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Andinoacara blombergi, a new species from the río Esmeraldas basin in Ecuador and a review of *A. rivulatus* (Teleostei: Cichlidae)

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Andinoacara blombergi, new species, is described from the río Esmeraldas basin in northern Ecuador. It is distinguished from the most similar species, *A. rivulatus* (Günther, 1860) by 25 vs. 24 scales in the E1 scale row, slightly higher average meristics, narrower head, and narrower interorbital space. *Andinoacara rivulatus* is redescribed on the basis of specimens from the Guayas, Túmbes and Zarumilla drainages in Ecuador and Peru. *Aequidens azurifer* Fowler, 1911 is a junior synonym of *A. rivulatus*. The syntypes of *Acara aequinoctialis* Regan, 1905 are also syntypes of *A. rivulatus*. A common lectotype is designated for *A. rivulatus* and *A. aequinoctialis*, making *A. aequinoctialis* a junior objective synonym of *A. rivulatus*.

Andinocara blombergi, nueva especie, es descrito del río Esmeraldas, cuenca hidrográfica ubicada al noroeste del Ecuador. Se diferencia de la especie similar *A. rivulatus* (Günther, 1860) por tener 25 escamas vs. 24 escamas presentes en la escala de la línea E1, promedios merísticos ligeramente superiores, cabeza menos ancha y menor espacio interorbital. *Andinocara rivulatus* se redescribe en base a especímenes de la cuenca del río Guayas, Túmbes y Zarumilla, drenajes del Ecuador y Perú. *Aequidens azurifer* Fowler, 1911, es un sinónimo junior de *A.rivulatus*. Los tipos de *A. aequinoctialis* también son los sintipos de *A. rivulatus*. Un lectotipo común es designado para *A. rivulatus* y *A. aequinoctialis*, haciendo el último un sinónimo junior primario de *A. rivulatus*.

Introduction

The South American cichlid genus *Aequidens* Eigenmann & Bray, 1894, with the type species *A. tetramerus* Heckel, 1840, was once a major, speciose genus, recognised from the revision by Regan (1905) mainly by the absence of conspicuous characters as present in related genera, and the presence of three rather than more anal-fin spines (Regan, 1905). Through a series of revisions, species of *Aequidens* sensu Regan were allocated to the genera *Cichlasoma* Swainson, 1839 (Kul-

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lander, 1983), *Bujurquina* Kullander (1986), *Laetacara* Kullander (1986), *Krobia* Kullander & Nijssen (1989), *Cleithracara* Kullander & Nijssen (1989), and most recently *Andinoacara* Musilová, Říčan & Novák (2009a). Species of *Andinoacara* are characterized by blue or green iridescent stripes on the side of the head and usually a somewhat dorsad slanting horizontal dark band along the side. The dark blotch at the base of the caudal fin is situated at the middle of the base, relatively small and only indistinctly ocellated if at all. This contrasts with *Aequidens* sensu stricto in which blue lines on the side of the head are rare, the lateral band is usually horizontal, and the caudal-fin blotch is distinctly ocellated and situated on the dorsal half. The colour pattern of *Andinoacara* is thus more reminiscent of the colour pattern in the cis-Andean genera *Bujurquina* and *Tahuantinsuyoa* Kullander, 1986, with which they also share a uniserial predorsal scale pattern. In the morphological phylogenetic analysis in Kullander (1998), species of *Andinoacar*a and *Tahuantinsuyoa macantzatza* Kullander, 1986 formed a trichotomy sister to *Krobia* and *Bujurquina*.

Two species groups are recognized within *Andinoacara* (Kullander, 1998; Stawikowski & Werner, 1998). The *A. pulcher* group is distributed in northern South America, from Trinidad west along the coast to the northern Pacific coast drainages in Colombia and adjacent Ecuador, and also present in the Orinoco River basin. Four nominal species have been described: *A. pulcher* (Gill, 1858), *A. latifrons* (Steindachner, 1878), *A. coeruleopunctatus* (Kner, 1863), and *A. brevirostris* (Steindachner, 1880). The *A. rivulatus* species group is restricted to Pacific versant rivers from the río Pisco in Peru north to the Esmeraldas river basin in Ecuador. The two groups differ in the generally higher meristics of the *A. rivulatus* group, and the pattern of predorsal scales which consists of a single row of large median scales in the *A. pulcher* group, and a median row of gradually smaller, posteriorly overlapping scales in the *A. rivulatus* group. *Andinoacara biseriatus* (Regan, 1913) from the Pacific coast of Colombia and río Atrato, and *A. sapayensis* (Regan, 1903) from the río Santiago in Ecuador are two little-studied taxa that were assigned to the *A. rivulatus* group by Stawikowski & Werner (1998) and Musilová et al. (2009b), but which present some transitional morphological character states.

Species of the *A. pulcher* group have been observed to lay eggs on movable substrates, similar to the leaf-spawning *Bujurquina*. Species of *Bujurquina* are mouth brooders, sheltering the hatched larvae in the mouth. So far all species of the *A. pulcher* and *A. rivulatus* group in which breeding has been observed, are substrate brooders, not providing oral shelter to the larvae or free-swimming young (Stawikowski & Werner, 1998); leaf-spawning is not recorded from the *A. rivulatus* group, but these species apparently deposit eggs on immovable structures.

Andinoacara rivulatus was described as *Chromis rivulata* by Günther (1860a), based on specimens from the "Andes of western Ecuador". *Acara aequinoctialis* Regan (1905), and *Aequidens azurifer* Fowler (1911), also from Western Ecuador, were considered to be synonyms of *A. rivulatus* by Eigenmann (1922: 201) and Kullander (2003). A second species was long known in the aquarium hobby by the name of "Green Terror", and was described by Musilová et al. (2009b) as *A. stalsbergi*, based on specimens from coastal drainages in Peru. Earlier records of *A. rivulatus* from Peru (e.g., Eigenmann, 1922) refer to misidentified *A. stalsbergi*.

We have examined a larger material of *Andinoacara* from more localities than used by Musilová et al. (2009a–b), including type specimens of all nominal species in the genus *Andinoacara*. In the course of this revision we found that two species have been confused under the name of *A. rivulatus* and that there has been an unfortunate misunderstanding about the type material of *A. rivulatus* and *A. aequinoctialis*. The present paper is dedicated to the description of the new species, and rectification of the type status of specimens referred to as types of *A. rivulatus* and *A. aequinoctialis*.

Material and methods

The procedures for recording measurements and counts are as described by Kullander (1986). Measurements were taken with digital callipers reading to 0.01 mm, rounded to nearest 0.1 mm. Counts were taken under a stereo dissecting microscope, except dorsal and anal fin-ray counts and vertebral counts, which were taken from X-radiographs. Vertebral counts include the last half-centrum. Specimen lengths are given as standard length (SL), measured from the tip of the upper jaw to the middle of the base of the caudal fin. Scale rows are numbered according

to Kullander (1990) where the horizontal row including the lower lateral line is designated as row 0. Horizontal rows above are numbered E1, E2, E3, etc., in dorsal sequence. Horizontal rows below are numbered H1, H2, H3, etc., from row 0. Scales in a longitudinal row (E1 row scales) are counted in the row immediately dorsal to that containing the lower lateral line, excluding any that to any extent overlies the pectoral girdle. Jaw tooth shape terminology, pharyngeal jaw measurements, and as far as practicable also pharyngeal tooth shape terminology, follows Barel et al. (1977). Colour marking terminology follows Kullander (1986); bar numbering follows Kullander (1983: fig. 4).

X-radiographs were made on Kodak X-omat V film using a Philips MG-105 low voltage X-ray unit. Images of pharyngeal jaws represent composite images at different distances composed in Helicon Focus (Kozub et al., 2009). Morphometric data were managed and analysed using PASW Statistics 18 (SPSS, 2009), except that the principal component analysis (PCA) of measurements was made using a separate procedure for component shearing, partialling out multivariate size residues from the second and further components as described by Humphries et al. (1981). The PCA was made with log-transformed measurement data to tenth of a millimetre in a covariance matrix, and without rotation. Pelvic-fin length was excluded from the PCA because of the signal of sexual dimorphism in the length of the pelvic fin. Linear regressions were calculated using the Curvefit module in PASW Statistics.

Specimens studied are stored in the following collections: ANSP, Academy of Natural Sciences, Philadelphia; BMNH, Natural History Museum, London; CAS, California Academy of Sciences, San Francisco; GNM, Museum of Natural History, Gothenburg; MEPN, Museo de Historia Natural Gustavo Orcés V., Instituto de Ciencias Biológicas, Escuela Politécnica Nacional, Quito; MHNG, Muséum d'Histoire Naturelle, Genève; NRM, Swedish Museum of Natural History, Stockholm; USNM, National Museum of Natural History, Smithsonian Institution, Washington, D.C.; ZMB, Museum für Naturkunde, Berlin; ZSM, Zoologische Staatssammlung, München.

Andinoacara blombergi, new species
(Figs. 1–2)

Diagnosis. Similar to *A. rivulatus* and *A. stalsbergi* in having 8–12 (usually 9–10) relatively small predorsal scales in a median row, and different from other species of *Andinocara* which have a median predorsal row of eight large scales. Distinguished from the most similar species, *A. rivulatus*, by E1 scale count 25, exceptionally 24 or 26 (vs. 24, exceptionally 23), narrower head (15.2–17.8 vs. 17.7–22.0 % SL) and narrower interorbital space (8.9–10.9 vs. 9.9–15.5 % SL). Distinguished from *A. stalsbergi* in colour pattern: in large males of *A. blombergi* scales on side light, with dark spot at centre, vs. scales with light centre and dark margin in *A. stalsbergi*. Lower part of head and chest may be spotted with blue but is otherwise pale except for preopercular blotch in females vs. lower part of head and chest blackish in preserved specimens of *A. stalsbergi*.

Holotype. MEPN 11180, adult female, 87.1 mm SL; Ecuador: Pichincha: río Esmeraldas drainage: 17 km downstream of Alluriquin, Rio Toachi; C. Weber, 31 Jan 1992.

Paratypes. All from Ecuador: MHNG 2725.026, 3, 23.2–35.1 mm SL; same data as holotype. – NRM 13866, 10, 34.3–80.7 mm SL; Esmeraldas: río Esmeraldas drainage: Choti stream, draining to río Viche; A. Stalsberg, 11 Jan 1987. – BMNH 1860.6.16:153, 1, 102.3 mm SL; "Esmeraldas"; L. Fraser, about 1859. – GNM Pi.ex. 3510–3516, 7, 37.4–95.6 mm SL; Pichincha: río Esmeraldas drainage: río Blanco between Quinindé [= Rosa Zarate] and Intag; R. Blomberg, 27–30 May 1955. – ZSM 22143, 2, 61.2–67.5 mm SL; Esmeraldas: Hacienda Chula; J. Förster, Sep 1956.

Non-types. All from Ecuador: CAS 14770, 4, 63.4–105.2 mm SL; Esmeraldas: lower río Santiago or in pools and marshes close to the river, near the village of Borbón; M. Olalla, Aug. 1951. [Locality questioned.] – GNM Pi.ex. 3504–3509, 6, 54.3–78.0 mm SL; Pastaza: región de Montalvo: río Pucayacu, R. Olalla, Jun 1955. [Locality apparently incorrect.] – GNM uncatalogued, 1, 60.3 mm SL; Pichincha: Santo Domingo de los Colorados: río Blanco. R. Blomberg, 25 Sep 1950. [Poor condition.]

Description. Based primarily on MEPN 11180 and GNM 3510–3516, which include adults of both sexes. See Figures 1–2 for general aspect.

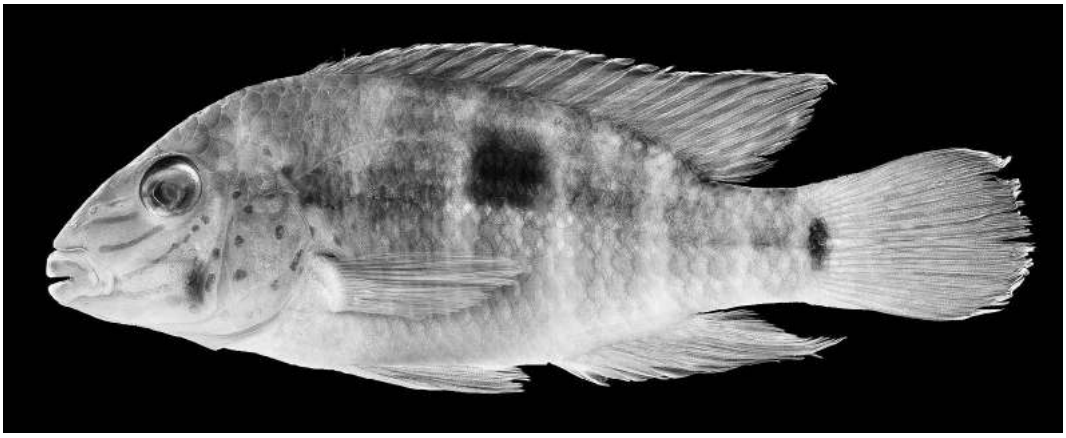

Fig. 1. *Andinoacara blombergi*, MEPN 11180, holotype, adult female, 87.1 mm SL; Ecuador: río Esmeraldas drainage.

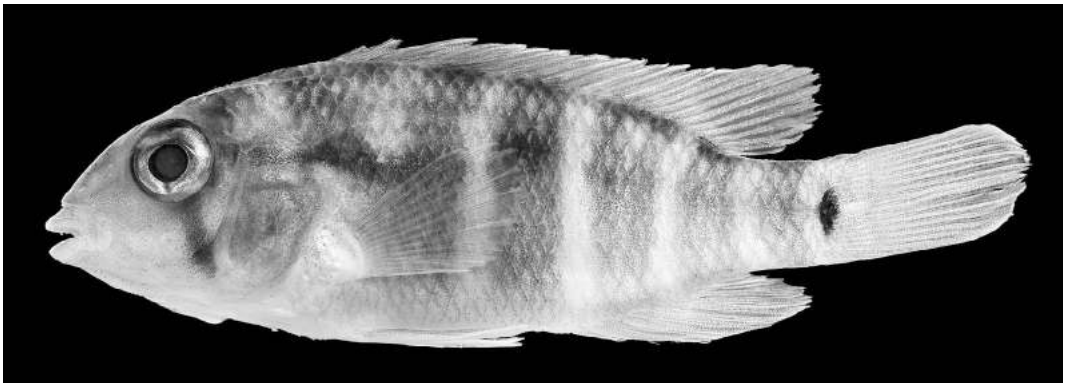

Fig. 2. *Andinoacara blombergi*, MHNG 2725.026, paratype, juvenile, 35.1 mm SL; Ecuador: río Esmeraldas drainage.

Measurement data are summarized in Table 1.

Moderately slender to moderately deep, laterally compressed. Head relatively short, snout somewhat produced. Predorsal contour straight ascending, steeper than prepelvic contour, slightly curved posterior to orbit (female) or close to dorsal-fin base. Dorsal-fin base slightly curved or straight except for stronger curvature immediately before caudal peduncle. Prepelvic contour sloping, straight or slightly curved. Orbit in middle of length of head, in upper half of depth of head. Interorbital space flat or slightly convex, slightly narrower than mouth width. Mouth terminal, upper only slightly projecting before lower jaw. Maxilla extending posteriorly to vertical halfway between nostril and orbit. Lips moderately thick, both upper and lower lip folds interrupted symphysially. Outer row of erect or slightly retrorse, fixed or slightly movable unicuspid teeth with slightly recurved tip, larger than inner teeth, very slightly increasing in size from posterior to symphysial, tips narrow, rounded, some teeth with abraded tip. Inner teeth in narrow band of anteriorly 2–3 rows in upper jaw, 3–4 rows in lower jaw, similar in shape to outer teeth but much shorter, slightly retrorse, depressible, few with abraded tips. Gill-rakers externally on first gill arch 1–3 on epibranchial, one in angle, 6 (1), 7 (14), 8 (13) ceratobranchial, relatively spaced, short, papilliform; epibranchial and two anterior ceratobranchial free, remainder supported medially by transverse swelling. Minute microbranchiospines on external face of second through fourth gill-arches. Lower pharyngeal jaw

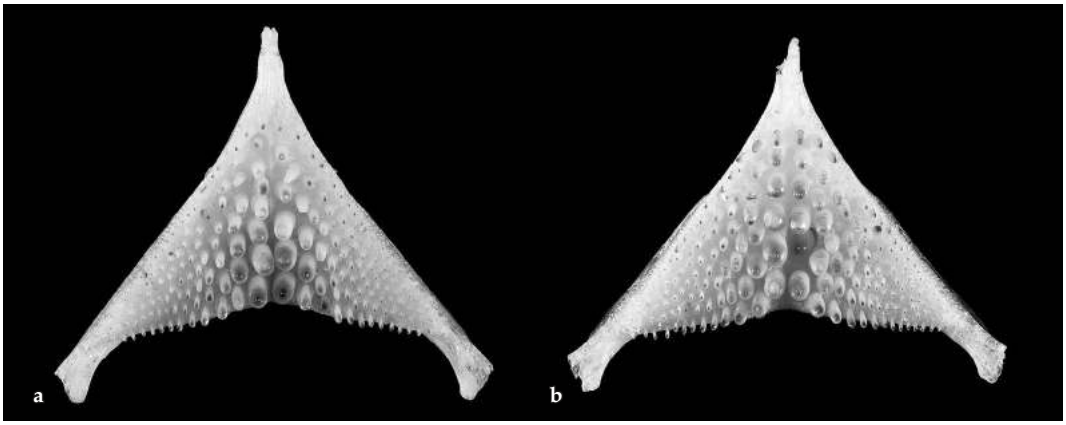

Fig. 3. Lower pharyngeal tooth plate in occlusal aspect. **a,** *Andinoacara blombergi,* NRM 13866, 69.9 mm SL; **b,** *A. rivulatus,* NRM 10358, 77.8 mm SL.

examined in one specimen (Fig. 3a), somewhat slender, length 86 % of width, toothed area length 64 % of width. Teeth along lateral margins erect, slender, laterally compressed, almost unicuspid, with only slight anterior bulge; remaining teeth slender, erect, bicuspid with posterior antrorse, more or less acute cusp and low, often inconspicuous anterior blunt cusp or bulge. Size of teeth gradually increasing mediad and posteriad, posterior and median teeth submolariform, posteriormost with median cusp and indicated anterior cusp, median teeth with worn, rounded or flat tips; 7–8 teeth on each side along median symphysis, 13 + 14 teeth in a row along the posterior margin. Lateralis canal openings on head including one median coronalis pore, on each side of head two nasal, four lachrymal, five infraorbital, three supratemporal, four frontal, five preopercular, and four dentary openings. Supraneurals 2 (28), 3 (1). Vertebrae 12 + 14 = 26 (5), 12 + 15 = 27 (22), 13 + 15 = 28 (1).

Scales in E1 row 24 (2, both from río Santiago), 25 (28), 26 (2). Scales on cheek, gill cover, anterior nape, chest and prepelvic area cycloid, remaining scales slightly ctenoid. Scale rows on cheek 3 (21), 4 (4). Predorsal scales with a definite midline row or with posterior overlapping scale pairs, scales along midline smaller than adjacent scales and smaller posteriorly; 8 (3), 9 (13), 10 (4), 12 (1). Prepelvic scales embedded in skin, small-

Table 1. Standard length (in millimeters) and proportional measurements in percents of standard length of *Andinoacara blombergi.* SD = standard deviation. Regression line parameters, a (intercept), b (slope), and r (Pearson's correlation coefficient) are calculated from measurements expressed in millimeters. The holotype (H) is included in calculated values, but also reported separately.

	H	n	min	max	mean	SD	a	b	r
Standard length (mm)	87.1	24	44.9	105.2	71.3	15.78			
Head length	33.3	24	30.6	36.2	33.5	1.47	1.846	0.308	0.977
Snout length	10.7	24	7.7	11.0	9.5	0.94	–1.648	0.119	0.958
Body depth	38.8	24	36.1	44.3	39.3	1.93	–0.231	0.397	0.973
Orbit diameter	9.8	24	8.8	12.3	10.7	1.04	2.420	0.071	0.890
Head width	16.8	24	15.2	17.8	16.7	0.66	0.723	0.157	0.977
Interorbital width	10.3	24	8.9	10.9	9.8	0.59	–0.788	0.110	0.971
Preorbital depth	9.2	24	6.0	9.3	8.0	0.84	–2.095	0.111	0.980
Caudal peduncle depth	15.3	24	13.3	16.4	14.5	0.75	–0.007	0.145	0.966
Caudal peduncle length	16.0	24	12.1	16.3	14.7	1.12	0.072	0.146	0.938
Pectoral fin length	26.4	23	26.4	32.8	29.9	1.78	1.677	0.274	0.949
Pelvic fin length	24.3	24	24.3	30.6	27.2	1.45	0.567	0.264	0.956
Last dorsal-fin spine length	14.2	24	12.5	17.3	14.7	1.17	0.692	0.137	0.929

est about half size of flank scales. Scales in upper/lower lateral line 15/9 (1), 16/9 (1), 17/8 (2), 17/9 (8), 17/10 (5), 18/8 (2), 18/9 (1), 18/10 (1), 19/8 (1), 19/9 (1). Upper lateral line separated from dorsal fin by 4–4½ scales anteriorly, 1½ scale posteriorly; upper and lower lateral lines separated by two horizontal scale rows; lower lateral line continued by usually 1–2 tubed scales basally on caudal fin. Short sequences of lateral line scales proximally between caudal-fin rays D1–D2 (up to 5 scales) and V3–V4 or V4–V5 (up to 9 scales), rarely one or both absent. Circumpeduncular scale rows 16 (7 above, 7 below lateral lines scale rows). Scales absent from fins, except caudal fin with small cycloid scales basally to almost middle.

Dorsal-fin rays XIV.11 (8), XV.10 (14), XV.11 (10), XVI.10 (1), XVI.11 (1). Dorsal-fin spines increasing in length to 6th, from which subequal in length, last two spines slightly longer; soft dorsal fin acuminate, 4th–5th ray longest, prolonged or not, reaching to about ⅕ or beyond middle of caudal fin. Anal-fin rays III.8 (4), III.9 (30). First anal-fin spine opposite antepenultimate dorsal fin spine; soft anal fin acuminate, 5th ray longest, not or slightly prolonged, reaching slightly past ⅕–⅓ of caudal fin. Pectoral-fin rays 13 (2), 14 (31), 15 (1). Pectoral fin asymmetric, with rounded dorsal tip, 3rd and 4th or 4th ray longest, reaching to above vent. Pelvic fin acuminate, first ray longest, not or only slightly prolonged, reaching almost to or almost to anal fin. Caudal fin subtruncate or slightly rounded.

Juveniles elongate (Fig. 2). Pectoral fin reaching to above middle of spinous anal-fin base. Soft dorsal and anal fins short, with rounded tips.

Colour pattern. Adults (over 70 mm SL) whitish on underside of head, middle of abdomen, and narrowly along anal fin base and ventral margin of caudal peduncle. Sides pale yellowish. Markings brownish. Five brownish vertical bars across caudal peduncle and sides, and two short bars or blotches on head: Bar 1 distally on caudal peduncle; Bar 2+3 below posterior part of dorsal fin and covering anterior half of caudal peduncle; Bar 4+5 above anterior and middle part of anal-fin base (below last two dorsal-fin spines and anterior three soft dorsal-fin rays); Bar 6 across middle of side, anterior to anal fin; Bar 7 immediately posterior to vertical from pelvic-fin insertion; Bar 8 below anterior three dorsal-fin spines and forward across nape, incorporating predorsal blotch; an indistinct dark blotch above eye, narrowly separated from Bar 7 by a lighter line. Interspaces separating vertical bars yellowish, much narrower than bars, those bordering bar 6 particularly light. Bars 4+5 often incompletely merged, indistinctly separated by lighter bar dorsally our throughout. Dark brown, squarish blotch in Bar 6, typically 3–4 scales wide, covering upper half of scales in E1 row, scales of E2 row and all or lower half of scales in E3 row, thus extending slightly dorsal of upper lateral line or stopping at the lateral line. Bar 7 with a dark blotch anterior to and less distinct than that in Bar 6. A more distinct dark blotch terminating bar 8 ventrally below the beginning of the lateral line. In some specimens blotches in Bars 7 and 8 may be contiguous. Depending on light conditions, scales below E2 row may show reflecting distal margin. Scale pigmentation often indistinct, but when pronounced, scale margins lighter than centres, and light overlapping margins creating a faint pattern of alternating lighter and darker horizontal stripes.

Snout dorsally and front greyish. Sides of head with 2 narrow brown lines from orbital margin obliquely rostrad and ventrad across preorbital to or almost to mouth; another narrow brown line, often broken up into spots posteriorly, from little posterior to orbit obliquely ventrad and rostrad to angle of mouth. Small dark spots scattered over gill cover: 5–6 on opercle, 3 on subopercle, 1 on interopercle; small dark spot at dorsal tip of opercle, immediately dorsal of origin of lateral line, and one or a few in region of beginning of lateral line. Females with a dark brown or blackish spot covering corner of preopercle and narrowly adjacent cheek.

Dorsal fin brownish with white lappets and dark brown spot at base of each lappet; corresponding markings also anteriorly on soft dorsal fin. Posterior part of soft dorsal fin with 2–3 transverse rows of indistinct lighter spots. Anal fin pale brownish with dark brown outer margin; posterior part of fin gradually lighter, with indistinct dark spots on posteriormost interradial membranes. Pectoral fin hyaline; a dark brown blotch across pectoral pedicle. Pelvic fin anterior margin or lappet whitish, rest of fin pale brownish, gradually lighter to hyaline on innermost part. Caudal fin with dark brown, short vertical bar across middle of base. Rest of fin dusky with indistinct pattern of lighter or darker small spots. Distal margin narrowly white.

Juveniles differ from adults in presence of a dark brown suborbital stripe from lower margin of orbit to the inner corner of preopercle and vertical bar 4+5 incompletely merged or with light vertical stripe dividing only upper portion of Bar 4+5. Fins hyaline or smoky with only indistinct light spots on soft portion of dorsal fin and caudal fin. Spots and lines on head developing gradually in specimens over 40 mm SL as suborbital stripe fades away.

Live colours. Live colours not recorded from specimens in type series, but available from colour slides of fresh collected specimens at MEPN. Large adult probable male about 13 cm SL photographed fresh preserved rosy on chest and abdomen. Flanks iridescent blue with dark brown or maroon spot at base of exposed portion of each scale, Head anteriorly with several iridescent blue lines, on gill cover several iridescent blue spots. Fins dark with blue spots on anal and caudal fin. Dorsal-fin margin and posterior margin of caudal fin white. Probable adult female similar, but iridescent stripes pale greenish, anterior flanks with yellowish cast. Dorsal and caudal fins with brownish spots, pelvic fin with iridescent blue stripes.

Geographical distribution. *Andinoacara blombergi* has been collected only in the río Esmeraldas drainage, but possibly also in the adjacent río Santiago in northern Ecuador (Fig. 4).

Etymology. Named in recognition of the life's work of explorer, writer, photographer, and filmmaker Rolf Blomberg (1912–1996). Blomberg, born in Sweden, made several expeditions in Ecuador and eventually settled in Quito, Ecuador (Repo, 2011).

Remarks. GNM 3504–3509 is labelled "Rio Pucayacu, region de Montalvo, Centro Oriente Ecuador". There are several places named Montalvo in Ecuador. Paynter (1993) and Cisneros-Heredia & McDiarmid (2006), however, indicate a most relevant place (lat. –2.0511, long. –77.0077) on the rio Bobonaza, a tributary of the río Pastaza in the Amazon lowlands, but differ on the exact location of the río Pucayacu. That Ramón Olalla collected fishes from the río Pucayacu at least in 1958 and 1960 is confirmed by a report by Orcés (1962). GNM 3504–3509 cannot be distinguished from *A. blombergi* from the Esmeraldas basin, however, and given that this is the only

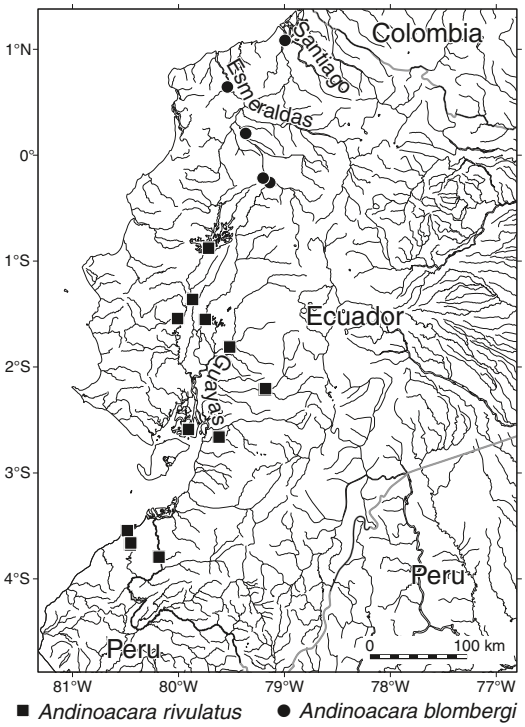

Fig. 4. Collecting sites of *Andinoacara blombergi* and *A. rivulatus* in Ecuador and adjacent Peru.

record of *Andinoacara* from the Amazon basin we prefer to leave it open whether they represent an Amazonian locality of *A. blombergi* (or a very similar species), or mislabelled *A. blombergi*. The record is interesting, however, in the light of reports of specimens from the Amazon tributary río Zamora drainage in eastern Ecuador by aquarists (Schindler & Morgenstern, 2010). No specimens are available from those observations. Whereas we would not exclude the possibility that *Andinoacara* may be present in the Amazon basin, it needs firm evidence from specimens with verifiable collecting data.

The locality data for GNM 3510–3516 is imprecise. The Esmeraldas is formed mainly by the rivers Guayllabamba, Quinindé and Blanco; the río Blanco rises in the Andes south of Intag, and meets the Quinindé at Rosa Zarate about 100 km to the west. The specimen from Santo Domingo de los Colorados, on the río Blanco, is not well preserved and no data were taken from it.

The sample of *A. blombergi* collected by Manuel Olalla at Borbón in 1951 is part of a larger collection of fishes of which specimens with the

Fig. 5. *Andinoacara blombergi*, paratype, BMNH 1860.6.16:153, 102.3 mm SL; Ecuador: "Esmeraldas". Photo courtesy and copyright The Natural History Museum, London.

same data are also present in the ANSP (Böhlke, 1958). Vari (1989: 23) identified two specimens of *Pseudocurimata boehlkei* among Olalla's Borbón material but considered the locality information doubtful, because *P. boehlkei* has afterwards not been sampled from the río Santiago, but is common in the Esmeraldas drainage (Barriga, 1994: 109). The only other *Pseudocurimata* in the río Santiago is *P. lineopunctata* which also occurs in Colombian Pacific versant rivers (Vari, 1989: 14; Barriga, 1994: 109). The río Santiago, as already pointed out by Orcés (1967) and Barriga (1994: 109) has a distinct fauna, which may be more similar to that of the Pacific coast of Colombia, than to that of the Esmeraldas. A major ichthyological survey of the rivers of north-eastern Ecuador obtained *A. blombergi* (then identified as *Aequidens rivulatus*) in the río Esmeraldas drainage, but the species was absent in collections from the rivers Mira, Mataje, and Santiago, and from rivers between the Santiago and the Esmeraldas (Barriga, 1994: 81).

The specimen BMNH 1860.6.16:153 (Fig. 5), identified by Regan (1905) as the "type" of *A. rivulatus* is here identified as *A. blombergi* based on the locality, "Esmeraldas", as well as the scale count (E1 row scales 25). The status of this specimen is discussed further below in the description of *A. rivulatus*.

Andinoacara rivulatus (Günther, 1860)
(Figs. 6–10)

Material examined. Ecuador, río Guayas drainage: ANSP 39118, 1, 98.5 mm SL, holotype of *Aequidens azurifer*; ANSP 39119–39120, 2, 47.5–79.9 mm SL, paratypes of *Aequidens azurifer*; Guayas: affluent of río Chimbo near Bucay. S. N. Rhoads, Jul 1911. – BMNH 1898.12.31: 30–32, 3, 84.6–94.6 mm SL; Pichincha: río Peripa, E. Festa, Nov 1897. – BMNH 1860.6.18:13, male, 72.1 mm SL; W. Ecuador; L. Fraser, 1860; lectotype of *Chromis rivulata* and *Acara aequinoctialis*. – BMNH 1860.6.18:14–16, 3, 33.1–56.9 mm SL; W. Ecuador, L. Fraser, 1860; paralectotypes of *Chromis rivulata* and *Acara aequinoctialis*. – BMNH 1898.12.31:33–34, 2, 39.5–63.8 mm SL; Los Ríos: río Vinces; E: Festa, no date. – BMNH 1920.12.20:179–184, 10, 55.5–117.3 mm SL; Guayas: Colimes: río Daule; A. Henn, 1913. – BMNH 1971.2.11:22–27, 5, 99.8–123.3 mm SL; Guayas: mouth of río Guayas; C. S. Webb, 1 May 1938. – NRM 10358, 11, 39.1–113.1 mm SL; Los Ríos: río de Clementina drainage, northwest of Babahoyo. C. Hammarlund, 1934. – NRM 12005, 5, 29.8–90.2 mm SL; Guayas: río Jaguar, 72 km south of Milagro near Naranjal. U. Werner, 28 Jul 1985. – ZSM 25356, 1, 62.2 mm SL; Guayas: Hacienda Clementina; K. von Sneidern, 1964.

Peru, Depto Túmbes: USNM 284461, 55, 32.0–117.3 mm SL (10 measured, 66.9–117.3 mm SL); río Túmbes above to below Rico Playa; R. P. Vari et al., 11 Aug 1986. – USNM 284462, 88, 18.4–90.4 mm SL; upper río Zarumilla at Pozo Lajas, on Peruvian-Ecuadorian border; R. P. Vari et al., 12 Aug 1986. – USNM 284464, 15, 40.5–76.2 mm SL; río Túmbes north of town of Francos; R. P. Vari et al., 10 Aug 1986. – USNM 284465, 7, 23.7–70.0 mm SL; drainage canal along road from Pan American Highway to mouth of río Túmbes, ca. ½ distance between those points; R. P. Vari et al., 8 Aug 1986. – USNM 284466, 18, 19.6–83.7 mm SL; río Túmbes and neighboring water bodies near Boca Tumba irriga-

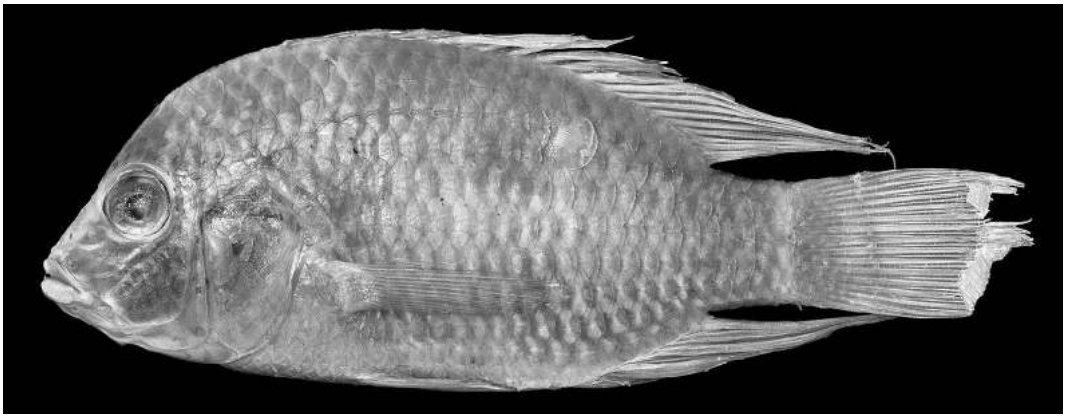

Fig. 6. *Andinoacara rivulatus*, BMNH 1860.6.18:13, male, 72.1 mm SL; W. Ecuador; lectotype of *Chromis rivulata* and *Acara aequinoctialis*. Photo courtesy and copyright The Natural History Museum, London.

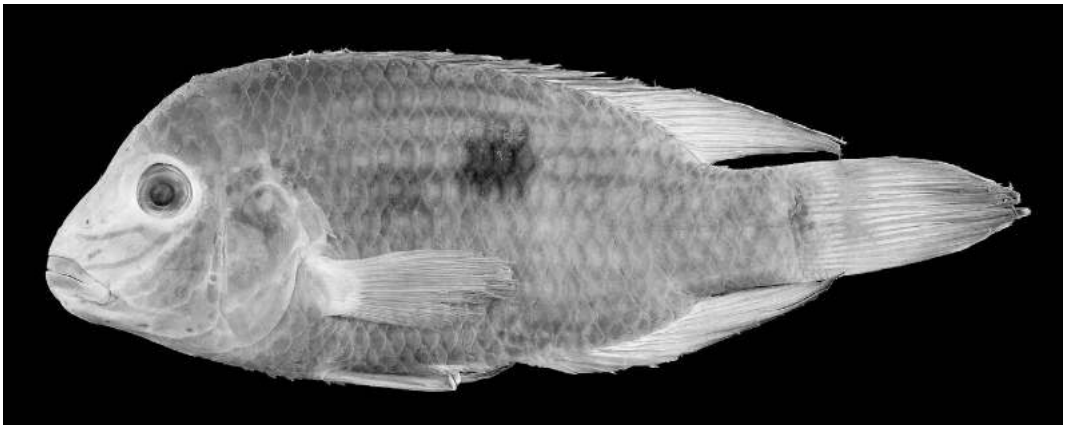

Fig. 7. *Andinoacara rivulatus*, ANSP 39118, adult male, 98.5 mm SL; Ecuador, río Guayas drainage; holotype of *Aequidens azurifer*. Photo by Amanda Labadie, ANSP.

Fig. 8. *Andinoacara rivulatus*, NRM 10358, adult female, 82.6 mm SL; Ecuador: río Guayas drainage.

tion project, just downstream of town of Francos; R. P. Vari et al., 10 Aug 1986.

Description. Based on Guayas basin specimens (Figs. 6–8), with consideration of Zarumilla (Fig. 9) and Túmbes (Fig. 10) specimens. Measurement data are summarized in Table 2.

Moderately deep, laterally compressed. Head relatively short, snout somewhat produced. Predorsal contour straight ascending, steeper than prepelvic contour, slightly curved posterior to orbit or close to dorsal-fin base. Large males with steep straight ascending frontal contour making a sharp curve some distance anterior to dorsal-fin origin, and straight horizontal from there. Only one male with distinct nuchal hump, 117.3 mm SL, from río Túmbes (Fig. 10). Dorsal-fin base slightly curved or straight except for stronger curvature immediately before caudal peduncle. Prepelvic contour straight sloping or curved. Orbit in middle of length of head, in upper half of depth of head. Interorbital space flat or very slightly convex, as wide as mouth width or slightly wider. Mouth terminal, jaws isognathous. Maxilla extending posteriorly to vertical halfway between nostril and from anterior margin of orbit, in large specimens slightly closer to orbit. Lips moderately thick, both upper and lower lip folds interrupted symphysially. Teeth in both jaws caniniform; an outer row of strong teeth, progressively larger toward symphysis, and a narrow band and much smaller teeth anteriorly. Outer row teeth may be abraded apically in large specimens. Outer row of erect or slightly retrorse, fixed or slightly movable, unicuspid teeth with slightly recurved tip, larger than inner teeth, very slightly increasing in size from posterior to symphysial, tips narrow, rounded, some teeth with abraded tip. Inner teeth in narrow band of anteriorly 2–6 rows in upper jaw, 3–4 rows in lower jaw, similar in shape to outer teeth but much shorter, slightly retrorse, depressible, few with abraded tip. Teeth in outer hemiseries in upper jaw 12–24, in lower jaw 12–21.

Gill-rakers externally on first gill arch usually two, occasionally one or three, on epibranchial, one (rarely none) in angle, 7 (3), 8 (24), 9 (24), 10 (3) ceratobranchial. Gill-rakers papilliform on epibranchial and in corner, on epibranchial papilliform but connected to soft medial transverse ridge across epibranchial. Minute microbranchiospines on external face of second through fourth gill-arches. Lower pharyngeal jaw examined in one specimen (Fig. 3b), somewhat slender, length 78 % of width, toothed area length 60 % of width. Teeth laterally erect, slender, laterally compressed, bicuspid, with more or less acute antrorse posterior cusp and low anterior blunt cusp. Size of teeth gradually increasing mediad and posteriad, medioposterior teeth submolariform with reduced or absent anterior cusp and apex rounded or with minor central cusplet. 6 teeth on each side along median symphysis, 16 + 16 teeth in a row along the posterior margin.

Scales in E1 row 23 (3), 24 (51). Scales on cheek, gill cover, anterior nape, chest and prepelvic area

Table 2. Standard length (in millimeters) and proportional measurements in percents of standard length of *Andinoacara rivulatus*. SD = standard deviation. Regression line parameters, a (intercept), b (slope), and r (Pearson's correlation coefficient) are calculated from measurements expressed in millimeters. The lectotype (L) is included in calculated values, but also reported separately.

	L	n	min	max	mean	SD	a	b	r
Standard length (mm)	72.1	46	55.7	123.3	86.4	18.51			
Head length	34.1	46	32.9	37.0	34.6	0.97	1.347	0.330	0.991
Snout length	7.9	46	7.7	11.0	9.7	0.74	–0.589	0.105	0.954
Body depth	45.5	46	39.3	51.3	45.2	3.07	–7.264	0.539	0.980
Orbit diameter	10.5	46	9.5	12.6	10.9	0.77	2.159	0.083	0.950
Head width	19.3	46	17.7	22.0	19.5	1.09	–2.205	0.222	0.980
Interorbital width	13.9	46	9.9	15.5	12.6	1.50	–5.034	0.187	0.970
Preorbital depth	8.7	46	7.7	11.3	9.4	0.79	–2.803	0.128	0.989
Caudal peduncle depth	16.4	46	14.9	18.3	16.4	0.87	–2.073	0.189	0.983
Caudal peduncle length	11.9	46	10.6	14.1	12.4	0.84	1.267	0.109	0.941
Pectoral fin length	35.4	46	29.5	39.6	33.5	2.28	–4.144	0.384	0.970
Pelvic fin length	27.9	46	24.8	35.7	30.0	2.63	–6.388	0.377	0.956
Last dorsal-fin spine length	17.5	46	15.4	20.7	17.0	0.97	–0.357	0.174	0.971

cycloid, remaining scales slightly ctenoid. Cheek scale rows 3 (55), 4 (1). Predorsal scales, following pair of scales bordering coronalis pore a definite midline row of 8 (10), 9 (23), 10 (11), 11 (1) scales becoming progressively smaller toward dorsal-fin origin, last scale occasionally difficult to observe covered by adjacent scales, or one or two posterior scales overlapping across predorsal midline. Prepelvic scales embedded in skin, smallest about half size of flank scales. Scales in upper/lower lateral line 15/8 (1), 15/9 (1), 16/7 (1), 16/8 (9), 16/9 (17), 16/10 (2), 17/7 (1), 17/8 (6), 17/9 (5), 17/10 (2), 18/7 (1), 18/8 (1), 18/9 (1), 18/10 (2), 19/10 (1). Upper lateral line separated from dorsal fin by 3–4½ scales anteriorly, 1–1½ scales posteriorly; upper and lower lateral lines separated by two horizontal scale rows; lower lateral line continued by usually 1–2 tubed scales basally on caudal fin. Short sequences of lateral line scales proximally between caudal-fin rays D1–D2 (up to 8 scales) and V3–V4 or V4–V5 (up to 8 scales), rarely one or both absent. Circumpeduncular scale rows 16 (7 above, 7 below lateral lines scale rows). Fins naked, except caudal fin with scales on basal ⅓.

Dorsal-fin rays XIII.10 (1), XIII.11 (4), XIII.12 (2), XIV.10 (16), XIV.11 (54), XIV.12 (7), XIV.13 (1), XV.10 (10), XV.11 (1), XVI.10 (1). Dorsal-fin spines increasing in length to 6th, from which subequal in length, last two spines slightly longer, or slightly increasing in length throughout, but increase less from about 6th spine; soft dorsal fin acuminate, 4th–5th ray longest, reaching to about ⅓ or little beyond middle of caudal fin; with long, slender tip in one large male (Fig. 10). Anal-fin rays III.8 (33), III.9 (62), III.10 (2). First anal-fin spine opposite antepenultimate dorsal-fin spine; soft anal fin acuminate, 4th–5th ray longest, reaching slightly past ⅓ or middle of caudal fin; with long slender tip in one large male (Fig. 10). Pectoral-fin rays 13 (3), 14 (43), 15 (8). Pectoral fin asymmetric, with rounded dorsal tip, 5th ray longest, reaching to above first anal-fin spine. Pelvic fin with pointed or rounded tip, first ray longest, reaching at most to base of first anal-fin spine (males), or at most to slightly beyond base of first anal-fin spine (females, and one large male; Figs. 8, 10). Caudal fin rounded. Supraneurals 1 (2), 2 (19) in Guayas specimens; 1 (16), 2 (32) in Túmbes and Zarumilla specimens. Vertebrae 12 + 13 = 25 (9), 12 + 14 = 26 (51), 12 + 15 = 27 (3), 13 + 13 = 26 (7), 13 + 14 = 27 (4).

Juveniles elongate. Pectoral fin reaching to above spinous anal-fin base. Soft dorsal and anal fins with rounded tips.

Colour pattern. Adults, over 70 mm SL, pale yellowish or whitish on underside of head, middle of abdomen, and narrowly along anal-fin base and ventral margin of caudal peduncle. Sides pale yellowish. Markings brown to dark brown. Four faint brownish vertical bars across caudal peduncle and sides in adults: Bar 1 distally on caudal peduncle; Bar 2 + 3 below posterior part of dorsal fin and covering anterior half of caudal peduncle; Bar 4 + 5 above anterior and middle part of anal-fin base (below last two dorsal-fin spines and anterior three soft dorsal-fin rays); Bar 6 across middle of side, anterior to anal fin. In juveniles also faint Bar 7 immediately posterior to vertical from pelvic fin insertion, Bar 8 below anterior three dorsal-fin spines and forward across nape, incorporating predorsal blotch. Indistinct dark blotch above eye narrowly separated from Bar 8 by a lighter line. Interspaces separating vertical bars yellowish, much narrower than bars, those bordering Bar 6 particularly light. Dark brown, squarish midlateral blotch in Bar 6, typically 3–4 scales wide, covering upper half of scales in E1 row, scales of E2 row and all or lower half of scales in E3 row, thus extending slightly dorsal of upper lateral line or stopping at the lateral line. Absent or indistinct brownish horizontal band from upper end of gill-cleft to light bar preceding midlateral blotch. Scale pigmentation often indistinct, but when distinct scales of lower and middle side and caudal peduncle light, even to reflecting white or light blue, with hyaline border except for dark spot at base of each scale and overlapping margin of preceding scale, creating a pattern of dark horizontal rows of spots on lighter background.

Snout and front dorsally pale brownish or greyish. Sides of head with 2 narrow brown lines from orbital margin obliquely rostrad and ventrad across preorbital to or almost to mouth; another narrow brown line, often broken up into spots posteriorly, from little posterior to orbit obliquely ventrad and rostrad to angle of mouth. Small dark spots scattered over gill cover: 6–7 on opercle, 3 on subopercle, 1 on interopercle; small dark spot at dorsal tip of opercle, immediately dorsal of origin of lateral line, and one or a few in region of beginning of lateral line. Both adult males and

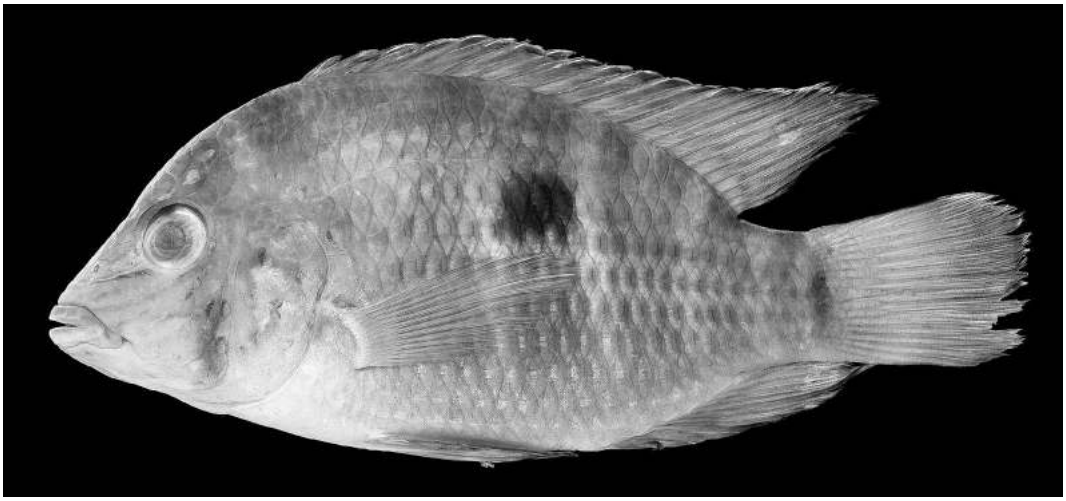

Fig. 9. *Andinoacara rivulatus,* USNM 284462, adult male, 83.4 mm SL; Peru: upper río Zarumilla.

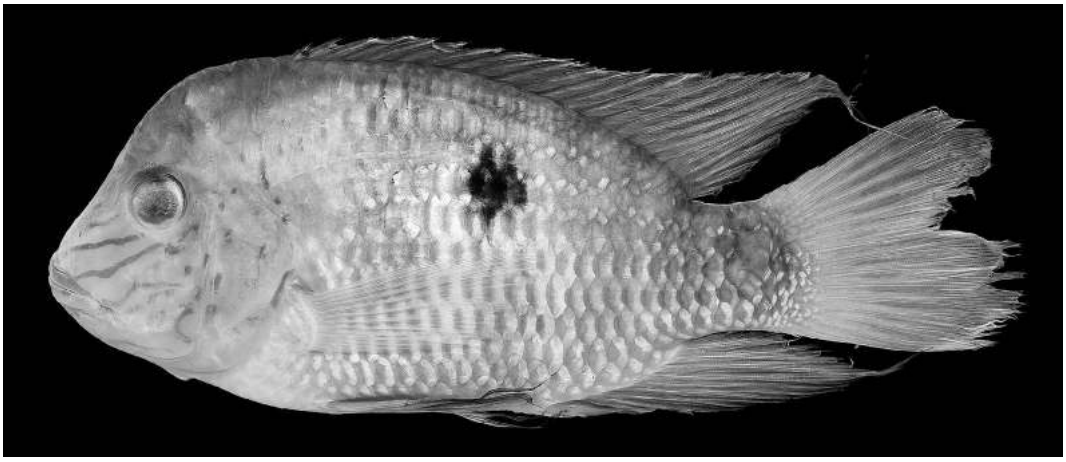

Fig. 10. *Andinoacara rivulatus,* USNM 284461, adult male, 117.3 mm SL; Peru: río Túmbes.

adult females usually with variably pigmented, pale brown to blackish spot covering corner of preopercle and narrowly adjacent cheek; spot occasionally absent.

Dorsal fin brownish with white lappets and dark brown spot at base of each lappet; corresponding markings also anteriorly on soft dorsal fin. Large males with short approximately horizontal stripes on interradial membranes of spinous portion of dorsal fin, forming 2–3 horizontal narrow stripes extending onto anterior part of soft dorsal fin. Posterior part of soft dorsal fin with 2–3 transverse rows of indistinct lighter spots. Anal fin pale brownish with dark brown outer margin; posterior part of fin gradually lighter, with indistinct dark spots on posteriormost interradial membranes. Pectoral fin hyaline; a dark brown blotch across pectoral pedicle. Pelvic fin anterior margin or lappet whitish, rest of fin pale brownish, gradually lighter to hyaline on innermost part, outer rays blackish in breeding females. Caudal fin with dark brown, short vertical bar across middle of base; rest of fin dusky, immaculate or with indistinct pattern of lighter or darker small spots. Distal margin narrowly white.

Juveniles differ from adults in presence of dark brown suborbital stripe from lower margin of orbit to the inner corner of preopercle and

vertical Bar 3 with a light vertical stripe dividing only upper portion of Bar 3. Fins hyaline or smoky with only indistinct light spots on soft portion of dorsal fin and caudal fin. Spots and lines on head developing gradually in specimens over 40 mm SL as suborbital stripe fades away.

Live colours. Photos of fresh collected specimens from the Guayas drainage maintained at MEPN show considerable variation. Large adult, probable male about 15 cm SL rosy on chest, abdomen and lower head. Flanks iridescent silvery blue with dark brown or maroon spot at base of exposed portion of each scale. Head anteriorly with several iridescent blue lines, on gill cover several iridescent blue spots. Fins dark with blue short stripes on spinous dorsal fin, and sparse blue spots on soft dorsal, anal and caudal fin. Dorsal-fin margin orange. Posterior margin of caudal fin broadly margined with orange. Other specimens with white margin to dorsal and caudal fin, and iridescent colours more subtle. Dark lateral blotch may be distinct or indistinct.

Zarumilla specimens. Specimens from río Zarumilla including both very deep-bodied (Fig. 9) and more elongate males, latter including some giving impression of stunting. Predorsal profile commonly with indentation anterior to orbit. Two large males, 79.3–82.9 mm SL with slightly elevate nape, indicating incipient nuchal hump. Jaw teeth pointed, without sign of apical wear. Spots absent from caudal fin; dorsal fin in males with or without horizontal dark stripes. Slim males with strong pattern of light or iridescent stripes and dark spots on scales; deep-bodied males with only indicated pattern of horizontal stripes. All specimens, of both sexes, with suborbital stripe, in larger specimens faint on cheek. Short horizontal stripe anterior to midlateral blotch absent of faint. Only three large females 60.2, 66.1, 78.3 mm SL; all other specimens over 57 mm (N = 15) males.

Túmbes specimens. Specimens from río Túmbes drainage including mainly deep-bodied (Fig. 10) but also several males with hunger-look. Only largest male, 117.3 mm SL, with noticeable large nuchal protuberance (Fig. 10) and long pointed tips to soft dorsal and anal fins, and pelvic fins. Females show distinct preopercular blotch, absent in males except one, 72.6 mm SL. Females up to 80.6 mm SL; one female 57.6 mm SL with noticeably dark overall coloration. Caudal fin spotted. Males particularly with flank colour pattern of light scale margins and dark middle as in Zarumilla specimens and in Figure 8.

Distribution. Specimens examined come from the Guayas, Túmbes, and Zarumilla river drainages. The species is also reliably reported from the Portoviejo and Chone rivers slightly to the north of the río Guayas on the coast of Ecuador (Eigenmann, 1922).

Remarks. *Chromis rivulata* was based on "several specimens of different ages; the largest 4 inches long" (Günther, 1860a). A specific locality was not given, but the species was described from a collection made shortly before by Louis Fraser in the "Andes of Western Ecuador". At that time the border of Ecuador extended east to the Amazon river, covering much of present-day northern Peru, so that "Western Ecuador" at that time largely represents present-day Ecuador as a whole.

Fraser's collection apparently arrived in three shipments, and was reported upon sequentially (Günther, 1859, 1860a, b). The first two papers have "Andes of Western Ecuador" in the title; only in the second paper, locality information is given for four out of 12 species reported, but then as "Western Andes of Ecuador", which might be interpreted as the Western slope of the Andes. Of the six new species described by Günther (1859, 1860a) five are later recorded only from the Pacific slope of Ecuador, some also from Peru. Only *Bryconamericus muelleri* (Günther, 1859), presently *Creagrutus muelleri,* is an eastern Andean high-altitude species (Lima et al., 2003). The holotype of an entirely cis-Andean species, *Pseudotylosurus angusticeps,* described later by Günther (1866) comes from the Fraser collection (Collette, 1974). The other species reported could be from either slope of the Andes, but we have not re-examined the specimens, and cannot verify Günther's identifications.

Günther's third report on Fraser's Ecuadorian fishes (Günther, 1860b) lists species specifically from either Guayaquil or Esmeraldas. "Esmeraldas" probably refers to the city of Esmeraldas, in analogy with the use of Guayaquil, but could also refer to the province or the river Esmeraldas. For three of the species described the locality is given as "Fresh waters of Esmeraldas". *Chromis rivulata* appears in the list of material from Esmeraldas, but only by name.

Günther (1862: 280) synonymised *Chromis rivulata* with *Cychlasoma pulchrum* Gill (1858), under the name *Acara pulchra*, listing one specimen (a) 5½ inches long, and others (presumably three) as (b–d) "half-grown and young" all with the locality "Western Ecuador".

Boulenger (1899) reported specimens of *Acara rivulata* collected by Enrico Festa in the Peripa and Vinces rivers. He noted that Günther's (1860a, 1862) count of 13 spines (D. XIII.11) in the dorsal fin was uniquely low, and provided fin-ray and scale counts for five type specimens of *Chromis rivulata*. Only one of the specimens listed by Boulenger has 13 dorsal-fin spines (D. XIII.12; probably, as verified by us, BMNH 1860.6.18:13, the lectotype) and none of the specimens has the combination of counts given by Günther (1860a, 1862). It is possible that Boulenger's count of five type specimens include both the initial type series in Günther (1860a) and the specimen from Esmeraldas listed in Günther (1860b).

Regan (1905) provided a new diagnosis of *Acara rivulata* based on one specimen, 136 mm [TL], from W. Ecuador, indicated as "type of the species", and three specimens from Rio Peripa, collected by Festa. He also described a new species, *Acara aequinoctialis*, based on four specimens, 52–96 mm [TL], stated to be "types of the species" and coming from "W. Ecuador", and also 2 specimens from the Rio Vinces, collected by Festa. The four syntypes of *A. aequinoctialis* are preserved as BMNH 1860.6.18:13–16. The specimen that Regan labelled as type of *A. rivulata* has catalogue number 1860.6.16:153. By indicating only BMNH 1860.6.18:13–16 as "types", and not listing the specimens from the río Vinces (BMNH 1898.12.31–33) as types, the latter are excluded from the syntype series under the International Code of Zoological Nomenclature Article 72.4.6 (International Commission on Zoological Nomenclature, 1999).

Regan remarked about *Acara aequinoctialis* that "Although similar to *A. rivulata* in colour, this species is markedly different in other characters". In his key, the only differences are that in *A. aequinoctialis* the dorsal-fin spines are said to be subequal from the fifth, and the cheek to have three series of scales, whereas in *A. rivulata* the dorsal-fin spines are said to increase in length throughout, and there would be three or four series of scales on the cheek. When we compare the two descriptions, several minor differences emerge, most important perhaps the greater number of scales along the side in *A. rivulata* (27–28) compared to *A. aequinoctialis* (25–26).

Search at the BMNH for additional documentation about Fraser's localities has not been successful, and original labels are not preserved with the specimens. In the BMNH registry are entered four *Heliases* as 1860.6.18:13–16, and one *Heliases* as 1860.6.16:153. Both are noted as coming from Fraser. *Heliases* is a genus of pomacentrids with resemblance to cichlids. It may be that the cichlid specimens were identified and shipped by Fraser as *Heliases*. Consequently, only five specimens in total were received from Fraser, and they are identifiable by the catalogue numbers.

This leads to the conclusion that the type series of *Acara aequinoctialis* is composed of the syntypes of *Chromis rivulata*, making *A. aequinoctialis* a junior objective synonym of *C. rivulata*. Because a very similar species is now recognized, and because of the confusion about the type series, we designate BMNH 1860.6.18:13 (Fig. 6) as lectotype of both *Chromis rivulata* and *Acara aequinoctialis*. The lectotype, 72.1 mm SL, 96.9 mm TL, is somewhat soft and discoloured, with considerable wear to fins. It is still the best preserved specimen among syntypes examined. It has E1 row scales 24 as characteristic of *Andinoacara rivulatus* in comparison with *Andinoacara blombergi*. Three more specimens in the same sample are paralectotypes, BMNH 1860.6.18:14–16. Two specimens in the Zoologisches Museum in Berlin, ZMB 2809, 46.5–50.3 mm SL, are labelled as types of *Chromis rivulata*, with locality Ecuador (Andes) and collector Fraser. Archived correspondence indicates that they were sent by Günther to H. M. Peters in Berlin possibly in 1862 (Christa Lamour, pers. comm.). We have examined images of the ZMB specimens which resemble the BMNH specimens in state of preservation and general colour pattern. Both have 24 scales in the E1 row. They are potential paralectotypes of *Chromis rivulata*. *Acara aequinoctialis* has practically never been used as a valid name after 1905, and literature on *Andinoacara rivulatus* is mostly associated with the species from the Guayas drainage.

Because Regan (1905) listed BMNH 1860.6.16: 153 as "type of the species" [*Chromis rivulata*], and at the same time listed remaining syntypes (BMNH 1860.6.18:13–16) under *Acara aequinoctialis*, he clearly designated 1860.6.16:153 as lectotype for *C. rivulata* conforming to the International Code of Zoological Nomenclature, Article 74.5 (International Commission on Zoological Nomen-

clature, 1999). However, as obvious from the lengths of the specimens, BMNH 1860.6.16:153 (136 mm) is not likely to have been included in the type series of *C. rivulata* in which the largest specimen was stated by Günther (1860a) to be 4 inches (102 mm), and the lectotype designation is invalid. It is obvious that Regan's "type" is identical with the 5½ inch (138 mm) specimen listed in Günther (1862). Considering that it entered in the accession registry of the BMNH at the same time as other Fraser specimens in June 1860, and that it conforms in meristics to the Esmeraldas basin species of *Andinoacara*, it is likely to represent material that Günther (1860b) reported from Esmeraldas, and we identify it as *Andinoacara blombergi*. Speculations about Regan's mistake in identifying the type of *Andinoacara rivulatus*, similar to the conclusions here, meanwhile appeared in German aquarium press (Schindler & Morgenstern, 2010).

Aequidens azurifer Fowler (1911) is clearly referable to *Andinoacara rivulatus*. It was described on the basis of three specimens, the holotype 98.5 mm SL, and two smaller specimens about 80 and 48 mm SL, from near Bucay, in the upper río Chimbo drainage. The Chimbo drains to the lower río Guayas. The holotype, a probable male with strongly inclined and slightly indented frontal contour, is relatively elongate (depth 41.2 % SL; Fig. 7), but possesses meristics characteristic of *Andinoacara rivulatus* rather than *Andinoacara blombergi*, viz., XIV.11 dorsal-fin rays, 24 E1 scales, nine ceratobranchial gill-rakers, and 12 + 14 = 26 vertebrae, which are the modal values for *Andinocara rivulatus*.

There are concerns about the locality of the type series of *Aequidens azurifer*. The collector, Samuel N. Rhoads provided a long general description of the río Chimbo, cited by Fowler (1911). It there appears that "all the fish described in this paper, with one or two exceptions, were dynamited by railroad men in the larger pools of clear-water streams flowing into the Chimbo River, about 2 miles from Bucay". Six other species described by Fowler (1911) from the same locality as *A. azurifer*: One of them, *Prochilodus stigmatura*, is considered to be a synonym of the Western Amazonian curimatid species *Steindachnerina dobula* by Vari (1991: 69). Fowler's (1911) *Astyanax notemigonoides* and *A. scierus* are listed as species inquirenda by Lima et al. (2003). *Brycon scapularis* in the same paper is now considered a synonym of *Brycon atrocaudatus*, one of five species of *Brycon* from the Pacific slope of Ecuador (Lima, 2003). *Piabucina aureoguttata* seems not to have been collected afterwards. It is illustrated with an adipose fin, and Weitzman & Weitzman (2003) considered it to be a potential synonym of *Lebiasina astrigata* from north-western Ecuador. i.e., not from the Guayas drainage. Böhlke (1958) listed specimens from a later collection from Bucay as *Lebiasina bimaculata*, a widespread species in Ecuador and Peru. *Rhoadsia altipinna* from different localities were studied by Böhlke (1958) and from his diagrams it seems like the holotype is similar to material from the Chimbo near Bucay collected in 1954. Fowler (1913) reported on the reptiles and amphibians purchased from Rhoads, and from the localities in this paper it appears that Rhoads made collections principally near Bucay in July 1911, but earlier in the year also in March (Chiguancay), as well as near río Bamba, Quito, and Guayaquil from February till June 1911. From these localities and dates, however, there seem to be no reason to think that the material would have been mixed with specimens from the Esmeraldas, or Santiago basins, from where *Andinoacara blombergi* is known.

Eigenmann (1922: 201) reported *Aequidens rivulatus* from Colimes (río Daule), Vinces, Naranjito, and Guayaquil market in the río Guayas basin, and Portoviejo and Chone on the western coastal rivers with the same names. He also examined a paratype of *A. azurifer* (FMNH 55908) and concluded that the latter, along with *A. aequinoctialis*, is a junior synonym of *A. rivulatus*. Specimens from Peru (Pacasmayo, Cultambo, Llallan, and Piura) listed by Eigenmann belong to *Andinoacara stalsbergi* or a similar species (pers. obs.). One of us has cursorily examined Eigenmann's Ecuadorian material except that from Portoviejo, and we refer it to *Andinocara rivulatus*. Fresh collections from the coast of Ecuador between the Esmeraldas and the Guayas would be of quite some interest for a more detailed analysis, however. Eigenmann (1922: pl. 30 fig. 3, pl. 33 fig. 2) provided two illustrations of *A. rivulatus*. One, a drawing shows a large male with prominent nuchal hump 202 mm TL from Chone (Eigenmann, 1922: pl. 30 fig. 3) and the other, a retouched photograph, shows a very large specimen, tentatively a female, 175 mm TL, from Naranjito.

Chirichigno (1963) reported two specimens of *A. rivulatus* from the Quebrada Casitas far upstream in the río Túmbes drainage, and illustrated one of them.

Comparative morphometry

Andinoacara rivulatus and *A. blombergi* differ only slightly in body shape. Caudal peduncle length and snout length provide most of the variability in the PCA (Fig. 11c–d; Table 3), although both are highly variable within species and instead head and interorbital width may be more diagnostic, wider in *A. rivulatus* than in *A. blombergi* at larger sizes (Tables 1–2). In the PCA there is some overlap, especially some small males of *A. rivulatus* from the río Túmbes clustering with *A. blombergi*. Sexual dimorphism was not detected in proportional measurements except that in *A. blombergi* the pelvic fin is usually slightly longer in males than in females of comparable size, and in *A. rivulatus* between about 80 and 100 mm, females may have longer pelvic fins than males. The longer pelvic fins in *A. rivulatus* females may relate to allometric growth. These females are near maximum size for females and may be older than similar sized males, which have not yet developed the slight elongations characterizing large males of the species (cf. Fig. 10).

Andinoacara rivulatus is a very variable species in overall shape, usually moderately slender, but may also be relatively elongate or, as expressed in large males, quite deep-bodied. Figures 6–10 give some idea of the variability. Nonetheless, *A. blombergi* tends to be consistently more elongate (body depth 36–44 % of SL vs. 39–51 % in *A. rivulatus*). The sample of *A. blombergi* may be too small to fully express the variation in body depth in *A. blombergi*. The relatively elongate body of *A. blombergi* is, however, reflected also in meristics, especially the scale count (25 vs. 24 scales in the E1 row) and the vertebral count with modally 27 vertebrae in *A. blombergi*, and modally 26 in *A. rivulatus*. The vertebral count in *A. blombergi* is unusual for a cichlasomatin cichlid, with a high frequency of 12–13 abdominal and 15 caudal vertebrae. Cichlasomatin cichlids usually have 13+13 vertebrae and variation is mainly in the reduction of the caudal number (Kullander, 1998).

The samples of *A. rivulatus* from the Zarumilla and the Túmbes drainages conform to material from the Guayas drainage in body proportions and meristics. Some slender males appearing starved or stunted in the Túmbes material overlap into *A. blombergi* in the PCA analysis, demonstrating the limits of diagnosability of characters influenced by ecological and physiological conditions. Even so, the Zarumilla and Túmbes samples tend to be intermediate between the Guayas and Esmeraldas samples in the PCA (Fig. 11c–d), and an expanded analysis of the Túmbes and Zarumilla samples may be called for. We cannot find any morphometric or meristics diagnostic character to separate the Túmbes and/or Zarumilla samples from the Guayas material. Both the Zarumilla and the Túmbes empty in the Golfo de Guayaquil as does the río Guayas, and it seems reasonable to expect some movement of fishes between the three rivers. Nevertheless,

Table 3. Variable loadings on principal components 1–3 and sheared components 2–3 from pooled morphological dataset of *Andinoacara blombergi* and *A. rivulatus*, specimens of SL > 40 mm (N = 69). Highest loadings in bold.

	I	II	Sheared II	III	Sheared III
SL	0.244	–0.205	–0.185	0.107	0.104
Head length	0.249	–0.091	–0.072	–0.101	–0.105
Snout length	0.287	**–0.463**	**–0.439**	**–0.556**	**–0.561**
Body depth	0.312	0.136	0.158	0.014	0.010
Orbital diameter	0.209	0.095	0.111	–0.053	–0.056
Head width	0.303	0.185	0.207	0.028	0.023
Interorbital width	0.378	0.328	0.355	0.298	0.292
Preorbital depth	0.361	–0.125	–0.097	–0.316	–0.322
Caudal-peduncle depth	0.298	0.107	0.128	0.041	0.037
Caudal-peduncle length	0.180	**–0.691**	**–0.674**	**0.577**	**0.574**
Pectoral-fin length	0.292	0.146	0.167	0.327	0.323
Last dorsal-fin spine length	0.288	0.201	0.222	–0.187	–0.191
Eigenvalue	0.857	0.024	NA	0.007	NA
Cumulative Variance %	95.10 %	97.70 %	NA	98.50 %	NA

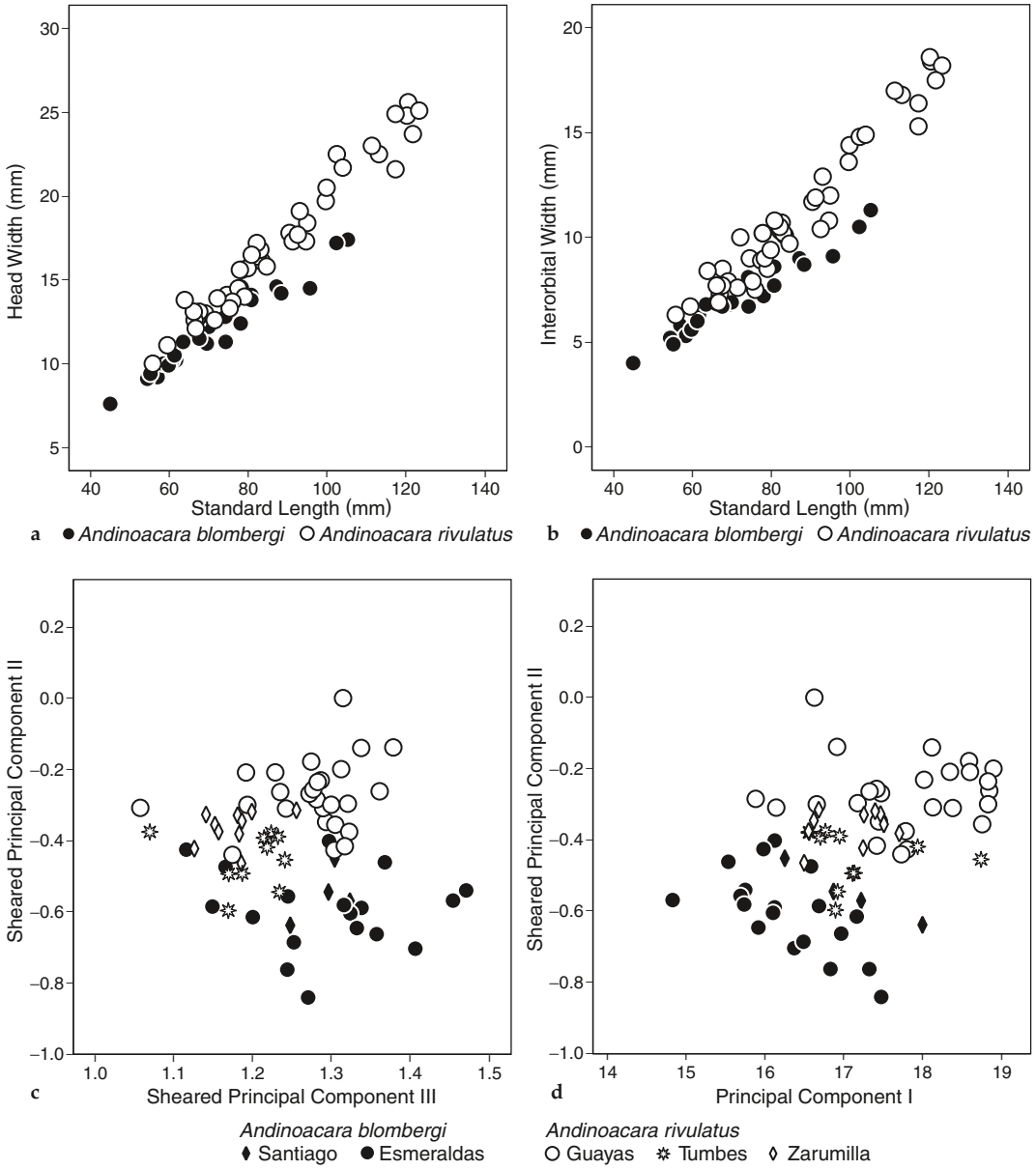

Fig. 11. Morphometric comparisons of *Andinoacara blombergi* and *A. rivulatus*. **a,** head width plotted against Standard Length showing slightly wider head in *A. rivulatus*; **b,** interorbital width plotted against standard length showing slightly wider interorbital space in *A. rivulatus*; **c,** plot of scores of sheared principal component II against sheared principal component III; **d,** plot of scores of sheared principal component II against principal component III.

whereas in Guayas and Túmbes rivers there is sexual dimorphism in the presence of a dark blotch at the angle of the preopercle, the blotch is present in both sexes in the Zarumilla sample although it may be more strongly expressed in females. Another colour character that may set the Zarumilla sample apart is the absence of small dark spots in the caudal fin, although the presence is variable from a few scattered spots to numerous spots in Guayas and Túmbes specimens. A note-

worthy characteristic of the Túmbes and Zarumilla specimens is the frequent loss of the posterior supraneural bone, in about 50 % of the specimens. With exception of the genera *Nannacara* Regan, 1905 and *Ivanacara* Römer & Han, 2007 all cichlasomatin cichlid species have invariably two supraneural bones, contrasting with the majority of cichlids which have one only (Kullander, 1998).

Discussion

Andinoacara blombergi and *A. rivulatus* differ from *A. stalsbergi* in Peru above all in colour pattern. In the diagnosis of *A. stalsbergi*, Musilová et al. (2009b) specifically mentioned two colour character states which they explained further on in their discussion: "(1) a conspicuous white margin in both the dorsal and caudal fin [vs. a broad orange margin in *A. rivulatus*] and (2) on the body sides scales with light centres and contrasting dark marginal lines forming a fine reticulate pattern [vs. light scale edges and dark scale centres forming a pattern of horizontal lines in *A. rivulatus*]." This diagnosis applies only to living specimens, however, and particularly adult males. In preserved specimens, the caudal fin is margined with white in both species, although in *A. rivulatus* the submarginal pigmentation appearing dark in preserved specimens can be orange or red (cf. figure in Stawikowski & Werner, 1998: 214) in living specimens. This submarginal pigmentation is absent in *A. stalsbergi*. Interestingly Stawikowski & Werner (1998: 213) illustrate a living aquarium specimen of Andinoacara from the Esmeraldas drainage with a fine white margin to the caudal fin, and no red submarginal pigmentation; according to those authors and literature cited by them, specimens with orange and white caudal-fin margin are syntopic in both the Esmeraldas and the Guayas drainages.

The ground colour pattern is indeed reciprocally inverse in *A. rivulatus* + *A. blombergi* and *A. stalsbergi*. However, preserved and living specimens differ and the diagnosis in Musilová et al. (2009b) applies only to living specimens: In preserved young and female specimens of *A. blombergi* and *A. rivulatus* there is no pronounced patterning of the scales, although a faint dark spot can be discerned on each scale, forming a pattern of narrow horizontal rows of spots along the side. In preserved *A. stalsbergi*, there is a pattern of dark scale centres (often with a lighter centre within) surrounded by light scale margins, more pronounced in adults. In large living male of *A. rivulatus* (and probably *A. blombergi*), however, the dark scale margins are composed of iridescent ice-blue, and the scale centres (or bases of exposed scale part) are brownish (cf. figure in Stawikowski & Werner, 1998: 214). In living *A. stalsbergi* scale centres are light and scale margins are dark (cf. photo in Stawikowski & Werner, 1998: 216).

The *Andinoacara rivulatus* species group is endemic to the Pacific coast rivers of Peru and Ecuador, with records ranging from north-western Ecuador in the Esmeraldas province to río Pisco south of Lima, Peru. Records from the río Santa southward have been suggested to be the result of introductions, however (Koepcke, 1961). Remaining species of *Andinoacara* occur from the río Santiago north along the Colombian coast to Panama, and then along the Caribbean coast to Trinidad, W.I., but with one species in the Orinoco basin (pers. obs.). This distribution partly overlaps with the curimatid genus *Pseudocurimata* which is endemic to Pacific coastal rivers from the Piura and Chira rivers in Peru north to the San Juan and Atrato rivers in Colombia (Vari, 1989). Specifically, the allopatric distribution of *A. blombergi* and *A. rivulata* as similar to that of *P. boehlkei* (río Esmeraldas and, questionably, río Santiago), and *P. troschelii* (Guayas, Túmbes and Zarumilla), respectively (cf. Vari, 1989). *Pseudocurimata boulengeri* occurs only in the Guayas basin (Vari, 1989).

Published DNA sequences for species of *Andinoacara* are mostly from aquarium sources, and represent two species. *Andinoacara rivulatus* in López-Fernandez et al. (2010) and Musilová et al. (2008) probably represent *A. rivulatus*, which is the common species in the aquarium trade. Musilová et al. list two specimens, one with locality río Guayas at Guayaquil and give the same GenBank number for the cytochrome *b* sequence of both. In GenBank there is no cytochrome *b* sequence for the Guayas sample, however. *Andinoacara* sp. Silbersaum (Peru) in Musilová et al. (2009a) probably represents *A. stalsbergi*, which is the Peruvian species that has been exported as aquarium fish. *Andinoacara stalsbergi* and *A. rivulatus* come out as sister taxa in the tree of Musilová et al. (2009b), based on eight genes. McCafferty et al. (2012) presented a phylogeographic study of *A. coeruleopunctatus* based on the mitochon-

drial gene ATP6/8. They used *A. rivulatus* as outgroup, but were apparently unaware of *A. stalsbergi*. In their tree, a specimen from río Túmbes *(A. rivulatus)* is sister group to specimens from the Peruvian rivers Jequetepeque, Cañete and Santa (= *A. stalsbergi*).

One additional species of *Andinoacara* is described from Ecuador, viz. *A.sapayensis* from the río Sapayo in the upper río Santiago drainage (Regan, 1903). This species has the characteristic large median predorsal scales as in species of *Andinoacara* from the Colombian and Venezuelan coasts. We could only examine the holotype, in a very bad state of preservation, the specimen from río Telembi figured by Eigenmann (1922: pl. 31, fig. 1), a specimen from the río Bogotá (BMNH 1902.5.27.43) and one from Carondelet (BMNH 1908.5.29.154). The Carondelet and río Bogotá specimens were identified by Regan (1905) as *Acara coeruleopunctata*. These specimens have only 24 scales in the E1 row. Except for BMNH 1908.5.29.154 the specimens of *A. sapayensis* have very indistinct colour pattern, and the midlateral blotch is absent or difficult to make out. These may be preservation effects, as other old *Andinoacara* (cf. Figs. 5–6) also do not display the midlateral blotch well. On the other hand, the holotype shows distinctly the dark stripes and spots on the side of the head that are characteristic of *Andinoacara*. The Telembi specimen is faded and shows almost no colour pattern at all, but it may be irrelevant as this locality is in Colombia in the río Patia basin. There is a place named Telembi in the Santiago basin in Ecuador, but Eigenmann (1922) clearly places his locality in the río Patia basin. All three specimens from the Santiago drainage differ significantly from *A. blombergi* in wider head (19.3–20.4 % SL, vs. 15.2–17.8) and wider interorbital space (13.2–13.6 % SL vs. 8.9–10.9). *Andinocara sapayensis* differs in colour pattern from *A. blombergi* and *A. rivulatus* in that the vertical bars are narrower, and bars 4 and 5 remain separate whereas in *A. blombergi* and *A. rivulatus* they are merged. This is also how it is shown on Eigenmann's (1922) drawing. Musilová et al. (2009b) presented DNA sequences for a specimen from the aquarium trade identified as *A. sapayensis* but their comparison with *A. stalsbergi* is based on Regan (1905) and Eigenmann (1922). *Andinoacara sapayensis* is apparently a distinct species in tributaries of the río Santiago representing the *A. pulcher* species group, but available specimens do not permit a full redescription of the taxon.

Musilová et al. (2009b) referred the Colombian species *Andinoacara biseriatus* to a clade including *A. sapayensis*, *A. stalsbergi*, and *A. rivulatus*, a position supported also by the analysis in McCafferty et al. (2012). The colour pattern with numerous dark dots on the scales shows some similarity to the more southern species, so this placement, already suggested by Stawikowski & Werner (1998: 218), is adopted here. *Andinoacara biseriatus* differs from all the more southern species of the genus, however, by the count of only 22 scales in the E1 row (vs. 24–25), only 2 rows of scales on the cheek (vs. 3–4), and less gill-rakers (5–6 vs. 8 or more).

Comparative material. *Andinoacara biseriatus*: NRM 12885, 15, 50.0–92.2 mm SL; Colombia: río Baudó; S. O. Kullander & A. M. C. Silfvergrip, 22–26 Feb 1989. *Andinoacara sapayensis*: BMNH 1902.5.27.43, 1, 102.9 mm SL; Ecuador: río Bogotá; W. F. H. Rosenberg, no date. – BMNH 1902.7.29.56, 1, 83.7 mm SL; Ecuador: río Sapayo. W. F. H. Rosenberg, no date; holotype of *Acara sapayensis*. – BMNH 1908.5.29.154, 1, 76.4 mm SL; Ecuador: Carondelet. W. F. H. Rosenberg, no date. *Andinoacara* cf. *sapayensis*: CAS 66931, 1, 84.2 mm SL, Colombia: río Telembi. A. Henn & C. Wilson, 17 Jan 1913.

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