

# Five new species of the killifish genus *Anablepsoides* from the Brazilian Amazon (Cyprinodontiformes: Rivulidae)

WILSON J. E. M. COSTA, PEDRO H. N. BRAGANÇA & PEDRO F. AMORIM

Laboratório de Sistemática e Evolução de Peixes Teleósteos, Instituto de Biologia, Universidade Federal do Rio de Janeiro, Caixa Postal 68049, CEP 21944-970, Rio de Janeiro, Brasil; wcosta(at)acd.ufrj.br, pedrobra88(at)gmail.com, pedro\_f\_a(at)hotmail.com

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## Abstract

Two new species of the *Anablepsoides urophthalmus* group and three new species of the *A. ornatus* group, collected in the Brazilian Amazon, are described. *Anablepsoides jari*, new species, and *A. roraima*, new species, are the first records of members of the *A. urophthalmus* group for tributaries of the Amazonas river basin draining the Guiana Shield, but phylogenetic relationships of these species with other taxa are still uncertain. *Anablepsoides jari*, from the Jari river drainage, is distinguished from congeners by the colour pattern of flank and unpaired fins in males, whereas *Anablepsoides roraima*, from the Branco river drainage, is distinguished by the spotted pattern of flank in males. Relationships of the three new species of the *A. ornatus* group, *Anablepsoides henschelae*, new species, *Anablepsoides ottonii*, new species, and *Anablepsoides gamae*, new species, are tentatively inferred upon the basis of derived colour patterns of caudal fin in males, which are also informative to diagnose each new species. *Anablepsoides ottonii* seems to be closely related to *A. ornatus* by both sharing a pointed caudal fin in larger specimens and the presence of reddish brown spots on the dorsal portion of the caudal fin in males, whereas *A. gamae* and *A. amanan* share a colour pattern of caudal fin in males, unique among aplocheiloids, in which the dorsal portion of the fin is orangish red with dorsal margin white and narrow black outer border. *Anablepsoides henschelae* is considered as the sister group to all other species of its group by not sharing an apomorphic asymmetrically coloured caudal fin in males.

## Key words

Amazon Forest, Amazonas river, Biodiversity, Guiana Shield, Systematics.

## Introduction

*Anablepsoides* HUBER, 1992 is a species-rich genus of Neotropical aplocheiloid killifishes, occurring in northern South America, including the Amazonas river basin, and in adjacent Caribbean islands (COSTA, 2011). Within this geographical distribution, the Amazonas river basin concentrates the highest diversity both in number of species and in specialized forms. However, whereas taxonomical studies developed in the last decades focused on taxa endemic to western Amazon, in Colombia, Ecuador, and Peru, little advance has been recorded for the Brazilian Amazon (COSTA, 2013). Seven nominal spe-

cies presently assigned to *Anablepsoides* were described from the Brazilian Amazon between 1863 and 1916 (STEINDACHNER, 1863, 1877; GÜNTHER, 1866; GARMAN, 1895; HENN, 1916), but no new description for taxa occurring in this huge area was published between 1916 and 2008, although frequent recent collections deposited in Brazilian museums. Possibly this was a result of the incomplete knowledge about species described before that period, making identification of recent collections uncertain. A new approach for the taxonomical state of *Anablepsoides* from the Brazilian Amazon was provided

by COSTA (2006), when new morphological characters were incorporated to rivuline taxonomy, making possible both to delimit taxa assigned to old names and to recognise new species (COSTA & LAZZAROTO, 2008; COSTA, 2010, 2013).

Amazonian species of *Anablepsoides* have been placed in different informal groups diagnosed by morphological characters. COSTA (2010) recognised two groups of similar species sharing longitudinal rows of red spots on the flank in males, frontal squamation E-patterned, and short unpaired fins, dorsal fin with 6–9 rays and anal fin with 12–15 rays. The first one, the *A. urophthalmus* group, included species of central and eastern Amazon, Guianas and eastern Venezuela, and the second one, the *A. limoncochae* group, included species from central and western Amazon. The former group was distinguished from the latter by the absence of contact organs on body scales and absence of an oblique red stripe on middle of the dorsal fin, besides species of the former group often having yellow pigmentation concentrated on the dorsal and ventral margins of the caudal fin in males. Although species of both groups being morphologically similar, molecular evidence has indicated that species of the *A. urophthalmus* group are more closely related to other species of *Anablepsoides* from the coastal rivers of northern South America than to species of the *A. limoncochae* group, whereas species of the latter group are more closely related to other species of *Anablepsoides* from the Amazon than to species of the *A. urophthalmus* group (e.g., MURPHY *et al.*, 1999).

Another species group of *Anablepsoides* peculiar to the Amazon is that comprising *A. ornatus* (GARMAN, 1895) and *A. amanan* (COSTA & LAZZAROTO, 2008), herein named as the *A. ornatus* group. Species of this group are small (maximum size about 28 mm SL), have depressed head and long caudal fin (between about 40 and 50 % SL). The objective of this paper is to describe two new species of the *A. urophthalmus* group and three new species of the *A. ornatus* group collected in Amazonas river tributaries draining the Guiana Shield and adjacent areas of central Brazilian Amazon.

## Material and methods

Material is deposited in the ichthyological collections of IEPA, Instituto de Pesquisas Científicas e Tecnológicas do Estado do Amapá, Macapá, INPA, Instituto Nacional de Pesquisas da Amazônia, Manaus, and UFRJ, Instituto de Biologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro. Morphological characters used in the description below were obtained from specimens fixed in formalin just after collection, for a period of about ten days, and then transferred to 70 % ethanol. Descriptions of colour patterns were based on photographs of live individuals taken in small aquaria just after collection; colour patterns

**Table 1.** Morphometric data of *Anablepsoides jari*.

	holotype	paratypes	
	male	males (5)	females (2)
Standard length (mm)	25.6	22.5–31.0	20.8–24.5
<b>Percent of standard length</b>			
Body depth	19.5	20.1–21.6	18.2–18.6
Caudal peduncle depth	13.8	13.5–15.1	11.8–13.1
Pre-dorsal length	80.3	78.0–81.9	77.9–79.9
Pre-pelvic length	53.6	54.2–57.8	54.4–55.2
Length of dorsal-fin base	6.8	6.2–8.8	7.3–7.5
Length of anal-fin base	16.0	16.6–19.4	16.2–18.4
Caudal-fin length	33.4	32.0–38.0	36.2–37.1
Pectoral-fin length	20.5	20.7–24.4	19.9–21.8
Pelvic-fin length	10.0	8.8–11.8	8.0–9.3
Head length	24.4	24.3–26.5	25.5–26.1
<b>Percent of head length</b>			
Head depth	63.0	61.7–67.6	59.3–62.0
Head width	81.3	75.4–81.4	74.5–75.9
Snout length	14.3	14.8–17.1	12.8–14.0
Lower jaw length	21.2	18.6–21.3	18.4–19.0
Eye diameter	31.9	31.1–34.6	30.8–32.8

derived from distribution of melanophores were also directly observed in all preserved specimens. Measurements and counts follow COSTA (1995). Measurements are presented as percentages of standard length (SL), except for those related to head morphology, which are expressed as percentages of head length. Fin-ray counts include all elements. Number of vertebrae and gill-rakers were recorded only from the cleared and stained specimen; the compound caudal centrum was counted as a single element. The osteological preparation was made according to TAYLOR & VAN DYKE (1985). Terminology for cephalic neuromast series follows COSTA (2001). The abbreviation C&S means specimens cleared and stained for bone and cartilage. Delimitation of species is according to the methodology of the Population Aggregation Analysis (DAVIS & NIXON, 1992), in which species are delimited by a unique combination of morphological character states.

## *Anablepsoides jari* spec. nov.

Fig. 1, Table 1

**Holotype:** UFRJ 9569, male, 25.6 mm SL; Brazil: Estado do Amapá: Município de Laranjal do Jari: stream tributary of Jari river, lower Amazonas river basin, 0° 45' 55" S 52° 31' 17" W; P.H.N. BRAGANÇA & E. HENSCHER, 25 July 2012.

**Paratypes:** All from Município de Laranjal do Jari, Estado do Amapá, Brazil. UFRJ 8839, 1 female, 20.8 mm SL; UFRJ 9570, 2 males, 22.1–23.1 mm SL, 1 female, 22.3 mm SL (C&S); collected with holotype. – INPA 2244, 11 males, 18.1–31.0 mm SL, 9 females, 17.8–24.5 mm SL; stream tributary to Jari river just below Santo Antônio waterfall; M. JEGU & J. ZUANON, 21 June 1987.

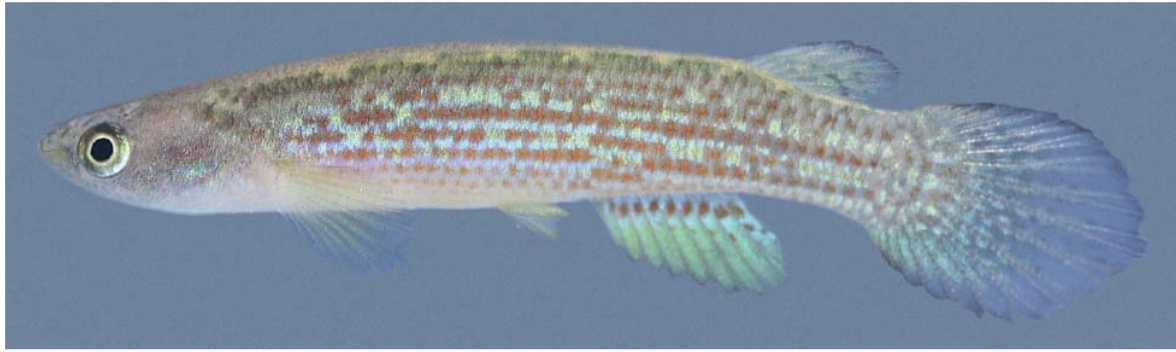


Fig. 1. *Anablepsoides jari*, UFRJ 9569, holotype, male, 25.6 mm SL: Brazil: Amapá: Laranjal do Jari.

**Diagnosis.** Distinguished from all other species of the *A. urophthalmus* group by having longitudinal rows of red dots interrupted and replaced by short rows of golden dots on the flank in males (vs. rows of red dots often continuous, when interrupted not replaced by golden dots), margins of unpaired dark grey in males (vs. never dark pigment concentrated on fin edge to form distinct coloured margins), and a horizontal row of red dots on the sub-basal region of the anal fin in males (never a similar colour pattern).

**Description.** Morphometric data appear in Table 1. Dorsal and ventral profiles slightly convex from snout to posterior end of dorsal and anal-fin bases, nearly straight on caudal peduncle. Body slender, sub-cylindrical, slightly depressed on head, compressed posteriorly. Greatest body depth at vertical just in front to pelvic-fin base. Jaws short, snout weakly pointed in lateral view.

Dorsal and anal fins small, sub-rectangular, extremity rounded. Caudal fin elliptical, short. Pectoral fin rounded, posterior margin reaching vertical at about 70 % of length between pectoral-fin and pelvic-fin bases. Pelvic fin small, slightly pointed, tip reaching anus; pelvic-fin bases medially in close proximity. Dorsal-fin origin on vertical through base of last two anal-fin rays or slightly posterior to anal-fin base; second proximal radial of dorsal fin between neural spines of 22<sup>nd</sup> and 24<sup>th</sup> vertebrae, first proximal radial of anal fin between pleural ribs of 15<sup>th</sup> and 17<sup>th</sup> vertebrae. Dorsal-fin rays 7–8; anal-fin rays 12–13; caudal-fin rays 28–29; pectoral-fin rays 13–14; pelvic-fin rays 7.

Scales small, cycloid. Body and head entirely scaled, except on jaws. Body squamation extending over anterior 40 % of caudal-fin base; no scales on dorsal and anal-fin bases. Frontal squamation E-patterned; E-scales not overlapping medially; scales arranged in regular circular pattern around A-scale without exposed margins; transverse row of scales anterior to H-scale. Longitudinal series of scales 38–40; transverse series of scales 8; scale rows around caudal peduncle 16. No contact organs on flank and fins.

Cephalic neuromasts: supraorbital 3+3, parietal 1, anterior rostral 1, posterior rostral 1, infraorbital 1+15+1, preorbital 2, otic 1, post-otic 2, supratemporal 1, me-

dian opercular 1, ventral opercular 2, preopercular 2+4, mandibular 4+1, lateral mandibular 3, paramandibular 1. Lateral line interrupted, alternating sets of 3–4 scales with one neuromast and without neuromasts. Two neuromasts on caudal-fin base.

Basihyal subtriangular, greatest width about 45 % of length; basihyal cartilage about 15 % of total length of basihyal. Six branchiostegal rays. Two teeth on second pharyngobranchial. Gill-rakers on first branchial arch 1+8. Vomerine teeth absent. Dermosphenotic present. Ventral process of posttemporal rudimentary. Total vertebrae 33–34.

**Colouration. Males.** Flank light blue, with eight longitudinal rows of red dots; rows often interrupted and replaced by short rows of golden dots; three rows posteriorly reaching caudal fin base, other five reaching vertical between anterior portion of anal-fin base and posterior portion of dorsal-fin base. Dorsum light brown laterally bordered by irregular dark brownish grey stripe. Venter white. Side of head and jaws light grey, opercular region purplish grey, with greenish blue iridescence. Iris pale greenish yellow, dorsal portion dark greyish yellow. Dorsal fin light yellow, with short transverse grey stripes on posterior portion, distal margin black. Anal fin light yellow, basal portion light blue, distal margin dark grey; horizontal row of red dots on sub-basal region of fin. Caudal fin greenish yellow, with transverse rows of small grey spots, fin margin grey to black. Pectoral fin yellowish hyaline. Pelvic fin light yellow.

**Females.** Colour pattern of live females not recorded. In preserved specimens, flank light brown with irregularly arranged light grey dots. Side of head light brown. Unpaired fins hyaline with transverse rows of grey dots; round, dark grey to black spot on dorsal portion of caudal-fin base. Paired fins hyaline.

**Distribution.** Known only from the type locality area in the lower Jari river drainage, Amazonas river basin, northern Brazil.

**Etymology.** The name *jari* is a reference to the main river at the type locality of the new species.

*Anablepsoides roraima* spec. nov.

Fig. 2, Table 2

**Holotype:** UFRJ 9571, male, 31.0 mm SL; Brazil: Estado de Roraima: Município de Bonfim: stream 87 km NE of Boa Vista, road BR-401, Tacutu river drainage, part of Branco river drainage, middle Amazonas river basin, 3° 15' 39" N 60° 04' 57" W; P.H.N. BRAGANÇA, F. OTTONI & E. HENSCHL, 10 September 2012.

**Paratypes:** UFRJ 9573, 7 males, 24.0–31.8 mm SL, 7 females, 23.2–29.0 mm SL; UFRJ 9572, 2 males, 21.3–22.2 mm SL, 3 females, 19.4–26.4 mm SL; collected with holotype.

**Additional material (non-types):** UFRJ 9575, 8 ex.; UFRJ 9574, 2 ex. (C&S); Brazil: Estado de Roraima: Município de Cantá: floodplains of stream in the road BR-432, Cachorro river drainage, part of Branco river drainage, middle Amazonas river basin, 2° 22' 32" N 60° 38' 52" W; P.H.N. BRAGANÇA, F. OTTONI & E. HENSCHL, 13 September 2012.

**Diagnosis.** Distinguished from all other species of the genus by possessing flank with eight longitudinal rows of spots, among which the spots of the three dorsal-most rows are reddish brown and separated by small interspace, and the spots of the other five rows are red and in contact to form long red stripes (vs. spots never forming that arrangement pattern). Also distinguished from all other species of *Anablepsoides* from the Brazilian Amazon by the presence of two well defined bright yellow stripes on the dorsal and ventral margins of the caudal fin in males (vs. stripes diffuse or absent).

**Description.** Morphometric data appear in Table 2. Dorsal and ventral profiles gently convex from snout to posterior end of dorsal and anal-fin bases, nearly straight on caudal peduncle. Body slender, sub-cylindrical anteriorly, slightly depressed on head, compressed posteriorly. Greatest body depth at vertical just in front to pelvic-fin base. Jaws short, snout weakly pointed in lateral view.

Dorsal and anal fins small, sub-rectangular, extremity rounded. Caudal fin elliptical, short. Pectoral fin rounded, posterior margin reaching vertical at about 50 % of length between pectoral-fin and pelvic-fin bases. Pelvic fin small, slightly pointed, tip reaching anus in males, slightly shorter in females; pelvic-fin bases medially in close proximity. Dorsal-fin origin on vertical through base of 10<sup>th</sup> or 11<sup>th</sup> anal-fin ray; second proximal radial of dorsal fin between neural spines of 22<sup>nd</sup> and 24<sup>th</sup> vertebrae, first proximal radial of anal fin between pleural ribs of 14<sup>th</sup> and 16<sup>th</sup> vertebrae. Dorsal-fin rays 7–8; anal-fin rays 13–14; caudal-fin rays 25–27; pectoral-fin rays 13–14; pelvic-fin rays 6.

Scales small, cycloid. Body and head entirely scaled, except on jaws. Body squamation extending over anterior 40 % of caudal-fin base; no scales on dorsal and anal-fin bases. Frontal squamation E-patterned; E-scales not overlapping medially; scales arranged in regular circular pattern around A-scale without exposed margins; transverse row of scales anterior to H-scale. Longitudinal

**Table 2.** Morphometric data of *Anablepsoides roraima*.

	holotype	paratypes	
	male	males (3)	females (5)
Standard length (mm)	31.0	26.3–31.8	26.3–29.0
<b>Percent of standard length</b>			
Body depth	22.1	19.7–21.4	19.6–21.5
Caudal peduncle depth	14.3	13.4–14.4	13.6–14.2
Pre-dorsal length	79.3	76.8–81.0	78.5–81.3
Pre-pelvic length	55.0	53.9–57.2	54.3–60.3
Length of dorsal-fin base	7.2	7.0–8.7	6.7–8.1
Length of anal-fin base	18.0	18.6–19.0	19.2–20.4
Caudal-fin length	33.8	32.8–34.7	34.3–35.6
Pectoral-fin length	18.3	18.6–20.7	18.9–21.2
Pelvic-fin length	7.5	7.1–9.5	7.3–8.7
Head length	24.3	23.5–25.1	23.8–26.4
<b>Percent of head length</b>			
Head depth	72.4	65.8–71.9	65.7–70.4
Head width	85.8	81.9–85.6	78.8–86.4
Snout length	14.6	14.4–16.0	14.1–15.5
Lower jaw length	22.8	23.0–23.5	20.0–24.5
Eye diameter	31.7	31.6–32.9	31.1–32.4

series of scales 37–38; transverse series of scales 9; scale rows around caudal peduncle 16. No contact organs on flank and fins.

Cephalic neuromasts: supraorbital 3+3, parietal 2, anterior rostral 1, posterior rostral 1, infraorbital 1+13–15+1, preorbital 3, otic 1, post-otic 1, supratemporal 1, median opercular 1, ventral opercular 1, preopercular 2+4, mandibular 4+1, lateral mandibular 3, paramandibular 1. Lateral line interrupted, alternating sets of 3–4 scales with one neuromast and without neuromasts. Two neuromasts on caudal-fin base.

Basihyal subtriangular, greatest width about 45 % of length; basihyal cartilage about 15 % of total length of basihyal. Six branchiostegal rays. Two teeth on second pharyngobranchial. Gill-rakers on first branchial arch 1+9. Vomerine teeth 2. Dermosphenotic present. Ventral process of posttemporal rudimentary. Total vertebrae 32–33.

**Colouration. Males.** Flank ground colour golden to light blue on ventral part. Flank with eight continuous longitudinal rows of dots, seven reaching caudal-fin base; three dorsal-most rows with spots dark reddish brown and separated by small interspace, other five rows with red spots in contact forming long stripes. Dorsum light brown, venter white. Side of head light brown, opercular region greenish golden to purplish grey with blue iridescence on ventral portion. Iris pale greenish yellow, dorsal portion dark greyish yellow. Dorsal fin light yellow, with short transverse grey stripes on posterior portion. Anal fin light yellow, basal portion light blue, sometimes with grey dots on posterior portion. Caudal fin light grey with minute brown dots, with yellow stripe on dorsal and ventral margins. Pectoral fin yellowish hyaline. Pelvic fin light blue.

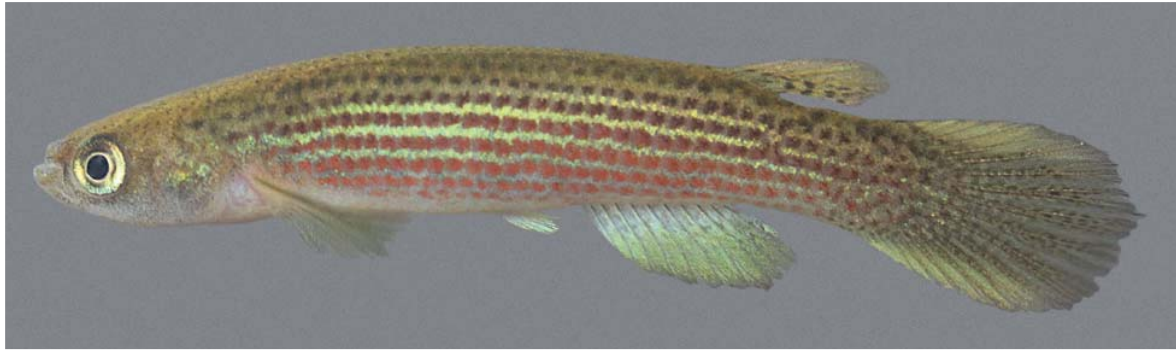


Fig. 2. *Anablepsoides roraima*, UFRJ 9571, holotype, male, 31.0 mm SL: Brazil: Roraima: Bonfim.

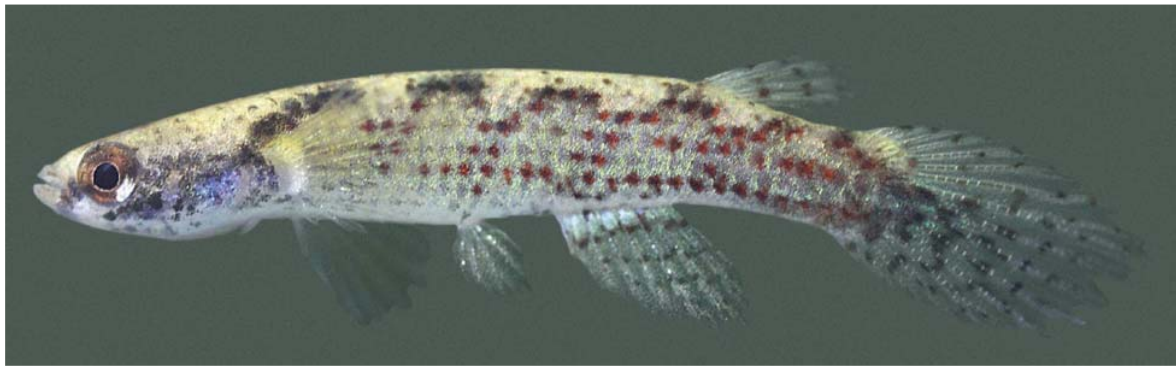


Fig. 3. *Anablepsoides henschelae*, UFRJ 9608, holotype, male, 22.5 mm SL: Brazil: Roraima: Rorainópolis.

**Females.** Flank light brown, with longitudinal rows of pale brown dots and irregularly arranged light blue to pale golden dots. Side of head light brown, opercular region metallic green with purplish blue iridescence. Iris light yellow. Unpaired fins hyaline with transverse rows of grey dots; round, dark grey to black spot on dorsal portion of caudal-fin base. Paired fins hyaline.

**Distribution.** Middle Branco river drainage, Amazonas river basin, northern Brazil.

**Etymology.** The name *roraima* refers to the occurrence of the new species in the Brazilian State of Roraima.

### *Anablepsoides henschelae* spec. nov.

Figs. 3, 4a, Table 3

**Holotype:** UFRJ 9608, male, 22.5 mm SL; Brazil: Estado de Roraima: Município de Rorainópolis: stream about 35 km W of Jundiá, road BR-431, Jauaperi river drainage, itself a part of the lower section of the Negro river drainage, Amazonas river basin, 0°13'45"S 60°59'30"W, P.H.N. BRAGANÇA, F.P. OTTONI & E. HENSCHEL, 15 September 2012.

**Paratypes:** UFRJ 9609, 4 females, 14.0–16.4 mm SL; UFRJ 9610, 3 females, 13.6–16.4 mm SL (c&s); collected with the holotype.

**Diagnosis.** Distinguished from all other species of the *A. ornatus* group by having the caudal fin in males with similar colouration on its dorsal and ventral portions (vs. always distinct colouration) and the presence of a longitudinal row of dark red dots on the ventral portion of the flank in males (vs. longitudinal row of dark red dots absent).

**Description.** Morphometric data appear in Table 3. Dorsal profile slightly convex from snout to end of caudal-fin base. Ventral profile approximately straight, slightly convex on pelvic-fin region. Body slender, depressed on head, gradually becoming compressed posteriorly. Greatest body depth at vertical through pelvic-fin base. Jaws short, snout slightly pointed in lateral view.

Dorsal and anal fins small, extremity rounded, dorsal sub-rectangular, anal fin sub-triangular. Caudal fin oval, slender and long. Pectoral fin rounded, posterior margin reaching vertical through pelvic-fin base in male, through urogenital papilla in females. Pelvic fin elliptical, extremity reaching anal-fin origin in males, reaching urogenital papilla in females. Pelvic-fin bases medially in close proximity. Dorsal-fin base posterior to anal-fin base; second proximal radial of dorsal fin between neural spines of 19<sup>th</sup> and 21<sup>st</sup> vertebrae, first proximal radial of anal fin between pleural ribs of 13<sup>th</sup> and 15<sup>th</sup> vertebrae. Dorsal-fin rays 6; anal-fin rays 9–11; caudal-fin rays 23–26; pectoral-fin rays 12–13; pelvic-fin rays 7.



**Fig. 4.** Colour pattern of the head in females, left side, of: a, *Anablepsoides henschelae*, UFRJ 9609, paratype, 16.4 mm SL; b, *Anablepsoides ottonii*, UFRJ 9613, paratype, 19.4 mm SL; c, *Anablepsoides gamae*, UFRJ 8840, paratype, 18.3 mm SL.

Scales small, cycloid. Body and head entirely scaled, except on jaws. Body squamation extending over anterior 25 % of caudal-fin base; no scales on dorsal and anal-fin bases. Frontal squamation F-patterned; E-scales not overlapping medially; scales arranged in regular circular pattern around A-scale without exposed margins; transverse row of scales anterior to H-scale. Longitudinal series of scales 27; transverse series of scales 7; scale rows around caudal peduncle 12. No contact organs on flank and fins.

Cephalic neuromasts: supraorbital 3+3, parietal 1, rostral 1, infraorbital 2+11+1, preorbital 3, otic 1, post-

otic 1, supratemporal 1, median opercular 1, ventral opercular 1, preopercular 2+4, mandibular 3+1, lateral mandibular 2, paramandibular 1. Lateral line interrupted, alternating sets of 3–4 scales with one neuromast and without neuromasts. Two neuromasts on caudal-fin base.

Basihyal subtriangular, greatest width about 60 % of length; basihyal cartilage about 15 % of total length of basihyal. Six branchiostegal rays. Second pharyngobranchial teeth absent. Gill-rakers on first branchial arch 1+8. Vomerine teeth 1–3. Dermosphenotic present. Ventral process of posttemporal absent. Total vertebrae 29–30.

**Colouration. Male.** Flank pale purplish grey, with oblique double rows of dark red dots connected to longitudinal row of similar dots along ventral part of flank and other one on middle of caudal peduncle; golden iridescence among oblique dot rows. Dorsum light yellowish grey with segmented longitudinal dark brown stripe on lateral portion. Oblique black bar between area just above pectoral-fin base and middle of opercle. Venter light grey. Side of head purplish grey, opercular and suborbital regions with dense concentration of small dark grey to black spots and dark blue iridescence on ventral portion of opercle; transverse black bar between orbits through chin. Ventral portion of head with dense concentration of small black spots, anteriorly bordered by not pigmented area just posterior to chin bar. Iris dark brown with postero-ventral silver spot. Dorsal fin hyaline, with two narrow dark grey transverse stripes. Anal fin hyaline to bluish white on basal portion, with three narrow dark grey transverse stripes. Caudal fin hyaline with small black spots and pale blue iridescence on middle of basal portion. Pectoral fin yellowish hyaline. Pelvic fin hyaline.

**Females.** Flank pale purplish grey, with oblique double rows of dark red dots, and narrow longitudinal dark brownish grey stripes. Dorsum light yellowish grey with segmented longitudinal dark brown stripe on lateral portion. Oblique black bar between area just above pectoral-fin base and middle of opercle. Venter light grey. Side of head purplish grey, opercular and suborbital regions with dense concentration of small dark grey to black spots; transverse black bar between orbits through chin. Ventral portion of head with longitudinal row of black spots anteriorly bordered by not pigmented area just posterior to chin bar. Iris dark brown with postero-ventral silver spot. Dorsal fin hyaline, with two narrow dark grey transverse stripes. Anal fin hyaline with three narrow dark grey transverse stripes. Caudal fin hyaline with narrow dark grey transverse bars. Pectoral fin yellowish hyaline. Pelvic fin hyaline.

**Distribution.** Known only from the type locality, a pool adjacent to stream about 35 km W of Jundiá, road BR-431, Jauaperi river drainage, Roraima state, Brazil.

**Etymology.** Named after Elisabeth Henschel, for her valuable help during collecting trips in the Amazon.



Fig. 5. *Anablepsoides ottonii*, UFRJ 9612, holotype, male, 20.1 mm SL; Brazil: Amazonas: Barcelos.

### *Anablepsoides ottonii* spec. nov.

Figs. 5, 4b, Table 4

**Holotype:** UFRJ 9612, male, 20.1 mm SL; Brazil: Estado do Amazonas: Município de Barcelos: Igarapé do Cajarazinho, a stream near the village of Balaio, a tributary of the Caurés river, Negro river drainage, Amazonas river basin, 1°06'17"S 62°58'42"W; P.H.N. BRAGANÇA, P. AMORIM & F.P. OTTONI, 17 November 2012.

**Paratypes:** Brazil: Estado do Amazonas: Município de Barcelos, Negro river drainage, Amazonas river basin. UFRJ 9613, 3 males, 20.6–22.2 mm SL, 7 females, 18.8–22.5 mm SL, and 21 juveniles of undetermined sex, 12.2–18.4 mm SL; UFRJ 9614, 2 males, both 18.5 mm SL, 2 females, 17.5–19.9 mm SL, and 2 juveniles of undetermined sex, 16.3–17.1 mm SL (c&s); collected with the holotype. – UFRJ 9615, 2 females, 20.6–22.4 mm SL, and 2 juveniles of undetermined sex, 16.7–18.3 mm SL; Igarapé Salgado, a stream tributary of the Caurés river, 0°58'41"S 62°55'50"W; same collectors and date as holotype.

**Diagnosis.** Distinguished from all other species of the *A. ornatus* group by having a unique colour pattern in the caudal fin in males, consisting of dorsal portion of fin white with dark reddish brown spots, contrasting with the ventral portion that is hyaline with dark grey dots and short lines (vs. never a similar colour pattern). Also distinguished from all species of the *A. ornatus* group, except *A. henschelae*, by the absence of teeth on the second pharyngobranchial bone (vs. presence); distinguished from *A. henschelae* by the absence of a longitudinal two of red dots on the ventral part of the flank in males (vs. presence). Also distinguished from all species of the *A. ornatus* group, except *A. ornatus*, by having caudal fin pointed in larger specimens (vs. elliptical) and reddish brown spots on the dorsal portion of the caudal fin; also distinguished from *A. ornatus* by the red pigmentation of ventral portion of caudal peduncle not extending on caudal fin (vs. extending over whole ventral portion of the fin) and dorsal portion of caudal fin white (vs. yellow).

**Description.** Morphometric data appear in Table 4. Dorsal profile slightly convex from snout to end of caudal-fin

base. Ventral profile approximately straight. Body slender, depressed on head, gradually becoming compressed posteriorly. Greatest body depth at vertical through pelvic-fin base. Jaws short, snout slightly pointed in lateral view.

Dorsal and anal fins small, extremity rounded, dorsal sub-rectangular, anal fin sub-triangular. Caudal fin pointed, slender and long. Pectoral fin rounded, posterior margin reaching 90 % of distance between pectoral-fin base and pelvic-fin base. Pelvic fin elliptical, extremity reaching urogenital papilla; pelvic-fin bases medially in close proximity. Dorsal-fin origin posterior to anal-fin base; second proximal radial of dorsal fin between neural spines of 20<sup>th</sup> and 21<sup>st</sup> vertebrae, first proximal radial of anal fin between pleural ribs of 14<sup>th</sup> and 15<sup>th</sup> vertebrae. Dorsal-fin rays 6–7; anal-fin rays 11–12; caudal-fin rays 25–26; pectoral-fin rays 12–13; pelvic-fin rays 7.

Scales small, cycloid. Body and head entirely scaled, except on jaws. Body squamation extending over anterior 20 % of caudal-fin base; no scales on dorsal and anal-fin bases. Frontal squamation F-patterned; E-scales not overlapping medially; scales arranged in regular circular pattern around A-scale without exposed margins; transverse row of scales anterior to H-scale. Longitudinal series of scales 28; transverse series of scales 7; scale rows around caudal peduncle 12. No contact organs on flank and fins.

Cephalic neuromasts: supraorbital 3+3, parietal 1, rostral 1, infraorbital 2+13+1, preorbital 2, otic 1, postotic 1, supratemporal 1, median opercular 1, ventral opercular 1, preopercular 2+4, mandibular 4+1, lateral mandibular 2, paramandibular 1. Lateral line interrupted, alternating sets of 3–4 scales with one neuromast and without neuromasts. Two neuromasts on caudal-fin base.

Basihyal subtriangular, greatest width about 65 % of length; basihyal cartilage about 10 % of total length of basihyal. Six branchiostegal rays. Second pharyngobranchial teeth absent. Gill-rakers on first branchial arch 1+8. Vomerine teeth 1–5. Dermosphenotic present. Ventral process of posttemporal absent. Total vertebrae 30–31.

**Table 4.** Morphometric data of *Anablepsoides ottonii*.

	holotype	paratypes	
	male	males (3)	females (6)
Standard length (mm)	20.1	20.6–22.2	19.4–22.5
<b>Percent of standard length</b>			
Body depth	19.2	16.9–19.4	16.9–19.7
Caudal peduncle depth	12.9	11.7–13.1	12.0–13.2
Pre-dorsal length	78.6	79.5–82.1	77.7–80.8
Pre-pelvic length	52.0	52.6–55.0	51.8–54.3
Length of dorsal-fin base	6.7	6.5–8.6	6.7–8.1
Length of anal-fin base	16.3	15.9–17.8	14.1–16.2
Caudal-fin length	45.1	45.2–49.8	43.1–46.7
Pectoral-fin length	24.5	23.5–24.5	23.1–24.6
Pelvic-fin length	11.9	10.9–13.6	10.1–12.5
Head length	26.6	26.3–28.4	25.8–27.7
<b>Percent of head length</b>			
Head depth	58.7	52.9–55.1	51.8–56.9
Head width	79.3	75.4–77.3	77.8–80.5
Snout length	14.4	13.1–14.9	13.0–14.5
Lower jaw length	25.2	22.0–24.6	18.7–24.1
Eye diameter	35.7	30.0–33.0	30.8–33.5

**Colouration. Males.** Flank pale green, with oblique rows of dark brownish red dots; longitudinal row of reddish brown dots on caudal peduncle, separated from reddish orange on postero-ventral part of caudal peduncle by bright blue zone slightly extending on caudal-fin base. Dorsum light brown with segmented longitudinal dark brown stripe on lateral portion. Oblique dark grey bar between area just above pectoral-fin base and middle of opercle. Venter light grey. Side of head light brown, opercular and suborbital regions with dense concentration of small dark grey to black spots and dark blue iridescence on ventral portion of opercle; transverse black bar between orbits through chin. Ventral portion of head with dense concentration of small black spots, anteriorly bordered by not pigmented area just posterior to chin bar. Iris dark brown with postero-ventral silver spot. Dorsal fin white with two narrow dark brown transverse stripes. Anal fin hyaline, with three transverse rows of dark grey dots and dark grey vermiculate marks. Caudal fin white with dark reddish brown spots on dorsal portion, hyaline with dark grey dots and short lines on ventral portion. Pectoral and pelvic fins yellowish hyaline.

**Females.** Flank pale yellowish grey, with oblique dark brown bars, often ventrally terminating in black spot, and narrow longitudinal dark brownish grey stripes. Dorsum light brown with segmented longitudinal dark brown stripe on lateral portion. Oblique black bar between area just above pectoral-fin base and middle of opercle. Venter light grey. Side of head light grey, opercular and suborbital regions with dense concentration of small dark grey to black spots; transverse black bar between orbits through chin. Ventral portion of head with longitudinal row of black spots anteriorly bordered by not pigmented area just posterior to chin bar. Iris dark

brown with postero-ventral silver spot. Dorsal fin hyaline, with two narrow dark grey transverse stripes. Anal fin hyaline with three or four transverse rows of dark grey dots. Caudal fin hyaline with transverse rows of dark grey dots; sometimes dark grey blotch on middle of caudal-fin base. Pectoral fin yellowish hyaline. Pelvic fin hyaline.

**Distribution.** Known from two localities in the Caurés river drainage, a tributary of the Negro river, Amazonas river basin, Amazonas state, Brazil.

**Etymology.** Named after the ichthyologist Felipe Ottoni for his constant enthusiasm and friendship, and important participation during expeditions to northern Brazil.

### *Anablepsoides gamae* spec. nov.

Figs. 6, 4c, Table 5

**Holotype:** UFRJ 9606, male, 21.1 mm SL; Brazil: Estado do Amapá: Município de Laranjal do Jari: stream tributary to Jari river, between Laranjal do Jari and Santo Antônio waterfall, Amazonas river basin, 0°45'55"S 52°31'17"W; P.H.N. BRAGANÇA & E. HENSCHER, 25 July 2012.

**Paratypes:** Brazil: Estado do Amazonas: Estado do Amapá: Município de Laranjal do Jari, Jari river drainage, Amazonas river basin. UFRJ 8840, 3 males, 17.5–18.9 mm SL, 2 females, 18.3–21.8 mm SL; UFRJ 9607, 2 males, 17.7–17.8 mm SL, 1 female, 18.1 mm SL (c&s); UFRJ 8841, 4 females, 16.5–18.5 mm SL; collected with the holotype. – IEPA 2755, 1 male, 22.2 mm SL; Laranjal do Jari; C. GAMA, 27 Oct. 2007.

**Diagnosis.** Distinguished from all other congeners, except *A. amanan*, by the colour pattern of the caudal fin and anal fin in males, consisting of dorsal portion of caudal fin orangish red with dorsal margin white and narrow black outer border (vs. never a similar colour pattern), middle portion of caudal fin black with bright greenish blue stripe extending from caudal peduncle to posterior portion of fin (vs. never a similar colour pattern), anal fin yellow with transverse red stripes on the posterior portion (vs. never a similar colour pattern) and by having a continuous row of 6 neuromasts on the mandibular series (vs. 3 or 4 neuromasts on an anterior section and a single isolated posterior neuromast). Distinguished from *A. amanan* and all other species of the *A. ornatus* group by having a unique colour pattern of flank in adult males, in which there are pairs of oblique rows of dark red dots, the dots of each posterior pair row being connected to form dark red oblique bars and each dot of the anterior pair row being usually connected to the posterior adjacent row (vs. never a similar colour pattern) and by a unique colour pattern on the head in females, consisting of a distinctive not pigmented area between a zone of small brownish grey spots on the post-orbital region and an oblique black bar crossing the middle of opercle (Fig.





Fig. 6. *Anablepsoides gamae*, UFRJ 9606, holotype, male, 21.1 mm SL: Brazil: Amapá: Laranjal do Jari.

4c) (vs. side of head pigmented, with small dark grey to black spots overlapped over opercular, post-orbital and infra-orbital region; Figs. 4a–b). Also distinguished from *A. amanan* by a longer pre-dorsal distance in males (81.3–84.6 % SL vs. 77.4–79.7 % SL).

**Description.** Morphometric data appear in Table 5. Dorsal profile slightly convex from snout to end of caudal-fin base. Ventral profile approximately straight, slightly convex on pelvic-fin region. Body slender, depressed on head, gradually becoming compressed posteriorly. Greatest body depth at vertical through pelvic-fin base. Jaws short, snout slightly pointed in lateral view.

Dorsal and anal fins small, extremity rounded, dorsal sub-rectangular, anal fin sub-triangular. Caudal fin oval, slender and long. Pectoral fin rounded, posterior margin reaching vertical through pelvic-fin base in male, through urogenital papilla in females. Pelvic fin elliptical, extremity reaching anal-fin origin in males, reaching urogenital papilla in females. Pelvic-fin bases medially in close proximity. Dorsal-fin base posterior to anal-fin base; second proximal radial of dorsal fin between neural spines of 19<sup>th</sup> and 21<sup>st</sup> vertebrae, first proximal radial of anal fin between pleural ribs of 13<sup>th</sup> and 14<sup>th</sup> vertebrae. Dorsal-fin rays 6–7; anal-fin rays 10–11; caudal-fin rays 23–25; pectoral-fin rays 12–13; pelvic-fin rays 7.

Scales small, cycloid. Body and head entirely scaled, except on jaws. Body squamation extending over anterior 20 % of caudal-fin base; no scales on dorsal and anal-fin bases. Frontal squamation F-patterned; E-scales not overlapping medially; scales arranged in regular circular pattern around A-scale without exposed margins; transverse row of scales anterior to H-scale. Longitudinal series of scales 28; transverse series of scales 7; scale rows around caudal peduncle 12. No contact organs on flank and fins.

Cephalic neuromasts: supraorbital 3+3, parietal 1, rostral 1, infraorbital 2+12+1, preorbital 2, otic 1, post-otic 1, supratemporal 1, median opercular 1, ventral opercular 1, preopercular 2+4, mandibular 6, lateral mandibular 1–2, paramandibular 1. Two neuromasts on caudal-fin base.

Basihyal subtriangular, greatest width about 60 % of length; basihyal cartilage about 15 % of total length of basihyal. Branchiostegal rays 6. Second pharyngobranchial with 3 teeth. Gill-rakers on first branchial arch 1+8. Vomerine teeth 5–6. Dermosphenotic present. Ventral process of posttemporal absent. Total vertebrae 29–30.

**Colouration. Males.** Flank greenish golden, with oblique row pairs of dark red dots, dots of each posterior pair row connected to form dark red oblique bars, each dot of anterior pair row usually connected to posteriorly adjacent row; red dots concentrated on posterior portion of caudal peduncle. Dorsum light brown with segmented longitudinal dark brown stripe on lateral portion. Oblique dark grey bar between area just above pectoral-fin base and middle of opercle. Venter light grey. Side of head light grey, opercular and suborbital regions with dense concentration of small dark grey spots and blue iridescence on ventral portion of opercle; transverse black bar between orbits through chin. Ventral portion of head with dense concentration of small black spots, anteriorly bordered by not pigmented area just posterior to chin bar. Iris dark brown with postero-ventral silver spot. Dorsal fin white, with two dark reddish brown transverse stripes. Anal fin pale yellow, basal portion light blue with dark red dots, posterior portion light blue with two or three dark red transverse stripes. Dorsal portion of caudal fin orangish red, dorsal margin white with narrow black outer border; middle portion of caudal fin black, with bright greenish blue stripe extending from caudal peduncle to posterior fourth of fin; ventral portion of caudal fin dark red to gradually black posteriorly. Pectoral fin hyaline. Pelvic fin yellowish hyaline.

**Females.** Flank light grey, with oblique dark grey bars, often ventrally terminating in black spot, and narrow longitudinal dark brownish grey stripes. Dorsum light grey with segmented longitudinal dark brown stripe on lateral portion. Venter light grey. Oblique black bar from area just above pectoral-fin base to infraorbital region, through middle of opercle. Side of head light grey, with zone of small brownish grey spots on post-orbital region,

**Table 5.** Morphometric data of *Anablepsoides gamae*.

	holotype	paratypes	
	male	males (4)	females (2)
Standard length (mm)	21.1	17.5–22.2	18.3–21.8
<b>Percent of standard length</b>			
Body depth	19.6	19.2–20.5	19.3–19.5
Caudal peduncle depth	12.2	12.3–13.3	11.4–11.6
Pre-dorsal length	82.3	81.3–84.6	82.6–83.3
Pre-pelvic length	54.7	52.2–54.3	54.1–54.5
Length of dorsal-fin base	6.6	5.4–7.6	4.8–5.5
Length of anal-fin base	15.9	14.9–17.8	13.5–14.9
Caudal-fin length	43.9	46.1–48.1	40.6–42.3
Pectoral-fin length	24.9	23.7–25.8	23.2–23.6
Pelvic-fin length	12.9	11.8–14.3	10.4–11.4
Head length	26.9	27.1–29.4	26.6–26.9
<b>Percent of head length</b>			
Head depth	57.1	52.9–54.7	54.0–55.6
Head width	80.4	73.9–78.1	80.7–83.5
Snout length	15.2	13.8–15.0	14.2–15.6
Lower jaw length	23.5	21.0–22.3	20.3–21.2
Eye diameter	33.2	31.8–35.0	31.8–33.1

separated from oblique opercular bar by not pigmented area; transverse black bar between orbits through chin. Ventral portion of head with great concentration of black spots anteriorly bordered by not pigmented area just posterior to chin bar. Iris dark brown with postero-ventral silver spot. Dorsal fin hyaline, with two narrow dark grey transverse stripes. Anal fin hyaline with three transverse rows of dark grey dots. Caudal fin hyaline with transverse rows of dark grey dots. Paired fins hyaline.

**Distribution.** Known only from the Jari river drainage, lower Amazonas river basin, Amapá state, Brazil.

**Etymology.** Named after Cecile Gama in recognition of her pioneering ichthyological field studies in the Amapá state, Brazilian Amazon.

## Discussion

*Anablepsoides jari* and *A. roraima* are the first records of members of the *A. urophthalmus* group for tributaries of the Amazonas river basin draining the Guiana Shield. Phylogenetic relationships of these species with other taxa included in that group are still uncertain, since both deep morphological data and DNA sequences are still unavailable for most taxa included in that group. However, morphological features exhibited by the new taxa make possible to unambiguously distinguish them from all other congeners.

*Anablepsoides jari* is easily distinguished from all other species of the *A. urophthalmus* group by having

longitudinal rows of red dots interrupted and replaced by short rows of golden dots on the flank in males, margins of unpaired dark grey in males, and a horizontal row of red dots on the sub-basal region of the anal fin in males, three character states of the colour pattern not found in any other species of the group. In addition, vomerine teeth are absent in *A. jari*, a condition not reported previously for species of that group. Contrasting with those unique diagnostic features, it was not possible to identify any morphological trait suggesting close relationships between *A. jari* and any member of the *A. urophthalmus* group. However, a similar horizontal row of red dots on the sub-basal region of the anal fin in males is also found in *A. beniensis* (MYERS, 1927), a species geographically widespread in the Madeira river drainage (COSTA, 2006), not belonging to the *A. urophthalmus* group. *Anablepsoides jari* is readily distinguished from *A. beniensis* by the former having more vertebrae (33–34 vs. 30–32), more caudal-fin rays (28–29 vs. 23–26), more scales on the longitudinal series (38–40 vs. 29–32), vomerine teeth absent (vs. 2 vomerine teeth), and lower jaw not distinctively pigmented (vs. black).

*Anablepsoides roraima* is distinguished from all other species of the genus by possessing flank golden in males, with eight longitudinal rows of spots, among which the spots of the three dorsal-most rows are reddish brown and separated by small interspace, and the spots of the other five rows are red and in contact to form long red stripes, a colour pattern not occurring in other species. The two well defined bright yellow stripes on the dorsal and ventral margins of the caudal fin in males of *A. roraima* suggest a close relationship with *A. deltaphilus* (SEEGERS, 1983), *A. lungi* (BERKENKAMP, 1984), *A. mazaruni* (MYERS, 1924) and *A. stagnatus* (EIGENMANN, 1909), all endemic from the Guianas and an adjacent region in Venezuela. The stripes are pale yellow or pale orange in *A. urophthalmus* (GÜNTHER, 1866), diffuse and inconspicuous in *A. tocantinensis* (COSTA, 2010) and *A. xinguensis* (COSTA, 2010), and absent in *A. jari*.

Among the species of the *A. ornatus* group herein described, *A. ottonii* is considered closely related to *A. ornatus*, a species occurring in the floodplains of the lower Negro river and adjacent rivers of central Amazon, and *A. gamae* to *A. amanan*, endemic to the Japurá-Solimões drainage. *Anablepsoides ottonii* and *A. ornatus* share a pointed caudal fin in larger specimens (vs. elliptical) and the presence of reddish brown spots on the dorsal portion of the caudal fin in males (vs. reddish brown marks absent), besides the caudal fin usually being longer in males (45.1–51.6 % SL vs. 40.1–46.9 % SL), but both species have distinct colour patterns of the caudal fin in males (see diagnosis above). On the other hand, *A. gamae* and *A. amanan* share an identical and unique colour pattern of caudal fin in males, more striking in the dorsal portion of the fin, which is orangish red with dorsal margin white and narrow black outer border, a colour pattern not found elsewhere among aplocheiloid killifishes. *Anablepsoides gamae* and *A. amanan* can be distinguished by the former having, in males, pairs of oblique rows of dark red dots,

the dots of each posterior pair row being connected to form dark red oblique bars and each dot of the anterior pair row being usually connected to the posterior adjacent row (vs. single oblique rows arranged as chevrons in *A. amanan*), the presence in females of a not pigmented area between a zone of small brownish grey spots on the post-orbital region and an oblique black bar crossing the middle of opercle (vs. not pigmented area absent), and a longer pre-dorsal distance in males (81.3–84.6 % SL vs. 77.4–79.7 % SL). Finally, *A. henschelae* possibly is the sister group to the remaining species of the group, since it does not share an apomorphic asymmetrically coloured caudal fin in males, in which the dorsal and ventral portion of the fin exhibit different colour patterns.

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