

# *Corydoras fulleri* (Siluriformes: Callichthyidae), a new catfish species from the rio Madeira basin, Peru

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## Abstract

A new long-snouted *Corydoras* species is described from two tributaries of the rio Manuripe and a tributary of the rio Madre de Dios, rio Madeira basin, Peru. *Corydoras fulleri* can be distinguished from its congeners by having the following features: (a) branch of the temporal sensory canal at sphenotic, which gives rise to the supraorbital canal, with two pores; (b) upper tooth plate of branchial arch with three series of teeth; (c) area at the corner of the mouth, ventral to the maxillary barbel, with a small fleshy flap; (d) two moderate-sized dark-brown or black blotches on caudal-fin base, one on its lateral portion and another one on its dorsal portion, blotches variably diffuse and/or fused with each other; (e) absence of a dark-brown or black stripe transversally crossing the orbit; (f) a longitudinal dark-brown or black stripe on the postdorsal region of flank midline, variably fused with the lateral peduncular blotch, some specimens with slender, longitudinally elongated, dark-brown or black blotch on flank midline, forming a dash-like marking, stripe or dash-like blotch diffuse in some specimens; and (g) region around dorsal-fin origin generally lacking dark brown or black blotch, or displaying diffuse blotch.

## KEYWORDS

Corydoradinae, *Corydoras acutus*, lineage 1, rio Beni basin, taxonomy

## 1 | INTRODUCTION

The Callichthyidae are armoured catfishes that can be promptly recognized among other Siluriformes by having two longitudinal series of dermal plates on their flanks (Reis, 1998, 2003). The family is currently comprised of more than 200 species which are grouped into eight genera, including *Corydoras* Lacépède, 1803, with 175 valid species, which makes it the most species-rich genus of the family and also of Siluriformes (Lima & Britto, 2020; Tencatt *et al.*, 2019). Comprehensive studies attempting to understand the taxonomy and phylogenetic relationships of the species within *Corydoras* have been made (*e.g.*, Alexandrou *et al.*, 2011; Britto, 2003; Eigenmann & Eigenmann, 1890; Ellis, 1913; Gosline, 1940; Nijssen, 1970; Nijssen & Isbrücker, 1967,

1980a, 1983a, 1986). However, their taxonomy and phylogeny are still poorly known (Britto *et al.*, 2007; Tencatt & Ohara, 2016a).

Despite the wide geographic distribution of *Corydoras* in cis-andean South America, its representatives predominantly occur in the Amazon basin, in which more than the half of the known species can be found (Tencatt & Ohara, 2016b). The rio Madeira basin, which flows into the rio Amazonas, is the world's richest drainage regarding the number of fish species (Jézéquel *et al.*, 2020; Torrente-Vilara *et al.*, 2013), and currently harbours 44 species of *Corydoras*, representing one quarter of the total species of the genus (Ohara *et al.*, 2016; Tencatt & Evers, 2016; Tencatt & Ohara, 2016a, 2016b). As discussed in Tencatt and Evers (2016), the Corydoradinae are extremely popular in the aquarium hobby, which leads to the capture

and discovery of many putative new species within the trade. Therefore, to prevent the creation of *nomina nuda* by using trade names, the C-number code-system was created, which was posteriorly replaced by CW-number coding (Evers, 1993; and see *Corydoras* World website). Among the coded species recorded for the rio Madeira basin, there are two morphotypes, *Corydoras* sp. C115 and C116, which can be distinguished from each other by the presence of a large, rounded, black patch on anterior portion of flank in C116, which is absent in C115. Despite these morphotypes have been initially considered as two distinct species, their captive breeding suggested that they are a single species with variable colour pattern. The analysis of material from the Manuripe and Madre de Dios river basins in Peru revealed the presence of specimens fitting *Corydoras* sp. C115/C116 morphological and colour patterns, and allowed its confirmation as an undescribed species, which is formally described herein.

## 2 | MATERIALS AND METHODS

### 2.1 | Morphological analysis

Measurements were obtained using digital callipers to the nearest tenth of millimetre. Morphometric and meristic data were taken following Reis (1997) with the modifications of Tencatt *et al.* (2013). Morphometrics are reported as proportion of standard length ( $L_S$ ) or as proportions of head length ( $L_H$ ). Terminology of barbels follows Britto and Lima (2003). For the osteological analysis, some specimens were cleared and stained (c&s) according to the protocol of Taylor and Van Dyke (1985). Osteological terminology was based on Reis (1998), with the exception of parieto-supraoccipital instead of supraoccipital (Arratia & Gayet, 1995), pterotic-extrascapular instead of pterotic-supracleithrum (Slobodian & Pastana, 2018), and scapulocoracoid instead of coracoid (Lundberg, 1970). Nomenclature of the latero-sensory canals and preopercular pores are according to Schaefer and Aquino (2000) and Schaefer (1988), respectively. The supra-preopercle *sensu* Huysentruyt and Adriaens (2005) was treated here as a part of the hyomandibula according to Vera-Alcaraz (2013). Vertebral counts include only free centra, with the compound caudal centrum (preural 1 + ural 1) counted as a single element. The last two dorsal-fin rays were counted as distinct elements. Pharyngeal teeth were counted in both sides of the branchial arches. Terminology regarding initial development follows Nakatani *et al.* (2001); the size of specimens in initial development is exceptionally expressed in total length ( $L_T$ ). In the description, numbers in parentheses represent the total number of specimens with those counts. Numbers with an asterisk refer to the counts of the holotype. Literature that may refer to the new species described herein, but from which it was not possible to corroborate its identification through voucher specimens, drawings or photographs were not included in the synonymic list.

Institutional abbreviations follow Sabaj (2019).

### 2.2 | Ethical statement

This study dealt only with previously preserved specimens in natural history collections, and therefore no specific permits were necessary.

## 3 | RESULTS

### 3.1 | *Corydoras fulleri*, new species

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*Corydoras* sp. C115: Fuller & Evers, 2005: p. 336 (photo in life; species catalogue). Alexandrou *et al.*, 2011 (supplementary information), p. 3, suppl. fig. 2 (phylogeny; member of the lineage 1).

*Corydoras* sp. C116: Fuller & Evers, 2005: p. 337 (photo in life; species catalogue).

### 3.2 | Holotype

MUSM 69317, 55.1 mm  $L_S$ , Peru, Madre de Dios, Tambopata, Las Piedras, stream tributary of the upper río Manuripe (or Manuripi), locally known as “Alegria”, a tributary of the río Orthon, rio Madeira basin, 12°06′02″S 69°03′28″W, H.G. Evers *et al.*, 24 Jun 2015.

### 3.3 | Paratypes

All from Peru, Madre de Dios, Tambopata, Las Piedras, río Manuripe basin, rio Madeira basin. MNRJ 52508, 4, 38.2–52.5 mm  $L_S$ , 2 c&s, 42.9–44.3 mm  $L_S$ , I. Fuller *et al.*, 12 Nov 2019; NUP 22727, 6, 41.6–53.7 mm  $L_S$ , H.G. Evers *et al.*, 19 Sep 2016; ZUFMS 6487, 27, 13.1–46.0 mm  $L_S$ , 1 c&s 46.0 mm  $L_S$ , H.G. Evers *et al.*, 24 Jun 2015; stream tributary of the río Manuripe, locally known as “Cheese Creek”, 12°11′22″S, 69°06′57″W. MZUSP 125828, 5, 21.5–51.2 mm  $L_S$ , same locality as holotype, H.G. Evers *et al.*, 29 Sep 2016.

### 3.4 | Diagnosis

*Corydoras fulleri* can be distinguished from its congeners, except for the species within lineage 1 *sensu* Alexandrou *et al.* 2011, by the presence of the following features: branch of the temporal sensory canal at sphenotic, which gives rise to the supraorbital canal, with two pores (*vs.* one pore); upper tooth plate of branchial arch with three series of teeth (*vs.* two series); and area at the corner of the mouth, ventral to the maxillary barbel, with a small fleshy flap (*vs.* fleshy flap absent); from the lineage 1 species, except for *C. areio* Knaack, 2000, *C. aurofrenatus* Eigenmann & Kennedy, 1903, *C. cortesi* Castro, 1987, *C. desana* Lima & Sazima, 2017, *C. filamentosus* Nijssen & Isbrücker, 1983b, *C. geoffroy* Lacépède, 1803, *C. negro* Knaack, 2004, *C. pastazensis* Weitzman, 1963, *C. saramaccensis* Nijssen, 1970, *C. sararensis* Dinkelmeyer, 1995, *C. septentrionalis*

Gosline, 1940, and *C. simulatus* Weitzman & Nijssen, 1970, by having two moderate-sized dark-brown or black blotches on caudal-fin base, one on its lateral portion and another one on its dorsal portion; blotches variably diffuse and/or fused with each other (vs. absence of such pattern); from *C. cortesi*, *C. desana*, *C. pastazensis*, *C. septentrionalis* and *C. simulatus* it differs by the absence of a dark-brown or black stripe transversally crossing the orbit (vs. presence of such stripe, forming the typical mask-like blotch); from *C. areio*, *C. aurofrenatus*, *C. geoffroy*, *C. negro*, *C. saramaccensis* and *C. sarareensis* it can be distinguished by having a longitudinal dark-brown or black stripe on postdorsal portion of flank midline, variably fused with the lateral peduncular blotch; some specimens with slender, longitudinally elongated, dark-brown or black blotch on flank midline, forming a dash-like marking; stripe or dash-like blotch diffuse in some specimens (vs. midline of flank lacking longitudinal, dark-brown or black stripes and/or dash-like marking); from *C. filamentosus* plus *C. pastazensis*, and *C. saramaccensis* by having region around dorsal-fin anterior origin generally lacking dark-brown or black blotch; blotch, when present, diffuse (vs. region around dorsal-fin anterior origin with conspicuous dark-brown or black blotch).

### 3.5 | Description

Morphometric data presented in Table 1. Head compressed with acutely convex dorsal profile; roughly triangular in dorsal view. Snout

well developed and conical; conspicuously pointed. Head profile slightly concave from tip of snout to anterior nares; nearly straight to smoothly convex in some specimens; ascending slightly convex from this point to dorsal-fin origin. Profile slightly convex along dorsal-fin base. Postdorsal-fin body profile slightly concave to adipose-fin spine; concave from this point to caudal-fin base. Ventral profile of body nearly straight from isthmus to pectoral-fin origin; slightly convex from this point to pelvic-fin origin; nearly straight from this point to base of first anal-fin ray; abruptly concave until caudal-fin base. Body roughly elliptical in cross-section at pectoral girdle, gradually becoming more compressed towards caudal fin. Greatest body depth at vertical through dorsal-fin anterior origin.

Eye rounded, located dorso-laterally on head; orbit delimited anteriorly by lateral ethmoid, anterodorsally by frontal, posterodorsally by sphenotic, posteroventrally by infraorbital 2 and anteroventrally by infraorbital 1. Anterior and posterior nares close to each other, only separated by flap of skin. Anterior naris tubular. Posterior naris close to anterodorsal margin of orbit, separated from it by distance nearly equal to naris diameter. Mouth small, subterminal, width slightly smaller than bony orbit diameter. Maxillary barbel well developed, slightly surpassing anteroventral limit of gill opening. Outer mental barbel slightly larger than maxillary barbel. Maxillary and outer mental barbels strongly reduced in some specimens, apparently damaged. Inner mental barbel fleshy, with base close to its counterpart. Area at mouth corner, ventral to maxillary barbel, with small

**TABLE 1** Morphometric data of the holotype and 19 paratypes of *Corydoras fulleri*

	Holotype	Low-high	Mean $\pm$ s.d.
Standard length (mm)	55.1	28.7–55.1	41.2 $\pm$ 8.0
Percentage of $L_S$			
Depth of body	36.3	34.1–38.7	35.9 $\pm$ 1.2
Predorsal distance	52.1	50.3–56.0	52.9 $\pm$ 1.4
Prepelvic distance	49.5	45.4–52.2	49.0 $\pm$ 1.7
Preanal distance	82.6	79.7–85.2	81.9 $\pm$ 1.5
Preadipose distance	84.9	82.8–87.0	85.5 $\pm$ 1.0
Length of dorsal spine	21.8	17.9–23.5	20.6 $\pm$ 1.6
Length of pectoral spine	21.6	19.5–25.6	22.1 $\pm$ 1.8
Length of adipose-fin spine	10.0	8.3–11.7	10.4 $\pm$ 0.8
Depth of caudal peduncle	13.4	13.1–16.6	14.3 $\pm$ 0.8
Length of dorsal-fin base	19.6	17.5–21.7	19.7 $\pm$ 1.0
Dorsal to adipose distance	18.9	15.8–19.9	18.2 $\pm$ 1.1
Maximum cleithral width	23.4	22.3–25.7	24.0 $\pm$ 1.0
Head length	43.9	43.1–48.1	45.7 $\pm$ 1.4
Length of maxillary barbel	19.6	8.1–21.4	16.5 $\pm$ 4.6
Percentage of $L_H$			
Head depth	77.3	68.7–79.3	72.9 $\pm$ 2.9
Least interorbital distance	22.3	20.2–24.2	22.4 $\pm$ 1.1
Horizontal orbit diameter	18.2	18.2–26.2	21.3 $\pm$ 2.3
Snout length	49.2	44.4–50.7	47.5 $\pm$ 1.9
Least internarial distance	13.6	9.6–14.0	11.5 $\pm$ 1.3

fleshy flap. Small rounded papillae covering entire surface of all barbels, upper and lower lips, snout and isthmus.

Mesethmoid long; anterior tip well developed, larger than 50% of the bone length (see Britto, 2003: 123, character 1, state 0; Figure 1a); posterior portion relatively narrow, entirely covered by thick layer of skin. Nasal slender, curved laterally, inner margin with moderately developed laminar expansion; outer margin with reduced laminar expansion; mesial border generally contacting only frontal. Frontal elongated, narrow, with width smaller than half of entire length; anterior projection relatively long, larger than nasal length. Frontal fontanel large, conspicuously slender; posterior tip markedly surpassing anterior margin of parieto-supraoccipital. Sphenotic somewhat trapezoid in shape, contacting parieto-supraoccipital dorsally, pterotic-extrascapular posteriorly, second infraorbital ventrally and frontal anteriorly. Pterotic-extrascapular roughly pipe-shaped, with posteriormost portion contacting first lateral-line ossicle, posteroventral margin contacting cleithrum and anteroventral margin contacting opercle and infraorbital 2. Parieto-supraoccipital wide, posterior process long and contacting nuchal plate; region of contact between posterior process and nuchal plate covered by thick layer of skin.

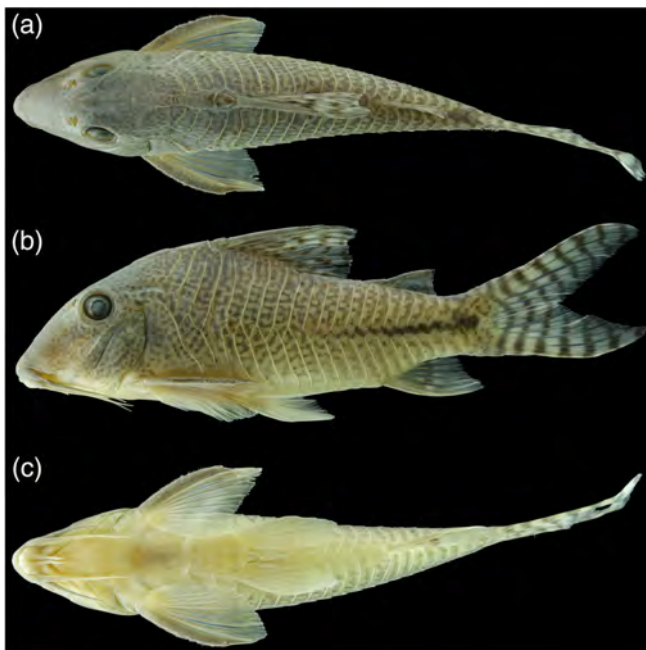
Two laminar infraorbitals with minute odontodes; infraorbital 1 large, ventral laminar expansion ranging from moderately to well developed; anterior portion with laminar expansion ranging from moderately to strongly well developed; inner laminar expansion strongly reduced (Figure 2a); infraorbital 2 small, widened; with posterior laminar expansion moderately to well developed; inner laminar expansion strongly reduced; posteroventral margin contacting posterodorsal

ridge of hyomandibula, posterodorsal edge contacting sphenotic and pterotic-extrascapular (Figure 2a). Posterodorsal ridge of hyomandibula close to its articulation with opercle slender and exposed; dorsal ridge of hyomandibula between pterotic-extrascapular and opercle covered by posterodorsal edge of infraorbital 2; exposed areas bearing small odontodes. Interopercle partially exposed; anterior portion covered by thick skin layer; roughly triangular, anterior projection well developed. Preopercle elongated, relatively slender; minute odontodes sparse on external surface. Opercle elongated dorso-ventrally, width slightly smaller than half of its length; free margin convex; posterodorsal region with smoothly concave area; without serrations and covered by small odontodes.

Four branchiostegal rays, decreasing in size posteriorly. Hypobranchial 1 deep; hypobranchial 2 somewhat triangular, tip ossified and directed towards anterior portion, posterior margin cartilaginous; ossified portion well developed, about twice size of cartilaginous portion. Five ceratobranchials with expansions increasing posteriorly; ceratobranchial 1 with strongly reduced process on anterior margin of mesial portion; ceratobranchial 3 with continuous laminar expansion on postero-lateral margin; ceratobranchial 5 toothed on postero-dorsal surface, 24 to 29 (2) teeth aligned in one row. Four epibranchials with similar size; epibranchial 2 slightly larger than others, with small pointed process on laminar expansion of posterior margin; epibranchial 3 with roughly triangular uncinat process on laminar expansion of posterior margin. Two wide pharyngobranchials (3 and 4), pharyngobranchial 3 with triangular laminar expansion on posterior margin; expansion generally notched. Upper tooth plate roughly oval; 37 to 53 (2) teeth aligned in three rows on postero-ventral surface.

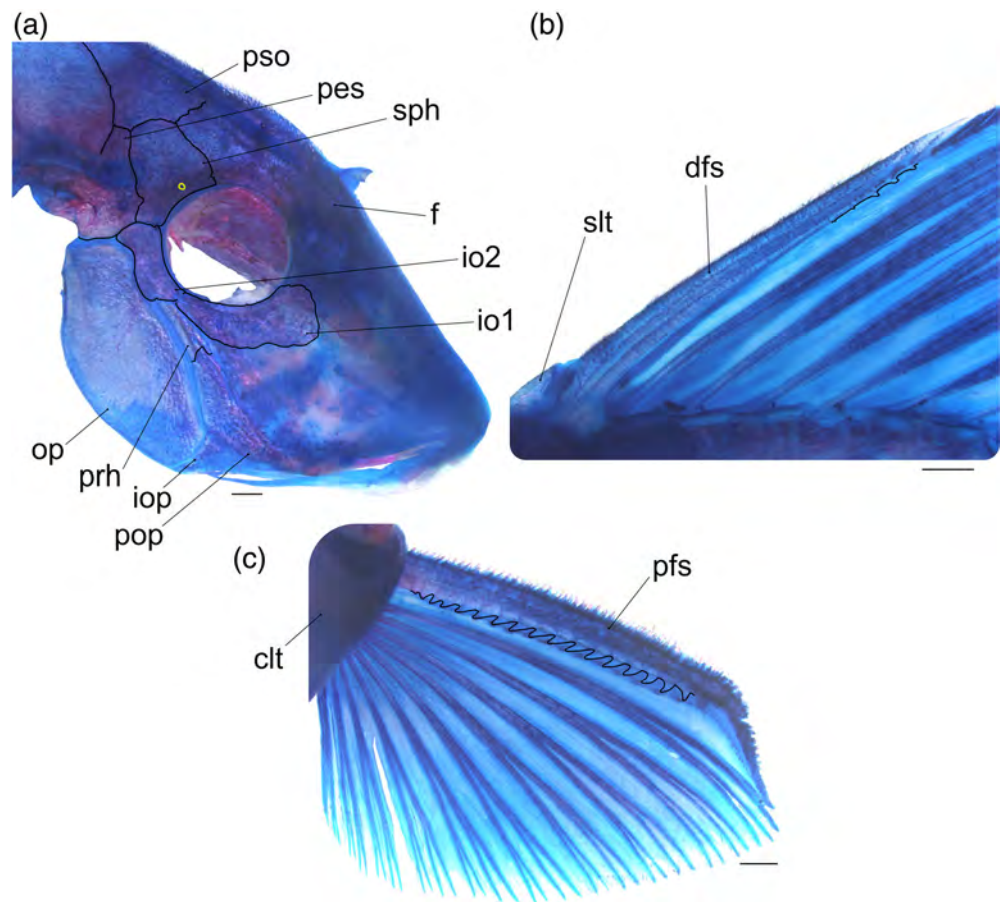
Lateral-line canal reaching cephalic laterosensory system through pterotic-extrascapular, branching twice before entering sphenotic: pterotic branch, with single pore; preoperculo-mandibular branch conspicuously reduced, with single pore opening close to postotic main canal; postotic main canal becoming widened just posterior to pterotic branch. Sensory canal continuing through pterotic-extrascapular, reaching sphenotic as temporal canal, which splits into two branches: one branch giving rise to infraorbital canal, other branch connecting to frontal through supraorbital canal, with one and two pores, respectively. Supraorbital canal branched, running through nasal bone. Epiphyseal branch relatively long; pore opening close to frontal fontanel. Nasal canal with three openings, first on posterior edge, second on posterolateral portion, generally fused with first pore, and third on anterior edge. Infraorbital canal running through entire infraorbital 2, extending to infraorbital 1 and generally opening into two pores. Preoperculo-mandibular branch giving rise to preoperculo-mandibular canal, which runs through entire preopercle with three openings, leading to pores 3, 4 and 5, respectively; pore 3 variably opening at posterodorsal ridge of hyomandibula.

Dorsal fin subtriangular, located just posterior to second or third dorsolateral body plate. Dorsal-fin rays II,8\* (25), II,9 (1), posterior margin of dorsal spine with none to five poorly developed serrations directed towards the tip of the spine; serrations arranged on distal half of posterior margin; anterior margin with small odontodes (Figure 2b).



**FIGURE 1** Holotype of *Corydoras fulleri*, MUSM 69317, 55.1 mm  $L_S$ , Peru, Madre de Dios, Tahuamanu, stream tributary of the upper río Manuripe, locally known as “Alegria”, a tributary of the río Orthon, río Madeira basin. Lateral (a), dorsal (b) and ventral (c) views

**FIGURE 2** Clear-and-stained paratype of *Corydoras fulleri*, ZUFMS 6487, 46.0 mm  $L_S$ , showing (a) lateral view of the head, (b) dorsal fin and (c) pectoral fin. Solid black lines in (a) represent the limits of the bones, whereas in (b) and (c) they represent the margins of the dorsal and pectoral serrations, respectively. Solid yellow line in (a) represents the additional pore at temporal sensory canal. Abbreviations: io1, infraorbital 1; io2, infraorbital 2; iop, interopercle; op, opercle; pes, pterotic-extrascapular; pop, preopercle; prh, posterodorsal ridge of hyomandibula; pso, parieto-supraoccipital; sph, sphenotic. Scale bars = 1.0 mm



Nuchal plate well developed; almost entirely exposed, with minute odontodes; spinelet short; spine moderately developed, adressed distal tip reaching to or slightly surpassing posterior origin of dorsal-fin base; anterior margin with small odontodes. Pectoral fin roughly triangular, its origin just posterior to gill opening. Pectoral-fin rays I,8 (1), I,9 (1), I,10\* (22), I,11 (2); posterior margin of pectoral spine with 16 to 25 conical serrations along almost its entire length; most serrations well-developed and directed towards pectoral-fin origin; serrations close to origin of spine conspicuously less developed; some serrations perpendicularly directed or directed towards tip of spine (Figure 2c). Anteroventral portion of cleithrum exposed; posterolateral portion of scapulocoracoid moderately developed, exposed, with anterior portion poorly expanded anteriorly. Pelvic fin oblong; located just below second or third ventrolateral body plate, and at vertical through first or second branched dorsal-fin ray. Pelvic-fin rays i,4 (1), i,5\* (25). Adipose fin roughly triangular, separated from base of last dorsal-fin ray by generally six dorsolateral body plates. Anal fin subtriangular, located just posterior to 12th or 13th ventrolateral body plates, and at vertical through anterior portion of adipose-fin spine. Anal-fin rays ii,3,i (1), ii,5,i\* (13), ii,6 (12). Caudal fin bilobed; markedly furcated, with dorsal lobe with similar size to or slightly larger than ventral lobe. Caudal-fin rays i,12,i\* (26), generally with four dorsal and ventral procurrent rays.

Four to six laterosensory canals on trunk; first ossicle tubular, second ossicle laminar, third, fourth, fifth and sixth lateral-line canals, if

present, encased in third, fourth, fifth and sixth dorsolateral body plates, respectively. Body plates with minute odontodes scattered over exposed area; conspicuous line of odontodes confined to posterior margins; dorsolateral body plates 23 (11), 24\* (12), 25 (3); ventrolateral body plates 20 (6), 21\* (15), 22 (5); dorsolateral body plates along dorsal-fin base 6 (12), 7\* (14); dorsolateral body plates between adipose- and caudal-fin 7 (6), 8\* (16), 9 (4); preadipose platelets 2 (4), 3\* (17), 4 (4), 5 (1); small platelets covering base of caudal-fin rays; small platelets disposed dorsally and ventrally between junctions of lateral plates on posterior portion of caudal peduncle. Anterior margin of orbit, above region of junction between frontal and lateral ethmoid, ventral and anterodorsal margins of nasal capsule, and lateroventral portion of snout with small platelets bearing odontodes. Ventral surface of head and trunk densely covered by small irregular platelets bearing odontodes.

Vertebral count 22 (2); ribs 5 (2), first pair conspicuously large, its distal tip reaching basiptyergium region; parapophysis of complex vertebra moderately developed.

### 3.6 | Colour in alcohol

Overall colour of body in Figure 1. Ground colour of body pale yellow or beige. Top of head dark brown. Region just above posterodorsal margin of orbit with a nearly straight, horizontally elongated

dark-brown or black blotch, forming eyebrow-like marking; blotch slightly arched, following outline of the orbit in some specimens; diffuse in some specimens. Dorsal surface of snout with conspicuous concentrations of dark-brown or black chromatophores, forming rounded or irregular, generally diffuse, blotches in some specimens; middle portion of snout, along mesethmoid, generally darker. Region bordering eye with conspicuous concentration of dark-brown or black chromatophores. Region between opercle and posterodorsal ridge of hyomandibula, and between opercle and preopercle with conspicuous concentration of dark-brown or black chromatophores. Opercle with conspicuous concentration of dark-brown or black chromatophores, variably forming larger, transversally elongated patches or rounded or irregular smaller blotches. Lateral surface of cleithrum generally with rounded or irregular, dark-brown or black blotches; diffuse blotches in some specimens. Dorsal portion of caudal-fin base with conspicuous concentration of dark-brown or black chromatophores, forming dorsal peduncular blotch; blotch diffuse in some specimens. Region around dorsal-fin end generally with conspicuous concentration of dark-brown or black chromatophores, generally forming conspicuous blotch; blotch diffuse in some specimens. Region around dorsal-fin origin generally lacking dark-brown or black blotch; blotch, when present, diffuse. Dorso- and ventrolateral body plates with relatively small rounded, irregular or elongated dark-brown or black blotches; blotches on ventrolateral body plates generally more conspicuous close to flank midline. Posterior margin of body plates with conspicuous concentration of dark-brown or black chromatophores, forming dark lines in some specimens; dark lines generally more evident along flank midline (forming zigzag pattern), on azygous precaudal and preadipose plates, and on dorsal portion of dorsolateral body plates around dorsal-fin posterior origin. Midline of flank with longitudinal dark-brown or black stripe, typically restricted to postdorsal portion of flank; some specimens with relatively slender, longitudinally elongated, dark-brown or black blotch on flank midline, forming dash-like marking; dash-like blotch restricted to posterior half of flank; stripe or dash-like blotch variably diffuse. Midline of flank on posterior portion of caudal peduncle with conspicuous concentration of dark-brown or black chromatophores, forming generally conspicuous, elliptical (longitudinally elongated), irregularly rounded, or roughly diamond-shaped (vertically elongated) lateral peduncular blotch; diffuse in some specimens; lateral peduncular blotch variably fused to longitudinal stripe or dash-like blotch, and/or to dorsal peduncular blotch. Middle portion of flank below dorsal fin with conspicuous concentration of dark-brown or black chromatophores, forming large, irregular or roughly ovoid patch in some specimens. Middle portion of caudal-fin base with small black dot; diffuse and/or fused with lateral peduncular blotch in some specimens. Dorsal-fin with conspicuous concentrations of dark-brown or black chromatophores, forming irregular spots on rays; spots diffuse in some specimens; chromatophores concentrated along ventral margin of fin, especially between spine and second branched ray, forming irregular blotch in some specimens; anterodorsal quarter of fin with conspicuous concentration of dark-brown or black chromatophores, mainly on membranes, forming larger patches ranging from diffuse to intensely black in some specimens; in

some smaller specimens (measuring less than 30 mm  $L_S$ ), anterodorsal quarter of fin entirely or almost entirely covered by single, large and intensely pigmented patch, which tends to reduce in size and intensity of pigmentation, or completely fade, as specimen grows. Pectoral and pelvic fins with dark-brown or black chromatophores, more numerous and concentrated on spine and soft rays; adipose fin with dark-brown or black chromatophores, generally more numerous and concentrated on spine, region of membrane around spine, and/or posterior portion of membrane. Anal fin with dark-brown or black chromatophores, generally more numerous and concentrated on ventral margin and rays; forming dark, dash-like blotches roughly aligned transversally on middle portion of fin; blotches diffuse in some specimens. Caudal fin with conspicuous concentrations of dark-brown or black chromatophores on rays, forming dark, dash-like blotches roughly aligned transversally in four to eight slender bars; some specimens with diffuse blotches/bars.

### 3.7 | Colour in life

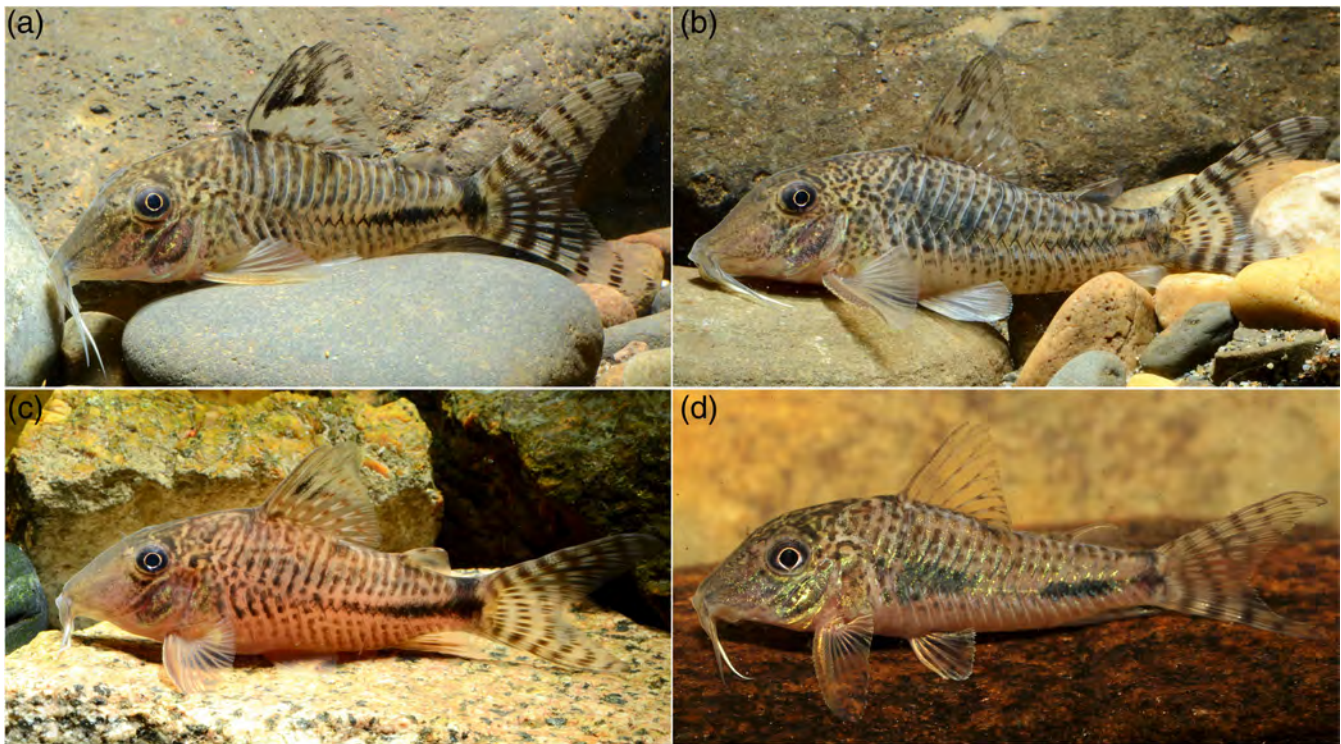
Similar to colour pattern of preserved specimens, but with lighter ground colour of body, and with greenish yellow iridescent colouration. Eyebrow-like blotch and ventral margin of eye generally with more evident colouration (Figure 3).

### 3.8 | Sexual dimorphism

As well-documented in Corydoradinae (see Britto, 2003; Nijssen & Isbrücker, 1980b), male specimens of *C. fulleri* present lanceolate genital papilla. Additionally, the males present a thickened pectoral spine, especially its distal half, which is generally covered by hypertrophied odontodes, and also formation of a segmented filament on the tip of the spine, as illustrated by Nijssen & Isbrücker (1983b: 81, fig. 10g).

### 3.9 | Ontogenetic development

The new species has been bred under aquarium conditions by one of the authors (HGE), who documented its ontogenetic development from 5 to 32 mm  $L_T$ , showing general changes in external morphology and colour pattern (Figure 4). Specimen with 5.0 mm  $L_T$  in final flexion stage (Figure 4a); head slightly depressed, with short and conspicuously rounded snout; barbels relatively short and with well-developed papillae, which will gradually become less developed along individual's growth; eye large; median fin fold present, extending from postcephalic region to genital opening; dorsal- and caudal-fin rays distinct, but fins not detached from fin fold; anal, pelvic and adipose fins not distinct; caudal-fin asymmetrical, dorsal portion distinctly longer than ventral; hypural plates visible by transparency; pectoral fin roughly rounded; body plates absent; dark-brown or black chromatophores more evident on anterior portion of body; oblique dark stripe from anteroventral margin of orbit to upper lip lateral area; midline of trunk



**FIGURE 3** Unpreserved aquarium specimens of *Corydoras fulleri*, showing the variable colour patterns in life of the new species, with (a) a specimen displaying more mottled pattern on flanks, large dark patch on dorsal fin, dash-like blotch not fused to lateral peduncular blotch and conspicuous zigzag pattern on midline of flank; (b) a specimen with more mottled pattern on flanks, small dark patch on dorsal fin, middle portion of flank below dorsal fin with large dark patch, diffuse longitudinal dark stripe fused with diffuse lateral peduncular blotch and conspicuous zigzag pattern on midline of flank; (c) a specimen presenting more mottled pattern on flanks, small dark patch on dorsal fin, longitudinal dark stripe fused with lateral peduncular blotch and slightly less marked zigzag pattern on midline of flank; and (d) a specimen with less mottled pattern on flanks, lacking dark patch on dorsal fin, middle portion of flank below dorsal fin with moderate-sized dark patch, dash-like blotch not fused to lateral peduncular blotch and diffuse zigzag pattern on midline of flank. Specimens (a) and (b) from Quebrada Loboyoc, and (c) from the “Cheese Creek”. Photograph (d) by Markus Kaluza

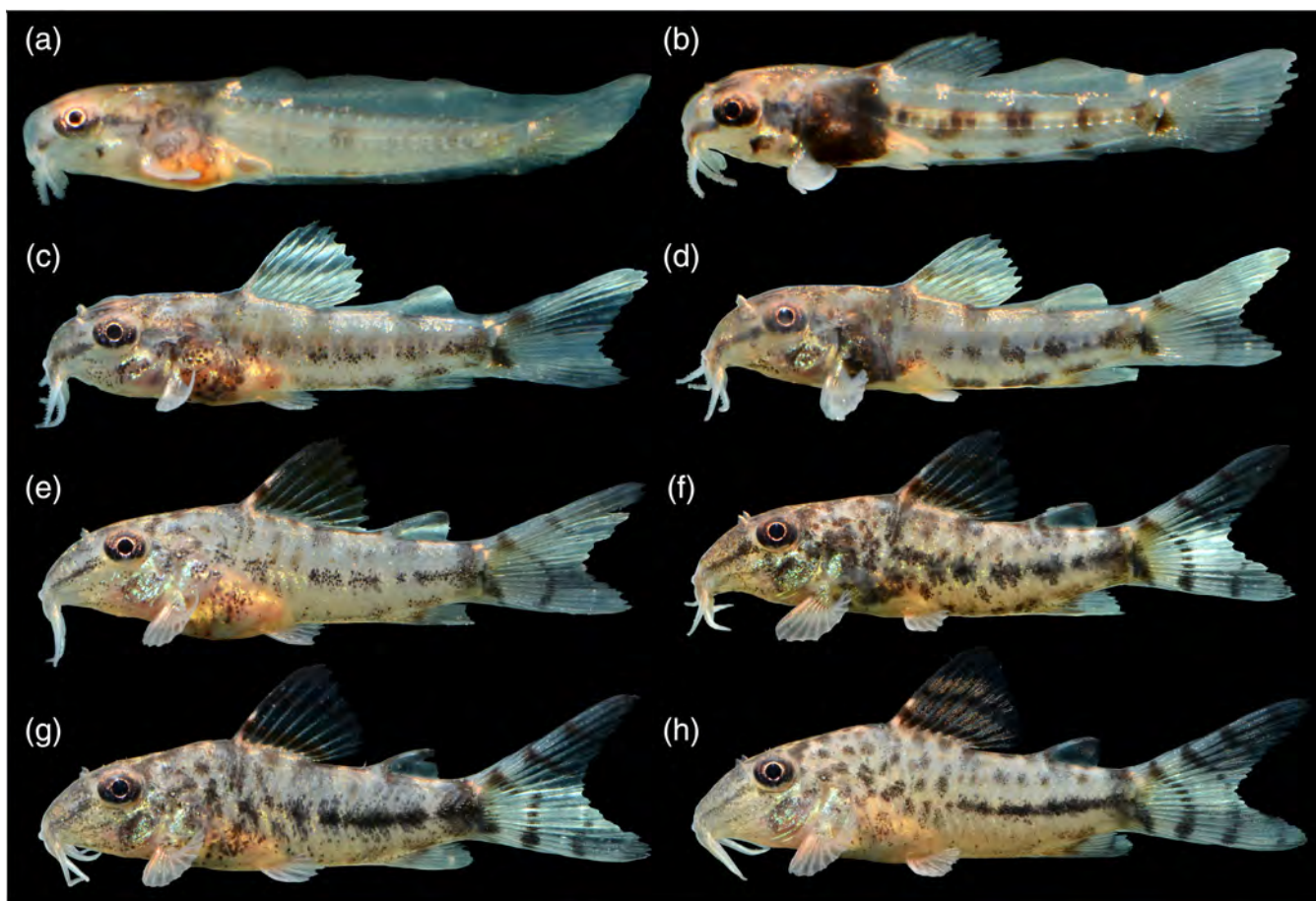
with diffuse moderate-sized dark blotch; body covered by greenish yellow iridescent colouration.

Specimen with 6.0 mm  $L_T$  in early post-flexion stage (Figure 4b) displays reduction of median fold, with dorsal and caudal fins partially distinct; pectoral fin slightly more developed; pelvic- and anal-fin fold partially detached; adipose fin indistinct; more pigmented body, with conspicuous dark blotches on midline and ventral portions of trunk; caudal fin with conspicuous concentration of dark-brown or black chromatophores; distinct dark blotch on caudal peduncle. Specimen with 8.0 mm  $L_T$  in final post-flexion stage (Figure 4c), with slightly more pronounced snout; median fold conspicuously retreated, with dorsal and caudal fins distinct; pelvic and anal fins clearly developed; adipose fin partially distinct, its spine partially formed; beginning of formation of lateral body plates; body slightly more pigmented, with conspicuous concentration of dark-brown or black chromatophores on dorsal and anal fins. Specimen with 12.0 mm  $L_T$  in early juvenile stage (Figure 4d) with snout slightly more pronounced and pointed, gradually becoming more pointed along individual's growth; median fold absorbed, with distinct adipose fin; body slightly more pigmented, with conspicuous concentration of dark-brown or black chromatophores on adipose fin; caudal fin with somewhat transversal slender dark bars.

Juvenile specimens from 18.0 to 26.0 mm  $L_T$  (Figure 4e–g) are strongly similar to each other, except for gradual development of lateral body plates and fin spines; presence of roughly longitudinal dark stripes on dorsal fin and roughly transversal dark bars on caudal fin; anal fin also gradually more pigmented; dorsal and lateral peduncular blotches similar to observed in adult specimens. Juvenile specimen with 32.0 mm  $L_T$  (Figure 4h) similar to adult specimens in general morphology and colour pattern, but with body plates not fully covering flanks.

### 3.10 | Distribution

*C. fulleri* is currently known only from two tributaries of the río Manuripe, itself a tributary of the río Orthon, and from a tributary of the río Madre de Dios, río Madeira basin, Peru, all close to the border between Peru and Bolivia (Figure 5). The record from the Quebrada Loboyoc, río Madre de Dios basin, was based on underwater observations plus photographic material by HGE (see Figure 3a,b). A specimen from the río Manuripi (= Manuripe), Bolivia, depicted by Cabrera & Vaca (2006: 24, catalogue number FMNH 106912) and attributed to



**FIGURE 4** Fry development of *Corydoras fulleri*, showing general morphology and colour pattern of unpreserved aquarium specimens with (a) 5.0 mm  $L_S$ , (b) 6.0 mm  $L_S$ , (c) 8.0 mm  $L_S$ , (d) 12.0 mm  $L_S$ , (e) 18.0 mm  $L_S$ , (f) 19.0 mm  $L_S$ , (g) 26.0 mm  $L_S$  and (h) 32.0 mm  $L_S$

*C. acutus*, seems to represent *C. fulleri*, which would confirm the presence of this species within Bolivian territory. Other specimens attributed to *C. acutus* from this same region could be traced in the FMNH online database, available at <https://collections-zoology.fieldmuseum.org/list>. Although likely, the assignment of these specimens to *C. fulleri* depends on the examination of such material.

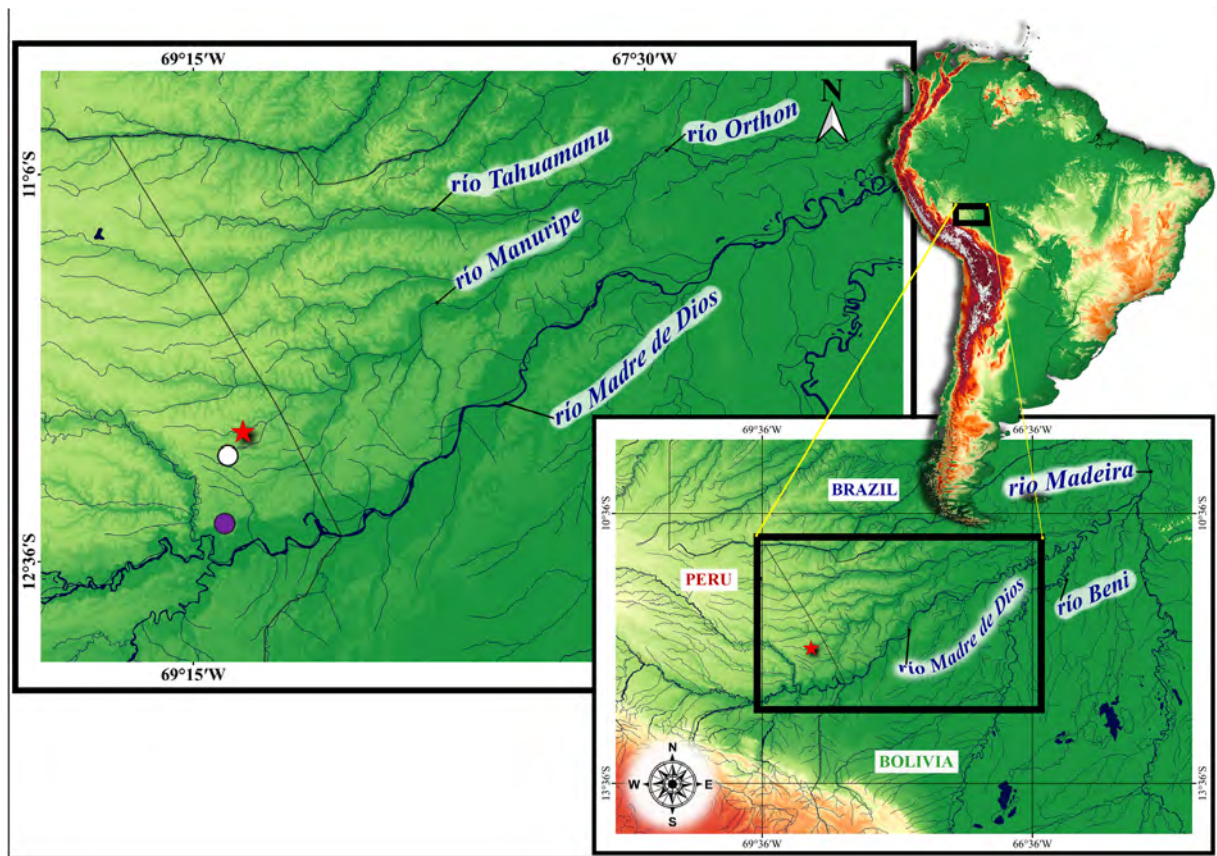
### 3.11 | Natural history and habitat notes

The new species occurs in clear water streams feeding the upper río Manuripe and the río Madre de Dios, in the border region of Peru and Bolivia (Figure 6). The region around the city of Puerto Maldonado is widely cleared rain forest with only a few strips of secondary gallery forest along larger rivers. Large floodplains forming swamps composes the still remote landscape of the border region. Illegal gold mining and ongoing logging as well as draining efforts for large papaya plantations (*Carica papaya*) have a huge influence on the water bodies. Creeks, rivulets and small rivers, partially with dense riparian vegetation, in the Pampa Hermosa and adjacent swamps carry crystal clear water with a low electrical conductivity between 20 and 35  $\mu\text{S cm}^{-1}$ , slightly acidic (pH 5.0 up

to 5.5) and with water temperatures varying from 23.0 to 26.5°C. Fine white sand, gravel, sunken roots and wood as well as leaf litter compose the substrate (Figure 7a). These streams fill up and empty a large swampy area with large palm groves built by the Aguaje palm tree (*Mauritia flexuosa*), so-called “Aguajales” in Spanish. *Corydoras fulleri* sp. n. occurs only in the open water bodies and not in the swamps or the palm groves themselves. In the aguajales, in the shade of the palm trees, *Corydoras* aff. *aeneus* (Gill, 1858) (CW41) and *Corydoras* cf. *napoensis* Nijssen & Isbrücker, 1986 (CW100) were the other Corydoradinae species found.

The open areas with both fast and slower flowing water are populated by at least three different *Corydoras* species. *Corydoras fulleri* can be observed alone/solitaire (Figure 7a) or to shoal together with a similar patterned species, *Corydoras* sp. CW62 (Figure 7b). The two species were observed forming interspecific shoals feeding over the sand and leave litter (Figure 7c). The new species digs deep into the fine sand, up to the eyes, while *Corydoras* sp. CW062 never digs deep, but only feeds on small particles from the surface of the sand (Figure 7d). During these observations, *Corydoras* sp. CW062 was more abundant than the new species. *Corydoras* sp. CW40 is the third species with a similar body colouration, which seems to be rare and





**FIGURE 5** Map showing the geographic distribution of *Corydoras fulleri*. The red star indicates the type-locality, “Alegria”, and the white circle represents the “Cheese Creek”, both tributaries of the rio Manuripe basin, Peru. The purple circle represents the Quebrada Loboyoc, a tributary of the rio Madre de Dios basin, Peru

could only be collected in association with the riparian vegetation. Although occurring in the same streams, *Corydoras* sp. CW040 was never observed shoaling with *C. fulleri*.

### 3.12 | Etymology

*Corydoras fulleri* is named in honour of Ian A.M. Fuller, an aquarist who has devoted most of his life to keeping and breeding Corydoradinae species. Ian runs the “*Corydoras World*” website and Facebook page, where people share all sorts of information on Corydoradinae, and where he administrates the CW-coding process (see Tencatt & Evers, 2016 for further information on the coding system). A genitive noun.

## 4 | DISCUSSION

Convergent colour patterns have apparently played an important part in Corydoradinae evolution, as supported by several studies (e.g., Alexandrou *et al.*, 2011; Britto, 2003; Britto *et al.*, 2009; Lima & Sazima, 2017; Nijssen & Isbrücker, 1980a, 1980c; Tencatt *et al.*, 2013, 2019; Tencatt & Britto, 2016; Tencatt & Ohara, 2016a, 2016b;

Tencatt & Pavanelli, 2015). While the data gathered by these papers makes it clear that snout shape is one of the most practical ways to differentiate the species with convergent colour patterns, their recognition goes far beyond that. *Corydoras fulleri* shares the synapomorphies of the lineage 1 *sensu* Alexandrou *et al.* (2011): (a) branch of the temporal sensory canal at sphenotic, which gives rise to the supraorbital canal, with two pores, (b) upper tooth plate of branchial arch with three series of teeth (vs. two series) and (c) area at the corner of the mouth, ventral to the maxillary barbel, with a small fleshy flap. Other nonexclusive features present in the remaining lineage 1 species, such as posterior margin of pectoral spine mostly with well-developed conical serrations directed towards the origin of the spine, distal half of dorsal-fin posterior margin with poorly-developed serrations directed towards the tip of the spine, and infraorbital 2 contacting sphenotic and pterotic-extrascapular, are also present in the new species. Therefore, we corroborate *C. fulleri* as a member of the lineage 1 as shown by Alexandrou *et al.* (2011)

*Corydoras fulleri* is commonly found shoaling with a putative new short-snouted species coded as *Corydoras* sp. CW 62 (see “Natural history and habitat notes”), which resembles *C. knaacki* Tencatt & Evers, 2016 but can be differentiated by some details in colour pattern, especially on lateral body plates and dorsal fin. As with *C. knaacki*, *Corydoras* sp. CW 62 can be potentially addressed to lineages



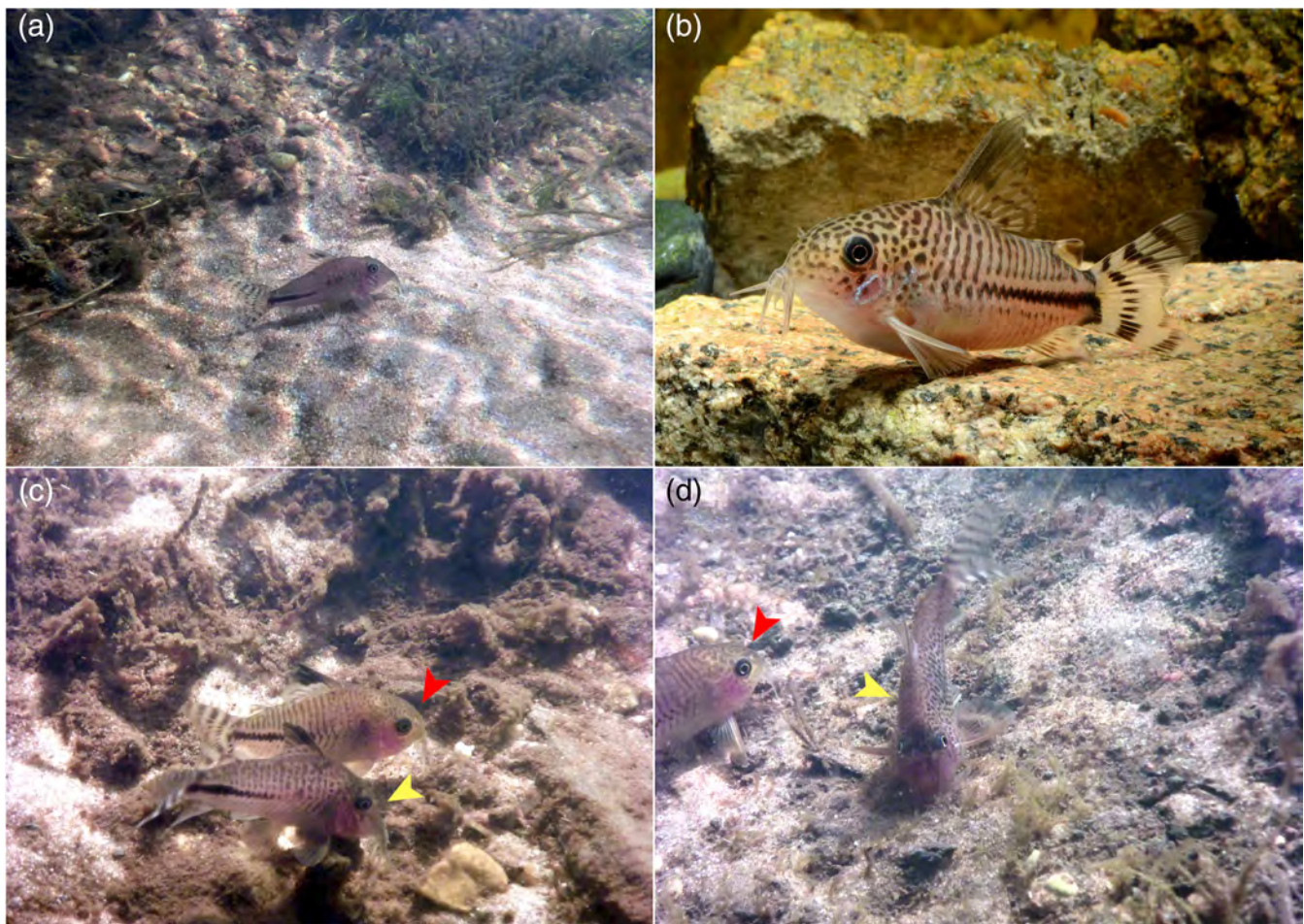
**FIGURE 6** Habitat of *Corydoras fulleri* showing (a) the type-locality, a stream tributary of the río Manuripe in the region locally known as “Alegria”, (b) the Quebrada Loboyoc, a tributary of the río Gamitana, and (c) a stream tributary of the río Manuripe locally known as “Cheese Creek”, all tributaries of the río Madeira basin in Peru

6 or 9, since both lineages comprise typical short-snouted species and no diagnoses for these lineages are available in the literature. Despite the difficulty in morphologically distinguishing lineage 6 from 9, *Corydoras* sp. CW 62 undoubtedly differs from the new species by having a short and rounded snout, whereas *C. fulleri* presents a long and pointed snout. Another syntopic species with similar colour pattern was coded as *Corydoras* sp. CW040, which strongly resembles *Corydoras leopardus* Myers, 1933, a species within lineage 8. *Corydoras leopardus* is a poorly-known species that was originally described based on two aquarium specimens with vague locality data, which was reported as “Brazil (probably the Amazon or one of the coastal streams immediately to the south)” (Myers, 1935: 10), and is known to present variable colour pattern. Therefore, assignment of *Corydoras* sp. CW040 to *C. leopardus* is currently unfounded considering the available information. Nonetheless, the new species can be distinguished from *C. leopardus* by the serration pattern of its dorsal-fin spine posterior margin (serrations directed towards the tip of the spine vs. directed towards the origin of the spine).

Regarding the species within lineage 1 *sensu* Alexandrou *et al.* (2011) and general colour pattern, the most similar congeners to *C. fulleri* are *C. acutus* Cope, 1872, *C. filamentosus* and *C. vittatus* Nijssen,

1971, from which it differs by details in its colour pattern. The new species can be distinguished from *C. acutus* and *C. vittatus* by having two moderate-sized dark-brown or black blotches on caudal-fin base, one on its lateral portion and another one on its dorsal portion, which can be variably diffuse and/or fused with each other (vs. peduncular blotches absent). Considering *C. filamentosus*, it can be distinguished by having the region around dorsal-fin anterior origin generally lacking a dark-brown or black blotch, and if such a blotch is present, it is diffuse (vs. region around dorsal-fin anterior origin with conspicuous dark-brown or black blotch).

The description of *C. fulleri* raises the number of *Corydoras* species from the río Madeira basin to 45, which represents one quarter of species within this genus. According to Dagosta and de Pinna (2019), more than the half of these species are currently considered as endemic/restricted to this basin, namely *C. albineatus* Knaack, 2004, *C. bilineatus* Knaack, 2002a, *C. brittoi* Tencatt & Ohara, 2016, *C. caudimaculatus* Rösse, 1961, *C. cervinus* Rösse, 1962, *C. cruziensis* Knaack, 2002b, *C. geryi* Nijssen & Isbrücker, 1983b, *C. gossei* Nijssen, 1972, *C. gracilis* Nijssen & Isbrücker, 1976, *C. guapore* Knaack, 1961, *C. haraldschultzi* Knaack, 1962, *C. isbrueckeri* Knaack, 2004, *C. knaacki* Tencatt & Evers, 2016, *C. latus* Pearson, 1924,



**FIGURE 7** Unpreserved living specimens of *Corydorass fullerii* and *Corydorass* sp. CW62, showing (a) a solitary specimen of *C. fullerii* in its natural habitat, (b) an unpreserved aquarium specimen of *Corydorass* sp. CW62, (c) a specimen of *C. fullerii* foraging alongside a specimen of *Corydorass* sp. CW62 and (d) a specimen of *C. fullerii* digging into the substrate for food sided by a specimen of *Corydorass* sp. CW62. Yellow and red arrows in (c) and (d) indicate *C. fullerii* and *Corydorass* sp. CW62, respectively. Photos (a), (c) and (d) were taken at the “Cheese Creek”

*C. mamore* Knaack, 2002c, *C. noelkempffi* Knaack, 2004, *C. paragua* Knaack, 2004, *C. paucerna* Knaack, 2004, *C. pavanelliae* Tencatt & Ohara, 2016, *C. sararensis* Dinkelmeyer, 1995, *C. seussi* Dinkelmeyer, 1996, *C. similis* Hieronimus, 1991, *C. spectabilis* Knaack, 1999, *C. sterbai* Knaack, 1962, and *C. zawadzki* Tencatt & Ohara, 2016. The authors also mentioned *C. hephaestus* Ohara, Tencatt & Britto, 2016 and *C. pantanalensis* Knaack, 2001 as restricted to the rio Madeira basin, however, the first species also occurs in the rio Juruena basin (W. Ohara, pers. comm.), while the second one also occurs in the rio Paraguay basin (see Knaack, 2001). Additionally, Ohara (2018) considered *C. negro* and *C. pinheiroi* as restricted to the rio Madeira basin. Therefore, the description of *C. fullerii* makes a total of 28 *Corydorass* species endemic to the rio Madeira basin, corresponding to 16% of the total species within the genus.

#### ADDITIONAL SPECIMENS EXAMINED

*Corydorass acutus*: ANSP 113928 (one specimen, 43.0 mm  $L_S$ ); MNRJ 3985 (two specimens, 47.1–54.8 mm  $L_S$ ); USNM 305324 (10 specimens,

13.6–40.8 mm  $L_S$ ); ZMA 110423 (one specimen, 49.8 mm  $L_S$ ). *Corydorass adolfoi*: MZUSP 26641 (holotype, 32.5 mm  $L_S$ ). *Corydorass aeneus*: USNM 1116 (lectotype, 38.2 mm  $L_S$ ). *Corydorass amapaensis*: IRSNB 476 (holotype, 55.5 mm  $L_S$ ); IRSNB 477 (paratypes, two specimens, 47.3–48.4 mm  $L_S$ ); IRSNB 478 (paratype, one specimen, 62.3 mm  $L_S$ ); IRSNB 479 (paratypes, three specimens, 25.2–46.4 mm  $L_S$ ); IRSNB 480 (paratype, one specimen, 34.4 mm  $L_S$ ); IRSNB 481 (paratype, one specimen, 43.4 mm  $L_S$ ); IRSNB 482 (paratypes, two specimens, 40.6–42.2 mm  $L_S$ ); IRSNB 483 (paratypes, two specimens, 41.9–54.5 mm  $L_S$ ); IRSNB 484 (paratypes, four specimens, 42.2–45.9 mm  $L_S$ ); MZUSP 38978 (paratype, one specimen, 55.6 mm  $L_S$ ); MZUSP 30842 (one specimen, 50.7 mm  $L_S$ ); MZUSP 30843 (one specimen, 50.6 mm  $L_S$ ); MZUSP 31606 (one specimen, 48.9 mm  $L_S$ ); USNM 205865 (paratype, one specimen, 46.0 mm  $L_S$ ). *Corydorass ambiacus*: ANSP 8291 (holotype, 40.4 mm  $L_S$ ); MZUSP 26053 (two specimens, 41.8–47.2 mm  $L_S$ ). *Corydorass amphibelus*: ANSP 8290 (holotype, 26.4 mm  $L_S$ ). *Corydorass approuaguensis*: IRSNB 696 (paratypes, two specimens, 45.7–52.2 mm  $L_S$ ); MZUSP 27895-6 (paratypes, two specimens, 43.0–46.1 mm  $L_S$ ). *Corydorass araguaiaensis*: MZUSP 87155 (four of 33 specimens, 24.9–46.7 mm  $L_S$ , two c&s specimens, 27.6–31.8 mm  $L_S$ ). *Corydorass*

*arcuatus*: BMNH 1939.3.3.1 (holotype, 43.3 mm  $L_S$ ). *Corydoras aricio*: ZUFMS-PIS 1314 (15 specimens, 34.4–41.9 mm  $L_S$ , two c&s specimens, 38.1–38.5 mm  $L_S$ ). *Corydoras armatus*: BMNH 1867.6.13.51 (lectotype, 42.1 mm  $L_S$ ). *Corydoras atropersonatus*: USNM 204359 (holotype, 37.1 mm  $L_S$ ). *Corydoras aurofrenatus*: NRM 23529 (10 of 33 specimens, 31.4–45.7 mm  $L_S$ ). *Corydoras bifasciatus*: MZUSP 38976 (paratypes, 16 specimens, 23.6–30.0 mm  $L_S$ ). *Corydoras blochi*: IRSNB 503 (paratypes, two specimens, 41.0–46.8 mm  $L_S$ ); BMNH 1970.10.30.1 (paratype, one specimen, 36.0 mm  $L_S$ ); MZUSP 8580 (paratypes, three specimens, 31.0–42.6 mm  $L_S$ ). *Corydoras boehlkei*: ANSP 148097 (holotype, 23.6 mm  $L_S$ ). *Corydoras bondi*: ROM 66202 (seven of 134 specimens, 33.8–39.9 mm  $L_S$ , three c&s specimens, 36.7–38.6 mm  $L_S$ ). *Corydoras brevirostris*: LBP 3080 (10 specimens, 23.8–27.7 mm  $L_S$ , three c&s specimens, 25.8–27.9 mm  $L_S$ ). *Corydoras britskii*: ZUFMS-PIS 862 (12 specimens, 72.0–78.0 mm  $L_S$ ). *Corydoras brittoi*: MNRJ 43316 (holotype, 38.1 mm  $L_S$ ). *Corydoras burgessi*: USNM 288461 (paratypes, two specimens, 43.7–44.8 mm  $L_S$ ). *Corydoras carlae*: NUP 711 (one specimen, 47.9 mm  $L_S$ ); NUP 4425 (one c&s specimen, 45.0 mm  $L_S$ ). *Corydoras cochui*: MZUSP 89055 (six specimens, 18.7–23.6 mm  $L_S$ ); MZUSP 35838 (four of six specimens, 16.1–18.5 mm  $L_S$ ). *Corydoras condiscipulus*: MZUSP 38957 (paratypes, seven specimens, 34.1–40.3 mm  $L_S$ ). *Corydoras copenamensis*: USNM 202129 (paratypes, five specimens, 33.0–35.8 mm  $L_S$ ). *Corydoras coriatae*: USNM 343866 (paratypes, two specimens, 53.2–57.1 mm  $L_S$ ). *Corydoras cortesi*: ZUEC 17328 (one specimen, 28.2 mm  $L_S$ ). *Corydoras crimmeni*: MZUSP 52490 (holotype, 36.1 mm  $L_S$ ). *Corydoras davidsandsi*: MZUSP 110066 (four of 40 specimens, 36.0–41.9 mm  $L_S$ , two c&s specimens, 40.9–42.1 mm  $L_S$ ). *Corydoras desana*: ANSP 200804 (paratypes, two specimens, 29.5–43.4 mm  $L_S$ ); MZUSP 121044 (holotype, 46.4 mm  $L_S$ ); MZUSP 92163 (paratype, one specimen, 42.8 mm  $L_S$ ); MZUSP 93008 (paratype, one specimen, 42.4 mm  $L_S$ ); ZUEC 13491 (paratype, one specimen, 43.7 mm  $L_S$ ); ZUEC 13492 (paratypes, two specimens, 26.0–31.55 mm  $L_S$ ). *Corydoras diffluviatilis*: MZUSP 75268 (holotype, 39.8 mm  $L_S$ ). *Corydoras diphyes*: ANSP 169756 (two specimens, 40.7–43.1 mm  $L_S$ ). *Corydoras ehrhardti*: NUP 11255 (15 specimens, 36.5–46.8 mm  $L_S$ ). *Corydoras elegans*: USNM 216716 (paralectotypes, 10 specimens, 36.3–43.3 mm  $L_S$ ). *Corydoras ephippifer*: MZUSP 38498 (paratypes, two specimens, 36.2–46.9 mm  $L_S$ ); MZUSP 38951 (paratypes, two specimens, 32.7–40.7 mm  $L_S$ ); MZUSP 31605 (two specimens, 44.9–49.1 mm  $L_S$ ). *Corydoras eques*: MCZ 8204 (paratypes, four of 12 specimens, 37.6–44.4 mm  $L_S$ ). *Corydoras filamentosus*: USNM 225536 (holotype, 30.2 mm  $L_S$ ). *Corydoras flaveolus*: MZUSP 424 (holotype, 33.4 mm  $L_S$ ). *Corydoras fowleri*: LBP 12462 (nine specimens, 44.3–59.9 mm  $L_S$ , one c&s specimen, 50.4 mm  $L_S$ ). *Corydoras garbei*: MNRJ 18089 (14 specimens, 19.2–25.3 mm  $L_S$ , two c&s specimens, 25.9–27.4 mm  $L_S$ ). *Corydoras geoffroy*: IRSNB 469 (paratypes of *Corydoras octocirrus*, three specimens, 48.5–50.1 mm  $L_S$ ); 471 (paratype of *Corydoras octocirrus*, one specimen, 49.2 mm  $L_S$ ); USNM 204222 (paratypes of *Corydoras octocirrus*, two specimens, 54.5–55.4 mm  $L_S$ ); ZMA 106.017 (holotype of *Corydoras octocirrus*, 65.1 mm  $L_S$ ); ZMA 105367 (paratypes, 14 specimens, 38.6–60.9 mm  $L_S$ ); ZMA 109066 (paratypes, three specimens, 40.5–43.8 mm  $L_S$ ). *Corydoras gossei*: MZUSP 38977 (paratypes, six specimens, 48.4–53.4 mm  $L_S$ ). *Corydoras gracilis*: USNM 216074 (paratype, one specimen, 19.2 mm  $L_S$ ). *Corydoras griseus*: MZUSP 108896 (four of 13 specimens, 31.5–36.2 mm  $L_S$ , two c&s specimens, 30.6–34.5 mm  $L_S$ ). *Corydoras gryphus*: MNRJ 40770 (holotype, 32.3 mm  $L_S$ ); NUP 14676 (paratypes, three c&s specimens, 27.7–32.4 mm  $L_S$ ). *Corydoras guapore*: ZUFMS-PIS 4000 (five specimens, 26.9–33.6 mm  $L_S$ , two c&s specimens, 28.8–29.2 mm  $L_S$ ). *Corydoras guianensis*: USNM 204218 (paratypes, two specimens, 26.0–32.0 mm  $L_S$ ). *Corydoras hastatus*: NUP 6862 (116 specimens, 13.1–20.7 mm  $L_S$ ). *Corydoras heteromorphus*: MZUSP 9084 (paratype, one specimen, 32.6 mm  $L_S$ ); MZUSP 9085 (paratype, one specimen, 36.7 mm  $L_S$ ); USNM 204224 (paratypes, two specimens, 37.0–42.7 mm  $L_S$ ). *Corydoras inolicana*: MZUSP 45717 (holotype, 47.6 mm  $L_S$ ). *Corydoras isbrueckeri*: MTD F 28474 (holotype, 43.2 mm  $L_S$ ); MTD F 28475 (allotype, 48.8 mm  $L_S$ ). *Corydoras julii*: NUP 16225 (one specimen, 46.8 mm  $L_S$ ). *Corydoras kanei*: MZUSP 52489 (holotype, 36.6 mm  $L_S$ ). *Corydoras lacrimostigmata*: MNRJ 40725 (holotype, 31.8 mm  $L_S$ ); NUP 14657 (paratypes, three c&s specimens, 30.9–34.5 mm  $L_S$ ). *Corydoras leopardus*: USNM 93305 (lectotype, 38.7 mm  $L_S$ ). *Corydoras longipinnis*: AI 221 (holotype, 59.5 mm  $L_S$ ); NUP 14440, two c&s specimens, 29.9–33.4 mm  $L_S$ ). *Corydoras loretoensis*: ANSP 121620 (paratypes, 32 specimens, 17.3–32.7 mm  $L_S$ ). *Corydoras loxozonus*: ANSP 150170 (holotype, 34.6 mm  $L_S$ ). *Corydoras lymnades*: MNRJ 15765 (six specimens, 15.8–17.7 mm  $L_S$ , two c&s specimens, 18.1–18.4 mm  $L_S$ ); MNRJ 40186 (holotype, 29.7 mm  $L_S$ ). *Corydoras maculifer*: BMNH 1970.10.30.3 (holotype, 35.1 mm  $L_S$ ); ZMA 110.681 (paratype, 22.9 mm  $L_S$ ); NUP 8970 (two specimens, 42.0–46.0 mm  $L_S$ ). *Corydoras melanistius*: BMNH 1864.1.21.86 (lectotype, 35.0 mm  $L_S$ ). *Corydoras melanotaenia*: BMNH 1909.7.23.41 (lectotype, 38.3 mm  $L_S$ ). *Corydoras micracanthus*: BMNH 1897.1.27.8 (lectotype, 33.7 mm  $L_S$ ). *Corydoras multimaculatus*: MCP 29025 (two specimens, 20.1–25.4 mm  $L_S$ ). *Corydoras napoensis*: USNM 270358 (paratypes, two specimens, 26.7–28.3 mm  $L_S$ ). *Corydoras narcissus*: ZMA 115.178 (holotype, 65.9 mm  $L_S$ ). *Corydoras nattereri*: MZUSP 110255 (four of 31 specimens, 32.0–32.8 mm  $L_S$ , two c&s specimens, 32.3–34.4 mm  $L_S$ ). *Corydoras negro*: MTD F 28472 (holotype, 41.8 mm  $L_S$ ); MTD F 28473 (paratype, one specimen, 46.3 mm  $L_S$ ); ZMA 143.8337 (paratype, one specimen, 38.5 mm  $L_S$ ); ZMA 143.934 (paratype, one specimen, 43.1 mm  $L_S$ ); ZMB 33534 (paratype, one specimen, 36.0 mm  $L_S$ ); ZMB 33535 (paratype, one specimen, 41.9 mm  $L_S$ ). *Corydoras noelkempffii*: MTD F 28576 (holotype, 46.5 mm  $L_S$ ). *Corydoras oiapoquensis*: USNM 205868 (paratypes, two specimens, 25.9–35.0 mm  $L_S$ ). *Corydoras orcesi*: ZMA 110.377 (paratypes, two specimens, 50.6–55.9 mm  $L_S$ ); ZMA 110.378 (paratypes, two specimens, 49.1–52.1 mm  $L_S$ ); ZMA 110.379 (paratypes, two specimens, 58.1–58.7 mm  $L_S$ ). *Corydoras ornatus*: USNM 216075 (paratype, one specimen, 37.8 mm  $L_S$ ). *Corydoras orphnopterus*: USNM 204361 (holotype, 55.9 mm  $L_S$ ). *Corydoras osteocarus*: USNM 157367 (paratype, one specimen, 25.1 mm  $L_S$ ). *Corydoras ourastigma*: IRSNB 498 (holotype, 58.9 mm  $L_S$ ); MZUSP 38950 (paratype, one specimen, 23.0 mm  $L_S$ ). *Corydoras oxyrhynchus*: ZMA 25329 (holotype, 47.1 mm  $L_S$ ); ZMA 25330 (paratype, 50.4 mm  $L_S$ ); ZMA 104.640 (paratype, one specimen, 46.5 mm  $L_S$ ). *Corydoras paleatus*: BMNH 1917.7.14.18 (lectotype, 30.0 mm  $L_S$ ); NRM 54230 (one specimen, 53.5 mm  $L_S$ ). *Corydoras panda*: BMNH 1969.7.15.8 (holotype,

38.9 mm  $L_S$ ); ROM 55815 (six specimens, 26.5–39.7 mm  $L_S$ ). *Corydoras pantanalensis*: NUP 10188 (one c&s specimen, 46.4 mm  $L_S$ ); NUP 12593 (21 specimens, 38.7–51.2 mm  $L_S$ ). *Corydoras parallelus*: MZUSP 45716 (holotype, 47.4 mm  $L_S$ ). *Corydoras pastazensis*: USNM 177216 (holotype, 46.2 mm  $L_S$ ). *Corydoras pavanelliae*: MNRJ 43317 (holotype, 45.1 mm  $L_S$ ). *Corydoras pinheiroi*: MZUSP 48099 (holotype, 54.3 mm  $L_S$ ). *Corydoras polystictus*: BMNH 1895.5.17.62 (lectotype, 27.5 mm  $L_S$ ). *Corydoras potaroensis*: ROM 61526 (three of 15 specimens, 35.0–44.8 mm  $L_S$ , two c&s specimens, 32.6–35.1 mm  $L_S$ ). *Corydoras pygmaeus*: ANSP 200357 (one specimen, 16.1 mm  $L_S$ ). *Corydoras punctatus*: ZMB 3149 (lectotype, 41.7 mm  $L_S$ ). *Corydoras robineae*: MZUSP 27175 (holotype, 33.7 mm  $L_S$ ). *Corydoras saramaccensis*: ZMA 106.018 (holotype, 50.4 mm  $L_S$ ); ZMA 105.563 (paratypes, eight specimens, 35.5–44.2 mm  $L_S$ ); ZMA 105.650 (paratype, one specimen 39.8 mm  $L_S$ ). *Corydoras sararensis*: MZUSP 48100 (holotype, 40.9 mm  $L_S$ ). *Corydoras septentrionalis*: USNM 130634 (paratype, one specimen, 42.3 mm  $L_S$ ); ZMA 112.288 (paratype, one specimen, 37.8 mm  $L_S$ ); ZMA 111.4238 (paratype, one specimen, 46.3 mm  $L_S$ ). *Corydoras seussi*: MZUSP 49323 (paratypes, 10 specimens, 44.3–54.0 mm  $L_S$ ). *Corydoras similis*: LBP 10648 (seven specimens, 21.4–34.3 mm  $L_S$ ). *Corydoras simulatus*: USNM 197615 (holotype, 49.1 mm  $L_S$ ); ZMA 110.384 (paratypes, two specimens, 44.5–45.8 mm  $L_S$ ). *Corydoras solox*: MNMH 1983-0531 (holotype, 60.0 mm  $L_S$ ); ZMA 119.106 (paratypes, four specimens, 52.6–63.1 mm  $L_S$ ). *Corydoras spilurus*: BMNH 1926.3.2.738 (lectotype, 43.3 mm  $L_S$ ). *Corydoras splendens*: NUP 12990 (one specimen, 43.7 mm  $L_S$ ); NUP 10195 (one c&s specimen, 54.6 mm  $L_S$ ). *Corydoras stenocephalus*: MHNG 2710.098 (three specimens, 48.7–57.3 mm  $L_S$ ); MNRJ 3625 (three specimens, 31.2–62.3 mm  $L_S$ ). *Corydoras surinamensis*: USNM 204223 (paratypes, two specimens, 29.1–34.3 mm  $L_S$ ). *Corydoras treitlii*: NMW 61103 (lectotype, 42.6 mm  $L_S$ ); NMW 46797 (paralectotypes, 13 specimens, 35.8–45.9 mm  $L_S$ ); NMW 46798 (paralectotypes, nine specimens, 41.5–44.9 mm  $L_S$ ); NMW 46799 (paralectotypes, four specimens, 41.5–45.5 mm  $L_S$ ); NMW 46800 (paralectotypes, six specimens, 29.0–48.3 mm  $L_S$ ); NMW 46801 (paralectotypes, 14 specimens, 24.3–45.0 mm  $L_S$ ); NUP 16224 (three specimens, 21.5–45.6 mm  $L_S$ ). *Corydoras trilineatus*: ANSP 8294 (lectotype, 31.8 mm  $L_S$ ); MZUSP 30857 (three of 25 specimens, 40.9–44.1 mm  $L_S$ , two c&s specimens, 44.2–43.8 mm  $L_S$ ). *Corydoras tukano*: MZUSP 82100 (holotype, 40.9 mm  $L_S$ ). *Corydoras undulatus*: BMNH 1912.7.10.5 (holotype, 41.8 mm  $L_S$ ). *Corydoras urucu*: ZUEC 14191 (nine specimens, 23.7–27.4 mm  $L_S$ ). *Corydoras virginiae*: MZUSP 45715 (holotype, 32.4 mm  $L_S$ ); USNM 326186 (paratypes, three specimens, 31.6–33.5 mm  $L_S$ ). *Corydoras vittatus*: ZMA 109990 (holotype, 40.3 mm  $L_S$ ); MHNG 2602.058 (one specimen, 46.6 mm  $L_S$ ); MPEG 5537 (one specimen, 40.6 mm  $L_S$ ); NMW 46803 (paratypes, two specimens, 35.4–39.7 mm  $L_S$ ). *Corydoras weitzmani*: USNM 206018 (paratype, one specimen, 38.5 mm  $L_S$ ). *Corydoras xinguensis*: USNM 205870 (paratype, one specimen, 27.9 mm  $L_S$ ). *Corydoras zawadzki*: MNRJ 45565 (holotype, 48.7 mm  $L_S$ ); NUP 17824 (paratype, one c&s specimen, 39.9 mm  $L_S$ ). *Corydoras zygatus*: MZUSP 30858, four of 15 specimens, 41.7–47.3 mm  $L_S$ ).

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