferior lip without any distinctive coloration (versus red inferior lip), by a dorsal fin with a low number of dots (versus transverse stripes on the middle of the dorsal fin) and by an absence of a dark margin on the dorsal fin (rather than a presence).

Resumen

Se describe la especie *Anablepsoides lineasoppilatae*, spec. nov. del sureste del Perú (Departamento de Puno y Madre de Dios). Es parte del grupo *A. limonconchae*, pero se diferencia de las otras especies de este tipo por su patrón de colores único. En los *Anablepsoides lineasoppilatae*, las rayas rojas en el flanco alcanzan sólo la zona posterior de la aleta pectoral (versus rayas que alcanzan la región del húmero). Además, este tipo se diferencia por su aleta anal gris (versus amarilla), por un labio inferior sin coloración distintiva (versus rojo), una aleta dorsal con un bajo número de puntos (versus frente a rayas transversales oblicuas completas en el medio de la aleta dorsal) y la ausencia de margen oscuro en la aleta dorsal (versus presencia).

Key words

Anablepsoides limoncochae group, new species, taxonomy, tropical Andes region, Rio Madre de Dios basin.

Introduction

The genus *Anablepsoides* was initially described by Huber (1992) for the dwarf and distinctive species *Rivulus atratus* Garman. Recently, however, the genus was redefined by Costa (2011). It is now treated as its own diversified genus of cis-Andean killifishes (formerly assigned to *Rivulus*), with more than 45 species assigned to different species groups (Costa, 2011; 2013). Most of these species inhabit the shallow parts of streams and swamps within dense forest or in open savannah (Fels & de Rham, 1982; Costa, 2006, 2010; Costa & De Luca, 2011; Valdesalici & Schindler, 2011). Their distribution includes the Southern Lesser Antilles; the Orinoco river basin in Venezuela; the river basins of the Guianas as well as adjacent parts of north-eastern Venezuela and northern Brazil; the Amazonas river basin in Colombia, Ecuador, Peru, Bolivia and Brazil; and in isolated drainages in north-eastern Brazil (Costa, 2011).

The greatest diversity within the *Anablepsoides limoncochae* species group has been found in western parts of the Amazonian drainage basin (Costa, 2010). This group includes the following species: *A. christinae* Huber, *A. erberi* Berkenkamp, *A. intermittens* Fels & de Rham, *A.iridescens* Fels & de Rham, *A. limoncochae* Hoedeman, *A. parlettei* Valdesalici & Schindler, *A. rubrolineatus* Fels & de Rham, *A. taeniatus* Fowler and *A. urubuiensis* Costa (Costa, 2010; 2013, Valdesalici & Schindler, 2011). During a killifish survey taken in the south-east of Peru in October 2004, C. Parlette & L. Peck collected *A. christinae*, *A. parlettei* as well as another species of the *Anablepsoides limoncochae* group, which is herein described.

Material and Methods

Measurements and counts were taken as described in Amiet (1987), Huber (1992) and Valdesalici (2010). Measurements were made with a digital calipers, under a dissecting microscope, and rounded out to the nearest 0.1 mm. All measurements are presented as percentages of standard length (SL), except for eye diameter and snout length, which are given as a percentage of head length (HL). Terminology of the cephalic neuromast series follows Costa (2001). Terminology of the frontal squamation as described in Hoedeman (1958) and Huber (1992). Osteological preparations (cleared and stained) were made according to Taylor & Van Dyke (1985), but not stained for cartilages.

Types and additional material are deposited in: Museo de Historia Natural, Universidad San Marcos (MUSM), Lima, Peru; Museo Civico di Storia Naturale „G. Doria" (MSNG), Genova, Italy; Senckenberg Naturhistorische Sammlungen Dresden, Museum für Tierkunde (MTD), Germany; Stefano Valdesalici Private Collection (CSV), Viano, Italy.

Anablepsoides lineasoppilatae spec. nov.

Figs.1–2, Table 1

Holotype. MUSM 46995, male, 35.3 mm SL, Peru, Departamento Puno, Rio San Gaban drainage (13° 27′21.4″ S, 70° 24′36.5″ W), *leg*. C. Parlette & L. Peck, October 2004.

Paratypes. MTD F 33003, 1 female 39.3 mm SL, collected with holotype. MSNG 57426, 3 males 33.9–37.3 mm SL, 2 females 33.5–40.8 mm SL, Peru, Departamento Madre de Dios, Rio Araza drainage (13° 11′16.6″ S, 70° 31′8.8″ W), *leg*. C. Parlette & L. Peck, October 2004.

Table 1. Morphometric data of *Anablepsoides lineasoppilatae*. All measurements are presented as percentages of standard length, except eye diameter and snout length as percentages of head length, standard length in mm.

	holotype	**males** (n = 4, including holotype)	**females** (n = 3)
Standard length	35.3	33.9–37.3	33.5–40.8
Depth at pelvic fins	21.5	18.2–23	19.5–20.8
Predorsal length	78.4	75.3–82.3	75.5–77.3
Preanal length	63.4	58.1–66.9	61.3–63.8
Prepelvic length	50.4	49.3–58.1	50.4–51.7
Caudal peduncle length	24.3	15.6–24.3	15.8–21.0
Caudal peduncle depth	12.7	12.3–13.2	11.9–12.8
Dorsal base length	8.7	8.5–9.5	9.1–10.7
Anal fin base length	15.8	15.8–20.3	13.7–17.9
Head length	25.2	25.2–28.6	22.9–26.5
Snout length	24.7	24.4–25.7	20.7–23.3
Eye diameter	29.2	24.4–29.8	26.9–33.3

Additional material non type. CSV 1010, 1 male, 35.0 mm SL C&S, collected with holotype. CSV 1011, 1 male 35.0 mm SL C&S, Peru, Departamento Madre de Dios, Rio Araza drainage (13° 11′16.6″ S, 70° 31′8.8″ W), *leg*. C. Parlette & L. Peck, October 2004.

Diagnosis. Males of *Anablepsoides lineasoppilatae* are distinguished from males of the remaining species in the *A. limoncochae* group by the red striped pattern on their flanks, running from the caudal peduncle to the posterior area of the pectoral fin only (versus pattern reaching to the humeral region). It can be additionally differentiated through a combination of the following characteristics (or character states): grey anal fin (versus yellow), an inferior lip without a distinctive coloration (versus red inferior lip), a dorsal fin with only a few dots (versus completely oblique transverse stripe on the middle of the dorsal fin) and the absence of a dark margin on the dorsal fin (versus presence).

Description. Measurements are summarised in Table 1. Largest examined male 37.7 mm SL; largest examined female 33.2 mm SL. Dorsal profile slightly convex from snout to end of dorsal fin base, nearly straight at caudal peduncle. Ventral profile slightly convex from lower jaw to anal fin origin; approximately straight from anal fin to posterior end of caudal peduncle. Body slender, subcylindrical anteriorly, compressed posteriorly, greatest body depth at midlength between pectoral fin base and anal fin origin. Snout short, rounded. Dorsal and anal fin rounded, without filaments in both sexes. Pectoral fins rounded. Pelvic fins small, reaching anus. Caudal fin rounded. Dorsal fin origin above base of the 7th or the 8th anal fin ray. Dorsal fin rays 8–10; anal fin rays 12–13; caudal fin rays 26; pectoral fin rays 14; pelvic fin rays 6. Scales large, cycloid. Body and head entirely scaled. No scales on dorsal fin and anal fin base. Frontal squamation E-patterned. Longitudinal series of scales

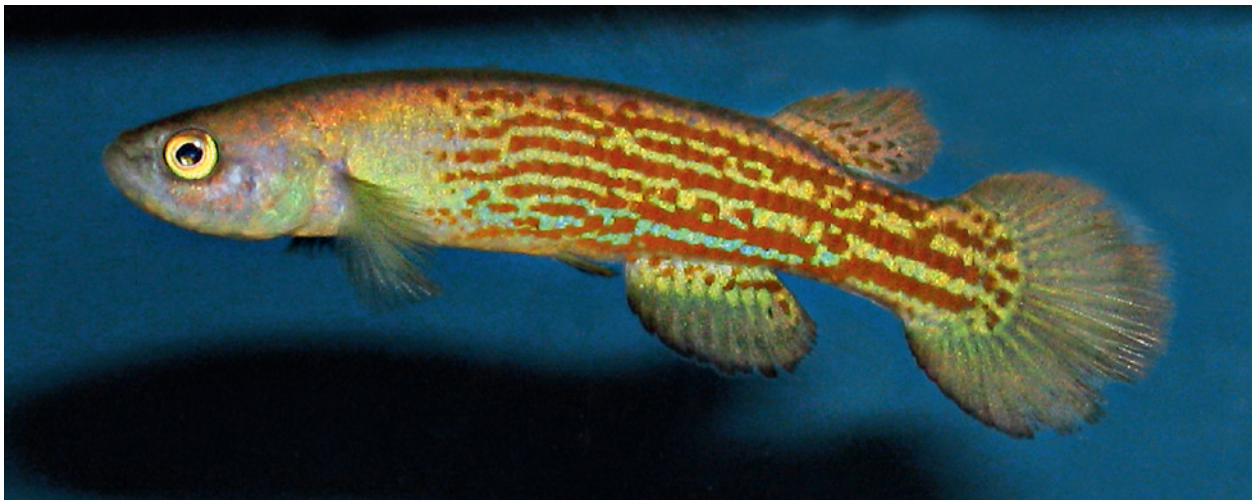

Fig. 1. *Anablepsoides lineasoppilatae,* MUSM 46995, male, holotype, 35.3 mm SL, Peru, Departamento Puno, Rio San Gaban drainage.

Fig. 2. *Anablepsoides lineasoppilatae,* female, MTD F 33003, female, 39.3 mm SL, Peru, Departamento Puno, Rio San Gaban drainage.

36–39. Cephalic neuromasts: supraorbital 3+3. Lateral line interrupted. Basihyal subtriangular. Second pharyngobranchial with one tooth. Vomerine teeth 2–3. Lateral process of post-temporal long. Single antero-dorsal process of urohyal.

Coloration. Body sides of males (Fig. 1) cream yellow with light blue reflection, with seven orange-red interrupted stripes, three of which lie between the middle part of the flank and caudal fin base. Dorsum brownish. Venter orange. Opercular region green-yellow with light blue reflection. Ventral part of head cream yellow. Upper and lower jaw dark brown. Iris yellow. Dorsal fin grey yellowish, with pale yellowish base, with red spots on median posterior portion. Anal fin pale grey, with cream yellow base and red spots. Caudal fin pale yellowish to grey yellow ventrally. Pelvic fins grey yellowish. Pectoral fins hyaline to slightly yellowish. Body sides of females (Fig. 2) pale light blue, with irregular orange spots forming three irregular lines on caudal peduncle, humeral region yellow. Dorsum brownish. Venter orange. Opercular region golden with large black blotch. Ventral part of head orange. Upper and lower jaw brown. Iris yellow. Dorsal fin hyaline to pale yellowish, with four transverse dark brown to grey stripes. Anal fin dark yellow, base light blue with grey spots. Caudal fin dark yellow to hyaline with grey spots on central part, and with a black spot close to its dorsal margin with a small yellow border. Pelvic fins and pectoral fins hyaline to light yellow.

Distribution. Currently known from the type locality, a small stream belonging to the San Gaban river drainage, at an altitude of about 600 m asl, Departamento Puno, and from a small spring in the Araza river drainage, at an altitude of about 450 m asl, Departamento Madre de Dios, south eastern Peru (Fig. 3).

Habitat notes. Type specimens were collected in a small pool (of about 30 square meter) fed by a forest creek (Fig. 4). The water was clear and transparent; temperature approximately 24 °C with a pH of 6.8. The only other fish present was *Pimelodus pictus*.

Etymology. From the Latin words *lineas*, meaning stripes and *oppilatae*, meaning barred, in reference to the interrupted stripes on the body flank.

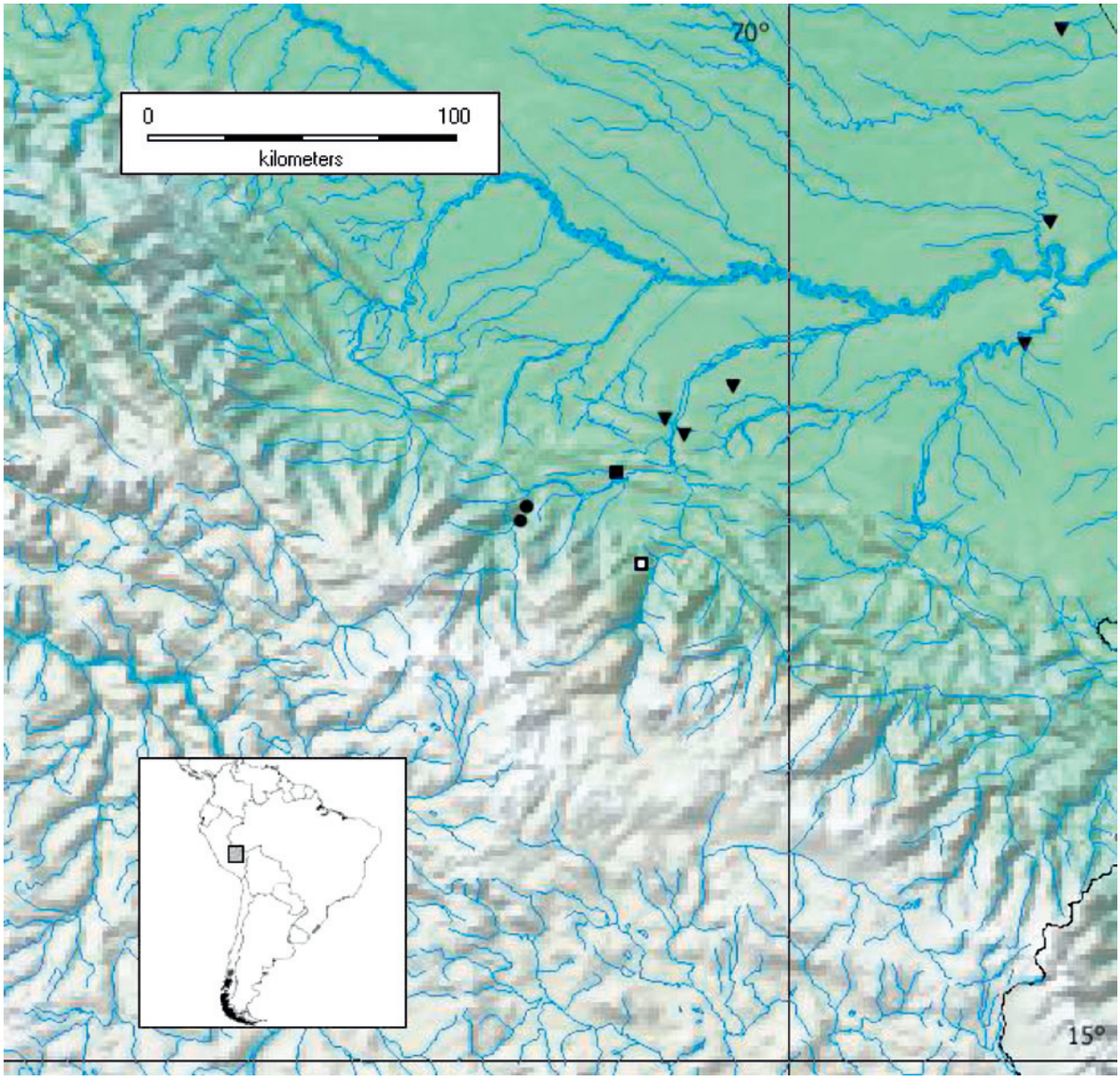

Fig. 3. Distribution map of *Anablepsoides lineasoppilatae,* (square, open square type locality), *A. christinae* (inverted triangle) and *A. parlettei* (circle).

Discussion

Anablepsoides was initially designated as a subgenus of *Rivulus* by Huber (1992), of the then taxonomically and morphologically isolated dwarf species *Rivulus atratus*. However, recently, the conceptualisation of *Anablepsoides* dramatically changed. It was lifted to genus rank and includes now more than 45 species (Costa, 2011; 2013). The re-diagnosis of *Anablepsoides* (including *Oditichthys* Huber and *Benirivulus* Costa) by Costa (2011) was based on a phylogenetic analysis comprising molecular (mitochondrial) and morphological data (however, the number of species included was limited, and no convincing autapomorphic characters or character states are given). According to Costa (2011) the species composition includes a group of small to medium-sized species (between approximately 25 mm and 60 mm SL) and another group of large sized species (formerly taxonomically pooled in the subgenus *Oditichthys*) of about 100 to 120 mm SL. Such an assemblage is obviously heterogeneous and further studies are needed to verify the taxonomic treatment (Huber, 2012). Nevertheless, for practical reasons, we are including the new species within *Anablepsoides* in order to continue with the nomenclature proposed and used by Costa (2011; 2013).

The new species *A. lineasoppilatae* is a member of the *A. limoncochae* species group as it has been re-defined by Costa (2010). This assemblage is differentiated by Costa (2010; 2013) from the *A. urophthalmus* group by the possession of contact organs on the flanks of males (versus the absence of contact organs), by the presence (versus absence) of an oblique transverse stripe on the

Fig. 4. Habitat (type locality) of *Anablepsoides lineasoppilatae*.

middle of the dorsal fin and by the absence (versus presence) of similar light yellow to orange zones on the dorsal and ventral margins of the caudal fin. However, our studies imply that the characteristics are taxonomically less usable because of its variable appearance (Valdesalici & Schindler, 2011).

In the *A. limoncochae* group, *A. lineasoppilatae* is hypothesized to be closely related to its geographic neighbours *A. christinae* and *A. parlettei* (cf. Valdesalici & Schindler, 2011). Both the latter two species are differentiated from *A. lineasoppilatae* by the substantial character states mentioned in the diagnosis. Divergent characteristics in male colour pattern play an important role in mate choice (Huber, 1992; 1998). Hence, it is likely that the differences in male colour pattern represent not only a phenotypical distinction but also contain a biological significance for speciation and species delimitation by pre-mating reproductive isolation.

These three species (*A. christinae*, *A. lineasoppilatae* and *A. parlettei*) are distributed in the Peruvian part of the Rio Madre de Dios basin. As far as is known presently, they can be found occurring at separate elevational gradients. *Anablepsoides christinae* is known to occur in the lowlands at the western border of the Departamento Madre de Dios (Huber, 1992; Valdesalici & Schindler, 2011), whereas *A. lineasoppilatae* and *A. parlettei* are described in the eastern foothills of the Andes (Valdesalici & Schindler, 2011; this study). *Anablepsoides parlettei* occurs in the upper Rio Inambari system in the Departamento Cusco at an altitude of about 800 m. In contrast A. *lineasoppilatae* occurs at an intermediate altitude of about > 400 and < 700 m asl in the San Gaban river (Departamento Puno) and also in the Marcapata river drainages (Departamento Madre de Dios). Since distinct elevational gradients are usually connected with different climatic and ecological variables, it can be presumed that the speciation of these species is linked with the adaptation to separate environmental niches. The tropical Andes region is presently recognised as one of the world's hyper-hotspots of biodiversity, charakterised by a high rate of endemism (Myers *et al*., 2000). The specific diversification of the members of the *A. limoncochae* group at the foothills of the Andes as described here may be treated as an additional example of such endemism and restricted geographic distribution.

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