ISSN Versión Impresa 1816-0719 | ISSN Versión en linea 1994-9073 | ISSN Versión CD ROM 1994-9081

The Biologist (Lima), 2020, 18(1), jan-jun: 29-38.

The Biologist (Lima)

The Biologist (Lima)

ORIGINAL ARTICLE / ARTÍCULO ORIGINAL

OSTEOLOGY OF *SCIADES COUMA* VALENCIENNES, 1864 (OSTEICHTHYES, SILURIFORMES; ARIIDAE)

OSTEOLOGIA DE *SCIADES COUMA* VALENCIENNES, 1864 (OSTEICHTHYES, SILURIFORMES; ARIIDAE)

Carlos Alailson Licar-Rodrigues[1]; Jociel Ferreira-Costa[1]; Luiz Bruno Oliveira-Chung[1]; Nayara Barbosa Santos-Espínola[1]: Diego Carvalho-Viana[1,*] & Jose Iannacone[2,3]

[1]Núcleo de Estudos Morfofisiológicos Avançados (NEMO), Programa de Pós-graduação em Ciência Animal (PPGCA)/Universidade Estadual do Maranhão(UEMA).
[2]Laboratorio de Ecología y Biodiversidad Animal. Facultad de Ciencias Naturales y Matemática. Grupo de Investigación en Sostenibilidad Ambiental (GISA). Escuela Universitaria de PostGrado (EUPG. Universidad Federico Villarreal- Lima-Perú.
[3]Laboratorio de Parasitología, Facultad de Ciencias Biológicas. Universidad Ricardo Palma- Lima- Perú.
*Corresponding Author: diego_carvalho_@hotmail.com

ABSTRACT

Sciades couma Valenciennes, 1864 is known as bragalhão, white catfish or common catfish. It has a wide geographical distribution and inhabits the estuarine/saltmarsh environments. Considering the lack of data in the literature about its osteology, this study aimed to describe the *S. couma* skeleton in order to assist future studies such as fish phylogeny and taxonomy. For this, a specimen of *S. couma* was used, and the removal of viscera, cleaning of the structures, elimination of residues and whitening of skeleton and fixing on a glass base. The results point to a similarity between the *S. couma* skeleton and other teleosts species, in which the elements of the spine articulate with each other, presenting similar relationships between the neurocranium, spine and caudal regions.

Keywords: actinopterigeos – Maranhão – osteotechnics

RESUMO

Sciades couma Valenciennes, 1864 é conhecido como bragalhão, bagre-branco ou bagre comum. Possui ampla distribuição geográfica e habita os ambientes estuarino/dulcícola. Considerando a carência de dados na literatura sobre a sua osteologia, este trabalho objetivou descrever o esqueleto de *S. couma* no sentido de auxiliar estudos futuros como filogenia e taxonomía de peixes. Para isso, utilizou-se um exemplar de *S. couma*, e foram realizados a remoção de vísceras, limpeza das estruturas, eliminação de resíduos, clareamento do esqueleto e fixação em base de vidro. Os resultados apontam uma similaridade entre o esqueleto de *S. couma* com outras espécies de teleósteos em que os elementos da coluna vertebral se articulam entre si, apresentando relações entre o neurocrânio, coluna vertebral e região caudal.

Palavras-chave: actinopterígeos – Maranhão – osteotécnica

doi: 10.24039/rtb2020181446

RESUMEN

Sciades couma Valenciennes, 1864 se conoce como bragalhão, bagre blanco o bagre común. Tiene una amplia distribución geográfica y habita los ambientes de estuarios / dulceacuícolas. Teniendo en cuenta la falta de datos en la literatura sobre su osteología, este estudio tuvo como objetivo describir el esqueleto de *S. couma* para ayudar a futuros estudios, como la filogenia y la taxonomía de peces. Para esto, se usó un ejemplar de *S. couma*, y se realizó la extracción de vísceras, limpieza de las estructuras, eliminación de residuos y blanqueamiento del esqueleto y fijación sobre base de vidrio. Los resultados apuntan a una similitud entre el esqueleto de *S. couma* y otras especies de teleósteos, en el que los elementos de la columna se articulan entre sí, presentando relaciones entre el neurocráneo, la columna vertebral y la región caudal.

Palabra clave: actinopterigeos - Maranhão - osteotécnica

INTRODUCTION

Sciades couma (Fig.1A and 1B) is commonly known as bragalhão, white catfish or simply common catfish. It is a species found in all estuarine environments, on muddy substrates of these estuaries, also occurring in fresh water (Soares *et al*., 2016). It is a species widely distributed from the Gulf of Paria (Venezuela) to the eastern coast of Maranhão. And the gender is formed by several *Sciades dowii* Gill, 1863; *Sciades herzbergii* Bloch, 1794; *Sciades parkeri* Traill, 1832; *Sciades passany* Valenciennes, 1840; *Sciades paucus* Kailola, 2000; *Sciades proops* Valenciennes, 1840; *Sciades sona* Hamilton, 1822 species. Its anatomical characteristics are very peculiar, presenting a fold of skin joining the posterior nostrils transversely; large semi-lunar pre-dorsal plate; 17 to 21 branchial traces in the 2nd branchial arch; dentiferous plaques of the roof of the mouth forming a wide transverse strip with the corners projected backwards, that is, the pointed dental plaques forming a narrow triangle on each side (Fig. 1). In addition, *S. couma* has two pairs of barbels (Cervigón *et al*., 1992).

Studies in Brazil about fish osteology are still scarce, especially those related to the Siluriform order. However, works are found for other species of fish through the following studies carried out by Andreata & Barbiéri (1993) for *Geophagus brasiliensis* Quoy & Gaimard, 1824; Bemvenuti (1995) for *Odontesthes mirinensis* Bemvenuti, 1996; Gonzalez & Amenomori (2003) for *Carcharodon carcharias* Linnaeus 1758; Bemvenuti (2005) for *Odontesthes bonariensis* Valenciennes, 1835; *O. humensis* De Buen, 1953, *O. retropinnis* De Buen, 1953, *O. perugiae* Evermann & Kendall, 1906, *O. mirinensis*, *O. incis* Jenyns, 1842 and *O. argentinensis* (Valenciennes, 1835); Lopes *et al.* (2014) for *Characidium timbuiense* Travassos, 1946. For the species of the Siluriformes order, Marceniukv (2005) works for *Genidens barbus* (Lacepède, 1803) and *Genidens machadoi* (Miranda Ribeiro, 1918), Buitrago-Suárez (2006) for *Pseudoplatystoma* sp., Betancur *et al.* (2007) for Ariidae family; Marceniuk & Menezes (2007) for the Ariidae family; Betancur *et al.* (2008) for *Sciades parkeri* Traill, 1832, Abrahão & Pupo (2014) for suliforms in general; Calegari & Reis (2016) for *Gelanoglanis nanonocticolus* Soares-Porto, Walsh, Nico & Netto, 1999, Silva *et al.* (2016) for the Neoplecostominae subfamily; Soares (2016) for *Genidens barbus* (Lacepède, 1803), *Mugil liza* Valenciennes, 1836 and *Pogonias cromis* (Linnaeus, 1766); Carvalho *et al.* (2017) for *Hoplomyzon* sp. Marceniuk *et al.* (2019) for *Chinchaysuyoa labiata* Marceniuk, Marchena, Oliveira & Betancur-R, 2019 and Shibatta (2019) for *Batrochoglanis castaneus* Shibatta, 2019, *B. transmontanus* (Regan, 1913), *B. raninus* (Valenciennes, 1840) were found.

The skeleton of the fish can be subdivided into two main parts: Axial which comprises the skull, spine,

sternum and ribs, and appendicular covering the limbs and fins / wings. Regarding the vertebral column, it can present parts classified as trunk vertebrae (TV) and flow vertebrae (FV) (Hildebrand, 1995). Considering the lack of data in the literature on osteology in fish, this study aimed to describe the skeleton of *S. couma* in order to assist future studies such as phylogeny and taxonomy of fish.

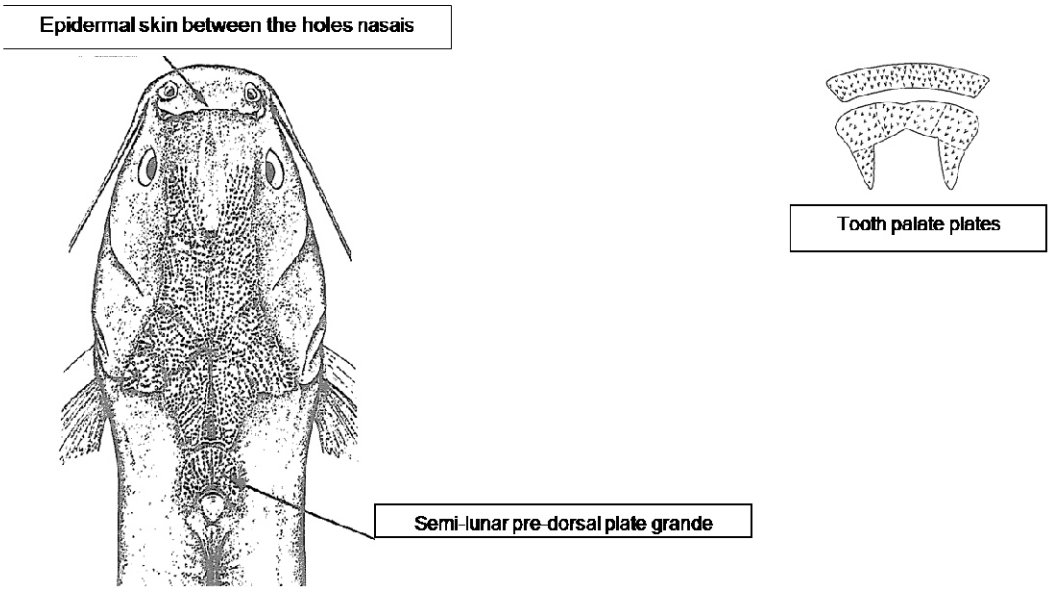

Figure 1. Description of the *Sciades couma* particular characteristics that differentiates it from other species of *Sciades* (Cervigón *et al*., 1992).

MATERIAL AND METHOD

Based on the detailed conservation in the discipline of Anatomical Techniques of the Graduate Program in Animal Science at the State University of Maranhão (UEMA), Brazil, this work was carried out with a single specimen of *S. couma*, as a way of contributing with information in the literature, measuring 50 cm in total length, 40 cm in standard length, weighing 805 g, female and not being sexually mature.

The specimen was eviscerated and then macerated to remove muscle tissue (Villarroel-Guerra & Troncoso-Felipe, 2017; Riquelme *et al*., 2018). To perform this procedure, the specimen was wrapped in aluminum foil and baked for 65 min. Then, a lot of muscle tissue was removed with a surgical forceps. Subsequently, the skeleton was exposed to the open air in order to attract flies and/or ants in order to remove remains of muscle tissue in regions where the forceps did not have access (Gutiérrez-Ramos, 2014).

To clear the skeleton and remove muscle tissue residues, the specimen was immersed in oxygen peroxide (H_2O_2) solution (40 vol) and distilled water, in the proportion of 90 ml of hydrogen peroxide and 1.500 ml of water for one time of 120 minutes (Rodrigues, 1998). For bone terminologies, Soares *et al*. (2016) was used. The prominent processes of the first pre-caudal and caudal vertebrae presented for the catfish are similar to those established by Weitzman (1962) for *Brycon mecki*. In the process of treatment and counting of the vertebrae, the growth marks used by La Marca (1966) and Daiber (1960) were observed. During this period, a toothbrush was used to help remove muscle tissue residues. Finally, the skeleton was exposed to the sun for drying. To assemble the skeleton, a glass base,

aluminum corner piece was used to support the bones that were glued using hot glue, tecbonder glue, cotton and salt. Photographswere taken to record all phases of the procedure.

Throughout the work, images were presented that illustrate and help to identify the vertebrae and their subdivisions, the neurocranium with its diagnostic structures, dorsal and pectoral fins, in addition to apparent rigid acuules and the caudal region. It should be noted that some anatomical structures found for *S. couma* are similar to those of other species of Teleosts. This variation can occur intraspecific and/or interspecific. The data presented in this work for *S. couma* were discussed in a comparative way, from other fish species already studied by several authors and made available in the scientific literature worldwide. Due to the scarcity of data and anatomical descriptions specific to *S. couma*, it was possible to obtain information and discuss it carefully so that the results obtained are consistent.

Ethic aspects: The authors point out that all national and international ethical aspects were observed.

RESULTS AND DISCUSSION

The skull of *S. couma* is broad and compact with granular surface bones, with the presence of a cranial fontanelle, being differentiated in anterior and posterior. Lateral ethmoid bone evident and premaxillary associating with dental plaques. Still in the skull, it is possible to see delineations on the plaque such as Sphenoid, Pterotic, Supracleitro, Extra-scapular, Parieto-Supraociptal and the frontal region. In the posterior region of the skull, it is possible to observe the supra-occipital process with projections of the dorsal fin aculeus (Fig. 2).

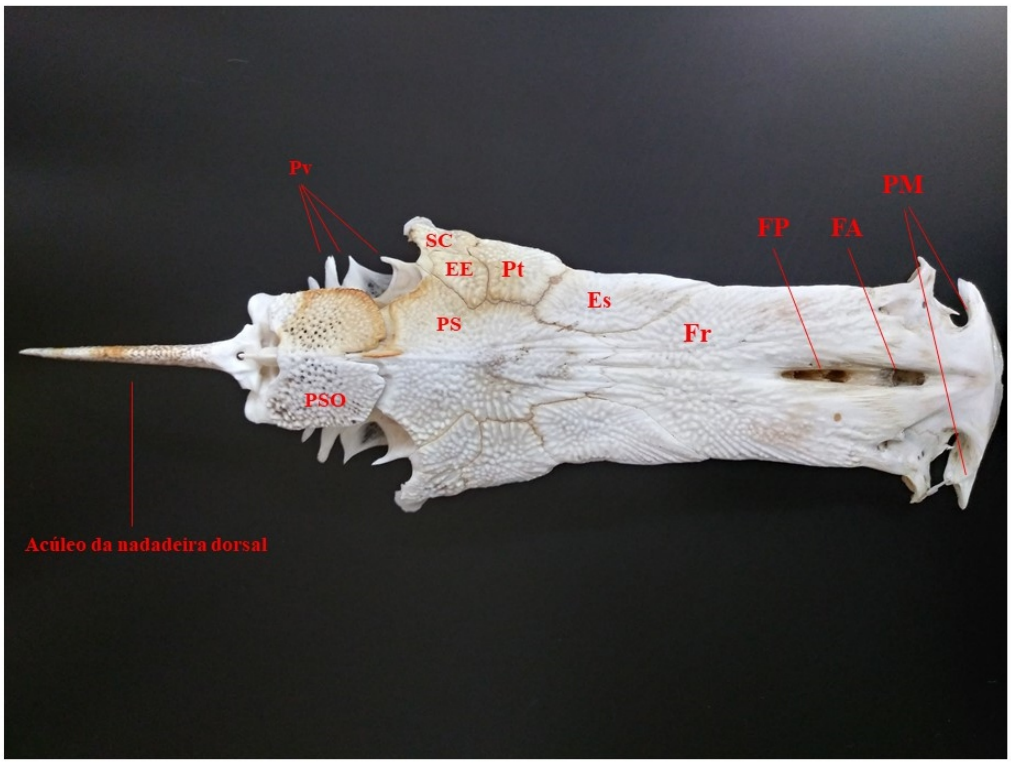

Figure 2. Ventral view (below) of the neurocranium of *Sciades couma* (catfish). PM - Pre-maxillary; FA - Anterior Fontanela; FP - Fontanela Posterior; Fr - Front; Es - Sphenoid; Pt - Pterotic; SC - Supracleitro; EE - Extra-scapular; PS - Parieto - supraociptal; PSO - Supra-occipital process; Pv - Parapophysis of the vertebra.

The neurocranium of *S. couma* differs between species of the gender. Soares *et al.* (2016) describes a detailed anatomy of the cranial structure of the sea catfish (*Genidens barbus*) very similar to the catfish, *S.couma*. Several anatomical structures described for *G. barbus* are similar to *S. couma* in which the presence of a granular surface constitutes one of the diagnostic characters of the Sciades genders. Its benthic habit (Buckup *et al.*, 2003), is one of the probable hypotheses for the ventral dorsum flattening of the neurocranium of this gender.

When comparing the structure of the *S. couma* neurocranium with the *Diapterus auratus* species, a certain similarity of the Parieto-Supraociptal (PS) is perceived as well as the Frontal structure (Fr), however the complex vertebra is different in both. The data described by Kobelkowsky (2004) for the *Dendrobates auratus* species are similar to those expressed in this work for *S. couma*, as well as those of Soares *et al*. (2016)

The species under study has a total of 52 vertebrae, being divided into 23 thoracic and 27 caudal, in addition to presenting 20 pairs of ribs, with the last two in the fusion process, forming the hematic spine in the other vertebrae (Fig. 3A and 3B). They also have a rigid dorsal fin, which is connected to the supra-occipital process (Fig. 2). The pectoral fins also have such rigid constructions.

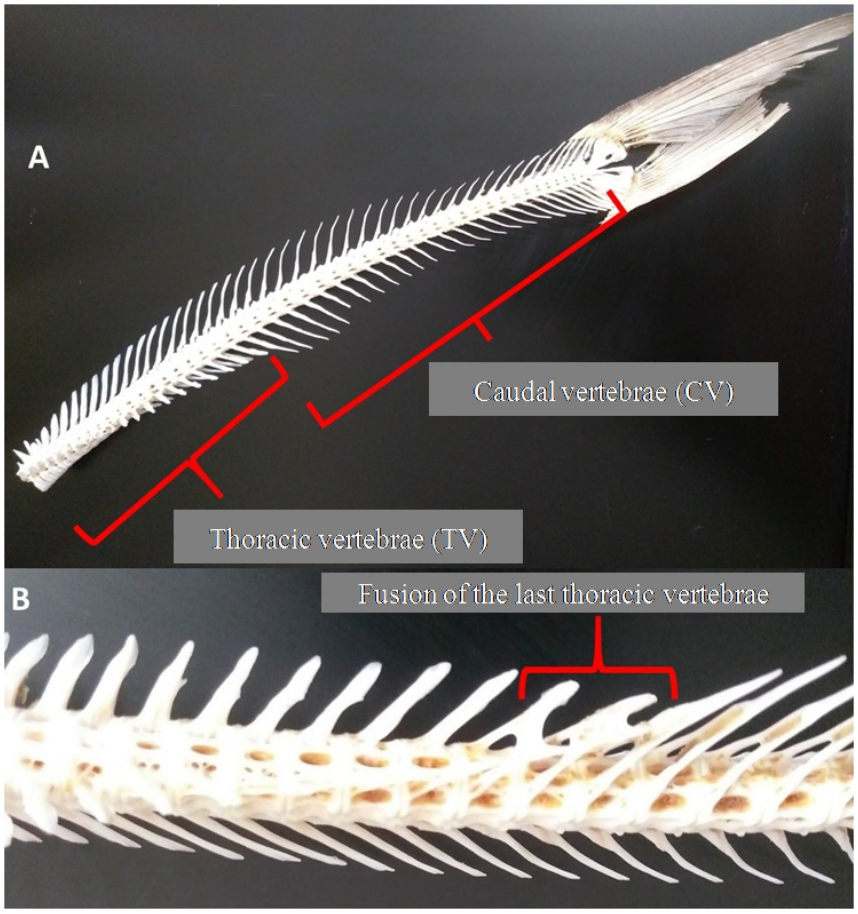

Figure 3. *Sciades couma* vertebrae description. A. *S. couma* spine division into caudal vertebrae (CV) and thoracic vertebrae (TV); B. Fusion of the last thoracic vertebrae (B).

The following structures were identified in the thoracic vertebrae: neural spine, neural arch, vertebral center and ribs. In the thoracic vertebrae, the spinous process is larger and decreases in size as observed in the more caudal vertebrae. Dorsal arches and zygapophyses between the vertebrae are evident (Fig. 4).

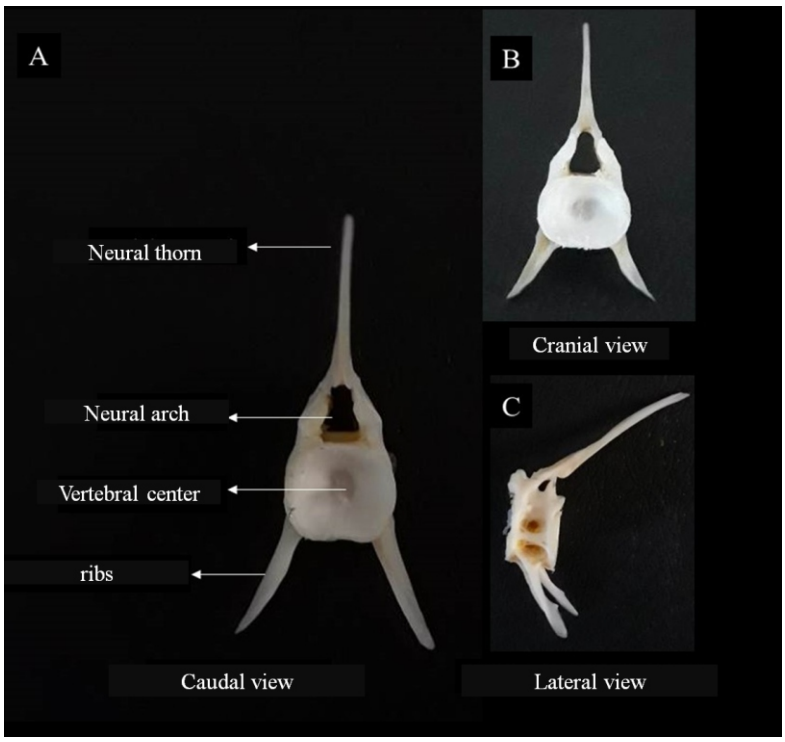

Figure 4. Description of the thoracic vertebrae of *Sciades couma*. A. Caudal view; B. Cranial view; C. Lateral view.

In the caudal vertebrae, the main structures observed are arch and neural spine, vertebral center, hematic arch and spine (Fig. 5). The caudal complex is formed by the last caudal vertebra, pleural center and structures that support the rays of the caudal fin (Fig. 6). The catfish species studied has a "furcated" fin very common in bone fish (Osteichthyes). In catfish, the prominence of rays in the fin and its subdivisions was verified according to the tail region. Serra & Langeani (2006) emphasizes the presence of hypurals in the caudal fin that differ and such differentiation is observed in the caudal fin of *S. couma*.

The prominent processes of the first pre-caudal and caudal vertebrae presented for the catfish are similar to those established by Weitzman (1962) for *Brycon mecki*. The total number of vertebrae varies according to the fish species which may be lower or higher than certain taxa. Bemvenuti (2005) demonstrates that the number of pre-caudal vertebrae is higher than that of the tail for some species, such as *Odontesthes bonariensis, Odontesthes humensis, Odontesthes mirinensis, Odontesthes perugiae and Odontesthes retropinis*, but in a much smaller number for *Odontesthes incisa*. In a comparative way, it is possible to notice that *S. couma* presented a smaller relative number of pre-caudal vertebrae and the caudal ones presented in a much larger number.

The elements of the spine articulate with each other through firm vertebral centers, with tissue structures between the adjacent amphicellic vertebrae, derived from the notochord, showing relationships between the neurocranium, spine and

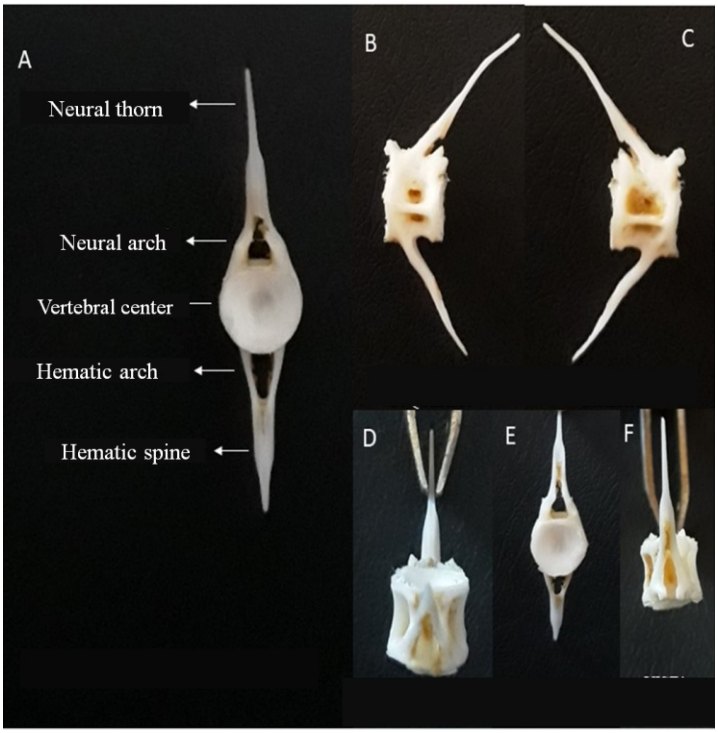

Figure 5. Description of the caudal vertebra of *Sciades couma*. A. Caudal view; B. Left Lateral view; C. Right lateral view; D. Ventral; E. Cranial; F. Dorsal.

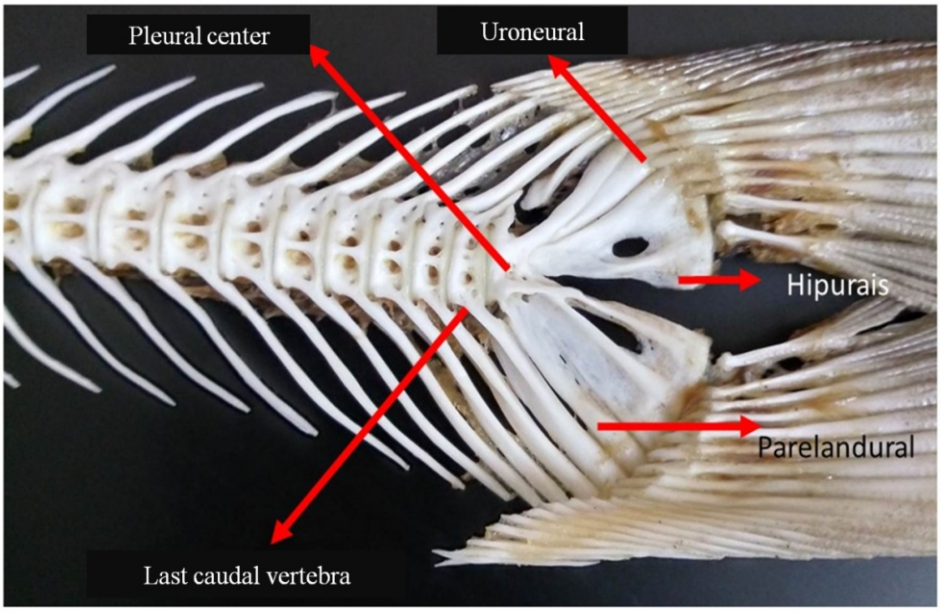

Figure 6. *Sciades couma* caudal complex showing the main structures in this region.

caudal region (Fig. 7A-C). In bony fish, the vertebrae usually have a central element, a neural arch with a spine and, on the tail, a hematic arch with a spine. It is possible to visualize the articulation of the caudal fin rays with elements of the spine differently from what happens with the other fins (even and odd) of fish, like *S. couma* (Pough *et al*., 2008; Carvalho, 2010).

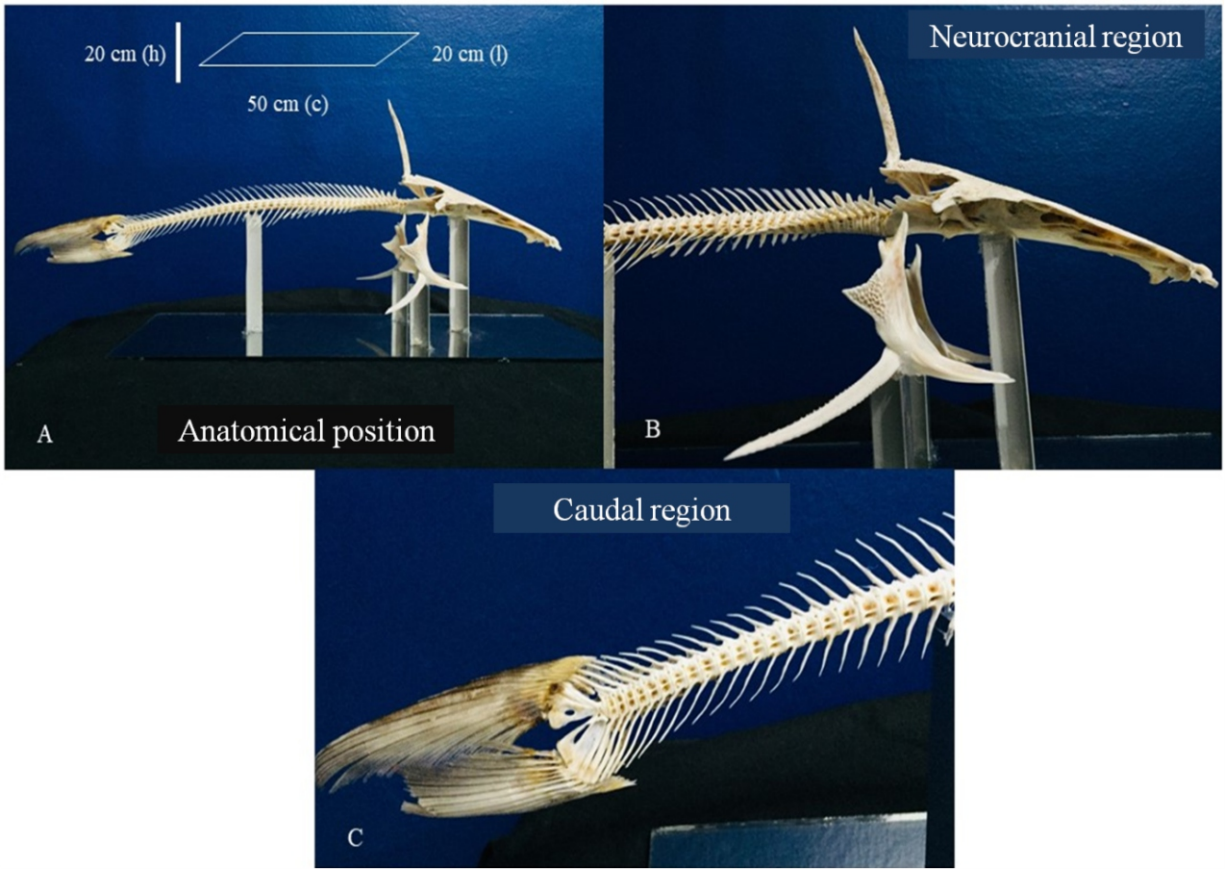

Figure 7. *S. couma* Skeleton. A. Anatomical position; B. Neurocranial region; C. Caudal region.

Although our work has demonstrated descriptions about the osteology of *S. couma*, the main anatomical structures and the contribution of its importance to the area of taxonomy in fish. According to Carvalho (2010), the Siluriformes order in which *S. couma* belongs, corresponds to one of the most diversified among teleost fish, having anatomical, physiological and behavioral variations important for living in the environment.

The anatomical pattern of *S.couma*, which comprises special structures such as a spine subdivided into thoracic and caudal vertebrae, a set of fins, a neurocranium and other structures, is compatible and compared to other species of teleost fish with a life habit similar to that studied in this work. It was possible to infer that the flattened structure of the S. couma skull reflects the benthic habit of the animal life.

The arrangement of the thoracic and caudal vertebrae are similar to other species of fish of the order Siluriformes, in which differences were found in their number, especially in the pre-caudal and caudal. The horizontal anatomical pattern of S. *couma* is noticeable, showing a strong relationship and synchrony of structures from the neurocranial region to the caudal. In this, you can conclude that

the tail is of the furcado type, presenting visible symmetrical parts.

Although it was possible to make a brief anatomical description using several bibliographic sources of studies already carried out with different species of fish, it is noticed that there are still gaps and incipient data about the osteology of *S. couma*. Therefore, future studies to characterize the phylogeny and taxonomy of fish are necessary for definition and other researchers areencouraged to contribute more information about the anatomy of *S. couma* in Brazil and in the world

BIBLIOGRAPHIC REFERENCES

Abrahão, V. P. & Pupo, F.M.R.S. 2014. Técnica de dissecção do neurocrânio de Siluriformes para estudo do encéfalo. Boletim da Sociedade Brasileira de Ictiologia, 112: 21-26.

Andreata, J.V. & Barbiéri, L.R.R. 1993. Osteologia do crânio de *Geophagus brasiliensis* (Quoy & Gaimard, 1824) (Perfiformes, Labroidei, Cichlidae). Biotemas, 6: 73-88.

Bemvenuti, M.A. 1995. *Odontesthes mirinensis sp. n.* um novo peixe-rei (Pisces, Atherinopsinae) para o extremo sul do Brasil. Revista Brasileira de Zoologia, 12: 881-903.

Bemvenuti, M.A. 2005. Osteologia comparada entre as espécies de peixes-rei Odontesthes Evermann & Kendall (Osteichthyes, Atherinopsidae) do sistema lagunar Patos-Mirim, no extremo sul do Brasil. Revista Brasileira de Zoologia, 22: 293-305.

Betancur, R.R.; Acero, P.A.; Bermingham, E. & Cooke, R. 2007. Systematic and biogeography of New World sea catfishes (Siluriformes: Ariidae) as inferred from mitochondrial, nuclear, and morphological evidence. Molecular Phylogenetics and Evolution, 45: 339-357.

Betancur, R.R.; Marceniuk, A.P. & Béarez, P. 2008. Taxonomic status and redescription of the Gillbacker Sea Catfish (Siluriformes: Ariidae: *Sciadesparkeri*). Copeia, 4: 827-834.

Buitrago-Suárez, U.A. 2006. Anatomía comparada y evolución de las especies de *Pseudoplatystoma* Bleeker 1862 (Siluriformes: Pimelodidae). Revista de la Academia Colombiana de Ciencias Exactas, físicas y Naturales, 30: 117-141.

Buckup, P.A.; Figueiredo, J.L. & Moura, R.L. 2003. *Catálogo das espécies de peixes marinhos do Brasil.* São Paulo: Museu de Zoologia da Universidade de São Paulo.

Carvalho, M. 2010. *Ontogenia comparada do esplancnocrânio, aparelho de Weber e esqueleto caudal de três espécies de Otophysi, com ênfase em Siluriformes (Pisces, Teleostei).* Tese de doutorado. Universidade de São Paulo, Ribeirão Preto, 345 p.

Carvalho, T.P.; Reis, R.E. & Friel, J.P. 2017. A new species of *Hoplomyzon* (Siluriformes: Aspredinidae) from Maracaibo Basin, Venezuela: osteological description using high-resolution computed microtomography of a miniature species. Neotropical Ichthyology, 15: e160143.

Calegari, B.B. & Reis, R.E. 2016. New species of the miniature genus *Gelanoglanis* (Siluriformes: Auchenipteridae) from the Tocantins River basin (Brazil) and osteological description of *G. nanonocticolus*. Journal of Fish Biology, 90: 1702-1716.

Cervigón, F.; Cipriani, R.; Fischer, W.; Garibaldi, L.; Hendrickx, M.; Lemus, A.J.; Márquez, R.; Poutier, J.M.; Poutiers, J.M.; Robaina, G. & Rodriguez, B. 1992. *Guia de campo de las especies comerciales de la costa septentrional de sur América.* Roma: Organizacion de las Naciones Unidas para la Agricultura y la Alimentacíon, Disponível em: https://periodicos.ufsc.br/index.php/biotemas/article/view/22708. Acesso em: 04 jul. 2019.

Daiber, F.C. 1960. A technique for age determination in the skate *Raja eglanteria*. Copeia, 3: 258-260.

Gonzalez, M.M.B. & Amenomori, S.N. 2003. Osteologia e utilização de dentes de tubarão-branco, *Carcharodon carcharias* (Linnaeus, 1758) (Elasmobranchii, Lamnidae) em Sambaquis do Estado de São Paulo. Revista do Museu de Arqueologia e Etnologia, 13:25-37.

Gutiérrez-Ramos, J.N. 2014. Taxidermia

conceptos: tendências, retos y desafios. Sagasteguiana, 2: 59-86.

Hildebrand, M. 1995. *Análise da Estrutura dos Vertebrados*. Ed. Atheneu, São Paulo. 764 p.

Kobelkowsky, A. 2004. Osteología de la mojarra de mar, *Diapterus auratus* Ranzani (Teleostei: Gerreidae). Hidrobiológica, 14: 1-10.

La Marca, M.J. 1966. A simple technique for demonstrating calcified annuli in the vertebrate of large elasmobranchs. Copeia, 2: 351-352.

Lopes, M.M.; Sarmento-Soares, L.M. & Martins-Pinheiro, R.F. 2014. *Osteologia Craniana de Characidium Timbuiense Travassos, 1946 (Characiformes: Crenuchidae)*. Anais do III Simpósio sobre a Biodiversidade da Mata Atlântica. Santa Teresa – ES. pp. 159-169.

Pough, F.H.; Janis, C.M.; Heiser, J.B. 2008. A vida dos vertebrados. 4 ed. São Paulo Atheneu Editora São Paulo Ltda.

Marceniuk, A.P. & Menezes, N.A. 2007. Systematics of the family Ariidae (Ostariophysi, Siluriformes), with a redefinition of the genera. Zootaxa, 1416: 1-126.

Marceniuk, A. 2005. Redescrição de *Genidens barbus* (Lacépède, 1803) e *Genidens machadoi* (Miranda-Ribeiro, 1918), bagres marinhos (Siluriformes, Ariidae) do Atlântico Sul Ocidental. Papéis Avulsos de Zoologia, 45: 111-125.

Marceniuk, A.P.; Marchena, J.; Oliveira, C. & Betancur-R, R. 2019. *Chinchaysuyoa*, a new genus of the fish family Ariidae (Siluriformes), with a redescription of *Chinchaysuyoa labiata* from Ecuador and a new species description from Peru Zootaxa, 4551: 362-378.

Riquelme, L.; Abarzúa, R. & Leichtle, J. 2018. Adaptación de osteotecnia para el montaje de un ejemplar de Delfín de Risso *Grampusgriseus* (Cuvier, 1812). Revista de medicina veterinária e Investigación, 1:102-108.

Rodrigues, H. *1998. Técnicas anatômicas/ Hildegardo Rodrigues*. 2. ed. - Vitória: Arte Visual. p. 222.

Serra, J.P. & Langeani, F. 2006. Redescrição e osteologia de *Bryconamericus exodon* Eigenmann, 1907 (Ostariophysi, Characiformes, Characidae). Biota Neotropica, 6: 1-14.

Shibatta, O.A. 2019. New species of bumblebee catfish of the genus *Batrochoglanis* Gill, 1858 (Siluriformes: Pseudopimelodidae) from the Aripuanã River basin, Mato Grosso, Brazil. Zootaxa, 4674: 243–263.

Silva, G.S.C.; Roxo, F.F.; Ochoa, L.E. & Oliveira, C. 2016. Description of a new catfish genus (Siluriformes, Loricariidae) from the Tocantins River basin in central Brazil, with comments on the historical zoogeography of the new táxon. ZooKeys, 598: 129–157.

Soares, B.P. 2016. *Osteologia de três espécies de peixes comumente registradas em sítios arqueológicos do litoral brasileiro*. 28 p. Trabalho de Conclusão de Curso. Londrina: Universidade Estadual de Londrina, Centro de Ciências Biológicas.

Soares, B.E.; Santos, A.C.C.; Mendes, F.L.S.; Barthem, R.B. & Montag, L.F.A. 2016. Length–weight relationship of seven marine catfishes (Siluriformes: Ariidae) in the Amazon Coastal Zone (Brazil). Journal of applied ichthyology, 32: 163-164.

Villarroel-Guerra, M.A. & Troncoso-Felipe, N.A. 2017. Combinación de Osteotecnia más Conservación de Músculos en Montaje Único de *Canis lupus familiaris*. International Journal of Morphology, 35:351-356.

Weitzman, S.H. 1962. The osteology of *Brycon mecki*, a generalized characid fish with an osteological definition of the family. Stanford Ichthyological Bulletin, 8:3-77.

Received December 2, 2019.
Accepted January 31, 2020.