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Redescriptions of two little-known pimelodid catfishes from the São Francisco River basin, Brazil: *Duopalatinus emarginatus* and *Bagropsis reinhardti* (Teleostei: Siluriformes)

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The São Francisco River basin in eastern Brazil harbors a highly endemic ichthyofauna, including the poorly known pimelodid catfishes *Duopalatinus emarginatus* and *Bagropsis reinhardti*. Despite being described in the 19th century, these species have remained taxonomically obscure due to limited specimen availability and confusion with other taxa. In this study, we provide detailed redescriptions of both species based on recently collected and newly identified material, including misidentified museum specimens. Morphological comparisons and osteological data confirm that *Duopalatinus emarginatus* and *Bagropsis reinhardti* are distinct, differing in several skeletal and meristic characters, as well as habitat preferences. Our findings support a revised classification within Pimelodidae, with *Bagropsis* (now including *Pimelodus atrobrunneus* and *P. paranaensis*) and *Duopalatinus emarginatus* together forming the newly proposed tribe Bagropsini. We also present updated distributional data, highlighting the distinct ecological niches occupied by each species within the São Francisco basin. These redescriptions are crucial for accurate species identification and have direct implications for conservation assessments. Key identification to Pimelodidae species from São Francisco River basin is provided.

Keywords: Endemic, Endangered species, Ichthyofauna, Identification key, Pimelodidae.

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A bacia do rio São Francisco, no leste do Brasil, abriga uma ictiofauna altamente endêmica, incluindo os bagres pimelodídeos pouco conhecidos *Duopalatinus emarginatus* e *Bagropsis reinhardti*. Apesar de descritas no século XIX, essas espécies permaneceram obscuras do ponto de vista taxonômico devido à disponibilidade limitada de espécimes e à confusão com outros táxons. Neste estudo, fornecemos redescrições detalhadas de ambas as espécies com base em material recentemente coletado e recém-identificado, incluindo espécimes de museu anteriormente identificados de forma incorreta. Comparações morfológicas e dados osteológicos confirmam que *Duopalatinus emarginatus* e *Bagropsis reinhardti* são espécies distintas, diferindo em vários caracteres esqueléticos e merísticos, bem como em preferências de habitat. Nossos resultados sustentam uma classificação revisada dentro de Pimelodidae, com *Bagropsis* (agora incluindo *Pimelodus atrobrunneus* e *P. paranaensis*) e *Duopalatinus emarginatus* juntos formando a tribo recém-proposta Bagropsini. Também apresentamos dados de distribuição atualizados, destacando os nichos ecológicos distintos ocupados por cada espécie dentro da bacia do São Francisco. Essas redescrições são essenciais para a identificação precisa das espécies e têm implicações diretas para avaliações de conservação. É fornecida uma chave de identificação das espécies de Pimelodidae da bacia do rio São Francisco.

Palavras-chave: Chave de identificação, Endêmico, Espécies ameaçadas, Ictiofauna, Pimelodidae.

INTRODUTION

The ichthyofauna of the São Francisco River basin in eastern Brazil is notable for its high level of endemicity. Barbosa *et al.* (2017) reported 241 native freshwater species, with nearly 60% endemic, presently six genera and 56 species of Siluriformes restricted to the São Francisco. These include species that are exceptionally distinctive in morphology and systematic position, such as *Conorhynchos* Bleeker, 1858 (Superfamily Pimelodoidea, *Incertae sedis*, Sullivan *et al*., 2006), *Lophiosilurus* Steindachner, 1877 (Pseudopimelodidae), *Franciscodoras* Eigenmann, 1925 (Doradidae), and *Plesioptopoma* Reis, Pereira & Lehmann A, 2012 (Loricariidae). Also, among these, the pimelodid catfishes *Duopalatinus emarginatus* (Valenciennes, 1840) and *Bagropsis reinhardti* Lütken, 1874, are of particular interest because they are poorly known taxonomically and ecologically. Despite their early descriptions well over a century ago, the available information on *D. emarginatus* and *B. reinhardti* has been insufficient to allow an evaluation of their taxonomic validity and systematic relationships. Until recently, neither species was represented by more than a handful of specimens preserved in natural history museums. In fact, it had been thought that the only extant specimens of *B. reinhardti* are its five syntypes deposited in the collections in Copenhagen (ZMUC), Vienna (NMW), and London (BMNH).

Duopalatinus emarginatus was described by Valenciennes (1840) as *Platystoma emarginatum*, and later Eigenmann, Eigenmann (1888) established the genus *Duopalatinus* for the single species. A second species, *D. peruanus*, was placed in the genus by Eigenmann, Allen (1942). However, *D. peruanus*, from the Amazon and Orinoco basins is more closely related to the so-called long-finned pimelodids (Parisi *et al*., 2006) including *Exallodontus* Lundberg, Mago-Leccia & Nass, 1991, *Propimelodus* Lundberg & Parisi, 2002, and *Pimelodus altissimus* Eigenmann & Pearson, 1942 (Lundberg *et al*., 2011; Rocha, 2012; Rocha, Littmann, 2025).

The genus *Bagropsis* was proposed by Lütken (1874) with *Bagropsis reinhardti* as its sole and type-species. Since its description, *B. reinhardti* has been a vaguely-known species with an uncertain position within Pimelodidae and known only by the syntypes at ZMUC (Copenhagen), BMNH (London), and NMW (Vienna). All the specimens of *B. reinhardti* recently found by us at MZUSP were misidentified as *Duopalatinus emarginatus*.

The impetus for the present study was our discovery in the fish collection at Museu de Zoologia da Universidade de São Paulo, Brazil, of mixed and uncertainly identified samples from the São Francisco basin, containing both *D. emarginatus* and *B. reinhardti*. Besides that, some new specimens of both species were recently collected, which provided the incentive for our reexamination of their taxonomic status.

Rocha (2012) provided a detailed morphological study of the family Pimelodidae and used the newly available specimens of both *D. emarginatus* and *B. reinhardti*. According to the cladogram obtained in Rocha (2012), it was shown that *Bagropsis reinhardti* is related to *Pimelodus atrobrunneus* Vidal & Lucena, 1999 and *Pimelodus paranaensis* Britski & Langeani, 1988, as well as the non-monophyly of *Duopalatinus.* Recently Rocha, Littmann (2025) based on Rocha's matrix proposed a new classification of Pimelodidae, including these taxa in a new tribe Bagropsini of the subfamily Pimelodinae. Thus, the purpose of this paper is to redescribe, compare and provide additional taxonomic and ecological information on these poorly known and closely similar pimelodids.

MATERIAL AND METHODS

Measurements and counts follow Lundberg, Parisi (2002). Vertebral counts include six elements in the Weberian complex; the compound caudal vertebra (PU1+U1) is counted as one; counts of fin rays include all rudiments; counts of gill rakers, for the first arch, include all rudiments. Radiographed, cleared and stained (c&s), and articulated dry skeletal (sk) specimens were used for counts of vertebrae, fin rays, and gill rakers. C&s specimens prepared according to Taylor, Van Dyke (1985) and x-ray images taken with a Faxitron LX-60 digital system housed at INPA. Institutional abbreviations follow Sabaj (2020). The geographic distribution map was prepared with the QGIS software (v. 2.14.5) using the tutorial of Calegari, Fontenelle (2017). The identification key provided was adapted from Ribeiro, Lucena (2006) and Britski *et al*. (1988), and is also based on the material examined in this study, as cited in the sections for each species.

RESULTS

Duopalatinus Eigenmann & Eigenmann, 1888

Type-species: *Platystoma emarginatum* Valenciennes, 1840, by original designation and monotypy.

Included species: *Duopalatinus emarginatus* (Valenciennes, 1840).

Diagnosis. *Duopalatinus* is a member of the family Pimelodidae, as indicated by its possession of the synapomorphic features proposed by Lundberg *et al*. (1991), Lundberg, Littmann (2003), Rocha (2012) and Rocha, Littmann (2025). Rocha, Littmann (2025) also recognized three subfamilies within Pimelodidae, with *Duopalatinus* recovered as a member of Pimelodinae, which comprises *Aguarunichthys* Stewart, 1986, *Bagropsis*, *Bergiaria* Eigenmann & Norris, 1901, *Calophysus* Müller & Troschel, 1843, *Cheirocerus* Eigenmann, 1917, *Duopalatinus*, "*Duopalatinus*" *peruanus*, *Exallodontus* Lundberg, Mago-Leccia & Nass, 1991, *Iheringichthys* Eigenmann & Norris, 1900, *Luciopimelodus* Eigenmann & Eigenmann, 1888, *Megalonema* Eigenmann, 1912, *Parapimelodus* LaMonte, 1933, *Pimelabditus* Lundberg & Parisi, 2009, *Pimelodina* Steindachner, 1876, *Pimelodus* Lacepède, 1803, "*Pimelodus*" *ornatus* Kner, 1858, *Pinirampus* Bleeker, 1858, and *Propimelodus* Lundberg & Parisi, 2002.

Within Pimelodinae *Duopalatinus* is distinguished from all genera by 1) the shape of its premaxillary tooth plate, with its posterolateral process twice the length of the symphysis, extending to the posterior end of lateral ethmoid, and almost contacting the anterior process of metapterygoid (Fig. 1) (*vs*. premaxillary tooth plate absent or extremely reduced in adults of *Iheringichthys*, *Bergiaria*, *Pimelodina*, and *Cheirocerus*; premaxillary tooth plate thin and curved, with few rows of teeth, lacking a posterior process, in *Pimelodus*, *Exallodontus*, *Calophysus*, *Propimelodus*, *Parapimelodus*, *Megalonema*, *Luciopimelodus* and *Pinirampus*; premaxillary tooth plate with its posterolateral process approximately equal in length to the symphysis, not surpassing the middle of the lateral ethmoid in *Aguarunichthys*, "*Duopalatinus*" *peruanus*, "*Pimelodus*" *ornatus* and *Bagropsis*; premaxillae butterfly-shaped in ventral view, each premaxilla greatly expanded posteriorly and posterolaterally with an edentulous posterior process in *Pimelabditus*); 2) the size and shape of vomerine tooth plate, consisting of two large, oval tooth plates, with the greatest length along the anteroposterior axis of the fish, and sometimes joined anteriorly at the midline (Fig. 1) (*vs*. vomerine tooth plate absent in *Aguarunichthys*, *Bergiaria*, *Calophysus*, *Cheirocerus*, *Exallodontus*, *Iheringichthys*, *Luciopimelodus*, *Megalonema*, *Parapimelodus*, *Pimelabditus*, *Pimelodina*, *Pimelodus*, "*Pimelodus*" *ornatus*, *Pinirampus*, and *Propimelodus*; two small to moderately sized, well-separated patches of vomerine teeth in *Bagropsis* and "*Duopalatinus*" *peruanus*).

It also can be distinguished from all genera of Pimelodinae except *Pimelabditus* by the acute posterior cleithral process with the posterior process distant to the posterior dorsal process and cleithrum with a concave ventral margin (Fig. 2) (*vs*. posterior cleithral process absent in *Cheirocerus* and *Megalonema*; posterior cleithral process reduced in *Aguarunichthys*, *Calophysus*, *Luciopimelodus*, *Pimelodina*, and *Pinirampus*; acute and long posterior cleithral process with ventral margin of cleithrum forming a straight line in “*Pimelodus*” *ornatus*; robust and truncate posterior cleithral process with the posterior process close to the posterior dorsal process in *Bergiaria*, “*Duopalatinus*” *peruanus*, *Exallodontus*, *Iheringichthys*, *Parapimelodus*, *Pimelabditus*, *Pimelodus*, and *Propimelodus*; short and acute posterior cleithral process, with a straight dorsal margin close to the posterior dorsal process of the cleithrum in *Bagropsis*. It can also be distinguished from all genera except *Bagropsis* and “*Duopalatinus*” *peruanus* by the presence of teeth on a large area of the anterior portion of the metapterygoid (Fig. 3).

Duopalatinus emarginatus (Valenciennes, 1840)

(Figs. 1–5; Tab. 1)

Platystoma emarginatum Valenciennes in Cuvier, Valenciennes, 1840:25 [19 of Strasbourg deluxe ed.]. Type-locality: rivière de Saint-Francois [rio São Francisco, Brazil]. Holotype: MNHN A.9353 (mounted).

Diagnosis. Same for the genus.

Description. Morphometric data presented in Tab. 1. General aspect of body showed in Fig. 4. Dorsal profile of head straight from tip of snout to supraoccipital process, then slightly convex to dorsal fin origin. Head depressed. Dorsal surface of head including the supraoccipital process covered by skin. Cranial roof bones well developed and ornamented with shallow grooves and reticulated ridges. Overall profile of neurocranium flat and more convex in posterior region of supraoccipital. Supraoccipital process strong, wider at its base, narrowing posteriorly, and reaching and interdigitating with anterior nuchal plate. Supraoccipital with a small fontanel. Sphenotic approximately larger than pterotic contacting supraoccipital, thus excluding the contact between frontal and pterotic. Pterotic with a long posterior process, contacting supracleithrum. Frontal long, external margin concave, between lateral ethmoid and sphenotic. Anterior fontanel present, long, delimited by frontals and mesethmoid. Fontanel visible, starting posterior to posterior nares and reaching the posterior orbital margin. Posterior nostril closer to anterior nostril than to eye. Eyes large and dorsally located; 15.3% of HL. Mouth gape large. Barbels narrow, elongate; maxillary barbel not reaching anal-fin tips; external mental barbel not surpassing pectoral-fin tips; internal barbel not reaching pectoral fin origin. Upper mandible projecting beyond lower. Premaxillary tooth plate visible from ventral view.

Villiform teeth in premaxillary, dentary, vomerine, and metapterygoid tooth plates. Premaxillary tooth plate large, with a postero-lateral projection that reaches the posterior half of the lateral ethmoid facet for autopalatine. Vomer lacking anterolateral process. Two large patches of vomerine tooth, sometimes joined anteriorly, plates oval-shaped, longer than wide (Fig. 1). Metapterygoid roughly rectangular, articulating with quadrate ventrally and hyomandibula posteriorly and to entopterygoid anterodorsally. Lateral process of metapterygoid well developed. A large patch of teeth on the anterior part of metapterygoid. Metapterygoid tooth patch longer than wide (Fig. 3). Entopterygoid long, curved, situated between metapterygoid and lateral ethmoid. Mesially contacting the pterygoid process of metapterygoid, posteriorly the lateral

TABLE 1 | Comparison of morphometric characteristics for *Duopalatinus emarginatus* and *Bagropsis reinhardti*. N = number of specimens, SD = Standard deviation.

	Duopalatinus emarginatus					*Bagropsis reinhardti*				
	N	Mean	Range		SD	N	Mean	Range		SD
Standard length (mm)	10		175-375			8		98.8-157.1		
Percents of standard length										
Preadipose length	10	66.6	62.5	69.6	2.4	8	66.3	64.0	68.7	1.4
Predorsal length	10	38.6	36.7	41.8	1.4	8	37.9	36.8	39.2	0.8
Prepectoral-fin length	10	27.0	24.7	29.7	1.4	8	26.2	23.4	29.4	1.9
Body depth	10	18.3	16.0	21.2	1.6	8	16.9	15.8	19.4	1.2
Body width	10	19.5	18.3	22.1	1.1	8	20.1	19.1	21.2	0.7
Head length	10	28.9	27.8	31.3	1.1	8	27.9	25.9	29.1	1.1
Dorsal spine	9	16.2	15.0	18.5	1.0	8	16.7	15.3	18.6	1.2
Dorsal-ray	10	19.3	17.3	21.4	1.1	8	21.9	20.8	23.9	1.2
Dorsal-fin base length	10	13.9	13.3	15.3	0.6	8	14.2	12.8	15.1	0.8
Dorsal fin - adipose fin distance	10	14.1	11.7	16.4	1.8	8	14.6	13.4	17.8	1.5
Adipose-fin base length	10	22.0	19.9	25.3	1.5	8	21.6	19.4	23.2	1.5
Adipose-fin height	10	5.1	4.5	6.1	0.4	8	6.3	5.8	6.8	0.4
Caudal peduncle length	10	17.8	16.9	19.4	0.8	8	18.7	17.2	20.2	1.1
Caudal peduncle depth	10	8.0	7.5	9.0	0.5	8	8.8	8.3	9.7	0.4
Anal-fin height	10	15.1	13.8	16.2	0.7	8	16.3	15.7	16.9	0.4
Anal-fin base	10	9.8	9.1	10.8	0.5	8	10.4	9.8	11.2	0.5
Pectoral-fin spine length	9	14.7	14.0	16.1	0.6	8	15.4	14.1	17.2	1.0
Pectoral-ray	9	16.2	14.6	17.8	1.1	8	18.1	17.1	19.4	0.8
Pelvic-fin length	10	14.9	14.2	15.7	0.4	8	16.4	15.4	17.4	0.8
Anus-anal-fin	9	15.9	14.6	16.9	0.7	8	15.7	14.8	16.9	0.8
Percents of head length										
Snout	10	49.4	46.4	52.4	1.7	8	47.1	45.0	48.9	1.2
Mouth width	10	41.0	35.3	43.3	2.4	8	41.1	37.3	45.3	2.7
Interorbital	10	21.2	17.9	23.4	1.8	8	23.4	20.0	28.1	3.0
Horizontal eye diameter	10	15.3	12.9	20.2	2.2	8	21.6	19.9	24.5	1.4
Vertical eye diameter	10	11.0	9.6	13.0	1.0	8	15.4	13.8	17.3	1.4
Posterior nostril-eye distance	10	24.6	22.2	26.4	1.4	8	19.2	17.1	21.1	1.4
Anterior-anterior nostril	10	17.1	14.9	18.7	1.0	8	13.3	12.3	14.7	0.8
Anterior-posterior nostril	10	11.7	10.5	13.6	0.9	8	12.5	11.5	14.6	1.2
Posterior-posterior nostril	10	17.5	16.5	19.3	0.8	8	18.4	17.2	19.9	0.9

ethmoid, and anteriorly the ectopterygoid. Ectopterygoid long, narrow, contacting autopalatine. Dentary with teeth similar in form and arrangement to those present on premaxilla. Hyomandibula broad, dorsally articulated to sphenotic and pterotic. Quadrate relatively large, sutured to metapterygoid, hyomandibula and preopercle, and articulated with angulo-articular. Opercle roughly triangular, with broad posterior border. Maxilla short, proximal end with hollow condylar process at base of maxillary barbel. Autopalatine long, rod-like. Nasal long, flat, running from anterior tip of mesethmoid to suture between mesethmoid and frontal; also, possessing small laterally oriented branch located at approximately the anteriormost one-fourth of the bone.

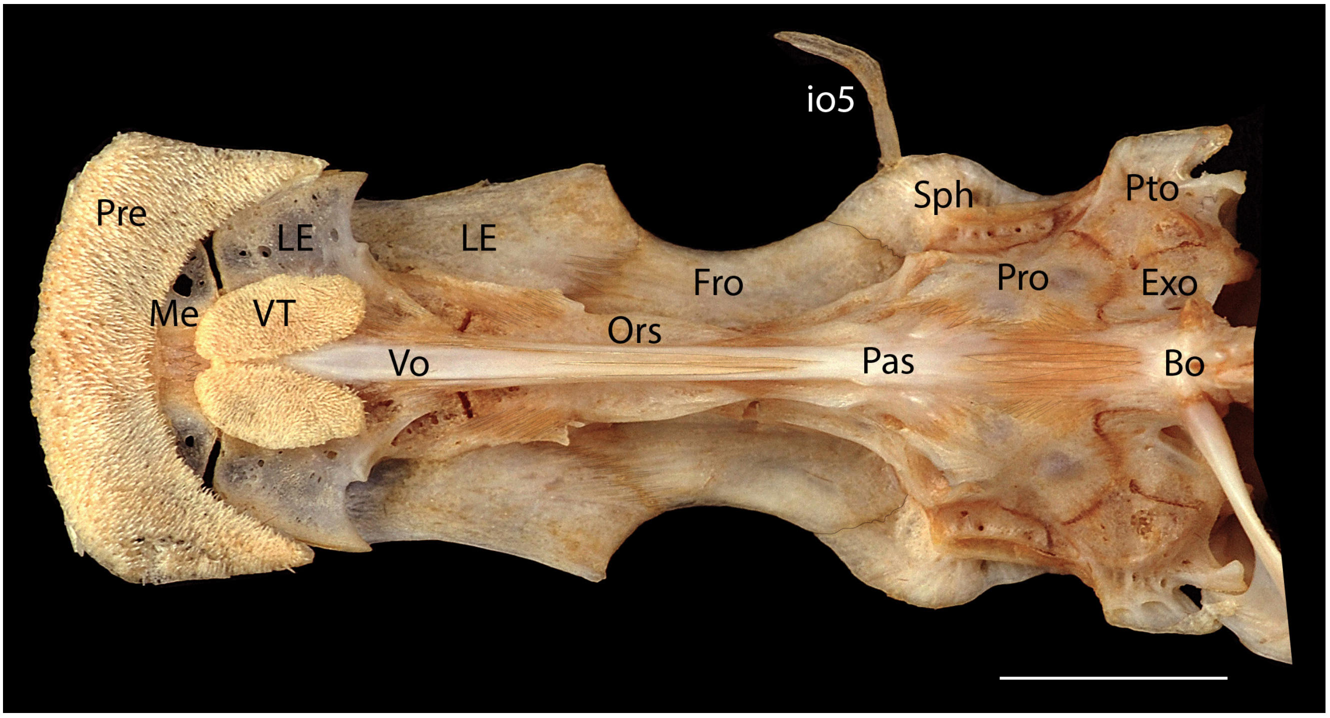

FIGURE 1 | Ventral view of neurocranium of *Duopalatinus emarginatus*, INPA 61686. Bo = basioccipital; Exo = exoccipital; Fro = frontal; io5 = infraorbital 5; LE = lateral ethmoid; Me = mesethmoid; Ors = orbitsphenoid; Pas = parasphenoid; Pre = premaxilla; Pro = prootic; Pto = pterotic; Sph = sphenotic; Vo = vomer; VT = vomer tooth plate. Scale bar = 1 cm.

Gill rakers long and slender, 17 on first branchial arch and 9 branchiostegal rays.

Dorsal fin inserted on anterior half of body. Dorsal fin with eight lepidotrichia: spinelet, spine, and six branched rays. Dorsal spine strong, slender, with some anterior dentations only on its base. Dorsal spine smaller than first branched ray. Posterior margin of dorsal spine with sparse, small, sharp, and retrorse or erect dentations on its distal part.

Adipose fin short, profile convex. Adipose-fin origin located at vertical before first anal fin ray. Adipose-fin base length larger than anal-fin base length. Pectoral girdle strong, broad, with well-developed dorsal, posterodorsal, and posterior processes of cleithrum. Posterior cleithral process elongate, pointed (length equal its depth), not in contact with posterodorsal process of cleithrum (Figs. 2, 5).

Pectoral fin with one spine and ten branched rays; first and second branched rays slightly longer than pectoral spine. Pectoral spine strong, sharp; posterior margin with numerous retrorse dentations regularly spaced; anterior margin with weak or no distal serrae but small antrorse dentations along middle third of spine.

Pelvic fin with six rays, first simple, third longest. Pelvic fin margin convex. Extension of anterior lateral process of basipterygium surpassing anterior medial process. Presence of a gap in the symphysis of the basipterygium.

Anal fin truncate; 12–13 total fin rays; eight branched and three-four simple rays; Last two anal-fin rays joined, articulating with single expanded pterygiophore. First pterygiophore contacting haemal spines of vertebrae 25–27.

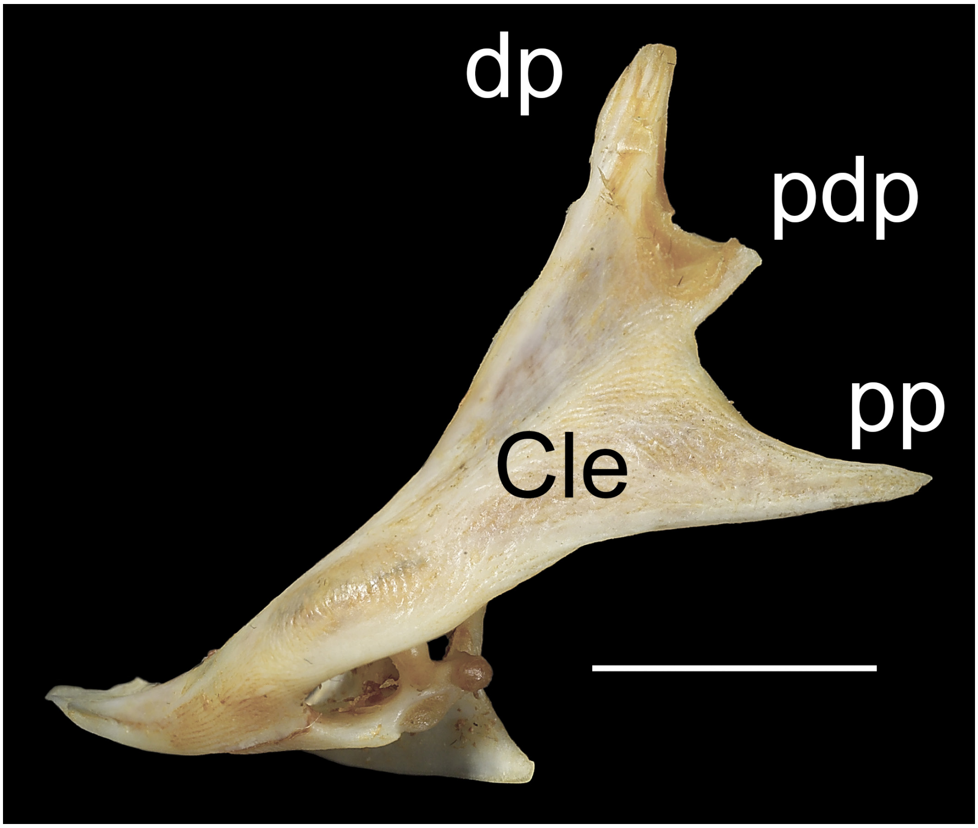

FIGURE 2 | Lateral view of cleithrum of *Duopalatinus emarginatus*, ANSP 206310, left side. Cle = cleithrum; dp = dorsal process; pdp = posterior dorsal process; pp = posterior process. Scale bar = 1 cm.

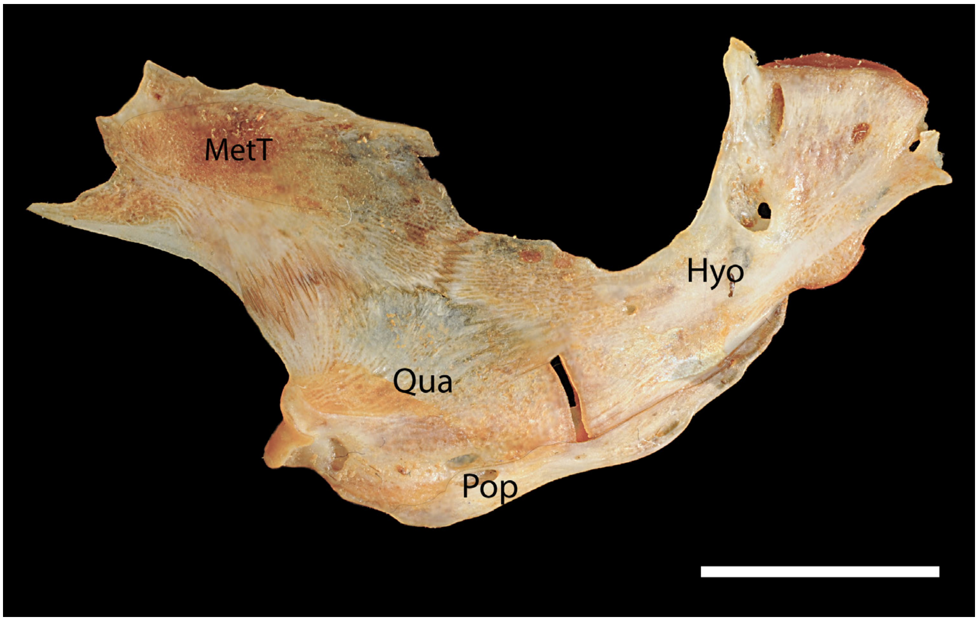

FIGURE 3 | Lateral view of the suspensorium of *Duopalatinus emarginatus*, ANSP 206310, left side. Hyo = hyomandibula; MetT = metapterygoid tooth plate; Pop = preopercle; Qua = quadrate. Scale bar = 1 cm.

Caudal fin forked with short and large lobes; without filament on tip of lobes; upper caudal-fin lobe slightly longer than lower lobe. Fifteen branched caudal-fin rays; seven branched rays on upper and eight on lower lobe. 16–17 dorsal and 14–18 ventral procurrent rays.

Total vertebrae 45–46. Vertebrae 4 and 5 parapophysis lateral edges sutured, forming a sheet over swimbladder, with a small gap close tips.

Aortic tunnel close. 11–12 ribs, first rib on vertebrae 6 parapophysis.

Coloration in alcohol. Preserved specimens color brown or gray dorsally and white ventrally, with small dark dots scattered over the body. Head gray dorsally and yellow to white ventrally. Dark brown dots on sides and dorsal areas; absent in ventral area and absent or inconspicuous on fins and head. Fins hyaline on their bases and clear gray on their tips.

Coloration in life. Live specimens color silvery dorsally and white ventrally, with small dark dots scattered over the body. Head gray dorsally and yellow to white ventrally. Dark brown dots on body sides and dorsal areas; absent in ventral area and absent or inconspicuous on fins and head. Fins hyaline on their bases and clear gray on their tips. Body covered with a yellowish mucus (Fig. 4).

Sexual dimorphism. Not observed.

Geographical distribution. This species is endemic to São Francisco River basin. See more information in discussion.

FIGURE 4 | Lateral view of *Duopalatinus emarginatus* immediately after collection, not preserved. Photo by Tiago Pessali.

FIGURE 5 | Lateral view of holotype of *Duopalatinus emarginatus*, MNHN A-9353.

Remarks. *Duopalatinus emarginatus* has never figured on lists of endangered species, either nationally or statewide (MG, BA), where it occurs along the São Francisco basin. It is known to occur in the São Francisco main channel and, at least, two of its larger tributaries (das Velhas and Paraopeba sub-basins). Misidentification may be one of the reasons for the few recent records of the species.

Material examined. MNHN A.9353, 310 mm SL, holotype; FMNH 95529, 1, 175 mm SL; INPA 61686, 1 alc, 2 sk, 210–290 mm SL; MCZ 7291, 1 alc not measured; MCZ 7294, 1 alc not measured; MNRJ 16321, 1 alc, not measured; MZUEL 4803, 3, 250–280 mm SL; MZUSP 24871, 2 alc, 221–265 mm SL; MZUSP 40252, 2, 350–370 mm SL; MZUSP 85622 dry sk of *D. emarginatus* at ANSP now ANSP 206310, 1 sk, 419 mm SL; USNM 44974, 1 alc, 177 mm SL.

Bagropsis Lütken, 1874

Type-species: *Bagropsis reinhardti* Lütken, 1874, by original designation and monotypy.

Included species: *Bagropsis reinhardti* Lütken, 1874; *Bagropsis atrobrunneus* (Vidal & Lucena, 1999); *Bagropsis paranaensis* (Britski & Langeani, 1988).

Diagnosis. *Bagropsis* is a member of the family Pimelodidae, as indicated by its possession of the synapomorphic features proposed by Lundberg *et al*. (1991), Lundberg, Littmann (2003), Rocha (2012) and Rocha, Littmann (2025). Rocha, Littmann (2025) also recognized three subfamilies within Pimelodidae, with *Bagropsis* recovered as a member of Pimelodinae, which comprises *Aguarunichthys*, *Bagropsis*, *Bergiaria*, *Calophysus*, *Cheirocerus*, *Duopalatinus*, "*Duopalatinus*" *peruanus*, *Exallodontus*, *Iheringichthys*, *Luciopimelodus*, *Megalonema*, *Parapimelodus*, *Pimelabditus*, *Pimelodina*, *Pimelodus*, *Pinirampus*, and *Propimelodus*.

Within Pimelodinae *Bagropsis* is distinguished from all genera except *Aguarunichthys*, "*Duopalatinus*" *peruanus*, and "*Pimelodus*" *ornatus* by its premaxillary tooth plate with its posterolateral process approximately equal in length to the symphysis, not surpassing the middle of the lateral ethmoid (Fig. 6) (*vs*. premaxillary tooth plate with its posterolateral process twice the length of the symphysis, extending to the posterior end of lateral ethmoid, and almost contacting the anterior process of metapterygoid in *Duopalatinus;* premaxillary tooth plate absent or extremely reduced in adults in *Iheringichthys*, *Bergiaria*, *Pimelodina*, and *Cheirocerus*; premaxillary tooth plate thin and curved, with few rows of teeth, lacking a posterior process, in *Pimelodus*, *Exallodontus*, *Calophysus*, *Propimelodus*, *Parapimelodus*, *Megalonema*, *Luciopimelodus* and *Pinirampus*; premaxillae butterfly-shaped in ventral view, each premaxilla greatly expanded posteriorly and posterolaterally with an edentulous posterior process, in *Pimelabditus*); it can also be distinguished from all genera except "*Duopalatinus*" *peruanus* by the presence of

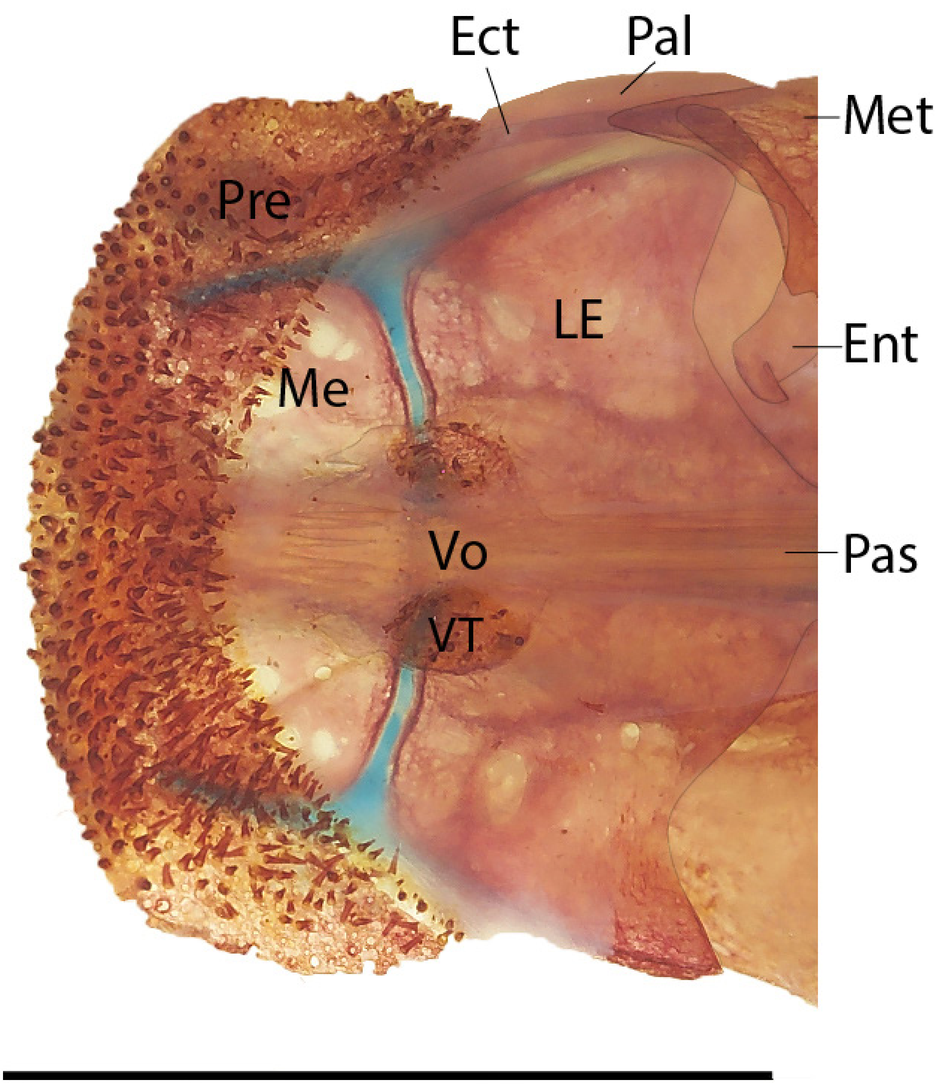

FIGURE 6 | Ventral view of anterior portion of neurocranium of *Bagropsis reinhardti*, MZUSP 39671. Ect = ectopterygoid; Ent = entopterygoid; LE = lateral ethmoid; Me = mesethmoid; Met = metapterygoid; Pal = autopalatine; Pas = parasphenoid; Pre = premaxilla; Vo = vomer; VT = vomer tooth plate. Scale bar = 1 cm.

two small to moderately sized, well-separated patches of vomerine teeth (Fig. 6) (*vs*. vomerine tooth plate, consisting of two large tooth plates that sometimes are joined at the midline in *Duopalatinus*; vomerine tooth plate absent in *Aguarunichthys*, *Bergiaria*, *Calophysus*, *Cheirocerus*, *Exallodontus*, *Iheringichthys*, *Luciopimelodus*, *Megalonema*, *Parapimelodus*, *Pimelabditus*, *Pimelodina*, *Pimelodus*, "*Pimelodus*" *ornatus*, *Pinirampus*, and *Propimelodus*; it can also be distinguished from all genera except *Duopalatinus* and "*Duopalatinus*" *peruanus* by the presence of teeth on a large area of the anterior portion of the metapterygoid (Fig. 7); it also can be distinguished from all genera of Pimelodinae by its short and acute posterior cleithral process, with a straight dorsal margin close to the posterior dorsal process of the cleithrum (Fig. 8) (*vs*. acute posterior cleithral process with the posterior process distant to the posterior dorsal process and cleithrum with a concave ventral margin in *Duopalatinus* and *Pimelabditus;* posterior cleithral process absent in *Cheirocerus* and *Megalonema*; posterior cleithral process reduced in *Aguarunichthys*, *Calophysus*, *Luciopimelodus*, *Pimelodina*, and *Pinirampus*; acute and long posterior cleithral process with ventral margin of cleithrum forming a straight line in "*Pimelodus*" *ornatus*; robust and truncate posterior cleithral process with the posterior process close to the posterior dorsal process in *Bergiaria*, "*Duopalatinus*" *peruanus*, *Exallodontus*, *Iheringichthys*, *Parapimelodus*, *Pimelabditus*, *Pimelodus*, and *Propimelodus.* Additionally, can be distinguished by a dark brown body (presence of small spots in *B. paranaensis* and *B. reinhardti*); adipose fin with rounded anterior margin and posterior process of parieto-supra-occipital triangular and flat.

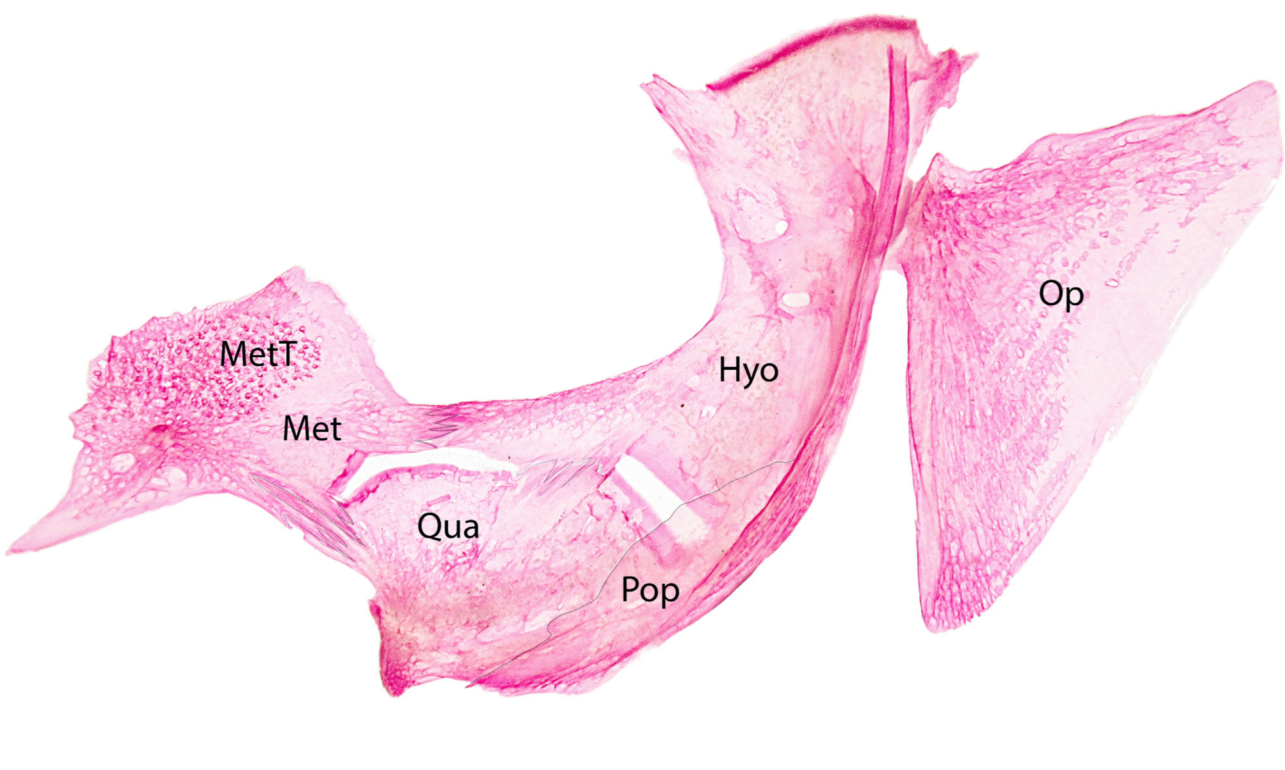

FIGURE 7 | Lateral view of suspensorium of *Bagropsis reinhardti*, INPA 61685, left side. Hyo = hyomandibula; Met = metapterygoid; MetT = metapterygoid tooth plate; Op = opercle; Pop = preopercle; Qua = quadrate. Scale bar = 1 cm.

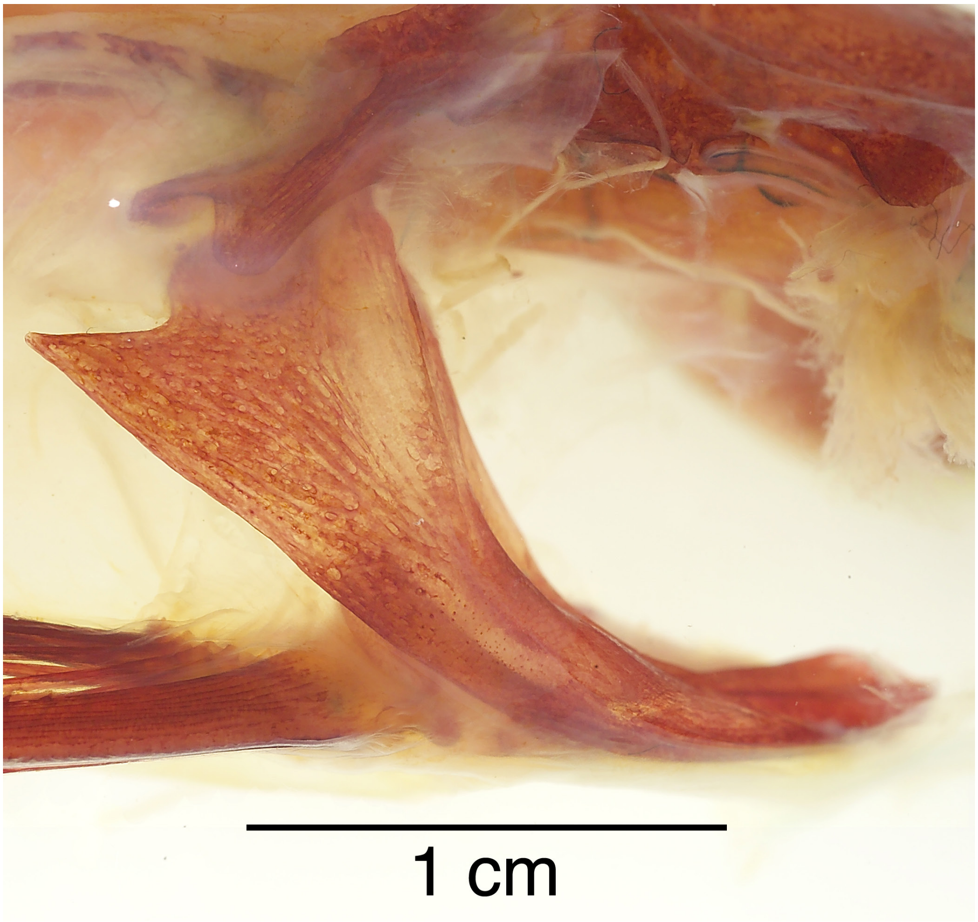

FIGURE 8 | Lateral view of cleithrum of *Bagropsis reinhardti*, MZUSP 39671, right side.

Bagropsis reinhardti Lütken, 1874

(Figs. 6–10; Tab. 1)

Diagnosis. *Bagropsis reinhardti* can be distinguished from *B. paranaensis* by the presence of teeth in the metapterygoid (*vs*. absent) and from *B. atrobrunneus* by showing small dark spots, more concentrated in the anterodorsal portion of the body (*vs*. brown color, without spots or stripes on the body).

Description. Morphometric data presented in Tab. 1. Dorsal profile of body slightly convex from tip of snout to dorsal fin origin, almost straight between dorsal and adipose fin, and concave at caudal peduncle region. Head depressed. Dorsal surface of head including the supraoccipital process covered by skin.

Cranial roof bones well developed and ornamented with shallow grooves and reticulated ridges. Supraoccipital process strong, wider at its base, narrowing posteriorly, and reaching and interdigitating with anterior nuchal plate. Supraoccipital with a small fontanel. Sphenotic approximately larger than pterotic contacting supraoccipital, thus excluding the contact between frontal and pterotic. Frontal long, external margin concave, between lateral ethmoid and sphenotic. Anterior fontanel present, long, delimited by frontals and mesethmoid. Fontanel visible, starting posterior to posterior nares and reaching the posterior orbital margin.

Posterior nostril closer to anterior nostril than to eye. Eyes large and dorsally located; 21.6% of HL. Three pairs of narrow barbels, flattened cross-section. Maxillary barbel inserted slightly closer to anterior nares than posterior. Maxillary barbel surpassing caudal-fin base. Outer mental barbel inserted slightly posterior to inner barbel. Outer mental barbel not surpassing pectoral fin tips. Inner barbel not reaching pectoral fin origin. Mouth gape large. Upper mandible projecting above lower. Villiform teeth in premaxillary, dentary, vomerine, and metapterygoid tooth plates. Premaxillary teeth visible from ventral view. Premaxillary tooth plate large with a postero-lateral projection. Two small patches of vomerine tooth, well separated (Fig. 6). Metapterygoid tooth present (Fig. 7).

Gill rakers long and slender, 22–24 and 9 branchiostegal rays.

Dorsal fin inserted on anterior half of body. Dorsal fin with eight lepidotrichia: spinelet, spine, and six branched rays. Dorsal spine straight, slender, without anterior dentations or anterior distal serrae, and bearing small terminal filament. Dorsal spine smaller than first branched ray; its length less than distance from snout tip to posterior eye margin. Posterior margin of dorsal spine with sparse, small, sharp, and retrorse or erect dentations.

Adipose fin short, its profile convex; its origin anterior to anal-fin origin. Adipose-fin base length larger than anal-fin base length. Pectoral girdle strong, broad, with well-developed dorsal, posterodorsal, and posterior processes of cleithrum. Posterior cleithral process short, pointed (length equal its depth), not in contact with posterodorsal process of cleithrum (Fig. 8). Its tip not reaching the vertical line at dorsal fin origin.

Pectoral fin with one spine and ten branched rays; first and second branched rays slightly longer than pectoral spine. Pectoral spine strong, sharp; posterior margin with numerous retrorse dentations regularly spaced; anterior margin with weak or no distal serrae but small antrorse dentations along middle third of spine.

Pelvic fin with six rays, first simple, third longest. Pelvic fin margin convex. Extension of anterior lateral process of basipterygium surpassing anterior medial process. Presence of a gap in the symphysis of the basipterygium.

Anal fin truncate; 14 total fin rays; eight branched and six simple rays; last two anal-fin rays joined, articulating with single expanded pterygiophore. First pterygiophore contacting haemal spines of vertebrae 26–28.

Caudal fin forked with short and large lobes; without filament on tip of lobes; upper caudal-fin lobe slightly longer than lower lobe. Fifteen branched caudal-fin rays; seven branched rays on upper and eight on lower lobe. 20 superior and 19–22 inferior procurrent rays.

Total vertebrae 47–49. Vertebrae 4 and 5 parapophysis lateral edges sutured, forming a sheet over swimbladder, with a small gap close tips.

Aortic tunnel close. 12 ribs, first rib on vertebrae 6 parapophysis.

Coloration in alcohol. Preserved specimens color overall brown, darker dorsally. Some specimens with faint small dark brown dots over flanks. Fins hyaline (Fig. 9).

FIGURE 9 | Lateral view of *Bagropsis reinhardti*, MZUSP 39671, 142.5 mm SL.

Coloration in life. Live specimens color dark gray dorsally and ventrally lighter (Fig. 10).

Sexual dimorphism. Not observed.

Geographical distribution. This species is endemic to the São Francisco River basin. See more information in discussion.

Remarks. *Bagropsis reinhardti* had been officially listed as an endangered species, in the Vulnerable (VU) category in MMA (2014), based on the IUCN criteria. But recently, in another government publication (MMA, 2022) the species is not listed, probably due to new records in other sub-basins, such as Paracatu (PSP, pers. obs.), Carinhanha (Salvador *et al*., 2020) and Pará rivers (Gilberto Salvador, 2024, pers. comm.), deposited at MCN, Belo Horizonte. It is known that the rivers where it occurs are under the same environmental conditions and there are no new records published in other areas of the basin.

Material examined. Brazil: Minas Gerais: *Bagropsis reinhardti*: syntypes: BMNH 1876.1.10.9., 184 mm SL; NMW 45905, 256 mm SL; ZMUC 223, 259 mm SL; ZMUC 225, 235 mm SL; ZMUC, 227, 177 mm SL. INPA 61685, 1 c&s (116 mm SL). MHN-UFMG 1429, 5 alc, rio Paraopeba, Jeceaba. MZUSP 39642, 1 alc, 110.6 mm SL. MZUSP 39671, 3 alc, 1 c&s, 98.8–142.5 mm SL. MZUSP 51509, 1 alc, 157.1 mm SL. MZUSP 73812, 1 alc, 153.6 mm SL. MZUSP 73738, 1, 137.6 mm SL. MZUSP 73819, 1 alc, 105.3 mm SL. *Pimelodus atrobrunneus*: Rio Grande do Sul: MCP 18912, 1 c&s (104.9 mm SL), rio Uruguai, Marcelino Ramos. MCP 19678, holotype, rio Ligeiro, rio Uruguai basin. UFRGS 10123, 1 alc, rio Marmeleiro, rio Uruguai basin. Santa Catarina: MCP 20402, 1 alc, rio Uruguai. *Pimelodus paranaensis*: Goiás: NUP 5799, 4 alc, 1 c&s (92.5 mm SL), Reservatório Corumbá, tributary of rio Paranaíba, upper rio Paraná basin, Ipameri. NUP 5800, 4 alc, 1 c&s (83.1 mm SL), rio do Peixe (foz), tributary of rio Paranaíba, upper rio Paraná basin, Ipameri. NUP 5802, 3 alc, rio Corumbá (Areia), tributary of rio Paranaíba, upper rio Paraná basin, Ipameri. Mato Grosso do Sul: MZUSP 24454, 1 alc (126.5 mm SL), paratype, rio Paraná, Ilha Solteira

FIGURE 10 | Lateral view of *Bagropsis reinhardti* immediately after collection, not preserved.

(impounded bay on the right bank). MZUSP 28431, 1 alc (103.8 mm SL), paratype, rio Paraná, Ilha Solteira (impounded bay on the right bank). MZUSP 28435, 1 alc, paratype, rio Paraná, Ilha Solteira (impounded bay on the right bank). Minas Gerais: MZUSP 37574, 1 alc, Volta Grande region, rio Grande. Paraná: MZUEL 1526, 6 alc (116–153 mm SL), 1 c&s (115.6 mm SL), 1 sk (125.1 mm SL), rio Iapó, Guartelá, Tibagi. MZUEL 1085, 1 alc (113.4 mm SL), rio Tibagi, Jataizinho. NUP 1712, 1 alc, rio Piquiri, tributary of rio Paraná, upper rio Paraná basin, Mariluz, on the border with Formosa do Oeste. São Paulo: MZUSP 23089, holotype (23.5 mm SL), Ilha Solteira, rio Paraná (impounded bay).

Key to identification of species of Pimelodidae from São Francisco River basin

1a. Vomer lacking tooth plates..2
1b. Vomer with tooth plates (Figs. 1, 6)...5
2a. Mouth ventral and very small; upper jaw projecting over dentary; fleshy lips prominent and upper lip curved upward with small median cleft; premaxillary and dentary tooth absent or weakly developed ....*Bergiaria westermanni* (Lütken, 1874)
2b. Mouth terminal, wide opened; upper jaw not projecting over dentary; lips thin and less developed; teeth present in rows forming a band in dentary and premaxilla ....*Pimelodus* (3)
3a. 15–18 rakers on first branchial arch; head depth 42.3–50.2% HL; interorbital width 12.1–14.9% HL; body color light gray lacking evident spots..*Pimelodus fur* (Lütken, 1874)
3b. 20–28 gill rakers on first branchial arch; head depth 58.6–79.0% HL; interorbital width 21.9–30.4% HL, body color light gray to brown with dark or faint spots ..4

4a. 25–28 rakers on first branchial arch; horizontal eye diameter 19.5–25.1% HL; body color light gray to brown with dark spots over the lateral covered with a yellowish mucous .... *Pimelodus* aff. *maculatus* Lacepède, 1803

4b. 20–25 rakers on first branchial arch; eye diameter horizontal 26.5–32.2% HL; body color light gray to brown with some specimens showing faint spots over the lateral .... *Pimelodus pohli* Ribeiro & Lucena, 2006

5a. Vomer tooth plate connected with metapterygoid tooth plate; metapterygoid tooth plate long, curved anteriorly; spots distributed regularly in six to eight rows from the posterior margin of the opercle to the tail...*Pseudoplatystoma corruscans* (Spix & Agassiz, 1829)

5b. Vomer tooth plate not connected with metapterygoid tooth plate; metapterygoid tooth plate short, straight; few spots distributed along the lateral of the body 6

6a. Premaxillary tooth plate with its posterolateral process twice the length of the symphysis, extending to the posterior end of lateral ethmoid, and almost contacting the anterior process of metapterygoid; two large tooth plates that sometimes are joined at the midline; acute posterior cleithral process .... *Duopalatinus emarginatus*

6b. Premaxillary tooth plate with a short posterolateral process; two small, well-separated patches of vomerine teeth; posterior cleithral process small .... *Bagropsis reinhardti*

DISCUSSION

Of the two species herein redescribed, *Bagropsis reinhardti* was not available to Lundberg *et al.* (1991:859) nor to Lundberg *et al*. (2011), and *Duopalatinus emarginatus* only to Lundberg *et al.* (1991). The first hypothesis of the relationship of these species, here redescribed, was done by Rocha (2012) based on available specimens for anatomy and included in his morphology matrix. Recently, Rocha, Littmann (2025), based on that matrix, proposed a new classification for Pimelodidae and created the tribe Bagropsini which shows *D. emarginatus* as sister taxa to a clade composed of *Pimelodus paranaensis* as sister taxa to *Bagropsis reinhardti* plus *Pimelodus atrobrunneus*. The genus *Bagropsis* was expanded to include *P. atrobrunneus* and *P. paranaensis.* According to the cladogram in Rocha, Littmann (2025), it was shown that *Bagropsis reinhardti* is related to *B. atrobrunneus* based on the serrated external margin of the middle and posterior nuchal plates. Britski, Langeani (1988), when describing *Pimelodus paranaensis* from the upper Paraná River region, noticed a similarity between *P. paranaensis* and *B. reinhardti*, both having teeth in the vomer. However, they can be differentiated by the presence of teeth in the metapterygoid in *B. reinhardti* and by certain body proportions. Still, Vidal, Lucena (1999) described *P. atrobrunneus* from the Uruguai River, a species with a peculiar coloring, different from other *Pimelodus* species by the brown color, without spots or stripes on the body, and by the presence of a posterolateral projection of the premaxilla and teeth present in small patches in the vomer (absent in the specimens analyzed by the authors but observed in some specimens in the present study). The color of *B. reinhardti* and *B. paranaensis* is also similar, consisting of small dark spots, more concentrated in the anterodorsal portion of the body, and absent in *B. atrobrunneus*.

For a long time, *Duopalatinus* included only two species, the type-species *D. emarginatus*, endemic to the São Francisco River basin, and *D. peruanus* Eigenmann & Allen, 1942, occurring in the Amazon and Orinoco basins. However, recent works based on morphological and molecular data (Lundberg, Parisi, 2002; Parisi *et al*., 2006; Lundberg *et al*., 2011; Rocha, 2012; Rocha, Littmann, 2025) have indicated a closer relationship of *D. peruanus* with *Exallodontus* and *Propimelodus*. The systematics of these species are being investigated and will be published elsewhere.

We found that in the MZUSP fish collection all specimens of *B. reinhardti* were misidentified as *D. emarginatus* due to their external similarity. However, the two species are distinguishable by some morphological characters: 1) posterior cleithral process shape acute in *D. emarginatus* (Fig. 2) (*vs*. short in *B. reinhardti*, Fig. 8); 2) vomerine tooth patch large and joined in *D. emarginatus* (Fig. 1) (*vs*. smaller and well separated in *B. reinhardti*, Fig. 6); 3) total number of vertebrae 45–46 in *D. emarginatus* (*vs*. 47–49 in *B. reinhardti*); 4) contact of first haemal spine between vertebrae 25–27 in *D. emarginatus* (*vs*. between vertebrae 26–29 in *B. reinhardti*); 5) 16–17 superior and 14–18 inferior procurrent caudal fin rays in *D. emarginatus* (*vs*. 20 superior and 19–22 inferior procurrent caudal fin rays in *B. reinhardti*); 6) small eyes in *D. emarginatus*, horizontal eye diameter 12.9–20.2% HL and vertical eye diameter 9.6–13% HL (*vs*. 19.9–24.5% HL and 13.8–17.3% HL in *B. reinhardti*); 7) large posterior nostril-eye distance in *D. emarginatus*, 22.2–26.4% HL (*vs*. 17.1–21.1% HL in *B. reinhardti*); 8) large anterior-anterior nostril distance in *D. emarginatus*, 14.9–18.7% HL (*vs*. 12.3–14.7% HL in *B. reinhardti*).

The Das Velhas River, the type-locality of *Bagropsis reinhardti*, is the longest tributary of the São Francisco basin. This river holds historical significance in Neotropical ichthyology, as it was extensively surveyed by Johannes Theodor Reinhardt, whose collections formed the basis for the classical monograph authored by Christian Frederik Lütken. In this work, Lütken not only described *B. reinhardti* but also several other new species, accompanied by detailed accounts and exquisite illustrations that remain valuable references to this day. The Das Velhas River is oriented in a southwest to northeast direction, and extends 807 km from its headwaters (Pompeu *et al*., 2025), at an altitude of 1,520 m, to its confluence with São Francisco River, at an altitude of 478 m. The estimated average annual flow is 300 m^3/s (Q95% = 103.69 m^3/s) with a drainage area of 29,173 km^2 and a mean width of 38.3 m (CETEC, 1983). The Das Velhas River has significant social and economic importance. Belo Horizonte, the state capital of Minas Gerais, with more than 2.3 million inhabitants (Pompeu *et al*., 2025), is in the upper portion of the Das Velhas River basin. The sewage from the whole Metropolitan Region of 5,7 million people is only partially treated. Immediately downstream of Belo Horizonte, the main stem is seriously degraded and presents pronounced signs of pollution and sedimentation (Pompeu *et al*., 2005). However, many well-preserved tributaries are still found in the basin, sheltering almost 83% of the total fish species (Pompeu *et al*., 2005). Recent unpublished studies conducted in the basin have provided information on the distribution patterns of the two species (CBMA, PSP, pers. obs.).

Twenty-three locations along the basin, including eight along Das Velhas River main stem, nine in tributaries, and six in the floodplains have been systematically sampled since 1999. *Bagropsis reinhardti* has been recorded only in tributaries, while *D. emarginatus* occurred mainly in the main stem. The two species have never been recorded in the floodplain, and sympatry is rare, having been reported only in the lower course of one major tributary. Differences in the characteristics between the sites where they have been collected are related only to the river size, since all of them presented satisfactory water quality. *Duopalatinus emarginatus* seems to be a typical species from the main steam, while *B. reinhardti* is found mainly in tributaries (Fig. 11).

All tributaries where *B. reinhardti* occur have high gradients and current velocity and have predominantly rocky substrates. On the other hand, the sampling sites of *D. emarginatus* have lower water velocities and mostly sandy or muddy substrates. Johannes T. Reinhardt collected fishes in two trips to Brazil, between 1850 and 1856, and registered *B. reinhardti* in the Das Velhas River near Lagoa Santa (Lütken, 1875). In this region, many historically recorded species were locally extinct due to the mining activities in the Das Velhas River headwaters, deposition of organic sediments from the Belo Horizonte metropolitan region, riparian vegetation clearing, sediment runoff from agriculture, and uncontrolled urbanization (Pompeu *et al*., 2005). It is important to point out that the only two sampling stations where *D. emarginatus* were not registered in the main stem were those located in the middle portion of the basin, which present the worst environmental conditions. The correct identification of both species (*Bagropsis reinhardti* and *Duopalatinus emarginatus*) will allow the precise definition of their present occurrence and a better evaluation of their conservation status.

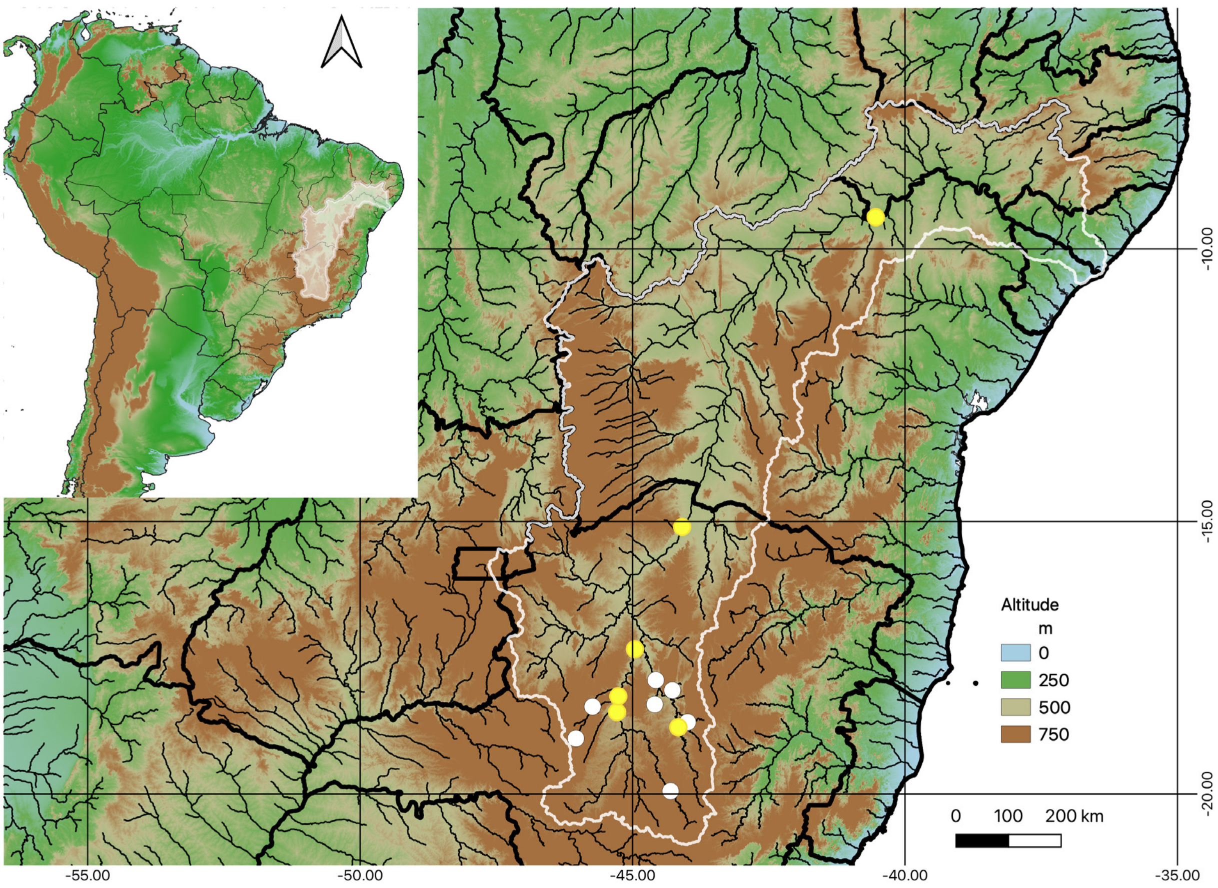

FIGURE 11 | Distribution of *Bagropsis reinhardti* (white circles) and *Duopalatinus emarginatus* (yellow circles) in the São Francisco River basin. Inset: South America with the São Francisco basin highlighted.

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AUTHORS' CONTRIBUTION

Marcelo Salles Rocha: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Writing-review and editing.
John G. Lundberg: Conceptualization, Data curation, Formal analysis, Investigation, Supervision, Writing-review and editing.
Paulo Santos Pompeu: Funding acquisition, Investigation, Resources, Validation, Writing-review and editing.
Carlos Bernardo M. Alves: Investigation, Methodology, Resources, Validation, Writing-review and editing.

ETHICAL STATEMENT

Not applicable.

DATA AVAILABILITY STATEMENT

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

COMPETING INTERESTS

The authors declare no competing interests.

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