Descriptive and illustrated diagnosis of the Ophiuroidea fauna (Echinodermata) in shallow waters of Northeastern Brazil

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ABSTRAT

In this study, we present descriptions, illustrations, comments, and bathymetric and geographic distributions of the brittle star species related to the estuary region of Camamu Bay, located in the State of Bahia, Brazil. The brittle star fauna lives on biological substrates, sand bottoms, mud and rubble in the Camamu Bay and comprises 12 species divided in five families. Almost all of them are common in the tropical and subtropical fauna in the regions of shallow water. Ophiophragmus filograneus *is reported for the first time in Bahia, and nine other species are recorded for the first time in the Camamu Bay:* Amphipholis januarii, Amphipholis squamata, Ophiophragmus filograneus, Ophiostigma isocanthum, Ophioderma cinerea, Ophioderma januarii, Ophiactis lymani, Ophiactis savignyi, *and* Ophiocoma echinata*. The results suggest that the ophiuroid assemblages are strongly affected by marine currents as well as by different kinds of bottom substrate.*

Key-words: brittle stars, estuary region, benthic fauna, taxonomy, ecology, distribution.

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INTRODUTION

Recent environmental issues have changed the current social context and call for urgency in the conservation, recuperation and management of the marine coastal environments. These regions have been exploited haphazardly, which results in the reduction of species and the irreversible loss of biological diversity (Ghilardi *et al.*, 2008).

Among the different biological compartments, marine benthos plays a vital role both as a receiver of energy from the pelagic environment and as a supplier of energy for organisms that forage near the bottom, such as fish, crustaceans and other invertebrates (Amaral & Rossi-Wongtschowski, 2004). Many benthic invertebrate species, or other species associated with the seafloor, have direct economic importance, as is the case with crustaceans and mollusks, or also indirect economic importance, since they often are the main food item of demersal fish species of economic interest (e.g. some polychaetes and echinoderms).

In this context, the study of biological benthic diversity and marine environments remains the basis for the formulation of ecology and preservation programs, including the monitoring of ecosystems and the environmental impact assessment, as well as procedures for their conservation. Hence, it is essential to

investigate these species in order to conduct any further study and/or planning towards the conservation of estuary regions (Almeida *et al.*, 2007). The situation is even worse regarding places in Northern and Northeastern Brazil, where many locations and environments have not been surveyed faunistically (Lana *et al.*, 1996).

Estuaries are some of the most productive ecosystems on the planet (Duxbury & Duxbury, 1996). They stand out as complex environments that serve as a shelter for many organisms and they constitute a suitable place for the reproduction, feeding and nursery of many species of fish and invertebrates (Fiori, 2007, Mesquita *et al*., 2006).

Despite their significant ecological and economic importance, little is known about the environmental and biological characteristics of Brazilian estuaries. A literature review on faunal and taxonomic studies conducted in these environments has shown that researchers mainly investigate specific groups, such as crustaceans (Almeida *et al.*, 2007; Severino-Rodrigues *et al.*, 2001), bivalves (Fiori, 2007), gastropods (Vasconcelos *et al.*, 2004; Fiori, 2007; Ourives, 2007), nematodes (Fiori, 2007), polychaetes (Vasconcelos *et al.*, 2004; Fiori, 2007), leeches (Fiori, 2007), cnidarians (Mesquita *et al.*, 2006; Fiori, 2007) and fishes (Loebmann & Vieira, 2005; Falcão *et al.*, 2006; Ramos & Vieira, 2001).

Echinoderms, especially ophiuroids, despite their important ecological role in marine benthic communities, are not among the most studied groups. Nonetheless, the importance of ophiuroids in these environments is evidenced by their abundance and wide distribution (Hendler, 1996). Studies conducted in the United States and France indicate the importance of these organisms in the characterization and stability of the environments they inhabit; and these studies also emphasize their use as bioindicators of polluted ecosystems (Thorson, 1957; Barnard & Ziesenhenne, 1961; Harmelin *et al*., 1981).

Studies about ophiuroids in Brazil are still insufficient for us to possess a full knowledge of the group. It is worth highlighting the studies conducted by Tommasi (1970, 1999), Alves & Cerqueira (2000), Manso (2004), Gondim *et al*. (2008), Lima & Fernandes (2009) and Lima *et al*. (2011), in the North and Northeast of Brazil, and Borges *et al*. (2002), Borges & Amaral (2005, 2007) and Borges & Campos (2011), in the South and Southeast of Brazil.

The estuary of the Camamu bay, located in the Brazilian State of Bahia, is an ecosystem of great ecological and economic significance for the local population due to fishing and tourism related activities. Yet, anthropogenic pollutants have affected this ecosystem (Guerrazzi, personal communication). Consequently, faunal inventories are of great importance, since few studies have been conducted in the region, with the exception of crustaceans studied by Almeida *et al*. (2007), gastropods by Ourives (2011) and echinoderms by Manso (2004).

Therefore, the purpose of our study is to survey the Ophiuroidea fauna of the estuary of Camamu Bay, in order to redescribe and illustrate the species we recorded, so as to identify the local biodiversity as well as to enable monitoring programs and wildlife management. Additionally, we will comment the occurrence of the species found in the study area, including published records.

STUDY AREA

The Camamu Bay is inserted in the compartment structure defined as Camamu Basin (Manso & Souza-Lima, 2007) and is located on the central coast of Bahia, between 13º50' - 14º06'S and 38º57' - 39º4'W (Figure 1). This bay is the third largest bay in Brazil after the Todos os Santos Bay (Bahia) and Guanabara Bay (Rio de Janeiro) (Oliveira *et al*., 1998, 2002).

The Camamu Bay has a roughly circular shape with an internal area of 85 km^2. It contains many islands in its interior and has an extensive estuary area bordered by mangroves, salt marshes, rocky shores and the Atlantic Forest, forming natural pools and reefs along the coast which are still well preserved and also little studied. Another peculiar characteristic of the area is the great opening of the mouth, which allows a massive

influx of sea water in comparison to the current flow of the rivers, giving the bay a favorable environment for marine life (Hatje *et al*., 2008; Almeida *et al*., 2007; Oliveira *et al*., 1998, 2002).
The humidity is high, with an annual average of approximately 75-85% relative humidity, lacking a dry season. The average annual temperature is 24°C, with minor variations over the year, with a maximum of 26°C and a minimum of 20°C.

MATERIAL AND METHODS

We collected samples during 18 months in the estuary of the Marau River, Camamu Bay (Bahia), at eight fixed stations (Figure 1). The stations were established approximately 2.5 km apart, and their coordinates were determined with a GPS device (Global Position System, 12X-L, Garmin). The samples were obtained between latitude 13°53'04" - 13°56'24"S and longitude 38°57'06" - 39°05'04"W.
The benthic organisms were sampled between isobaths from 1.5 to 15.5 m, using a fishing boat (trawler type) with a trawl door system, mesh of 3 cm (measured internodes) and mouth of 4 m. At each station, the drag lasted approximately 10 minutes, at a constant speed of 2.5 km/h.
We also collected sediment samples, using a vanVeen dredge for granulometric parameter estimates of sediment and organic matter from the substrate.
The samples of biological material from the trawling were initially screened onboard the vessel and fixed in 70% alcohol.
Brittle stars were identified with the help of specific references and identification keys (Hendler *et al.*, 1995; Borges *et al.*, 2002; Borges & Amaral, 2005; Pomory, 2007), and counted. Species names are according to Stöhr *et al.* (2014) and the terminology adopted from Stöhr *et al.* (2012). Most of the material was deposited in the collection of *Echinodermata* at the Laboratory of Ecology at the State University of the Southwest of Bahia, Campus Jequié, labelled with the symbol UESBOFR. Duplicates were deposited in the collection of *Ophiuroidea* at the Museum of Zoology at the University of Campinas, labelled with the symbol ZUEC OPH.

RESULTS

We analyzed and identified 6,282 individuals belonging to five families in the order Ophiurida (Müller & Troschel, 1840) and 12 species.

Checklist of brittle stars from the Camamu Bay, Bahia, Brazil

Order OPHIUROIDEA Gray, 1840
- Suborder OPHIURIDA Müller & Troschel, 1940
  - Family Amphiuridae Ljungman, 1867
    - *Amphipholis januarii* Ljungman, 1866
    - *Amphipholis squamata* (Delle Chiaje, 1829)
    - *Microphiopholis atra* (Stimpson, 1852)
    - *Ophiophragmus filograneus* (Lyman, 1875)
    - *Ophiostigma isocanthum* Say, 1825
  - Family Ophiactidae Matsumoto, 1915
    - *Ophiactis lymani* Ljungman, 1871
    - *Ophiactis savignyi* (Müller & Troschel, 1842)
  - Family Ophiocomidae Ljungman, 1867
    - *Ophiocoma echinata* (Lamarck, 1816)
  - Family Ophiodermatidae Ljungman, 1867
    - *Ophioderma cinerea* Müller & Troschel, 1842
    - *Ophioderma januarii* Lütken, 1856

Family Ophiotrichidae Ljungman, 1867

Ophiothrix (Ophiothrix) angulata (Say, 1825)

Key to the families of brittle stars from the Camamu Bay, Bahia, Brazil

1 Presence of cluster of dental papillae on the apex of the jaw……..……..……**3**
Without cluster of dental papillae……..……..……..…….……..**2**

2 One pair of infradental oral papillae on the apex of the jaw…….……...…..**Amphiuridae**
Only one apical papilla on the apex of the jaw……. …….……...…….……..**4**

3 A continuous series of lateral oral papillae……. ……..……..**Ophiocomidae**
Without lateral oral papillae……..……..……..……..**Ophiotrichidae**

4 Disc covered with granules; numerous oral papillae in continuous series ….……..**Ophiodermatidae**
Disc covered by scales and spines. Presence of a diastema separating the lateral oral papillae from the apical papilla…….....**Ophiactidae**

Key to the members of the family Amphiuridae registered from the Camamu Bay, Bahia, Brazil

1 Distal oral papilla of similar size as the other lateral papillae….***Ophiophragmus filograneus*** (Fig. 5)
Larger, opercular, distal oral papilla, partly or fully closing the oral slit…….……..……..**2**

2 Disc covered by scales; two perpendicular tentacle scales; distal oral papilla partly closing the oral slit…….....**3**
Disc covered by small papillae; two parallel tentacle scales; distal oral papilla fully closing the oral slit…….....…….…….***Ophiostigma isocanthum*** (Fig. 6)

3 Small and delicate disc…….....**4**
Larger disc (up to 1 cm), covered with smaller scales; perpendicular marginal scales, forming a fringe …….……..…….***Microphiopholis atra*** (Fig. 4)

4 Disc covered with small scales; three or four arm spines, the second and third with two hyaline denticles at the tip. Narrow and long radial shields.....***Amphipholis januarii*** (Fig. 2)
Disc with larger scales; three arm spines with tip tapering. Radial shields slightly longer than broad.....***Amphipholis squamata*** (Fig. 3)

Key to the members of the family Ophiactidae identified in the Camamu Bay, Bahia, Brazil

1 Six arms; disc covered with small and strong overlapping scales, with some spines scattered over the dorsal disc; much larger radial shields. One or two lateral oral papillae ..... ***Ophiactis savignyi*** (Fig. 8)
Six arms; disc covered by larger scales slightly overlapped; few delicate spines usually restricted to the disc margin, easily lost. One oral papilla.....***Ophiactis lymani*** (Fig. 7)

Key to the members of the family Ophiodermatidae identified in the Camamu Bay, Bahia, Brazil

1 Robust, greenish disc; radial shelds not visible, covered by granules.....***Ophioderma januarii*** (Fig. 11)
Robust, brown disc; oval radial shelds visible not covered by granules..***Ophioderma cinerea*** (Fig. 10)

SYSTEMATICS

Family AMPHIURIDAE Ljungman, 1867
Genus *Amphipholis* Ljungman, 1866
Amphipholis januarii Ljungman, 1866
(Figure 2A-C)

EXAMINED MATERIAL: 24ex.: St. 2, 13°53'21"S, 38°57'49"W, ix.9.2006 (UESB OFR 19, 3 ex.; ZUEC OPH 989, 2 ex.); St. 4, 13°54'06"S, 39°00'22"W, iii.24.2005 (UESB OFR 483, 1 ex.; UESB OFR 494, 1ex.); St. 5, 13°54'14"S, 39°00'34"W, iv.24.2004 (UESB OFR 193, 1ex.; UESB OFR 336, 1 ex.; UESB OFR 337, 1 ex.; UESB OFR 338, 1 ex.; UESB OFR 376, 1 ex.), viii.28.2004 (UESB OFR 217, 1 ex.), viii.29.2004 (UESB OFR 449, 1 ex.), ix.25.2004 (ZUEC OPH 999, 1 ex.), x.31.2004 (UESB OFR 64, 1ex.; UESB OFR 175, 1ex.; UESB OFR 396, 3 ex.; ZUEC OPH 982, 1 ex.), viii.7.2005 (UESB OFR 438, 1 ex.), ix.8.2005 (UESB OFR 290, 1 ex.), St. 6, 13°55'21"S, 39°02'13"W, ix.11.2006 (ZUEC OPH 973, 1 ex.).

DESCRIPTION: Disc diameter: 2.0 to 6.0 mm. Dorsal disc covered with small and imbricated scales. Primary scales evident. Radial shields narrow and long, separated proximally by one or two scales (Fig. 2A). Ventral interradius covered by scales similar to the dorsal surface. Oral shields slightly longer than wide, diamond-shaped, with rounded edges and small latero-posterior indentations. Adoral shields distally extended and separated proximally. Two oral papillae on each side of jaw angle, the distal one twice as wide as the proximal. A pair of elongated infradental papillae, widely separated from each other (Fig. 2B). Long arms, approximately 10 times the diameter of the disc. Dorsal arm plates slightly wider than long (Fig. 2A); ventral arm plates pentagonal, sub-elliptical, with rounded edges. Two tentacle scales, the larger supported on the ventral arm plate and the smaller on the lateral arm plate (Fig. 2C). Four elongated arm spines, reduced to three at the end of the arms. In segments with four spines, the second ventralmost with one or two lateral terminal denticles and smaller denticles at all edges. At segments with three spines, the middle one presents such denticles (Fig. 2C). Spines at the proximal segments and on the distal arms, lack denticles.

REMARKS: *Amphipholis januarii* is a characteristic habitant of soft bottoms, sand and mud, but is also found on algae, under rocks, rubble, associated with sponges, corals, among others (Hendler *et al.*, 1995; Borges & Amaral 2005; Pomory, 2007). This species is commonly sampled in live substrate, together with other brittle stars, such as *Amphipholis squamata*, *Ophiactis savignyi* and *Ophiothrix* (*O.*) *angulata*. In Brazil, the species has been recorded in the States of Rio de Janeiro (type locality), São Paulo, Pará, Ceará, Paraíba, Alagoas and Bahia (Tommasi, 1970; Albuquerque, 1986; Borges, 2006; Gondim *et al.*, 2008; Manso *et al.*, 2008; Lima *et al.*, 2011). In this study, it was sampled in the phytal zone and under rocks.

GEOGRAPHICAL DISTRIBUTION: South Carolina to Florida, Texas, Mexico, Antilles, Cuba, Puerto Rico, Virgin Islands, Tobago, Barbados and Brazil (Hendler *et al.*, 1995; Borges & Amaral, 2005; Laguarda-Figueras *et al.*, 2009).

BATHYMETRIC DISTRIBUTION: 1 – 311 m (Tommasi, 1970; Hendler *et al.*, 1995; Borges, 2006; Laguarda-Figueras *et al.*, 2009). In this study, it was sampled from 4.2 to 8.4 m deep.

RECORDS IN THE STATE OF BAHIA: Todos os Santos Bay, city of Porto Seguro and Salvador (Itapuã and Ondina beaches) (Magalhães *et al*., 2005; Manso *et al.*, 2008).

RECORDS IN CAMAMU BAY: this is a new record of this species in the study area.

Amphipholis squamata (Delle Chiaje, 1829)
(Figure 2D-F)

EXAMINED MATERIAL: 418 ex.: St. 1, 13°53'04"S, 38°57'06"W, iv.24.2004 (UESB OFR 260, 2 ex.; UESB OFR 261, 3 ex.), viii.6.2005 (UESB OFR 309, 1 ex.); St. 2, 13°53'21"S, 38°57'49"W, iv.24.2004 (UESB OFR 71, 1 ex.); ix.25.2004 (UESB OFR 07, 2 ex.); viii.6.2005 (UESB OFR 51, 1 ex.); St. 3, 13°54'25"S, 38°59'14"W, iii.24.2004 (UESB OFR 23, 2 ex.); viii.28.2004 (UESB OFR 354, 17 ex.; UEBS OFR 392, 1 ex.; UESB OFR 414, 3 ex.; UESB OFR 425, 14 ex.; UESB OFR 454, 12 ex.; UESB OFR 470, 7 ex.; UESB OFR 496, 14 ex.); ix.7.2005 (ZUEC OPH 969, 1 ex.); ix.19.2000 (UESB OFR 205, 2 ex.); x.31.2004 (UESB OFR 313, 1 ex.); St. 4, 13°54'06"S, 39°00'22"W, ix.13.2003 (UESB OFR186, 1 ex.); iii.24.2004 (UESB OFR 442, 1 ex.); iii.24.2005 (UESB OFR 368, 1 ex.; UESB OFR 482, 8 ex.); iv.24.2004 (UESB OFR 197, 1 ex.; UESB OFR 242, 4 ex.; UESB OFR 270, 1 ex.); ix.25.2004 (UESB OFR 406, 5 ex.); x.30.2004 (UESB OFR 302, 1 ex.; UESB OFR 311, 1 ex.; UESB OFR 366, 1 ex.; UESB OFR 421, 2 ex.); viii.6.2005 (UESB OFR 488, 10 ex.; UESB OFR 493, 14 ex.); ix.6.2005 (UESB OFR 452, 6 ex.); ix.7.2005 (UESB OFR 199, 1 ex.); ix.11.2005 (UESB OFR 150, 2 ex.); ix.9.2006 (UESB OFR 416, 2 ex.); St. 5, 13°54'14"S, 39°00'34"W, iv.24.2004 (UESB OFR 230, 12 ex.; UESB OFR 268, 8 ex.; UESB OFR 336, 1 ex.; UESB OFR 339, 1 ex.; UESB OFR 378, 3 ex.; UESB OFR 379, 1 ex.; UESB OFR 381, 2 ex.; UESB OFR 395, 2 ex.; UESB OFR 477, 5 ex.); vii.28.2004 (UESB OFR 274, 5 ex.); vii.29.2004 (UESB OFR 156, 1 ex.); viii.25.2004 (UESB OFR 283, 1 ex.); viii.28.2004 (UESB OFR 318, 7 ex.); viii.29.2004 (UESB OFR 152, 13 ex.; UESB OFR 398, 1 ex.; UESB OFR 403, 5 ex.; UESB OFR 408, 18 ex.; UESB OFR 423, 6 ex.; UESB OFR 448, 5 ex.; UESB OFR 471, 4 ex.; UESB OFR 480, 3 ex.); ix.25.2004 (UESB OFR 216, 1 ex.; UESB OFR 273, 1 ex.; UESB OFR 275, 1 ex.; UESB OFR 287, 1 ex.; UESB OFR 328, 2 ex.; UESB OFR 329, 4 ex.; UESB OFR 388, 8 ex.; UESB OFR 410, 22 ex.); x.31.2004 (UESB OFR 183, 1 ex.; UESB OFR 389, 1 ex.); iii.25.2005 (UESB OFR 340, 14 ex.; UESB OFR 404, 5 ex.; UESB OFR 405, 1 ex.; UESB OFR 446, 13 ex.; UESB OFR 486, 1 ex.; ZUEC OPH 1006, 2 ex.); viii.7.2005 (UESB OFR 06, 13 ex.; UESB OFR 78, 2 ex.; UESB OFR 391, 1 ex.; UESB OFR 431, 4 ex.; UESB OFR 433, 13 ex.; UESB OFR 435, 5 ex.; UESB OFR 437, 13 ex.); ix.8.2005 (UESB OFR 413, 7 ex.; UESB OFR 473, 25 ex.); St. 6, 13°55'21"S, 39°02'13"W, viii.29.2004 (UESB OFR 338, 1 ex.; x.31.2004 (UESB OFR 390, 1 ex.); ix.11.2006 (ZUEC OPH 972, 1 ex.); St. 7, 13°56'19"S, 39°03'57"W, viii.7.2005 (UESB OFR 234, 1 ex.); St. 8, 13°56'24"S, 39°05'04"W, ix.14.2005 (UESB OFR 294, 2 ex.).

DESCRIPTION: Disc diameter: 1.0 to 3.0 mm. Disc covered with irregular and imbricated scales. Radial shields slightly longer than wide, contiguous throughout, except at the proximal edge, where there is a small triangular scale (Fig. 2D). Outside edge of the radial shields lightly curved and straight internally. Ventral interradius covered by imbricated scales, smaller than those of the dorsal surface. Oral shields diamond-shaped, with convex distal edge; adoral shields well developed, the distal end winglike enlarged and proximally united. Two oral papillae at each side of jaw angle, the distal one rectangular, enlarged and wider than the proximal one. A pair of elongated infradental papillae (Fig. 2E). Bursal slits visible. Dorsal arm plates wider than long, fan-shaped with rounded edges; ventral arm plates pentagonal, with a small lateral notch at the tentacle pores (Fig. 2F); lateral arm plates well-developed, meeting in the longitudinal mid-line, both dorsal and ventral. Two tentacle scales. Three pointed arm spines, almost as long as an arm segment (Fig. 2F).

REMARKS: This species is known to dwell on several types of bottoms, such as sand, rock, rubble, and different types of biological substrates such as sponges, bryozoans, corals, polychaete colonies, algae, mainly in the shallow zone, even though there are many records for 100 m depth. There are also records in mangroves and estuaries (Hendler *et al*., 1995; Borges & Amaral, 2005; Pomory, 2007). In Brazil, it was reported in the States of Pará, Ceará, Paraíba, Alagoas, Bahia and São Paulo (Tommasi, 1970; Albuquerque, 1986; Borges, 2006; Gondim *et al.*, 2008; Manso *et al.*, 2008; Lima *et al.*, 2011). In this study, it was collected in seagrass and under rocks.

GEOGRAPHICAL DISTRIBUTION: Cosmopolitan in tropical and subtropical areas, absent only from the Polar Regions (Hendler *et al.*, 1995; Borges, 2006). However, this is most likely a species complex (Boissin *et al.*, 2008).

BATHYMETRIC DISTRIBUTION: From 0 to 1962 m depth (considering the species complex) (Alvarado & Solís-Marín, 2013). Borges *et al.* (2002) sampled at 147 m and Borges (2006) between 5 and 240 m. In this study, this species was collected from 3.2 to 9.6 m deep.

RECORDS IN BAHIA: Todos os Santos Bay, city of Porto Seguro and Salvador (Itapuã and Ondina beaches) (Magalhães *et al.*, 2005; Manso *et al.*, 2008)**.**

RECORDS IN CAMAMU BAY: this is a new record of this species in the study area.

Genus *Microphiopholis* Turner, 1985
Microphiopholis atra (Stimpson, 1852)
(Figure 3)

EXAMINED MATERIAL: 1 ex.: St. 6, 13°55'21"S, 39°02'13"W, iv.25.2004 (UESB OFR 370, 1 ex.).

DESCRIPTION: Disc diameter: 3.1 to 10.0 mm. Disc covered by small and imbricated scales. Approximatelly 20 scales between the centrodorsal and the edge of the disc. Primary scales evident. Radial shields twice as long as wide, with abradial edge convex, pairs separated proximally by two to four elongated scales. Scales near a pair of shields slightly bigger than the rest of the disc (Fig. 3A). Ventral interradius covered with scales smaller than the dorsal ones and strongly imbricated (Fig. 3B). Oral shields lozenge-shaped, longer than wide with the proximal and distal edges tapered. Rounded madreporite, with pores in the anterior margin, distally narrow. Adoral shields wing-like extended at their distal end, united and narrow proximally. Two oral papillae at each side of jaw angle, triangular, the distal one twice as wide as the proximal, and more elongated. A pair of semi-rectangular infradental papillae, spaced from one another (Fig. 3C). Dorsal arm plates two to three times wide as long, contiguous. Ventral arm plates sub-rectangular to pentagonal, with a small notch in the distal edge. Three thin arm spines. Two tentacle scales well-developed; one in the ventral plate and another on the lateral plate.

REMARKS: *Microphiopholis atra* is possibly a scavenging infaunal species, due to the large amount of sediment found in its stomach contents (Tommasi, 1970; Borges' personal observation). It is a common specimen in the intertidal zone at approximately 100 m depth, and it occurs on soft bottoms such as sand, mud and puddles, often with other infaunal brittle stars (Borges & Amaral, 2005; Pomory, 2007). In Brazil, they have been reported in the States of Pará, Maranhão, Pernambuco, Bahia, Rio de Janeiro, São Paulo, Paraná and Santa Catarina (Tommasi, 1970; Albuquerque, 1986; Borges, 2006; Manso *et al.*, 2008). We collect the specimens on soft bottoms of puddles and mud, with rich organic matter.

GEOGRAPHICAL DISTRIBUTION: From Virginia, Gulf of Mexico and Puerto Rico to Brazil (Borges & Amaral, 2005).

BATHYMETRIC DISTRIBUTION: Intertidal zone - 100m (Alvarado & Solís-Marín, 2013). Tommasi (1970) records it at 20 m, and Borges (2006) between 13 and 24 m. In our study, they were sampled at 4.5 m depth.

RECORDS IN BAHIA: Salvador, Camamu Bay, Todos os Santos Bay and Aratu Bay (Tommasi, 1970; Manso, 2004; Magalhães *et al.*, 2005; Manso *et al.*, 2008).

PREVIOUS RECORDS IN CAMAMU BAY: Manso (2004).

Genus *Ophiophragmus* Lyman, 1865
Ophiophragmus filograneus (Lyman, 1875)
(Figure 4)

EXAMINED MATERIAL: 1 ex.: St. 5, 13°54'14"S, 39°00'34"W, ix.13.2003 (ZUEC OPH 1018, 1 ex.).

DESCRIPTION: Disc diameter: up to 9.0 mm. Disc with circular outline, covered by imbricated scales. Primary plates evident (Fig. 4A). Radial shields twice as long as wide, proximally united; distal end separated by two or three scales; the proximal scale triangular and larger, and the posterior small and narrow. Disc edge delineated by small papillae (Fig. 4A, B). Ventral interradius lacks scales, covered with fine papilliform granulation. Bursal slits visible (Fig. 4C). Oral shields lozenge-shaped. Adoral shields subtriangular, slightly wider at the distal end, united in the midline. Two oral papillae at each side of jaw angle, distal one slightly larger. A pair of subrectangular infradental papillae, separated from one another (Fig. 4C, D). Dorsal arm plates trapezoid, wider than long, flabelliform, with a rounded distal edge. Ventral arm plates pentagonal. Lateral arm plates touch ventrally. Three subequal, conical arm spines; the median one with tiny denticles. Two tentacle scales, the inner one larger and more elongated.

REMARKS: *Ophiophragmus filograneus* is a species of soft bottom and seagrass (Hendler *et al.*, 1995). It is also have been found in brackish water in Florida (USA). In Brazil, it was reported on sandy bottoms and gravel with calcareous algae in the States of Pará and Maranhão (Albuquerque, 1986). In our study, this species was sampled under rocks and associated with algae.

GEOGRAPHICAL DISTRIBUTION: Florida, Gulf of Mexico, Antilles and Brazil (Albuquerque, 1986; Hendler *et al*., 1995; Stöhr *et al*., 2014).

BATHYMETRIC DISTRIBUTION: Species of shallow regions, recorded at approximately 80 m depth (Albuquerque, 1986; Hendler *et al.*, 1995). In the current study, we sampled it at 6.7 m.

RECORDS IN BAHIA: First records by the current study.

RECORDS IN CAMAMU BAY: this is a new record of this species in the study area.

Genus *Ophiostigma* Lütken, 1856
Ophiostigma isocanthum (Say, 1825)
(Figure 5)

EXAMINED MATERIAL: 5,476 ex.: St. 1, 13°53'04"S, 38°57'06"W, iv.24.2004 (UESB OFR 09, 12 ex.; UESB OFR 13, 10 ex.; UESB OFR 24, 37 ex.; UESB OFR 190, 1 ex.; UESB OFR 191, 7 ex.; UESB OFR 192, 14 ex.); St. 2, 13°53'21"S, 38°57'49"W, ix.19.2000 (UESB OFR 474, 2 ex.), ix.14.2003 (UESB OFR 164, 1 ex.); St. 3, 13°54'25"S, 38°59'14"W, ix.19.2000 (UESB OFR 262, 1 ex.; UESB OFR 427, 19 ex.), iv.24.2004 (UESB OFR 129, 1 ex.; ZUECOPH 985, 1 ex.), viii.28.2004 (UESB OFR 38, 78 ex.; UESB OFR 39, 41 ex.; UESB OFR 250, 5 ex.; UESB OFR 251, 9 ex.; UESB OFR 252, 2 ex.; UESB OFR 253, 1 ex.; UESB OFR 254, 1 ex.; UESB OFR 255, 1 ex.; UESB OFR 355, 15 ex.; UESB OFR 357, 1 ex.; UESB OFR 358, 1 ex.; UESB OFR 359, 1 ex.; UESB OFR 360, 1 ex.; UESB

OFR 362, 34 ex.; UESB OFR 363, 70 ex.; UESB OFR 453, 80 ex.; UESB OFR 469, 71 ex.; UESB OFR 315, 19 ex.; ZUEC OPH 991,1 ex.; ZUEC OPH 992,1 ex.); St. 4, 13°54'06"S, 39°00'22"W, ix.10.2003 (UESB OFR 42, 3 ex.; ZUEC OPH 1010, 1 ex.), ix.13.2003 (UESB OFR 12, 1 ex.; UESB OFR 159, 4 ex.; UESB OFR 198, 2 ex.), iii.24.2004 (UESB OFR 441, 13 ex.; UESB OFR 481, 178 ex.), iv.24.2004 (UESB OFR 01,63 ex.; UESB OFR 26, 11 ex.; UESB OFR 27, 12 ex.; UESB OFR 115, 1 ex.; UESB OFR 349, 1 ex.; UESB OFR 350, 1 ex.; ZUEC OPH 976, 1 ex.), vi.13.2004 (UESB OFR 240, 1 ex.), ix.25.2004 (UESB OFR 31, 46 ex.), x.30.2004 (UESB OFR 33, 6 ex.; UESB OFR 54, 8 ex.; UESB OFR 55, 8 ex.; UESB OFR 66, 13 ex.; UESB OFR 98, 1 ex.; UESB OFR 303, 1 ex.; UESB OFR 321, 1 ex.; UESB OFR 495, 1 ex.; UESB OFR 323, 1 ex.; UESB OFR 324, 1 ex.; UESB OFR 364, 10 ex.; UESB OFR 365, 2 ex.; UESB OFR 383, 1 ex.; UESB OFR 420, 1 ex.; ZUEC OPH 968, 1 ex.; ZUEC OPH 978, 12 ex.; UESB OFR 304, 6 ex.; UESB OFR 307, 1 ex.), x.31.2004 (UESB OFR 170, 88 ex.; UESB OFR 325, 2 ex.), viii.6.2005 (UESB OFR 95, 1 ex.; UESB OFR 119, 1 ex.; UESB OFR 120, 1 ex.; UESB OFR 121, 1 ex.; UESB OFR 220, 2 ex.; UESB OFR 221, 1 ex.; UESB OFR 222, 2 ex.; UESB OFR 223, 6 ex.; UESB OFR 322, 7 ex.; UESB OFR 487, 119 ex.; UESB OFR 492, 295 ex.; UESB OFR11, 2 ex.), ix.6.2005 (UESB OFR 450, 124 ex.), ix.7.2005 (UESB OFR 218, 3 ex.), ix.9.2006 (UESB OFR 37, 10 ex.); St. 5, 13°54'14"S, 39°00'34"W, ix.10.2003 (UESB OFR 202, 2 ex.), iii.25.2004 (UESB OFR 85, 23 ex.; UESB OFR 286, 1 ex.), iv.24.2004 (UESB OFR 117, 1 ex.; UESB OFR 48, 26 ex.; UESB OFR 03, 14 ex.; UESB OFR 20, 11 ex.; UESB OFR 227, 5 ex.; UESB OFR 228, 6 ex.; UESB OFR 335, 2 ex.; UESB OFR 375, 84 ex.; UESB OFR 380, 1 ex.; UESB OFR 458, ex. 63 ex.; UESB OFR 475, ex. 130 ex.; ZUEC OPH 979, ex. 19 ex.; ZUEC OPH 983, ex. 13 ex.), viii.28.2004 (UESB OFR 243, 7 ex.; UESB OFR 244, 1 ex.; UESB OFR 245, 6 ex.; UESB OFR 246, 2 ex.; UESB OFR 426, 1 ex.), viii.29.2004 (UESB OFR 104, 82 ex.; UESB OFR 110, 1 ex.; UESB OFR 112, 1 ex.; UESB OFR 113, 126 ex.; UESB OFR 153, 1 ex.; UESB OFR 154, 14 ex.; UESB OFR 157, 1 ex.; UESB OFR 52, 34 ex.; UESB OFR 35, 98 ex.; UESB OFR 158, 1 ex.; UESB OFR 317, 5 ex.; UESB OFR 319, 70 ex.; UESB OFR 320, 26 ex.; UESB OFR 316, 1 ex.; UESB OFR 463, 86 ex.; UESB OFR 447, 73 ex.; UESB OFR 394, 1 ex.; ZUEC OPH 977, 10 ex.; ZUEC OPH 987, 2 ex.; UESB OFR 478, 89 ex.; UESB OFR 479, 1 ex.; UESB OFR 484, 1 ex.), ix.25.2004 (UESB OFR 34, 341 ex.; UESB OFR 213, 65 ex.; UESB OFR 214, 9 ex.; UESB OFR 274, 1 ex.; UESB OFR 277, 1 ex.; UESB OFR 278, 14 ex.; UESB OFR 285, 15 ex.; UESB OFR 327, 1 ex.; UESB OFR 330, 46 ex.; UESB OFR 331, 15 ex.; UESB OFR 332, 2 ex.; UESB OFR 334, 17 ex.), ix.29.2004 (UESB OFR 276, 1 ex.), x.25.2004 (ZUEC OPH 993, 2 ex.), x.31.2004 (UESB OFR 108, 1 ex.; UESB OFR 68, 63 ex.; UESB OFR 69, 1 ex.; UESB OFR 74, 3 ex.; UESB OFR165, 1 ex.; UESB OFR 166, 1 ex.; UESB OFR 167, 30 ex.; UESB OFR 168, 1 ex.; UESB OFR 169, 1 ex.; UESB OFR 171, 23 ex.; UESB OFR 172, 83 ex.; UESB OFR 173, 11 ex.; UESB OFR 176, 3 ex.; UESB OFR 177, 1 ex.; UESB OFR 182, 9 ex.; UESB OFR 184, 2 ex.; UESB OFR 305, 2 ex.; UESB OFR 312, 13 ex.; UESB OFR 460, 125 ex.; ZUEC OPH 981, 9 ex.; ZUEC OPH 1009, 2 ex.; ZUEC OPH 1016, 2 ex.), xii.19.2004 (UESB OFR 429, 37 ex.; ZUEC OPH 997, 1 ex.), iii.25.2005 (UESB OFR 84, 81 ex.; UESB OFR 86, 13 ex.; UESB OFR 194, 1 ex.; UESB OFR 343, 27 ex.; UESB OFR 344, 8 ex.; UESB OFR 347, 63 ex.; UESB OFR 443, 120 ex.; UESB OFR 445, 1 ex.; UESB OFR 459, 58 ex.; UESB OFR 485, 118 ex.; ZUEC OPH 1005, 1 ex.), vii.7.2005 (UESB OFR 36, 23 ex.), viii.7.2005 (UESB OFR 32, 44 ex.; UESB OFR 45, 93 ex.; UESB OFR 79, 1 ex.; UESB OFR 118, 1 ex.; UESB OFR 384, 1 ex.; UESB OFR 400, 1 ex.; UESB OFR 430, 226 ex.; UESB OFR 432, 146 ex.; UESB OFR 434, 116 ex.; UESB OFR 436, 133 ex.), ix.8.2005 (UESB OFR 57, 11 ex.; UESB OFR 465, 175 ex.; UESB OFR 466, 158 ex.), ix.11.2005 (UESB OFR 151, 1 ex.), ix.11.2006 (ZUEC OPH 975, 4 ex.), ix.25.2006 (UESB OFR 333, 1); St. 6, 13°55'21"S, 39°02'13"W, ix.14.2003 (UESB OFR 163, 1 ex.; ZUEC OPH 965, 1 ex.), iv.25.2004 (UESB OFR 295, 2 ex.; UESB OFR 296, 1 ex.), vi.13.2004 (UESB OFR 263, 1 ex.), viii.29.2004 (UESB OFR 76, 1 ex.; ZUEC OPH 984, 1 ex.), x.31.2004 (UESB OFR 16, 2 ex.; UESB OFR 162, 1 ex.; UESB OFR 271, 1 ex.; UESB OFR 272, 1 ex.; UESB OFR 367, 1 ex.), xii.19.2004 (UESB OFR 114, 1 ex.), iii.25.2005 (UESB OFR 02, 3 ex.; UESB OFR 235, 5 ex.; UESB OFR 236, 4 ex.; UESB OFR 264, 4 ex.; UESB OFR 265, 1 ex.; UESB OFR 266, 2 ex.; UESB OFR 269, 1 ex.; UESB OFR 270, 1 ex.; UESB OFR 281, 1 ex.; UESB OFR 282, 1 ex.; UESB OFR 280, 1 ex.), iii.25.2006 (UESB OFR 267, 1 ex.); ix.11.2006 (ZUEC OPH 974, 2 ex.); St. 7, 13°56'19"S, 39°03'57"W, vi.7.2000 (UESB OFR 204, 4 ex.), iv.24.2004 (ZUEC OPH 996, 24 ex.), viii.29.2004 (ZUEC OPH 994, 1 ex.), viii.7.2005 (UESB OFR 49, 5 ex.; UESB OFR 237, 1 ex.); St.8, 13°56'24"S, 39°05'04"W, vi.7.2000 (UESB OFR 179, 1 ex.; UESB OFR 180, 1 ex.; UESB OFR 206, 2 ex.), ix.14.2003 (UESB OFR 301, 2 ex.; UESB OFR 373, 48 ex.), x.31.2004 (UESB OFR 17, 5 ex.).

DESCRIPTION: Disc diameter: up to 5.0 mm. Disc circular to pentagonal, covered by small blunt tubercles. Some large and blunt tubercles distributed in the interradius, usually near the radial shields (Fig. 5A). Ventral interradius covered by short and blunt tubercles similar to the dorsal ones (Fig. 5B). Radial shields small,

434 united and little evident due to the tubercles on the disc. Oral shield lozenge-shaped, somewhat wider than
435 long, narrow proximally; distal margin slightly rounded and lobed. Adoral shields big, sub-triangular, with
436 rounded edges, united proximally. Two oral papillae on each side of jaw angle, distal operculate, large,
437 occupying more than half the length of the jaw and closing oral slit. Proximal papillae small and squared. A
438 pair of blunt infradental papillae, close to each other (Fig. 5C). Long arms, at least four times the diameter of
439 the disc. Dorsal arm plates flabelliform, separated by the lateral plates. Ventral arm plates pentagonal with
440 slightly rounded distal edge. Lateral arm plates touching dorsally. Three small and rhombic arm spines that
441 are smaller than the length of one arm segment, with tiny marginal denticles. Two elongated tentacle scales
442 (Fig. 5C).
443
444 REMARKS: Small and delicate species with long arms, common in environment with reefs, under rocks and
445 on different types of biological substrates (algae, corals, sponges). Seagrass beds, under stones and rubble,
446 and in branching coral and algae (Hendler *et al*., 1995; Manso *et al*., 2008; Gondim, 2009). In Brazil,
447 *Ophiostigma isocanthum* was recorded in the States of Pará, Ceará, Paraíba, Pernambuco, Alagoas and Bahia
448 (Albuquerque, 1986; Manso *et al*., 2008; Gondim, 2009). In this study, it was found on sandy bottoms with
449 mud and organic matter as well as associated with algae and under rocks.
450
451 GEOGRAPHICAL DISTRIBUTION: Florida, North Carolina, México, Bermuda, Bahamas, Tortuga, Cuba,
452 Jamaica, Puerto Rico, Virgin Islands, Leeward Islands, Barbados, Tobago, Curacao, Aruba, Costa Rica,
453 Panama, Colombia, Venezuela, Antilles and Brazil (Albuquerque, 1986; Albuquerque & Guille, 1991;
454 Hendler *et al.*, 1995; Laguarda-Figueras *et al.*, 2005; Manso *et al.*, 2008; Gondim, 2009).
455
456 BATHYMETRIC DISTRIBUTION: 1 to 223 m (Albuquerque, 1986; Laguarda-Figueras *et al.*, 2005).
457 Between 1.5 and 56 m (Manso *et al.*, 2008). In this study, species were collected at 3.2 to 9.6 m depth.
458
459 RECORDS IN BAHIA: Abrolhos Archipelago, Todos os Santos Bay (Albuquerque & Guille, 1991; Manso
460 *et al.*, 2008).
461
462 RECORDS IN CAMAMU BAY: this is a new record of this species in the study area.
463
464 Family OPHIACTIDAE Matsumoto, 1915
465 Genus *Ophiactis* Lütken, 1856
466 *Ophiactis lymani* Ljungman, 1872
467 (Figure 6A-C)
468
469 EXAMINED MATERIAL: 41 ex.: St. 2, 13°53'21"S, 38°57'49"W, ix.25.2004 (UESB OFR 399, 1 ex.), ix.9.2006
470 (ZUEC OPH 990, 1 ex.); St. 3, 13°54'25"S, 38°59'14"W, vi.12.2004 (UESB OFR 181, 2 ex.), viii.28.2004 (UESB
471 OFR 356, 1 ex.; UESB OFR 397, 1 ex.; UESB OFR 415, 1 ex.; UESB OFR 455, 1 ex.), ix.7.2005 (ZUEC OPH 971, 2
472 ex.); St. 4, 13°54'06"S,39°00'22"W, viii.6.2005 (UESB OFR 490, 4 ex.); St. 5, 13°54'14"S, 39°00'34"W, ix.13.2003
473 (UESB OFR 116, 1 ex.), iii.25.2004 (UESB OFR 88, 1 ex.), iv.24.2004 (UESB OFR 377, 1 ex.; UESB OFR 476, 1 ex.;
474 ZUEC OPH 980, 1 ex.), viii.28.2004 (UESB OFR 155, 2 ex.), viii.29.2004 (UESB OFR 409, 2 ex.; UESB OFR 418, 1
475 ex.; UESB OFR 419, 1 ex.; UESB OFR 422, 1 ex.; ZUEC OPH 986, 1 ex.), ix.25.2004 (UESB OFR 326, 1 ex.; UESB
476 OFR 387, 4 ex.; UESB OFR 411, 1 ex.), x.31.2004 (UEBS OFR 393, 1 ex.), iii.25.2005 (UESB OFR 248, 1 ex.),
477 viii.7.2005 (UESB OFR 369, 1 ex.; UESB OFR 440, 2 ex.), ix.8.2005 (UESB OFR 472, 2 ex.); St. 7, 13°56'19"S,
478 39°03'57"W, viii.29.2004 (ZUEC OPH 995, 1 ex.).
479
480 DESCRIPTION: Disc diameter: from 1.0 to 5.0 mm. Disc subcircular, covered with large and irregular
481 scales. Radial shields are twice as long as wide and joined distally, along most of their length separated by a
482 long scale (Fig. 6A). Delicate spines sparse on disc. Ventral interradius covered by small scales with some

spines that are smaller than the dorsal ones (Fig. 6B). Oral shields sub-lozenge shaped and slightly narrower above the curved distal edge. Adoral shields are strongly wing-like extended laterally, almost united proximally, and truncated distally. One lateral oral papilla at each jaw edge. A rectangular apical papilla (Fig. 6C). Bursal slits are large (Fig. 6B). Usually hexamerous, occasionally pentamerous. Dorsal arm plates flabelliform (Fig. 6A); ventral arm plates pentagonal; lateral arm plates robust, meeting on longitudinal mid-line dorsally and ventrally from the 4th or 5th segment. One tentacle scale. Three sub-equal, blunt arm spines, with marginal denticles. Distal segments with serrated, hooked spines.

REMARKS: Species with fission and regeneration capacity. Hexamerous individuals. Sometimes arms of different sizes, usually three smaller arms e half of the disc, indicating recent regeneration. They occur on sandy bottoms and are associated with different types of substrates such as sponges, algae, corals and polychaetes colonies (Borges & Amaral, 2005; Lima *et al*., 2011). In Brazil, *Ophiactis lymani* has been registered in the States of Pará, Maranhão, Ceará, Paraíba, Pernambuco, Alagoas, Bahia and São Paulo (Tommasi, 1970, Albuquerque, 1986; Borges *et al*., 2002; Borges & Amaral, 2005; Neves *et al*., 2007; Gondim *et al*., 2008; Manso *et al*., 2008; Lima *et al*., 2011). In this study, it was sampled under rocks and associated with algae.

GEOGRAPHICAL DISTRIBUTION: Species with amphi-Atlantic distribution, recorded at the West coast of Africa (Senegal to the Gulf of Ginea), Inhaca Island, Antilles and Brazil (Tommasi, 1970; Borges *et al*., 2002; Borges & Amaral, 2005).

BATHYMETRIC DISTRIBUTION: the intertidal zone up to 600m deep (Alvarado & Solís-Marín, 2013). In this study, they were sampled between 3.2 and 9.6 m.

RECORDS IN BAHIA: Todos os Santos Bay (Magalhães *et al*., 2005; Manso *et al*., 2008).

RECORDS IN CAMAMU BAY: this is a new record of this species in the study area.

Ophiactis savignyi (Müller & Troschel, 1842)
(Figure 6D-F)

EXAMINED MATERIAL: 35 ex.: St. 3, 13°54'25"S, 38°59'14"W, viii.28.2004 (UESB OFR 314, 1 ex.; UESB OFR 353, 1 ex.; UESB OFR 424, 1 ex.; UESB OFR 461, ex. 1 ex.; ZUEC OPH 1017, ex. 2 ex.), ix.7.2005 (ZUEC OPH 970, 1 ex.); St. 4, 13°54'06"S, 39°00'22"W, vii.12.2003 (UESB OFR 219, 1 ex.), x.30.2004 (ZUEC OPH 1007, 1 ex.), iii.24.2005 (UESB OFR 224, 1 ex.; UESB OFR 225, 2 ex.), iii.29.2005 (UESB OFR 210, 1 ex.), viii.6.2005 (UESB OFR 489, 1), ix.6.2005 (UESB OFR 451, 1 ex.); St. 5, 13°54'14"S, 39°00'34"W, iv.24.2004 (UESB OFR 374, 1 ex.), viii.29.2004 (UESB OFR 101, 1 ex.; UESB OFR 407, 1 ex.; ZUEC OPH 962, 1 ex.), ix.31.2004 (ZUEC OPH 967, 1 ex.), x.31.2004 (UESB OFR 174, 1 ex.), iii.25.2005 (UESB OFR 87, 1 ex.; UESB OFR 195, 2 ex.; UESB OFR 209, 1 ex.; UESB OFR 249, 3 ex.; ZUEC OPH 1003, 2 ex.), viii.7.2005 (UESB OFR 99, 1 ex.; UESB OFR 107, 1 ex.), ix.8.2005 (UESB OFR 200, 1 ex.; UESB OFR 229, 1 ex.); St. 6, 13°55'21"S, 39°02'13"W, vi.13.2004 (UESB OFR 257, 1 ex.).

DESCRIPTION: Disc diameter: 0.5 to 8.5 mm. Disc covered with imbricated, irregular scales; those around the radial shields are larger. Some small spines on the disc, more numerous at the edges. Radial shields large and triangular, length about one third of the diameter of the disc. They are united distally and proximally separated by approximately two scales (Fig. 6D). Ventral interradius covered with smaller scales with sparse spines (Fig. 6E). Oral shields sub-lozenge shaped, slightly wider than long. Adoral shields wider distally and separated proximally. Two spatulate oral papillae at each side of a jaw, sometimes only one. One rectangular

apical papilla (Fig. 6F). Bursal slits are large. Hexamerous species, occasionally pentamerous, five or six arms (Fig. 6D,E). Dorsal arm plates sub-rectangular; ventral arm plates octagonal. Five to six arm spines, with marginal denticles, the ventral one smaller. One large tentacle scale.

REMARKS: The species is usually found in high densities, associated with different types of biological substrates. It has a high degree of fission and is commonly found with arms and parts of the disc in regeneration. Its ability for sexual and asexual reproduction may explain its abundance and wide distribution, since it is one of the most common species in fauna associated with biological substrates such as algae, sponges, bryozoan colonies, polychaete tubes, coral reefs, seagrass. It also occurs on sandy bottoms, mud, among rocks and mangroves (Borges & Amaral, 2005; Hendler *et al*., 1995). In Brazil, it has been registered in the States of Amapá, Pará, Maranhão, Ceará, Paraíba, Pernambuco, Alagoas, Bahia, Rio de Janeiro and São Paulo (Tommasi, 1970; Albuquerque, 1986; Albuquerque and Guille, 1991, Borges *et al*., 2002; Borges and Amaral, 2005; Neves *et al*., 2007; Gondim *et al*., 2008; Manso *et al*., 2008; Lima *et al*., 2011). In this study, we registered them on sandy bottoms with mud and organic matter, under rocks and associated with algae.

GEOGRAPHICAL DISTRIBUTION: Species considered to be circum-tropical and circum-subtropical. Records of occurrences in the Mediterranean Sea and the Red Sea, Philippines, Zanzibar, Madagascar, Reunion, Mauritius, Mozambique, Sandwich Island, Tortuga, Africa (west, south and the Gulf of Guinea), Sea of Japan, Australia (west), Hawaii , California Bay, Florida, South Carolina (USA), Gulf of Mexico, Bermuda, the Caribbean, West Indies, Bahamas, Jamaica, Puerto Rico, Mexico, Panama and Brazil (Tommasi, 1970; Hendler *et al*., 1995; Borges *et al*., 2002).

BATHYMETRIC DISTRIBUTION: Common species in shallow waters, but already recorded up to about 520 m depth (Alvarado & Solís-Marín, 2013). In this study, it was sampled at between 4.5 to 9.6 m depth.

RECORDS IN BAHIA: Porto Seguro, Salvador (Itapuã, Pituba, Ondina and Ribeira beaches), Todos os Santos Bay, Aratu Bay, Abrolhos Archipelago (Magalhães *et al.,* 2005; Manso *et al.,* 2008).

RECORDS IN CAMAMU BAY: this is a new record of this species in the study area.

Family OPHIOCOMIDAE Ljungman, 1867
Genus *Ophiocoma* L. Agassiz, 1835
Ophiocoma echinata (Lamarck, 1816)
(Figure 7)

EXAMINED MATERIAL: 1 ex.: St. 2, 13°53'21"S, 38°57'49"W, viii.29.2004 (UESB OFR 348, 1 ex.).

DESCRIPTION: Disc diameter: 15 mm. Disc pentagonal, covered with spherical granules, a little denser at the edge. Radial shields not contiguous, covered by granules (Fig. 7A). Ventral interradius also covered by granules, wedge-shaped from the disc edge inwards, leaving the proximal part bare. Bursal slits elongated (Fig. 7B). Oral shield longer than wide and subquadrangular. Adoral shields small and sub-triangular, proximally separated. Four elongated oral papillae at each side of jaw angle (Fig. 7B). A cluster of dental papillae at the apex of the jaw, at the same level as the lateral papillae (Fig. 7C). Dorsal arm plates wider than long, fan-shaped, with curved distal edge (Fig. 7A). First ventral arm plate sub-pentagonal; subsequent ones slightly hexagonal. First tentacle pore with two well-developed, oval tentacle scales. Following segments with one tentacle scale (Fig. 7C). Four blunt arm spines, the dorsal-most largest.

REMARKS: Species is considered to be large, with records on unconsolidated bottoms (especially sand with gravel) in reef and mangrove areas, with calcareous algae, corals, sponges, among others. It is particularly abundant under rocks (Hendler *et al*., 1995; Manso *et al*., 2008; Gondim, 2009). In Brazil, there are records in the States of Ceará, Paraíba, Pernambuco, Alagoas and Bahia (Tommasi, 1970, Albuquerque, 1986; Manso *et al*., 2008; Gondim, 2009; Lima *et al*., 2011). In this study, *O. echinata* was recorded associated with algae.

GEOGRAPHICAL DISTRIBUTION: Florida (USA), Bermuda, Bahamas, Barbados, Antilles, Panama, Curacao, Venezuela, Haiti, Puerto Rico, Cuba, Mexico, Jamaica and Brazil (Tommasi, 1970; Albuquerque & Guille, 1991; Hendler *et al.*, 1995).

BATHYMETRIC DISTRIBUTION: Intertidal at 183 m deep (Hendler *et al.*, 1995; Laguarda-Figueras *et al.*, 2005). In this study, it was sampled at 4.2 m.

RECORDS IN BAHIA: Porto Seguro, Salvador (Itapuã, Pituba, Amaralina and Ondina beaches), Todos os Santos Bay (Tommasi, 1970; Magalhães *et al.*, 2005; Manso *et al.*, 2008).

RECORDS IN CAMAMU BAY: this is a new record of this species in the study area.

Family OPHIODERMATIDAE (Ljungman, 1867)
Genus *Ophioderma* Müller & Troschel, 1840
Ophioderma cinerea Müller & Troschel, 1842
(Figure 8A-C)

EXAMINED MATERIAL: 7 ex.: St. 2, 13°53'21"S, 38°57'49"W, ix.19.2000 (UESB OFR 189, 1 ex.); St. 6, 13°55'21"S, 39°02'13"W, iii.14.2003 (UESB OFR 385, 1 ex),iv.25.2004 (UESB OFR 239, 1 ex.; UESB OFR 291, ex. 3 ex.), vi.13.2004 (UESB OFR 256, 1 ex.).

DESCRIPTION: Disc diameter: 2.0 to 16.0 mm. Disc covered with small granules, except on the radial shields, which are visible, oval and separated from each other (Fig. 8A). Ventral interradius and jaw covered by granules similar to dorsal ones (Fig. 8B, C). Subtriangular oral shields with a slightly rounded proximal margin and a slightly straight distal margin, slightly convex in middle part. Eight to nine oral papillae on each side of a jaw, proximal one the narrowest, and the two distal-most larger and more rounded; there is a triangular distal oral papilla. A pair of long and robust apical papillae, similar to the lateral ones (Fig. 8C). Two bursal slits in each interradial margin (Fig. 8B). Dorsal arm plates subdivided into irregular pieces (Fig. 10A). Ventral arm plates as wide as long, with rounded distal margin. Eight compressed short arm spines; the ventral most largest and partially covered by the outer tentacle scale. Two well-developed and spatulate tentacle scales, located on the lateral plate, the inner one long and narrow, the outer one small and subtriangular (Fig. 8C).

REMARKS: A large and robust species, member of the epifauna on unconsolidated bottoms, rocky shores, reefs and/or in rock cracks. It is also found associated with sponges, corals and coralline algae, as well as between macroalgae and mangrove (Albuquerque, 1986; Hendler *et al*., 1995; Borges & Amaral, 2005; Borges, 2006; Lima *et al*., 2011). In Brazil, it has been registered from the States of Ceará (North) to São Paulo (Southeast), including the Fernando de Noronha archipelago (Tommasi, 1970, Albuquerque, 1986; Gondim, 2009; Lima *et al*., 2011). In this study, *O. cinerea* was sampled on soft bottom, mud with sand and organic matter.

GEOGRAPHICAL DISTRIBUTION: Florida (USA), Mexico, Central America, Brazil. Also in the East Atlantic of Senegal to Angola (Tommasi, 1970; Hendler *et al.*, 1995; Borges, 2006).

BATHYMETRIC DISTRIBUTION: Species is most common in the intertidal and shallow waters (Tommasi, 1970; Hendler *et al.*, 1995). In this study, it was sampled between 4.2 and 4.5 m deep.

RECORDS IN BAHIA: Todos os Santos Bay, city of Porto Seguro, Abrolhos Archipelago, city of Salvador (Itapuã, Pituba, Amaralina and Ondina beaches), Medo/Itaparica Islands (Tommasi, 1970; Magalhães *et al.*, 2005; Tanure & Cerqueira, 2007).

RECORDS IN CAMAMU BAY: this is a new record of this species in the study area.

Ophioderma januarii Lütken, 1856
(Figure 8D-F)

EXAMINED MATERIAL: 66 ex.: St. 3, 13°54'25"S, 38°59'14"W, ix.19.2000 (ZUEC OPH 958, 1 ex.), viii.28.2004 (UESB OFR 351, 1 ex.; UESB OFR 352, 1 ex.); St. 4, 13°54'06"S, 39°00'22"W, iv.24.2004 (UESB OFR 187, 2 ex.), x.30.2004 (ZUEC OPH 988, 1 ex.), iii.24.2005 (UESB OFR 226, 1 ex.), viii.6.2005 (ZUEC OPH 956, 3 ex.; ZUEC OPH 960, 2 ex.); St. 5, 13°54'14"S, 39°00'34"W, iv.24.2004 (UESB OFR 188, 1 ex.; UESB OFR 232, 1 ex.), viii.29.2004 (UESB OFR 70, 1 ex.; UESB OFR 97, 1 ex.; UESB OFR 345, 1 ex.; UESB OFR 402, 1 ex.; UESB OFR 417, 1 ex.; UESB OFR 464, 1 ex.), ix.25.2004 (ZUEC OPH 961, 1 ex.), x.31.2004 (UESB OFR 47, 3 ex.), xii.19.2004 (ZUEC OPH 998, 1 ex.), iii.25.2005 (UESB OFR 29, 13 ex.; UESB OFR 211, 1 ex.; UESB OFR 258, 4 ex.; UESB OFR 259, 1 ex.), viii.7.2005 (UESB OFR 4, 2 ex.; UESB OFR 135, 1 ex.; UESB OFR 178, 2 ex.; UESB OFR 439, 1 ex.; ZUEC OPH 1004, 1 ex.), ix.8.2005 (UESB OFR 201, 2 ex.; UESB OFR 310, 3 ex.; UESB OFR 467, 1 ex.), ix.25.2009 (UESB OFR 105, 1 ex.); St. 6, 13°55'21"S, 39°02'13"W, iv.15.2004 (UESB OFR 293, 1 ex.), iii.25.2005 (UESB OFR 123, 1 ex.); St. 8, 13°56'24"S, 39°05'04"W, ix.14.2003 (UESB OFR 14, 6 ex.).

DESCRIPTION: Disc diameter: 7.0 to 26.0 mm. Disc and radial shields covered by granules (Fig. 8D). Radial shields not-visible. Radial region of the disc with a recess bearing three or four dorsal arm plates, lined by small scales without granules. Oral shields rounded triangular (Fig. 8E, F). Adoral shields small, short, proximally separated. Jaw also covered by granules. Seven to eight oral papillae tapered and sub-equal; in line with these, there is a triangular distal oral papilla. A pair of apical papillae, similar to the lateral ones (Fig. 8F). Two bursal slits along each arm, the proximal one wider and shorter than the distal one (Fig. 8E). Dorsal arm plate wider than long, rectangular (Fig. 8D). Basal ventral arm plates slightly wider than long; subsequent ones as wide as long and octagonal. Eight to ten short, compressed arm spines. Two well-developed and rounded tentacle scales, situated at the lateral plate (Fig. 8E, F).

REMARKS: A large and robust species, common in the infralittoral, at depths up to 120 m. A member of the epifauna, it lives mainly on sandy bottoms, mud, rubble and shell fragments. In Brazil, *Ophioderma januarii* has already been recorded in the States of Rio de Janeiro (type locality), São Paulo, Amapá, Pará, Sergipe, Bahia and the South Region (Tommasi, 1970, Albuquerque, 1986; Borges & Amaral, 2005). It is important to note the similarity between *Ophioderma januarii* and *Ophioderma brevispina*, the latter being a more common species in the North and Northeast of Brazil. According to Costa & Costa (1962) and Albuquerque (1986), what separates the two species is the aspect of the arm, in *O. januarii* it tapers towards the end, whereas in *O. brevispina* the diameter is maintained throughout the arm. In this study, species were sampled on sandy bottoms with mud and organic matter, as well as under rocks and seaweed.

GEOGRAPHICAL DISTRIBUTION: Antilles and Brazil (Tommasi, 1970; Albuquerque, 1986; Borges, 2006).

BATHYMETRIC DISTRIBUTION: Intertidal zone at 1500 m depth (Alvarado & Solís-Marín, 2013). In this work, they were sampled between 3.5 and 9.6 m.

RECORDS IN BAHIA: Aratu Bay and Abrolhos Archipelago (Tommasi, 1970; Magalhães *et al.*, 2005).

RECORDS IN BAY CAMAMU: this is a new record of this species in the study area.

Family OPHIOTRICHIDAE Ljungman, 1867
Genus *Ophiothrix* Müller & Troschel, 1840
Ophiothrix (Ophiothrix) angulata (Say, 1825)
(Figure 9)

EXAMINED MATERIAL: 58 ex.: St. 1, 13°53'04"S, 38°57'06"W, vii.12.2003 (UESB OFR 185, 1 ex.), x.30.2004 (UESB OFR 342, 1 ex.), viii.6.2005 (UESB OFR 309, 1 ex.), ix.9.2006 (ZUEC OPH 1014, 1 ex.); St. 2, 13°53'21"S, 38°57'49"W, ix.19.2000 (UESB OFR 462, 1 ex.), ix.13.2003 (UESB OFR 59, 1 ex.), iv.24.2004 (UESB OFR 386, 1 ex.); St. 3, 13°54'25"S, 38°59'14"W, iv.28.2004 (UESB OFR 56, 1 ex.), ix.28.2004 (UESB OFR 62, 2 ex.; UESB OFR 63, 1 ex.; UESB OFR 215, 1 ex.), ix.13.2005 (UESB OFR 341, 1 ex.); St. 4, 13°54'06"S, 39°00'22"W, ix.13.2003 (UESB OFR 289, 1 ex.), iv.24.2004 (UESB OFR 109, 1 ex.; UESB OFR 142, 1 ex.; UESB OFR 196, 3 ex.), ix.25.2004 (UESB OFR 28, 1 ex.), x.30.2004 (UESB OFR 306, 1 ex.), iii.24.2005 (UESB OFR 292, 1 ex.), viii.6.2005 (UESB OFR 491, 1 ex.; ZUEC OPH 966, 1 ex.; ZUEC OPH 1000, 1 ex.; ZUEC OPH 1001, 1 ex.; ZUEC OPH 1013, 1 ex.); St. 5, 13°54'14"S, 39°00'34"W, ix.13.2003 (UESB OFR 207, 2 ex.), viii.28.2004 (UESB OFR 284, 1 ex.), iii.25.2005 (UESB OFR 308, 2 ex.), viii.7.2005 (UESB OFR 46, 8 ex.), ix.8.2005 (UESB OFR 231, 3 ex.), ix.11.2006 (UESB OFR 149, 1 ex.); St. 6, 13°55'21"S,39°02'13"W, ix.19.2000 (UESB OFR 203, 1 ex.); St. 7, 13°56'19"S,39°03'57"W, x.31.2004 (UESB OFR 83, 1 ex.; UESB OFR 160, 1 ex.; UESB OFR 238, 1 ex.; ZUEC OPH 957, 4 ex.; ZUEC OPH 964, 1 ex.), iii.25.2005 (UESB OFR 161, 1 ex.); St. 8, 13°56'24"S, 39°05'04"W, ix.14.2003 (UESB OFR 70, 1 ex.; UESB OFR 300, 2 ex.), viii.7.2005 (UESB OFR 21, 1 ex.).

DESCRIPTION: Disc diameter: 2.0 to 8.0 mm. Disc covered by small, hyaline bifid and/or trifid spines. Radial shields longer than wide, triangular, separated by a row of scales with spines, distally united. Spines on the radial shields (Fig. 9A). Ventral interradius covered by scales with small spines, except the region near the oral shields and bursal slits (Fig. 9B, C). Oral shield wider than long, rhombic, with a slight projection at the distal edge; adoral shields are wing-like extended distally, proximally united. Jaws formed by separated oral plates and without lateral oral papillae. A cluster of dental papillae at the apex of the jaw (Fig. 9C). Bursal slits large. Second tentacle pore wide (Fig. 9C). Dorsal arm plates lozenge-shaped, small and overlapping subsequent ones; ventral arm plates quadrangular, slightly longer than wide (Fig. 9B). Single small tentacle scale. Five to eight long arm spines, vitreous and denticulate, the second to ventralmost smallest and the ventralmost modified into a hook with hyaline teeth facing the disc (Fig. 9D).

REMARKS: This species is commonly found on different types of substrate, such as soft bottoms with shells, rubble, rocks, corals, algae, sponges and gravel (Tommasi, 1970; Albuquerque, 1986; Hendler *et al.,* 1995; Borges & Amaral, 2005; Lima *et al.,* 2011). It has a wide variety of phenotypes and needs taxonomic revision, especially when comparing populations from different regions, such as the Brazilian Southeast and North-Northeast. According to Hendler *et al*. (1995), *Ophiothrix (O.) angulata* is commonly found with other species of the same genus and with *Ophiactis,* constituting the main component of the fauna associated with the biological substrate. In Brazil, it has already been found in the North, Northeast and Southeast states

(Tommasi, 1970, Albuquerque, 1986; Borges & Amaral, 2005; Borges, 2006; Lima *et al*., 2011). In our study, they were sampled on sandy bottoms with mud and organic matter as well as associated with algae and under rocks.

GEOGRAPHICAL DISTRIBUTION: Species with broad geographical distribution, occurring from North Carolina (USA) to Uruguay (Tommasi, 1970; Albuquerque, 1986; Hendler *et al*., 1995; Borges & Amaral, 2005; Borges, 2006; Manso *et al.*, 2008; Gondim, 2009).

BATHYMETRIC DISTRIBUTION: 1 to 540 m depth (Alvarado & Solís-Marín, 2013). In this study, specimens were sampled between 3.2 and 9.6 m.

RECORDS IN BAHIA: Abrolhos Archipelago, Camamu Bay, Todos os Santos of Bay, Aratu Bay, city of Porto Seguro, city of Salvador (Itapuã, Pituba, Ondina and Amaralina beaches), Medo/Itaparica Islands (Tommasi, 1970; Manso, 2004; Manso *et al.*, 2008).

RECORDS IN CAMAMU BAY: Manso (2004).

DISCUSSION

The Ophiuroidea fauna we registered for the Camamu Bay comprised 11 species from five families. These families are common in tropical and subtropical regions, in the bathymetric range and type of bottom sampled. The most frequent species were those species found on biological substrates, sand, mud and gravel bottoms. *Amphipholis squamata, Amphipholis januarii, Ophiostigma isocanthum, Ophiactis lymani, Ophiactis savignyi and Ophiothrix (O.) angulata* preferably inhabit algae, sponges and other living substrates, occurring also on unconsolidated bottoms. We recorded a few epifaunal individuals, such as Ophiodermatidae, which occur mainly on sand and mud bottom.

The family Amphiuridae was the best represented, contributing with five species: *Amphipholis januarii*, *Amphipholis squamata*, *Microphiopholis atra*, *Ophiophragmus filograneus* and *Ophiostigma isocanthum*. Individuals of this family are often infaunal, burying in soft substrate and exposing the arms in the water column to obtain food; however, both species of *Amphipholis* and *O. isocanthum* are commonly found associated with different biological substrates, including algae and sponges.

Among the species we recorded, *Ophiophragmus filograneus* represents the first occurrence for the State of Bahia, while nine are reported for the first time in the Camamu Bay: *Amphipholis januarii, Amphipholis squamata, Ophiophragmus filograneus, Ophiostigma isocanthum, Ophiactis lymani, Ophiactis savignyi, Ophiocoma echinata, Ophioderma cinerea* and *Ophioderma januarii.* Therefore, we can say that *O. filograneus* has expanded its geographic distribution. Manso (2004), in a study conducted in the coastal region of the estuary of Camamu Bay, found 10 species of brittle stars, mainly infaunal ones and only two were also sampled here: *Microphiopholis atra* and *Ophiothrix (Ophiothrix) angulata*.

Two of the species recorded, *Ophiactis savignyi* and *Amphipholis squamata,* are considered cosmopolitan species and they have been widely recorded in Brazil, at least in the Southeast (Tommasi, 1970; Hendler *et al*., 1995; Borges *et al*., 2002; Borges & Amaral, 2005). *Ophiactis lymani* is recognized as an amphi-Atlantic species (Borges *et al*., 2002), and it is also common at the coast of the State of São Paulo.

Borges (2006) found *Amphipholis squamata, Ophiactis lymani, Ophiactis savigny* and *Ophiothrix (O.) angulata* associated with algae on rocky shores and in the subtidal region in the Brazilian Southeast. These species prefer habitats with live substrates, such as sponges, corals and algae; yet they are not limited to them (Chao & Tsai, 1995; Hendler *et al*., 1995; Borges, 2006). Morgado & Tanaka (2001) reported them associated with the bryozoan colonies *Schizoporella errata*. Boffi (1972), analyzing the brittle stars associated with 23 species of algae in Ubatuba (state of São Paulo), saw the prevalence of *Ophiactis lymani*

and *Amphipholis squamata,* which occurred in nearly all algae species, with higher frequencies and greater densities, similar to our study. According to Boffi (1972), *Ophiothrix (O.) angulata* and *Ophiactis savignyi* prefer to inhabit sponges and other living substrates, but they are not exclusive.

Amphipholis squamata is a common species in the shallow depths on the Brazilian coast, found up to 550 m depth; it is widely studied due to its cosmopolitan distribution, and it is known to inhabit various types of substrates, from sand to silt, algae, sponges, corals and polychaete aggregates. Boffi (1972) mentions its occurrence in the intertidal zone at approximately 5 m depth.

Recently, in a study conducted in the shallow waters of Maceió (State of Alagoas - also from Brazilian Northeast), in reef environments, Lima *et al*. (2011) recorded 16 species of Ophiuroidea, six of them were registered in our study: *Amphipholis januarii*, *Amphipholis squamata*, *Ophiactis lymani*, *Ophiactis savignyi*, *Ophiothrix* (*O.*) *angulata* and *Ophioderma cinerea*.

Regarding the spatial distribution within the Bay, at the collecting stations, deeper substrate consisted of a mixture of algae and monocot, organic matter, rock, clay and mud. Accordingly, the number of species and individuals was more representative, and it reached eight species and 4,256 specimens at collecting station 5, with an average depth of 6.7 m. Possibly, the greatest species richness and abundance are related to the diversity of available microhabitats, such as algae, monocots bottoms, sand, mud and clay that provides more heterogeneous environments and thus greater availability of food resources. The stations with the highest species richness and greatest number of individuals were 3, 4 and 5, with depths between 2 and 15.5 m with a varied background.

At shallower stations, these numbers were lower as, for example, stations 1, 7 and 8, where we found an average of four species, especially *Ophiostigma isocanthum* and *Ophiothrix* (*O*) *angulata*, and between 40 and 90 individuals.

Another important factor that may be related to the faunal composition of brittle stars is the hydrodynamics of the current tides within the estuary that influences the type of substrate found at the collecting stations.

These two abiotic factors, and the type of bottom currents, seem to be crucial for the composition of the fauna of brittle stars along the estuary.

As we have shown, studies on brittle stars are still scarce in Brazil, especially in the Northeast, including the State of Bahia. We consider that information about the biodiversity and biology of the group is increasingly necessary for a thorough framework for further conservation and environmental monitoring, since this group is relatively abundant in the marine benthos and directly linked to other invertebrates and vertebrates with high ecological and commercial value.

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Figure 1: Map of the study area in the Camamu Bay, Bahia, Brazil, detail showing the eight sampling stations (St1-St8). Source: Ourives *et al.* (2011) with modifications.

Figure 2: *Amphipholis januarii*: A – dorsal view; B – ventral view; C – ventral view of the arm. *Amphipholis squamata*: D - dorsal view; E – ventral view; F - ventral view of the arm. Scale bar (A, B, D, E, F)= 0.5 mm; (C)= 0.2 mm.

Figure 3: *Microphiopholis atra*: A – dorsal view; B – ventral view; C – oral view. Scale bar (A, B)= 1 mm; (C)= 0.5 mm.

Figure 4: *Ophiophragmus filograneus*: A – dorsal view; B – dorsal view with detail of the radial shields; C – ventral view; D - oral view. Scale bar (A,C)= 0.5 mm; (B)= 0.2 mm; (D)= 0.1 mm.

Figure 5: *Ophiostigma isocanthum*: A – dorsal view; B – ventral view; C – oral view. Scale bar (A, B)= 1 mm; (C)= 0.2 mm.

Figure 6: *Ophiactis lymani*: A – dorsal view; B – ventral view; C – oral view. *Ophiactis savignyi*: D – dorsal view; E – ventral view; F – oral view. Scale bar (A, B, C, F)= 0.5 mm; (D, E)= 1 mm.

Figure 7: *Ophiocoma echinata*: A – dorsal view; B – ventral view; C – oral view. Scale bar (A, B)= 2 mm; (C)= 1 mm.

Figure 8: *Ophioderma cinerea*: A – dorsal view; B – ventral view; C – oral view. *Ophioderma januarii*: D – dorsal view; E – ventral view; F – oral view. Scale bar (A, B, D, E)= 2 mm; (C)= 1 mm; (F)= 1.5 mm.

959 Figure 9: *Ophiothrix (Ophiothrix) angulata*: A – dorsal view; B – ventral view; C – oral view; D - ventral
960 view of the arm and spines. Scale bar (A, B)= 1 mm; (C)= 0.5 mm; (D)= 0.3 mm.