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## Abstract

One new species of *Caulleryaspis* Sendall & Salazar-Vallejo, 2013 (Annelida: Sternaspidae), *C. chicosciencei* sp. nov., is described based on material collected in north-eastern Brazil. Specimens were collected in muddy bottoms in the Suape estuary complex in 7–16 m water depth. *Caulleryaspis chicosciencei* sp. nov. differs from the other known species by the combination of the following characters: small size, abundant cirriform papillae evenly distributed throughout body; chaetigers of introvert with 18–21 falcate hooks per bundle; ventral shield without ribs and undeveloped concentric lines, covered by long cirriform papillae with sediment particles adhered; marginal chaetal fascicles include eight lateral shield chaetae in an oval arrangement, and six posterior shield chaetae in slightly curved pattern. *Caulleryaspis chicosciencei* sp. nov. is the first species of the genus *Caulleryaspis* described from Brazil and it increases the number of sternaspids recorded from shallow water in the south-western Atlantic Ocean.

## Introduction

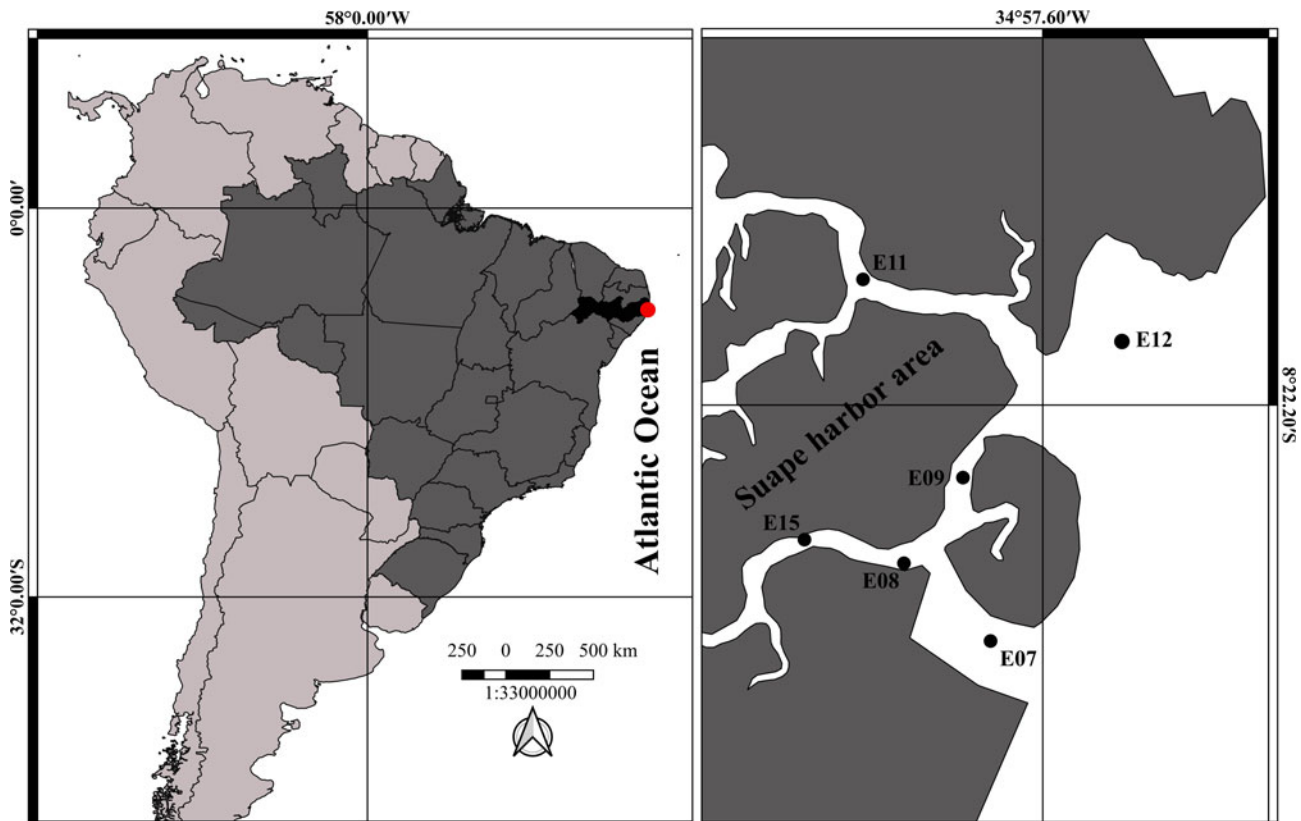
The family Sternaspidae Carus, 1863 present as one of their characteristics a peanut-like body shape (Yoshino *et al.*, 2016) and a characteristic stiff ventral shield which presents different shapes and pigmentation patterns in different species (Hutchings, 2000; Salazar-Vallejo, 2017). This family is formed by four genera and 48 species, and is widely distributed in all oceans, from shallow to deep sea waters (Méndez & Yáñez-Rivera, 2015; Díaz-Díaz & Rozbaczylo, 2017; Fiege & Barnich, 2020; Chuar & Salazar-Vallejo, 2021; Plathong *et al.*, 2021); members of the family are motile, subsurface deposit feeders (Jumars *et al.*, 2015; Hutchings, 2000), occurring in substrates varying from coarse sand to mud (Sendall & Salazar-Vallejo, 2013; Díaz-Díaz & Rozbaczylo, 2017). The species identification in Sternaspidae is currently based on the morphology of a limited set of characters, e.g. segments of the anterior region of the abdomen, type of introvert hooks and the ventro-posterior shield, the latter is the only characteristic used to define this family (Sendall & Salazar-Vallejo, 2013; Drennan *et al.*, 2019). In the recent revision of sternaspids performed by Sendall & Salazar-Vallejo (2013), the described species were grouped into three genera: *Sternaspis* Otto, 1821, *Caulleryaspis* Sendall & Salazar-Vallejo, 2013 and *Petersenaspis* Sendall & Salazar-Vallejo, 2013, based on characteristics of the caudal shields, introvert hooks and number of anterior abdominal segments (Sendall & Salazar-Vallejo, 2013; Wu & Xu, 2017). Recently, Fiege & Barnich (2020) proposed a new genus with a new species, *Mauretanspis longichaeta* Fiege & Barnich, 2020 from deep sea off Mauritania and Angola.

In Brazil only two species of Sternaspidae have been reported, *Petersenaspis capillata* (Nonato, 1966) [= *Sternaspis capillata* Nonato, 1966] (Amaral *et al.*, 2012; Sendall & Salazar-Vallejo, 2013), and *Sternaspis* aff. *nana* Zhadan, Tzetlin & Salazar-Vallejo, 2017 (Craveiro & Rosa Filho, 2021), which is herein regarded as a new species belonging in *Caulleryaspis*. *Petersenaspis capillata* was described from samples collected in muddy bottom (depth 52–126 m) of the São Paulo state, south-eastern Brazil. *Sternaspis* aff. *nana* were observed from samples collected in muddy bottom (15 m depth) of the external area of the Suape Harbour in Pernambuco state, north-eastern Brazil. Based on that, herein we report the new record of the species of Sternaspidae from Brazil and describe a new species of *Caulleryaspis* from shallow water in north-eastern Brazil.

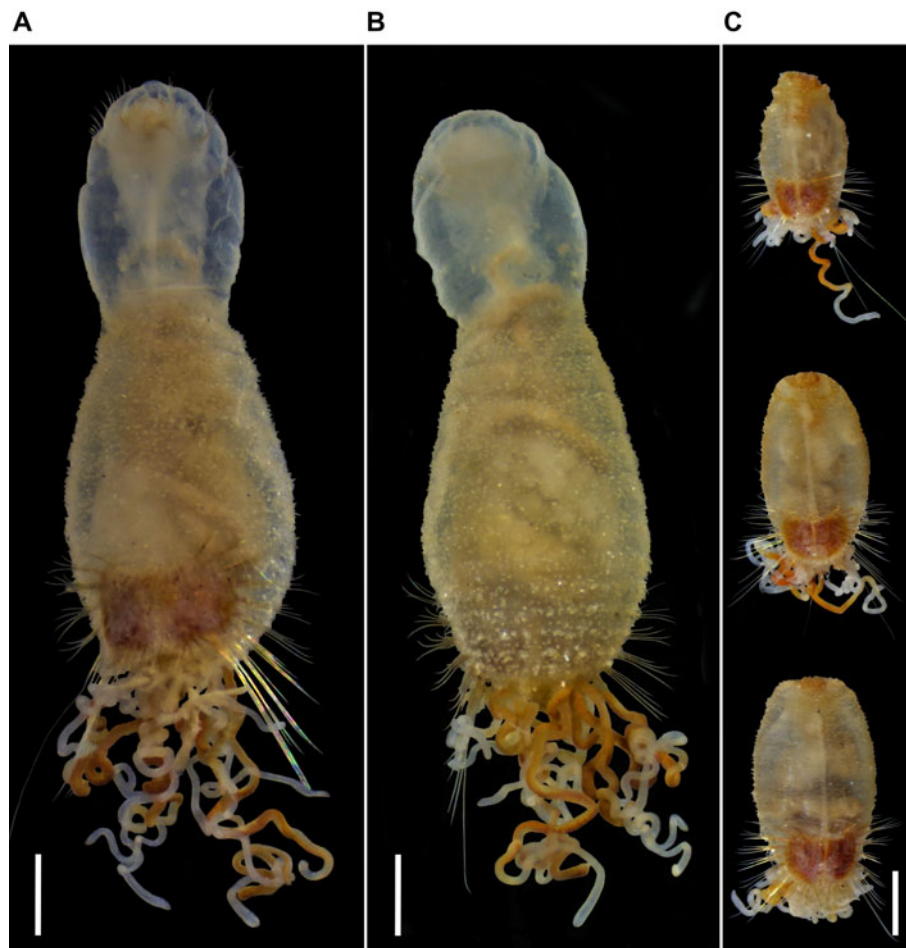
## Materials and methods

The specimens were collected in the Suape harbour area (Suape estuary complex), Pernambuco – Brazil (Figure 1) in January and June 2019. Samples were taken with a van Veen grab in muddy bottom in 7–16 m depth. After sampling, the individuals were fixed in 4% formalin solution in seawater and transferred to 70% ethanol for preservation. Thereafter, the specimens were identified to species level according to Sendall & Salazar-Vallejo (2013) and Salazar-Vallejo (2017). In addition, some specimens were examined using scanning electron microscopy (SEM) investigations. Specimens were dehydrated by a graded ethanol series, critical-point dried using CO<sub>2</sub>, mounted on aluminium stubs, coated





**Fig. 1.** Geographic location of the study area, showing type locality collection stations (indicated by the black circles) of *Caulleryaspis chicosciencei* sp. nov. Suape Harbour area (Suape estuary complex), Pernambuco – Brazil.



**Fig. 2.** *Caulleryaspis chicosciencei* sp. nov., holotype (MOUPFE 004). (A) General ventral view; (B) General dorsal view; (C) Paratype: Series of juvenile specimens with introvert fully inverted. Scale bars: 0.5 mm.

with gold, and examined and photographed at the Technology Platforms Center/FIOCRUZ. Specimens were deposited in the 'Museu de Oceanografia Prof. Petrônio Alves Coelho (MOUPFE)' at Federal University of Pernambuco, Recife, Brazil.

## Results

### Systematics

Order Terebellida Rouse & Fauchald, 1997

Family Sternaspidae Carus, 1863

Genus *Caulleryaspis* Sendall & Salazar-Vallejo, 2013

*Caulleryaspis chicosciencei* sp. nov.

(Figures 2–4)

### Type Material

Holotype: MOUPFE 004, complete specimen (3.8 mm long, 1.35 mm wide; left shield plate 0.4 mm long, 0.4 mm wide), Suape, Pernambuco-Brazil, St E12 (8°21'52.02"S 34°57'11.14"W), mud, 15 m depth, Ipojuca, 22 Jan. 2019. Paratypes: MOUPFE 005, same field data as the holotype, 5 specimens. Three specimens with anterior ends retracted, 0.98–1.45 mm long, 0.63–0.94 mm wide; left shield plate 0.23–0.30 mm long, 0.15–0.30 mm wide. Two specimens' anterior ends protruded 2.8–3.9 mm long, 1.2–1.55 mm wide; left shield plate 0.48–0.50 mm long, 0.30–0.43 mm wide.

Additional material: Suape, Pernambuco-Brazil. 22 Jan. 2019, Sta E08 (8°23'1.71"S 34°58'19.59"W), muddy substrate, 12 m depth: 5 specimens; 22 Jan. 2019, Sta E15 (8°22'54.30"S

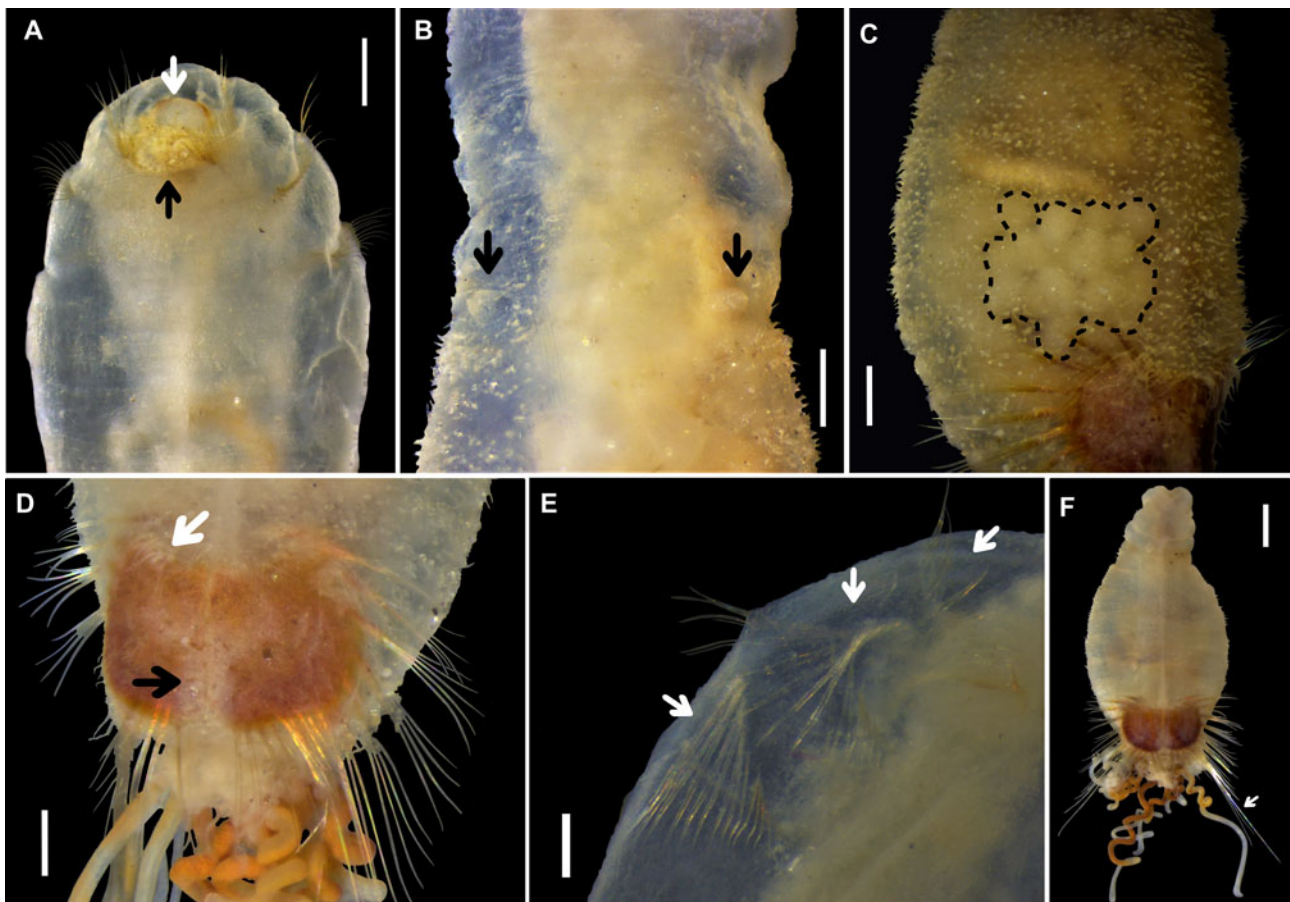
34°58'50.83"W), muddy substrate, 9 m depth: 3 specimens. Suape harbour area, Pernambuco – Brazil. 26 Jun. 2019, Sta E15 (8°22'54.30"S 34°58'50.83"W), mud substrate, 9 m depth: 1 specimen; 26 Jun. 2019, Sta E12 (8°21'52.02"S 34°57'11.14"W), muddy substrate, 15 m depth: 1 specimen; 26 Jun. 2019, Sta E11 (8°21'32.51"S 34°58'32.44"W), muddy substrate, 11 m depth: 1 specimen; 26 Jun. 2019, Sta E09 (8°22'34.79"S 34°58'1.06"W), mud substrate, 7 m depth: 4 specimens; 26 Jun. 2019, Sta E07 (8°23'26.16"S 34°57'52.39"W), muddy substrate, 16 m depth: 1 specimen.

### Diagnosis

Sternaspid with introvert hooks falcate. Seven segments between genital papillae (gonopodial lobes) and shield. Body with abundant minute cirriform papillae evenly distributed, both dorsally and ventrally. Ventro-caudal shield surface visible, covered by long cirriform papillae, papillae longer along its margins, shallow suture extended throughout shield; ribs indistinct; lateral margins medially expanded. Peg-chaetae not seen.

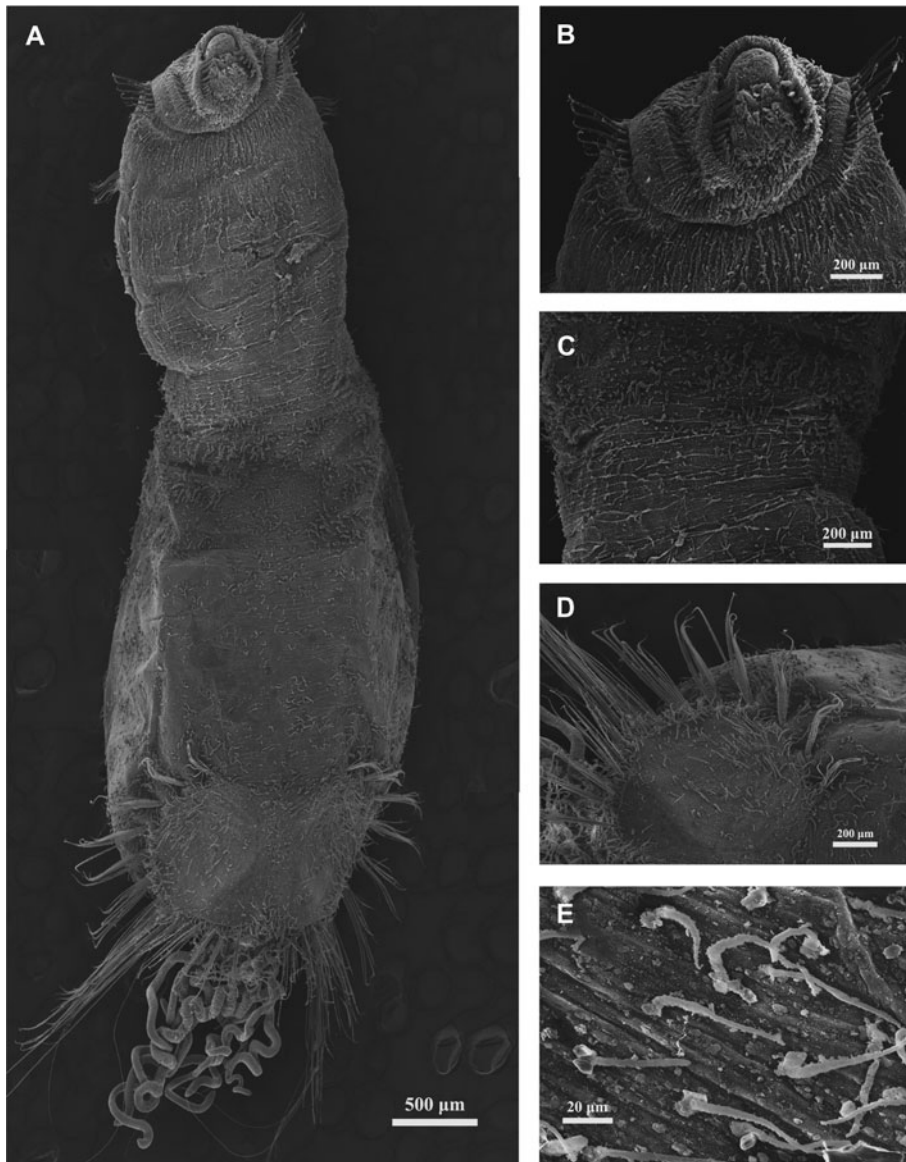
### Description

Holotype complete 3.8 mm long; 1.35 mm wide; left shield plate 0.4 mm long, 0.4 mm wide; about 26 segments. Body pale to yellowish with barely evident segments, hourglass-shaped, body wall semi-transparent; introvert colourless, fully exposed, narrower than abdomen. Abdomen cream-whitish with abundant long cirriform papillae evenly distributed ventrally, in posterior



**Fig. 3.** *Caulleryaspis chicosciencei* sp. nov., holotype (MOUPFE 004). Prostomium, peristomium and introvert, ventral view. (A) Anterior part. White arrows showing prostomium; black arrows showing mouth. (B) Posterior part. Black arrows showing genital papillae (gonopodial lobes). Paratypes. (C) Pre-shield, abdominal region and ventro-caudal shield, ventro-lateral view showing body papillae. Black dotted area showing oocytes; (D) Pre-shield and ventro-caudal shield, ventral view. White arrows showing long cirriform papillae in the ventro-caudal shield. Black arrows showing sediment particles attached to ventro-caudal shield; (E) First three chaetigers. White arrows showing falcate hooks; (F) Ventral view. White arrows showing delicate, long capillary chaetae. Scale bars. A–D: 0.2 mm, E: 0.1 mm, F: 0.5 mm.





**Fig. 4.** *Caulleryaspis chicosciencei* sp. nov. Paratypes, by SEM. (A) Ventral view; (B) Detail of the prostomium, peristomium, mouth and introvert hooks falcate; (C) Detail of the genital papillae (gonopodial lobes); (D) Detail of the ventro-caudal shield: marginal chaetal fascicles include eight lateral shield chaetae in an oval arrangement, and six posterior shield chaetae in slightly curved pattern; (E) Detail of the long cirriform papillae in ventro-caudal shield and sediment particles adhered.

segments in rather regular transverse rows dorsally (Figures 2A–B & 3B–C). Intestine, ventral nerve (Figure 2A, B) and oocytes (Figures 2B & 3C) visible through body wall. Prostomium hemispherical, projected, small, semi-translucent, with two reddish-brown eyespots (Figure 3A). Mouth small, round, covered by abundant minute papillae (Figures 3A & 4B).

First three chaetigers with 18–21 falcate hooks transparent tapering to sharp points, not subdistally expanded (Figures 3A, E & 4B). Constriction between segments seven and eight. Genital papillae (gonopodial lobes) small, protruding ventrally from seventh chaetiger (Figures 3B & 4C). Pre-shield region with eight segments, covered with abundant long cirriform papillae, with sediment particles adhered, without fine capillary chaetae.

Ventro-caudal shield reddish-brown, soft, without ribs and underdeveloped concentric lines, covered by long cirriform papillae (integument papillae), papillae larger towards margins; with small quantity of sediment particles firmly adhered (Figures 3D & 4E). Shallow suture extended throughout shield (Figures 2A, C & 3D). Shield plates with anterior margins slightly rounded; anterior depression very shallow; anterior keels not exposed. Lateral margins rounded, not expanding posteriorly, and posterior margins slightly rounded. Fan slightly projected beyond posterior corners, margin smooth, with median notch (Figures 2A, C & 3D).

Marginal chaetal fascicles (each containing many chaetae) include eight lateral shield chaetae in an oval arrangement, and six posterior shield chaetae in slightly curved pattern (Figure 4D). Peg-chaetae not seen. Two delicate long capillary chaetae, 2–3 times longer than posterior chaetae, in the first bundle of posterior shield chaetae (Figures 2A–C & 3F). Branchial filaments long numerous, slender, curled or spiralled (Figures 2, 3B & 4A).

#### Variation

Paratypes smaller, very similar to holotype. The number of chaetae of the introvert increases with body size. Body colour varies from pale to yellowish with little evident segments, less evident in juveniles (Figures 1A–C & 3C–F). Body shape almost oval in those specimens with introvert fully inverted (Figure 2C). Ventro-caudal shield translucent in small juveniles and reddish-brown to orange in larger juveniles and adults (Figures 2A, C & 3D, F).

#### Habitat

Muddy sediments with organic matter and seagrass detritus and lesser amounts of sand, depth varying between 7 and 16 m.

#### Geographic Distribution

Known only from the type locality in Suape estuary complex, State of Pernambuco, north-eastern Brazil.

Table 1. Main morphological features of *Caulleryaspis chicosciencei* sp. nov. and *Caulleryaspis nana*

Species	BP	IH	S	SP	LSC	PSC	PC	Source
<i>C. chicosciencei</i> sp. nov.	Abundant long cirriform evenly distributed ventrally, and in more or less regular transverse rows dorsally in posterior segments	18–21	Without ribs and underdeveloped concentric lines. Sediment particles adhered; covered by long cirriform papillae.	SF: visible; AM: slightly rounded; LM: rounded; AD: very shallow; AK: not visible; SUT: distinct; FAN: slightly projected	8 in oval pattern	6 slightly curved pattern	Not seen	This study
<i>C. nana</i>	Very small evenly distributed tubercles, and long cirriform forming one row per segment.	13	Ribs and concentric lines not visible. Without papillae and no sediment particles attached	SF: visible; AM: rounded; LM: slightly curved; AD: very shallow; AK: visible <sup>a</sup> ; SUT: distinct; FAN: concave.	8 in oval pattern	5–6 slightly curved pattern	Present	Zhadan <i>et al.</i> (2017)

BP, Body papillae; IH, Introvert Hooks; S, Shield; SP, Shield parts; SF, Surface features; AM, Anterior margins; LM, Lateral margins; AD, Anterior depression; AK, Anterior keel; SUT, Suture; LSC, Lateral shield chaetae; PSC, Posterior shield chaetae; PC, Peg Chaetae.  
<sup>a</sup>In some specimens.

### Etymology

*Caulleryaspis chicosciencei* is named after Francisco de Assis França (stage name Chico Science), a remarkable Brazilian singer and songwriter (13 March 1966–02 February 1997), and one of the main collaborators and influencers in the mangubeat musical movement, along with the band 'Nação Zumbi'. The specific epithet is a noun in the genitive case (ICZN 1999, Art. 31.1.2).

### Remarks

The ventro-caudal shield flexible, introvert hooks tapered and anterior abdomen with seven segments are the main distinctive characteristics of the genus *Caulleryaspis* (Sendall & Salazar-Vallejo, 2013), and the presence of these characters in *Caulleryaspis chicosciencei* sp. nov. leads it to being placed in this genus.

*Caulleryaspis chicosciencei* sp. nov. differs from other known species in *Caulleryaspis* by a combination of features related to the ventro-caudal shield (presence of sediment particles, colour, and presence of ribs), and number of the lateral shield chaetae. The shield is masked by sediment in *Caulleryaspis laevis* [Caullery, 1944], *Caulleryaspis fauchaldi* Salazar-Vallejo & Buzhinskaja, 2013 and *Caulleryaspis gudmundsoni* Sendall & Salazar-Vallejo, 2013, but clearly visible in *Caulleryaspis chicosciencei* sp. nov., as in *Caulleryaspis nuda* Salazar-Vallejo & Buzhinskaja, 2013, *Caulleryaspis nana* Zhadan, Tzvetlin & Salazar-Vallejo, 2017, *Caulleryaspis villamari* Salazar-Vallejo, 2017 and *Caulleryaspis sundaensis* Chuar & Salazar-Vallejo, 2021. Regarding colour of the shield, in *Caulleryaspis chicosciencei* sp. nov. it is reddish brown, whereas in *C. nuda* it is pale brown, in *C. villamari* it is greyish, and it is dark reddish-brown in *C. sundaensis*. Ribs are absent in *Caulleryaspis chicosciencei* sp. nov., whereas they are present in *C. nuda*, *C. villamari* and *C. sundaensis*. Finally, *Caulleryaspis chicosciencei* sp. nov. has eight lateral shield chaetae, and there are 10 lateral shield chaetae in *C. nuda*, *C. villamari* and *C. sundaensis*.

*Caulleryaspis chicosciencei* sp. nov. is very similar to *Caulleryaspis nana* from Vietnam because both have shield soft, reddish-brown; shield surface visible, without ribs, eight lateral shield chaetae in oval pattern; papillae present around ventral shield margins, and have small and abundant body abdominal papillae. However, these two species differ, mainly in the characteristics of the shield, where the Brazilian species, *Caulleryaspis chicosciencei* sp. nov., is covered by long cirriform papillae in shield surface and in *C. nana* the surface is smooth. Other features that differentiate these species are that *Caulleryaspis chicosciencei* sp. nov. has chaetigers of introvert with 18–21 falcate hooks per bundle, whereas *C. nana* has 13. *Caulleryaspis chicosciencei* sp. nov. has body papillae abundant long cirriform evenly distributed ventrally, and in rather regular transverse rows dorsally in posterior segments, whereas *C. nana* has body abdominal papillae of two kinds: abundant, very small tubercles, not arranged in series; other papillae long cirriform, forming rows on each abdominal segment. In *Caulleryaspis chicosciencei* sp. nov. no capillary chaetae were seen laterally in the segments, whereas *C. nana* has 1–2 fine capillary chaetae laterally in some segments. *Caulleryaspis chicosciencei* sp. nov. has posterior shield chaetae with six fascicles each containing many chaetae in slightly curved pattern, whereas in *C. nana* has five to six posterior fascicles each containing only one thick chaeta in slightly curved pattern. The morphological features are summarized in Table 1.

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**Author contributions.** NC: research conceptualization, data collection, picture editing, data analysis and interpretation, roles/writing – original draft; writing – review and editing. JSRF: research conceptualization, data analysis and interpretation, roles/writing – original draft; writing – review and editing.

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**Conflict of interest.** None.

**Ethical standards.** All research pertaining to this article did not require any research permits.

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