

A new miniature species of *Odontocharacidium* (Characiformes: Crenuchidae) from the Río Orinoco basin, Venezuela

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A new species of *Odontocharacidium* is described from the upper Río Orinoco basin, in Venezuela. The new species is distinguished from its only congener, *Odontocharacidium aphanes*, by the presence of: the antorbital, the parietal branch of the supraorbital laterosensory canal, the postcleithrum 1, the conspicuous bars extending ventrally below the middle portion of the body posteriorly, and two dark round blotches at the tip of the caudal peduncle. With the recognition of an additional species of *Odontocharacidium* the diagnostic characters of the genus and the variability in the number of maxillary teeth in specimens are discussed.

Keywords: Characidiinae, Miniaturization, Neotropics, Taxonomy, Teleostei.

Uma nova espécie de *Odontocharacidium* é descrita para a bacia do alto rio Orinoco, na Venezuela. A nova espécie se distingue da sua única congênera, *Odontocharacidium aphanes*, pela presença: do antorbital, do ramo parietal do canal látero-sensorial supraorbital, do pós-cleitro 1, de barras conspícuas estendendo-se ventralmente à porção média do corpo e de duas manchas escuras e arredondadas na margem distal do pedúnculo caudal. Com o reconhecimento de uma espécie adicional de *Odontocharacidium*, são discutidos os caracteres diagnósticos do gênero e a variação no número de dentes maxilares nos espécimes.

Palavras-chave: Characidiinae, Miniaturização, Neotrópico, Taxonomia, Teleostei.

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INTRODUCTION

Odontocharacidium Buckup is a miniature representative of the Crenuchidae, a moderately diverse Neotropical family containing 95 valid species distributed in 11 genera and two subfamilies (Fricke *et al.*, 2020). The genus was erected to allocate its type species *Klausewitzia aphanes* Weitzman, Kanazawa as it was considered more closely related to the also miniature genera *Microcharacidium* Buckup and *Elachocharax* Myers, than to *K. ritae* Géry (the type species of *Klausewitzia*) in the sole phylogenetic study for the Crenuchidae (Buckup, 1993a). That close relationship between the three genera (clade EMO) was based on the lack of the parietal branch of supraorbital laterosensory canal; the absence of uroneurals; the presence of only conical teeth in both jaws; the incomplete lateral line; and the presence of a pair of dark blotches, located at the base of the dorsal and ventral caudal-fin lobes (Buckup, 1993a).

Odontocharacidium was diagnosed from the other crenuchids by: 1) absence of posttemporal; 2) absence of the supratemporal laterosensory canal; 3) absence of the pterotic laterosensory canal, and 4) pterotic, parietal and sphenotic lacking dermal portions between the semicircular canals, with the posttemporal fossa limited anteriorly by the sphenotic; 5) absence of postcleithrum 1 (Buckup, 1993b). In addition to these characters, the genus can be recognized by the lack of conspicuous dark pigmentation on the median portions of the pectoral and pelvic fin-rays, and the lack of a conspicuous black blotch on the posterior margin on the adipose fin (Buckup, van der Sleen, 2018). To date, the genus included only its type species, *Odontocharacidium aphanes* (Weitzman, Kanazawa) from the rio Negro in the Amazon basin (Weitzman, Kanazawa, 1977), but during a revisionary study of the genus, a new species from the Río Orinoco in Venezuela was detected among museum samples, and is described herein.

MATERIAL AND METHODS

Counts and measurements follow Buckup (1993b). Measurements were made from photographs of the left side of specimens, with aid of the software Axion Vision 4.8. All measurements are presented as proportions of standard length (SL), except for subunits of the head, which are presented as proportions of the head length (HL). The values for each meristic data in the description are followed by their frequency in parentheses with an asterisk indicating the values for the holotype. Counts of vertebrae, supraneurals, branchiostegal rays, and teeth were obtained from cleared and stained (c&s) specimens prepared according to Taylor, Van Dyke (1985). Vertebrae of the Weberian apparatus were counted as four precaudal elements, and the fused PU1+U1 of the caudal region as a single element. Specimens were sexed macroscopically through a small incision on the right side of the body for gonad inspection.

Institutional abbreviations are Academy of Natural Sciences of the Drexel University (ANSP), Field Museum of Natural History (FMHN), Instituto Nacional de Pesquisas da Amazônia (INPA), Laboratório de Biologia e Genética de Peixes (LBP), Museo de Historia Natural La Salle (MHNLS), Museu Paraense Emílio Goeldi (MPEG), Museu de Zoologia da Universidade de São Paulo (MZUSP), and National Museum of Natural History/Smithsonian Institution (USNM).

RESULTS

Odontocharacidium varii, new species

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(Fig. 1; Tab. 1)

Odontocharacidium aphanes (not Weitzman, Kanazawa, 1977). —Buckup, 1993a:305–41 (phylogenetic study of Characidiinae). —Buckup, 1993b:136 (description of *Odontocharacidium*; distribution). —Buckup, 2003:93 (Checklist; occurrence in Venezuela). —Buckup, van der Sleen, 2018:147 (Field guide; distribution).

Holotype. MHNLS 26156, 14.7 mm SL, Venezuela, Río Negro Municipality, Río Orinoco, Caño Chola, where it crosses the road from San Carlos de Río Negro to Solano, 1°58'00"N 67°00'00"W, 11 Apr 1985, R.P. Vari.

Paratypes. All from Venezuela, Amazonas: ANSP 161317, 8, 14.3–15.8 mm SL, Venezuela, Amazonas, Cano Caño entering eastern side of Río Casiquiare ca. 7.0 km approx. downstream from mouth of Río Pamoni, 2°48'00"N 65°58'00"W, 20 Mar 1987, B. Chernoff, S.W.G. Lopes, J. Fernandez, O. Castillo, M.E Antonio. FMNH 105971, 4, 12.7–12.8 mm SL, Venezuela, Território Federal Amazonas [Currently Estado Amazonas], Caño Curcutito about 1 km upstream mouth in Río Autana, 4°43'48"N 67°37'12"W, 11 Feb 1992, B. Chernoff, A. Machado–Allison, J. A Wheeler, J. Fernandez, N. M. Gotschall. USNM 270149, 21, 14.1–16.6 mm SL (2 c&s), 14.8–15.8 mm SL, collected with holotype.

Diagnosis. *Odontocharacidium varii* differs from *O. aphanes* by the presence of the antorbital (*vs.* antorbital absent); the presence of the supraorbital laterosensory canal (*vs.* canal absent); the presence of postcleithrum 1 (*vs.* postcleithrum 1 absent); the presence of conspicuous bars extending ventrally to the middle portion of the body (*vs.* bars restricted to the dorsal portion of the body); and the presence of two dark round blotches located at the tip of caudal peduncle (*vs.* blotches absent).

Description. Morphometric data for the holotype and paratypes, Tab.1. Body short, relatively compressed. Dorsal profile convex from snout tip to dorsal-fin terminus, slightly concave or nearly straight from that point to insertion of anteriormost dorsal caudal-fin procurrent rays. Ventral profile convex from lower lip to pelvic-fin insertion, moderately convex from that point to anal-fin origin, becoming slightly concave from that point to insertion of first ventral procurrent caudal-fin ray.

Mouth small, terminal. Teeth on both jaws conical, Fig. 2. Premaxilla with single row of 9(1) or 10(1) teeth decreasing in size laterally. Maxilla reaching vertical through anterior margin of orbit. Maxilla with 9(1) or 10(1) teeth along entire ventral edge, Fig. 2. Dentary with two series of teeth, outer series with 8(2), inner series with 9(1) or 12(1). Ectopterygoid teeth 6(1) or 7(1). Endopterygoid edentulous. Nostrils round distinctly separated by fleshy bridge without dermal flaps. Posterior nostril closer to orbit and

TABLE 1 | Morphometrics of *Odontocharacidium varii*. Number of individuals (20), mean, minimum (Min), maximum (Max) and standard deviation (SD) include values of the holotype.

	Holotype	Min	Max	Mean	SD
Total length (mm)	18.6	17.5	19.8	18.7	0.5
Standard length (mm)	14.7	14.1	16.7	15.1	0.6
Head length (mm)	4.5	4.0	5.1	4.5	0.3
Percentage of SL					
Body depth at dorsal-fin origin	23.0	22.0	25.9	23.3	1.0
Body depth at anal-fin origin	12.0	11.8	14.7	13.5	0.8
Body depth at caudal peduncle	9.9	7.7	15.9	9.1	1.7
Head length	30.8	27.9	31.4	30.0	1.1
Preal distance	75.0	72.8	77.4	74.7	1.1
Predorsal distance	49.8	47.6	90.6	49.0	0.7
Prepectoral distance	33.0	29.9	33.5	31.5	1.1
Prepelvic distance	53.2	48.7	53.2	51.1	1.3
Anal-apex distance	88.5	86.7	90.6	88.7	1.1
Body width	14.0	11.9	15.5	13.7	0.9
Percentage of HL					
Snout length	18.9	18.7	23.8	20.4	1.3
Orbital diameter	37.2	35.2	42.0	38.6	1.8
Cheek depth	7.2	4.3	9.8	7.2	1.4
Anterior naris-orbit	6.2	4.3	8.7	6.3	1.1
Posterior naris-orbit	5.7	5.7	15.3	10.5	2.1
Snout-maxillary tip	20.0	15.6	25.9	19.9	2.5
Interorbital distance	28.4	21.4	35.1	27.5	3.1

slightly larger than anterior nostril. Small cranial fontanel bordered by supraoccipital, parietal and frontal. Branchiostegal rays 4(2); 3(2) in the anterior ceratohyal, and 1(2) between the anterior ceratohyal and posterior ceratohyal. Antorbital present. Parietal branch of supraorbital laterosensory canal present.

Scales cycloid. Lateral line longitudinal series with 29(1), 30*(5), 31(7), 32(3) or 33(2) scales, of which 4(6), 5*(8) or 6(2) are perforated. Longitudinal series above lateral line 3(18) or 4*(2); and 4*(17) or 5(2) below. Predorsal scales 6(1), 7*(10) or 8(9). Isthmus completely scaled. Circumpeduncular scales 12*(20).

Pectoral-fin total rays 7(1), 8(5) or 9*(14), second and third rays longest. Tip of adpressed pectoral fin not reaching pelvic-fin origin. Postcleitrum 1 present. Pelvic-fin total rays 8(3), 9*(14) or 10(2); first, second and third rays longest. Longest pelvic-fin rays reaching vertical through anal-fin origin. Supraneurals 4(2), anterior to neural spines of vertebral centra 5-8(2). Dorsal-fin rays ii,9*(22); second and third rays longest; first pterygiophore anterior to neural spine of centrum 9(2). Adipose fin present or absent, present in holotype. Anal-fin rays ii,5(5), ii,6*(6) or ii,7(9); third and fourth rays longest; first pterygiophore anterior to haemal spine of centrum 20(1) or 21(1). Caudal-fin principal rays 10/8(1) or 10/9*(21). Hypural 6 present. Precaudal vertebrae 17(2), caudal 15(2); total vertebrae 32(2).



FIGURE 1 | *Odontocharacidium varii*, new species, A. Holotype, MHNLS 26156, 14.7 mm SL, Venezuela, Río Negro Municipality, Río Orinoco; Paratype, USNM 270149, 14.3 mm SL, Venezuela, Río Negro Municipality, Río Orinoco. Scale bar = 1 mm.

Coloration in alcohol. Background color of head and body pale yellow. Dark brown chromatophores scattered on sides of head. Chromatophores conspicuously concentrated on upper lip, with area between nostrils forming diffuse band. Small concentration of chromatophores from lower lip to near terminus of maxilla. Concentration of chromatophores forming dark triangular suborbital blotch. Dorsal profile of head and posterior margin of orbit with scattered chromatophores forming light brown pigmentation. Dorsal portion of head conspicuously more pigmented than lateral portions. Opercular membrane hyaline.

Humeral blotch present, conspicuous. Vertical bars on dorsal portion of body 6(2), 7(8), 8*(7) or 9(3); bars anterior to insertion of dorsal fin 2*(19) or 3(1); 2*(20) along dorsal-fin base; 3(1), 4*(16) or 5(3) between dorsal-fin terminus and distal tip of caudal peduncle. Bars reaching beyond the midline portion of the body ventrally usually between pelvic-fin and anal-fin origins, with posterior most four bars reaching ventral portion of body. Horizontal septum intermittently pigmented, forming series of thin, dark dashes from pectoral girdle to near tip of caudal peduncle. Ventral portion with

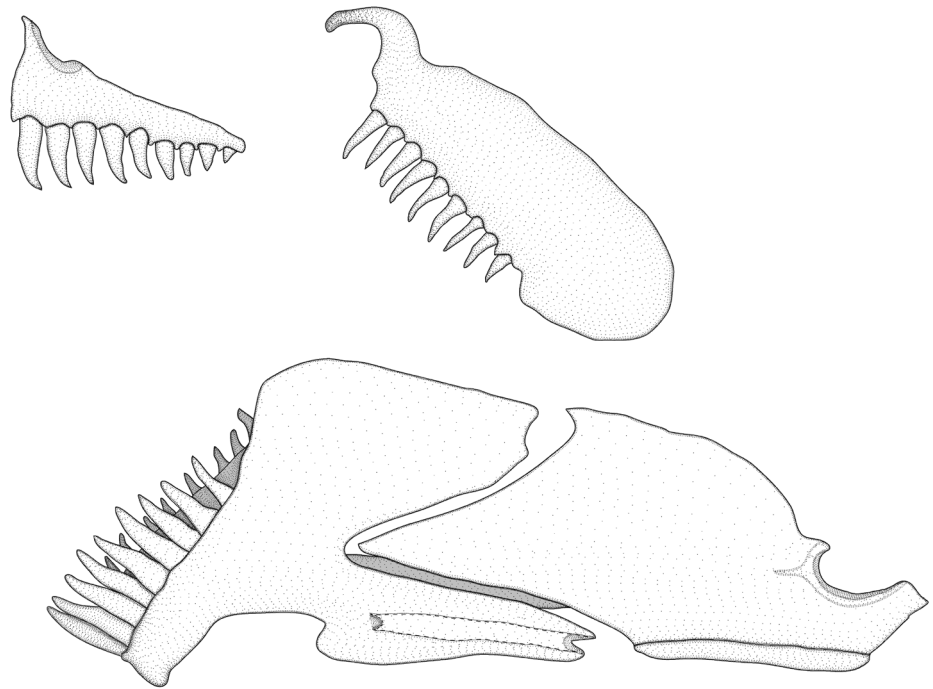


FIGURE 2 | *Odontocharacidium varii*, new species, USNM 270149, paratype, 15.8 mm SL, Venezuela, Río Negro Municipality, Río Orinoco. Lateral view of mandibular arch and dentition, flipped right side, anterior to left.

concentration of chromatophores on mid-ventral scales forming three thin dark bands at pelvic-fin origin, near anus and at anal-fin base. Caudal peduncle with two dark round blotches at base of each caudal-fin lobe. Pectoral, pelvic, anal and caudal fins hyaline with scattered chromatophores at distal tips. Dorsal fin with concentration of chromatophores forming two discrete horizontal bands, one at middle of in rays and the other at distal tip.

Sexual dimorphism. Dissection of paratypes of *Odontocharacidium varii* for gonad inspection failed to unambiguously determine sex of available specimens, as gonads of all examined specimens seemed to be immature or in resting stages. Additionally, no distinguishable external secondary sexually dimorphic characters were observed in those specimens.

Geographical distribution. *Odontocharacidium varii* is known from the upper portion of the Río Orinoco, Fig. 3.

Etymology. The specific epithet is in honor to Richard P. Vari, first collector of the new species and constant professional inspiration to the authors. A noun in genitive.

Conservation status. *Odontocharacidium varii* is known from three different localities in the upper Río Orinoco basin. Although none of the sampling sites is within preservation areas, those appear to be well preserved. Besides, there are several national

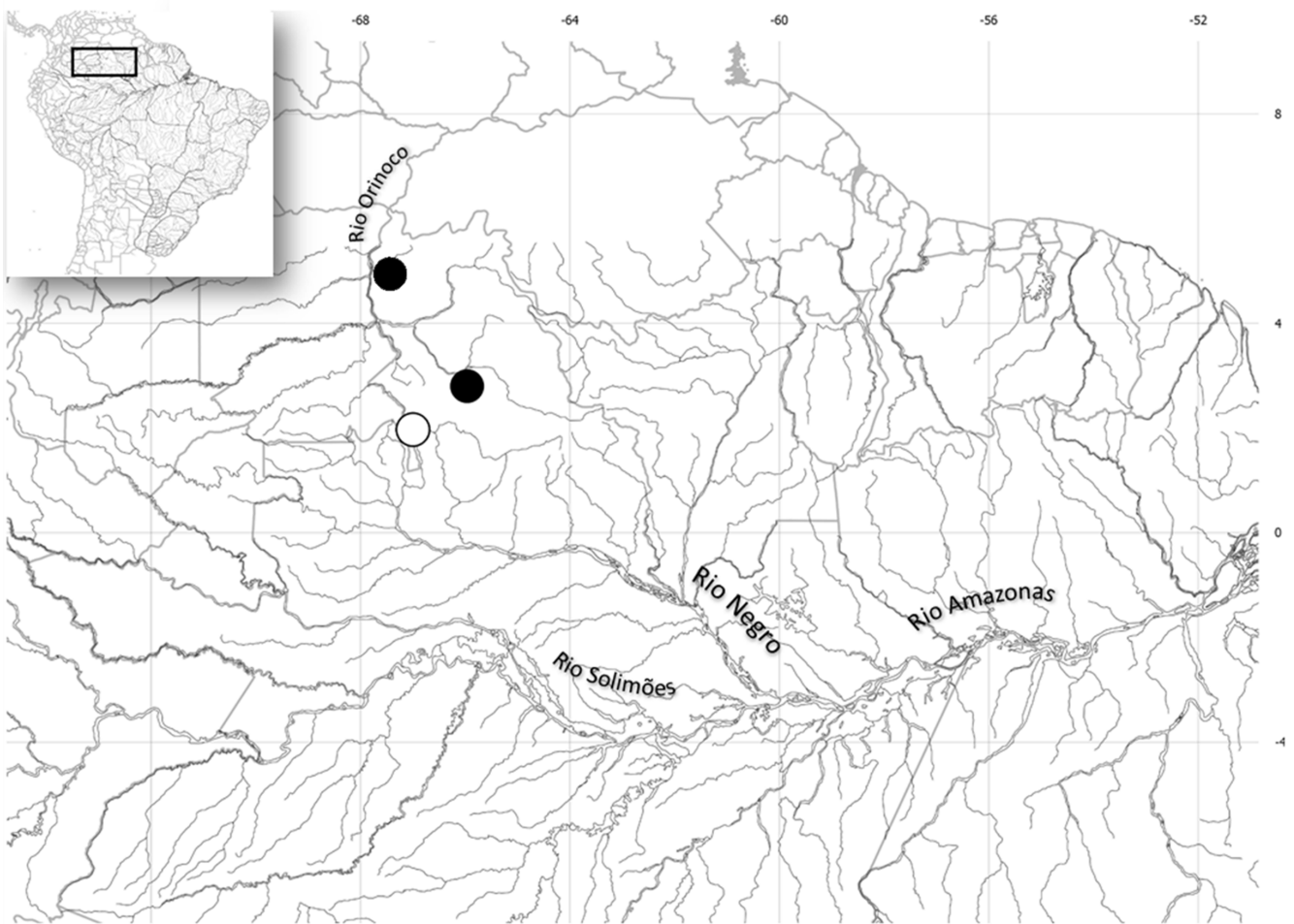


FIGURE 3 | Map of geographical distribution of *Odontocharacidium varii* (circles). Type-locality represented by the same symbol in white color.

parks and indigenous areas surrounding the known area of occurrence of the species, suggesting the lack of significant threats to the conservation of the species. Therefore, *Odontocharacidium varii* can be classified herein as a Least Concern (LC) species according to the International Union for Conservation of Nature (IUCN) categories and criteria (IUCN, 2019).

Remarks. *Odontocharacidium varii* present a slight variation of color pattern, with some specimens having it more pronounced than others. The bands, bars and the humeral blotch can vary in intensity among specimens from the same lot, Fig. 1. It is unclear at this moment if this phenomenon is indicative of intraspecific variation or coloration fading of the specimens. Nevertheless, both limits of the variation range allow unambiguous distinction between specimens of *O. varii* from *O. aphanes*.

Comparative material examined. Brazil, Rio Negro: MZUSP 12978, 1, 13.4 mm SL (holotype of *Odontocharacidium aphanes* Weitzman & Kanazawa, 1977). MZUSP 12979, 3, 11.4–13.0 mm SL (paratypes of *Odontocharacidium aphanes*). MZUSP 109657,

2, 12.3–11.8 mm SL. MPEG 25491, 2, 14.6–16.2 mm SL. **Rio Branco:** INPA 39429, 2, 13.1–12.4 mm SL. MZUSP 113270, 3, 10.1–10.3 mm SL. MZUSP 113665, 36, 10.8–13.3 mm SL. LBP 15115, 12, 14.1–15.9 mm SL, 1 c&s, 14.6 mm SL. LBP 15114, 8, 15–16.1 mm SL, 1 c&s, 14.7 mm SL.

DISCUSSION

The close relationship between *Odontocharacidium varii* and *O. aphanes* is proposed herein as both species share most diagnostics characters hypothesized by Buckup (1993b) as defining the genus: 1) absence of the posttemporal; 2) absence of the the supratemporal sensory canal; 3) absence of the pterotic sensory canal, and 4) pterotic, parietal and sphenotic lacking dermal portions between the semicircular canals, with the posttemporal fossa limited anteriorly by the sphenotic; 5) absence of postcleithrum 1 (Buckup 1993b). Conversely, unlike *O. aphanes*, the specimens of *Odontocharacidium varii* examined herein present a bilaterally symmetric postcleithrum 1, an antorbital and the parietal branch of supraorbital laterosensory canal, conditions absent in *O. aphanes*. The sharing of four out of five exclusive characters defining *Odontocharacidium* justifies not only the inclusion of the species described herein in the genus, but also to re-diagnose the genus, based only on the absence of the posttemporal, the absence of the the supratemporal sensory canal, the absence of the pterotic sensory canal, and the lack of dermal portions on the pterotic, parietal and sphenotic between the semicircular canals, with the posttemporal fossa limited anteriorly by the sphenotic.

The diagnostic features of *Odontocharacidium* proposed by Buckup (1993b) and reviewed herein seem to represent developmental truncations, associated to the miniaturization process, which usually leads to losses and simplifications of dermal bones (*i.e.* posttemporal and postcleithra) or dermal portions of composite bones (*i.e.* pterotic and sphenotic) (Britz, Conway, 2009; Britz *et al.*, 2009; Toledo-Piza *et al.*, 2014; Mattox *et al.*, 2016). Although no mature specimens of *Odontocharacidium varii* were detected in the present study, none of the 34 representatives of the species examined herein is larger than 17 mm SL, suggesting a size range similar to that of *O. aphanes* for *O. varii*. The new species would, therefore, fit the criteria established by Weitzman, Vari (1988) to consider this species a miniature, bringing the number of miniaturized crenuchids to 17 (Toledo-Piza *et al.*, 2014; Mendonça, Netto-Ferreira 2015).

Although Buckup (1993a) considered the absence of the parietal branch of the supraorbital canal as a synapomorphy for the clade including *Elachocharax*, *Microcharacidium* and *Odontocharacidium* (EMO), representatives of the new species described herein present a small bony tube branching from the supraorbital laterosensory canal, topologically similar to that illustrated by Buckup (1993c) for *Characidium fasciatum* Reinhardt, and by Weitzman (1962) for *Brycon meeki* Eigenmann, Hildebrand, and attributed as the parietal branch of the supraorbital canal. Representatives of *O. aphanes* and species of *Microcharacidium*, on the other hand, indeed lack any branching on the supraorbital canal as described by that author, and the presence of that condition in *O. varii* may be considered a reversal. Likewise, the pair of dark blotches at the base of each caudal-fin lobe, also hypothesized as synapomorphic of the aforementioned clade containing the three genera seems to have been secondarily lost in *Odontocharacidium*

aphanes. Buckup (1993a) considered this character as present in *O. aphanes*, but in fact, such interpretation was actually based on specimens of the lot USNM 270149, herein recognized as *Odontocharacidium varii* (see synonymy list).

Weitzman, Kanazawa (1977) observed a conspicuous variability in the number of maxillary teeth (9 to 17), when describing *Odontocharacidium aphanes*. The examination of specimens of *O. aphanes* herein resulted in a slightly greater variation (3 to 15), although no specimens with more than 15 teeth were found. Within that variation, some specimens seem to present consistently teeth restricted to the anterior portion of the maxilla, whereas other specimens usually have teeth covering the entire ventral surface of the bone. Unlike *O. aphanes*, all examined representatives of *O. varii* have teeth along the entire ventral edge of the maxilla, Fig. 2. A similar condition was described associated with sexual dimorphism in *Copella* and *Pyrrhulina* members of the Lebiasinidae (Netto-Ferreira, Marinho, 2013; Marinho, Menezes, 2017; Vieira, Netto-Ferreira, 2019).

To this moment, *Odontocharacidium varii* had been confused with *O. aphanes* in collections and by Buckup (1993a,b), who examined the specimens from Caño Chola (USNM 270149). Such misidentification may have been induced by the distinctive overall morphology of *Odontocharacidium* among Characidiinae, besides the diminutive size of the specimens, which can be considered an additional difficulty in detecting the variation among different populations or species in the genus. Considering the minute size of the representatives of the genus, and the lack of taxonomic studies subsequent to those of Buckup (1993a), it is likely that the species richness in *Odontocharacidium* and other miniature Crenuchidae may be considerably underestimated and pending formal description, as was recently observed by (Toledo-Piza *et al.*, 2014; Mattox *et al.*, 2016) for the heterocharacin *Priocharax* Weitzman, Vari.

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AUTHOR'S CONTRIBUTION

Elizabeth Kathleen de Queiroz Rodrigues: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Validation, Writing-original draft, Writing-review & editing.

Andre Luiz Netto-Ferreira: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Writing-review & editing.

ETHICAL STATEMENT

Not applicable.

COMPETING INTERESTS

The authors declare no competing interests.

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