

New Species of *Creagrutus* (Teleostei: Characiformes: Characidae) from the Río Magdalena Basin, Colombia

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A new species of *Creagrutus* from the Río Magdalena basin, Colombia, is described. This species is distinguished from all congeners by a combination of morphometric, meristic, and morphological features. The species is the first member of the genus known to have breeding tubercles with keratinized caps. The phylogenetic position of the new species and various aspects of its ecology and behavior are discussed.

Es descrita una nueva especie de *Creagrutus* de la cuenca del Río Magdalena, Colombia. Ésta especie se distingue de sus congéneres por su combinación de características morfométricas, merísticas y morfológicas. Ésta es la primera especie de *Creagrutus* en la que se hayan observado tubérculos reproductivos con casquetes queratinizados. Se discute la posición filogenética de la nueva especie y se comentan varios aspectos de su ecología y comportamiento.

HAROLD and Vari (1994) and Vari and Harold (2001), respectively revised the trans- and cis-Andean species of *Creagrutus*. Even though those authors dramatically increased the number of recognized species within *Creagrutus*, it is striking that the species-level diversity within the genus continues to rise as a consequence of recent collecting efforts in ichthyologically poorly explored regions of South America (i.e., Vari and Lima, 2003; Ribeiro et al., 2004). This pattern continues with the description herein of a new species of *Creagrutus* from the Río Magdalena drainage, a basin whose ichthyofauna, albeit the best sampled in Colombia, still includes unknown species.

MATERIALS AND METHODS

Morphometric and meristic measurements were taken following Harold and Vari (1994) and Vari and Harold (2001). Vertebral counts were taken from radiographs. Some specimens were dissected to observe myological and osteological characters, with the latter examined in specimens cleared and counter-stained for bone and cartilage using a modification of the method of Taylor and Van Dyke (1985). Breeding tubercles were examined histologically to confirm the presence of a keratinized cap. The species concept used was the phylogenetic species concept as modified by Nixon and Wheeler (1990), which considers a species to be a population sample diagnosable by a unique combination of character states. The data for the phylogenetic analysis were based on the matrix in Vari and Harold (2001) for the species of *Creagrutus* with the addition of information on the subsequently described *C. tuyuka* (Vari and

Lima, 2003) and *C. varii* (Ribeiro et al., 2004). This analysis was carried out using Nona (vers. 2.0, P. S. Goloboff, Fundación e Instituto Miguel Lillo, Tucumán, Argentina) with the RAS-TBR heuristic method (h/1, h 10000, 500 iterations, 100 replicates); the resulting trees were observed with WinClada (vers. 0.9.9, K. C. Nixon, Ithaca, New York). All characters were treated as unordered and equally weighted. Institutional abbreviations are as listed in Leviton et al. (1985). Cleared-and-stained specimens are indicated as CS.

Creagrutus guanes, new species

Figure 1

Holotype.—ICNMHN 8520, 72.9 mm SL, Colombia, Santander, Valle de San José, Río Magdalena system, Río Fonce, beside road from San Gil to Charalá, under bridge of road to Balneario Monas, 6°28'39.4"N, 73°7'3.0"W, M. Torres-Mejia and F. Rangel-Serpa, 19 Dec. 2003.

Paratypes.—All collected by M. Torres-Mejia and F. Rangel-Serpa. ICNMHN 8521, 25, 49.3–66.2 mm SL, same locality as holotype, 16 Jan. 2004. ICNMHN 8522, 1, 62.8 mm SL, same locality as holotype, 14 Feb. 2004. ICNMHN 9893 (formerly ICNMHN 8520, in part), 20, 53.9–70.5 mm SL, 1 specimen stained with alizarin and partially dissected; ICNMHN 9898, 2, 61.2–67.0 mm SL, 2 CS, collected with holotype. ICNMHN 9894, 9, 27.9–51.4 mm SL, Río Fonce System, Río Mogoticos, Santander, Valle de San José, Balneario Monas, 6°28'46.3"N, 73°6'51.5"W. ICNMHN 9895, 1, 46.8 mm SL, Río Fonce, beside road from San Gil to Charalá, after exit to Páramo, 6°25'12.7"N, 73°9'31.3"W.



Fig. 1. *Creagrutus guanes*, new species, holotype, ICNMHN 8520, 72.9 mm SL; left lateral view.

ICNMHN 9896, 3, 23.9–54.6 mm SL, Río Fonce, Santander, beside road from San Gil to Charalá, in front of “El Trapiche” bar, 6°31′5.2″N, 73°7′32.7″W, 17 April 2004. ICNMHN 9897, 2, 48.7–65.3 mm SL, 2 CS, same locality as ICNMHN 9896, 10 Nov. 2003.

Non-type material.—ICNMHN 2389, 25, 35.3–73.5 mm SL, 2 cleared-and-counterstained for bone and cartilage, Cundinamarca, Yacopí, Guadualito, Río Magdalena System, Río Hatillo. ICNMHN uncataloged, 1, 53.8 mm SL, Río Fonce, beside road from San Gil to Charalá, after exit to Páramo, 6°25′12.7″N, 73°9′31.3″W.

Diagnosis.—*Creagrutus guanes* is distinguished from its trans-Andean congeners by the combination of the unmodified, completely pored lateral line-scales, the absence of a distinct patch of dark pigmentation on the basal portions of the caudal fin, the absence of a stripe of dark pigmentation along the middle rays of the caudal fin, the relatively wide third infraorbital, a straight to slightly convex predorsal profile, the caudal peduncle depth 11.31–13.42% of SL, and the possession of 10 to 12 branched anal-fin rays and 36 to 38 lateral-line scales.

Creagrutus guanes differs from all described species of *Creagrutus* by the combination of a distance from the dorsal-fin origin to the pelvic-fin origin 26.7–34.1% of SL, the rotund or somewhat vertically-elongate humeral mark, the reticulate pattern of dark pigmentation on the dorsal portion of body, the maxilla with a thick anterior process, robust posterior portion, and a distinct flexion in the region where it extends past the posterior limit of the premaxilla, the lack of a bony plate on the dorsal surface of fourth basibranchial, the presence of one or more teeth on the third infrapharyngobranchial, the dorsolateral portion of the dilatator groove that is roofed to varying degrees by processes from the frontal and pterotic, and the absence of

a narrow ring-like process of the scapula forming the anterior border of scapular foramen.

Description.—Morphometric and meristic data for the holotype and paratypes presented in Table 1. Head and anterior portion of body variably robust, with relative robustness increasing ontogenetically, more so in mature females. Region of body posterior of vertical through anal-fin origin slender. Greatest body depth situated three or four scales anterior to dorsal-fin origin. Dorsal profile of head distinctly convex from margin of upper lip to vertical through posterior nares; straight to slightly convex from that point to tip of supraoccipital spine. Interorbital region somewhat convex transversely. Dorsal profile of body ranging from nearly straight to slightly convex from tip of supraoccipital spine to dorsal-fin origin and typically demonstrating distinct shift of alignment relative to dorsal profile of head. Convexity most pronounced in posterior one-third of predorsal profile and more obvious in live specimens. Ventral profile of head with obtuse angle at anteroventral corner of dentary, approximately straight from that angle to isthmus. Some specimens with profile of anterior border of lower jaw slightly concave as consequence of anterior projection of lower lip. Ventral profile of body convex from isthmus to anal-fin insertion. Convexity increasing ontogenetically, more so in mature females. Head blunt in lateral and dorsal views.

Upper jaw distinctly longer than, and overhanging, lower jaw. Anterior portion of snout fleshy. Infraorbital series moderately developed. Ventral margin of third infraorbital falling short of ventral limb of preopercle. Posterior margins of third through fifth infraorbitals distinctly separated from vertical limb of preopercle. Ventral and posterior margins of third infraorbital ranging from rounded to almost straight and perpendicular to each other, with margin of posteroventral corner of bone broadly rounded.

TABLE 1. MORPHOMETRIC AND MERISTIC DATA FOR HOLOTYPE AND 62 PARATYPES OF *Creagrutus guanei*, NEW SPECIES. Standard length is expressed in millimeters; values 1 to 14 are percentages of standard length and 15 to 18 are percentages of head length.

	Holotype	Paratypes
Morphometrics		
Standard length	72.9	23.9–70.5
1. Snout to anal-fin origin	64.6	57.9–66.7
2. Snout to pelvic-fin insertion	47.8	43.1–50.1
3. Snout to pectoral-fin insertion	22.6	22.6–27.0
4. Snout to dorsal-fin origin	46.2	42.9–51.1
5. Dorsal-fin origin to hypural joint	59.1	54.1–59.1
6. Dorsal-fin origin to anal-fin origin	35.9	29.0–35.9
7. Dorsal-fin origin to pelvic-fin insertion	34.1	26.7–34.1
8. Dorsal-fin origin to pectoral-fin insertion	36.9	24.2–37.7
9. Caudal peduncle depth	12.8	11.3–13.4
10. Pectoral-fin length	18.5	18.0–22.5
11. Pelvic-fin length	14.4	12.9–17.4
12. Dorsal-fin length	22.9	18.8–25.1
13. Anal-fin length	18.2	15.8–21.4
14. Head length	24.0	23.4–26.7
15. Postorbital head length	45.9	39.5–52.1
16. Snout length	28.0	19.0–30.1
17. Bony orbital diameter	31.6	27.4–38.2
18. Interorbital width	36.7	29.3–37.8
Meristics		
Lateral-line scales	38	36–38
Scale rows between dorsal-fin origin and lateral line	4	4–5
Scale rows between anal-fin origin and lateral line	4	3–4
Predorsal median scales	12	10–12
Branched dorsal-fin rays	8	7–9
Branched anal-fin rays	11	10–12
Branched pelvic-fin rays	7	7
Pectoral-fin rays	12	11–14
Vertebrae	37	35–38

Breeding tubercles with keratinized caps distributed on head and lateral surface of body above pelvic and anal fins. Distribution of tubercles varies interspecifically and ontogenetically. Small individuals of each sex with tubercles limited to dorsal portions of head. Large males with tubercles distributed on dorsal surface of head from anterior of nares to tip of supraoccipital, opercle, ventrolateral portions of infraorbitals, and ventrolateral surface of body except for area below pectoral fin. Tubercles in mature females as in large males with additional tubercles extending posteriorly from head almost to dorsal-fin origin in region proximate to mid-dorsal line. Tubercles on scales primarily located along posterior borders, more so in females.

Premaxillary dentition in three series: primary row formed of five (30) or six (33) teeth (some individuals with different counts on opposite sides) arranged in anteriorly more pronounced curve; triangular cluster of three larger teeth situated medial to main row; and single lateral tooth situated exterior to main row. Single tooth positioned proximate to third, fourth, or fifth tooth of main series or proximal to gap between two of these teeth. Relative position of single tooth depends on number of teeth in main row, with single tooth near third tooth when five teeth present on primary row, but usually located near fourth or fifth tooth when six teeth present in that row. Maxilla with two (3), three (40), or four (10) tricuspid teeth. Dentary with six (10) or seven (15) tricuspid teeth, with three anterior teeth robust and relatively large, fourth tooth one-third shorter than three anterior-most teeth, and last three or four teeth compressed and distinctly smaller than anterior teeth.

Dorsal-fin rays ii,7 [2], 8 [59], 9 [2]. Dorsal-fin origin located at, or slightly anterior to, vertical through pelvic-fin insertion. Profile of distal margin of dorsal fin slightly concave, with anterior rays longest. Two anterior-most branched dorsal-fin rays with three and two hooks, respectively. Hooks situated on basal portion of the posterior branch of each ray. Anal-fin rays ii,10 [17], 11 [43], 12 [3]. Distal profile of fin convex. Anal fin of mature males and some large sized females with hooks on posterior branches of branched-rays. Hooks in males located on branched portion of second through eighth anterior-most branched rays, often present on distal segments of unbranched portion of second or third anterior-most branched rays, and sometimes present on second unbranched ray. Two hooks present on each hook-bearing segment of anal-fin rays of males, with number of hooked segments per ray progressively decreasing posteriorly. Females with hooks only on some segments of posterior branch of first or first and second branched anal-fin rays. Hooks in spread anal fins of both sexes oriented posterodorsally at acute angle relative to longitudinal axis of body. Pectoral-fin rays i,10 [3], 11 [23], 12 [36], or 14 [1]. Distal tip of pectoral fin extending to point one or two scales short of vertical through pelvic-fin insertion. Pelvic-fin rays i,6,i [in three smallest specimens], i,7 [60]. Tip of pelvic fin reaching to anal-fin origin in small specimens but falling short of that point by one or two scales in larger individuals. Mature males and some large-sized females with hooks on pelvic-fin rays, particularly on segmented posterior branch and on distal portion of unsegmented basal section of each fin

ray. Males with hooks on six or seven branched pelvic-fin rays. Most females with hooks on pelvic-fin rays limited to several segments of posterior branch of two or three anterior-most branched rays. Single row of hooks present on all hook-bearing rays, with one hook per segment. Hooks in spread fin directed posteriorly. Adipose fin inserted at, or slightly anterior to, vertical through distal tip of posterior-most anal-fin ray. Basal portion of each caudal-fin lobe covered with dcales. Gill-rakers 6–8+10–12 (14 specimens).

Coloration in life.—Dark pigmentation masked by overall silvery pigmentation when observed from direct lateral view, but visible when specimen tilted dorsally. Specimens thus appear dark, silvery, or white when seen from dorsal, lateral, and ventral views, respectively. Dorsal midline of body and dorsal portion of head dark greenish-brown, except for iridescent light green pigmentation overlying brain region. Iris silvery overall, but with crescent-shaped red mark on dorsal portion. Central portion of opercle somewhat dark. Dorsal portion of body ranging from grayish to brown, with reticulate pattern formed by contrasting silvery central regions and dark brown anterior and posterior portions of scales. Humeral mark and midlateral horizontal stripe relatively pale in comparison with coloration in preserved specimens, but with dark, midlateral stripe always visible on caudal peduncle. Guanine more concentrated over midlateral stripe and forming silvery-white lateral band, with band more obvious than stripe in some specimens. Thin, stippled, yellow line present above midlateral stripe when specimen observed dorsally from 45° angle. Ventral portion of head and body with slightly yellowish ground coloration from infraorbitals to anal-fin base where yellow pigmentation becomes paler. Yellow pigmentation variably covered by guanine. Dorsal, pelvic, anal, and caudal fins yellowish, with scattered iridescent yellow highlights. All specimens greater than 30 mm SL with anterior-most one or two rays of pelvic and anal fins white. Middle rays of caudal fin slightly darker than rest of fin. Some specimens with white coloration on one or two ventral-most rays of ventral lobe of caudal fin. Pectoral fin hyaline to yellowish. Adipose fin bright orange.

Coloration in alcohol.—Intensity of pigmentation differs within population samples and more so between samples collected in same river on consecutive months. Overall ground coloration light tan. Dorsal portion of head usually dusky, with fronto-parietal fontanel ranging from pale

gray to black and region over brain sometimes distinctly darker. Latter more intense coloration possibly due to deep-lying dark pigmentation overlying membranes of brain in many species of *Creagrutus*. Snout and upper lip variably darkly pigmented, with snout tip usually lighter than surrounding areas. Crescent-shaped patch of densely concentrated, dark chromatophores often positioned forward of anterior nares. Posterior margin of orbit sometimes bordered by crescent-shaped line of dark pigmentation. Canal system in first and second infraorbitals underlain by dispersed chromatophores variably continuous posteriorly with dark pigmentation located along posterior border of eye. Portion of head posterior to orbit with pattern of dark pigmentation ranging from very diffuse to forming irregularly defined stripe. Lower portion of cheek occasionally with scattered dark chromatophores. Middle section of upper portion of opercle semi-translucent and darkly pigmented on inner surface, giving appearance of dark mark from external view.

Scales of dorsal portion of body in all specimens, and also ventrolateral region of body in darker individuals, with dark chromatophores concentrated along posterior margin of exposed portion of scales. Dark pigmentation forming overall reticulate pattern in these regions. Most specimens with scattered, dark chromatophores located along myosepta in region ventral of lateral line and above anal fin. Humeral mark dark and ranging in form from almost circular to diamond-shaped, with central portion bordered by variably-developed, less intensely-pigmented dorsal and ventral extensions. Dark pigmentation less intense or sometimes absent along irregular horizontal line within body of humeral mark. Some individuals with ventral one-half of humeral mark below unpigmented horizontal line very faint. Midlateral stripe extending along surface of body from slightly posterior of rear margin of humeral mark to posterior portion of caudal peduncle; stripe wider on caudal peduncle. Posterior limit of midlateral stripe usually coincides with posterior border of hypurals. Guanine limited to lateral and ventral portion of head and body in region from infraorbitals to caudal peduncle. Guanine band partially or totally masking dark midlateral stripe in some specimens.

Dorsal fin with dark chromatophores distributed mainly along two anterior-most unbranched fin rays and intermediate interradiated membrane. Dorsal-fin pigmentation changes ontogenetically from homogenous across fin in smaller individuals to being more concentrated on middle one-third of rays of adults. Anal-fin membranes with

TABLE 2. CHARACTER STATES OF *Creagrutus guanei*, NEW SPECIES, ARRANGED IN SAME ORDER AS IN THE MATRIX IN VARI AND HAROLD (2001); VALUES IN PARENTHESES INDICATE POLYMORPHIC FEATURES.

Character					
1-10	11-20	21-30	31-40	41-50	51-57
1110110111	1110000010	1100111011	0111110101	(0/1)110(0/1)01110	0000100

dark chromatophores forming faint, dusky, diagonal stripe beginning on middle one-third of anterior rays and terminating on proximal one-half of posterior rays. Caudal-fin with scattered, small, dark chromatophores located primarily on interradiation membranes, with lesser number of chromatophores situated on rays. Scales on basal portion of fin variably dark. Dark pigmentation slightly more concentrated on middle caudal-fin rays, albeit not forming distinct stripe. Pelvic and pectoral fins hyaline or with scattered dark chromatophores outlining rays.

Ecology.—The specimens of *Creagrutus guanes* reported above along with other examined samples were collected in piedmont rivers with a conductivity of 513 to 1434 μ S, water temperatures from 18.6 to 25.5 C, pH from 6.93 to 7.78, and Secchi visibility from 5 to 122 cm. These parameters change between the dry and rainy seasons, which, respectively, occur in the type locality region from December to March and from April to November (data provided by IDEAM, Instituto de Meteorología, Hidrología y Estudios Ambientales, Colombia). *Creagrutus guanes* commonly inhabits wide portions of the river and small embayments along the river bank where water flow is minimal. The species forms schools of variable numbers of individuals at different depths within the water column or grazes along the river bottom (pers. obs.). Mature males were captured during both the dry and rainy seasons over a five-month period of continuous sampling, four of which fell within the dry season. Mature females and larvae were, instead, captured only during the dry season.

Distribution.—The type-series of *Creagrutus guanes* was collected in the Río Fonce and one of its tributaries, the Río Mogoticos, within the Río Magdalena basin of northwestern Colombia.

Phylogenetic relationships.—The states in *Creagrutus guanes* for the 57 osteological, myological, meristic, and coloration characters used by Vari and Harold (2001) in the phylogenetic analysis of *Creagrutus* and *Piabina* are presented in Table 2. The strict consensus of 1645 equally parsimonious optimal trees of 148 steps yielded a tree with

CI = 0.21 and RI = 0.25. *Creagrutus guanes* shared the synapomorphies for *Creagrutus* proposed by Vari and Harold (2001:39, clade C) and Ribeiro et al. (2004, clade 2). Under the resultant phylogenetic hypothesis, *C. guanes* was a component of clade E and its inclusive clade F of Vari and Harold (2001:40). Within clade F, *C. guanes* formed part of the polytomy named “Remaining species”. Under the Ribeiro et al. (2004) hypothesis of phylogenetic relationships within *Creagrutus*, *C. guanes* similarly possessed the synapomorphies proposed for the “Remaining Species of *Creagrutus*” (Clade 3 of that study), that corresponds to all species of *Creagrutus* with the exception of *C. varii*, which was described in that study. The phylogenetic analysis failed to demonstrate a close relationship between *C. guanes* with its Río Magdalena congeners or indeed any other trans-Andean species of the genus, a conclusion that coincides with Vari and Harold’s (2001) observation of the non-monophyletic nature of the trans-Andean assemblage of the species of *Creagrutus*.

Remarks.—The presence of epidermal breeding tubercles with keratinized caps as demonstrated by histological examination has not been previously reported for a species of *Creagrutus*, although the papillae reported by previous authors on the head of other members of the genus may represent homologous structures. Breeding tubercles have a spotty known distribution across the Characiformes, being reported in various other genera now assigned to the Characidae (Collette, 1977; pers. obs.), members of the Parodontidae and Lebiasinidae (Wiley and Collette, 1970), and one genus in the African family Distichodontidae (Vari and Ferraris, 2004). The rarity of these processes in many species that are known from good samples may indicate that the structures are only well-developed for a restricted period during the height of the breeding season.

Two cleared-and-stained non-type specimens from ICNMHN 2389 captured at Yacopi-Guadualito on the Río Hatillo, Department of Cundinamarca, Colombia agree with *C. guanes* in all features other than in lacking the third post-temporal fossae that is present in *C. guanes*.

Additional samples from that region must be examined in order to resolve the question of whether the feature is intraspecifically variable or these samples represent another species.

Etymology.—The species name, *guanés*, refers to the Guanés, an indigenous group that occupied the area of the Río Fonce basin, the river inhabited by *Creagrutus guanés*, and who likely first encountered this species. The Guanés intensely resisted the Spaniard conquistadors (Melo, 1996), resulting in their near complete total extinction, with the survivors subsequently mixing with the Spaniards. The species name is treated as a noun in apposition.

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LITERATURE CITED

- COLLETTE, B. B. 1977. Epidermal breeding tubercles and bony contact organs in fishes, p. 225–268. *In*: Comparative Biology of the Skin. R. I. C. Spearman (ed.). Symposia of the Zoological Society, London, 39, Zoological Society of London, London.
- HAROLD, A. S., AND R. P. VARI. 1994. Systematics of the trans-Andean species of *Creagrutus* (Ostariophysi: Characiformes: Characidae). *Smith. Contrib. Zool.* 551:1–31.
- LEVITON, A. E., R. H. GIBBS, JR., E. HEAL, AND C. E. DAWSON. 1985. Standards in herpetology and ichthyology: part I. Standard symbolic codes for institutional resource collections in herpetology and ichthyology. *Copeia* 1985:802–832.
- MELO, J. O. 1996. Historia de Colombia: el establecimiento de la denominación española. Online publication. <http://www.banrep.gov.co/blaaavirtual>.
- NIXON, K. C., AND Q. D. WHEELER. 1990. An amplification of the phylogenetic species concept. *Cladistics* 6:211–223.
- RIBEIRO, A. C., R. C. BENINE, AND C. A. FIGUEREIDO. 2004. A new species of *Creagrutus* Günther (Teleostei: Ostariophysi: Characiformes), from the upper Rio Paraná basin, central Brazil. *J. Fish Biol.* 64:597–611.
- TAYLOR, W. R., AND G. C. VAN DYKE. 1985. Revised procedures for staining and clearing fishes and other vertebrates for bone and cartilage study. *Cybio* 9:107–119.
- VARI, R. P., AND C. J. FERRARIS, JR. 2004. A new species of *Nannocharax* (Characiformes: Distichodontidae) from Cameroon, with the description of contact organs and breeding tubercles in the genus. *Proc. Biol. Soc. Wash.* 117:551–563.
- , AND A. S. HAROLD. 2001. Phylogenetic study of the neotropical fish genera *Creagrutus* Günther and *Piabina* Reinhardt (Teleostei: Ostariophysi: Characiformes), with a revision of the cis-Andean species. *Smith. Contrib. Zool.* 613:1–239.
- , AND F. C. T. LIMA. 2003. New species of *Creagrutus* (Teleostei: Characiformes: Characidae) from the Rio Uaupés basin, Brazil. *Copeia* 2003:583–587.
- WILEY, M. L., AND B. B. COLLETTE. 1970. Breeding tubercles and contact organs in fishes: their occurrence, structure, and significance. *Bull. Amer. Mus. Nat. Hist.* 143:143–216.
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