

Anoplodactylus (Pycnogonida: Phoxichilidiidae) from Brazil, new records and two new species

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Abstract: *Anoplodactylus* is the largest and the most abundant genus of Phoxichilidiidae, with 134 described species, most from shallow waters. The genus is cosmopolitan and easily encountered in Brazil. The present work catalogues the species of *Anoplodactylus* found in Brazilian waters and describes two new species for the coast of northeastern Brazil. The material analyzed here was deposited in the Invertebrate Collection Paulo Young, which comprises the specimens collected for several studies along the Brazilian coast. Unsourced species were recorded from the literature. We extend the known records of seven species (*A. batangensis*, *A. californicus*, *A. eroticus*, *A. evelinae*, *A. insignis*, *A. monotrema*, and *A. stictus*), and provide the first record of *A. stictus* for northeastern Brazil. Eighteen species of *Anoplodactylus* are now known from Brazil, including the two new species described herein, *Anoplodactylus ricardoi* sp. nov. and *Anoplodactylus ganchiformis* sp. nov. The first species has incomplete segmentation, elongate lateral processes, and many small setae on the dorsal surface. The second species has the third article of the oviger with a small hook directed backwards. The genus needs revision because traditional taxonomy has been unable to solve the taxonomical problems with this genus.

Key words: Sea spiders, Southwest Atlantic, Pantopoda, new species

1. Introduction

The Brazilian littoral covers over 7300 km, reaching 8500 km when all the coastal contours are added (Silva, 1999; Ministério do Meio Ambiente, 2002). The coastline offers a large diversity of environments such as beaches, dunes, cliffs, estuaries, deltas, sandbanks, and islands (Pinheiro et al., 2008), as well as the only reef formation in the South Atlantic, which extends for 3000 km (Amaral and Jablonski, 2005). However, the marine invertebrate fauna remains insufficiently known in Brazil (Amaral and Jablonski, 2005). For some regions, sampling is simply nonexistent for a large number of taxa (Marques and Lamas, 2006). This applies particularly to the Pycnogonida.

The study of the Pycnogonida in Brazil began in the 19th century with the expeditions “Challenger” (Hoek, 1881) and “Vettor Pisani” (Schimkewitsch, 1890). Despite these early beginnings, the study of Brazilian Pycnogonida was only continued in 1940 by Ernst Marcus, who published a catalogue of Pycnogonida from South America (Marcus, 1940). This remains, perhaps, the most important contribution for this region. Since the initial work by Marcus, several authors published on the fauna of Pycnogonida from Brazil. Between 1940 and 1970, at least 16 papers were published, mainly by Sawaya, Mello-Leitão, Corrêa, du Bois-Reymond

Marcus, Zilberberg, and Zago. These papers recorded 65 species in total, belonging to 20 genera and 11 families (Lucena and Christoffersen, 2018). This flow of papers led Stock (1992) to comment that the Brazilian littoral was well sampled for Pycnogonida. However, only seven papers deal with the pycnogonid fauna of northern and northeastern Brazil (Stock, 1966, 1974; Child, 1982a; Lucena et al., 2015, 2017; Rabay et al., 2017; Lucena and Christoffersen, 2017). This section of the coastline alone extends for over 4200 km (Amaral et al., 2008; Pinheiro et al., 2008).

Among the genera recorded in the Brazilian littoral, *Anoplodactylus* Wilson, 1878 possibly contains the largest number of species (16) in Brazil. Classified in the family Phoxichilidiidae Sars, 1891, it is a cosmopolitan genus with 134 described species (Arango and Maxmen, 2006; Arango and Wheeler, 2007; also see World Register of Marine Species available at <http://www.marinespecies.org/aphia.php?p=taxdetails&id=134592>). They predominate in shallow warm waters (Williams, 1941), with rare records in the Antarctic and deep waters (1000 m) (Child, 1998a; Arango and Maxmen, 2006). Their body dimensions vary from 0.6 mm to 6 mm, but smaller species are also known (Arango and Maxmen, 2006; Lucena et al., 2015). Despite being a morphologically homogeneous group, and possibly

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monophyletic (Arango and Wheeler, 2007; Nakamura et al., 2007), the necessity for a revision of the genus is pointed out in the literature (Arango and Maxmen, 2006; Müller and Krapp, 2009). The present work aims to catalogue the species of *Anoplodactylus* found in Brazilian waters and to describe two new species for the coast of northeastern Brazil.

2. Materials and methods

The material analyzed was collected along the Brazilian coast during 1981–1983 and 2005–2015 (Figure 1), and it was deposited in the Invertebrate Collection Paulo Young (CIPY), at the Federal University of Paraíba (UFPB). Unsampld species were recorded from the literature.

For identification, permanent slides in Hoyer’s medium were prepared, containing leg 3 and the ovigers. Specimens were drawn using a camera lucida. Types are deposited in CIPY, at Federal University of Paraíba.

Acronyms

UFPB.PYC – Pycnogonida Collection of Universidade Federal da Paraíba.

3. Results

Family Phoxichilidiidae Sars, 1891

Diagnosis: see Bamber (2007).

Key for the genera of the Phoxichilidiidae

- 1. Ovigers present in male and female *Phoxiphilyra*
- Ovigers present only in male 2

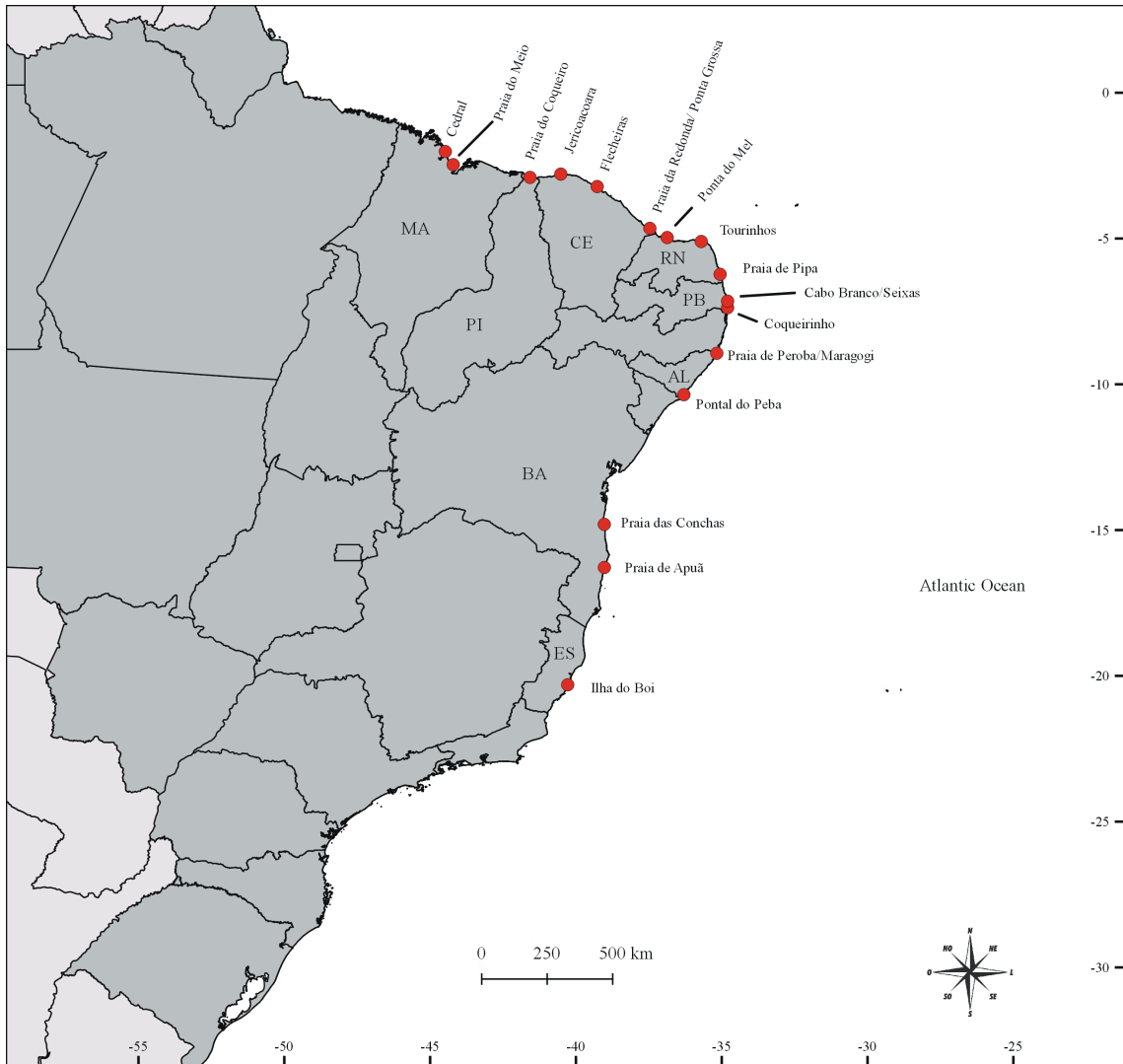


Figure 1. Map of the Brazilian coastline. Red circles: localities where specimens were collected. Overlapping localities at this scale were put together and separated by a bar. Abbreviations: AL, Alagoas; BA, Bahia; CE, Ceará; ES, Espírito Santo; MA, Maranhão; PB, Paraíba; PI, Piauí; RN, Rio Grande do Norte State.

2. Without dorsal segmentation, segmentation only visible ventrally. Cheliphores smaller than proboscis
 *Pycnosomia*
 – Segmentation present dorsally, or completely absent. Cheliphores larger than proboscis 3
 3. Auxiliary claws long, located distally to main claw
 *Phoxichilidium*
 – Auxiliary claws reduced or absent, located on dorsal basis of main claw *Anoplodactylus*

Genus *Anoplodactylus* Wilson, 1878

Type species: *Anoplodactylus lentus* Wilson, 1878, by original designation.

Diagnosis: see Child (1998a).

Remarks: *Anoplodactylus* is the largest and the most abundant genus of Phoxichilidiidae. It is among the three most numerous genera of Pycnogonida, with 134 species. It is considered a shallow-water genus, having a pantropical distribution. Bamber (1998) proposed that *Anoplodactylus* has species that disperse passively in the plankton, riding on medusae, thus explaining their wide global distribution (Bamber and Costa, 2009).

Wilson (1878), in the original description, stressed that the main diagnostic characters of *Anoplodactylus* are the ovigers, with 6 articles, and the absence of auxiliary claws. However, for Marcus (1940) the only distinctive character of the group is the elongation of the neck over the proboscis. This applies particularly after the synonymization of *Halosoma* Cole, 1904, a genus with specimens having 5 articles in the oviger, the discovery of a new species, and the transfer of species of *Phoxichilidium* Milne Edwards, 1840 to *Anoplodactylus*. The latter species are distinguished only by the position of the auxiliary claws (reduced and basal in relation to the main claw in *Anoplodactylus*, long and terminal in *Phoxichilidium*) (Child, 1995).

Despite being considered a stable, morphologically homogeneous (Arango and Maxmen, 2006), and monophyletically robust group (Arango and Wheeler, 2007), as suggested by the absence of palps and ovigers in the females, and by a stable number of segments in the ovigers of males (Hedgpeth, 1948; Child, 1998a; Arango and Maxmen, 2006; Lucena et al., 2015), the species of *Anoplodactylus* display large variations in the structure of the cement glands, in body shape and segmentation, and in the size and shape of the proboscis (Arango, 2002).

According to Hedgpeth (1948), the species of *Anoplodactylus* form a variable group whose identification is uncertain. That is because their distinction is based on a set of one or two distinct characters, or by a unique combination of distinct characters, particularly of the male (Arango and Krapp, 2007). This situation indicates the necessity for a revision of the group, as is pointed out by Williams (1941), Hedgpeth (1948), Arango and Maxmen (2006), and Müller and Krapp (2009).

Given the large morphological variations and high number of described species, taxonomic groups were proposed on the basis of species distributions and morphological characters (Arango and Krapp, 2007). A series of species-complexes were recognized: *A. pygmaeus* (Stock, 1974), *A. insignis* (Stock, 1974), *A. robustus* (Stock, 1979), *A. gestiens* (Nakamura and Child, 1991), *A. californicus-digitatus* (Arango and Maxmen, 2006), *A. tenuicarpus* (Arango and Krapp, 2007), and *A. angulatus* (Krapp et al., 2008; Lucena et al., 2015).

We point out the great difficulty in defining species in the genus (Arango and Krapp, 2007), resulting from incomplete diagnoses, absence of illustrations (Sawaya 1949), and similarity among species due to lack of variations in some characters (Child, 1998a). Furthermore, the males have the main diagnostic characters: the ovigers and the cement gland. Females are impossible to identify when not accompanied by males (Nakamura and Child, 1991; Child, 1998a). As a consequence, a large number of species remain to be named (Williams, 1941; Hedgpeth, 1948).

To date, this is the only genus of Phoxichilidiidae recorded from Brazil, being one of the most abundant genera in shallow waters in all regions of Brazil.

Key to the Brazilian species of *Anoplodactylus* (adult specimens)

1. Oviger with 5 articles 2
 - Oviger with 6 articles 3
2. Trunk partially segmented, segmentation absent between segments 3 and 4. Chelae well developed. Fingers with teeth *A. monotrema*
 - Trunk without segmentation. Chelae with movable finger well developed, immovable finger reduced. Fingers without teeth *A. marcusii*
3. Segments 1 and 2 of trunk with a bifid tubercle near margin of segment *A. evelinae*
 - Segments of trunk without ornamentation 4
4. Proboscis styliform, with terminal region directed upwards. Tube of cement gland with transverse rings
 *A. batangensis*
 - Proboscis not styliform. Tube of cement gland without transverse rings 5
5. Animal with very small trunk, less than 0.6 mm 6
 - Animal with trunk not very small, larger than 0.6 mm 8
6. Lateral processes contiguous. Movable finger of chela reduced *A. marcusii*
 - Lateral processes not contiguous. Movable finger of chela equal to fixed finger 7
7. Trunk segmentation present between segments 1–2 and 2–3 *A. brasiliensis*
 - Trunk segmentation completely absent *A. mirim*
8. Ocular tubercle low or absent, eyes absent or very small and unpigmented *A. typhlops*

- Ocular tubercle regular, eyes present and pigmented ..
..... 9
- 9. Lateral processes smooth or ornamented only with
setae 10
- Lateral processes ornamented with tubercle; with or
without setae 14
- 10. Tube of cement gland long and narrow, extended
forwards. Lateral processes with small dorsal spine and
two smaller lateral spines *A. aragaoi*
- Tube of cement gland short 11
- 11. Trunk without segmentation *A. maritimus*
- Trunk with segmentation complete or absent between
segments 3 and 4 12
- 12. Trunk very long. Lateral processes separated by
twice their diameter. Legs with long dorsal spores on
femur and tibia 1 *A. massiliformis*
- Trunk short. Lateral processes separated at most by
their diameter. Legs without dorsal spores 13
- 13. Coxa 2 of all legs with long spurs on ventral region
in males. Lateral processes with three long dorsal setae
..... *A. eroticus*
- Coxa 2 of legs 3 and 4 with spurs not very long,
remaining legs with very short spur. Lateral processes with
many small setae *A. ricardoii*
- 14. Lateral processes with large, triangular or elongate
tubercles 15
- Lateral processes with small, rounded tubercles 17
- 15. Third article of oviger with a small hook directed
backwards, near base *A. ganchiformis*
- Third article of oviger straight, without a hook 16
- 16. Chelifere with anterior tubercle. Opening of cement
gland elongate *A. insignis*
- Chelifere without tubercle, but with many setae. Tube
of cement gland robust, conical large, directed obliquely to
distal region *A. spurius*
- 17. Trunk not segmented *A. petiolatus*
- Trunk partially or completely segmented 18
- 18. Ocular tubercle conical. With a small rounded
tubercle on lateral processes. A small constriction present
near base of third article of oviger *A. stictus*
- Ocular tubercle rounded. With small rounded
tubercles dorsally on lateral processes. No constriction at
the base of third article of oviger *A. californicus*

Anoplodactylus aragaoi Sawaya, 1949

Anoplodactylus aragaoi: Sawaya, 1949: 63–67, figures 1–9; Stock, 1992: 130, figures 63–64.

Diagnosis: Segments 3 and 4 of trunk fused. Dorsodistal margin of lateral processes 1–3 with a small median seta and a smaller seta on each side. Palps reduced to a small cylindrical tubercle. Length of legs circa 3 times the length of the trunk. Coxae 1 and 3 with 2 lateral setae. Femur with a conical tubercle on distal margin, and a long apical seta. Tube of cement gland thin and elongate, tilting

forwards. Propodus with a spine on heel, and 2 smaller spines on sole. Sole with 9 quadrangular spines, and a small terminal cutting lamina. Auxiliary claws absent (modified from Sawaya, 1949).

Distribution: Brazil: Espírito Santo (Stock, 1992).

Depth: 35–38 m.

Anoplodactylus batangensis (Helfer, 1938)

For older synonyms and references, see Müller (1993: 220).

Anoplodactylus batangensis: Müller and Krapp, 2009: 88–90, figure 47; Lucena et al. 2015: 430–432, figures 1–5.

Material examined: Alagoas: (UFPB.PYC–173) 2 ♂♂ and 1 ♀♀, Pontal do Peba, intertidal, 15 Jun. 2014, coll. R.A. Lucena, J. Prata and J.P. de Araújo. Paraíba: (UFPB.PYC–150) 1 ♀♀, Coqueirinho, intertidal, 17 Apr. 2014, coll. R.A. Lucena; J. Prata and J.P. Araújo. Rio Grande do Norte: (UFPB.PYC–144) 1 ♀♀, Tourinhos, 16 Jul. 2014, coll. R.A. Lucena and L.M. Falkenberg. Ceará: (UFPB.PYC–135) 3 ♂♂, Praia da Redonda, 09 Aug. 2014, coll. R.A. Lucena and J. Prata.

Diagnosis: Animal small. Segmentation incomplete, absent between segments 3 and 4. Chelae small with short fingers. Proboscis cone-shaped and curved upwards. Lateral processes with a rounded dorsal tubercle. Distal region of the 2 anterior lateral processes more expanded than the 2 posterior lateral processes. Legs short. Tube of cement gland narrow, formed by small transversal rings. Auxiliary claws very small or absent.

Distribution: Circumtropical. Brazil (Bahia, Alagoas, Pernambuco, Paraíba, Rio Grande do Norte, Ceará), Curaçao, Venezuela, Caribbean coast of Colombia, Atlantic and Pacific coasts of Panama, Caribbean coast of Costa Rica, Belize, Gulf coast of Mexico, Barbados, Martinique, Guadalupe, Antigua, Dominican Republic, Jamaica, Ilhas Cayman, Bahamas, USA (Flórida), Bermuda, Cameroon, Madagascar, Tanzania, Australia, New Caledonia, Papua New Guinea, the Philippines, Sulu Sea, Tonga (Müller, 1993; Arango, 2003; Müller and Krapp, 2009).

Depth: Up to 40 m deep.

Remarks: Easily recognized by the shape of the proboscis (styliiform and directed upwards) and by the structure of the cement gland (formed by transversal rings) (Child, 1996; Müller and Krapp, 2009). The first record for Brazil was given by Lucena et al. (2015), for the States of Pernambuco and Paraíba. Subsequently it was recorded for the coast of Bahia (Lucena and Christoffersen, 2017), which is the most southern occurrence in the southern Atlantic. Here we provide the first references for the States of Alagoas, Rio Grande do Norte, and Ceará.

Anoplodactylus brasiliensis Hedgpeth, 1948

Anoplodactylus pygmaeus Marcus, 1940: 63–65, Pl. VI figure 6a–d.

Diagnosis: Trunk small, completely fused. Lateral processes separated by a distance smaller than their

diameter. Ocular tubercle wide and rounded. Scape very short and wide, less than twice as long as chela. Chelae with strong spines. Legs with many setae. Coxa 2 with a dorsal tubercle. Femur and tibiae with a long distal seta. Tube of cement gland long and narrow. Propodus curved, heel with 2 spines. Sole with 2–6 median spines and a cutting lamina occupying one-third to half of the sole. Main claw little more than half length of propodus. Auxiliary hooks very small or absent (modified from Marcus, 1940).

Distribution: Brazil (São Paulo), USA (Georgia) (Marcus, 1940; du Bois-Reymond Marcus and Marcus, 1967).

Depth: Infralittoral.

Anoplodactylus californicus Hall, 1912

For older synonyms and references, see Müller (1993: 222).

Anoplodactylus californicus: Arango and Maxmen, 2006: 60, 62 [key], figure 3f; Melzer et al. 2006: 238–240, figures 2b, 2f, 2g; Müller and Krapp, 2009: 90–93, figure 48; Weis and Melzer, 2012: 200–201, figures 2b, 10f, 10g, 11a–11g.

Material examined: Bahia: (UFPB.PYC–182) 1 ♀ and 4 juveniles, Praia das Conchas, 16 May 2015, coll. R.A. Lucena, L.M. Falkenberg and J. Prata. Paraíba: (UFPB.PYC–099) 2 ♂♂ and 7 juveniles, Cabo Branco, intertidal in *Sargassum vulgare*, 01 Feb. 2014, coll. E. Canuto and K.S. Pacheco; (UFPB.PYC–100) 1 ♂♂ and 1 juvenile, Cabo Branco, intertidal in *Gracilaria ferox*, 31 Jan. 2014, coll. E. Canuto and K.S. Pacheco; (UFPB.PYC–149) 1 ♂, 1 ♀ and 1 juvenile, Cabo Branco, intertidal in *Gracilaria* sp., 31 Jan. 2014, coll. E. Canuto and K.S. Pacheco; (UFPB.PYC–151) 3 ♀♀ and 3 juveniles, Coqueirinho, intertidal, 17 Apr. 2014, coll. R.A. Lucena; J. Prata and J.P. Araújo; (UFPB.PYC–168) 2 ♀♀, Seixas, Paraíba, 09 Nov. 2014, coll. T. Dias. Rio Grande do Norte: (UFPB.PYC–219) 2 ♂♂, 2 ♀♀ and 5 juveniles, Tourinhos, intertidal, 6 Jul. 2014, coll. R.A. Lucena and L.M. Falkenberg. Ceará: (UFPB.PYC–218) 24 ♂♂, 15 ♀♀ and 23 juveniles, Jericoacoara, intertidal, 11 Aug. 2014, coll. R.A. Lucena and J. Prata; (UFPB.PYC–220) 1 ♂, 4 ♀♀ and 3 juveniles, Flecheiras, intertidal, 13 Aug. 2014, coll. R.A. Lucena and J. Prata; (UFPB.PYC–244) 1 ♂, Jericoacoara, intertidal in hydrozoans, 11 Aug. 2014, coll. R.A. Lucena and J. Prata. Piauí: (UFPB.PYC–221) 2 ♂♂, 1 ♀ and 11 juveniles, Praia do Coqueiro, intertidal, 19 Mar 2015, coll. R.A. Lucena, J. Prata and J.P. de Araújo.

Diagnosis: Body elongate, trunk segments 3 and 4 fused. Two small setae inserted laterally near the bases of the cheliphores. Chela with a row of small setae in the direction of palm-finger, and 3 or 4 setae on ventral side of palm. Movable finger with 5 median dorsal setae. Legs very long. Femur with a small dorso-distal tubercle. Spur on legs 3 and 4 long in both sexes. Tube of the cement gland short and oval. Propodus with 2 spines on heel.

Female with a pair of wing-like tubercles on proboscis. Palp vestigial.

Distribution: Pantropical, pantemperate. Strait of Magellan, Brazil (Santa Catarina, São Paulo, Bahia, Pernambuco, Paraíba, Rio Grande do Norte, Ceará, Piauí), Colombia, Curaçao, Bonaire, USA (Florida, Hawaii), Egypt, Turkey, Israel, Italy, Chile (Marcus, 1940; Sawaya, 1949; Stock, 1974; Child, 2004; Müller and Krapp, 2009).

Depth: Up to less than 100 m deep.

Remarks: *Anoplodactylus californicus* may be identified by the robust appearance, the strigilum on the oviger, with many setae, cement gland with a short tube pointing distally, long spur on coxa of leg 4 of male, the peculiar alate process on the proximo-ventral region of the proboscis of the female (Child, 1992; Bamber and Takahashi, 2005) and the large, abnormal sprout representing the palp (Child, 1995).

This species was referred to erroneously under several names because the type-species was poorly described and insufficiently illustrated by Hall (1912). The material corresponding to this species was considered lost until it was rediscovered and reexamined by Child (1987). Apparently, this is one of the few species of Pycnogonida that have a high thermal tolerance. They occur in Subantarctic habitats, temperate localities in the South America, tropical latitudes in the eastern Pacific, and temperate latitudes of the northern hemisphere (Child, 1995).

We detected a certain plasticity in certain characters that differ from the original description and from those presented by Müller and Krapp (2009). Some specimens had the ocular tubercle conical, while others had a rounded ocular tubercle. Complete segmentation was observed in some specimens, and a small rounded tubercle occurred above the insertion of the proboscis in some specimens. Some individuals had the abdomen slightly curved backwards, and some presented a small elevation, less than a tubercle, on the lateral processes ornamented by setae. Some individuals had a tubercle only on the lateral process 4, a femur with one elongate dorso-terminal tubercle and one apical seta. Furthermore, there were differences among the cement glands in specimens from different localities along Brazil, some being longer, others being more robust. Here, we recorded this species for the first time for Bahia, Paraíba, Ceará, and Piauí States.

Anoplodactylus eroticus Stock, 1968

Anoplodactylus eroticus Stock, 1968: 49, figure 18; Arango and Maxmen, 2006: 55, figures 2a–2e, 3a, 3b, 4, 5; Lucena et al. 2015: 435, figures 12–28.

Material examined: Rio Grande do Norte: (UFPB.PYC–216) 1 ♂, 4 ♀♀ and 1 juvenile, Tourinhos, intertidal, 16 Jul. 2014, coll. R.A. Lucena and L.M. Falkenberg. Piauí: (UFPB.PYC–120) 2 ♂♂, 2 ♀♀ and 1 juvenile, Praia do

Coqueiro, intertidal, 19 Mar. 2015, coll. R.A. Lucena, J. Prata and J.P. de Araújo.

Diagnosis: Trunk elongate. Segmentation complete. Lateral processes ornamented with three long setae. Legs long with many setae. Coxa 2 with long spurs on all legs. Tube of cement gland short and erect distally. Propodus with 2 spines on heel, and a small cutting lamina on distal region. Auxiliary claws reduced.

Distribution: Brazil (Alagoas, Paraíba, Rio Grande do Norte, Ceará, Piauí, and Maranhão), India, USA (Hawaii) (Stock, 1968; Arango and Maxmen, 2006; Lucena et al., 2015).

Depth: Not cited.

Remarks: This species was recorded for the first time in Brazil by Lucena et al. (2015), for the States of Alagoas, Paraíba, Rio Grande do Norte, Ceará, and Maranhão. This is the second record for Brazil, and the first from the State of Piauí.

Anoplodactylus evelinae Marcus, 1940

Anoplodactylus (Labiodactylus) evelinae: Stock, 1954.

Anoplodactylus evelinae Marcus, 1940: 55, figure 4; Hedgpeth, 1948: 232, figure 31; Fage, 1949: 27-28, figure 3; Müller and Krapp, 2009: 93-94, figure 49.

Material examined: Bahia: (UFPB.PYC-170) 1 ♂ and 1 juvenile, Praia de Apuã, intertidal, 17 Apr. 2015, coll. R.A. Lucena, L.M. Falkenberg and J. Prata. Alagoas: (UFPB.PYC-128) 2 ♂ and 1 ♀, Praia de Peroba, intertidal, 13 Jun. 2014, coll. R.A. Lucena, J. Prata and J.P. de Araújo.

Diagnosis: Body small. Trunk segments 3 and 4 fused. Cuticulum with small tubercles. Segments 1 and 2 with a bifurcate median-dorsal tubercle, near posterior border of segment. Proboscis robust, of similar size to segment 1, and with small ventral tubercles near median line. Abdomen small, with a rounded tubercle at base. Fingers with small teeth. Legs short and robust. All articles of legs with small median and dorsal tubercles. Cement gland opening onto femur by a median-dorsal pore. Propodus with 1 spine on heel. Main claw two-thirds length of propodus. Auxiliary claws strongly reduced.

Distribution: Brazil (São Paulo, Rio de Janeiro, Bahia and Alagoas), Colombia, Atlantic and Pacific Panama, Anguilla, Jamaica, Belize, Mexico, USA (Florida), Congo (Marcus, 1940; Sawaya, 1949; Müller, 1993; Müller and Krapp, 2009).

Depth: Up to 30 m deep.

Remarks: The species is clearly distinguished from the remaining species of the genus for having some rare characters, otherwise commonly found in the genus *Pycnogonum* (Ström, 1762): The short dorso-median tubercles on the trunk very rare or unique to this genus, abdomen inflated and extending horizontally from trunk, very short legs, with tibia as long as wide (Stock, 1979; Child, 2004), and propodus with very pronounced heel having a robust spine (Child, 1982b).

For Müller and Krapp (2009), *A. evelinae* is related to *A. arescus* du Bois-Reymond Marcus, 1959 and *A. tarsalis* Stock, 1968, for having a compact structure with similar tarsus and propodus. They may be distinguished by the cement gland, which in *A. evelinae* does not have a tubular opening.

Here we record this species for the first time in the Brazilian State of Alagoas.

Anoplodactylus insignis (Hoek, 1881)

Phoxichilidium insigne Hoek, 1881: 82-84, plate XIV, figures 5-7.

Anoplodactylus insignis bermudensis Cole, 1904: 325-327, plate XX, figures 1-3, plate XXII, figures 21-29.

Anoplodactylus insignis calcaratus: Stock, 1986: 437-438, figures 15a-15b.

Anoplodactylus insignis: Hedgpeth, 1948: 226-228, figures 28d-28g; Stock, 1974: 1056-1058, figure 44; Child, 1992: 46-49, figure 21.

Material examined: Maranhão: (UFPB.PYC-110) 1 ♀, Cedral, 19 Jul. 1982, coll. M.L. Christoffersen and I.A. Kanagawa.

Diagnosis: Trunk long, tenuous. Trunk segments 3 and 4 fused or partially fused. Lateral processes short, with setose dorso-distal tubercles that diminish in size in the posterior pairs. Ocular tubercle conical, directed obliquely forwards. Proboscis of male with a pair of medio-ventral alar protuberances. Scapus of chelifore with anterior setose tubercles. Chela setose without teeth on fingers. Legs with long ventro-distal tubercles on coxa 2, dorso-distal tubercles on femur and tibia 1. Cement gland opening into long groove. Propodus with distal tubercles, a pronounced heel with 3 spines, without a lamina. Auxiliary claws absent.

Distribution: Brazil (off Espírito Santo, Bahia, Maranhão, Pará, off Amapá), French Guyana, Suriname, Guyana, Trinidad and Tobago, Venezuela, Caribbean coast of Colombia, Curaçao, Guadeloupe, Gulf of Mexico, Bermuda, USA (Florida, Georgia, North Carolina) (Stock, 1986, 1992; Child, 1992; Müller, 1993; Arango, 2000).

Depth: Up to 90 m deep.

Remarks: This species has tubercles on the chelifores and long legs, which makes it easy to distinguish from the remaining species of the genus and from the species considered the closest to it, *A. lentus* Wilson, 1878 (Child, 1992; Child, 1998b).

Stock (1986) proposed the variety *calcaratus* based on the difference in the size and number of the tubercles on the lateral processes and legs; the larger tubercles occur in *calcaratus*. This difference may represent an intraspecific or interspecific variation (Arango, 2000). However, further analyses are necessary to determine the validity of this character and of this variation. In the specimens examined herein, the tubercles are short, differing from

those described by Stock (1986) and Arango (2000), both from specimens coming from northern South America.

There are two recognized varieties of *A. insignis*, *Anoplodactylus insignis* var. *bermudensis* Cole, 1904 and *Anoplodactylus insignis* var. *calcaratus* Stock, 1986, both having the same geographical and bathymetric distribution.

The variety proposed by Cole does not have lateroventral tubercles on the femur, nor segmentation between segments 3 and 4, but has the cement gland in the shape of a sieve (Hedgpeth, 1948). The variety by Stock has a small anterior tubercle and a long posterior tubercle on the dorsal surface of coxa 1, a long tubercle in the distal region of the femur, and two small tubercles on the antero-lateral and postero-lateral surfaces of the femur, some long tubercles on the proximal region of tibia 1, and a small tubercle on the dorsal margin of tibia 2 (Stock, 1986).

The specimen examined by us is more similar to the material examined by Arango (2000), which differs from the variety by Stock for not possessing a dorsal tubercle on the lateral processes. However, the ocular tubercle is longer than that described by Arango, and a latero-distal tubercle is present on the femur and two dorsal proximal tubercles occur on tibia 1, as indicated by Stock, except that they are extremely reduced, being almost imperceptible on some legs. On tibia 2, the present specimen has two small tubercles with an apical seta at the distal apex, in a latero-distal position. The remaining characters agree with the description by Hoek (1881).

We agree with Arango (2000) and Stock (1986) in that a larger number of animals from different locations are necessary for deciding upon the intra- or interspecific value of these coxal morphological variations. Here we recorded this species for the first time in the State of Maranhão.

Anoplodactylus marcusii (Mello-Leitão, 1949)

Halosoma marcusii Mello-Leitão, 1949: 168-173, figures 1-4.

Anoplodactylus robustus: Zilberberg, 1963: 25-27, figures 5-7 (Dohrn, 1881).

Diagnosis: Cuticle with many hypodermic glands. Trunk small and robust. Lateral processes contiguous. Proboscis slightly shorter than half length of trunk. Abdomen strongly reduced. Cheliphore and chela with few setae. Fixed finger almost half as long as movable finger. Oviger with 5 articles. Legs robust with few setae. Propodus only slightly smaller than femur, with 2 spines on heel. Sole with small spines along its length. Auxiliary claw strongly reduced (modified from Mello-Leitão, 1949).

Distribution: Brazil (Rio de Janeiro, Ilha de Trindade) (Mello-Leitão, 1949; Zilberberg, 1963).

Depth: Intertidal to 40 m deep.

Anoplodactylus maritimus Hodgson, 1914

Anoplodactylus parvus Giltay, 1934: 1-3, figures 1-5; Hedgpeth, 1948: 223-224, figures 27e-27f; Stock, 1951: 13, figures 14-16; Boourdilon, 1955: 590-591, figure 1, plate 1 figure 2.

Anoplodactylus maritimus: Stock, 1974: 1069-1074, figure 54; Child, 1992: 52-53, figure 23.

Diagnosis: see Child (1992).

Distribution: Brazil (São Paulo, Rio de Janeiro), Amphi-Atlantic, Belize, Caribbean Sea, Gulf of Mexico to USA (Virginia), Central Atlantic (24°55'N, 44°00'W), Macaronesian Islands: Cape Verde Islands, Madeira Island, Canary Islands, Azores (Child, 1992; Stock, 1992; Müller, 1993; Turpaeva and Raiskiy, 2014).

Depth: Up to 4379 m deep.

Anoplodactylus massiliformis Stock, 1974

Anoplodactylus massiliformis Stock, 1974: 1063-1066, figures 48 and 49.

Diagnosis: see Stock (1974).

Distribution: Brazil (off Amapá), French Guyana, Guyana, Marguerita Island, Aruba, Barbados, Caribbean coast of Panama (Stock, 1974, 1986; Müller, 1993).

Depth: up to 100 m deep.

Anoplodactylus mirim Lucena, de Araújo & Christoffersen, 2015

Anoplodactylus mirim Lucena et al. 2015: 432, figures 6-11.

Diagnosis: see Lucena et al. (2015).

Distribution: Brazil: Paraíba (Lucena et al., 2015).

Depth: Up to 30 m deep.

Anoplodactylus monotrema Stock, 1979 (Figures 2a-2g)

Halosoma robustum: Marcus, 1940: 68-71, figures 8a-8c (Dohrn, 1881).

Anoplodactylus robustum: Stock, 1955: 237, figures 12b and 12c.

Anoplodactylus monotrema: Stock, 1979: 15-18, figures 4 and 5; Müller and Krapp, 2009: 105-107, figure 56.

Material examined: Alagoas: (UFPB.PYC-127) 1 ♂, Galés de Maragogi, intertidal, 14 Jun. 2014, coll. R.A. Lucena, J. Prata and J.P. de Araújo; (UFPB.PYC-129) 1 ♀, Praia de Peroba, intertidal, 13 Jun. 2014, coll. R.A. Lucena, J. Prata and J.P. de Araújo.

Diagnosis: Trunk robust. Trunk segments 3 and 4 fused. Lateral processes separated by one-fourth of their diameter, with a dorsal seta. Proboscis very robust, cylindrical. Cheliphores moderately robust. Chela with curved fingers having 3 teeth. Oviger with 5 articles. Tube of cement gland oval and long, placed at end of first fourth of femur. Propodus slightly curved, heel with 2 robust spines and 2 smaller subventral spines. Sole with 6 small spines, curved towards distal region, and bordered by 5 short setae on both sides. Main claw robust. Auxiliary claws strongly reduced.

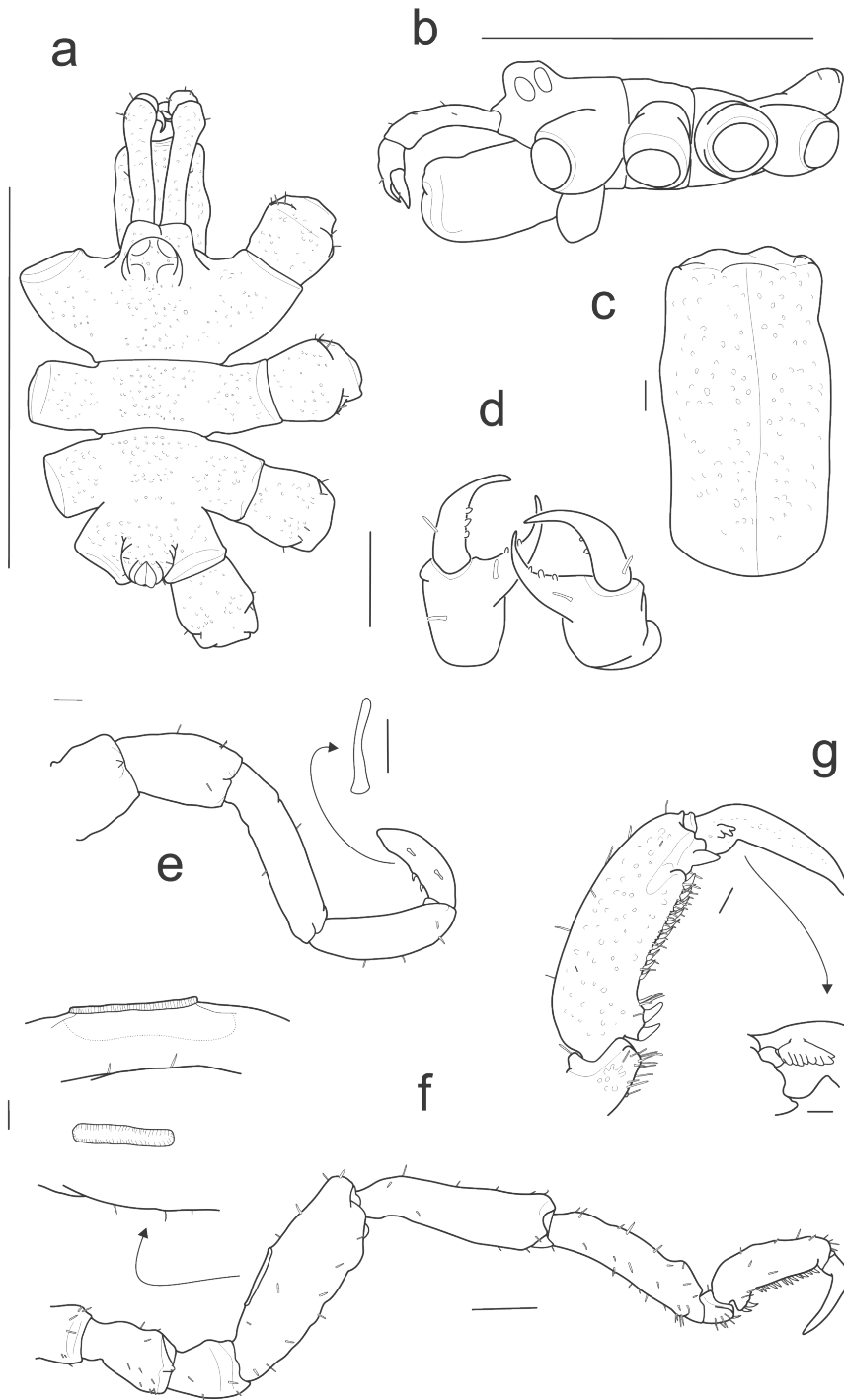


Figure 2. *Anoplodactylus monotrema* Stock, 1979 (UFPB.PYC-127). Adult male. Habitus: a, dorsal view (scale bar: 1 mm); b, lateral view (scale bar: 1 mm); c, proboscis ventral view (scale bar: 0.05 mm); d, chela (scale bar: 0.1 mm); e, oviger (scale bar: 0.25 mm; detail of e: 0.05 mm); f, leg 3 (scale bar: 0.25 mm; detail of f, 0.05 mm); g, propodus (scale bar: 0.05 mm; detail of g, 0.025 mm).

Distribution: Brazil (São Paulo, off Espírito Santo, Alagoas), Colombia; Curaçao, Aruba, Bonaire, Caribbean coast of Panama, Virgin Islands, Jamaica, Bahamas,

Mexico, USA (Florida), Galapagos (Stock, 1992; Müller, 1993; Müller and Krapp, 2009).

Depth: Up to 41 m deep.

Remarks: *A. monotrema* belongs to a group of species of *Halosoma* Cole, 1904 (later synonymized with *Anoplodactylus*) that have 5 articles on the oviger instead of 6, as is more common in *Anoplodactylus*, known as the *A. robustus* group (Dohrn, 1881) (Stock, 1979; Child, 1982a). *A. robustus*, *A. virescens* (Hodge, 1864), and a few other species, together with *A. monotrema*, are characterized for being small, stout, with contiguous lateral processes, and short articles on appendages (Child, 1982a).

We may differentiate the three main species of the group by the absence of teeth on the fingers in *A. robustus* and *A. virescens*, segmentation completely absent in the trunk of *A. robustus* (absent only in the segments 3 and 4 in the remaining species), 3–6 pores in the cement gland in *A. robustus* and *A. virescens* (only one in *A. monotrema*). The abdomen surpasses the lateral process 4 in *A. virescens* (in *A. monotrema* it reaches the margin of the process) and coxa 1 has dorso-distal tubercles in *A. robustus* (smooth in *A. monotrema*) (Stock, 1979; Child, 1979, 1982b; Müller and Krapp, 2009).

In the material examined here, all the characters are equal to the original description (Figures 2a–2f) but the pore of the cement gland is longer (Figure 2f) than that described by Stock (1979) and Müller and Krapp (2009). Besides, the auxiliary claws are ornamented by teeth (Figure 2g), a character not observed in other species of the genus. Both characters differ from the original description by Stock (1979) for specimens representing the first record in Brazil (see Stock, 1992).

The female observed herein has the proboscis somewhat longer and more robust, the abdomen is more erect, and the lateral processes are more widely separated in the female, as also described for the female by Stock (1992). Segmentation is complete in our material, as in the description of *A. monotrema*. More specimens have to be examined in order to determine if the reduced auxiliary claws observed in the material from Alagoas is a useful character for the characterization of this species. Here we record this species for the first time in the northeastern State of Alagoas.

Anoplodactylus petiolatus (Krøyer, 1844)

For older synonyms and references, see Müller (1993: 239).

Anoplodactylus petiolatus: Melzer et al., 1996: 167–171, figures 1 and 2; Ros-Santaella, 2004: 7, figure 6; Bamber and Costa, 2009: 168, figure 2g; Lehmann et al., 2014: 167, figures 47 and 48.

Material examined: Espírito Santo: (UFPB.PYC–126) 1 ♂, Ilha do Boi, intertidal, 01 Nov. 2005, coll. K. Paresque.

Diagnosis: Trunk elongate with all segments fused. Lateral processes with rounded tubercles. Scapus of cheliphore slender. Movable finger with one seta on inner and outer margin. Tube of cement gland thin, directed

obliquely backwards, beginning in the middle region of femur. Propodus curved. Heel with 2 to 4 spines. Sole almost straight, with 3 or 4 distally curved spines along proximal half, and a cutting lamella on distal half. Main claw slightly curved, thin. Auxiliary claws strongly reduced.

Distribution: Brazil (off Rio Grande do Sul, Santa Catarina, off Paraná, São Paulo, Rio de Janeiro, Espírito Santo), Argentina, Uruguay, French Guiana, Surinam, Guyana, Bonaire, Venezuela, Curaçao, Caribbean coast of Colombia, Mexico, Bahamas, USA (Florida, Alabama, Texas, Georgia), Sargasso Sea, Cape Verde, Morocco, Mediterranean, Spain, Black Sea, Ireland, United Kingdom, Belgium, Holland, Denmark, Faroe Islands, Russia, Terra del Fuego (Beagle Channel), Chile (Stock, 1986, 1992; Müller, 1993; Bamber and Costa, 2009; Lehmann et al., 2014; Turpaeva and Raiskiy, 2014).

Depth: Up to 4825 m deep.

Remarks: *A. petiolatus* and *A. maritimus* are very similar species (Müller and Krapp, 2009). They may be distinguished, superficially at least, by the more tenuous and slender habitus of the first species, with larger appendages than the second species (Child, 1992).

The examined specimen is a little more robust than the specimens illustrated by Stock (1974), Child (1992), and Müller and Krapp (2009). It is very similar to the specimen described by Marcus (1940). It has a cutting lamella on the propodus, the fingers of the chelae and the tubercles of the lateral processes are similar to those described by Stock (1974) and Müller and Krapp (2009). Furthermore, it complies with the description by Stock (1974) in the following characters: the auxiliary claws small, but easily discernible, the rectangular palm of the chela, and the third oviger more than 5 times as long as broad.

As noted by Stock (1992) for Brazilian specimens, our specimen has 8 spines in the sole of the propodus, 4 of which are more robust, being located medially on anterior half of sole, and there are median-sized tubercles on the lateral processes that are as broad as long. We were unable to observe vestigial tubercles on coxa 1, as described by Stock (1992).

Anoplodactylus spurius Stock, 1992

Anoplodactylus spurius Stock, 1992: 132–134, figures 65–75.

Diagnosis: See Stock (1992).

Distribution: Brazil: São Paulo, Rio de Janeiro (Stock, 1992).

Depth: From 19 to 220 m deep.

Anoplodactylus stictus Marcus, 1940

Anoplodactylus stictus Marcus, 1940: 65–68, plate VI, figures 7e–7f, plate VII, figures 7a–7d; Sawaya, 1945: 231–234, figures 1 and 2; Bremec et al., 1986: 36–37, figures 7 and 8; Stock, 1992: 134, figure 62.

Material examined: Rio Grande do Norte: (UFPB.PYC-112) 1 ♀, Ponta do Mel, Brazil, 23 Jun. 1982, coll. A.I. Kanagawa. Ceará: (UFPB.PYC-111) 1 ♂ and 1 ♀, Ponta Grossa, 24 Jun. 1982, coll. M.L. Christoffersen and A.I. Kanagawa.

Diagnosis: Trunk elongate with segmentation between segments 3 and 4, or segmentation absent. Lateral processes separated by less than their diameter, with 1 or 2 hairs and a rounded dorsal tubercle. Ocular tubercle elongate. Proboscis of female with a cordiform protuberance. Scapus and palm with few setae that are concentrated at the basis of the movable finger. Third article of oviger with a pseudo-segmental fold. Legs long. Coxa 2 with a small dorso-median tubercle. Femur with a distal tubercle and a long terminal seta. Tube of cement gland short. Tibiae 1 and 2 with a long distal seta. Heel of propodus with 1 or 2 spines. Sole with 6 to 10 spines in proximal region, and a cutting lamina in distal region. Auxiliary claws varying in size within the same individual.

Distribution: Brazil (off Santa Catarina, Paraná, São Paulo, Rio de Janeiro, Espírito Santo, Rio Grande do Norte and Ceará), Argentina (Marcus, 1940; Bremec et al., 1986; Stock, 1992).

Depth: Up to 250 m deep.

Remarks: As described by Marcus (1940), *A. stictus* has nondentate alar processes on the proboscis of the female, a tubercle on the lateral processes of the male, and a cutting lamina on the distal third of the propodal sole, which is different from *A. californicus*, the closest known species.

We did not observe the presence of a cutting lamina on the sole of the propodus, this being the only important difference detected in relation to the original description. We also observed that individuals of *A. californicus* tended to be larger than individuals of *A. stictus*, a character hypothesized by Marcus (1940) as diagnostic to differentiate the two species.

An association of *A. stictus* with the hydrozoan *Tubularia crocea* (Agassiz, 1862) was recorded (Genzano, 2002), probably representing a predator (Varoli, 1994). However, they were also recorded as parasites of a new hydrozoan species of the genus *Podocorina* Sars, 1846, an association established by chance in an incrusting community of experimental plates in Paranaguá, Paraná (Bettim and Haddad, 2013). According to Marcus (1940), *A. stictus* is the closest to *A. californicus* but may be distinguished mainly by the larger size, by the presence of a remnant of the propodus in *A. californicus*, by the presence of a cutting lamina in the propodal sole in *A. stictus*, and by a small protuberance on the movable finger of the chela (Stock, 1992).

This species is known to exist in shallow waters, most species occurring along the upper continental platform

in Brazil (Marcus, 1940; Sawaya, 1945) and northern Argentina (Stock, 1992).

In the specimens examined by us, the male had a more elongate and conical ocular peduncle than the female. Segmentation between segments 3 and 4 was almost imperceptible and, in some cases, completely absent. On the coxae 1, there were small lateral projections, each with a terminal seta, more conspicuous in males. Some females and juveniles had small tubercles on the lateral processes, more developed in young specimens. According to Marcus (1940), these were only present in males. Vestiges of auxiliary claws were not observed in any of the four examined specimens.

Here we recorded this species for the first time in northeastern Brazil, in the States of Rio Grande do Norte and Ceará.

Anoploactylus typhlops Sars, 1888

Anoploactylus typhlops Sars, 1888: 341-342, plate 2, figures 3a-3c; Sars, 1891: 29-31, plate II, figures 3a-3e; Carpenter, 1905: 175, plate III, figures 12-19; Stephensen, 1933: 44-45, figure 12; Hedgpeth, 1948: 228-229, figures 29a-29c; Stock, 1955: 235-236, figure 12a; Turpaeva, 1973: 181-183, plate I, figures 1-8; Stock, 1991: 207, figure 55.

Anoploactylus neglectus Hoek, 1898: 293-295, figures 7-10.

Anoploactylus pelagicus Flynn, 1928: 25-27, figures 14a-14b; Barnard, 1954: 128, figures 19a-19g.

Diagnosis: See Barnard (1954).

Distribution: Brazil (off Pernambuco), Bermuda, northwest coast of Africa, South Africa, Spain, Ireland, Norway, from Prince Edward to Crozet Islands, Tasman Sea, Costa Rica (Cocos Ridge), Gulf of Alaska (Hedgpeth, 1948; Child, 1992; Müller, 1993; Raiskiy and Turpaeva, 2006).

Depth: From 900 to 3620 m deep.

Anoploactylus ricardoi sp. nov. (Figures 3a-3h)

Material examined: Rio Grande do Norte: Holotype - (UFPB.PYC-245) 1 ♂, Praia de Pipa, intertidal, 14 Jul 2014, coll. R.A. Lucena and L.M. Falkenberg. Paratypes - (UFPB.PYC-134) 2 ♂♂ and 1 ♀, same collection data as holotype.

Diagnosis: Segmentation incomplete, absent between segments 3 and 4. Lateral processes separated by half of diameter; elongate and with many small setae on dorsal surface. Fingers elongate, with setae at base of fixed finger; movable finger with setae in median region. Palp reduced, formed by a single cylindrical article in female. Propodus with eight spines on heel, 2 large at apex and 6 directed towards sole. Sole with eight small spines along its extension, marginalized by small setae. Female with 2 alar ornamentations, formed by small teen of distal margin, at the base of the proboscis.

Description (Male): Trunk rounded dorsally, with incomplete segmentation, absent between segments 3 and

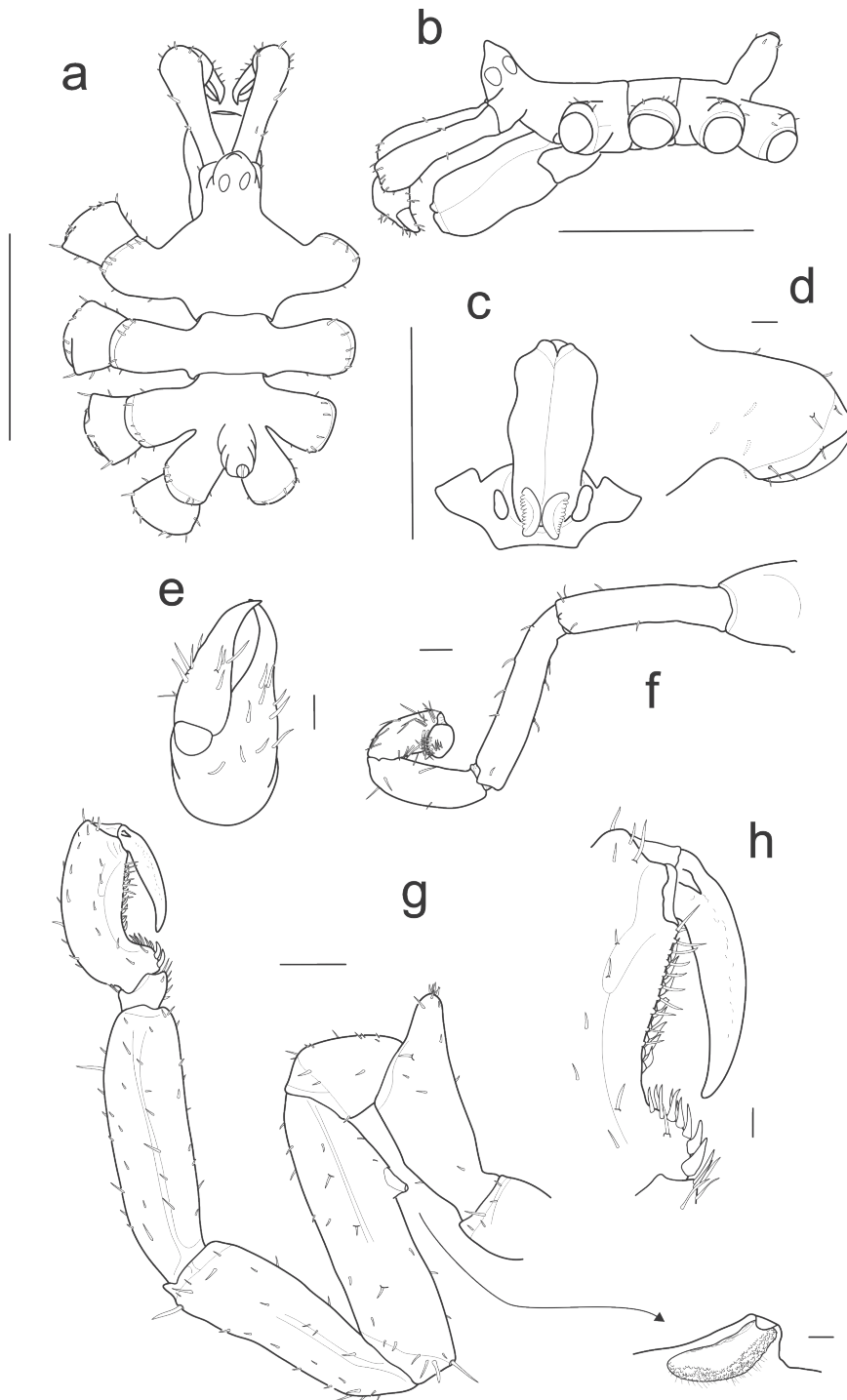


Figure 3. *Anoplodactylus ricardoi* sp. nov. (UFPB.PYC-245). Adult male. Habitus: a, dorsal view (scale bar: 1 mm); b, lateral view (scale bar: 1 mm); d, lateral process (scale bar: 0.05 mm); e, chela (scale bar: 0.05 mm); f, oviger (scale bar: 0.1 mm); g, leg 3 (scale bar: 0.25 mm); detail of g: 0.025 mm); h, propodus (scale bar: 0.05 mm). (UFPB.PYC-134) Adult female. c, proboscis ventral view (scale bar: 1 mm).

4 (Figures 3a–3b). Proboscis cylindrical. Lateral processes separated by half diameter, elongate and with many small setae on dorsal surface (Figure 3d). Ocular tubercle

conical, short; eyes well developed, strongly pigmented. Abdomen cylindrical, slightly larger than tubercle, curved backwards, with distal setae.

Cheliphores with scapus uniaarticulate, with sparse setae, more concentrated on distal margin. Palm of chela smaller than fingers, with many setae (Figure 3e). Fingers elongate, with setae at base of fixed finger; movable finger with setae in median region. Ovipiger with 6 articles (Figure 3f). First article very dilated, without setae. Setae beginning on second article. Second and third articles almost of the same size, the third being slightly bigger. Fourth and fifth articles dilated. Sixth article ovalate. Fifth and sixth articles with many setae.

Legs elongate with many setae (Figure 3g). Coxa 1 smaller than 3, together both smaller than coxa 2. Femur and tibia robust, with an elongate setae on dorso-distal region. Tube of cement gland short, directed upwards, forming an almost square rectangle with the femur. Tibia 1 smaller than tibia 2. Tibia 2 smaller than femur. Tarsus rectangular, larger than length; with many setae on ventral surface. Propodus with 8 spines on heel, 2 large ones at apex and 6 directed towards the sole (Figure 3h). Sole with eight small spines along its extension, marginalized by small setae. Main claw with two-thirds of length of propodus. Auxiliary claws strongly reduced.

Description (Female): Almost equal to male, differing by owning 2 alar ornamentations, formed by small teeth on distal margin, at base of proboscis. Palp reduced, formed by a single cylindrical article (Figure 3c).

Measurements (Holotype – in mm): Length of trunk, 1.66; width of trunk (above segment 2), 1.20; length of abdomen, 0.38; length of proboscis, 0.74; length of cheliphore, 0.97; third leg v coxa 1, 0.26; coxa 2, 0.61; coxa 3, 0.39; femur, 1.03; tibia 1, 0.81; tibia 2, 1.00; tarsus, 0.13; propodus, 0.67; main claw, 0.38; auxiliary claws, 0.05.

Distribution: Brazil (Rio Grande do Norte).

Type locality: Praia de Pipa, Rio Grande do Norte, Brazil.

Etymology: The specific epithet “*ricardoi*” is a homage to the professor Doctor Ricardo Lucena, from Federal University of Paraíba.

Depth: Mesolittoral.

Remarks: This species belongs to the group *A. californicus-digitatus*, proposed by Arango and Maxmen (2006). The group consists of 14 species that have one or more pairs of tubercles in the ventral region of the proboscis of the female.

Of the 14 known species, the new species is very similar to *A. californicus* and *A. stictus*, mainly due to the pair of alar processes on the proboscis of the female, the tube of the cement gland, and its body pattern. The absence of dorsal tubercles on the lateral processes, the presence of dentate alar processes on the proboscis of the female, and the large quantity of setae on the appendages and body are the main characters that distinguish the two species.

As for *A. californicus*, the closest species, we may distinguish it from *Anoplodactylus ricardoi* sp. nov. by

the latter being more robust, with lateral processes closer to each other and larger in the distal margin, and with many small dorsal setae; ocular tubercle and abdomen more robust; ocular tubercle closer to the insertion of the cheliphores, which are conical and occupy all the lateral region of the neck; auxiliary claws almost imperceptible; presence of a small tubercle above the insertion of the ovigers.

***Anoplodactylus ganchiformis* sp.nov.** (Figures 4a–4j)

Material examined: Ceará: Holotype – (UFPB.PYC–242) 1 ♂, Jericoacoara, intertidal, 11 Aug 2014, coll. R.A. Lucena and J. Prata. Paratypes – (UFPB.PYC–217) 11 ♂♂, 6 ♀♀ and 24 juveniles, Jericoacoara, intertidal, same collection data as holotype. Further material – (UFPB.PYC–243) 1 ♂, 2 ♀♀ and 1 juvenile, Jericoacoara, intertidal in hydrozoan, 11 Aug. 2014, coll. R.A. Lucena and J. Prata. Maranhão: (UFPB.PYB–222) 3 ♂♂, 2 ♀♀ and 10 juveniles, Praia do Meio, 21 Mar. 2015, intertidal, coll. R.A. Lucena, J. Prata and J.P. de Araújo.

Diagnosis: Segmentation absent between segments 3 and 4. Lateral processes separated by half their diameter, with a dorsal triangular tubercle and a small lateral seta. Processes 3 and 4 contiguous. Third article of the oviger with a small hook directed backwards, near the base. Propodus with 8 spines on heel, 2 large, apical, and 6 directed towards sole. Distal region of sole with a very small cutting lamina. Female with 2 alar processes at the base of the proboscis, formed by four lobules, each lobule formed by small teeth on distal margin. Palp reduced to a small cylindrical tubercle present only in females.

Description (Male): Trunk elongate, with incomplete segmentation, absent between segments 3 and 4 (Figures 4a–4b). Shoulders with a small rounded tubercle. Proboscis cylindrical, elongate (Figure 4c). Lateral processes separated by half their diameter, with a triangular dorsal tubercle, and a small lateral seta. Processes 3 and 4 contiguous. Ocular tubercle conical, elongate, eyes well pigmented. Abdomen located between processes 3 and 4, completely erect and large.

Cheliphores elongate, with uniaarticulate scapus, very close at base but gradually becoming distanced (Figure 4e); with few setae that are more concentrated in distal region. Chela robust, smaller than fingers. Fingers elongate; fixed finger with seta near base; movable finger with setae on external margin. Ovipiger with 6 articles (Figure 4f). First article robust and without setae. Second and third articles almost of same size, the third being only slightly bigger, third article with a small hook directed backwards, near the base. Fourth and fifth articles robust; sixth rounded. Fifth and sixth articles with many setae.

Legs elongate, with small setae (Figure 4g). Coxae 1 and 3 very small, together almost of the same size as the second. Coxa 2 with a very elongate spur on legs 3 and 4

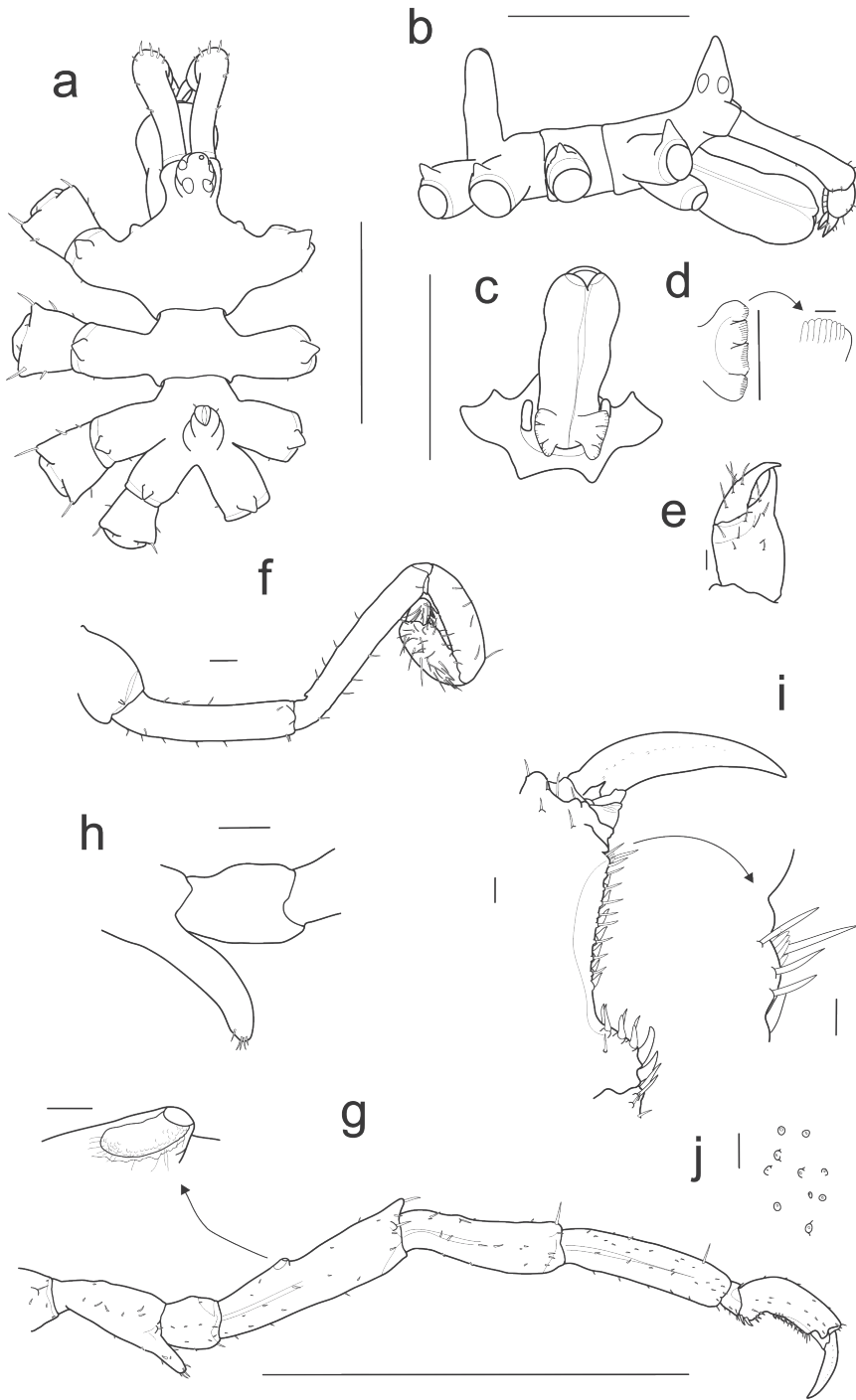


Figure 4. *Anoplodactylus ganchiformis* sp. nov. (UFPB.PYC-242). Adult male. Habitus: a, dorsal view (scale bar: 1 mm); b, lateral view (scale bar: 1 mm); e, chela (scale bar: 0.06 mm); f, oviger (scale bar: 0.05 mm); g, leg 3 (scale bar: 2.5 mm; detail of g, 0.05 mm); h, coxa 2 of leg 4 (scale bar: 0.1 mm); i, propodus (scale bar: 0.05 mm); j, pores in the body (scale bar: 0.025 mm). (UFPB.PYC-217) Adult female. C, proboscis ventral view (scale bar: 0.025 mm); d, alar process (scale bar: 0.25 mm; detail of d, 0.025 mm).

(Figure 3h). Femur elongate, with 3 small distal tubercles. Tube of cement gland short, forming a sharp angle with the femur, with median region of tube directed forwards;

located in middle region of femur. Tibiae 1 and 2 of the same size, with elongate setae on dorso-distal region. Tarsum trapezoid, with dorsal setae and ventral setae with

a fine spine. Propodus with 8 spines on heel, the 2 apical ones large and the 6 remaining ones directed towards the sole (Figure 4i). Sole with 8 small spines along its extent, marginalized by small setae. Distal region of sole with a very small cutting lamina. Main claw with three-fourths of length of propodus. Main claw extremely reduced.

Description (Female): Almost equal to male, differing by owning two alar processes at base of proboscis. Alar processes formed by 4 lobes, each lobe formed by small teeth of distal margin. Palp reduced to a small cylindrical tubercle present only in females.

Juveniles: With the 2 lateral processes fused. There is only 1 spine on heel.

Measurements (Holotype – in mm): Length of trunk, 1.70; width of trunk (above segment 2), 1.23; length of abdomen, 0.53; length of proboscis, 0.76; length of cheliphere, 1.02; third leg – coxa 1, 0.25; coxa 2, 0.70; coxa 3, 0.39; femur, 1.28; tibia 1, 1.04; tibia 2, 1.09; tarsum, 0.17; propodus, 0.20; main claw, 0.44; auxiliary claws, 0.05.

Distribution: Brazil (Ceará and Maranhão).

Type locality: Jericoacoara, Ceará, Brazil.

Etymology: The specific epithet “*ganchiformis*” refers to the shape of the hook on the third article of the oviger.

Depth: Mesolittoral.

Remarks: Like *Anoplodactylus ricardoi*, this species belongs to the group *A. californicus-digitatus*. This species is easier to distinguish from the remaining species. Its large triangular tubercle on the lateral processes, the very elongate spur on the coxa 2 of legs 3 and 4, the basal constriction of the third article, forming a hook directed backwards, the three tubercles on the distal region of the femur, and the alar process formed by 3 or 4 dentate lobules on the proboscis of the female make this species unique.

As *Anoplodactylus ricardoi*, this species is also close to *A. californicus* and *A. stictus* due to its body pattern. In addition to the above-mentioned characters, this species is more elongate than the remaining ones and has the lateral processes 3 and 4 almost contiguous, while the remaining species are more robust and the lateral processes are more separated, at least half as much as their own diameter.

Of the three species (*Anoplodactylus ricardoi*, *A. californicus* and *A. stictus*), *A. stictus* is the closest for having tubercles on the lateral processes. However, the male of *Anoplodactylus ganchiformis* sp. nov. has an abdomen that is almost twice as long as the ocular peduncle and becomes distally narrow (it is short in *A. stictus*). The lateral processes have an elongate, conical tubercle (short in *A. stictus*). Lateral processes 3 and 4 are almost contiguous, while the remaining species are separated by their diameter (they are close only basally in *A. stictus*). The ventral spur of coxa 2 of the legs 3 and

4 are extremely long, that of leg 4 being quite robust (it is short in *A. stictus*). There are 3 tubercles on the dorsal region of the femur, the median one quite long (only the median tubercle is present in *A. stictus*). There is a small hook on the third article of the oviger (no such structure in *A. stictus*). Regarding the female, both species have the same pattern of ornamentation and rudimentary palps. *A. stictus* has a small tubercle, which is cylindrical in *Anoplodactylus ganchiformis*.

We observed that the hook of the oviger was variable. It may be well made of or represented by a mere tubercle slightly directed backwards. Maybe this ornamentation as well as the tubercle of the femur are dependent on the size of the animal, as juveniles have these structures reduced in size and development.

4. Discussion

Eighteen species of *Anoplodactylus* are now known from Brazil, including two new species described herein. This represents the most common warm-water genus of Pycnogonida found along the Brazilian coast.

By the diagnosis of the genus provided above, we have not yet identified any unique characters that may be used to convincingly indicate the monophyly of the genus. The genus needs revision as previously indicated in the literature. The traditional taxonomy of the group is involved, because there is sexual dimorphism in the genus, usually the male being decisive for the identification of species (characters of the cement gland are considered decisive for species identification), and species diagnoses are often based on a combination of presence/absence of characters, which is often responsible for the creation of paraphyletic groupings in traditional taxonomy. Furthermore, many characters used for the identification of the species of this genus occur more broadly in Pycnogonida, but knowledge on the precise generalities of these characters is still missing.

In our opinion, traditional taxonomy is presently limited by many pre-evolutionary conceptions. Even a monographic revision of species is not guaranteed to resolve all the intricate problems existing in a traditional taxonomy. On the other hand, phylogenetic systematics sensu Hennig (1950) represents a significant perspective for advances in our knowledge regarding the natural system of living groups. Phylogenetic principles are based on evolutionary theory and require that similarities and differences perceived among taxa are contextualized in an evolutionary context before they are incorporated strictly as apomorphies in a phylogenetic system. The way forward is to integrate Linnaean Taxonomy with Phylogenetic Systematics in order to discover natural groups that are the products of evolutionary diversification and for the

production of a system of the Pycnogonida that reflects its evolutionary history.

Nomenclatural acts: This work and the nomenclatural acts it contains have been registered in ZooBank. The ZooBank Life Science Identifier (LSID) for this publication is: <http://zoobank.org/> urn:lsid:zoobank.org:pub:1F845C98-2EF6-4037-A156-582B301E8CA4

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