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A new western Atlantic species of *Didiscus* Dendy, 1922 (Porifera: Demospongiae: Halichondrida) with a key to the species of the genus

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Didiscus gladius *sp. nov. is described from Bahia State (Brazil). The sponge is thinly encrusting to lump-shaped and has a glassy, translucent appearance, through which the spiculation is clearly visible. The megascleres are styles and two categories of oxeas. The microscleres are discorhabds. Colour is beige or brown in ethanol.* Didiscus verdensis *is the nearest relative in the Atlantic which differs from the new species in a series of traits (e.g. absence of true styles and presence of strongyles). A key to species of* Didiscus *is given.*

Keywords: Sponges, *Didiscus*, new species, taxonomy, southwestern Atlantic, Bahia State, Brazil

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INTRODUCTION

The genus *Didiscus* Dendy, 1922 is known from the Eocene–Oligocene (Hinde & Holmes, 1891). It is defined by possession of an ectosomal crust of 'discorhabd'-like microxea microscleres (Hooper, 2002), which is the most important diagnostic feature distinguishing the genus among the Halichondrida (Corriero *et al.*, 1997). Hiemstra & van Soest (1991) reorganized the taxonomic status of *Didiscus* and van Soest (1993) discussed the problem of the homogeneity of the taxon based on historical and geographic data. The genus currently has eight valid species (van Soest *et al.*, 2014; see Figure 1): *Didiscus aceratus* (Ridley & Dendy, 1886 from the Indopacific), *D. anisodiscus* Vacelet & Vasseur, 1971 (Madagascar), *D. oxeata* Hechtel, 1983 (Western Atlantic), *D. placospongioides* Dendy, 1922 (Indian Ocean), *D. pseudodidiscoides* (Corriero *et al.*, 1996 from the Mediterranean), *D. spinoxeatus* Corriero *et al.*, 1997 (Mediterranean), *D. stylifer* Tsurnamal, 1969 (Mediterranean), *D. verdensis* Hiemstra & van Soest, 1991 (Eastern Atlantic). In Brazil, the genus has records of one species (*D. oxeata*) and another without identification at specific level (Muricy *et al.*, 2011).

The present paper describes the new species of *Didiscus* and focuses on interspecific affinities and differences within the genus. In addition, a key to all species of *Didiscus* is provided.

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MATERIALS AND METHODS

Specimens were collected manually during a faunistic survey conducted in the area of the Camamu-Almada Basin (15°35′5.91″S 38°46′36.35″W), situated in the Bahia State (Eastern Brazil Ecoregion, North-eastern Brazil geopolitical region) coastline (Figure 2). Dissociated spicule mounts and skeletal sections were made using classical procedures for Demospongiae (Hajdu *et al.*, 2011). A minimum of 30 spicules from each category were measured. Images of specimens, sections and SEM preparations were obtained digitally. The specimens were preserved in 80% ethanol and deposited in the Porifera collection of Universidade Federal de Pernambuco (UFPEPOR). The classification followed in this work is proposed by Hooper & van Soest (2002) in *Systema Porifera*. Taxonomic comparisons were made with data tabulated for all species of *Didiscus* available in the *World Porifera Database* (van Soest *et al.*, 2014).

SYSTEMATICS

Class DEMOSPONGIAE
Order HALICHONDRIDA Gray, 1897
Family HETEROXYIDAE Dendy, 1905
Genus *Didiscus* Dendy, 1922

Synonymy

Didiscus Dendy, 1922b: 135; van Soest *et al.*, 1990: 33; Hiemstra & van Soest, 1991: 45; Diaz *et al.*, 1993: 145.

Definition

Heteroxyidae with ectosomal crust of 'discorhabd'-like microxea microscleres (Hooper, 2002). Type species: *Didiscus placospongioides* Dendy, 1922 (by monotypy).

Didiscus gladius sp. nov.
(Figures 1–4, Table 1)

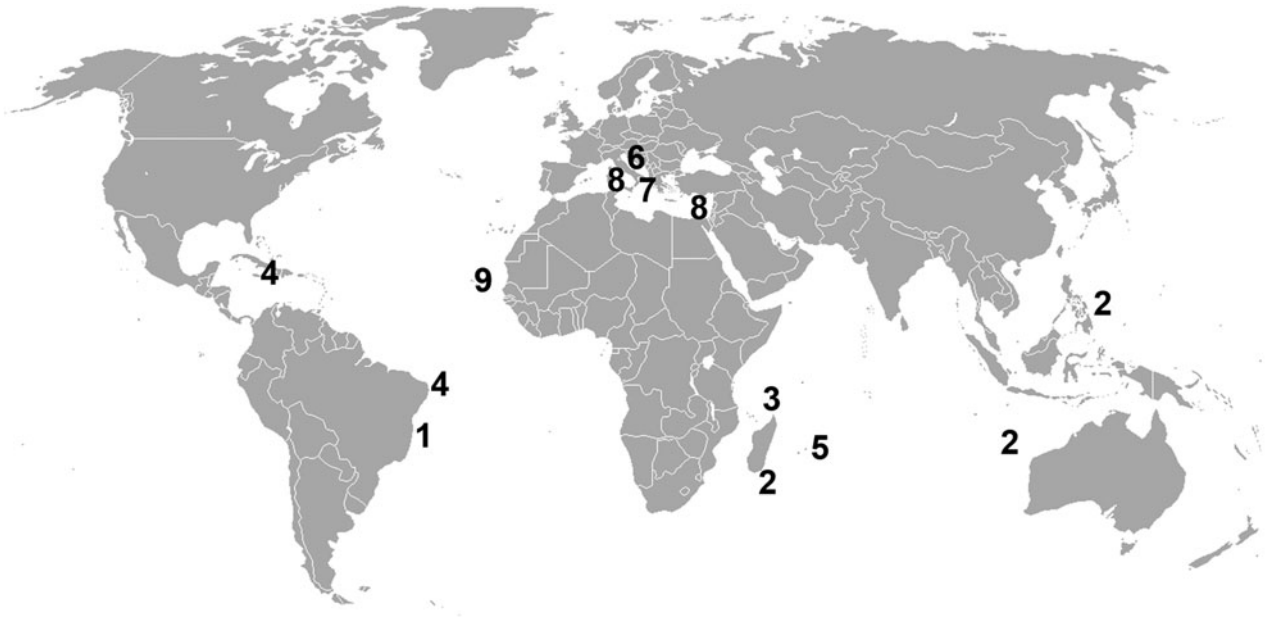

Fig. 1. Known distribution of all valid species of *Didiscus*. Numbers indicate approximate localities from which species were reported: (1) *Didiscus gladius* sp. nov.; (2) *D. aceratus*; (3) *D. anisodiscus*; (4) *D. oxeata*; (5) *D. placospongioides*; (6) *D. pseudodidiscoides*; (7) *D. spinoxeatus*; (8) *D. stylifer*; (9) *D. verdensis*.

TYPE MATERIAL

Holotype. UFPEPOR 1535, off Canavieiras, Camamu-Almada Basin (15°35′5.91″S 38°46′36.35″W), Bahia State, Brazil, 25–50 m depth, X. 2011.

Paratype. UFPEPOR 1536 (collected together with the holotype).

DIAGNOSIS

Didiscus gladius sp. nov. is the only *Didiscus* with styles and two categories of megascleres exclusively oxeas.

DESCRIPTION

Thinly encrusting (5 mm length × 1 mm thickness) to lump-shaped (3 mm height), with large styles and oxeas projected beyond the surface (Figure 2A). Consistency is compressible and fragile. Colour is a translucent beige or brown in ethanol (80%). In the translucent regions spicules are clearly visible (Figure 2B). Oscules not observed.

Fig. 2. Map indicating in detail the type locality of the new species of *Didiscus*. Circle and arrow indicate position of the new species.

Skeleton

An ectosomal layer of discorhabds (very dense) arranged diffusely to the surface (Figure 2D). Choanosomal skeleton shows confused radial tracts that support the ectosome (Figure 2C); discorhabds are diffusely distributed; little spongin.

Spicules

Styles (Figure 3A, F, Table 1): Longer, slender, usually slightly curved, completely smooth body (510–***695***–890/0.9–***1.4***–2). Oxeas I (Figure 3B): Longer, usually slightly curved, completely smooth body (320–***456.7***–640/8–***10.3***–13). Oxeas II (Figure 3C–E): smooth body to rugose (granular spination), slightly curved, swellings (irregular and nodulose swellings) often occur at the middle of the shaft of the spicule (few spicules do not have swellings) (148–***184.6***–231/4–***6.1***–7). Discorhabds (Figure 3G): rugose or finely spined (except at the apices) microxeas, sharply pointed with ragged points, possessing two unequally sized discs asymmetrically aligned along the shaft. The discs average 9 and 16 μm in diameter and the major are typically curved inwards (67–***73.7***–81/3–***4.5***–6).

ECOLOGY

Encrusting calcareous nodules along with some colonies of bryozoans (e.g. *Aetea curta* Jullien, 1888; *Arbocuspis belulla* (Hincks, 1881); *Cradoscrupocellaria curacaoensis* (Fransen, 1986); *Exechonella* sp.; *Micropora* sp.; *Nolella stipata* Gosse, 1855; *Parasmittina* sp.; *Plesiocleidochasma* sp. and *Puellina* sp.).

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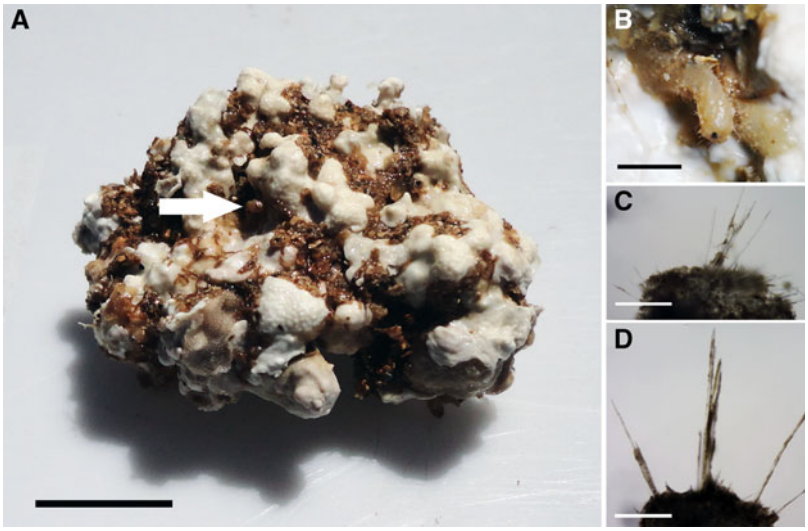

Fig. 3. *Didiscus gladius* sp. nov. (A) Whole specimen. Arrow points at holotype (UFPEPOR 1535); (B) Detail showing the holotype; (C) thick section showing the ectosome and choanosome; (D) thick section showing the spicules protrude externally. Scale bars: A, 1 cm; B, 3 mm; C, 400 μm; D, 200 μm.

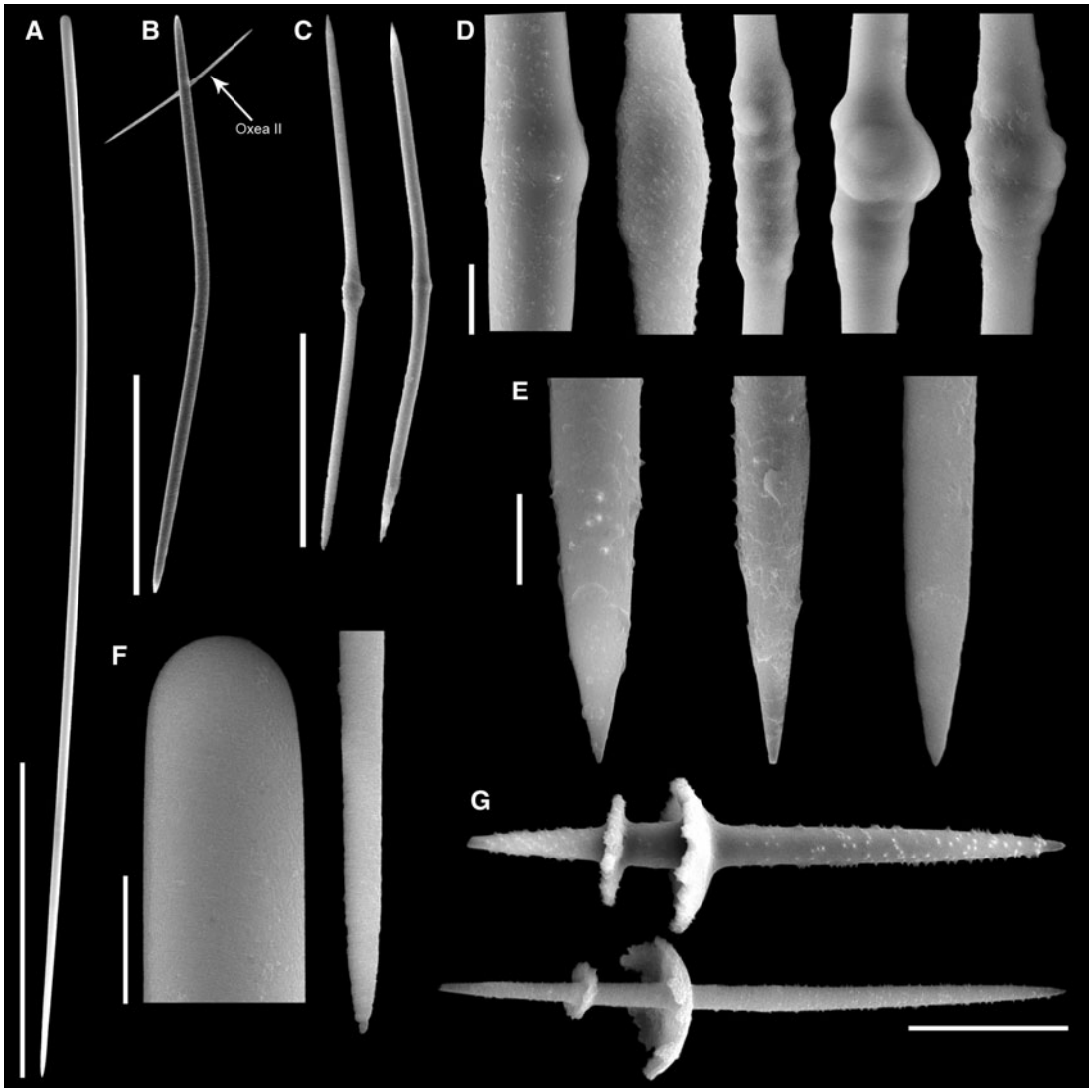

Fig. 4. Scanning electron micrographs of spicule complement from *Didiscus gladius* sp. nov. (UFPEPOR 1535, holotype) A, styles; B, oxea I and oxea II; C, two variations of oxea II; D, details of lumped swellings on oxea II; E, details of the apex of oxea II; F, details of the base and apex of a style; G, two variations of discorhabd. Scale bars: A, 200 μm; B, 250 μm; C, 80 μm; D and E, 5 μm; F, 1 μm; G, 20 μm.

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Table 1. Comparative micrometric data on the spicules of the living species of *Didiscus*. Values are in micrometres (μm), expressed as follows: minimum–maximum or minimum–***mean***–maximum length, length/width or disc diameter (D.d. – in the case of discorhabd). References are numbered in parentheses and listed after the table.

Species	Location/depth (m)	Shape	Megascleres	Discorhabd	Other spicules
Didiscus gladius **sp. nov.**	Bahia State (Brazil)/ shallow water	Thinly encrusting to lump-shaped	Styles – 510–***695***–890/0.9–***1.4***–2 Oxeas I – 320–***456.7***–640/8–***10.3***–13 Oxeas II – 148–***184.6***–231/4–***6.1***–7	67–***73.7***–81/3–***4.5***–6 D.d.1 – 14–***16.3***–19 D.d.2 – 7–***9.9***–12	–
D. oxeata Hechtel, 1983 (2)	Bahia State (Brazil)/60	Lobate	Oxeas – 206–***720***–1586/4.6–***16.6***–23	58–***68.8***–74/3.5–***5.1***–6 D.d.1 – 13–***15.9***–18 D.d.2 – 9–***9.9***–12	–
D. verdensis Hiemstra & van Soest, 1991 (1)	São Tiago (Cabo Verde)/6–15	Thinly encrusting	Oxeas I – 430–1300/5–13 Oxeas II – 190–336/2–4	65–90/2–2.5 D.d. – 8–12	–
D. pseudodidiscoides (Corriero *et al.*, 1996) (4)	S. Domino Island (Mediterranean)/ 0.5–2	Encrusting	Oxeas – 96–165/2.5–5	150/4 D.d. – not record (as pseudodidiscorhabds)	12–40/3–7 (microstrongyles)
D. spinoxeatus Corriero *et al.*, 1997 (5)	Italy (Mediterranean)/ 1	Encrusting or thin cushion-shaped	Styles – 900–1120/9–13 Oxeas – 93–375/3–11 Tylostyles – 140–260/10–12	47–143/3–6 D.d.1 – 9–11 D.d.2 – 5–6	–
D. stylifer Tsurnamal, 1969 (6)	Israel (Mediterranean)/7	Encrusting	Styles – 660–1320/4–13 Oxeas – 120–310/4.5–11 Tylostyles – 180–240/9–13 Strongyles – 92–264/6.7–11	40–86/2.2–5 D.d.1 – 10–13 D.d.2 – 6–9	–
D. aceratus (Ridley & Dendy, 1886) (1)	Madagascar and Indonesia (Indian Ocean)/not record	Encrusting to lump-shaped	Strongyles I – 850–1295/9–15 Strongyles II – 275–450/7–10	25–54/2–6 D.d. – 8–12	–
D. anisodiscus Vacelet & Vasseur, 1971 (7)	Madagascar (Indian Ocean)/30–50	Massively encrusting to lump-shaped	Styles – 1200/10–15 Oxeas – 500–600/10	45/4 D.d.1 – 30 D.d.2 – 10–15	–
D. placospongioides Dendy, 1922 (3)	Cargados Carjos (Indian Ocean)/not record	Massively encrusting to irregularly cylindrical	Oxeas – 400–1400/1.4–20 Tylostyles – 160/8	90/5 D.d.1 – 18 D.d.2 – 12 (as oxydiscorhabds)	–

References: (1) Hiemstra & van Soest (1991); (2) Hechtel (1983); (3) Dendy (1922); (4) Corriero *et al.* (1996); (5) Corriero *et al.* (1997); (6) Tsurnamal (1969); (7) Vacelet & Vasseur (1971).

DISTRIBUTION

At present, *Didiscus gladius* sp. nov. is known only from the type locality (off Canavieiras, Bahia State, Brazil), depth range from 25 to 50 m.

ETYMOLOGY

The specific name refers to the occurrence of discorhabds resembling swords.

REMARKS

The new species display the typical morphology of *Didiscus* spp., most of which are encrusting or amorphous massive. *Didiscus gladius* sp. nov. differs from others by its combination of styles and oxeas in two size categories. Its closest affinity is with *D. verdensis* (from Eastern Atlantic; see Figure 1). Both species have discorhabds, very similar in shape: sharp, microspined in most of its length and with rough, irregular discs. But both differ mainly on size of larger discs: 12 μm (*D. verdensis*) against 19 μm (*D. gladius* sp. nov.). Finally, both species can be distinguished in megascleres categories: *Didiscus verdensis* has only two categories (the first oxeas with styloid and strongylote modifications, the second centrotylote oxeas with some strongylote modifications but always with smooth tips) *vs* three categories of megascleres in *Didiscus gladius* sp. nov. (styles, oxeas I and oxeas II). The presence of styles distinguishes *Didiscus gladius* sp. nov. from the three species: *D. oxeata* (from Brazil), *D. pseudodidiscoides* (Mediterranean) and *D. placospongioides* (Indian Ocean). Additionally, despite *D. oxeata* having the same geographic distribution as the new species, it differs by its shape, which is generally lobate, the absence of styles and oxeas II, and discorhabds having oxeote tips.

Another four species contain styles like the new species: *D. spinoxeatus* (Mediterranean), *D. stylifer* (Mediterranean), *D. aceratus* (Indian Ocean) and *D. anisodiscus* (Indian Ocean), but they differ in other ways.

Didiscus spinoxeatus has tylostyles with bi-trilobate head and large size of discorhabds with irregular shape (nodulose swellings; they rarely show true discs). *Didiscus stylifer* has strongyles and tylostyles. *Didiscus aceratus* has strongyles and short discorhabds (see Table 1). Finally *D. anisodiscus* has short discorhabds with parallel or upward turned discs and oxea with a few stylote modifications.

KEY TO THE SPECIES OF *DIDISCUS* DENDY

1. Only oxeas present as megascleres 2
   - Other megascleres present 3
2. Oxeas in two sizes, slender and discorhabds thin with disc edges frayed ..... *D. verdensis*
   - Microscleres are microstrongyles and pseudodidiscorhabds ..... *D. pseudodidiscoides*
   - Discorhabds with rounded tips and blunt-ended ..... *D. oxeata*
3. Megascleres predominantly oxeas or stylotes 4
   - Only strongyles present as megascleres and discorhabds short ..... *D. aceratus*
   - Megascleres predominantly styles; discorhabds small (not over 60 μm), blunt ended, discs incurved ..... *D. stylifer*
   - Megascleres may be oxeas, styles and tylostyles ..... *D. spinoxeatus*
4. Styles may show transitions to tylostyles 5
   - Discs of the discorhabds of highly unequal diameter, bowl-shaped; discorhabds <50 μm in length ..... *D. anisodiscus*
5. Megascleres predominantly tylostyles; discorhabds stout ..... *D. placospongioides*
   - Megascleres are slender styles, oxeas I (stout) and oxeas II (centrotylote); microscleres are discorhabds, with disc edges malformed ..... *D. gladius* sp. nov.

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