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Two unknown species of Mollusca Gastropoda from the Archipelago Fernando de Noronha (Brazil), with description of a new species belonging to the genus *Phidiana* Gray, 1850 and a new record of *Dendrodoris senegalensis* Bouchet, 1975 *

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SUMMARY: The Brazilian Archipelago of Fernando de Noronha lies off Cape Sao Roque, State of Rio Grande do Norte, about 195 nautical miles offshore. Only a few faunistic lists of this tropical archipelago have been published, and only four species of Gastropoda Opisthobranchia were cited. In this paper two species of Opisthobranchia Nudibranchia are recorded from this Archipelago. *Dendrodoris senegalensis* Bouchet 1975, known from Cape Verde and Senegal, amplifies its extension range toward the Western Atlantic. The brazilian specimens differ from the African specimens, in the presence of a completely white branchial tuft. *Phidiana riosi* sp nov clearly differs from other co-generic species in its colour pattern, having a red ground colour, with numerous white spots scattered on the dorsum. The rhinophores are orange and the cerata white with the cnidosac orange. Internally, this species has jaws with a single row of denticles, and the radular teeth have a central cusp with 7-8 denticles each side. The penis is armed with a black spine and the seminal receptacle connects with two independent ducts, the oviduct and the vaginal duct. Both species are compared with other similar taxa.

Key words: Gastropoda, Opisthobranchia, *Phidiana riosi* sp. nov., *Dendrodoris senegalensis*, Brazil, Archipelago Fernando de Noronha, taxonomy.

RESUMEN: DOS ESPECIES DESCONOCIDAS DE MOLUSCOS GASTERÓPODOS DEL ARCHIPIÉLAGO FERNANDO DE NORONHA (BRASIL), CON DESCRIPCIÓN DE UNA ESPECIE NUEVA DEL GÉNERO *PHIDIANA* GRAY, 1850 Y NUEVOS DATOS DE *DENDRODORIS SENEGALENSIS* BOUCHET, 1975. – El archipiélago de Fernando de Noronha se encuentra aproximadamente a 195 millas náuticas del Cabo Sao Roque, Estado de Rio Grande do Norte. De este archipiélago se han publicado escasos listados faunísticos, en los cuales sólo se han citado cuatro especies de Gasterópodos Opistobranquios. En el presente artículo, se estudian dos especies de Opistobranquios Nudibranquios, capturados en dicho archipiélago. La especie *Dendrodoris senegalensis* Bouchet, 1975, conocida de Cabo Verde y Senegal, amplía su rango de distribución hacia el Oeste. Los ejemplares brasileños difieren de los africanos por la presencia de un penacho branquial completamente blanco. *Phidiana riosi* sp. nov. difiere claramente de otras especies del género *Phidiana* por su modelo cromático, con una coloración general roja, con numerosas manchas pequeñas de color blanco dispuestas por el dorso. Los rinóforos son naranja y los cerata son blancos con la región del cnidosaco naranja. Internamente, esta especie tiene las mandíbulas provistas de una sola fila de dentículos; los dientes radulares tienen una cúspide central y 7-8 dentículos en cada lado. El pene está armado con una espina negra, mientras que desde el receptáculo seminal parten dos conductos independientes, el oviducto y el conducto vaginal.

Palabras clave: Gastropoda, Opisthobranchia, *Phidiana riosi* sp. nov., *Dendrodoris senegalensis*, Brasil, Archipiélago Fernando de Noronha, taxonomía.

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INTRODUCTION

The Brazilian Archipelago of Fernando de Noronha lies off Cape Sao Roque, State of Rio Grande do Norte, about 195 nautical miles offshore (Fig. 1). It is composed of several islands of volcanic origin, lying in the north branch of the South Equatorial Current. This Archipelago was used as a Brazilian prison, but is preserved as a National Park. The islands are composed mostly of hard substrate with only a few sandy beaches, dominated by *Sargassum* and calcareous algae bottoms. The marine fauna of the archipelago is poorly known. Only a few taxonomic lists have been published (Laborel, 1969; Matthews and Kempf, 1970; Fausto Filho, 1974; Eston *et al*., 1986). In 1970, Matthews and Kempf revised the mollusc fauna from Atol das Rocas and Fernando de Noronha, and listed 77 and 168 species of molluscs respectively. However, only four species of gastropod opisthobranchs were cited: *Micromelo undata* (Bruguière, 1792), *Hydatina vesicaria* (Solander, 1786), *Retusa canaliculata* (Say, 1827) and *Cylichna noronhensis* Watson, 1883.

Two previously unrecorded species of nudibranchs were collected during the accomplishment of the project "Moluscos do Parque Nacional Marinho de Fernando de Noronha" (reference IBAMA licença 070/99), organised by Prof. Ricardo S. Absalão, from the Department of Zoology of the Federal University of Rio de Janeiro (Brazil). One of them was identified as *Dendrodoris senegalensis* Bouchet, 1975 and the second belongs to an undescribed species of *Phidiana.*

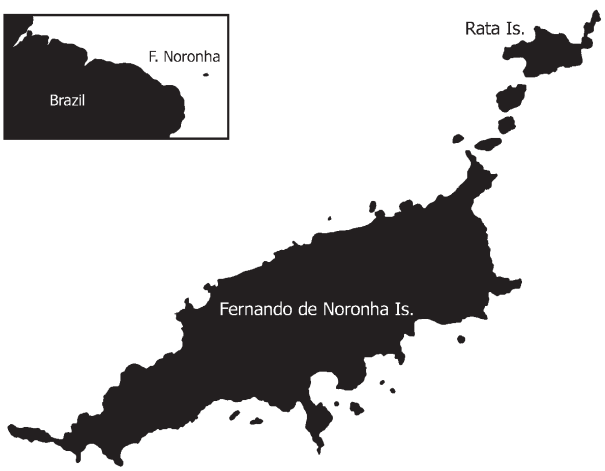

FIG. 1. – Map of Archipelago Fernando de Noronha.

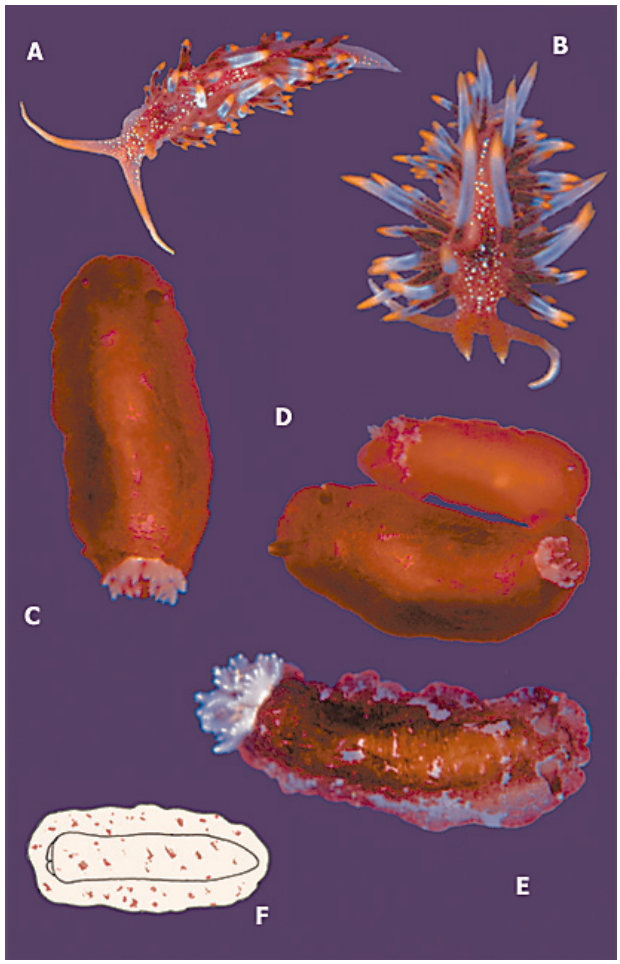

FIG. 2. – A. *Phidiana riosi*, specimen 15 mm (Holotype). B. *Phidiana riosi*, animal disturbed. C. *Dendrodoris senegalensis*, specimen 14 mm. D. *Dendrodoris senegalensis*, specimens 9 and 14 mm. E *Dendrodoris senegalensis*, specimen 21 mm. F. *Dendrodoris senegalensis*, ventral view.

RESULTS

Phidiana riosi sp. nov.
(Figs. 2A, B, 3-6)

Material examined: Holotype, one specimen of 15 mm in length, collected at 14 m depth at Rata Island (17/06/2000), deposited at the Museu Oceanográfico "Prof. Eliézer de Carvalho Rios" from the Foundation University of Rio Grande, in Rio Grande, Brazil, with the registration number 42.010. Paratypes, two specimens, 16 and 18 mm in length, collected at 12 m depth at the same station (18/06/2000), are deposited in the Museo Nacional de Ciencias Naturales de Madrid (Spain) with the registration number MNCN 15.05/44363.

Other material: Three specimens, 11, 16 and 17 mm in length, collected at 14 m depth at Rata Island (17/06/2000). These specimens were used for dissection.

Etymology: The name *riosi* was chosen in honor of Dr. Eliézer de Carvalho Rios, a Brazilian malacologist and friend.

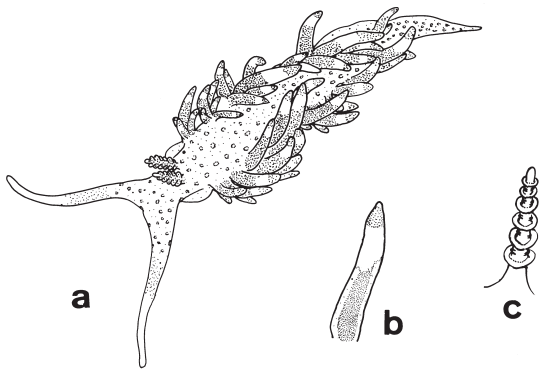

FIG. 3. – *Phidiana riosi,* A, dorsal view of an animal. B, detail of a cera. C, detail of the rhinophore.

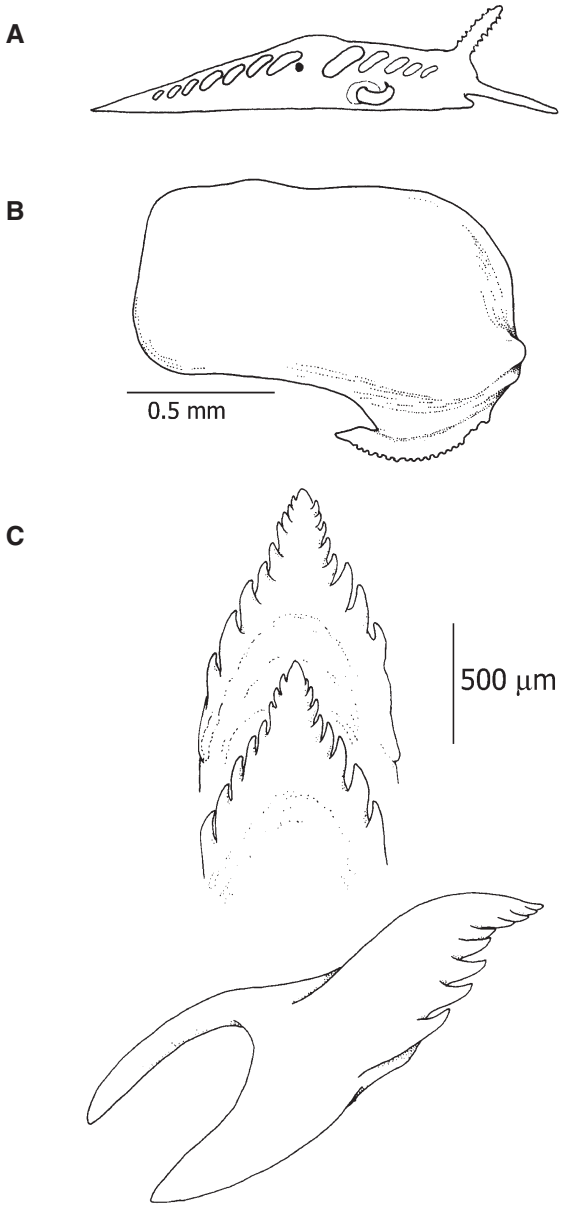

FIG. 4. – *Phidiana riosi*, A, diagrammatic right profile showing the insertion of the cerata. B, jaw. C, radular teeth.

External anatomy (Figs. 2A, B; 3, 4A): The body is elongated; length between 11 and 18 mm. The oral tentacles are long (3.2-5 mm) and cylindrical. The rhinophores are slightly shorter than the oral tentacles, having 6-7 large annulations and 6-7 shorter annulations intercalated between them. The eyes lie behind the base of the rhinophores.

The cerata are cylindrical and the cnidosac is pointed. The precardiac cerata are arranged in five oblique rows and the postcardiac ceratal clusters are arranged in seven oblique rows, having one ceratal row per branch of the posterior liver duct. The outer cerata of the rows are shorter than the inner ones. The number of cerata per cluster in the 17 mm specimen is: precardiac rows with 3, 5, 7, 8 and 7 cerata respectively on the right side and 5, 4, 7, 7 and 7 cerata respectively on the left side. The postcardiac rows with 3, 6, 5, 3, 3, 2 and 2 cerata respectively on the right side and 7, 5, 6, 3, 4, 2 and 2 cerata respectively on the left side. The genital papilla is situated on the right side of the body, below the fourth precardiac ceratal row. The anus opens between the last precardiac ceratal row and the first postcardiac row. The foot is narrow and the propodial tentacles are absent.

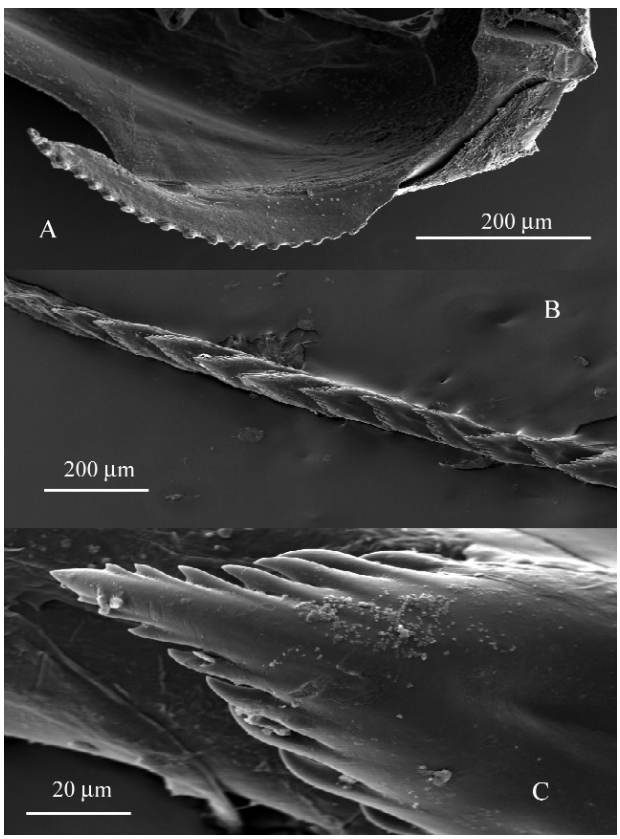

FIG. 5. – *Phidiana riosi*, A. SEM photograph of jaw cutting border. B,C, SEM photographs of the radula.

When the animals are disturbed, the rhinophores are directed forward, the body is slightly curved and the cerata are straight, showing a symmetrical disposition along the animal. The innermost cera of some ceratal rows become erect, while the others stand out horizontally (Fig. 2B).

Coloration (Figs. 2A, B, 3): The ground colour is reddish with numerous white spots on the dorsal and lateral surfaces of the body. The basal third of the oral tentacles is reddish with white spots, the middle third is orange and the apical third is hyaline white. The foot is reddish. The rhinophores are orange with a white tip. The cerata have the surface of cnidosac area orange; the subapical area of the cerata are white with a translucent basal third. Dark brown digestive gland branches are visible through the translucent tissue.

Internal anatomy: The jaws are colourless, ovate and convex on the outer surface. The masticatory border has a single row with 17 rounded denticles in a specimen of 17 mm in length (Figs. 4B, 5A). The radular formula of the same specimen is 13 x 0.1.0. The teeth have a median cusp and 7-8 hooked denticles on either side. Outer denticles are bigger than median denticles (Figs. 4C, 5B,C).

Reproductive system (Fig. 6). The hermaphroditic duct widens into a convoluted ampulla, which divides into an oviduct and a short deferent duct. The oviduct connects separately with an ovoid seminal receptacle. The distal end of the vaginal duct connects with the seminal receptacle next to the oviduct. The deferent duct lacks a morphological differentiated prostate. The penis is cylindrical and armed with a pointed apical black spine.

Table 1.- Comparative table of *Phidiana* species.

	P. riosi	*P. pegasus* Willan 1987	*P. milleri* Rudman 1980	*P. militaris* (Alder & Hancock 1864)	*P. bourailli* (Risbec, 1928)	*P. salaamica* Rudman 1980
References	present paper	Willan 1987	Miller, 1974; Rudman 1980; Willan 1987	Gosliner 1979; Rudman 1980	Rudman 1980; Marshall & Willan 1999	Rudman 1980
Locality	Fernando de Noronha (Brazil)	New Zealand	New Zealand, India	India, Japan, New Caledonia	Australia, Tanzania	Tanzania
Length	18 mm	22 mm	42 mm	35 mm	18 mm	13 mm
Tentacular foot	absent	present	present	present	present	present
Oral tentacles	1/4 the body length	1/3 the body length	1/3-1/6 the body length	1/6 the body length	longer than rhinophores	similar than rhinophores
Rhinophores	6-7 complete lamellae and 6-7 intercalated small lamellae	with low pustules	smooth, sometimes with wrinkled bases	smooth, distinctly inflated in the central region	3-5 large complete flanges	smooth
Anus	below the 1st postcardiac ceratal row	between 2nd and 3rd ceras in ninth row	between the lower cerata of 4 row in the 1st post-pericardial cluster	base of the anterior rows of the 2nd cluster	base of 3 row of the 2nd ceratal cluster	between two central rows of 2nd cluster
Cerata	arranged in 12 single oblique rows	arranged in 6 single, parallel, oblique rows	arranged in 6-9 cluster with oblique rows. 1st cluster with 6-9 rows	6 precardial oblique rows; 5 postcardial clusters with 6,4,3,4,4 oblique rows	3-4 clusters widely spaced of oblique rows	9 cluster of 2 oblique rows, 1st cluster with 5 rows
Color pattern	reddish with numerous white spots	pigmentation uniform, rich apricot-orange	translucent white. Head deed orange. Cerata deep reddish-brown with white apices	white rather than translucent. Head with 3 oranges lines	translucent white with opaque white spots and thin vivid vermilion lines	translucent white
Radula	13 teeth. 8-9 sharply pointed denticles on either side of central cusp	14-17 teeth. Strong median cusp and 3-5 denticles flanking it	17 teeth. Prominent median cusp flanked ut to 5 large denticles on each side	22-24 teeth. Prominent central cusp and 6-8 large denticles on each side	19 teeth. Prominent cusp and 5-7 pointed denticles on each side	30 teeth
Masticatory border of jaws	a row of 17 large rounded teeth	a row of 12-15 rounded denticles	a row of large rounded denticles	a row of about 20 large rounded denticles	a row of spaced rounded denticles	a row of spaced rounded denticles
Connection of vagina and oviduct to seminal receptacle	double	single	single	single	-	single
Penial stylet	present	absent	absent	absent	basal region with semicircular structure bearing a row of warts, each surmounted by a chitinous spine	penial papilla with a sharply angled ridge up one side bearing small chitinous projections

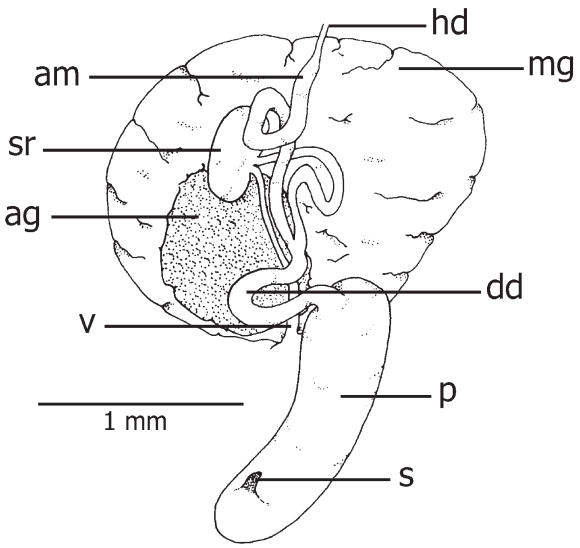

FIG. 6. – *Phidiana riosi.* Reproductive system. ag, albumen gland; am, ampulla; dd, deferent duct; hd, hermaphroditic duct; mg, mucous gland; p, penis; s, spine; sr, seminal receptacle; v, vagina.

Remarks: This species belongs to the genus *Phidiana* because it has long oral tentacles, the rhinophores are lamellate, the foot is anteriorly rounded, all the ceratal clusters are disposed in oblique rows, the jaws have a masticatory border with a row of denticles, the radular teeth are provided with lateral denticles on a central cusp and the penis is armed with a spine. A comparative table of *Phidiana* species is presented in Table 1. Only one species of *Phidiana* has been described from Brazilian coasts, *P. lynceus* Bergh, 1867, which differs clearly from our specimens in the colour pattern; *P. lynceus* has a white line running mid-dorsally which branches up the basal parts of the oral tentacles, and orange bands on the rhinophores and oral tentacles. Furthermore, there are several ceratal rows from each branch of the posterior liver duct, while there is only one row per branch in *P. riosi.* Finally, in the reproductive sys-

Table 1 (Cont.).- Comparative table of *Phidiana* species.

	P. hiltoni (O'Donoghue, 1927)	*P. lynceus* Bergh 1867	*P. lascrucensis* Bertsch & Ferreira 1974	*P. mariadelmarae* García & Troncoso 1999	*P. newcombi* (Angas 1864)	*P. longicirrha* Eliot, 1906	*P. lottini* (Lesson, 1831)
References	Lance 1962; MacFarland 1966; Roller 1972; Behrens 1991	Edmunds 1964; Marcus & Marcus 1967; Thompson 1980	Bertsch & Ferreira 1974	García & Troncoso 1999	Burn 1957, 1966	Eliot 1906	Engel 1925; Marcus 1959
Locality	California, Mexico	Jamaica, Brazil	Mexico	Coiba Island (Panama)	Australia	Cape Verde	Peru
Length	63 mm	18 mm	22 mm	17 mm	15 mm	9 mm, preserved	15-90 mm
Tentacular foot	absent	present	absent	absent	present	absent	-
Oral tentacles	1/4 the body length	-	1/4-1/3 the body length	longer than rhinophores	-	longer than rhinophores	-
Rhinophores	11 complete folds, 11 intercalated on posterior side	annulations rarely complete anteriorly	15 complete annulations	basal third smooth, 2 apical thirds with 12 annulations	4 encircling rings of nodular papillae	perfoliated	perfoliated
Anus	below the middle of 2nd group	between 3rd and 4th postcardial row	about the middle of the 2nd cerata group	-	-	-	-
Cerata	10 precardial oblique rows and 20 postcardial oblique rows	in rows	two group of 6-9 and 8-15 ceratal rows	2 groups of 7 and 8 oblique rows	4-5 groups, first 2 groups set on horseshoe, rest on oblique rows	cerata perfoliated and disposed in 2 set of rows	20-26 rows
Color pattern	translucent white; orange line along anterior side of the head and basal fourth of oral tentacles	silvery-grey; head suffused with orange	orangish with numerous white specks	orange, white middorsal line extending to the apex of the oral tentacles	body colour pale green maculated with cream	white translucent with white specks	grey whitish, or reddish, with 2 white spots anterior and posterior to rhinophores
Radula	21 teeth. 4-6 large denticles on lower margin of the teeth, central cusp with 3-4 smaller denticles	14 teeth. A central cusp and 8-10 lateral denticles	15 teeth. A central cusp and 8-10 lateral denticles	20 teeth	prominent central cusp. 4-5 lateral denticles	strong central cusp, 4-5 lateral denticles	teeth with 6 lateral denticles
Masticatory border of jaws	25-30 irregular blunt denticles	with 18 denticles	2 rows of denticles	a row with 15 -22 hooked denticles	-	a row of large denticles	a row of denticles
Connection of vagina and oviduct to seminal receptacle	single	single	-	single	-	-	-
Penial stylet	present	present	present	present	-	absent	present

tem of *P. riosi* the seminal receptacle is serial with two independent ducts (oviduct and vaginal duct), while there is only one duct in *P. lynceus.*

Other species of *Phidiana* with reddish or orange colour are *P. lottini* (Lesson, 1831), *P. lascrucensis* Bertsch and Ferreira 1974 and *P. mariadelmarae* García and Troncoso 1999, all of them from Pacific Ocean. *P. lottini* is grey whitish, some times reddish, having two white spots lying anterior and posteriorly to the rhinophores; the cerata are organized in 20-26 rows and the radular teeth only have 6 lateral denticles (Engel, 1925; Marcus, 1959, cited as *P. inca*). *P. lascrucensis* is orangish to orange-yellow with numerous white specks scattered randomly along the dorsum, and the jaws are characterised by the presence of a masticatory border with two rows of denticles (Bertsch and Ferreira, 1974). *P. mariadelmarae* is orange having a middorsal longitudinal white line that bifurcates at the base of the rhinophores, and only one duct joining the seminal receptacle in the reproductive system (García and Troncoso, 1999).

In warm western Atlantic waters, fourteen facelinid species have been described. Among them, only *Facelina coenda* Marcus, 1958 has the cerata in rows (Marcus, 1958). However this species differs from *P. riosi* in the coloration and in the spines of the penis (Marcus, 1958).

Dendrodoris senegalensis Bouchet 1975
(Figs. 2 C, D, E, F, 7, 8)

Material examined: Two specimens 9 and 14 mm in length, collected at 14 m depth at Rata Island (19/06/2000). One specimen, 21 mm in length, collected at the intertidal zone at Fernando de Noronha Island (07/07/1999).

External anatomy (Figs. 2 C-F): The body is soft and smooth, lacking spicules. The notal margin is delicate and slightly striated. The rhinophores have a cylindrical stalk and the club is lamellate. The branchial tuft has five moderately long tripinnate gills arranged in a circle. The anal papilla lies at the centre of the branchial circle. The oral tentacles are absent.

Coloration (Figs. 2 C, D, E, F): The dorsal surface and notal margin are uniformly red except in the 21 mm long specimen, which is red-brown with irregular white areas (Fig. 2E). The rhinophores are red with the tip white. The gills are uniformly white. The anal papilla is uniformly white too. Ventrally, the notal margin and foot are white with small red spots (Fig. 2F).

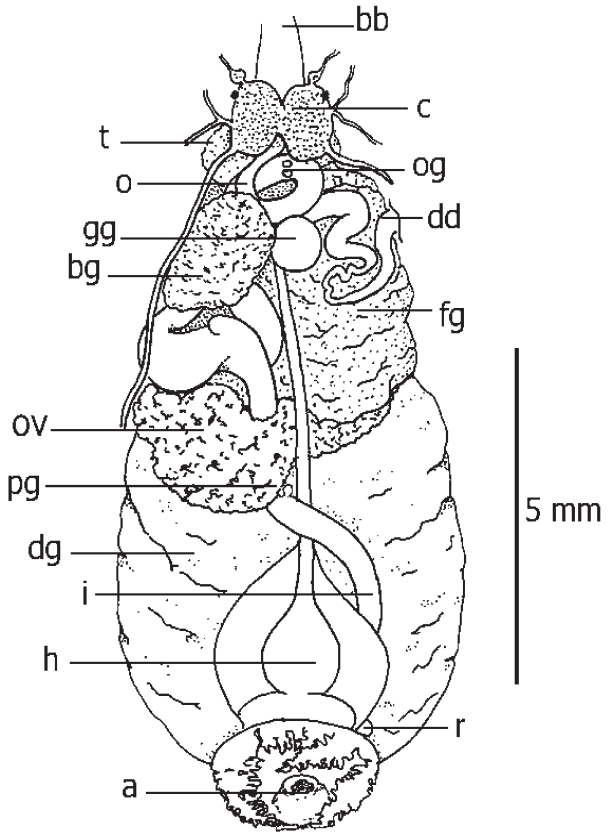

FIG. 7. – *Dendrodoris senegalensis*. Dorsal view of the internal organs. a, anus; bb, buccal bulb; bg, blood gland; c, central nervous system; dd, deferent duct; dg, digestive gland; fg, female gland; gg, gametolytic gland; h, heart; i, intestine; o, oesophagus; og, oesophageal gland; ov, ovotestis; pg, pyloric gland; r, renal sac, t, ptyaline gland.

Internal anatomy: An impair ptyaline gland is connected to the buccal bulb. The oesophagus is long, with two small oesophageal glands near to the buccal bulb. The intestine has a small pyloric gland. The heart is connected through the aorta to the blood gland (Fig. 7).

The reproductive system has an ovotestis lying interdigitating on the anterior portion of the digestive gland (Figs. 7, 8). The hermaphroditic duct connects with a short and enlarged ampulla. The deferent duct has a proximal prostatic portion and a narrow and folded distal region. The male eversible cirrus has numerous hooks with slightly elongate bases. The gametolytic gland is spherical. A separate duct connects with the smaller, long stalked seminal receptacle just before it enters the female gland mass.

*Remarks***:** On Brazilian coasts only one species of *Dendrodoris* has been described, *D. krebsii* (Mörch, 1863) (Marcus, 1977; Rios, 1994; Valdés *et*

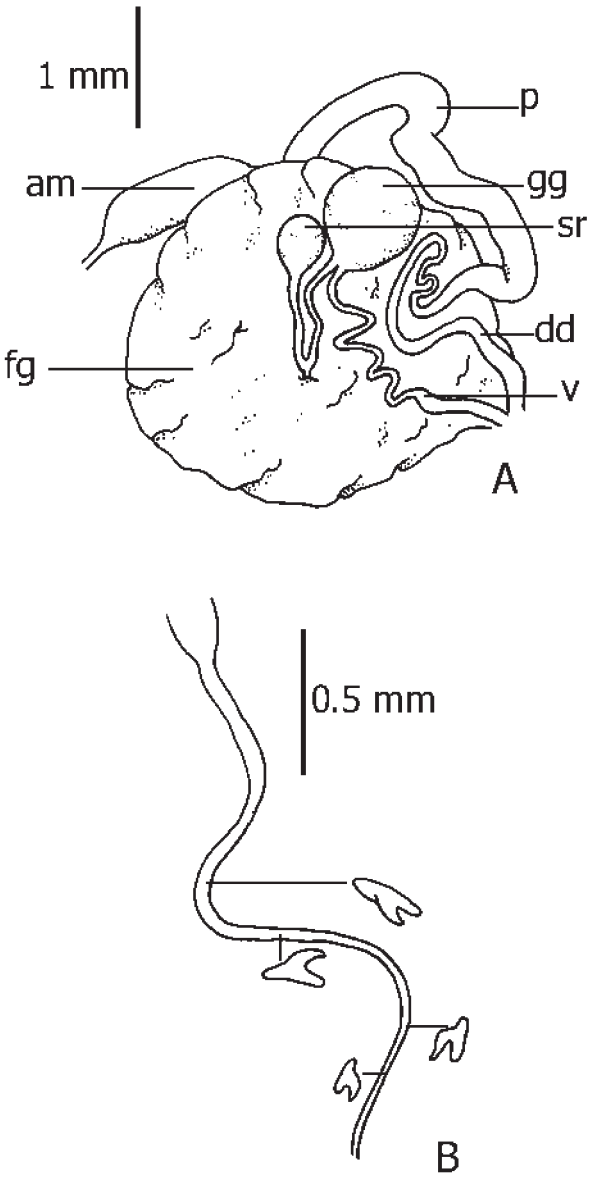

FIG. 8. – *Dendrodoris senegalensis.* A. Reproductive system. B. Hooks along the male eversible cirrus. am, ampulla; dd, deferent duct; fg, female gland; gg, gametolytic gland; p, prostatic duct; sr, seminal receptacle; v, vagina.

al., 1996), which differs from our specimens in the coloration; besides this, the notal margin is clearly wider in *D. krebsii*, the blood gland is larger and the reproductive system of *D. krebsii* has the ampulla with a fold, and the length of it and the prostate are greater than those of our specimens. Finally, the male cirrus of our specimens has hooks with very short bases, whereas they are large in *D. krebsii* (Valdés *et al.*, 1996).

D. senegalensis is known from Cape Verde and Senegal, on the east coast of Africa (Bouchet, 1975; Valdés *et al*, 1996). The real geographic range of this species is unknown, owning to the lack of sampling effort in this part of the World. Our specimens differ from those from Africa in the coloration of the gills. Bouchet (1975) and Valdés *et al* (1996) stated that the gills of *D. senegalensis* have the same coloration as the dorsum, having the external border white; however in the Brazilian specimens the gills and anal papilla are uniformly white, clearly different from the dorsum, which is red or red brown with white irregular spots. Internally, our specimens coincide with the descriptions of *D. senegalensis* by Bouchet (1975) and Valdés *et al.* (1996).

As stated above, the Fernando de Noronha Archipelago lies in the north branch of the South Equatorial Current. It is possible that larvae are able to cross the Atlantic Ocean in this area, which is the narrowest point, following the ocean currents. As the only consistent difference of our specimens is the presence of a white gill, and coloration is extremely variable in species of *Dendrodoris*, we consider that our specimen belongs to the species *D. senegalensis*, providing a considerable range extension for this taxon.

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